

Intelligent Driver State Recognition System with Authentication Access Control for Engine Ignition Using Raspberry Pi

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Abstract: Road accidents in India keep increasing every year despite legislative amendments, awareness programmes and enforcements of traffic rules. In 2019 around 47% of Indian accident case's drivers weren't issued a license. And 15% of accidents were caused due to drunken driving. The current checking method by the police is very ineffective considering its manual it's non-scaleable. Our smart capstone project will help provide safety not only to the driver and pedestrian but will provide robust safety for the car. The project shall remain scaleable, meaning with increasing population it won't fail.

Keywords: Raspberry Pi, Digitalization, License Authentication, Face recognition, Fingerprint.

1. Introduction

Road accidents in India keep increasing every year despite legislative amendments, awareness programmes and enforcements of traffic rules.

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The current checking method by the police is very ineffective considering it's manual it's non-scaleable.

Our smart capstone project will help provide safety not only to the driver and pedestrian but will provide robust safety for the car. The project shall remain scaleable, meaning with increasing population it won't fail.

Driving without a license is a major issue in many countries. Survey says that the accidents happened mostly by unlicensed drivers, drunken drivers and less usage of seatbelts. Owing to unsafe conditions on roads, the rate of accidents has been very high. Here another major problem in most of the countries that we should address is vehicle theft.

By considering all these points we are implementing this project using Fingerprint, face Recognition, alcohol sensor and cloud database.

The main objective of this project is to revolutionize the current license verification and car security systems while keeping the legislative laws in mind.

2. Objective

Road safety continues to be a major developmental issue, a public health concern and a leading cause of death and injury across the world, killing more than 1.35 million globally as reported in the Global Status report on Road Safety 2018 with 90% of these casualties happened in the developing countries & 11% alone being accounted by India. As per the Report on Road accidents in India 2019, the accident related deaths in India in 2019 were 1,51,113 in number. It is indeed a matter of great concern even after continued efforts of the Government in this regard and our commitments for having fatalities we have not been able to register significant progress on this front. This capstone can completely take care of 47% non licensed drivers accidents and all 15% of the drunken driving cases.

3. Existing methods

In the current scenario the vehicles have to stop and wait for a long time to get verification from the traffic police. If their documents are clear then no problem arises. Suppose if their documents are not in a clear manner, this system provides lots of disadvantages.

Even with RFID tags on a vehicle, the details of the vehicles like Insurance, RC BOOK and pollution certificate can be easily identified. The License of a

particular person cannot be verified by the help of RFID tags. Because every person will have a unique License. So, they have to carry the License along with them wherever they go. This creates discomfort to the person.

Not to forget with the growing population the ~15% growth of drivers every 3 years will not only make it hard but completely impossible for the traffic police to take place manual form of checking.

Not to forget this is not a good enough reason for accidents to take place.

4. Proposed system

In order to come up with a solution for the problem the combined implementation of fingerprint sensor, face id and gas sensors interfacing with SoC is done. (Embedded System implementation).

The biometric data is stored in the database, upon verifying license, the alcohol content in the air is checked and the ignition process is initiated.

If the buzzer goes off indicating that he/she does not have license or in case of alcohol a continuous beep can be heard. In either case the engine's power supply will be cut off. The whole process will take less time than the traditional methods prevalent.

Further implementation of an Email delivery system will be done, which can tell when someone enters the car, with an image of the same.

To overcome this problem here we are using Web Camera, Fingerprint and Raspberry Pi. All the faces and fingerprints of those who have licenses are stored in one database. When the face and fingerprint is matched then the person is an authorized person it means he or she has a license.

If the face and fingerprint does not match then the motor will automatically turn off. IF the face and fingerprint is matched then it will check for alcohol of the person. If the alcohol is detected, a buzzer alert will be given and the motor will turn off.

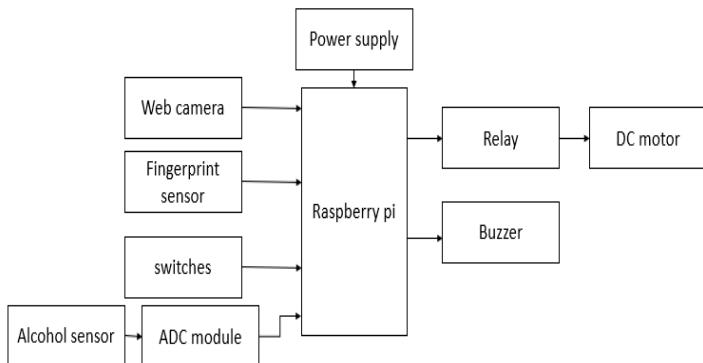
fig 1. Block diagram of proposed system

5. Implementation flow:

- **Step 1:**
Considering the problems of existing methods and giving solution to that problem by considering the formal requirements for the proposed system
- **Step 2:**
Considering the hardware requirement for the proposed system
For this we need to select these parts :
 1. Micro-controllers
 2. I/O devices input type like sensors & drivers
 3. Output type I/O like relays & loads
- **Step 3:**
After considering hardware we need to check the software requirements. Based on micro-controller we do select three exists different software for code compile debug. We need to write source code for that proposed system based on our requirement then compile then debug the code in the software .
- After completing, bringing both together in order to work for our system. For this we need to burn our source code to micro-controller, after burning our source code to micro-controller then connect all I/O modules as per our requirement.

6. Embedded system

An embedded system is a type of computer system primarily designed to perform multiple tasks such as accessing, processing, and storing and managing data in various electronic systems. An embedded system is a combination of hardware and software, the software commonly referred to as firmware embedded in the hardware. One of the most important characteristics of these systems is that they provide timely o/p. Supports embedded systems for more complete and convenient operationTherefore, we often use embedded systems for both simple and complex devices.



Embedded system applications are mainly used in real life for

many devices such as microwave ovens, calculators, TV remote controls, home security and traffic control systems, etc.

3. Physical memory addresses must be assigned to the relative offsets within the relocatable program in a process called relocation.

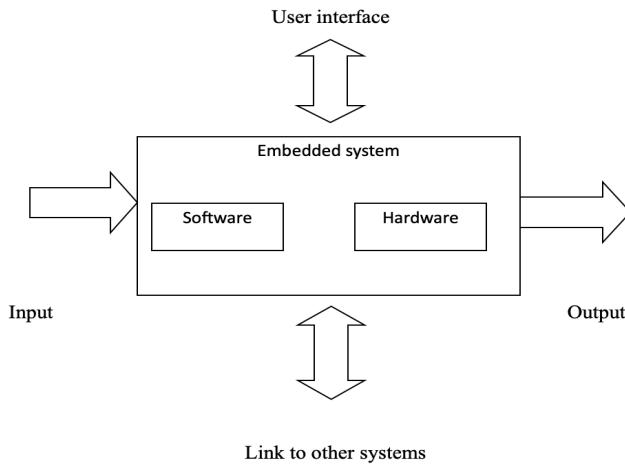


fig 2. Overview of embedded system

Embedded System :

As with any electronic system, an embedded system needs a hardware platform to fulfill its role. Embedded system hardware consists of a microprocessor or microcontroller. Embedded system hardware has elements like I/O interfaces, user interface, memory and the display. Usually, an embedded system consists of:

- Power-Supply-Unit
- Processor-SoC
- Memory-
- Timer
- Serial-communication ports
- Output circuits

Embedded system includes mainly two sections, they are

1. Hardware parts
2. Software parts

To make software to work with embedded systems we need to bring software and hardware together. This requires writing the source code in a hardware component, a microprocessor or microcontroller, and the embedded system does whatever the code is supposed to do.

For this case we have followed these steps:

1. Each of the source files must be compiled or assembled into an object file.
2. All the object type file(s) that result from the first ladder should be linked together to produce a singular object file, can be called a relocatable program.

The result of the final step is a file containing an executable binary image that is ready to run on the embedded system.

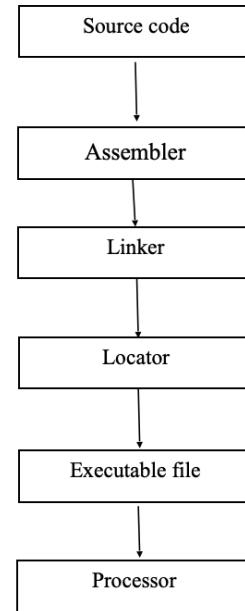


fig 3. Burning of source code to processor

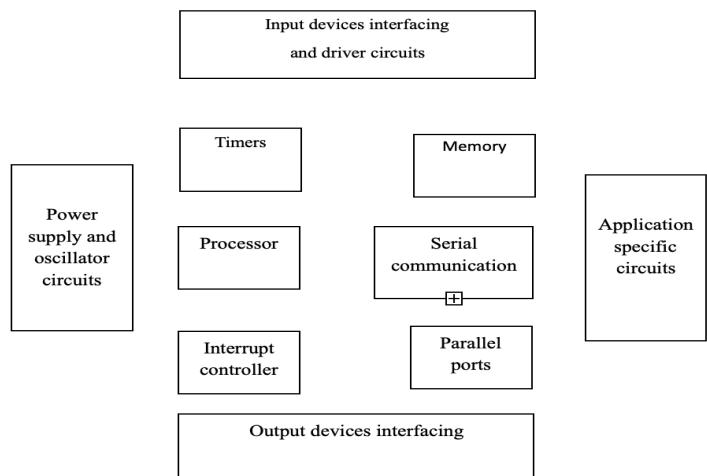


fig 4. block diagram of an Embedded system

7. Hardware & Software used –

1. Raspberry pi-4

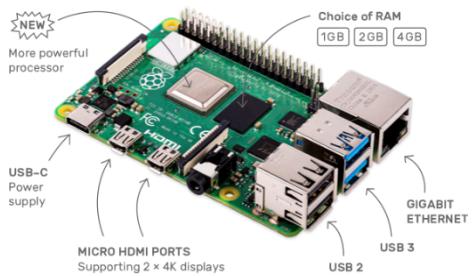


Fig - Raspberry Pi 4

The Raspberry Pi is a small computer running the Linux operating system. It is a mini computer mainly used to run large and intelligent programs for fast output. The Raspberry Pi 4 B+ (RP4) is the latest model developed by the company, with all the modern wired and wireless communication systems needed for most smart projects. One Raspberry Pi 4 comes with a QuadCore processor, but there are three versions that offer three different sizes of RAM. The Pi 4 uses mini HDMI and also has two ports for two 4K displays..

2. Web camera



A camera that feeds/ streams an image and video in real time to or through a network such as Internet. Webcams are typically small that sit on a desk or on a wall, attach to a monitor, or are built into some hardware. Webcams can be used during a video chat session involving two or more people, with conversations that can include live audio and video.

Webcam software enables users to record a video or stream the video on the Internet. As video streaming over the Internet requires much bandwidth, such streams usually use compressed formats. The maximum resolution of webcams is lower than most portable camcorders as the resolution is reduced during transmission. Because of their lower resolution, webcams are relatively inexpensive compared to most camcorders, but they work well for video chat sessions.

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3. Fingerprint sensor



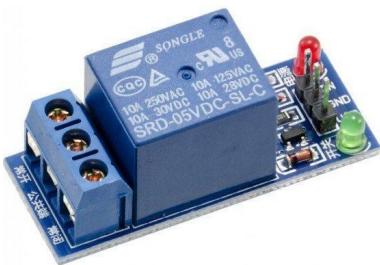
Fingerprint enrollment, image processing, character acquisition, fingerprint template creation, fingerprint template storage, fingerprint comparison (1:1, 1:N), fingerprint deletion. This module can work with various UAWRT-based devices such as PC, SCM, etc. Only a simple fingerprint scheme and module can turn the product into strong fingerprint authentication. Widely used in electronics, information security, access control, identity authentication and other security industries.

4. MQ2 sensor



Gas sensors are available in a variety of specifications depending on the sensitivity level, type of gas being measured, physical dimensions, and many other factors. This understanding relates to methane gas sensors that can detect gases such as ammonia, which can be derived from methane. When a gas interacts with this sensor, it is first ionized into its components and then absorbed by the sensing element. This adsorption creates a potential difference in the device, which is transmitted in the form of a current through the output contact to the processor unit.

5. Relay-



A relay is an electromagnetic switch used to turn a circuit on and off with a low-power signal, or when multiple circuits need to be controlled with a single signal. Most high-tech industrial devices have relays that work efficiently. A relay is a simple switch that is controlled both electrically and mechanically. A relay consists of an electromagnet and a set of contacts. The switching mechanism is carried out using an electromagnet. There are other principles of its work. However, it depends on the application. Most devices have a relay application.



Relay Design

Four main parts work together to form a relay. They are

- Electromagnets
- Moving-Armature
- Switch-point-contacts
- Springs

6. DC Motor-



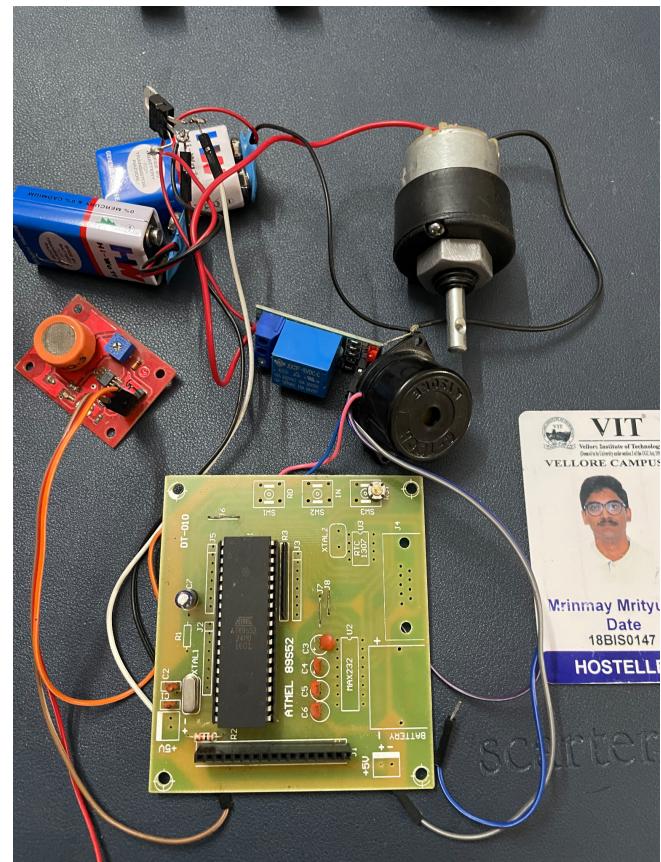
A direct current (DC) motor is a type of electrical machine that converts electrical energy into mechanical energy. DC motors take electricity through direct current and convert this energy into mechanical rotation. DC motors use a magnetic field due to the generated current to drive a rotor mounted on an output shaft. Output torque and speed depend on electrical input and design the motor.

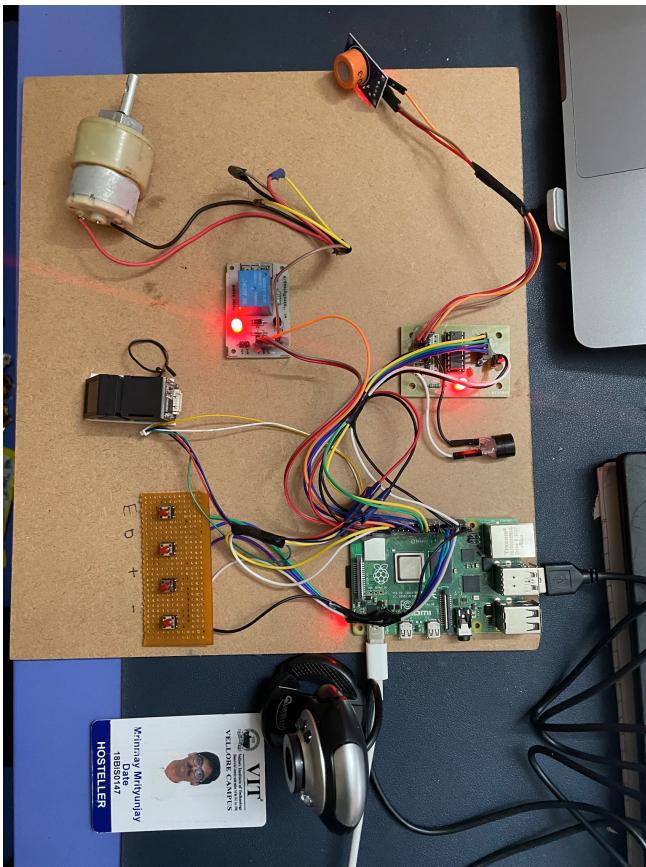
SOFTWARES USED

For rPi - use of Raspbian OS or Noobs is implemented. This software will also interact with our Rpi and communicate with all of the The storing and displaying of license on web and mobile the use of Thingspeak will be used. The facial recognition model based on Python 3 IDLE is being used.

For coding environment we have decided to use Microsoft visual basic.

Pictures of hardware: without Rpi





8. Face recognition algorithm

The rpi is a light hardware system, this doesn't support heavy operations, or it must be taken care that it doesn't have to go under heavy operations.

For deciding an algorithm we will be using a test case of mask detection.

We compare three different kinds of neural network models here and then train the face detection data set over these in order to find out which of these models gives best accuracy ,once that is completed we will show that is output in the end.

Dataset This is the fifth face mask dataset, which contains 4500 photos of people wearing and not wearing masks. The data was obtained via kaggle. The dataset is split into two parts: one for training and the other for testing. Images are offered in 80 percent of cases for training and 20 percent of cases for testing. CNN, Yolo, and MobileNetV2 all use the same dataset.

Before transmitting the images to the neural network for training, they are pre-processed. Because the dataset's order is to compare their accuracy and try to find out which one of them is best suited for its highest accuracy and also the one which is best suited for its efficiency all these models will be done through the same dataset, which comprises 4500 images.

The final comparison will be made between the images that we used to train and the ones we will correct ourselves. photos are limited, augmentation is used to increase the size of the images by 20,000 pixels and resize them.

Deep Neural Networks for Training Following the face detection, different deep neural networks such as CNN, yolo, and MobileNetV2 are used to train the model. During training, the features are extracted and categorized. layer. The input image matrix is convoluted with the help of filters (kernels) to build the feature map in the Convolutional Layer.

Convolution is essentially a multiplication of 200 kernels with a 3x3pixel input image. The Pooling layer aids in the reduction of large features to smaller ones. The pooling layer reduces the quantity of data generated by the convolutional layer for each feature while preserving the key elements. There are several sorts of pooling algorithms accessible, including maximum pooling, minimum pooling, average pooling, and so on.

The most common approach for pooling is the maximum pooling method. It's pooled to a maximum of 22 pixels. The ReLU function, which flattens the layer and transforms the input, can be used.

The face mask dataset in this system consists of photos of people wearing and not wearing masks, which are preprocessed and fed into a neural network for training, which determines whether the person happens to wear a mask or not. For the face mask detection system, three algorithms are compared: CNN, Yolo, and MobileNetV2.

Matrix of Perplexity(Confusion matrix) The confusion matrix is used to assess a classification model's performance in order to determine the true values based on a set of test data. We can determine how well our model is trained and produces outcomes by examining various factors such as accuracy, precision, recall, and f1- score.

$$\text{Accuracy} = (\text{TP} + \text{TN}) / (\text{TP} + \text{FP} + \text{FN} + \text{TN})$$

$$\text{Precision} = \text{TP} / (\text{TP} + \text{FP})$$

$$\text{F1-Score} = 2 * (\text{Recall} * \text{Precision}) / (\text{Recall} + \text{Precision})$$

Model	Actual Class		
	Class	With Mask	Without Mask
Predict Class	With Mask	TP = True Positive	FP = False Positive
	Class	FN = False Negative	TN = True Negative

TABLE II. USING CNN

Internal Validation On 4000 Images			External Validation On 100 Images		
Class	M	WM	Class	M	WM
M	TP = 2090	FP = 290	M	TP = 34	FP = 12
WM	FN = 310	TN = 1310	WM	FN = 16	TN = 38
Accuracy = 0.85 Precision= 0.87 Recall= 0.8 F1-score=0.8			Accuracy = 0.72 Precision= 0.73 Recall= 0.68 F1-score =0.69		

Where M = with mask , WM = without mask

TABLE III. USING yolo

Internal Validation On 4000 Images			External Validation On 100 Images		
Class	M	WM	Class	M	WM
M	TP = 2148	FP = 188	M	TP = 37	FP = 12
WM	FN = 252	TN = 1412	WM	FN = 13	TN = 38
Accuracy = 0.89 Precision= 0.89 Recall= 0.8 F1-score =0.8			Accuracy = 0.77 Precision= 0.78 Recall= 0.74 F1-score =0.7		

Where M = with mask , WM = without mask

TABLE IV. USING MOBILENETV2

Internal Validation On 4000 Images			External Validation On 100 Images		
Class	M	WM	Class	M	WM
M	TP = 2272	FP = 112	M	TP = 42	FP = 12
WM	FN = 128	TN = 1488	WM	FN = 8	TN = 38
Accuracy = 0.94 Precision= 0.95 Recall= 0.9 F1-score =0.9			Accuracy = 0.85 Precision= 0.89 Recall= 0.8 F1-score =0.8		

Where M = with mask , WM = without mask

These algorithms are trained and tested on the same dataset.

- Eighty percent of the photos are used for training and twenty percent are used for testing.
 - 16,000 photos are given for training and 4000 images are given for testing out of a total of 20,000 images.
 - The accuracy of the Convolutional Neural Network was 85 percent.
 - Yolo's accuracy was 89 percent.
 - The accuracy of MobileNetV2 was 94 percent.
 - In comparison to CNN and Yolo, MobileNetV2 has the highest accuracy rate and is computationally more efficient.

9. Conclusion

This system will produce effective results in reducing the number of road accidents which happen because of illegal driving. This system will ensure that

one doesn't commit unlawful activities that could lead to huge damage to the person and their family when an accident occurs. The system is also low cost so that it can be used by everyone. Our system reduces accidents by ensuring a driver has a license verifying through cloud database. sends an email in case some intruder tries to enter your vehicle.

- 1- Our system will check the status of the person before starting vehicle that the person has a license or not
- 2- Our system will even monitor that one who is driving the vehicle has consumed the alcohol or not.
- 3- Send email incase an intruder enters your vehicle.

10. References

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