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RFID Based Toll Tax Collection System

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Abstract: With the help of RFID based toll deduction system we make the transportation system more efficient and perfect. Each and every user will have a RFID card. RFID card is used to pay the toll tax. By putting the card in the range of the RFID reader at the collection center one can pay the toll tax with ease. The amount will then automatically deduct from the balance in the card. And if there is not sufficient balance in the card then it can also be recharged at the same collection system. Apart from this, the amount deducted and the available amount in the card will be sent to the registered number.

Keywords: RFID card, RFID reader, GSM, FRDM Controller.

I. INTRODUCTION

This project focuses on an electronic toll collection (ETC) system using Radio frequency identification. (RFID) technology. The RFID system uses tags, through which information embedded on the tags are read by RFID readers, the proposed system eliminates the need for motorists and toll authorities to manually perform ticket payments and toll fee collections, respectively. Thus it is a more efficient toll collection by reducing traffic and eliminating possible human errors.

This system will have two benefits. First benefit is that movement of traffic will be much faster as user will not wait for the money exchanges because, driver has to just swipe the RFID card in to the card reader. Second benefit is that driver doesn't have to carry the money each time.

He can just recharge the RFID card by certain amountandcan use this card each time he travels. This is little bit similar to using credit cards.

II. DESCRIPTION OF PROJECT

A. Problem with current toll tax system

The main disadvantage of the current toll tax system is that it is more time consuming. It takes almost 20-30 seconds for the money exchange process at any of the toll tax collection system. By digitalizing the whole process we can save this much of time per vehicle at the collection center.

This process also reduces the traffic per lane by 200-300 %. This amount of traffic is accountable for the highways and expressways.

Also, this process has many more advantages as it is fuel efficient and it is easy for the user to get rid of the problem of carrying money each time one travels. Also, it is ease to operate as just one have to swipe it to the RFID reader at the toll tax collection Centre.

B .RFID Card and Reader

RFID tags, or simply "tags", are small transponders that respond to queries from a reader by wirelessly transmitting a serial number or similar identifier. They are usually thought of as an advanced barcode.

RFID transponders (tags) consist in general of:

- Antenna
- Case
- Battery (for active tags only)

The size of the chip depends mostly on the Antenna. Its size and form is dependent on the frequency the tag is using. The size of a tag also depends on its area of use. It can range from less than a millimeter for implants to the size of a book in container logistic. In addition to the microchip, some tags also have rewritable memory attached where the tag can store updates between reading cycles or new data like serial numbers. As said before the antenna has the largest impact of the size of the tag. The microchip is visible in the center of the tag.

Energy Sources (RFID)

We distinguish 3 types of RFID tags in relation to power or energy:

- Passive
- Semi-passive
- Active

Passive tags do not have an internal power source, and they therefore rely on the power induced by the reader. This means that the reader has to keep up its field until the transaction is completed. Because of the lack of a battery, these tags are the smallest and cheapest tags available; however it also restricts its reading range to a range between 2mm and a few meters. As an added benefit those tags are also suitable to be produced by printing. Furthermore their lifespan is unlimited since they do not depend on an internal power source. The second type of tags is Semi-Passive tags. Those tags have an internal power source that keeps the microchip powered at all

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times. There are many advantages: Because the chip is always powered it can respond faster to requests, therefore increasing the number of tags that can be queried per second which is important in some applications.
The third type of tags is active tags. Like semi-active tags they contain an internal power source but they use the energy supplied for both, to power the microchip and to generate a signal on the antenna. Active tags that send signals without being queried are called beacons. An active tag's range can be tens of meters, making it ideal for locating objects or serving as landmark points. The lifetime is up to 5 years.
Frequency Bands
RFID tags fall into three regions in respect to frequency:

- Low frequency (LF, 30 - 500kHz)
- High frequency (HF, 10 - 15MHz)
- Ultra high frequency (UHF, 850 - 950MHz, 2.4 - 2.5GHz, 5.8GHz)

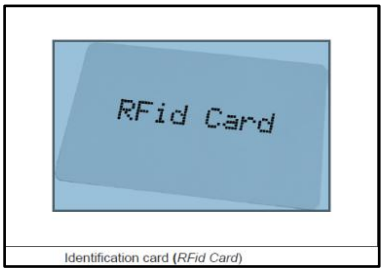


Figure 1: RFID card

RFID reader is powered via development system it is connected to. The presence of power supply is indicated by LED marked POWER. When the RFID is turned ON, a 125 kHz voltage is supplied on its antenna. As a result antenna starts emitting an EMF necessary for reading the RFID card. As passive RFID does not have its own power source it features a coil where the voltage is automatically induced by approaching the card to the RFID reader's antenna. This voltage is necessary for the chip featured on the card to work. The memory chip on the RFID card contains a unique identification code. This code is sent by the card when it is placed closed to RFID Reader's antenna. The code is sent via this antenna.

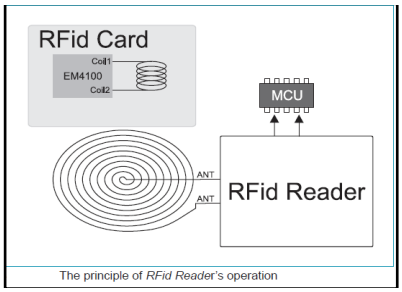
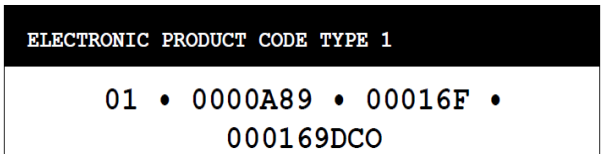


Figure 2: Principle of RFID

Developing RFID Standards
The sponsors have proposed a new standard Electronic Product Code as the next standard for identifying products. The Auto-ID Center has proposed open standards for tags and readers with the intention of bringing the costs down to a level where RFID tags could be applied to individual items. The work may lead to the creation of a new global Internet network that would allow companies to track items and enable end users to access the full benefits of RFID.
The Auto-ID Center has developed a specification for RFID tags to be used in the retail sector. The specification does not mandate what type of tag to be used but is intended to provide guidelines on data structure and how the tags should perform so that they can be used over a common platform. It is tailored around the experiences gained from the implementation of UPC and its success in the marketplace for more than 25 years.
The Electronic Product Code (EPC)
The EPC is a number made up of a header and 3 sets of data as shown in the figure below. The header identifies the EPC version number – which will allow for different lengths or types of EPC later on. The second part of the number identifies the EPC manager – typically this would be the manufacturer of the item the EPC is attached to. The third part is called object class and refers to the exact type of product– most often the stock-keeping unit (SKU). The fourth series of numbers is the serial number that is unique to the item. (The second and third sets of data are similar in function to the numbers in UPC barcodes.)



Above is an example of a 96-bit EPC. It will allow sufficient capacity for 268 million companies. Each manufacturer will have the ability to create up to 16 million object classes with 68 billion serial numbers in each class. This should provide sufficient capacity to cover all products manufactured in the world for many years to come. As an interim step, the Auto-ID center is also proposing a 64-bit tag in order to minimize cost in the near term.

MICROCONTROLLER
KL25Z128VLK, a device boasting a max operating frequency of 48MHz, 128KB of flash, a full-speed USB controller, and loads of analog and digital peripherals. The FRDM-KL25Z is the first hardware platform to feature the Free scale open standard embedded serial and debug adapter known as Open SDA. This circuit offers several options for serial communications, flash programming and run-control debugging.
The features of the FRDM-KL25Z include:
• MKL25Z128VLK4 in an 80 LQFP package
• Capacitive touch slider
• MMA8451Q accelerometer
• Tri-color (RGB) LED

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• Flexible power supply options – USB, coin cell battery, external source
• Battery-ready, power-measurement access points
• Easy access to MCU I/O via Arduino ™ R3 compatible I/O connectors
• Programmable Open SDA debug interface with multiple applications available including:

- Mass storage device flash programming interface
- P&E Debug interface provides run-control debugging and compatibility with IDE tools
- CMSIS-DAP interface: new ARM standard for embedded debug interface
- Data logging application.

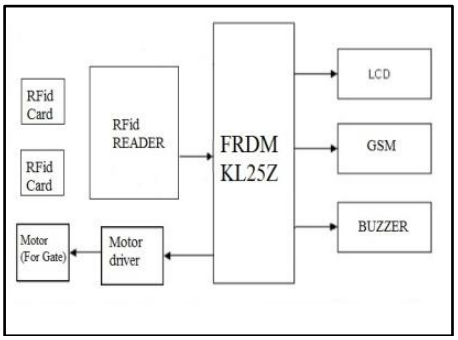

Figure 3: Block diagram

GSM

- GSM/GPRS Modem-RS232 is built with Dual Band GSM/GPRS engine- SIM900A, works on frequencies 900/ 1800 MHz The Modem is coming with RS232 interface, which allows you connect PC as well as microcontroller with RS232 Chip (MAX232). The baud rate is configurable from 9600-115200 through AT command. The GSM/GPRS Modem is having internal TCP/IP stack to enable you to connect with internet via GPRS. It is suitable for SMS, Voice as well as DATA transfer application in M2M interface. The onboard Regulated Power supply allows you to connect wide range unregulated power supply. Using this modem, you can make audio calls, SMS, Read SMS; attend the incoming calls and internet through simple AT commands.
- In this project the main use of GSM-900 is to send the information of the amount deducted and the available balance in the card to the registered mobile number.

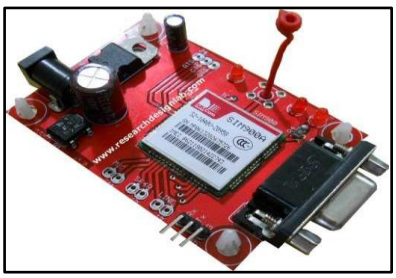

Figure 4: SIM-900

III. APPLICATIONS

- TOLL TAX COLLECTION CENTRES
- SECURITY SYSTEMS
- OFFICES

The original purpose of this project is to automatically collect toll tax at the collection centers using RFID technology. Moreover, this technology can also be used for security purpose. By using RFID cards as a security card thus, only few and authorized persons will be allowed access to the place. Such technologies are also used in Offices to make sure that not every worker is allowed access to the restricted areas of the office. With the help of RFID technology only few individuals will be allowed to enter using RFID cards.

IV. CONCLUSION

The module we've developed is an elementary yet realistic model for automatic collection of the toll tax at the collection centers. This system also provides prior information about the remaining balance and amount deducted on the registered user's mobile number. So, if there is lack of balance during the next visit one can recharge the card with some amount. In the future, we hope that this project will be encouraging our Prime Minister Mr. Narendra Modi's concept of digital India and also we hope that on implementing this project at such big level the bank will grant permission to recharge the card using bank account details.

This will help the users to recharge their card anytime, anywhere. Also, the users will be get rid of recharging their cards at the toll tax collection centers. We believe that this will be a very practical application which is able to efficiently reduce the traffic on National highways and expressways. Further improvements of this system might include increasing the frequency of the reader so that the reader will be fitted at the edge of the bridge at the centers. The speed of the vehicle will be reduced at the center and as soon as the reader comes in range of the card (installed at the front of the car) the amount will automatically be deducted and the message will be sent to the registered user's mobile number. There is no need of even keeping the card in front of the reader.

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BIOGRAPHIES

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