

Recent Trends in the technological development of Modern Navigation System

Snehasish Bera¹, Koushik Pal², Saynee Paul³, Suniket Pradhan⁴, Aritra Das⁵

Department of Electronics and Communication Engineering^{1,2,3,4,5}

Gurunanak Institute of Technology, Kolkata, India

Abstract: We know that people are connected in the world by their modern technologies which can give them a access to freedom and also they want all the possibilities that we have. So, in this paper we are describing about the navigation system of our modern technology through which we can provide comfort, accuracy on the road, giving voice assistant to protect the driver while driving and also integrate Bluetooth, GPS and Wi-Fi etc. By reviewing this paper, we are instigating the new innovation in the field of navigation system and also here we know the key development in the industry of navigation from where we can see our secure world for our upcoming future generation.

Keywords: Navigation, Augmented Reality, GPS, Radar, Adaptive Routing, IPS etc

I. INTRODUCTION

A system which is called as navigation, are also known as a GPS or Global positioning System. This GPS or navigation system is a technology by using this we can determine the position of the particular vehicles, persons, places, things etc. It's also helps us for reaching that particular position by navigating us through our device which is directly linked with our global satellite. By calculating the positional data, Satellite is used to transmit signals which are also combined with some kind of sensors and mapping technology and give us accurate data of that particular location.

A navigation system has some key component and features which are-

1.1 Satellites: Satellites are majorly used in the navigation system to provide the positioning of the data by relying on a satellite network in the Earth orbit. The navigation device continuously receives the transmitted signals from the satellite.

1.2 Maps and Routing: To exhibit the roads, city, country, landmark and other interesting point navigation system are used typically. For routing related things, they analysing some algorithms to calculate distance, recent condition of traffic and other things which are based on the various factors for a specific type of destination.

1.3 GPS Signal Receiver: The main component of navigation is known as GPS signal receiver. By transmitting the signals towards satellite, it takes the receiving signals and calculates the position of our device.

1.4 Voice Guidance: This system is actively used in so many types of navigation system. Its offer voice guided instructions while driving a vehicle or helps to reach in a particular place. This system provides spoken type technology which provides direction for upcoming lane changes, turns and other types of maneuvers for safety purposes.

1.5 Traffic Information on real time: These types of navigation systems provide alternative types of routes for avoiding accidents and congestion by providing the traffic data. This information gives the users to make some informal decision while they are on the road and enhances the estimated arrival time's accuracy

1.6 POI or Points of Interest: This system also helps user for searching some POIs and help them to receive some desired destinations, such as restaurants, tourist attraction gas stations, hotels and many more things.

1.7 Connectivity: Connectivity is also helps to connect any smart phones with Bluetooth or Wi-Fi through the advance navigation system and updated their devices by additional features and services.

1.8 Advance Features: Lane guidance, information about speed limit, mapping 3D, recognizing voice for hand free operation, and vehicles systems integration like audio and climate changing are the advanced features which depends on the sophistication of the system.

Now a days, navigation systems is majorly used in vehicles, portable devices and Smartphone's which enhancing the users safety, convenient and build to navigate secure route for safety purposes.

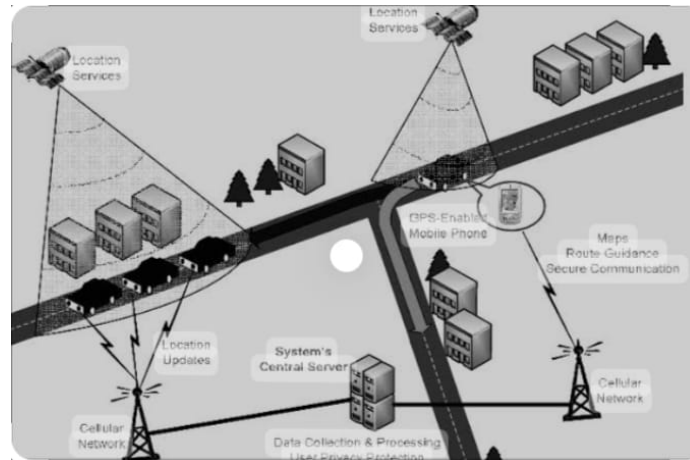


Fig.1 Image of Traffic Information

Innovations in Navigation System

- **Augmented Reality Navigation:** Augmented Reality navigation systems are in corporate use in some big companies like Google and Apple. AR provides some visual cues and direction to the live camera where the digital information displayed on the screen through the real view. Complex urban areas are majorly navigated by using this technology.
- **Car connecting navigation:** Modern vehicles are featuring the integrated navigation system for vehicle functions. On the price of fuel, parking, weather conditions and vehicle health information, real-time data is provided in this system. Seamless information is provided by syncing with the Smartphone app from phone to the car.
- **Indoor Navigation:** Indoor navigation is used to help people where the GPS signals can be weak or non-existent. They are navigated by showing large buildings, airports, shopping malls and stadiums. For providing accurate type of positioning and guidance, these systems use some kind of technology like Bluetooth beacon, Wi-Fi or IPS.

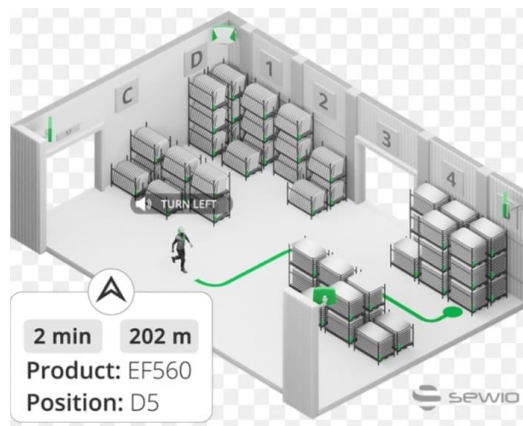


Fig.2 Image of Indoor navigation

- **Language Processing and voice assistant:** Amazon Alexa or Google Assistant are some kind of voice assistant used in navigation systems for increasing incorporating attitude. It allows the users to display the systems by using their natural command language. They can use this type of system by voice command without hands off from the wheel.
- **Cloud-based navigation:** Navigation systems are broadly used this cloud computing system for enhancing it. This type of navigation system gives an access in up-to-date data collection, traffic information and remote

server route calculations. This depends on the current condition which is based on the faster updating time, accuracy improvement and dynamic routing allocation.

- **Personalized and adaptive routing:** Historical data, traffic patterns and individual driving are becoming capable and more intelligent for learning user's preference and habits. These provide personal route suggestions. For avoiding accidents, road closures and traffic congestion, adaptive routing allows the real-time conditions which can dynamically optimized the route.

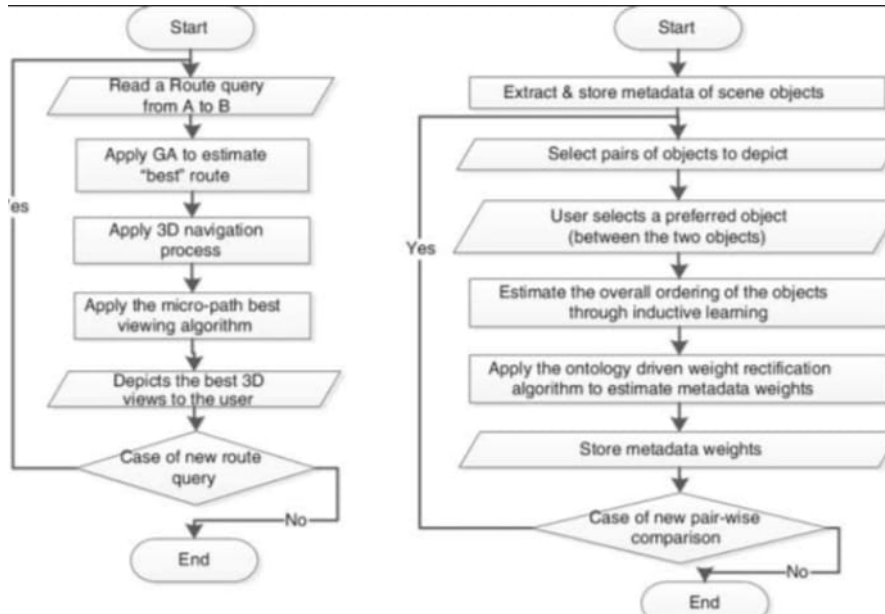


Fig.3 Image of Personalized and Adaptive Routing

- **Integration with Smart Wearable's:** Integration with Smart Wearable's is expanding the navigation system like AR glasses and smart watches. These wearable gives valuable access to navigate conveniently without need of a smart phone or any other devices.

These are some innovations in the navigation system which is according helps us to increase our access rate beyond our boundaries. This technology integrates other emerging technologies like AR, machine learning and sensor fusion.

Key developments in navigation field

There are some developments and advancements in the field of navigation systems and also there are some key area which are-

- **Autonomous Vehicles:** Autonomous Vehicles is one of the most notable developments in the navigation system. Sophisticatedly this type of navigation system includes high-precision GPS, LiDAR sensors and cameras to navigate without intervene human being. There are some companies which are using Automobile navigation technology like Tesla, Waymo and Uber.
- **High-Precision positioning:** For few meter accuracy, traditional GPS provide real time date by their possible way but that's not sufficient now a days. That's why; high-precision positioning system has been focusing to develop them like Real-Time Kinematic GPS and precise point positioning. This technology gives a centimeter level accuracy, enabling precise navigation in industries like agriculture, surveying and construction.
- **Indoor Positioning System (IPS):** IPS technologies are developing for indoor areas where traditional GPS system doesn't work. It relies with RFID (Radio Frequency Identification), Wi-Fi, Bluetooth beacons or other types of method for providing accurate navigation system and great indoor positioning. Ips is used in indoor faculties like airport, shopping mall, retail store etc.
- **Predictive Analysis and Real-Time Traffic Information:** Real-Time traffic information now also provide in the navigation system for better routing purpose and better arrival times. Dynamic routing options and traffic

patterns is used to analyze from various sources including probes, GPS, road sensors and crowd information from our smart phones. Before occurring the congestion, predictive analytics is anticipated those traffic conditions and providing alternate routes.

- **Cloud computing services:** For computational resources and vast amount of data providing ability, cloud computing in navigation system has been revolutionized step by step. This system provides faster routing calculations, fast accuracy and real time updates. Route optimization and personalized recommendations in machine learning have some cloud resource for leverage this system.
- **Multi-sensor fusion:** Multi sensor fusion provides multiple sensors and data source to enhance the speed and relativity. Technologies like sensor fusion like data combining with GPS, magnetometers, radar, LiDAR, inertial sensors and cameras for obtaining reliable navigation solution. This system can handle some challenge environments like urban areas, canals with reception of poor GPS.
- **Advanced Mapping and 3D Visualization:** Advance mapping technologies are providing realistic representations and more details of the environment by leveraging navigation system. For more visually and accurate maps appealing some basic technologies are allows to provide high satellite imaginary, 3D mapping and aerial photography. For navigate complex networks of road in effective way, 3D visualization techniques enable the particular users to allow their maps from different way as they wish.

These are the key developments of the navigation field in our environment and it's described how can we navigate or communicate with our community and socially. Hence, more efficient transportation, open up driving are giving us new possibilities in factories or industries for urban planning and services in emergency.

II. LITERATURE SURVEY

In the paper 1: Embedded vehicle dynamics aiding of USBL/INS underwater navigation system which is held in "IEEE Transactions on Control Systems Technology" where the authors name of this paper are Marco Morgado, Paulo Oliveria, Carlos Silvestre, Jose Fernandes Vasconcelos. This paper describes about the INSs which are low cost and some attitude error, position, velocity technique which can apply under water. They are using some VD which provides motion information. Kalman filters are also described in this paper which is required for VD equations of motion. Also they want to show some results about vehicle dynamics which can produce relevant performance enhancements and the accuracy of the robust modeling uncertainties.

In the paper 2: Reviewing the neurobiological based mobile navigation with robot research system performance which is held in "Journal of Robotics" at the year of 2016 where the belonging author's name are Peter J Zeno, Sarosh Patel, Tarek M Sobh. In this paper they want to describe about the neurobiological and neurophysically navigation system researches since 2000 where they describes about our brain works for navigating and how can a smarter technology navigates everything. It is also incorporate about the models of navigation brain cells and spatial awareness. They want to explore the functionality of the robot systems towards mapdeveloped in the mobile which gives route planning and many more suggestions.

In the paper 3: A mapping in Sonar-based navigation system which is held in the "IEEE International Conference on Robotics and Automation" in 7th April at the year of 1986 at San Francisco in USA. The author of this paper is Alberto Elfes. This paper describes about a sonar-based navigation system which can collect sonar range data to build a multilevel description for the robot level environment. Also he wants to describe about the dolphin system which related to the various mapping representations useability. This systems contexts advance architecture of the software in the autonomous mobile robots.

In the paper 4: Accuracy for achieving high navigation using navigation system inertial way in autonomous underwater vehicles which is held in "Ocean 2011 IEEE" at the year of 2011 in Spain. The paper author's are Robert Panish, Mikell Taylor. This paper represents about the INS navigation system in the AUV manufactured system by Bluefin Robotics Corporation. Here, they want to see the accuracy of the data acquisition. This paper also provides an assessment comprehensively of the advantages and disadvantages of the INS and attentive nature on the accuracy of navigation, power draw, physical size and radiated noise acoustically.

III. CONCLUSION

From all of the above, we can conclude that, we are totally connected with our modern technologies and navigation system is one of the most advance technologies in our real world which exists beyond our mind. This system provides safety, accuracy, comfort, information, suggestion, possibilities, remote control servers, voice guidance for driver's safety and many more outstanding implementation. This also provides GPS navigation system towards our satellite communication and develops themselves day by day which are the key advantage for the human being. Navigation system is not only help every people it also helps us to get a good knowledge about our network communication which have a vast scope for research and development in this field.

REFERENCES

- [1]. Embedded Vehicle Dynamics Aiding for USBL/INS Underwater Navigation System.
Author: Marco Morgado, Paulo Oliveira, Carlos Silvestre, José Fernandes Vasconcelos
7th March, 2013, IEEE Transactions on Control Systems Technology
- [2]. J. B Review of Neurobiologically Based Mobile Robot Navigation System Research Performed Since 2000
Author: Peter J. Zeno, Sarosh Patel, Tarek M. Sobh 25th September, 2016
- [3]. A sonar-based mapping and navigation system
Author: Alberto Elfes
7-10th April, 1986, for IEEE at 6th January, 2003, San Francisco, CA, USA, IEEE International Conference on Robotics and Automation.
- [4]. Achieving high navigation accuracy using inertial navigation systems in autonomous underwater vehicles.
Author: Robert Panish; Mikell Taylor
6-9 June, 2011, for IEEE explore 25th August, 2011, OCEANS 2011 IEEE – Spain
- [5]. Tightly coupled ultrashort baseline and inertial navigation system for underwater vehicles: An experimental validation
Author: M.Morgado, P.Oliveria, C.Silvestre
10th December, 2012