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INTELLIGENT COST AWARE SMART TOLL AND VEHICLE FINE COLLECTION USING IOT

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Abstract:

Internet of things is an integral part in today's development of smart city, now without internet it has become like nothing is possible in the world especially for corporate systems where they use internet for communication purpose. This concept implements IOT based electronic toll collection system as a part of smart city implementation using Raspberry Pi and RF wireless chips. These electronic booths automatically collect toll from user account corresponding to the RF pasted on windshield of car. The toll amount is deducted from the user account each time it passes through a toll plaza. Along with toll gate implementation strategy, vehicle fine collection system also integrated in this concept. If any files exists on that vehicle an automated warning info will be sent to owner mobile. Then Based on voice alter received from owner's mobile app vehicle fine collection also takes place simultaneously along with toll collection.

Keywords: Automated Toll collection, Radio frequency, HT12E, Smart city, Internet of Things, Billing systems and Metropolitan cities, , Intelligent transport systems, system on a chip.

Introduction:

Transportation is the major contributor to the nation‟s economy. Improvements in the field of transportation enabled us to have a fast pace lifestyle characterized by exceptional independence of movement, huge trades in manufactured goods and services, high jobs and social movements. The nation‟s economic treasure can be said to be directly proportional to the productive transportation methods. As we know numbers of vehicles on the road are increasing day by day, problems such as congestion, accidents, air pollution has become a major factor of concern [1].Because of the major development in Roadways, there is an increase in the number of toll plazas and leading to have long queues in toll plazas and causing

money leakage which leads to more delay. We have designed an IOT based Toll booth Manager System in which a person can use an RFID to pay the Toll charge. When the RFID is displayed, the system would check if it has sufficient balance and then deduct the toll charge and update the balance through IoT. Internet of Things is basically the „things" which are connected to networks and can exchange data with the help of sensors, electronics, software and connectivity. These systems do not require any human interaction. Any vehicle in an automobile field, the maximum and high quality of features is given to the luxury vehicle, even the economy vehicle deservers some features and these days automobiles are more there are a lot of automobiles these are sometime causing traffic.

Toll gate collection in India is operated manually so it consumes more time, slow process, traffic jam, and increases vehicle operating cost, power loss due to the continuous turning on of receiver system, so there is need of automatic toll collection system to overcome the problem. The toll gates are mostly found on national highways and bridges etc., and we pay standing over a queue in the form of cash, although, the mobility of vehicles gets interrupted by this method which takes longer travel time, more consumption of fuel and also pollution level get increased in that region, instead of that the method commonly used by industries and in advanced countries is the Electronic Toll Collection System. Electronic toll collection system is the technology that enables the automatic electronic toll collection from the prepaid account registered on the name of vehicle owner, determining whether the vehicle is registered or not and informs the toll authorities avoiding toll violations.

Literature Review:

Electronic toll assortment was 1st enforced in 1986. Subsequently, several electronic toll assortment systems square measure enforced with completely different techniques. A number of them square measure as follows: System proposed in [2] uses Wi-Fi for communication with the Smartphone of the user. This phone contains all necessary knowledge associated with the user registration. The user has registered at toll booth automatically as he passes through. But in countries with less Smartphone penetration, the system may not work effectively. System proposed in [3] uses RFID Technology. It is unique technology to transfer the electronic data. The system uses both active and passive RFID's. System proposed in [4] uses NFC chips for the detection of vehicle identity. The NFC chips are designed to work in the close vicinity of the reader. If the distance between reader and chip is more than the critical limit, the system will not detect the vehicle. System proposed in [5] uses an overhead camera to detect number

plate and uses it as the account number of the user. The database is stored on a central server. But deterioration of number plates or duplicate numbers may introduce false positives in the system. System proposed in [5] uses GPS base ETC system. GPS Toll assortment uses contact less automatic vehicle identification technology for identification of car Owner passing through that individual toll assortment centers. This paper aims at developing software to collect toll by providing the top user a postpaid wireless telephone Considering the constraints of former systems, RFIDs stands out with several benefits. RFID tags want no battery as they'll work dead with the ability transmitted by RFID reader. not like variety plate, physical wear and tear don't have any hurt. the gap of the tag from the reader isn't an issue as high power radio waves will sight the tag up to the comfortable distance. not like Wi-Fi, it doesn't need any authentication thus quicker than system projected in [5]. More to the current the raspberry pi primarily based toll assortment system provides a cheap implementation as parts are fairly cheap. Studies so far show that automatic tool collection system is important and gaining more attention. Dr. S. Hussain [11] et al. proposed an automatic toll ticketing system using for transportation system using MSP430 processor. In this work propose a minimal effort and productive system called electronic toll collection utilizing RFID modules that consequently gathers the toll from moving vehicles when they cross toll boot it’s pretty old system and it is slow Atif Ali Khan et al. [12] proposed a RFID based toll collection system using Atmel8051 microcontroller and it uses active tag which consumes more power from vehicle battery and it is difficult to modify or update the system V. Sridhar et al. [13] proposed a smart card based toll gate automated system using 8051 microcontroller. This system describes, the smart card removes handy cash-transaction to eliminate traffic at toll plaza. using smart card even consume time so it’s not that efficient in saving time , It’s better to use upgraded version like raspberry pi or Arduino N. Poornima et al. [14] proposed an automated toll plaza verification system for an automobile at a check point using visual studio .net .08 software. The proposed system uses active RFID tags, which are placed on the vehicles. SeokJu Lee et al. [15] proposed a vehicle tracking system using GPS/GSM/GPRS technology and smart phone application. An in-vehicle gadget, a server and a cell phone application are utilized for the vehicle tracking framework. In this work in-vehicle gadget is made out of a microcontroller Atmega328 and GPS/GSM/GPRS module. It uses google map which most of the time it is inefficient and we don’t three module only two module is enough (GSM and GPS) to show a vehicle area on google maps. Pradeep V Mistary et al. [16] proposed a real time vehicle tracking system based on ARM7 GPS and GSM technology. This system shows a vehicle tracking system to track the

correct area of moving or stationary vehicle in real time. This system is a combination of hardware module and programming module. Sanchit Bhargava et al. [17] proposed a Vehicle Tracking System Using "GPS" And "Google Maps". It only track the vehicle doesn't give any alert when a vehicle is stolen or some try to breach .Google maps are not always accurate

SYSTEM DESIGN AND IMPLEMENTATION:

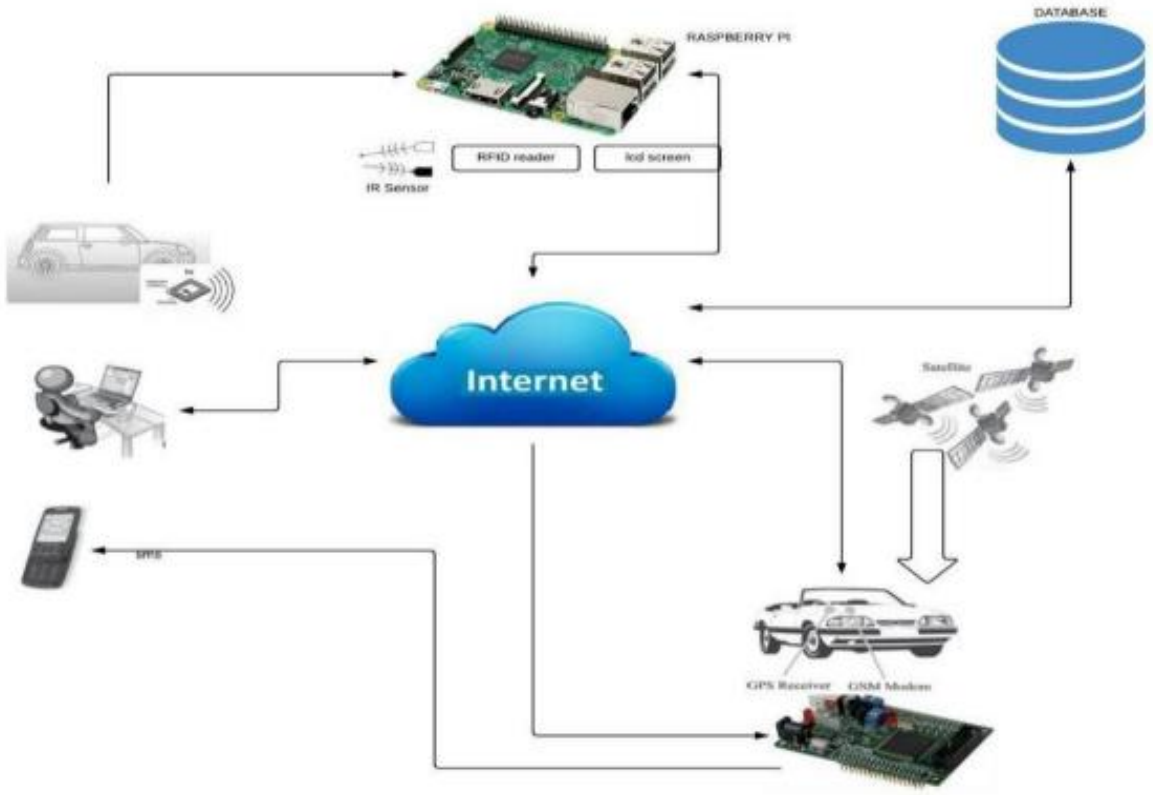


Figure 1: System Architecture

Considering the limitations of former systems, RF stands out with many advantages. RF CHIPS needs tiny battery as they can work perfectly with the a small power source. Unlike number plate physical wear and tear has no harm.

Distance of chip transmitter from receiver is no issue as high power radio waves can detect the tx up to sufficient distance. Unlike Wi-Fi it does not require any authentication hence faster than system proposed.

More to this the raspberry pi based toll collection system provides a cost effective implementation as components are fairly inexpensive.

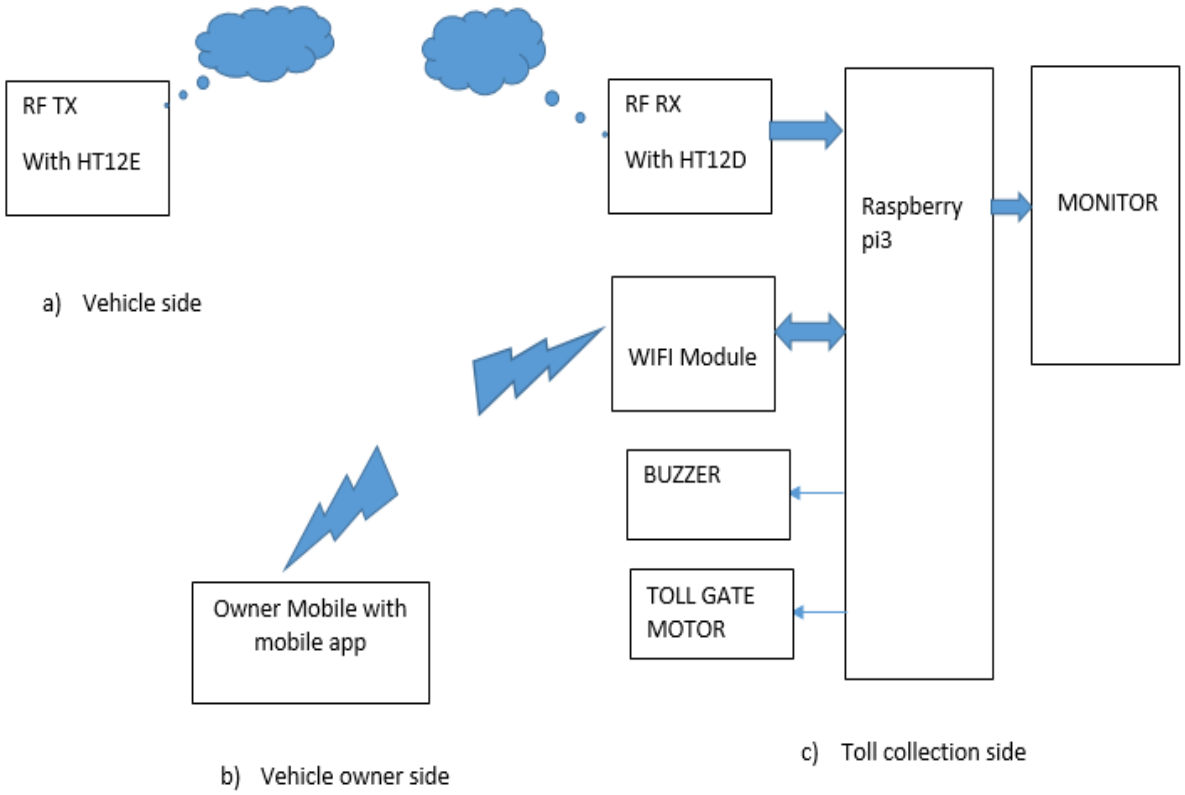


Fig2: Proposed Smart vehicle toll collection system

Proposed block consists of three modules to implement whole circuit strategy. In figure2, a) represents vehicle side module with HT12E encoder IC using RF communication; b) represents owner side mobile application to get acknowledgement to deduct vehicle fine amount; Finally c) represent s toll side implementation using raspberry pi with whole algorithm introduction to recognise vehicle info, vehicle owner info. Amount to be collected is based on toll amount, vehicle fine amount if any exists in past history. Finally toll motor will be on if everything is legitimate else buzzer will on and motor will remains same state.

The raspbian os is used in the raspberry pi board. It is a free operating system that is based on Debian which is particularly optimized for the Raspberry Pi hardware. It comes with over 35,000 packages and precompiled software bundled in a simple format for easy installation in the Raspberry Pi. The coding for all the sensors and the robot movement are done using the python coding. Python is preferred since it is a simple and a minimalistic language

When the vehicle passes through the toll plaza the RF tx is detected by the RF receiver placed overhead. This chip is constantly emitting RF waves at 433 Mhz. As soon as the signal comes in field of receiver number is detected and sent to Raspberry Pi via serial interface. The monitor screen will display card detection message and number of card.

If sufficient balance is present in corresponding user account then, proposed system will check for vehicle fine history. If any fine remains, automatically warning info will be sent to owner mobile and it will wait for owner reply. If positive acknowledgment received, stipulated amount will be deducted. This amount depends upon type of vehicle and vehicle fine. The motor driver will open the gate for predetermined time of seconds and the vehicle will pass through the toll booth. In case of insufficient balance in user account the user will have to pay toll manually with some penalty. The user can recharge his account from the toll booth itself. Penalty will encourage the user to keep sufficient balance in account.

RF chip & HT12E:

Radio waves are a form of electromagnetic radiation with identified radio frequencies that range from 3kHz to 300 GHz. Here, in this concept 433MHz frequency is utilised for communication purpose.HT12E converts the parallel inputs into serial output. It encodes the 12 bit parallel data into serial for transmission through an RF transmitter. These 12 bits are divided into 8 address bits and 4 data bits. HT12E has a transmission enable pin which is active low. When a trigger signal is received on TE pin, the programmed addresses/data are transmitted together with the header bits via an RF or an infrared transmission medium. HT12E begins a 4- word transmission cycle upon receipt of a transmission enable. This cycle is repeated as long as TE is kept low. As soon as TE returns to high, the encoder output completes its final cycle and then stops.

Blynk's App:

With Blynk's iOS and Android mobile apps you can remotely control the connected devices and visualize data from them in the dashboard. You can create a standalone UI for the app and make it different from what you have on the web dashboard, depending on your needs. Mobile dashboard is built from Widgets - modular UI elements which can be simply placed on the canvas. Connecting Data streams to the widget allows communicating with the device and displaying the data on the mobile dashboard. We've got everything from simple buttons and sliders to cool charts, image gallery widget, map widget, and even a video streaming one. Blynk Library is an extension that runs on your hardware. It handles connectivity, device authentication in the cloud, and commands processing between Blynk app, Cloud, and hardware. It's highly flexible whether you are starting from scratch, or integrating Blynk into existing project.

Results:

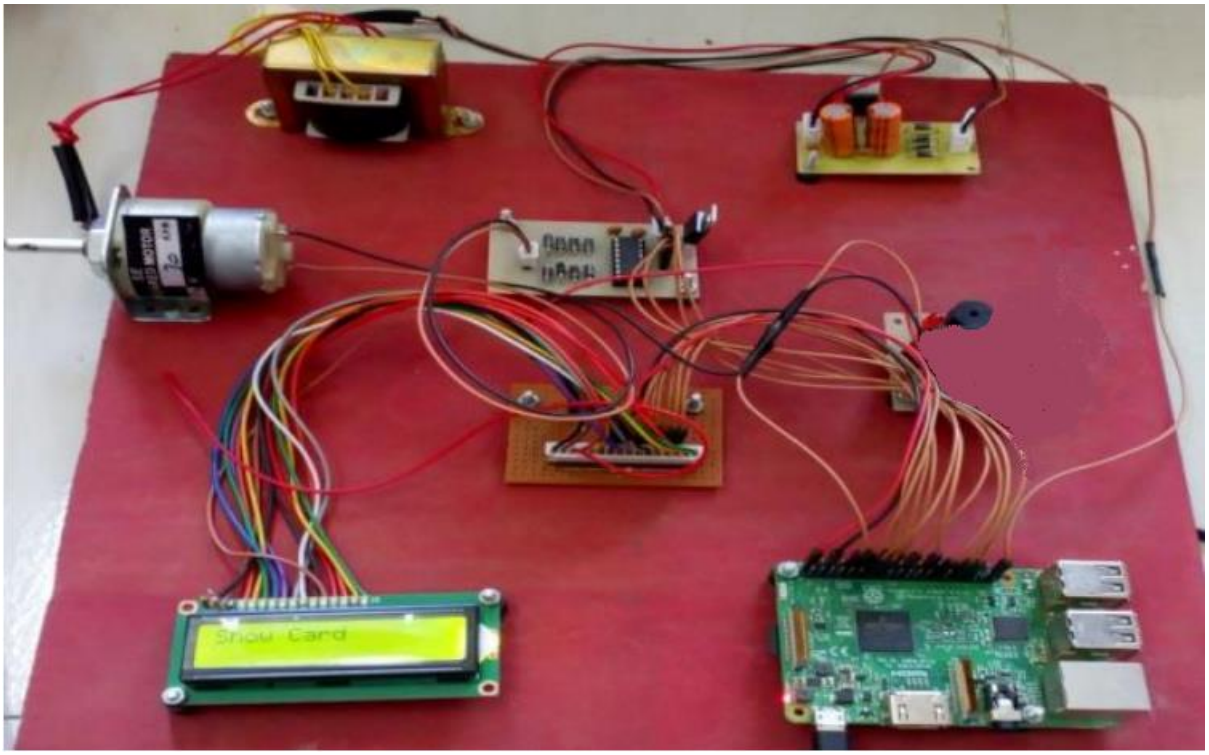
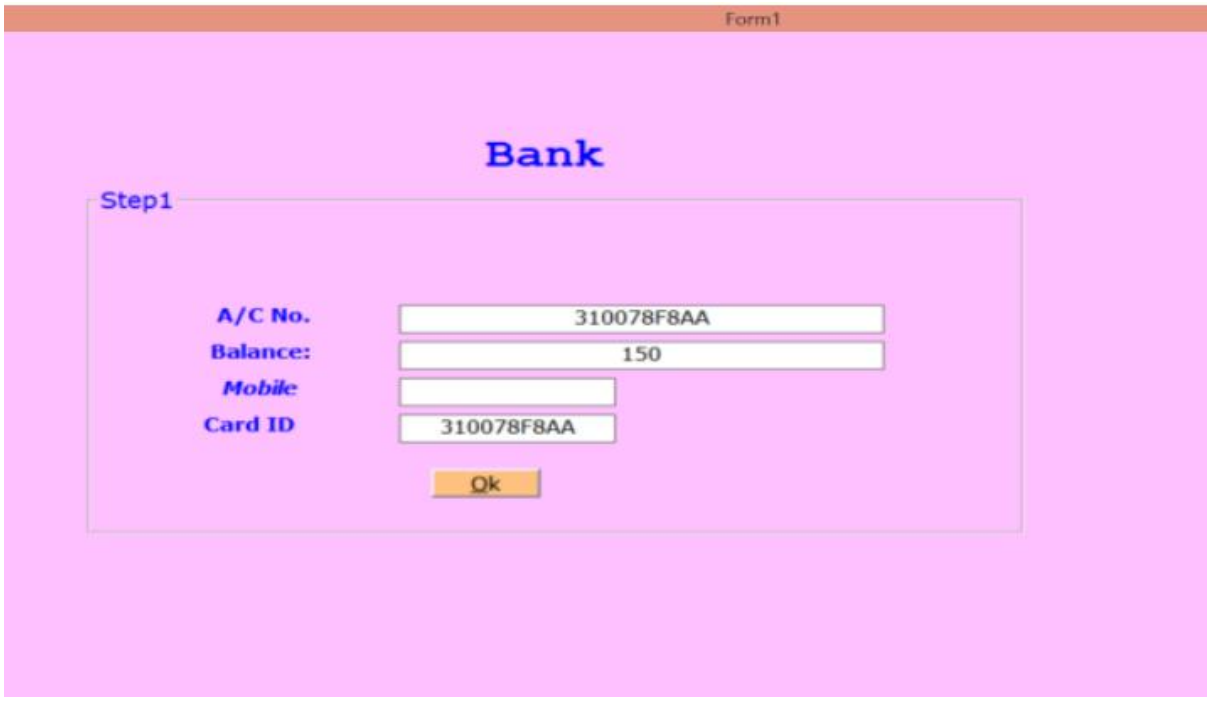


Fig: 3 proposed hardware prototype

Above screen shot represents proposed hardware prototype kit with raspberrypi, RF and IOT technologies. Integrated technologies yields more efficient toll collection architecture as shown in above.



Fug4: Proposed Software screenshot at Toll side

Above figure represents proposed software screenshot taken in matlab environment.

Conclusion:

Issues like long queues are completely eliminated by implementation of the system. This system saves time and fuel. Transparency in toll collection is increased as reports are stored digitally. Need for manpower is reduced on a large scale. User will get proper information of his account on the toll booth display. Skipping of toll will be avoided. Therefore, the Raspberry Pi based Automatic Toll Collection System using IOT, RF will eliminate many issues of the toll plaza at one go. This system will ensure faster commutation on highways. The performances of this automated electronic system make it an efficient choice among its competitors especially in those situations when the cost of the application has to be maintained at reasonable levels.

Future Scope:

In future, This concept can be integrated using the QUALCOMM mobile processor, which is used to track the vehicle and the user details world-wide. Currently system uses prepaid mode. This can be changed to postpaid. For the prepaid system online recharge system can be implemented. Cameras can be used for more stable system in case of RF chip failure. System for stolen vehicle detection can be implemented with little change in software.

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