International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-8 Issue-5S, May 2019

IoT Based Smart Card Pollution and Traffic Control System

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Abstract*: In today's world, the urban mobility is one of the major problems, especially in metropolitan cities. Improvisation is required in existing traffic management systems in order to manage it efficiently. One of the primary complications among Indian cities are that the existing infrastructure cannot be expanded more. Poor and fragmented mobility has been considered a key contributor to Congested Traffic. Widening of Roads, making Flyovers, increasing public buses are not the only Solution for these challenges. Hence, we propose a smart card (RFID) based pollution and traffic control system, which has been implemented using Arduino Uno R3 along with RFID module interfaced with standalone application built over JAVA platform.

Keywords*: Traffic management system, congested traffic, RFID, Arduino Uno R3, JAVA.

I. INTRODUCTION

At present, the traffic without an appropriate management is "definitely a mess, it's faster to walk than drive". An improved Traffic management is a backbone of any smart city. Building new flyovers can transform the problematic point, but they are not a permanent solution. A survey done by Deccan Herald and TOI in 2017 points the immense increase in the number of city vehicles in the past decade with respective fuel usage and gives a glance about the aggravate traffic condition in Bengaluru.

In urban traffic network, the traffic flow with contagious intersections are strongly pertinent. Along with one section has heavy traffic flow, the cascade effect will result in the regional congestion [1]. Utilization of Smart Transportation Systems, such as Advanced Traffic Management Systems, focuses on management of traffic in smarter way to narrow the divergence between traffic demand and supply, but is inadequate to outstrip the traffic on roads [2]. RFID technology in fuel station are generally used in order to automate the traditional time-consuming process and the amount of fuel to be dispensed from the user automatically, but it doesn't make an effort to control the pollution [3-5]. Air pollution related to vehicular traffic have been found conjoined with cardiovascular diseases due to emissions of VOCs, carbon dioxide, methane and carbon monoxide [7]. Our model targets the fuel consumption which will pave a path in reducing commute time, improving the feasibility of public transport and Pollution control adequately.

Manuscript published on 30 May 2019.
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The paper is organized as follows. Section II deals with the related work. Section III contains the detailed methodology of the proposed system. Section IV describes the Results and Discussion. Section V concludes the research work with future scope.

II. RELATED WORK

A smart city incorporates active traffic management system which is able to manage the abrupt expansion of urban mobility efficiently with respect to commute time, feasibility of public transport along with several other necessary elements and hence enhancing the quality of living for its citizens. By seeing the increasing pollution in Delhi, government came up with 'odd-even' initiative to curb the same. The traffic plan, closing the roads on alternate days to vehicles with odd and even registration numbers. However, after the induction of this methodology, readings from Central Pollution Control Board (CPCB) monitors in Delhi showed no reduction in pollutants in the air. This hike was due to the commuters who dodged odd-even by leaving for work early. Readings during the day increased too as mentioned by authorities. The sales of the used car increased dramatically when the rule was implemented, as a result the citizens are now having multiple cars. Apart from these, multiple waivers were granted under the rule for two-wheelers and women. All these have been one of the major reasons for the abrupt fallout. Furthermore, the rule was only applicable from morning 8 am to evening 8 pm, and were not implemented on Sundays [7]. Emission standards have been set by Indian Government such as banning the sale of BS-III vehicles, due to the toxic vehicular emissions.

In today's world, leading smart cities have introduced advanced regional traffic coordination control system, such as TRANSYT, SCOOT, SCAT system etc., but these systems can't be very good in assent with city traffic characteristic of metropolitan cities, the result of use are unsatisfactory [6]. Use of VANET (Vehicular Ad-Hoc Network) has been discussed and it focuses over the automatic traffic control. However, it will be incompetent when the traffic is dispersed in high density in peak hours [8].

So, as per to the road traffic characteristics, it is crucial to design a new regional traffic coordination control system and hence we proposed a unique system which focuses on curbing the use of petrol and diesel.

III. METHODOLOGY

The main aim of this project is to curb pollution and to have an effective traffic management by targeting fuel consumption which can help in reducing commute time and traffic congestion among cities.

IoT is the key technology used here for the deployment of this model. In order to maintain an advantage over the existing system we have made use of RFID module, along with RFID UID's registered for users. The overall system is automated. This performs the computation locally. Data is stored in the centralized database and the application runs on the device itself. An application is used by the server to send instruction to be performed, monitors analysis and updates the required ones. The system consists of a RFID reader which is connected to Arduino Uno R3. The microcontroller is connected to the system locally. The RFID UID data is accessed when the individual scans the tag against the RFID reader, 12-digit hex-code gets retrieved from it. This value is fed to server, to cross check with centralized database for a verified user in order to perform respective transactions. Only an authorized user will have access to it. The application requires username and password for authentication from user to track his monthly usage. Administrator can also keep a track of fuel transactions done by users with developed application. Moreover, alert messages pop up for user when the consumption of fuel exceeds the monthly quota.

Our Model puts on the monthly limit towards consumption of petrol/diesel as 30 litres for two-wheeler and 68 litres for four-wheeler per user and this limit will reset automatically at the start of every month. After exhausting the monthly quota, one has to pay a hike of 30% on the respective price of fuel, if the individual wishes to get his vehicle refueled. We are only targeting city vehicles. Public and other private modes of transportation including the cab, buses are exempted from the proposed system's regulation which were to be implemented. Fuel prices tends to change every day, thus making use of selenium web drivers to fetch the updated price of fuel every day.

Java is the primary language used for the development of project. Java is a dynamic, robust language especially when it comes to Standalone application development. Java has wide library support and runs on various platforms like Windows, Linux, etc. We have made use of Swing Framework in Java to build a graphical user interface standalone application. The basic protype of the project is shown in the Fig.1.

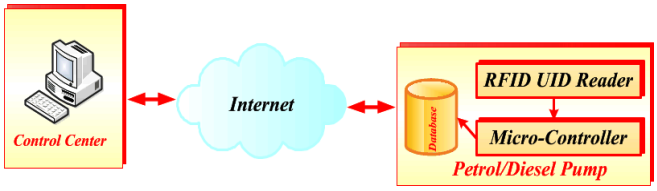


Fig.1. Prototype of working Model.

Fig.2. shows the flowchart for proposed system, which is interfaced by a RFID module. With the help of GUI made using Java Swings Framework facilitates further interaction with developed application. Initially user chooses to refuel his vehicle, thus swaps his RFID UID. The microcontroller retrieves 12-digit hex-code, sends to system locally thereafter verifying the individual.

Now java code on server side takes the RFID hex-code to identify each individual uniquely and does the respective transaction as per the values entered by the user. Once the transaction is completed it updates the same to database and sends the message to the owner. The status of each individual is maintained in a real time database which stores all required and updated transactions of user. We have made use of MySQL to store user data.

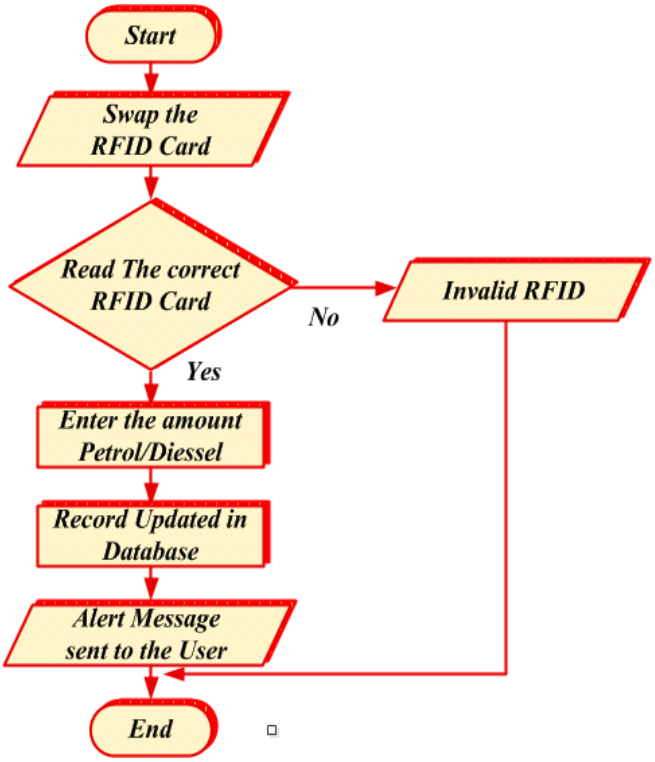


Fig.2. Working of the proposed system.

IV. RESULTS AND DISCUSSION

The following figure shows the experimental setup.

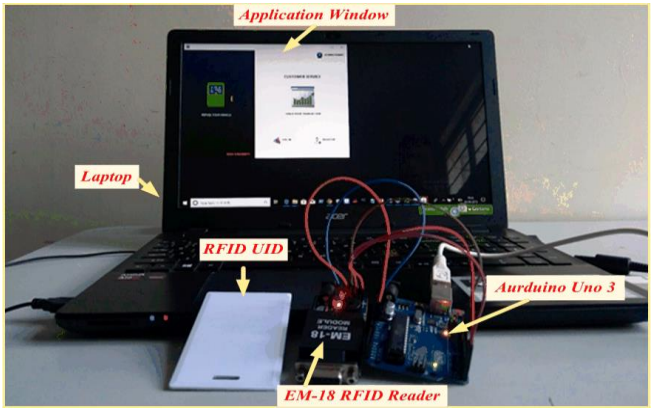
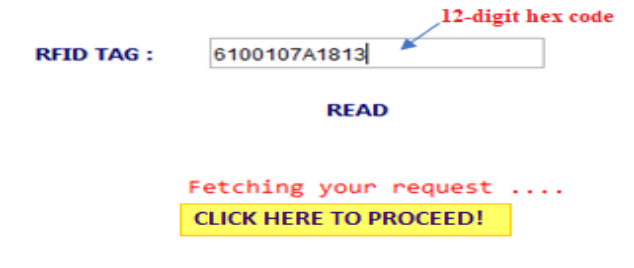
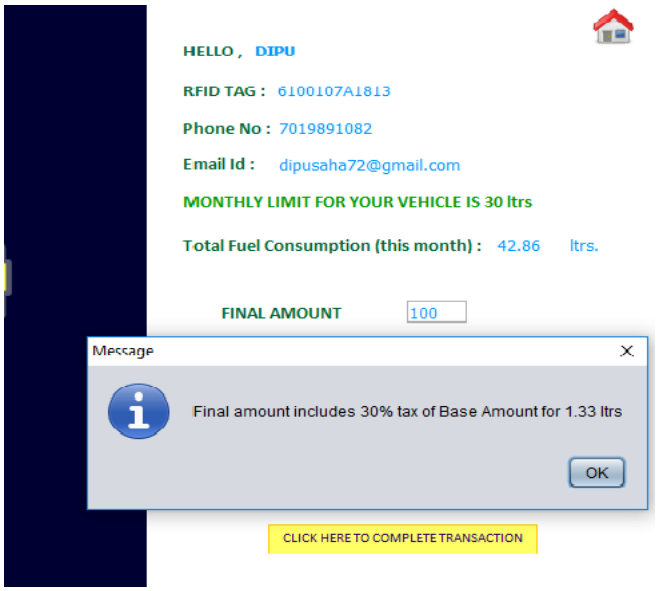


Fig. 3. Experimental setup for the proposed work

This consists of Arduino Uno R3 connected to an EM-18 RFID module to scan the respective 12-digit hex-code of RFID tag which is fetched to Application Window shown in Fig.3. The EM-18 RFID reader is used to read the tags of frequency 125 kHz, after reading the RFID UID it transmits 12-digit hex-code to microcontroller serially using URAT communication. This RFID module doesn't require line-of-sight and operates over the range of 5-8 cm. We have made use of passive RFID module where the RFID tags do not have their own transmitter and power source unlike the active system modules, they just reflect radio waves back, coming from RFID reader.



(a)



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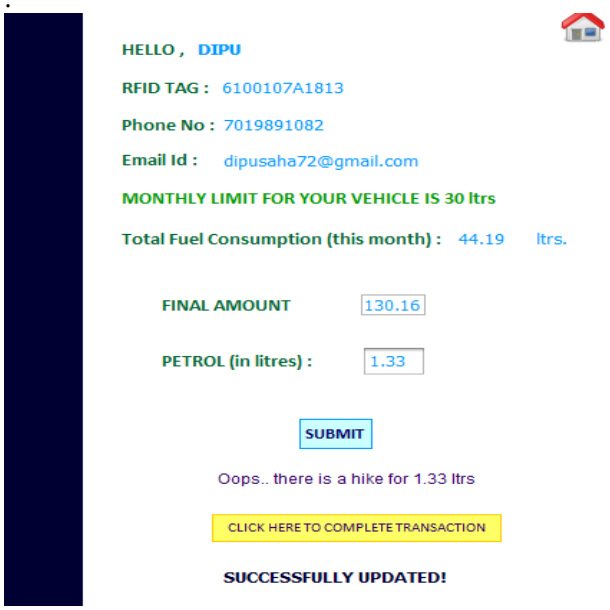
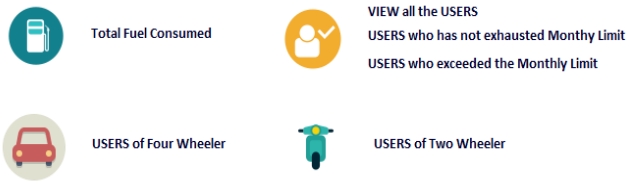


(c)



(d)

Fig .4. Output Screen of Application

The RFID tag's 12-digit hex code is being retrieved when the individual swaps the tag over RFID reader based on the connections made in Fig.3, and this opens the gateway for further transactions for a registered and verified user as shown in Fig.4a.

When the individual clicks Refuel button and it proceeds to the next window. The user enters the amount of petrol and if the amount exceeds the monthly quota, it pops up an alert message with the respective amount of petrol in litres shown in Fig.4b. The resultant final amount is displayed and respective transaction is updated to the database can be seen in Fig.4c. Admin can track the all users and can have an eye over the total fuel consumed along with various factors as shown in Fig.4d. The usage of fuel, with contrast to the implementation of the project as a use case is depicted in Table-I.

Table-I: Usage of fuel by the vehicles.

S. No.	Before Proposed System (in litres)	After Proposed System (in litres)	Difference (in litres)
FW 1.	66.66	64.26	2.4
TW 2.	36.56	35.39	1.17
FW 3.	54.78	52.21	2.57
TW 4.	28.50	29.59	-1.09
TW 5.	42.42	40.12	2.3
TW 6.	33.41	30.48	2.93
FW 7.	72.54	68.65	3.89
FW 8.	56.27	53.91	2.36
FW 9.	52.93	53.56	-0.63

*FW=Four-Wheeler, TW=Two-Wheeler

Fig.5. shows the comparison of the fuel usage before and after the proposed system along with difference in consumption of fuel usage respectively based on assumed data tabulated in table I.

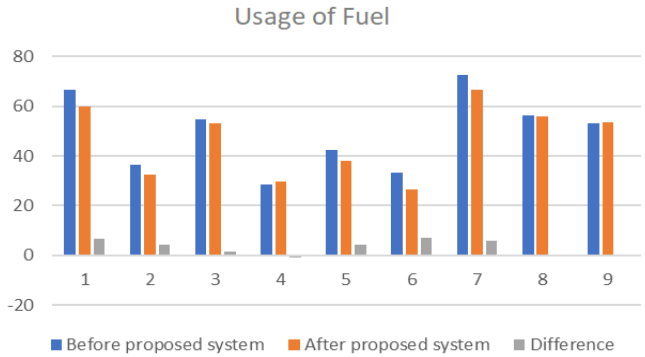


Fig.5. Plot of graph based on fuel usage

Pollution from the vehicles which runs on petrol and diesel respectively have been plotted. In the current scenario, as per our analysis and the data taken from the survey done by DECCAN HERALD, April 2017, and TOI September 2017, in Bengaluru 70.28 lakhs city vehicles running over petrol consumes 8440 lakhs litres of petrol and emits 2.01 crores kg of C02. Similarly, 35.98 lakhs of city vehicles run over diesel and consumes 3914 lakhs litres of diesel, thus produces 1.03 crores Kg of C02. 1 litre of petrol and diesel does 2.30 and 2.63 kgs of CO2 emission respectively. Hence city vehicles altogether produce 3.04 crore kg of CO2 emission., which is depicted in Fig.6. in the form of pie chart.

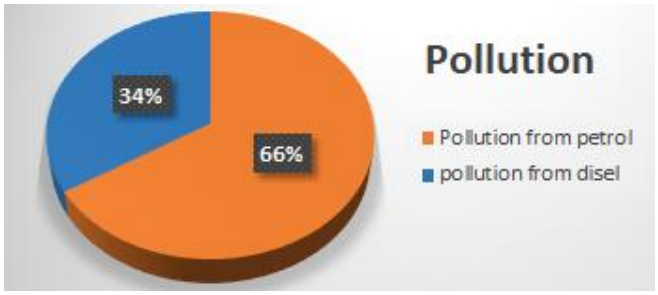


Fig. 6. Pollution based on current scenario

After considering the proposed method for the use case taken above, we are able to curb down 1.76 litres of fuel per vehicle. Hence for 70.28 lakhs vehicle running over petrol, we will save 124.11 lakh litres, which is 1.47% of the total petrol used by the city vehicles in Bengaluru. In similar way for 35.98 lakhs of city vehicles running over diesel, we are able to save 63.32 lakh litres of diesel, which is 1.61% of total amount of diesel used by vehicles. Fig.7. shows a reduction of 3.08% in pollution level based on the analysis. Henceforth through our proposed method we will be able to curb the pollution by curbing petrol/diesel consumption and this makes an effort to eliminate traffic congestion.

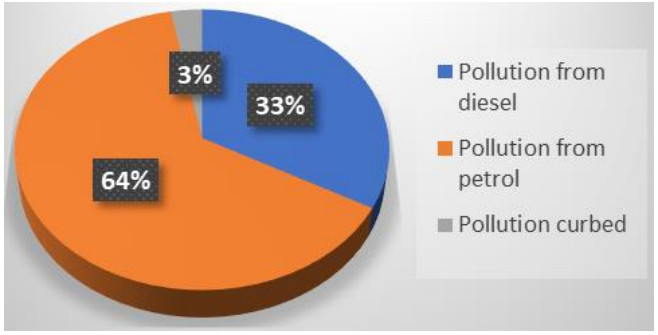


Fig. 7. Reduction in Pollution level with proposed method

V. CONCLUSION

We made an effort to build smart card-based pollution and traffic control system. This would increase the feasibility of public transport and reduce the commute time in cities. The major short coming of this project is the unavailability of real time user details. This can be rectified by executing this project at larger scale and taking help of government agencies to provide real time vehicle data. The monthly limit which is now decided just on the basis of short survey. With the help of the proposed system petroleum administrators can keep a regular track of fuel as everything is digitalized and will diminish the fuel fraudulent. Car Pooling and smart parking spaces, are some of the future enhancements that can be done where this project can find its place.

ACKNOWLEDGMENT

We sincerely thank our guide Prof. Farooque Azam for his valuable guidance throughout the project. We would like to thank the Director, Dr. Sunil Kumar S Manvi, SoCIT, REVA University for his support.

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