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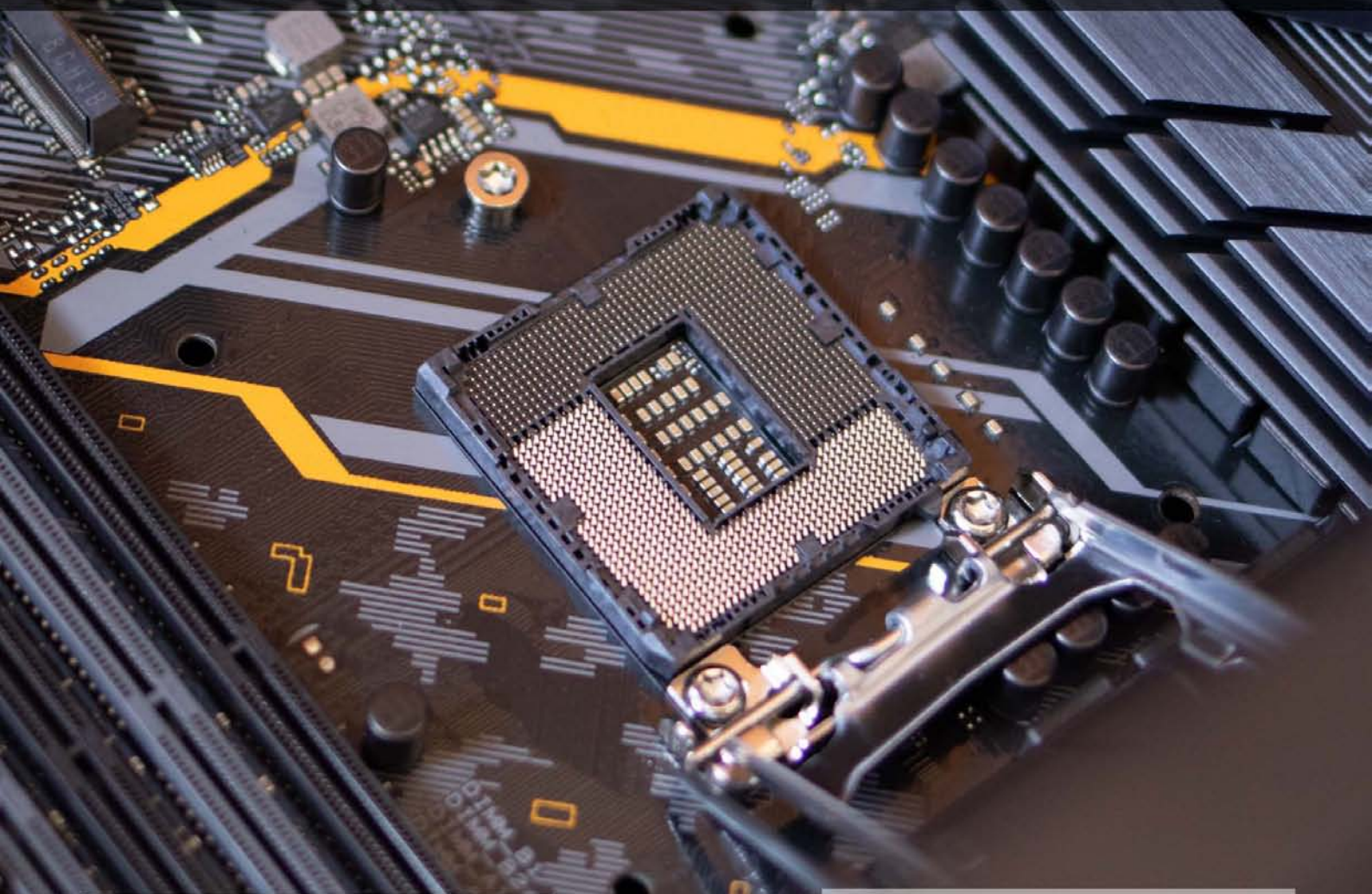

Fractional Weibull Distribution

Educational Assistance Management

Highlights

Verification of UML Class Models

Management System for Batangas

Discovering Thoughts, Inventing Future

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Towards Verification of UML Class Models using Formal Specification Methods: A Review

By Kruti P. Shah & Emanuel S. Grant
University of North Dakota

Abstract- In today's world, many elements of our lives are being affected by software and for that we are in greater need of high-quality software. The Unified Modeling Language (UML) is considered the de facto standard for object-oriented software model development. UML class diagram plays an important role in the design and specification of software systems. A class diagram provides a static description of system components. The purpose of a class diagram is to display classes with their attributes and methods, hierarchy (generalization) class relationships, and associations (general, aggregation, and composition) between classes in one model. However, there are many concepts in the UML with imprecise semantics for that reason the models created may be incorrectly designed. Also, there are number of designers involved in the model designing process who are prone to making mistakes, which gives rise to potential conflicts, uncertainty, and ambiguity. The development of these models is a highly time-intensive process. Therefore, it is extremely important to check the correctness of these models and identify the problems in the early stage of the software development process.

Keywords: *formal methods; model verification; MDE; UML models; UML class diagrams.*

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Towards Verification of UML Class Models using Formal Specification Methods: A Review

Kruti P. Shah [α] & Emanuel S. Grant [σ]

Abstract- In today's world, many elements of our lives are being affected by software and for that we are in greater need of high-quality software. The Unified Modeling Language (UML) is considered the de facto standard for object-oriented software model development. UML class diagram plays an important role in the design and specification of software systems. A class diagram provides a static description of system components. The purpose of a class diagram is to display classes with their attributes and methods, hierarchy (generalization) class relationships, and associations (general, aggregation, and composition) between classes in one model. However, there are many concepts in the UML with imprecise semantics for that reason the models created may be incorrectly designed. Also, there are number of designers involved in the model designing process who are prone to making mistakes, which gives rise to potential conflicts, uncertainty, and ambiguity. The development of these models is a highly time-intensive process. Therefore, it is extremely important to check the correctness of these models and identify the problems in the early stage of the software development process. Error detection and verification of these models at early stage may save costs and time of software development. Therefore, an integration of UML and formal methods is required to overcome such type of issues. Formal methods have proven effective in the development of safety critical systems. The purpose of this work is to provide an overview of formal specification methods (Z notation and OCL) for verifying the UML class model. This review will be helpful to understand current research trends and identify open issues or other areas for improvement in the domain of UML class model verification.

Keywords: formal methods; model verification; MDE; UML models; UML class diagrams.

I. Introduction

Graphical models of software systems are designed and developed in the initial phase of the Software Development Life Cycle (SDLC) [1]. A model is an abstract representation that is used to analyse and understand a different aspect of software system [2]. In Model-Driven Engineering (MDE), the software design model is considered a foundation of all development activities. Models in software engineering are used to elicit requirements, design the system, and develop the code of the proposed system.

In software engineering, it is essential and beneficial to design a model before the implementation. It provides an understandable view of the system and improves communication among technical developers and non-technical users. Along with that, the software design model provides identification of ambiguities and uncertainties at the initial level of SDLC with the help of model verification techniques [3,4].

Unified Modeling Language (UML) [2] is a widely used graphical modeling language, and it is extensively used in MDE. It is used to specify, simulate, and construct software system components. The UML has been adopted and standardized by the Object Modeling Group [5]. It has many static and dynamic models for dealing with different aspects of software.

The class model is an essential part of UML which performs a major role in analysis and design of software [5].This work considers the UML class diagram, which is the most fundamental and widely used among all UML models according to a survey presented in [6]. A Class Diagram provides a static description of system components. The key components of a class model are classes with their attributes and methods, hierarchy (generalization) class relationships, and associations (general, aggregation, and composition) [2, 7].

UML is considered the standard for object-oriented software model development that allows modeling of various aspects of complex systems [2, 7]. However, there are many concepts in the UML with imprecise semantics, which limit the use of the UML and reduce the quality of the UML models. Also, they lack a formal foundation. Therefore, model verification is not possible in them. Thus, developing technologies for the analysis and verification of UML models is significant to developers who use UML for system modeling.

The programming language code is developed with the reference of the design models in MDE, and defects and ambiguities in the model can implicitly transfer into the programming code, making it more difficult to determine and rectify. Also, the development of these models is a highly time-intensive process. Therefore, it is extremely important to check the correctness of these models and identify the problems in the early stage of the software design process.

Model verification ensures that the design model is unambiguous, correct, and bug-free. It essentially verifies the model's accuracy and guarantees that the model is consistent and acceptable. The ability to analyse and validate UML models is provided by

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formal specification methods [8]. Formal methods involve the use of a specification language and mathematical theories to design models. They enhance consistency, eliminate design flaws, and improve system reliability.

Despite the challenges that model complexity has introduced into MDE-based software development processes, as well as the benefits of using formal methods to verify software, there has been a lot of work done on applying formal methods and formal analysis techniques to ensure the model correctness.

This paper reviews the progress of some research articles on UML class model verification methods Z(zed) and Object Constraint Language (OCL) and directs future research in the area of formal specification language. The primary goal of this work is to provide a summary of approaches considered in selected articles, along with the quality of their results and conclusions. This review will be useful for researchers to understand the important open issues in existing methods and limitations that need to be addressed in the area of model correctness.

The remainder of the paper is organized as follows. Section 2 represents the review process including the research questions and the inclusion/exclusion criteria. Section 3 gives a brief theoretical background of UML class model along with the model transformation and formal methods to verify the correctness of UML models. Section 4discusses the studies and work done in the area of verification and correctness of UML class models using formal methods. Section 5 discusses the review summary and important open issues in the domain of formal specification methods followed by the conclusion.

II. Review Process

This section discusses the Research Questions followed by defining inclusion and exclusion criteria for the review.

a) Research Questions

This paper focuses on providing an analysis and comparison of the research initiatives done in the field of formal verification approaches mainly Z(zed) notation and Object Constraint Language (OCL). More precisely, we aim to answer the following research questions in this literature review:

RQ1: What is the importance of UML models and static CD models?

RQ2: What is the importance of model transformation and formal specification methods?

RQ3: Which model defects have been undertaken in proposed approach?

RQ4: Is a verification approach supported by the tool?

RQ5: What are the deficiencies associated with the selected formal approach?

b) Inclusion/Exclusion Criteria

In this section, we defined inclusion/exclusion criteria to determine the related works. The inclusion criteria focus on: 1)studies related to the verification of UML class model using formal methods Z and OCL and 2) paper published in English. On the other hand, We exclude the formal verification studies that are related to dynamic UML models. Based on the inclusion/exclusion criteria, I have selected following studies that are related to the Z-notation and OCL for this review.

Table 1: Selected studies for this survey

Study	Method	Reference Title
S1	Z-notation	1) The UML as a formal modeling notation 2) Reasoning with UML class diagrams 3) Foundations of the unified modeling language 4) The Z notation Manual
S2	OCL	1) Finite satisfiability of UML class diagrams by constraint programming 2) A UML model consistency verification approach based on meta-modeling formalization 3) Reasoning about UML/OCL class diagrams using constraint logic programming and formula 4) Incremental verification of UML/OCL models 5) Verification of UML/OCL class diagrams using constraint programming 6) UML to CSP: A tool for the formal verification of UML/OCL models using constraint programming 7) Towards domain refinement for UML/OCL bounded verification

III. Theoretical Background

This section covers some of the theories and prior work in the area of UML models and various aspects of UML class diagrams along with the description of the requirement of model transformation and formal specification methods to verify the correctness of such models.

a) Unified Modeling Language (UML)

UML [2,7] has been widely accepted as the standard language for modeling and documenting software systems. Their significance has been enhanced with the beginning of the Model-Driven Development (MDD) approach, in which analysis and design models play an essential role in the process of software development. The UML offers a number of diagram forms to describe particular aspects of software artifacts. These diagram structures can be divided into two categories static or dynamic views:

Static view: It describes the structural aspect of the system and its components. It includes objects, classes, attributes, operations, and their inter-relationships. The structural view can be represented by class diagrams and composite structure diagrams.

Dynamic view: It describes the behavioral aspect of the system. The dynamic view reflects the changes related to the internal states of individual objects and changes in the system's overall state. This view can be represented by sequence, activity, and state chart diagrams.

i. *UML Class Diagram*

The UML class diagrams are used to represent the static structure of system components [2,7]. It describes the system structure in terms of classes, attributes, and constraints imposed on classes (operations) and their inter-relationships.This work focuses on the use of the UML class diagrams. Class diagrams are used at the analysis phase to present a view of the static entities in the problem domain, and at the design phase to present a view of the static entities (classifiers) in the solution domain. A class diagram is best described as a set of graph elements connected by their relationships.

Classes in UML models are represented as rectangles. Each class consists of a name, set of attributes, and set of operations on the class's attributes. Figure 1 shows an example of a class diagram consisting of classes, associations (aggregations and compositions), and generalizations.

ii. *UML Association (Aggregation, Association, Composition, generalization)*

There are some rules and requirements for combining the classes to construct partial or complete UML class models.

Association It can be depicted as bi-directional or unidirectional. The association lines indicate the possible relationship between the class entities [9]. An association represents attributes and objects from the related classes, such as the relationship between class A and class C seenin Fig. 1.

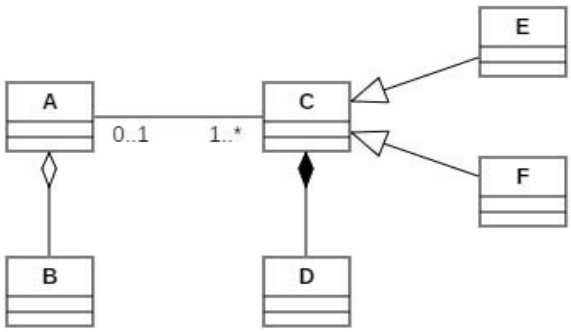

Figure 1: UML Class Diagram

Association ends can be annotated with labels, known as association end names and multiplicities. For example, multiplicity can be expressed as specific numbers, ranges of numbers, or unlimited numbers, as shown in Figure 1 between classes A and C.

Aggregation —◇An aggregation is represented as an association with a white diamond on one end, where the class at the diamond end is the aggregate (container class). It includes or owns instances of the class (contained class) at the other end of the association [9] (e.g., the relationship between class A and B in Figure 1).

Composition —◆ It is a special type of aggregation in which instances of the contained class are explicitly owned by instances of the container classes [9]; if an instance of the container class is deleted, the instances of the contained class are also deleted. Figure 1 shows class C, the container class, and class D, the contained class. It is represented as an association with a black diamond.

Generalization —▷A generalization is represented by an association with a triangle on one end represents, where the class at the triangle end of the association is the parent class of the classes at the other ends of the association, called subclasses [9]. A subclass inherits all of the parent class's attributes, operations, and associations (e.g., subclasses E and F inherit properties of parent class C in Figure 1).

b) Model Transformation

Models provide a level of abstraction that allows developers and stakeholders to visualize different parts of the system while avoiding implementation details. A large number of models can exist for any given system,

and it is essential to assure the consistency of those models [10].

Most software engineering operations have included model transformation in their development life cycle. It is the process of transforming a graphical model for the purposes of analysis, optimization, evolution, migration, or even code generation. Model transformation employs a collection of rules known as transformation rules, which take one or more input models and output one or more target models [11].

Model transformation can be either manual or automatic. Manual transformation involves an application of custom transformation rules while in automatic transformation the predefined transformation rules are applied to class model [11]. Regardless of the transformation method used, it is essential that the software engineer has a thorough understanding of the project's scope, as well as the syntax and semantics of the source and target models. Transformation rules will be designed and applied to the models in order to automate the transformation process. The source models will be UML class diagrams, and the target models will be their equivalent formal specification schemas.

c) Formal Specification Methods

The inadequacies of system and software specifications are one of the primary issues with software-intensive systems. Although the requirements should usually accurately describe the functions of the software system, many of the details that should be carried out and defined in a more detailed specification are not addressed.

As a result, there are inconsistencies and misinterpretations, which lead to issues in the latter stages of design and implementation. These issues are frequently identified during the system integration stages. There are graphical software development methods, such as data-flow diagrams, finite state machines, and entity relationship diagrams, that have been shown to help with the development of better specifications, but they lack precision in the details of the specification and a smooth way of developing a design and implementation.

Formal specification methods are feasible solution to these issues. They precisely define the system and ensure a smooth transition from specification to design to implementation. There are a number of formal specification languages such as Z notation, Object Constraint Language (OCL), VDM, Alloy etc. In general, all of these formal specification languages involve formal specification, refinement, and verification, which comprise of set theory, predicate logics, and algebra, among other things. The primary goal of our review is to compare two of these formal specification approaches i.e., Z notation and OCL.

The syntax and semantics of static and dynamic aspects of a system are formally specified in terms of mathematical notations in formal languages. Formal languages improve the system's reliability and security by reducing ambiguity in the system's requirements using their mathematical representation. The use of formal languages is essential while working with the large/complex real-time software systems in which the accuracy of the system is important.

The importance of formal languages increases in real-time safety critical systems where the primary concern is reliability and performance of the system. There is decent amount of work done in terms of defining and specifying formal languages for software systems and UML models, with some being accepted by the industry, such as Z, OCL, VDM, B, Alloy, etc. As each language has its own pros and cons, this survey compares two languages Z and OCL that can be utilize for verifying real-time safety critical systems.

i. *Z-notation*

The Z notation [12]-[15] is based on first-order logic and typed set theory. A schema i.e., a component of Z notation that describes the state and operations of a specification. A schema is a collection of variable declarations accompanied by a set of predicates that constrain the variable's possible values.

ii. *Object Constraint Language (OCL)*

The Object Constraint Language (OCL) [16]-[22] is a constraint expression language for object-oriented languages and other modeling artifacts. OCL is a component of the Unified Modeling Language (UML) that plays a key role in the software lifecycle's analysis phase. For a detailed and unambiguous specification, traditional graphical models, such as class models, are insufficient. Therefore, We require to add some more constraints to the objects to resolve those issues. However, the classic formal method requires a significant knowledge of mathematics, making it difficult for the average business or system modeler to employ. OCL has been designed to bridge this gap. It was created by IBM's Insurance group as a business modeling language.

IV. Literature Review

a) Z notation

The Z notation is used in the first research [S1, 12-15] to formalize and verify the UML class model. The authors (Evans et al.) employed Z notation to develop the formal foundation for the UML core meta model in S1. They claimed that the formal foundation provides a number of benefits, including transparency, extendability, consistency testing, refinement, and proof [12, 13].

They have defined a compositional schema with multiple subschema a as to represent the UML

class model. The sub-schemas formalize UML model elements such as type, instance, values, operation, associations, generalization etc. The authors also propose three alternatives for formalizing the UML model [12]: 1) Supplementary: In this way, the UML model's informally specified elements are formally expressed. 2) Object-Oriented Extended Formal Language: In this approach, established formal methods are extended with object-oriented principles such as Object-Z and Z++. 3) Method Integration: In this method, the complete UML model is translated into a formal model in order to improve its precision.

The authors of [12] expanded on their previous work by proposing a graphical representation transformation of the UML class model. They also offered a three-step roadmap for formalizing and verifying models: 1) Select a formal language that is both expressive and well supported by the tools for the model's static and dynamic features of UML class model. 2) Formally describe a graphical modeling notation's abstract syntax. 3) Define a function that transforms the model's syntax and semantics into formal notation. Finally, tools for validating formal semantics should be developed.

The authors of [14] suggested that formal UML analysis alone is insufficient for determining semantic correctness. Furthermore, the authors stated that it is not particularly accessible to practitioners with limited knowledge of discrete mathematics, and that industry experts' comments is also necessary for the semantic validity of the UML model. In [15], Authors designed a formal methods reference manual for Z notation, which precisely and explicitly specifies the semantics of UML concepts. Along with that, the Inference rules for examining various UML model properties are provided in the reference manual [15].

b) Object Constraint Language (OCL)

In the second study [S2, 16-22], object constraints language (OCL) used for verification of the UML class model.

Cadoli et al. [16] proposed a constraint programming-based linear inequality-based method for finite model verification. They used the Constraint Satisfaction Problem (CSP) to represent the UML class model, and the ILOG's Solver assessed the satisfiability of the UML class model [16]. The Managed Object Format (MOF) syntax is used by the ILOG solver as an input. In addition, two class model correctness issues were addressed and encoded into CSP. In the first problem, they check that all the model's classes are completely satisfied at the same time. In the second problem, they prove that a finite non-empty model can be generated from the class model.

To verify the UML class model, Malgouyres and Motet [17] employed Constraint Logic Programming (CLP). They used CLP clauses to translate the UML class model, metamodel, and meta-metamodel [17]. In this approach, c Concrete metamodel and UML class model elements are translated into CLP facts while abstract elements and constraints are transformed into rules. CLP's goals are also specified, which contradicts the consistency standards. Finally, the inconsistencies are handled by a unified checker. The UML class model is considered inconsistent if the unified checker identifies the solution to the goal and if the goals are resolved.

Pérez and Porres [18] proposed a system for using CLP to assess the satisfiability of a UML class model. The suggested methodology detects design flaws in UML class models with OCL annotations. They used the bounded verification approach and used the model-finding tool formula to reason about finite constraints for the number of instances of the model. The suggested method verifies predefined correctness features such as satisfiability and the lack of redundant constraints. It can also be used to analyze complex models in order to discover the optimal object model for the domain. They also used an eclipse plug-in called CD-to-Formula to design the proposed framework.

Cabot et al. [19] presented incremental verification of the class model's OCL integrity constraint. Integrity checking is a technique used for determining whether an operation violates a specified integrity constraint. They introduced the term Potential Structure Event (PSE) and stated that verifying integrity requirements after each structure event (e.g., Insert, Update, Delete, or Specialized Entity) can be costly and time-consuming [19]. As a result, PSEs for each integrity constraint are recorded, and only those events that can violate the constraint are represented. Furthermore, only the instances of entity and relationship types that have been affected by PSEs are validated and verified.

Cabot et al. [20] presented an approach to translate UML class models annotated with OCL constraints into a constraint satisfaction problem (CSP). The authors briefly discussed translation of UML/OCL classes, associations, generalization sets, and OCL invariants into CSP. A tool based on CSP [21] is then used to verify a predefined set of correctness properties for the original UML/OCL diagrams. The UML/OCL language combination integrates well with automated inference systems. If the generated CSP is solvable, the model is considered satisfiable otherwise is considered unsatisfiable. The CSP tool supports bounded reasoning about satisfiability, consistency, finite satisfiability, independence of invariants, and partial state completion. It handles class diagrams with multiplicity, class hierarchy, association-class constraints but does not allow multiple inheritance. Along with that, tool does not support all the features in

OCL specification, such as constraints on a string, aggregation, and composition relationship.

Cabot et al. presented the UML to CSP tool in [21]. It takes the XMI format for the class model and OCL as a separate text file for input. The model and OCL are translated to CSP, which is then verified by the CSP solver. The XMI file is parsed using the Metadata Repository API, while OCL constraints are processed by the Dresden OCL Toolkit.

Cabot et al. [22] expanded on their previous work [20], arguing that an insufficient constraint or bound could miss defects in the model due to a small search space or could be inefficient if set too large. Large initial bounds and constraints are set in the proposed solution [22]. Then, using the interval constraint propagation technique, the set of bounds is tightened up as much as feasible with user input, and unwanted value from the bounds is removed. Since then this technique has been enhanced to the point where verification bounds are now defined automatically whenever its possible.

V. Review Summary and Conclusion

Software design models play an important part in modern software development. They are useful for more than just documentation; they are also used for analysis, design, testing, and even code development using an automated transformation technique. The transformation technique allows existing software artifacts to be reused automatically. However, it has several flaws, such as the fact that model flaws are automatically transmitted to the changed model through the transformation. These flaws are difficult to detect and correct. Model verification appears to be a viable solution to the problem.

The verification of the UML class model is essential for assuring model quality prior to transformation. Verification of the UML class model through formal notation has been discussed in several studies. In this review, we discussed prior works in the field of formal specification specially related to Z and OCL methods. We presented a comparison of these formal methods in Table 2 based on the analysis of studies [12]-[22]. This comparison is performed based on the features like support for UML features, Tool support, feedback for the user, and the efficiency of the methods and verification tool. Both the methods provide support for association, aggregation, and generalization relationships and do not support the features like dependency relationships (aggregation and composition) and x or constraint. Z notation is supported by Z word and Z/Eves verification tools. USE and UML to CSP tools are capable of working with OCL. Both of these tools support semi-automatic transformation.

Table 2: Comparison of Z and OCL formal methods

Method	Support for UML Features	Tool Support	Feedback to user	Efficiency
Z	Association, Generalization, Multiplicity Constraints	Z Word, Z/Eves	Error: Does not provide meaningful feedback Successful: message in textual form on a pop-up window	Not efficient with large or complex UML class models
OCL	Association, Association Classes, Generalization, Multiplicity Constraints	USE Tool UMLtoCSP	Error: Does not provide meaningful feedback Successful: object model	Not efficient with large or complex UML class models

Both the tools (Z word and USE) provide feedback to users in order to notify them of the verification process's outcome. Z word provides the successful message in textual form on a pop-up window. In case of USE tool, if the verification process ends successfully it is complemented by a sample object model. This sample object model acts as the proof of the verification. When the verification process does not succeed, the Z Word and USE tools can display some hints in textual form on a window. This can help model designers in identifying the reasons for the failure and adjusting the model accordingly.

However, this models or tools require from the user a significant level of expertise on formal aspects in order to understand the feedbacks and resolve the issues. Overall, We can say that the existing verification tools, apart from being certainly limited in size, is in some cases targeted at a very limited or specific audience.

Finally, efficiency is a major concern. Current UML class model verification methods effectively verify the correctness of small models with few constraints. However, in some circumstances, especially when dealing with large and complex models, their performance suffers. Along with that, they also lack support for certain key features of the UML class model.

Unfortunately, none of the verification tools examined in this study performs well in terms of achieving the verification requirements. These tools and methods in general do not integrate well and have been developed to conduct verification apart from the rest of the activities that characterize a model designer's work. It forces users to switch between model editors and verification tools to check for errors every time

models are refined or improved, usually with little or no hint on where to apply fixes if the verification fails.

To conclude this, in my opinion, a verification tool, in order to be effective and widely adopted, has to present, at least, few important characteristics: 1) It should provide support for some key features of UML class model (i.e., aggregation, composition, x or constraint), 2) It should easily integrate into the model designer tool chain, 3) It should offer meaningful feedback for the user, and 4) It should be relatively efficient while verifying the large or complex real-world UML class models.

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ICA and Sparse ICA for Biomedical Signals & Images Denoising Based on Fractional Weibull Distribution

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Abstract- Biomedical signs or bio signals are a wide range of signals obtained from the human body that can be at the cell, organ, or sub-atomic level. Electromyogram refers to electrical activity from muscle sound signals, electroencephalogram refers to electrical activity from the encephalon, electrocardiogram refers to electrical activity from the heart, electroretinogram refers to electrical activity from the eye, and so on. Monitoring and observing changes in these signals assist physicians whose work is related to this branch of medicine in covering, predicting, and curing various diseases. It can also assist physicians in examining, prognosticating, and curing numerous conditions.

However, these signals are frequently affected by the accumulation of many different types of noise; it is critical to remove this noise from the signals in order to obtain useful information; the noise removal process is accomplished by proposing a new flexible score functions family for blind source separation, based on the exponentiated transmuted Weibull densities family.

Keywords: biomedical signals denoise; fractional weibull distribution; source separation; maximum likelihood; fast independent component analysis; sparse independent component analysis; electroencephalogram, electrocardiogram.

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A. M. Adam [α], R. M. Farouk [σ] & B.S. El-Desouky [ρ]

Abstract- Biomedical signs or bio signals are a wide range of signals obtained from the human body that can be at the cell, organ, or sub-atomic level. Electromyogram refers to electrical activity from muscle sound signals, electroencephalogram refers to electrical activity from the encephalon, electrocardiogram refers to electrical activity from the heart, electroretinogram refers to electrical activity from the eye, and so on. Monitoring and observing changes in these signals assist physicians whose work is related to this branch of medicine in covering, predicting, and curing various diseases. It can also assist physicians in examining, prognosticating, and curing numerous conditions.

However, these signals are frequently affected by the accumulation of many different types of noise; it is critical to remove this noise from the signals in order to obtain useful information; the noise removal process is accomplished by proposing a new flexible score functions family for blind source separation, based on the exponentiated transmuted Weibull densities family. To obtain the independent source signals blindly, we use the well-known Fast independent component analysis (Fast-ICA) algorithm and the statistically principled method known as Sparse Code Shrinkage, with the parameters of similar score functions estimated using an effective system based on maximum likelihood. The results obtained in our mechanism by using exponentiated transmuted Weibull densities outperform those obtained by other distribution functions.

Keywords: biomedical signals denoise; fractional weibull distribution; source separation; maximum likelihood; fast independent component analysis; sparse independent component analysis; electroencephalogram, electrocardiogram.

I. Introduction

Blind Source Separation (BSS) is a high-level image/sign processing mechanism with numerous applications including sound signals, communication, images, and biomedicine [1,2,3,4]. The goal of BSS is to recover the source (signals/images) from a noisy source with little known information. Non-Gaussianity [5,6], mutual information minimization [7,8], maximum likelihood [9], and neural networks [10,11,12] are some of the BSS algorithms that have been debated from various perspectives. Denoising and optimization procedures are critical in BSS. The noise separation step determines the separability of the noise, and the optimization step determines the best solution for the objective function obtained from the denoising algorithm. Because of the variable features of generalized distributions, they generally produce good blind denoising results.

In the Independent Component Analysis (ICA) framework, precisely estimating the statistical model of the sources remains an open and difficult problem [2]. Practical BSS procedures make use of difficult, complicated source distributions, as well as situations involving abundant sources with varying mixed probability density functions (pdf). Numerous parametric density models have been made available in recent literature in this direction. Similar models include the generalized gamma density [13], the generalized Alfa-Beta distribution (AB- divergences) [14], and combinations and generalizations such as the super and generalized Gaussian admixture model [15], the generalized Gaussian density [16], the Pearson family of distributions [17], and the so-called extended generalized lambda distribution [18], which is an extended parameterization of the previously mentioned generalized lambda distribution and generalized beta distribution models [19].

We can find out how medical signals studies are very important and many researches are published continuously, for instants, Stationary wavelet transform based Electrocardiogram (ECG) signal denoising method [20], Electrocardiogram signal denoising [21], semi-supervised deep blind compressed sensing for analysis and reconstruction of biomedical signals from compressive measurements [22], biomedical signals reconstruction and zero-watermarking using separable fractional order Charlier–Krawtchouk transformation and sine cosine algorithm [23], research on AR-AKF model denoising of the Electromyography (EMG) signal [24], threshold parameters selection for empirical mode decomposition-based EMG signal denoising [25], Variational Mode Decomposition (VMD)-based denoising methods for surface electromyography signals [26], ECG signal denoising method using conditional generative adversarial net [27], motion artifacts suppression from Electromyogram (EEG) signals using an adaptive signal denoising method [28],

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research on improved Flexible Analysis Wavelet Transform (FAWT) signal denoising method in evaluation of firefighter training efficacy based on sEMG [29], lung sound signal denoising using discrete wavelet transform and artificial neural network [30], deep learning-based framework For ECG signal denoising [31], denoising of ECG signals using weighted stationary wavelet total variation [32], denoising of medical images utilizing neural network [33], denoising of biomedical images using two-dimensional Fourier-Bessel series [34].

Although Fast ICA has drawbacks, such as the difficulty of optimizing the log-likelihood function, which means the suitable source signals aren't insulated, and the order of the independent components (ICs) is difficult to determine, it is still one of the most robust methods and generally drives veritably good results.

In addition, we present Sparse Code Shrinkage [35], a statistically principled method. which is very similar to independent component analysis.

Still, studying medical signals has become extremely important and necessary; it is extremely difficult to extract useful information from these signals in the time domain simply by observing them. They are fundamentally non-linear and non-stationary. Biomedical signals are generally affected by various types of noise, which is considered a difficult and difficult problem. For example, one of the challenges of EEG technology is that the electrical activity generated by the brain is minute, on the order of a millionth of a volt. As a result, scalp recorded electrical pulses are a mixture of genuine brain signals mixed with a lot of noise-called artifact-generated by other parts of the body, such as heart activity, eye movements and blinks, other facial muscle movements, and so on, which produce electrical signals 100 times greater than those produced by the brain. Furthermore, the background noise is typically generated outside of the brain.

As a result, in order to extract the important information from the signals, noise must be removed. Many different advanced signal processing mechanisms have been developed to accomplish this. The Fractional Weibull Distribution (FWD) with ICA is presented in this paper for noise removal from biomedical signals. The accuracy of the proposed algorithm is measured, and the numerical results show that the FWD consistently produces good results. The remainder of the paper is structured as follows: Section 2 introduces the BSS model. The FWD is discussed in Section 3. In Section 4, we estimate the parameters of FWD using maximum likelihood. Finally, we demonstrate the computational efficiency of our proposed mechanism.

II. Blind Source Separation (BSS) Model

Le $S(t) = [s_1(t), s_2(t), .., s_N(t)]^T (t = 1, 2, ..., l)$ denotes an independent source signal vector that comes from N signal sources, then we can get the observed mixtures

$X(t) = [x_1(t), x_2(t), \ldots, x_K(t)]^T (N = K)$ under the circumstances of the instantaneous linear mixture. This leads us to the BSS model

$$X(t) = AS(t), \quad (1)$$

where A is a $N \times N$ mixing matrix. The target of the BSS algorithm is to recover the sources from mixtures $x(t)$ by using

$$U(t) = WX(t). \quad (2)$$

where W is a $N \times N$ separation matrix and $U(t) = [u_1(t), u_2(t), \ldots, u_N(t)]^T$ is the estimate of N sources.

Generally, sources are assumed to be unit-variance and zero-mean signals with at most one of Gaussian distribution. To solve the source estimation problem, the unmixing matrix W must be obtained. Generally, the maturity of BSS approaches performs ICA, by basically optimizing the negative log-likelihood (objective) function concerning the un-mixing matrix W such that:

$$L(u, W) = \sum_{l=1}^{N} E[\log p_{ul}(u_l)] - \log|\det(W)|, \quad (3)$$

where $E[.]$ represents the expectation operator an $p_{u1}(u_1)$ is the model for the marginal pdf of u_l, for all $l = 1,2, \ldots, N$. In effect, when the distribution of the sources is correctly assumed, the maximum likelihood (ML) principle leads to estimating functions, which are the source score functions [15]

$$\varphi_l(u_l) = -\frac{d}{du_l} \log p_{ul}(u_l). \quad (4)$$

In principle, the separation criterion can be optimized by any suitable ICA algorithm where contrasts are employed (see; e.g.,[2]). The FastICA [3], based on

$$W_{k+1} = W_k + D(E[\varphi(u)u^T] - \text{diag}(E[\varphi_l(u_l)u_l]))W_k, \quad (5)$$

where, as defined in [4]

$$D = \text{diag}\left(\frac{1}{E[\varphi_l(u_l)u_l] - E[\varphi_l'(u_l)]}\right), \quad (6)$$

where $\varphi(t) = [\varphi_1(u_1), \varphi_2(u_2), \ldots, \varphi_n(u_n)]^T$, valid for all $l = 1, 2, \ldots, n$.

The following section explains FWD for signal modelling.

III. Independent Component Analysis (ICA)

a) Definition of ICA

"It's a technique for identifying underlying factors or components in multivariate (multi-dimensional)

statistical data." The ICA differs from other methods in that it seeks components that are both statistically independent and non-Gaussian." [36]

Now, assume that we observe n linear mixtures $x1,\ldots,x_n$ of n independent components [37].

$$x_j = a_{j1}s_1 + a_{j2}s_2 + \ldots + a_{jn}s_n, forallj. \quad (7)$$

The time indicator t has been removed; in the ICA model [36,37], it is assumed that each admixture x_i and independent element s_k is an arbitrary variable rather than a suitable time signal. The observed values $x_j(t)$, for example, microphone signals, are a sample of this arbitrary variable. As a preliminary step, we can assume that both the admixture variables and the independent factors have zeromean. If not, the observed variables, x_i can always be centered by reducing the sample mean, resulting in a zero-mean model. It would be possible to use a vector-matrix memo instead of totalities as in the previous equation. Let's denote by x the arbitrary vector whose rudiments are the fusions $x_1,\ldots,x_n$, and by s the arbitrary vector with rudiments $s_1,\ldots,s_n$, and by A the matrix with rudiments a_{ij} The mixing model is written as

$$x = As. \quad (8)$$

Also, can be written as

$$x = \sum_{i=1}^{n} ai\ si. \quad (9)$$

The statistical model in Eq. 6 is called the ICA model.

It's a generative model that describes how the observed data are generated by a process of mixing the factorssi

The main idea for ICA is veritably simple, assume that the components si are statistically independent. also, they must have non-Gaussian distributions.

b) The Fast ICA Algorithm

We introduced various non-Gaussianity measures [36,37], i.e. objective functions for ICA estimation. In practice, we also require an algorithm for maximizing the cost function. The FastICA Algorithm is one of the most effective ICA algorithms, and it will be used in our new proposed system.

c) Sparse Code Shrinkage

Another example of using the ICA decomposition to find ICA filters for medical (images/signals), removing noise from images (signals) contaminated with Gaussian noise. A collection of medical images was used. As x, represent the vector of pixel grey levels of a window in an image. The elements of x are indexed by their position in the image window or patch. The 2-D structure of the windows is irrelevant here:

Row-by-row scanning was used to convert a square image window into a vector.

Now, suppose the noisy image model:

$$z = x + n, \quad (10)$$

where $\boldsymbol{n}$ is uncorrelated noise, with elements similarly indexed in the image window as $\boldsymbol{x}$, and $\boldsymbol{z}$ is the measured image window contaminated with noise. Assuming that $\boldsymbol{n}$is Gaussian and $\boldsymbol{x}$is non-Gaussian.

There are numerous methods for removing noise, including Discrete Fourier Transform (DFT) transformation to spatial frequency space, low-pass filtering, and return to image space via Inverse Discrete Fourier Transform (IDFT) [38]. However, this is inefficient. Better methods include the recently introduced Wavelet Shrinkage method [39], which employs a wavelet-based transform, or methods based on median filtering [38]. These methods, however, did not take advantage of image statistics.

We present Sparse Code Shrinkage [35], another statistically principled method that is very similar to independent component analysis. Compactly, if we form the density of $\boldsymbol{x}$by ICA, and suppose $\boldsymbol{n}$Gaussian, the Maximum Likelihood (ML) solution for $\boldsymbol{x}$given the measurement $\boldsymbol{z}$can be developed in the signal model (10).

The ML solution can be computed simply, albeit roughly, by using an orthogonalized version of ICA decomposition. The transform can then be given by

$$Wz = Wx + Wn = s + Wn, \quad (11)$$

where $\boldsymbol{W}$ is an orthogonal matrix which is the best orthogonal approximation of the inverse of the ICA mixing matrix. The noise term $\boldsymbol{Wn}$is still Gaussian and white. With a quietly suitable choice of orthogonal transform, however, the density of $\boldsymbol{Wx} = \boldsymbol{s}$ becomes largely non-Gaussian, e.g., super-Gaussian with a highly positive kurtosis. This relies obviously on the original **x** signals, as assuming, in fact, there exists a model $\boldsymbol{x} = \boldsymbol{W}^T\boldsymbol{s}$for the signal, where the "source signals" or elements of **s** have a positive kurtotic density, in such case the ICA transform gives highly super-Gaussian components.

It was shown in [35]that, assuming a Laplacian density for s_i, the ML solution for s_i is given by a "shrinkage function" $\hat{s}_i = g([\boldsymbol{Wz}]_i)$, or in vector form, $\hat{\boldsymbol{s}} = g(\boldsymbol{Wz})$. Function $g(.)$ has a characteristic shape: it is zero close to the origin and then linear after a cutting value depending on the parameters of the Laplacian density and the Gaussian noise density. Supposing other forms for the densities, other optimal shrinkage functions can be obtained [35].

The shrinkage process in the Sparse Code Shrinkage model is performed in the rotated space, and the signal estimation in the original space is obtained by rotating back:

$$\hat{\boldsymbol{x}} = \boldsymbol{W^T}\hat{\boldsymbol{s}} = \boldsymbol{W^T}\,\boldsymbol{g(Wz)}. \quad (12)$$

Thus, we obtain the Maximum Likelihood estimation for the image window $\boldsymbol{x}$in which most of the noise has been removed. The rotation operator $\boldsymbol{W}$ is such that the sparsity of the components $\boldsymbol{s} = \boldsymbol{W}\boldsymbol{x}$ is maximized. The operator can be learned with a modification of the FastICA algorithm; see [35] for details. The results of the Sparse Code Shrinkage method and classic wiener filtering are given, indicating that Sparse Code Shrinkage may be a promising approach. The noise is reduced without blurring edges or other sharp features as much as in wiener filtering. This is largely due to the strongly nonlinear nature of the shrinkage operator, which is optimally adapted to the inherent statistics of images.

IV. Proposed Algorithm

a) Fractional Weibull distribution

Fractional Weibull Distribution (FWD) or the fractional Weibull probability density (FWPD).

$$f(x,\lambda,k) = \frac{k(1-\delta)}{\lambda}\left(\frac{x}{\lambda}\right)^{k-1} e^{-(x/\lambda)^k}, x \geq 0 \qquad (13)$$

where k>0 is the shape parameter and λ>0 is the scale parameter of the Weibull distribution. Compared to the standard Weibull distribution, equation (13) has a scaling factor (1- δ1) that is smaller than 1.0, which is the reason why equation (13) is called the fractional Weibull distribution, or the fractional Weibull probability density (FWPD).

The corresponding cumulative distribution is given by:

$$F(x,\lambda,k) = (1-\delta)\left[1 - e^{-(x/\lambda)^k}\right], x \geq 0 \qquad (14)$$

b) Maximum likelihood estimation method

To demonstrate the method, the Maximum Likelihood Estimation (MLE) procedure is used to determine the values of the Weibull parameters, λ and k. to illustrate the method. For this purpose, the first-order optimality conditions below are used.

c) Parameter stimation

To estimate the parameters of FWD, the maximum likelihood is used. Let $X_1, X_2 \ldots, X_n$ be a sample of size N from an FWD. Then the log-likelihood function ($\mathcal{L}$) is given by:

$$\ell = \prod_{i=1}^{n} f_i(x,\lambda,k) = \prod_{i=1}^{n}\left[\frac{k(1-\delta)}{\lambda}\left(\frac{x_i}{\lambda}\right)^{k-1} e^{-(x_i/\lambda)^k}\right]. \qquad (15)$$

Hence, the log-likelihood function $\mathcal{L} = \log \ell$ becomes

$$\mathcal{L} = \log \ell = \log\left(\prod_{i=1}^{n}\left[\frac{k(1-\delta)}{\lambda}\left(\frac{x_i}{\lambda}\right)^{k-1} e^{-(x_i/\lambda)^k}\right]\right). \qquad (16)$$

$$\mathcal{L} = \log \ell = \log\left((1-\delta)^n \left(\frac{k}{\lambda}\right)^n \prod_{i=1}^{n}\left(\frac{x_i}{\lambda}\right)^{k-1} \prod_{i=1}^{n} e^{-(x/\lambda)^k}\right) \qquad (17)$$

$$\mathcal{L} = \log \ell = n\log(1-\delta) + n log\left(\frac{k}{\lambda}\right) + (k-1)\sum_{i=1}^{n} \log\left(\frac{x_i}{\lambda}\right) - \sum_{i=1}^{n}\left(\frac{x_i}{\lambda}\right)^k. \qquad (18)$$

Therefore, the maximum likelihood estimation of λ and k is derived from the derivatives of $\mathcal{L}$. They should satisfy the following equations:

$$\frac{\partial \mathcal{L}}{\partial \lambda} = 0, \qquad \frac{\partial \mathcal{L}}{\partial k} = 0\,. \qquad (19)$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} = \frac{n\lambda}{k}\left(\frac{-k}{\lambda^2}\right) + (k-1)\sum_{i=1}^{n}\frac{\lambda}{x_i}\left(\frac{-x_i}{\lambda^2}\right) + k\sum_{i=1}^{n}\left(\frac{x_i}{\lambda}\right)^{k-1}\frac{x_i}{\lambda^2}\,. \qquad (20)$$

$$\frac{\partial \mathcal{L}}{\partial k} = \frac{n}{k} + \sum_{i=1}^{n} \log\left(\frac{x_i}{\lambda}\right) - \sum_{i=1}^{n}\left(\frac{x_i}{\lambda}\right)^k \log\left(\frac{x_i}{\lambda}\right). \qquad (21)$$

The system of equations (20, 21) must be solved in order to estimate the value of parameters. However, it can be solved using MATLAB or using the Newton-Raphson method as in [19,37]. also, the genetic algorithm (GA) [40,41] can be used as an alternative numerical method to estimate the parameters the GA optimization technique is distinguished by its ability to minimize the negative of the log-likelihood objective function in (3) without relying on any derivative information. , the best estimation found at $\hat{\lambda} = 13.55195, \text{and } \hat{k} = 2.2376$.

V. Numerical Results

Numerical experiments show that the estimated parameters provide an acceptable solution with significantly fewer function evaluations; we generate random samples from the fractional Weibull distribution along with various parameter combinations, and then the ML estimates are obtained.

A procedure called (ga) in MATLAB can be used to obtain the ML estimate, and a similar procedure is extremely fast and accurate. The proposed mechanism produces outstanding results for both EEG and electrocardiogram (ECG) signals.

VI. Experimental Results

Resolve FastICA algorithm for (BSS). It is based on the estimated values of the parameters and an un-mixing matrix W estimated by the Fast ICA algorithm, and we used a data sample of size 10 from a real data set (1000). By substituting (7) into (4) for the source estimates u_l , $l = 1, 2, \ldots, n$, it snappily becomes obvious, that the proposed score function inherits a generalized parametric structure, that can be attributed to the flexible FWD parent model. So, a simple calculus yields the flexible BSS score function

$$\varphi_l(u_l) = -\frac{d}{du_l}\log\frac{k(1-\delta)}{\lambda}\left(\frac{x}{\lambda}\right)^{k-1} e^{-(x/\lambda)^k}. \quad (22)$$

In principle $\varphi_l(u_l|\theta)$ is able to model a large number of signals as well as various other types of heavy- and light-tailed distributions. Experiment trials were done to measure the performance of the used method through three applications [one in EEG signal denoising (using two different EEG signals) and one in electrocardiogram (ECG) signal denoising (using two different ECG signals) and the last one on medical images (using two different medical images)] when Gaussian noise is presented.

In all trials, the performance of the method is compared with tanh, skew, pow3 [36], and Gauss [15], we measured performance by Cross-Correlation (CC), the Mean Squared Error (MSE), Signal to Noise Ratio (SNR), Mean Absolute Error (MAE), and Peak Signal to Noise Ratio (PSNR).

Example 1

Electroencephalogram (EEG) [42], electrical action from the brain, one of the most vital signals from the human body, studying and improving this field of research is very important to physicians whose work is related to this branch of medicine, monitoring and observing changes in these signals help them to cover, predict, and cure brain diseases. In this example we applied the proposed mechanisms for denoising two different EEG signals, the results are shown in figure.1 for EEG signal 1, and figure.3 for EEG signal 2. The results for EEG signal 1 for the Gauss filter, Pow3 filter, Skew filter, and Tanh filter for EEG signal 1 are shown in figure.2, and in figure.4 for EEG signal 2, The performance is evaluated for all denoising algorithms using: Cross-Correlation (CC), the Mean Squared Error (MSE), Signal to Noise Ratio (SNR), Mean Absolute Error (MAE), and Peak Signal to Noise Ratio (PSNR), shown in table 1. The FWD and Sparse FWDhave higher performance compared to other algorithms, while Sparse FWD is even better.

Table 1: The Performance of the Proposed Denoising Algorithm for EEG Signals

Dist.	Signal	(MSE)	(MAE)	(SNR)	(PSNR)	(CC)
Gauss	EEG1	0.1777	0.4141	7.5456	19.1214	0.9965
	EEG2	0.1769	0.4135	7.5440	16.2369	0.9966
Pow3	EEG1	0.1778	0.4140	7.5429	19.1187	0.9966
	EEG2	0.1758	0.4123	7.5695	16.2624	0.9968
Skew	EEG1	0.1753	0.4109	7.6033	19.1791	0.9962
	EEG2	0.1731	0.4066	7.6671	18.1044	0.9961
Tanh	EEG1	0.1757	0.4108	7.5946	19.1704	0.9963
	EEG2	0.1725	0.4072	7.5684	16.2613	0.9970
FWD	EEG1	0.1683	0.4017	7.7805	19.3563	0.9965
	EEG2	0.1695	0.4025	7.7631	19.1116	0.9968
Sparse FWD	EEG1	0.1673	0.3987	7.8071	19.3828	0.9967
	EEG2	0.1703	0.4050	7.7421	19.0906	0.9968

Example 2

Electroencephalogram (ECG) [43], is an electrical activity from the heart that, like other types of biomedical signals, is frequently contaminated with various types of noise. In this example we used two mechanisms for denoising two different ECG signals, the FWD and the sparse FWD, the results are shown in figure.5 for ECG signal 1, and figure.7 for ECG signal 2,

The results for ECG signal 1 for the Gauss filter, Pow3 filter, Skew filter, and Tanh filter for EEG signal 1 are shown in figure.6, and in figure.8 for EEG signal 2, Cross-Correlation (CC), Mean Squared Error (MSE), Signal to Noise Ratio (SNR), Mean Absolute Error (MAE), and Peak Signal to Noise Ratio (PSNR) are used to evaluate the performance of all denoising algorithms, as shown in Table 2. When compared to other algorithms, FWD and Sparse FWD perform better, with Sparse FWD performing even better.

Table 2: The Performance of the Proposed Denoising Algorithm for ECG Signals

Dist.	Signal	(MSE)	(MAE)	(SNR)	(PSNR)	(CC)
Gauss	ECG1	0.1936	0.4326	20.1974	20.7429	0.9962
	ECG2	0.1745	0.4103	19.8627	21.7396	0.9965
Pow3	ECG1	0.1653	0.3976	20.8868	21.4323	0.9963
	ECG2	0.1668	0.3988	20.0631	21.9399	0.9961
Skew	ECG1	88.1655	9.1746	-6.3845	-5.8390	0.9969
	ECG2	74.1626	8.3769	-6.4173	-4.5405	0.9965
Tanh	ECG1	0.1707	0.4055	20.7445	21.2900	0.9965
	ECG2	0.1790	0.4163	19.7546	21.6315	0.9965
FWD	ECG1	0.1442	0.3712	21.4790	22.0245	0.9966
	ECG2	0.1424	0.3693	20.7510	22.6278	0.9967
Sparse FWD	ECG1	0.1468	0.3738	21.4014	21.9469	0.9971
	ECG2	0.1570	0.3873	20.3260	22.2029	0.9964

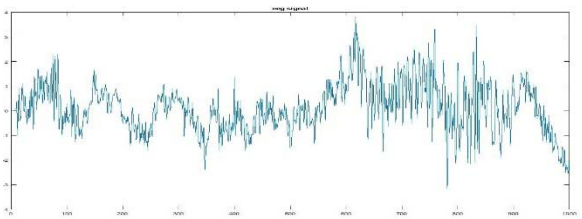
Example 3

In this example, we show how our algorithm performed for both ICA and Sparse ICA techniques to denoise two medical images from [44]. Where Figures (9,10,11, and 12) show the original images, noised images, and denoised images after applying algorithms of Gauss, pow3, skew, and tanh. However, Figure 17 shows the denoising results for the FWD algorithm, and Figure 18 shows the denoising results for Sparse FWD; the results are illustrated in the Figures, and Table 3 shows the performance of these algorithms. FWD and Sparse FWD outperform other algorithms, with Sparse FWD outperforming them all.

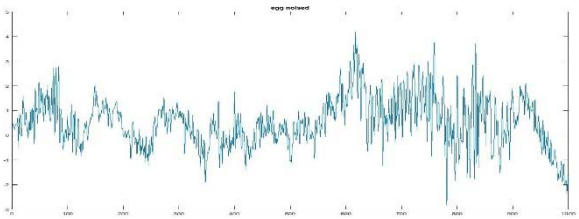
Table 3: The Performance of the Proposed Denoising Algorithms for Medical Images

Distribution / PSNR	First Image (Medical)			Second Image (Medical)			Elapsed time (in seconds)
	MSE	RMSE	PSNR	MSE	RMSE	PSNR	
Gauss	0.0065	0.0079	85.0652	0.016	0.0128	80.9828	2.416944
Pow3	0.0083	0.0357	77.0871	0.091	0.0302	78.5261	4.316100
Skew	0.0072	0.0374	76.6692	0.051	0.0124	79.2583	2.340723
Tanh	0.0360	0.0188	82.6281	0.033	0.0180	83.0044	2.314567
FWD	0.0053	0.0073	90.8593	0.013	0.0117	86.7631	1.555153
Sparse FWD	0.0058	0.0076	90.4310	0.014	0.0122	86.3910	1. 535551

A



B



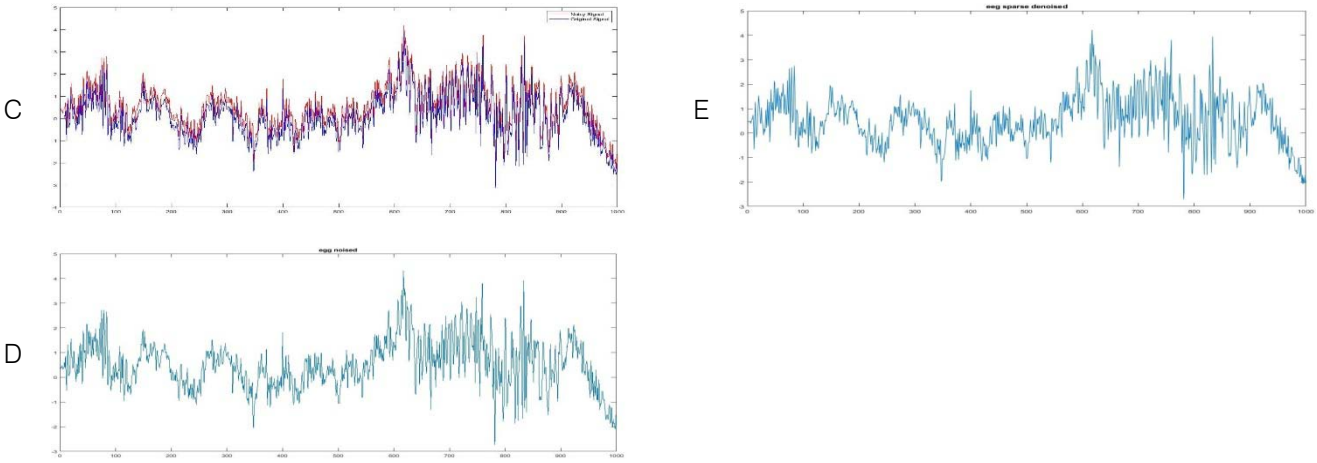


Fig. 1: FWD & Sparse FWD Filters (EEG signal 1): A original signal, B noised signal, C noised signal (original signal in blue and noise in red), D denoised signal (FWD), E denoised signal (Sparse FWD)

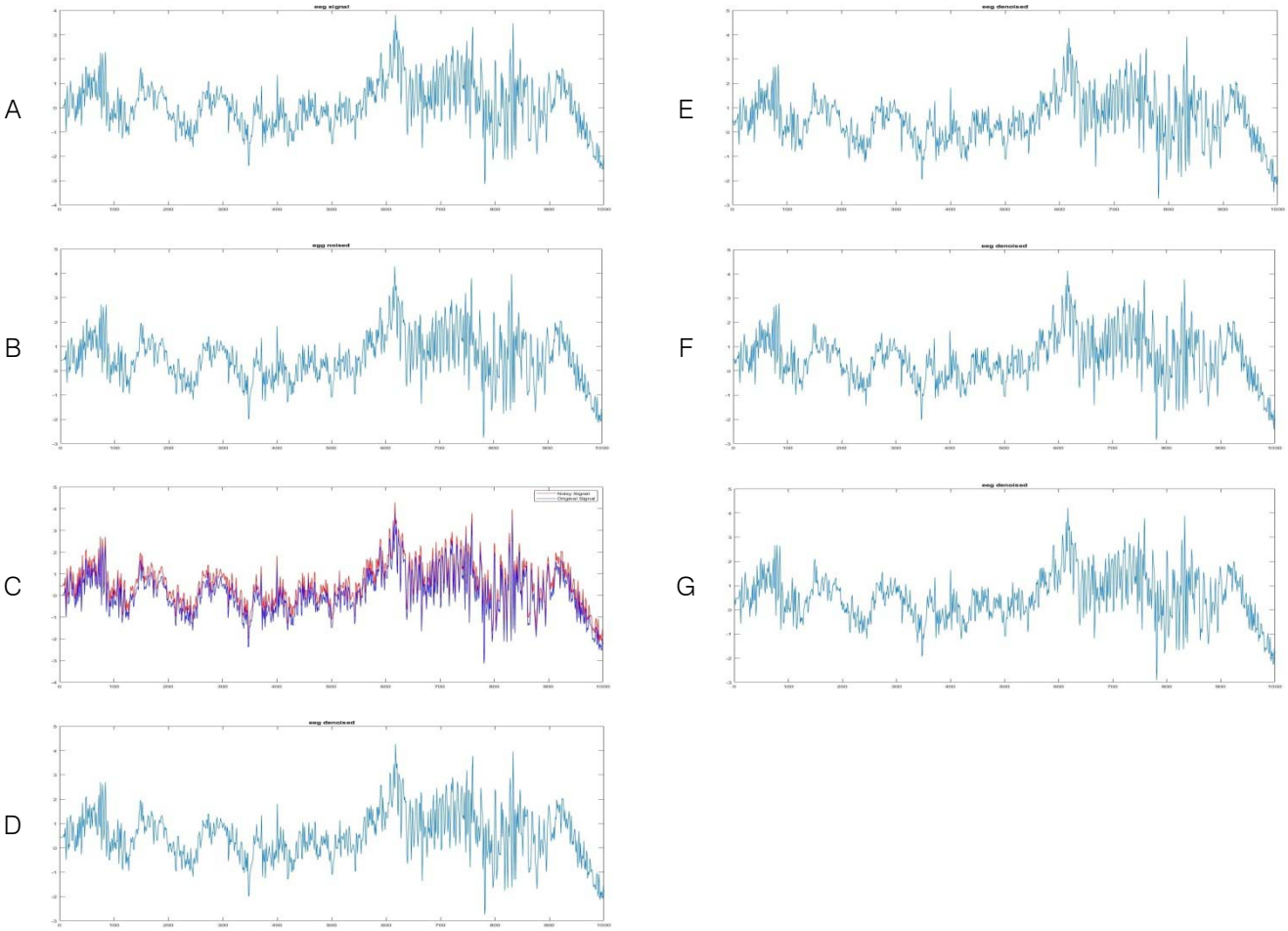


Fig. 2: (EEG signal 1): A original signal, B noised signal, C noised signal (original signal in blue and noise in red), D denoised signal (Gauss filter), E denoised signal (Pow3 filter), F denoised signal (skew filter), G denoised signal (Tanh filter).

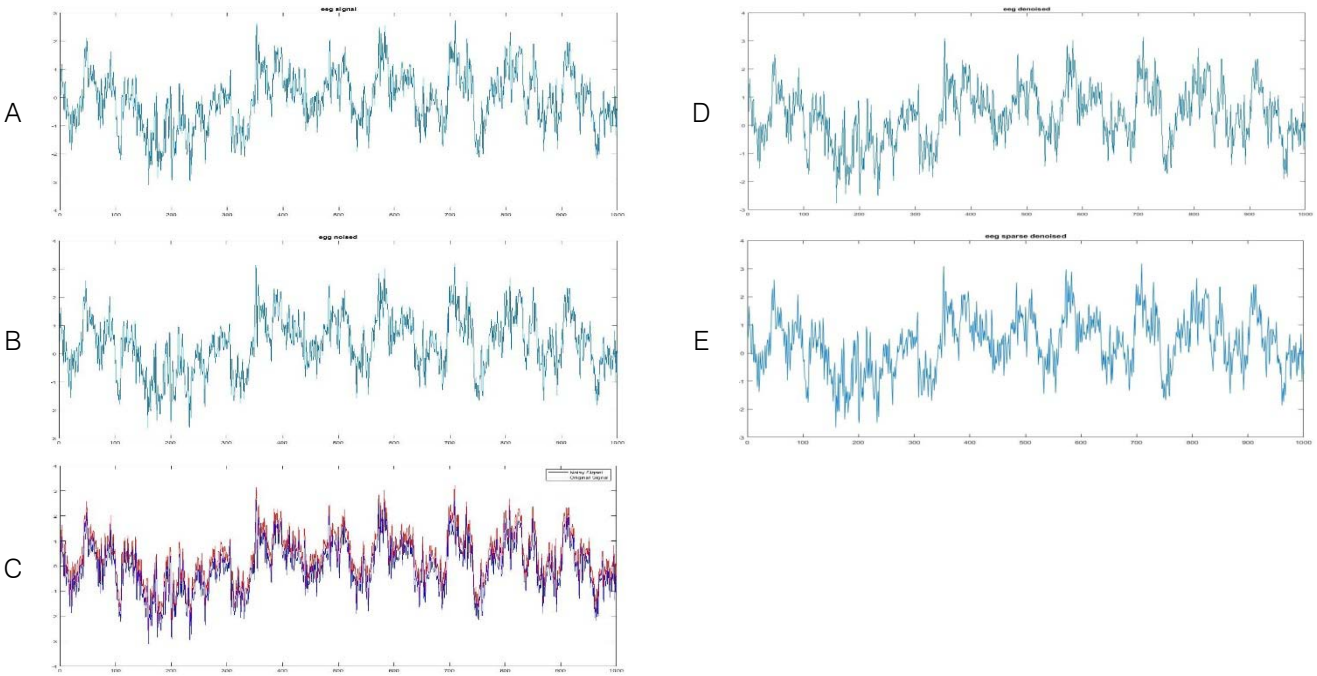


Fig. 3: FWD & Sparse FWD Filters (EEG signal 1): A original signal, B noised signal,C noised signal (original signal in blue and noise in red), D denoised signal (FWD), E denoised signal (Sparse FWD)

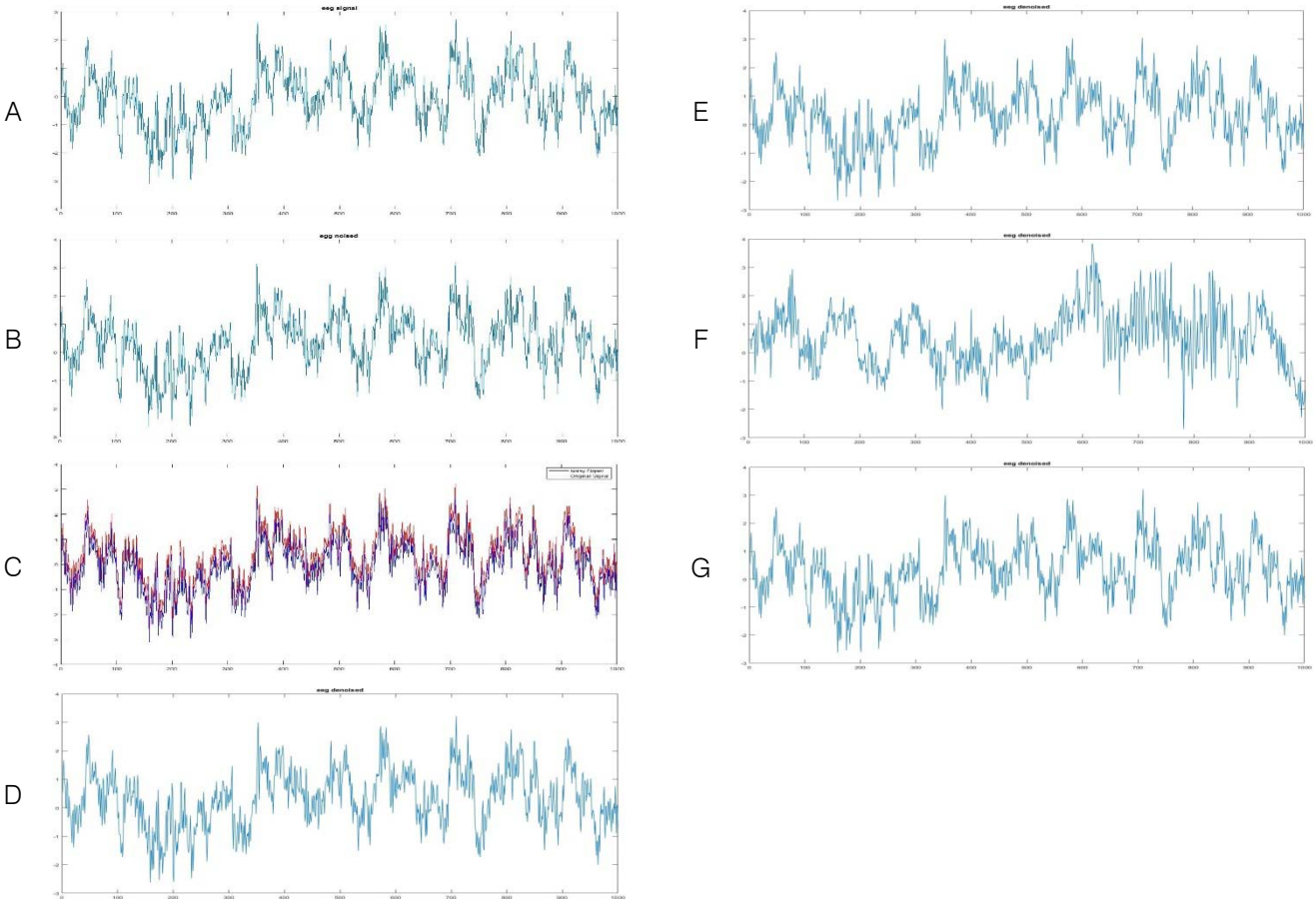


Fig. 4: (EEG signal 2): A original signal, B noised signal, C noised signal (original signal in blue and noise in red), D denoised signal (Gauss filter), E denoised signal (Pow3 filter), F denoised signal (skew filter), G denoised signal (Tanh filter)

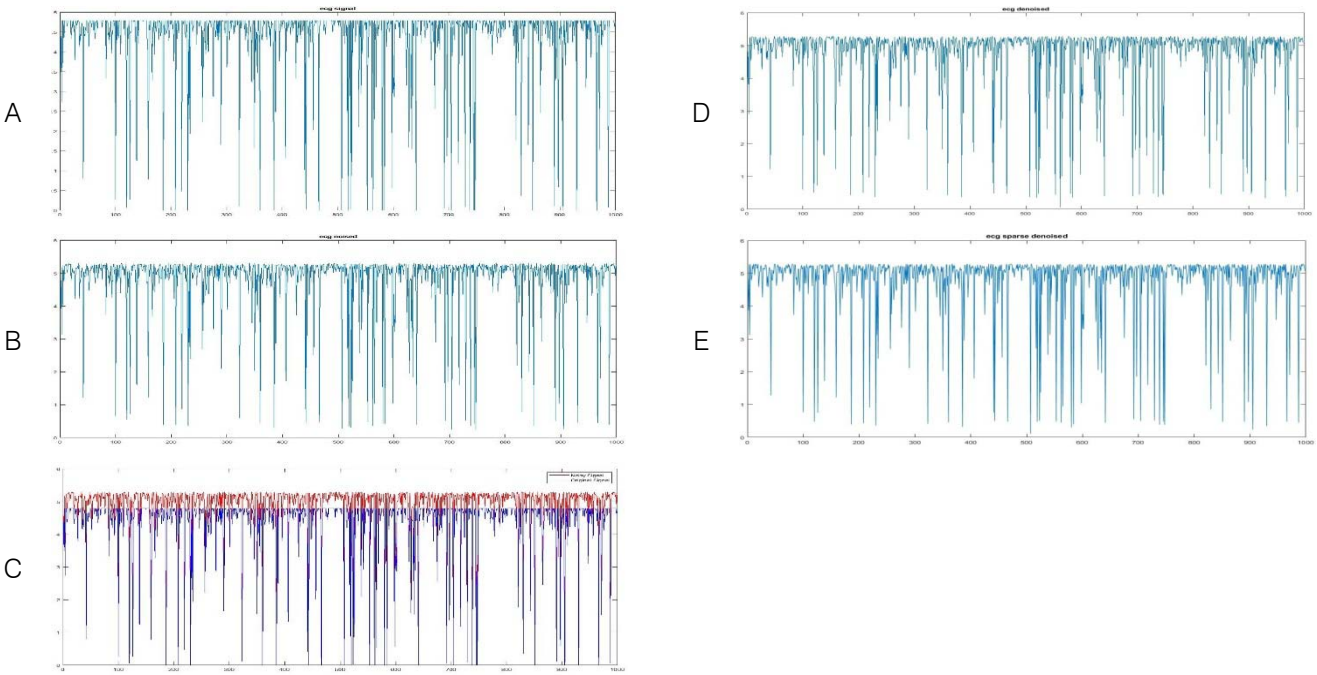


Fig. 5: FWD & Sparse FWD Filters (ECG signal 1): A original signal, B noised signal,C noised signal (original signal in blue and noise in red), D denoised signal (FWD), E denoised signal (Sparse FWD)

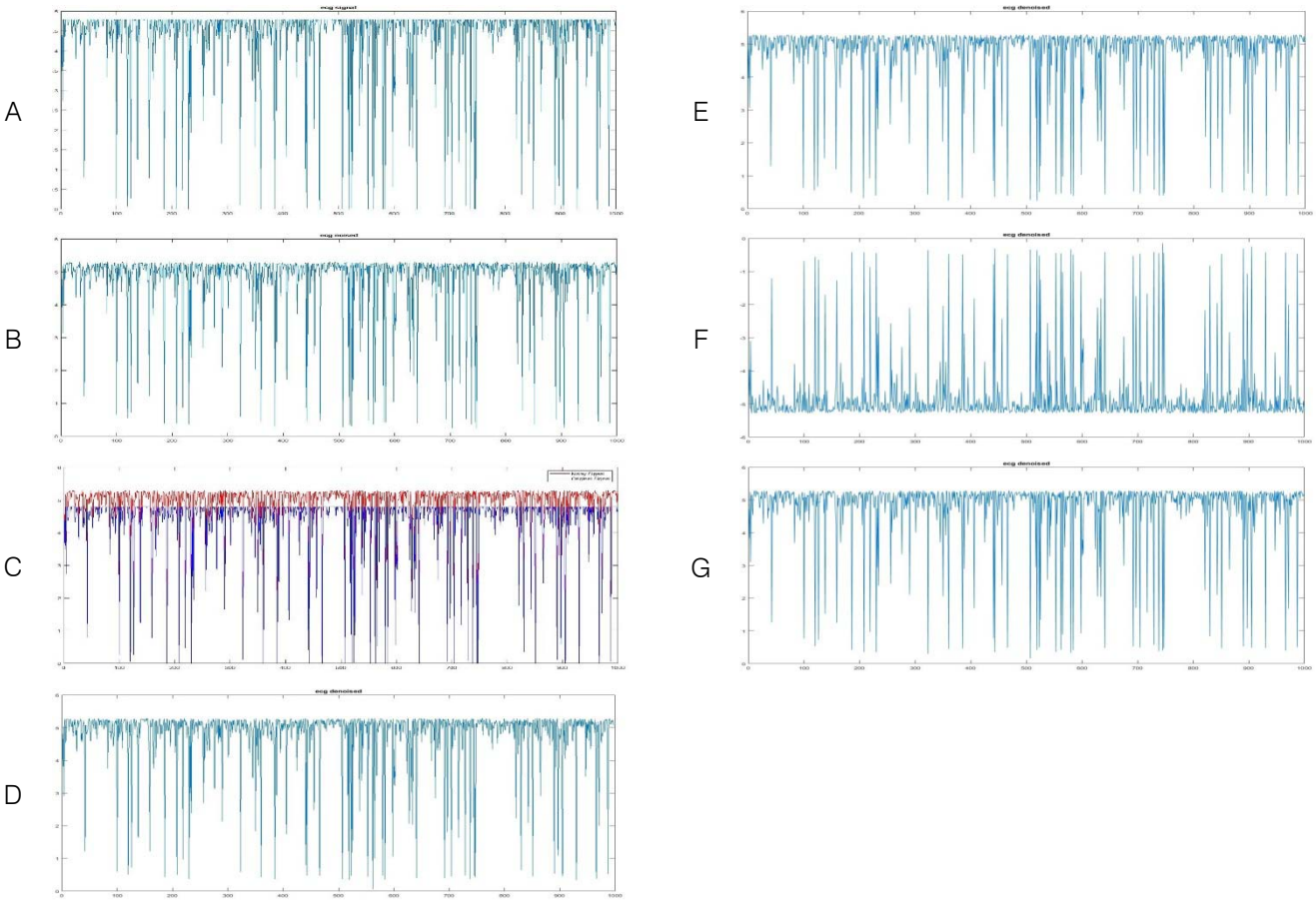


Fig. 6: (ECG signal 1): A original signal,B noised signal, C noised signal (original signal in blue and noise in red), D denoised signal (Gauss filter), E denoised signal (Pow3 filter), F denoised signal (skew filter), G denoised signal (Tanh filter)

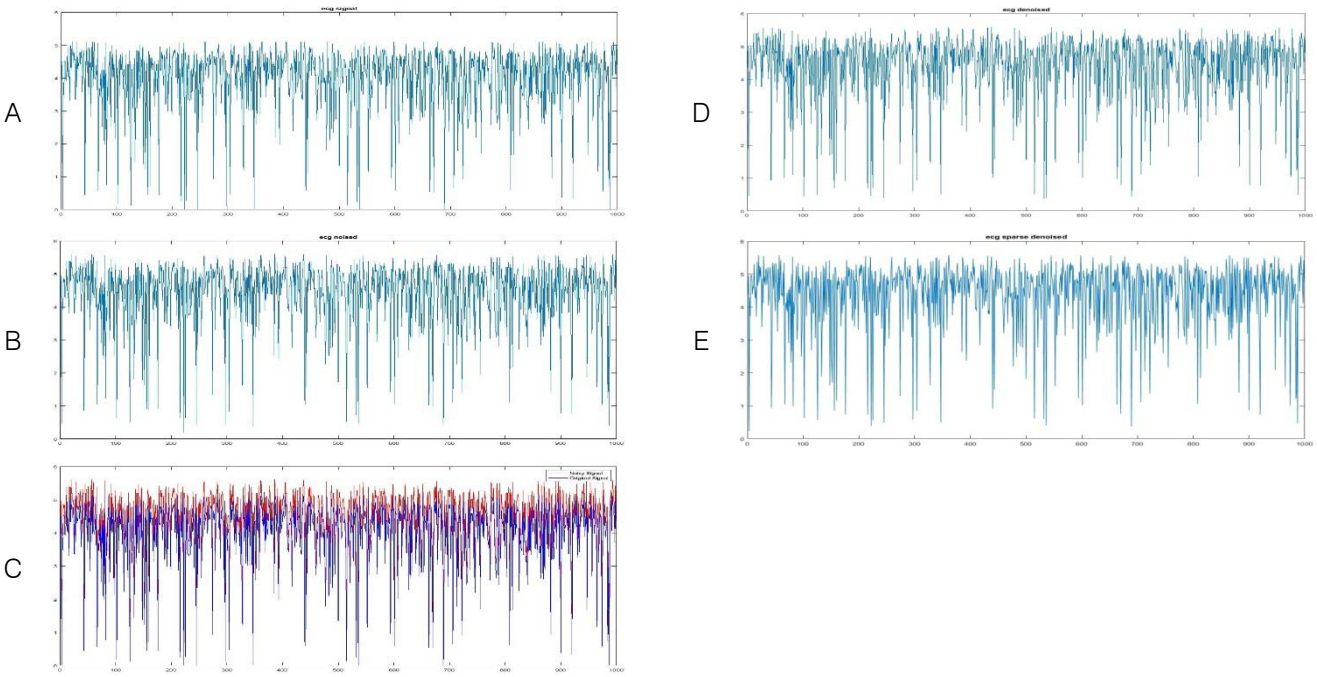


Fig. 7: FWD & Sparse FWD Filters (ECG signal 2): A original signal, B noised signal, C noised signal (original signal in blue and noise in red), D denoised signal (FWD), E denoised signal (Sparse FWD)

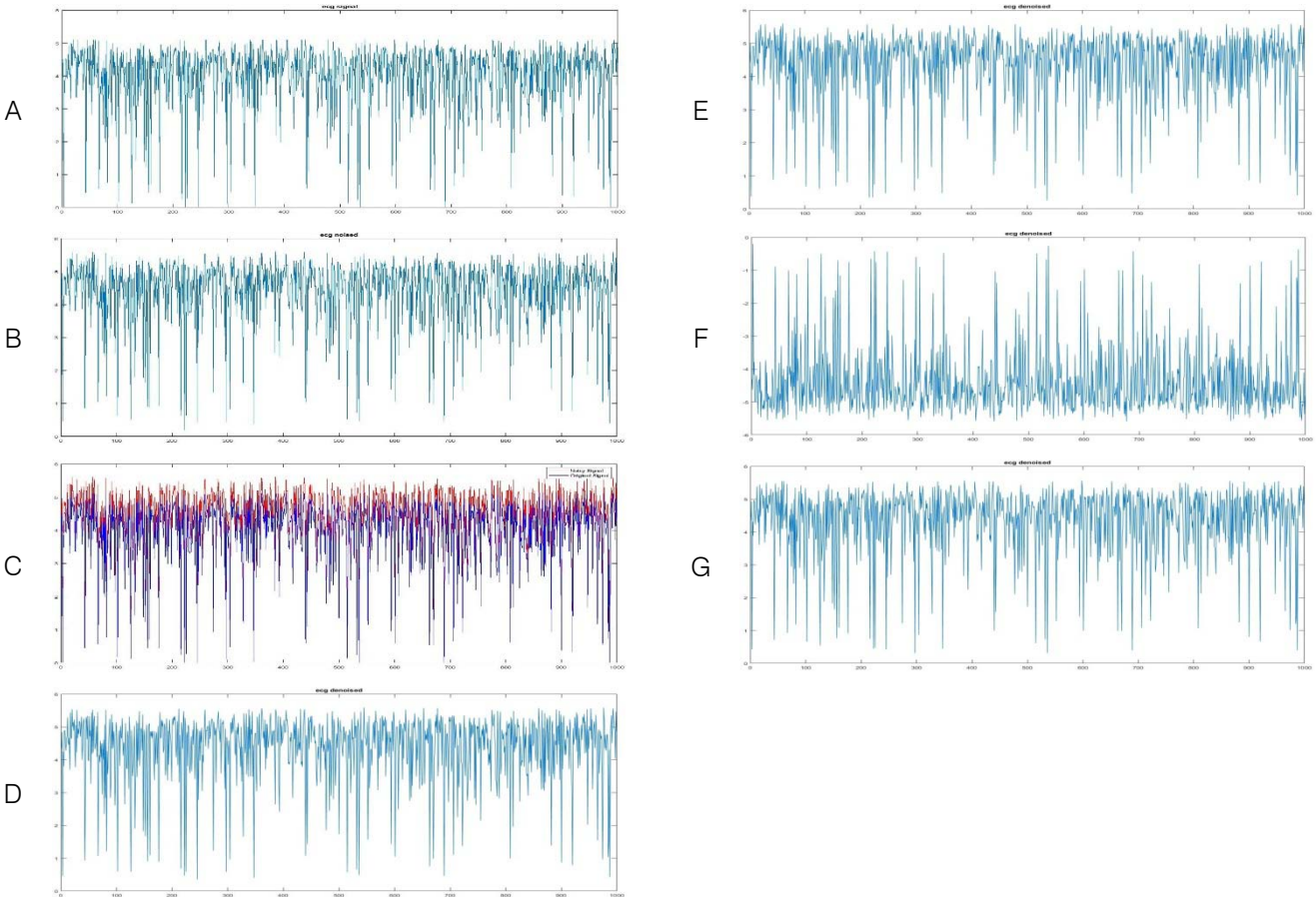


Fig. 8: (ECG signal 1): A original signal,B noised signal, C noised signal (original signal in blue and noise in red), D denoised signal (Gauss filter), E denoised signal (Pow3 filter), F denoised signal (skew filter), G denoised signal (Tanh filter)

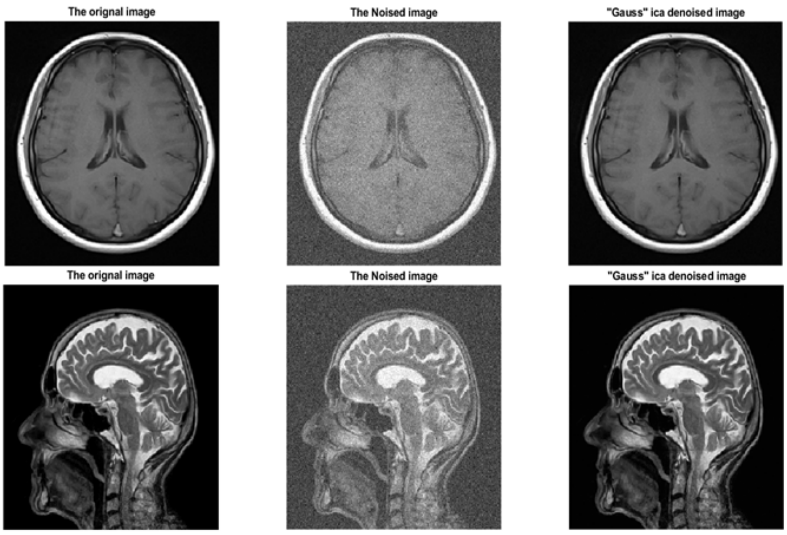


Fig. 9: ICA Gauss filter: The original Pics to the left, the noised pics in the middle, and the denoised pics to the right

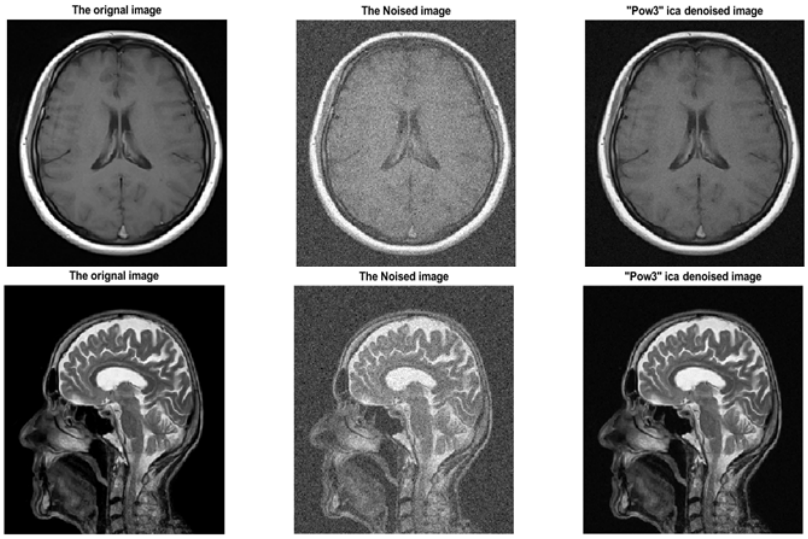


Fig. 10: ICA Pow3 filter: The original Pics to the left, the noised pics in the middle, and the denoised pics to the right

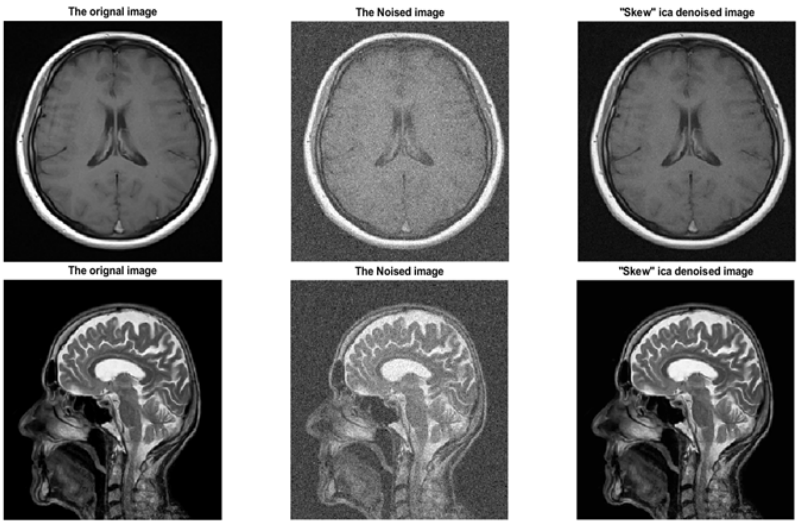


Fig. 11: ICA Skew filter: The original Pics to the left, the noised pics in the middle, and the denoised pics to the right

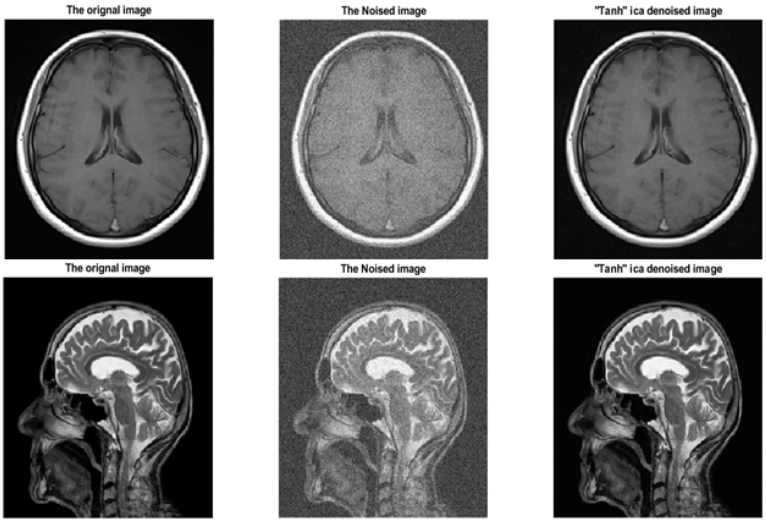


Fig. 12: ICA Tanh filter: The original Pics to the left, the noised pics in the middle, and the denoised pics to the right

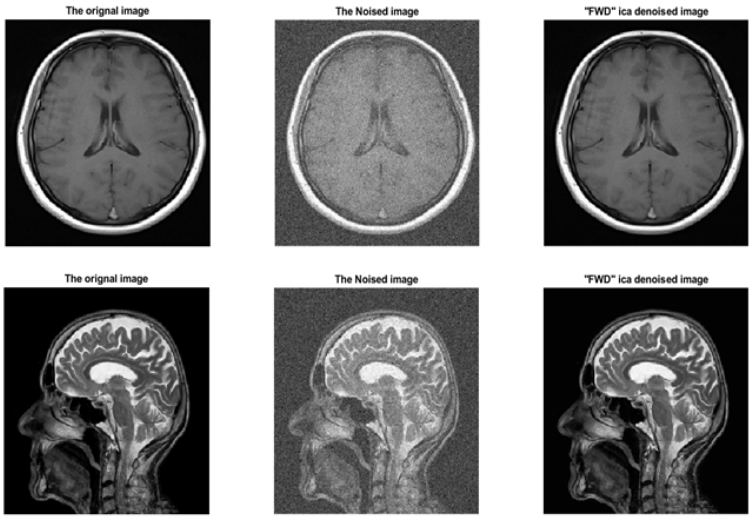


Fig. 13: ICA FWD filter: The original Pics to the left, the noised pics in the middle, and the denoised pics to the right

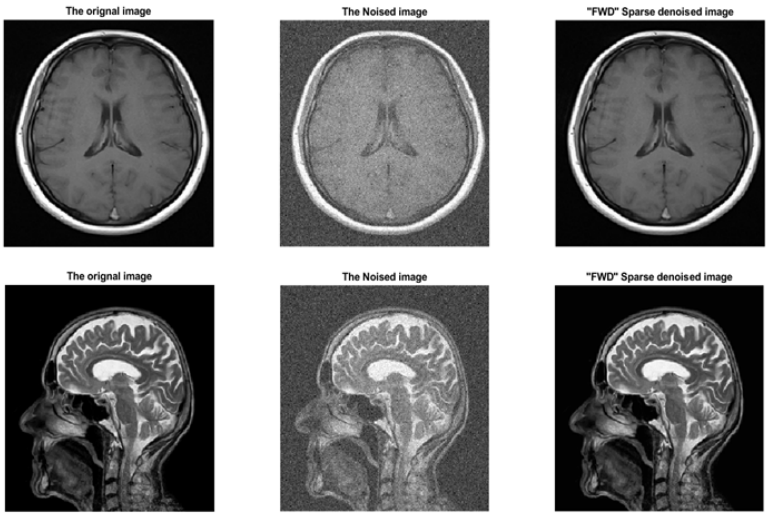


Fig. 14: Sparse ICA FWD filter: The original Pics to the left, the noised pics in the middle, and the denoised pics to the right

VII. Conclusion

The fractional Weibull distribution and the sparse fractional Weibull distribution were used in this paper to introduce two mechanisms for medical signal denoising and blind source separation. In terms of denoising quality and computational cost, the mechanisms outperform existing solutions. We tested the mechanisms on two different types of biosignals (EEG signals and ECG signals) and two different types of medical images; the results were very good, and the mechanisms could be extended to work on other types of biosignals and medical images.

In future work, we aim to apply the algorithms to natural image denoising and mixed image separation.

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Software System Model Correctness using Graph Theory: A Review

By Kruti P. Shah & Emanuel S. Grant
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Abstract- The Unified Modeling Language (UML) is the de facto standard for object-oriented software model development. The UML class diagram plays an essential role in design and specification of software systems. The purpose of a class diagram is to display classes with their attributes and methods, hierarchy (generalization) class relationships, and associations (general, aggregation, and composition) between classes in one model. A model designing process can include a large number of designers. An issue with this is that the models created may be incorrectly designed. Moreover, there are many concepts in the UML that give rise to potential conflicts, uncertainty, and ambiguity. This paper evaluates the concept of software system model correctness. In this paper,a systematic literature review is conducted to examine how researchers identify problems related to software system model correctness. There are seven papers included in the literature review which cover different approaches for handling model correctness in software systems. The results of this review indicate that UML model correctness is a highly active area of research. There are already some valuable contributions in this direction. However, there are many concepts in the UML with imprecise semantics, which limit the use of the UML and reduce the quality of the UML models. This paper is concluded by providing some directions to identify and prove the mathematical equivalence of the UML class diagram models using standard graph theorems.

Keywords: *UML models, UML class diagrams, software engineering, model correctness, graph theory.*

GJCST-H Classification: *FOR Code: 090699*

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Software System Model Correctness using Graph Theory: A Review

Kruti P. Shah [α] & Emanuel S. Grant [σ]

Abstract- The Unified Modeling Language (UML) is the de facto standard for object-oriented software model development. The UML class diagram plays an essential role in design and specification of software systems. The purpose of a class diagram is to display classes with their attributes and methods, hierarchy (generalization) class relationships, and associations (general, aggregation, and composition) between classes in one model. A model designing process can include a large number of designers. An issue with this is that the models created may be incorrectly designed. Moreover, there are many concepts in the UML that give rise to potential conflicts, uncertainty, and ambiguity. This paper evaluates the concept of software system model correctness. In this paper,a systematic literature review is conducted to examine how researchers identify problems related to software system model correctness. There are seven papers included in the literature review which cover different approaches for handling model correctness in software systems. The results of this review indicate that UML model correctness is a highly active area of research. There are already some valuable contributions in this direction. However, there are many concepts in the UML with imprecise semantics, which limit the use of the UML and reduce the quality of the UML models. This paper is concluded by providing some directions to identify and prove the mathematical equivalence of the UML class diagram models using standard graph theorems.

Keywords: UML models, UML class diagrams, software engineering, model correctness, graph theory.

I. Introduction

UML (Unified Modeling Language) [1] is a graphical modeling language used to specify, simulate, and construct software system components. The UML has been adopted and standardized by the Object Modeling Group [2].

UML is considered the standard for object-oriented software model development that allows modeling of various aspects of complex systems [2]. However, there are many concepts in the UML with imprecise semantics, which limit the use of the UML and reduce the quality of the UML models. Thus, developing technologies for the analysis and verification of UML models is significant to developers who use UML for system modeling.

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This work considers the UML class diagram, which is the most fundamental and widely used among all UML models. A Class Diagram provides a static description of system components. The purpose of a class diagram is to display classes with their attributes and methods, hierarchy (generalization) class relationships, and associations (general, aggregation, and composition) between classes in one model [3].

There is number of designers involved in the model designing process who are prone to making mistakes, which gives rise to potential conflicts, uncertainty, and ambiguity. Also, the development of these models is a highly time-intensive process. Therefore, it is extremely important to check the correctness of these models and identify the problems in the early stage of the software design process.

In this paper, seven articles related to the field of software system model correctness were extracted and considered for review. The primary goal of this work is to provide a summary of approaches considered in selected articles, along with the quality of their results and conclusions.

Research articles included in this review are based on several different criteria in the scope of model correctness: problem identified, the approach taken in addressing the identified problem, results and conclusions, differences between the selected articles, and deficiencies in the research of the publications. This review will be useful to understand the important open issues in existing methods and limitations that need to be addressed in the area of model correctness.

The remainder of the paper is organized as follows. Section 2 gives a brief theoretical background of UML models and UML class diagram which is the most fundamental and widely used in UML models. Section 3 describes the review process in the area of verification and correctness of UML models. Section 4 discusses the review summary and important open issues in the domain of software system model correctness followed by the conclusion in Section 5.

II. Background

a) Theoretical Background

This section covers some of the theories and prior work in the area of UML models along with various aspects of UML class diagrams.

i. *Unified Modeling Language (UML)*

UML [2] has been widely accepted as the standard language for modeling and documenting software systems. Their significance has been enhanced with the beginning of the Model-Driven Development (MDD) approach, in which analysis and design models play an essential role in the process of software development. The UML offers a number of diagram forms to describe particular aspects of software artifacts. These diagram structures can be divided into two categories static or dynamic views:

Static view: It describes the structural aspect of the system and its components. It includes objects, classes, attributes, operations, and their inter-relationships. The structural view can be represented by class diagrams and composite structure diagrams.

Dynamic view: It describes the behavioral aspect of the system. The dynamic view reflects the changes related to the internal states of individual objects and changes in the system's overall state. This view can be represented by sequence, activity, and state chart diagrams.

ii. *UML Class Diagram*

The UML class diagrams are used to represent the static structure of system components [2]. It describes the system structure in terms of classes, attributes, and constraints imposed on classes (operations) and their inter-relationships. Class diagrams are used at the analysis phase to present a view of the static entities in the problem domain, and at the design phase to present a view of the static entities (classifiers) in the solution domain. A class diagram is best described as a set of graph elements connected by their relationships.

Classes in UML models are represented as rectangles. Each class consists of a name, set of attributes, and set of operations on the class's attributes. Figure 1 shows an example of a class diagram consisting of classes, associations (aggregations and compositions), and generalizations.

iii. *UML Association (Aggregation, Association, Composition, generalization)*

There are some rules and requirements for combining the classes to construct partial or complete UML class models.

Association —— It can be depicted as bi-directional or unidirectional. The association lines indicate the possible relationship between the class entities [4].

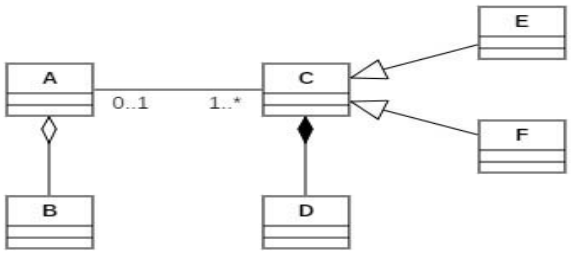

Figure 1: UML Class Diagram

An association represents attributes and objects from the related classes, such as the relationship between class A and class C seen in fig. 1. Association ends can be annotated with labels, known as association end names and multiplicities. For example, multiplicity can be expressed as specific numbers, ranges of numbers, or unlimited numbers, as shown in fig. 1 between classes A and C.

Aggregation —▷ An aggregation is represented as an association with a white diamond on one end, where the class at the diamond end is the aggregate (container class). It includes or owns instances of the class (contained class) at the other end of the association [4] (e.g., the relationship between class A and B in fig. 1).

Composition —◆ It is a special type of aggregation in which instances of the contained class are explicitly owned by instances of the container classes [4]; if an instance of the container class is deleted, the instances of the contained class are also deleted. Fig. 1 shows class C, the container class, and class D, the contained class. It is represented as an association with a black diamond.

Generalization —◇ A generalization is represented by an association with a triangle on one end represents, where the class at the triangle end of the association is the parent class of the classes at the other ends of the association, called subclasses [4]. A subclass inherits all of the parent class's attributes, operations, and associations (e.g., subclasses E and F inherit properties of parent class C in fig. 1).

III. Literature Review

In this section, several studies related to the verification and correctness of UML models are discussed.

a) Review Process

Seven publications were selected for this study, each covering a distinct technique to dealing with model correctness in software systems. The following is a list of

distinct stages that are being considered during the review process for each publication:

1. Problem identified in the selected publication
2. The approach taken in addressing the issue
3. Results and Conclusion
4. Statement of deficiencies in the research of the publication

In AGG: A graph transformation environment for modeling and validation of software [7], the author Taentzer briefly discussed the graph transformation tool, that defines the rule-based manipulation of graphs. Graph grammars and graph transformations are very mature approaches used to generate, manipulate, recognize, and evaluate graphs [8].

Taentzer proposed a graph transformation tool (AGG) [7] which supports the modelling and verification of software. It has visual editors for graphs, graph grammars as well as the formal foundation based on the algebraic approach for graph transformation. Transformation in AGG can be performed using debug or interpretation mode. In debug mode one selected rule is applied exactly once to the current host graph while in interpretation mode whole sequence of rules applied to host graph. AGG also offers support for model validation techniques like graph parsing, consistency checking, along with the conflict detection of graph transformation rules. It consequently implements the theoretical results available for algebraic graph transformation to support their validation.

The authors extended their work and compared AGG to other transformation tools (PROGRES, Fujaba, DiaGen, and GenGED). They found that AGG is the only tool that implements the theoretical results available for algebraic graph transformation.

However, there is number of limitations associated with AGG tool. AGG does not support the represent of aggregation and composition concepts used by the UML meta model. Therefore, the type graph needed to be simplified by using the more generic concept of association. AGG does not provide a satisfactory control structure for organizing and combining rules, also the supplied mechanisms for composing rules were not sufficient to describe model refactoring. Along with that, the specification techniques found in graph grammars and transformation languages were not sufficient, as they do not follow UML concepts.

In [9],Towards formal verification of UML diagrams based on graph transformation, authors Zhao et al. presented a meta-level and highly automated technique that could formally transform UML diagrams for verification. UML has a lack of precise formal semantics [10], which hinders the formal verification and validation of system design. So, transformations of UMLmodels in various mathematical domains such as Petri-nets are significant for the analysis and verification of the UML model.

Zhao et al. suggested an approach for transforming UML diagrams into Petri nets based on meta-modelling and graph transformation techniques [9]. First, they formally transform UML statecharts and behavioral diagrams to Petri nets for verification. Then, they identified three layers of relationship among various UML diagrams: the relationships among the same UML diagram from different contextual instances; the relationships among various diagrams from the same view of a system; and the relationships among various diagrams from different views of a system.

Authors extended their work and proposed a debugging approach to modify the transformation rules according to the concrete semantic constraints through a case study. They have also conducted experiments on the verification of relatively simple UML statechart diagrams. However, a drawback still persists in modeling large complex problems. In this work, the authors only considered experiments on verifying simple UML statechart diagrams. Also, the third layer, which describes the relationship between the diagrams of static structure view and the diagrams of dynamic behavior view, is rarely considered in this work i.e., related to the verification and transformation of UML models. Along with that, author did not consider the diagrams of static view (e.g., class diagram) which is an essential part of UML.

In Verifying UML diagrams with model checking: A rewriting logic-based approach[11], Mokhati et al. presented a framework supporting the automatic translation of UML diagrams into a formal specification and verification using the Maude language. UML allows the modelling of various aspects of complex systems. However, there are many inconsistencies and ambiguities associated with UML models. Therefore, UML suffers from a lack of formal semantics [12].

Mokhati et al. presented an approach for formal verification of static and dynamic features of UML diagrams using object-oriented and concurrent Maude language specifications [11]. In this work, the authors transformed UML models into formal languages and verify the system's dynamic aspects. The authors extended their work by defining some Linear-time Temporal Logic (LTL) properties and used Maude's model checker to validate those properties associated with UML models.

Authors in this workclaimed to transform all the static and dynamic aspects of UML models into formal languages and validating them using Maude's model checker [11]. However, they could only translate simple UML statechart and communication models and a drawback still persist in translating complex dynamic models (statechart and communication models). Along with that, the authors did not mentioned how translation could be done for other static and dynamic models.

In Verification of UML/OCL class diagrams using constraint programming [13], Cabot et al.

suggested an approach for using the Constraint Programming paradigm to verify UML/OCL class diagrams.

UML models become the primary artifacts of the software development process. Unfortunately, formal verification of software models is a difficult process. As a result, verifying the correctness of such models is a key issue. This is also the case when focusing on verifying UML class diagrams extended with Object Constraint Language (OCL). As a consequence, specification and design problems are not recognized until the implementation stage, causing the development process to be more expensive.

In [13], authors presented an approach to translate UML class models annotated with OCL constraints into a constraint satisfaction problem (CSP). The authors briefly discussed translation of UML/OCL classes, associations, generalization sets, and OCL invariants into CSP. A tool based on CSP (UMLtoCSP) is then used to verify a predefined set of correctness properties for the original UML/OCL diagrams. The UML/OCL language combination integrates well with automated inference systems.

The CSP tool supports bounded reasoning about satisfiability, consistency, finite satisfiability, independence of invariants, and partial state completion. It handles class diagrams with multiplicity, class hierarchy, association-class constraints but does not allow multiple inheritance. Along with that, tool does not support all the features in OCL specification, such as constraints on a string.

In Model checking and code generation for UML diagrams using graph transformation [14], Chama et al. developed a formal specification framework that allows automatic translation of UML models into its equivalent Maude code using AToM3 graph transformation tool. UML contains a large number of diagrams that are used to describe various aspects of a software system. However, the developed UML models can contain inconsistencies and uncertainties, which are difficult to detect manually as UML suffers from a lack of formal semantics.

Chama et al. [14] presented a visual modelling based automatic approach and a tool to check UML models using the graph transformations. They considered both static and dynamic models for inconsistency checking. Their idea was to map class diagrams, statecharts, and communication diagrams into an equivalent Maude specification. They used a meta-modelling approach that could help in model checking. The subset of UML diagrams is considered to develop a metamodeling tool AToM3 integrated framework for model checking by transforming them into a rewriting system expressed in the Maude language and graph grammars. The formal verification is performed using the Linear Temporal Logic (LTL) Model Checker. They also used Maude's model checker to verify objects interactions.

In Chama et al. [14], the UML models used for Maude language and LTL model verification were incorrectly drawn. Since UML models are ambiguous, validated models can be ambiguous as well.

In Towards an automatic evaluation of UML class diagrams by graph transformation [15], Outair et al. presented an approach for evaluating UML diagrams produced by the students during their course work. As the number of university students enrolled in courses is growing, the evaluation of UML diagrams produced by students is often experienced by teachers as a tedious and challenging task. Since UML does not provide the methodology for modeling, the students have difficulties constructing a class diagram. Furthermore, when students construct a UML diagram with several solutions, it might be presented in different ways and points of view. For this reason, the authors proposed an approach to offer assistance to the teacher to evaluate the UML diagrams produced by students. In this work, the authors mainly focused on evaluating the class diagram because it is the most used and considered the most important aspect of object-oriented modeling.

The authors proposed a student diagram assessment system that provides a verification mechanism wherein the teacher manually compares his/her solution with the ones designed by the student.At the end of the comparison process, the system generates a list with the differences and comments that a student can use to improve his/her diagram. The contribution revealed in this work is the proposal of a transformation method of the class diagram into a graph using UML metamodel. In addition, authors considered a case study for a library management system to demonstrate their approach.

Outair et al. discussed a student diagram assessment system where authors considered an example of a model containing a teacher's class diagram and a student's class diagram to detect all differences between them [15]. They have found several differences in class, attribute, method, relationship, orientation relationships, and multiplicities. However, those differences have been listed manually, so there is a chance of uncertainty and ambiguity. Moreover, for graph transformation, the authors considered a library management system case study in which the graph model is designed manually from a UML diagram. These manually generated graph models can be incorrectly designed. Therefore, a tool for verifying the converted graph model is required to ensure the correctness of the generated graph.

In the Automation and Visualization of Program Correctness for Automatically Generating Code [16], Jason developed a Tool using mathematical analysis that can verify the correctness of the generated code from the input specifications in program synthesizer.

Program synthesis systems [17] are used to generate code automatically from given specifications. It can be considered as a tool that can make programs. It involves different applications such as data analysis for air traffic control data, satellite guidance, navigation, and control system. Two program synthesis systems developed by NASA researchers are easy to use, semi-automated, and quick. However, it includes the manual design of graphical system models. The development of these models is highly time-intensive and can be incorrect. The user would require active assistance to refine the specification. The results are not easy to verify manually for a large amount of data. Due to which these systems suffer from an issue that is the correctness of the generated code. Mathematical analysis can be used to correct such models but require a tremendous amount of work.

Jason [16] extended a technique developed by Grant et al. in collaboration with NASA researchers [17] of program correctness (for verification of generated code from the input specifications) by applying it to AUTOBAYES. This approach models the input specifications, the output code, and the relationships between them using UML Class models and OCL constraints. The author used Code Generator, in which input is in the form of a statistical model (class diagram) and output in the form of a program file in the requested language, which can be used to define a relationship between the input and output constraint. Then as a next step, a class diagram, and constraints for both input and output are defined. Then, these constraints were transformed into the formal specification language and analyzed with the USE tool. Finally, the USE Tool checks whether the constraints defined on the class diagram satisfied the model representation or not.

Jason developed techniques for AUTOBAYES in [16], employing UML class diagrams as an input to a code generator to offer code verification. However, the issue still persists in the system as the class diagrams used as an input for verification are manually designed, which can be ambiguous. Moreover, the USE Tool checks whether the constraints defined on the class diagram satisfied the model representation or not. However, USE is not concentrating on the correctness or verification of the class diagrams.

b) Significant difference in research publications

Table 1 briefly described the differences between the selected research publications. The comparison of selected approaches will be beneficial for researchers to understand existing approaches more efficiently.

For each reference, the following information is listed: the approach or tool used to transform UML models into graphs, supported UML models (static or dynamic), the translation procedure from UML to graph(manual, semi-automatic, or automatic), the verification process (manual, semi-automatic, or automatic)and other limitations of the associated method.

Table 1: Significant difference in research publications

Reference	Approach	Diagram support	Translation	Verification	Limitation
[7]	AGG	UML Models	Automatic	Automatic	It does not support aggregation and composition concepts used by the UML metamodel.
[9]	UML metamodel	UML Statechart diagram	Automatic	Automatic	It does not consider diagram of static view.
[11]	Maude Model Checker	UML Statechart and Communication diagrams	Automatic	Automatic	It does not consider diagram of static view.
[13]	UMLtoCSP	UML/OCL Class diagrams	Automatic	Automatic	It does not support aggregation and composition relationship of UML class models.
[14]	AToM3 tool based on Maude Model Checker	UML Statechart, and Communication diagrams	Manual	Automatic	The UML models used for Maude language and LTL model verification were incorrectly drawn. However, no ambiguities found at the end of verification process.
[15]	UML metamodel	UML Class diagram	Manual	Manual	A manually generated models are used for translation and verification.
[16]	USE	UML Class diagram	Manual	Automatic	Does not provide meaningful feedback Not efficient with large and complex UML class models

In UML metamodel [15], both the translation and verification of UML class models done manually while UML metamodel [10], Maude Model Checker [12], and UML to CSP [13] offer both automated translation and verification procedures, although [10] and [12] do not take static view diagrams into account. UML to CSP [13] supports static diagrams (UML class models) with general OCL constraints but does not consider multiple inheritance or the aggregation and composition relationships in the UML class model.

In [14] authors used the AToM3 tool, which is based on the Maude model checker, although the translation into UML meta model is done manually. Furthermore, the UML models utilized for verification were incorrectly drawn, resulting in ambiguous verified models.

AGG [8] utilizes semi-automatic approach for both the translation and verification procedures of UML models. The only limitation is that it does not support some UML metamodel concepts (e.g., aggregation and composition).USE tool [17] considers a manually generated class diagram as an input for translation while the verification process is automatic.

IV. Review Summary and Conclusion

There are several studies related to the verification and correctness of UML models identified for this review, of which seven were selected for this work. These studies are selected based on methodology used and level of automation for the translation and verification process in the domain of software system models. The result of this review shows that model correctness is a highly active area of research. There are several approaches proposed in this area. However, it still has some important open issues and limitations e.g., these studies did not provide enough support for verification and correctness of UML class model.

It is important to check and verify the correctness of UML models to enhance its usability. To achieve that goal as a first step, my plan is to consider the UML class diagram, which is the most fundamental and widely used among all UML models. Therefore, future work can concentrate on identifying and proving the mathematical equivalence of features of the UML class diagram models by applying standard graph theorems.

Mathematically equivalency would reduce concepts in the UML class diagram model, thus leading to a better understanding of the model. An approach to resolve this problem is to simplify the semantics of the class diagram through the application of mathematical formality to the definition and usage of class diagram concepts. The applicable mathematical principles result in a reduction of complexity in the UML class diagram model. Along with that, we can eliminate redundant components (e.g., generalization/specialization relationship) by applying mathematical principles and set theory.

A correlating effort of the future work would be proving the correctness of the class diagrams developed with the reduced number of model concepts. A tool that transforms the class diagram into a graph representation and then applies appropriate graph theories to identify anomalies in the class diagram model's design will be developed. Then, this work will be validated by integrating the class diagram correctness technique with an industrial program synthesizer input/output validation process.

By resolving certain limitations and open issues associated with verification and correctness of UML class model, we can produce simplified and formalized concepts of software system modeling notation that will advance learning and appreciation of skills fundamental to producing the next generation of reliable and correct software systems. It will also contribute to the work on program correctness that is complementary to existing work on verifying the synthesizer input/output validation process.

Program synthesizers are used in multiple safety-critical domains; one is that of space exploration. These tools have specification language problem instance inputs and output a program that implements a solution of the input problem. However, verifying the output with respect to the input has been a challenging area of research. A promising approach lacks proof of correctness of the used UML class diagrams. These issues can be resolved as a part of future work. This work will also be beneficial to software engineering pedagogy, as a simpler set of software modeling components should lead to a greater appreciation of modeling strategies.

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Educational Assistance Management System for Batangas State University Arasof-Nasugbu

By Albert V. Paytaren, Hazel G. Gonzales & Rhannel D. Dinlasan

Batangas State University ARASOF-Nasugbu

Rationale: As technological innovation rapidly grows in technology and education, scholarship offices manage educational assistance that helps students continue their studies. Most admin and scholarship officers of various scholarship programs use traditional ways of managing scholarship programs. Traditional keeping records of documents and requirements can be misplaced, and finding records is also a tedious job. Therefore, the researchers came up with making a web application for managing educational assistance, which helps scholarship officers in collecting and managing information of scholars as well as for scholars to easily apply and submit requirements online.

Objectives: The study's general objective is to develop an online management system of educational assistance for Batangas State University ARASOF-Nasugbu. Especially, the study attempted to answer the following questions: (1) What are the common problems of scholars and scholarship officers on the existing management of educational assistance in terms of Scholarship Program Management and Scholarship Application? (2) What features of the system should be developed to address the problems the scholars and scholarship officers encounter?

Keywords: *educational assistance, likert scale, management, descriptive-developmental, web application.*

GJCST-H Classification: *FOR Code: 080699*

EDUCATIONALASSISTANCEMANAGEMENTSYSTEMFORBATANGASSTATEUNIVERSITYARASOFNASUGBU

Strictly as per the compliance and regulations of:

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Albert V. Paytaren [α], Hazel G. Gonzales [σ] & Rhannel D. Dinlasan [ρ]

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Methodology: The researchers used the descriptive developmental research design, and incremental and iterative development to make the process more flexible. In addition, the researchers used the questionnaire for comparing and measuring the level of acceptability of the scholars and scholarship officers on the developed educational assistance management system. The researchers used the Likert Scale to measure the holistic view and opinion to measure the level of acceptance and satisfaction of the study. The researchers used convenience sampling due to the ongoing pandemic.

Results: Based on the evaluation among respondents, the study yielded the following findings: a. the scholars are having issues in the existing system in getting scholarship program announcements; b. several features are developed to solve the problems encountered by the scholarship officer and scholars; SMS and Email Notification, a feature that helps scholarship officers to decide who are eligible candidates for the scholarship program, and online chat communication; c. the IT consultant suggested to developed Validation check in compliance with the data privacy law when asking personal information and scholarship program link.

Conclusions: By the findings of the study, the following conclusions were drawn; a. The researcher concluded that most of the scholars, admin, and scholarship officers are having difficulties in getting scholarship program announcements b. The researcher concluded that the features of the developed system would be a big help for the scholars and scholarship officers to address the problem encountered on the existing/manual system; c. The researcher concluded that the system lacks compliance with data privacy; d. The researcher concluded that the existing system is not that convenient for the scholars and scholarship officers to use; e. The developed system can be easier, faster, and convenient.

Keywords: educational assistance, likert scale, management, descriptive-developmental, web application.

I. Introduction

Emerging technology changes society's history. Technology makes people's lives easier. As time goes by, the invention of computers, laptops, mobile phones, and smartphones takes place. People tend to enjoy using that invention in everyday life. Most people treat their mobile phones as best buddies and spend most of their time using them [1].

With technological innovation, every work becomes more efficient and effective. Technology becomes one of the most significant elements of today's generation in everyday living. Since the majority of people have gadgets, living becomes easier by simply tapping, clicking, and scrolling through their gadgets. Smartphones and laptops together with an internet connection allow people to complete tasks easier. This helps people to access the web pages they need.

It plays a vital role in different areas such as banking, communication, online shopping, and education. Generally, education helps to educate people to be productive members of society. However, not everyone is lucky enough to attain an education because of several factors present in society such as marginalization and poverty, but the major reason is financial difficulties. Despite that, the government and different organizations offer scholarships or educational assistance as an action on the problem [2].

There are many public and private sectors offering educational assistance. Some scholarship

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programs will only be applicable in a municipality and depend on the qualifications. Despite their good deeds, they still find difficulties in handling and managing the data of the scholars due to the manual processes. On the other hand, there are still scholars who got more than one scholarship because the specific admin of every educational assistance had problems in determining eligible applicants. To have a general awareness, it will be more convenient if there will be a platform to sort out students in various types of scholarships.

With that in mind, the researchers came up with the idea "Educational Assistance Management System for Batangas State University-ARASOF Nasugbu". This web application will be beneficial to the scholarship officer and scholars because it will serve as a tool to increase the quality and fast service on collecting data about the scholars as well as identifying what type of scholarship they already had.

II. Objectives

The general objective of the study is to develop an online management system for educational assistance.

Specific Objectives:

1. What are the common problems of scholars and scholarship officers on the existing management of educational assistance in terms of;
   a. Scholarship Program Management; and
   b. Scholarship Application?
2. What features of the system should be developed to address the problems encountered by the scholars and scholarship officers?
3. What are the components of the system tested by the IT consultant that needs revision?
4. What is the level of acceptance of scholarship offices in the developed Educational Assistance Management System in terms of:
   a. Managing scholarship application;
   b. Accessing scholar's information; and
   c. Notifying scholars?
5. What is the level of acceptance of scholars on the developed educational assistance management system in terms of:
   a. Submission of Requirements;
   b. Finding Available Scholarship Program; and
   c. Scholarship announcement?

III. Literature Review

Based on the study conducted by Annapurna Kasi (2015) from the research entitled "Scholarship Information System", they created a system for the group of colleges to manage their scholarship program. In creating the Scholarship Information System, they aim to help in managing students' scholarship details. It can also help to filter the eligible students for the scholarship program. The system can maintain the data without any loss or damage and time-consuming checking and finding information about various, scholarships will be lessened. The system is developed using MySQL and C#. JavaScript and AJAX for the web and HTML. The developed system provides ease of data entry for the user. After testing the system, they found out that the system has overcome the limitations of the existing system and worked according to the specifications. The system meets the need in providing reliable information and the requirements. The system consumes less time and effort than the old way of managing scholarships [3].

Based on the study conducted by Ayishetu, Seidu (2017) from the research entitled "Scholarship fund management system", discusses that the increasing number of applicants for scholarships over the years are manually managed in Ghana. Only advanced high school students from economically disadvantaged backgrounds are eligible for scholarships from this non-profit organization. To reduce the amount of effort and time spent on management, the NGO switched from a manual process to a web-based system. This existing/manual system enables them to enter the information of new applicants, award scholarships, and monitor student performance. The purpose of this research is to improve the system by adding functionalities that will allow it to track scholarship payments and provide reporting functionality for the scholarship application process. The system is built with HTML, CSS, and SQL and employs PHP as the application's controller, which is aided by AJAX [4].

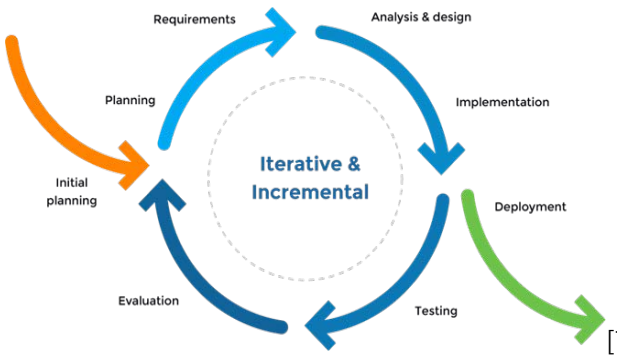
Based on the study conducted by Jibrin, Musa, and Tahir (2016) from the research entitled "Development of E-Scholarship System.", A scholarship is a grant or payment made to support a student's education that is awarded based on academic or another achievement. Many scholarships are awarded based on merit, and recipients are not required to repay them. As a result, the Niger State Scholarship Board is seeking qualified candidates to sponsor outstanding students at the undergraduate and postgraduate levels as part of its effort to develop professionals who will serve as change agents and agents of scientific and technological advancement. The developed e-scholarship system was able to automate the scholarship application process. The system was also able to provide the scholarship board with an application that can be used for relationship award letter screening. The Object-Oriented Analysis and Design methodology are being used in the system for the software development approach (OOAD). The application, on the other hand, was created using the Hypertext Preprocessor (PHP), AJAX, JavaScript, and HyperText Mark-up Language (HTML). The development of a Scholarship system provides online application

solutions that save time and effort, as well as sending notifications about the status of applications via SMS alerts and emails [5].

Based on the study conducted by Marave, Engr. Ariel M. entitled "Online Scholarship Application and Record Management System for AYZ City", the scholarship office of AYZ City manages scholarships through a manual process. Scholarship admin finds it difficult to manage scholarship programs especially if there are bulk records and compilations. To solve the problem, this system is developed to serve as an instrument for fast service and quality services by having paperless work on managing scholarships. The developers of the system use PHP and the programming tools and MYSQL as the database [6].

IV. Materials and Methods

In this research, the development process that is used by the researchers is Iterative Incremental development. incremental and iterative development is more flexible because the development plan is broken up into pieces, and those pieces are developed and implemented one by one. Incremental development saves a lot of time because researchers can test more frequently and iterate on the work before coding something that is not going to work. This frequent testing makes the researchers flexible if errors and problems arise. The iterative development makes progress with repetition and through successive refinement until it meets the goals. The iterative is a compromise of the following stages: planning, analysis, and design, implementation, testing, and evaluation.



[7]

Figure 1: Iterative and Incremental Development

Planning Stage: The project starts in planning according to the set of requirements and to define the requirements, feedback needs to be analyzed. At this stage, researchers will identify the goal and purpose of the system by answering the question "What is the purpose of this financial assistance management system?"

In the planning stage, the researchers came up with the idea of using PHP and JavaScript as the language, HTML and CSS for the web technology, and XAMPP for the backend.

Analysis and Design: This stage is to determine the business logic of the project. The analysis clarifies the problems and objectives. Design is to identify a set of instructional design, conceptual and structure for the final development.

In this stage, the researcher will interview the scholarship officers to identify the difficulties they encountered in managing scholarship data.

Implementation: This stage is the start of the development process based on the requirements. This is where vision and plans become reality.

In this stage, the interface and contents of the system will be determined. The system should be user-friendly and easy to navigate and understand.

Testing: This stage performs testing to find and fix errors and bugs. This is where the system undergoes assessment to identify if the system meets every requirement.

Evaluation: This is the last stage of iterative design where the researchers meet the clients to evaluate the system and identify if all requirements are met.

The researchers will formulate an evaluation instrument in the form of a survey questionnaire.

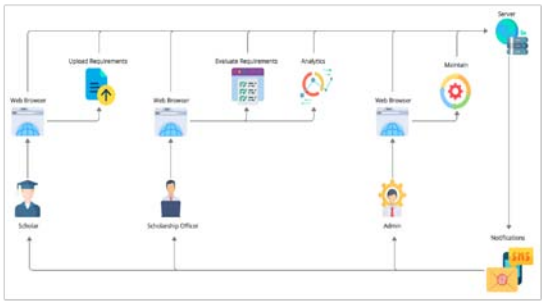


Figure 2: System Architecture of the Developed System

The figure illustrates a system architecture that helps the researchers to define the structural behavior of the proposed system. The system to be developed will be launched using a cloud server and web hosting to access the internet. Since the system is launched on the internet, different devices that support browsers such as chrome can access it. Admin, scholarship officer, and scholars will have access to the system.

Figure 3: Use Case Diagram of the Developed System

The figure illustrates the representation of the user's interaction that shows the relationship between other users. Scholars can apply for scholarships and submit requirements. Scholarship officers manage the scholars, he/she evaluates the requirements and approve the application. Scholarship admin can also approve scholarship applications and assign another scholarship officer. Admin assigns the scholarship admin and creates pages for our scholarship programs.

Figure 4: Context Diagram of the Developed System

The figure illustrates the boundaries of the system. It identifies the flows between the system and external entities. Scholars must check first the available scholarship and fill out the application form then submit the requirements. If the Scholarship officer or admin approves a scholarship application, the scholars will receive email notifications. The admin is the one who assigns the scholarship admin and adds a scholarship program to the system.

The following are the software and hardware requirements that were used during the development process of the proposed system.

Table 1: Software Requirements

PARTICULARS	SOFTWARE
Operating system	Windows 10 Pro
Environment	Sublime Text 3
Language	PHP, JavaScript
Web Technology	HTML, CSS
Backend	XAMPP

Table 2: Hardware Requirements

HARDWARE	SPECIFICATION
Processor	At least 1.8 GHz
Ram	4GB or more
Monitor	14" Color
Hard Disk	500GB SSD or more
Keyboard	Standard 102 Keys
Mouse	Optical 2 buttons

V. Results and Discussion

In the preparation and evaluation stage, the proposed system will be evaluated according to respondents' answers to the survey questionnaire. The Likert scale will be used to verify intervals between rankings of the evaluation.

$$i=(Hs-Ls)/T$$

Where:

i= Interval
Hs= Highest scale in the survey questionnaire
Ls= Lowest scale in the survey questionnaire
T= Total number of scales in the survey questionnaire

Weighted Mean Formula:

$$WM=\frac{\Sigma fx}{N}$$

Where in:
WM = Weighted Mean
fx= sum of the products off and x where f is the frequency of each score and x is the weight of each score
x= is the weight of each score
N= total number of respondents

Table 1: Evaluation of the Existing/Manual System of the problems encountered by Admin and Scholarship Officer in terms of Scholarship Program Management

Problems	Frequency	Rank
The existing/manual system has difficulties in viewing the scholar list and searching for a scholar's information.	2	1
The existing/manual system has difficulties in determining if a scholar has another existing/manual scholarship.	1	2
Time-consuming updating the scholars regarding the scholarship program.	1	2
The existing/manual system has difficulties in accessing submitted requirements.	2	1
It is very time-consuming in submitting the requirements and other documents to the scholarship office.	1	2
The existing/manual system has difficulties in verifying all documents submitted by the scholars.	2	1
The existing/manual system has difficulties in giving updates for the scholarship program.	2	1
The existing/manual system has difficulties in reaching scholars to send announcements regarding the scholarship program.	2	1
The existing/manual system has difficulties in sending and disseminating information to the scholars if changes take place.	1	2

Table 1 presents the problems encountered by the Admin and Scholarship Officer on the Existing/Manual System relative to Scholarship Program Management. Based on the result, parameters one, four, six, seven, and eight ranked first. According to the study conducted by Ayishetu Seidu (2017), increasing numbers of scholar applicants become their major problem since they have manual management of scholarship. The researchers found that more scholarship officers have trouble in scholarship program management.

Table 2: Evaluation of the Existing/Manual System of the problems encountered by Scholars in terms of Scholarship Application

Problems	Frequency	Rank
The existing/manual system has difficulties in getting scholarship program announcements.	26	1
The existing/manual system has difficulties in submitting scholarship applications/ requirements.	23	3
The existing/manual system has difficulties in identifying if there are additional documents to be submitted.	17	6
The existing/manual system has difficulties in communicating between scholars and officers.	21	4
The existing/manual system has difficulties in getting up to date with information regarding the scholarship program.	23	3
The existing/manual system has difficulties with identifying which scholarship programs are open for new applicants.	25	2
The existing/manual system has difficulties in identifying if they are accepted on the scholarship application.	20	5

Table 2 presents the problems encountered by the Scholars on the Existing/Manual System relative to Scholarship Application. Based on the result, "The existing/manual system has difficulties in getting scholarship program announcements" got the highest rank. The researchers found that more scholars have trouble in getting scholarship program announcements. "The existing/manual system has difficulties in identifying if there are additional documents to be submitted" problem got the lowest rank based on the result of the evaluation. The existing/manual process of identifying additional documents to be submitted is difficult if there are no on-time updates. According to Mahmoud (2019) and there should be a system that follow-up all the stages of scholarship application from the initial procedures up to the final stage and can process the submission of application and retrieval time by saving the processing type and effort.

Table 3: Evaluation of the Developed System on the level of acceptability by the Admin and Scholarship Officer in terms of Managing Scholarship Application

Parameters	Weighted Mean	Verbal Interpretation
1. The developed system allows the scholarship office to access and verify the scholars' submitted documents/applications.	5	Highly Acceptable
2. The developed system allows the scholarship officer to accept eligible applicants and deny applications.	4.5	Highly Acceptable
3. The developed system can easily set the eligibility criteria and deadlines on the application.	4	Acceptable
Combined Weighted Mean:	4.5	Highly Acceptable

Table 3 shows the evaluation of the admin and scholarship office on the developed system in terms of Managing Scholarship applications. The overall result was Highly Acceptable. The highest-rated parameter is the first parameter because the developed system helps the scholarship office in accessing the scholar's application. According to the study conducted by Marave, Engr. Ariel M. (2019), the manual process of scholarship is difficult especially if there are bulk records and compilations.

Table 4: Evaluation of the Developed System on the level of acceptability by the Admin and Scholarship Officer in terms of Accessing Scholar's Information

Parameters	Weighted Mean	Verbal Interpretation
1. The developed system could be a major platform for accessing scholars' information.	4	Acceptable
2. The developed system has accurate and reliable scholarly information.	4.5	Highly Acceptable
3. The developed system allows scholarship officers to access and verify if the scholar has another scholarship.	4.5	Highly Acceptable
Combined Weighted Mean:	4.33	Highly Acceptable

Table 4 shows the evaluation of the admin and scholarship officer on the developed system in terms of Accessing Scholars Information. The overall result was Highly Acceptable. The highest-rated parameter was the second and third parameter because evaluators find that the developed system has accurate and reliable scholarly information and it allows them to access and verify if the scholars have another scholarship. According to the study conducted by Annapurna Kasi (2015), creating a scholarship system helps to manage scholar's details and filter eligible students for the scholarship program, which is also considered in creating this study.

Table 5: Evaluation of the Developed System on the level of acceptability by the Admin and Scholarship Officer in terms of Notifying Scholars

Parameters	Weighted Mean	Verbal Interpretation
1. The developed system can easily reach scholars through the posting of announcements.	4.5	Highly Acceptable
2. The developed system has an email and SMS notifications facility that can use to disseminate information.	5	Highly Acceptable
3. The developed system has a chat feature that allows the scholars and scholarship officers to exchange messages with each other.	5	Highly Acceptable
Combined Weighted Mean:	4.83	Highly Acceptable

Table 5 shows the evaluation of the admin and scholarship office on the developed system in terms of Managing Scholarship applications. The. a chat feature that allows users to exchange information with each other. This variable is inclined in the study conducted by Ayishetu, Seidu (2017) that allows to trach the scholarship application process.

Table 6: Evaluation of the Developed System on the level of acceptability by the Scholars in terms of Requirements Submission

Parameters	Weighted Mean	Verbal Interpretation
1. The developed system allows scholars to submit requirements through file attachments in an efficient and timely manner.	4.78	Highly Acceptable
2. The developed system supports changing of incorrect documents.	4.70	Highly Acceptable
3. The developed system is more convenient in terms of online submission of requirements rather than printing the requirements and submitting them to the scholarship office.	4.78	Highly Acceptable
Combined Weighted Mean:	4.75	Highly Acceptable

Table 6 shows the evaluation of the scholars on the developed system in terms of Requirements Submission. The overall result is Highly Acceptable. The high parameter is the first and the third parameters because the evaluators find that it is easy to submit requirements through attachments online rather than printing the documents before submitting them. The lowest rate parameter was the second parameter, which is the changing of incorrect documents. According to the study conducted by Marave, Engr. Ariel M. (2019)., online management of scholarship application and requirements submission will help to have fast service in managing submitted requirements.

Table 7: Evaluation of the Developed System on the level of acceptability by the Scholars in terms of Finding Available Scholarship Program

Parameters	Weighted Mean	Verbal Interpretation
1. The developed system allows scholars to find available scholarship programs.	4.80	Highly Acceptable
2. The developed system allows scholars to search and choose which scholarship program is applicable.	4.82	Highly Acceptable
3. The developed system allows the scholars to view the details of the scholarship program.	4.80	Highly Acceptable
Combined Weighted Mean:	4.81	Highly Acceptable

Table 7 shows the evaluation of the scholars on the developed system in terms of the Finding Available Scholarship Program. According to Surigayti, et al (2018)., having a system that can handle scholarship programs is a big help in different organizations to lessen their manual work. The overall result is Highly Acceptable. The highest-rated parameter was the second parameter because evaluators find that it is easier to search and choose available scholarship where they can apply, while the lowest parameter is the first and third parameter, which is finding an available scholarship and viewing the details of the scholarship program.

Table 8: Evaluation of the Developed System on the level of acceptability of the Scholars in terms of Scholarship Announcement

Parameters	Weighted Mean	Verbal Interpretation
1. The developed system allows scholars to receive announcements on time.	4.90	Highly Acceptable
2. The system can address the difficulties in communication between scholars and officers by having a chat feature and a comment section on the system's posts/announcements.	4.84	Highly Acceptable
3. The developed system allows the scholars to receive announcements through SMS.	4.86	Highly Acceptable
Combined Weighted Mean:	4.87	Highly Acceptable

Table 8 shows the evaluation of the scholars on the developed system in terms of Receiving Scholarship announcements. The overall result is Highly Acceptable. The highest-rated parameter was the first parameter because evaluators found that they could receive announcements on time. According to the study of Setiyani, the existing manual system has slow decision-making in accepting scholars as well as sending announcements. The result of this evaluation means that the developed system is effective and efficient to use in sending announcements and decision making [8].

VI. Conclusions

From the findings of the study, the following conclusions were drawn:

1. The researcher concluded that most of the scholars are having difficulties in getting scholarship program announcements while the admin and scholarship officers are having difficulties in terms of scholarship program management. It means that the existing/manual system is not convenient for the scholars and scholarship officers to manage the scholarship application. This helps the researchers to create educational assistance management system so that they can solve the problem of scholars and scholarship officers.
2. The researcher concluded that the features of the developed system would be a big help for the

scholars and scholarship officers to address the problem encountered on the existing/manual system.

3. The researcher concluded that the system lacks compliance with data privacy.
4. The high ratings of scholarship officers for the developed system when it comes to managing scholarship applications, accessing scholars' information, and notifying scholars give the researchers the idea that the existing system is not that convenient for the scholars and scholarship officer to use.
5. The high ratings of requirements submission, finding an available scholarship, and scholarship announcements give the researchers the conclusion that the developed system will be very useful for the scholars. Using the developed Educational Assistance Management System can be easier, faster, and convenient.

VII. Recommendations

The following are the recommendations for the enhancement of the Educational Assistance Management System for Batangas State University-ARASOF Nasugbu.

1. The developed system is recommended by the researchers to be used by the scholarship office for handling and managing different scholarship programs.
2. The educational assistance management system should have an android and iOS application so that it can be easily downloaded from Play Store and App Store.
3. The educational assistance management system should be able to predict who are the possible scholars that will have a better job opportunity based on their performance.
4. The research team recommends that the system should be integrated with the validation check in compliance with data privacy law.
5. For the future researcher, the research team recommends having Frequently Asked Questions (FAQs) on the online chat feature of the system.

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Cryptocurrency based on Blockchain Technology

By Sultan Badran & Dr. Mousa Farajallah
Palestine Polytechnic University

Abstract- The state of Palestine does not own national currency, so Palestine loses a lot of money yearly due to the use of foreign currencies and the Paris Protocol agreement prevents Palestinian own currency. For that, the crypto-currencies based on block-chain instead of physical currency will help the state of Palestine to avoid the obstacles that prevent to own currency. In this paper, we will study the cryptocurrency based on Blockchain technology that uses peer-to-peer (P2P) and timestamp server. In additional, exploring the main components of bitcoin currency as an example.

Keywords: *blockchain, P2P, timestamp, digital currency, cryptocurrency, bitcoin.*

GJCST-H Classification: *FOR Code: 080699*

Strictly as per the compliance and regulations of:

Cryptocurrency based on Blockchain Technology

Sultan Badran [α] & Dr. Mousa Farajallah [σ]

Abstract- **The state of Palestine does not own national currency, so Palestine loses a lot of money yearly due to the use of foreign currencies and the Paris Protocol agreement prevents Palestinian own currency. For that, the crypto-currencies based on block-chain instead of physical currency will help the state of Palestine to avoid the obstacles that prevent to own currency. In this paper, we will study the cryptocurrency based on Blockchain technology that uses peer-to-peer (P2P) and timestamp server. In additional, exploring the main components of bitcoin currency as an example.**

Keywords: blockchain, P2P, timestamp, digital currency, cryptocurrency, bitcoin.

I. Introduction

The Palestinians does not have their currency. Therefore, they are using different foreign currencies such as Israeli Shekel (NIS), Jordanian Dinar (JD), United State Dollar (USD), and Euro in small and large payments, this leads to losing tens of NIS millions [1].

According to the Paris Protocol agreement since 1994 which gave the Palestine Monetary Authority (PMA) the functions of a central bank without the ability to issue currency. This agreement obligates the Palestinian to use the NIS in Palestinian territory as main currency [2].

This agreement has several negative influences on Palestinian economic; one important issue was the currency. Azzam Shawwa head of the Palestine Monetary Authority (PMA) said, "If we print currency, to get it into the country you would always need clearance from the Israelis and that could be an obstacle," [2]. This led the PMA to think hard to use the digital currency, and think to create their own official digital currency and the PMA plan to call it as Shawwa said. "It will be called the Palestinian pound." [2].

The PMA planned to see the Palestinian digital pound in the real world after five years since 2017 [2].

One of the important technologies used to create the digital currencies is the blockchain, the bitcoin is considered as one of the first and famous currency used the blockchain.

Blockchain is a set of continuous data records called blocks and linked together as a chain according to creation time, blocks are secured using cryptography tools, the data saved into block are immutable and cannot be changed once it has created. The Blockchain is managed by autonomously using peer- to-peer (P2P) network and distributed time stamping servers. Blockchain is a decentralized, distributed and public digital ledger that used to save all transactions across all nodes in the community of blockchain.

In this paper, we suggest a Blockchain technology that used for cryptocurrency that enables Palestinian people to use their own currency securely and freely without interference of external sides.

The rest of the paper is structured as follows. Section II Blockchain technology. Section III presents the Cryptocurrencies. Section IV presents Literature review. Finally, Section V concludes the paper and points out our future work.

II. Blockchain

The Blockchain technology typically includes the four core concepts:

A shared ledger: The shared ledger appends only the distributed transaction record. Any node inside the network could access those transactions. This could control illegal operations.

Cryptography: Cryptography in a blockchain used to ensure authentication and verifiable transactions. By using Hashing function and digital signature (Public/Privet Keys).

Consensus: Trust systems refer to using the power of the network to verify transactions. Trust systems are central to blockchain systems in the authors of book view; "they are at the heart of blockchain applications, and we believe trust system is the preferred term over consensus system since not all validation is done through consensus." [3]

Smart contracts: are the business terms that embedded in a blockchain transaction database and executed with each transaction. In addition, this contract needed to define the flow of value and state of each transaction.

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Figure 1 illustrate a good idea of these concepts:

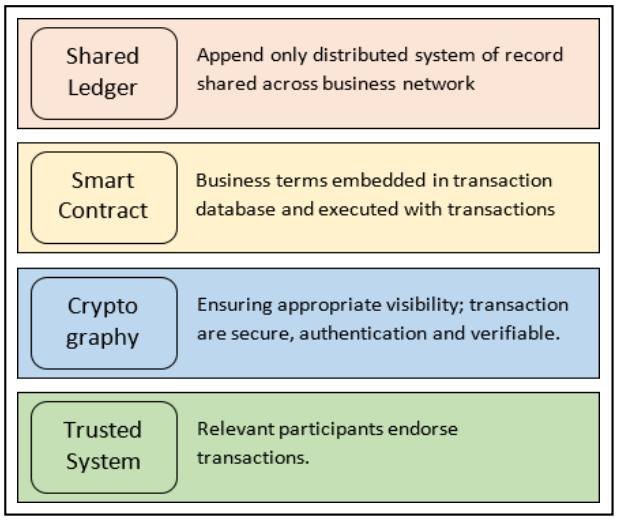

Figure 1: Four core building blocks of Blockchain framework

The Blockchain according to assess the permissions management could be categorized into three types [4] [5].

Table 1: Blockchain types (Source [4], [5])

	Public	Consortium	Private
Participation	Free	Permissioned	
	Anonymous	Identified and Trusted	
Consensus Mechanisms	Mining (Prof-of-Work)	Coting/Multi-party Consensus Algorithm	
	No Finality 51% attack	Lighter, Faster Enable finality	
energy consumption	Large	Low	
Transaction Approval time	Long (e.g. 10 min)	Short (100x msec)	
Uses Case	Cryptocurrency	Transaction in financial and business sectors, e.g. Documents archive.	

Additional to four-core concepts there are others characteristics make the blockchain technology stronger and stable, such as:

Timestamp Server: A timestamp server works by taking a hash of a block of items to be time stamped and widely publishing the hash, such as in a newspaper or Usenet post. The timestamp proves that the data must have existed at the time, obviously, in order to get into the hash. Each timestamp includes the previous timestamp in its hash, forming a chain, with each additional timestamp reinforcing the ones before it [6].

Proof-of-Work: The Blockchain data structure used as a mechanism to deal with the problems happened by openness [7]. Therefore, to implement a distributed timestamp server on a peer-to-peer basis, we will need to use a proof-of-work system [6], more information will be discussed in Cryptocurrencies section.

Exchanges: A crypto-exchange is a digital marketplace where traders can buy and sell coins using different currencies. A currency exchange is an online platform that acts as an intermediary between buyers and sellers of the Cryptocurrency. More information can be found on [8].

Peer to peer network: There are no servers in a peer-to-peer (p2p) computer network, the entire network is includes users running instances of the application on their computers. A small amount of processing and storage resource to the network offered by each running instance, so that it can deliver the services such as privacy, verification, authentication, currency creation and transfer of ownership [9].

III. Cryptocurrencies

One of the first and most famous digital currency is bitcoin, a decentralized Peer-to-Peer cryptocurrency [6], this digital coin was and still the source of worry and argue to governments, traders and businessmen. Start dealing with bitcoins in 2009, in Japan. One of the main reasons to widespread of bitcoin is the design of cryptography, which reflects a surprising amount of ingenuity and sophistication [10].

Height	572068
Hash	00000000000000000028b5b402 8a6f18779d1fb5c2ba71bab8ab2 dbd4e49b269
Previous Block	00000000000000000328a138 ad146210b4ae089cd3298cae1df 93ef5d2aacb
Next Blocks	00000000000000000001b599ff7 0104bc4f51b46f5c98e050d8351 71eae15633c
Time	2019-04-17 19:57:25
Received Time	2019-04-17 19:57:25
Relayed By	BTC.com
Difficulty	6,393,023,717,201.86
Bits	388761373
# of Transactions	2472
Output Total	33,006.04692641 BTC
Estimated Transaction Volume	6,678.17484335 BTC
Size	1435.611 KB
Version	0x20000000
Merkle Root	1. 41f2c4daca3a24bd0fcd33b82218301 5fe400440d0e6d32 8ee370ac2f19534a7
Nonce	3994304272
Block Reward	12.5 BTC
Transaction Fees	0.71588765 BTC

Figure 2: Example block of bitcoin

The main purpose of Bitcoin1 is to allow users to transfer currency securely without a third party or a centralized controller, using a publicly very able Blockchain [6]. Bitcoin can generate trustable records of bitcoin transactions, without needing a central owner or manipulator such as banks.

Bitcoin represents a new concept of money, as it is a currency, One of the important specifications is Proof-of-Work, it uses Hashcash-double SHA-256 to generate a unique hash value for each block in the blockchain, Figure 2 depicts an example of block includes a transaction generates around 33,000 BTC [11]. The connectivity of the blockchain is accomplished by linking the hash of a new block to the hash of generating block in the chain [6] [12].

Each block in the blockchain encapsulates one or more transactions. A new block can be linked to the chain if it has a valid proof-of-work. The hash of a block is calculated based on a random nonce value and the block's header data, e.g., previous block hash value, timestamp. For clarifying we can say the calculated hash value should be lower than or equal to the current network target, which makes the probability of finding a valid proof-of-work very low, in addition, the required time and required power consuming process [12].

1. In Bitcoin network, any node connected. It can participate in creating a block by finding a valid proof-of-work, this process called "bitcoin mining" too. In return for the mining process, bitcoins are generated and sent out as a reward to miners, for any node finding a proof-of-work and participate in creating blocks. ع لى العثور يتم لم !أطخ.المرجع مصدر summarizes the vital requirements of a good proof-of-work algorithm [12].
2. Scalable difficulty, the ability to adjust proof-of- work difficulty must not be fixed. In other words, if the block generation rate is high therefore the difficulty should increase and it should decrease otherwise.
3. Fair distribution of wealth, all miners are equally likely to get the mining rewards. In Bitcoin, the SHA-256 hash cash function along with the difficulty adjustment algorithm guarantee this .
4. Easily verifiable results, the ability to verify proof- of-work values by network nodes promptly and without delaying or relying on a central authority. SHA-256 by its nature is a one-way, fast and easy to verify function.
5. Sensitivity to tempering block data. This is essential to strengthen blockchain's connectivity and to maintain the network's security by preventing malicious attackers from modifying transactions within blocks.

Worthy to mention that there are digital cryptocurrency used globally called Entercoin owned by Palestinian Company called Bitstine, Entercoin exchange based on Ethereum's public blockchain, the sale and exchange of Entercoin start in October 2017 [13].

IV. Literature Review

Today, several of cryptocurrencies based on blockchain has been widely used. Many works of literature focus on architecture of digital currencies in general and others focus on bitcoin technology. On the other hand, there are several streams of research investigate in optimizing algorithms to improve the characteristics of the technology, such as peer-to- peer.

Nakamoto, Satoshi [6] proposed a solution to the double-spending2 problem by using a peer-to-peer network. The authors are using hashing to hash the network timestamps transactions into an ongoing chain of hash-based proof-of-work, this leads to a record that cannot be modified without redoing the proof-of-work.

The authors review the main blockchain components (Although the blockchain is not explicitly mentioned in the paper, the components mentioned by the authors are the same as the components of the blockchain).

The authors start with transaction as the first component in blockchain; define a digital coin as a chain of digital signatures. Each owner transfers the coin to the next by digitally signing include hash of the previous transaction and the public key of the next owner and adding these to the end of the chain. One important issue is a payee could verify the signatures to verify the ownership of chain in addition to prevent the double spending.

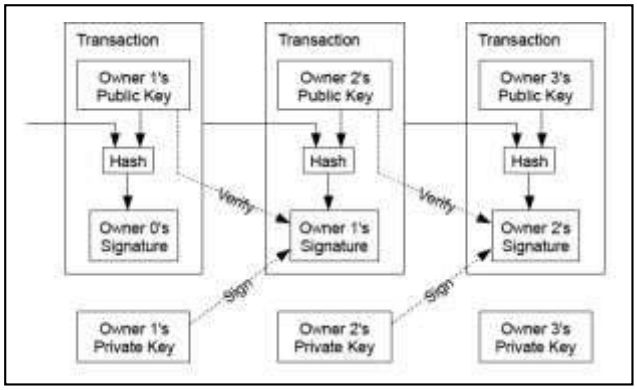

Figure 3: Example how transactions linked together (Source [6])

Figure 3 show the example of linked transactions that could be achieved without a trusted party, transactions must be recorded in a public shared ledger, and use a system for participants to agree on a single history of the order in which they were received (Blockchain). The payee needs proof that at the time of each transaction, the majority of nodes agreed it is the first received.

The authors propose a Timestamp Server used to generate a timestamp, this timestamp includes a

block of items. The timestamp proves that the data must have existed at the time, clearly, in order to get into the hash. Each timestamp includes the previous timestamp in its hash, to be like a chain, with each additional timestamp supporting the ones before it.

The author's emphasis that distributed timestamp server on a peer-to-peer basis to be implemented, they need to use a proof-of-work system.

In timestamp network, they implement the proof-of- work by incrementing a nonce in the block until a value is found that give the block's hash the required zero bits. After the CPU effort has been expended to make it satisfy the proof-of-work, the block cannot be modified without redoing the work again, due to that block is chained after it, the work to modify the block would include redoing all the blocks after it.

Algorithm 1 أسفل خطأ! لم يتم العثور على مصدر المرجع presents steps to run the network:

Algorithm 1 Steps of run network (Source [6])	
1	New transactions are broadcast to all nodes
2	Each node collects new transactions into a block.
3	Each node works on finding a difficult proof-of-work for its block.
4	When a node finds a proof-of-work, it broadcasts the block to all nodes.
5	Nodes accept the block only if all transactions in it are valid and not already spent.
6	Nodes express their acceptance of the block by working on creating the next block in the Chain, using the hash of the accepted block as the previous hash.

Network nodes always consider that longest chain is the correct one and will keep working on extending that chain. If two nodes broadcast different versions of the next block at the same time, some nodes may receive the block or the other first. In that case, they work on the first one received, but keep the other branch in case it becomes longer.

The authors clarify the Simplified Payment Verification process, by keeping a copy of the block headers of the longest proof-of-work chain the, payment verification could be done without running a full network node.

In the end, the verification becomes more reliable as long as honest nodes control the network, but there is more risk vulnerable if the network is overpowered by attackers. While network nodes can verify transactions for themselves, the simplified method can be fooled by an attacker's fabricated transaction for as long as the attacker can continue to overpower the network. The authors suggest a strategy to protect against such attack would be to accept alerts from network nodes when they detect an invalid block, prompting the user's application to download the full block and alerted transactions to confirm the inconsistency.

The authors suggest to combining and splitting value using multiple inputs and outputs for transactions as illustrated in Figure 4. By default, there will be either a single input from a larger previous transaction or multiple inputs combine smaller amounts. Mostly the output will be two amounts in two blocks, the first block for the payment, the second block for returning the change, if any, and this block back to the sender's chain.

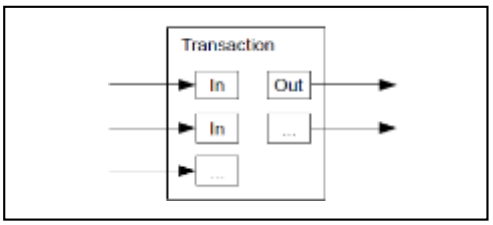

Figure 4: Combining and splitting value (Source [6])

The Authors did not forget to mention privacy, they maintain the privacy by breaking the flow of information in another place: by keeping public keys anonymous. Someone could send an amount to someone else, this transaction the public can see it, but without information linking the transaction to anyone. To achieve that the authors suggest using a key pair, this new key pair should be used for each transaction to avoid linked transaction to the owner.

Simon, Boyen, Shi, and Uzun [10] perform an in- depth investigation to understand why bitcoin is so successful, compared with cryptographic e-cash. In addition to that, the authors asking how bitcoin could become a better candidate for a long-lived stable currency.

Authors addresses the most vital problems most expeditiously as below:

1. No central point of trust. Therefore, Bitcoin architecture is completely distributed. Actually, "bitcoin assumes that the majority of nodes in its network are honest, and resorts to a majority vote mechanism for double- spending avoidance, and dispute resolution."
2. Incentives and the economic system. Bitcoin's ensures that users have economic motivations to participate. In fact, "bitcoin miners" solve computational puzzles to generate new bitcoins, and this process is closely coupled with the verification of transactions previously created. Furthermore, miners also gain optional transaction fees for their effort of vetting said transactions.
3. Predictable money supply, new coins will be minted at a fixed rate.
4. Divisibility and fungibility. One of the most advantages of Bitcoin is the ease of dividing and recombining the coin to create essentially any denomination possible.
5. Versatility, openness, and vibrancy. Bitcoin is highly flexible due to open-source nature [7] [10].

6. Scripting. bitcoin has feature, which allows users (payers and payees) to embed scripts in their bitcoin transactions, websites, and Applications.
7. Transaction irreversibility. bitcoin transactions are irreversible. This advantage of attracting a niche market where sellers are concerned about credit-card fraud and chargebacks.
8. Low fees. The bitcoin verifiers' market currently awards very low transaction fees, which were attractive in micropayments where fees can majority.
9. Readily available implementations. In comparison with other digital cash schemes, bitcoin used a variety of implementation environments, such as desktop computers and mobile phones.

Algorithm 2 The Blockchain protocol (Source [7])

1. Protocol: Blockchain, from the perspective of peer *p*
2. **Intialization**:
3. *C* ← the current Bockchain, obtained from CA
4. trigger Start event
5. **On Event** Start:
6. *b* ← the newest block in *C*
7. mine(*b*)
8. **On Event** mine (*b*) retuerns block *b**:
9. propose_block(*b**) using CA
10. **On Event** CA commints a block *a*:
11. Stop mining
12. *C* ← the new blockchain from CA
13. If $a \neq b^*$ then
14. Trigger Start event

Decker et. Al., [7] provide a new system (called PeerCensus), built on the Bitcoin blockchain to enable strong consistency. The system acts as a certification authority, manages node identities in a peer-to-peer network so that enhance Bitcoin and similar systems with strong consistency.

The authors [7] mention that the main objective of the provided system is to enable the creation of a cryptocurrency that provides forward security and supports fast confirmations. They do that by using the techniques from Bitcoin, resulting in strong consistency guarantees. They mention three reasons for Known agreement protocols are not applicable to a peer-to-peer environment in which Bitcoin operates.

Algorithm 2.المرجع مصدر على العثور يتم لم أطخ! is described in [7] in order to illustrate integral tool used in the Blockchain protocol called Proof-of-Work, they expressed how the protocol maintains a list of functions triggered when a new block join the chain, starting creating the hash through the mining until Chain Agreement (CA) accept the block.

Decker concludes that the digital cryptocurrency "Discoin", which builds on top of the new PeerCensus system, is easier to analyze and implement than the current Bitcoin system, additional to that, it provides a stronger guarantees and faster confirmations.

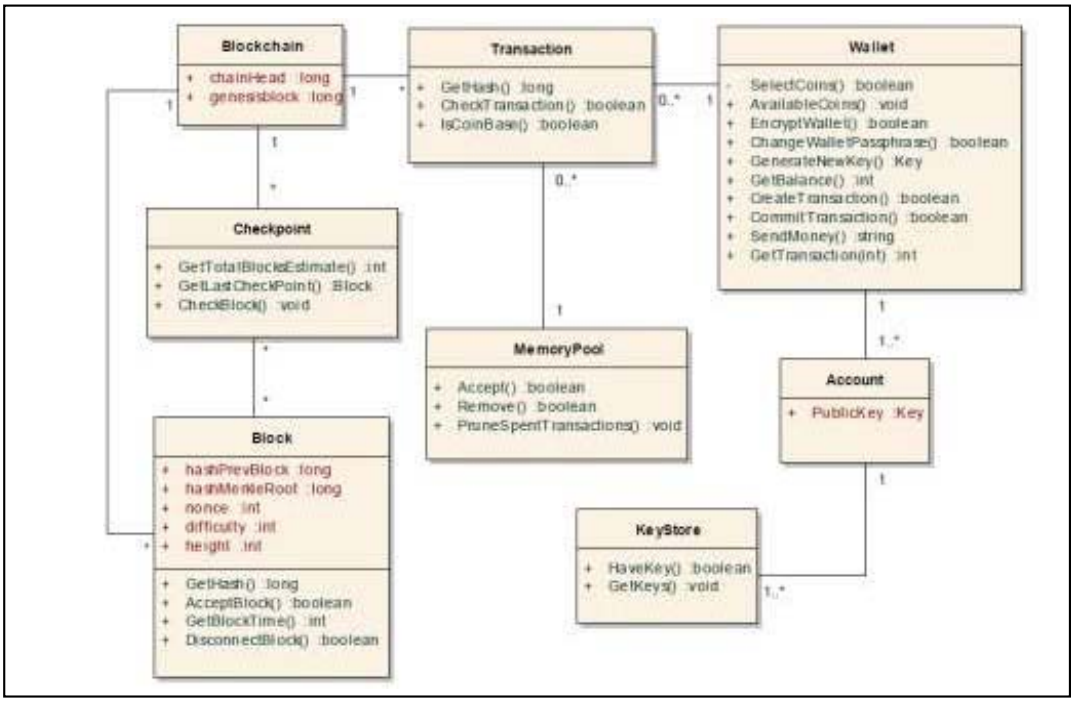

Figure 5: Bitcoin transaction domain model (Source [12])

Israa Alqassem, Davor Svetinovic [12], provide an up-to-date protocol specification and architectural analysis of the system of the first cryptocurrency called bitcoin. The authors perform that analysis as the first step towards the specification of the cryptocurrency reference architecture. The described architecture will consider as a starting architectural point for the development process of new systems that influence on Bitcoin protocol in different contexts and for different purposes. In addition, the authors discuss whether the current architecture satisfies the system's primary purpose, for example, providing a pure decentralized version of the cryptocurrency.

The authors emphasize that in order to develop an architecture model. it should achieve the below goals to make it modifiability, maintainability, reusability, and comprehensibility [12]:

1. Provide a basis for eliciting additional requirements and constraints by evaluating the system's technical feasibility.
2. Help in understanding and evaluating the rationale behind the Bitcoin design and implementation, hence paving the way towards alternative design approaches that improve and refine the current architecture.
3. Alleviate potential security risks when integrating further components or extending the system.
4. Map the quality attributes such as scalability, security, and performance onto advanced modular architectures.

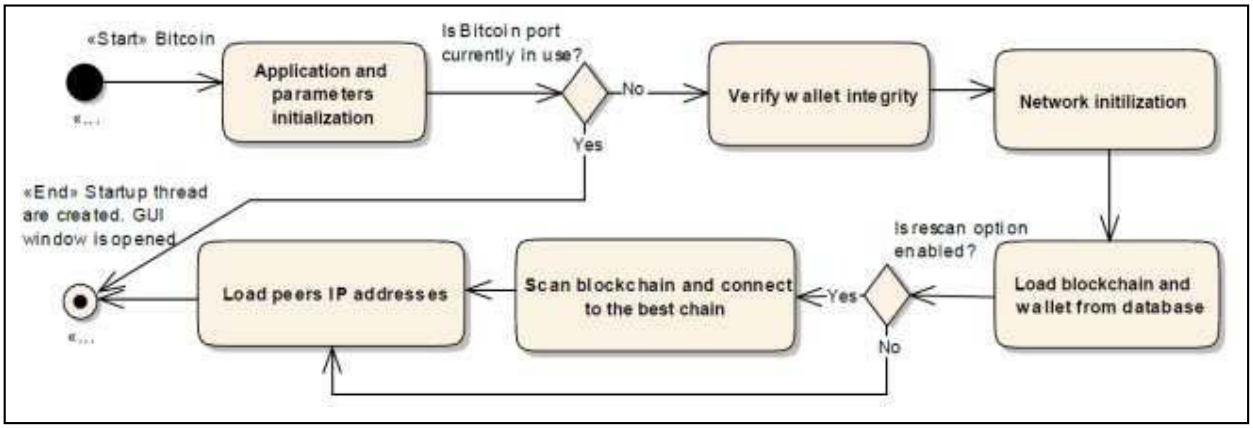

Figure 6: Bitcoin initialization (Source [12])

Their work examines the high priority aspects of Bitcoin architecture3, for example, the main components and the required interactions between the components; Figure 5 shows the Bitcoin transaction domain Model, and bellow مصدر على العثور يتم لم !أخطأ.المرجع the description of components. The authors cover both structure (static architecture) and behavior (dynamic behavior) aspects of the system [12].

Transactions: Transactions serve as a payment verification system, as a mechanism to transfer money from one entity to another.

Memory Pool: In each node, there is a local storage of unconfirmed transactions.

Wallet and Coin Selection: All information about user's accounts is saved in Bitcoin wallet, i.e., addresses and the transitions related to them. Moreover, the user has to decide which previous transaction outputs should be selected from the wallet as inputs to the current transaction.

Blockchain: Blockchain serves: first, facilitates the coordination between network's nodes to process transactions. Second, encapsulates the values of proof-of-work which it responsible for maintaining network's security. Finally, helps in verifying the ownership of transferred coins.

Alerting System: When a critical problem occurs, a notification message broadcast over the Bitcoin network

File System and Database: The file system and the database structure maintained by fully compliant Bitcoin clients

The authors describe the Bitcoin initialization and running processes, Figure 6 illustrates a flowchart of the processes that take place once the Bitcoin application starts.

The authors recommend finding alternative design approaches that enhance and improve the current architecture and decrease potential security risks when integrating further components or extending the current system architecture.

Figure 8 show the initialization process of the bitcoin from the parameters step load till the GUI step.

V. Conclusion and Future Work

The purpose of this review was to view the trends in cryptocurrencies studies and see how the blockchain technology concept used in order to create cryptocurrencies and solve cryptocurrencies problems. It is clear from the research reviewed that the blockchain solving many problems such as double spending and avoid using a trusted third party to do the transactions.

Along with this, it is also clear that there are some factors in Bitcoin protocol need to be improving like consistency. Current research supports the use of blockchain, as discussed above; however, we recommend the cryptocurrencies based on blockchain technology as a good solution to replace the existing physical currencies.

Future work might take a closer look at how to customize blockchain to be using as Palestinian currency and building the mathematical model of this currency.

Acknowledgement

I would like to make this a useful document, updating it as I receive comments. Please take a moment to email me any comments or suggestions for improvement. Thanks to Dr. Fadi Shrouf for supporting me.

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- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11'", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.

Format Structure

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, “What words would a source have to include to be truly valuable in a research paper?” Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

Preparation of Eletronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

Tips for writing a good quality Computer Science Research Paper

Techniques for writing a good quality computer science research paper:

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of computer science then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

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.

Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.

Segment draft and final research paper: You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else's analysis. Do not allow anyone else to proofread your manuscript.

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.

Criterion for Grading a Research Paper (Compilation) by Global Journals Inc. (US)

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals Inc. (US).

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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Global Journal of Computer Science and Technology

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