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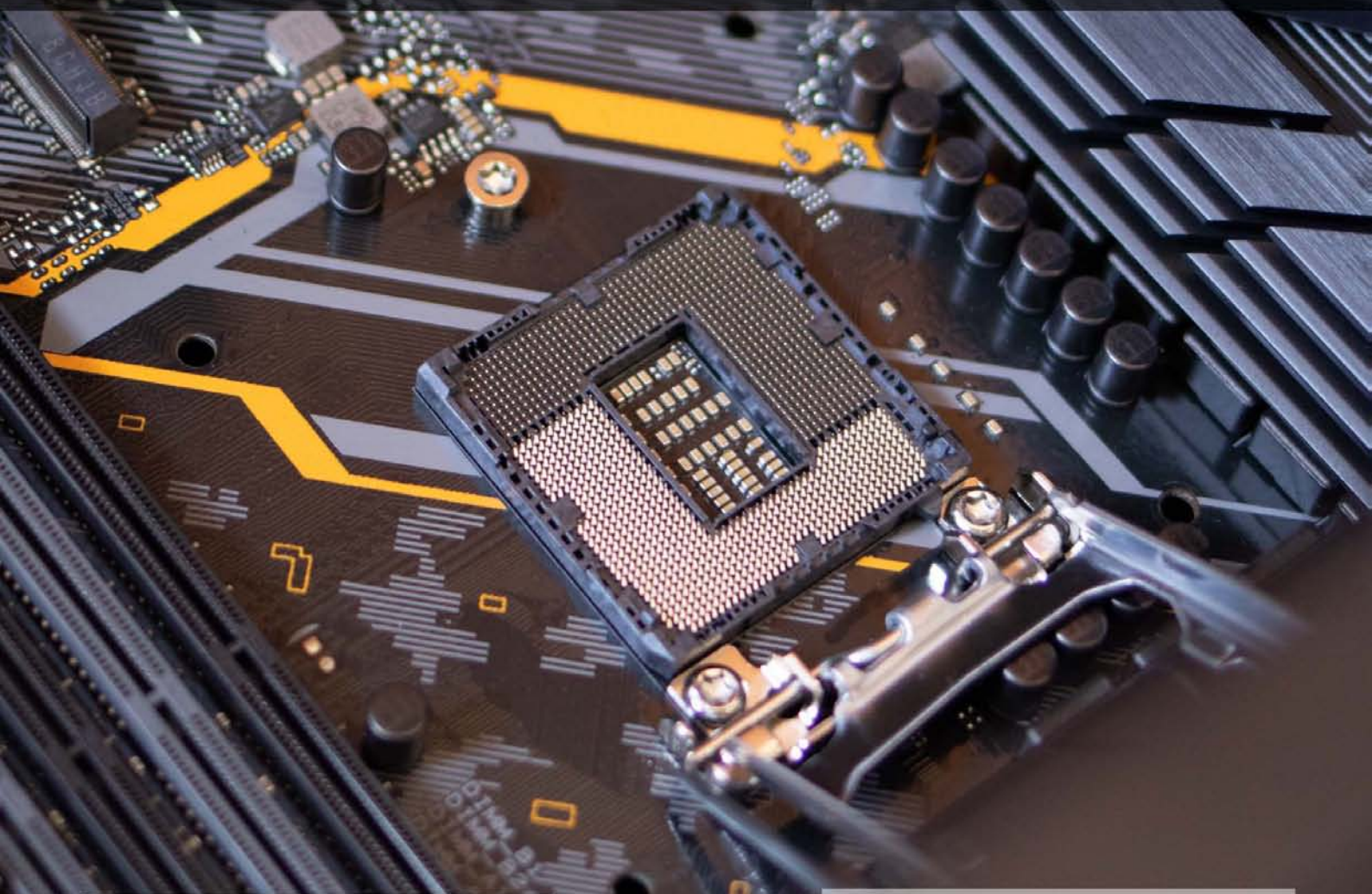

Self-Driving Cars in UAE

Online Distance Education Systems

Highlights

Textile Manufacturing Plants

Evaluation of Instructional Videos

Discovering Thoughts, Inventing Future

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On Systems of Systems Engineering: Online Distance Education Systems Key Challenges

By Arwa A. Al Shamsi
The British University in Dubai

Abstract- Technology development have affected educational delivery around the world. The utilization and implementation of online learning is rising at a staggering manner. Online Distance learning has become an urgent need recently. The use of distance learning has appeared in the past ten years, the learning has been extended by the technology from classrooms in the schools into online learning. Online Learning adopted in various universities, educational institutions and schools worldwide. Recently, with the emergency situations due to the epidemic of COVID -19, and according to the recommendations by World Health Organization for social distance, most of the educational institutions worldwide tend to utilize the online learning instead of traditional learning. Although the online learning has been implemented years ago, still it faces challenges. The author of this research paper aim to explore the key challenges that reported while implementing Online Distance Education System as Systems of Systems. The author then outlines research agenda that identifies 11 research themes that can be considered as a solution for the current Online Distance Education System implementations challenges.

Keywords: *online; learning; education; SoS; SoSE; challenges.*

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Arwa A. Al Shamsi

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Keywords: online; learning; education; SoS; SoSE; challenges.

I. Introduction

"System of Systems"(SoS) is an emerging topic that has been in use in recent years. SoS involve system consisting of several systems that are operated independently. SoS offer a way to reach the required set of capabilities which make them very important. SoS recently have been found in different areas, such as healthcare, defense, transport, education, energy and logistics. The developments in the field of science and technology in the 21st century have broadened the educational system's duties and responsibilities; new opportunities have also been brought [1]. Online Distance Education System which involve the Online Distance learning has been emerged with great benefits, it is considered as effective method for learning, it allows for class education to be offered to anyone anywhere all around the world. Moreover, Online Distance Learning Considered as cost effective [2]. Online learning is very attractive to a vast number of students, because it provides versatility of attendance, ease of access and comfort [3]. Online Distance Learning offered great solution in some urgent accidents and situations. Due to the recent urgent situation of Corona Virus Emerging situation, Online Distance Learning considered as effective approach for Education while performing the social distancing and avoid gathering. However, the current implementations of Online Distance Education SoS have number of challenges that have been encountered. In this research paper, Author firstwill introduce the concept of SoS and SoSE. Second, author will present the types of SoS. Third, Education System as Systems of Systems SoS will be introduced. Forth, Online Distance Education System as System of Systems SoS will be introduced. Fifth, Online Distance Education System key challenges will be identified. Finally, author will propose a structure for the research agenda for the Future of Online Distance Education that can be considered as a solution for the current Online Distance Education implementations challenges.

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II. Literature Review

a) Systems of Systems SOS

Systems of Systems shortly known as SoS. SoS concept has been addressed by large numbers of researches and identified in various ways. The key feature of SoS is that it consists of number of systems that function independently [4]. SoS concept become very common. It has been explored and addressed in different conferences, books, reports and researches [5]. One definition of SoS concept is as it is set of systems that are resulted from the integration of independent systems into bigger system that offer unique abilities[6]. Another definition of SoS concept as it is a composition of systems that are operated independently and managed independently [7]. SoS described by [8] as it has the following characteristics: systems operated, managed and evolved independently from their constituent systems, geographical distribution, and emergent behaviors. Although SoS definition has been addressed by number of researches, there is no exact definition of SoS concept [5]. However, it has been noticed that almost all the definitions of SoS agreed on the following characteristics of SoS i.e. complexity, variability, systems distributed geographically, independent subsystems, evolution, heterogeneity [5].

b) Systems of Systems Engineering SOSE

Systems of Systems Engineering shortly known as SoSE. SoSE is field that recently emerged in order to

deal with problems that SoS posed. Although SoSE concept has been identified in number of research papers, there is no definition of SoSE that is accepted widely[9]. Below are some definitions of SoSE that are defined in research papers. SoSEinvolve utilizing the existing assets and take the value from them and then design new better assets that can be re-purposed[10]. SoSE described by [8] asit involves constituent systems to be combined in order to fulfil the requirements that are frequently changing. SoSE identified by [11] as it involves plan, analyze, arrange and merge the abilities of constituent systems into SoS ability that is larger than the combination of the abilities of the constituent systems. Literature studied and explored SoSE concepts agreed on the following elements that are related to SoSE concept [9]. The most common and related elements to SoSE concept are systems independently operated and managed, distributed geographically, Interoperability, Complementarity, and Holism [9].

c) Types of System of Systems SOS

SoS classified into 4 types i.e. (a) Directed, (b)Acknowledged, (c) Collaborative, and (d) Virtual [8].

Directed SoS: consists of constituent systems that are independent and geographically distributed. The constituent systems preserve the power to run independently, however their operational mode normally is subordinated to the purpose that are managed centrally [12]. The constituent systems intended to achieve specific purposes. Most likely these constituents owned by single organization.

Acknowledged SoS: have objectives, resources and nominated manager. the constituent systems of Acknowledged SoS maintain their objectives, development, sustainability, funding and autonomous ownership. The constituent systems of Acknowledged SoS work in collaboration to fulfill a larger target that cannot be achieved by themselves[13].

Collaborative SoS: consist of constituent systems that are independent, these systems cooperated voluntarily and there is no agreed director for these systems [14].

Virtual SoS: does not have central governance management authority. The participant systems in the virtual SoS may not agree on the objectives of the system. Virtual SoS depends on mechanisms that are invisible in order to preserve it [8].

III. Education System as Systems of Systems SOS

Education system considered as one of the large-scale Systems of Systems SoS. Education system consists of constituent systems such as Ministry of Education, Universities, Colleges, Educational institutes, Schools, Students, Parents, Teachers, Transportation and Supporting Services i.e. maintenance, cleaning and security services. In this research paper, Author is concentrating on Online Distance Education System as Systems of Systems.

IV. Online Distance Education System as System of Systems SoS

Technology development have affected educational delivery around the world. Online learning is rising at a staggering pace [15]. Online Distance learning has become an urgent need recently. The use of distance learning has appeared in the past ten years, the learning has been extended by the technology from classrooms in the schools into online learning. However, what the world is witnessing today has made online distance learning so important. As an example, when the problem of the epidemic that hit most of the world countries and affected millions of people emerged i.e. Virus Covid 19, this urgent situation derive an urgent need for social distancing, and because the health and safety of our children as well as the people is a top priority for governments, the decision to implement online distance learning has been taken in many countries of the world.

The Theory of e-learning comprises of three components. E-learning may be described through a theory-based paradigm that relates learning tools, instructional techniques and pedagogical models or constructs [16]. However, author in this research paper concentrating on Online Learning as Systems of Systems. Online Distance Learning system considered as one of the large-scale Systems of Systems. Based upon the E-Learning Systems' Theoretical Framework [16] in which the E-Learning System consists of three main systems i.e. People, Technologies and Services. People such as students, teachers, Ministry of Education, technology providers and content providers. Technologies include content, communication and collaboration. Services include pedagogical models and Instructional strategies [16]. Based upon this E-learning System's Theoretical Framework the Online Distance Learning System can be described as Systems of Systems that consists of the following constituent systems: (a) People and it includes: students, Ministry of Education, The authors of the curriculum, Teachers, School Admins and supervisors, (b) Technologies and it includes: content and the software and platforms that are used for the communication and collaboration in the online education, (c) Services and it includes: IT support, and Telecommunication companies. In this research, author aim to investigate the Online Distance Education System Key challenges, then author will propose the Future of Online Distance Education that can be considered as a solution for the current Online Distance Education implementations challenges. Figure 1 below illustrates the Online Distance Education System as SoSs.

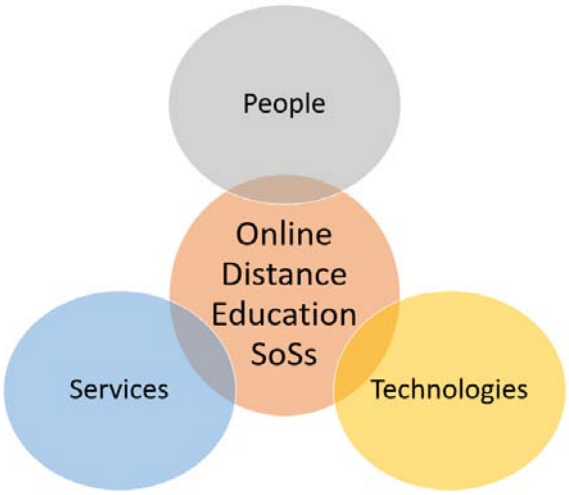

Figure 1: Online Distance Education SoSs.

V. Online Distance Education System of Systems key Challenges

The implementation of Online Distance Education System presented number of challenges. In this section, author explained the most common key challenges of the Online Distance Education System. The presented challenges are based upon the previously described constituent systems of Online Distance Education System:

a) People

i. *Achieve Learning Outcomes:*

The most recent works and researches that are centered on whether online learning is as successful as traditional learning in classrooms. For some studies online learning has been found to be equivalent to face-to-face learning in traditional classrooms in terms of the learning quality as well as the satisfaction of the students[15]. Additionally, the students received higher grades in the online learning followed by mix learning in which both online and traditional learning methods applied and then the traditional learning environments and this considered as indication that online learning is more successful than classroom-based learning [15]. However, the implementation of Online Distance Learning considered as challenging and may affect achieving the learning outcomes. For students it is hard for them to understand that the role of an instructor in an online classroom is much more student centered compared to traditional teacher-centered classrooms [17]. This may result in situations in which students fail to take on the role of an active learner and, as a consequence, they simply do not learn so well and this negatively affect achieving the learning outcomes[17].

ii. *Students Engagement*

Student Engagement in the Online Distance Learning is very important. Student Engagement is described as the student's psychological interest in, and effort to study, understand or master the information, skills or crafts that are intended to facilitate academic work [18].The student participation and engagement in online learning is essential because the student participation can be shown as proof of the significant effort needed by students for their cognitive growth and their desire to construct their own skills, contributing to a high level of student achievement [18]. Students view online courses differently than traditional courses. Negative expectations can result in unfavorable learning results like reduced motivation and endurance [15]. The student's engagement in the Online Distance Learning considered as challenge. Some students may be embarrassed to ask questions or express opinions through online classes which affect the interactions and overall learning outcomes of them [17]. Strategies, methods and tools must be developed in order to ensure students engagement in the learning [18].

iii. *Students Evaluation*

Students Evaluation may be considered as a challenge while the implementation of Online Distance Education as it has been proven that grades of students while implementing online learning are better that the grades while implementing traditional Face-to-Face learning. The students received higher grades in the online learning followed by mix learning in which both online and traditional learning methods applied and then the traditional learning environments [15]. This may indicate that students achieved the learning outcomes, however this may also indicate that students may got help during the exam time, or they may navigate the web to get answers for exams questions.

iv. *Users Satisfaction*

Ensuring user's satisfaction considered as a challenge while implementing online distance education system. Students Satisfactions affected by different factors. Student participation raises the level of student satisfaction, moreover it improves student motivation to learn, decreases sense of isolation, and the performance of the online learning will be improved [18].In the online learning environment, importance of aligning educational material and assessment metrics with learning results is crucial to positive learning outcomes and student's satisfaction [15]. It is important as well to achieve teacher's satisfaction in order to motivate them for better teaching process. School Admins, Parents, accreditation team's satisfaction is important as well.

v. *Curriculum Design*

Designing a Curriculum that lead to achieve learning outcomes and student's satisfaction considered as a challenge while implementing Online Distance Education System. Researchers investigated the curriculum design factors that lead to efficient online learning in terms of outcomes and satisfaction [15]. Results presented that the following factors positively

affected online learningprocess such as the designing of adaptable content and designing the content that promote student's interaction[15].

vi. *Ensuring the quality of education*

It is essential to ensure the quality of the delivered education for students while implementing Online Distance Education System. As In traditional Learning environment, usually school admins and supervisors keep track of the education process at schools, it is necessary to keep track of the education process online as well.

vii. *Some job titles and duties end*

The complete turning into the implementation of the Online Distance Education System may lead to some employees losing their jobs. For example, when applying the distance learning system, jobs related to each of the following services considered as not necessary, such as guarding, security, cleaning services, building maintenance services, and transportation services to and from school, which may result in negative effects on society, such as high unemployment. On the other hand, this may have positive effects, such as the termination of transportation usage will positively affect the environment by reducing emissions and improve the air quality.

b) Technologies

There are number of challenges that are related to technologies while implementing Online Distance Education System.

i. *Availability of Devices*

In order to effectively implement the Online Distance Education System, it is essential to ensure that all students have their own device that they can use for learning. This can be considered as a challenge because some families with low income may not be able to offer each of their children a device that they can use for online learning. However, in many countries, charities sponsor education and provide electronic devices for needy students.

ii. *Achieving Security Requirements*

Online Distance Education System infrastructure represents a charming learning environment that's popularity increased, and people tend to increasingly interest in online courses[19]. However, Online Distance Education System infrastructure is fundamentally depending on the utilization of the Internet platform that witnessed an increasing set of illegitimate actions. The Online distance education System infrastructure may expose to different types of threats. [19]. Moreover, several online learning platforms are carried out without considering many of the security concerns [19]. It is highly recommended to address security requirements and fulfill them while implementing Online Distance Education System.

iii. *Ensuring Privacy of the users i.e. students, teachers*

Ensuring the privacy of the Online Distance Education System's users is critical issue. Some of the implementation in this field include signing term of use policy and setting up a penalty list for any break of the privacy for the system's users.

c) Services

i. *Internet Connection Reliability*

Internet connection has great impact on the process of online learning process. A study conducted in order to examine the relationship between student's success and the bandwidth connectivity and it concluded that students that have higher bandwidth connectivity engaged more in the online classes and their grades are higher as well [20]. It is essential to ensure that the Internet connection is reliable, and its bandwidth is high while implementing Online Distance Education System for both students and instructors.

VI. The Research Agenda: the Future of Online Distance Education that can be Considered as a Solution for the Current Online Distance Education Implementations Challenges

The author of this research paper aim to offer a research agenda that identifies 11 proposed frameworks and approaches to overcome the challenges of the implementation of Online Distance Education System. Figure 2 below represent the adopted strategies for Research themes generation[8]. Below are the research themes suggested to overcome the current Online Distance Education implementations challenges. Please Note that the research themes listed without any importance priority. Table1 represent brief description of each research theme.

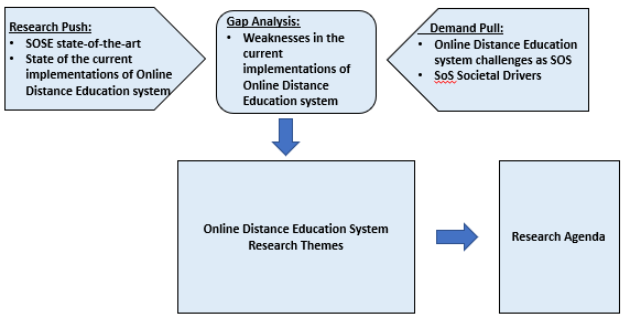

Figure 2: The adopted strategies for Research themes generation [8]

Below represented research themes in no priority order:

Table 1: Brief description of each of the 11-research theme

Research Theme	Brief Description
Achieve Learning Outcomes	This research theme addresses the research need to develop approaches to ensure achieving learning outcomes while using complex SoSs that makes it hard to achieve the requested learning outcomes.
Students Engagement	This research theme addresses the research need to develop approaches for ensuring student's engagement while using complex SoSs that makes the students engagement hard to measure.
Students Evaluation	This research theme addresses the research need to develop approaches and framework for student's evaluation to ensure fair evaluation of students while using complex SoSs that makes the fair evaluation of students hard to accomplish.
Users Satisfaction	This research theme addresses the research need to develop approaches for ensuring user's satisfaction while using complex SoSs that makes the users satisfaction hard to achieve.
Curriculum Design	This research theme addresses the research need to develop approaches and framework for designing effective curriculum while using complex SoSs that makes it hard to design effective and suitable curriculum.
Ensuring the quality of education	This research theme addresses the research need to develop approaches and framework for ensuring the quality of the education while using complex SoSs that makes it hard to ensure the quality of the learning and teaching process.
Some job titles and duties end	This research theme addresses the problem of increasing in unemployment percentage due to the fact that the use of online education system may result in ending some job titles and duties. This research theme addresses this challenge and how to overcome its effects.
Availability of Devices	This research theme addresses the need to ensure the availability of Devices for both students and instructors that can be used for online learning while using complex SoSs.
Achieving Security Requirements	This research theme addresses the need to achieve security requirements that provide a holistic security vision for ensuring the security of complex SoSs which are liable to constant changes that makes them exposed to new threats
Ensuring Privacy of the users i.e. students, teachers	This research theme addresses the need to ensure privacy of the users which provide a holistic vision for the requirements to ensure users privacy while using complex SoSs which are susceptible to constant changes that makes the users exposed to break into their privacy.
Internet Connection Reliability	This research theme addresses the research need to ensure the reliability of the internet connection while using complex SoSs that makes the unreliable internet connection may result in systems' failure.

a) *Theme 1: Online Distance Education System Approaches to ensure Achieving Learning Outcomes*

Achieving learning outcomes is one of the most important goals of the educational system. When applying the online distance learning system, achieving learning outcomes is a real challenge. It is essential to ensure that this goal is achieved, however, it may be hard to measure while applying online learning system. The author of this research paper believes that it is essential to develop a framework to ensure achieving learning outcomes, the framework should consider the following points: First, All the learning outcomes must be clear and clarified in the beginning of each online session, before the end of each online session it is recommended to apply short quiz to evaluate the level of achieving learning outcomes, moreover, it is recommended as well to explore students opinions after each online session. Second, explore students that need extra lessons and explanations and offer them extra classes in order to ensure that the learning outcomes are achieved. Third, strategies and plans needed to be developed for the purpose of achieving learning outcomes while implementing the online distance learning system. Forth, it is recommended to develop smart application that capture students' understandings levels based upon their performance in all of the online subjects and predict students' performance as well. Finally, it is recommended to explore other successful implementations of online distance learning systems worldwide and benefit from their experience.

b) *Theme 2: Online Distance Education System Approaches to ensure Students Engagement*

The student's engagement has great impact on student's satisfaction, motivation and achieving learning outcomes. Students engagements in the online distance classes is an indication of the successful online distance education process. Moreover, it motivates student to learn and teachers to innovate. Author of this research paper believes that it is essential to develop framework for ensuring student's engagement in the education process while implementing online distance education

system. The developed framework should consider the following recommendations: first, the developed curriculum must be attractive and encourage student's engagement. Second, part of the evaluation of student's performance must consider student's engagement in online classes. Third, strategies and plans must be developed to include several ways that ensure student's engagement. Forth, smart software can be used and installed in student's devices in order to monitor their behavior during online classes and detect student's engagement during the online classes as well. In the case of young students, specialists in children's behaviors and parents' opinions could provide valuable recommendations for ensuring students engagement during online classes.

c) *Theme 3: Online Distance Education System Framework for effective students' evaluation*

Researches and studies that dealt with the level of students performance when applying the online distance learning system have proven that students' grades were higher than when applying the traditional education system, this may be an evidence of the effectiveness of online distance learning system, but it may also be an indication of the lack of credibility of the evaluation when applying the online distance learning system, for example, the student may receive external assistance during the application of exams, or the student may use external sources or the web, for example, to answer questions. Hence, it is clear that effective evaluation of students when applying the distance learning system may constitute a real challenge. In this regard, number of suggestions and approaches have been proposed. The author of the research paper believes that evaluation framework must be set up and number of points should be considered. First, the students should be evaluated not only based upon exams, participation during the online class should be considered. Second, online exams should have protocols like keeping the cameras and microphones on. Third, exam questions must be reviewed against the web to make sure that students cannot find their answers there. Forth, it is advisable to develop software that is mandatory to be installed in students' devices which can be used for detecting students' behavior during online exams, further approaches can be considered as well. Moreover, teachers can participate in developing the online evaluation framework as well.

d) *Theme 4: Online Distance Education System Approaches for ensuring user's satisfaction*

One of the most important factors in the success of the educational SoS is the satisfaction of users, whether they are students, teachers, school administration and parents. When implementing online distance learning system, achieving user satisfaction is a real challenge. The satisfaction of the student and the teacher must primarily be achieved. In order to ensure user's satisfaction, it is essential to develop framework that consider the following points: First, ensure students participation in the online classes as the student participation raises the level of students satisfaction, improves student motivation to learn, and decreases sense of isolation, moreover it raises teacher's satisfaction as it indicated the effectiveness of learning. Second, it is essential to align educational materials with assessment metrics which lead to positive learning outcomes and student's satisfaction. Third, it is important to continuously support and appreciation for efforts of students as well as teachers. Forth, to investigate and survey user's point of view about all systems aspects in order to improve it and ensure users satisfactions. Fifth, strategies and plans needed to be developed in order to take necessary steps that will positively lead to user's satisfactions. Finally, exploring different successful implementations of online distance education system worldwide will help in developing a holistic vision about framework for achieving user's satisfactions.

e) *Theme 5: Online Distance Education System Framework for Curriculum Design*

Designing the appropriate curriculum for the online distance learning process is a real challenge for curriculum developers and teachers as well. An approach should be developed in which all required educational outcomes can be achieved while applying a distance learning system over the Internet. Therefore, the author of this research paper believes that a framework for curriculum design should be developed and consider the following points: It is advised to take advantage of other experiences in preparing curriculum for online learning, the prepared curriculum should be suitable with different age stages, moreover, the prepared curriculum for online learning should enforce students to engage in learning process, additionally, the developed curriculum should require students participation, moreover, teachers and students feedback about curriculum must be taken into consideration. Finally, the developed software and applications that are used for online learning such as virtual labs, and virtual classrooms should be improved in a way that makes the students feel as if they are in real classroom environment.

f) *Theme 6: Online Distance Education System Approaches for ensuring the quality of education*

It is very important to ensure the quality of education processes when applying the online distance learning system. In the traditional learning environment, many methods are used to ensure the quality of the education process, such as achieving learning outcomes, students results, accreditation teams, and school evaluation, and the largest role of school administrations that continuously visit classrooms and follow levels of academic achievement for the students.

Thus, in the context of SOSE, an approach should be followed in order to ensure the quality of the education process while using online distance learning system. Number of points should be taken into consideration: first, Administration continuous to attending online sessions along with students. Second, Accreditation teams continuous to visit online schools and evaluate education process. Third, surveys and feedback should be requested from students as well as their parents in the case of young students. Forth: sudden online quizzes should be held in continuous manner, fifth: all the online sessions must be recorded and saved for later usage. Finally, strategies of ensuring online education quality must be developed in which all of the users of Online Distance Education SoSs must be involved such as: managers, teachers, students, members of Education Ministry, members of accreditation teams, curriculum developers as well as parents.

g) *Theme 7: Online Distance Education System Framework for minimizing the effects of unemployment*

The implementation of the online distance learning SoS has many benefits to society, individuals and the environment. For example, applying an online distance learning system contributes to reduce the expenses from financial budget of schools such as guarding, cleaning and maintenance services and the costs of school services such as electricity, water and communications services, also it has a great benefit to the environment as the implementation of the online distance learning system means dispensing with school transportation Which directly affects improving air quality by reducing emissions from school buses and cars that transport students to and from schools. Also, the implementation of online distance learning system enhances the student's confidence by transforming the dependence on the teacher in learning in the traditional education environment into the dependence on the student, whereby the student conducts researches and explorations and attempts to solve problems, which also enhances the research skills of students. On the other side, some job titles and duties will be end, like for example school guard, school cleaners, bus drivers, which will result in raising the percentage of unemployment in the community. The author of this research paper believes that it is necessary to cooperate with government agencies for human resources to find a solution to this problem and limit its negative effects on families and individuals in society. Plans and strategies must be developed to ensure that individuals who have lost their jobs are transferred to other institutions that are in need of employees, moreover, It is recommended to cooperate with charities to provide the necessary financial supports for them during this period until they can obtain other jobs.

h) *Theme 8: Availability of Devices Requirements for Online Distance Education SoSs*

One of the biggest challenges facing the success of the implementation of online distance education system is ensuring that there is an electronic device for each student. Some families with low incomes may not be able to offer an electronic devices for their children, or they may provide an electronic device which more than one of their children share it, which may affect the effectiveness of learning, as it is possible that two of their children have an online class at the same time. Hence, the author of this research paper highly recommend that it is essential to collaborate all the efforts between the government, Education Ministry and the charities in the country to ensure that there is an electronic device for every student studying in the online distance learning system. Thus, in the context of SOSE, a framework must be developed in order to ensure the availability of devices for each student. First, the student's family's financial situations must be surveyed in order to investigate and report the families with low income. Second, a survey sent to the low-income families to explore whether they have devices for each of their children. Third, plan must be developed to offer devices to the students that are in need based upon agreement between Education Ministry and Charities in the country. Forth, ensure that families with low income have internet connection at their houses. Fifth, continuous check and investigate to ensure the availability of devices for each student studying in the online distance education system.

i) *Theme 9: Security Requirements for Online Distance Education SoSs*

Although the interaction between the constituent systems of the Online Distance Education SoSs offer huge benefits, this interaction may result in different forms of security breaches. Therefore, it is essential to ensure the security confidence between the constituent systems of the Online Distance Education SoSs. Thus, in the context of SOSE, it is essential to ensure that each of the constituent systems of the Online Distance Education SoSs are secure. However, many factors may affect the process of ensuring the security of the constituent systems of the Online Distance Education SoSs such as the graphical distribution, and SoSs are independently operated and managed. For this challenge, author of this research paper believes that the utilization of Blockchain-Based Security Requirements Engineering Framework [8]for ensuring the security of the constituent systems of the Online Distance Education SoSs. The blockchain is growing as one of cyber security's most propitious and cleverest innovations [21]. Using Blockchain to ensure the security of SOSs for Online Distance Education System would merge a consensus mechanism in the architecture of the SoSs that would allow a majority or all

constituent systems to agree to work as a group or even survive if some of them were compromised [8]. The author of this research paper believes that a Blockchain-based Security Requirements Engineering Framework would provide great protection for overall SoSs of the Online Distance Education System. It would be great if strategies that ensure the security of the constituent SoSs of the Online Distance Education System developed. Moreover, Agreement of the security rules must be signed up by all of the users in the constituent systems of the Online Distance Education SoSs.

j) Theme 10: User's Privacy Requirements for Online Distance Education SoSs

Although the utilization of Online Distance Education SoSs offer huge benefits, this utilization may result in privacy breaks for the systems users. Therefore, it is essential to ensure the privacy of the users of the constituent systems of the Online Distance Education SoSs. Thus, in the context of SOSE, it is essential to ensure that the privacy of each of the users of each of the constituent systems of the Online Distance Education SoSsis achieved. However, many factors may affect the process of ensuring the privacy of the users of the Online Distance Education SoSs such as the systems independencies and the graphical distribution. For this challenge, author of this research paper believes that a trust-based framework which facilitates the automated integration of trust-based policies is important [22]. Moreover, access control services should be sufficiently flexible to capture the dynamic, context, or attributes or credential-based access requirements and enforce the least privilege principle [22]. These access management systems can need to include standards for privacy security, articulated by specific laws [22]. Privacy policy must be set and consider all concepts related to the privacy of each user in the system.

The author of this research paper believe that a Blockchain-based Security Requirements Engineering Framework would enhance privacy protection for all SoSs users of the Online Distance Education System. It would be great to develop strategies that ensure the privacy of the constituent SoSs of the Online Distance Education System users.

k) Theme 11: Internet Connection Reliability Requirements for Online Distance Education SoSs

One of the important requirements while implementing an online distance education system is to ensure Internet Connection Reliability. Actually, any unreliable or poor connection will strongly have negative effects especially for the live online classes. Thus, in the context of SOSE, it is essential to ensure the reliability of the internet connection during the implementation of online distance education system. First, ensure that all students have a strong internet connection at their home. Second, the Education Ministry should sign a contract with the Internet Service Providers companies by which they offer the internet connection with strong connectivity and high bandwidth to students. Third, it is recommended to sign an agreement with Internet Service Providers companies by which the internet connection offered free of charge while using any platform or website for the education purposes. Forth, all online sessions must be recorded and offered for students by which student who has failed to connect to the live online session can attend the recorded class. Fifth, an emergency technical teams must be available for technical assistant on daily manner, especially during the online classes.

VII. Timelines and the Need for a New Research Agenda

Author believes that great efforts have been accomplished in addressing some of the mentioned challenges, however, author believes that the proposed research themes in this research paper may help to cope with the challenges of Online Distance Education SoSs.

Author of this research paper believes that the research agenda that is proposed in this research paper offer a road map for the coming 25 years. Author believes that all community parts should actively involve in the proposed research themes to overcome the challenges while implementing Online Distance Education System. The proposed research themes in this research paper can be considered as a foundation for the methods, approaches, tools and techniques of SoSE. Governments and Educational Institutes should invest in the online learning field in order to reach powerful future of online distance learning.

VIII. Conclusion

The emergence of the internet has great effects in peoples' lives. Recently, statistics presented that peoples tend to use internet in an increasing manner, and this affected the development in the field of Technology and motivated it. Online learning has become an urgent need recently. Online Learning adopted in various educational institutions worldwide. Although the online learning has been implemented years ago, still it faces challenges. The author of this research paper presented the key challenges that reported while implementing Online Distance Education System as Systems of Systems. The author then outlines research agenda that identifies 11 research themes that can be considered as a solution for the current Online Distance Education System implementations challenges.

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Sustainable Manufacturing: Application of Optimization to Textile Manufacturing Plants

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Abstract- The main goal of manufacturing industry is to produce the end products on time with good quality and keep the resource wastage low. However, manufacturing industry face several challenges such as bottle necks in the workflow, unsynchronized production, and sudden increase in product demands.

In this paper, we are proposing a management platform for textile manufacturing plants with following modules: (1) sewing workflow optimization (2) quality assurance workflow optimization and (3) finishing workflow optimizations. We have used Genetic Programming (GP) approach, to optimize the workflows, considering different factors that affect each workflow. Our results show that, using our proposed platform, the manufacturing workflows can be optimized and reduce the bottle necks in the workflows and resource wastage in the manufacturing plant.

Keywords: manufacturing plant, textile industry, optimization, planning, scheduling, genetic programming (GP).

GJCST-H Classification: J.6

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I. Introduction

The textile industry is an important segment in the worlds' manufacturing industry, playing a crucial role in economic development. It is an ever-growing market, with key competitors being China, European Union, United States, and India [19]. The textile sector offers huge employment opportunities for people, especially for the people reside in rural area.

In the textile industry, specifically in manufacturing plants, the production process is a combined effort of different sections such as designing, cutting, sewing, packing, and delivering. They ensure that the clothes are produced with good quality and delivered on time with minimal wastage. However, the textile industry faces several challenges such as bottle necks in the workflow, unsynchronized production, sudden increases in product demands and unseen product wastages [20].

Therefore, it is necessary to adopt to a proper planning and scheduling approach, so that the workflows of manufacturing plants can be optimized. The optimal planning and scheduling are traditionally modeled as Integer Linear Programming (ILP) optimization. However, there is the intrinsic constraint that ILP optimization is a NP-complete problem, and even when solutions are obtained for limited classes, it might be too slow [5]. Therefore, ILP calculation is unfeasible for optimization problems with dynamic nature, even though an ILP formalization of the problem gives an exact solution. The best approach would be to use an approximation approach (heuristic-based approach) for planning and scheduling of manufacturing plants activities.

In this paper, we have proposed a platform for planning and scheduling of a manufacturing plant, specifically targeting the textile industry. We have identified three main workflows of a textile manufacturing plants: sewing, quality assurance and finishing. Therefore, the proposed platform includes following modules: (1) sewing workflow optimization (2) quality assurance workflow optimization and (3) finishing workflow optimization. We have used an approximation (heuristic) based approach: Genetic Programming (GP), to optimize the identified work flows. The GP approach is a well-known method in the planning and scheduling context [1-16].Moreover, they have been widely used for research works related to manufacturing planning systems.

We have identified several parameters that effect each workflow, and processes required to be optimized in each workflow. We have consulted and visited textile manufacturing plants, their management and workers to identify the factors contributing to optimizing workflows. We have conducted experiments to measure the performances of our algorithms using the Sri Lankan textile manufacturing industry as a case study. With the real data sets, our results show that, our proposed GP approach can decide the optimal planning of each work flow dynamically in the order of seconds.

The rest of the paper is organized as follows. Section II presents the related work. Section III introduces the proposed optimization algorithm for planning and scheduling of textile manufacturing plants. In section IV, the result and discussions are presented. Our final remarks can be found on Section V. The references are mentioned in Section VI.

II. Related Work

The Genetic Programming (GP) approach is a well-known method in the planning and scheduling

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context [1-16], especially for NP-hard problems, In this section, we will discuss the most recent work on scheduling and planning in the textile manufacturing context.

The work on [1] shows that resource-constrained project scheduling problems are NP-hard and therefore, it is recommended to use approximation (heuristic) approaches to solve the problem. They have proposed a multi-objective evolutionary algorithm to solve the problem with multiple activity performance modes and two objectives to minimize project makes pan and resource utilization smoothness. They have used GP for their proposed algorithm. The authors of [2] used GP approach to implement an optimal resource allocation algorithm, that minimizes the average execution time of the critical path of workflow under constraints. The authors of [3] show that Master Production Scheduling (MPS) is the key action for success of a textile manufacturing plant. First, they have analyzed the constraints, mainly the installed capacity and the number of workers. Next, with the use of genetic algorithms, the MPS is optimized to carry out production planning, with an improvement of up to 96% of the level of service provided. The research [4] developed a system that uses GP approach to optimize pattern generation in textile production. Their results show that the system can generates enough patterns for fabric designers according to a given set of constraints. The work on [5] focuses on scheduling trousers collection orders, considering dates of starting orders and exporting them, the quantities of each order and the combined importance of customer and style. They have used GP approach to generate the best orders scheduling solution. The study of [6] addresses the production scheduling problem in a textile factory and they have used GP approach to find the minimum total make-span. The authors of [7] presented a methodology to design a control strategy to optimize a complex production process using a neural network combined with GP. The GP approach is used to optimize the architecture and the underlying parameters of the neural network in order to achieve the most effective model of the production process and to obtain set point values and raw material characteristics for an optimal tenacity and elongation of the spinning yarns.

Our research work has been inspired by these works, and we are focusing on a proposing a management platform which helps textile manufacturing plants to optimize their workflows and schedule them with minimum bottle necks and wastages.

III. Methodology

We are proposing to use an approximation approach (heuristic-based approach) for planning and scheduling of textile manufacturing plants workflows, which have a dynamic nature. Specifically, we are proposing to use Genetic Programming (GP) approach. We have identified 3 workflows in the textile manufacturing plant to apply the optimization: sewing, quality assurance and finishing. We have implemented the E-Optimizer platform, which can be used to optimize sewing, quality assurance and finishing workflows. Figure 1 Shows the system diagram of E-Optimizer.

It is important to note that, there are several factors to be considered when optimizing selected workflows in the textile manufacturing plant. As the initial step, we have identified parameters that effect each workflow, and processes required to be optimized in each workflow. We have consulted and visited textile manufacturing plants, their management and workers to identify the factors contributing to optimizing workflows.

For sewing process, parameters such as number of pieces to be sew, number of pieces that can be handled by one machine, number of sewing machines and time taken for one item to be sewed, effect the effectiveness of workflow. In the quality assurance workflow, parameters such as availability of chemical stain removers, hot water and steam generators, number of washers, spinners, and dryers, effect the effectiveness of workflow. For the finishing workflow, parameters such as availability of hand irons with a vacuum press table, scissors press, carousel machines, steam dollies, availability of plastic bags, boxes, and cartons, effect the effectiveness of workflow.

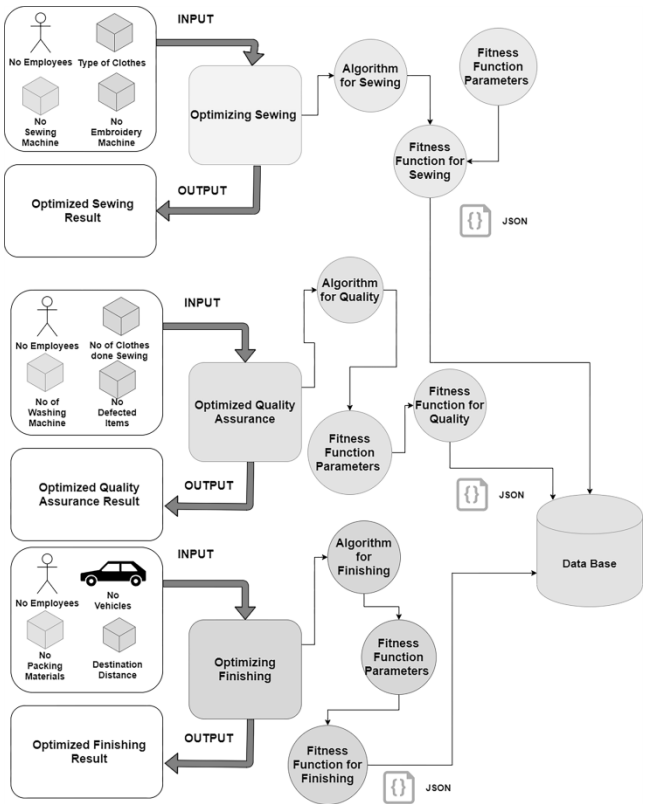

Fig. 1: System diagram of E-Optimizer

a) Genetic Programming (GP) approach

GP is a method of processing the initial population (a group of individual solutions) to get adapted to a new better environment, through three-major genetic operators: (1) selection, (2) crossover and (3) mutation [18]. The group of individual solutions gradually evolved into a better area of the search space by continuing to evolve from generation to generation. They will eventually converge to the most appropriate individual solution, which is the optimal solution for a problem.

GP can be described by the following five main steps [18]:

1. The initial population P(0) is generated with x solutions
2. The fitness value V(p) is calculated for each individual solution p in the current population P(t)
3. The next population P(t+1) is generated, by selecting n best solutions from P(t)
4. Offsprings are produced by applying the genetic operators to population P(t+1)
5. The process is repeat from Step 2 until a satisfying solution.

The process begins with generating a set of individuals which is called a Population. Each individual is a Solution to the problem. After the initial population is generated, afitness function is used to measure how good each solution is. Out of all the solutions, the best solutions are selected for next generation population.

Then genetic operations are applied to selected solutions to generate new solutions. We have considered two types of genetic operators to produce offspring: (1) mutation and (2) crossover. Crossover and mutation perform two different activities. Crossover is a convergence operation which is intended to pull the current population towards a local min/max. But the Mutation is a divergence operation, and it infrequently break one or more members of a population out of a local min/max space and possibly discover a better space. Since the end goal is to bring the population to convergence, crossover happen more frequently and mutation, being a divergence operation, happen less frequently.

The newly generated solutions are added to the existing set of solutions, which is known as the current population. This process is continued until y number of generations are explored. In the final generation, the solution that gives the best fitness value is selected as the best solution.

b) Optimization of sewing workflow

The optimization goal for sewing workflow is to optimize the sewing capacity arrangement; that is to find the best set of clothes to be sew within a given time limit. Cloth types are prioritized based on their profit generation capabilities, and given a priority, where high profit generating clothes are given a high priority value, to ensure maximum profit generation.

The sewing workflow optimization can be explained as the following constrained optimization:
Maximize:

$$\sum_{i=1}^{n} C_i \,.\, P_i \tag{1}$$

Subject to the constraint:

$$\sum_{i=1}^{n} C_i \,.\, A_i \;\leq\; X \tag{2}$$

Where,

n	Chromosome size
Ci	i^{th} gene (Cloth type)
Pi	Priority of the Cloth type i
Ai	Time taken to sew the Cloth type i
X	Time Threshold

The constraint (2) ensures that the selected set of clothes can be sewn within the given time threshold.

When we apply GP approach to the optimization problem, the encoding of a Chromosomes (optimal set of clothes to be sew within a given time limit) is demonstrated in Figure 2. The set of Chromosomes: A1, A2, A3 and A4 build the population. In a Chromosome, each gene supplies two pieces of information: (i) the gene index number represents the cloth type and (ii) the value in the gene signifies the whether the cloth type has been selected to sew or not. A "1"indicates that the respective item is selected and a "0" indicates that it is not selected. For example, the value of the last gene of Chromosome A1, indicates that the cloth type "Denim" has not been selected to sew.

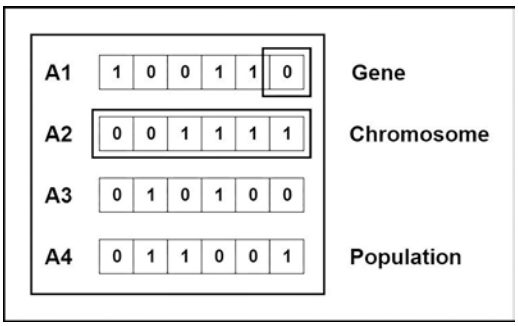

Fig. 2: Population built with Chromosomes A1, A2, A3 and A4

Each Chromosome is evaluated according to the fitness function given in Equation (3).

$$Fitness = \sum_{i=1}^{n} C_i \,.\, P_i \tag{3}$$

Next, the genetic operators are applied to Chromosomes to produce off-springs. Even though the traditional way of producing off-springs is to select the fittest chromosomes and perform genetic operations, it would lead to chromosomes that are closer to one another and results in less diversity. Therefore, we have used Roulette Wheel Selection method [17] and generated better off springs, with more diversity.

In the Roulette Wheel Selection method, a circular wheel is divided into *n* pies, where *n* is the number of Chromosomes in the population. Each Chromosome gets a portion of the circle which is proportional to its fitness value.

As given in Table I, first, the fitness value percentage is calculated for each Chromosome.

Table 1: Fitness percentages of chromosomes

Chromosome	Fitness	Percentage of Fitness
A1	26	20.8
A2	25	20
A3	42	33.6
A4	32	20.6

Then the Roulette Wheel is represented as shown in Figure 3, where each Chromosome gets a portion of the circle which is proportional to its fitness value.

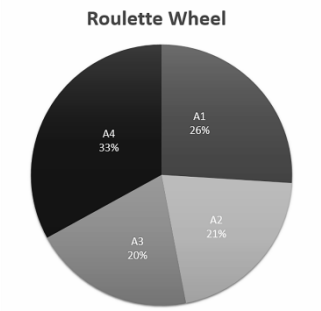

Fig. 3: Roulette Wheel Selection representation

To select parents to generate off-springs, first the wheel is rotated, and then the region of the wheel which comes in front of a fixed point is chosen as the parent. For the second parent, the same process is repeated. Genetic operations are performed to the selected two parents. We have performed one-point crossover and mutation to generate off-springs. This process is continued until x number of generations are explored. In thefinal generation, the solution that gives the best fitness value is selected as the best solution.

c) Optimizaiton of quality assurance workflow

The quality assurance process in textile industry ensures that there are no stains on manufactured clothes. Therefore, if a stain in spotted, the cloth is sent for cleaning. The optimization goal for quality assurance workflow is to optimize the cleaning process; that is to find the best set of clothes to be cleaned within a given time limit.

The quality assurance workflow optimization can be explained as the following constrained optimization:
Maximize:

$$\sum_{i=1}^{n} C_i \,.\, P_i \tag{4}$$

Subject to the constraint:

$$\sum_{i=1}^{n} C_i \,.\, B_i \;\leq\; Y \tag{5}$$

Where,

n	Chromosome size
Ci	i^{th} gene (Cloth type)
Pi	Priority of the Cloth type i
Bi	Time taken to clean the Cloth type i
Y	Time Threshold

The constraint (4) ensures that the selected set of clothes can be cleaned within the given time threshold.

The GP approach used to optimize the quality assurance workflow is same as the GP approach used to optimize the sewing workflow, except for the fitness function, which measures how good a solution is.

The fitness function used in optimization of the quality assurance workflow is given in Equation (6).

$$Fitness = \sum_{i=1}^{n} C_i \,.\, P_i \tag{6}$$

d) Optimizing finishing workflow

The finishing process in textile manufacturing carries out pressing and ironing of the cloth. The optimization goal for finishing workflow is to optimize the finishing process; that is to find the best set of clothes to be pressed and ironed within a given time limit.

The finishing workflow optimization can be explained as the following constrained optimization:
Maximize:

$$\sum_{i=1}^{n} C_i \,.\, P_i \tag{7}$$

Subject to the constraint:

$$\sum_{i=1}^{n} C_i \,.\, D_i \;\leq\; Z \tag{8}$$

Where,

n	Chromosome size
Ci	i^{th} gene (Cloth type)
Pi	Priority of the Cloth type i
Di	Time taken to finish the Cloth type i
Z	Time Threshold

The constraint (8) ensures that the selected set of clothes can be cleaned within the given time threshold.

The GP approach used to optimize the quality assurance workflow is same as the GP approach used to optimize the sewing workflow, except for the fitness function, which measures how good a solution is.

The fitness function used in optimization of the quality assurance workflow is given in Equation (9).

$$Fitness = \sum_{i=1}^{n} C_i \,.\, P_i \tag{9}$$

IV. Experiments and Results

In this section, we are presenting the results and observations of the modules:(1) sewing optimization (2) quality assurance optimization and (3) finishing optimization, which were implemented using

the GP based approaches. We have consulted and visited textile manufacturing plants, their management and workers to identify the factors contributing to optimizing workflows and to collect the data sets related to three workflows.

We have used GP as our heuristic-based optimization approach because it gives reasonable results fast. We derived three individual fitness functions for the three work flows, based on the factors effecting each flow. We have used mutation and one-point cross over as genetic operations and selected parents using Roulette Wheel approach to generate off-springs.

a) Optimizing sewing workflow

Case 1: As explained in the in previous section, with the GP process the given initial solution is improved by mutations and crossover operations over the generations. Therefore, we explored how GP process improves the initial solution when optimizing the sewing workflow. First, we find the initial solutions, and then apply GP process to improve the solution. As shown in the Figure 4, most of the improvements in the fitness function happens early on (during first 8 generations) and after that improvements happens very rarely.

Case 2: Next we explored the relationship between time and number of generations for sewing optimization process. As shown in Figure 5, time taken for generations shows a sub-linear growth, and the optimal values are produced within milliseconds.

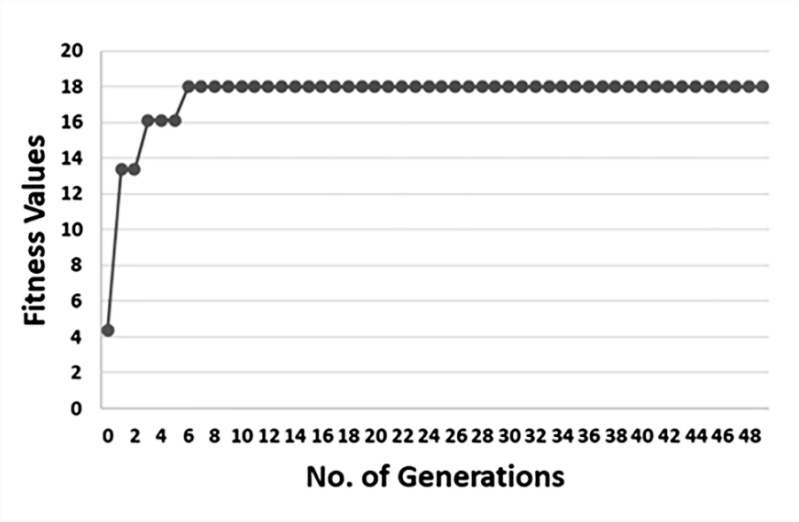

Fig. 4: Optimizing sewing: Effect of number of generations to Fitness Value

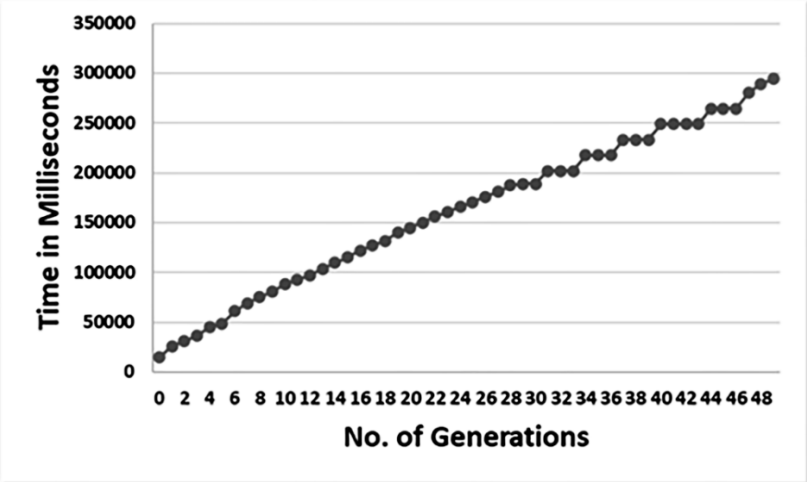

Fig. 5: Optimizing sewing: Effect of number of generations to Time

b) Optimizing quality assurance workflow

Case 3: To explore how the initial solution improves by applying GP process when optimizing the quality assurance workflow, we conducted experiments. First, we find the initial solutions, and then applies GP process to improve the solution. As shown in the figure 6, most of the improvements in the fitness function happens early on (during first 5 generations) and after that improvements happens very rarely.

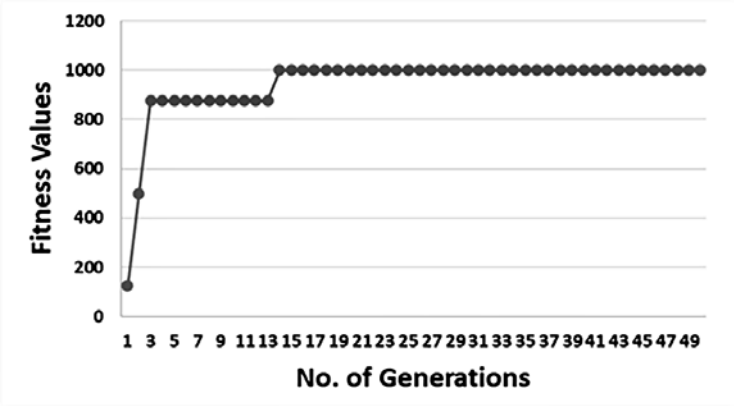

Fig. 6: Optimizing quality assurance: Effect of number of generations to Fitness Value

Case 4: We explored the relationship between time and number of generations for quality assurance optimization process. As shown in Figure 7, time taken for generations shows a sub-linear growth, and the optimal values are produced within milliseconds.

c) *Optimizing finishing workflow*

Case 5: To explore how the initial solution is improved with GP process when optimizing the finishing workflow, we conducted experiments. First, we find the initial solutions, and then applied GP process to improve the solution. As shown in the Figure 8, most of the improvements in the fitness function happens early on (during first 6 generations) and after that improvements happens very rarely.

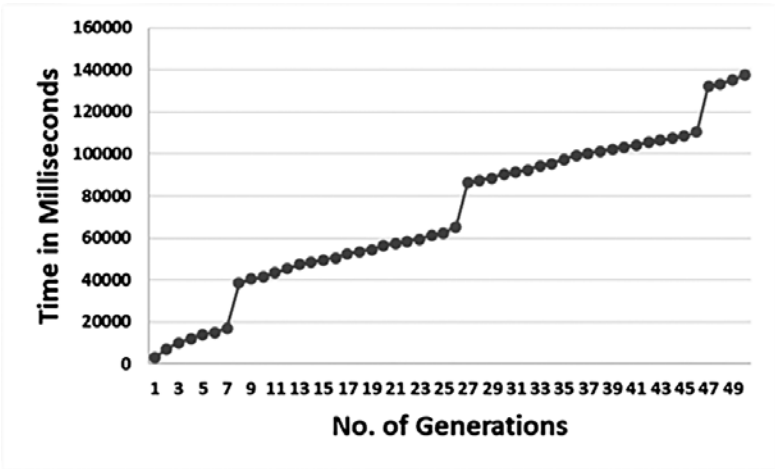

Fig. 7: Optimizing quality assurance: Effect of number of generations to Time

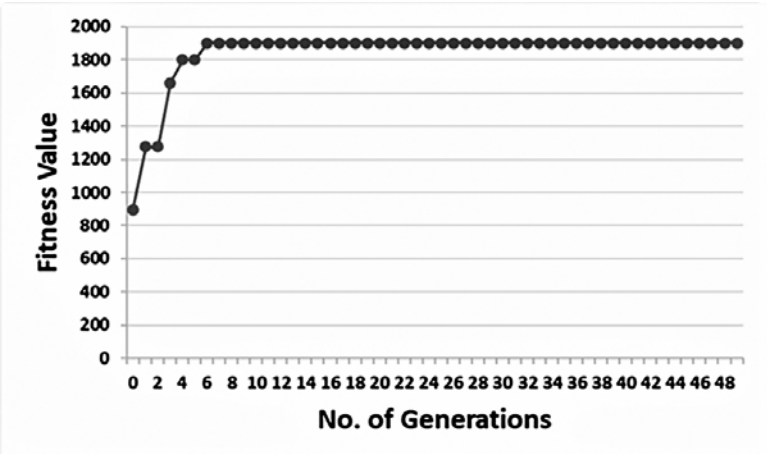

Fig. 8: Optimizing finishing: Effect of number of generations to Fitness Value

Case 6: Finally, we explored the relationship between time and number of generations for finishing optimization process. As shown in figure 9, time taken for generations shows a sub-linear growth, and the optimal values are produced within milliseconds.

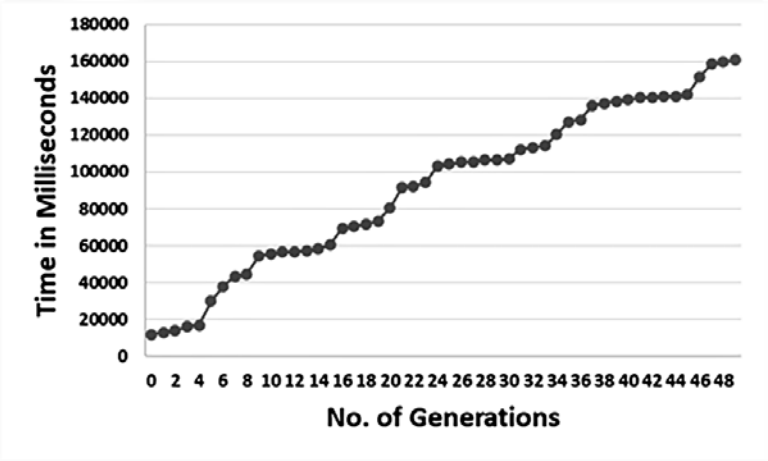

Fig. 9: Optimizing finishing: Effect of number of generations to Time

V. Final Remarks

We have proposed a management platform for optimization and scheduling of textile manufacturing plant, specifically for following workflows: (1) sewing optimization (2) quality assurance optimization and (3) finishing optimization. We have used Genetic Algorithms as our heuristic-based optimization approach to get reasonable results fast. We have consulted and visited textile manufacturing plants, their management and workers to identify the factors contributing to optimizing workflows. We derived three individual fitness functions for the three work flows, based on the factors effecting each flow. Our results show that, using our proposed modules, the manufacturing plant work flows can be optimized and scheduled efficiently and effectively.

As the future work, we are planning to extend the optimization research work, specifically to explore other heuristic approaches such as Iterated Local Search (ILS), and make recommendations on most suitable optimization approaches.

Also, we are planning to work on a prediction module, that predicts the expected time to finish workflow, specific for different cloth types, instead of using an average time threshold for all cloth types. The prediction module will help us to build a complete platform for optimization and scheduling of textile manufacturing plant.

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Acceptance of Self-Driving Cars in United Arab Emirates

By Arwa A. Al Shamsi
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Abstract- Transportation industry witnessing a revolution of the emerging of self-driving cars which are autonomous vehicles that drive by itself without human involvement. It is expected that self-driving cars would have powerful feature and would provide a lot of benefits such as reducing traveling time, reducing traffic jams, reducing car accidents and many other benefits. The government of United Arab Emirates adopt technology implementation in all life aspects in the country starting by turning into smart government and then smart education and many other implementations of using technology in different aspects of the country. This adoption of technology positively affected UAE people's intention toward accepting technology. As UAE government always adopt best technology practices, it is expected that United Arab Emirates would adopt the using of autonomous cars. The aim of this research paper is to investigate UAE people's intention to turn into using self-driving cars. Researcher aim as well to explore the most common factors that may affect people's intention to turn into using self-driving cars. This research paper methodology based on quantitative methods for gathering data in which questionnaire developed and sent to people live in United Arab Emirates.

Keywords: *self-driving car; autonomous; intention; features; specifications.*

GJCST-H Classification: *I.2.m*

Strictly as per the compliance and regulations of:

Acceptance of Self-Driving Cars in United Arab Emirates

Arwa A. Al Shamsi

Abstract- Transportation industry witnessing a revolution of the emerging of self-driving cars which are autonomous vehicles that drive by itself without human involvement. It is expected that self-driving cars would have powerful feature and would provide a lot of benefits such as reducing traveling time, reducing traffic jams, reducing car accidents and many other benefits. The government of United Arab Emirates adopt technology implementation in all life aspects in the country starting by turning into smart government and then smart education and many other implementations of using technology in different aspects of the country. This adoption of technology positively affected UAE people's intention toward accepting technology. As UAE government always adopt best technology practices, it is expected that United Arab Emirates would adopt the using of autonomous cars. The aim of this research paper is to investigate UAE people's intention to turn into using self-driving cars. Researcher aim as well to explore the most common factors that may affect people's intention to turn into using self-driving cars. This research paper methodology based on quantitative methods for gathering data in which questionnaire developed and sent to people live in United Arab Emirates. It was found that UAE people have great intention to turn into using self-driving cars. It was found as well that specifications and features of self-driving cars positively impacted people's decision to turn into using self-driving car. It is recommended for further research to explore the infrastructure requirements in United Arab Emirates for the adoption of self-driving cars.

Keywords: self-driving car; autonomous; intention; features; specifications.

I. Introduction

As technology development has taken on all aspects of life, the world of transportation is witnessing a major revolution due to the emergence of self-driving cars. The emergence of self-driving cars attracted the attention of the media as well as individuals in it. Brandon Schoettle and Michael Sivak, (2014) stated that the emergence of self-driving cars attracted people and researchers as well who aim to explore people's perception of self-driving car. Researchers as well aim to explore how reliable the self-driving car is and what benefits the user may got when using this type of car. Self-driving car as defined by Daniel Howard and Danielle Dai, (2013) is an automated vehicle that has the ability to drive and move without human involvement. Self-driving car system is powerful, it is equipped as well with tools and resources that allow it to sense the world around it.

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The adoption of self-driving cars may be necessary duo to many reasons related to regular transportation system and pollution as well. It is expected that self-driving cars would have great impact on transportation system by reducing car accidents, respecting road rules, reaching destinations fast and reducing traffic jams. Self-driving cars as well expected to reduce emissions which positively impacted environment. Old peoples and people who cannot drive may depend on self-driving cars for reaching their destinations as stated by Corey D.Harper, Chris T.Hendrickson, Sonia Mangones, Constantine Samaras, (2016). Even though self-driving cars expected to have lots of benefits and its features claimed to be extraordinary; it is essential to explore the people's intention to turn into using such car type.

The UAE is one of the best countries in the world in the adoption of technology in all aspects of life. UAE government is turned into smart government, the schools adopt smart learning methodologies and the UAE people rely on the use of technology in almost their daily transactions. It is expected that the United Arab Emirates would be one of the leading countries to adopt the usage of self-driving cars. Although the self-driving cars may provide huge benefits to the user compared to the traditional cars that the user drive, the people perception to turn into using this type of cars may vary as some users prefer to engage in driving by themselves.

The aim of this research paper is to investigate the UAE people's intention to turn into using self-driving cars. This investigation is important for UAE government to explore UAE people's acceptance toward using autonomous cars and to take steps for the adoption of such cars in the future such as setting up regulations and preparing infrastructure as well, for this transportation revolution.

This research applied quantitative methods for collecting data based upon utilization of questionnaire that was prepared and sent for respondents living in United Arab Emirates.

Study Design: the research organized starting by the first section which is the introduction of the research in which the researcher identified the topic as well as the purpose of the research. After that research problem statement identified in the second section. Third section is the research justification/theoretical background in which research papers discussed similar

research topic were addressed and explored. The fourth section includes the research questions and related hypothesis that author aim to explore. The fifth section of the research defined the methodology utilized in this research paper. The sixth section includes the Data Analysis and statistical tests conducted in this research. The seventh section includes the research findings. The eighth sections include the discussion. Finally, conclusion included at the ninth section of the research paper.

II. Research Problem Statement

Recently, technology involved in all life aspects such as the emergence of self-driving car which considered as huge revolution in the industry of transportation. This revolution attracted researchers, individuals, companies and the media for different reasons either to explore the reliability of this type of cars as well as the people's perception of self-driving cars, or to investigate the intention of the people to turn into using this type of cars. Brandon Schoettle and Michael Sivak, (2014) stated that the revolution of self-driving cars attracted many people and researchers as well. Self-driving car is an automated vehicle that has the ability to drive and move without human involvement as defined by Daniel Howard and Danielle Dai, (2013).Semi-automated cars are utilized widely while full-automated cars have been used in some countries as stated by Gora and Inga Rüba, (2016). The self-driving cars that is considered in this research paper is the full-automated cars.

Traditional transportation result in many problems such as air pollution and traffic jams. Daniel Howard and Danielle Dai, (2013) explained how self-driving cars are expected to reduce emissions, reduce traffic jams, reduce car accidents and allow users to reach their destinations fast. Corey D.Harper, Chris T.Hendrickson, Sonia Mangones, Constantine Samaras, (2016) as well showed how there is a need for self-driving cars as people with disabilities, old peoples and people who cannot drive for any reason, could depend on self-driving cars for reaching their destinations.

Brandon Schoettle and Michael Sivak, (2015) mentioned that self-driving car would provide comfortability, safety and will reduce traffic jam as well. Michael A. Nees, (2016)believed that self-driving cars will give the users the chance to take benefits from road time. Ward C., Raue M., Lee C., D'Ambrosio L., Coughlin J.F, (2017) agreed on the mentioned benefits and added that self-driving cars will reduce traveling time and car accidents. Many research papers stated that self-driving cars expected to provide benefits for users.

The aim of this research paper is to explore the UAE people's intention to turn into using self-driving cars. The researcher aims to investigate the factors that affect people's decision to use self-driving cars. The researcher as well aim to examine the standard Technology Acceptance Model in case of introducing self-driving car for public.

The UAE is seeking the first position in all fields. One of the most important areas of interest to the Government of the United Arab Emirates is the technological field. The Government of the United Arab Emirates has become a smart government and technology is being applied in most of the life's aspects, which has established great acceptance to the transformation to technology among the people of the UAE. As the UAE continues to adopt international best practices in the field of technology, the revolution of using self-driving cars is expected to be supported by the Government of the United Arab Emirates. The adoption of self-driving cars requires investigating people's perception about this type of cars, it require as well exploring infrastructure requirements to adopt self-driving cars, New road regulations must be set in order to adopt self-driving cars. But before taking any of the previously mentioned steps, it is essential to explore the UAE people's intention to turn into using self-driving car.

Existing researches deals mostly with people perception to autonomous cars, and some case studies conducted in in USA states and other countries to measure people's intention toward using autonomous cars. This research paper aim to fulfil the gap of measuring UAE people' intention to turn into using self-driving car. The standard Technology Acceptance Model slightly modified by adding new constructs in order to measure the most common factors that affects UAE people's intention to turn into using self-driving cars.

The results from this investigation is important for the government of United Arab Emirates in order to explore UAE people's acceptance to turn into using autonomous cars and to take steps for autonomous cars adoption in the future such as setting up new road regulations and preparing infrastructure as well, for this transportation revolution.

III. Research Justification/ Theoretical Background

a) Autonomous self-driving car

As technology development has taken on all aspects of life, we are witnessing a revolution in various means of transportation. One of the most important example of transportation revolution is the emergence of self-driving cars.Brandon Schoettle and Michael Sivak, (2014) stated that the emergence of self-driving cars gain the interest of many people as well as researchers who were interested in measuring the people's perception of such car. The Media as well was interested in self-driving car topic as it takes part of their reports and news.

Daniel Howard and Danielle Dai, (2013) defined the self-driving car as an automated vehicle that has the ability to drive and move without human involvement. Self-driving car supplemented with resources that allow it to sense the world around it such as the radar and the GPS. Self-driving car equipped with powerful control system to control the movement of the car.

Daniel Howard and Danielle Dai, (2013) stated thatself-driving car history began with Achen Motor Company as it was the first company that brought up the idea of automation when it presented in Milwaukee a phantom motor car in early 1920s.

The appearance of truly autonomous cars was in 1980s as mentioned by Pawel Gora and Inga Rüba, (2016), those emerged cars were less computerized as compared to autonomous cars nowadays. Later the automated car revolution has been emerged. In 2013 noticeable number of car companies became interested in self-driving cars such as Ford and Audi. Famous IT companies such as Google and Apple are doing their projects to introduce their own self-driving cars. Oxford University as well has developed models of self-driving cars.

Semi-automated cars are already been used widely while full-automated cars have been used in some countries for example in United States, in some states the use of self-driving cars is allowed such as Florida and California as mentioned by Gora and Inga Rüba, (2016).

National Highway Traffic Safety Administration NHTSA, (2013) introduced levels for automation classification that are ranged from 0 to 4 as explain below:

- 0: No Automation: Driver is completely responsible about driving.
- 1: Function-specific Automation: One or more of the control functions can be automated but they operated independently of each other and the driver is fully responsible about driving.
- 2: Combined Function Automation: Minimally two of the control functions can be automated and work together, and driver may have time to take hands and feet off the control.
- 3: Limited Self-Driving Automation: Automated car but the driver is expected to participate in driving when it is needed i.e. driving control will be shifted to the driver in some situations.
- 4: Full Self-Driving Automation: Driver will not participate in driving just will provide the destination.

b) The need for self-driving car

When considering the current transportation system, there are many problems that governments seek to find solutions for such as traffic congestion and air pollution resulting from the emissions of carbon dioxide from cars. one of the suggested solutions is the adoption of smart cars i.e. self-driving cars.

With the emergence of self-driving cars and people's interest in them, this important question comes to our minds, is there a need for this type of cars? There are many reasons to adopt the idea of self-driving cars. MatjažKnez, MatevžObrecht, (2019) stated that the car registration worldwide increased sharply year after year, and this increase directly affect the environment and raising the air pollution since most of these cars are fuel-based cars.Self-driving car is smart car some of these cars are fuel-based and some others are electric-based. The use of self-driving cars would give the users the opportunity to reach their destinations faster which may reduce the driving time hence reduce emissions. Daniel Howard and Danielle Dai, (2013) explained how self-driving cars depends on Intelligent Transportation Systems (ITS) that provides high safety level and smart calculation for best road to reach destination. The use of smart transportation system will result in reducing traffic jams, reducing car accidents hence saving lives and reducing emissions hence reducing air pollution.

Corey D.Harper, Chris T.Hendrickson, Sonia Mangones, Constantine Samaras, (2016) stated that people with disabilities, old people as well as people that are not driving due to medical problems consider the self-driving car as a solution for them to reach their destinations hence there is an increase need for such cars. From what is mentioned earlier, it is clear that there is an increasing need for self-driving cars.

c) Benefits of self-driving car

Brandon Schoettle and Michael Sivak, (2015) believed that it is expected that the self-driving cars would provide great benefits to the users. It is expected that the self-driving cars will provide comfortability compared to traditional cars that the human drive which may result in increased of traveling and mobility. It is expected as well that the self-driving cars reduce traffic jams and provide high standards of safety. Michael A. Nees, (2016) stated as well that the self-driving cars would increase the safety and reduce traffic problems. Michael A. Nees, (2016) believed that self-driving cars would allow the users of the car to take benefits of the road time.

Ward C., Raue M., Lee C., D'Ambrosio L., Coughlin J.F, (2017) agrees on the benefits mentioned earlier that self-driving cars have great benefits such as reducing traveling time, reducing traffic jams, reducing car accidents and allowing the users to take benefits of the travelling time.

Yu Shi, Jiefeng Chen, Qi Li, (2017) studied how the use of self-driving cars effects the capacity of the traffic and found that the cooperation of self-driving cars will results in raising traffic capacity, researchers as well stated that self-driving cars are efficient is speeding up the traffic flows.

Self-driving cars would provide great transportation solution for people with disabilities, old

people as well as people that are not driving due to medical problems as mentioned by Corey D.Harper, Chris T.Hendrickson, Sonia Mangones, Constantine Samaras, (2016).

When reviewing the benefits mentioned earlier, benefits of self-driving cars can be concluded as:

- Self-driving car expected to provide high safety as it respects road rules and will reduce the accidents that are due to human errors.
- The self-driving cars give the user the opportunity to take benefits of roads times.
- Self-driving car tends to provide comfort to the user of the car which can lead to increase in the travelling and mobility.
- Self-driving cars would have great impact on traffic system as it will reduce traffic jams and raise the traffic flows especially at peak-hours.
- Self-driving cars will reduce the transportation time as it will give the users the chance to reach destinations faster and as a result the fuel consumption will be reduced as well as the emissions from the cars will be reduced and that will have positive impacts on the environment.
- Self-driving car could be perfect transportation method especially for people with disabilities, old people and people that cannot drive due to medical problems.

d) Challenges for self-driving car adoption

Brandon Schoettle and Michael Sivak, (2014) mentioned how it is important to set new traffic regulations that consider self-driving cars. Michael A. Nees, (2016) raised an important challenge when start using self-driving cars as that type of cars may share the roads with traditional cars that the human drive and this may provide unexpected results.

Michael A. Nees, (2016) believed that the ideal prototype of the self-driving cars that has been advertised may not actually materialize when self-driving cars widely used in real world and this challenge may have negative impacts on public.

Daniel Howard and Danielle Dai, (2013)stated that despite that the self-driving cars planned to be more efficient and sustainable as well it is assumed that is would be a safe car, the perception of public to turn into using self-driving cars may be challenging as public concerned about the real safety and liability the self-driving cars that will be provided in real world. Researchers as well mentioned the manufacturing cost as a challenge as it is expected that self-driving cars would be of high cost for users to own and for government to adapt the road infrastructure for the use of such cars.

M. König, L. Neumayr, (2016) raised the uncertainty challenge for the adoption of self-driving cars as researchers mentioned how people as well as stakeholders may resist to adopt such cars because of their opinions about car's uncertainty. Researchers as well mentioned the people's resistance to change and caution's to "new thing" as a big challenge for the adoption of self-driving cars. One more challenge raised by the researchers that some people drive for pleasure and racing purposes; those people may resist to turn into using self-driving cars.

Frank Douma and Sarah Aue Palodichuk, (2012) stated that self-driving cars may be target for hackers or terrorists. As self-driving cars route can be tracked easily; it is essential to consider the system security and privacy of the self-driving cars. People tend to care about their privacy hence securing the system of the self-driving cars is another challenge for the adoption of self-driving cars.

IV. Research Questions

As been discussed in the previous sections, the research gab is to measure the people's intention to turn into using self-driving cars in United Arab Emirates. The objective of this research paper is to investigate the user's preferred specifications in self-driving cars and the relationship between self-driving car's features and the user's intention to turn into using self-driving car. The researcher as well aim to measure the difference between the male and females in their intention to turn into using self-driving car.

The emerge of self-driving cars attract0ed the interest of governments, car companies, researchers and people as well, surveys conducted in this field to report people's intention to use the self-driving cars.

The main research question to fulfil the gap is "To what extent people in United Arab Emirates have the intention to turn into using self-driving car?" This main research question will be addressed through the following research questions:

Q1: To what extent UAE people care about specifications of the self-driving car?
Q2: Does the specifications of the self-driving car impact the UAE people's intention to turn into using self-driving car?
Q3: Does the self-driving car's features impact the UAE people's intention to turn into using self-driving car?
Q4: To what extent people in United Arab Emirates have the intention to turn into using self-driving car?
Q5: Does the Gender factor have different impact on the intention to turn into using self-driving car?
Q6: Does the Driving Experience factor have different impact on the intention to turn into using self-driving car?
Q7: Does the Education Level factor associated with the intention to turn into using self-driving car?
Q8: Does the Gender and Driving Experience associated?

This research aims to study the UAE people's intention to turn into using self-driving car and whether

the self-driving car's features affect the user's decision and intention to use this type of cars. Thus, this research hypothesis that there is strong association between the self-driving car's features and people's intention to turn into using self-driving car. Author of this research paper stated the hypothesis of this research as following:

H1: UAE people highly care about the specification of self-driving car
H2: There is significant association between self-driving car's specifications and the UAE people's intention to turn into using self-driving car.
H3: There is significant association between self-driving car's features and the UAE people's intention to turn into using self-driving car.
H4: There is significant association between self-driving car's safety features and the UAE people's intention to turn into using self-driving car.
H5: There is significant association between self-driving car's performance features and the UAE people's intention to turn into using self-driving car.
H6: There is significant association between self-driving car's Ease of Use features and the UAE people's intention to turn into using self-driving car.
H7: There is significant association between self-driving car's Usefulness features and the UAE people's intention to turn into using self-driving car.
H8: there is no significant difference between males and females in their intention to turn into using self-driving car.
H9: Driving Experience have positive impact on the intention to turn into using self-driving car.
H10: Level of Education is not associated with the intention to turn into using self-driving car.
H11: there is significant association between gender and driving experience.

Research hypothesis associated with research questions:

Table 1: Research hypothesis associated with research questions

Research Question	Related Hypothesis
Q1: To what extent UAE people care about specifications of the self-driving car?	*H1*: UAE people highly care about the specification of self-driving car
Q2: Does the specifications of the self-driving car impact the UAE people's intention to turn into using self-driving car?	*H2*: There is significant association between self-driving car's specifications and the UAE people's intention to turn into using self-driving car.
Q3: Does the self-driving car's features impact the UAE people's intention to turn into using self-driving car?	*H3*: There is significant association between self-driving car's features and the UAE people's intention to turn into using self-driving car.
	H4: There is significant association between self-driving car's safety features and the UAE people's intention to turn into using self-driving car.
	H5: There is significant association between self-driving car's performance features and the UAE people's intention to turn into using self-driving car.
	H6: There is significant association between self-driving car's Ease of Use features and the UAE people's intention to turn into using self-driving car.
	H7: There is significant association between self-driving car's Usefulness features and the UAE people's intention to turn into using self-driving car.
Q4: To what extent people in United Arab Emirates have the intention to turn into using self-driving car?	*H8*: People in United Arab Emirates have great intention to turn into using self-driving car.

Table 2: Research hypothesis associated with demographic questions:

Demographic Questions	Related Hypothesis
Q5: Does the Gender factor have different impact on the intention to turn into using self-driving car?	*H9*: there is no significant difference between males and females in their intention to turn into using self-driving car.
Q6: Does the Driving Experience factor have different impact on the intention to turn into using self-driving car?	*H10*: Driving Experience have positive impact on the intention to turn into using self-driving car.
Q7: Does the Education Level factor associated with the intention to turn into using self-driving car?	*H11*: Level of Education is not associated with the intention to turn into using self-driving car.
Q8: Does the Gender and Driving Experience associated?	*H12*: there is significant association between gender and driving experience.

The hypothesis above are tested utilizing bivariate correlation and Regression and other statistical tests. Sections below define the methodology and discuss the results found.

Technology Acceptance Model (TAM) utilized as basis for developing conceptual model for this research; Paul Legrisa, John Inghamb, Pierre Collerettec, (2003) stated that Technology Acceptance Model was introduced by Davis, (1989) in order to investigate users' reasons for accepting or rejecting technology, Figure 1 below illustrate Technology Acceptance Model (TAM).

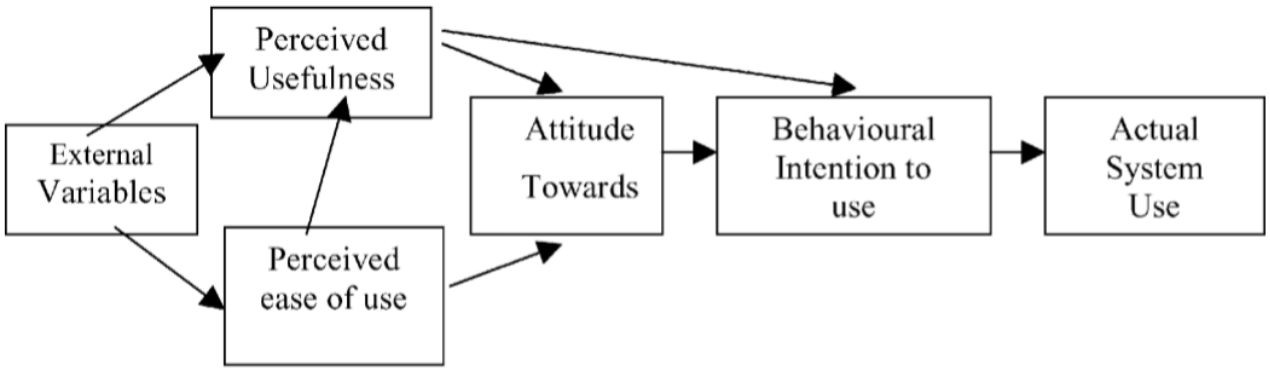

Figure 1: Original Technology Acceptance Model

For this research paper, Figure 2 illustrates research's conceptual Model. The intention to turn into using self-driving car model for this research paper developed based upon the basic Technology Acceptance Model. In this research paper, researcher identified two factors that affects user's intention to turn into using self-driving car i.e. specifications and features of self-driving car. Researcher aim to investigate whether the UAE people care about self-driving car specifications when intending to buy a car and to what extent they care about these specifications. Researcher identified the specifications as the information, facts and important details about the self-driving cars that most of the regular car companies displayed and proposed for the customers. These specifications are real and available in regular cars as well, such as: system, car outside look, wheels, braking system, engine, luxury and comfort, entertainment, number of passengers and seating. The second factor that is identified by the researcher and affect the intention to turn into using self-driving car is the features of the car. Researcher identified features based upon the Technology Acceptance Model as it consists of the Ease of Use features, Usefulness features and researcher added the safety and performance features as well, as presented by Figure 2 below. Self-driving features in this research paper represent the expected features in the self-driving car.

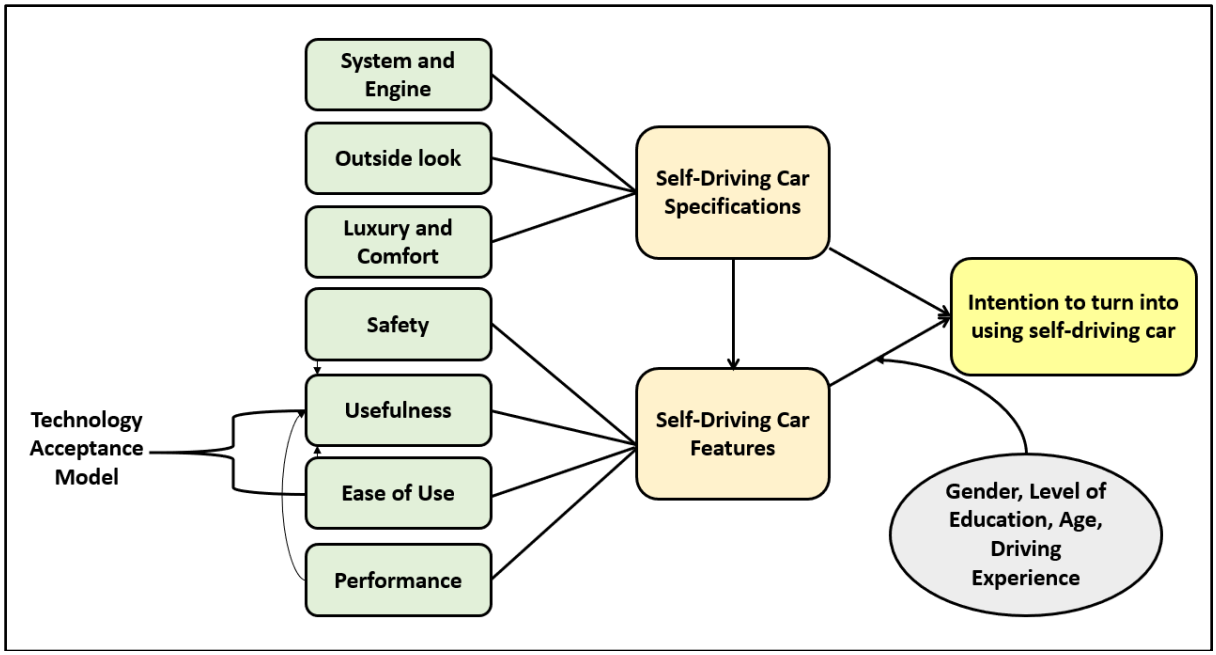

Figure 2: Research's conceptual framework

V. Methodology

Data utilized in this research paper is gathered through online questionnaire. Before start responding to the questionnaire, respondents must read brief description about the self-driving car. The questionnaire consists of four sections, the first section consists of five demographics i.e. age, gender, level of education, nationality and driving experience, the second section is to measure respondent's interest and care about the self-driving car's specifications, the third section is about self-driving car's features, and the forth section is to measure the respondent's intention to turn into using self-driving car. Questionnaire utilizes seven-point scales. The questionnaire is included in Appendix A.

The questionnaire was sent to number of respondents for testing and checking the accuracy of the questions as well as evaluating the clearness of the questions. The targeted population of the questionnaire is people in United Arab Emirates.

After testing the questionnaire, the questionnaire has been sent into 50 persons and the number of collected responses was 39 responds. Number of males participated in answering the questionnaire was 20 persons, while number of females was 19 persons. The age of the respondents to the questionnaire is up to 59 years old, nobody of 60 years old or above participated in answering the questionnaire. Questionnaire was sent to people of different education levels, but most of the responses were from people holding bachelor's degree. Information about driving experience as well collected from respondents to investigate if the driving experience has impact of respondent's decision to turn into using self-driving car.

Research hypothesis were investigated through statistical experiments in order to answer the three main research questions. Before conducting experiments, it is essential to identify the dependent and independent variables for each of the research questions as follows:

- For the first research question:
  Q1: To what extent UAE people care about specifications of the self-driving car?
  Dependent variables: user's interest in self-driving car's specification
  Independent variables: Self-Driving car specifications (comfort, luxury, wheels and tires, braking-system, outside look, steering, number of passengers, seating, entertainment, safety system, multi-view technologies, car engine, speed, complete autonomous driving system, partial autonomous driving system)
  Group: UAE people.
- For the second research question
  Q2: Does the specifications of the self-driving car impact the UAE people's intention to turn into using self-driving car?
  Dependent variable: user's intention to turn into using self-driving car
  Independent variable: self-driving car specifications (comfort, luxury, wheels and tires, braking-system, outside look, steering, number of passengers, seating, entertainment, safety system, multi-view technologies, car engine, speed, complete autonomous driving system, partial autonomous driving system)
  Group: UAE people.

- For the third research question
  Q3: Does the self-driving car's features impact the UAE people's intention to turn into using self-driving car?
  Dependent variable: user's intention to turn into using self-driving car
  Independent variable: self-driving car features (safety, performance, ease of use, benefits)
  Group: UAE people.
- For the fourth research question:
  Q4: To what extent people in United Arab Emirates have the intention to turn into using self-driving car?
  Dependent variable: intention to turn into using self-driving
  Group: UAE people.
- For the fifth research question:
  Q5: Does the Gender factor have different impact on the intention to turn into using self-driving car?
  Dependent variable: intention to turn into using self-driving
  Group: Male and Female
- For the sixth research question:
  Q6: Does the Driving Experience factor have different impact on the intention to turn into using self-driving car?
  Dependent variable: intention to turn into using self-driving
  Group: UAE people with different Driving Experience
- For the seventh research question:
  Q7: Does the Education Level factor associated with the intention to turn into using self-driving car?
  Dependent variable: intention to turn into using self-driving
  Group: UAE people with different Education Level

The questionnaire questions uploaded into Google Forms to create online survey. Then the created survey was sent to the respondents. After gathering responses, file of responses was downloaded from Google Forms into SPSS software for analyzing results.

VI. Data Analysis (Statistical Tests)

Responses were gathered and uploaded into SPSS software for data analysis purposes, number of statistical tests conducted as follows:

a) Construct and scale validity

It is essential to start with construct and scale validity test for the questionnaire. Haradhan Kumar MOHAJAN, (2017) stated that reliability and validity considered as essential and critical for questionnaire evaluation of good research paper. Validity is essential to indicate the finding's truthfulness, while reliability indicate how stable the findings are. The first test researcher started with is construct validity test then scale validity test. Sections below present results of construct and scale validity tests.

i. *Construct Validity*

Construct validity test conducted to measure whether the construct measured what it supposed to measure. Nigel Norris, (1997) stated that one method for measuring the validity is by checking the bias as human nature may result in some activity failings. Researchers as human may create some failings and mistakes. checking common bias can be used to indicate the validity. Below Table 3 present construct validity test by checking common bias.

Table 3: Construct Validity test to check common bias

Component	Initial Eigen values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	15.719	40.306	40.306	15.719	40.306	40.306	10.354	26.550	26.550
2	4.275	10.961	51.267	4.275	10.961	51.267	3.643	9.340	35.889
3	2.649	6.793	58.059	2.649	6.793	58.059	3.572	9.159	45.049
4	2.165	5.550	63.610	2.165	5.550	63.610	3.181	8.156	53.205
5	1.851	4.745	68.355	1.851	4.745	68.355	2.856	7.324	60.528
6	1.705	4.371	72.726	1.705	4.371	72.726	2.747	7.043	67.572
7	1.274	3.267	75.993	1.274	3.267	75.993	2.318	5.943	73.515
8	1.260	3.230	79.223	1.260	3.230	79.223	1.774	4.548	78.062
9	1.019	2.612	81.835	1.019	2.612	81.835	1.471	3.773	81.835
10	.919	2.356	84.192						
11	.760	1.948	86.139						
12	.744	1.907	88.046						
13	.662	1.697	89.744						
14	.656	1.681	91.425						

15	.526	1.350	92.775						
16	.424	1.086	93.861						
17	.377	.968	94.828						
18	.322	.826	95.654						
19	.320	.821	96.475						
20	.270	.693	97.168						
21	.217	.555	97.723						
22	.185	.475	98.198						
23	.149	.381	98.579						
24	.134	.344	98.923						
25	.093	.240	99.163						
26	.080	.205	99.367						
27	.063	.162	99.530						
28	.049	.125	99.655						
29	.038	.098	99.753						
30	.030	.078	99.831						
31	.022	.057	99.888						
32	.018	.047	99.935						
33	.016	.041	99.976						
34	.006	.014	99.990						
35	.003	.007	99.997						
36	.001	.002	99.999						
37	.000	.001	100.000						
38	8.073E-16	2.070E-15	100.000						
39	-5.243E-16	-1.344E-15	100.000						
Extraction Method: Principal Component Analysis.									

Data was checked for common bias; results from Table 3 above show that data in this case loaded on 39 components, and the first component is only explained 26.550 variation of data, therefore there is no common bias in the collected data.

ii. *Scale Validity*

In this research paper, the developed questionnaire utilizes 7-point Likert scales ranging from Agree Strongly to Disagree Strongly. It is essential to test the scales reliability to ensure the consistency of the questions of the questionnaire. Cronbach's Alpha is the important value to measure in the reliability test as it indicated how questions are interrelated in the questionnaire. The higher the value of Cronbach's Alpha, the more reliability of the scale. Below are tables for scale validity i.e. reliability test.

The basic statistical measures of the constructs (Mean and Standard Deviations) are illustrated in Table 4, Table 7 and Table 10. No missing data has been detected as seen that valid N=39 is similar for all.

Reliability for self-driving car's specification construct's variables:

Table 4: Item statistics

Item Statistics			
	Mean	Std. Deviation	N
P1V1comfort	6.436	.8521	39
P1V2safetysystem	6.795	.9782	39
P1V3luxury	6.462	.6426	39
P1V4wheels	6.615	.9066	39
P1V5brakingsystem	6.846	.3655	39
P1V6look	6.436	.9678	39
P1V7passengers	6.282	.9719	39
P1V8seating	6.564	.7538	39
P1V9entertainment	6.282	.9162	39
P1V10multi-view	6.205	.9509	39
P1V11engine	6.462	.8840	39

P1V12speed	6.256	.8801	39
P1V13complete-autonomous	5.436	1.3916	39
P1V14partial-autonomous	6.231	.8099	39

Table 5: Reliability Statistics - Cronbach's Alpha

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.771	.773	14

A reliability analysis was carried out. The scale covering 14 items i.e. construct's attributes. Cronbach's alpha in Table 5 showed the questionnaire to reach acceptable degree of reliability for the first construct i.e. self-driving car's specifications, Cronbach's Alpha (α)= 0.771 (Table5).

Table 6: Total Reliability Statistics

Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
P1V1comfort	82.872	40.167	-.072	.264	.796
P1V2safetysystem	82.513	37.099	.173	.534	.779
P1V3luxury	82.846	36.239	.447	.578	.755
P1V4wheels	82.692	34.640	.436	.696	.753
P1V5brakingsystem	82.462	38.939	.228	.409	.770
P1V6look	82.872	32.904	.565	.712	.739
P1V7passengers	83.026	32.710	.581	.741	.737
P1V8seating	82.744	34.038	.626	.841	.739
P1V9entertainment	83.026	34.289	.465	.737	.750
P1V10multi-view	83.103	32.831	.585	.728	.737
P1V11engine	82.846	35.502	.364	.777	.760
P1V12speed	83.051	35.260	.390	.386	.757
P1V13complete-autonomous	83.872	31.220	.447	.521	.755
P1V14partial-autonomous	83.077	36.915	.258	.438	.768

Table 6 shows that most items appeared to be worthy of retention, resulting in a decrease in the alpha if deleted. Except two items i.e. P1V1comfort and P1V2 safety system, which would increase the alpha to α = 0.796 and α = 0.779. There is no need to delete these items since the α = 0.771 which is high and the increase in Cronbach's Alpha if item deleted is not significant.

Reliability for self-driving car's features construct's variables:

Table 7: Item statistics

Item Statistics			
	Mean	Std. Deviation	N
P2V1safe	5.513	1.2539	39
P2V2speed-limit	5.641	1.1353	39
P2V3road-rules	5.564	1.3138	39
P2V4reduce-accidents	5.205	1.4360	39
P2V5safety-encourage	5.718	1.1227	39
P2V6reach-destination	5.231	1.5638	39
P2V7fuel	5.436	1.3533	39
P2V8performane-encourage	5.615	1.1611	39
P2V9easy-to-use	5.564	1.3138	39
P2V10easy-to-learn	5.897	1.0953	39
P2V11easy-encourage	5.821	.8545	39
P2V12efficient-destination	5.513	1.2952	39
P2V13 benefit-comfort	5.974	1.0127	39
P2V14 reliable	5.179	1.4303	39
P2V15 benefit-safe	5.333	1.3045	39

P2V16 reduce-traffic	5.333	1.2425	39
P2V17road-time	6.000	1.1471	39
P2V18 reduce-pleasure	6.026	1.2028	39
P2V19 benefit-encourage	5.795	1.4722	39

Table 8: Reliability Statistics - Cronbach's Alpha

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.957	.958	19

A reliability analysis was carried out. The scale covering 19 items i.e. construct's variables. Cronbach's alpha in Table 8 showed the questionnaire to reach high degree of reliability for the second construct i.e. self-driving car's features, $\alpha = 0.957$ (Table8).

Table 9: Total Reliability Statistics

Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
P2V1safe	100.846	289.291	.728	.844	.954
P2V2speed-limit	100.718	290.366	.782	.750	.954
P2V3road-rules	100.795	288.536	.709	.789	.955
P2V4reduce-accidents	101.154	282.660	.770	.883	.954
P2V5safety-encourage	100.641	293.078	.718	.909	.955
P2V6reach-destination	101.128	279.536	.764	.808	.954
P2V7fuel	100.923	289.178	.672	.872	.955
P2V8performane-encourage	100.744	289.143	.796	.857	.953
P2V9easy-to-use	100.795	282.588	.851	.892	.952
P2V10easy-to-learn	100.462	299.045	.572	.897	.956
P2V11easy-encourage	100.538	300.150	.711	.826	.955
P2V12efficient-destination	100.846	288.239	.728	.764	.954
P2V13 benefit-comfort	100.385	295.874	.718	.872	.955
P2V14 reliable	101.179	282.625	.775	.807	.954
P2V15 benefit-safe	101.026	284.078	.822	.936	.953
P2V16 reduce-traffic	101.026	292.920	.646	.704	.956
P2V17road-time	100.359	293.131	.699	.837	.955
P2V18 reduce-pleasure	100.333	290.965	.719	.808	.955
P2V19 benefit-encourage	100.564	291.358	.565	.674	.957

Table 9 shows that all items appeared to be worthy of retention, resulting in a decrease in the alpha if deleted.

Reliability for intention to turn into using self-driving car construct's variables:

Table 10: Item statistics

Item Statistics			
	Mean	Std. Deviation	N
P3V1 willing-pay	5.103	1.4653	39
P3V2 lot-benefits	5.872	.9509	39
P3V3 recommend-use	5.692	1.3984	39
P3V4 ease-of-use	5.692	1.2387	39
P3V5 willing-buy	5.410	1.4818	39
P3V6 own-idea	5.769	1.3468	39

Table 11: Reliability Statistics - Cronbach's Alpha

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.942	.946	6

A reliability analysis was carried out. The scale covering 6 items i.e. construct's variables. Cronbach's alpha in Table 11 showed the questionnaire to reach high degree of reliability for the third construct i.e. intention to turn into using self-driving car, $\alpha = 0.942$ (Table11).

Table 12: Total Reliability Statistics

Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
P3V1 willing-pay	28.436	33.779	.773	.620	.939
P3V2 lot-benefits	27.667	38.754	.797	.703	.939
P3V3 recommend-use	27.846	33.028	.878	.809	.925
P3V4 ease-of-use	27.846	35.818	.792	.701	.935
P3V5 willing-buy	28.128	32.062	.884	.865	.924
P3V6 own-idea	27.769	33.498	.884	.850	.924

Table 12 shows that all items appeared to be worthy of retention, resulting in a decrease in the alpha if deleted.

From construct and validity test it was found that the there is no common bias in the collected data and the reliability test presented high score of Cronbach's Alpha which indicated high degree of reliability.

b) Univariate statistics

Data were collected and organized, the univariate test is simple test conducted in order to explore the data and measure the frequencies of attributes as well as mean, median and mode. Univariate test utilized for description purposes; it doesn't involve finding relationships between data.

In this research paper, questionnaire consists of 39 questions, univariate statistical test carried out for exploring frequencies and description purposes. Appendix B consists of the Univariate Statistics for construct's attributes as well as Univariate Statistics for Demographics. Tables below consists of comparison between frequencies of construct's attributes:

i. *Comparison of the percent of each of the specification of self-driving car that user interested in:*

When comparing the self-driving car's specifications; statistics presented that respondents highly care about safety specifications. Statistics as well represented the following as seen in Table 13 and Figure 3 below:

1. Around 95% of respondents care about comfort specifications.
2. More than 97% of respondents with different degree of agreement care about safety, luxury, braking system, car's outside look, speed, number of passengers, wheels and seating's specifications, engine specifications of self-driving car.
3. Around 92% of respondents care about entertainment specifications.
4. Partial-autonomous cars are much preferred than complete autonomous cars.

From all above, it is clear that people highly care about all the specifications of the self-driving car.

Table 13: Self-driving car specifications frequencies

	P1V1comfort	P1V2safetysystem	P1V3luxury	P1V4wheels	P1V5brakingsystem	P1V6look	P1V7passengers	P1V8seating	P1V9entertainment	P1V10multi-view	P1V11engine	P1V12speed	P1V13complete-autonomous	P1V14partial-autonomous
Strongly Disagree	0	2.6	0	0	0	0	0	0	0	0	0	0	0	0
Disagree	0	0	0	2.6	0	2.6	2.6	0	0	0	0	0	5.1	0
Slightly Disagree	2.6	0	0	0	0	0	0	0	0	2.6	2.6	2.6	5.1	0
Neutral	2.6	0	0	0	0	0	0	2.6	7.7	2.6	0	0	10.3	2.6
Slightly Agree	0	0	7.7	2.6	0	7.7	10.3	7.7	7.7	12.8	10.3	12.8	25.6	15.4
Agree	38.5	5.1	38.5	20.5	15.4	28.2	38.5	20.5	33.3	35.9	23.1	38.5	28.2	38.5
Agree Strongly	56.4	92.3	53.8	74.4	84.6	61.5	48.7	69.2	51.3	46.2	64.1	46.2	25.6	43.6

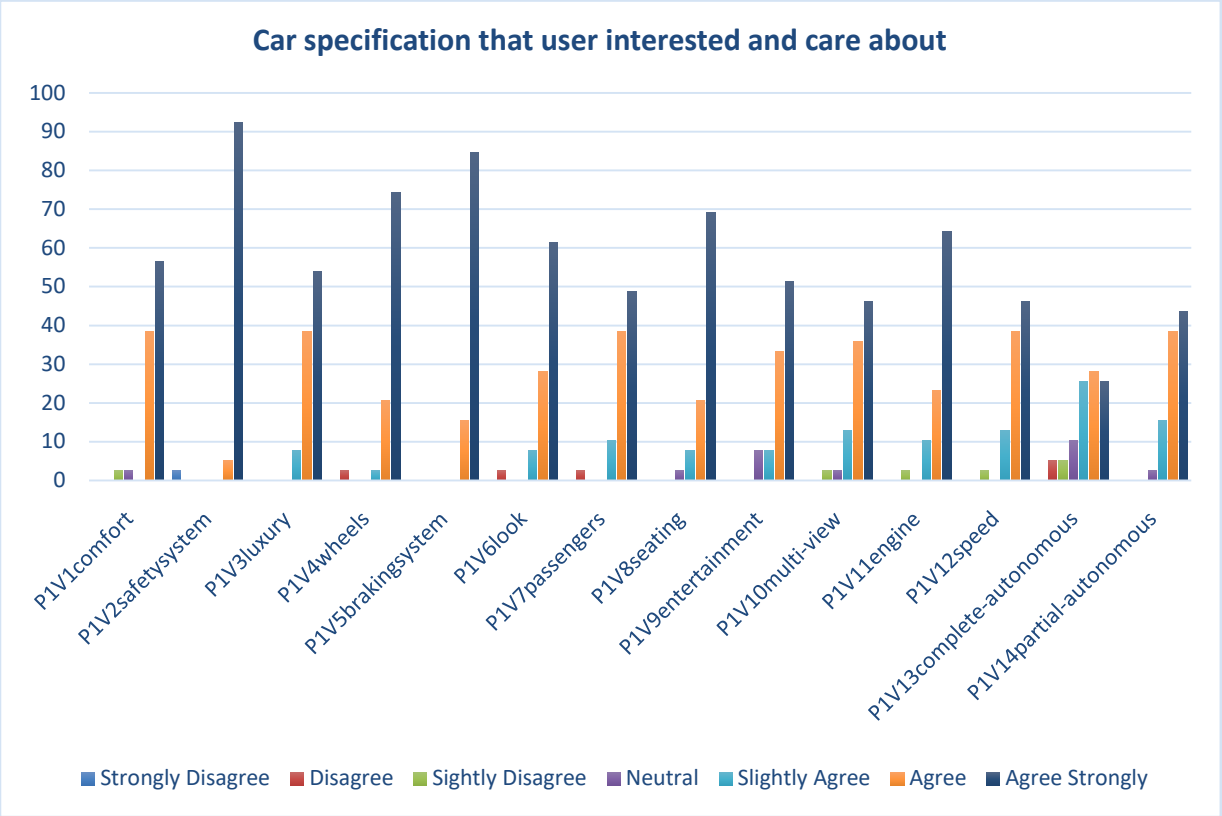

Figure 3: Self-driving car specifications frequencies

ii. *Comparison of the percent of each of the user's expectations of self-driving car safety features:*

Respondents highly care about safety of self-driving car. Statistics represented the following as seen in Table 14 and Figure 4 below:

1. More than84% of respondents believe that self-driving car is safe.
2. More than 87% of respondents believe that self-driving car will never exceed speed limit.
3. More than 79% of respondents believe that self-driving car will never break road rules.
4. More than 69% of respondents believe that self-driving car will reduce car accidents while around 13% disagree that self-driving car will reduce car accidents.
5. More than 87% of respondents believe that self-driving car safety features have great impact that will encourage people to buy such car.

From all above, people highly believe that self-driving car would be a safe car, and safety features would encourage people to buy such car.

Table 14: Expected safety features frequencies

	P2V1safe	P2V2speed-limit	P2V3road-rules	P2V4reduce-accidents	P2V5safety-encourage
Strongly Disagree	2.6	0	0	2.6	0
Disagree	0	2.6	2.6	0	2.6
Slightly Disagree	2.6	2.6	5.1	10.3	0
Neutral	10.3	7.7	12.8	17.9	10.3
Slightly Agree	28.2	23.1	20.5	17.9	23.1
Agree	35.9	43.6	30.8	33.3	38.5
Agree Strongly	20.5	20.5	28.2	17.9	25.6

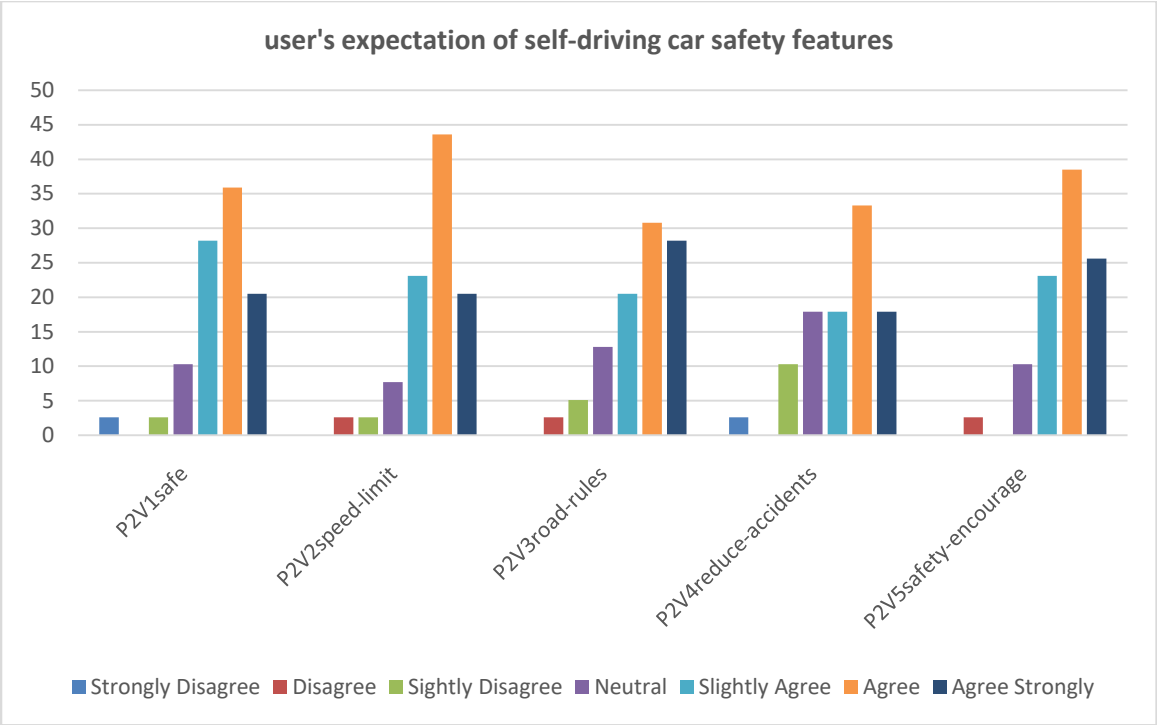

Figure 4: Expected safety features frequencies

iii. *Comparison of the percent of each of the user's expectations of self-driving car performance:*

Respondents have high expectations about performance of self-driving car. Statistics represented the following as seen in Table 15 and Figure 5 below:

1. More than 74% of respondents believe that self-driving car would efficiently reach destination fast, on the other side, around 15% disagree about this.
2. 80% of respondents believe that self-driving car will not consume much fuel.
3. More than 87% of respondents believe that the performance features of self-driving car will encourage them to buy it.

From all above, people highly believe that self-driving car would have great performance, and performance features would encourage people to buy such car.

Table 15: Expected performance features frequencies

	P2V6reach-destination	P2V7fuel	P2V8performane-encourage
Strongly Disagree	2.6	0	0
Disagree	5.1	2.6	2.6
Slightly Disagree	7.7	10.3	2.6
Neutral	10.3	5.1	7.7
Slightly Agree	20.5	30.8	28.2
Agree	33.3	25.6	35.9
Agree Strongly	20.5	25.6	23.1

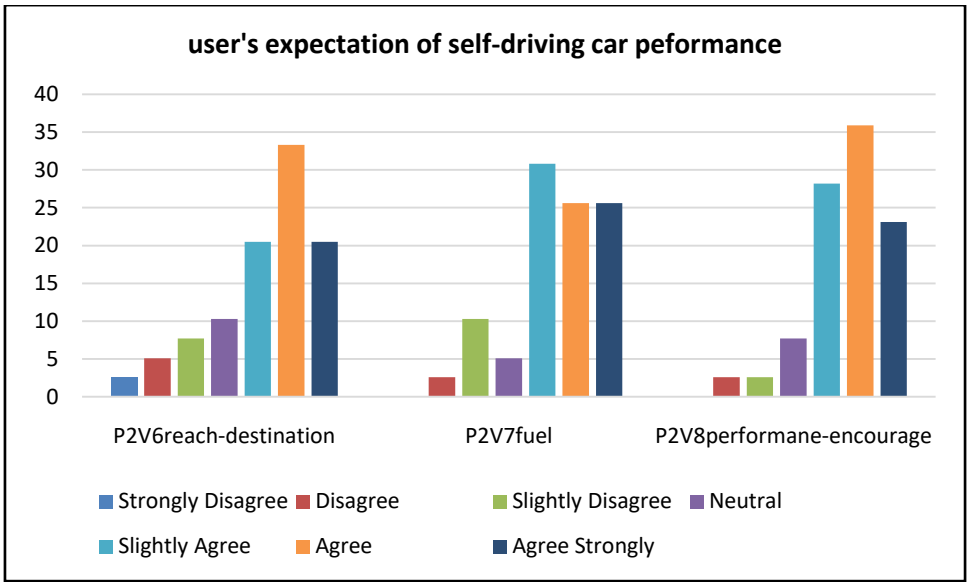

Figure 5: Expected performance features frequencies

iv. *Comparison of the percent of each of the user's expectations of self-driving car ease of use features:*

Respondents have high expectations about Ease of Use features of self-driving car. Statistics represented the following as seen in Table 16 and Figure 6 below:

1. Around 90% of respondents believe that self-driving car would be easy to use.
2. Around 95% of respondents believe that they will learn how to use self-driving car fast.
3. More than 92% of respondents believe that the Ease of Use features of self-driving car will encourage them to buy it.

From all above, people highly believe that self-driving car would be easy to use, and they will learn fast how to use it, people as well believe that Ease of Use features would encourage them to buy such car.

Table 16: Expected Ease of Use features frequencies

	P2V9easy-to-use	P2V10easy-to-learn	P2V11easy-encourage
Strongly Disagree	0	0	0
Disagree	7.7	2.6	0
Slightly Disagree	0	2.6	0
Neutral	2.6	0	7.7
Slightly Agree	30.8	23.1	23.1
Agree	35.9	41	48.7
Agree Strongly	23.1	30.8	20.5

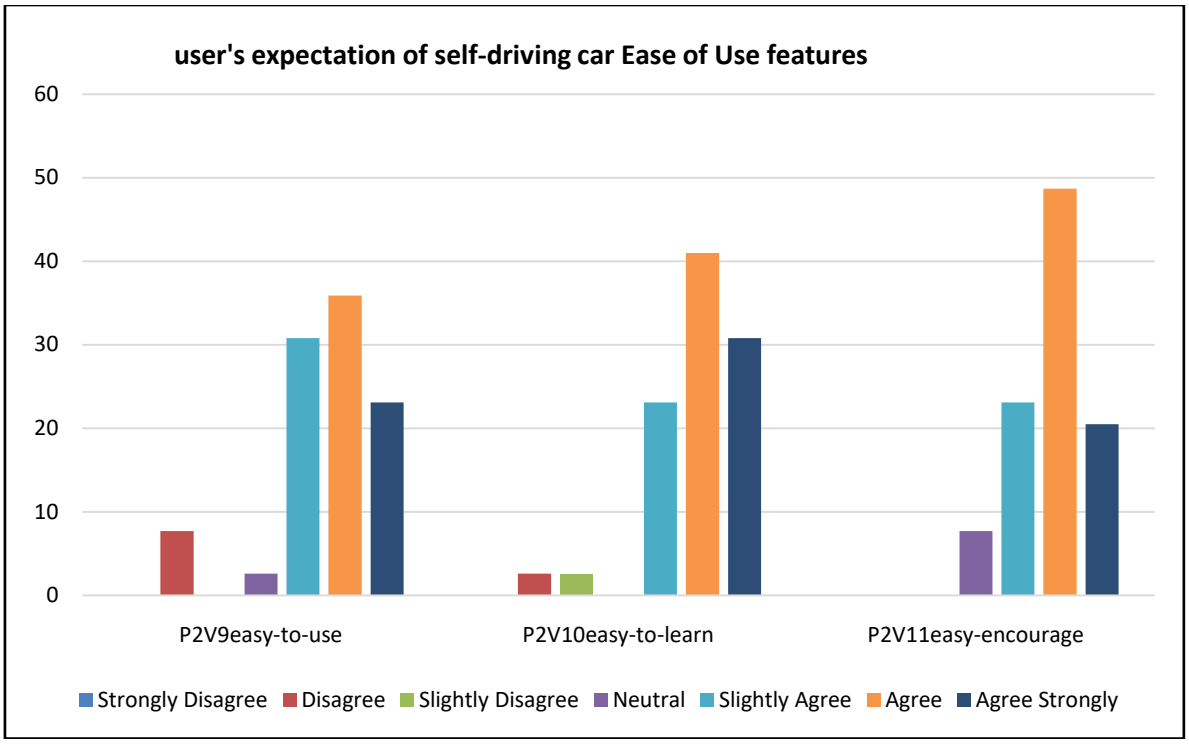

Figure 6: Expected Ease of Use features frequencies

v. *Comparison of the percent of each of the user's expectations of self-driving usefulness:*

Respondents have high expectations about the usefulness of self-driving car. Statistics represented the following as seen in Table 17 and Figure 7 below:

1. More than 92% of respondents believe that self-driving car would provide comfort to them.
2. More than 74% of respondents believe that self-driving car would be reliable car and it would reduce traffic jam.
3. More than 87% of respondents believe that self-driving car will reduce the pressure due to driving.
4. More than 87% of respondents believe that the benefits of self-driving car will encourage them to buy it.

From all above, people highly believe that self-driving car would provide benefits to them and these usefulness features would encourage them to buy such car.

Table 17: Expected Usefulness features frequencies

	P2V12efficient-destination	P2V13 benefit-comfort	P2V14 reliable	P2V15 benefit-safe	P2V16 reduce-traffic	P2V17road-time	P2V18 reduce-pressure	P2V19 benefit-encourage
Strongly Disagree	2.6	0	0	2.6	0	0	0	2.6
Disagree	0	0	7.7	2.6	0	0	2.6	2.6
Slightly Disagree	2.6	2.6	5.1	0	7.7	5.1	0	5.1
Neutral	12.8	5.1	12.8	15.4	17.9	5.1	10.3	2.6
Slightly Agree	25.6	20.5	28.2	28.2	30.8	17.9	12.8	15.4
Agree	33.3	35.9	28.2	35.9	20.5	28.2	28.2	33.3
Agree Strongly	23.1	35.9	17.9	15.4	23.1	43.6	46.2	38.5

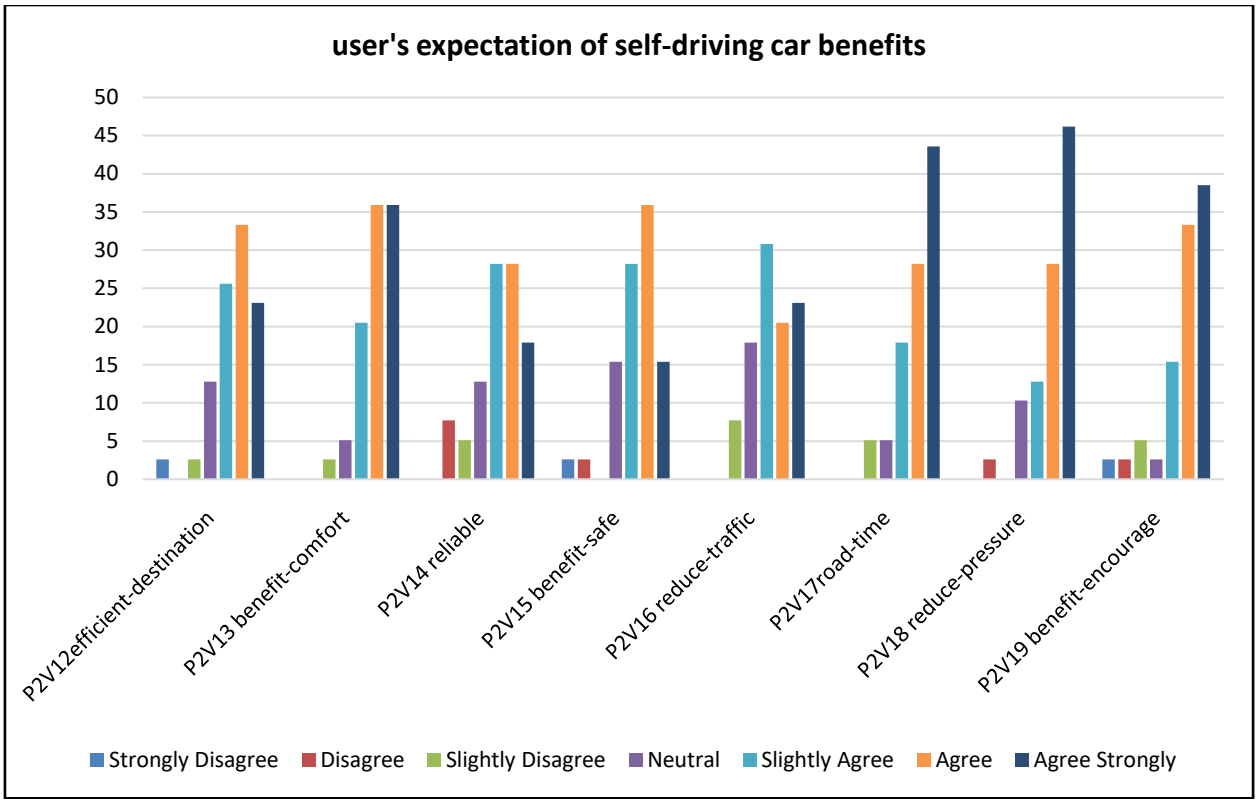

Figure 7: Expected Usefulness features frequencies

vi. *Comparison of the percent of the attributes of the people's intention to turn into using self-driving car construct:*

Respondents have high intention to turn into using self-driving car. Statistics represented the following as seen in Table 18 and Figure 8 below:

1. More than 71% of respondents are willing to pay even more for the self-driving car while around 13% disagree about this.
2. 77% of respondents would recommend using self-driving car.
3. More than 87% think that owning self-driving car is a good idea even that only 77% of respondents have the intention to buy self-driving car in the future while around 10% haven't the intention to buy such car in the future.

From all above, people in UAE have great intention to turn into using self-driving car in the future.

Table 18: Intention to turn into using self-driving car frequencies

	P3V1 willing-pay	P3V2 lot-benefits	P3V3 recommend-use	P3V4 ease-of-use	P3V5 willing-buy	P3V6 own-idea
Strongly Disagree	2.6	0	2.6	0	0	2.6
Disagree	2.6	0	0	2.6	7.7	0
Slightly Disagree	10.3	0	0	2.6	2.6	2.6
Neutral	12.8	10.3	20.5	10.3	12.8	7.7
Slightly Agree	25.6	20.5	15.4	23.1	23.1	25.6
Agree	30.8	41	23.1	30.8	25.6	23.1
Agree Strongly	15.4	28.2	38.5	30.8	28.2	38.5

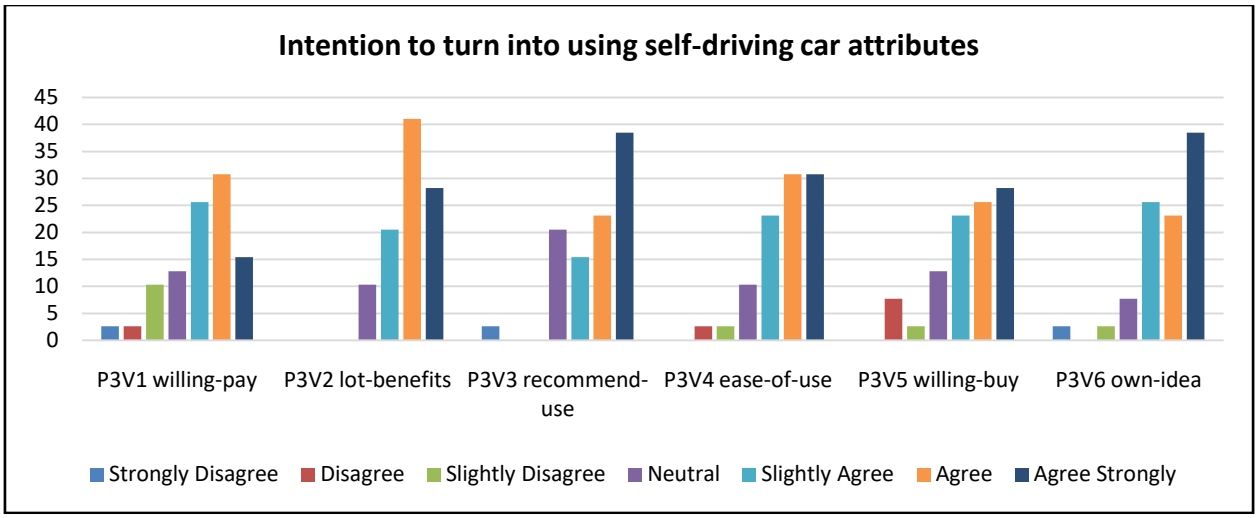

Figure 8: Intention to turn into using self-driving car frequencies

c) Results of Research Questions and Hypothesis Testing

In order to investigate the answer for the research questions and testing the defined hypothesis for the research, number of statistical tests are conducted as presented below:

i. *Frequency test to measure UAE people interest about self-driving car's specifications:*

Q1: To what extent UAE people care about specifications of the self-driving car?
H1: UAE people highly care about the specification of self-driving car.

When comparing the self-driving car's specifications; statistics presented that respondents highly care about self-driving car's specifications. Statistics as well represented the following as seen in Table 19 and Figure 9 below:

1. Around 95% of respondents care about comfort specifications.
2. More than 97% of respondents with different degree of agreement care about safety, luxury, braking system, car's outside look, speed, number of passengers, wheels and seating's specifications, engine specifications of self-driving car.
3. Around 92% of respondents care about entertainment specifications.
4. Partial-autonomous cars are much preferred than complete autonomous cars.

From all above, it is clear that UAE people highly care about all the specifications of the self-driving car, Thus Hypothesis H1 is accepted.

Table 19: Specifications of self-driving car that UAE people car about

	P1V1comfort	P1V2safetysystem	P1V3luxury	P1V4wheels	P1V5brakingsystem	P1V6look	P1V7passengers	P1V8seating	P1V9entertainment	P1V10multi-view	P1V11engine	P1V12speed	P1V13complete-autonomous	P1V14partial-autonomous
Strongly Disagree	0	2.6	0	0	0	0	0	0	0	0	0	0	0	0
Disagree	0	0	0	2.6	0	2.6	2.6	0	0	0	0	0	5.1	0
Slightly Disagree	2.6	0	0	0	0	0	0	0	0	2.6	2.6	2.6	5.1	0
Neutral	2.6	0	0	0	0	0	0	2.6	7.7	2.6	0	0	10.3	2.6
Slightly Agree	0	0	7.7	2.6	0	7.7	10.3	7.7	7.7	12.8	10.3	12.8	25.6	15.4
Agree	38.5	5.1	38.5	20.5	15.4	28.2	38.5	20.5	33.3	35.9	23.1	38.5	28.2	38.5
Agree Strongly	56.4	92.3	53.8	74.4	84.6	61.5	48.7	69.2	51.3	46.2	64.1	46.2	25.6	43.6

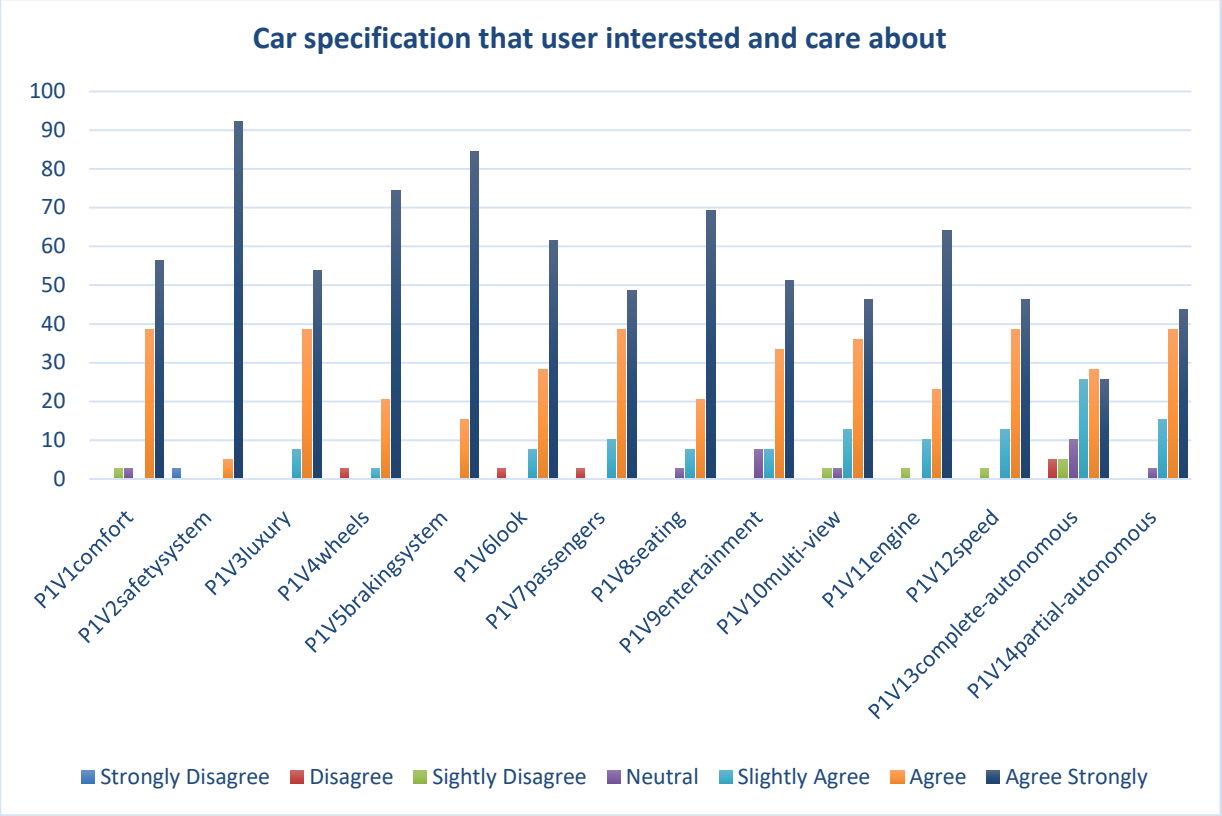

Figure 9: Specifications of self-driving car that UAE people car about

ii. *Correlation test and Regression test to measure the relationship between self-driving car's specification and people's intention to turn into using self-driving car:*

Q2: Does the specifications of the self-driving car impact the UAE people's intention to turn into using self-driving car?

H2: There is significant association between self-driving car's specifications and the UAE people's intention to turn into using self-driving car.

For this research question, global variables identified as following:
INT: intention into using self-driving car
SPC: specification of self-driving car

Correlation Test:

Table 20: Correlation test

Correlations			
		INT	SPC
INT	Pearson Correlation	1	.383*
	Sig. (2-tailed)		.016
	N	39	39
SPC	Pearson Correlation	.383*	1
	Sig. (2-tailed)	.016	
	N	39	39
*. Correlation is significant at the 0.05 level (2-tailed).			

A Bivariate correlation test was conducted as seen in the table 20 above. Correlation test was carried out to check if there is association between Intention to turn into using self-driving car (INT) and specification (SPC) of self-driving car at (0.05) level, findings are:

- The correlation between features (SPC) and intention (INT) is intermediate = 0.383, i.e. 0.25≤ r < 0.75 and positive

The results show that there is an intermediate positive relationship between the constructs (Global Variables) along with intermediate correlation. So, the above suggested Hypotheses H2 is accepted.

Regression Test:

Regression test conducted to whether the specifications of self-driving car could predict the UAE people's intention to turn into using self-driving car.

Intermediate positive correlation exists between the self-driving car's specifications and the people's intention to turn into using self-driving car (R= .383) and the regression model predicted 14% of the variance. In other words, UAE people's intention to turn into using self-driving car is intermediately predicted by self-driving car's specifications as seen in Table 21 below.

Table 21: Regression Model Summary

Model Summary[b]									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.383[a]	.147	.124	6.55839	.147	6.376	1	37	.016
a. Predictors: (Constant), SPC									
b. Dependent Variable: INT									

As seen in table 22below, the regression model can predict the dependent variable (INT) by checking the regression row and the (Sig) column it is clear that the statistical significance of the regression model that was run; Here, $p < 0.05$, and indicates that, overall, the regression model can significantly predicts the outcome variable.

Table 22: Analysis of Variance for intention to use self-driving car based on its specifications

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	274.231	1	274.231	6.376	.016[b]
	Residual	1591.462	37	43.012		
	Total	1865.692	38			
a. Dependent Variable: INT						
b. Predictors: (Constant), SPC						

Also, Table 23 below shows that the for the independent variable (SPC), the probability for the t statistic (2.525) for b coefficient is .016 which is less than the level of significance (.05). So, there is a statistically significant relationship between the specifications of the self-driving car and the intention to use that car. Therefore, H2 is accepted. Also, b coefficient that associated with SPC (.383) is positive and implies that the better the specifications of the self-driving car the higher intention of the user to turn into using self-driving car.

Table 23: Coefficients of intention to use self-driving car based on its specifications

Coefficients[a]										
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	-4.342	15.039		-.289	.774	-34.813	26.130		
	SPC	.424	.168	.383	2.525	.016	.084	.765	1.000	1.000
a. Dependent Variable: INT										

iii. *Correlation test and Regression test to measure the relationship between self-driving car's features and people's intention to turn into using self-driving car:*

Q3: Does the self-driving car's features impact the UAE people's intention to turn into using self-driving car?
H3: There is significant association between self-driving car's features and the UAE people's intention to turn into using self-driving car.
H4: There is significant association between self-driving car's safety features and the UAE people's intention to turn into using self-driving car.
H5: There is significant association between self-driving car's performance features and the UAE people's intention to turn into using self-driving car.
H6: There is significant association between self-driving car's Ease of Use features and the UAE people's intention to turn into using self-driving car.
H7: There is significant association between self-driving car's Usefulness features and the UAE people's intention to turn into using self-driving car.

For this research question, global variables identified as following:

FET: expected features of self-driving car
SFET: expected Safety features of self-driving car
PFET: expected Performance features of self-driving car
EFET: expected Ease of Use features of self-driving car
BFET: expected Usefulness features of self-driving car
INT: intention into using self-driving car

Correlation Test:

Table 24: Correlation for features of self-driving car and intention to use the car

Correlations							
		FET	SFET	PFET	EFET	BFET	INT
FET	Pearson Correlation	1	.882**	.823**	.812**	.939**	.856**
	Sig. (2-tailed)		.000	.000	.000	.000	.000
	N	39	39	39	39	39	39
SFET	Pearson Correlation	.882**	1	.676**	.638**	.760**	.741**
	Sig. (2-tailed)	.000		.000	.000	.000	.000
	N	39	39	39	39	39	39
PFET	Pearson Correlation	.823**	.676**	1	.556**	.711**	.686**
	Sig. (2-tailed)	.000	.000		.000	.000	.000
	N	39	39	39	39	39	39
EFET	Pearson Correlation	.812**	.638**	.556**	1	.760**	.787**
	Sig. (2-tailed)	.000	.000	.000		.000	.000
	N	39	39	39	39	39	39
BFET	Pearson Correlation	.939**	.760**	.711**	.760**	1	.772**
	Sig. (2-tailed)	.000	.000	.000	.000		.000
	N	39	39	39	39	39	39
INT	Pearson Correlation	.856**	.741**	.686**	.787**	.772**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	
	N	39	39	39	39	39	39
**. Correlation is significant at the 0.01 level (2-tailed).							

A Bivariate correlation test was conducted as seen in the table24. Correlation test was carried out to check if there is association between Intention to turn into using self-driving car (INT) and features (FET), safety features (SFET), performance features (PFET), ease of use features (EFET) and usefulness (BFET) of self-driving car at (0.01) level, findings are:

- The correlation between features (FET) and intention (INT) is strong = 0.856, i.e. $0.75 \leq r < 1$ and positive
- The correlation between safety (SFET) and intention (INT) is intermediate = 0.741, i.e. $0.25 \leq r < 0.75$ and positive
- The correlation between performance (PFET) and intention (INT) is intermediate = 0.686, i.e. $0.25 \leq r < 0.75$ and positive
- The correlation between ease of use (EFET) and intention (INT) is strong = 0.787, i.e. $0.75 \leq r < 1$ and positive
- The correlation between usefulness (BFET) and intention (INT) is strong = 0.772, i.e. $0.75 \leq r < 1$ and positive

The results show that there is a strong positive relationship between all of the constructs (Global Variables) along with strong correlation. So, the above suggested Hypotheses are all accepted, and all the null Hypotheses were rejected.

Regression Test:

Regression test conducted to whether the features of self-driving car could predict the UAE people's intention to turn into using self-driving car. Strong positive correlation exists between the self-driving car's features and the people's intention to turn into using self-driving car (R= .875) and the regression model predicted 76% of the variance. In other words, UAE people's intention to turn into using self-driving car is strongly predicted by self-driving car's features as seen in Table 25 below.

Table 25: Regression Model Summary

Model Summary[b]									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.875[a]	.766	.731	3.63367	.766	21.660	5	33	.000
a. Predictors: (Constant), BFET, PFET, EFET, SFET, FET									
b. Dependent Variable: INT									

As seen in table 26below, the regression model can predict the dependent variable (INT) efficiently by checking the regression row and the (Sig) column it is clear that the statistical significance of the regression model that was run; Here, $p < 0.05$, and indicates that, overall, the regression model can significantly predicts the outcome variable.

Table 26: Analysis of Variance for intention to use self-driving car based on

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1429.974	5	285.995	21.660	.000[b]
	Residual	435.718	33	13.204		
	Total	1865.692	38			
a. Dependent Variable: INT						
b. Predictors: (Constant), BFET, PFET, EFET, SFET, FET						

Also, Table 27 below shows that the for the independent variable (FET), the probability for the t statistic (10.054) for b coefficient is .000 which is less than the level of significance (.05). So, there is a statistically significant relationship between the perceived features of the self-driving car and the intention to use that car. Therefore, H3 is accepted. Also, b coefficient that associated with FET (.856) is positive and implies that the much excellent features of the self-driving car the higher intention of the user to turn into using self-driving car.

Table 27: Coefficients of intention to use self-driving car based on car's features

Coefficients[a]										
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	-2.000	3.583		-.558	.580	-9.261	5.261		
	FET	.334	.033	.856	10.054	.000	.267	.401	1.000	1.000
a. Dependent Variable: INT										

Also, Table 28below shows that the for the independent variable (SFET), the probability for the t statistic (6.717) for b coefficient is .000 which is less than the level of significance (.05). So, there is a statistically significant relationship between the perceived features of the self-driving car and the intention to use that car. Therefore, H4 is accepted. Also, b coefficient that associated with FET (.741) is positive and implies that the much excellent Safety features of the self-driving car the higher intention of the user to turn into using self-driving car.

Table 28: Coefficients of intention to use self-driving car based on car's safety features

Coefficients[a]										
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	8.419	3.817		2.206	.034	.685	16.152		
	SFET	1.146	.171	.741	6.717	.000	.800	1.491	1.000	1.000
a. Dependent Variable: INT										

Also, Table 29 below shows that the for the independent variable (PFET), the probability for the t statistic (5.733) for b coefficient is .000 which is less than the level of significance (.05). So, there is a statistically significant relationship between the perceived features of the self-driving car and the intention to use that car. Therefore, H5 is accepted. Also, b coefficient that associated with FET (.686) is positive and implies that the much excellent Performance features of the self-driving car the higher intention of the user to turn into using self-driving car.

Table 29: Coefficients of intention to use self-driving car based on car's Performance features

Coefficients[a]										
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	14.471	3.427		4.222	.000	7.526	21.415		
	PFET	1.788	.312	.686	5.733	.000	1.156	2.419	1.000	1.000
a. Dependent Variable: INT										

Also, Table 30below shows that the for the independent variable (EFET), the probability for the t statistic (7.765) for b coefficient is .000 which is less than the level of significance (.05). So, there is a statistically significant relationship between the perceived features of the self-driving car and the intention to use that car. Therefore, H6 is accepted. Also, b coefficient that associated with FET (.787) is positive and implies that the much excellent Ease of Use features of the self-driving car the higher intention of the user to turn into using self-driving car.

Table 30: Coefficients of intention to use self-driving car based on car's Ease of Use features

Coefficients[a]										
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	5.242	3.711		1.413	.166	-2.277	12.762		
	EFET	2.469	.318	.787	7.765	.000	1.825	3.113	1.000	1.000
a. Dependent Variable: INT										

Also, Table 31 below shows that the for the independent variable (BFET), the probability for the t statistic (7.386) for b coefficient is .000 which is less than the level of significance (.05). So, there is a statistically significant relationship between the perceived features of the self-driving car and the intention to use that car. Therefore, H7 is accepted. Also, b coefficient that associated with FET (.772) is positive and implies that the much excellent Usefulness features of the self-driving car the higher intention of the user to turn into using self-driving car.

Table 31: Coefficients of intention to use self-driving car based on car's Usefulness features

Coefficients[a]										
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	3.183	4.173		.763	.450	-5.272	11.637		
	BFET	.771	.104	.772	7.386	.000	.560	.983	1.000	1.000
a. Dependent Variable: INT										

iv. *Frequency test to measure UAE people intention to turn into using self-driving car:*

Q4: To what extent people in United Arab Emirates have the intention to turn into using self-driving car?
H8: People in United Arab Emirates have great intention to turn into using self-driving car.

Results presented that UAE people have high intention to turn into using self-driving car. Statistics represented the following as seen in Table 32 and Figure 10 below:

1. More than 71% of respondents are willing to pay even more for the self-driving car while around 13% disagree about this.
2. 77% of respondents would recommend using self-driving car.
3. More than 87% think that owning self-driving car is a good idea even that only 77% of respondents have the intention to buy self-driving car in the future while around 10% haven't the intention to buy such car in the future.

From all above, people in UAE have great intention to turn into using self-driving car in the future. Thus, Hypothesis H8 is accepted.

Table 32: UAE people's intention to turn into using self-driving car

	P3V1 willing-pay	P3V2 lot-benefits	P3V3 recommend-use	P3V4 ease-of-use	P3V5 willing-buy	P3V6 own-idea
Strongly Disagree	2.6	0	2.6	0	0	2.6
Disagree	2.6	0	0	2.6	7.7	0
Slightly Disagree	10.3	0	0	2.6	2.6	2.6
Neutral	12.8	10.3	20.5	10.3	12.8	7.7
Slightly Agree	25.6	20.5	15.4	23.1	23.1	25.6
Agree	30.8	41	23.1	30.8	25.6	23.1
Agree Strongly	15.4	28.2	38.5	30.8	28.2	38.5

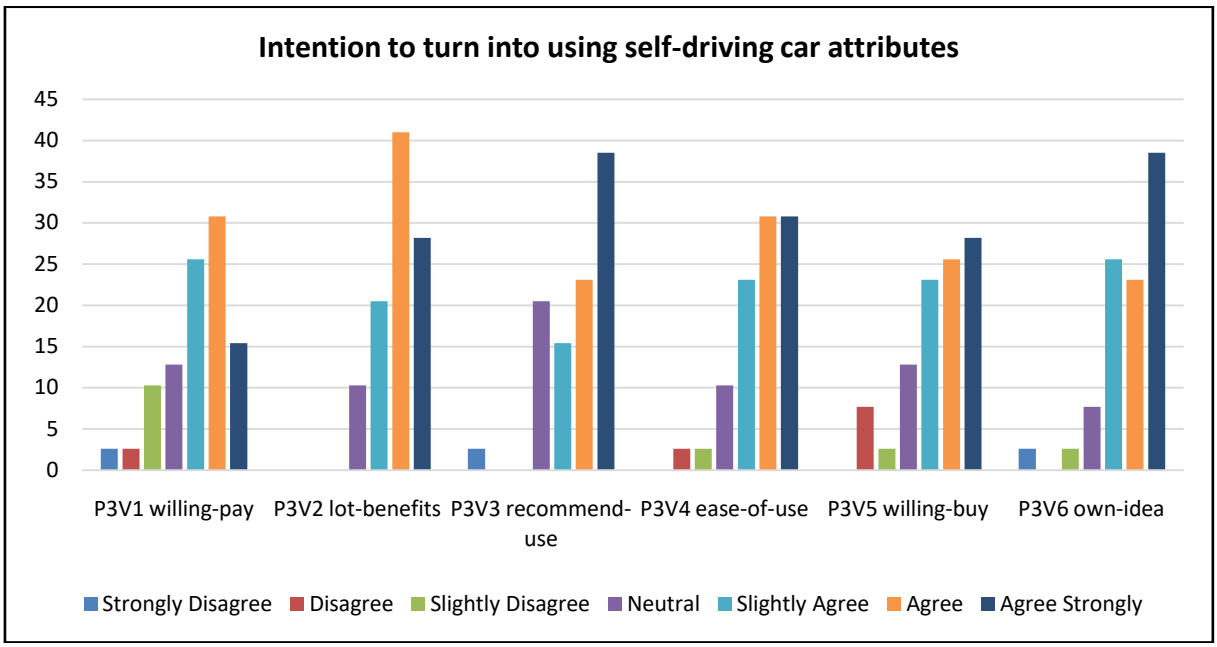

Figure 10: UAE people's intention to turn into using self-driving car

v. *T-Test to investigate whether the gender factor have different impact on the intention to use self-driving car:*

Q5: Does the Gender factor have different impact on the intention to turn into using self-driving car?
H9: there is no significant difference between males and females in their intention to turn into using self-driving car.

T-Test conducted to compare the intention to turn into using self-driving car based on the gender. An independent samples test was carried out to compare the intention to turn into using self-driving car based on gender. As seen in table 33 and table 34 There is no significant difference in the intention between Male and Female, t(39)= -0.533, p>0.05, two tailed with Female (M=34.1579, SD=7.80501) have slight higher intention to turn into using self-driving car than Male (M=32.9500, SD=6.30351). the magnitude of the difference in the means (mean difference 34.1579-32.9500=1.2079, 95% CI: -5.79966 to 3.38387) was small (eta squared = 0.0076). Since there is no significant difference in the intention between Male and Female to turn into using self-driving car, therefore, H9 is accepted.

Table 33: Simple statistics of intention to turn into using self-driving car based on gender

Group Statistics					
	Gender	N	Mean	Std. Deviation	Std. Error Mean
INT	Male	20	32.9500	6.30351	1.40951
	Female	19	34.1579	7.80501	1.79059

Table 34: Independent sample T test of intention to turn into using self-driving car based on gender

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
INT	Equal variances assumed	.094	.761	-.533	37	.597	-1.20789	2.26620	-5.79966	3.38387
	Equal variances not assumed			-.530	34.624	.599	-1.20789	2.27880	-5.83590	3.42011

vi. *Anova test to investigate whether the Driving Experience factor have different impact on the intention to use self-driving car:*

Q6: Does the Driving Experience factor have different impact on the intention to turn into using self-driving car?

H10: Driving Experience have positive impact on the intention to turn into using self-driving car.

Table 35: Descriptive statistics of UAE people's intention to turn into using self-driving car based on Driving Experience

Descriptives								
INT								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Never	4	33.2500	5.31507	2.65754	24.7925	41.7075	27.00	40.00
Less than 5 years	5	35.4000	5.54977	2.48193	28.5090	42.2910	28.00	42.00
5-9	2	39.5000	3.53553	2.50000	7.7345	71.2655	37.00	42.00
10-14	6	35.0000	9.01110	3.67877	25.5434	44.4566	20.00	42.00
15 - 20	13	33.1538	8.47394	2.35025	28.0331	38.2746	14.00	42.00
More than 20 years	9	30.8889	5.13431	1.71144	26.9423	34.8355	21.00	36.00
Total	39	33.5385	7.00694	1.12201	31.2671	35.8098	14.00	42.00

From table 36 below, it is clear that there are no statistically differences between the groups as a whole since the sig > 0.05.

Table 36: Analysis of variance for intention to turn into using self-driving car based on Driving Experience

ANOVA					
INT					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	166.661	5	33.332	.647	.665
Within Groups	1699.031	33	51.486		
Total	1865.692	38			

One-way between groups analysis of variance was conducted to explore the impact of Driving Experience on the intention to turn into self-driving car. Participant were divided into six groups as the following (Never, Less than 5, 5-9, 10-14, 15-20, More than 20). We can see that the significance values 0.998, 0.913, 0.999, 0.994, 0.983, 0.991, 0.867, 0.971, 0.850, 0.645, 0.995, 0.883, 0.997 and 1.000 (i.e., p= values 0.998, 0.913, 0.999, 0.994, 0.983, 0.991, 0.867, 0.971, 0.850, 0.645, 0.995, 0.883, 0.997 and 1.000) which is above 0.05 as seen in table 37 below. Therefore, there is no statistically significant difference in the rating of intention to turn into using self-driving car based on the Driving Experience of the respondents. Thus, hypothesis H10 is rejected.

Table 37: Multiple comparisons for the intention to turn into using self-driving car based on Driving Experience

Multiple Comparisons						
Dependent Variable: INT						
Tukey HSD						
(I) Driving Experience	(J) Driving Experience	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Never	Less than 5 years	-2.15000	4.81338	.998	-16.7034	12.4034
	5-9	-6.25000	6.21404	.913	-25.0384	12.5384
	10-14	-1.75000	4.63168	.999	-15.7540	12.2540
	15 - 20	.09615	4.10267	1.000	-12.3084	12.5007
	More than 20 years	2.36111	4.31185	.994	-10.6759	15.3981
Less than 5 years	Never	2.15000	4.81338	.998	-12.4034	16.7034
	5-9	-4.10000	6.00334	.983	-22.2513	14.0513
	10-14	.40000	4.34490	1.000	-12.7369	13.5369
	15 - 20	2.24615	3.77592	.991	-9.1705	13.6628
	More than 20 years	4.51111	4.00222	.867	-7.5897	16.6120
5-9	Never	6.25000	6.21404	.913	-12.5384	25.0384
	Less than 5 years	4.10000	6.00334	.983	-14.0513	22.2513
	10-14	4.50000	5.85866	.971	-13.2138	22.2138
	15 - 20	6.34615	5.45008	.850	-10.1323	22.8246
	More than 20 years	8.61111	5.60924	.645	-8.3486	25.5708
10-14	Never	1.75000	4.63168	.999	-12.2540	15.7540
	Less than 5 years	-.40000	4.34490	1.000	-13.5369	12.7369
	5-9	-4.50000	5.85866	.971	-22.2138	13.2138
	15 - 20	1.84615	3.54139	.995	-8.8613	12.5536
	More than 20 years	4.11111	3.78175	.883	-7.3231	15.5453
15 - 20	Never	-.09615	4.10267	1.000	-12.5007	12.3084
	Less than 5 years	-2.24615	3.77592	.991	-13.6628	9.1705
	5-9	-6.34615	5.45008	.850	-22.8246	10.1323
	10-14	-1.84615	3.54139	.995	-12.5536	8.8613
	More than 20 years	2.26496	3.11144	.977	-7.1426	11.6725
More than 20 years	Never	-2.36111	4.31185	.994	-15.3981	10.6759
	Less than 5 years	-4.51111	4.00222	.867	-16.6120	7.5897
	5-9	-8.61111	5.60924	.645	-25.5708	8.3486
	10-14	-4.11111	3.78175	.883	-15.5453	7.3231
	15 - 20	-2.26496	3.11144	.977	-11.6725	7.1426

vii. *Correlation test to investigate there is association between Education Level and the intention to turn into using self-driving car:*

Q7: Does the Education Level factor associated with the intention to turn into using self-driving car?

H11: Level of Education is not associated with the intention to turn into using self-driving car.

A Bivariate correlation test was conducted as seen in the table 38below. Correlation test was carried out to check if there is association between Intention to turn into using self-driving car (INT) and the Education level, test presented that:

- The correlation between Education Level and intention to turn into using self-driving car (INT) is weak and positive = 0.175, i.e. $0 < r < 0.25$ and positive. Therefore, hypothesis H11 is rejected.

Table 38: Correlation for Education Level and intention to use the car

Correlations			
		Education	INT
Education	Pearson Correlation	1	.175
	Sig. (2-tailed)		.287
	N	39	39
INT	Pearson Correlation	.175	1
	Sig. (2-tailed)	.287	
	N	39	39

viii. *Chi-squared test to investigate whether there is association between gender and Driving Experience:*

H12: there is significant association between gender and driving experience.

The sample size is less than 40, i.e. 39 so the smallest expected frequency is at least 5. Chi-Square test can be used to compare if there is an observed frequency distribution with an expected frequency distribution. Chi-Square test will be used to compare if there is observed frequency between driving experience and gender within the population.

Table 39 displays how gender is associated with driving experience.

Table 39: Crosstabs (Gender*Driving Experience)

Gender * Driving Experience Crosstabulation									
			Driving Experience						Total
			Never	Less than 5 years	5-9	10-14	15 - 20	More than 20 years	
Gender	Male	Count	0	0	1	3	8	8	20
		% within Gender	0.0%	0.0%	5.0%	15.0%	40.0%	40.0%	100.0%
		% within Driving Experience	0.0%	0.0%	50.0%	50.0%	61.5%	88.9%	51.3%
		% of Total	0.0%	0.0%	2.6%	7.7%	20.5%	20.5%	51.3%
	Female	Count	4	5	1	3	5	1	19
		% within Gender	21.1%	26.3%	5.3%	15.8%	26.3%	5.3%	100.0%
		% within Driving Experience	100.0%	100.0%	50.0%	50.0%	38.5%	11.1%	48.7%
		% of Total	10.3%	12.8%	2.6%	7.7%	12.8%	2.6%	48.7%
Total		Count	4	5	2	6	13	9	39
		% within Gender	10.3%	12.8%	5.1%	15.4%	33.3%	23.1%	100.0%
		% within Driving Experience	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	10.3%	12.8%	5.1%	15.4%	33.3%	23.1%	100.0%

When interpreting results from table 40 below, results of Pearson Chi-Square row shows that $x(2) = 15.121$, corresponding to $p<0.05$ (note: the Asymptotic Significance (2-sided) value in this row, 0.010, is the p value rounded to 5 decimal places and should not be quoted in this form. Since p is less than 0.05 then there is an evidence of strong relationship between the gender and driving experience. This indicates that there is statistically significant association between Gender and Driving Experience.

Table 40: Chi-Square tests

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	15.121[a]	5	.010
Likelihood Ratio	19.347	5	.002
Linear-by-Linear Association	13.895	1	.000
N of Valid Cases	39		
a. 10 cells (83.3%) have expected count less than 5. The minimum expected count is .97.			

Phi and Cramer's are both tests of the strength of association. From table 41 below, we can see that the strength of the association between variables is moderate and significant. P is less than 0.05 then hypothesis H12 is accepted.

Table 41: Symmetric Measure to examine strength of association

Symmetric Measures			
		Value	Approximate Significance
Nominal by Nominal	Phi	.623	.010
	Cramer's V	.623	.010
N of Valid Cases		39	

VII. Findings

Statistical Analysis conducted in previous section in order to answer research questions as well as examining hypothesis, table below present whether the hypothesis accepted or rejected:

Table 42: Findings of research questions and related hypothesis

Research Question	Related Hypothesis
Q1: To what extent UAE people care about specifications of the self-driving car?	*H1*: UAE people highly care about the specification of self-driving car(Accepted)
Q2: Does the specifications of the self-driving car impact the UAE people's intention to turn into using self-driving car?	*H2*: There is significant association between self-driving car's specifications and the UAE people's intention to turn into using self-driving car.(Accepted)
Q3: Does the self-driving car's features impact the UAE people's intention to turn into using self-driving car?	*H3*: There is significant association between self-driving car's features and the UAE people's intention to turn into using self-driving car.(Accepted)
	H4: There is significant association between self-driving car's safety features and the UAE people's intention to turn into using self-driving car. (Accepted)
	H5: There is significant association between self-driving car's performance features and the UAE people's intention to turn into using self-driving car.(Accepted)
	H6: There is significant association between self-driving car's Ease of Use features and the UAE people's intention to turn into using self-driving car.(Accepted)
	H7: There is significant association between self-driving car's Usefulness features and the UAE people's intention to turn into using self-driving car.(Accepted)
Q4: To what extent people in United Arab Emirates have the intention to turn into using self-driving car?	*H8*: People in United Arab Emirates have great intention to turn into using self-driving car.(Accepted)

Table 43: Findings of demographic questions and related hypothesis

Demographic Questions	Related Hypothesis
Q5: Does the Gender factor have different impact on the intention to turn into using self-driving car?	*H9*: there is no significant difference between males and females in their intention to turn into using self-driving car.(Accepted)
Q6: Does the Driving Experience factor have different impact on the intention to turn into using self-driving car?	*H10*: Driving Experience have positive impact on the intention to turn into using self-driving car.(Rejected)
Q7: Does the Education Level factor associated with the intention to turn into using self-driving car?	*H11*: Level of Education is not associated with the intention to turn into using self-driving car.(Rejected)
Q8: Does the Gender and Driving Experience associated?	*H112*: there is significant association between gender and driving experience.(Accepted)

Statistical Analysis conducted as well for construct and scale validity; it was found that the there is no common bias in the collected data and the reliability test presented high score of Cronbach's Alpha which indicated high degree of reliability.

Univariate statistical test carried out for exploring frequencies and description purposes and results reported in previous section.

VIII. Discussion

In this research paper, Technology Acceptance Model modified by the author of this research paper to include additional constructs. The aim of this research paper to investigate the validity of the modified model in case for the acceptance of self-driving car in United Arab Emirates as the research main purpose is to investigate the intention of UAE people to turn into using self-driving car.

Statistical tests for answering first research question presented that UAE people highly care about the specifications of self-driving car. Responses showed that each of the specifications is important, but the most important specifications are safety, luxury, system, wheels and car's outside look. This result indicated that people are in UAE become more aware about their rights as customers to know about the product's specifications. People as well become more knowledgeable about the importance of each of the specifications of the self-driving car.

Results from statistical tests for answering second research question presented that self-driving car's specification is associated with the intention to turn into using self-driving car.

Results from statistical tests for answering third research question presented that self-driving car's features have strong positive impact on the UAE people's intention to turn into using self-driving car. This result is compatible with the Technology Acceptance Model that was introduced by Davis as stated by Paul Legrisa, John Inghamb, Pierre Collerettec, (2003). The Ease of Use features are strongly associated with the UAE people's intention to turn into using self-driving car. Results presented as well that the Usefulness features are strongly associated with the UAE people's intention to turn into using self-driving car. These results are consistent with the Technology acceptance Model. Author of this research paper investigated Safety features and performance features effects, and results presented that both of the defined features strongly associated with the intention to turn into using self-driving car. Hence, self-driving car's features are strongly associated with the intention to turn into using self-driving car.The features of self-driving car have stronger impact on the intention to turn into using self-driving car than the specification does.

Fourth research question results presented that people in United Arab Emirates have high intention to turn into using self-driving car as results showed that people are willing to pay even more for the self-driving car, they would recommend using self-driving car for others and they think that owning such car is a good idea. This Result is consistent and compatible with the Technology Acceptance Model as the features of self-driving car positively impacted the people's intention to use the car.

Statistical tests conducted to answer fifth research question and results showed that there is no significant difference in the intention between Male and Female to turn into using self-driving car. Therefore, the gender factor has no impact on the intention to turn into using self-driving car. Statistical tests for answering sixth research question presented that Driving Experience as well has no impact on the intention to turn into using-self-driving car.

Seventh research question results showed that the Education Level slightly impact the people's intention to turn into using-self-driving car. Hence from all above statistical experiments conducted, the features as well as specifications of self-driving car is strongly associated with the intention to turn into using the car, hence the features and specifications of self-driving car impacted UAE people's intention to accept and turn into using such car and this result consistent and compatible with the Technology Acceptance Mode. Below is the updated conceptual research model.

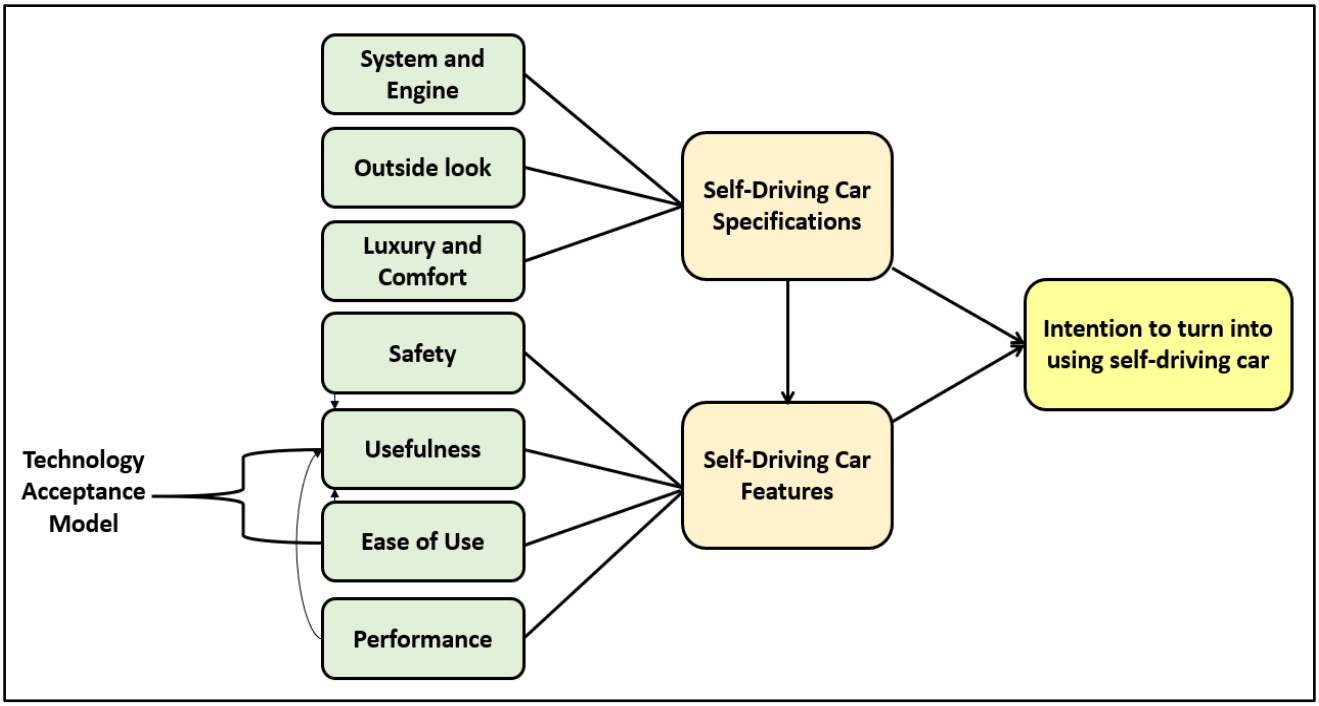

Figure 11: Adjusted conceptual model for research

Figure 11 above illustrated findings of this research paper, i.e. both the specifications of self-driving car as well as the features impacted the intention to turn into using self-driving car. The features of self-driving car have stronger impact on the intention to turn into using self-driving car than the specification does.

IX. Conclusion

The emergence of self-driving cars has raised the interest of the media as well as individuals in it and how reliable and what benefits the user may get when using this type of car. Although the self-driving car may provide huge benefits to the user compared to the traditional car that the user drive, the people perception to turn into using this type of car may vary as some users prefer to engage in driving by themselves. This research paper aim to explore UAE people's intention to turn into using self-driving car. To explore the research aim, based upon standard Technology Acceptance Model (TAM), author of this research paper adjusted TAM by adding new constructs. Quantitative methodology followed in this research paper and questionnaire was prepared and sent to respondents i.e. people live in UAE. Results presented that UAE people have high intention to turn into using self-driving car. Results presented as well that both specifications and features of self-driving car have great impact on people's intention to use the car and this result consistent with TAM. It is recommended for future research to investigate the infrastructure requirements for the adoption of self-driving car, and the impacts of the adoption of self-driving car as well.

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Appendices

Appendix A

Demographic Questions		
Gender	**Age**	**Education**
□ Male □ Female	□less than 30 □ 30-39 □ 40-49 □50-59 □ 60 and above	□ High School □ Diploma □ Bachelor □ Master □ PhD
Driving Experience		
□ Never □Less than 5 years □5-9 □10-14 □15 – 20 □More than 20 years		
1. Self-driving car specifications that users care about (SPC)		
I care about comfort features in the self-driving car		P1V1comfort
I care about safety system in the self-driving car		P1V2safetysystem
I care about luxury features in the self-driving car		P1V3luxury
I care about wheels and tires features in the self-driving car		P1V4wheels
I care about braking-system features in the self-driving car		P1V5brakingsystem
I care about the outside look of the self-driving car		P1V6look
I care about number of passengers in the self-driving car		P1V7passengers
I care about seating features in the self-driving car		P1V8seating
I care about entertainment features in the self-driving car		P1V9entertainment
I care about multi-view technologies in the self-driving car		P1V10multi-view

I care about car engine features in the self-driving car		P1V11engine
I care about speed features in the self-driving car		P1V12speed
I prefer complete autonomous driving system in the self-driving car		P1V13complete-autonomous
I prefer partial autonomous driving system in the self-driving car		P1V14partial-autonomous
2. Perceived self-driving car features (FET)		
2.1 Safety (SFET)	2.1 I believe self-driving car is safe	P2V1safe
	2.1 I believe self-driving car will never exceed speed limit	P2V2speed-limit
	2.1 I believe self-driving car will never break road rules	P2V3road-rules
	2.1 I believe self-driving car will reduce the incident of car accident	P2V4reduce-accidents
	2.1 I believe that the safety system in the self-driving car will encourage me to use the car	P2V5safety-encourage
2.2 Performance (PFET)	2.2 Self-driving car efficient in reaching destination fast	P2V6reach-destination
	2.2 Self-driving car will not consume much fuel	P2V7fuel
	2.2 I believe that the performance of the self-driving car will encourage me to use the car.	P2V8performane-encourage
2.3 Ease of Use (EFET)	2.3 I believe that self-driving car is easy to use	P2V9easy-to-use
	2.3 I believe that I will learn fast how to use self-driving car	P2V10easy-to-learn
	2.3 I believe that the ease of use of the self-driving car will encourage me to use the car	P2V11easy-encourage
2.4 Usefulness (BFET)	2.4 I believe self-driving car is efficient in reaching destination faster	P2V12efficient-destination
	2.4 I believe self-driving car provides comfort to me	P2V13 benefit-comfort
	2.4 I believe self-driving car is reliable as it depends on computers to work	P2V14 reliable
	2.4 I believe that self-driving car would be safe car	P2V15 benefit-safe
	2.4 I believe self-driving car would reduce traffic jam	P2V16 reduce-traffic
	2.4 Self-driving car will give me the chance to take benefit of the road time	P2V17road-time
	2.4 Self-driving car will reduce the pressure due to driving cars	P2V18 reduce-pleasure
	2.4 I believe that the benefits of the self-driving car will encourage me to own the car	P2V19 benefit-encourage

3. Intention to turn into using self-driving (INT)	
I am willing to pay more for self-driving car	P3V1 willing-pay
I believe self-driving car has a lot of benefits	P3V2 lot-benefits
I would recommend trying self-driving car	P3V3 recommend-use
I believe that self-driving car is easy to use	P3V4 ease-of-use
I would buy self-driving car in future	P3V5 willing-buy
Owning self-driving car is a great idea	P3V6 own-idea

Figure 12: Questionnaire used in the study

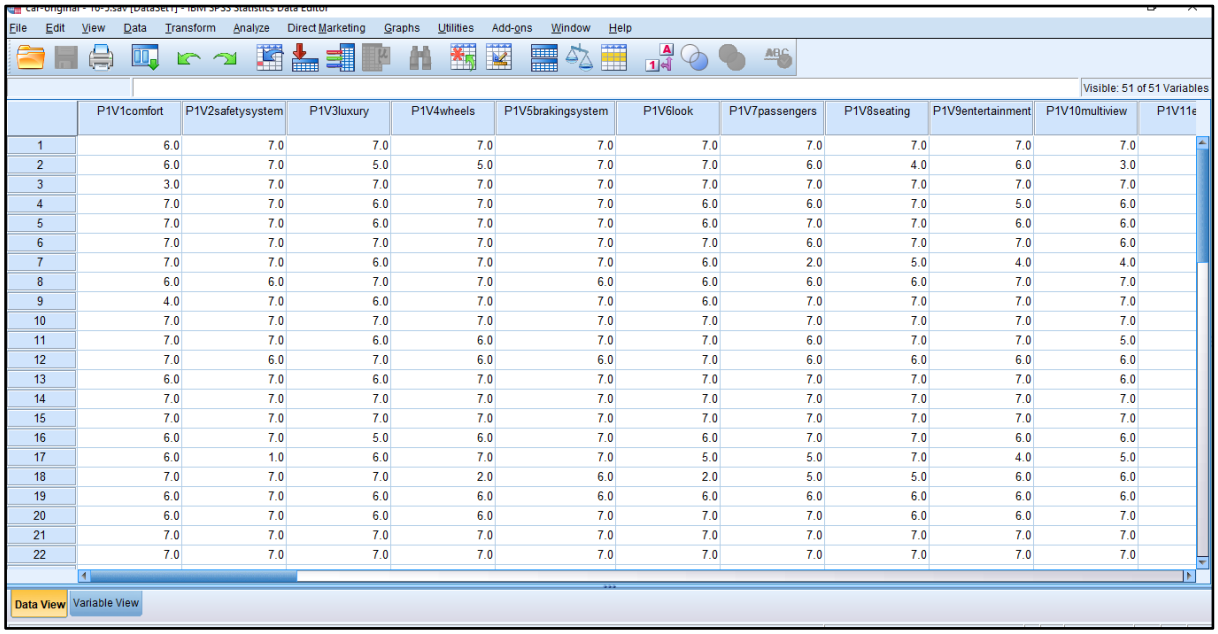

Figure 13: Data view in SPSS for the valid 39 survey entries

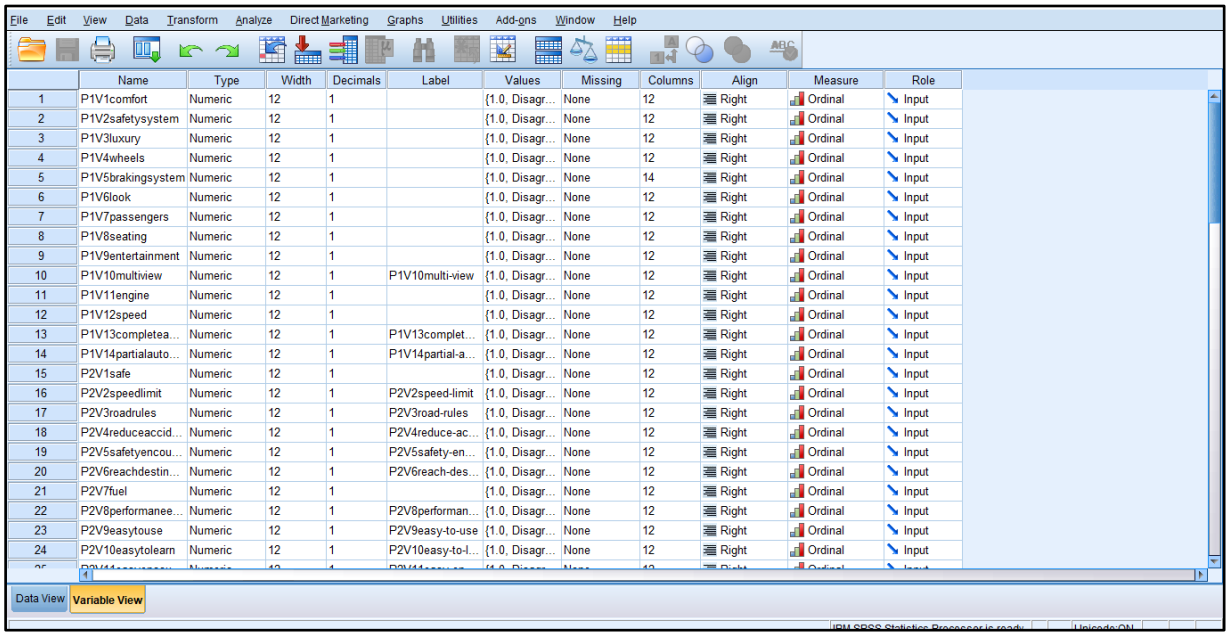

Figure 14: Variable view in SPSS for the survey used in the study

Appendix B

a) Univariate Statistics for Demographics:

i. *Descriptive Statistics: Demographics*

The responses showed that percentage of Male respondent is (51.3%) which slightly bigger than Female respondent's percentage that is (48.7%) as seen in (Table 44 and figure15).

Table 44: Gender Frequency in the population

Gender					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	20	51.3	51.3	51.3
	Female	19	48.7	48.7	100.0
	Total	39	100.0	100.0	

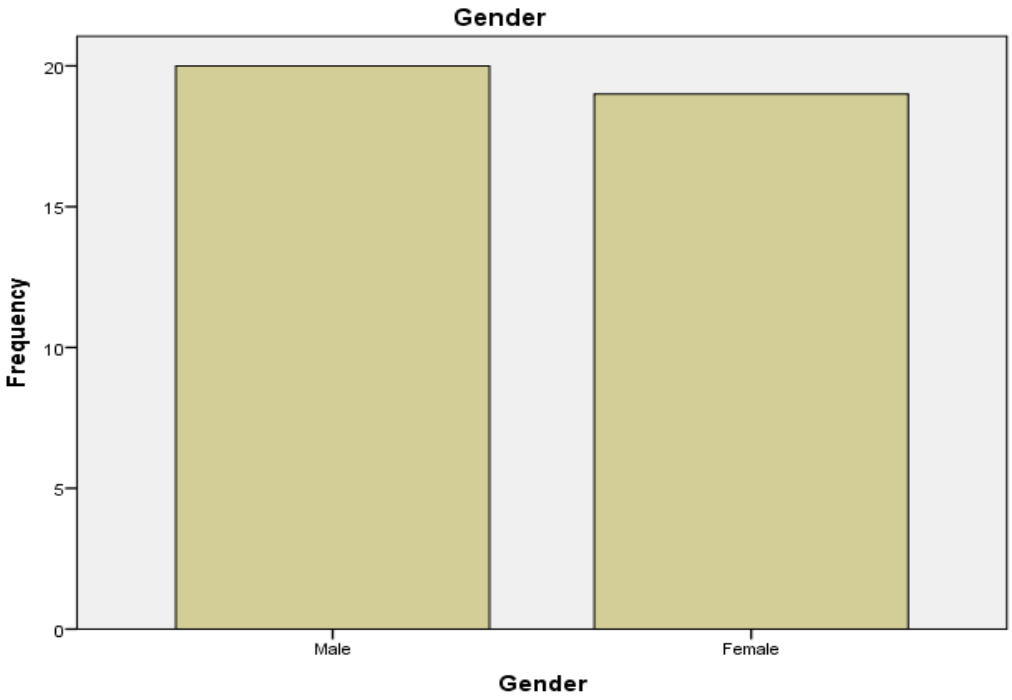

Figure 15: Presentation of Gender in the population

The responses showed that most of the respondents are between 30 and 49 years old, and only few respondents of age (50-59) participated in the survey of (7.7%) as seen in table 45 and figure 16 below.

Table 45: Age Frequency in the population

Age					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 30	10	25.6	25.6	25.6
	30-39	13	33.3	33.3	59.0
	40-49	13	33.3	33.3	92.3
	50-59	3	7.7	7.7	100.0
	Total	39	100.0	100.0	

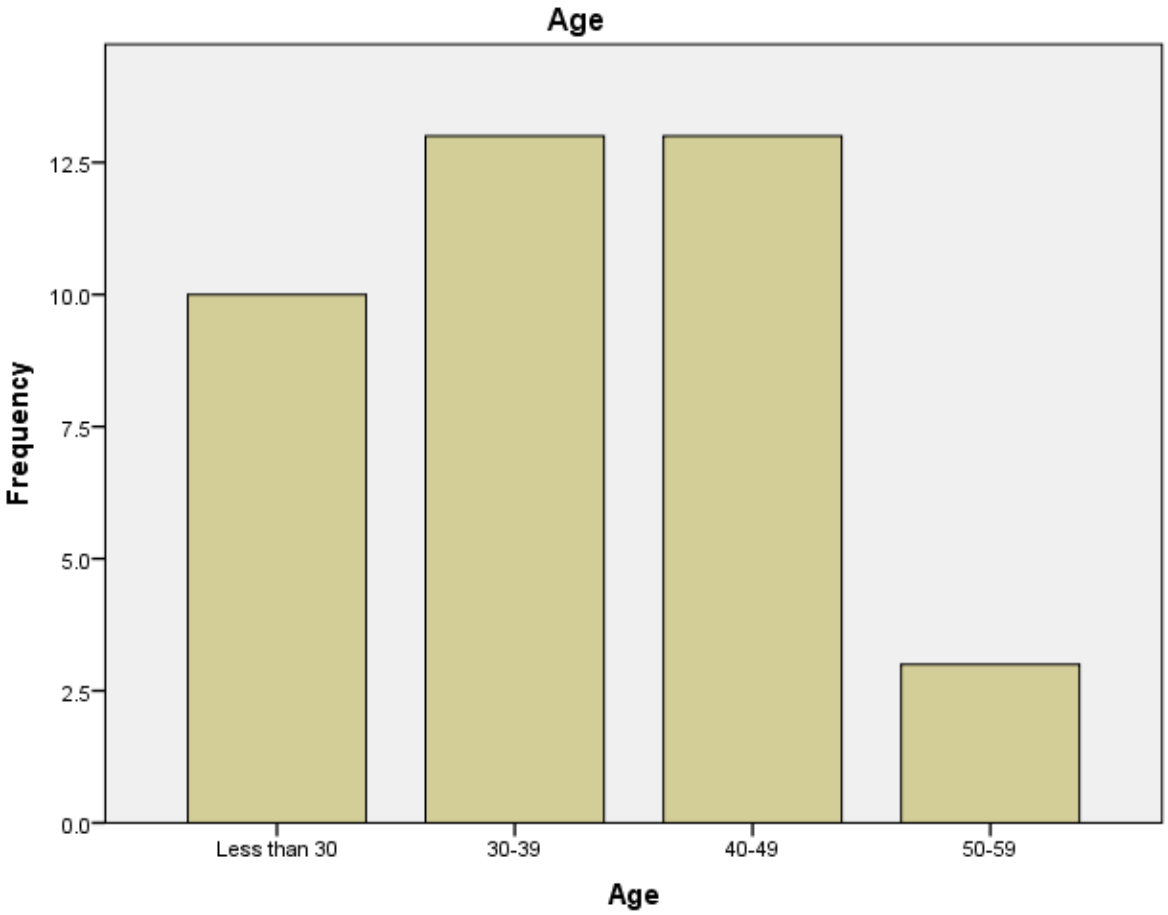

Figure 16: Presentation of Age in the population

The responses showed that people with bachelor's degree are the most respondents (64.1%) as shown in figure 17 and table 46.

Table 46: Level of Education Frequency in the population

Education					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	PHD	2	5.1	5.1	5.1
	Master	9	23.1	23.1	28.2
	Bachelor	25	64.1	64.1	92.3
	Diploma	1	2.6	2.6	94.9
	Highschool	2	5.1	5.1	100.0
	Total	39	100.0	100.0	

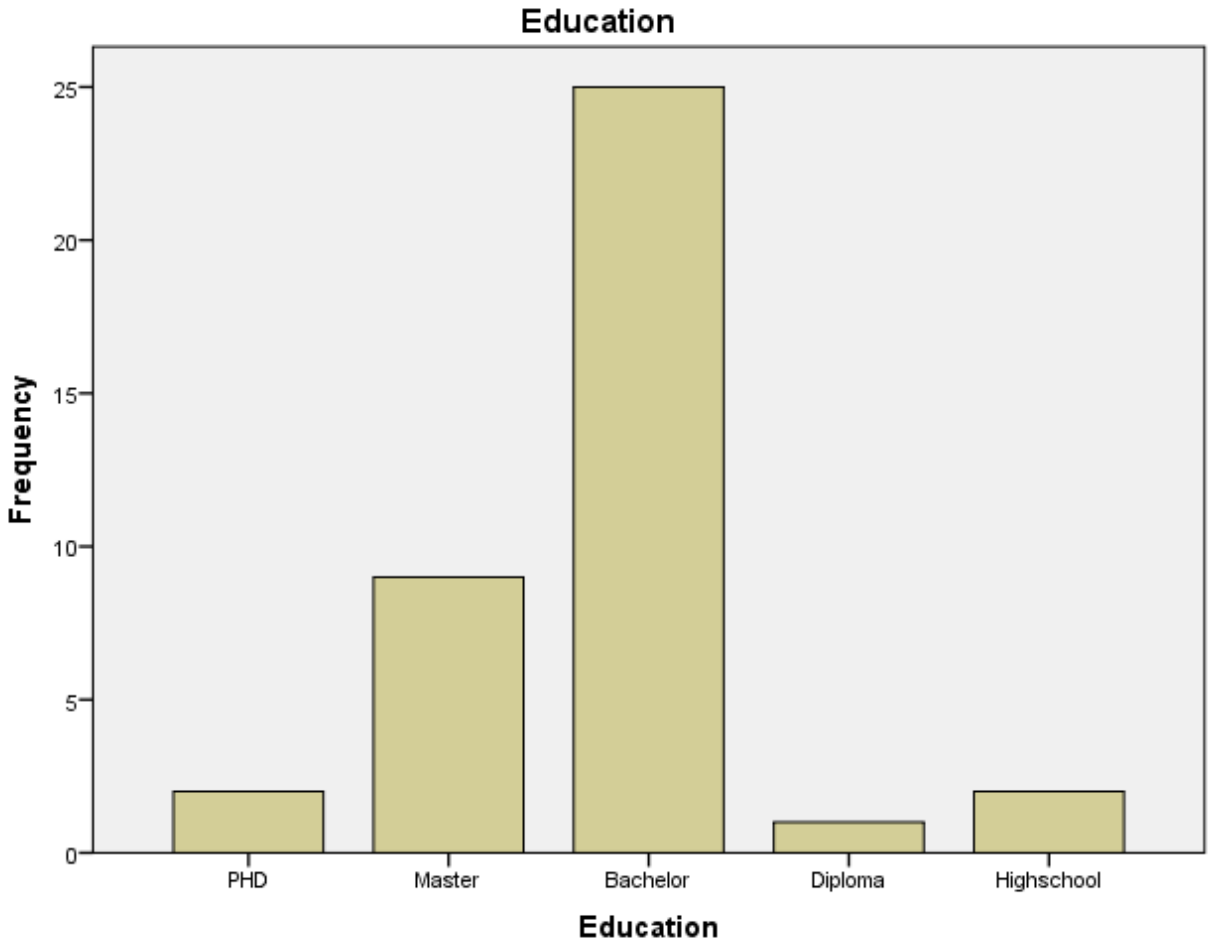

Figure 17: Presentation of Level of Education in the population

ii. *Descriptive Statistics: Driving Experience*

The responses showed that the majority (32.5%) of respondents have driving experience of 15 to 20 years, while only (7.5%) of respondents have driving experience of 5 to 9 years as seen in (Table 47 and figure 18) below.

Table 47: Driving Experience Frequency in the population

Driving Experience					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	4	10.3	10.3	10.3
	Less than 5 years	5	12.8	12.8	23.1
	5-9	2	5.1	5.1	28.2
	10-14	6	15.4	15.4	43.6
	15 - 20	13	33.3	33.3	76.9
	More than 20 years	9	23.1	23.1	100.0
	Total	39	100.0	100.0	

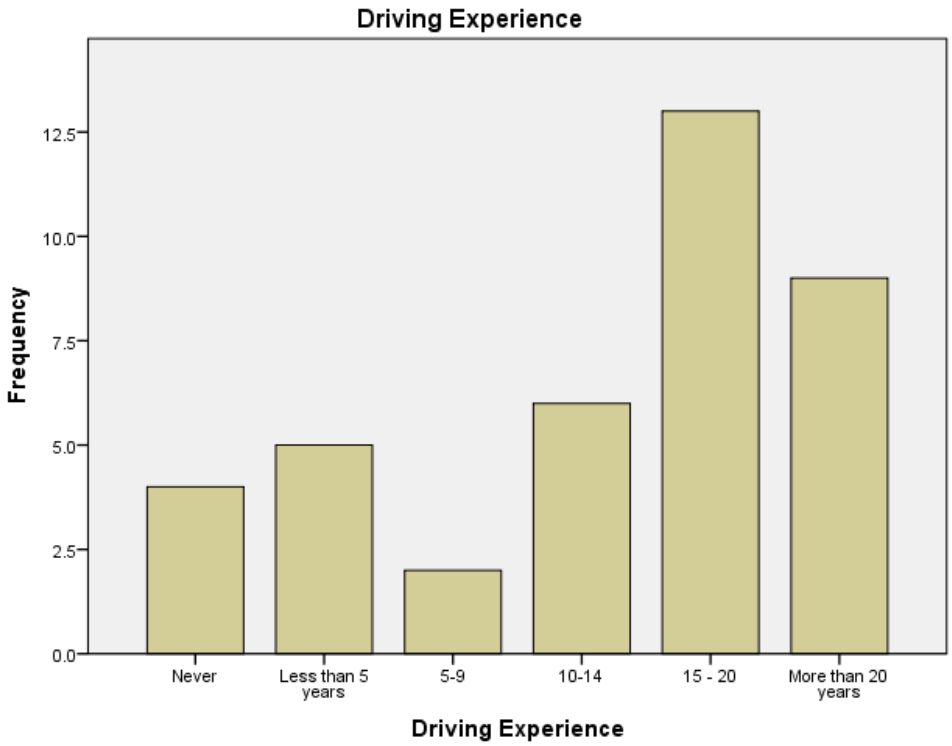

Figure 18: Presentation of driving experience in the population

iii. *Descriptive Statistics: Nationality*

The majority of respondent's nationality is UAE of (95%) while only (5%) of the respondents from Middle East as seen in (Table 48 and figure 19 below).

Table 48: Nationality Frequency in the population

Nationality					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	UAE	38	95.0	95.0	95.0
	Middle East	2	5.0	5.0	100.0
	Total	40	100.0	100.0	

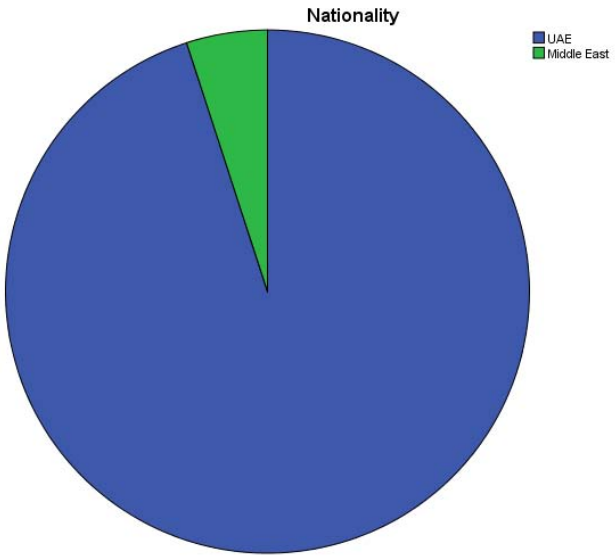

Figure 19: Presentation of Nationality of the population

iv. *Univariate Statistics for construct's variables:*

a. *Univariate Statistics for the attributes of the construct: specifications of self-driving car that user cares about:*

Table 49: Descriptive Statistics: frequencies

P1V1comfort					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly Disagree	1	2.6	2.6	2.6
	Neutral	1	2.6	2.6	5.1
	Agree	15	38.5	38.5	43.6
	Agree Strongly	22	56.4	56.4	100.0
	Total	39	100.0	100.0	

Table 50: Descriptive Statistics: frequencies

P1V2safetysystem					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree Strongly	1	2.6	2.6	2.6
	Agree	2	5.1	5.1	7.7
	Agree Strongly	36	92.3	92.3	100.0
	Total	39	100.0	100.0	

Table 51: Descriptive Statistics: frequencies

P1V3luxury					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly Agree	3	7.7	7.7	7.7
	Agree	15	38.5	38.5	46.2
	Agree Strongly	21	53.8	53.8	100.0
	Total	39	100.0	100.0	

Table 52: Descriptive Statistics: frequencies

P1V4wheels					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	2.6	2.6	2.6
	Slightly Agree	1	2.6	2.6	5.1
	Agree	8	20.5	20.5	25.6
	Agree Strongly	29	74.4	74.4	100.0
	Total	39	100.0	100.0	

Table 53: Descriptive Statistics: frequencies

P1V5brakingsystem					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	6	15.4	15.4	15.4
	Agree Strongly	33	84.6	84.6	100.0
	Total	39	100.0	100.0	

Table 54: Descriptive Statistics: frequencies

P1V6look					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	2.6	2.6	2.6
	Slightly Agree	3	7.7	7.7	10.3
	Agree	11	28.2	28.2	38.5
	Agree Strongly	24	61.5	61.5	100.0
	Total	39	100.0	100.0	

Table 55: Descriptive Statistics: frequencies

P1V7passengers					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	2.6	2.6	2.6
	Slightly Agree	4	10.3	10.3	12.8
	Agree	15	38.5	38.5	51.3
	Agree Strongly	19	48.7	48.7	100.0
	Total	39	100.0	100.0	

Table 56: Descriptive Statistics: frequencies

P1V8seating					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	1	2.6	2.6	2.6
	Slightly Agree	3	7.7	7.7	10.3
	Agree	8	20.5	20.5	30.8
	Agree Strongly	27	69.2	69.2	100.0
	Total	39	100.0	100.0	

Table 57: Descriptive Statistics: frequencies:

P1V9entertainment					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	3	7.7	7.7	7.7
	Slightly Agree	3	7.7	7.7	15.4
	Agree	13	33.3	33.3	48.7
	Agree Strongly	20	51.3	51.3	100.0
	Total	39	100.0	100.0	

Table 58: Descriptive Statistics: frequencies

P1V10multi-view					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly Disagree	1	2.6	2.6	2.6
	Neutral	1	2.6	2.6	5.1
	Slightly Agree	5	12.8	12.8	17.9
	Agree	14	35.9	35.9	53.8
	Agree Strongly	18	46.2	46.2	100.0
	Total	39	100.0	100.0	
P1V11engine					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly Disagree	1	2.6	2.6	2.6
	Slightly Agree	4	10.3	10.3	12.8
	Agree	9	23.1	23.1	35.9
	Agree Strongly	25	64.1	64.1	100.0
	Total	39	100.0	100.0	

Table 59: Descriptive Statistics: frequencies

P1V12speed					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly Disagree	1	2.6	2.6	2.6
	Slightly Agree	5	12.8	12.8	15.4
	Agree	15	38.5	38.5	53.8
	Agree Strongly	18	46.2	46.2	100.0
	Total	39	100.0	100.0	

Table 60: Descriptive Statistics: frequencies

P1V13complete-autonomous					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	2	5.1	5.1	5.1
	Sightly Disagree	2	5.1	5.1	10.3
	Neutral	4	10.3	10.3	20.5
	Slightly Agree	10	25.6	25.6	46.2
	Agree	11	28.2	28.2	74.4
	Agree Strongly	10	25.6	25.6	100.0
	Total	39	100.0	100.0	

Table 61: Descriptive Statistics: frequencies

P1V14partial-autonomous					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	1	2.6	2.6	2.6
	Slightly Agree	6	15.4	15.4	17.9
	Agree	15	38.5	38.5	56.4
	Agree Strongly	17	43.6	43.6	100.0
	Total	39	100.0	100.0	

b. *Univariate Statistics for the attributes of the construct: features of self-driving car that user interested in:*

Table 62: Descriptive Statistics: frequencies

P2V1safe					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree Strongly	1	2.6	2.6	2.6
	Slightly Disagree	1	2.6	2.6	5.1
	Neutral	4	10.3	10.3	15.4
	Slightly Agree	11	28.2	28.2	43.6
	Agree	14	35.9	35.9	79.5
	Agree Strongly	8	20.5	20.5	100.0
	Total	39	100.0	100.0	

Table 63: Descriptive Statistics: frequencies

P2V2speed-limit					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	2.6	2.6	2.6
	Slightly Disagree	1	2.6	2.6	5.1
	Neutral	3	7.7	7.7	12.8
	Slightly Agree	9	23.1	23.1	35.9
	Agree	17	43.6	43.6	79.5
	Agree Strongly	8	20.5	20.5	100.0
	Total	39	100.0	100.0	

Table 64: Descriptive Statistics: frequencies

P2V3road-rules					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	2.6	2.6	2.6
	Slightly Disagree	2	5.1	5.1	7.7
	Neutral	5	12.8	12.8	20.5
	Slightly Agree	8	20.5	20.5	41.0
	Agree	12	30.8	30.8	71.8
	Agree Strongly	11	28.2	28.2	100.0
	Total	39	100.0	100.0	

Table 65: Descriptive Statistics: frequencies

P2V4reduce-accidents					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree Strongly	1	2.6	2.6	2.6
	Slightly Disagree	4	10.3	10.3	12.8
	Neutral	7	17.9	17.9	30.8
	Slightly Agree	7	17.9	17.9	48.7
	Agree	13	33.3	33.3	82.1
	Agree Strongly	7	17.9	17.9	100.0
	Total	39	100.0	100.0	

Table 66: Descriptive Statistics: frequencies

P2V5safety-encourage					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	2.6	2.6	2.6
	Neutral	4	10.3	10.3	12.8
	Slightly Agree	9	23.1	23.1	35.9
	Agree	15	38.5	38.5	74.4
	Agree Strongly	10	25.6	25.6	100.0
	Total	39	100.0	100.0	

Table 67: Descriptive Statistics: frequencies

P2V6reach-destination					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree Strongly	1	2.6	2.6	2.6
	Disagree	2	5.1	5.1	7.7
	Slightly Disagree	3	7.7	7.7	15.4
	Neutral	4	10.3	10.3	25.6
	Slightly Agree	8	20.5	20.5	46.2
	Agree	13	33.3	33.3	79.5
	Agree Strongly	8	20.5	20.5	100.0
	Total	39	100.0	100.0	

Table 68: Descriptive Statistics: frequencies

P2V7fuel					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	2.6	2.6	2.6
	Slightly Disagree	4	10.3	10.3	12.8
	Neutral	2	5.1	5.1	17.9
	Slightly Agree	12	30.8	30.8	48.7
	Agree	10	25.6	25.6	74.4
	Agree Strongly	10	25.6	25.6	100.0
	Total	39	100.0	100.0	

Table 69: Descriptive Statistics: frequencies

P2V8performane-encourage					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	2.6	2.6	2.6
	Slightly Disagree	1	2.6	2.6	5.1
	Neutral	3	7.7	7.7	12.8
	Slightly Agree	11	28.2	28.2	41.0
	Agree	14	35.9	35.9	76.9
	Agree Strongly	9	23.1	23.1	100.0
	Total	39	100.0	100.0	

Table 70: Descriptive Statistics: frequencies

P2V9easy-to-use					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	3	7.7	7.7	7.7
	Neutral	1	2.6	2.6	10.3
	Slightly Agree	12	30.8	30.8	41.0
	Agree	14	35.9	35.9	76.9
	Agree Strongly	9	23.1	23.1	100.0
	Total	39	100.0	100.0	

Table 71: Descriptive Statistics: frequencies

P2V10easy-to-learn					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	2.6	2.6	2.6
	Slightly Disagree	1	2.6	2.6	5.1
	Slightly Agree	9	23.1	23.1	28.2
	Agree	16	41.0	41.0	69.2
	Agree Strongly	12	30.8	30.8	100.0
	Total	39	100.0	100.0	

Table 72: Descriptive Statistics: frequencies

P2V11easy-encourage					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	3	7.7	7.7	7.7
	Slightly Agree	9	23.1	23.1	30.8
	Agree	19	48.7	48.7	79.5
	Agree Strongly	8	20.5	20.5	100.0
	Total	39	100.0	100.0	

Table 73: Descriptive Statistics: frequencies

P2V12efficient-destination					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree Strongly	1	2.6	2.6	2.6
	Slightly Disagree	1	2.6	2.6	5.1
	Neutral	5	12.8	12.8	17.9
	Slightly Agree	10	25.6	25.6	43.6
	Agree	13	33.3	33.3	76.9
	Agree Strongly	9	23.1	23.1	100.0
	Total	39	100.0	100.0	

Table 74: Descriptive Statistics: frequencies

P2V13 benefit-comfort					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly Disagree	1	2.6	2.6	2.6
	Neutral	2	5.1	5.1	7.7
	Slightly Agree	8	20.5	20.5	28.2
	Agree	14	35.9	35.9	64.1
	Agree Strongly	14	35.9	35.9	100.0
	Total	39	100.0	100.0	

Table 75: Descriptive Statistics: frequencies

P2V14 reliable					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	3	7.7	7.7	7.7
	Slightly Disagree	2	5.1	5.1	12.8
	Neutral	5	12.8	12.8	25.6
	Slightly Agree	11	28.2	28.2	53.8
	Agree	11	28.2	28.2	82.1
	Agree Strongly	7	17.9	17.9	100.0
	Total	39	100.0	100.0	

Table 76: Descriptive Statistics: frequencies

P2V15 benefit-safe					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree Strongly	1	2.6	2.6	2.6
	Disagree	1	2.6	2.6	5.1
	Neutral	6	15.4	15.4	20.5
	Slightly Agree	11	28.2	28.2	48.7
	Agree	14	35.9	35.9	84.6
	Agree Strongly	6	15.4	15.4	100.0
	Total	39	100.0	100.0	

Table 77: Descriptive Statistics: frequencies

P2V16 reduce-traffic					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly Disagree	3	7.7	7.7	7.7
	Neutral	7	17.9	17.9	25.6
	Slightly Agree	12	30.8	30.8	56.4
	Agree	8	20.5	20.5	76.9
	Agree Strongly	9	23.1	23.1	100.0
	Total	39	100.0	100.0	

Table 78: Descriptive Statistics: frequencies

P2V17road-time					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly Disagree	2	5.1	5.1	5.1
	Neutral	2	5.1	5.1	10.3
	Slightly Agree	7	17.9	17.9	28.2
	Agree	11	28.2	28.2	56.4
	Agree Strongly	17	43.6	43.6	100.0
	Total	39	100.0	100.0	

Table 79: Descriptive Statistics: frequencies

P2V18 reduce-pressure					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	2.6	2.6	2.6
	Neutral	4	10.3	10.3	12.8
	Slightly Agree	5	12.8	12.8	25.6
	Agree	11	28.2	28.2	53.8
	Agree Strongly	18	46.2	46.2	100.0
	Total	39	100.0	100.0	

Table 80: Descriptive Statistics: frequencies

P2V19 benefit-encourage					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree Strongly	1	2.6	2.6	2.6
	Disagree	1	2.6	2.6	5.1
	Slightly Disagree	2	5.1	5.1	10.3
	Neutral	1	2.6	2.6	12.8
	Slightly Agree	6	15.4	15.4	28.2
	Agree	13	33.3	33.3	61.5
	Agree Strongly	15	38.5	38.5	100.0
	Total	39	100.0	100.0	

c. *Univariate Statistics for attributes of intention to turn into using self-driving car construct:*

Table 81: Descriptive Statistics: frequencies

P3V1 willing-pay					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree Strongly	1	2.6	2.6	2.6
	Disagree	1	2.6	2.6	5.1
	Slightly Disagree	4	10.3	10.3	15.4
	Neutral	5	12.8	12.8	28.2
	Slightly Agree	10	25.6	25.6	53.8
	Agree	12	30.8	30.8	84.6
	Agree Strongly	6	15.4	15.4	100.0
	Total	39	100.0	100.0	

Table 82: Descriptive Statistics: frequencies

P3V2 lot-benefits					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	4	10.3	10.3	10.3
	Slightly Agree	8	20.5	20.5	30.8
	Agree	16	41.0	41.0	71.8
	Agree Strongly	11	28.2	28.2	100.0
	Total	39	100.0	100.0	

Table 83: Descriptive Statistics: frequencies

P3V3 recommend-use					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree Strongly	1	2.6	2.6	2.6
	Neutral	8	20.5	20.5	23.1
	Slightly Agree	6	15.4	15.4	38.5
	Agree	9	23.1	23.1	61.5
	Agree Strongly	15	38.5	38.5	100.0
	Total	39	100.0	100.0	

Table 84: Descriptive Statistics: frequencies

P3V4 ease-of-use					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	2.6	2.6	2.6
	Slightly Disagree	1	2.6	2.6	5.1
	Neutral	4	10.3	10.3	15.4
	Slightly Agree	9	23.1	23.1	38.5
	Agree	12	30.8	30.8	69.2
	Agree Strongly	12	30.8	30.8	100.0
	Total	39	100.0	100.0	

Table 85: Descriptive Statistics: frequencies

P3V5 willing-buy					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	3	7.7	7.7	7.7
	Slightly Disagree	1	2.6	2.6	10.3
	Neutral	5	12.8	12.8	23.1
	Slightly Agree	9	23.1	23.1	46.2
	Agree	10	25.6	25.6	71.8
	Agree Strongly	11	28.2	28.2	100.0
	Total	39	100.0	100.0	

Table 86: Descriptive Statistics: frequencies

P3V6 own-idea					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree Strongly	1	2.6	2.6	2.6
	Slightly Disagree	1	2.6	2.6	5.1
	Neutral	3	7.7	7.7	12.8
	Slightly Agree	10	25.6	25.6	38.5
	Agree	9	23.1	23.1	61.5
	Agree Strongly	15	38.5	38.5	100.0
	Total	39	100.0	100.0	

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Comparative Analysis of Random Forest and J48 Classifiers for "IRIS" Variety Prediction

By Youssef Fakir, Youness Lakhdoura & Rachid Elayachi
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Abstract- Data mining may be a computerized technology that uses complicated algorithms to seek out relationships and trends in large databases, real or perceived, previously unknown to the retailer, to market decision support. Data mining is predicted to be one of the widespread recognition of the potential for analysis of past transaction data to enhance the standard of future business decisions. The aim is to arrange a set of knowledge items and classify them.

In this paper, we apply two classifier algorithms: J48 (c4.5) and Random Forest on the IRIS dataset, and we compare their performance based on different measures.

Keywords: IRIS, J48 classifier, proficiency comparison, random forest classifier.

GJCST-H Classification: J.1

Strictly as per the compliance and regulations of:

Comparative Analysis of Random Forest and J48 Classifiers for "IRIS" Variety Prediction

Youssef Fakir [α], Youness Lakhdoura [σ] & Rachid Elayachi [ρ]

Abstract- Data mining may be a computerized technology that uses complicated algorithms to seek out relationships and trends in large databases, real or perceived, previously unknown to the retailer, to market decision support. Data mining is predicted to be one of the widespread recognition of the potential for analysis of past transaction data to enhance the standard of future business decisions. The aim is to arrange a set of knowledge items and classify them.

In this paper, we apply two classifier algorithms: J48 (c4.5) and Random Forest on the IRIS dataset, and we compare their performance based on different measures.

Keywords: IRIS, J48 classifier, proficiency comparison, random forest classifier.

I. Introduction

People are often susceptible to making mistakes during analyses or, possibly, when trying to determine relationships between multiple features. This fact, makes it difficult for them to seek out solutions to certain problems. Data mining involves the utilization of sophisticated data analysis tools to get previously unknown, valid patterns, and relationships in the datasets[1]. These tools can include statistical models, mathematical algorithms, and machine learning methods [2].

Consequently, data processing consists of quite a collection and managing data, it also includes analysis and prediction [1].

The classification technique is capable of processing a sort of data than regression and is growing in popularity [3].

II. Dataset Used

In this research work, we use the IRIS plant data set, one of the most popular databases for the classification problems, it is obtained from UCI Machine Learning Repository and created by R.A. Fisher while donated by Michael Marshall (MARSHALL%PLU @io.arc.nasa.gov) on July 1988[4].

The IRIS dataset contains three different classes of IRIS plants depending on their pattern [5,6]. Each class of IRIS plant contain fifty objects. The attributes that already predicted belongs to a category of IRIS plant. The list of attributes presents within the IRIS is often described as categorical, nominal, and continuous. The experts have mentioned that the info set is complete i.e. there isn't any missing value found in any attribute of this data set [6].

This research makes use of the documented IRIS dataset, which contains three classes of fifty instances each. The 150 instances, which are equally divided between the three classes, hold the subsequent four numeric attributes:

1. Sepal length - continuous
2. Sepal width - continuous
3. Petal length - continuous
4. Petal width –continuous

And therefore the fifth attribute "Variety" is that the predictive attribute which identifies which class of the following belongs the instance: IRIS Setosa, IRISVersicolor, or IRIS Virginica [5,6].

III. Classifiers Used

In this paper, we compared the proficiency assessment of IRIS variety for two tree based classifiers: Random Forest and J48 Classifiers.

a) Random Forest Classifier

Random Forest [7] is considered one of the best "off-the-shelf" classifiers for high-dimensional data. Random forest is a mix of tree predictors sampled autonomously count on the values of a random vector following an equivalent distribution for all trees of the forest. The generalization error of random forest classifier depends on the association between the individual trees inside the forest and the strength of them. The dataset divided into a training dataset to learn each tree, and the remaining of the data set is used to estimate error and variable importance. Class assignment is formed according to the number of votes for any of the trees, to apply the model of the results. it's almost like bagged decision trees with hardly some key differences as given below:

For every split point, the search isn't overall p variables but just over m (number of tested) variables (where, e.g,m = [p/3])

No pruning necessary. Trees are often grown until each node contains just only a few observations.
The Random Forest gave better prediction, and almost no parameter adjustment is necessary.

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b) J48 Classifier

The J48 classifier is an extension of the decision tree C4.5 algorithm for classification [8], which creates a binary tree. It's the foremost useful decision tree approach for classification problems. This system constructs a tree to model the classification process. After the tree is made, the algorithm is applied to every tuple within the database and leads to classification for that tuple [9].

Algorithm J48 [9]:

```
INPUT:
P//Training data
OUTPUT
DT //Decision tree
DTBUILD (*P)
{
DT=φ;
DT= Create root node and label with splitting attribute;
DT= Add arc to root node for each split
predicate and label;
For each arc do
P= Database created by applying spliting
predicate to P;
If stopping point reached for this path, then
DT'= create leaf node and label with
appropriate class;
Else
DT'= DTBUILD(P);
DT= add DT' to arc;
}
```

The absent values are ignored byJ48 while building a decision tree, i.e. the known information about the attribute values for the other records is helpful to predict the value for that item. The idea is to divide the data into a range based on the attribute values for that element which are identified in the training sample [10].

IV. Performance Measures Used

Various scales are wont to gauge the performance of the classifiers.

a) Classification Accuracy (CA)

Classification accuracy presents the percent of correctly classified instance in the test dataset. We calculate it by dividing the correctly classified instances by the total number of instance multiplied by 100.

b) Mean Absolute Error (MAE)

Mean absolute error is that the average of the variance between predicted and actual value altogether test cases. It's an honest measure to measure performance.

c) Root Mean Square Error (RMSE)

Root mean squared error is employed to scale dissimilarities between values. It's determined by taking the root of the mean square error.

d) Confusion Matrix (CM)

A confusion matrix is a tool checking in particular how often the predictions are correct compared to reality in classification problems.

V. Results and Discussion

In this work, to evaluate the performance of the different Tree-based Classifiers (Random Forest and J48), we used a well-known open-source tool in the machine learning field called "WEKA". The performance is tested using two methods, first by splitting the dataset into training (70%) and testing (30%) datasets, as well as using different Cross-Validation methods.

a) Performance of Random Forest Classifier

Table 1 show the global evaluation summary of Random Forest Classifier using both of the test modes: splitting and different cross-validation methods. Fig.1 and Fig.2 display the performance of Random Forest Classifier in terms of Classification Accuracy and time taken to build the model. From Table I to Table VI we gave the confusion matrix for different test modes.

By applying these test modes using Random Forest Classifier, we got 95.55% accuracy, spending 0.17s on building the model for the split. Using different cross-validation methods to check their performance, we obtained around 94.99% accuracy, spending 0.06s on building the model.

Table 1: Random Forest Classifier Overall Evaluation Summary

Test Mode	Correctly Classified Instances	Incorrectly Classified Instances	Accuracy	Mean Absolute Error	Root Mean Squared Error	Time Taken to Build Model (Sec)
Split (70%)	43	2	95.55%	0.0363	0.1532	0.17
5 Fold CV	143	7	95.33%	0.037	0.1531	0.05
10Fold CV	142	8	94.66%	0.0408	0.1624	0.03
15Fold CV	142	8	94.66%	0.0385	0.1613	0.14
20Fold CV	143	7	95.33%	0.0379	0.1558	0.03

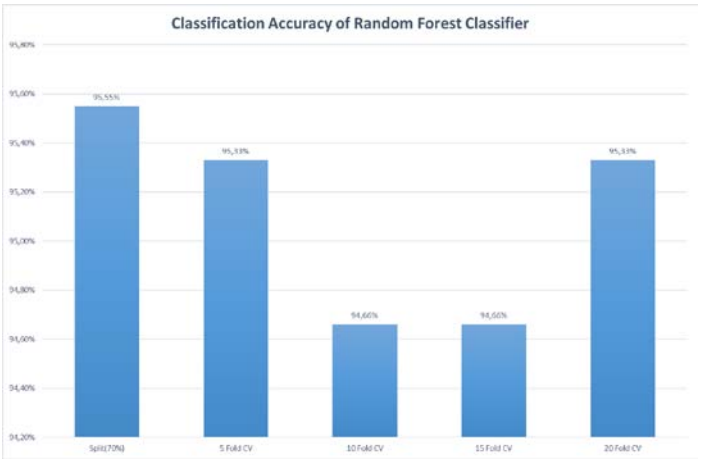

Figure 1: Classification Accuracy of Random Forest Classifier

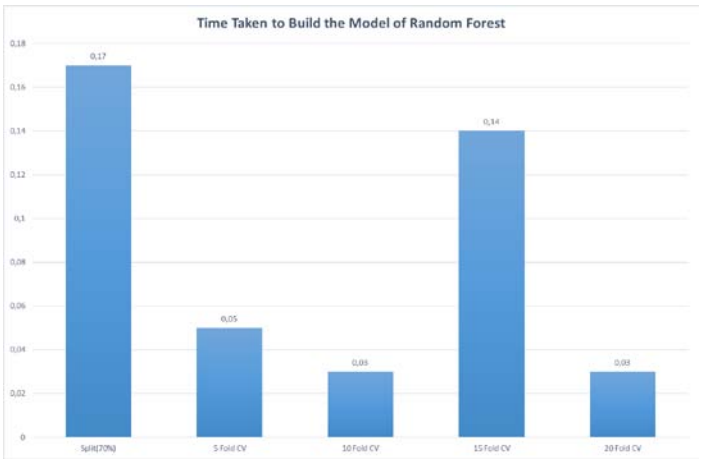

Figure 2: Time Taken to Build the Model of Random Forest Classifier

Table 2: Confusion Matrix – Random Forest Classifier (Split 70 %)

	Setosa	Versicolor	Virginica	Actual (Total)
Setosa	14	0	0	14
Versicolor	0	16	0	16
Virginica	0	2	13	15
Predicted (Total)	14	18	13	45

Table 3: Confusion Matrix – Random Forest Classifier (5 Fold CV)

	Setosa	Versicolor	Virginica	Actual (Total)
Setosa	50	0	0	50
Versicolor	0	47	3	50
Virginica	0	4	46	50
Predicted (Total)	50	51	49	150

Table 4: Confusion Matrix – Random Forest Classifier (10 Fold CV)

	Setosa	Versicolor	Virginica	Actual (Total)
Setosa	50	0	0	50
Versicolor	0	47	3	50
Virginica	0	4	46	50
Predicted (Total)	50	51	49	150

Table 5: Confusion Matrix – Random Forest Classifier (15 Fold CV)

	Setosa	Versicolor	Virginica	Actual (Total)
Setosa	50	0	0	50
Versicolor	0	47	3	50
Virginica	0	5	45	50
Predicted (Total)	50	52	48	150

Table 6: Confusion Matrix – Random Forest Classifier (20 Fold CV)

	Setosa	Versicolor	Virginica	Actual (Total)
Setosa	50	0	0	50
Versicolor	0	47	3	50
Virginica	0	4	46	50
Predicted (Total)	50	51	49	150

b) Performance of J48Classifier

Table VII show the global evaluation summary of J48classifier using both of the test modes: splitting and different cross-validation methods. Fig.3 and Fig.4 display the performance of J48classifier in terms of classification accuracy and time taken on building the model. From Table VIII to Table XI we gave the confusion matrix for different test modes.

By applying these test modes using J48classifier we got 95.55% accuracy, spending 0.05s on building the model for the split mode. Using different cross-validation methods to check their performance, on average we obtained around 95.83% accuracy, spending 0.025s to build the model.

Table 7: J48 Classifier Overall Evaluation Summary

Test Mode	Correctly Classified Instances	Incorrectly Classified Instances	Accuracy	Mean Absolute Error	Root Mean Squared Error	Time Taken to Build Model (Sec)
Split (70%)	43	2	95.55%	0.0416	0.1682	0.05
5Fold CV	144	6	96%	0.035	0.1582	0.02
10Fold CV	144	6	96%	0.035	0.1586	0.02
15Fold CV	143	7	95.33%	0.0395	0.1758	0.03
20Fold CV	144	6	96%	0.0354	0.1586	0.03

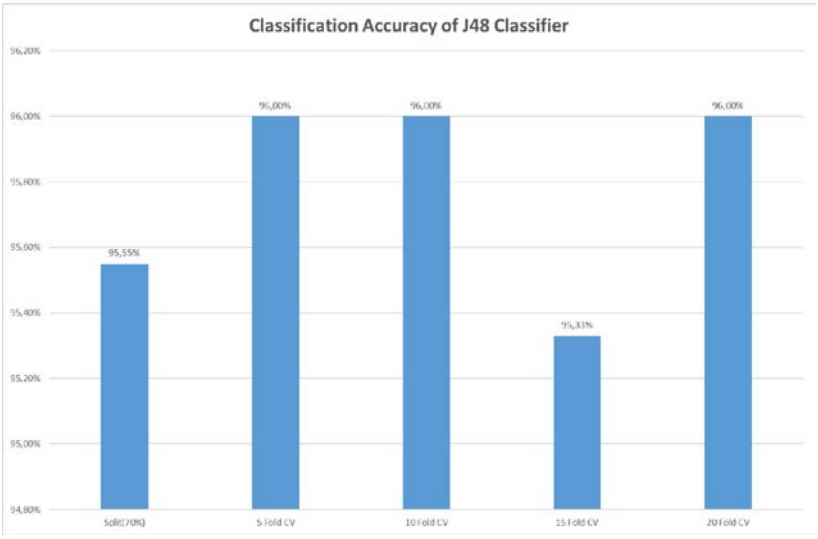

Figure 3: Classification Accuracy of J48 Classifier

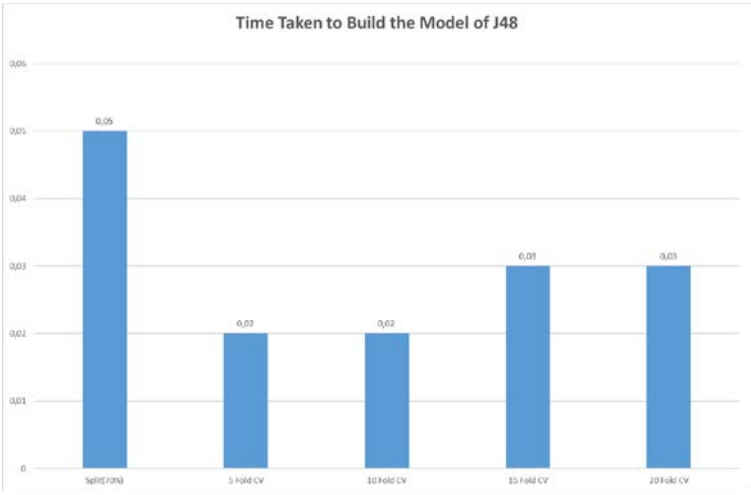

Figure 4: Time Taken to Build the Model of J48Classifier

Table 8: Confusion Matrix – J48 Classifier (Split 70 %)

	Setosa	Versicolor	Virginica	Actual (Total)
Setosa	14	0	0	14
Versicolor	0	16	0	16
Virginica	0	2	13	15
Predicted (Total)	14	18	13	45

Table 9: Confusion Matrix – J48 Classifier (5 Fold CV)

	Setosa	Versicolor	Virginica	Actual (Total)
Setosa	49	1	0	50
Versicolor	0	47	3	50
Virginica	0	2	48	50
Predicted (Total)	49	50	51	150

Table 10: Confusion Matrix – J48 Classifier (10 Fold CV)

	Setosa	Versicolor	Virginica	Actual (Total)
Setosa	49	1	0	50
Versicolor	0	47	3	50
Virginica	0	2	48	50
Predicted (Total)	49	50	51	150

Table 11: Confusion Matrix – J48 Classifier (15 Fold CV)

	Setosa	Versicolor	Virginica	Actual (Total)
Setosa	49	1	0	50
Versicolor	0	47	3	50
Virginica	0	3	47	50
Predicted (Total)	49	51	50	150

Table 12: Confusion Matrix – Random Forest Classifier (20 Fold CV)

	Setosa	Versicolor	Virginica	Actual (Total)
Setosa	49	1	0	50
Versicolor	0	47	3	50
Virginica	0	2	48	50
Predicted (Total)	49	50	51	150

VI. Comparison of Random Forest and J48 Classifiers

Fig. 5 and Fig. 6 illustrate a comparison between Random forest and J48 according to classification accuracy and time taken on building the model.

Through the comparison of the performance using training set (70%) process and various cross-validation methods between Random Forest and J48 classifiers depending on time taken on building the model, CA, MAE, and RMSE values, we reached thatJ48 classifier outperforms Random Forest.

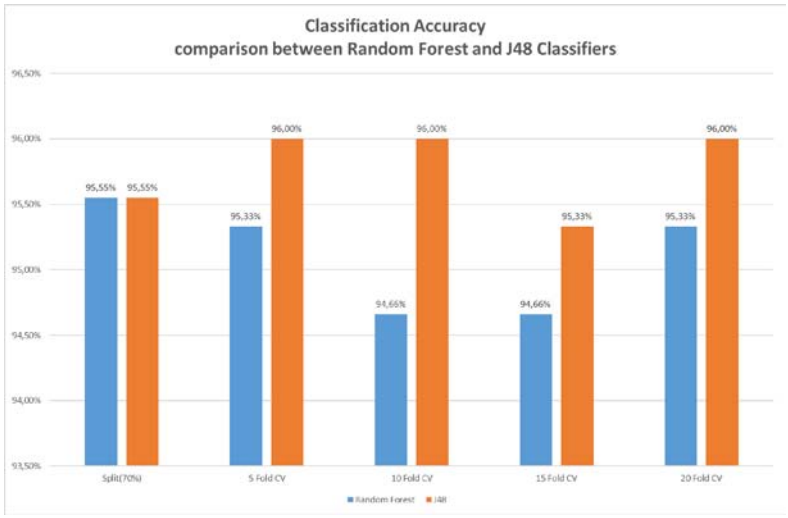

Figure 5: Classification Accuracy, Comparison between Random Forest and J48 Classifiers

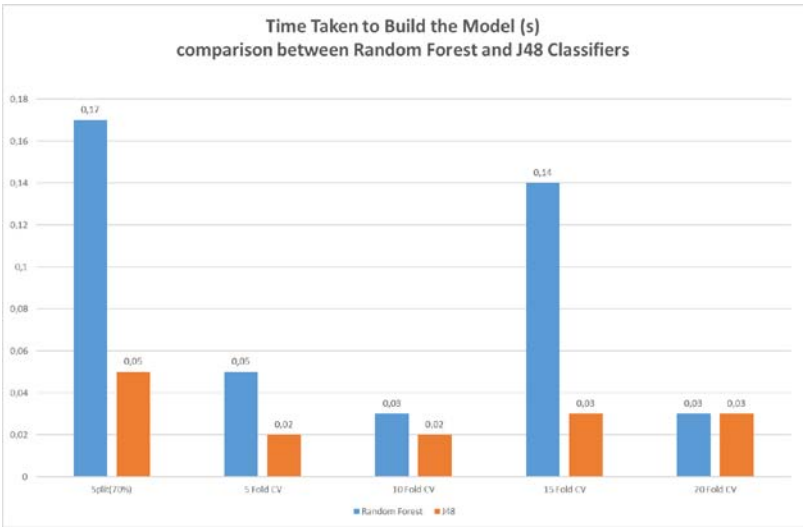

Figure 6: Time Taken to Build the Model, Comparison between Random Forest and J48 Classifiers

VII. Conclusion

This research work compares the efficiency of Random Forest and J48 Classifiers for IRIS variety prediction. The test is accomplished using WEKA 3.9in a machine with a processor i5-2430M 2.40 GHz and 4.00GB in RAM. Also, we compare the performance of both of the classifiers in terms of different scales of effectiveness evaluation. At last, we observed that J48classifier performs best than Random Forest classifier for IRIS variety prediction by taking different measures, including classification accuracy, Mean Absolute Error, and Time Taken to Build the Model.

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Evaluation of Instructional Videos for Teaching and Learning Safety Precautions in Kano State Technical Colleges Workshops

By Shuaibu Saminu, Peter Ayoola Ajelabi & Kabiru Bawa

Yusuf Maitama Sule University

Abstract- Instructional videos play a vital role towards effectiveness and efficiency in teaching and learning. The main objective of the study was to investigate the availability, effectiveness of the devices, teachers' competencies on the uses of these devices and the students' adherence towards safety rules in the schools' workshops. Research questions were formulated based on the objective of the study. The research design adopted descriptive survey. All the teachers and students in the Technical Colleges in Kano State were the population of the study. The sample of the study was made up of 80 teachers and 346 students respectively. A Questionnaire (QEIVTLSP) for collecting the data was developed and validated. A reliability estimate of 0.87 was obtained using test-retest method for ensuring reliability of the instruments. Data was collected and analysed and the results were presented and discussed. Recommendations were made accordingly.

Keywords: evaluation, instructional videos, teaching and learning, safety precautions, workshop.

GJCST-H Classification: K.3.1

Strictly as per the compliance and regulations of:

Evaluation of Instructional Videos for Teaching and Learning Safety Precautions in Kano State Technical Colleges Workshops

Shuaibu Saminu [α], Peter Ayoola Ajelabi [σ] & Kabiru Bawa [ρ]

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Keywords: evaluation, instructional videos, teaching and learning, safety precautions, workshop.

I. Introduction

Teaching and learning are two sides of the same coin. The teacher imparts the knowledge, skills, values, and attitudes to the learners. These impartation takes various forms: some makes the learners active and some makes them passive. It has been noted that learners learn better when they are actively participating in the classroom (Kadzera, 2006). In the same vein, teaching is the act of imparting knowledge or skill from teacher to the student while learning is the process of acquiring new or modifying existing knowledge, behavior, skills, values or preferences. It involves changes in behaviours which are demonstrated by people (Anka, 2016). More so, Van Dantton and Britte (2003) observed teaching is the guidance of pupils through planned activities so that they may acquire the richest learning possibilities from experience and requires the active participation of the child.

Like every other aspect of human endeavour, teaching has had its own share of challenges this has promoted many educational researches. Cecilia Boakiye and Ghartey Ampiah(2017) explored that lack of resources for teaching and learning, time management, deficiency in content knowledge, students' inability to understand the lessons taught, student indiscipline were among the major challenges faced in teaching and learning situation in addition, Kasim & Abdurajak, (2018) opined that pedagogical incompetence such as inexperience on the application of students centred teaching method among teachers is one of the challenging factor in teaching and learning. Moreover, Amadike Okechuku and Vincent Agwi (2015) revealed that the tools/equipment/devices in technical training institutions are bad/obsolete for sequence of operations in the training workshops. In addition to other challenges, Omwenga (2001) observes that many teachers complain about lack of instructional resources, at the same time they are guilty of not using what is available. The desire to conduct this research is not only because the researchers are technology-based scholars but more importantly because of the role instructional videos plays in the development of teaching and learning Safety Precautions in Technical Colleges Workshops.

One of the means of making learners achieve a better performance and become very active is the use of real form, graph, diagram, video, or improvisation of the real form of the instructional materials (Čubrilo, Crvenković, Obadović, and Segedinac, 2014). This is because the learners engage all the five sense organs. Ajelabi (2006) explained that, computer assisted instruction (which is video in form) is useful for direct learning in a classroom without the presence of the teacher. It is seen as one of today's educational reform movement which attempts to bring successful instructional models into our schools. Video is now recognized by most educators as a powerful communications medium which, in combination with other learning resources and instructional strategies, can perform a vital role in modern education (Denning 1998).Leidner and Jarvenpaa (1995), added that, individuals are assumed to learn better when they discover things by themselves and when they control the pace of learning. This is why Donkor (2010) discussed that, the video-based instructional materials are more effective than the print-based instructional materials in equipping the distance learners with practical skills.

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Generally, instructional videos in teaching and learning plays an important role towards acquisition of knowledge because, of all the emerging areas of technology, video has been one of the most widely used tools for teaching and learning (Zhang, Lundeberg, Koehler, & Eberhardt, 2011). Thorpe (2006), opined that when video appropriately matched with specific instructional goals, video materials helps more students to achieve higher levels and tend to engage many more students in ways that are more compelling than printed resources. However, each instructional videos should be developed in consideration of the level of the students' interests and abilities (Donkor, 2010).

Evaluating instructional videos for teaching and learning workshop safety precaution can be viewed as a process or step by step motion/projected procedures on how best students can use hardware and machine tools and any other practical equipment in an organized manner in such a way that hazard is minimized or totally prevented (Denning, D. 1998). Life of individuals or students should be taken into consideration when working or learning at the workshop. This research therefore, chose to evaluate instructional videos in order to see how it can best facilitate effective and efficient teaching and learning workshop on safety precaution by students at Technical Colleges in Kano State in particular and Nigeria at large.

II. Statement of the Problem

Safety precautions in workshops has been a major concern for not only the teachers, technicians, and technologists, but also the government as a whole. Safety precautions are normally taught through demonstrating or via the use of pictures in books. However, this has not really helped the students because accidents and incidents do happen regularly, particularly in workshops during practical sessions.

The use of printed media in teaching and learning safety precautions in technical colleges nowadays may be considered out-dated, too acquainted to the students and difficult to teach skills or convey emotions and feeling through print material. In addition, print media cannot be used for large group of students, hold large amount of data as well, it is Prone to get spoil easily and time consuming during preparation

a) Objectives of the Study

The study is targeted at achieving the following objectives:

1. To investigate the availability of instructional videos in Kano State Technical Colleges.
2. To investigate the effectiveness and efficiency of devices to be used for playing instructional videos in Kano State Technical Colleges.
3. To investigate the teachers' competency in operating the devices used for playing instructional videos in Kano State Technical Colleges.
4. To assess the students' adherence in applying safety habit during practical sessions in Kano State Technical Colleges Workshop.

b) Research questions

1. Are there available instructional videos in Kano State Technical Colleges?
2. What are the effectiveness and efficiency of devices used for playing instructional videos in Kano State Technical Colleges?
3. What are the levels of teachers' competency in operating the devices used for playing instructional videos in Kano State Technical Colleges?
4. What are the levels of students' adherence in applying safety habit during practical sessions in Kano State Technical Colleges Workshop?

III. Methodology

a) Research design

Descriptive survey design involving the use of observations, focused group discussion with the students and teachers was employed. Also questionnaires was administered to the students to find out their perception on the use of instructional videos to learn safety precautions.

b) Population of the study

The population of the study consist of all the teachers (122) and students (4318) of Technical Colleges located in Kano State, Nigeria.

c) Sample and sampling technique

The sample size for the population includes 80 teachers and 346 students which was based on the research advisor (2006). The students were SSII and SSIII from the following technical colleges viz: Government Technical College Kano, Government Technical College Ungogo, Government Technical College Bagauda and Government Technical College Tiga (formerly GTC Wudil).

d) Research Instrument

Well-constructed and self-developed questionnaires titled "Evaluation of Instructional Videos for Teaching and Learning Safety Precautions in Kano State Technical Colleges Workshops" (QEIVTLSPKSTCW) was used to collect the desired data from the respondents. The questionnaires for both the teachers and the students was divided in to two sections (A and B) each. Section A comprises of demographic information of the respondents while section B consisted of required information on evaluation of instructional videos for teaching and learning safety precautions in Kano State Technical Colleges Workshops through response option of

strongly agree (SA), agree (A), disagree (D) and strongly disagree (SD).

e) Reliability of the Instrument

Cronbach Alpha co-efficient reliability of 0.87 and 0.80 index was the value obtained using test-retest method for ensuring reliability of both the teachers and the students' instruments, respectively.

f) Data Collection Procedure

The researchers collected the data through the use of questionnaire and its administration in all the four technical colleges. The administration of the questionnaires were carried out by the researchers with the aid of research assistants, a total of 426 copies of questionnaires were distributed and filled by the respondents and retrieved on the spot by the researchers. This is done to avoid wrongly filled or missing.

The data collected from the respondents was analyzed using the descriptive statistic of mean and standard deviation. Descriptive statistics was used with the aid of statistical software package called SPSS Version 20.0 in analyzing the responses on evaluation of instructional videos for teaching and learning safety precautions in Kano State Technical Colleges Workshops while, demographic information of the respondents was not analyzed because it has less or no significant value on the research.

g) Results Presentations

The result of the finding expressed the perception of both the students and teachers on evaluation of Instructional Videos for Teaching and Learning in Kano state Technical Colleges' workshops. While analyzing the data 2.50 mean average was considered as decision rule, being four-point Likert scale was used to categorized the level of agreement among the teachers and the students. Therefore, any decision less than 2.50 is considered rejected while 2.50 and above accepted.

From tables 1 and 2 below, items number one to six attempted to answer research question one and the results were found to be of mean score which is greater than 2.50 (3.27 to 3.98) with grand mean score of 3.16and 3.00 (SD=0.65 and 0.52) except in items number two and three in both the teachers and the students responses with mean score of less than 2.50 (1.46,2.39and1.27, 2.39), respectively.

Regarding the result of research question two, that is items number seven to twelve, it was found that the mean score of all the items in both the teachers and the students' responses were between 2.64 and 3.93 with grand mean score of 3.68 and 3.32 (SD=0.58 and 0.72).

In research question three, ranging from items thirteen to eighteen, the means score of all the items were less than 2.50 (1.43 to 2.33) except in items number sixteen (16) each from the teachers and students' responses with mean score of3.98 and 3.98. The grand mean score of all the items were found to be 2.21 and 2.14 (SD=0.68 and 0.68).

Items 19 to 24 attempted to answer research question four. The mean score of items 20 to 24 were found to be between3.14 and 4.44 which were above 2.50 and items 19 each from teachers and students responses was haven the mean score of 1.31 and 1.82, and the entire grand mean of all the items was 3.32 and 3.31(SD=1.31 and 0.68), respectively.

Teachers

Table 1: Mean Scores of the Respondents on evaluation of instructional videos for teaching safety precautions in Kano State Technical Colleges' workshops(N = 80)

S/N	STATEMENTS	X	SD	Remarks
1	The school have video projectors for teaching safety precautions	3.98	0.22	Agreed
2	Teachers used instructional videos for teaching safety precautions at the beginning of the term.	1.46	0.81	Disagreed
3	Teacher usually used safety precautions videos for each type of program	2.39	0.96	Disagreed
4	There are available sources of power (e.g. Generator or batteries) for playing instructional videos for safety precautions.	3.68	0.63	Agreed
5	The studio/workshop/laboratory for displaying instructional videos for safety precautions are conducive for learning	3.75	0.67	Agreed
6	The projectors for displaying instructional safety precautions are in good condition	3.68	0.63	Agreed
	Grand Mean/SD	3.16	0.65	Agreed
7	The various instructional videos for teaching safety precautions are up to date/latest	3.39	0.74	Agreed
8	The school projectors are in good working conditions	3.88	0.46	Agreed

9	The school smart boards are in good working conditions.	3.84	0.51	Agreed
10	The teachers' mobile phones used for displaying online/offline videos are in good working conditions	3.76	0.48	Agreed
11	The supplementary devices such as generators, electrical wiring and socket outlets are in good condition	3.74	0.47	Agreed
12	There is routine maintenance on all the devices and equipment we used in the workshop	3.46	0.83	Agreed
	Grand Mean/SD	3.68	0.58	Agreed
13	Teachers used their mobile phones to display safety precautions videos to their students	2.03	0.76	Disagreed
14	Teachers provide various website links for the students to access instructional videos for safety precautions.	2.33	0.84	Disagreed
15	Teachers show competency in operating the projectors for displaying instructional videos for teaching safety precautions.	2.04	0.80	Disagreed
16	Government supply electronics devices to the teachers for teaching in workshop	3.98	0.22	Agreed
17	Teachers used various method in presenting the instructional videos for better understanding	1.43	0.78	Disagreed
18	Teachers permit student-teacher interaction during and after displaying the instructional videos	1.46	0.70	Disagreed
	Grand Mean/SD	2.21	0.68	Disagreed
19	Teachers permit students-teacher interactions after displaying the instructional videos	1.31	0.72	Disagreed
20	Teachers encourage the students to use Personal Protective Equipment (PPE) during practical sessions	3.46	0.83	Agreed
21	Teachers encourages their students to observe safety rules during practical sessions.	3.83	0.57	Agreed
22	Teachers strictly observes students' adherence to safety habits while conducting practical exercise in the workshops.	3.39	0.74	Agreed
23	The students usually conduct accident free practical with the help of the safety videos guide.	3.51	0.68	Agreed
24	Teachers usually encourages the students to advice each other when trying to violate safety rules that were observed in the videos.	4.44	4.37	Agreed
	Grand mean/SD	3.32	1.31	Agreed

Source: Field survey, 2019

Students

Table 1: Mean Scores of the Respondents on evaluation of instructional videos for teaching and learning safety precautions in Kano State Technical Colleges' workshops(N = 346)

S/N	STATEMENTS	X	SD	Remarks
1	Our school have video projectors for teaching safety precautions	3.98	0.17	Agreed
2	Our teachers use instructional videos for teaching safety precautions at the beginning of the term	1.27	0.52	Disagreed
3	Our teacher usually used safety precautions videos for each type of programme	1.46	0.70	Disagreed
4	We have available sources of power (e.g. Generator or batteries) for playing instructional videos for safety precautions	3.91	0.35	Agreed
5	The studio/workshop/laboratory for displaying instructional videos for safety precautions are conducive for learning	3.63	0.75	Agreed
6	The projectors for displaying instructional safety precautions are in good condition	3.73	0.65	Agreed
	Grand Mean/SD	3.00	0.52	Agreed
7	The various instructional videos for teaching safety precautions are up to date/latest	2.75	0.96	Agreed
8	The school projectors are in good working conditions	3.93	0.34	Agreed

9	The school smart boards are in good working conditions	3.59	0.86	Agreed
10	The teachers' mobile phones used for displaying online/offline videos are in good working conditions	3.52	0.56	Agreed
11	The supplementary devices such as generators, electrical wiring and socket outlets are in good condition	3.46	0.55	Agreed
12	There is routine maintenance on all the devices and equipment we used in the workshop	2.64	1.03	Agreed
	Grand Mean/SD	3.32	0.72	Agreed
13	Our teachers use their mobile phones to display safety precautions videos to us	1.55	0.73	Disagreed
14	Our teachers provide many website links for us to access instructional videos for safety precautions	1.98	0.76	Disagreed
15	Our teachers show competency in operating the projectors for displaying instructional videos for teaching safety precautions.	2.01	0.79	Disagreed
16	Government supply electronics devices to the teachers for teaching in workshop.	3.98	0.17	Agreed
17	Our teachers use various method in presenting the instructional videos for better understanding	1.81	0.77	Disagreed
18	Our teachers permit student-teacher interaction during and after displaying the instructional videos.	1.50	0.86	Disagreed
	Grand Mean/SD	2.14	0.68	Disagreed
19	Our teachers permit students-teacher interactions after displaying the instructional videos	1.82	0.74	Disagreed
20	We use Personal Protective Equipment (PPE) during practical sessions.	3.83	0.54	Agreed
21	We usually observe safety rules during practical sessions	3.85	0.51	Agreed
22	Teachers strictly observed our adherence to safety habits while conducting practical exercise in the workshops.	3.14	0.92	Agreed
23	We mostly conduct accident free practical with the help of the safety videos guide.	3.32	0.93	Agreed
24	We do advice each other when trying to violate safety rules that were observed in the videos	3.90	0.44	Agreed
	Grand mean/SD	3.31	0.68	Agreed

Source: Field survey, 2019

IV. Discussion of Results

From the results above, it was identified that from the teachers and the students perceptions there are availability of instructional videos for teaching and learning safety precautions in Kano state technical colleges workshops as well, the generators, batteries and projectors are all in good working conditions. Although there was no compliance in the use of instructional videos for teaching and learning safety precautions at the beginning of the term and using videos for teaching safety precautions for each type of program.

From the results, it was also observed that the various instructional videos for teaching safety precautions are up to date/latest, and all the devices such as projectors, generators/batteries, smart boards, mobile phones, electrical wirings, sockets outlets that are directly or indirectly aiding the use of instructional videos were all effectives and efficient as well. This is because there was always routine maintenance on all the devices and equipment available in the workshops. However, this finding is contrary with the finding of Amadike Okechuku and Vincent Agwi (2015) where they revealed that the tools/equipment/devices in technical training institutions are bad/obsolete for sequence of operations in the training workshops.

The results also shows that teachers' competency in operating the devices used for playing instructional videos such as using mobile phones to display safety precautions videos, provision of various website links for the students to access instructional videos for safety precautions, ability in operating the available projectors in the schools, were all poor although, all the necessary electronics devices needed for displaying the instructional videos were all supplied by Government. This is because the teachers were not trained and have no experience on how to operate these devices. Therefore, this finding is in agreement with the Omwenga (2001) who observes that while many teachers complain about lack of instructional resources, they are guilty of not using what is available.

Moreover, the results indicated that that levels of students' adherence in applying safety habit during practical sessions was quite commendable. This is because there was encouragement and supports from teachers with regards to the use of Personal Protective Equipment (PPE) during practical sessions, observing safety rules during practical sessions and as well encouraging the students to advice each other when trying to violate safety rules.

V. Summary of the Major Findings

From the discussions above, it was found that the video projectors and the sources or alternate sources of power such as generators and batteries were available and in good working condition moreover, the studios, workshops and laboratories for displaying the instructional videos for teaching safety precautions were all conducive for teaching and learning.

In addition, the instructional videos, the projectors, the smart boards and the teachers' mobile phones were latest, up to date and in good working condition meanwhile, all other supplementary devices and components such as electrical wirings and socket outlet are all effective and in good working condition.

On the other hand, the teachers are not competent in operating the devices because using their mobile phones, provision of web sites links for safety precautions and even presentation or displaying the instructional videos to the students are all not common practices among them.

It was observed that the students adhere in applying safety precaution during practical session in their school workshops being they usually conduct accident-free practical and this is because of the courage and advice to use personal safety equipment, advice among students when trying to violate safety rule during practical and strictness by their teachers in observing the safety regulations.

VI. Conclusion

The benefit and influence of instructional videos in teaching and learning safety precautions is undeniable because, the virtual and auditory nature of the instructional videos appeals to the extensive number of students and allow them to process information in a way that is natural and convenient for them. It is believed that the use of instructional videos in teaching and learning allow for more efficient processing and memory recall. Thus, the use of instructional videos in teaching and learning safety precautions in technical colleges serves not only benefits to the students but similarly, the teachers and the technical colleges at large.

VII. Recommendations

Based on the findings of this study, the following recommendation were made:

Since all the projectors, instructional videos and other devices were available and in good working condition. The Head of Departments, Teachers, Store Keepers and Workshop/Laboratories/Studios attendants should collaborate to ensure good care, proper storage and regular maintenance of all the projectors, instructional videos and other devices for long lasting and effectiveness.

Being all the instructional videos, the projectors, the smart boards and the teachers' mobile phones were latest, up to date and in good working condition. The school Principals, Teachers/Supervisors/Workshop attendants should collaborate in ensuring maximum utilization of all these devices for effective teaching and learning safety precautions in their Technical Colleges.

Since the teachers are not competent in operating the projectors/instructional videos therefore, the school authority in collaboration with the Science and Technical Schools Board should encourage regular attendance of teachers of a seminars or workshops on utilization of instructional videos for teaching and learning for them to be equipped with the required knowledge and skills for operating the projectors.

Although there was adherence to safety rules and regulation in the schools workshops by the students, there is need for students-teacher interaction before and after the practical session to ensure maximum adherence to the safety rules and regulation in the schools workshops.

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5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.

6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10.Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.

Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

The Administration Rules

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

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Written material: You may discuss this with your guides and key sources. Do not copy anyone else's paper, even if this is only imitation, otherwise it will be rejected on the grounds of plagiarism, which is illegal. Various methods to avoid plagiarism are strictly applied by us to every paper, and, if found guilty, you may be blacklisted, which could affect your career adversely. To guard yourself and others from possible illegal use, please do not permit anyone to use or even read your paper and file.

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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