IoT based Automatic Vehicle Identification and Driving License Checking System

***Abstract*—During traffic movement, many underdeveloped country's sub-inspector or Police Control Board (PCB) manually check the validity of the vehicle identification and driving license. This manual checking procedure, however, not only affects the traffic movement but also consumes lots of time. Moreover, fake licenses are difficult to detect. To overcome these problems, this paper proposed an automated micro-controller based vehicle and driving license checking (VDLC) system. The proposed VDLC prototype implemented with RFID sensors and Node MCU (Wifi Module) which in-cooperate with Android and web application. This application may able to facilitate both driver and PCB to check the current status of the licenses in real-time. A survey had been conducted with 5 intend users (i.e. 4 automobilists and 1 sub-inspector) to analyze the effectiveness of the proposed system. All the participants agreed that the VDLC system may increase productivity, reduce the chance of corruption, additionally, carrying hard copies of licenses and ID card can be minimized.**

***Index Terms*—Real-time data, Driving licence, Vehicle licence, IoT, Mobile application, RFID technology, WSN.**

I. Introduction

Ongoing increment in the development of car industry combined with the unending interest of workers urged for the need of better and smarter traffic and driving license checking system to reduce the cost and as well as hassle free system. Though lot of researches were conducted study in this area, most of the existing license checking systems rarely address the issues of automatic checking system for both license (e.g; driving and car) using IoT(Internet of Things).

In Bangladesh, most of the time police check car license by manual system. To check the license police hold the car and asked driver to show all the documents manually. Showing the required papers of license police put some required data to a system to check whether it is validate or not. In the mean time, there is another protocol use to check the car license. In this existing system image processing technique is used to identify the license authentication. Car template reader is used here to put data to a system and then check the validity and authenticity. Both above mentioned systems have some hassle and are also time consuming that are pointed by the police (who works on it) and as well as the driver. To convert this manual system into automated wireless sensor network (WSN) can be used.

The widespread utilizations of wireless technologies combined with the progression in wireless applications for licence checking for that, digital data scattering could be the key for resolving the licence checking challenges. Wireless sensor network (WSN) have a great potential great potential towards giving a simple and cost-effective solution for this capable applications for different reasons. By considering it's easy installation and development of WSN for licence check mainly increased our attention to develop a WSN Technology for licence check.

Adaptability to couple with modern, however, modest sensor that can precisely recognise vehicles makes WSN a possible solution to solve the emerging the emerging vehicle and driving licence checking system.

Wireless sensor network comprises of a large number of hubs that are conveyed detecting territory and are equipped with with various types of of sensing, calculations and correspondence units. These practical units empower WSN hubs to comparatively collect, process and transit data to the the sink.

Compare with the existing licence checking system, this study proposes an intelligent and smart licence checking system based on Wireless Sensor Network Technology. This conducted research was persuaded by the requirement for an automation, financially savvy, real time and simple-to-utilise system for licence check. The proposed Framework is fit for checking the validity and authentication, moreover, it can send notification to the owner, provide the accurate information, identify approximate location of the vehicle and make case file for the concern, who has not valid driving license and car license, as well.

In this study, we have made a survey about our proposed system. We made some questionnaire and send them to the traffic police who are responsible to check the driving and car license, moreover, drivers of different ages also asked to fill up the survey form. The survey questions and results details are described at section V and VII. In this research we find better results than any other existing system. Response time of the system is not so high, so we find desired result in a short period of time. This proposed system is design for real time data, however no other system detect the driving license and car license at a time in a short period of time.

II. Background Study

Different explanation have been proposed to detect the vehicle based on NFC (Near Field Communication). In this section we look to the existing research work.

A. Vehicle Licence Tracking System

In [1], Jianxin proposed an architectural design for tracking vehicle. This work [1] demonstrated six layers (physical,

network, tools, application etc.) of network to detect the car. Moreover, the research also showed intercommunication between vehicle, traffic enforcement, road information management, traffic enforcement, real time RFID data management, wireless, mobile communication terminals to conducting tracked vehicles information. Therefore, RFID passive tag is used for tracking individual's informations.

Yu [2] proposed a system for tracking the running vehicle and collecting vehicles necessary information using active RFID through readers and antennas. In [2] two things are referred such as build up network and monitoring software. At the time of inaccurate verification, basically two methods are used in [2]. The methods are named as anti-interference and data clearing.

RFID based collision detector to identify violent driver is proposed by Jeevegan [3]. To detect the collision some collision sensors were used to find out crash percentage between two vehicles.

Priyanka [4] highlighted the complexity of the current traffic control. In [4] author claimed that RFID [5] and automatic license plate recognition (ALPR) technologies were used to detect traffic. By using this system owner can identify their stolen car, authors [4] claimed in their study.

Pretorius et al. [6] claimed for a system to offer a solution for authentication of tracking vehicle using UHF passive RFID. In this system, reader read data from a screen. Larionov [7] proposed a system which is fitted with a passive EPC UHF RFID tags within vehicles and stationary readers with antennas placed over the road lanes. In the mean time, they claimed for a protocol for antenna arguments and media conditions.

There some other research to identify car licence using image processing techniques. In [8], fuzzy logic and neural networks being used for image processing. Shi [9] identified number plate and check the validity automatically by using color image processing. In 2010, Navan [10] claimed for a mobile image processing based system for licence plate recognition. In 2020, a mechanism for High-Security License Plate Detection and Recognition for Indian Vehicle is design with the help of cctv footage.

There are so many image processing techniques to identify the vehicle number detection, specially for Licence Plate Recognition (LPR). For achieving high accuracy to detect the accurate number of vehicle using image processing is challenging task for several reasons. For identifying the vehicle identification number image processing is mostly used, some researchers worked with different algorithms of image processing such as Support Vector Machine (SVM), Optical Character Recognition (OCR) [11], Smearing algorithm [12], Feed-forward Neural Network [13], edge detection [14], [15] etc. Most of the techniques gives less than 90% accuracy according to [16].

B. Driving License Tracking System

Vaheeswari [17] implemented a system to get rid of current license tracking system which save the times than other existing methods. In [17], RFID used as fast wireless data collection, fingerprint to detect authenticate person, MQTT(MQ Telemetry Transport) protocol act as a bridge adapter between reader and back end server to store information.

Dass et al. [18] presented a system of an effective authentication pattern by using Pseudo Random Number Generators (PRNG) and also elementary cryptographic process. However, this system was implemented easily. Private data of the vehicle stored inside the tags which could communicate in a more secured way.

So many research has already done for driving license detection and ensure validity using finger print technology [19], [20], [21], [22], [23]. Hsieh [24] identified a method to detect the suspected vehicle license using video streaming without a number plate and real-time ITS applications without using any GPU.

C. Approximate Location Tracking

Many researches are going on to track the approximate car location using GPS or other sensors. Narain [25] worked for Security of GPS/INS based Location Tracking Systems. In this study, GPS technology used for tracking the approximate location and also securely suggest the best path to which can be followed by the user. Boucher at al. [26] track the location of the car using smartphone of the driver to suggest the best rout for travelling. In [27], author claimed to track the loction using IoT based image processing system.

In our proposed prototype, we used RFID tag, RFID reader and Node MCU for design, logo cars are also used as vehicle. In this proposed prototype we deal with real time data which sense using RFID technology and send it to real time database named as firebase. This proposed system can check the authentic car licence and driving licence as well as identify the approximate location without using any GPS. This system also can notify through email to the car owner about any anomalies in license (driving, car etc.). Moreover, this prototype also make case file and also generate fine against the driver or car owner at the time of any violation of law. There is no other automated system which can check both car and driving licence check at a time with real time data.

III. SYSTEM ARCHITECTURE

In this section, we describe the system architecture of Automatic Vehicle Identification and License Management System which consists of WSN, Database cloud, Management Station, Entrance Display within android and web application. At a glance, the system shall be able to graphically display real time information related to the identified valid or invalid vehicle licences also after creating fine notifying to driver or vehicle owners.

Figure 1 details the architecture of system. The overall architecture is divided into three major subsystems as mentioned. The functions of each subsystem are as follows.

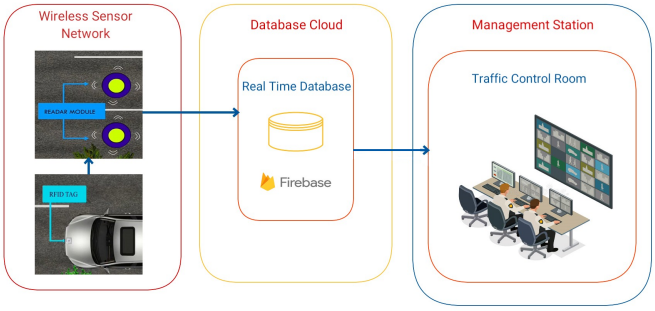

Fig. 1: System Architecture

A. WSN Subsystem

WSN (Wireless Sensor Network) subsystem basically maintain the tag reading procedure while passing a vehicle. The tags are then pushed to the database for identification. Where reader-module act as a bridge adapter for sensing and transferring the vehicle ID.

B. Database Cloud

The database cloud subsystem guessing vehicle ID pushed by reader module within corresponding node and provide interface to GUI display. Where a list of valid licenses and their information is already stored in the database. The database also stores the case-file list and approximate location of the reader node. It should be noted that a driver has been assigned on a vehicle by log into driver android app.

C. Management Station

This subsystem acts as the heart of entire system. Real-time information of the tracked vehicles from the traffic control room is displayed here. In this case traffic police might be able to identifying either a vehicle has valid licence or not or a driver has valid licence or not.This process executed by web application GUI and also proposed android app for more lightweight authentication purpose. In the case of an invalid license for a vehicle, the owner will receive a mail about fine and driver also will be notified through android app for invalid driving license.

IV. System Design

Our traffic management system was developed by an RFID sensor, Wi-Fi module (in the figure 1). We use an RFID tag on every vehicle (in the figure 2). When a vehicle crosses the reader then we get data by reading the tag (in the figure 3). This data compares to our real-time database (in the figure 4) and send feedback to the control room (in the figure 5 and figure 6). If it is valid then our system doesn't take any action however, when it is not valid our proposed system makes a case automatically. Our system will be notified to the police control room if the driver does the same fault again and again. We have all kind of information about vehicle's owner and driver to identify them.

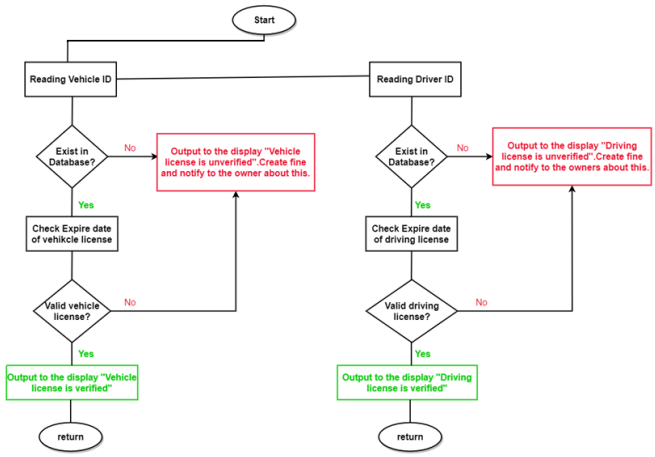

Fig. 2: Subsystem Level Flowchart

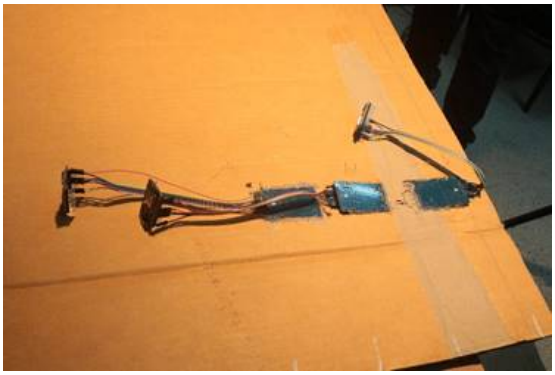

Fig. 3: Reader and Wi-Fi module

V. Research Methodology

An exploratory usability study has been considered to evaluate the proposed prototype i.e. VDLC system, which has been designed to aid PCB and automobilists for the validation of the vehicle license and driver license. We have gathered data to create baseline usability measurements on the basis of users' perspectives. The qualitative data have been collected from the interviews of the intent participants (i.e. sub-inspector and

Fig. 4: Tag beneath the vehicle

Fig. 5: Passing vehicles above the RFID sensors

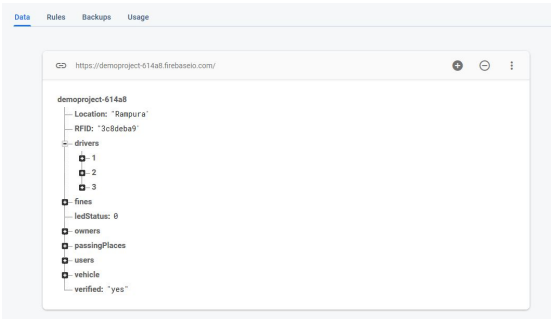

Fig. 6: Database scheme

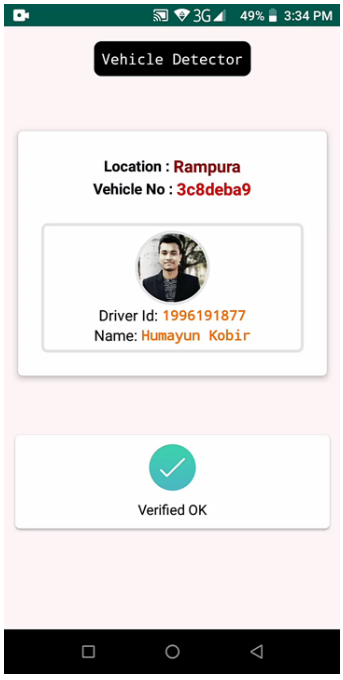

Fig. 7: Valid vehicle's status

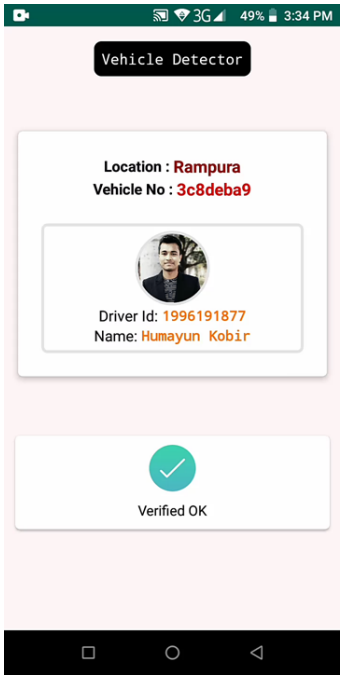

Fig. 8: Invalid vehicle's status

TABLE I: Participants details

Participant ID	Designation	Year of experience	Vehicle operate
P1	Driver	15	Private car
P2	Driver	20	Private car
P3	Driver	5	CNG
P4	Driver	40	Private car
P5	ATSI	4	-

automobilists) and the quantitative data have been collected by measuring the performance of the proposed prototype i.e. VDLC system.

VI. Case Study

A case study has been considered to collect subjective data as well as objective measurement. Four experience automobilists and an Assistant Town Sub-Inspector (ATSI) have participated in the survey. The details of the participants are presented in Table I. To meet the goal of qualitative evaluation of the research, few questionnaires have been considered on the perspective of two genres i.e. Police control board (PCB), and driver. The questionnaires are as follows:

- Common questions for both participants:
  - You are ... ...
  - Designation
  - Year of experience
- For the traffic control board:
  - Questionnaires about existing system
    - How do you check vehicle license? Please explain.
    - What problems do you faces during checking?
    - How do you check driving license?
    - What difficulties do you face during checking driver license?

  - Questionnaires about proposed prototype
    * In perspective of Bangladesh, how successful the proposed project will help the PCB?
    * Does the proposed system meet the basic needs?
    * How much effectively it may replaces the existing supporting systems to the users (i.e. for both drivers and PCB)?
    * Does the proposed system reach the user goal efficiently?
    * Any further suggestions?
- For driver:
  - Vehicle operated so far... ...
  - What difficulties do you face regularly during checking driving license and vehicle license?
  - How much do you think the automation system will be beneficial for you?

The total interview session took an average of around 20 minutes for each participant.

VII. Interview and observation

The following participants were interviewed and observed in their own environment.

"P5" is an assistant town sub-inspector (ATSI), working since 4 years in the same profession. From his experience, checking vehicle license and driving license is very cumbersome, because they need to check both license manually. For manual checking, they first stop the car and check the validity of both hard-copies of license papers. If they found an invalid vehicle license, they create a case file manually through portable POS machine application and provided a fine receipt to the driver. During checking of driving license validation, they use a portable POS application provided by BRTA(Bangladesh Road Transport Authority) where they insert driver ID, which displays all information about driving license. And again if they find any unverified driving license they create a case file manually through a portable POS machine and provide a receipt to the driver. In the query of "What problem do you dealing during checking?", he provided a list of difficulties they face, which are as follows:

- Time is waste for the long process
- Delayed traffic movement
- Increase human harassment
- Students and working people's time are wasted
- Drivers are more prone to cheat
- Manual procedure does not provide accurate validation
- Often drivers disagree with the punishments and argue over fines
- Fake license are difficult to detect

According to the BRTA, there are over 3.5 million registered vehicles in the country, however, the valid licenses have been issued only by 2.6 million [28]. To overcome the existing problem, the ATSI appreciated that the proposed automation system will definitely helpful for both genres, i.e automobilist, and PCB. Since in this system, all the processes of vehicle and driving license identification and actions can be done automatically, as the system used sensor as a receiver, so it can be implemented easily in the road and adjust tag on vehicles also a reliable solution. It would be effective to make our roads safe and license validation would occur in less time. As the proposed VDLC system can be implanted within web and android applications, so it will be the light-weight medium for drivers and for PCB as well. It will be easy to monitor vehicle status from the traffic control room through a web application or android application. He suggested that we should test this system in real-time and then we may be able to validate the system usability and efficiency accordingly.

Automobilists (these are P1, P2, P3, and P4) have also participated in the survey, 3 private cars, and a CNG automobilist interviewed, details are provided in Table I. All of them states that checking both licenses consumes a lot of time, especially it trouble more during office time. Additionally, due to checking it causes slow traffic movement. Even during the emergency period, it is difficult to violate the rule as still, they have to face a typical manual license checking system. Nevertheless, they have to deal all the problems and fine if their owner is guilty. However, due to poor system up-gradation, paperwork took a lot of time and due to this, illegal activities (i.e. bribery) occurred for faster up-gradation of licenses.

All of the automobilist agreed that the proposed vehicle and driving license checking system may reduce labour and time, and increases productivity. It may reduce the hassle of checking manually and there will be less chance of corruption. Additionally, fake licenses can be identified. The system may aid to reduce day-to-day congestion by improving traffic movement. Nevertheless, no need to worry about losing a hard copy of licenses and ID cards as well.

VIII. Result and Discussion

For better understanding, the performance of the vehicle and driver license tracking application system has been measured by executing toy cars by dragging those at different speeds. In our case, to analyze the general usability, we considered the 3 toys (e.g. lego) cars which cross the 1.5 meters in 5s which is considered as high speed, 7.5s is a medium speed, and 12s is a low speed. The quantitative analysis has been provided in Table II, which represents the response time of the tracking system with respect to a different speed. Meantime for each speed per meter is less than 0.9 seconds, which indicates that the speed does not affect the tracking system. However, we could not state that the measurement is accurate as we have not conducted in real-time as well as in the actual environment, with real cars.

From the perspective of intent users, it has been observed that both genres (i.e. PCB and driver) appreciated the automation system, which may aid to track the vehicle and driving license without any manual interruption. Not only that, by using the proposed system, time consumption, illegal activity, and unnecessary harassment could also be able to minimize. Additionally, the proposed system may aid to increase productivity, timeliness, well-organized traffic movement, and be

TABLE II: Response time with respect to vehicle speed

Vehicle no.	Response Time in High Speed (5 sec/1.5 meters)	Response Time in Medium Speed (7.5 sec/1.5 meters):	Response Time in Low Speed (12 sec/1.5 meters)
1.	0.9s	1.0s	0.9s
2.	0.8s	0.85s	0.85s
3.	0.9s	0.8s	0.8s
Mean	0.87	0.88s	0.85s
Standard Deviation	0.06	0.10	0.05
Standard Error	0.03	0.06	0.03

able to identify fake licenses. Overall the proposed system has been appreciated by both genres (i.e. PCB and driver). Both suggested to evaluate the system in the real environment to analyze the efficiency of the intended purpose.

IX. Conclusion and Future Work

In this paper, we have presented a vehicle and driver license checking (VDLC) system, which could be a more efficient traffic management system compare to manually handled existing systems using in Bangladesh. The proposed VDLC system check vehicle and driver license automatically and provide a live update of vehicles/driver condition on the web as well as android application to the traffic control board. It can also helpful for the owner of vehicles as they can track the location of their vehicle(s) and informed them about their case and fines automatically via mail in case of any violence of rules and regulations. This system may operate more accurately by using a powerful RFID reader and Wi-fi module along with heavy bandwidth. The proposed system is easy to adapt and the methods we have implemented could provide precise results.

In the future, we will in-cooperate a fully automatic traffic management system through an app that additionally consists of managing signal, lane, and traffic. The proposed IoT based automated traffic license checking system can be a significant step towards the development of future digital cities. Our future plan is to incorporate our proposed system in the real environment and analyze the usability of the system.

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