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AUTOMATIC VEHICLE SPEED SURVEILLANCE AND PENALTY SYSTEM

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Abstract:- *Nowadays violent driving is the main cause for accidents. Most of which are the result of crossing the speed limit. Our highways are provided with speed limit signs. But often drivers don't follow these signs and chances of accident increases. It is not possible to monitor each and every vehicle manually and if that is possible we can't monitor them closely. So if there is a system that can detect the speed limit violation as well as penalize the driver automatically, these traffic violations can be taken under control. Our goal was to build such a system. Our concept is divided into three sections. (1) IR based speed detector, (2) vehicle recognition from RFID based number plate, (3) automatic penalty for over speed. We built a prototype of the system to demonstrate the entire process. Implementation of the system is possible using RFID reader with extended range.*

Keywords: ARDUINO mega, database server, Eclipse software for android development, GSM technology, IR sensor, RFID based number plate and reader.

1. INTRODUCTION

Road fatality is the major concern in the world. Recent studies show that one third of the number of fatal or serious accidents is associated with excessive or inappropriate speed. Reduction of the number of accidents and mitigation of their consequences are a big concern for traffic authorities. Presently, most of the countries in the world are using such a system in which police monitor vehicle speed with a hand held device and if any vehicle seems to cross the speed limit predetermined for that particular road, the police issues a fine to the driver for speed violation. In Bangladesh this system is not adapted yet because it requires much workforces and won`t be convenient for a developing country. The process is also lengthy which can be replaced by a more efficient and centrally controlled automatic system.

As it requires no intermediate workforce, there will be reduced system loss. The automatic system can be developed in such a way that can detect the speed as well as the vehicle identification number and automatically deduce the amount of fine from a bank account connected to the license of the particular vehicle. The device will be implemented beside the road hidden from the driver. Speed and license number of every vehicle passing by the device will be detected. If the speed measured by the detection device crosses the limit (specified in a traffic sign beside the road) for the road, the information of the license number will be sent to the central server and the amount of fine will be automatically deduced from the bank account of the driver [1].

2. LITERATURE REVIEW

There are various methods available for speed detection such as pacing, VASCAR (Visual Average Speed Computer and Recorder), RADAR (Radio Detecting and Ranging) aircraft surveillance, hoses, Orbis (a Greek word meaning eye), traffic radar, and LIDAR (laser Infrared Detection And Ranging) [2]. These speed detection techniques have been used or are still being used all over the world.

The speed detection technique proposed is rather simple, accurate and cost effective for Bangladesh. In this system speed detection is done using IR transmitter and receiver. Two sets of IR transmitter and receiver are used. The transmitter in one side and the receiver on the other side of the road aligned face to face. The two sets are kept at a predetermined distance from each other. When the vehicle passes through, the IR beam is interrupted. With the help of certain algorithm, the average speed is measured.

2.1. Vehicle ID Recognition System

Recently, RFID based number plate has become available in our country as an experimental project. For recognition of vehicle ID from number plate, RFID receiver is kept proximate to the road. Once vehicle ID is obtained along with respective speed, this system determines if speed is beyond limit or not. Then it initiates the algorithm to determine if obtained data is to be transmitted to the server. Only the vehicle IDs which are crossed the limited speed zone with over speed sent to the database. This database contains information about respective vehicle license holder.

2.2. Communication System

In this project GSM protocol is used for data communication from the device to the server. This protocol is used because it is easier and flexible communication system.

3. METHODOLOGY

The general idea is to measure the speed and if the speed limit is crossed, the particular ID of the vehicle is transmitted to the traffic server. The traffic server then sends the data to the bank server. The amount of fine is then reduced from the account

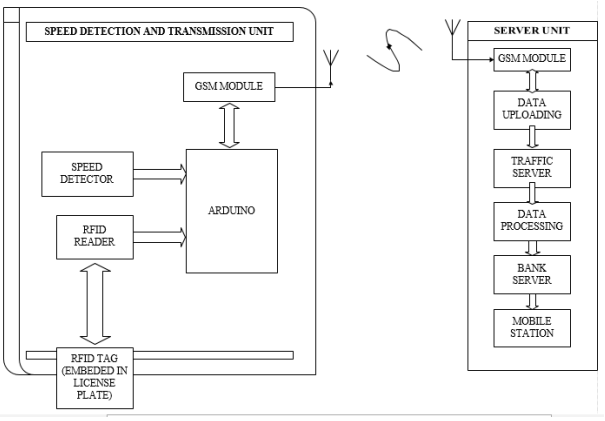

Fig.1: Functional block diagram of the system [3].

3.1 Velocity Measurement Unit

As mentioned before, two sets of IR LED and IR receiver is used for measuring the average speed. LED is placed on one side of the road and the receiver is placed on the other side. When a vehicle passes through the 1st IR beam, the analog value of the Arduino becomes less than predefined analog value 700 and the Arduino starts the time count and when the vehicle passes through the 2nd beam, the time count stops. The distance is divided by the time to calculate the average speed. The ID of the vehicle that crosses the speed limit is then sent to the server.

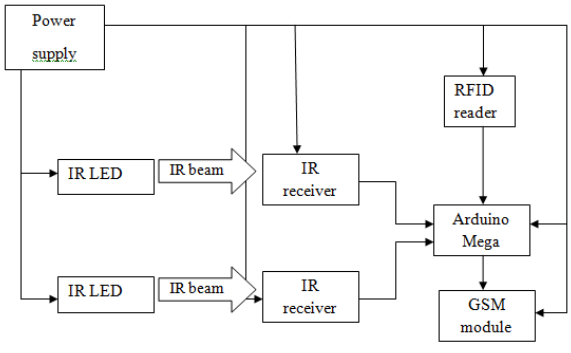

Fig. 2: Speed measurement and data transmission unit.

To detect the ID of the vehicle RFID reader is used. Each vehicle has a RFID tag in its number plate that contains unique 14 digit number (#, ##, ##, ##, ##, ##, ##, ##, ##, ##, ##, ##, ##, ##, #). The reader reads the 14 digit number. But this is not really the registration number. Registration numbers are given across the 14 digit numbers. So the reader actually recognizes the vehicle by its 14 digit RFID number not the corresponding registration number. The Arduino code then verifies the registration number and sends it to the server [3][4].

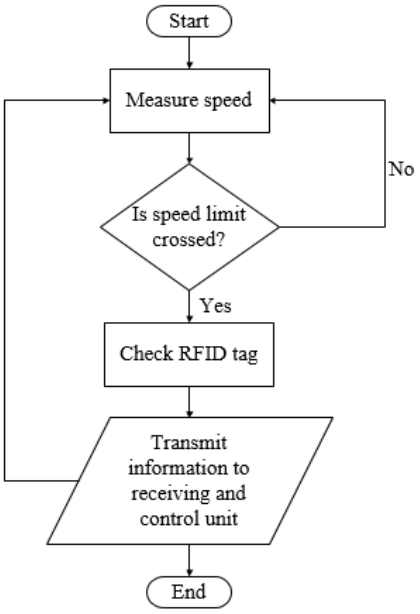

Fig.3: Flow chart of the Arduino program.

3.2 Data Transmission

The data transmission to the server is a bit indirect as the GSM module Arduino Shield (SIM 900) can't upload data directly to the server. An intermediate unit is needed to receive and upload data to the server. Here an Android mobile phone is that intermediate unit. The GSM module sends the ID of the vehicle to the Android mobile phone as an SMS. The SMS is read by an Android application 'updatesms' which is developed for this purpose. When the SMS is received by the application running in backend, then it reads the SMS first. Then it uploads the data of the SMS automatically to the server [5].

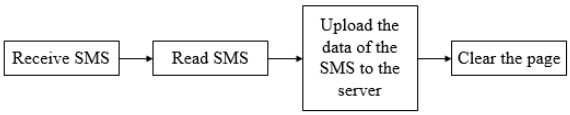

Fig. 4: Block diagram of the app 'updatesms'.

3.3 The BRTA Server

The BRTA server contains information of all vehicles. The particular information is stored across the registration number of the vehicles. So the server recognizes any vehicle by its registration number generally such as "XXX Metro XXX ######". When the server receives the data (only the vehicle's registration number), it matches the number with the numbers stored. After verifying the number, the server determines the fine or penalty against it. The penalty amount, along with all other information is stored in the server.

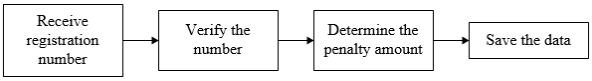

Fig.5: Block diagram of server operation.

3.4 Bank Server

The bank server receives the registration number simultaneously. Receiving the information, the server does some major calculations. Every vehicle must have an account in the bank. The particular account contains certain amount of money deposited periodically. The penalty amount imposed is debited from the account.

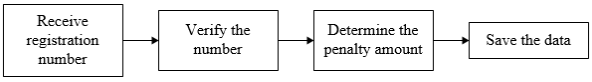

Fig.6: Block diagram for bank server.

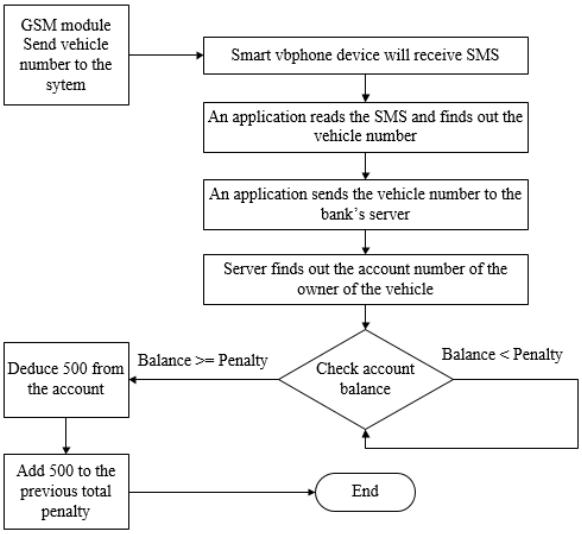

Fig.7: Complete flow chart of data acquisition and processing in database.

4. TESTS & RESULTS

4.1 Speed Measurement

When a vehicle passing by maintains the speed limit, the device measures the speed and collects the vehicle registration number using RFID reader. But if any vehicle crosses the speed limit, the device measures the speed and decides to send the registration number of the vehicle using GSM module to an android mobile and 500unit fine is recorded.

Fig.8: Output for limited speed of ctg metro gha 386103.

Fig.9: Output for over speed of ctg metro gha 386203.

4.2 Data uploading

The GSM module used here transmits data only to mobile. It can't connect to net directly. So to upload data to the server, an android application updatesms is developed. When the registration number (ctg-metro-gha-386203) is sent as a SMS to the android mobile, the app receives the number and uploads it to the server.

Fig.10: The registration number received.

C. Data base

The data base receives the registration number of the vehicle and the BRTA data base shows the increase in the amount of fine.

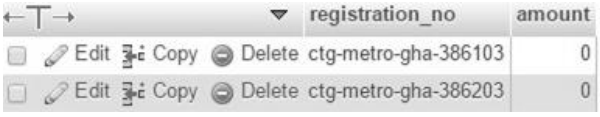

Fig.11: Penalty amount before fine in BRTA database.

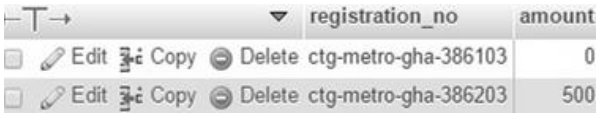

Fig.12: Penalty amount after fine in BRTA database.

At the same time the bank account data base shows the reduced amount and the remaining balance in the particular account of the owner of the car.

ac_name	ac_no	initial_amount	deduced_amount	balance	brta_penalty_registrati
RAM	01512400125	7000	0	7000	ctg-metro-gha-386103
SAM	01512400126	7000	0	7000	ctg-metro-gha-386203

Fig.13: Bank account database before fine.

ac_name	ac_no	initial_amount	deduced_amount	balance	brta_penalty_registratio
RAM	01512400125	7000	0	7000	ctg-metro-gha-386103
SAM	01512400126	7000	500	6500	ctg-metro-gha-386203

Fig.14: Bank account database after fine.

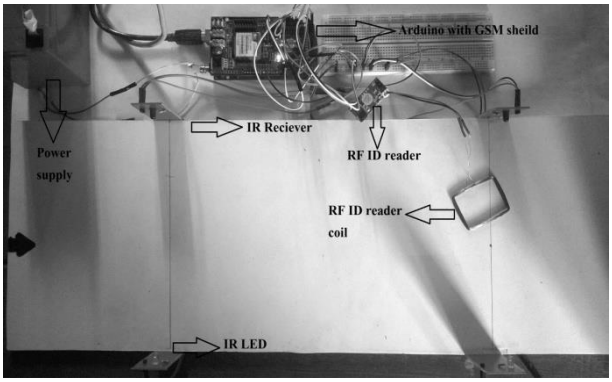

Fig 15: The complete setup of the prototype.

5. COST ESTIMATION

With the limited resources available in Bangladesh, we tried to develop the prototype. The approximate cost of it is 108.57$. For practical implementation, components with higher range and configurations are required. So the cost of the practical system may vary between 451.5- 560.5$ as per our estimation. The prices are compared in table 1 and table 2.

Table 1: Cost analysis of the prototype [6] [7]

Component	Price
IR detector (2 sets)	0.32$
Arduino Mega 2560	20.54$
RFID reader (RDM630)	14.77$
RFID tag 125Khz (2 piece)	1.03$
SIM900 module with antenna	61.63
Power supply (12V battery)	8.99$
Connectors & ports	1.28$
Total	108.57$

6. APPLICATIONS AND FUTURE WORKS

This project is a small implication of our concept in automating and monitoring a system. The practical applications of this project are immense and can have vast level of implementation [8].

(1) Implementation of this system in the highway will grow consciousness among reckless drivers in our country.

(2) As automatic penalty from respective bank account is instant and unavoidable, this will bring additional revenue for Bangladesh Road Transport Authority (BRTA).

(3) Automated system for highway toll collection and penalty system for unauthorized parking may be developed by making some modifications of this system.

(4) Another important application of this system is monitoring vehicle to avoid theft. Vehicle tracking is also one of the major possibilities.

(5)There is no chance of biasing or avoiding the fine as the system is developed to cut out the fined amount automatically from the bank account.

This project we have undertaken can be used as a reference or as a base for realizing an advanced automated system. Microwave static RADAR can be used instead of IR detector for speed measurement which may give better response or concentrated and large power IR-LED (50mW-100mW and above) will do better. We used 125 KHz RFID skimmer to accumulate vehicle ID simultaneously. Low frequency RFID readers used in this prototype has lower reading range but UHF RFID readers (900MHz), today, have the capability to read tags that are as far away as 8 meters (approx. 26 feet). We used android application as via for data uploading to the database. GPRS enabled GSM module will do better for direct data uploading. We tried to pave the way to develop automated traffic surveillance system for Traffic Rule Enforcement Authority. Advancement of this system should have done in a larger scale to make it implementable in our country.

Table 2: Estimated cost for practical system [6] [7]

Component	Price range
IR sensor (1 pair)	20$
Development board (Intel Galileo or PC Duino3)	90-129$
SIM 5320 module (3G HSDPA/ WCDMA and Quadband GSM/ GPRS/ EDGE)	65$
UHF 900MHz Gen-2 RFID reader	220-270$
Passive tags (1 pair)	11.5$
Power supply	45-65$
Total	451.5-560.5$

7. CONCLUSION

In the last few years, RFID technology has been gradually incorporated to commercial transportation systems. A well-known example is the RFID-based highway toll collection systems which are now routinely employed in many countries. Other uses include monitoring systems to avoid vehicle theft, access control to car parking or private areas, and embedding of RFID tags in license plates with specially coded IDs for automatic vehicle detection and identification [9].

In recent years, RFID license plates have been installed on the vehicles of our country. Our main target was to extend the applications of RFID implanted license plate. In our project an automated traffic speed surveillance system along with instant penalty is developed by using limited resources available.

In places like the UK, Australia, Brazil, Bermuda and many others, similar systems are already being developed and tested. A key benefit of the RFID plate is that the tag provides an encrypted and secure ID code which is registered in Transport's vehicle database. This code prevents tampering, cloning, or other forms of fraud that can currently happen. [10].

8. ACKOWLEDGEMENT

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