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Electronic Control Unit Based Stolen Vehicle Tracking System

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Stolen vehicle tracking systems are becoming essential nowadays, mainly in the case of stolen automobiles. Vehicle burglary is a significant issue these days, and retrieving those stolen vehicles is another issue in addition. It has become increasingly difficult to solve this problem over a long period of time due to differences in car license plates, the destruction and confusion of some parts stolen. In light of these complexities, it is difficult to stop every vehicle and determine what method of managing work is required to reduce the effort and find the stolen vehicle. We propose to develop a framework that will upload the number of a stolen vehicle and be able to detect fraudulent vehicles with the assistance of the digital signature based ECU and will also be ready to send the coordinates of a fraudulent vehicle to the local department. To fight against theft, this technique can be a powerful tool. This will drastically reduce the danger of auto theft, saving car owners hundreds of dollars in insurance and other damages and will also help law enforcement. The interface is complemented with the help of other microcontrollers and a few modules. The key goal was to make this technology as simple as feasible, while keeping the cost as low as possible without compromising its reliability.

Keywords: ECU, MATLAB, Image processing, Number plate, Tracking, Microcontroller, Modules.

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1. INTRODUCTION

The DIGITAL SIGNATURE based Electronic Control Unit (ECU) is another plan technique to execute the counter burglary framework at a spot. It broods three significant issues in the overall enemy of framework for keeping up the security that are.

• The vehicle that is stolen isn't constantly left the same as when it is taken. Actual appearance of the vehicle may be changed making it hard to identify the stolen vehicle.

• The majority of the time, when a car is taken, the first thing that is done is to replace the number plates. This complicates the process of locating the car even more by requiring procedures such as locating the case number each time a vehicle must be examined [1].

As a result, to increase the identification productivity of the burglary vehicle while also sending the nuances of the car's present location, an advanced mark based ECU with image preparation is a plan that can accomplish all of this at the same time.

The MATLAB Number Plate Detection Model is used to recognize a vehicle's license plate from photographs stored in a database. This will target at detecting the number plate of a vehicle by using the MATLAB software and then using the extracted information from the ECU to match whether the detected number plate is stored in the database or not.

The system will detect the number plate of the approached vehicle. The system will read each frame coming from the camera input in the form of a series of images using MATLAB. Then each gray scale image is changed into a binary image where each pixel is black and white. The detected image of the number plate will be sent to the RF transmitter. Then it extracts the image of the number plate registered to the digital signature. If the recognized number plate image matches with the registered number, the vehicle is permitted to pass freely. If the detected image does not match with registered one GPS module will send the current coordinates of the vehicle to the concerned authorities and thus stolen vehicle will be detected [2].

The system has a computer system connected with a camera which detects the number plate of an approaching vehicle by the means of MATLAB. An Arduino Nano is used to link the system. This microcontroller will be in charge of obtaining the ECU's digital signature from the car. After this is completed successfully,

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the system searches for the already registered number. The system's camera detects the number plate of the approaching car. Only the approaching vehicle is permitted to pass if the detected number plate matches the registration number of that car. If the registration number differs from the detected number, the GPS module's coordinates are used to maintain track of the fraudulent vehicle and are notified to the appropriate authorities.

The rest of the article organization is as follows. section 2 discusses the literature survey of various work done in this domain. In section 3, proposed work and result is discussed where design approach as well as working of the whole system is elaborated along with flowchart and circuit diagram. Finally, it is concluded with the future directions in section 4.

2. RELATED WORK

Real Time Vehicle Tracking System using GSM and GPS Technology-An Anti-Theft Tracking System: The Global Positioning System (GPS) module continuously interfaces with several satellites (at least 3) to get the coordinates of the concerned vehicle then these coordinates are sent from GPS to the Arduino using Universal Asynchronous Receiver/Transmitter (UART). The Arduino is programmed such that it draws the essential information from the GPS. Before getting the coordinates from the GPS the Arduino instructs the Node MCU ESP8266 to get the Internet Protocol (IP) address. The obtained data from the GPS also contains the longitude and latitude that are used to track down the malicious automobile. On reloading the webpage, the user gets the exact coordinates, and the data is then sent to the webpage over Wi-Fi with some extra details along with the Google maps link in it. When the link is opened, the user is redirected to Google maps with current coordinates or the location as a red spot on it [3].

Design and Deployment of a National Detecting Stolen Vehicles Network System. This system's technique is based on the notion of a combined examination of registration panel letters and other vehicle parameters such as color and model variant, as well as a database of enrolled automobiles. If there is a disparity, the system flags the car was stolen. It discusses the design and implementation of a National Detecting Stolen Vehicles Network System (NDSVNS) for a country and a police management authority. NDSVNS primarily uses pattern recognition techniques to establish a Stolen Vehicle Identification System (SVIS) and connects many heterogeneous datasets from various municipal and county police departments [4].

Identification and Recognition of a Vehicle's License Plate: Recognition of number plates is important in this fast-paced environment as the number of cars on the road increases by the day. This process includes capturing the image of the license plate of the vehicle and is matched with the database stored of different vehicles in the system. This dissertation provides a morphology-based technique for identifying a license plate in a vehicle picture. The recognition technique deviates from the traditional strategy of using Optical Character Recognition (OCR) systems, instead employing the idea of color coherence vectors [5].

Automatic Number Plate Recognition System for Vehicle Identification using Optical Character Recognition. This paper proposed a system that is used in a rather limited place like army zones or place round pinnacle authority's places of work like Parliament, Supreme Court etc. This advanced device first detects the image of the vehicle and then Vehicle variety plate vicinity is extracted from the usage of the photograph segmentation in a photograph. Optical person popularity method is used for the person's popularity. The ensuing facts are then used to examine the information on a database so one can give you the unique statistics just like the vehicle plate owner, vicinity of registration, address, etc. The device is carried out and simulated in MATLAB, and its overall performance is examined on actual photographs. It is discovered from the test that the advanced device efficiently detects and apprehends the car variety plate on actual images [6].

Securing Vehicle ECU Communications and Stored Data. According to their research, automobiles have a master ECU. Hash values are stored in the master ECU and used to validate the eus. They also avoid using the public key infrastructure (PKI) by using the Key Pre-Distribution System (PKS). ECUs would form a dependable cluster, according to Groll and Ruland [10]. The center entrance will serve as a crucial distribution hub (KDC). Each group receives symmetric keys from the KDC, which it generates and distributes. The symmetric key used to communicate with the group's ECUs. The Access Control List is unique to each ECU (ACL). The teams' members are specified in the ACL [7].

Vehicle detection and License Plate Recognition System. The system detects vehicles entering the area and allows only a specific vehicle type depending on vehicle license plate. License plate recognition is implemented after color segmentation. Experimental results of implementing the proposed method using video sequences provided by surveillance cameras show superior performance and the system detects moving objects successfully [8].

Review of the License Plate Recognition (LPR) using Edge Detection. This paper has proposed a strategy during which the input image is to be converted into grayscale and so we convert the image into a binary image where each pixel is black and white respectively. While designing the system no random images are captured and only the desired images are obtained [9].

Multi- scale License Plate Detection and Location for Traffic Surveillance: The specific technique outlined in this work is to perceive the plate based on the high density of vertical edges inside it, detecting license text, and distinguishing it from similar patterns based on the geometrical connection between the letters composing the license numbers.

These plates are frequently produced in a wide range of colors, languages, and fonts [10].

3. PROPOSED WORK AND RESULT DISCUSSION

The system includes a MATLAB-based personal computer (PC) foundation. It contains a power supply that will power the entire structure, as well as a camera that will recognize the number plate of an ap-

proaching car. The entire system is controlled by an Arduino Nano microcontroller. The microcontroller is in charge of retrieving the vehicle's ECU computerized signature.

Following the recovery of the vehicle's computerized signature, the framework searches for the vehicle's matching enrolled number plate. The camera recognizes the vehicle's license plate. The GPS module communicates the current instructions to monitor the vehicle if the distinguished number plate differs from the enlisted number plate. Similarly, the car is immobilized after a specific number of minutes by the authorities stopping the wheels.

3.1 Design Approach (for the Software)

1. The first step is to read each frame coming from the camera input in a form of a series of images. Then we have to convert each image in a 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.

2. Then we must identify all of the image's linked areas. Edge detection and morphological processing are two approaches that can be investigated. On the foreground, we arrange and identify related areas. If two pixels have the same value and are next to one other, they are said to be linked.

3. When we use the region props method on a labelled picture, it will return a list of all the regions as well as their attributes such as area, bounding box, label, and so on. We made advantage of the fixes. To draw a rectangle across all mapped zones, we used the Rectangle method.

4. We can observe from the resultant image that additional locations that do not include the license plate are also mapped. To get rid of them, we'll use certain features of a common license plate:

- They have a rectangular form.
- The breadth exceeds the height.
- The percentage of the width of the license plate region to the total image varies between 15 and 40 %.

The full image is between 8 and 20 percent. Then we have to eliminate the regions which are not license plates. For this a vertical analysis is done by adding pixels in the highlighted region. It is common to understand that the region with the number plate will have more dark pixels than other regions due to the presence of characters.

3.2 Working

The proposed system will work into different stages.

When the vehicle approaches the system will read each frame coming from the camera input in a form of a series of images. Each image will be converted to gray-scale. Then we have to convert each gray scale image into a binary image where each pixel is completely black or white. While designing the system no random images will be captured. The resulting number plate will have the following characteristic, and shown in Fig. 1 (Number plate after gray scaling on MATLAB) and Fig. 2 (Number plate of the vehicle is detected):

- Number plate will be rectangular in shape.
- Height is less than the width.
- The number plate region will have more dark pixels than other regions due to the presence of characters.

Fig. 1 – Number plate after gray scaling on MATLAB

Fig. 2 – Number plate of the vehicle is detected

After the number plate image has been detected, the recognized image of license will be sent to the RF transmitter. The whole framework is associated with an Arduino Nano microcontroller. Then it extracts the image of the number plate registered to the digital signature. If the recognized number plate image matches with the registered image the vehicle passes freely.

If the detected number plate image does not match the registered one, the GPS module will provide the vehicle's real-time coordinates and enable the flag to disable the vehicle by halting the vehicle after a few minutes. At the other moment, concerned authorities are informed about the fraudulent vehicle [1].

The Arduino Nano is housed on the transmitter board, and it serves as the structure's brain, controlling the placement of servo motors using feedback from ultrasonic sensors connected via jumper connections. Other sensors are connected to the Arduino Nano via jumper heads on the boards, such as the radio transceiver module, GPS module, and driving microcircuit (IC). This device assists the Arduino Nano in detecting various vehicle number plates [11-13].

The design is similar to that of a software-controlled ECU, except that the ECU will be connected to a motor that will operate in accordance with the commands issued by the ECU. The ultrasonic sensors are one of the components of this system, and they work because the feedback determines which speed change takes place. A second computer completes the image processing by recognizing the identifying number and

extracting the essential information from it. The radio frequency transceiver transmits this data to the ECU. There is an electric battery in the ECU, as well as a driver IC that requires electricity to work. It comprises a second transceiver attached to a specific digital signature or 'PASS or STOP' information is conveyed by connecting an Arduino Nano to the receiver board using a jumper patch connection.

Table 1 – Various component which are used

S. No	Component name	Model
1.	Microcontroller	Arduino Nano, Arduino uno
2.	GPS Module	GY-GPS6MV2
3.	Radio transceiver module	NRF24L01+

3.3 Flow Chart

This sub-section presents the flow chart in the Fig. 4, which depicts the flow of our proposed methodology. Further, Table 1 shows the list of various components which are used to identify the stolen car. Moreover, Fig. 5 and Fig. 6 illustrate the circuit diagram of transmitter and receiver board.

4. CONCLUSIONS AND FUTURE DIRECTIONS

For the aim of protection, the system is beneficial to the country's local government department. They will just input the stolen car number or the engine number for a more precise search. This strategy has the potential to be a strong implementation in the fight against thievery. With the help of the digital signature-based ECU, the system developed is able to detect fraudulent cars and is ready to report the fraudulent car's coordinates to the local department. As a result, when the vehicle is sent into breakdown mode, it leaves the piece of ground after a few seconds to become stranded and unable to proceed farther. The system might be incubated with the digital signatures on the various component parts. Because a typical vehicle has over 40-70 separate ECUs for various functions, they can interact with one another to see if the body has been tampered with. The technology uses aerial cameras to catch the vehicle as soon as feasible at traffic signals. The main goal has been to maintain this method as simple as possible while keeping the price as low as possible without sacrificing its reliability. This strategy will significantly lower the risk of auto theft, saving vehicle owners hundreds of dollars in insurance and other damages, and greatly assist law enforcement.

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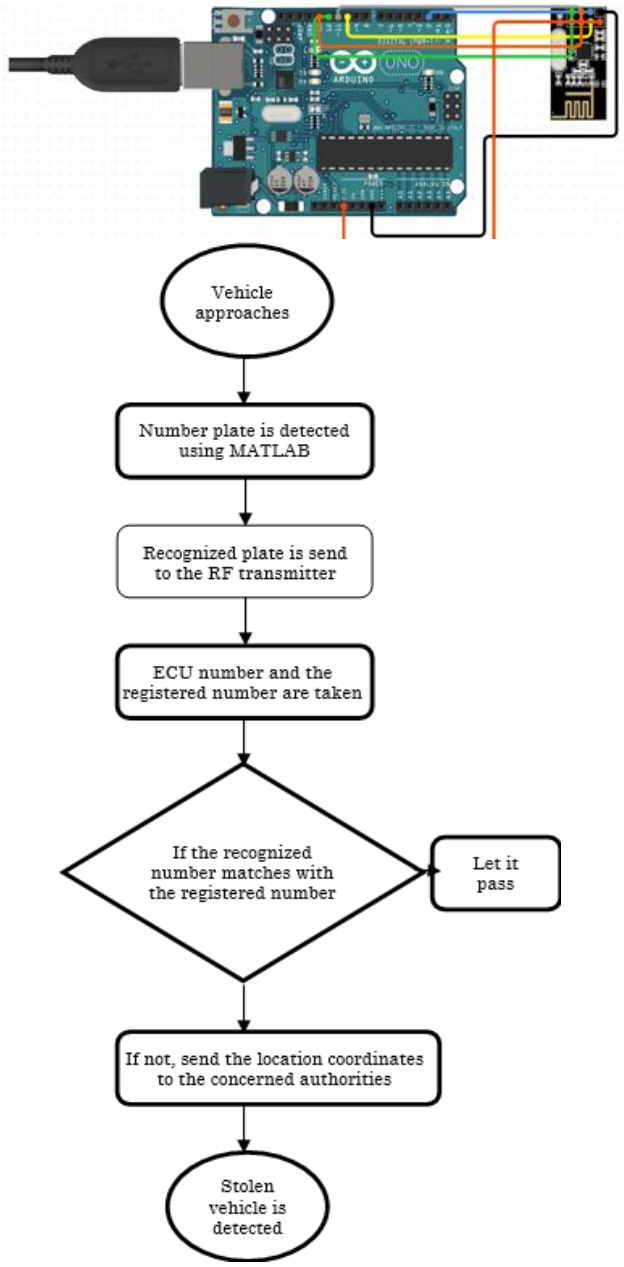

Fig. 3 – Flow chart of the proposed methodology

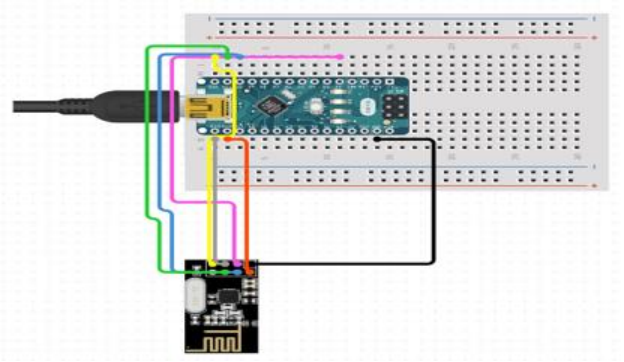

Fig. 4 – Circuit diagram of the receiver board

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Система стеження за викраденими автомобілями на основі електронного блоку керування

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Системи стеження за викраденими транспортними засобами стають все більш важливими в даний час, переважно у випадку викрадених автомобілів. Сьогодні крадіжка зі зломом є великою проблемою, а вилучення цих викрадених транспортних засобів – ще однією. Вирішити дану проблему протягом тривалого часу стає все важче, що пов'язано з відмінністю в номерних знаках автомобіля, руйнування і плутанина деяких частин викраденого. У світлі цих складнощів важко зупинити кожен транспортний засіб і визначити, який метод керування роботою потрібен, щоб зменшити зусилля та знайти викрадений транспортний засіб. Ми пропонуємо розробити фреймворк, який завантажуватиме номер викраденого транспортного засобу та виявлятиме шахрайські транспортні засоби за допомогою ECU на основі цифрового підпису, а також буде готовий надсилати координати шахрайського транспортного засобу до місцевого відділу. Для боротьби з крадіжками така техніка може стати потужним інструментом. Це різко знизить небезпеку викрадення автомобілів, заощадивши власникам автомобілів сотні доларів на страхуванні та інших збитках, а також допоможе правоохоронним органам. Інтерфейс доповнюється іншими мікроконтролерами та кількома модулями. Основна мета полягала в тому, щоб зробити цю технологію максимально простою, зберігаючи при цьому якомога нижчу вартість, не ставлячи під загрозу її надійність.

Ключові слова: ECU, MATLAB, Обробка зображень, Номерний знак, Відстеження, Мікроконтролер, Модулі.