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TOLL COLLECTION AUTOMATION

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Abstract - *Various technologies have been implemented in highway toll collection process currently. Examples for current technologies are manual toll collection, RF tags, Barcodes, Number plate recognition. Each of these technologies have their own drawbacks. Here we have put forth a technique that is more efficient and cost effective compared to current techniques. It works importantly based on the Computer Vision vehicle detection using OpenCV library in Embedded Linux platform. The hardware used in this system is Raspberry pi. Initially the camera will capture the vehicle's number plate image. Based on the size of the vehicle identified from the image the vehicle will be classified as heavy or light. This will then be sent to raspberry pi which then verifies it with the server data. When raspberry pi comes to know the vehicle, then it accesses the web server information and according to the type of the vehicle, appropriate toll is charged. This system can also be made to count moving vehicles from pre-recorded videos or stored videos by using the same algorithm and procedure that we follow in this paper.*

Keywords- Toll Collection System; Vehicle Detection; OpenCV; Background Subtraction; Kalman Filter; Tesseract.

I. INTRODUCTION

India is a country where we get to observe most extensive National highways. Government plans various phases to complete the projects under construction. The government signs agreement with the private companies who build the infrastructure like road, port and other stuff for a particular span of time generally in years. The invested amount is charged from the vehicles passing on that newly built highway. This charged amount is called as toll tax. People have no choice to pay for toll tax for using the infrastructure. The private agency involved in the manufacturing of the infrastructure is free to charge citizens. For some places it is observed that toll tax is still being collected even after completion of contract period.

Initially there were toll collection systems such as manual toll collection without generating computer receipts. This method of payment was used to stop the vehicles at toll station and wait for relatively long time for their turn to come. The states of congestion and inefficiency prompted government to plan and implement Electronic Toll Collection (ETC) system which can remove out these problems and facilitate convenience for all who involved in the process of toll collection directly or indirectly. ETC systems are designed and developed to cooperate in the operations of toll management through the use of technology. These systems gather data on the basis of traffic, then they will classify the vehicles and collect the expected amount of fare. There are various methods of ETC in which toll is collected and also various toll booths on which these toll collection systems are implanted.

There are many toll collection systems which are present for very long duration still they are collecting toll from people. There is no transparency provided by these systems. Transparent systems play an important role in toll collection such that there will be no corruption regarding toll. The proposed system is transparent to appropriate toll collection.

II. LITERATURE SURVEY

[1] Dilpreet Singh, Akhil Sood, Gulshan thakur, Nikhil Arora, Alok Kumar, " Design and Implementation of Wireless Communication System for Toll Collection Using LIFI," 4th IEEE Conference, vol.51,no. 12,pp.50-59,Dec. 2017.

Light Fidelity otherwise known as LIFI is a developing technology which transfers data through light. The vehicle which passes through the toll will transfer the light which is captured and transferred as data. This will display the vehicle details and other information. Using this information, bill will be generated by manual. Here the use of power of LIFI for wireless communication to transmit user information from vehicle to toll. Every vehicle will be having a microcontroller and a memory connected to it. In addition, the setup will be used to send useful encoded data like vehicle number via LED. An intelligent processor will be there at receiver side, which will automatically process the toll tax payment according to the type of vehicle through a wallet linked with vehicle number. The technology will be helpful in preserving the fuel consumption of vehicle and will create an eco-friendly environment.

[2] Uke Nilesh J., adn Ravindra C. Thool. "Moving vehicle detection for measuring traffic count Using OPENCV." Journal of automation and Control Engineering Vol 1.4(2013)

Moving vehicle detection for measuring traffic count is designed and implemented with Visual C++ software with Intel's OpenCV video stream processing system to realize the real-time automatic vehicle detection and vehicle counting. Expressways, highways and roads are getting overcrowded due to increase in number of vehicles for the traffic management, vehicles detection is the critical step. The proposed system presented is inexpensive, portable and Computer Vision based system for moving vehicle detection and counting. The extracted background is used in subsequent analysis to detect and classify moving vehicles as light vehicles, heavy vehicles and motorcycle.

[3] Kamalakannan, P., et al." Automated Toll Collection with complex security System." Education Technology and Computer (ICETC), 2010 2nd International Conference on vol-4. IEEE, 2010.

The existing system is concerned with automated toll collection system using the active RFID tags; vehicles are made to pass through a sensor system that is embedded on the highway just before the tollgate. The proposed toll system will electronically classify the vehicle and calculate the exact amount to be paid by the vehicle owner, ensuring no pilferage of the toll amount. Vehicle owners, who frequently pass through tollgates, are required to have a prepaid smartcard, which will deduce the appropriate amount, by using an automated smart card reader. A Micro controller consists of a powerful CPU tightly coupled with memory RAM, ROM or EPROM), various I / O features such as Serial ports, Parallel Ports, Timer/Counters, Interrupt Controller, The Data Acquisition interfaces-Analog to Digital Converter (ADC), Digital to Analog Converter (DAC), are all mounted on to the single silicon chip. Using RS232 data adapter, the microcontroller is connected with a computer.

[4] KRaihan, Kawser Jahan, et al." Raspberry Pi Image Processing based Economical Automated Toll System." Global Journal of Researches in engineering 13.13(2013).

The highway toll system has already been developed and widely used in many developed countries. But most of them use Radio Frequency ID. In developing countries RFID for each car does not exist. And using RFID is still a costly solution. Currently in many countries various costly image processing techniques are implemented therefore it cannot be afforded by many governments. Therefore, we propose a raspberry pi technique where a camera will be used to take picture of the vehicle's name plate to sort the toll charge according to vehicles category. Block diagram consists of a web camera that takes the image of the number plate of the vehicle, The eye is divided into six coordinates and EAR (Eye Aspect Ratio) is calculated and sent to the controller MQTT (Message Queuing Telemetry Transport) alerts the driver through laptop speaker. Camera 1 is used for pedestrian detection and camera 2 for side view detection. Ultrasonic sensor calculates the distance between the human and vehicle or object and vehicle and send to RPI. Depending on the distance calculation value, either the vehicle slows down or there is an emergency stop.

III. SYSTEM DESIGN

The architecture diagram represented in Fig 1 consists of a Web camera that takes the image of the number plate of the vehicle. The captured image is converted into two-dimension pixel array for further calculation or processing. This image is processed with the Kalman filter which is available in OpenCV which reduces background subtraction. The acquired image is processed using the tesseract algorithm which does segmentation and classification using trained images. Then a text document is opened then the converted image to text document is stored in the opened text file. The database for the processed content is fetched and displayed. The amount is detected from the person virtual account and the bill for same is generated through a text message. The GSM module is used for the same.

ARCHITECTURE DIAGRAM

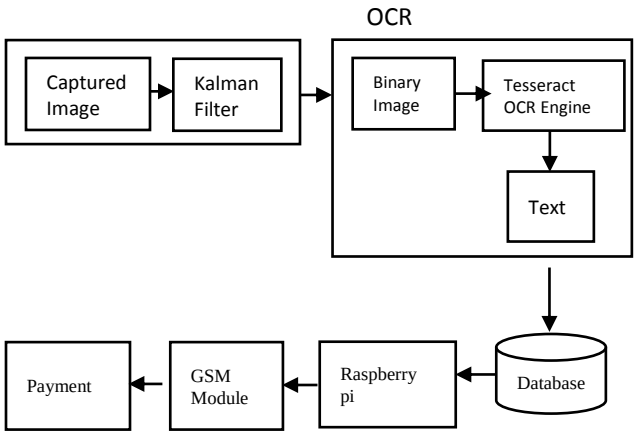

Fig.1 Architecture Diagram

IV. WORKING

A. IMAGE CAPTURING

Initially, the image as shown in Fig 2 is acquired using open CV and converted into pixels and stored in an array and this stage is called as image acquisition.

The pixel value will be compared with the threshold value and if it is greater than the threshold value it will be assigned a value 1 (white) else it is assigned another value 0 (black) the function used is cv2.threshold. First image is the source image which is then converted to the grayscale image and this grayscale image is converted to the binary image. Third argument is the maxVal which represents the value to be given if pixel value is more than (sometimes less than) the threshold value. OpenCV provides different styles of thresholding and it is decided by the fourth parameter of the function.

Fig.2 Number plate detection

B. KALMAN FILTER

Then the data is filtered using pixel wise filtering that is each pixel is checked for presence of salt which is large in white content and pepper which is high in black content and these contents are removed using a formulation and this is stage is called as preprocessing. In MATLAB, an RGB image is basically a M*N*3 array of color pixel, where each color pixel is a triplet which corresponds to red, blue and green color component of RGB image at a specified spatial location. Similarly, A Grayscale image is viewed as a single layered image. In MATLAB, a grayscale image is basically M*N array whose values have been scaled to represent intensities. In MATLAB, there is a function called rgb2gray () is available to convert RGB image to grayscale image. If it is an RGB image convert it into the gray scale image and then to the binary image.

C. OCR

Trained data sets are obtained which will be in pixel matrix format and classified with the preprocessed data sets matrix that is process of tesseract algorithm, the obtained data will be the vehicle number plate and this stage is called as classification stage. The classified data is then stored in variable and compared with the database, obtains detail about the person and this stage is called as identification stage. The OCR works as follows as shown in the Fig 3

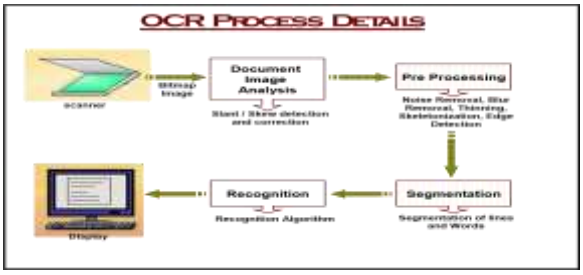

Fig.3 OCR Process

D. RASPBERRY PI

Raspberry Pi is a mini computer and it is called a system on chip. Hence operating system (OS) should be installed. As the Raspberry doesn't have hard drive, OS is installed in the external memory. OpenCV library with tesseract algorithm is installed in the same memory card where the OS is installed. There are different types of operating system but we preferred to talk about NOOBS (New Out of the Box Software) as it is suitable for the beginners. We can either buy a preinstalled SD card or empty SD card. In pre-installed SD card, NOOBS is already copied and ready to boot.

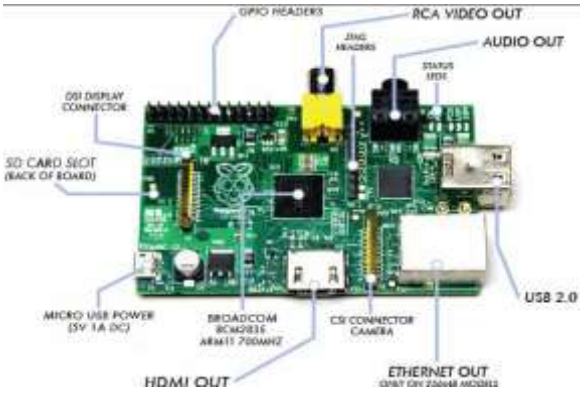

Fig 4 Raspberry pi

V. EXPERIMENTAL RESULT

In the present work we report vehicle number plate detection, optical character definition and image processing. In the existing system using LIFI the communication of the vehicles with receiver provides less accuracy than the day time. In the proposed system camera automatically captures the vehicle's number plate with more accuracy than the existing system. The use of Kalman filter and tesseract algorithm gives more accuracy as shown in the Table 1.

Table 1 Experimental Result

PARAMETER	EXISTING METHOD	EXISTED VALUE	PROPOSED METHOD	PROPOSED VALUE
FILTER	MEDIAN	70%	KALMAN	85%
PROCESSING	SVM	80%	TESSERACT	95%
PAYMENT	ZIGBEE	10m	GSM	INFINITY

VI. CONCLUSION AND FUTURE SCOPE

Thus, from developed Toll Collection Automation system we will be able to reduce consumption of fuel and reduce the congestion during peak hours. So, the passerby need not wait in the queue for long time.

In proposed system further scope can be made for the real time application

- Reducing the fuel consumption by implementing in all the toll booths.
- E-payment by paying it online.
- Reducing the violation of government recognized patterns of number plates.
- Finding the theft vehicles by comparing it with the database records
- Tracking the location of the vehicle using GPS.

REFERENCES

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[2] Uke Nilesh J., and Ravindra C. Thool. "Moving Vehicle Detection for Measuring Traffic Count Using OpenCV." Journal of Automation and Control Engineering Vol 1.4 (2013).

[3] Kamalakannan, P., et al. "Automated toll collection with complex security system." Education Technology and Computer (ICETC), 2010 2nd International Conference on. Vol. 4. IEEE, 2010.

[4] KRaihan, Kawser Jahan, et al. "Raspberry Pi Image Processing based Economical Automated Toll System." Global Journal of Researches In Engineering 13.13 (2013).