

# Review Paper on Navigation, Navigational Systems and Methodologies

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**Abstract-** Navigation is a field of study that focuses on the process of monitoring and controlling the movement of a craft or vehicle from one place to another. It is very important as without methods of navigation, man would not have explored the planet and life as we know it today, would not have existed. This paper reviews the various navigational devices and their methods of alerting the user of route changes. A navigation device or simply GPS is an object which is capable of obtaining the co-ordinates by the help of satellite and then determine the exact geographic location of the device. The device may either display the location or route on a screen or through various other means such as LEDs, vibration actuators etc. It concludes that each and every device in use today has their own advantages and drawbacks. After the deployment of new satellites, the accuracy, uptime and accessibility of GPS will improve all around the world. Technology has been moving at a rapid pace in the 21st century, and GPS is no exception. With the development of new software, the new generation of GPS vehicle trackers in the 2020s will have an increased accuracy, up to centimeters close to an asset. The future of GPS tracking is going to be more accurate and effective for personal tracking, as well as business use.

**Keywords-** GPS, Location, Navigation, Route

## I. INTRODUCTION

The field of Navigation deals with the study of the monitoring and control of a vehicle from one point to another. There are four categories of navigation, namely, space navigation, aeronautic navigation, land navigation and marine navigation. The basic concepts of navigation are:

Latitude – angular distance

north or south of the equator

Longitude – angular

distance east or west of the

prime meridian

Loxodrome – line crossing

all meridians of longitude at

the same angle



Figure 1: Lines of Latitude and Longitude

We present a narrative followed by a review of various themes. The paper is divided into the following sections: Section I gives an introduction to navigation, Section II gives the historical perspective about navigation, Section III explains the sensitivity parameters of GPS, Section IV talks about satellite navigation, Section V explains the literature survey on GPS navigation, Section VI explains the literature survey on RFID, Section VII explains the literature survey on GSM, Section VIII is the conclusion for the paper followed by the references.

## II. HISTORICAL PERSPECTIVE

The modern GPS system can be linked as the outcome of the Cold War in the 20th century due to military interest. In 1960, the US Navy introduced Transit Satellite based navigation system in order to facilitate ship navigation.

Following this, the US military consistently improved its navigation technology and satellite system. In 1973, they planned for a worldwide navigational system which eventually became to be known as GPS (Global Positioning System). In 1990, the first production car in the world with built-in GPS navigation system was introduced (Mazda's Eunos

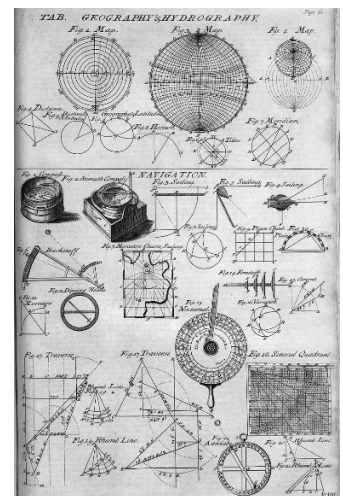


Figure 2: Table of geography, hydrography, and navigation

Cosmo) [1]. In 1991, Mitsubishi introduced GPS

car navigation on the Mitsubishi Debonair (MMCS: Mitsubishi Multi Communication System) [2]. In 1997, a navigation system using Differential GPS was developed as a factory-installed option on the Toyota Prius [3].

As GPS systems became more popular and renowned, the pricing began to fall as their availability increased. Mitac Mio 168 was the first PocketPC to contain a built-in GPS receiver [4]. While the American GPS was the first satellite navigation system to be deployed on a global

scale, and to be made available for commercial use, this is not the only system of its type. Due to military and other concerns, similar systems have been, or will soon be deployed by Russia, the European Union, China, India, and Japan.

The Arab empire significantly contributed to navigation as they had trade routes from the Atlantic Ocean and Mediterranean Sea in the west to the China Sea and Indian Ocean in the east [5]. The sea lanes between India and neighboring lands were the usual form of trade for many centuries, and are responsible for the widespread influence of Indian culture to the societies of Southeast Asia.

### III. SENSITIVITY

GPS devices have different speed, sensitivity and other performance parameters. High sensitivity GPS receivers use large correlator banks to search for GPS signals. They can provide positioning in several but not all indoor locations as the signals are attenuated by various objects or by the building materials. Examples of high sensitivity receiver chips include SiRFstarIII and MediaTek's MTK II [6].

Conventional GPS receivers combine the received GPS signals for 1ms. This allows it to acquire and track signals whose strengths are around -160dBW.

### IV. SATELLITE NAVIGATION

A Satellite Navigation system or Satnav makes use of satellites in order to provide geo-spatial positioning. It can be used for providing position, navigation or tracking. Such systems operate independently of any telephonic or internet reception, even though the use of such technologies can enhance the position information. Few examples for global navigation satellite systems are:

- GPS
- GLONASS
- Galileo
- BeiDou-2



Figure 3: Satellite Navigation

### V. LITERATURE SURVEY ON GPS NAVIGATION

Song Ying; Yu Yang: Song Ying et al proposed Study on Vehicle Navigation System with Real-Time Traffic Information [7]. The paper displays present traffic status picture at the screen terminal through creating new base-line layer on GIS platform. The research studies and improves the dynamic navigation-oriented data content and data model based on GIS-T



Figure 4: Smartphone Navigation

Shivam Verma; Rohit Omanwar; V Sreejith; G S Meera et al proposed a smartphone based indoor navigation system [8]. It presents a system for indoor navigation using off-the-shelf smartphones. In the first phase, a user creates an indoor map of the area by linking panoramic images using our web application, Map Maker. This indoor map is then used by the smartphone-based Navigation application to estimate a user's location, calculate the shortest path and help in navigating the user to a destination. In future work, they plan to extend their smartphone application to automate the process of step counting when capturing panoramas. They also plan to explore real-time image matching techniques using smartphones to increase the accuracy of their indoor navigation system.

Viktor Sineglazov; Stanislav Shildskyi et al proposed Navigation systems based on GSM [9]. Here the necessity of development of navigation system on the base of mobile network for positioning of moving objects was explained. The main advantage of this method is rather fast capability of defining the coordinates in the city. Main disadvantage – is low accuracy of this method of defining the coordinates, because of a huge amount of buildings in the city, that creates interference during the positioning.

J. Saarinen; J. Suomela; S. Heikkila; M. Elomaa; A. Halme et al proposed Personal navigation system [10]. The goal of the project is to develop a localization system that supports localization of multiple entities in the same frame of reference. In the near future, the aim is to develop and test map-based localization for PeNa. The great challenge of the work is to cope with partial priori map.

D. Obradovic; H. Lenz; M. Schupfner et al proposed Sensor fusion in siemens car navigation system [11]. This paper has presented two novel sensor and information source fusion methods implemented in the Siemens car navigation systems. The first sensor fusion is implemented via Kalman

Filter, which updates the odometer and gyroscope signals needed for dead reckoning by using the appropriate GPS measurements. The second novelty presented in this paper is the evaluation of different position candidates on the road map based on the historical information. The Siemens navigation system implemented in Opel cars was awarded the first place (test winner among ten different navigation systems) in January 2002 by the German car magazine Auto Bild.

Hong Zhan; Zhigang Wen; Yuxin Wu; Junwei Zou; Shan Li et al proposed A GPS navigation system based on the internet of Things platform [12]. With the help of this system, the pressure of traffic system will be eased. It can reduce the time and energy consumption. Similarly, dynamic GPS navigation can also be used in some emergency vehicle, for example, fire trucks and emergency vehicles can find the best path to save property and lives.

Ryo Nitami; Akimasa Suzuki; Yoshitoshi Murata et al proposed Development of a pedestrian navigation system without additional infrastructures [13]. In this paper, the authors proposed an indoor navigation system that utilizes room numbers and the numbering pattern of a floor. A smartphone application is developed for navigation from the entrance of a floor to a target room.

E. Abbott; D. Powell et al proposed Land-vehicle navigation using GPS [14]. The purpose of this paper is to introduce the reader to various land-vehicle navigation applications and to present research that explores one particular technical aspect of land-vehicle navigation.

Susovan Jana; Matangini Chattopadhyay et al proposed Event-driven university campus navigation system on android platform [15]. This paper deals with the development of an application for in-campus navigation. It provides the shortest route for users from their current location to desired location and can also be customized depending upon the events.

Adam Satan et al proposed Bluetooth-based indoor navigation mobile system [16]. It is an application for indoor navigation which uses Bluetooth Low Energy beacons to calculate the user's position. Dijkstra's shortest path algorithm is used to determine the route. Information about the building is stored in a local database on the smart phone so the app can work off-line. The application was implemented in Android platform.

## VI. LITERATURE SURVEY ON RFID

R. Want et al proposed Introduction to RFID technology [17]. This paper deals with the types of RFID and

how they are implemented. It also states the various applications where RFID is used and how they are advantageous over the conventional methods.

Dong-Liang Wu; Wing W. Y. Ng; Daniel S. Yeung; Hai-Lan Ding et al proposed Brief survey on current RFID applications [18]. RFID technology has a lot of advantages, such as simultaneous collection



Figure 5: RFID Applications

of large quantities of data with high accuracy, contactless, etc. RFID technology has an increasing influence to our lives and gradually replaces barcode in supermarket and logistics management. Most of current RFID applications are for access control and goods location tracking. In fact, RFID provides the function of individual goods identification and online changeable data storage.

Xiaolu Cheng; Jessica Lu; Wei Cheng et al proposed a Survey on RFID Applications in Vehicle Networks [19]. The systems covered in this paper prove that many functions needed in vehicle networks can be actualized with the help of RFID. Although those functions haven't been put into practice yet, and simulation experiments haven't been done to test some of these systems, concepts illustrated in this paper are feasible in theory.

T.S. Lim; S.C. Sim; M.M. Mansor et al proposed RFID based attendance system [20]. This paper describes a low-cost RFID Based Attendance System prototype. The prototype of the system provides several advantages over conventional method of taking attendance in class. It is compact and light weight. The attendance taken is secure and accurate since the tag ID encoding is done using Wiegand 26-bit format.

Takanori Washiro et al proposed Electric RFID communication via human body [21]. Electric RFID communication via human body is achieved by developing electric field antenna for electric inductive coupling. It is easy to adopt RFID to

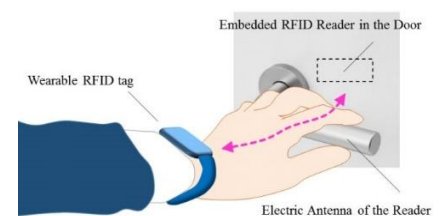


Figure 6: Smart Key with electronic RFID

Human Body Communication by converting magnetic field to electric field of conventional RFID. It has a big potential to make the ambient intelligence and the smarter IoT. RFID of



Human Body Communication provides opportunities to use RFID where it has not been used.

Chang-He Li; Keng-Weng Lao; Kam-Weng Tam et al proposed a Flooding Warning System based on RFID Tag Array for Energy Facility [22]. In this paper, a flood warning system is proposed which uses an RFID tag array. The main focus of this paper is Received Signal Strength Indicator (RSSI), which is the measurement of the power present in the received radio signal. Based on this RSSI, flood condition can be detected.

G. SriHarsha Vardhan; Naveen Sivadasan; Ashudeb Dutta et al proposed QR-code based chip-less RFID system for unique identification [23]. The proposed design gives the accessibility to know the details of person by reading the tag and also to get the information about the people who have been stuck in building in a disaster hit area. It consists of QR code antennas for transmission of information.

Zhu Zhi-yuan; Ren He; Tan Jie et al proposed a method for optimizing the position of passive UHF RFID tags [24]. This paper deals with how the positions of the RFID tags can affect the reading rate. The distance between the tag and the reader is varied along a container and the positions at which data rate is maximum is taken into consideration. However the restrictions are that this method can only be implemented for regularly shaped objects and for simple environments.

Norakmar Arbain; Noor Firdaus Nordin; Naimah Mat Isa; Shuria Saaidin et al proposed LAS: Web-based laboratory attendance system by integrating RFID-ARDUINO technology [25] is a project that improves the current attendance system in university especially in laboratory. The system facilitates the staff in easier ways to perform the student's attendance evaluation, grading process and distributions of laboratory documents, as it can be done online. Furthermore, this RFID Arduino approach system helps the university management in several aspects such as reduce cost and saved energy and time for human efforts and facilities. It can encourage the community to use widely the information and communication technology (ICT) in daily human activities.

Aneeqa Ramzan; Saad Rehman; Aqib Perwaiz et al proposed RFID technology: Beyond cash-based methods in vending machine [26]. The paper introduces a cashless and secure payment system development in vending machine, using RFID technology based on electromagnetic fields. Contactless and battery free wireless sensor RFID, integrated with GSM and Arduino provides numerous benefits, and has

also solved the issues related to traditional coin and note based payment methods like insecurity, auditing and storing of cash.

## VII. LITERATURE SURVEY ON GSM

Tigor Hamonangan Nasution; Muhammad Anggia Muchtar; Ikhsan Siregar; Ulfi Andayani; Esra Christian; Emerson Pascawira Sinulingga et al proposed Electrical appliances control prototype by using GSM module and Arduino [27]. The system consists of an Arduino microcontroller as a control, SIM900 as SMS gateway, Relays as outputs and phones as input. The working principle is Arduino will receive input in the form of a string of data from mobile phones via SMS gateway. Then Arduino will process the data and control

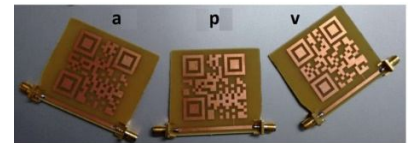


Figure 7: QR code Antennas

relay in accordance with the data. If the relay is ON, the electrical equipment such as lights, fans, and others will be ON as well and also if the relay off the electrical equipment will be off as well.

Pratiksha W. Digarse; Sanjaykumar L. Patil et al proposed Arduino UNO and GSM based wireless health monitoring system for patients [28]. Arduino UNO and GSM Based Wireless Health monitoring system is the enhanced technology as compared to the existing technology because it sends SMS quickly, is easy to use and also it can work for longer distances at a very low cost. It sends measured heart rate (heart beat), body temperature and saline level to the doctor so if any critical situation occurs in the patient's biomedical parameters, then doctors can easily take action.

Sneha Chaudhari; Purvang Rathod; Ashfaque Shaikh; Darshan Vora; Jignesha Ahir et al proposed Smart energy meter using Arduino and GSM [29]. This method provides domestic power consumption accurately, safely and with relatively fast update rate. This system allows the consumer to monitor and track their usage. Information about energy consumption helps the user to reduce energy usage and helps save both money and energy.

Md. Marufi Rahman; Jannatul Robaiat Mou; Kusum Tara; Md. Ismail Sarkar et al proposed Real time Google map and Arduino based vehicle tracking system [30]. The proposed Arduino based vehicle tracking system using GPS and GSM technology were developed and tested successfully to track the exact location of a moving or stationary vehicle in real time. The system provides better service and cost-effective solution for users. A vehicle's geographic coordinates obtained from an in-vehicle device. A cell phone has been used to display location of vehicle on Google map. The system was able to

experimentally demonstrate its effective performance to track a vehicle's location anytime from anywhere.



Figure 8: Real time co-ordinates of the vehicle

K. Balamurugan; S. Elangovan; R. Mahalakshmi; R. Pavithra et al proposed Automatic check-post and fast track toll system using RFID and GSM module with security system [31]. This system can reduce the real time problem of checking process at check posts and also reduce the waiting time and fuel consumption of every vehicle in the toll plaza by automatic checking and automatic deduction of toll fee. It also enhances the security of the vehicle.

P. Satya Ravi Teja; V. Kushal; A. Sai Srikar; K. Srinivasan et al proposed Photosensitive security system for theft detection and control using GSM technology [32]. This paper illustrates the design and development of a theft control system for security lockers, homes, bank lockers, jewelry outlets, etc. The proposed system consists of an LDR (Light Dependent Resistor) based sensor which acts as an electronic eye for detecting the theft or attempt, and a signaling procedure based on SMS using GSM (Global Systems for Mobile communications) technology. The GSM based communication helps the owner and concerned authorities to take necessary and timely action in order to prevent the theft.

Himadri Nath Saha; Tanishq Banerjee; Suvrojit Kumar Saha; Ayush Das; Arjun Dutta; Anirup Roy; Samabrit Kund; Arghyadyuti Patra; Arkodip Neogi; Smita Bandyopadhyay; Sampri Das; Niloy Chakravorty et al proposed Smart Irrigation System Using Arduino and GSM Module [33]. This project has been made in order to reduce the work load of the farmers and increase the efficiency of the irrigation process. With the help of this system, the water tank will be automatically filled with water, when empty, from reservoir, without any manual work. When the water reaches the highest level in the tank, which is measured by the water level circuit,

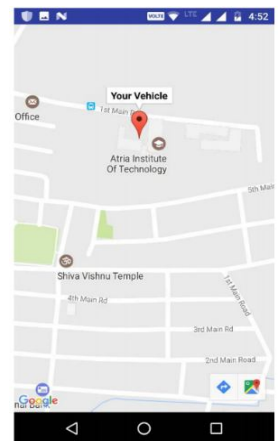


Figure 9: Overall circuit

the Arduino gets the signal and again sends SMS alert to the owner of the crop. After SMS alert, the Arduino switches off the second pump, with the help of the relay module.

N. S. Ishak; Aziati H. Awang; N. N. S. Bahri; A. M. M. Zaimi et al proposed GSM activated watering system prototype [34]. Here, the Arduino UNO is connected directly with AC to DC adapter that is functioning as power supply for the system. The moisture sensor will start measuring according to the code that has been uploaded into the Arduino board. Then, if the analog sensor reading is reached more than a set value, GSM will send a simple text SMS to user. User needs to reply "ON" or ignore the SMS and the system will not do anything. If user reply "ON", the water pump starts working and the pump will stop until the moisture sensor reading reached the set value.

Neha Mangla; G Sivananda; Aishwarya Kashyap; Vinutha et al proposed a GPS-GSM predicated vehicle tracking system, monitored in a mobile app based on Google Maps [35]. A mobile app is developed using android studio and google maps API to locate the traced vehicle on the map and also help the user navigate to it. The vehicle tracking system consists of a GPS antenna that generates the coordinates, a GSM modem for receiving requests from the user and sending the coordinates (viz. latitude and longitude) of the vehicle generated by the GPS antenna via SMS, an Atmega microcontroller as an interface and a mobile application based on google maps to point out the location of the vehicle.



Prashant Ahuja; Ketan Bhavsar et al proposed Microcontroller Based Smart Helmet Using GSM & GPRS [36]. The device

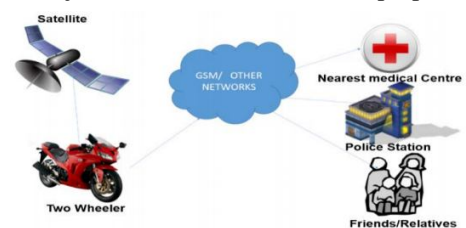


Figure 11: Proposed system

described in this paper works in the following manner. If the adder detects two or more sensor's yes signal; then it will give active signal to Arduino Atmega328 controller which will perform its assigned work that it has to track the GPRS location data of vehicle immediately, send text message and voice message to

registered number (Ambulance, Police Station, Family members) through GSM module.

### VIII. CONCLUSION

After extensive study of papers based on GPS navigation, RFID and GSM, we conclude that these technologies are very versatile and can be used for multiple applications. Since we are mainly focused on navigation, our prime concern is the accuracy of the readings i.e. location. The implemented method/technology must be energy efficient and reliable. Most GPS navigational systems are satellite based and are used with the help of smartphones. Based on the study of RFID, we found that the system needs to have certain level of security in order to protect it from unauthorized access. It also needs to operate at high data rate to ensure speedy functioning of the device. Lastly, based on the study of GSM, we require the SMS to be sent to the user as soon as possible i.e. immediately when a particular event occurs. Overall, we must ensure that all the above said criteria are met in the implementation of our prototype.

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