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A SURVEY ON SMART NAVIGATION

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Abstract— *This paper aims to provide the reader with a review of the main technologies explored in the literature to solve the smart navigation and tracking issue. Furthermore, some systems that use these technologies in real-world situations are presented and discussed. This could deliver a better understanding of the state-of-the-art and motivate new research efforts in this promising field. Finally, focusing on one of the major challenges in the field of smart navigation, i.e., navigating, tracking and communication have been reviewed and compared by analysing advantages and drawbacks.*

Key Words: Smart Navigation, GPS, GSM, Location, Navigation, Route.

1. INTRODUCTION

Navigating through the city has become routine work to every other human being. Either trying to find a certain place for work, lunch, entertainment, etc. The traditional way of asking by-standers for directions has become obsolete, people no longer tend to disturb other people or do not even liked to be disturbed for problems not pertaining to themselves. An online analysis website by the name eMarketer predicts that almost 67.6% of more than 155 million smartphone users rely on inbuilt maps and navigation apps by the year 2021, which is more than half the amount of smart phone users. We can be certain of the fact that it is human tendency to open their phone to search for anything they are stuck on, like the same when they have to find a place, they open their in-built navigation app to find the directions for the same. Now keep their phone switched on for the whole time from the starting point of their journey to their destination would be a draining task for both the phone and the person. The phone has to keep running at the background while the person actually advances to his destination which results in battery loss; this is the deciding factor for everyone buying a new phone. The person tends to glance through his phone every time there is a stop or when there is a notification incoming from social media or spam notifications from other apps. This is disturbing to the peace of mind while driving and tends to cause accidents or loss of concentration. In a survey conducted by The Times of India it was found that in the year 2019 fatalities in road crashes caused due to use of mobile phones increased by 33% (4,945) compared to the previous year (3,707) out of total crashes which came up to 44,358.

Tracking is another pressing issue we face in this world. In this era talking about tracking maybe seen as a minor issue but real time tracking is quite adding the fact the same system could help you navigate. People demand real time updates of almost everything (e.g., food delivery, package, buses, trains, airplanes, etc.). Real time tracking helps in estimation of journeys estimated time for your package delivery and in worst case scenarios retrieval of vehicle in case of theft, which is a safety precaution for everyone as they might have invested the better part of their hard-earned money into their vehicles for commutation. Real time tracking can be implemented through integration of Global Positioning System (GPS) and Global System for Mobile Communication (GSM). The former helps in locating the vehicle around the world and the later helps in communicating the location of the same vehicle to the concerned device/individual who wants to know the location of the same.

In the literature, there are several surveys dealing with smart navigation. Some of them focus their attention on one technology pertaining to the navigation system. The paper analyses twenty-three research projects, with the designs, equations, devices, setup and performance evaluation of each paper described in detail and provides directions for future research.

The paper aims to give an updated overview on the popular technologies pertaining to smart navigation in order to demonstrate each applicative scenario requires different requirements and thereby have different outcomes. Finally, in order to provide a practical example, the smart navigation problem is analysed more in detail and different existing systems are compared.

2. LITERATURE SURVEY

Wang B.J; Yang C.H; *et al* developed a smart flashlight navigation support for cyclists [1]. The paper talks about the holographic projection technique that indicates the direction to the riders. The direction beam will be projected in front of the rider. They have worked on factors like bicycle dynamics and visual angle .They have used an android navigation development kit which gives an easy navigation service. They have also integrated a servo motor to control the angle of rotation of the shading plate. Further improvements could be, the navigation system could be integrated on the bicycle,

instead of an extra flashlight mounted on it. The present technique is implemented for bicycles but the same can be implemented to bikes and even for cars. With the inclusion to the direction, more roadmap information can be inserted to show the exact road.

Trent .M ; Abdelgawad .A ; Yelamarthi K ; *et al* proposed a smart wearable navigation system for visually impaired [2]. The paper's main motive is to develop an inexpensive and low power IOT navigation system for blind people. The system contains an array of sensors which are placed on waist belt to detect obstacles, iBeacons to recognize the location and a Raspberry pi to do the data processing. The microcontroller detects the iBeacon's ID and passes it to the cloud accordingly, it will get the information. The text information is converted into audio and plays it via a Bluetooth headset to the user. Thus the above system acts as navigation assistant for blind people. But the usage of the ultrasonic sensors can cause a disadvantage to the system as they have limited detection range and they are sensitive to variation in the temperature.

Devi A ; Therese M.J ; Ganesh R.S ; *et al* implemented a smart navigation guidance system for visually challenged people [3]. In this paper, a system is developed for blind people to guide them in an intelligent way .They have used various modules like camera, ultrasonic sensor ,heartbeat sensor, All the modules are integrated with the main raspberry board which are mainly used to detect and measure the information. The microcontroller module guides them to perform the required action for example, the measured values of the heart beat is greater than the threshold value, it gives the information through the headphone. The global positioning system is used for the continuous tracking of the visually impaired people. They have used various hardware and software packages like tensor flow detection and recognition interface, open CV –python and e-speak. Further enhancement can be inserted with various sensors for examining the health and collecting the information about the objects.

Agarwal ; Mohamaad ; *et al* developed a system for tracing the path with Arduino Uno using GPS and GSM [4]. The main aim of the paper is to develop an embedded system which will be able to track the road in real time. They have used three main modules the GPS shield with A6BGPS, GSM and arduino uno R3 MCU. Global positioning system obtains the information continuously from the satellite and last part is sent to arduino. Arduino extracts that part and converts that into traceable co-ordinates. These are sent to the mobile of the user. The whole process takes 60-75 seconds. By this, the minimum path distance between two points and the time taken can also be found. The main drawbacks are, the system do not have the control on the time cycle of the message. The time taken by the system to send the SMS can be reduced. The position of the satellites plays an important role in obtaining the co-ordinates.

Datta P; U.S.G.V. Dontiboyina *et al* proposed their work Naviride: A smart bicycle computer with GPS waypoint indicators [5] . In this paper, they have introduced a customized guidance which will help the riders in selecting a exact road from many predefined latitude/longitude waypoints. The protocols like SPI and NMEA comes into picture. The current system here is proposed for a bicycle and hence this also includes anti theft tracking system and calorie counter. But the main component here is GPS guidance through which navigation guidance can be obtained. Once the user wants to navigate, a list of saved paths is displayed on LCD. The way points which are stored, are received by the microcontroller and that will guide the users along with their opted paths. Further enhancement of the system can be, instead of fixing list of paths, internet can be used to give better guidance. An application can be developed for the self assessment of workout sessions and routes travelled.

Takahiro Kawamura; Keisuke Umezu; Akihiko Ohsuga *et al* proposed Mobile Navigation for elderly- preliminary Experiment and Evaluation[6].Here they have proposed a system that gathers information about the nearby barriers and gives us information of the barriers accordingly through mobile which consists of GPS. In this paper they've also proposed a system that consists of cellular phones along with GPS. This paper also has the requirements for Navigation system and the barrier notification mechanism. Mainly mobile Navigation system requires data, for the data to get access the information there should be proper networks and the network connections cannot be assured to be proper everywhere, hence network connectivity can be enhanced.

V.B.Larin; A.A.Tunik *et al* proposed On Inertial Navigation system Error Correction [7]. This paper defines an algorithm that has both inertial and navigation system, where varoius devices are used which helps in calculating parameters like speed, etc. The method can replace the biasing the rate of angular sensors. Many assumptions are made which are simplified as sensors cannot give us great accuracy. Next, this kind of application can be used in objects that can travel with lesser seep that cover lesser distance. As this paper is based on the integration of global Navigation system, magnetometer and barometer these meters may depend on the physical environmental parameters such as temperature etc, so this might change the accuracy accordingly.

K.Rajan; E.Kalaiselvan *et al* proposed Intelligent Navigation system for Blind people with Real Time Tracking [8]. This paper talks about the people who cannot see the world and these people who use white canes for travelling. So movement of such kind of people is restricted and hence the main intention is to provide a system that will help blind people to travel with safety. Here they have used ultrasonic sensors to know the range of barriers and they also have used microcontroller. It includes a system that warns through voice and through vibrations. As here ultrasonic

sensors have been used, these sensors include limited testing distance.

Priyan Malarvizhi Kumar; Ushadevi Gandhi; R. Varatharajan; Gunasekaran Manogaran; Jidhesh R; Thanjai Vadivel *et al* proposed Intelligent face recognition and navigation system using neural learning for smart security in IoT[9]. Here they have discussed about recognizing an image and the travel system which gives instant notifications in the form of audio for the blind people. With this these people can move easily from one place to another without any fear. The overall performance of this system is analyzed through ROC. This can be enhanced by implementing this in IoT devices for seeing face reactions.

Francesco Biral; Paolo Bosetti; Roberto Lot *et al* proposed Experimental Evaluation of a system for assisting motorcyclist to safety road bends[10]. In this paper they have discussed about the curve warning concept and its implementation. This experiment has been tested for a pilot campaign, which shows that this system can detect the dangerous situations within less time. With this the riders can drive with confidence towards the curves. This system also has a function called SAFERIDER , which helps riders when they travel through the curved roads.

Velmurugan, L., Raghuraj, G., & Simon, M. J. Google*etal* [11]. This paper tells us about how to develop an optical head mounted device having a wearable computer. It also suggests that the GPS navigation can be done using the Google glass which appears to be virtual reality through smart watch. The Google glass is the receiver circuit which receives the GPS signal and convert the signal into virtual reality image. The processor used is Texas Instruments OMAP4430 that helps in the conversion of the GPS navigation signal into a light signal. This signal then hits the Google glass and the user may see the virtual reality image on it. The few drawbacks of this project are that network system maybe slow in some cases and it is very important to get network for the function of GPS. The device needs handling with utmost care and the breakage cost is high. The usage of the Google Glass over a long period strains the eyes and causes headache.

Kanani, P., &Padole, M. *etal*[12]. This paper tells in case of an emergency it is very critical to know the exact location of the patient so that the right service can be made available. The GPS Neo6m is the sensor used to sence the GPS coordinates and GSM Sim800L sends data over the cloud using mobile network and acting as a gateway. The interfacing is done by Arduino. Google maps API displays the live location of the patient on the Google maps.

Lee, S., Tewelde, G., & Kwon, J. *etal*[13].This paper proposes an effective vehicle tracking system using GPS\GSN\GPRS and a smart-phone application with micro controller to provide better service. They have made use of Atmega328 based Arduino Uno micro controller which is embedded into the vehicle whose real-time location is to be tracked. The information about the geographical coordinates of the vehicle's movement is sent to the data base via GSM\GPRS module at regular intervals of time. The Google maps API helps to display the information of the vehicle according to the requirement of the user.

Goh, B. S., Mahamad, A. K., Saon, S., Isa, K., Ameen, H. A., Ahmadon, M. A., & Yamaguchi, S. *etal*[14]. This paper talks about the importance of system and product development simultaneously and configuration Bluetooth RSSI of an ESP32 module. System development combined required components and libraries and processes to convert the raw data collected from hardware devices into view able results. It makes use of IOT and Proof of concept for indoor locating-based system using Bluetooth connectivity. The method used develop an IOT application of ILS using BLE RSSI process must be an open source. The main challenge was to setup indoor positioning platform. The small drawback of this device is that it only detects devices with Bluetooth signal.

Wongthai, W., Khruahong, S., Srithong, P., &Samphao-ngoen, M *etal*[15].From this paper we can infer how to collect data from a commuting bus based on IOT. It also tells us about the benefits of cloud computing such as storage, processing platforms for the user, etc... Along with the use of smart phone application to determine the position of the bus, they have used infrared sensors to detect, count the number of passengers and automate doors. The bus driver turns on the Wi-Fi which enables MCU and the GPS module. This information is then uploaded onto Thingspeak. After that the passenger can request all types of information given about the bus.

P. Chang, J. M. Lin and Y. Lo *etal* [16] explains how GPS, INS and GIS integration can be achieved which are the three main principles for achieving proper navigation. The integration of GPS with INS was achieved using Kalman filter. The algorithm is explained in detail. The attention is then moved towards voice control being integrated with a smart system that can compute the commands for getting the required output feasible for our need; But what is noticed that the device is not quite perfect with the surrounding noise interfering being a major problem for detecting commands and also practical implementation in devices is very power consuming at the same time.

Beheshti, E., Van Devender, A., & Horn, M. *et al* [17] lays emphasis on the fact how recipients should use navigational strategies for navigation. For example, one should use landmarks or certain references for moving around a place. Then there is an extensive differentiation between different type of interfaces and their interaction and listing out their advantages and disadvantages. Out of the three comparisons presented the most effective turns out to be multi-touch gestured map interaction as it is where the future is heading and the other interactions consisting of only mouse and touch seem to be obsolete. While this being said we can also infer that there is not much research done in the same area

as there might be a lack of scope that is sensed by people and hence a proper conclusion wouldn't be fair for the same.

Wang, Yang &Beullens, Patrick & Liu, Honghai& Brown, David & Thornton, Tim & Proud, Richard [18]. The paper mainly revolves around the notion both travel distance and travel time are important performance criteria in a navigation system and thereby to understand and obtain travel speed. It later factors in an algorithm called dynamic routing algorithm that is used to find the most optimum route between two points depending on shortest distance or fastest arrival time and numerous other factors. It continues to explain speeding algorithm using time series approach which is a set of statistical observations recorded sequentially in a chronological order. The most challenging part of this ideology is that it relies mainly on expert knowledge and might vary when partial domain knowledge is available.

Serrão, M. &Shahrabadi, Saeed & Moreno, M. & José, João & Rodrigues, José & Rodrigues, Joao & du Buf, J *et al* [19] explain geographic information system in a smaller scale for better understanding while at the same time providing a feasible solution for navigation of blind people in buildings. They start off by creating a database containing the building details with all it specifics, that is the position of corridor, windows, doors, elevator, etc. Then they tag certain unique objects or positions as landmarks to able to clearly discriminate all the places in the building clearly. Then the various algorithms are run to detect doors and other obstacles through the input camera data and the distance through mapping of the image depth through the same. The same is repeated for the stairs as well. Now putting all this together, the optimal route is planned and mapped and is set for easy navigation. Landmarks did not prove to be the most effective and similar features present in the same building at different floors made it quite difficult for implementation. More obstacles were faced when it came to detection of doors, stairs and a few errors due to poor lighting conditions.

Hlaing, Ni & Naing, Ma & Naing, San*et al [20]*. This paper stresses on how important tracking is, how real time tracking can be implemented and how it is the future of tracking. It showcases a device that sends and receives a message using GSM module and another GSM based mobile phone. The message is sent to the owner /client mobile with the location of the vehicle which is in form of latitude and longitude which can be put into google maps to get the visual location.A GSM modem is used to send latitude and longitude of the vehicle from aremote place. The GPS modem gives the data i.e., the latitude and longitude indicating the position of the vehicle.This paper also shows how to interface GSM, GPS module to an Arduino board along with a lcd screen for live tracking and communication with the mobile device and the vehicle. There was no direct way to access google maps without having to copy paste the co-ordinates, but it is very easily upgradable model. It can work only where there is good connectivity with the satellite, even when there was a good connection sometimes it failed to function.

3. CONCLUSIONS

The attention towards smart navigation is slowly but surely blooming having a very bright future for most features discussed above implemented into a single device which can be attached to your mode of commutation, keeping in my mind this may differ with respect to different cases and specific application required by the user. There is a huge scope in terms of accuracy, coverage, cost, area, robustness, scalability, and so on. This paper provides a brief if not detailed view of previous attempts of reaching smart navigation or certain applications being implemented in the past by various researchers and research groups. Particular attention has been given to navigation outside the phone either through Bluetooth or Wi-fi which has been a daunting task to do for most people who have tried. This paper can be used as a reference if not the source for future developments and blooming ideas in this field.

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