

Wireless Transmission of GPS Values for UAV's Navigation using 802.15.4b Lan Standard Protocol (Zigbee)

Mannika Garg¹, Abdul Wahid Ansari² and Sushabhan Choudhury³

¹ Univeristy of petroleum and energy studies

Received: 7 December 2012 Accepted: 1 January 2013 Published: 15 January 2013

Abstract

In the last few years UAVs systems have become relevant for many military applications including non military security work such as surveillance of pipelines. An autonomous UAV is often preferred for those missions that are dull, dirty or dangerous for manned aircraft. It has the ability to hover and it has free band GPS direction and tilt sensors for smooth navigation. There is no person on board to control the aircraft. Due to the advancement in satellite receiver tracking systems, an integrated system employing latest tracking techniques using satellite Receiver in the form of GPS is integrated with this vehicle. The data of GPS is transferred to the vehicle wirelessly with the help of Zigbee transceiver module. The GPS has made navigation systems practical for a number of land-vehicle navigation applications. In this paper we have devised an algorithm and hardware implementation scheme to transfer the GPS values from the PAV to the ground station wirelessly to control its aerial navigation.

Index terms— GPS, microcontroller, UAV usart, wireless module (Zigbee).

1 Introduction

n UAV is an aerial aircraft with no onboard pilot. It can be RC (Remote Controlled) or can be controlled autonomously whether using preprogrammed plans or dynamically complex control systems [1]. As UAVs are free from the burden of physiological limitations caused by human pilots, they can be designed for maximum on-station times.

They are mainly used for surveillance, reconnaissance [10] and penetration of hostile territory without the deployment of human beings in areas of high risk. Now-a-days, motorvehicles, farming and mining equipment, and many varieties of land-based vehicles are equipped with GPS based navigation system [8]. As per recent technologies used a vehicle tracking system was designed for making a smart farm in the framework of precision agriculture by employing the GPS and Zigbee wireless network including software for acquiring data from the vehicle, storing and displaying it in real time on a web site. [2]. System was employed as tractor tracking system based on mesh topology to cover the large area and data is collected from the tractor [3]. Using 32 bits LPC2220 microprocessor of ARM7, and muC/OS-II real-time embedded operating system, GPS with Zigbee a record system is designed that can provide precise synchronization among instruments and also position the fault, and also allow communication among instruments [4]. The DDAU (Distributed Data Acquisition Unit) used in three-dimensional electromagnetic exploration targeted for oil and gas (hydrocarbon) detection, is composed of data acquisition and DSP module, embedded control module, GPS sync and timing module, and power supply module. The embedded control module includes ZigBee OEM board, temperature sensor, Ethernet, 4 UARTs, 4 SPIs, 2 SSCs, 8 GB NAND flash and 8 MB NOR flashes, is based on AT91RM9200 and Linux 2.6 [5]. With the advancement in technology an enhancement scheme for GPSSignals received on an unmanned aerial-vehicle helicopter system is introduced where using Kalman filter the smooth and accurate signals are generated for automatic flight control systems [6]. A Real-time Aerial Monitoring System performing the rapid mapping in an emergency situation using the position/attitude information obtained from GPS/IMU is used to perform the

aerial triangulation without GCPs. The positions and attitudes of GPS/INS integration with the solution from AT in regular intervals are updated. The GPS/IMU/Image data for an UAV-based aerial monitoring system is simulated and compared with the result of GPS/INS/AT with and without updates from AT [7].

In this paper we are representing an aerial system which can fly in the air based on the decisions and directions decided by the person sitting on the ground to make it move on a concerned path to fulfill the target. Here we are focusing on the wireless navigation system which can control the system during its flight. First we are preparing a database which contains the GPS values of different locations which are traversed frequently. This database is included in the program code. Whenever change in the position of the vehicle is required a command is send from the control room and then vehicle will continuously check the GPS value of that particular location where it has to reach. When the value matches with the stored GPS value that becomes its destination. Here we have designed a network with its hardware design. This module is designed using center tapped 9-0-9 transformer [9] to step down the AC voltage, 1000uf/35V electrolytic capacitor which is used as a filter circuit, IN4007 diodes used to form a bridge rectifier to convert AC to DC, 7805 regulated IC to obtain a 5V at the output of the regulator, 330 Ω resistor and a LED as an indicator. These components are mounted to obtain 5V, 500mA of power supply to drive our whole protocol.

ii. Embedded Microcontroller There is a whole wide range of controllers available in the market. But this particular project is developed using AVR series of microcontroller (ATMEGA16) because of its inbuilt USART and its variable frequency. ATmega16 is a low-power CMOS 8bit microcontroller based on the AVR RISC architecture [11]. By executing powerful instructions in a single clock cycle, the ATmega16 achieves throughputs approaching 1 MIPS per MHz, allowing the system designed to optimize power consumption versus processing speed. Further it also minimizes the cost of this personal area network.

iii. Transmitting module It is a low power, low cost 2.4 GHz transceiver designed for wireless applications. The ZigBee is designed for the 2400-2483.5 MHz ISM (Industrial, Scientific and Medical) and SRD (Short Range Device) frequency band. This is the radio frequency receiver module, through which OEM designers can design the remote control applications in the fastest way. The circuit is designed with SMD components and the module size is small enough that can be used for all types of applications. The modules are using IC CC2500 made by Texas Instrument.

2 iv. GPS (Navigation module)

The GPS is actually a constellation of 27 Earthorbiting satellites (24 in operation and three extras in case one fails). GPS is widely characterized as satellite navigation or a satellite positioning system, providing signals for geo location and for safe and efficient movement, measure, and chase of individuals, vehicles, and different objects anyplace from the earth's surface to celestial orbit in house.

3 v. USART

The USART is additionally called a Serial Communications Interface or SCI. The USART are often configured as a full duplex asynchronous system that may communicate with peripheral devices like CRT(Cathode Ray Tube) terminals and private computers, or it are often configured as a half -duplex synchronous system that may communicate with peripheral devices like A/D or D/A integrated circuits and Serial EEPROMs etc. The components used under this section are described below: i. Power Supply Unit: It is same as described above.

ii. Zig Bee Module: It is same as explained above in transmitting section

iii. Display Module

The LCD LM016L (16x2) is interfaced with AVR microcontroller to display the data information. The data pins of LCD i.e., 11,12,13,14 are connected to port C (PC0 through PC3) of the AVR microcontroller. The control pins of LCD 4, 5, 6 i.e., Register-select (RS), Read/write(R/W) and enable respectively, are interfaced with PD6, PD5 and PD7 of the AVR microcontroller, severally. R/W pin is keep for good low to place the digital display into writing mode. This unit receives character codes (8 bits per character) from a chip or PC, latches the codes to its show knowledge RAM (80-byte) Doctor of Divinity RAM for storing eighty characters,

4 Software Development

The software development of designed system is used to get integration and functionality. Here, 'C' language is used to develop the program to drive the system designed and AVR studio4 is used as compiler (WINAVR is running in backend). AVR studio4 software is free firmware for Windows and Linux operating systems.

To get the result of wireless personal area network application, the microcontroller has been programmed, which involved the following steps.

5 b) Compiling

After collecting the program, it's regenerate to machine level language within the sort of 0's and 1's. This file is named because the Hex file and is saved with the extension (.hex). The compiler additionally generates errors within the program that ought to be removed for correct execution of the program.

The Program is compiled after removing all the errors generated.

6 c) Burning

Burning the machine language (hex) file into the microcontroller's program memory is achieved with a fervent engineer, that is attached to a PC's peripheral. PC's port has been used for the aim.

7 d) Evaluation

The system performs as desired by the user and performs all the tasks expeditiously and effectively the code development section is over and therefore the project is prepared to be put in in any of the economic sites as a private space network. If not, the whole method is perennial once more to rectify the errors.

In the programming of the proposed system is used the following .c and .h file.

8 Conclusion & Future Scope

Both the hardware and software system was tested with real time data and accurate values of the positions were recorded.

This system as compared with other traditional manual inspection is more accurate since it increases the accuracy of data acquisition by using nonlicensed Zigbee protocol which also supports real-time transmission. Also, its operation is flexible since its flight can be controlled from ground station by the designed hardware platform. The measurement is accurate (accuracy in position-5 meters, accuracy in velocity-.1m/s, accuracy in time: 0.1 s). The operation is simple and power consumption is also low (12V/750mA) and it is cost effective also because of using non licensed band. Being wireless it also reduces the complex wiring system. Here, a personal area wireless network is designed and implemented. This can be used for surveying at emergency situations like pipeline damages etc. Further if system is carrying payload then in that case it can be used for transferring the load as per the changes in plans.



Figure 1:

¹© 2013 Global Journals Inc. (US) Global Journal of Computer Science and Technology

²© 2013 Global Journals Inc. (US)

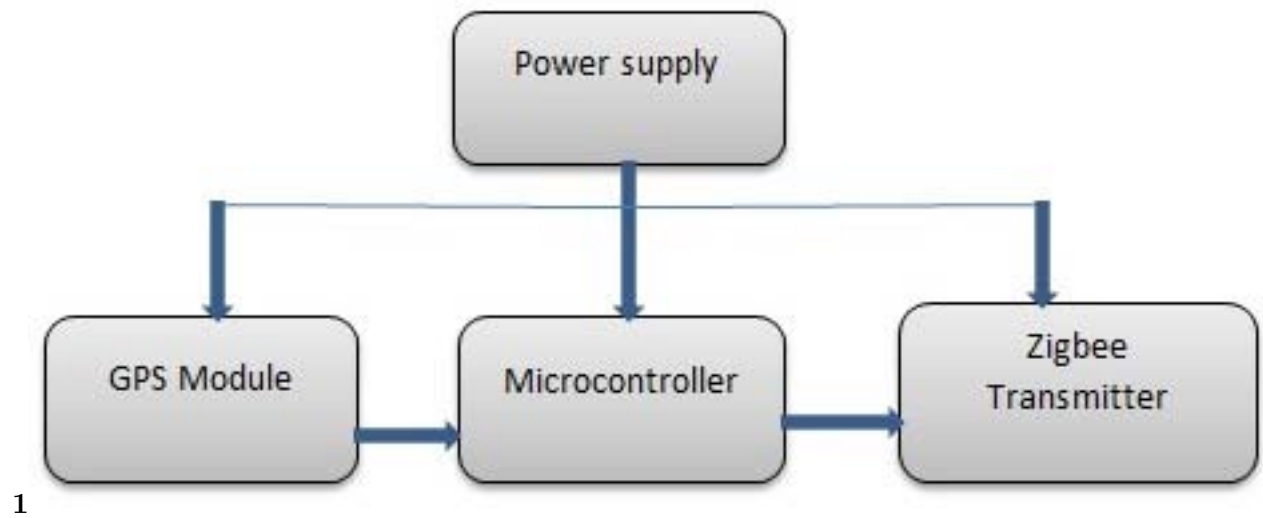


Figure 2: Figure 1 :

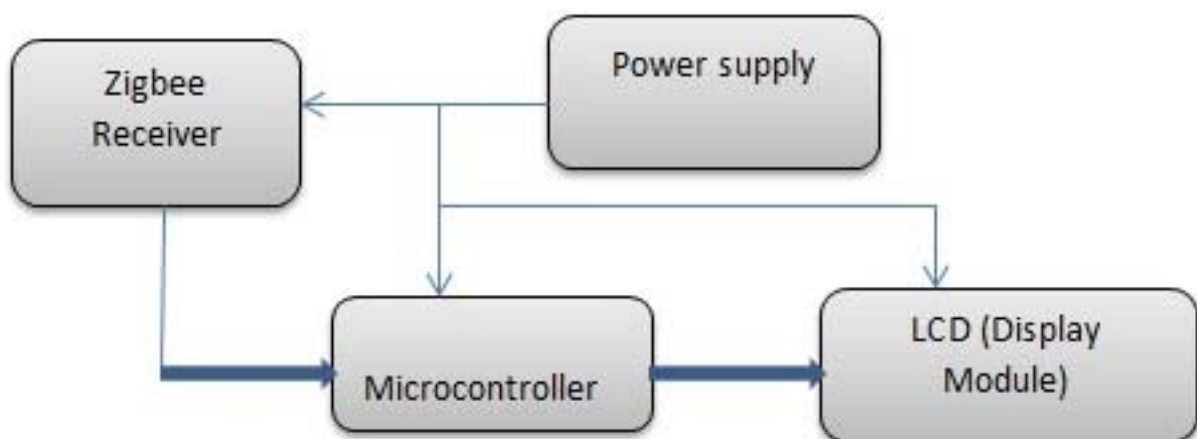
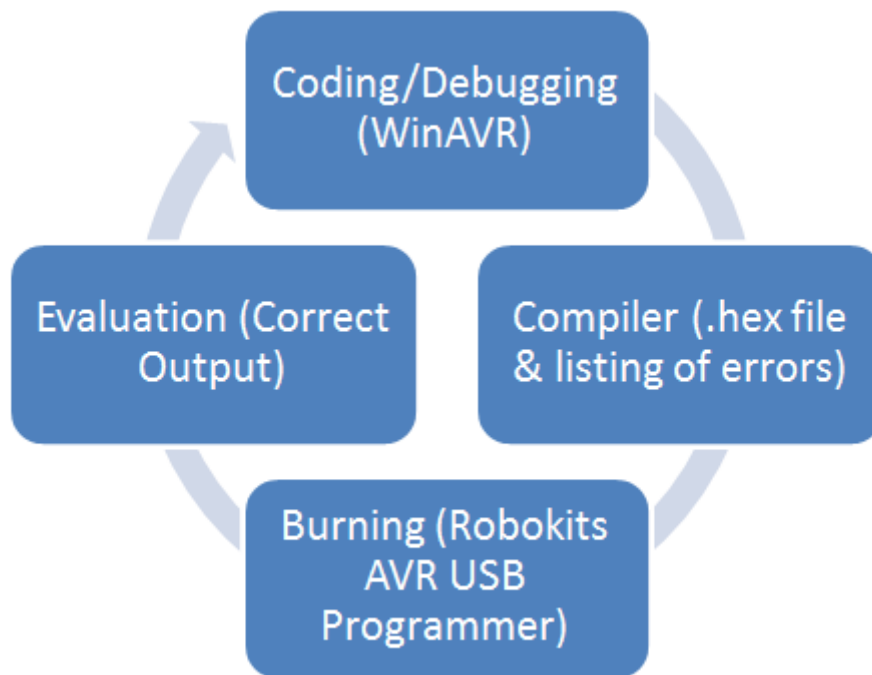
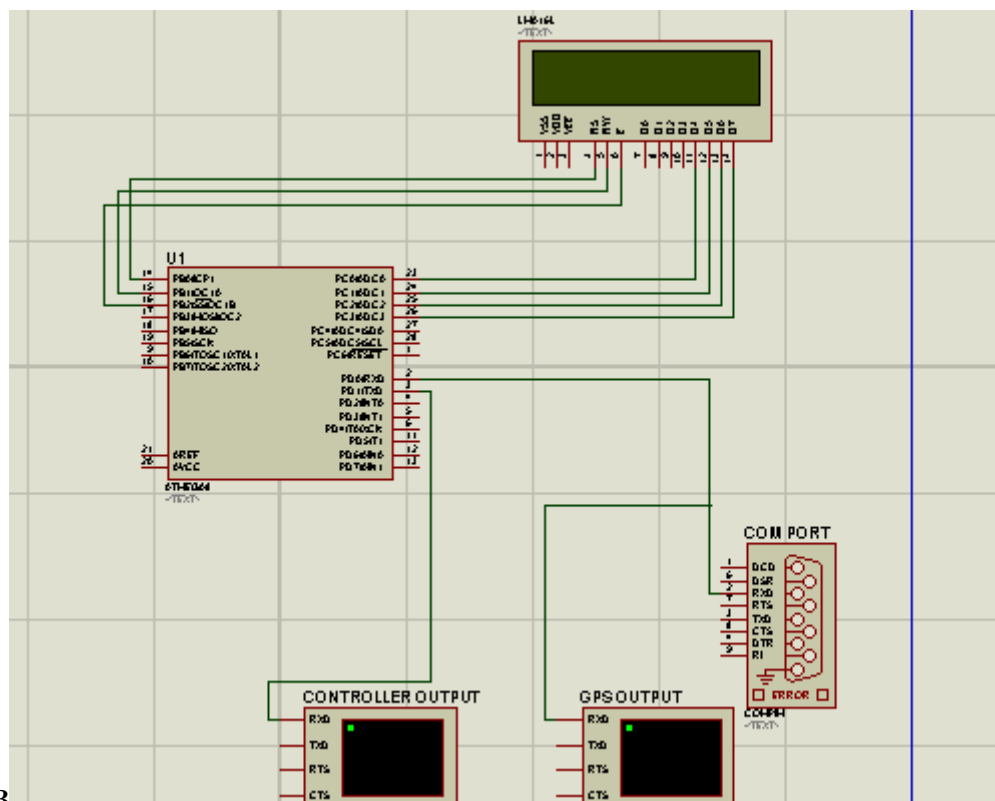


Figure 3:



2

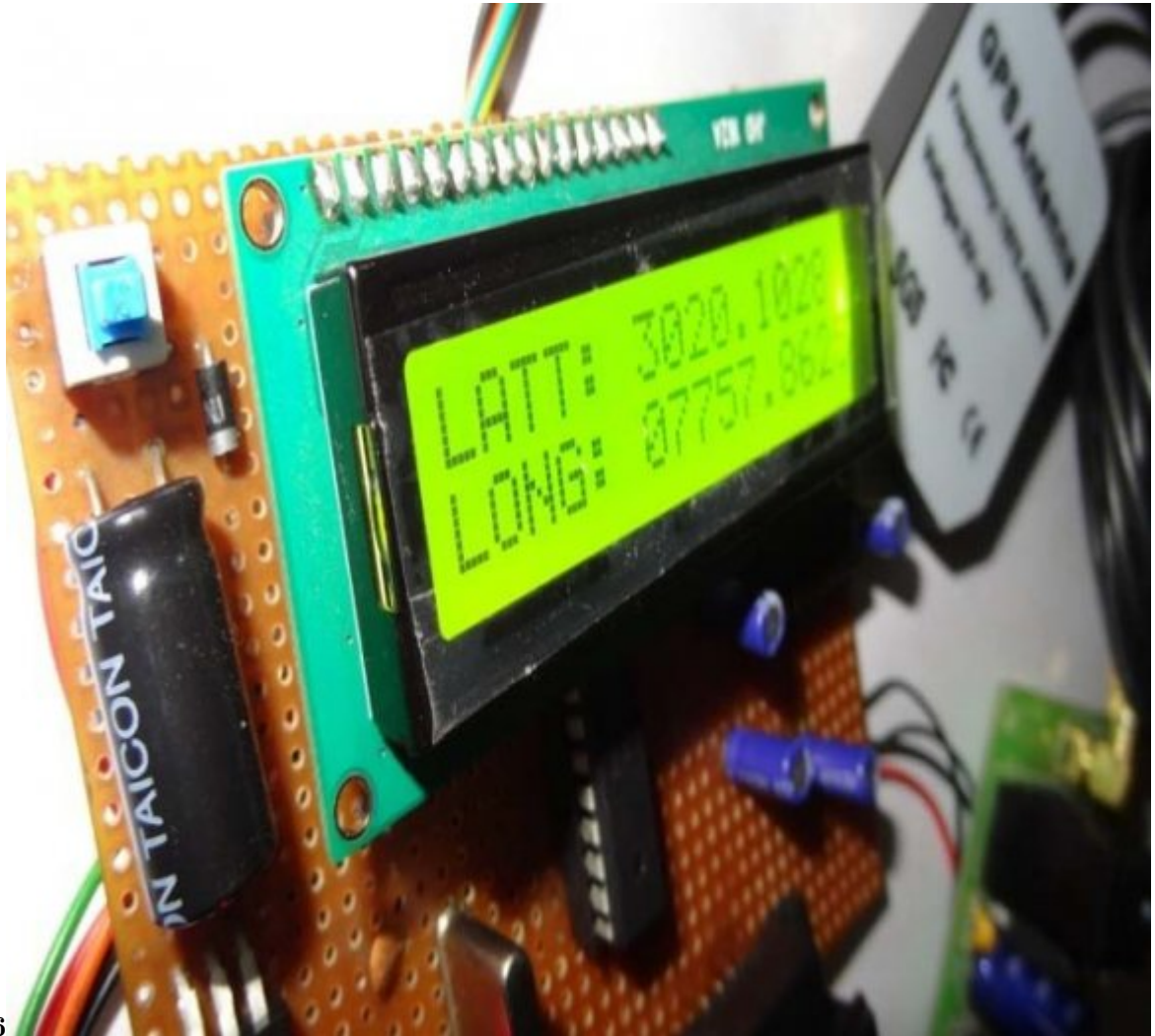
Figure 4: Figure 2 :



3

Figure 5: Figure 3 :





56

Figure 7: Figure 5 :EFigure 6 :

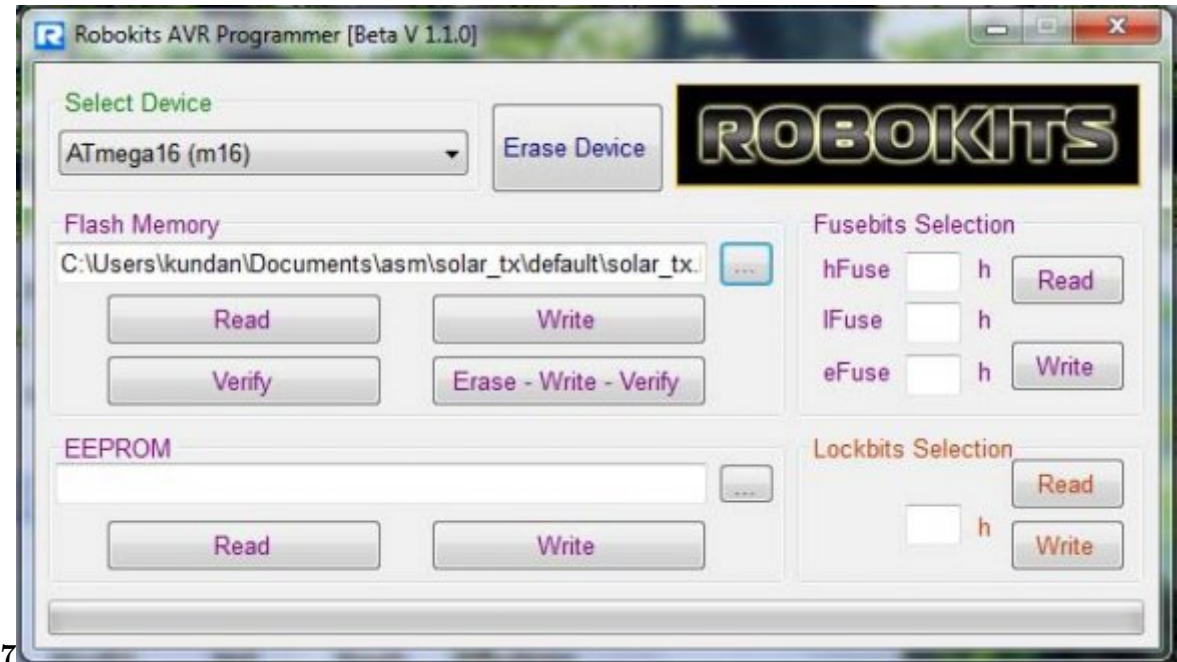


Figure 8: Figure 7 :

.1 Acknowledgement

The authors are thankful to the administration of the UPES, Dehradun for their support in implementation of the work.

[Yun] , Ben Yun .

[Peng] , Kemao Peng .

[Han] , Joong-Hee Han .

[Kwon] , J H Kwon . (Impyeong Lee)

[Qayyum and Mazher] ‘Autonomous Navigated Global Positioning System Based Surveillance Unmanned Aerial Vehicle’. Abdul Qayyum , Moona Mazher . *ITEE Journal* (1) .

[Hualichen; Zhifan and Feng ()] ‘Design of Data Acquisition and Record System Based on Zig Bee and GPS’. Hualichen; Zhifan , Feng . *Workshop on Computational Intelligence and Industrial Application* 2008. p. . (PACIIA ’08. Pacific-Asia)

[Chen ()] ‘Distributed data acquisition unit based on GPS and Zig Bee for electromagnetic exploration” Instrumentation and Measurement Technology Conference (I2MTC)’. Rujun Chen . *He Zhangxiang ; QiuJieting ; He Lanfang ; CaiZixing*, 2010. p. .

[Chen ()] ‘Enhancement of GPS Signals for Automatic Control of a UAV 2 E Helicopter System’. B M Chen . *International Conference on Control and Automation* 2007. p. . (ICCA 2007. IEEE)

[Wang et al.] *Integration of GPS/INS/Vision sensors to navigate unmanned aerial vehicles” Commission I, ICWG I/V*, Jinling Wang , Matthew Garratt , Andrew Lambert , Jack Jianguo Wang , Songlai Han , David Sinclair .

[Abbott and Powell] ‘Land vehicle navigation using GPS” for Heat Detection by Infrared thermography & Alkali metal detector and their alloys in fast reactors Using ZIGBEE Transceiver module based Personal Area Network’. Eric Abbott , David Powell . *UIT Journal*

[Choi ()] ‘Position and Attitude Determination for UAV-Based GPS’. Kyoungah Choi . *IMU and AT without GCPs” International Workshop on Multi-Platform/Multi-Sensor Remote Sensing and Mapping (M2RSM)*, 2011. p. .

[Angel and Brindha ()] ‘Real-time monitoring of GPS-tracking multifunctional vehicle path control and data acquisition based on Zigbee multi-hop mesh network’. G Angel , A Brindha . *International Conference on Recent Advancements in Electrical, Electronics and Control Engineering (ICONRAEeCE)* 2011. p. .

[Watthanawisuth et al. ()] ‘Real-time monitoring of GPStracking tractor based on Zig Bee multi-hop mesh network’. N Watthanawisuth , N Tongrod , T Kerdcharoen , A Tuantranont . *International Conference on Electrical Engineering/Electronics Computer Telecommunications and Information Technology (ECTI-CON)*, 2010. p. .

[Singh et al.] ‘Wireless Micro Power Meter System up to 100 W Load Simulation and Design using 2.4 GHz Transceiver Module’. Rajesh Singh , Siddharth Sobti , Naman Bhandula , Shashank Agarwal , Laxman Poonia . *International Journal of Engineering Research and Applications (IJERA)* 2248-9622.

[Singh et al. (2012)] ‘Wireless Personal Area Network Node Design And Simulaton Of Alcohol Sensor Using Zigbee Transceiver Module’. Rajesh Singh , Shashank Akanksha , Ankit Mishra , Joshi . *International Journal of Engineering Research and Applications (IJERA)* 2248-9622 www.ijera.com. May-Jun 2012. 2 p. .