

A Review of use of GIS in Mobile Technology

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Abstract— *Use of GIS in mobile technology finds a large number of applications in location tracking, safety, as a wearable device etc. In this work we review some of the applications related to acquiring the spatial coordinates of the object/place under consideration and using them for analysis, tracking, safeguarding people/objects making use of mobile technology and IOT. It is observed that with most of the applications unidirectional information is obtained. However efforts are underway and implemented in very few systems to have bidirectional response.*

Keywords— *Arduino Uno device, Safety, wearable, GSM, GPS, location, tracking, security, encryption, GIS.*

I. INTRODUCTION

GIS stands for geographic information system. GIS is a tool for working with geographic information [1]. It is also called as a geospatial information system. The data and associated attributes are spatially referenced to the earth which can be captured, stored, analyzed and managed using this system.[1].

Spatial data is obtained from satellite using GPS / GSM Module and sent to the central server by mobile SMS getaway of web based technology. GIS tool integrated with the server uses this spatial coordinates for further processing.

II. REVIEW

GIS can be used for a variety of mobile based applications. Some of these applications like, Tracking, Safety, Remote Sensing and Monitoring and Security have been discussed here.

A. Tracking:

A fully automatic system for theft detection called radioactive source tracer anti-theft system was developed in [2]. It uses a detection probe, along with an RFID, GSM and GPS.

In this system the source object is embedded with radioactive material. If source object is stolen the system can acquire non-contact information about the object. In case of an unauthorized movement of radioactive source, the anti-theft system starts working. The system maintains and tracks its movements and sends alarm messages to specified contact and also displays the location of the radioactive source.

Thus source tracer anti-theft system starts working automatically. Functions of monitoring and tracking ,sending alarm message to specified phone number , display of location of the source and it's movement can be tracked automatically [2].

Use of sensors and micro controller technologies has enabled gathering of vehicle data / information on mobile [3]. On-Board Diagnostics (OBD) allows collecting data like RPM of engine, speed, consumption of fuel, GPS Locations etc, of moving vehicles. For real-time and offline analysis the information can then be sent to a remote server.

In [3] authors have developed data collection and visualization tools to analyse driving behaviours. They have also developed library for accessing various sensors in vehicles. They also discuss security, and privacy issues specific to vehicular networks.

Other dimension of use of GIS can be seen in [4]. Here GIS along with real time monitoring ability of GPS is exploited to avoid accident / provide immediate assistance in case of bus accident. With increasing bus accidents that took place place in Malaysia in 2008, despite the installation of GPS Tracking System being installed, became a grave concern. This necessitated the need to find the root clause in existing GPS monitoring system to identity and improve the methods. It was found that in the system only real-time record keeping was implemented and there was no vehicle monitoring. So the speed management model was required to be re-modelled so as to send alert message to driver and passengers in case of accident prone conditions. Systematic and effective implementation of this model was achieved in [4] by using real –time monitoring with GPS.

Another early accident detection system is developed in [5] which use microcontroller, piezoelectric sensors, GPS and GSM modules. This was designed with the objective to improve the survival rate and reduce fatality by reducing the time of providing medical assistance at the accident site.

This is done using real time wireless accident tracker with mobile to sense occurrence of an accident. Notification is sent to central server giving accident location with the help of GPS.

In case of accident of a vehicle, the impact on vehicle and its severity is detected with a piezoelectric sensor and message is sent to central server. The server acknowledges this message and further sends another message containing coordinates of the locations. Another addition to tracking objects in moving vehicles is implemented in [5-6]. Here authors used Arduino Uno board with SIM808 module and determine vehicle's location and send the coordinates to monitoring body which can be viewed on tracking website and Google Maps. They have also incorporated security features like determining identity of driver and alerting the authority in case of a possible theft.

Today with increase in population and number of vehicles,

Accidents are on the rise. The prime requirement is the availability of medical personnel at the accident site to improve survival rate after the accident. It is thus important to reduce the time between occurrence of an accident and provision of medical help. The delay can be minimized by use of Real Time Wireless Accident Tracker using mobile Phone [6]. Such a system is designed in [6] to automatically detect the accident location using GPS and send notification to central emergency server. This system uses piezoelectric sensors, PIC 16F microcontroller, GPS and GSM modules.

When an accident occurs, sensor detects and measures impact on the vehicle and sends a help message to central emergency server. GPS coordinates of accident location are sent as another message after previous acknowledgement is received.

Hand-held devices for positioning are widely used in military, transportation and civilian applications. In [7] the authors have developed a combination device. In this a handheld positioner and tracker for loss of items, children, and elderly is developed. The tracking details can be seen on TFT/LCD screen. Use of GPS Navigation and GSM wireless data transmission is made to achieve this. It can provide data mapping and it is easy to operate. Another tracking application is for low flying aircrafts which are always difficult to track because of radar horizon limitation. However tracking of aircrafts is necessary for safety. Radar detection can be achieved via aircraft to ground link or satellite phone. GPS and GSM can also be used for the above. In [8], authors have developed a helicopter tracking device using GPS / GSM to track aircrafts flying at low height on various routes.

We now discuss some of the GIS based safety applications.

B. Safety:

In today's world with increasing crime against girl child, women and children in general, their safety becomes very important. A number of applications and wearable devices

for safety of girl child and women are available and a lot of research is still being done in this field. Use of body position and physiological signals is made in [9] to obtain information of girl / women in case of encountering a dangerous situation. In such a situation, due to fear, person starts sweating, body temperature and galvanic skin resistance parameters of the person will change/deviate from normal values. Sensors acquire this data and machine learning algorithm is used to recognize this activity.

Real-time monitoring of data can be done by sending sensor data to cloud. Thus continuously monitoring of the subjects can be done based on parameters and necessary action can be initiated.

Another safety application for children is smart a wearable device. This wearable can be used with any inexpensive smart phone by a common individual [10]. The device allows parents to ensure security of their child. A number of applications use Wi-Fi and Bluetooth medium but it's not so reliable. Therefore in [10] authors have developed a mechanism where an SMS based communication between the child's wearable and the parent is implemented. When the parent sends a text with specific keywords like, "LOCATION", "TEMPERATURE", "UV" "SOS" "BUZZ", the wearable device will respond with a text containing a response related to the parameters as sent by parent. This will contain real time accurate location of child which when clicked will give direction to the child's location on the google map. This will help parents to track security of their child. However this method cannot be trusted many a times. So the authors have used a secondary measure to alert the people in the vicinity of the child who may instantly take action for the child's safety before the arrival of parents or the people around the child at that location can contact the parents and help them locate the child. This is implemented by sending out a bright SOS light and distress alarm/ buzzer on the wearable device of the child which is initiated from the parents' end after they get the alert that child is in a difficult situation. This light / alarm when activated will send SOS. When the parent understands that the child is in distress then he sense an SMS text displaying SOS which will cause light / alarm on the wearable to work brightly / with high intensity. Then the people in his vicinity will come into action.

Next we discuss how GIS can be used in remote sensing and monitoring.

C. Remote Sensing and Monitoring:

Raspberry Pi based Smart spy surveillance robotic system was designed in [11] for remote sensing and security. Use of web browser and android apps is made to control the system wirelessly. On board camera captures the environment view. Ultrasonic sensor and GPS module

measure the distance and track the location continuously. With the increasing incidences of accidents of school bus it becomes important for school administration to ensure safety of students by providing a safe and trusted transport service. A model for school bus monitoring to take care of the safety of school going students by determining the time when they board the bus and alight from the bus and sending this information to their parents is implemented in [12]. The model picks up information like location of bus, it's speed, route, schedule of the driver etc. for this purpose. If required, driver or parent can be also be contacted by school authorities. The model makes use of RFID and GPS technologies to connect to a remote server over Wi-Fi using an ESP8266 microcontroller.

Security is also an important aspect with regard to individual security, vehicle Security, valuable security etc. GIS also finds applications to provide such security.

D. Security:

Public security has always been challenging in itself. Police geographic information system (PGIS) is being effectively used to provide national security. One of the important functions of PGIS is Police intelligence analysis function. It's objective is to reduce damage and protect national security. In [13] authors made use of data mining to get useful information from all available police information systems in addition to PGIS and obtain statistical reports and analyze them to find out regions where crime occurs frequently. GIS spatial analysis functions provide timely information regarding this to all level of police stations.

This work helps to take decisions and provide quick response to deal with complex emergencies.

Another system is designed not only to provide security to motorcycle riders but also to track their path in [14]. The system is basically a helmet controlled safety system in which the motorcycle ignition is turned on only when the helmet is worn by the rider and the bike stand is removed.

The GPS tracker incorporated in the motorcycle provides current location of motorcycle and also when it is stolen. The tracker unit is implemented with SIM 908 module. The co-ordinates obtained of the rider's path are remotely plotted using a plotter.

There can be several examples where security is a concern. In the banking sector, smart security systems are required for operation of ATM machines. In [15] author has developed such a system with embedded and latest technology and advanced features. Use of RFID card and IR sensor is made in ATM. The fan and light automatically turn on when card is placed in the card holder. If the ATM is tempered by any person then message service is

activated and an SMS is sent to two main centre stations by using GSM module. In case cash from money box is stolen then GPS is used to track the location of ATM. Also the system identifies and verifies where there the centre money was handled by authorized bank personnel or thief by counter checking the finger print. In this manner the system can provide greater security in using ATM.

III. CONCLUSION

In this paper, we have reviewed a number of applications of GIS in mobile technology for Tracking, Safety, Remote Sensing and Monitoring and for security. It is observed that in all the applications the coordinates obtained from GPS signal are relayed to central server. This data is further used for creating maps, tracking, navigating, analysis etc. which will help to track vehicle, objects, people, monitor various activities, ensure security of device / person etc. In most of the work it is observed that the information of person or object that is collected is unidirectional. However very few cases have a bi-directional tracking/navigation and response mechanism.

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