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Theft Vehicle Detection Using Image Processing integrated Digital Signature Based ECU

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***Abstract*—Vehicle theft detection is becoming as an increasingly important challenge in many urban areas. Some of the factors that affect the detection of such thievery are: a change in the original vehicle number plate, dismantling and mismatching the parts of the vehicle, and alteration in the original vehicle colour. These complications have led to serious difficulties in identifying the theft vehicles. In order to reduce the effort required in tracking the stolen vehicles, this research work has developed a system that can efficiently detect the theft vehicle irrespective of its altered vehicle number plate and colour. The proposed vehicle theft detection process is done with the help of microcontrollers and some modules.**

Keywords—Machine learning; engine control unit; optical character recognition; electronic design automation; global positioning system

I. INTRODUCTION

The digital signature based engine control unit [ECU] is a new design methodology developed for implementing the anti-theft system. Modern vehicles are not just a combination of engine, chassis, body, and wheels. They are equipped with many sensors and electronic devices to assist drivers. The vehicle industry is expanding exponentially and more features are being added to vehicles for safe driving. Most of these features are integrated as an electronic system or subsystem. To coordinate these electronic systems, vehicle manufacturers introduced Electronic Control Units (ECU). An ECU takes inputs from sensors and computes data for its required task. Besides, one ECU can take inputs from another ECU to perform its tasks. 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 purposes 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.

Automatic number-plate recognition is a technology that uses optical character recognition on images to read vehicle registration plates to create vehicle location data. It can use existing closed-circuit television, road-rule enforcement

cameras, or cameras specifically designed for the task. ANPR is used by police forces around the world for law enforcement purposes, including to check if a vehicle is registered or licensed. It is also used for electronic toll collection on pay-per-use roads and as a method of cataloguing the movements of traffic, for example by highways agencies.

Automatic number-plate recognition can be used to store the images captured by the cameras as well as the text from the license plate, with some configurable to store a photograph of the driver. Systems commonly use infrared lighting to allow the camera to take the picture at any time of day or night. ANPR technology must consider plate variations from place to place.

Privacy issues have caused concerns about ANPR, such as government tracking citizens' movements, misidentification, high error rates, and increased government spending. Critics have described it as a form of mass surveillance.

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

II. Related Work

Creation and Implementation of Theft Vehicle system for a Country: The creation an implementation of Theft vehicle (NDSVNS) for a country and how the police authority handles this situation is discussed in this paper. The database possesses data of stolen vehicles and number plate identification files from 26 cities and local police division throughout the area.

Clever Theft Vehicle Recognition using Video Identification:

This paper presents the idea of colour and character recognition of the vehicle around the plate under different illuminations using the famous Bayes' rule and matching them with the database. The usage of the information fused enhancement colour identification technology is also given in this paper for the stolen vehicle identification. The approach behind this system is established upon the concept of combined evaluating a registration panel letters and additional attributes of a vehicle such as its color and model variant and comparing the seta database of enlisted cars. If any mismatch occurs, the given methodology identifies the vehicle as probably stolen.

Computerized Identification and Recognition of a Vehicle's License plate:

Because of the increase in the number of vehicles every day, the Recognition of License Plate (RLP) plays a vital position in this bustling environment. Identification of a license plate, identification of characters and recognizing each and every character; are some of the fundamental process steps. Among them, segmentation is a crucial part, since the precision of recognition is dependent on how accurate the segmentation is done.

Using the Method of Bounding Box to identify a vehicle license plate and recognize it: Day by day, there is an exponential increase in the usage of vehicles in our daily lives. This is resulting in the rise of the number of vehicles violating traffic rules, vehicle thefts, entry into restricted areas, accidents on roads, and also a substantial rise in law offense and criminality rates as well. In order to be able to identify a vehicle, the number plate identification plays a crucial function in this vehicle-driven society. In order to find a vehicle, usually deployed to enhance the system making it safer and secure, Registration plate identification and recognition holds a vital place and there is a necessity to identify the license plate number from a definite distance.

Check post, Fast-tag Tollgate System through RFID and GSM and Automatic Secure Means: Checking vehicles for the license, insurance and RC book is a huge trouble to the people in the present world. It is a waste of time and it bothers traffic. At the tollgate systems, when a traffic halt happens, time and fuel consumption is increased. This paper deals with Automated Toll collection.

Automated Toll Tax Collection System using Cloud Database: In the present world, there are a large number of vehicles, and due to this reason, the tollbooth is a nuisance to deal with for everyone in the world because of their manual operations. It might take a lot of time to pass the toll system because of this process. To tackle this problem, this paper deals with the automation of the whole toll system by enabling the technology of Internet of Things (IoT). There will be a reduction in the physical work and as a result, the time taken by all the vehicles in the tollbooth will be significantly lowered.

III. Proposed Work

The paper consists of a mechatronics design. The design is made by selecting a dummy car model which replicates the design of a real time car. The movement of the car is achieved by using a DC motor. The DC motor controlling is done through the usage of a driver IC circuitry which is in-turn controlled by the micro controller. Two different power supplies are used. One to provide voltage to the driver IC to run the motors and other power supply to coordinate the functioning of the microcontroller which is basically functioning as our Engine Control Unit. The Ultra sonic sensors are also embedded into the system just to know to stop whenever a toll booth is nearing by. This ultrasonic sensor helps in predicting the distance. A radio transceiver is used which helps in establishing a communication connection between the image processing computer and the car module.

Architecture Design

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 identify the license plate of an incoming vehicle. The entire 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.

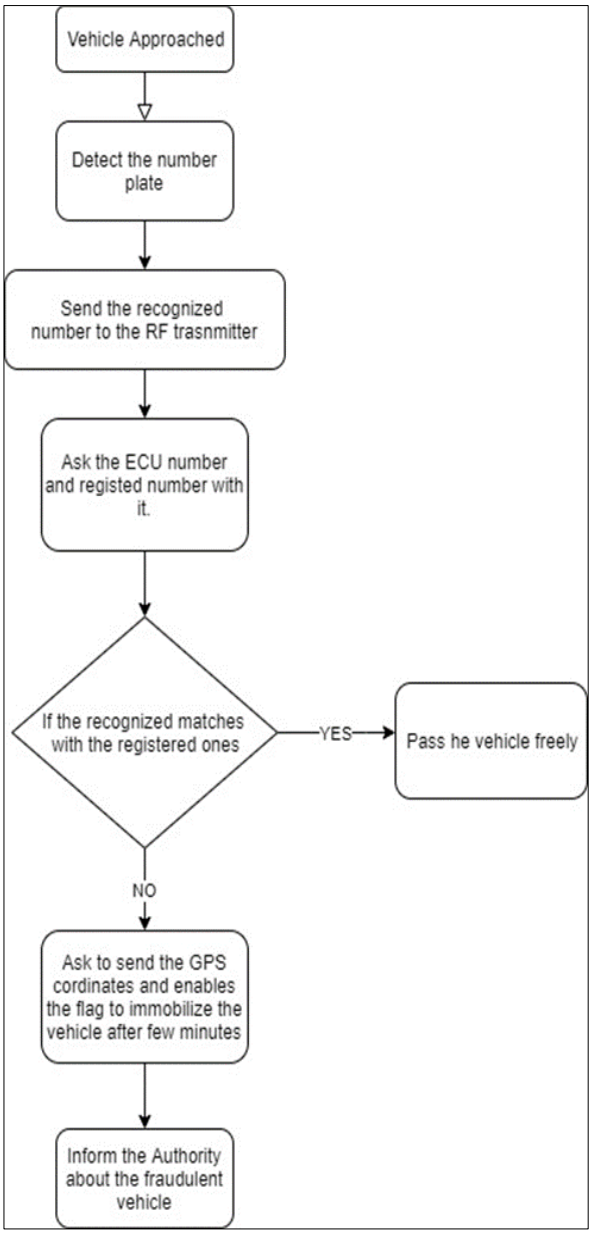

Fig 1: Model Workflow

The Fig.1 shows the working flow model of the system will first detect whether a vehicle is approaching. The real time security camera will capture the license plate of the vehicle and send the recognized set of characters to the RF transmitter. It then receives the registered number from the ECU. If the recognized number and registered number are same, then no action is to be done.

If they happen to be different, then the system sends the GPS coordinates and enables the flag to immobilize the vehicle after few minutes. At the same time, the concerned authority is informed about the fraudulent vehicle.

HARDWARE COMPONENTS

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

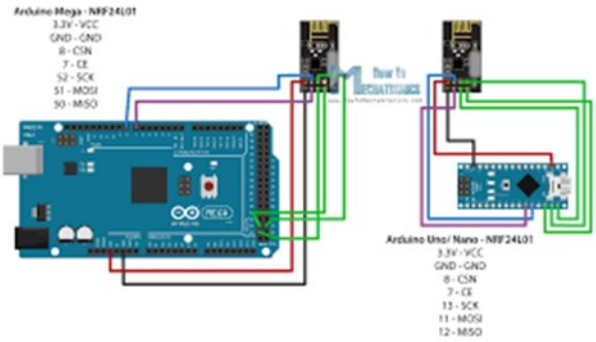

Fig 2 : View of proposed 3D model

Table 1. Hardware Component specifications

Microcontroller	Arduino Nano	IC: Atmega328-P I/p voltage: 5-12V Flash memory: 32K
Radio transceiver module	NRF24L01+	Data Transfer rate: up to 2mbps Ultra-low power operation Voltage: 1.9 - 3.6V
GPS Module	GY-GPS6MV2	Working voltage: 3-5V Default baud rate: 9600
Ultrasonic Sensors	HC-SR04	Power Supply: +5V DC Ranging Distance: 2cm – 400 cm

Microcontroller

Atmega 328P is the microcontroller used in the paper. The microcontroller uses a breakout board named Arduino Nano which has SFF compared to Arduino UNO R3 with same microcontroller. Nano uses TQFP package of the IC by Atmel Corporation. The Arduino Nano is a portable, compatible microcontroller which is small in size, user friendly, and can

be used on breadboard, it is based on the ATmega328P.This micro controller has almost the similar operational functions of the Arduino UNO, but this comes in a different package. This microcontroller lacks a DC power jack, and only operates with a Mini-B USB cable instead of the normal one.

Radio Transceiver Module:

This RF module is based on the nRF, the nRF24L01 is a unintegrated circuit chip transmitter and receiver in the radio frequency for the wide 2.4 - 2.5 GHz Industrial Scientific and Medical band. The transmitter receiver contains a wholly integrated frequency producer, one powerful amplifier, an oscillator, a modulator-demodulator and high Enhancement protocol model. The O/p power, various frequency channels, and protocol start-up are effortlessly configurable through a Serial Peripheral Interface. The Current absorption is less, only 8.0milli Amperes at an o/p power of -7dBm and 14.5milli Amperes in the receiver mode. The default inbuilt Down Power and Standby operation types helps in saving power effort less.

GPS Module

The GY-GPS6MV2 model is the family of unique Global Positioning Systems receivers providing a very heavy performance 8 position module. Their simple build architecture, low-power and storage memory features make NEO-8 modules most suitable for moving devices which are operated through a battery which also have very strict cost and space constraints. The **assigned** acquirement driver is able to operate very high time and frequency searches parallelly, making it to find satellites **instantly**. NEO-8 GPS provides excellent navigation options even in the most challenging conditions.

Ultra-Sonic Sensors

The HC-SR04 Ultrasonic (US) sensor is a 4-pin unit, whose pin names are Vcc, Trig, Echo and Gnd respectively. These ultrasonic sensors are widely used in the mechanical aspects of a vehicle design whenever it involves sensing an object or identifying the distance. This unit has two paper ions on the front which look like human eyes. These two from the transmitter and receiver of this unit. This sensor works based on the simple formula that

Distance = Speed × Time

This sensor initially sends an ultrasonic wave. This signal traverses in air and whenever an obstruction or an object is hit, it reflects back to the receiver present. This time taken to reach back is considered and the distance is thus calculated internally and the Fig.3 demonstrates the architecture of the working system design."

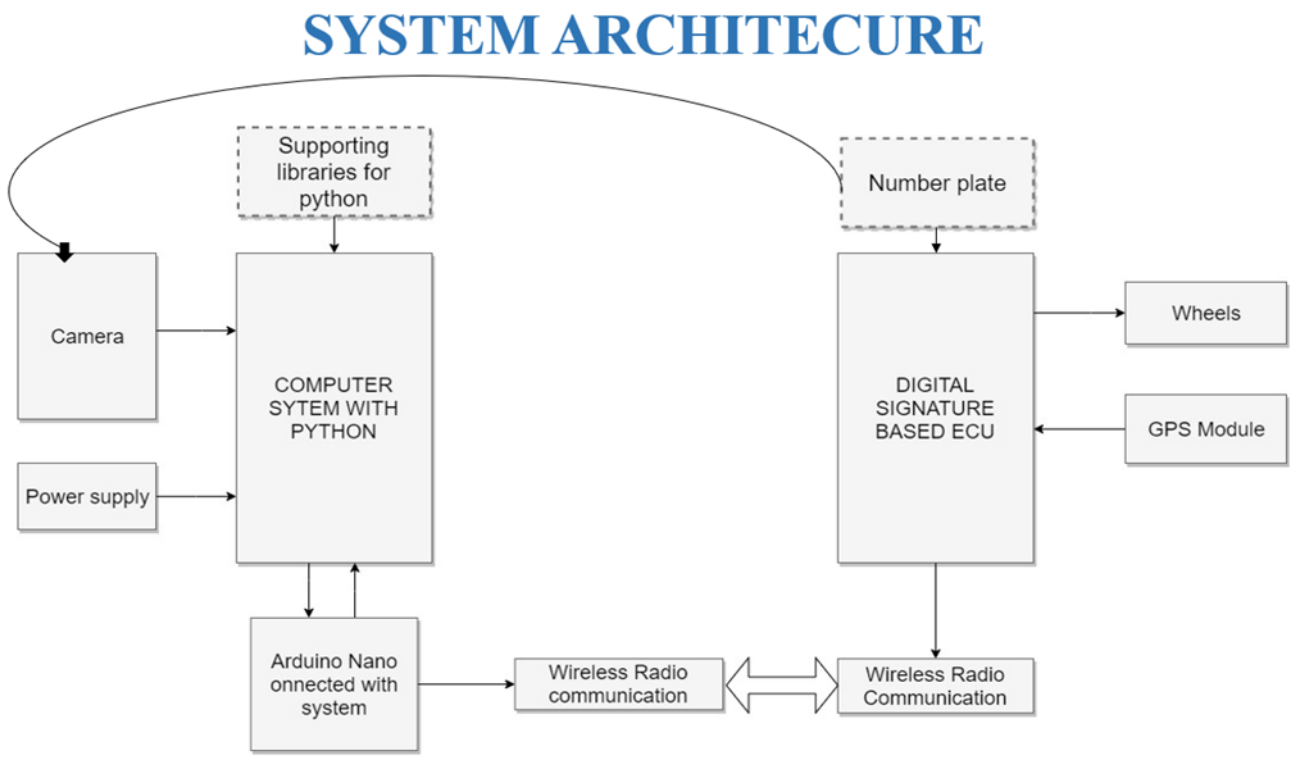

Fig. 3. Architecture of the design

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 ultrasonic sensors 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 reduce the hectic wired connections the Fig.4 Shows the Schematic of Transmitter board.

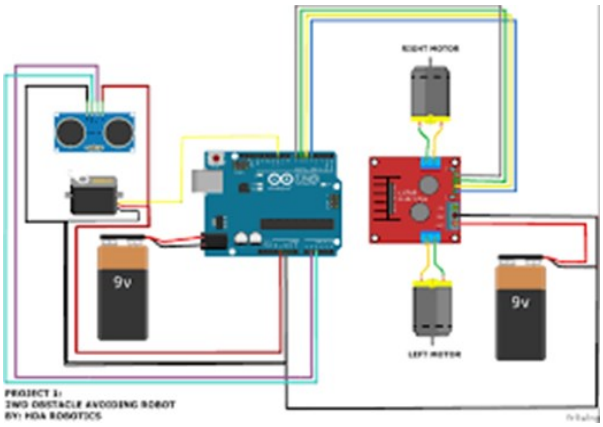

Fig 4. Schematic of transmitter board

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

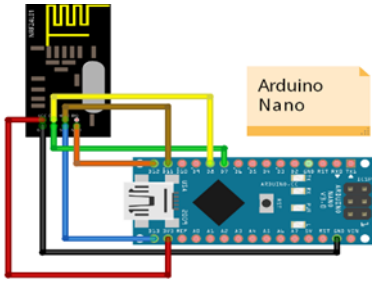

Figure 5: Schematic of receiver board

IV. CONCLUSION

In is concluded that, the system can be useful for the police department for various safety purposes. They can just upload the theft vehicle number or the engine number for the more refined search. To fight against the theft, this system has an in-built digital signature-based ECU and it is able to send the coordinates of the fraudulent car. So, it also becomes easy to track the vehicle by enabling the breakdown mode after few seconds it left the toll plaza to immobilize the theft vehicle. The system can be incubated with the digital signature on different body part components. As an average, vehicle as almost 40-70 different ECUs are used for different purpose, where they can communicate with each other to check whether the body has been altered. Fig.5 shows the schematic representation of receiver board system that can be deployed in traffic signals with directional antenna to detect the theft vehicle as earlier as possible.

Fig 6. Number plate detection inside the highlighted rectangular box

The main idea is to keep this more simple and cost effective without compromising on the reliability. The average cost consumed for building this model is around $100 to $150. In the near future, the proposed system will be implemented in a large scale, where it will substantially reduce the probability of vehicle theft and save many vehicle owners from further loss.

REFERENCES

[1] Weiping Chang, Chingwei Su. (2010). "Design and Deployment of a National Detecting Stolen Vehicles Network System". Intelligence and Security Informatics - PAISI 2010.

[2] Rami Al-Hmouz, Subhash Challa. (2007). "Intelligent Stolen Vehicle Detection using Video Sensing". Information, Decision and Control - 2007.

[3] Chirag Indravadanbhai Patel, D. Shah, Atul Patel. (2013). "Automatic Number Plate Recognition System (ANPR): A Survey". International Journal of Computer Applications - 2013.

[4] P.Meghana, S. SagarImambi, P. Sivateja, K. Sairam. (2019). "Image Recognition for Automatic Number Plate Surveillance". International Journal of Innovative Technology and Exploring Engineering (IJITEE - 2019).

[5] K. Balamurugan, S. Elangovan, R. Mahalakshmi, R. Pavithra. (2017). "Automatic Check-Post and Fast Track Toll System using RFID and GSM module with Security System". International Conference on Advances in Electrical Technology for Green Energy (ICAETGT - 2017).

[6] Priyanka Prabhakar, P Anupama, S R Resmi. (2014). "Automatic Vehicle Number Plate Detection and Recognition". International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT - 2014).

[7] Abhishek Kashyap, B Suresh, Anukul Patil, Saksham Sharma, Ankit Jaiswal. (2019). "Automatic Number Plate Recognition". International Conference on Advances in Computing, Communication Control and Networking (ICACCCN - 2019).

[8] Anumol Sasi, Swapnil Sharma, Alice N. Cheeran. (2017). "Automatic Car Number Plate Recognition". International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS - 2017).

[9] Cheng-Hung Lin, Yong-Sin Lin, Wei-Chen Liu. (2018). "An Efficient License Plate Recognition System using Convolution Neural Networks". IEEE International Conference on Applied System Invention (ICASI - 2018).

[10] Prathamesh Kulkarni, Ashish Khatri, Prateek Banga, Kushal Shah. (2009). "Automatic Number Plate Recognition (ANPR) System for Indian conditions". 19th International Conference Radioelektronika - 2009.

[11] Balamurugan G, Sakthivel Punniakodi, Rajeshwari K, Arulalan V. (2015). "Automatic Number Plate Recognition System using Super-Resolution Technique". International Conference on Computing and Communications Technologies (ICCCT - 2015).

[12] Riazul Islam, Kazi Fatima Sharif, Satyen Biswas. (2015). "Automatic Vehicle Number Plate Recognition using Structure Elements". IEEE Conference on Systems, Process and Control (ICSPC - 2015).

[13] Xiaojun Zhai, Faycal Bensaali, Klaus McDonald-Maier. (2013). "Automatic Number Plate Recognition on FPGA". 20th International Conference on Electronics, Circuits, and Systems (ICECS -2013)

[14] Chuin-Mu Wang, Jian-Hong Liu. (2015). "License Plate Recognition System". 12th International Conference on Fuzzy Systems and Knowledge Discovery (FSKD -2015).

[15] Jin Chong, Chen Tianhua, Ji Linhao. (2013). "License Plate Recognition based on Edge Detection Algorithm". Ninth International Conference on Intelligent Information Hiding and Multimedia Signal Processing – 2013

[16] Sayyad, S., Mohammed, A., Shaga, V., Kumar, A., & Vengatesan, K. (2020). Digital Marketing Framework Strategies Through Big Data (pp. 1065–1073). https://doi.org/10.1007/978-3-030-24643-3_127

[17] Kumar, P., & Kumar, A. (2019). Information technology impact on E-commerce business growth. International Journal of Innovative Technology and Exploring Engineering, 8(5), 1014–1017.

[18] Wu Wei, Yuzhi Li, Mingjun Wang, Zhongxiang Huang. (2001). "Research on Number Plate Recognition based on Neural Networks". Neural Networks for Signal Processing XI: Proceedings of the 2001 IEEE Signal Processing Society Workshop (IEEE Cat. No.01TH8584).

[19] M. T. Qadri, Muhammad Asif. (2009). "Automatic Number Plate Recognition System for Vehicle Identification using Optical Character Recognition". Education Technology and Computer, ICETC - 2009.

[20] Vengatesan, K. & Karuppuchamy, V & Shaktivel, Rakesh & Singhal, Achintya. (2019). Face Recognition of Identical Twins Based On Support Vector Machine Classifier. 577-580. 10.1109/I-SMAC47947.2019.9032548

[21] K. Akila, B. Sabitha, R. Jayamurugan, M. Teveshvar, N. Vignesh. (2019). "Automated License Plate Recognition System using Computer Vision". International Journal of Engineering and Advanced Technology (IJEAT - 2019).

[22] Dhiraj Y. Gaikwad, Pramod B. Borole. (2014). "A Review Paper on Automatic Number Plate Recognition (ANPR) System". Semantic Scholar - 2014.

[23] Chandy, A. (2019)," A review on iot based medical imaging technology for healthcare applications", Journal of Innovative Image Processing (JIIP), 1(01), 51-60.

[24] Shaga, Vikrant & Sayyad, Samee & Vengatesan, K.. (2020). Fact Findings Of Exploring ICT Model In Teaching Learning. International Journal of Scientific & Technology Research. 8. 2051-2054.

[25] Dhaya, R. "CCTV Surveillance for Unprecedented Violence and Traffic Monitoring." Journal of Innovative Image Processing (JIIP) 2, no. 01 (2020): 25-34.