

IoT Based Embedded System for Vehicle Security And Driver Surveillance

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Abstract— Toady due to rapid increase in vehicles, there is an exponential increase in crime and accidents hence it has become challenge for governments to limit such crimes especially from professional thieves. This paper proposes designing and development of anti-theft as well as driver surveillance embedded system that uses biometric authentication to access the vehicle. This system contains camera which take the image of a person trying to get access of vehicle and compare with authorized person’s image and then allowing or denying access.

In The case of denial of vehicle access or even if there is an accident occurs, camera will capture the images and email it to the owner or authorizer. This will help to catch thieves, also allows the surveillance of driver and also the inner part of vehicle. The recent work on proposed embedded system is written in this paper.

The system is designed and developed using raspberry pi, high resolution camera, vibration sensor and open source software.

Keywords—*rasberry pi 3; raspbian; camera; OpenCV; vibration sensor; vehicle security-alert; Email; driver surveillance and alert*

I. INTRODUCTION

Today with exponential increase in population has lead to exponential increase in vehicles. Many new companies introduce new vehicles in market with latest and advanced features. Almost all of them are electronically operated. In these features, some are related to luxury, some of them are related to comfort while few are related to safety measure. For these features they offer heavy charges. But we observe that, after paying such heavy amount, still few of these features are weak especially in safety of vehicle and driver. Those weaknesses are not capable to reduce crimes like vehicle theft, misuse etc. and are increasing day by day. Another major thing is increase in vehicle accidents and there isn’t such a feature which will help in surveillance of driver.

We can’t blame on the efficiency or the efforts of police or cops but the proper solution is still under development, one of them which one is impressive and effective is, vehicle access using “Biometric Authentication”. It is already introduced but still there is scope of enhancing a solution to make it more effective.

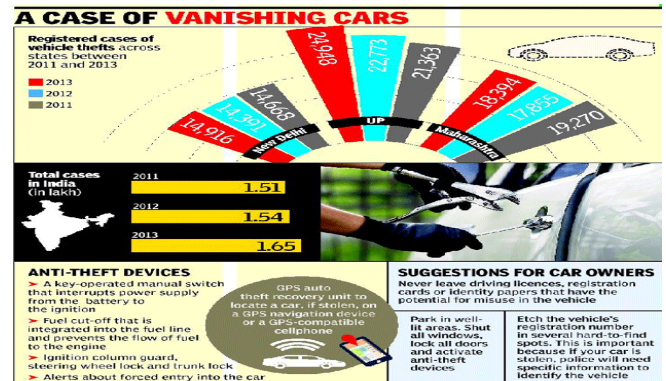


Figure 1 Survey of Stolen Vehicle [1]



Figure 2 Worldwide Android, IOS and others User [2]

India is the one of the highest internet data consuming country. That’s why day by day number of IP based systems (which can be accessed through internet) are increasing, most of the electronic things are capable to communicate through internet [3]. So here we are working to make “Biometric Authentication” system, more user friendly by featuring IP address for the communication through internet as well as also trying to provide driver surveillance in case of accident by the means of additional sensors and camera [4].

II. LITERATURE REVIEW

To avoid vehicle theft there are already many methods already introduced from nineteenth century. According to their operation they are divided as tracking

method of vehicle and other is biometric method, in biometric they are further subdivided on the basis of "Biometric Authentication" type such as finger, eye, face etc.

A. Tracking Method

In recent years many techniques and ideas are evolved for vehicle safety or to avoid vehicle robbery. These are use of GPS ("Global Positioning System") [5][6] sensor which provides position of vehicle in altitude and longitude. Then this information is transferred over air to owner or cop. That wireless transmission mostly done using the GSM ("Global System for Mobile Communication") module. Below diagram can give brief idea about it [7] [8].

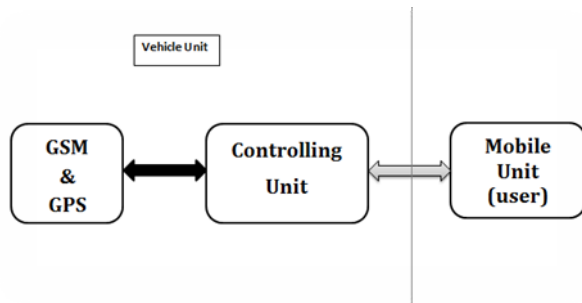


Figure 3 GSM & GPS Based System

B. Biometric Authentication

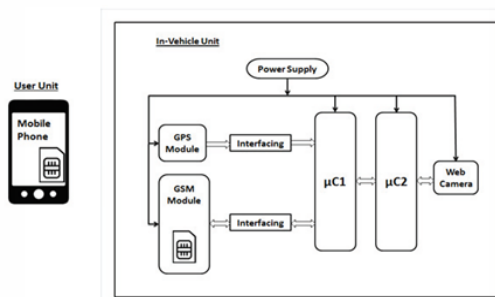


Figure 4 Block diagram of Biometric based system [9]

Under biometric authentication-based systems, introduced methods are like, use of finger scanner, voice authentication, eye (retina) scanning and commanding [9-11], then the most trustable yes that is face authentication. With above biometric systems they also implement awareness like providing alarm or cutting off fuel supply, locking doors, sending images to another system. All transmission of data is mostly done by the SMS or MMS through GSM/GPRS modules. [12-17]

In voice authentication and commanding proposer also provided some functions to vehicle which were operated by driver's voice only [14]. Which was also impressive utilization making vehicle driving more comfortable and effortless which were allowing driver to drive more comfortably with proper concentration.

III. PROBLEM DEFINATION

The tracking of vehicle helps to recover vehicle but the victim remains unknown. Just rejecting the access to unauthorized person is like allowing that victim to do another crime. The actual victim is not identified. Robbed vehicle will get recovered but crime has already happened, the vehicle might have been already misused and due to no identification of victim, the innocent people might have suffered. Hence the actual problem is identification of the actual victim.

The method, which includes SMS and MMS has their own demerits like MMS charges are not affordable as compare to its efficiency also its dependency on network availability. Even in the tracking method if the battery gets drained, will result in the system failure.

In cases of accident it becomes difficult to observe the condition of driver or internal side of vehicle. Some immediate surveillance is essential which will at least show the interior part of vehicle. The driver surveillance systems aren't yet introduced in the existing methods. Hence the system should prevent the crime, system should help to identify the victim and should also provide some extra features, within same hardware without increasing complexity and cost.

IV. PROPOSED SOLUTION

Proposed solution is conceptually much simple. The Idea behind it is, a providing low cost, less complex, highly reliable and most importantly user friendly to implement as well as handle for Alay man. The person accessing the vehicle must get identified first and then authorized. The following embedded system is proposed with increased simplicity and functionality.

A. Block Diagram

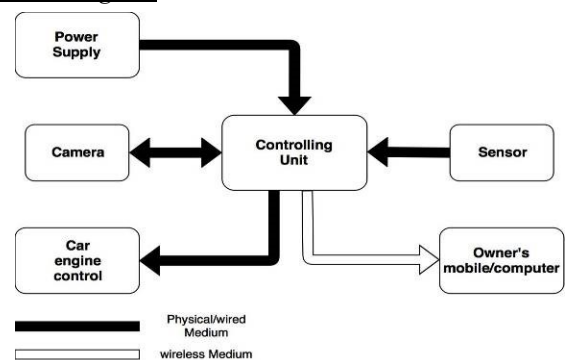


Figure 5 Block Diagram of our Proposed Embedded System

- **Power supply:** Our proposed system is powered by 5V/ 2A power supply according to system component's power compatibility and requirement. Mostly system will get 12v supply from "AC to DC" SMPS adapter and then it will be down converted using voltage regulator ICs like 7805 and some other passive components.

- **Camera:** It acts like a transducer and it will take image and will provide suitable form of image in electric signal. This data will be provided to processor for further operation. We have used 5MP camera having maximum resolution of “2592 × 1944”. Still we are taking pictures of “1024× 768”.
- **Sensor:** It is the vibration sensor. It simply detects the vibrations and makes output pin voltage low, directly connected by wire to the controlling unit as we can see in block diagram.
- **Controlling unit:** It is actual brain of the proposed system. All the inputs are collected as well as processed by this unit. And related required action is also taken by it by means of actuating the output devices. We have used Raspberry pi 3 development board. It is powered by “quad core 1200MHz Broadcom BCM2837 64bit ARM cortex A53 CPU”. It has built in Wi-Fi and Bluetooth hardware. Because of built in Wi-Fi module and many built in features Raspberry pi 3B is the most suitable and flexible board we found in the market. Also, it is easily available without any high cost.
- **Vehicle control:** It is the internal part of vehicle which is key components of the vehicle ignition system it will be handled by the controlling unit. Normally this section is like controlling mechanical part of ignition system.
- **Owner device:** It is complete user or owner part who is actual authorized person. Device means it could be the mobile or Computer from where user can access an email account.

Proposed system consists of physical or wired and also the wireless medium that's why both are represented with different color connection lines. Controlling unit and actual owner's device is connected wirelessly, rest of all devices, sensors will be interfaced using wired media. As described above is actual outline of proposed system in detail.

B. Software Information

Operating system

We have installed the newest version of “Raspbian” named as Raspbian stretch Operating System. We have installed it through noobs as per standard procedure. It is open source and free to use. It is ‘Debian’ - based ‘operating system’ and specially developed for ‘Raspberry Pi’. We have done all the coding in python language and we have used VI editor for writing and editing our program.

OpenCV

For image processing we have installed “OpenCV” on Raspbian. It is “open source library of programming functions” developed by ‘Intel’. It is free for academic work as well as commercial use, under “the open-source BSD license”.

For face Recognition there are 3 algorithm-based functions made available in OpenCV. These are ‘Eigenfaces’, ‘Fisherfaces’ and ‘Local Binary Patterns Histograms’ (LBPH).

These three methods do ‘the Face Recognition’ by comparing the face to be recognized with Some images of training image database of captured known faces. In the training image database, we provide the algorithm faces and check it to which person they match with. When an algorithm is used to recognize unknown faces, it uses our training image database to do the recognition. Each of them uses the training image database a little bit differently. ‘Eigenface’s and ‘Fisherfaces’ finds a mathematical relation or description of the most prior dominant property of our training image database as a whole. LBPH analyzes every face in our training image database individually and independently.

C. Flowchart

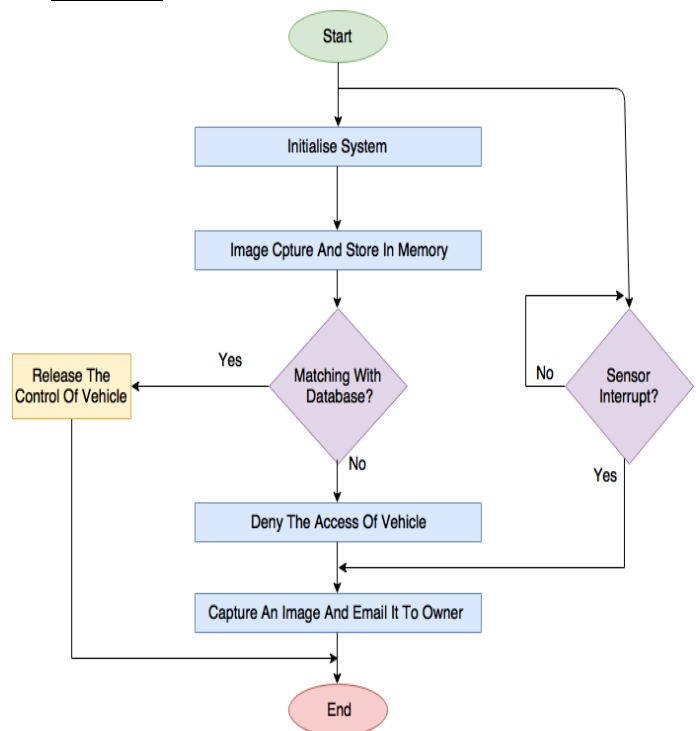


Figure 6 Flowchart of Proposed System

Above flow chart is explained in detail as follow in steps.

Whenever a person tries to access the vehicle, the system will be turned on by the battery supply. The image of the person seated on driver's seat is captured via camera which is located at top and in front of the driver in such manner that it can easily take picture. Once image is captured camera will convert that picture into compatible format of controller and feed it to controller. The binary data of authorized person's image is already stored in the memory of controller. Authorized person can be single or multiple. Now controller will do its main part that is the comparison of recent image captured by the camera and the pre-stored images. If the result is true means comparison of images matches, then and then only controller will release the access of vehicle for

authorized person. if the result is false that means image is not matching with the database images controller detects it as unauthorized person will not give access of vehicle to the accessing person instead of that it will send the image of unidentified person through an e-mail to an authorized person.

As soon as system starts, sensors get actuated. Whenever sensors detect sudden any heavy vibrations it will change its idle state. This change in state will interrupt controller instantly and it will give a command to camera to capture images and will alerts the owner and send the captured image to owner's email ID.

V. RESULT

In this system we have used LBPH face recognition as it is simpler as well as gives better result in different light conditions.



Figure 7 the image database

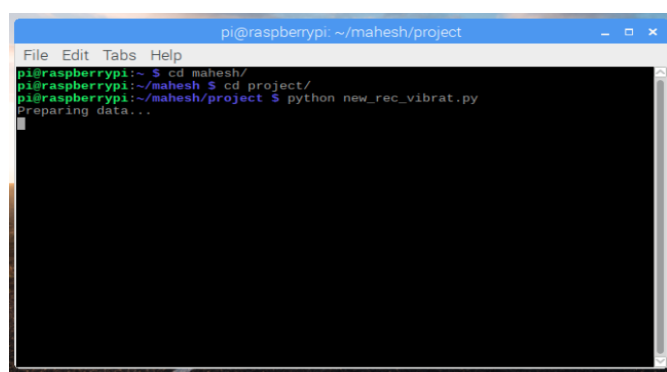


Figure 8 processing database

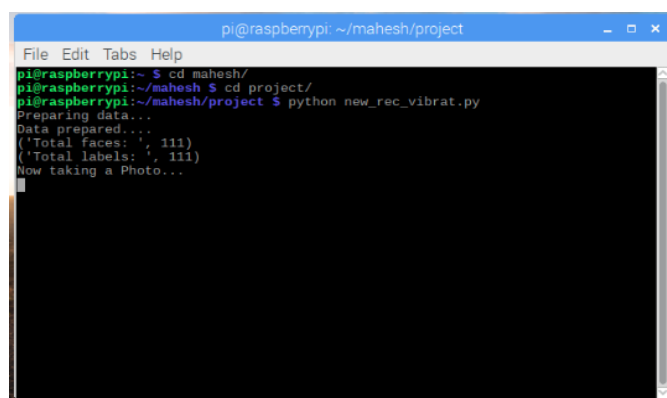


Figure 9 system prepared to capture image

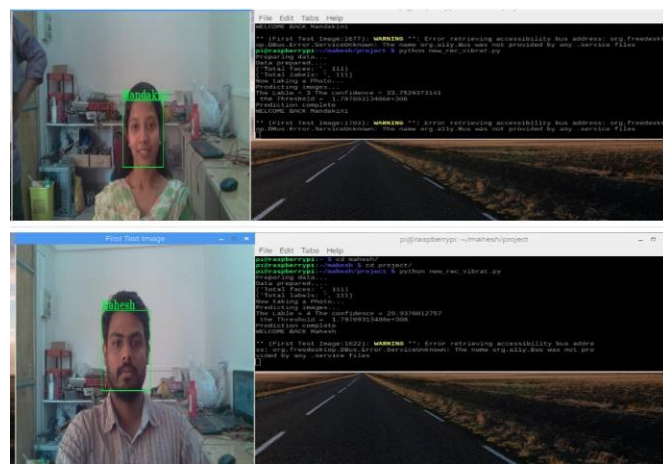


Figure 10 successfully recognized and detected face of known person

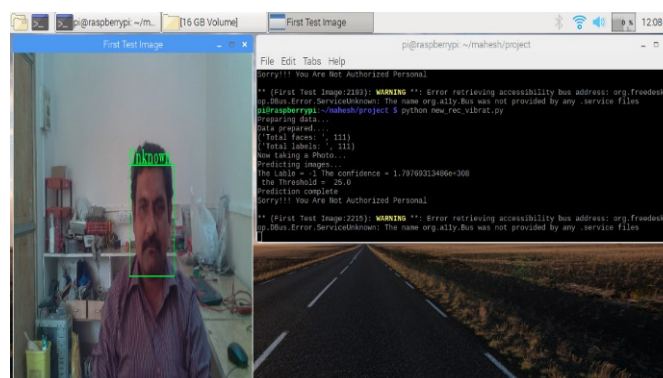


Figure 11 successfully detected unknown person

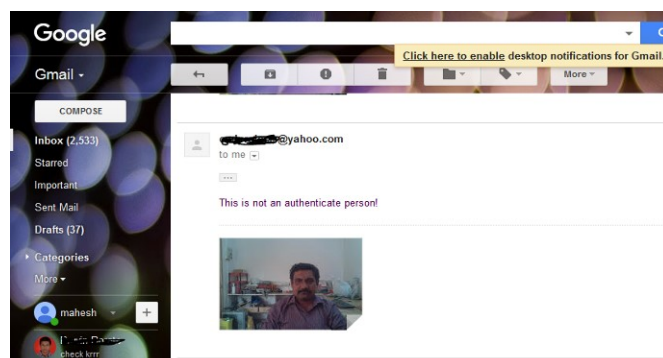


Figure 12 email received after unknown person found

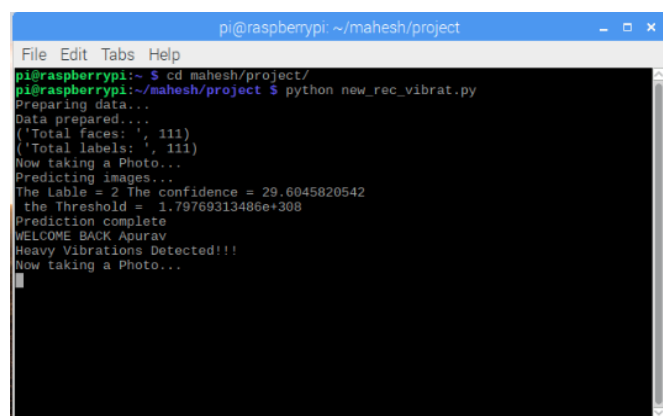


Figure 13 vibrations successfully detected

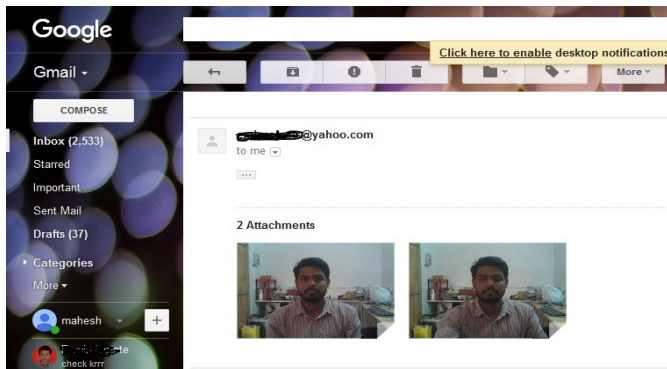


Figure 14 email received after detecting vibrations

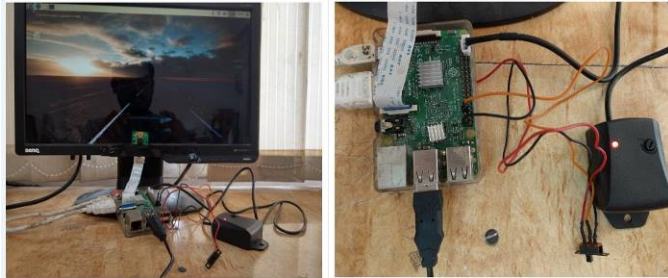


Figure 15 the final setup

VI. CONCLUSION

The owner can park his vehicle without thinking of vehicle robbery or misuse of it, because any unknown person who will try to access vehicle will get captured in camera silently. Car owner can easily see these images on mobile or on computer and can forward to cops with the proof.

With this strong security mechanism, we have also achieved driver surveillance too, without any use of additional heavy investments and complexity. This additional feature not only provides the alert of accidents but also provides the surveillance of driver. This system silently monitors the driver as well as our car.

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