Real-Time Object Tracking System using Arduino with Spot-it Mobile Application

Sandeep B[1], Spoorthi D A[2], Supriya B A[3], Tanuvi M K[4], Varsha K[5]

Assistant Professor, Department of CS&E, JNNCE, Shimoga, India[1]

Research Scholar, Department of CS&E, JNNCE, Shimoga, India[2-5]

Abstract: Nowadays, misplacing valuables are very common, so tracking is becoming essential for the purpose of improving our life condition. In order to safeguard our valuables such as, wallets, keys, toddlers, animals and so on, we require some device which helps to locate these misplaced or stolen objects. So that a real-time object tracking system is implemented using Google Maps and Arduino with the integration of Global Positioning System (GPS) technology. The GPS module provides geographic coordinates of the object at regular intervals, and transmits the location information to the owner/user's cell phone in terms of latitude and longitude. The owner/user can continuously monitor the objects such as vehicles, animals, children, using their cell phone. The system is user-friendly, compact, ensuring safety and surveillance at a low maintenance cost. The experimental results of the proposed system show its feasibility and effectiveness in real-world scenarios.

Keywords: GPS; Cell phone; Arduino UNO; Android Studio.

I. INTRODUCTION

In modern times, safety and security are major concerns for individuals and organizations alike. To ensure the safety of any object, GPS tracking systems can be installed. These tracking systems use GPS technology to provide real-time location updates. This technology provides a reliable and effective means of surveillance and ensures the safety and security of the objects being tracked. According to the Delhi Police, there were 38,735 cases of motor vehicle theft reported in Delhi in 2019, which was a decrease of 13% in motor vehicle theft cases in 2019 compared to the previous year. In that work, a laptop embedded with Google Earth was used for tracking and viewing the location and status of the vehicle on a map.

In this paper, a real time Arduino based object tracking system with GPS is attached to the moving object to enable the owner/user to track the location of that object. This proposed system will continuously monitor a moving object and report the status of the object. The GPS receiver will continuously give the data indicating the position of the object in terms of latitude and longitude in real time.

II.   LITERATURE REVIEW

The Author A. Z. M. Tahmidul Kabir, Plabon Kumar Saha et al.[11] have proposed an IoT based tracking system, through which it is very easy to track the child, elder, or any type of luggage. This system has separate features for tracking each of these things, which have been completed by the IoT device and the Android app. NodeMCU, GPS, and GSM have been used as hardware to build the system, and Firebase Server and Google API services have been used for the Android app. This system has two modes of operation to fulfill its purpose. The first is, an IoT device connects with the user's mobile app through a Bluetooth connection. This mode is needed when the user himself/herself goes with the IoT device holder. For instance, the user goes shopping with children, or the user carries his/her own luggage with valuable material. The second way is, the IoT device is not connected through Bluetooth to the user's mobile. This mode is needed when the IoT device is allowed to go far from the user, and the user can track the device from anywhere. Initially, the IoT device is connected to the operator's mobile phone via Bluetooth. The range of Bluetooth is up to 100 meters. So as soon as the IoT device and the phone gets disconnected, the phone will get a vibration, so the owner or the parent of the child will instantly be warned to take necessary caution. After getting disconnected from the Bluetooth, the IoT device will also be triggered. Then it will start sending GPS coordinates to the firebase server.

Diaa Salama at el.[2] have proposed a child tracking system to assure parents that their child is safe from suspicious actions The information of the child being missed is sent to the respective parent's mobile if they move beyond the coverage area. Also, when children want to convey that they are in danger, they will press a panic button on their school

i-card. Mobile terminals have internet. It adopts message from the child and delivers to respected parent's android mobile using internet. Kids and object tracking system is based on GPS, GSM, GPRS modules and Arduino. As Arduino is the mastermind and organizes all the system processes. The sensor knows the state of the body for its Pitch or Roll; also, it exists in the system connection between Arduino and Smartphone are made by a device called See Shield Interface. It also helps the child ask for help by sending SMS with the location in the message. The energy needed by the device ranges from 9-12 volts to a small battery that gives Arduino energy to work, and Arduino feeds its sensors. It is found that the performance of the proposed system varies from place to place. The results shows that the proposed system's functionality depends upon the cellular networks, and sometimes the working is poor due to low cellular connectivity.

Shruti Anant Tiwarkar at el.[3] explained an Android based solution to aid parents to track their children in real time. The aim of this project is to develop a Safety System which provides the details of entry and exit of the student from school using RFID. The proposed system provides a facility to track the exact location of the child using RFID and GPS in a cost-effective way. So, this could be implemented even in small scale schools. Such systems must be installed in order to reduce the number of abductions taking place. The system will also make the attendance of the student. The attendance and the location will be notified on Android application to the Parent. This system uses three modules. Firstly, RFID scanning which will scan the attendance at door step of the school and notify the attendance status to the parent. Secondly, Notification Display the attendance of particular student to the teacher. This becomes analysing data easy for the teacher. The RFID to each student will reduce the work process of the teachers, and attendance management becomes easier. The attendance message will be sent to the parent. Lastly, Location Identification through GPS, the second module is getting the location of ID card and tracing the current location of the student..

Indira R, Bhavya G et al[4] proposes an IOT Asset tracking system. which is developed to increase the safety of women, children, people with mental disorder and any valuable items through the technology of Radio Frequency along with IOT. Radio Frequency module consists of transmitter and receiver. The transmitter is placed with the object to be tracked which sends radio waves to the receiver. If the object being tracked moves out of frequency range, an alert message and call will be sent to specified guardians through Global System for Mobile communication. Further the location of the object can be tracked whenever required through Global Positioning System. In addition, sound and vibration sensors are used to sense human behaviour like loud voice and movement of human body. If the sensor reading exceeds threshold value, messages are sent to specified mobile numbers. The system uses RF technology which refers to communicating through wireless electromagnetic signal with radio frequency that ranges from 3 kHz to 300 GHz. IoT plays a vital role in the development of the system which allows devices to connect, interact and exchange data over the internet and can be remotely controlled and monitored.

III.   METHODOLOGY

A. *System Architecture*

This consists of five modules namely,
1.   Internet Of things
2.   Global Positioning System
3.   Firebase
4.   Application
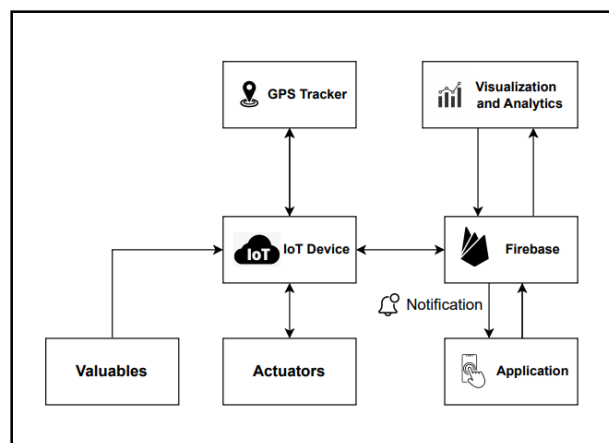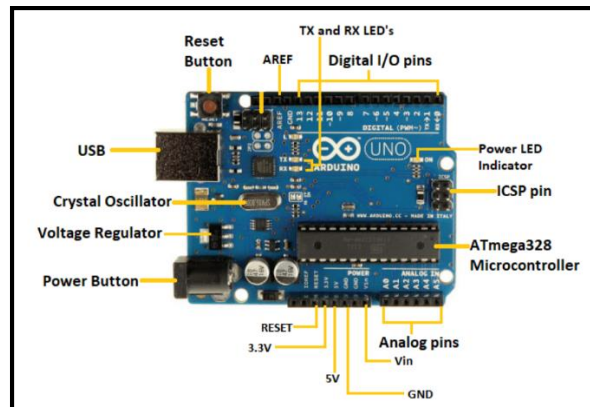5.   Visualization and Analytics

Fig. 1: System design

1) *Internet Of Things (IOT)*

Fig. 2: Arduino UNO Board

IoT devices are the nonstandard computing devices that connect wirelessly to a network and have the ability to transmit data. It is considered as an ecosystem that contains smart objects equipped with sensors, networking and processing technologies integrating and working together to provide an environment in which smart services are taken to the end users. This project includes Arduino UNO. Arduino UNO is based on an ATmega328P microcontroller. It is easy to use compared to other boards, such as the Arduino Mega board, etc. The board consists of digital and analogue Input/Output pins (I/O), shields, and other circuits.

2) *Global Positioning System (GPS)*
The system uses GPS to determine the exact position of the target. The GPS tracking system works by receiving information from specialized satellites orbiting the Earth. GPS receiver obtains location coordinates (Latitude & Longitude) from GPS satellites. The information in NMEA format is decoded to find the coordinates and Time of the location, which then sends the information to the firebase. Here NEO-6M is used as GPS module which can track up to 22 satellites on 50 channels and achieves the industry's highest level of sensitivity i.e., -161 dB tracking, while consuming only 45mA supply current.

3) *Firebase*
The Firebase Realtime Database uses data synchronization. Firebase application remain responsive even when offline because, the Firebase Realtime Database SDK persists the data to disk. Once connectivity is re-established, the client device receives any changes it missed. The Firebase real time database can be accessed directly from a mobile device. The mobile application connected to firebase spots the position of the object, which is stored in the firebase at real time.

4) *Application*
Application is the top layer of android architecture. The development of a user interface is needed in order to visualize the output. Here we are developing an android application called "SpotIt" which helps the user to locate their valuables and also keep track.

5) *Visualization and Analytics:*
The information from the firebase is analysed and can visualize the data gathered so forth. Thus, providing clear analytics of the product usage and tracking. Also, the location data that has been collected during the tracking of a person/object is utilized in machine learning algorithms and various analysis and predictions are made.

B. *Workflow*

The workflow of this system: First, the GPS module of IoT device which is fixated in the valuables starts sending data in the form of latitude and longitude which is stored in the firebase. User can view current location of the object through an App and gets notified of any movements. At the same time, a user can set the location and timings of the object to keep track. Alongside, the device will update the longitude and latitude of the required object. At every moment notifications are sent to user's phone. In case of any disturbances, the latest location of the device is tracked. This process follows a repetitive cycle for tracking of every valuable of user.
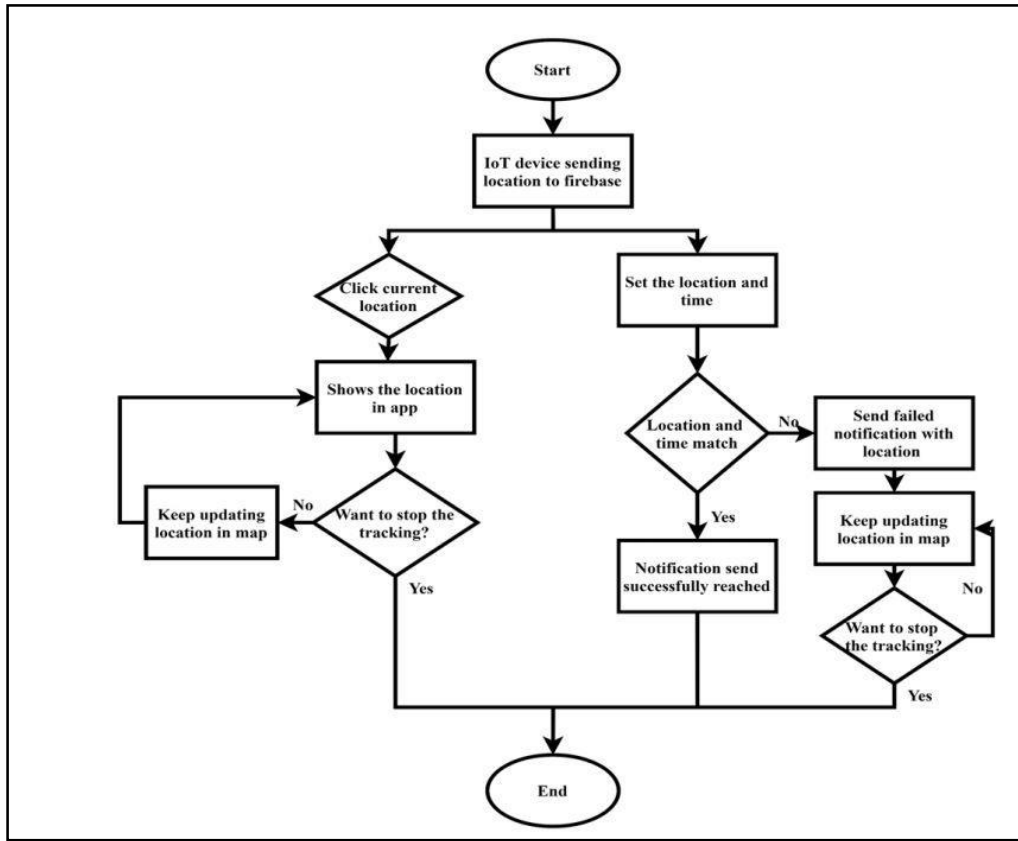
Fig. 3: Workflow diagram

IV.   RESULTS

The prototype of the Real-time Object Tracking System using Arduino is shown in the Fig 4. The Arduino UNO and the NEO-6M connections has been made in the following manner.
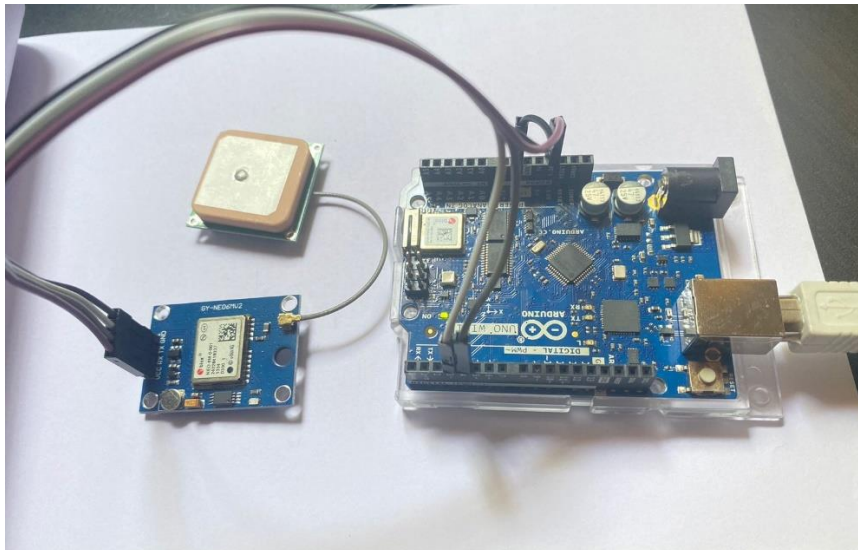

Fig. 4: Real-Time Object Tracking System

The location co-ordinates of the object that is being tracked are obtained from the NEO 6M GPS module that has been attached to the Arduino UNO. The Fig 4 shows the latitude and longitude of the object in Arduino IDE.

Fig. 5: Latitude and Longitude in Arduino IDE

Fig. 6: Latitude and Longitude stored in Firebase

Further the location co-ordinates are stored in real time database which is Firebase. It is show in Fig 5.

The real time location data is fetched from the Firebase and the location of the object is displayed in the "Spot-it" mobile application.
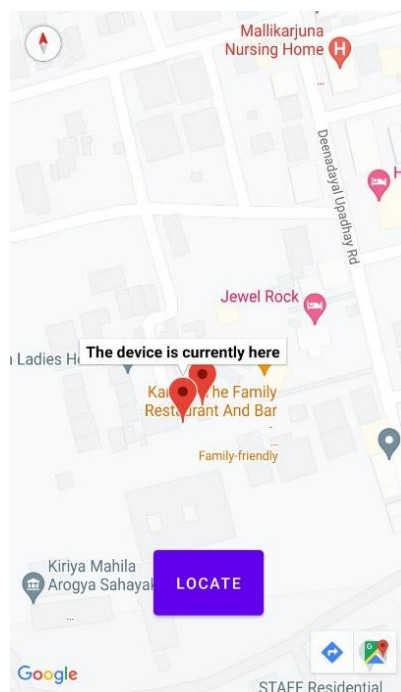

Fig. 7: Latitude and Longitude stored in Firebase

V. CONCLUSION

The device which is being developed under this project would be helping to track the location of physically or mentally challenged people, toddlers, school going kids, domestic animals and any other valuable things. It is based on IoT tools such as Arduino, GPS, Android Mobile Application Development tools. The existing products are not being used effectively by everyone, so the development of this product is much needed. The idea is to make this device available for a wide range by using GPS module, and thus overcoming the range problems. Also developing a user-friendly mobile application for the users which help them to locate their valuables accurately and keep track.

REFERENCES

[1]. A. Z. M. Tahmidul Kabir, A. Mamun Mizan, P. K. Saha, G. Kibria, A. J. Ta-sin and M. Saniat Rahman Zishan, "A Comprehensive Smart IoT Tracker for the Children, Elder, and Luggage with the Assistance of Mobile App," *2020 International Conference on ICT for Smart Society (ICISS)*, Bandung, Indonesia, 2020, pp. 1-5.

[2]. Diaa Salama Abd-Elminaam, Rasha Orban, and Fatma Sakr, "IOT Based Smart Life Saver System for Kids and Objected Tracking" *Conference Paper*, November 2020.

[3]. Shruti Anant Tiwarkar, Shaila Suresh Bhumannavar, Gaurav Kishor Kshirsagar, Aishwarya Dinkar Ghare, "School Child Tracker System Using IOT" *International Journal of Innovative Science and Research Technology,* volume 5. *2020*

[4]. Indira R , Bhavya G, Dheva Dharshini S, Devaraj R, "IOT Asset Tracking System", *SSRG International Journal of Computer Science and Engineering (SSRG IJCSE)*-Special Issue ICFTESH Feb 2019.

[5]. D. Bangladesh, "Child found dead after 4-day of missing," Daily Bangladesh. [Online]. Available: https://m.dailybangladesh.com/english/Child-found-dead-after-4-day-ofmissing/47493. [Accessed: 18-Sep-2020].

[6]. S. O. Report, "Police officer's son missing for 4 days," The Daily Star, 21-Jan-2020. [Online]. Available: https://www.thedailystar.net/city/bangladesh-police-officer-sonmissing-for-4-days-1857079. [Accessed: 18-Sep-2020].

[7]. A. Gupta and V. Harit, "Child Safety & Tracking Management System by Using GPS, Geo-Fencing & Android Application: An Analysis," 2016 Second International Conference on Computational Intelligence & Communication Technology (CICT), Ghaziabad, 2016, pp. 683-686, doi: 10.1109/CICT.2016.141.

[8]. A. L. Abhang, C. L. Mahale, V. R. Desai and P. Biswas, "International Journal of Scientific Research in Science and Technology Volume , Issue , Article first published online: -," IJSRST Xplore Digital Library, 25-Mar-2018. [Online]. Available: http://ijsrst.com/PDF.php?pid=4167. [Accessed: 18-Sep-2020].

[9]. R. Tesoriero, R. Tebar, J.A. Gallud, M.D. Lozano, V.M.R. Penichet, "Improving Location Awareness in Indoor Spaces using RFID Technology".

[10]. With 60,000 children going missing in India every year, social media has propelled child lifting fear," 30-Aug-2019. [Online]. Available: https://www.hindustantimes.com/india-news/with-60-000-childrengoing-missing-in-india-every-year-social-media-has-propelled-childlifting-fear/story-AvL4yvASeN4fgXQPoAkBKP.html. [Accessed: 18- Sep-2020].

[11]. Baruah1, B. and Dhal1, S. (2019), 'An IoT Based Secure Object Tracking System,' Wireless Personal Communications, 106, 1209–1242, 2019.

[12]. Maryam Said Al-Ismaili, Ali Al-Mahruqi, Jayavrinda Vrindavanam, "Bus Safety System for School Children Using RFID and SIM900 GSM MODEM"

[13]. Chaudhari, B. S., Zennaro, M. and Borkar, S. (2020), 'LPWAN Technologies: Emerging Application Characteristics, Requirements, and Design Considerations,' MDPI, March 2020.

[14]. Zhang, H., Zhang, Z., Zhang, L., Yang, Y., Kang, Q. and Sun, D. (2019),' Object Tracking for a Smart City Using IoT and Edge Computing,' MDPI, 2019.

[15]. Rajput, K., Chavan, A., Tanawade, O.Sonawane, S. P. (2019), 'CHILD SAFETY USING IOT,' Computer Science, 2019.