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COVID-19 PATIENT TRACKING SYSTEM

Victoria Bopearachchi
University of Hertfordshire
School of physics, engineering, and computer science
Colombo, Sri Lanka

Abstract: **on 11th match 2020, Covid-19 was recognized as a pandemic. Since then, high number of deaths and the critical mass of global hospitalized patients was recorded in order of millions. Carefully managing covid-19 infected patients care the overall public health and support to lighten its impact on vulnerable populations, healthcare arrangements. A GPS based tracking system is proposed to track covid-19 patients. The system can provide a real time map of the patient location. Internet of things (IoT) is a technology that aids in increasing the comfort ability of mankind. IoT is increasingly used in the health care industry, and these systems and technology are considered a lifesaving attempt. This presented system can be used by medical sector/ quarantine centers for officers to track covid-19 infected patients. Apart from real time tracking of the patient, proposed tracking system can be utilized by the patients to get help in an emergency. Furthermore, alert system introduced, if the patient escapes the geofence area, alert is sent to the officers in the quarantine center. Desktop application introduced to manage officers, patients and covid centers, web application is introduced to view the map interface.**

I. INTRODUCTION

Tracking systems are widely used across the globe in various fields. Proliferation in the covid-19 infected patient number has resulted many countries to become economically unstable and for many people to lose hope on the future. A problem has been identified in Sri Lanka on covid-19 infected patients escaping from quarantine centers. Hours pass between the escape and the knowledge of the escaping reaching the officers enabling the patient to wonder around the society which can cause the rise of covid-19 patients in a country.

According to survey conducted in UK (Ipsos mori, 2020) graphs prove that number of Britons following government rules have fallen to 47% in January 2021 [1]. Moreover, in India before the huge rise in corona virusin the country, 20 covid patients have escaped from quarantine Center In Maharashtra on 25th April 2021, it was also reported that officers in Tamil nadu was unable to find the patient escaped even after 24 hours, in Jharkhand over 100 migrants have escaped from quarantine center and in Nalanda over 17 inmates have escaped [2]. In Sri Lanka first patient escaped from kandakadu rehabilitation centre on 24th July 2020 [3] and since then patient escaping has been continued, it is reported that police officials take days to find the patients. It is stated that patients in drug rehabilationscentres, prisons have shown signs to be more vulnerable in remaining in respective centers when covid-19 infected [4].

Internet of things technology is successfully emerging to provide support for the construction of these monitoring systems. IOT began in 1980 with the main aim of creating embedded systems, making everything digital, increase living standards and easy to access. Architecture of IOT consists of hardware (sensor nodes and submerged communication), middle ware (data storage and accessing resources), presentation layer (efficient visualization tools providing end-user human readable arrangement) [5]. Communication section in the IOT implementation is comprised of 3 connections they are:

1. P2P connections- includes person-to-person data transfer
2. M2M connections-include machine to person data transfer
3. M2P connections- include machine-to-machine interactions omitting any human interactions

Geolocation technologies

Geolocation technology is achieved incorporating various technologies. Some are GPS, WI-FI, Bluetooth low energy, network based, RFID, LORA.

RFID (radio frequency identification)- form of wireless communication operating with electromagnetic fields. Consists of scanning antenna, a transceiver, a transponder. Two main types of RFID tags are active RFID (contains own power source), passive RFID (tag receives power from reading antenna). Types of RFID systems are low-frequency RFID systems (range from 30Khz to 500KHz), high-frequency RFID systems (range from 3MHz to 30MHz), UHF RFID systems (range from 300MHz to 960MHz), microwave RFID systems (run at 2.45GHz).

BLE (Bluetooth Low Energy)- wireless short-range communication technology, requires less power, signal do not carry very far, requires more BLE beacons and access to Bluetooth, device placed in 10m gaps.

NFC tags (near-field technology)- NFC labels can be utilized to store and exchange data.

Paper on “smart location tracking system for dementia patients” proposes a tracking system including GPS module,

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GSM SIM900 module, Arduino uno board as the hardware implementation, android app developed by android studio as the software implementation [6]. android app contains information on the location history of the patient. Location of the patient will be sent to the caretaker as an app through the GSM module. However, power consumption increases, heaviness of the device rises since Arduino uno and gsm module is already large in size. Providing sufficient battery power is a major challenge in most the GPS associating technologies

GPS (global positioning systems)-satellite-based radio navigation system, contains the ability to locate up to 5m accuracy, requires more power hence batteries provided, works efficiently for outdoor navigation.

GPS stands for global positioning systems. GPS systems was first introduced in 1957 by the Soviet Union when launching sputnik, I satellite, resulting GPS systems to be mainly used in military services with precise positioning systems features. Furthermore, in 1959 U.S navy further developed GPS systems for the consumption by submarines. In 1995 U.S military introduced fully functional 24 satellites to be used for Global positioning systems [7].

GPS structure consists of 3 segments as

1.space segment- consists of set of satellites.

2.control segment-consists of communication between ground control and satellites.

3.user segment-consists of users of the received GPS data.

GPS systems containing geofencing features

Most tracking devices built for tracking implementations do not include geofencing features. “IOT based prisoner escape alert and prevention system” discusses on a system built for the prison to prevent prisoners escaping with geofencing features [8]. each prisoner wears a device consisting of GPS, GSM, microcontroller, virtual fence is established, if the prisoner tries to escape, geofencing and alert the officers in charge through GSM module, GSM module, is an open and digital cellular 2G technology allowing multiple users to share the same bandwidth resulting some amount of interference if many users pass the wall, 2G speed is lower than in 3G technology[9].

System analysis

system functions

To solve the problem of patient escaping from quarantine centers, reduce the burden on officers in the quarantine centers/ police officers following functions for the needs of covid-19 tracking systems implemented:

- Potable device: device design consists of potable tracking device ensuring the comfortability of the wearer (patient).
- real time tracking systems: patient location can be viewed by the officers in real time.
- each patient assigned a patient identification code: officer with the authority can view patients’ location based on the identification number.
- push button to be used for patients to get help in an emergency: since system manages covid patients, in any respiratory related emergencies can be common.
- geofencing alert: patient assigned a geofence region, if patient passes through this area alert sent to the officers.
- provide a user-friendly desktop application to officers.

System structure

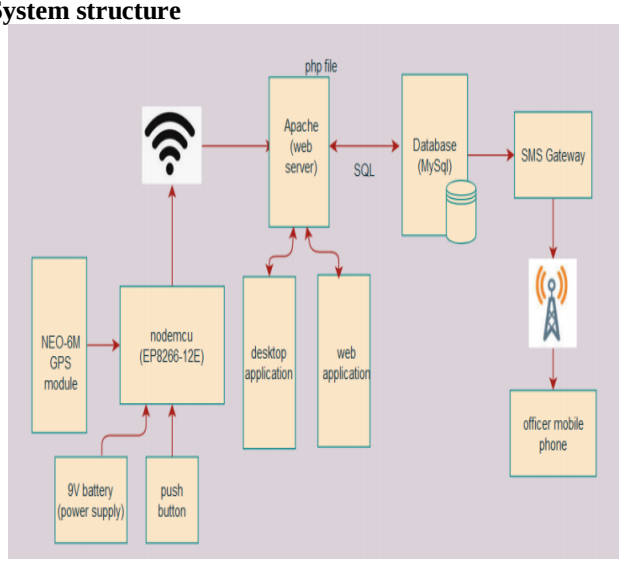

Figure 1: system architecture

System details

The proposed system comprises of NEO-6M GPS module, ESP8266-12Eand a push button. All components are chosen considering the small size,and the wider availability. System architecture of the tracking system is shown in figure 1. Nodemcu ESP8266-12E is the central control unit, location coordinates (latitude, longitude) data is sent from the NEO-6M GPS module to the Nodemcu. Power supplied to the system through a 9V battery. System makes use of wireless communications.

Main Hardware components used:

1. microprocessor unit Nodemcu ESP8266

Nodemcu is a system-on-chip utilized by IOT based applications having Tensilicaxtensa 32-bit LX106 RISC microprocessor and RTOS supported, operate at 80MHz to 160MHz adjustable clock frequency with 128KB RAM and 4MB flash memory to store data and programs. Nodemcu size= 49mm × 26mm, contains WIFI connectivity, consume low power than most other microcontrollers in the market

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Figure 2: Nodemcu

2. NEO-6M GPS module

NEO-6M GPS module is a cheap and is readily available in the market, Module has good sensitivity for indoor and outdoor applications, Easy to handle patch antenna (small).

Figure 3: NEO-6M GPS module

System implementation

The proposed system diagram is shown in figure 4. GPS module has four pins Tx(transmitter), RX (receiver), ground and +3.3V supply. D1 pin of nodemcu is connected to Rx of the GPS module, D2 pin of the nodemcu connected to TX of GPS module. Connections are made to get reliable output as per the coding uploaded by the Arduino. Ide.

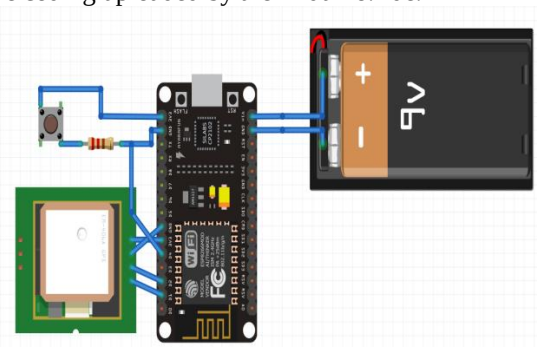

Figure 4: circuit diagram

NEO-6M GPS module transmits and receives signals containing data on the user location through communication with satellites. obtained location coordinates are sent to nodemcu, if nodemcu connected to Wi-Fi successfully, latitude and longitude data read, nodemcu connect to local host (XAMPP server) and sends read php scrips to dens HTTP request which then calls POST method to store location coordinates on the database.

In case of any emergency, when the patient needs help, push button in available which when pressed sends a notification to officers in the quarantine center, SMS API is written in php to connect to SMS gateway. Once the patient presses the push button, server reads officer mobile phone from database according to the covid center patient is located and SMS sent.

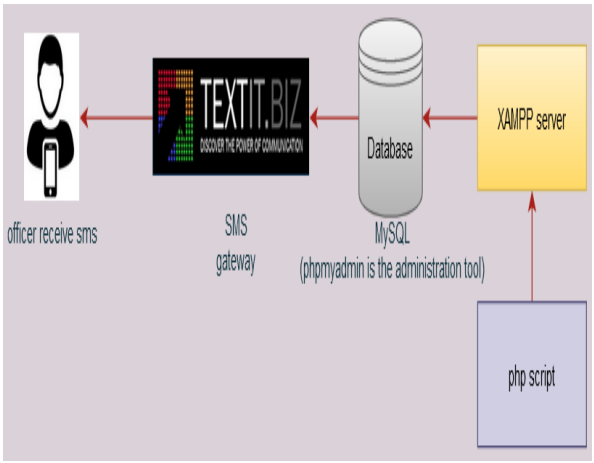

Figure 5: SMS API calling process

If patient escaped quarantine center, SMS sent to officers in the quarantine center. As illustrated in figure 6 geofence plan works. Point 2 is the location coordinates in the quarantine center. Point 1 is the current location coordinates of the patient. If the patient walks to the area patients cannot word SMS alert is sent to the officers in the quarantine center.

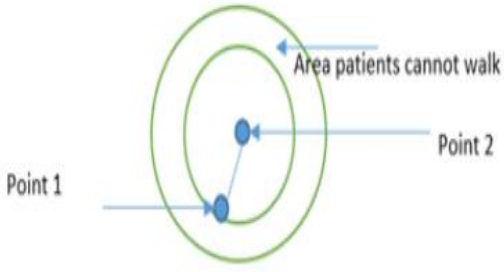

Figure 6: geofence plan

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Patient can walk between the distance where point 1 and point 2 is. The algorithm to check if the patient escapes quarantine center works as: if location coordinates of the patient are in the range where patients cannot work geofence alerts are triggered.
Desktop application is developed with java language to manage patients, manage officers and manage covid centers.

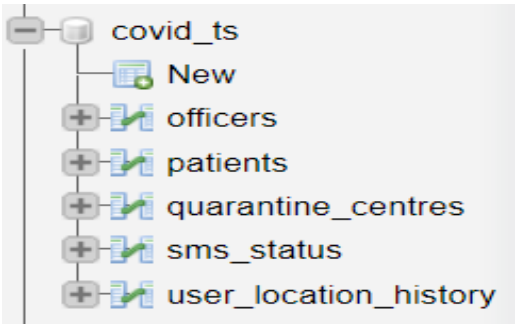


Figure 7: database tables

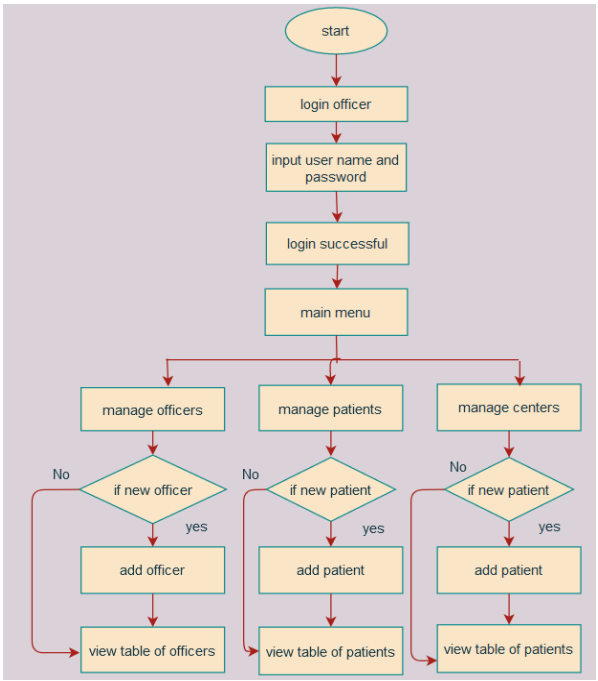


Figure 8: desktop application flowchart

Desktop application consists of:

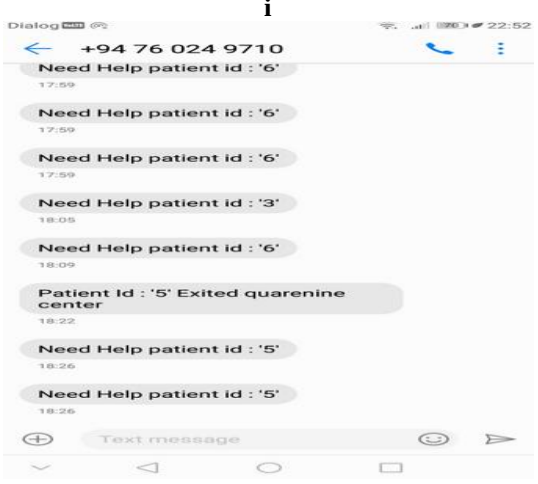
a) Login form: the login form is to allow only the registered officers to enter
b) Main menu: on the main menu there are three buttons, manage officers, manage patients, and manage covid centers.
c) Manage patients form contains the table with all the patients and options to edit, delete and add patients
d) Manage officers form contains the table with all the officers and options to edit, delete and add officers
e) Manage covid centers form- contains the table with all covid centers in the country and their latitude and longitude to be used in geofencing algorithm.

Moreover, web application developed with php scripts to get patient location and post on the map. Using of web application enables officers to view patient location from any device with the internet connection.

II. RESULTS

Testing is under following assumptions: quarantine centers are located in an open area with no severe obstructions or multipath, all quarantine centers contain strong Wi-Fi signal availability.
When the patient presses the push button or if the patient escapes the quarantine center (walks in the region patient not allowed to walk) SMS is sent to officers in the quarantine center. As in figure 9.

i



ii

Figure 9: notification received as text messages when patient exits quarantine center or push button pressed, tested for patient 3, 5, 6

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Figure 10: Main menu page

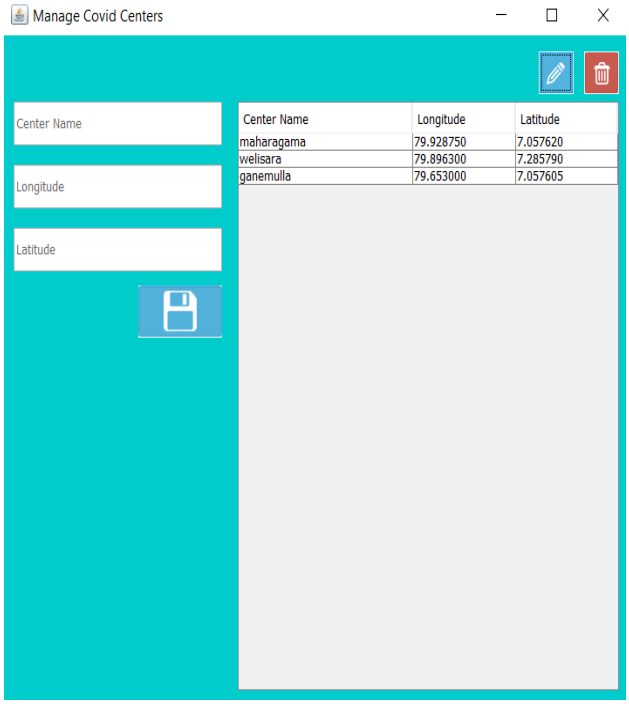

Figure 11: Manage covid centers page

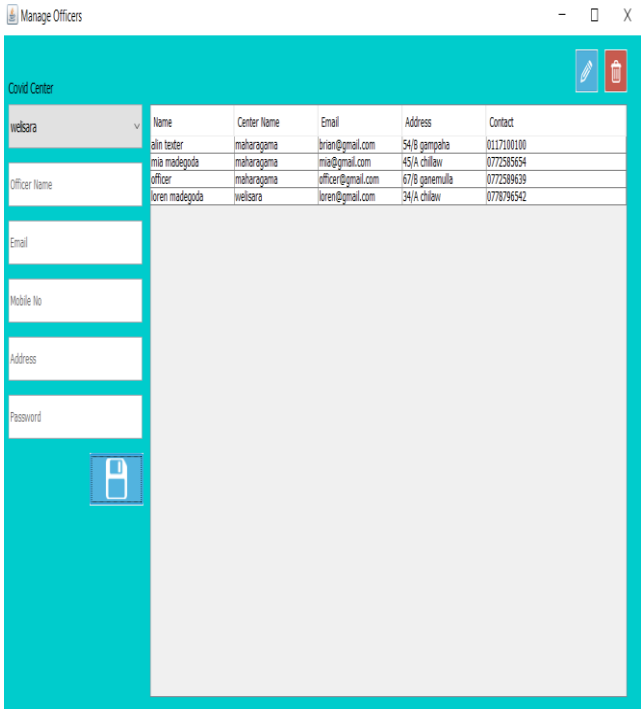

Figure 12: Manage officer's page

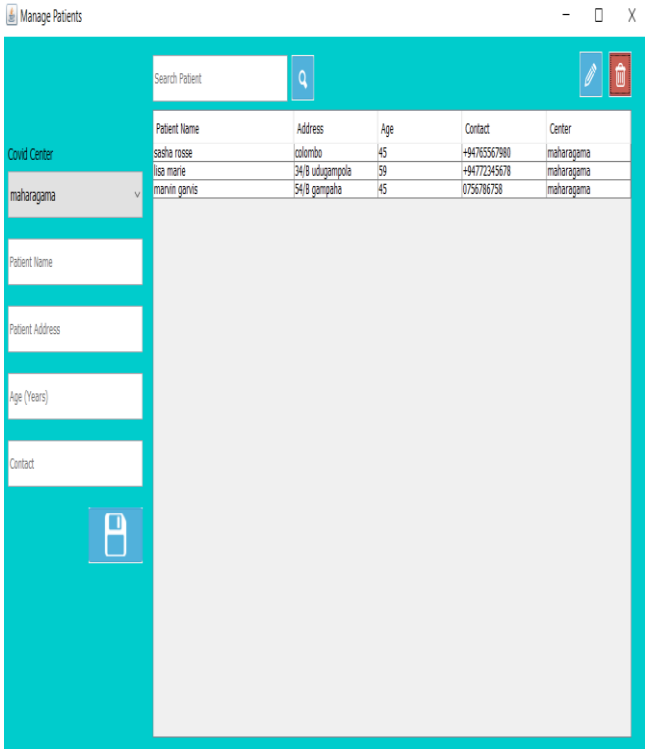

Figure 13: Manage patient's page

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When testing done connected to the Arduino. Ide, latitude, longitude data displayed on the serial monitor.

Figure 14: results obtained on Arduino. Ide

3 patients in the manage patients since 3 devices are built, furthermore messages are sent to all the officers belonging to the respective covid center.

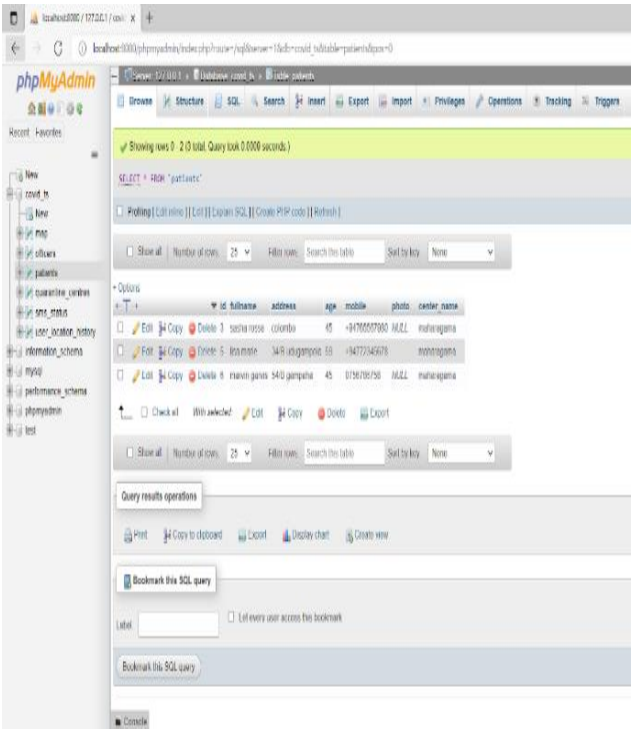

Figure 15: database to manage patients

When a patient attempts to escape the quarantine center massage status gets updated showing that the message is sent.

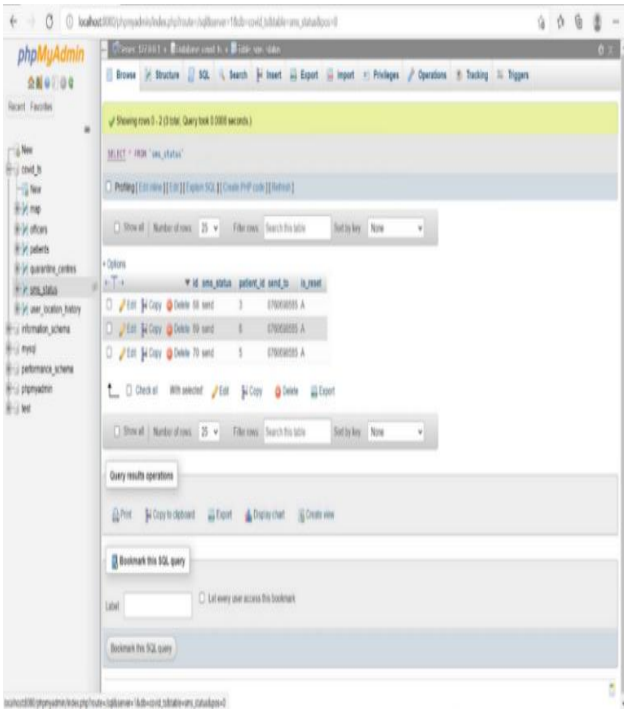

Figure 16: database table to manage SMS status

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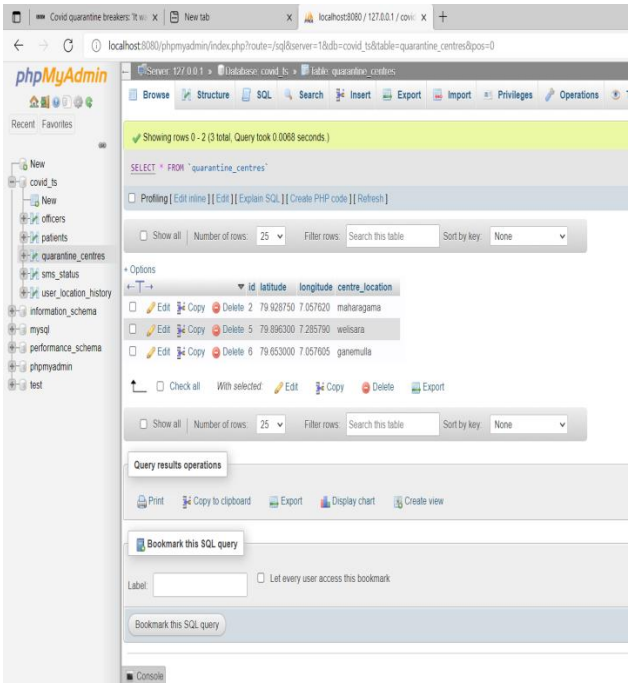

Figure 17: database table to manage covid centers

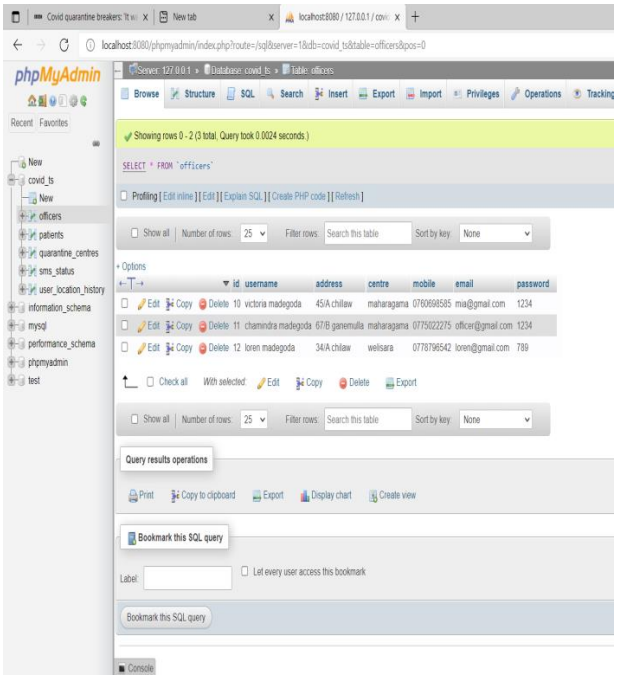

Figure 18: database table to manage officers

All patient location history is maintained in the user location history in the database with times and dates with the respective patient id. For the officer to check patient current location, officers can enter the patient id on the web interface containing the map and the location can be viewed.

Web application provides real time mapping of the patient hence red marker on the map changes when the patient moves/changes location.

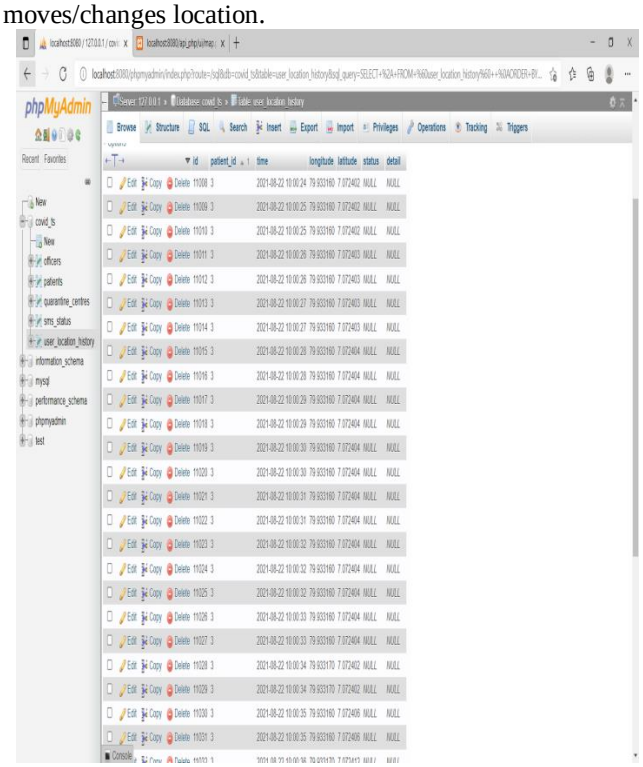

Figure 19: database containing user location history

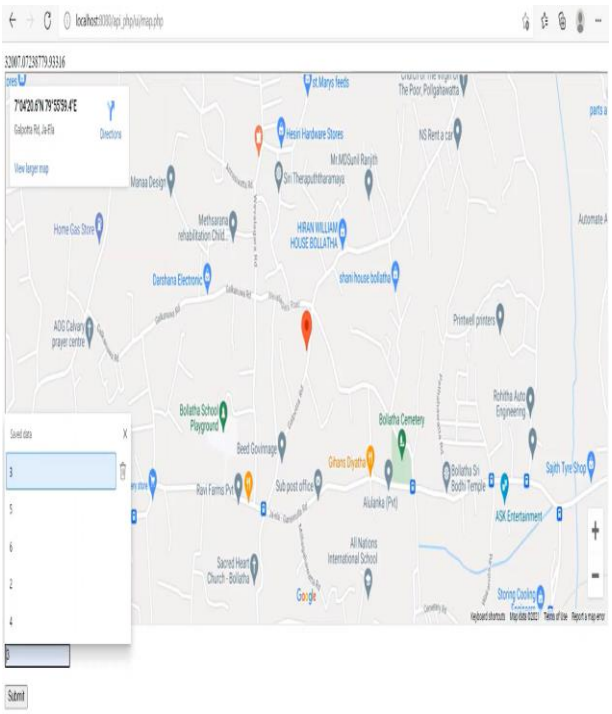

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Figure 20: officers can either enter patient id or select patient id from saved data

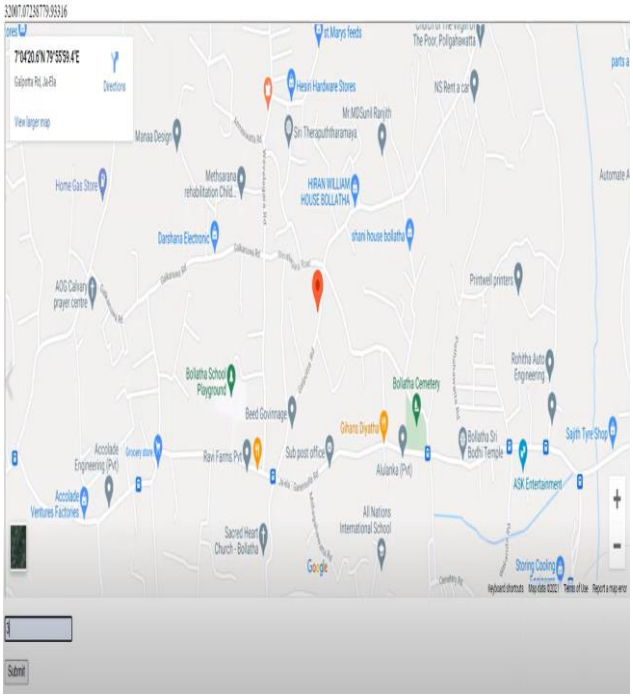

Figure 21: location of patient 3 on map

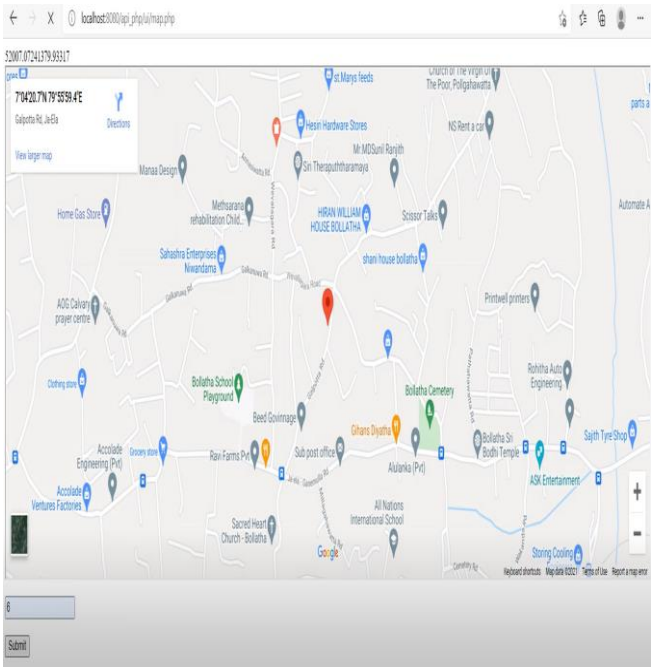

Figure 22: location of the patient 6 on map

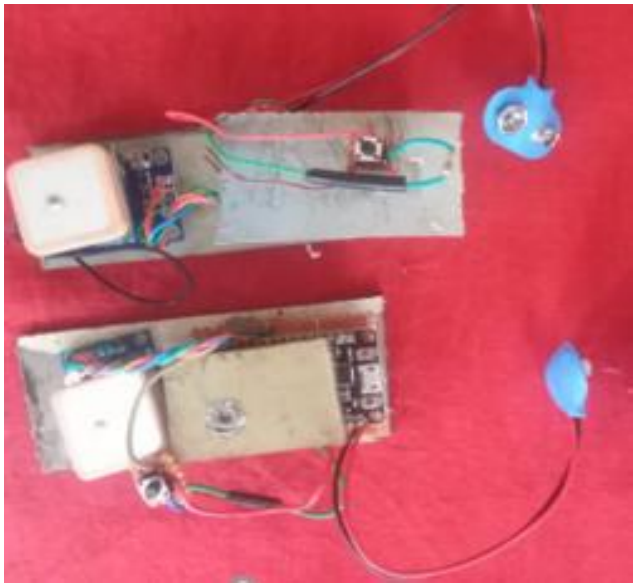

Figure 23: actual view of the proposed system hardware components

III. CONCLUSIONS

Tracking device is proposed for covid-19 patients to lessen the work done by quarantine center officer/ police officers in an attempt of patient escaping.The system is based on IOT technology and involves wireless communication between devices.Proposed system has low cost, portable, low power consumption equipment. Tracking of the patient is done by the tracking device and officers can effortlessly track the patients. Testing has proved that communication between the tracking device and officer mobile phones are successfully in events where SMS is to be delivered. 3 devices are built, and monitoring done successfully using all 3. Messages are sent for emergency help and geofence trigger for all3 devices. Real time tracking testing carried out in different locations and for patients moving with different speeds, all results yield accurate results.When the patients walk in the region not allowed for the patient to be in or in an emergency when the patient presses the pushbutton SMS alert is sent to the officers in the respective quarantine center. system can be fixed as a watch or a belt considering the comfort of the patient and is low weight device with the freedom to choose between the belt and watch. the proposed system meets all aims and objectives. For further research, the tracking device can be developed with purchasing google map API to view multiple patients on the same map.

IV. ACKNOWLEDGEMENT

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V. REFERENCES

[1]. BBC,2020, Covid-19 quarantine breakers. [online], available in:https://www.bbc.com/news/uk54346001

[2]. Times of India, accessed 20 august 2021,"Covid-19: why people flee quarantine centres", https://timesofindia.indiatimes.com/india/covid-19-why-people-flee-quarantine-centres/articleshow/75783193.cms

[3]. 08 august 2021“covid positive inmate from kandakadu is on loose after escaping from IDH police” https://economynext.com/covid-positive-inmate-from-kandakadu-is-on-the-loose-after-escaping-from-idh-police-72309/#modal-one,

[4]. August 4th 2021, “five quarantine inmates escape from Bogambara prison, one die during attempt”, ColomboPagesrilanka internet newspaper, http://www.colombopage.com/archive_20B/Nov18_1605677384CH.php

[5]. L. Farhan, R. Kharel, O. Kaiwartya, M. Quiroz-Castellanos, A. Alissa, and M. Abdulsalam,2018, "A Concise Review on Internet of Things (IoT) - Problems, Challenges and Opportunities," 2018 11th International Symposium on Communication Systems, Networks & Digital Signal Processing (CSNDSP), pp. 1-6, doi: 10.1109/CSNDSP.2018.8471762. available in: https://ieeexplore.ieee.org/document/8471762

[6]. M. H. Kasliwal and H. Y. Patil, 2017,"Smart location tracking system for dementia patients," International Conference on Advances in Computing, Communication and Control (ICAC3, pp. 1-6, doi: 10.1109/ICAC3.2017.8318786.

[7]. M. Wright, D. Stallings and D. Dunn,2003, "The effectiveness of global positioning system electronic navigation," IEEE SoutheastCon, 2003Proceedings., pp. 62-67, doi: 10.1109/SECON.2003.1268431

[8]. Dr.J.Cynthia, C.Bharathi Priya, Dr. Nageswara Guptha M,2018,"IOT based prisoner escape alert and prevention system", international journal of pure and applied mathematics Volume 120 No. 6, 11543-11554. available in: http://www.acadpubl.eu/hub/

[9]. VishakaYadev, L.kumar, P.kumar,2019,”evolution and development of wireless communication systems”, international conference on computing, power and communication technologies.

[10]. Xiao Lu, Ping Wang, Dusit Niyato, Dong In Kim, and Zhu Han, 2015“wireless charging technologies: fundamentals, standards, and network applications”, 2015 IEEE communications surveys, doi: 1509.00940v2

[11]. [11]N. Ari and N. Mamatnazarova, 2014,"Programming languages," 2014 11th International Conference on Electronics, Computer and Computation (ICECCO), pp. 1-8, doi:10.1109/ICECCO.2014.6997548.available in: https://ieeexplore.ieee.org/document/6997548

[12]. [12R. A. Garcia-Huerta, I. E. Villalon-Turrubiates, L. E. GonzcHez-Jiménez and G. AllendeAlba, 2019"Accuracy Estimation of a Low-Cost GPS Receiver Using Landmarks on Aerial Images," IGARSS 2019 - 2019 IEEE International Geoscience and Remote Sensing Symposium, pp. 9244-9247, doi: 10.1109/IGARSS.2019.8899767. available in: https://ieeexplore.ieee.org/document/8899767

[13]. [13] Megha, Y. & Pranay, T. & Adi, Suvarnamma& Swathi, M. ,2018, Security assistance device using wireless technology for women. International Journal of Pure and Applied Mathematics. 119. 16743-16747