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ENHANCED SMART TRANSPORTATION AND AUTOMATIC TOLLGATE SYSTEM POWERED BY INTERNET of THINGS (IoT)

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Abstract: In today's era vehicles are large in number, the tollbooth seems to become bottleneck to pass through the gates due to their manual operations. This process may take few minutes to pass the toll system. In order to decrease this passing time, we decided to automate the process of toll system by doing technology enablement of Internet of Things (IoT). Automated Toll Collection System used for collecting tax automatically. In this we do the identification with the help of radio frequency. A vehicle will hold an RFID tag. This tag is nothing but unique identification number assigned. This will be assigned by RTO or traffic governing authority. As vehicles don't have to stop in a queue, it assures time saving, fuel conservation. This work would reduce the manual work and hence would make the passing of the vehicles much faster as compared to traditional toll system and also introduce identification system for vehicles against which stolen and accident cases.
Keywords: RFID, Internet of Things (IoT)

I. INTRODUCTION

Automation has made its way into our lives and is slowly seeping to our lifestyle. We see wide spectra of places where this can be used for the betterment of the society. The number of vehicles on the road is increasing at an alarming rate because of which the condition of the roads is worsening quickly. Then major roads have manual toll systems, where every vehicle has to stop and pay for toll tax and then leave the lane. With enormous increase in number of vehicles on road, the process of traditional toll system has become worst and at times on popular routes the waiting times of vehicles is significantly high. So the objective was to give a solution of this delayed manual toll system by designing and implementing an automatic tolling framework for gathering toll. The system, which is better in terms of accuracy, efficiency and cost effectiveness with lesser delay for vehicles. So such systems are the need of society now a day's to speed up the toll passage process.

In our day to day life, we pay certain amount of tax through toll plaza to the government. 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 wallet account registered on the name of vehicle owner, determining whether the vehicle is registered or not and informs the toll authorities avoiding toll violations. Over last decades, electronic toll collection system has been implemented in United States and many other countries with a new improvement in it.

Considering the present toll collection system where each vehicle has to stop and pay taxes. Suppose the manual toll collection system is very efficient then for one vehicle to stop and pay taxes total time taken is 60 seconds. And suppose 100 vehicles cross the toll plaza. Then, time taken by 1 vehicle with 60 second average stop in a month is: 60x30= 1800 seconds Yearly total time taken = 1800x12 = 216200 seconds = 6.0 hours On average each vehicle that passes through the toll plaza has to wait 6.0 hours in engine start condition yearly. The figure is staggering if on an average we take 100 vehicles pass through the toll plaza each day, then yearly 36000 vehicles pass through the toll plaza. And each year 36000 vehicles just stand still for 6.0 hours in engine start condition thereby aiding pollution and wasting fuel and money. This study is if the system is very efficient but what if the vehicle has to wait for 5 minutes? This is a figure considering one toll plaza. If considering 50 toll systems the above figure will drastically increase and the wastage of fuel, money will increase and pollution will also increase.

II. RELATED WORKS

An electronic toll collection system (ETC) that automatically deducts tolls from prepaid account. ETC system uses the dedicated short-range communications (DSRC) technology by semi-passive RFID at frequency of 5.8 GHz in order to communicate between the transceiver called the road side unit (RSU) and the transponder called the on board unit (OBU)[1], Sensors placed in the tank which continuously informs the water level at the current time. This information will ATCSR is an Automated Toll Collection System using RFID used for collecting tax automatically. In this we do the identification with the help of radio frequency. A vehicle will hold an RFID tag. This tag is nothing but unique identification number assigned. This will be assigned by RTO or traffic governing authority. In accordance with this number we will store, all basic information as well as the amount he has paid in advance for the TOLL collection [2]. focused on how the electronic toll collection system reduces manual work load using RFID technology. Ultimately, this system reduces environment pollution due to the burning of fuel as well as reduces the waiting time of users in toll queue. Users can access the website and may perform their toll transaction from any location. Their transaction will reflect in the centralized database. Due to the use of online transaction, users do not need to carry cash with them. This leads in the reduction of human error occurring at the toll booths[3].

III. PROPOSED METHODOLOGY

With the significant development in Roadways, there is an increase in the number of toll plazas. These toll plazas have long queues and the time consumed in paying cash and returning change causes all the 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 swiped, the system would check if it has sufficient balance and then deduct the toll charge and update the balance through IOT.
Internet The automatic toll e-ticketing system is the approach used for the, Vehicle when it reaches the toll plaza, this is detected by using RF ID is used to read each vehicle with the help of RF ID receiver. This then transmits the vehicle number through the RF ID transmitter located in vehicle. We assume that vehicles have identification numbers. The read the signal and information about vehicles owners. These RF signals are received by an RF receiver at the toll plaza, which send data to a computer's parallel port. A software program running on the computer retrieves vehicle details from its vehicle database.

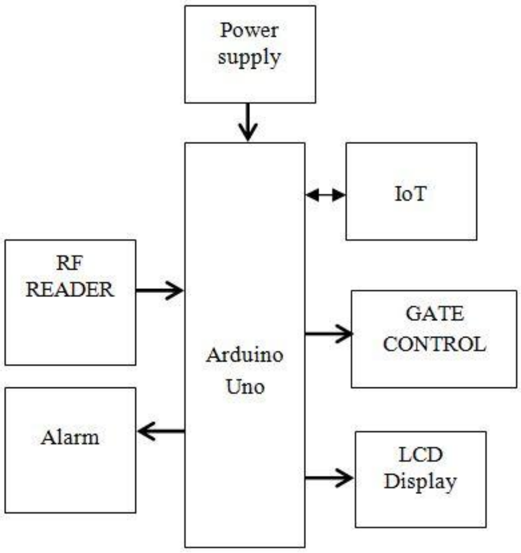
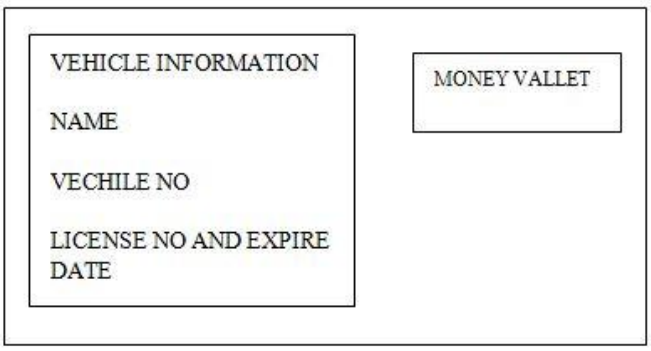


Figure: Proposed System Block Diagram

MONITORING SYSTEM
GLOBAL MONITORING



Depending on this information, appropriate toll tax is deducted from the pre-paid account of the vehicle's owners .The owner receives an SMS message on his/her mobile about the details of the payment. If the balance in the owner's account is low or if the vehicle is not equipped with an RF system, the toll gate remains close. Next method proposes a very simple method for enhancing the performance of infrared electronic-toll-collection systems, in such a case, the vehicle owner will have to recharge the toll collect the receipt.
On the other side, if any vehicle owner registers a complaint to RTO office regarding theft of the vehicle, that vehicles ID is flagged in the stolen vehicle database. When a vehicle with same ID approaches at toll plaza, system identifies the stolen vehicle and informs the authorities

IV. HARDWARE REQUIREMENT

ARDUINO UNO
The Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.
"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdate boards see the Arduino index of boards.

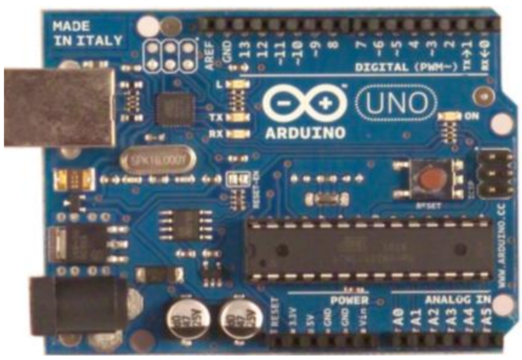


Figure: Arduino Uno

INTERNET OF THINGS
The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability produced by Shanghai-based Chinese manufacturer, Espressif Systems
The chip first came to the attention of western makers in August 2014 with the ESP-01 module, made by a third-party manufacturer, Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make

simple TCP/IP connections using Hayes-style commands. However, at the time there was almost no English-language documentation on the chip and the commands it accepted. The very low price and the fact that there were very few external components on the module which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation.
The ESP8285 is an ESP8266 with 1 MiB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi.

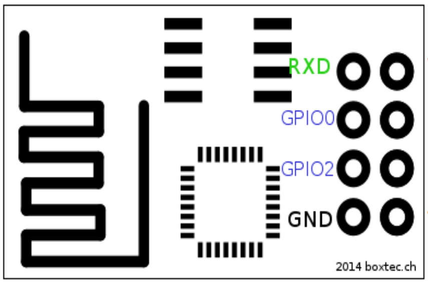


FIGURE: ESP8266 AND PIN DIAGRAM

Features

- Integrated low power 32-bit MCU
- Integrated TCP/IP protocol stack
- Integrated TR switch, balun, LNA, power amplifier and matching network
- 802.11 b/g/n WiFi 2.4 GHz, support WPA/WPA2
- Support STA/AP/STA+AP operation modes
- 10-bit ADC, SDIO 2.0, (H) SPI, UART, I2C, I2S, IR Remote Control, PWM, GPIO

RADIO FREQUENCY IDENTIFICATION (RFID).

Radio Frequency Identification (RFID) is a fast and reliable means of automatically identifying and logging just about anything, including retail items, vehicles, documents, people, components, library books and works of art. Because it makes use of radio waves, there is no need for “line of sight” reading of information, which is one of the limitations associated with barcode systems. It means RFID tags can be embedded in packaging or, in some cases, in the goods themselves – in addition, an RFID system can, in many case, read hundreds of tags at the same time. A basic RFID system consists of:
Reader – this may be an industrial portal for supply chain applications or could be a piece of furniture in a library application essentially it is equipment that sends and receives the radio signals.
Antenna – connected to the reader, and usually embedded as part of the same equipment, is one more antennae. The reader uses the antennae to convert digital signals into radio waves and vice versa.
Tag or smart label – the tag is the final component, which consists of a small piece of silicon (the intelligence and memory) and an antenna. Tags can be packaged in many formats, however, the most common format is the smart label – a tag embedded within a self-adhesive wafer-thin label than can be printed and applied to objects. In addition to a tags automatic identification and data capture capabilities, RFID tags or labels can also provide the Electronic Article Surveillance (EAS) function a case of single technology taking the place of two. EAS is the means by which items in a retail environment are protected from theft typically they are deactivated at the point of purchase to prevent exit alarms from activating. An RFID tag can work just like a barcode in other words, it can hold a unique article number which works like a “licence plate”, calling the information relating to that number from a separate database. But because it can contain a relatively large amount of digital data, the RFID tag can hold source information itself, as opposed to a mere “look-up” number, thus making it infinitely more useful for supply chain and many other applications. In addition, RFID “readers” in a read-write system are also “writers”: that means information can be written to tags at any point in, for instance, a supply chain, a security and access procedure or a maintenance operation, using a hand-held or fixed reader. With a barcode system, the only way of changing information is to print a new barcode or alter information in the system’s database.

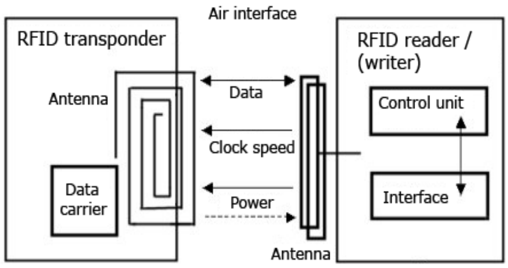
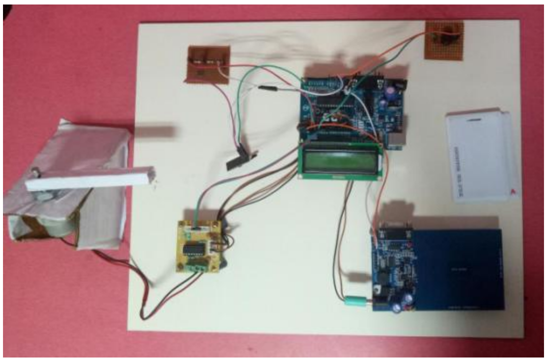


Figure: Radio Frequency Identification

DC MOTOR

Whenever a robotics hobbyist talk about making a robot, the first thing comes to his mind is making the robot move on the ground. And there are always two options in front of the designer whether to use a DC motor or a stepper motor. When it comes to speed, weight, size, cost... DC motors are always preferred over stepper motors. There are many things which you can do with your DC motor when interfaced with a microcontroller. For example you can control the speed of motor, you can control the direction of rotation, you can also do encoding of the rotation made by DC motor i.e. keeping track of how many turns are made by your motors etc. So you can see DC
Usually H-bridge is proffered way of interfacing a DC motor. These days many IC manufacturers have H-bridge motor drivers available in the market like L293D is most used H-Bridge driver IC. H-bridge can also be made with the help of transistors and MOSFETs etc. rather of being cheap, they only increase the size of the design board, which is sometimes not required so using a small 16 pin IC is preferred for this purpose.

V. IMPLEMENTATION RESULTS



VI. CONCLUSION

The automated toll collection system will help in greatly reduce the time required to complete the process of issuing toll receipts and enable the whole system to be swifter. The system also eliminates possibility of any kind of human error that might be possible with the conventional toll collection systems. There will be also great reduction in carbon emissions as well as fuel consumption as the car needs not to stop at the toll plazas. This system in this way paves way to a cleaner, greener and swifter process as compared to the current system. In this paper, we have presented the implementation of IoT technology in the application of toll tax system. IoT toll collection stations allow the traffic to flow continuously and vehicle having been avoided stopping and starting again. This in combination with reduced fuel consumption has positive effect on environment i.e. pollution created will be minimum. Implementing the IoT technology is also not so costly. IoT based toll booth monitoring system is an Arduino based toll collection system. The results obtained from working have shown that the system performance is quite reliable. The system has successfully overcome the shortcomings of the existing system by reducing the man power at the toll booth. It provides easy way of toll collection and maintenance of the information.

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