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Intelligent System for Vehicles Number Plate Detection and Recognition

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Abstract— **Vehicle's plate number is a unique identity by which individual vehicle can be identified. Vehicle plate recognition system helps to capture a vehicle plate number, extract the numbers on the plate and check the details of the car owner. As the number of car owners in a country increases, identifying and charging unlawful vehicles on the road has been a tedious work for law enforcement agents. In this paper, we present an automatic vehicle plate recognition system using Raspberry pi. A Camera was incorporated to help in capturing the plate number images and it is interfaced to a Raspberry pi processor for authentication. Using the Open Computer Vision (Open CV) and Optical Character Recognition (OCR), the system can extract numbers from the captured plate image and completely automate the license plate recognition. The experimental results from several testing in different locations and conditions show that the system performed better than most of the baseline studies considered.**

***Keywords*— Vehicle Plate; Recognition system; Open CV; OCR; Raspberry Pi; Character extraction**

I. INTRODUCTION

Automation is believed to be the most frequent term in most area of electronics and intelligent systems. Due to automation, a revolution has occurred in the existing technologies. Identifying vehicles automatically has become necessary due to its several applications; for example, traffic surveillance, access control, parking fees and toll payments, ticket issuing, theft control, vehicles document verification, etc [1]. The task of identifying vehicle's plate number using automatic recognition techniques can be seen as an important research area of the modern automation system and intelligent transportation system which has been widely studied for several decades [2-3]. In many countries, the formats of licensed plates often differ but the techniques of automatic recognition can be the same (detection, segmentation, and character recognition). From the three key automatic recognition techniques, the most crucial task is to detect the license plate and failure of which will greatly affect the accuracy of the recognition.

According to [4], edge-based methods seems to be popular and widely accepted. The second task after detection is character segmentation, where the captured characters are segmented according to their height and width values. Projection method [5], is believed to be a highly effective method of character segmentation used for most plate number recognition. Character recognition is the last stage and once the license plate is well segmented in-line with the frame of the license plate into a separate of blocks. Different methods can be used to achieve this, such as; template matching [6], corner detection algorithm [7], Neural Networks [8-10], Raspberry Pi [11-13], etc. In this study, raspberry pi is the heart of the system. In many industries environment, unknown vehicles are not allowed.

Security is of high importance hence this study will help to recognize the plate number of vehicles approaching at the gate by allowing security officials to automatically verify the plate number of vehicles entering and exiting seamlessly. Thus, confirming the identity of the owner and the vehicle's particular through the system stored information. The recognition of the vehicle number plate is in four steps. The first is image acquisition, second is license plate extraction, third is license plate segmentation, and last is character recognition.

II. RELATED WORK

The work reported in [6], address a robust approach of license plate detection and recognition that is based on Hough lines with the use of Hough transformation and template matching. It was developed for Islamabad standardized vehicles plate numbers. In the proposed ANPR technique, two modules (License plate detection module using the Canny detector and Hough transformation) were used. The result of the experiments on 102 samples from different scenes under various illumination conditions showed that ANPR scored 89.70% for all the number of plates considered. Character recognition technique using the Harris corner algorithm was proposed in [7], to capture plate number image even in changing motion and illuminated lighting conditions. In the approach, the segmentation stage is accomplished by connecting the component analysis consolidated with Pixel count, Aspect ratio and the Height of characters. The results obtained from the experiments for proper license plate identification was 96.92%.

In [8], a weighted statistics method to make a number plate images in a more prominent position was presented using Neural Network (NN). Thick grid feature extraction and momentum BP neural network algorithm were combined to distinguish the license plates. The experimental results show that the method improves the accuracy and the speed of character recognition. The research in [9] also proposed the use of a neural network algorithm. In the study, a unified ConvNet-RNN model that can recognize the captured license plate and a Convolutional Neural Network (ConvNet) to perform feature extraction was used. The experimental results from the approach in comparison with a sliding window-based approach showed that the approach outperforms the window-based approach scoring over 76% accuracy in recognizing plate number characters with a percharacter accuracy of about 95.1%.

In the work presented in [10], the core technology of the system (Sighthounds license plate detection and recognition system) was developed using deep Convolutional Neural Networks (CNNs). The CNNs were trained and fine-tuned for better performance in different conditions and for varieties of license plate numbers. For quantitative analysis, we show that our system outperforms the leading license plate detection and recognition technology i.e. ALPR on several bench-marks. The use of Raspberry pi for automatic license plate recognition was proposed in [11], the study explores the use of Optical Character Recognition (OCR) to extract the images of license plate captured by the camera. The captured is processed by the segmentation of the characters and verified for authentication by the Raspberry Pi. The study is similar to the approach used in our study although our algorithm is considerably different. The results of the experiment showed an accuracy of 96%. Other interesting research on the use of Raspberry pi is reported in [12-14].

In the work in [15], the number plate recognition method used was Color Edge Detection and fuzzy maps. The steps taken were Pre-processing which consist of binarization using a variable thresholding technique then Connected Component algorithm was applied to binarized the plate numbers to eliminate the undesired area. Also, Huge transformed was used for alignment of extracted components for further process. The OCR (Optical Character Recognition) was another step in which the character recognition process took place and the task of character categorization accomplished by the compositional semantics of license numbers, Topological Shorting to compute the topological features of characters for further process. Then the self-organizing Template test was performed to match the input character to the database and the best match was found. Experimental results performed on 1601 images give an overall success rate of 93.7%.

In [16], Sauvola Method and Sliding Concentric Windows (SCWs) segmentation techniques were used for faster detection of the region of interest (ROI). The character recognition task was done by Trainable OCR (Optical Character Recognition) system based on Neural Networks which used the approach of PNN (Probabilistic Neural Network) with two individual probabilistic networks. The Experiment was performed on 1334 images and the segmentation rate was achieved around 96.5% and With the PNN approach plate recognition recorded 89.1%. The overall rate of success achieved was 86.0%.

The algorithm for number plate recognition was described in [17] with Pre-processing and Plate Recognition as the main steps which help to improve the image quality by converting the coloured image to grey level using Standard NTSC model and median filtering. Feature-based number plate localization method was implemented for further processing. Edge detection, resampling, thresholding and filtering Image processing technique was applied for localization and isolation of the license plate

and the characters. The results under varying illumination conditions show a success rate of about 80%. In the work of [18], an automatic vehicle license plate recognition using artificial neural networks was proposed. The vehicle plate images were taken from a CCD camera while the image pixels were determined using image processing algorithms. Canny edge detection operator and the blob colouring method were for image recognition. As a result, 247 license plates in 259 vehicle image were recognized correctly in this work, so the overall recognition percentage of the system is 95,36%. Another interesting research on License Plate Recognition (LPR) is as reported in [19-23].

III. PROPOSED SYSTEM

There is necessity to recognize the vehicle number plate when it is kept in front of pi camera then the system must be capable of capturing image by camera automatically by using raspberry pi3. When number plate is recognized then the verification will take place if the condition satisfies then only the gate will be opened and when number plate is not recognized gate will remain closed. In this system, ALPR technique are used. Also the features like SMS or email notifications are provided.

The aim of the project is to recognize the number plate of vehicle which passes through system and capture image by camera automatically by using raspberry pi. When number plate is recognized at that time gate will be opened and when number plate. is not recognized gate will remain closed. In this system, open CV and OCR (optical character recognition) platform are used.

The challenges faced by traffic law enforcement agents in Nigeria to bring unlawful vehicles to justice formed part of the reason for this study. We seek to eliminate the challenges using our vehicle recognition system which uses Open CV [24] and OCR in capturing and identifying the vehicle plates. The system makes use of an onboard computer, which is commonly termed as Raspberry Pi. The onboard computer can efficiently communicate with the output and input modules which are being used. The Raspberry Pi is a creditcard-sized single-board computer interfaced with 2MP Pi Camera and a 3.5" Touch Screen for display.

The Vehicle Plate image is captured with the help of the interfaced 2MP Pi Camera and it's being stored in an SD card memory for preprocessing and recognition. After the preprocessing is done by the initiation of the OpenCV, the characters on the plate are recognized using the Optical Character Recognition (OCR) and the corresponding characters found on the plate are displayed.

The core components used are: 1) Raspberry pi zero 2) Raspberry pi camera, 3) DC Motor and 4) Buzzer

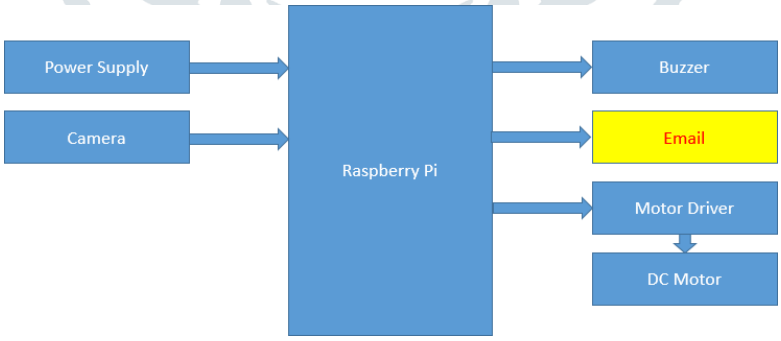

Fig 1 Block Diagram of metering System

A single-phase energy monitor chip made by the foreign company HLW Technology is the HLW8012. It computes RMS voltage, RMS active power, and RMS current. It has a PWM interface and an indoor clock. It is employed to figure out how much energy the chosen load uses. The ESP microcontroller is interfaced with the HLW8012. The cloud platform Things peak is connected to the ESP 8266 in this setup. The Virtuino App on consumer smart phones is then connected to Things peak so that whatever data the system collects may be viewed from a mobile device.

Hardware section:

1. **Raspberry Pi:** Raspberry pi is a credit card sized single board computer which was developed in UK by raspberry pi foundation. Raspberry pi have 40 pins out of which 27 pins is of General purpose input and output (GPIO) and remaining 13 pins are used for VCC and GND. It is the minicomputer which it has inbuilt operating system, but it Requires inbuilt SD card for booting and long term storage
2. **Camera:** This camera is able to capture an image of 5Mp and Resolution of camera 5 Megapixel. It is capable of 2592*1944 pixel static images and also supports 1080P30, 720P60 and 640*480P 60/90 video.
3. **Buzzer:** Buzzer is an electrical device that makes a buzzing noise and is used for signaling. It makes noisy sound irrespective of the voltage variation applied to buzzer. It Provides 3 to 27 volt and sound in the range 2 to 4KHZ.
4. **DC Motor:** The main principle in controlling a DC Motor with Raspberry Pi deals with the Motor Driver. A Motor Driver is a circuit or IC that provides the power (or rather the current) to the motor for smooth as well as safe operation. Even a small 5V DC Motor draws a high initial current of around 300 – 400 mA.

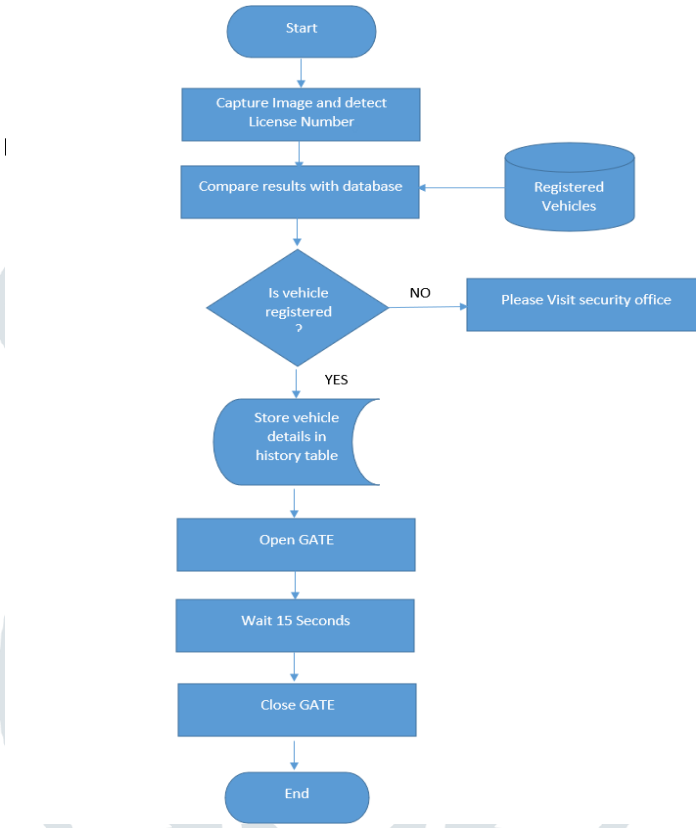

Fig 2. Flow chart of the System

Software section:

1. **Python 3 :** Python is a high-level, general-purpose programming language. Its design philosophy emphasizes code readability with the use of significant indentation. Python is dynamically-typed and garbage-collected. It supports multiple programming paradigms, including structured (particularly procedural), object-oriented and functional programming. It is often described as a "batteries included" language due to its comprehensive standard library.
2. **Raspbian OS :** Raspberry Pi OS (formerly Raspbian) is a Unix-like operating system based on the Debian Linux distribution for the Raspberry Pi family of compact single-board computers. First developed independently in 2012, it has been produced as the primary operating system for these boards since 2013, distributed by the Raspberry Pi Foundation

IV. RESULTS AND DISCUSSION

The implementation of the design passed the entire necessary design test conducted. Each stage in the development process was tested and evaluated in relation to the existing setup. The stages involved are pre implementation and post-implementation.

A) Pre-implementation testing : The pre-implementation testing was carried out on the components to ensure that each component works as specified.

B) Post-implementation testing : The test was conducted to ensure that the system components are working properly. We conducted the test using different vehicle numbers at various conditions to show the effectiveness of our system.This tests show that the system performs relatively well as compared to the existing systems. The functionality was further confirmed by capturing some vehicle plates and all the details of the vehicle plate which were already stored on the database of the system were displayed.

Advantages

A cloud server can be set up in a Raspberry Pi which could be used as a storage device for applications involving real time signals. Raspberry Pi is a cheaper microprocessor in which cloud computing infrastructure can be obtained using cloud platforms. Authentication of vehicle number plate would become much easier using cloud computing. The use of real time data storage for quicker responses.Also the use of notification features like SMS, email

V. CONCLUSION

The creation of a workable model of "Wireless Intelligent Energy Metering to Increase Efficiency & Accuracy in Current Billing Methodology" has been attempted. The propagating model is used to estimate the household's energy usage and even provides a useful reading for the energy unit. As a result, it decreases energy waste and raises awareness among everyone. Even so, the manual intervention will be subtracted.

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