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THEFT VEHICLE DETECTION USING DIGITAL SIGNATURE BASED ECU AND IMAGE PROCESSING

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***Abstract*—**Vehicle theft is a serious problem and catching hold of stolen vehicles is another issue on top of that. Which gets complicated as time passes. Some of the factors which effect the complications are- a change of the number plate of the vehicle, dismantling and mismatching the parts of the vehicle, altering the color of the vehicle. Because of these complications, it is difficult to stop each vehicle and verify, which is an ineffective way of doing work.

To reduce the effort required and to track down the stolen vehicle, we propose to develop a system which can efficiently detect which is stolen irrespective of the fact that the number plate or the colour of the vehicle might be altered. The whole process is done with the help of microcontrollers and some modules.

***Abbrevations*—ALPR-Automatic License Plate Recognition; ML-Machine Learning; ECU-Engine Control Unit; OCR- Optical Character Recogniton; EDA-Electronic Design Automation; GPS- Global Positioning System**

1. INTRODUCTION

The DIGITAL SIGNATURE based ECU is a new design methodology for implement the anti theft system at a place. It incubates three major issues in the general anti system for maintaining the security that are:

The stolen vehicle is not always left same as when it is stolen. Physical appearance changes might be made making it difficult to identify the vehicle.

Mostly whenever a vehicle is stolen the first thing done is to change the number plates. This makes it further much more complicated to find out the vehicle involving processes like having to find out chassis number every time a vehicle has to be searched.

So, to increase the detection efficiency of the theft vehicle and at the same time send the details of the current location of the vehicle, digital signature based ecu with image processing is a design which can do all at the same time.

ALPR is a technique under supervised machine learning in which a model is trained with certain data set after which the model is able to compare the actual data with the information extracted from the test data and give output.

Here, the main purpose of using Supervised Machine Learning (ML) are:

1. The type of data we are accepting is number plate which has a standard rule. So, the doesn't need to have the generative response for the expected input.

2. Since, the input type is known, training the model on test data will reduce the computation time during the real world scenario.

3. Complexity level in the supervised ML model are less as compared to unsupervised ML models. So, for increasing the productivity of the ALPR system, we are using a supervised ML model. For implementation, we have chosen the python platform on top of which opencv is used for image processing

The paper has been divided into following section: Section I is the introduction of the paper, Section II deals with the methodology of the proposed system, Section III is the design approach of the model, Section IV is the conclusion of the paper and Section V is the references with respect to the paper.

2. METHODOLOGY

The design consists of a computer system which runs on Python. It is already loaded with all the supporting libraries that is required. It has the power supply which will run the whole system and also the camera which will detect the number plate of an incoming vehicle. The system is connected with an Arduino Nano

microcontroller. The microcontroller is responsible for retrieving the ECU digital signature from the vehicle.

After retrieving the digital signature from the vehicle, the system then searches for its corresponding registered number. The camera detects the number plate of the car. If the detected number is different from the registered number, then the GPS module sends the current coordinates to keep track of the vehicle. Also, the car is immobilized after some minutes by stopping the wheels.

At the same time, the concerned authority is informed about the fraudulent vehicle.

The flowchart according to the system has been represented in the Figure 1.

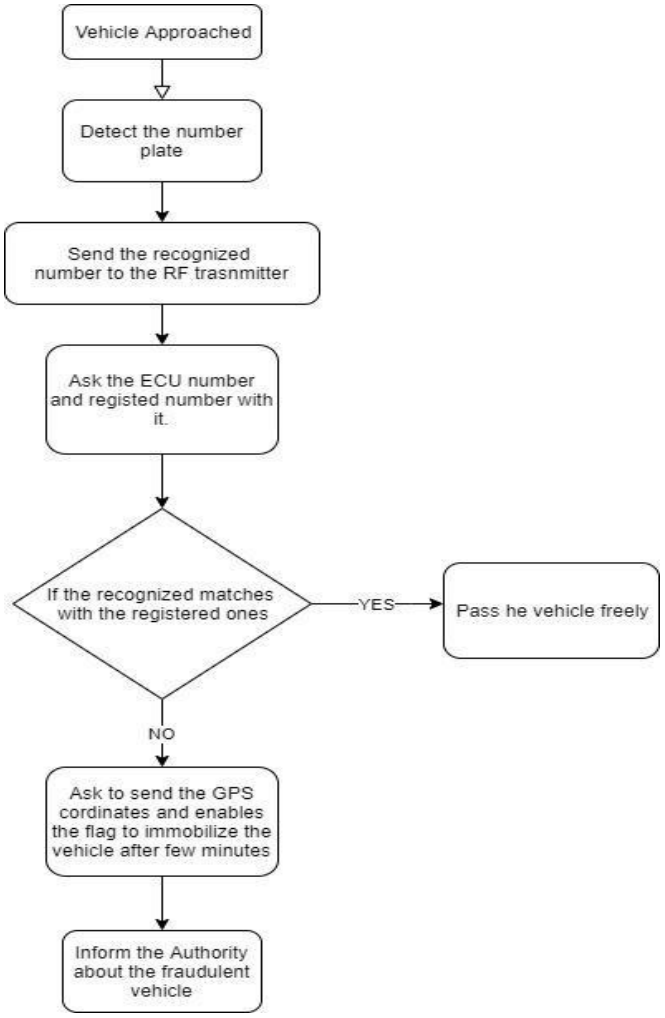

Fig. 1. Flowchart

3. DESIGN APPROACH

The model design is broken down into different stages:

1. The first step is to read each frame coming from the camera input in a form of series of images. Then we have to convert each image in gray scale where the pixel value varies from 0 to 255. Then we have to convert each gray scale image into a binary image where each pixel is completely black or white.

The before and after conversion of images from gray to binary is seen in Figure 2.

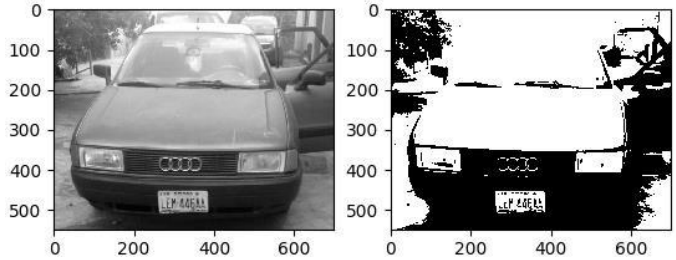

Figure 2: First step conversion from gray scale image to binary

2. Then we need to identify all the connected regions in the image, using the concept of connected component analysis (CCA). Other approaches like edge detection and morphological processing can also be explored. CCA basically helps us group and label connected regions on the foreground. A pixel is deemed to be connected to another if they both have the same value and are adjacent to each other.

3. Calling the region props method on the labelled image will return a list of all the regions as well as their properties like area, bounding box, label etc. We used the patches. Rectangle method to draw a rectangle over all the mapped regions.

4. From the resulting image, we can see that other regions that do not contain the license plate are also mapped. In order to eliminate these, we will use some characteristics of a typical license plate to remove them.

• They are rectangular in shape.

• The width is more than the height.

• The proportion of the width of the license plate region to the full image ranges between 15 to 40 percent.

• The proportion of the height of the license plate region

to the full image is between 8 and 20 percent.

5. Then we have to eliminate the regions which are not license plates. For this a vertical analysis is done by adding pixel in the highlighted region. It is common to understood that the region with number plate will have more number of dark pixels than other regions due to presence of characters

6. This is going to be the last stage, it's at this stage we introduce the concept of machine learning. Here, we have to read the characters from the extracted plate image.

All we need now is to get a training data set, choose a supervised learning classifier, train a model, test the model and see how accurate it is, then use the model for prediction. We did training on the 10 images which form the data base.

7. The last step would be to detect the characters and give the number plate text is given as the output. Seen in Figure 2.1

Figure 2.1: Detected number plate is being shown inside a rectangle.

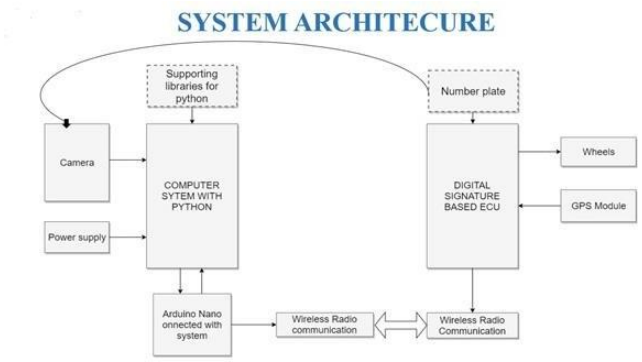

Fig. 2.2. Architecture of the design

A. Design of the transmitter board

The transmitter board houses an Arduino Nano as the brain of the structure which controls the positioning of the servo motors by the feedback from the ultrasonicsensors connected to it with jumper cables. The other sensory equipment such as radio transceiver module, GPS module the driver IC are all connected to the Arduino Nano via jumper heads mounted on the Boards.

The Board work as breakout for the Arduino Nano aiming to

This model will detect the different vehicles number plates and give them as text reduce the hectic wired connections.

Output from the Application program interface (API).

B. Architecture of the Design

The design is similar to a software-controlled ECU where the ECU will have an attached motor to it which functions according to the commands provided by the ECU. One part of this system are the ultrasonic sensors that function as the feedback based on which speed change occurs.

The image processing is done through a separate computer that has the capability to identify the registration number and derive the corresponding information from it.

This information can be communicated to the ECU via the Radio Frequency Tranceiver.

There is battery installed so as to provide the ECU and the driver IC it's required power in order to function

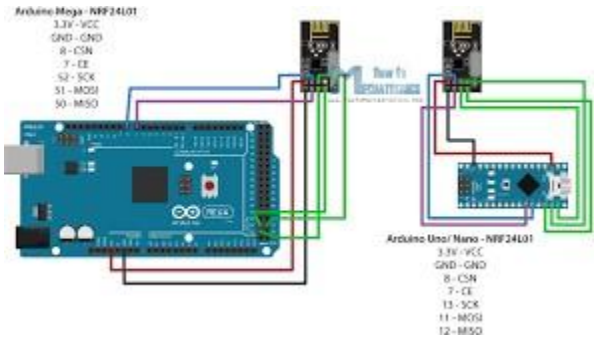

Figure 3: Skeletal Structure of the ECU and the receiver microcontroller

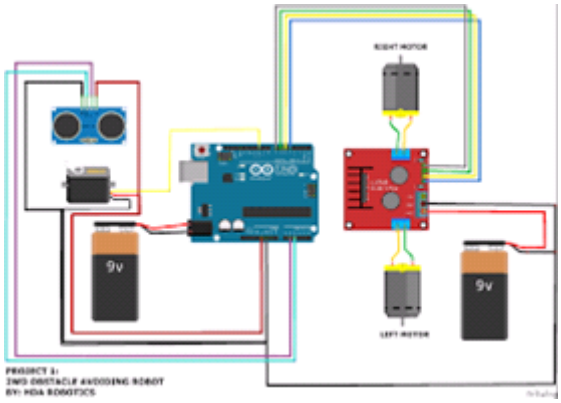

Figure 4.1: Schematic of transmitter board

C. Design of receiver board

It consists of another Transceiver connected to another Arduino nano via a jumper patch cable directly onto receiver board which facilitates in transmitting the details of either the digital signature or the 'PASS or STOP' information

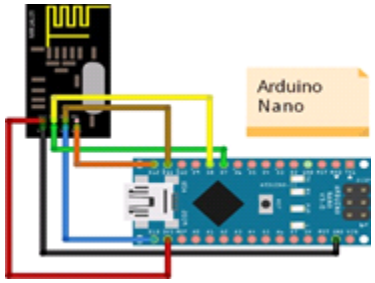

Figure 4.2: Schematic of receiver board

4. CONCLUSIONS

The system can be useful for the police department of the country for the safety purpose. They an just upload the vehicle number that is being stolen or the engine number for the more refined search.

To fight against the theft, this system can be come out to be powerful implementations.

The system implemented is able to detect the fraudulent cars with the help of the digital signature based ECU and it is able to send the coordinates to of the fraudulent car the police department.

So, it becomes easy to track also the vehicle is sent to breakdown mode after few seconds it left the toll plaza so that is immobilized and couldn't move further.

The system can be incubated with the digital signature on the different body part components. As a Average vehicle as almost 40-70 different ECU for different purpose, the can communicate with each other to check if the body has been altered.

The system can be deployed to traffic signals with directional antenna to more catch the vehicle as earliest as possible.

The main focus has been to keep this system simple and cost effective, without compromising on its reliability. On an average it costs around $100 to $150 to build this module. If implemented on a wide scale, this system will drastically reduce the threat of vehicle theft and save vehicle owners thousands in insurance money and other losses.

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