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REVIEW PAPER: SMART GPS GEOFENCING SYSTEM

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Abstract- **Nearly everything around us holds significance, be it data, expensive items, land, people and/or animals. It is essential that we keep all that matters to us safe and secure. To employ the highest form of security, we want to keep track of all the significant things on our own. This gives rise to the need for the meantime tracking of anything which is highly valuable to us. Hence, GPS tracking is employed in this technological solution to keep track. Innovative technology, based on telematics and satellite positioning, is the subject of this study on geofencing. With the use of geofencing technology, users can create virtual boundaries in the context of the actual world. By automatically detecting when monitored mobile items enter or leave geographical areas that are encircled by a virtual fence, it aids in the surveillance of those areas. A geofence is a virtual barrier that is set up around a specific region of interest utilizing several technologies, including Wi-Fi, cellular mobile, RFID, and GPS. A specific radius area on the map can be specified by the user. If any entry or exit is made from that location, they will be updated in real time. This assures the asset's safety and security and provides a system for inspection to deter any unwanted activity.**

I. INTRODUCTION

With geofencing, a location's boundaries are defined virtually using GPS technology. A geofence is a hypothetical fence that encompasses a certain location. A geofence can be any boundary that the user defines or a circle with a specific radius. GPS is used for tracking. Positioning, navigation, and timing (PNT) services are offered by the Global Positioning System (GPS), a U.S.-owned service. GPS is a system of satellites and receiving equipment used to pinpoint a specific location on Earth. Some GPS receivers have a precision of 1 centimeter, allowing them to pinpoint their location. As a result of atomic clocks on board, GPS satellites emit radio signals that include their positions, operational status, and accurate time. The GPS radio signals move through space at a rate of greater than 299,792 km/s, or the speed of light. The radio signals are picked up by a GPS device, which utilizes the precise time of arrival to determine how far away each satellite is from it. Using geometry, a GPS device can locate itself on Earth in three dimensions after it knows how far it is from at least four satellites. When a tracked object crosses the virtual border (geofence) set by the Smart GPS Geofencing System, an alert is generated. A base location and a threshold distance will be configured in this device. The buzzer will automatically begin to alarm when the gadget senses that it has moved past the predetermined distance, and at the same time, a message notifying the designated numbers to the crossing will be sent. Any asset, person, or animal can be tracked with the help of the Smart GPS Geofencing System. It can be used for numerous things. It can be used for a variety of purposes, including tracking package locations, fleet and freight management, preventing vehicle theft, child surveillance, school bus monitoring, rental car operations, taxi operations, employee tracking, employee safety, surveilling prisoners or those under house arrest, pet care, and tracking the movement of livestock, among others.

II. LITERATURE REVIEW

A. Alzimio: A mobile App with Geofencing, Activity-recognition and Safety Features for Dementia Patients (by JadHelmy and Ahmed Helmy)

Millions of people around the world are affected by Alzheimer's, Autism, and dementia problems. Patients who experience forgetfulness have a propensity to stray and maybe endanger themselves. The Alzimio mobile app is being developed in this study to offer these patients safety features such as safe-zone geofencing, activity-based alarms, take me-home, route to nearest friend, and check-on-me. The main objectives of Alzimio include improving user safety and bringing comfort to their loved ones and caregivers. Utilizing safe-zone technology Geofencing: It is possible to create both circular geofences (supported by the Android API) and non-circular geofences using polygons (not supported by the Android API). The ray- casting technique is used to find region-crossing. Drawing a line from outside the barrier, crossing it where the user is, and then counting the points where the line intersects the fence is how this works. The user is outside the fence if the number is even; else, they are inside the fence.

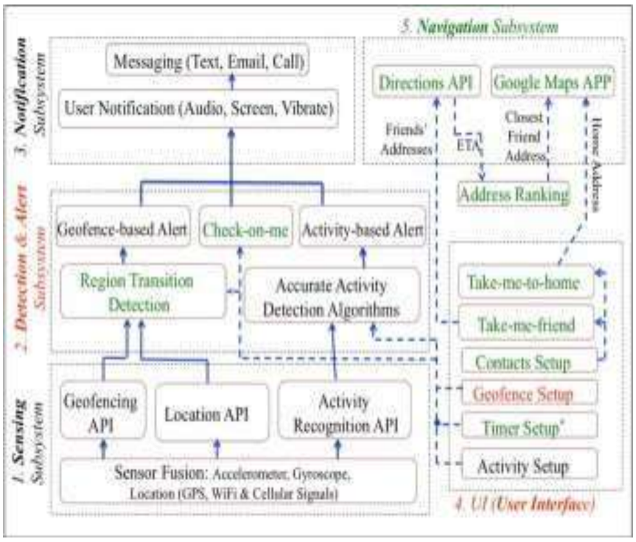

Fig 1. The Software Architecture Block Diagram for **Alzimio**

The first mobile app combining adjustable safe-zone geofencing, optimized activity recognition, and navigation to safety is presented in this work and is intended for people with dementia (including those with Alzheimer's and autism).

B. GPS Trajectories Based Personalized Safe Geofence for Elders with Dementia (by Qiang Lin, Xin Shuai Liu and Weilan Wang)

In this paper, a data mining-based approach is proposed to construct a personalized safe geofence by mining people's historical GPS trajectories. The goal is to develop a solution that is able to prevent elderly persons with dementia from experiencing elopement or boundary transgression, which is frequently related to getting lost or other adverse events if without timely assistive services. Traditional approaches frequently involve using physical constraints on dementia patients to stop them from straying when dealing with BT related to wandering. Traditional approaches to protecting wanderers, however, are impractical or ineffectual because to the physical and/or psychological issues that are brought on by physical constraints. Preventive approaches are primarily intended to manage wandering rather than prevent it by emphasizing a move away from prevention and toward promoting safe walking. A continuous, real-time ambulatory monitoring of human mobility in various situations is now possible thanks to recent advancements in sensing, communication, and computation systems. For the management of wandering related BT of elderly people with dementia in both indoor and outdoor settings, many sensors-based devices have been created. Each elder's previous movement trajectories acquired by GPS sensors built into smart phones or PDAs are mined using a data mining-based technology to construct secure geofencing for each of them. The regular trajectories are those trajectories that have a support degree greater than a predetermined threshold. The proposed technique is assessed using the GPS dataset of real-world individuals. The experimental findings show that our suggested approach to build customized safe geofence based on people's GPS trajectories is practical.

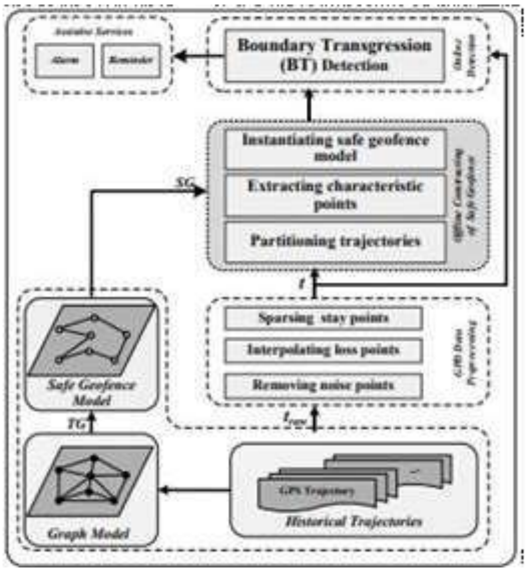

Fig 2. A whole process of constructing safe geofence by mining individuals' GPS trajectories

C. Geofencing for Fleet & Freight Management (by Fabrice Reclus and Kristen Drouard)

The effective enforcement of heavy goods vehicle (HGV) regulations, such as weight and height restrictions on specific routes or tunnels, restrictions on the transport of dangerous goods, and access restrictions in urban areas, may also be facilitated by global navigation satellite-based tracking and tracing systems with a geofencing feature. Using a set of coordinates, a virtual barrier (geofence) is built around a physical location. Whether the monitored object is inside or outside the geofenced area is determined by the system. An alert is generated when the monitored object enters the geofence. The spatial closeness of tracked mobile devices to a certain geofenced region can also be calculated using this method. An information chain connecting tracked mobile objects and the control center is primarily made up of four linked segments in tracking and tracing systems. Here are these four sections:

- A spatial segment: GPS, GLONASS, and EGNOS signals from the Global Navigation SatelliteSystems.
- A telecommunications sector, such as satellite communications for remote locations or mobile phone networks.
- An application segment: interface solutions can be accessed via a protected connection to the Web or a virtual private network.

- A user segment made up of the control panel and an on-board unit. Smart phones and other mobile gadgets, such PDAs, can also be used for monitoring.

Automatic monitoring of mobile items moving around or inside a geofenced area is made possible by geofencing. When mobile devices enter or exit the boundary, alarms are produced. To define the geofence boundary, coordinates from the shape's defining points are required. These coordinates are provided to the computation method, together with the geofence's inclusiveness or exclusivity, allowing it to compute warnings. The radius is parameterized based on the distance from the point of interest that is considered to be "proximity" (POI). Because it only requires two parameters—the coordinates of the center and the radius—this technique is the simplest approach to construct geofencing. The algorithm determines how far the moving object is from the circle's center. The movable item will be categorized as being inside or outside the geofence depending on whether this distance is greater or less than the radius's value. Route adherence refers to the observation of a mobile object during a journey, from the place of departure to the destination. It is feasible to guarantee that a vehicle stays on its designated route by using geofencing.

D. Geofencing Based Technology Towards Child Abuse Prevention (by Sarifah Putri Raflesia, Dinda Lestarini, Taufiqurrahman and Firdaus)

Recently, one of the major global issues has been child abuse. Every country in the globe has a sizable number of child abuse cases. The majority of nations in the globe are compelled to establish private organizations to address the child abuse problem. In this study, a virtual fence is set up for child monitoring as part of a child abuse prevention strategy using the geofencing technique. Every location that their children frequently visit will receive a label from the parents. The technology will be built into portable devices like tablets, smart watches, and smartphones. If the youngster enters or exits the fence, the child's parents will be notified. This device offers a panic button for the child to use in an emergency. There are three ways to communicate using this panic button. Parents and a local child protection commission will receive the notification. This model's major objective is to help parents and the local child protection commission monitor children's activity and stop potential crimes against children. A location-based service (LBS) is a service that utilizes the position or location of a mobile device in conjunction with other data to offer value for the user. Geofencing combines awareness of the user's current location with awareness of the user's proximity to a location that may be of interest.

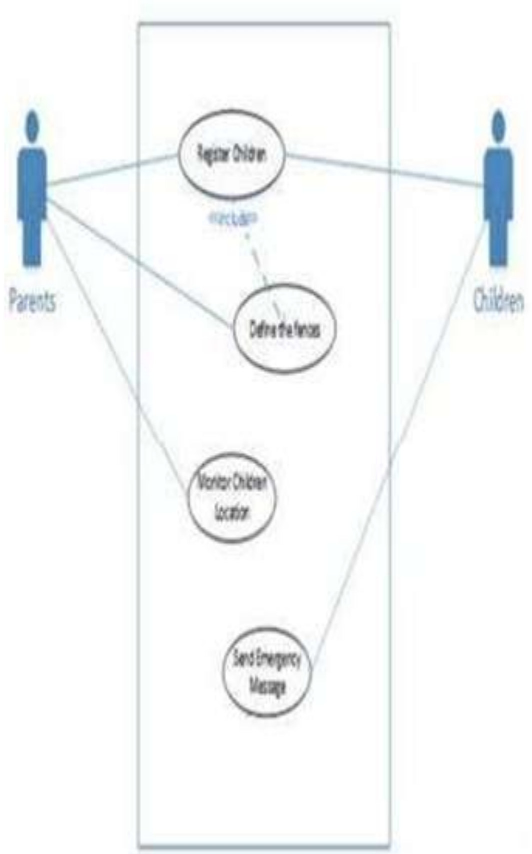

Fig 3. Use Case Diagram of Proposed Geofencing-Based Technology

E. Teenager Monitoring Mobile Application using Geofencing (by Ayunni Syamimi Binti Amir Boktar, Izzatdin Abdul Azizand Nur Syakirah Mohd Jaafar)

Teenagers go missing for a variety of reasons, some of which include peer pressure, interpersonal issues, and kidnapping. With the aid of technology, a preset area that is encircled by a virtual barrier can be remotely monitored using a geofencing technique. A notification or alert will be sent out whenever the targeted user crosses the boundary or leaves it. By doing this, parents can keep track of where their kids are and get notifications if they leave the designated region. Going outside the designated area during the allotted time would indicate that the youngster may have engaged in an unintended activity, which could result in a potentially dangerous event. Various tracking techniques are used, most common being GPS and RFID. Below is the comparison between GPS and RFID.

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Type of technology	RFID	GPS
Typical data transmitted	Unique identification	Location
Method of data transmission	Wireless	Wireless
Location Accuracy	Approximately 0.5 meter	Approximately 1.0 meter
Communication Range	Short range	Long range
Best Area of Usage	Tracking within a building or a facility	Tracking transoceanic shipments and very high-value assets

Fig 4. Comparison between GPS and RFID

Based on the table, GPS has been selected since it has a greater communication range. As a result, the prototype is not limited to a certain area.

III. EXPERIMENT AND RESULT

The Adafruit FONA, NMEA GPS, and SSD1306 ASCII libraries must be initialized in the first section of the code, and then the pin numbers for the serial communication with the SIM 800l module must be defined. After that, we will set up the base position, or center point of the geofencing, from which we wantto begin.

Base Location

```
NMEAGPS gps;

// The base location, in degrees * 10,000,000
//NeoGPS::Location_t base( 0.000221,0.000117 );
NeoGPS::Location_t base( 0.001651,0.000241);
void setup()
```

Fig 5. Setting up Base Location

The baud rate for the SIM800L Module will then be set to 4800, which is the default baud rate for our GSM Module, in the setup function that we will develop next. The GPS Module's baud rate will then be set to 9600. Here, both serial debugging and communication with the GPS module have been accomplished using the hardware serial port of the Arduino. The OLED Display will then be set, and communication with it will be initiated.

```
void setup()
{
  DEBUG_PORT.begin(9600);
  DEBUG_PORT.println( F("NMEAdistance.ino started.") );
  DEBUG_PORT.println( F("Looking for GPS device on " GPS_PORT_NAME) );
  pinMode(13,INPUT);
  gpsPort.begin(9600);
   fonaSerial->begin(4800);
  if (! fona.begin(*fonaSerial)) {
    Serial.println(F("Couldn't find FONA"));
    while(1);
  }
  Serial.println(F("FONA is OK"));

  // Print SIM card IMEI number.
  char imei[16] = {0}; // MUST use a 16 character buffer for IMEI!
  uint8_t imeiLen = fona.getIMEI(imei);
  if (imeiLen > 0) {
    Serial.print("SIM card IMEI: "); Serial.println(imei);
  }

  fonaSerial->print("AT+CNMI=2,1\r\n");  //set up the FONA to send a +CMTI notification when an SMS is received

  Serial.println("FONA Ready");
   oled.begin(&Adafruit128x64, I2C_ADDRESS);
  //oled.setFont(TimesNewRoman16_bold);
 oled.setFont(Callibri11_bold);

} // setup
```

Fig 6. Setting up Baud Rate and OLED Display

To update the location on the OLED Display, we will then develop a loop function that runs constantly and checks the GPS location. We establish the threshold distance, or, as you would say, the maximum distance that one can be permitted to travel from the base location, in the same loop's If condition. The device notifies the designated numbers of the geofencing break and sends an alarm if someone crosses thisline.

```
void loop()
{

  while (gps.available( gpsPort )) {
    gps_fix fix = gps.read(); // save the latest

    // When we have a location, calculate how far away we are from the base location.

      float range = fix.location.DistanceMiles( base );

      DEBUG_PORT.print( F("Range: ") );
      DEBUG_PORT.print( range );
      DEBUG_PORT.println( "range in miles" );
      oled.clear();
      oled.println(" Distance from base/n");
      oled.print(range);
      oled.print("miles\n");
      oled.println("Distance from base in km\n");
      oled.print((range*1.609));
      oled.print(" km");

   if (range>=8732.82){
    Serial.println("grater");
    digitalWrite(13,HIGH);
     if (!fona.sendSMS("7979952235", "Hey, This man gone out of range please catch")) {
        Serial.println(F("Failed"));
     } else {
        Serial.println(F("Sent!"));
        delay(4000);
     }
  }else{
```

Fig 7. Updating location

IV. CONCLUSIONS

Firstly, geofencing is a highly flexible technique, because it can be used for a multitude of purposes. Geofencing implies the formation of a virtual boundary using GPS. The Smart GPS Geofencing System can be used in a variety of applications. It can be installed safely and will keep track of what it is attached to. Geofencing can be used with mobile applications or electronic devices to alert any deviation from the geofence. We have combined the geofencing technology with IoT to form an alerting system when the tracked user/object moves outside the specified area. Previously, geofencing and GPS together have been used for tracking elderly, patients with Alzheimer's disease, kids and teenagers, vehicles, fleet and freight, etc. Hence, the Smart GPS Geofencing System is used as a generalized method to track various things.

V. ACKNOWLEDGMENT

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