Vehicle Detection and Classification for Toll Collection using Image Processing

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***Abstract*—**There are many vehicle toll collection techniques present in India. Which includes Manual toll collection, ETC (Electronic Toll Collection) RFID tags (FAStags), Barcode readers, Number plate recognition. Altogether have some drawbacks which lead to some inaccuracies in the above techniques. This project presents the existing toll collecting schemes, their merits and demerits and also intends to develop a new effective approach for vehicle toll collection system using Image processing. We use image processing toll box of MATLAB. This will be a low cost substitute for existing systems. In this system camera captures the vehicle pictures passing over toll roads. By using background subtraction and based on the area occupied by the vehicle, it's detected and categorized as Motor Bike or LMV (Light Motor Vehicle) or HMV (Heavy Motor Vehicle).Based on the type of vehicle appropriate toll is charged. Further this data is passed to Renesas Microcontroller, where it displays the vehicle type, its count and toll amount on LCD. And also this information is uploaded to server (AWS) using MATLAB commands.

Keywords—AWS, Background Subtraction, Toll Collecting Systems, MATLAB

I. INTRODUCTION

The objective of this work is to design a vehicle toll collection system by classifying vehicles using image processing. In this project camera captures the vehicle pictures passing over toll roads. Based on the area occupied by the vehicle, it's detected then categorized and appropriate toll is charged. The scope of the project is designing efficient vehicle classification systems for toll collection system using image processing. We use MATLAB image processing tool box for this operation. Using background subtraction area of the vehicle is calculated and categorized as MB (Motor Bike), LMV (Light Motor Vehicle), HMV (Heavy Motor Vehicle) This information is passed serially to microcontroller and displayed on LCD, and also uploaded to server, so that concerned person can see the total vehicles passed, and amount collected at any given time in a day.

II. PROBLEM DEFINITION

There are various highway toll collection schemes in India. Some of these comprise manual toll collection, RF tags, Barcode reader, Number plate recognition. All these systems have some drawbacks, which lead to faults in the corresponding systems Manual toll collection is not trustworthy because any discrepancy between amounts collected can be possible through operator. RF tags cannot be implemented on each and every vehicle because it will be more expensive to put on each vehicle. And optical readers' accuracy rate is less. So we would like to design low cost efficient vehicle classification systems for toll collection using image processing.

III. EASE OF USE

Background subtraction is the one of the technique is used for object identification. After background subtraction we do morphological operations to the images. Then finally based on the area covered the vehicle is identified and categorized. This information is used for toll collection.

IV. PROPOSED SYSTEM

The proposed system which is vehicle detection and classification for toll collection using image processing is designed using MATLAB. Design block diagram, description and internal modules are explained.

A. Features and Block Diagram of design

Key features of the systems includes to real time vehicle detection and classification from the video obtained by the camera placed at the toll booth by doing morphlologcilcal operations to the images. And charge appropriate toll based on vehicle type and same is displayed on the LCD of Renesas controller and all the vehicle entry and exit and each vehicle toll details are uploaded to amazon web server.

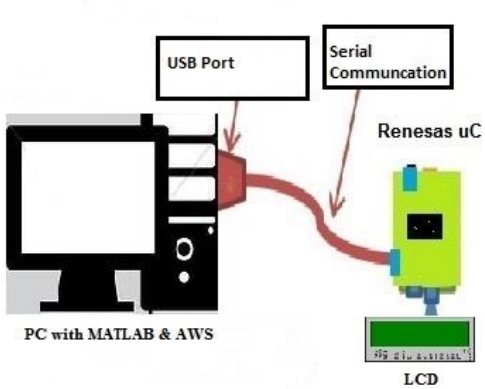


Fig.1: **Block Diagram of the proposed system**

B. Renesas Micro Controller with LCD:

- The Renesas Microcontroller is used for displaying the vehicle type and toll amount in LCD display.

- Once the vehicle is detected through the morphological operations in MATLAB, the same data is sent to microcontroller through serial communication.
- Based on the vehicle type the toll charge and each vehicle count is displayed on LCD.

C. Amazon web services:

- The AWS provides on demand cloud computing platforms to individuals, companies and governments, on subscription basis. AWS handles the below functionalities:
- We have created the AWS account, where we get 2GB space free in cloud
- The database is created in AWS, with all the required fields. This is accesses via link. MATLAB uses the link to connect to the server. Once connected, all the vehicle details and toll collected for each vehicle is uploaded to the server. The concerned people can check the data any time when they wish to see.

D. Flow Chart : Refer Fig2.

V. RESULTS

We have taken the recorded video of the toll plaza for testing purposes. We have tested the algorithm for different types of vehicles. The results obtained are satisfactory.

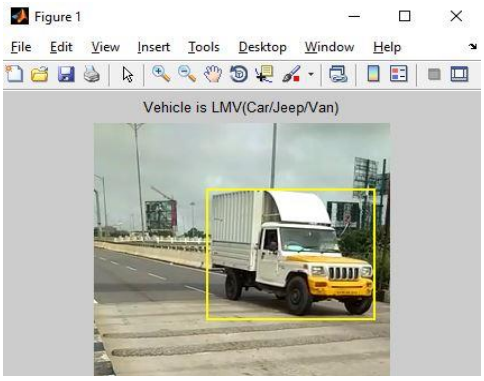


Fig 3: Vehicle detected is LMV

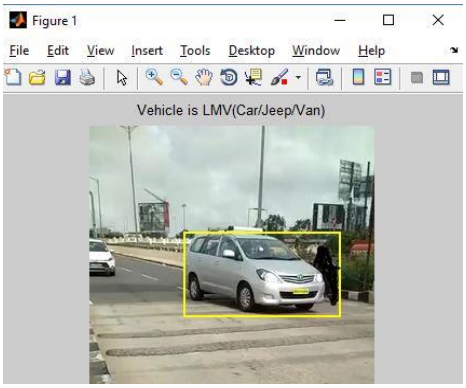


Fig 4: Vehicle detected is LMV

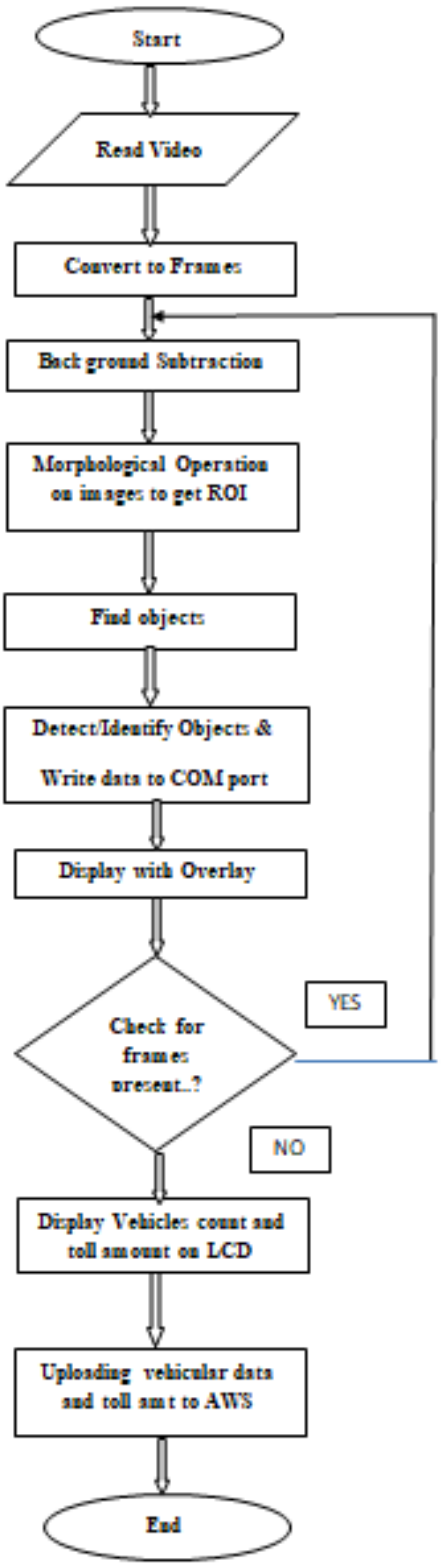


Fig2: **Block Diagram of the proposed system**

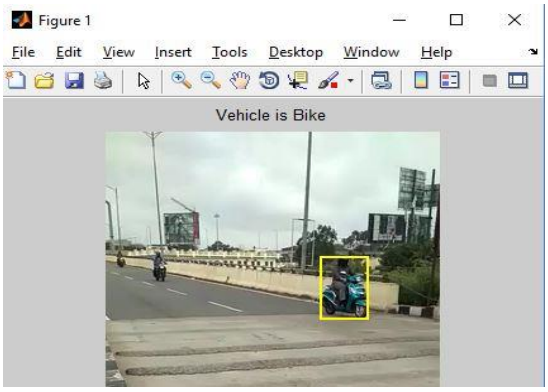


Fig 5: Vehicle detected is Motor Bike

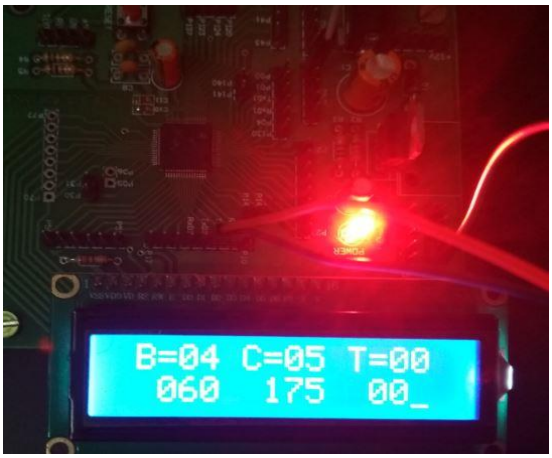
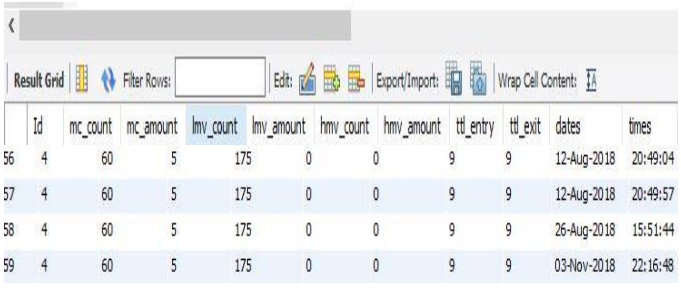


Fig 6: Vehicle count and toll charges on LCD. Vehicular and toll data uploaded to Amazon Web Sever



Result Grid | Filter Rows: | Edit: | Export/Import: | Wrap Cell Content:

	Id	mc_count	mc_amount	lmv_count	lmv_amount	hmv_count	hmv_amount	ttl_entry	ttl_exit	dates	times
56	4	60	5	175	0	0	9	9		12-Aug-2018	20:49:04
57	4	60	5	175	0	0	9	9		12-Aug-2018	20:49:57
58	4	60	5	175	0	0	9	9		26-Aug-2018	15:51:44
59	4	60	5	175	0	0	9	9		03-Nov-2018	22:16:48

Fig 7: Vehicle count and toll charges in and Entry/Exit count in AWS

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VI. CONCLUSION AND FUTURE ENHANCEMENTS

The proposed Vehicle Detection and Classification for Toll collection system is low cost alternative for existing toll collection system. We can use this technique for vehicles which cannot afford or do not have RFID tags. The results obtained are satisfactory. The robustness of the algorithm can be confirmed from the tests. MATLAB is very useful tool which provisions image processing and also interfaces to peripherals like COM ports. It also supports uploading data to server. We can also use MySQL test bench, to execute query to check vehicular data at server and toll collected at any instant of time. We have taken recorded toll video for testing purposes for prototype. We can also make standalone system by wireless transmission of real-time videos to the processing system.

The proposed technique can also be used to count entry and exist of different types of vehicles at any interstate borders, where we cannot have RFID tags for every vehicle.
It is also used inside cities to control traffic by counting classifying different types of vehicles.
It is also used to calculate vehicle density on roads. It is also used to keep eye on illegal parking. We have used student MATLAB version which can be affordable and we can take only necessary toll boxes which further reduces the cost. The accuracy of the algorithm can be further improved by using Machine Learning techniques.

VII. REFERENCES

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