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Design and Implementation of Smart Vehicle Theft Detection Using Raspberry Pi and Iot for Real Time Applications

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Abstract: ***The crime related to vehicle theft has been a tremendous rise with burglar's becoming smarter every day. This generates an crucial need for an effective vehicle theft diagnosis system. In this paper, a compact, cheap and efficient system is studied, designed and explored using Raspberry Pi as the core processing unit of the whole system. Sensors data of Passive Infra-Red (PIR) motion sensor, pressure sensor, gas sensor, including Global Positioning System (GPS), Pi camera, buzzer and a Liquid Crystal Display (LCD) display are collected by embedded Linux system. The device functions in two modes: User mode and Theft mode. The gadget has ability of detecting intrusion and on detection will ring an alarm and send coordinates to the user's assigned E-mail. The device will send the latitude and longitudinal details to the user's e-mail along with the captured image using remote sensing whenever there is an intrusion or if the device is displaced after a certain threshold as in the case of bike theft wherein the complete vehicle can be effortlessly displaced without starting the engine or deactivating physical locks. It is easy to locate the vehicle and get accurate position on Google Maps using this design. This paper explores the possibility of a compact, versatile, viable, cheap and efficient vehicle theft detection system.***

Keywords: ***Raspberry pi, GPS module, IOT, Pi camera, PIR sensor, Tracking, Embedded***

I. INTRODUCTION

With the rise in the number of vehicles, the theft related to it has also risen exponentially. Every year more than 10 million vehicles are stolen around the world and majority remain untraced. Criminals are becoming smarter day by day and have reached the stage of consummation against the existing vehicle safety systems. Stolen cars and bikes are frequently used in serious crimes that result in property damage, physical injuries and loss of life after an accident. This calls in for a need of an efficient theft detection system. The vehicle tracking hardware is fitted on to the vehicle. It is fitted in such a manner that it is not visible to anyone who is outside the vehicle. Internet of Things (IOT) is the smart technology which helps devices to stay connected in the current generation. All devices can be coupled jointly and used to exchange data with remote login users to make life simpler as shown in fig-1. Security plays an salient role in today's emerging technology. Vehicle security has accomplished numerous fast changes yet the security designs cost are very high and not tolerable for all owners. An anti-theft system is a hardware or mechanism used to avoid the unapproved access of someone's vehicle. In this paper we are proposing a system which alerts and notifies the owner in case of any intrusion or theft of the vehicle and also sends the updated location of the device at regular intervals, which will be an addition to the already existing handle and wheel locks. Owner will be alerted regarding theft attempt and will be provided with the co-ordinates of the vehicle using GPS module through an E-mail. Piezoelectric sensor is used to detect any unnecessary vibrations caused due to physical tampering, gas sensor to detect any fire warnings and a PIR motion sensor is used to detect intrusion .Wi-Fi dongle is used for accessing the internet. Python scripting is used for programming the board as it is compatible with Pi. After the vehicle has been parked, it will be switched to 'theft' mode and if an intruder tries to displace the vehicle above certain threshold, the alarm starts ringing and an image with the respective GPS co-ordinate is sent to the user. The GPS co-ordinates, date and time can be explicitly stored in a database and further user can retrieve the data using webpage. We are tending towards Raspberry pi because it's cheap, compact, powerful and the availability of tools for better maintenance. This gives an edge over other pieces of technology for the same purpose.

II. LITERATURE SURVEY

Mechanical devices have the disadvantage of being destroyed comfortably using other mechanical tools. We have studied the recent alternate systems on theft detection using image processing technology which captures the image of the driver and compares with the saved image of owner to detect an intrusion but have a significant amount of drawbacks and flaws, and fingerprint detection which seems inconvenient and very expensive to implement on two-wheelers. The existing systems also occupy more area which is

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one of the major constraints for two-wheelers. Thieves and criminals have devised techniques to counter the existing systems. The demand is to design a system taking size, cost and power as constraints. In [1], the paper exhibits objective of fleet monitoring and management. The system has two units: the main is the security unit consisting of a GSM, GPS, relay, current sensor and microcontroller. The current sensor will transmit an analog signal to the controller whenever the car is moving and confirmation is done by sending SMS to the owner. In [2], the framework acknowledges the message and through CAN Bus broadcasts the message to the whole vehicle network. The exact location will be send to the owner within very less time. The GSM modem interfaced to the microcontroller gets the message, the yield of which enacts a component that cripples the ignition of the vehicle by using flow sensor which results in stopping of the vehicle. In [3], the author depicted a system to alert the user if the unauthorized person tries to take away the vehicle and stop the ignition and deactivate the gadget. In [4], author proposed a car security system involved with a GPS and a GSM module. The user connects through this substructure with vehicles and decides their present areas and status using Google Earth and the position of alerted vehicles can be followed by client. In [5], motors of vehicles are controlled using GSM and microcontroller. The secret word which has been declared needs to be sorted out for the vehicle to start. At the point when the secret word coordinates then and at exactly that point ignition of the vehicle will begin. Every time secret key neglects to match up to the three trials then framework will starts the siren and it will send the message to the owner through GSM system.

III. WORKING AND OPERATION

The Raspberry Pi is a 32-bit credit card sized single-board computer using Broadcom BCM 2837 System on Chip (SoC), containing a quad core ARM cortex-A53 running at 1.2GHz and a videocore4 GPU as shown in fig-2**.** It does not come with a real-time clock (RTC), so an OS must use a network time server. However, a RTC with battery powered can be added via the I²C interface. The power supply is from the USB hub which outputs 5v, 2A dc. The Ethernet cable is connected to the Pi and the Laptop to provide the host server. The OS used is Raspbian Squeeze and the program is written in Python IDE. Also, a 16 GB bootable SD card with Linux is mounted to the Pi Board for storage. There is also a built in Wi-Fi for the board but for external applications, though an external USB Wi-Fi dongle can be integrated for the internet connectivity.

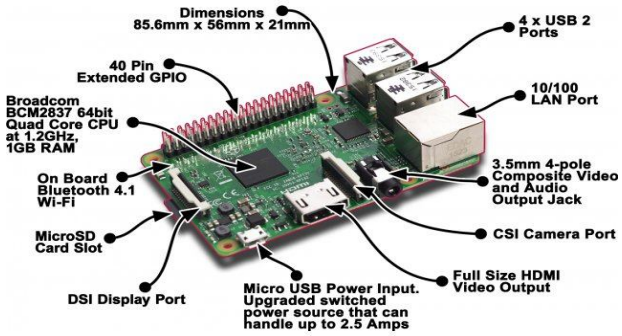

Fig.2 Raspberry Pi 3 model B v2.2

The camera module v2 connects to CSI-2 camera port and consumes 250mA of power from the board using a short ribbon cable. The camera data is processed and ultimately converted to an image on the SD card. The camera is of 5 megapixels and we have used 720p resolution so that it consumes less amount of storage. The images are stored in .jpeg format.A Neo-6m GPS module is satellite navigation system that provides position and time information in all weather conditions. The GPS receiver gives output in NMEA format (-157dBm). The recorded location data can be saved within the tracking unit and can be sent to registered email upon detection of theft. There are three sensors integrated with the design. The PIR gets a HIGH signal whenever motion is detected by the PIR module. Along with PIR, other sensors such as pressure sensor to detect the vibration above certain threshold and MQ-2 gas sensor for alarming if fire turns up around the vehicle. A buzzer is also interfaced for alarm purposes.

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A. Proposed System

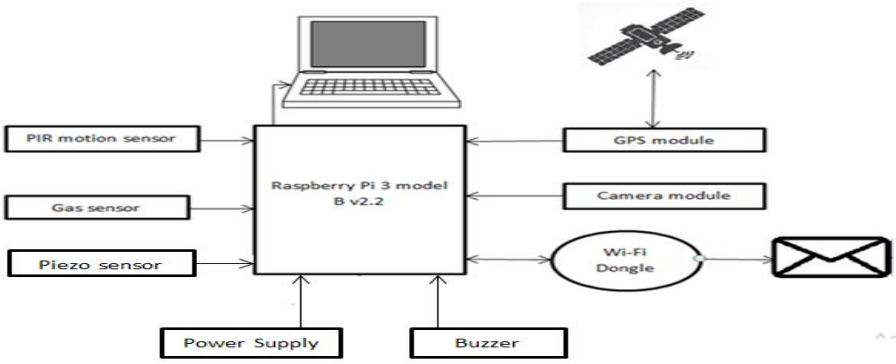

Fig.3 Proposed block diagram.

B. Algorithm

1) Initially the system will be working on user mode.
2) After the vehicle is parked, theft mode can be turned on using a switch.
3) PIR, pressure and gas sensors will continuously monitor any burglaries.
4) If output on those pins is HIGH, the camera module captures the image instantaneously.
5) GPS module tracks latitude, longitude, and date and time co-ordinates of the system.
6) If the vehicle is displaced by 120metres, then also the GPS module saves the revised co-ordinates of the system.
7) Camera image along with a link to respective spot are sent to the user via registered E-mail.
8) The authorized user can view the image and open the Google Maps to track the vehicle.
9) Once the user reaches to the vehicle, user mode can again be turned on.

C. Testing and Simulation

The components such as Pi camera, GPS module, PIR motion sensor, Gas sensor, and buzzer were interfaced with Raspberry Pi 3 board using USB cable and Ethernet LAN cable as shown in fig.4.

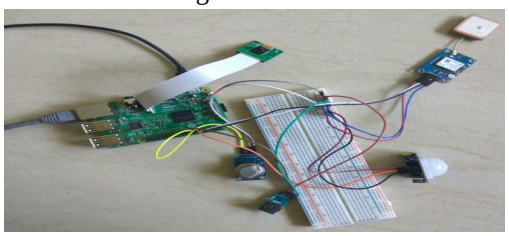

Fig.4 System Implementaion

After the successful execution of the above idea, whenever there is an intrusion with the vehicle or fire around the vehicle, the buzzer started beeping and the co-ordinates were seen at pi terminal along with theft detected message. In addition to it, a mail was sent to the user with the image and a link to Google Maps to track the position. Furthermore, if the vehicle was displaced from its original position, then correspondingly the modified link will also be accessible to the user as shown in fig-5. This results in efficient vehicle theft detection device with low cost and improved features.

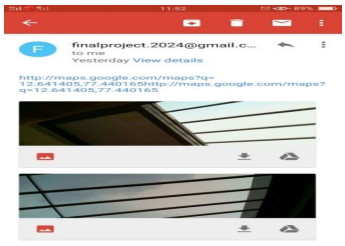

Fig.5 Simulation and Results

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The basic goal is to create a compact mobile device with the connections mentioned below. Initially, the engine will be ON by the power supply of the micro-controller, which means that the engine is running in user mode and doesn't need any protection. After the user has parked the vehicle, the theft mode can be instantiated. If an intruder tries to start the vehicle i.e. if any unwanted vibration greater than a threshold value is detected or the vehicle is dislocated to a radius greater than the desired value ,a buzzer starts to ring by sensing activity using a piezoelectric sensor and an email is sent to the owner stating that a break-in has occurred. The user can then take instant action by either informing the nearby police station or using some control functions like immobilising the vehicle from remote distance.

IV. CONCLUSIONS

We got to learn a lot about system implementation, component interfacing on the board and efficient, compact programming. Vehicle theft detection device is the need of the hour and a compact, efficient and cheap device can be made using Raspberry pi. A powerful product can eventually be made out of this system. We can improve the accuracy by increasing the cost of the components. We can add ambulance contact numbers and police station contact number so that they can reach out very fast to that location. The application can be made capable of generating the voice based alert to the user. Also, the features to block the ignition unit by sending some instructions to the microcontroller can be added make the vehicle impossible to start for improved security. The entire system can be integrated with an android app and the relevant data can be stored in a database so that it might more easily be accessible to the user.

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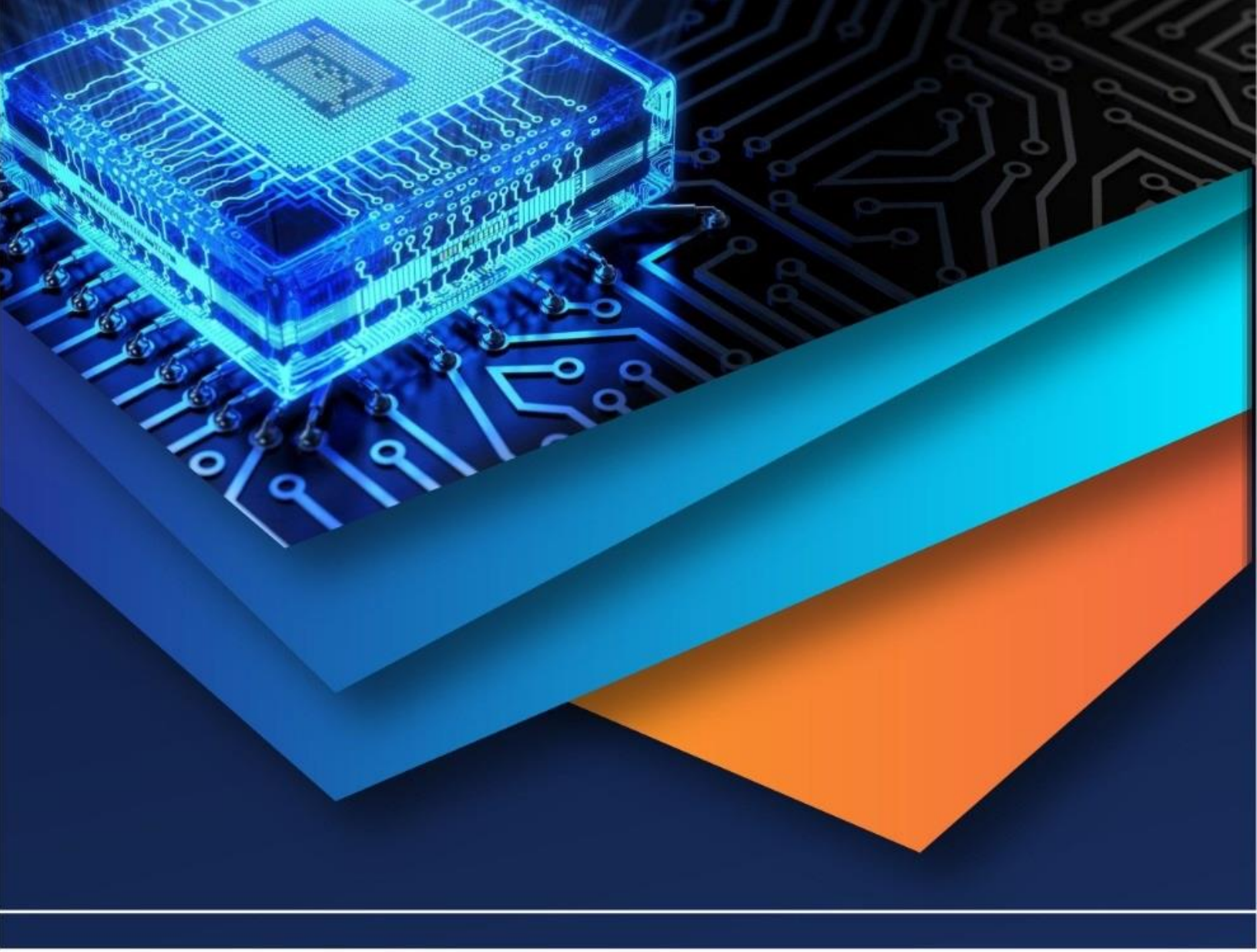

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