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INTRUSION ALARM SYSTEM BASED ON RADIO FREQUENCY TECHNOLOGY, GPS, GSM AND DIJIKSTRAT ALGORITHM FOR NOTIFICATION TRIANGULATION

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Abstract
In today's world, cars are important products that are essential to life. But when it comes to vehicle security, it's hard to start. "Vehicle theft is on the rise. Most stolen vehicles are exported abroad. The aim of this research is to develop a remote sensing notification module. In the event of a break-in, the driver is notified by SMS using GSM technology, uses GPS to track the location of the vehicle and trace the route, maps the location and uses the DIJIKSTRAT algorithm to find the nearest send a notification to the police station. The module also incorporates a prediction system for suspicious events associated with an infrared sensor. The overall idea of this research is to use large amounts of information and suspicious movements to develop a scientific model for intrusion detection. When a person approaches a parked vehicle, infrared sensors detect and compare suspicious movements in the knowledge base to detect possible intrusions. This paper proposes an anti-theft system to help car owners avoid theft and locate their car after it has been stolen. The materials referred to in this project are also actually designed.

1.0 INTRODUCTION

In contrast to previous years, nowadays the purchase of vehicles is affordable for many categories of people. As the number of vehicles grows, so does their sophistication and cost. As a result, vehicle safety remains a top priority. To strengthen the security of the vehicle, two notification systems will be used: an audible notification (alarm) and then a notification by SMS (intrusion detected in your vehicle, and GPS coordinates on the location of the vehicle). It is assumed that the owner of the vehicle is away from it in case of intrusion. Then the system will notify the owner by short message service (SMS). In case of an intrusion, two main things will happen: First, the notification to the owner. Also, threat to the suspect that the alarm will sound in a loop without interruption. This system also alerts the police department to request their intervention. To alert the police, the location of the vehicle is required. For this, a GPS sensor is installed in the vehicle.

Both notification systems will have to exploit the Global System for Mobile Communications (GSM) technology to ensure a long-range notification transmission thanks to its coverage. To achieve this, two approaches will be used in this study Behavioral approach: which is based on the assumption that we can define a "normal" behavior of an individual, and that any deviation from it is considered potentially suspicious. Scenario approach: based on the knowledge of the techniques used by thieves. Once an event is considered potentially

suspicious, there are some events that are predefined in the security system and classified in our knowledge base for comparison and confirmation in case of a suspicious movement.

Several solutions can be considered and in this work, the approach adopted is that of a proximity detector, using RF technology in the form of a beacon. The RF technology can activate or deactivate the module, automatically or manually [1] [2]. As a contribution, when the user's beacon is not in the field of vision of the module (radius of n meters), the system is automatically armed and the start of vehicle monitoring is triggered. As long as the system is activated, if one of the vehicle doors is opened, the controller will activate the vehicle alarm (or an installed siren) for T seconds and send a notification via SMS to the user's phone number through the GSM modem.

2.0 Related Work

M. Laas-Bourez, D. Coward A general overview of the International Robotic Optical Telescope Array is given in. Discussions revolved around the benefits of using the array to participate in a satellite and space debris tracking program[3]. This array will access almost all objects in the geostationary belt and provide the first real-time satellite positioning capability. The inclusion of the Zadko 1-m telescope in the array greatly extends the efficiency and sensitivity of the existing two-telescope configuration. And this system is very costly to implement; this proposed technology is used to make good use of the security system based on remote sensing. The advantage is on the point of view of geographical coverage which has a very large range and this in order to better control the vehicle which is the main target. The exploitation of the GSM system is very useful for the simple fact that an alert will be transmitted to you no matter the distance that separates you from the vehicle.

N. Kiruthiga N. Kiruthiga, talks about a vehicle security solution: a real-time biometric based vehicle security system with GPS and GSM technology. The main objective of this research is to protect the vehicle from unauthorized access, using fingerprint recognition technique. This vehicle security system indicates the status of the vehicle to the owner using GSM communication technology. If the person is successfully authenticated, the access to the vehicle is allowed. In today's world, there are machine learning algorithms that can generate fake fingerprint images that can fool a fingerprint authentication system[4].

The vulnerability lies in the fact that fingerprint-based authentication systems have small sensors that do not capture the user's full fingerprint. Instead, they scan and store partial fingerprints. Many smartphones allow users to enroll multiple fingers in their authentication system. Identity is confirmed when a user's fingerprint matches one of the stored prints. This search is only applicable when the thief is successful and does not offer a workaround, as the goal is not always to recover a stolen vehicle, but primarily to prevent it from being stolen.

In the same vein, the approach proposed here aims to model a new paradigm of intrusion detection system using radio frequency technology to alert and notify the owner in real time. This system uses an infrared beam sensor network for the detection of suspicious movement and also proximity sensors for the control of each door of the vehicle, also GSM technology is used (SMS, geolocation), which allows to control the vehicle everywhere else, when the system is armed. This coverage is due to the range of coverage of the network which is quite large.

Samir Rana proposes an anti-theft security system for vehicles with some features that are created in the application and will communicate with the device in the vehicle, to control it. However, for this system to work, the phone and the device must have an internet connection. Thus, since the system uses an internet connection for communication, it has an unlimited range, which means it can control the vehicle from any part of the world; The weakness of this approach is that a mobile phone used in the car can easily discharge, Also, the internet connection is not always available.

The present paper proposes a standalone solution in terms of power source, the security module will be on standby when the suspicious movement is not intercepted. And, this is in operation with a possibility to sound the alarm, send SMS and also the geographical coordinates of the car even before the intrusion occurs [5].

Montaser N. Ramadan and Mohammad A have implemented an automotive security module using an in-vehicle system equipped with GPS and GSM. The client interacts via this system with the vehicles and determines their current location and status using Google Earth. The user can track the position of the targeted vehicles on Google Earth. Using the GPS locator,

the current location of the target is determined and sent, along with various parameters received through the vehicle's data port, via the short message service (SMS).

Each time the owner needs to track the vehicle, he/she has to send an SMS containing a special code, after which he/she will receive an SMS containing the GPS coordinates of the car, with the SMS updating its contents every predetermined period. This system seems to be very complex for a user, he is supposed to consult his phone at any time to monitor his vehicle; this will have a high cost and will not be within the reach of the general public. The objective of this vehicle anti-theft design is to provide a complex, yet simple to use and affordable model to reach the general public and also protect the vehicle before the incident occurs [6].

In K. A. Mamun designs an anti-theft security system for vehicle and using a sensor network system that uses global positioning system (GPS) and global mobile communication system (GSM) to track the vehicle. When the vehicle is stolen, it can be traced through this bimodal security system by knowing an alert message including the geographical coordinates of the vehicle's location.

This design will continuously monitor a moving vehicle and report the location of the vehicle on demand. The advanced technology of this system is capable of protecting, monitoring and tracking the vehicle even within a minute. The system is good, but has limitation in that it cannot alert before intrusion, and also the monitoring is possible only on request of the owner. The study conducted in this work is that the remote sensing system is capable of alerting before, during and after intrusion [7].

In J. Arellano-Zubiate has developed a system that allows, through the application of the Internet of Things (IoT), the management of software and hardware technologies. These technologies allow the user to have access to various actions such as the location of the vehicle via GPS and the identification of the offender, through radio frequency identification (RFID), as well as GSM. The objective of this work is to design a mobile application that will be installed in a Smartphone and connected to the Internet that will ensure the location of the vehicle after theft with a possibility to stop the engine remotely. The result is the design of the mobile application, with its anti-theft system, vehicle blocking and unauthorized ignition notification [8].

Unlike previous authors, our approach aims to propose a new paradigm of intrusion detection system using a system capable of detecting suspicious movement before, during and after theft; Able to alert and notify the owner and the nearest security service in real time. This system is based on GSM technology, which allows the vehicle to be monitored in any part of the world, when the system is activated. This coverage is due to the network coverage range.

3.0 Materials

Microcontroller (Arduino)

An Arduino is a single board microcontroller that comes with a software suite for programming in embedded systems. The hardware consists of an Atmel AVR processor and a simple open hardware design for the controller with integrated I/O support. The software consists of a standard programming language and a bootloader that runs on the board. In other words, an Arduino is a microcomputer that you can program yourself to manage the inputs and outputs between your device and the external components connected to it.

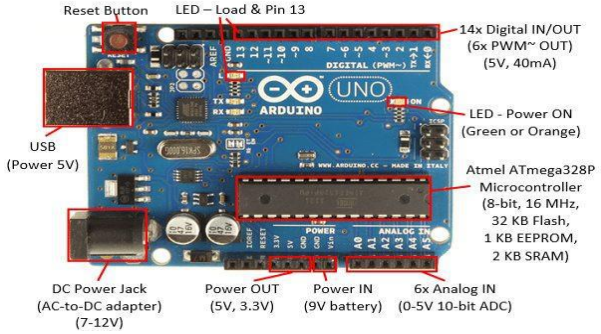

Figure 1 Arduino uno [9]

GSM module

A GSM module is required for communication between the system and the user via SMS. The GSM/GPRS module from SeedStudio is an Arduino compatible interface board. For the GSM module, the GSM type SIM900A is chosen to perform the task in the communication part. It operates in dual band from 900 to 1800 MHz and is intended for use outside Europe and the United States only.

As the third generation GSM dual frequency module, TC35 GSM module has the following features: compact and low power consumption; support dual frequency of GSM900 and GSM1800; provide standard AT command interface to users; provide fast, reliable and safe transmission of data, voice, short message and fax. It is ideal for this system because of its high quality short message function [10].

RF technology

Radio frequency (RF) technology technology uses radio waves, commonly known as radio waves. This is electromagnetic radiation with frequencies below 300 GHz. Vacuum wavelengths greater than 1 meter (frequencies below 300 MHz) for so-called "high frequency" radio waves and vacuum wavelengths greater than 1 millimeter (frequencies between 300 MHz and 300 GHz) for so-called "microwave" radio waves. Radio waves are suitable for the transmission of audio and image signals, enabling radio communications (walkie-talkies, cordless phones, remote controls, mobile phones, etc.), broadcasting and radar. Their biological and ecological effects at specific frequencies and intensities have been the subject of much research and discussion, especially in the context of wireless communications and 5G developments [11].

Magnetic Sensor

A device that can detect when one of the doors is open. A magnetic switch is used in this project. The integrated Hall effect magnetic sensor is used in the automotive and computer industries. Deeper penetration into other applications is hampered by problems with switching noise and delay and drift, mainly related to packaging stress. The magnetic switch is a switch with two ends that form a magnetic field. When the ends are separated and the field disappears, the switching contacts open. For this application, place one end on the door and the other end on the vehicle frame. This way, as long as the door is closed, the edges come together as soon as the door is opened. The contact is open [12].

Infrared beam sensor

The infrared detector detector is a device designed to detect movement or a physical presence over the entire surface covered by its sensor. A passive infrared detector can analyse the thermal radiation emitted by any mammal. A body with a temperature above absolute zero produces infrared radiation. Humans have an external temperature of around 35°C. He therefore emits infrared radiation. The average wavelength of this radiation is approximately 10 µm. This wavelength is "below" that of red (0.65 µm = 650 nm for red lasers) [13].

4.0 METHOD

Overall system design

Here is the architectural diagram of the vehicle monitoring system:

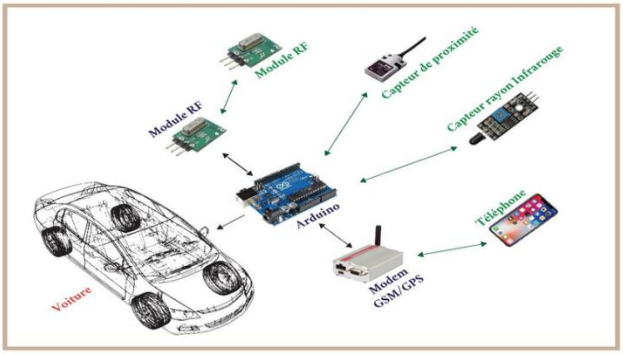

Figure 2 System architecture diagram

Figure 2 shows a remote sensing reporting system with several components:

GPS module, GSM modem, proximity and infrared sensors, buzzer and Arduino UNO and NANO controllers. The GPS module determines the geographical coordinates of the vehicle's position (longitude, latitude, altitude, precision). The alarm is intended to warn your environment by a sound signal. A GSM SIM 900 modem is used to send alerts to the owner and the nearest police station; infrared detection sensors are used to read suspicious movements and trigger the alarm, and proximity sensors are used to monitor each door of the vehicle. We place ourselves for the moment in the plane. If the signal is emitted at the point S_1 at time t_1 = 0 and the signal is moving at a speed c, then at any time t > 0, the signal is perceived exactly at any point of the circle C_1centered at S_1 and of radius c - t. If the center S_1 has coordinates (x_(1,) y_1) then the equation of this circle is :

$$\sqrt{(x - x_1)^2 + (y - y_1)^2} = c \cdot t.$$

Or by squaring [14]:

$$(x - x_1)^2 + (y - y_1)^2 = c^2 \cdot t^2.$$

Recall that we are trying to determine the position P. Therefore, if we receive a signal at time t, we conclude that we are on the circle C_1 (of radius c - t) [14].

The block diagram of Security system

The flow of system functions can be seen in the following flowchart:

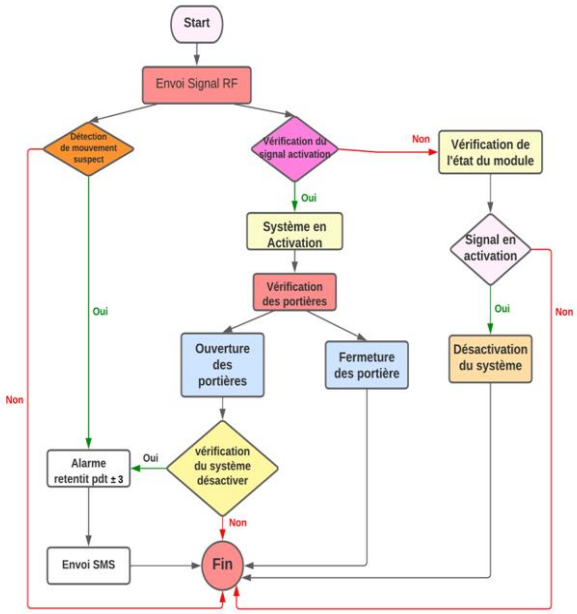

Figure 3 The block diagram of Security system

The transmitter algorithm is shown in Figure 5(c). The transmitter sends a signal to the RF, which can check the type of signal to enable or disable the system. If the signal is the lock signal, the controller checks if the module is locked.

Geographic triangulation system for sending targeted messages to the vehicle owner and the police office

Terminology:

- Root of a graph G=(S,V);
- Tree G=(S,V);
- Tree G=(S,V);
- Quasi-strongly connected graph G=(S, V) ;
- Network G=(S, V);
- Label of a vertex j ;
- Tree of PCCs in a network G=(S, V).

Geolocation of the nearest police station

The problem of geolocating the nearest police station to the mobile object (vehicle) is the optimal path problem in a quasi-strongly connected network G= (S, V, C) defined as follows:

(1) S≠∅: set of nodes that represents the moving object as well as the different police stations lying inside the circle centered at the point $(X_0 - Y_0)$ and of radius R= E, or $(X_0 - Y_0)$: the geographical coordinates of the moving object on the geographical map.

Note that each i∈S node is marked by its geographic coordinates $(X_1 - X_2)$ on the geographical map.

(2) $Vc\ SxS = \{(i,j)|i \in S\ et\ j \in S\}$ set of edges that represent the line segments connecting the nodes 2 by 2.

(3) $C = (Cij)\forall(i,j)\in V$ a matrix of weights $Cij\in\mathbb{R}_*^+$ determining the length of the segment $(i,j)\in V$ or the distance between $i,j\in S$. Let two nodes $i\ et\ j$ of respective geographical coordinates (X_1, X_2) and $(Y_1, Y_2)$the length of the segment (i,y) is given by the following formula:

$$dij = \sqrt{(Y_1 - X_1)^2 + (Y_2 - X_2)^2}$$

Statement of the problem

Given the quasi-strongly connected network G=(S, V, C) thus defined above. Let us assume that there are no constraints related to the practicability state of the sections; the geolocation problem of the nearest police consists in determining the tree of PCCs starting from the mobile object i of geographical coordinates $X_0 - Y_0$ to the police stations j inside the circle centered at $(X_0 - Y_0)$ and of radius R=E

The police station j whose label $\ell\ \Gamma_{ij}=\sum d_{xy}, \forall(x,y) \in C\ \Gamma_{ij}$ is minimal, is therefore the nearest police station or Γ_{ij} is the path between i and j in the PCCs tree.

The PCC problem in the network G=(S, V, C) defined above, consists in determining a path Γ_{ij} between a vertex i and a vertex j in the network G=(S, V, C) such that $\ell\ \Gamma_{ij}=\sum_{(x,y)\in\Gamma_{ij}} d_{xy}$ is minimal, among so many possible paths Γ_{ij} between i and j.

Solving the problem

This PCC problem can be solved by categories of algorithms including Tree Builder and Matrix algorithms. In the framework of our study, we use the DIJIKSTRA algorithm among the Tree Builder algorithms whose characteristic is to determine the shortest paths between a root vertex and all the other vertices of the network. So the DIJIKSTRAT algorithm allows us to build this tree of PCCs from a well identified root node [15].

DIJIKSTRAT algorithm

This algorithm [15] can be applied to a directed or undirected graph G=(S, V, C) such that ∀(i,j)∈V, C_{ij}≥0.

Given our quasi-strongly connected network G=(S, V, C) defined above, we denote by :

(1) S: set of all nodes in the network
(2) ∏: set of optimal vertices
(3) s the network node considered as root
(4) weight (x) the label of the node x
(5) pred (x) predecessor of the node x
(6) neighbor (x) set of neighbors of the node x

The algorithm looks like this:

Beginning:
weight (s)←0
weight (x)←=+∞ , ∀ $x\in S, x \neq s$
∏←∅
As long as ∏≠S
Select $x\in S\backslash\prod$ such that weight (x)=min $\{poids\ (y)\ |\ y\in S\backslash\prod\}$
$y\in\ voisin\ (x)\backslash\prod\rightarrow\prod\leftarrow\prod\cup\{x\}$
If weight $(x) + d_{xy}$< weight (y) then
Weight (y)←weight $(x) + d_{xy}$

Pred $(y) \leftarrow x$
End if
End $\forall_y$
End as long as
End
In the worst case, the complexity of the DIJISKTRAT algorithm is 0(n^2) with n=|S|.

5.0 RESULTS AND DISCUSSION

Implementation

Material implementation

The hardware implementation consists of several elements, namely Arduino uno, Arduino nano, magnetic sensor, infrared sensor, buzzer, breadboard, push buttons, radio frequency module transmitter / receiver, GSM / GPRS card and a power supply stabilize. The components are arranged on two cards that have a length of 12 cm, a width of 10 cm and a height of 10 cm: one card is the remote control and the other is the module of intrusion detection. The figure .... shows the results of the hardware implementation. In this paper, a low-cost vehicle tracking and monitoring system is presented.

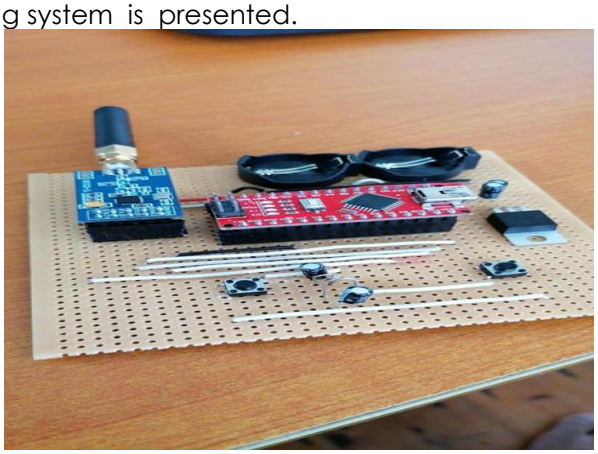

Figure 4 Télécommande RF

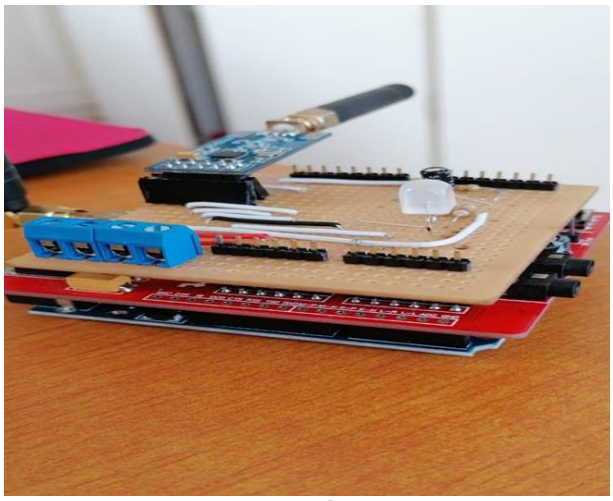

Figure 5 Module du détecteur d'intrusion

Intrusion detection system comparison chart

The system proposed in [5], is quite long due to the fact that you have to authenticate by password, and also in case of rejection, the system sends you the message. We have simplified things by setting up a remote control for activation and deactivation of the system and other functionality mentioned above.

Exemple [5]:

The snapshots taken during the system working are shown in this section. Figure 6 shows the prototype where the antitheft module is implemented on vehicle. Here a small 4 wheel robot

is used in the place of a vehicle. The snapshots taken during the system working are shown in this section. Figure 6 shows the prototype where the antitheft module is implemented on vehicle. Here a small 4 wheel robot is used in the place of a vehicle. The snapshots taken during the system working are shown in this section. Figure 6 shows the prototype where the antitheft module is implemented on vehicle. Here a small 4 wheel robot is used in the place of a vehicle.

Figure 6 Prototype of the project

Counting the number of wheel rotations during emergency condition to move vehicle for certain distance using default password id shown in figure 7.

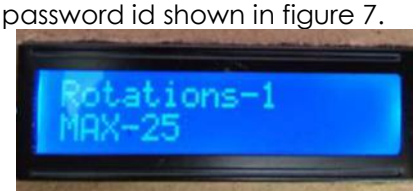

Figure 7 Message during default password

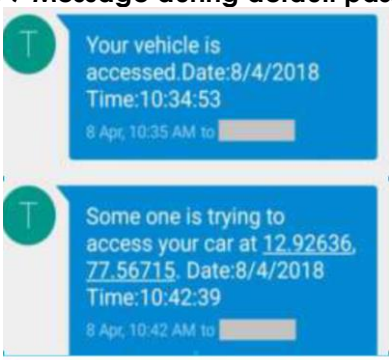

Figure 8 Messages received by owner

The messages received by the owner during correct and incorrect password entries are shown in figure 8.

We offer this much improved model:

Table 1 Content of the message with precision

Intrusion Alert	Contact information	Sending time Message
Alarm	audio	Serial.print("ALERT! Intrusion detected in your vehicle.\r\n");//The message sent. delay(2000);
SMS	Intrusion detection in your vehicle	
Latitude:	S 4°25'9.92064"	
Longitude:	E 15°18'38.96172"	
Altitude:	431.3m	
Accuracy:	38.45	
Transmission notification:	two users (owner and police office)	

This table shows us the information transmitted during an intrusion, as well as the complexity of 2 seconds to send the message.

Figure 9 Alert message

In this paper, we designed and built a TTY that provides a powerful vehicle loss detection and notification system. Existing TTYs are mainly based on short-range unannounced post-flight warning systems, but our contribution was to add a notification layer to the TTY to improve its detection, autonomy and suspicious motion detection mechanisms. It is based on the principle of intrusion detection with the ability to predict the suspicious movement of a malicious person. We implemented a distance problem between the vehicle and the owner using SMS notification and also geographic coordinates on the location of the vehicle.

Our experiments have guided our approach to different configurations. An SMS is sent to the car owner when an intrusion is detected and also by triangulation to target the nearest police office to send a message including its location. In case of false alarms, the owner has the option to disable the ringing of the notification system. Compared to previous work, IDS notification systems tend to be faster and the materials used to build the TTY are much cheaper.

There are interesting ways to further the understanding of TTY. It would be best to start by theoretically establishing a TTY in the vehicle. In addition, machine learning and computer vision could be used to enable a smart version of the TTY and reduce false positives. Finally, there is interest in improving the notification system and optimizing the battery consumption.

6.0 CONCLUSIONS

While existing anti-theft systems rely mainly on short-range, unannounced post-theft alert systems, our contribution adds a notification layer to anti-theft systems to provide detection, range and suspicious movement mechanisms to improve detection and search. Display a map of the nearest police station and send a message to the police station phone number. It is based on the principle of intrusion detection and can predict suspicious movements of malicious people. Implemented distance output between vehicle and owner using SMS notification and geographic coordinates of vehicle location. Based on the design, observations and facts of the existing systems, it can be concluded that the designed intrusion detection system can alert the owner of the vehicle at the moment T and also alert the nearest police office with a message containing the location of the vehicle before, after and during intrusion.

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