Original Research Paper

PortaX Secure Automation System Using IoT – A Survey

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Abstract: In recent times, everything around us is automated. People are looking to make things easier and easier day by day, by reducing the work they do, but not reduce the efficiency of work. The most important thing in this technically forward world, is, what we mentioned above i.e. Automation and Security. Travel needs a lot of automation in this day and age, especially Airports. The idea of a bag can check-in by itself, and tell us where it is and deprive us of the worry of continuously checking or thinking if the luggage is okay, is just a dream for most people.

Keyword: IoT, Raspberry Pi, Home Automation, Smart Mirror, Magic Mirror.

1. Introduction

The robots have taken over the world and, it is a fact that we have to agree upon and in recent days there have been so many advancements in this field. PortaX Secure Automation System will incorporate these robots, that function in such a way where they will both, navigate themselves to where their owner is, or in other words, follow their owner and also tell the owner that it is safe, in the transmitted coordinates. It will use GPS-GSM collaborated systems that are integrated using the IoT microcontrollers to provide the above-mentioned functionalities [5]. Mainly, the tracking system must be able to send the location of the luggage as it should make the owner, able to track it. One way of doing this is to install a GPS module in the luggage integrated to a GSM or a RFID module and then installing a GSM module on the receiver, that is connected to a map application or an interface that will be able to show its coordinates [6][7]. In addition to this, we can integrate with a Alarm System, that will help us to know if the bag is stolen or is out of reach, or has been through a security breach. This is not the only functionality of the system. We have tried to incorporate the Automation- part of the luggage using the integration of three robots: Obstacle Avoidance Robot, Line Following Robot and Human Following robot. The combination of all two parts i.e. automated part and the Security System part will be the PortaX Secure Automation System. It can be useful in the Airports, Metro Stations and Average Crowded social places while the security part of the system can be used anywhere where there is a substantial network connection [1][2]. We can extend the applications to even tracking your children and the buses [3][4].

There are some methodologies used:
1. Global Positioning System for Object Tracking
2. Obstacle Avoidance Robot
3. A new invention of Alarm Reminder Locking (ARL) security system
4. Luggage Anti - Lost Wireless Security Card Structure
5. Wearable – Logo antenna for GPS – GSM based tracking systems
6. A Multipurpose Vehicle tracking based on ARM CORTEX-M3, STM32, HMC5883L, MPC-6050, GPS and GSM
7. GPS Based Android Application for Women Security

2. Global Positioning System for Object Tracking:

Damani, Shah and Vala have proposed using a GPS system for the object tracking [8]. The paper has analyzed how our predecessors' GPS system was working. They specify that the GPS system that was used in 1973 by US DOD had 24 satellites and they have overcome so many limitations up till now. GPS system was originally developed for military purposes but now has widened its horizons. They specify that GPS is a GNSS i.e. a Global Navigation Satellite System that is mainly used to determine a location or position. Hence, the word Geo-Positioning. We used to have special receivers, but now all mobile phones have a built-in application. The main application they have used it for is Anti-Theft and they use arm processor hardware.

In the model that they have developed, they have installed GSM modules on two - transmitter and receiver to communicate and the GPS module calculates the geographical coordinates and sends it to the GSM module in the receiver from the transmitter.

3. Obstacle Avoidance Robot

Bhagat, Deshmukh, Dhonde and Ghag pitched a model for the Obstacle Avoidance Application [9]. Obstacle Avoidance robot stops near the obstacle on its way, reroutes itself and continues moving. Few methods that were told in this paper are wall following, edge detection, line following etcetera. Wall following methodology is mainly used for the floor cleaning robots. Edge detection methodology can be used for obstacle avoidance in general but the main disadvantage is that it has to stop right ahead of the object to give the accurate measurement. The sensors used here are Infrared sensors, Ultrasonic Sensors, cameras – used for computer vision. The Steering Algorithm need not stop in front of the obstacle to navigate from it. When the obstacle is found, it avoids it and takes back the original path.

This proposed model in the paper uses an Obstacle Avoidance Algorithm and a Steering Algorithm. From the start, till the end, the main function of the Obstacle Avoidance Algorithm is to dodge any kind of obstacles and direct it / reroute it to the end point.
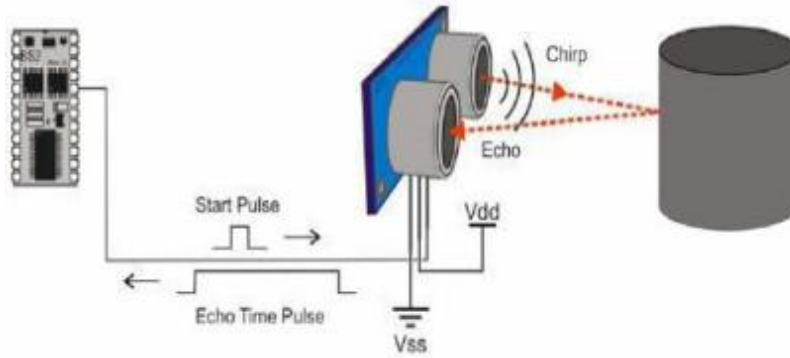
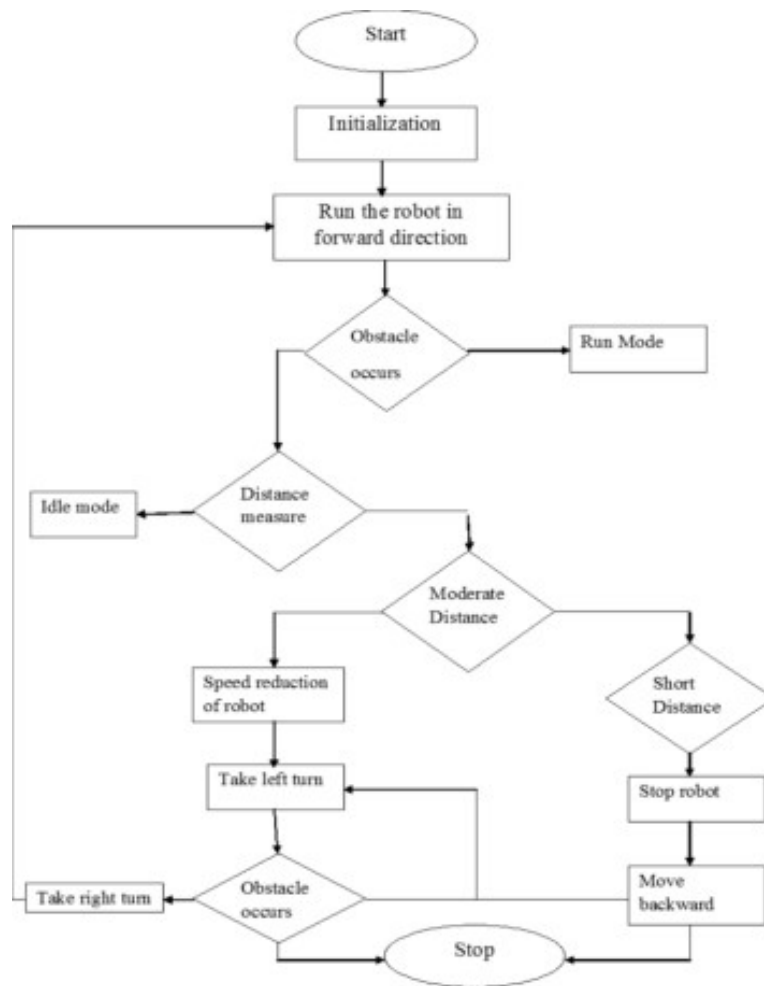**Figure 1.   Working of Ultrasonic Sensors [9]**

Figure 2.   Obstacle Avoidance Flowchart [9]

4. A new invention of Alarm Reminder Locking (ARL) security system

Effendi, Shayfull et.al [10] proposed this locking system in the paper that was published in Feb-Mar 2016. This paper deals with the security of the door systems used at various places, such as houses, offices, and various other places. This paper makes use of the Arduino controller and global system for communication to receive updates on the security. This paper includes three functionalities-an

alarm to inform the user about the security, a locking system and also a reminder in case the user forgets to lock the front door. This paper aims maximizing the security of the most valuable possessions of the user. This paper makes use of the ARL door security in order to safeguard any of the valuable data, assets and various confidential documentation. This methodology provides the highlights of its door security to its user. This methodology makes use of Arduino microcontroller and GPS and GSM sim 900 in order to prevent its belongings from any theft or physical damage. This methodology makes sure if the door is closed appropriately and if not, it activates the buzzer in order to inform the owner about the door being not shut.
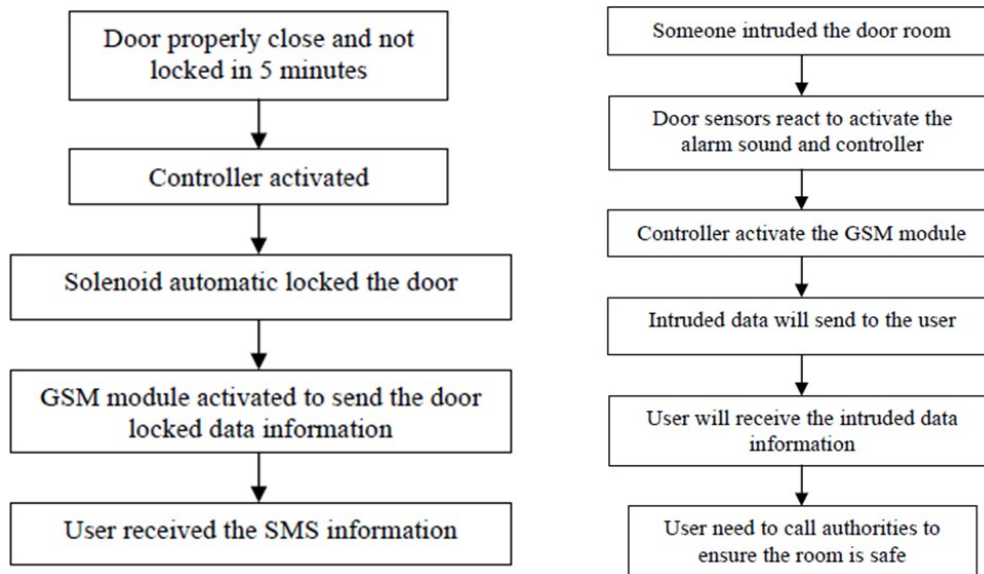

Figure 3.   The Process Flow of Automatic Locker and Flow Process of Intrusion Situation [10]

This model mainly makes use of the GPS and GSM modules in order to track the progress of the security and also receive updates in the form of messages which are sent to the user. The system sends in a warning when a random intruder who has not been granted access to the house tries to enter the house with an intention to rob and threat the environment of the house.

5. Luggage Anti - Lost Wireless Security Card Structure

This is actually a patent application from the US that, mainly aims at providing security to the luggage systems in order to prevent any theft or physical damage to the belongings of the user [11]. This model makes use a security tag prototype which can send signals to the tag number to the outside environment in order to detect the bag. In order to receive the update of the location of the bag an external application is used in order to keep the users informed about his belongings. When the luggage of the user is out of sight of the user the application will send a warning to the user about the bag losing its range and as per the warning the user can immediately take action.

The user is also provided with an application where, he can receive notifications of this luggage and also warning, if there is a threat to his luggage. The application is used for the users to login and have an overview of his luggage. Thus, installing a sense of security to the user while traveling and making his journey more blissful. In this way, the user can look out for his bag and also secure the confidential belonging's. The security tag/card could be installed within the luggage and can be managed using a wireless smart device such as a smartwatch or even a mobile. Only the authorized and authenticated user will have access to the application and does not allow any random intruder to hack or have an overview of the luggage therefore providing complete security and minimizing the chances of the burglary.
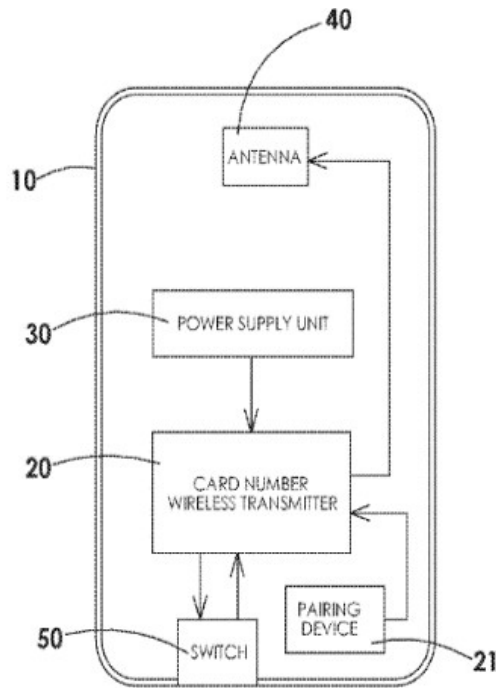
Figure 4.   Implementation of the Structure [11]

The card-wireless transmitter can transmit the signals that it has received from the antenna to the outside, to track the location of the luggage. Bluetooth wireless transmitter is also used in order to keep the user updated about its luggage and also sends a warning if the luggage is out of range of the user.

6. Wearable – Logo antenna for GPS – GSM based tracking systems

Due to increased theft, the anti-theft systems have created a major demand and play an important role especially in fashion industries and automobiles. The GPS-GSM based tracking devices are one of the most common and cost-effective systems. These modules are embedded in the objects which can be tracked at all times. The tracking system is embedded on expensive objects such as leather bags, cars and other prideful artefacts. It is also embedded permanently on small portable objects such as mobile phones and laptops. The GPS-GSM system consists of two major blocks - the data handling block and a wearable antenna [12].

The first block comprises of: a) GSM modem b) GPS receiver c) Microcontroller. In case of theft, the GSM modem is activated and alerts the microcontroller. The micro controller in turn activates the GPS receiver and it send the GPS co-ordinates to the GSM modem. The second block is necessary for wireless data exchange. Since its mostly used alongside with leather which is 1.65mm thick a non-woven conductive fabric is used. This material is ideal as it has high mechanical strength, has no fraying problems and low-cost. It can also be used in complicated structures/geometry and it also preserves all electro-textile features. The antenna should have high value for F/B ratio and HPBW. It also should be able to operate alternatively GPS L1 band and GSM-1800 band.

Two major strategies to reconfigure the antenna's frequency are:
1) Modify the geometry radiating element and
2) Introduce short circuits between radiating element and ground plane.

As mention in the paper, until now, this tracking system has produced great results and are cost effective. It also can be used without creating any with the working of the device and can be fully integrated with leather bags and other small portable devices.
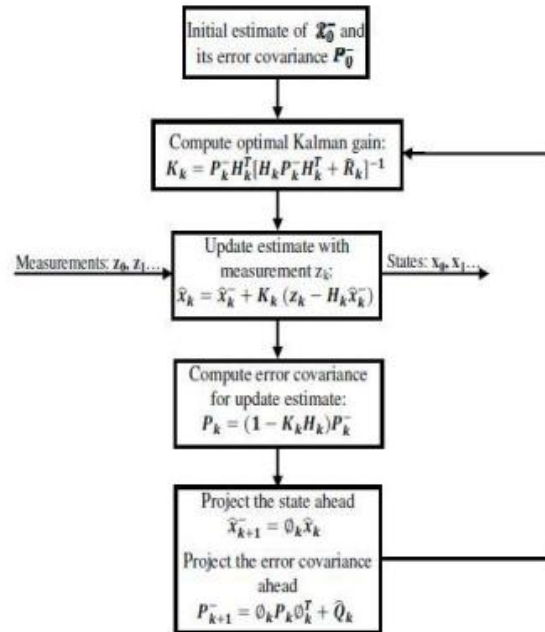
Figure 5.   Kalman Filter Algorithm Flowchart [12]

8. A Multipurpose Vehicle tracking based on ARM CORTEX-M3, STM32, HMC5883L, MPC-6050, GPS and GSM

In this paper, they have mentioned that the ratio of road accidents has increased and therefore it is necessary to take precautions against the prone accidents [13]. This project aims at the security of the vehicle from any theft or any physical damage or unforeseen case of accident. This project makes use of two systems: active and passive system Passive systems will be architectured simply to track a location of the vehicle and later the data can be used to for analysis purpose. The active system is used to transmit the vehicles location in real time to a central location. The active system used in this project informs the user of the vehicle via the messages in order to keep the owner informed about his vehicle. This is used by many of the food delivery franchises in order to track the activity of the employees.

This project involves two parts: A device embedded in the vehicle to be tracked using the GPS and also the application which will provide a visual detection of the vehicles co-ordinates. Sometimes the location provided by the GPS may not be as accurate as in real time so for this an improvement was made by making use of a matching algorithm. This algorithm is included with the vehicle bearing in order to get the exact dimension of the of the road. Vector maps are used to get the exact position of the vehicle. For an accident alert the data is collected from the pressure sensors and the accelerometer and after analysing the data it is then sent as a message to inform the user.

The main motive of this project is to provide security to the user of his vehicle and also provide him the current updates of his vehicle's whereabouts. This can also be used to track the stolen vehicles and also help the investigation team to reach the culprit faster. This also informs the user if the vehicle was involved in an accident case.

9.   GPS Based Android Application for Women Security

In this paper we will look at how useful android applications can be and how it ensures the safety of women in case of any emergencies/attacks [14]. It emphasises on the integrity of the application and how quick actions can be taken in the time of emergency. As we all know even in the current times women are criticised and exploited in public, this android application helps reduce and works towards creating a better society. In case of emergencies the application sends a message along with a Uniform Resource Locator (URL) which is the current location of the user to the emergency contacts registered on that particular devices.

- Abhaya-a click on this app will send a message to the emergency contacts of the person along with the URL. It also triggers a phone call to the first person on the list. the unique feature of this app is that it sends messages continuously for every 5 mins until stop button is pressed. There is a continuous tracking facility available via SMS to the victim's location.
- SafetyPin- this app helps you to get to know the how safe your locality is or in fact any locality on the world. It keeps a step ahead about various harassments so you can be aware and get to know the place better to be safer.
- BSafe- this app works on the slogan called "never walk alone". It triggers a message to the chosen contacts by a push of a button. It has two modes: a) risk mode which has GPS and real time tracking and b) timer mode with an automatic timer activation.
- Sthree Raksha- By a push of a button the nearest police station is alerted and uses the victim's GPS to track the location and also helps catch the culprit thereby reducing the number of crimes.
- Allegedly, this application has saved a lot of lives and has helped majorly in reduction of crime. Thanks to the technology and safety apps like these that women can be confident and freely walk around anywhere in the society without being harassed. There are few drawbacks which are definitely being worked on. Hope more there can be more things like this to do and make the world a crime free and better place to live in.
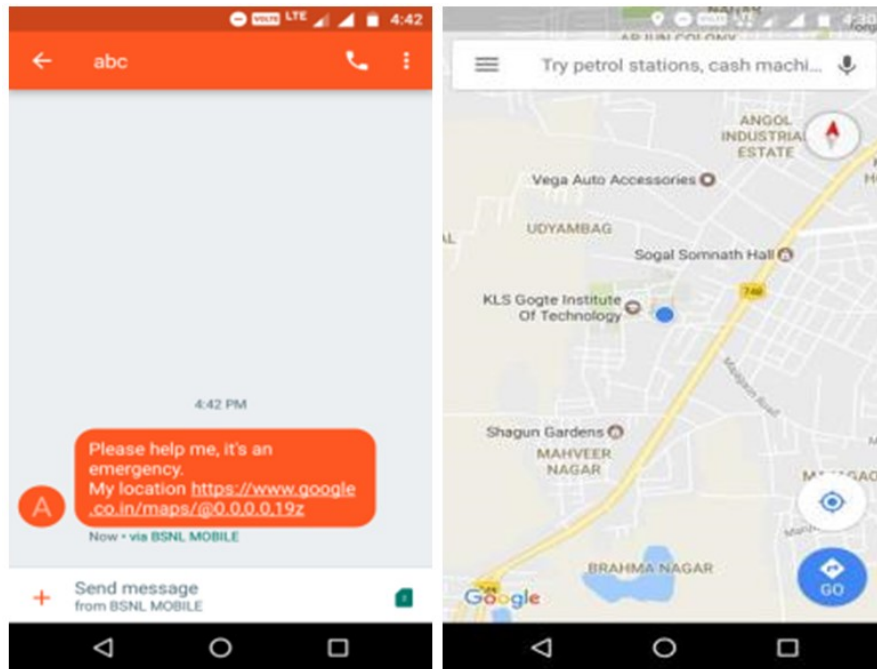

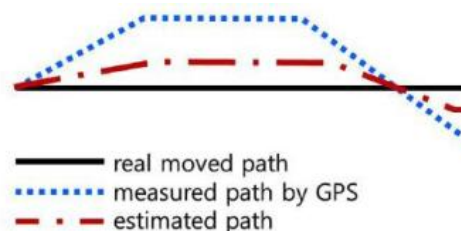**Figure 6.   The Notification Received and the Location Pinned in the Application [14]**

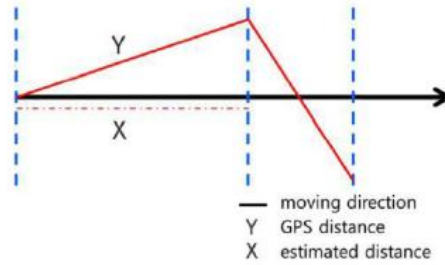**Figure 7.   Real Path v/s Actual Path [8]**

Figure 8.   Result of Localization Algorithm by Trigonometric Function [8]

Result Comparision:
In the paper Global Positioning System for Object Tracking [8], they have used a calculation method to see the actual position and the position pinned on the map. The accuracy and the exactness of the system was measured and it was shown here.

While the same was calculated for the Obstacle Avoidance Robot implements, it showed deviations of about 2O than the actual path that had to be travelled. Realistically the angle of the first curve is 69O while the calculated angle is 67O. This is due to some error in the GPS readings and this error can relatively be accepted. In the autonomous trip, the realistic dimensions of the path are shown in Fig. 10 where the red line represents the saved track and the blue line represents the autonomous track.
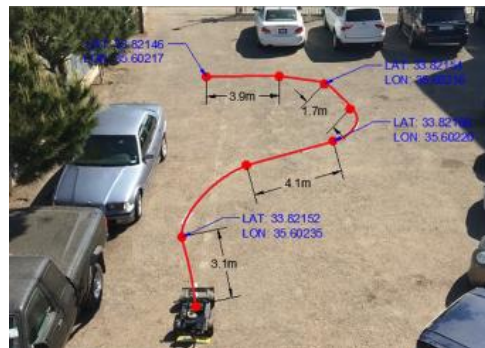

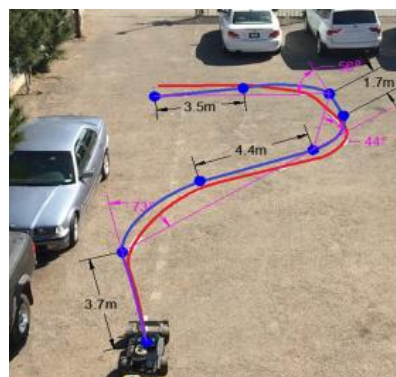**Figure 9.   Saved Parameters of the Path [16]**

Figure 10. Actual Path traversed compared to the one that was calculated [16]

12. Conclusion

Luggage security or security of objects has been one of the most important issues, as there are a lot of cases on theft in India alone. Due to the digitization of India and movements like Digital-India, we now can afford to use technology in a bigger, wider and better manner, than we could have a few decades ago. Hence, this project will both help in keeping the belongings secure, and create a hassle-free travel experience for the users. This project helps to provide the user assurance of security and also provides current updates of the belongings. It also helps to prevent any ounce of threat or theft prone to the belongings.

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