AUTOMATIC TOLL TAX SYSTEM

Project Report submitted in partial fulfilment of the requirement for the degree of

Bachelor of Technology

in

Electronics and Communication Engineering

By

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Certificate

This is to certify that the project report entitled "Automatic Toll Tax System", submitted by Navdeep Singh, Raminder Pal Singh and Vivek Bansal in partial fulfillment for the award of degree of Bachelor of Technology in Electronics and Communication Engineering to Jaypee University of Information Technology, Waknaghat, Solan has been carried out under my supervision.

Date: May 15, 2010 **(D.C. Kulshreshtha)**

(Professor)

Certified that this work has not been submitted partially or fully to any other University or Institute for the award of this or any other degree or diploma.

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Abstract

RFID Based Toll Road Payment systems have really helped a lot in reducing the heavy congestion caused in the metropolitan cities today. It is one of the easiest methods used to organize the heavy flow of traffic. When the car moves through the toll gate on any road, the RFID reader indicates that the car has crossed the clearing. The need for manual toll based systems is completely reduced in this method and the tolling system works through RFID. The system installed is, thus quite expedient reducing the time and cost of travellers since the tag can be deciphered from a distance. By implementing this project we can deduct toll tax according to the distance travelled by the vehicle on the toll road. Money will be deducted according to the distance between the different toll plazas, from where we have entered and left the toll road.

The people using this method for toll payment do not need any other gadget to get through the toll but the RFID tag carried by their vehicle. A commuter passing the toll gets to know how much amount has been paid and how much money is left in the tag. It does not require the person to carry cash with him to pay the toll tax. The long queue waiting to pay toll is reduced, which in-turn reduces the consumption of fuel. The RFID toll payment systems are really useful in preventing trespassing on borders. The software developed can ensure a smooth running of vehicles. With entry/exit tolls, the passing vehicle collects a ticket when entering the highway, which displays the fare it will pay when it exits, which, further, depends on the distance travelled. Upon exit, the driver pays the amount listed for the given exit. If the ticket indicates a travelling violation or is lost, the driver would typically pay the maximum amount for travel on that highway.

Short toll roads with no intermediate entries or exits may have only one toll plaza at one end, with motorists travelling in either direction paying a flat fee when they enter or exit the toll road. A variant of the entry/exit toll system exists where mainline barriers are present at the two endpoints of the toll road and each interchange has a ramp toll that is paid upon exit or entry. In this case a motorist would pay a flat fee at the ramp toll and another flat fee at the end of the toll road, thus no ticket is necessary. Modern toll roads often use a combination of the two, with various entry and exit tolls supplemented by occasional mainline tolls.

List of Figure and Tables

CHAPTER 1

INTORDUCTION

1.1 Overview

Any structure, building or system needs maintenance and rehabilitation which are of course costly. Highways and roads are also not an exception. From the very past, the construction, extension, maintenance and operating costs of highways, roads, bridges and tunnels were collected directly or indirectly. In the older indirect method, the expenses are compensated either by tax payment on fuel or rubber, or by budget allocation from the national income. The shortcoming of this method is that a number of tax payers, who do not use some of the roads and carriageways, have to pay extra money. However, in the other system, called direct method, the tolls are taken directly from the drivers passing that road or street.

In the common traditional method the road is blocked by some barriers in the route and the vehicles are permitted to pass the road after they pay the toll (in cash or by ticket). The course of vehicle is interrupted, which in turn results in longer travel time, higher fuel consumption and increased pollution level in that region. Another method that is commonly used today in industrial and advanced countries is the Electronic Toll Collection (ETC) in roads and carriageways. In this method, tolls are collected using electronic equipment on road sides with no speed reduction or vehicle stopping. This method will bring about intercity traffic reduction, reduced travel time, reduction in fuel consumption, and unified monetary network.

1.2 Toll Collection Methods

The choice of toll collection method should be based on the operational requirements of the individual toll project, recognizing the need for interoperability with other systems around the State. The following types of systems are currently available:

• **Manual Toll Collection** – This traditional approach has been there for centuries. A driver stops at a tollbooth and pays the required toll directly to a toll collector. Toll plazas can be located on highway mainlines or at entrances or exits to the facility. Manual toll collection can accommodate up to 400 vehicles per hour in a pure-cash environment. However, credit transactions reduce this rate considerably.

• **Unattended Toll Collection** – An early step in automation was the introduction of automatic coin machines, where drivers placed the required toll payment in a basket and the machine counted the amount. While coin machines have become less popular with toll agencies because of high maintenance requirements and the introduction of ETC, a related approach is still being used at locations and times of low-traffic volume. A self-service machine – similar to parking pay and display machines – is used to allow the driver to pay the toll with currency or credit card when a toll collector is not present. The need for right-of-way remains, but staffing costs are reduced. This practice is used for low-volume facilities and during late night hours at many facilities.

• **Electronic Toll Tax Collection (ETC)** – This method uses automatic vehicle identification technology that identifies a toll customer while the vehicle passes through a toll plaza, sometimes at highway speeds. Customers need to have an identification tag, usually an electronic transponder that is linked to the customer's account, which is automatically debited for the amount of the toll. ETC may be used in dedicated lanes, or combined with manual toll collection. Cameras are used to identify violators.

1.3 Problem with Existing System

The main problem of the Manual and Unattended toll tax system is that these are not efficient. Manual toll collection lanes handle only about 350 vehicles per hour (vph), and automated coin lanes handle about 500 vph. Customer has to stop on the toll plaza. As a result of this, congestion increases on toll roads, fuel economy decreases and pollution increases. To overcome this problem, we have Electronic toll tax system which can process 1200 vehicles per hour (vph). It reduces fuel consumption by removing the need to stop and thus eliminating deceleration/acceleration time. But the problem of this system is that once we enter on the toll road we have to pay for the whole distance of the toll road.

Thus, we are developing system in which tolls are collected using electronic equipment on road sides with no speed reduction or vehicle stopping. Toll is deducted according to the distance travelled by the customer on the toll road.

1.4 Objective of Our System

The most common approach for collecting tolls has been to have the driver stop and pay the toll to a toll collector sitting in a tollbooth. The toll collector determines the amount to be paid by each vehicle based upon its characteristics or classification. Generally, the vehicle sensors (called Automatic Vehicle Classification) are used to crosscheck these characteristics against the toll collected by the toll attendant. Enforcement was mainly addressed by the use of gates that were raised after the toll was paid. Manual lanes can accept an extensive variety of payment-means, such as cash, checks, credit / debit cards, and smart cards. A manual lane can process approximately 400 vehicles per hour. This is too low in comparison to a free flow freeway lane, with capacity approaching 2,000 vehicles per hour. Meeting peak period demand required the construction of large toll plazas. Traffic demand, coupled with the need for each vehicle to stop, resulted in significant congestion at many of these toll plazas.

Objective of our project is to make a system that can accurately identify a specific vehicle at highway speeds, thereby enabling a wide variety of ATC applications. In its basic form, a vehicle passing through a toll collection point has its identification device read, after which the toll is deducted from the customer's pre-existing account. If there is not enough money in the account of the customer, he has to stop at the toll plaza and recharge his account. If he has enough money in the account, he pays the toll without stopping. We endeavoured to make a system in which money is deducted according to the distance travelled by the customer on the toll road.

ATC also determines whether the cars passing are enrolled in the program. It gathers information on the vehicle for further collection or enforcement action. Therefore, to accomplish this objective in our project of Automatic Toll Tax System we do the following steps:

- To construct RF transmitter and receiver unit with frequency alignments and design a port relay sensor unit with a buzzer, at the out port of PC parallel port.
- To design software (using C language) for deducting toll tax according to the distance travelled.

1.5 Benefits of ETC Method

Among the several advantages of the ETC method, the following needs special mention:

- ETC lanes improve the speed and efficiency of traffic flow and thus save drivers' time. Manual toll collection lanes handle only about 350 vehicles per hour, and automated coin lanes handle about 500 vph. An ETC lane can process 1200 vph.
- Reduces fuel consumption by removing the need to stop and eliminating deceleration / acceleration time.
- Reduces the number of personnel required for toll collection,
- Reduces air pollution.
- Increases passenger convenience.
- Reduces cash flow and increases revenue: time savings, faster throughput, and better service attract more customers, thus increasing revenue.
- Reduces accident rates/ improved safety because of less slow-and-go driving.

CHAPTER 2

LITERATURE SURVEY AND RELEVANT THEORY

2.1 History of RFID

This section is intended to give a background to the work performed in the thesis. The purpose of this thesis is to investigate what secure electronics access system is feasible. The investigation will be based on a theoretical study, a practical test assessment and building a prototype.

Similar technology, such as the Identification Friend or Foe (IFF) transponder invented in the United Kingdom in 1915, was routinely used by the allies in World War II to identify aircraft as friend or foe. Transponders are still used by most powered aircraft to this day. Another early work exploring RFID is the landmark 1948 paper by Harry Stockman, titled "Communication by Means of Reflected Power" (Proceedings of the IRE, pp 1196–1204, October 1948). Stockman predicted that "... considerable research and development work has to be done before the remaining basic problems in reflected-power communication are solved, and before the field of useful applications is explored."

In 1945, Léon Theremin invented an espionage tool for the Soviet Union which retransmitted incident radio waves with audio information. Sound waves vibrated a diaphragm which slightly altered the shape of the resonator, which modulated the reflected radio frequency. Even though this device was a covert listening device, not an identification tag, it is considered to be a predecessor of RFID technology, because it was likewise passive, being energized and activated by electromagnetic waves from an outside source.

Mario Cardullo in 1973 was the first true ancestor of modern RFID; a passive radio transponder with memory. The initial device was passive, powered by the interrogating signal, and was demonstrated in 1971 to the New York Port Authority and other potential users and consisted of a transponder with 16 bit memory for use as a toll device. The basic Cardullo patent covers the use of RF, sound and light as transmission media. The original business plan presented to investors in 1969 showed uses in transportation (automotive vehicle identification, automatic toll system, electronic license plate, electronic manifest, vehicle routing, vehicle performance monitoring), banking (electronic check book, electronic credit card), security (personnel identification, automatic gates, surveillance) and medical (identification, patient history).

The first patent to be associated with the abbreviation RFID was granted to Charles Walton in 1983. The largest deployment of active RFID is the US Department of Defence using Savi active tags on each one of its more than a million shipping containers that travel outside the continental United States (CONUS). The largest passive RFID deployment is the Defence Logistics Agency (DLA) deployment across 72 facilities implemented by ODIN who also performed the global roll-out for Airbus consisting of 13 projects across the globe.

2.2 Radio Frequency Identification

A proven technology that has been around since about the 1940s, Radio Frequency Identification (RFID) has the potential to dramatically improve various industrial and service applications through automatic detection, unique identification, and control. RFID is expected to provide immense supply chain efficiencies, reduced labor costs, and accurate real-time resource information.

As the name RFID signifies, it is a kind of identification system, which uses radio frequency. RFID uses wireless technology operating with the 50 kHz to 2.5 GHz frequency range. It does not require any physical connection for identification between the unit to be identified and the identifier unit, which in this case is the reader. For automatic identification purposes each piece of equipment (which is to be identified) shall be fitted with a small electronic device (called tag) containing unique identification code.

The tag in the presence of sensing equipment (reader) operating on ultra high frequency (UHF) radio waves reflects altered radio waves (modulated) to determine the identification of the equipment.

For further analysis, the reader shall optionally add its own identification number, the date and time and shall transmit this data with tag information to the user's computer system.

2.3 Components of RFID

A basic RFID system consists of three components:

(a) An antenna or coil

(b) A transponder (RF tag)

(c) A transceiver (with decoder)

2.3.1 Antenna

The antenna emits radio signals to activate the tag and read and write data to it. Antennas are the conduits between the tag and the transceiver, which controls the system's data acquisition and communication. Antennas are available in a variety of shapes and sizes; they can be built into a door frame to receive tag data from persons or things passing through the door, or mounted on an interstate tollbooth to monitor traffic passing by on a freeway. The electromagnetic field produced by an antenna can be constantly present when multiple tags are expected continually. If constant interrogation is not required, a sensor device can activate the field.

Often the antenna is packaged with the transceiver and decoder to become a reader (interrogator), which can be configured either as a handheld or a fixed-mount device. The reader emits radio waves in ranges of anywhere from one inch to 100 feet or more, depending upon its power output and the radio frequency used. When an RFID tag passes through the electromagnetic zone, it detects the reader's activation signal. The reader decodes the data encoded in the tag's integrated circuit (silicon chip) and the data is passed to the host computer for processing.

2.3.2 Tags (Transponders)

An RFID tag comprises of a microchip containing identifying information and an antenna that transmits this data wirelessly to a reader. At its most basic, the chip contains a serialized identifier, or license plate number, that uniquely identifies that item, similar to the way many bar codes are used today. A key difference, however is that RFID tags have a higher data capacity than their bar code counterparts. This increases the options for the type of information that can be encoded on the tag, including the manufacturer, batch or lot number, weight, ownership, destination and history (such as the temperature range to which an item has been exposed). In fact, an unlimited list of other types of information can be stored on RFID tags, depending on application needs. An RFID tag can be placed on individual items, cases or pallets for identification purposes, as well as on fixed assets such as trailers, containers etc.

Tags come in a variety of types, with a variety of capabilities. Key variables include: "Read-only" versus "read-write". There are three options in terms of how data can be encoded on tags: (1) Read-only tags contain data such as a serialized tracking number, which is pre-written onto them by the tag manufacturer or distributor. These are generally the least expensive tags because they cannot have any additional information included as they move throughout the supply chain. Any updates to that information would have to be maintained in the application software that tracks SKU(Stock Keeping Unit) movement and activity. (2) "Write once" tags enable a user to write data to the tag one time in production or distribution processes. Again, this may include a serial number, but perhaps other data such as lot or batch number. (3) Full "read-write" tags allow new data to be written to the tag as and when needed—and even written over the original data.

2.3.1.1 Active Tags

An RFID tag is an **active tag** when it is equipped with a battery that can be used as a partial or complete source of power for the tag's circuitry and antenna. Some active tags contain replaceable batteries for years of use; others are sealed units. (Note that it is also possible to connect the tag to an external power source.)

The major advantages of an active RFID tag:

- It can be read at distances of one hundred feet or more, greatly improving the utility of the device.
- It may have other sensors that can use electricity for power.

The problems and disadvantages of an active RFID tag are:

- The tag cannot function without battery power, which limits the lifetime of the tag.
- The tag is typically more expensive, often costing Rs 1000 or more each.
- The tag is physically larger, which may limit applications.
- The long-term maintenance costs for an active RFID tag can be greater than those of a passive tag if the batteries are replaced.
- Battery outages in an active tag can result in expensive misreads.

Active RFID tags may have all or some of the following features:

- Longest communication range of any tag.
- The capability to perform independent monitoring and control.
- The capability of initiating communications.
- The capability of performing diagnostics.
- The highest data bandwidth.

Active RFID tags may even be equipped with autonomous networking; the tags autonomously determine the best communication path.

2.3.1.2 Passive Tags

A **passive tag** is an RFID tag that does not contain a battery; the power is supplied by the reader. When radio waves from the reader are encountered by a passive RFID tag, the coiled antenna within the tag forms a magnetic field. The tag draws power from it, energizing the circuits in the tag.

The major disadvantages of a passive RFID tag are:

- The tag can be read only at very short distances, typically a few feet at the most. This greatly limits the device for certain applications.
- It may not be possible to include sensors that can use electricity for power.
- The tag remains readable for a very long time, even after the product to which the tag is attached has been sold and is no longer being tracked.

The advantages of a passive tag are:

- The tag functions without a battery; these tags have a useful life of twenty years or more.
- The tag is typically much less expensive to manufacture.
- The tag is much smaller (some tags are the size of a grain of rice). These tags have almost unlimited applications in consumer goods and other areas.

2.3.3 RFID Receiver

The strategic placement of RFID readers is essential for the functionality of an RFID system. The reader is normally comprised of a coupling unit (the antenna), a modulation unit and an interface towards the back-end system and works by continuously broadcasting tag interaction requests. Additionally the reader has to have a control unit incorporating logic for e.g. tag collision avoidance. The RF transceiver may be enclosed in the same cabinet as the reader or it may be a separate piece of equipment. When provided as a separate piece of equipment, the transceiver is commonly referred to as an RF module. The RF transceiver controls and modulates the radio frequencies that the antenna transmits and receives. The transceiver filters and amplifies the backscatter signal from a passive RFID tag.

2.4 Back-End System

To minimize the computation effort made as well as the amount of information held by the RFID tags we choose to push as much logic and tag specific data as possible toward the back-end system. Ultimately the back-end system provides the tag information to the reader through a secure channel. In our system, the black-end system coincides with two trusted third parties. One party is keeping track of distance information and tag identities while the other party controls transactions.

2.5 Frequencies and Bandwidth

Due to regulations, the frequency ranges available to RFID systems are limited. The frequency mentioned is the centre frequency in the radio spectrum being transmitted. As the transmission speed as well as the reading range depends on the signal frequency, the properties of different frequency ranges are inherently different. Simply stated, as the frequency is raised, there is a linear improvement in the amount of information transferred per time unit. Furthermore, the speed depends on the bandwidth available. By bandwidth, we mean the width of the radio spectrum being transmitted. The wider the bandwidth, the better is the resolution and more is the information kept in the signal being sent. Put in other words, we are able to transfer more information per time unit, the wider the bandwidth. The precise relationship between bandwidth and transmission rate depends on the way the signal was originally coded. In the case of the Manchester coding, often used on the backward channel from the RFID tag to the RFID reader, there is a linear dependence. The amount of information transferable during a tag interaction is therefore limited by the fact that bandwidth is regulated together with the frequency. The restricted information transmission has consequences in the conciseness of the protocol interaction being deployed. Hence, for example the 13.56 MHz frequency requires a protocol with few rounds and an efficient collision avoidance algorithm while an RFID system working at the 915 MHz frequency can afford a more rigorous avoidance algorithm. Meanwhile, the tag reading range depends on the transmission frequency as well. Though the spreading range of radio waves is theoretically larger with lower frequency, other aspects will have to be taken into account when discussing reading range in the RFID context. As earlier mentioned, there is a transmission asymmetry between the reader and the tag. The forward channel range can easily exceed 100 metres while the backward channel range is limited by the amount of energy the tag accumulates. The amount of energy accumulated is positively correlated with the frequency of the signal that reaches the tag. Consequently, there is a positive correlation between the transmission range on the backward channel and the forward channel frequency. The transmission range on the backward channel is most often between 1 and 10 metres, setting the upper limit on the RFID system reading range. Furthermore, other aspects influence the choice of frequency. In the car toll context, we have almost clear sight to the RFID tag, which promotes a higher frequency tag.

Devices	**Bandwidth**	**Frequency**	**Example**
LOW	30 - 300 Hz	125 - 134 kHz	Short Range Applications: Live Stock Identification, Antitheft Systems
HIGH	3 - 30 kHz	13.56 MHz	Smart Card, Toll Collection Applications
VERY HIGH	300 kHz- 3 MHz	902-928 MHz	Product Labeling

Table 2.5 Frequency Range and Applications

2.6 Applications of RFID

2.6.1 Automation:

The RFID technology is poised to change the way supply chains function. The RFID lead supply chain promises to enhance visibility at lower cost and effort through a high degree of automation. It can automate processes such as receiving, picking, and tracking involved in automotive value chain. Manufacturers, distributors, and retails can gain extensively from the visibility we provide.

Manufacturers: Principal areas of application for RFID (Radio Frequency Identification) in manufacturing industries that can be easily identified include inventory control/pilferage and processing. Vehicle tracking during production helps minimize the level of offline work-in-progress. This also makes sure that quality issues are addresses efficiently. Quick detection of high-value equipment used in the manufacturing process like as tools, dies, jigs and test equipment ensures efficient use with minimal investment.

Distributors: Vehicle handling and their transportation has a significant effect on distributor margins. This margin can be managed by efficiently moving vehicles and their minimal handling. RFID can reduce the time spent on searching parking lots that contain thousands of vehicles, thereby cutting down labour costs ensuring on-time delivery. Knowing the precise location of vehicles makes last-minute addition of custom orders from retailers and helps improve customer service.
Retailers: Inventory counts are a painful process for dealers, especially those with large lots. Once all products have RFID tags, a RFID gate takes note of the entire production at one go without the necessity of scanning each product separately. RFID can replace manual counts, which generate high error rates. Automated inventory counts also improve customer service.

2.6.2 Management of Books in Libraries

To speed up the checkout process, more and more libraries are beginning to manage inventory by inserting RFID chips on all of their books. Few examples of RFID application in Education and Library system include the following:

According to librarians, the biggest reasons books can't be found in a library are (1) theft, (2) non-returns, and (3) miss-filed books. Certainly, the first two reasons are not surprising. But the third reason is quite eye-opening. Apparently, miss-filed items are a big problem. Even though the items are in the library, they're still "missing." But with the use of RFID, the entire collection is tagged. All books can be easily located and precisely found. It also minimizes the time spent on library management, Inventory of the library usually takes an entire month, and the library needs to be closed for that. Once the RFID system is fully implemented, inventory management will take half a day.

2.6.3 Tracking School Kids

RFID tags can be used to keep track of students. The tags can be attached to kids' clothes or backpacks, with readers to be installed in school gates and similar locations. When the kids cross the school gate, the parents get a message on their mobile phone. In this way, the kids can be tracked to be safe.

2.5.4 Patient and Staff Location in Hospitals

With both patients and staff on the move, hospitals face significant challenges in managing the cautious and attentive process of patient care. Also, with patients often scheduled for multiple, consecutive procedures, knowledge of their location helps optimize the patient-care process and helps manage schedules in real-time. Constant location tracking is particularly beneficial for patients in critical-care situations such as those recovering from cardiac surgery, as it offers quick and effective medical assistance if the patient's condition abruptly deteriorates. Locating medical staff is also important. And it is both ways: in case of emergencies in which a particular physician is required immediately and also to locate and help the staff in case they need assistance themselves.

2.6.5 Tracking of Medical Devices and Other Assets

Medical care units lose expensive medical equipments each year and spend invaluable countless hours searching for patient-care assets. These equipments include medical devices like infusion pumps, portable x-ray machines, and patient monitoring devices, as well as other movable assets such as wheelchairs, gurneys, and stretchers. Inability to quickly search for missing equipment results in the loss of productive hours: instead of attending to patients, nurses spend their time seeking the devices. The competence to locate assets instantaneously saves these valuable hours and cuts the money spent on replacing lost equipment.

2.6.6 High Value and Sensitive Asset Tracking

Government needs to track assets in its various segments. These assets include weapons and other sensitive materials in munitions and manufacturing units. High value assets include valuable military supplies involved in the supply chain to the front line and various medical devices used in government healthcare institutions.

2.6.7 Military Personnel Tracking

In the military, tracking applications have equally high relevance both in training environments and on the field. Location-enabled training environments can impart much better and advanced learning during exercises. Also, our solutions are highly suitable for urban indoor/outdoor combat environments. Besides this, the security systems in military bases can also be improved through personnel tracking and by determining unauthorized entrance or exit from specifically defined areas.

2.6.8 Transportation

The transportation industry is always striving to ensure passenger and employee security, reduce loss and theft, streamline cargo processes and more. RFID technology is transforming transportation operations worldwide by providing processes that enable customers to effectively meet these and other challenges. Flexible, easy-to-use RFID solutions are ideal for transportation operations, as they provide reliable identification and tracking technology and improved asset management, providing effective results in dozens of diverse applications. RFID provides real solutions with real benefits, which includes the following:

1. Enhanced passenger and employee safety by virtually eliminating security risks.

2. Improved and efficient baggage handling processes that reduces loss and theft and increases customer satisfaction.

3. Streamlines cargo processes and reduces labor costs.

4. Controls costs by improving all facets of inventory tracking and management.

2.5 Advantages of RFID versus Barcodes

RFID and barcodes both carry information about products. However, there are important differences between these two technologies:

- Barcode readers require a direct line of sight to the printed barcode; RFID reader do not require a direct line of sight to either active RFID tags or passive RFID tags
- RFID tags can be read at much greater distances; an RFID reader can pull information from a tag at distances up to 300 feet. The range to read a barcode is much less, typically no more than fifteen feet.
- RFID readers can interrogate, or read, RFID tags much faster; read rates of forty or more tags per second are possible. Reading barcodes is much more time-consuming; due to the fact that a direct line of sight is required, if the

items are not properly oriented to the reader it may take seconds to read an individual tag. Barcode readers usually take a half-second or more to successfully complete a read.

- Line of sight requirements also limit the **ruggedness of barcodes** as well as the **reusability of barcodes**. (Since line of sight is required for barcodes, the printed barcode must be exposed on the outside of the product, where it is subject to greater wear and tear.) RFID tags are typically more rugged, since the electronic components are better protected in a plastic cover. RFID tags can also be implanted within the product itself, guaranteeing greater ruggedness and reusability.
- Barcodes have no read/write capability; that is, you cannot add to the information written on a printed barcode. RFID tags, however, can be read/write devices; the RFID reader can communicate with the tag, and alter as much of the information as the tag design will allow.
- RFID tags are typically more expensive than barcodes, in some cases, much more so.

CHAPTER 3

HARDWARE DISCRIPTION

3.1 Block Diagram

The main circuitry includes a transmitter or smart card or RFID tag. The range of transmitter is approximately 10 m (approx.). The receiver is then connected to the relay unit which is further attached to the serial input of computer. On receiving the signal the computer then activates its output pins which are connected to another relay switch and a buzzer to confirm the valid user. Relay switch is attached to a motor which controls the barrier.

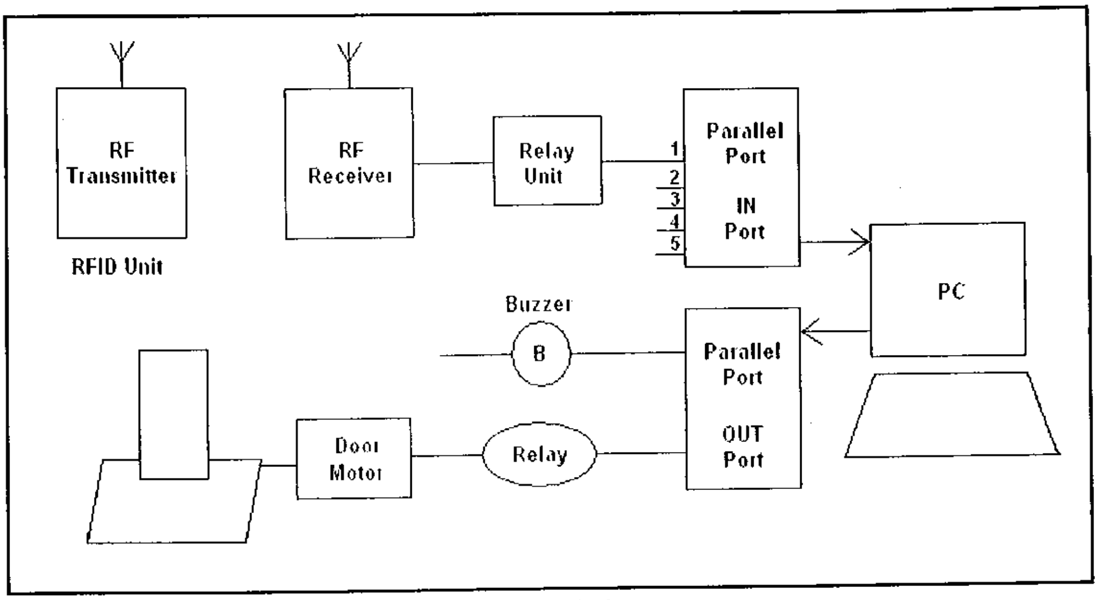


Figure 3.1 *System block diagram*

The basic components used for the design of "RFID based automatic toll tax collection system" are:

1. Power supply source

2. Radio Frequency Transmitter Unit

3. Radio Frequency Receiver Unit

4. Relay switching unit

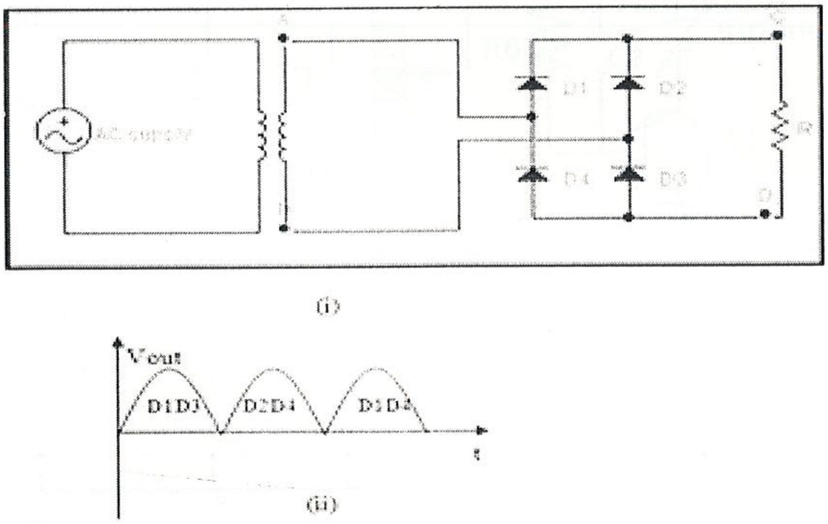
5. RFT (RF transformer)

3.2 Power Supply Source

The source of power supply is the AC input from the normal 220v switch. The supply is rectified first for further use. Rectification is the process of converting an alternating voltage or alternating current into direct voltage or direct current. The device used for rectification is called rectifier. Rectifiers are mainly two types, half wave rectifier and full wave rectifier.

Half wave rectifier is a circuit which rectifies only one of the halves of the ac cycle. During the half cycles when P is positive and N is negative, the diode is forward biased and will conduct. When P is negative and N is positive, the diode is reverse biased and will not conduct. Efficiency of the half wave rectifier will be about 40.6%. Full wave rectifier is a circuit which rectifies both half cycles of the AC, when P of 1st diode is positive; the 1st diode is forward biased and will conduct. Now the 2nd diode will not conduct as it is reverse biased. In all the half cycles either of the two diodes will be conducting. The efficiency of a full wave rectifier is about 81.2 %, twice the efficiency of a half wave rectifier.

The figure below shows the circuit diagram and components used



Full wave bridge wave rectifier (i) Circuit diagram (ii) waveforms.

Figure 3.2(i) *Full wave rectifier circuit*

Figure 3.2(ii) *Full wave rectifier waveform*

Full wave Bridge Rectifier requires four diodes, during the positive half-cycle of the secondary voltage, diodes D1 and D3 are conducting and diodes D2 and D4 are non-conducting. Therefore, current flows through the secondary winding, diode D1, load resistor RL and diode D3. During negative half-cycles of the secondary voltage, diodes D2 and D4 conduct, and the diodes D1 and D3 do not conduct. The current therefore flows through the secondary winding, diode D2, load resistor RL and diode D4. In both cases, the current passes through the load resistor in the same direction. Therefore, a fluctuating, unidirectional voltage is developed across the load.

3.3 Radio Frequency Transmitter Circuit

This part of project is supposed to be in the hands of the customers. This is in form of a card which contains the code known as EPC (Electronic Product Code) which further contains the identity of a customer. The circuit diagram of the transmitter is shown below with the component list used in the circuit.

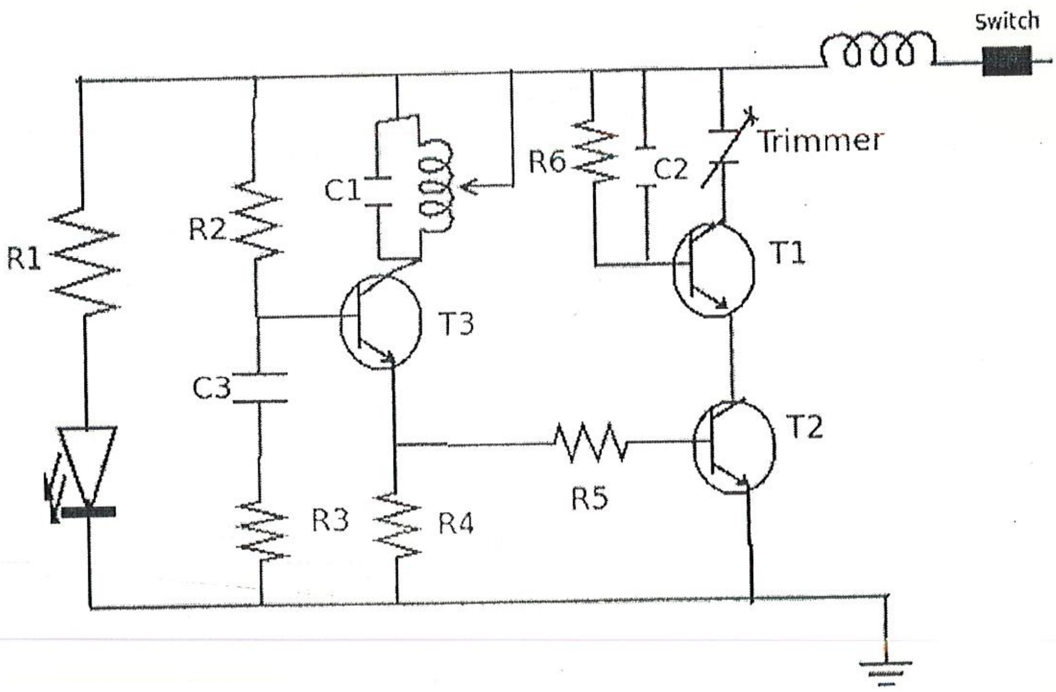


Figure 3.3 *Radio frequency transmitter units*

The RF remote transmitter contain an oscillator comprises one BF-194 (radio frequency modulator transistor). This transistor is coupled with CE configuration with other NPN 548 transistor for biasing. The basic oscillator is formed by transistor T3 working under CE configuration. From the collector an LC circuit is generating the source oscillation that super imposes to the T-2 base from its emitter follower circuit. R2 provides biasing Vcc to T3. R1 and LED indicate the power 'on' while pressing the key. The basic modulation circuit comprises T-1, R-6, C-2 and a trimmer variable capacitor. By changing the IFT at the T3 collector (LC circuit) we can change frequency for transmission. Varying trimmer at collector of T-1 can do the range and alignment between transmitter and receiver. A 9V portable battery powers the whole unit.

3.3.1 Components of Transmitter

RESISTANCE:-

R1	-	100Ω
R2	-	330K
R3, R4, R5	-	2K7
R6	-	47K

CAPACITORS:-

C1	-	.022
C2, C3	-	.001

TRANSISTOR:-

T1	-	BF494
T2	-	BC548

3.4 Radio Frequency Receiver Circuit

In the receiver circuit the transmitter Q1 also working as LC tank circuit basic oscillator that receives the variable frequencies Q2, Q3 are two basic low power amplifier provides amplification to all frequencies. L2 coil (IFT) selects the specific frequency to further amplifiers and fed at the base of Q4 via R-14 resistor. The power amplification is provided by Q5 transistor. In the circuit R2 and R3 provides biasing Vcc to Q1 same as R10 provides biasing Vcc+ to Q2 transistors. C1 and R5 give CE follower circuit for Q1 and same as for Q2 as R8 and C6 doing the same function. Rest other resistor and capacitor provides necessary basing Vc and frequency cut off function at different stages of the circuit. Finally from Q5 the driver unit given output to the buzzer or any other connected device to operate that unit.

3.4.1 Components of Receiver

RESISTANCE:-

R1, R5	-	2K7
R2	-	38K
R3	-	100K
R4	-	22K
R6, R7, R9	-	1K5
R8	-	10K
R10	-	470K
R11, R12	-	1M
R13	-	1K2 (VR2 20K)
R14	-	47K
R15	-	1K
R16	-	10K
R17	-	4K7
R18	-	1.5K

CAPACITORS:-

C1	-	.02
C2	-	100Pf
C3	-	3.3Pf
C4	-	.002

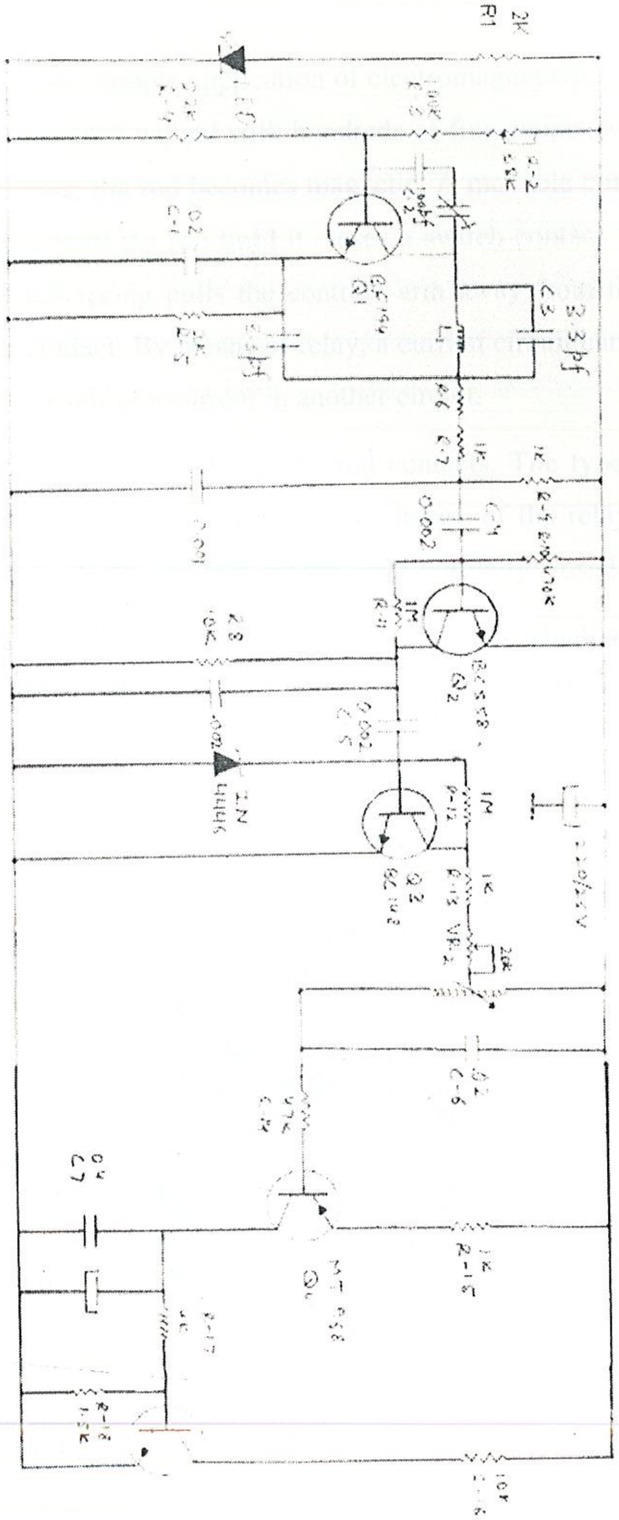


Figure 3.4 *Radio Frequency receiver unit*

3.5 Relay

Relay is a common, simple application of electromagnetism. It uses an electromagnet made from an iron rod wound with hundreds of fine copper wire. When electricity is applied to the wire, the rod becomes magnetic. A movable contact arm above the rod is then pulled toward the rod until it closes a switch contact. When the electricity is removed, a small spring pulls the contract arm away from the rod until it closes a second switch contact. By means of relay, a current circuit can be broken or closed in one circuit as a result of a current in another circuit.

Relays can have several poles and contacts. The types of contacts could be normally open and normally closed. One closure of the relay can turn on the same normally open contacts; can turn off the other normally closed contacts.

Relay requires a current through their coils, for which a voltage is applied. This voltage for a relay can be D.C. low voltages up to 24V or could be 240V a.c.

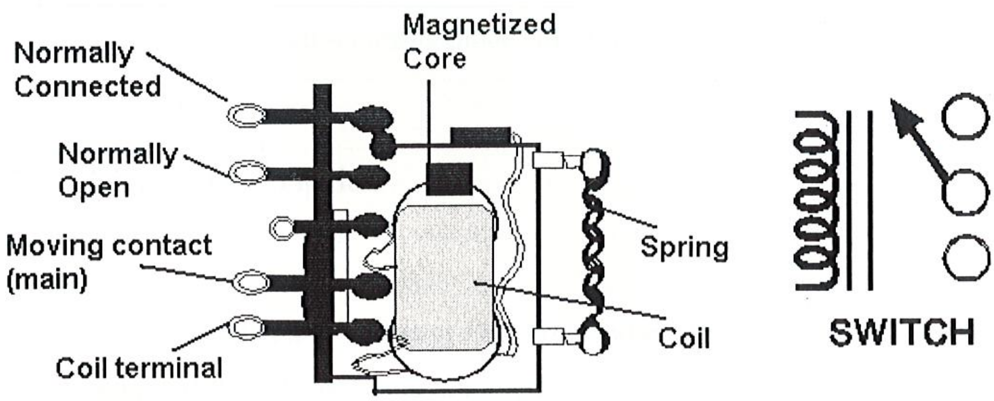


Figure 3.5 *Internal structure of relay*

3.5.1 Operation

When a current flows through the coil, the resulting magnetic field attracts an armature that is mechanically linked to a moving contact. The movement either makes or breaks a connection with a fixed contact. When the current to the coil is switched off, the armature is returned by a force that is half as strong as the magnetic force to its relaxed position. Usually this is a spring, but gravity is also used commonly in industrial motor starters. Relays are manufactured to operate quickly. In a low voltage application, this is to reduce noise. In a high voltage or high current application, this is to reduce arcing.

If the coil is energized with DC, a diode is frequently installed across the coil, to dissipate the energy from the collapsing magnetic field at deactivation, which would otherwise generate a spike of voltage and might cause damage to circuit components. If the coil is designed to be energized with AC, a small copper ring can be crimped to the end of the solenoid. This "shading ring" creates a small out-of-phase current, which increases the minimum pull on the armature during the AC cycle.

By analogy with the functions of the original electromagnetic device, a solid-state relay is made with a thyristor or other solid-state switching device. To achieve electrical isolation, a light-emitting diode (LED) is used with a photo transistor.

3.5.2 Circuit Description

The circuit is simple NPN transistor common emitter switching circuit. The transistor T-1 is supplied through negative at emitter. The base is conducted through the port output from computer and collector gives output to energies the relay commonly connected to +ve supply. The diode prevents back emf produced by relay while working.

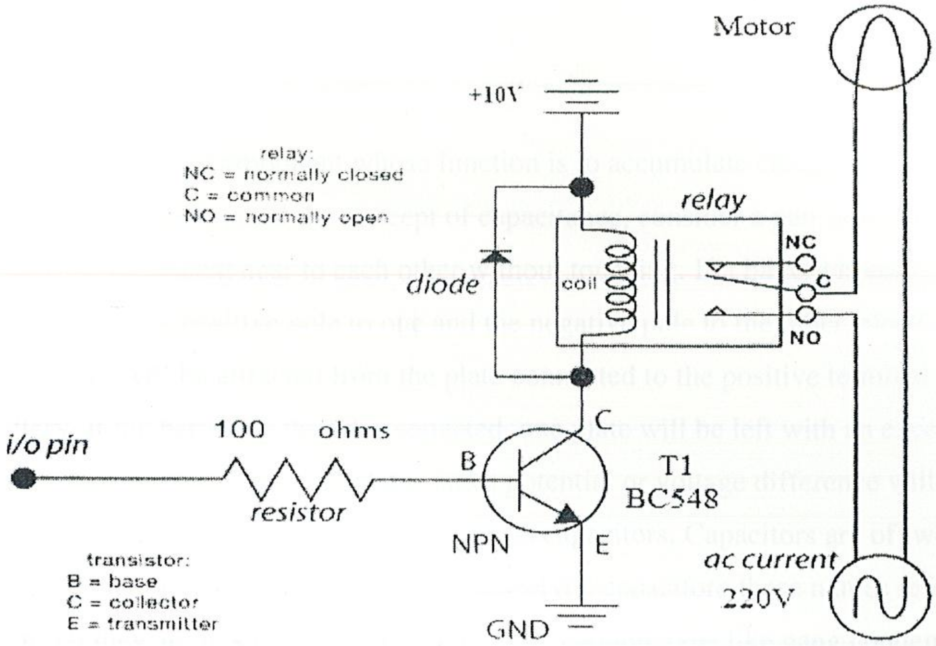


Figure 3.5 *Circuit of relay*

3.6 Resistors

Resistance is the opposition of a material to the current. It is measured in Ohms. All conductors represent a certain amount of resistance, since no conductor is 100% efficient. To control the electron flow (current) in a predictable manner, we use resistors. Electronic circuits use calibrated lumped resistance to control the flow of current. Broadly speaking, resistor can be divided into two groups viz. fixed & adjustable (variable) resistors. In fixed resistors, the value is fixed & cannot be varied. In variable resistors, the resistance value can be varied by an adjuster knob. It can be divided into (a) Carbon composition (b) Wire wound (c) Special type. The most common type of resistors used in our projects is carbon type.

3.7 Capacitor

It is an electronic component whose function is to accumulate charges and then release it. To understand the concept of capacitance, consider a pair of metal plates which all are placed near to each other without touching. If a battery is connected to these plates the positive pole to one and the negative pole to the other, electrons from the battery will be attracted from the plate connected to the positive terminal of the battery. If the battery is then disconnected, one plate will be left with an excess of electrons, the other with a shortage, and a potential or voltage difference will exists between them. These plates will be acting as capacitors. Capacitors are of two types: - (1) fixed type like ceramic, polyester, electrolytic capacitors-these names refer to the material they are made of aluminium foil. (2) Variable type like gang condenser in radio or trimmer.

3.8 Diodes

The simplest semiconductor device is made up of a sandwich of P-type semi conducting material, with contacts provided to connect the p-and n-type layers to an external circuit. This is a junction Diode. If the positive terminal of the battery is connected to the p-type material (cathode) and the negative terminal to the N-type material (Anode), a large current will flow. This is called forward biased.

3.8.1 Light Emitting Diode (LED)

When a junction diode is forward biased, energy is released at the junction diode is forward biased, energy is released at the junction due to recombination of electrons and holes. In case of silicon and germanium diodes, the energy released is in infrared region. In the junction diode made of gallium arsenate or indium phosphide, the energy is released in visible region. Such a junction diode is called a light emitting diode or LED.

3.9 Picture of Model

One portion of the figure shows the transponder/transmitter and the other shows the rest of the project showing the receiver, relay, transformer, buzzer, door, relay, motor and every other part. The knob act as four different toll plazas.

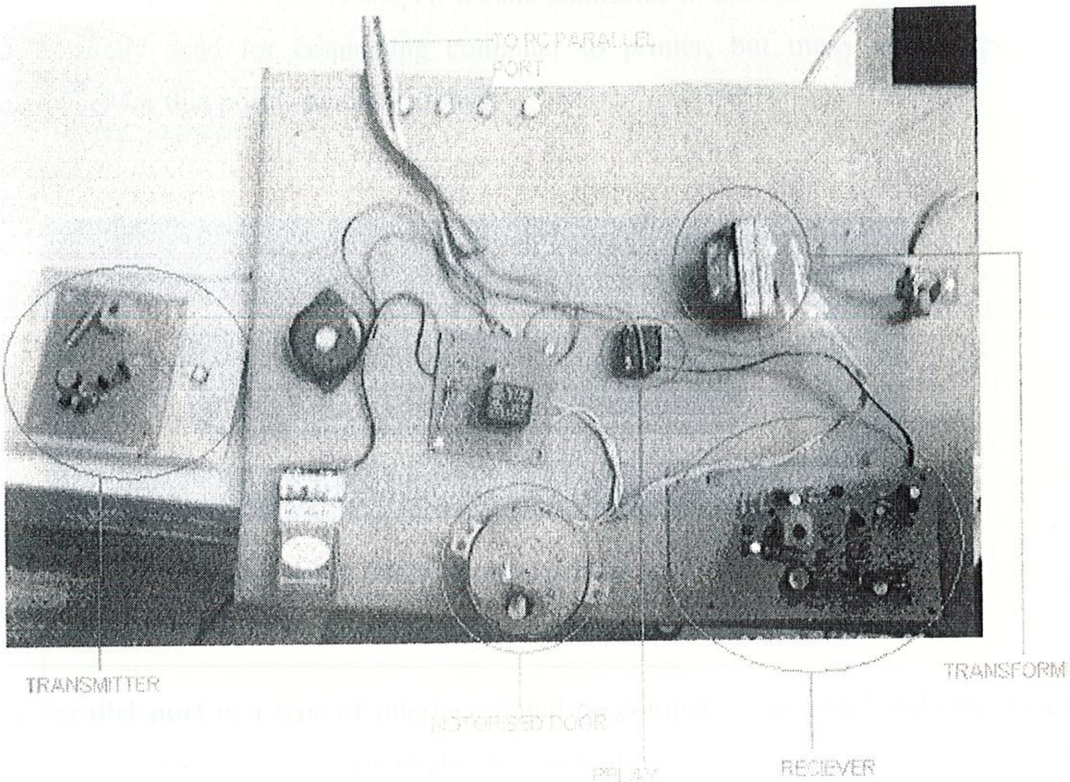


Figure 3.9 *Picture of working model*

CHAPTER 4

SOFTWARE SHEMATICS

4.1 Parallel Port Interfacing

PC parallel port is 25 pin D-shaped female connector in the back of the computer. It is normally used for connecting computer to printer, but many other types of hardware for that port is available today.

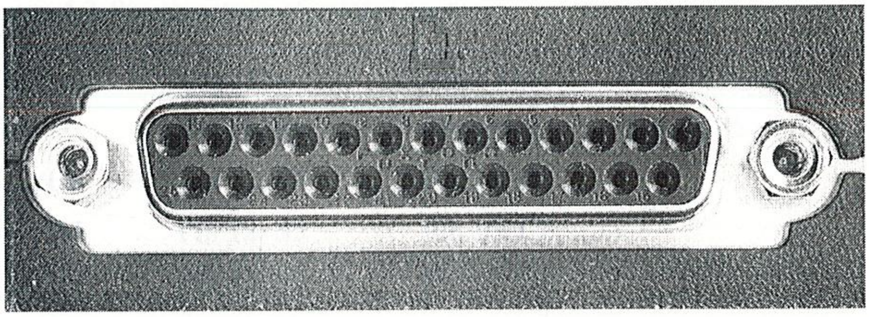


Figure 4.1 *A DB25 parallel printer port*

A **parallel port** is a type of interface found on computers (personal and otherwise) for connecting various peripherals. In computing, a parallel port is a parallel communication physical interface. It is also known as a **printer port** or **Centronics port**. The IEEE 1284 standard defines the bi-directional version of the port. This transmits particular amount of bits in parallel at the same time. This is opposite to serial transition where one bit will be transmitted at a time.

Those data pins are TTL level output pins. This means that they put out ideally 0V when they are in low logic level (0) and +5V when they are in high logic level (1). In real world the voltages can be something different from ideal when the circuit is loaded. The output current capacity of the parallel port is limited to only few milliamperes.

4.2 Pin Structure of port

[Data Port] Address: 0x378H

[Status Port] Address: 0x379H

[Control Port] Address: 0x37AH

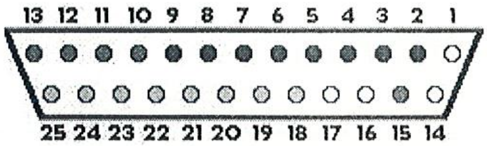


Figure 4.2 *Pin structure of printer port*

Data Pins	Status Pins	Control Pins	Ground Pins
Pin 9: D7	Pin 10: S6	Pin 1: C0	Pin 18-25
Pin 8: D6	Pin 11: S7	Pin 14: C1	
Pin 7: D5	Pin 12: S5	Pin 16: C2	
Pin 6: D4	Pin 13: S4	Pin 17: C3	
Pin 5: D3	Pin 15: S3		
Pin 4: D2			
Pin 3: D1			
Pin 2: D0			

4.3 How to calculate your own values to send to program

You have to think the value you give to the program as a binary number. Every bit of the binary number control one output bit. The following table describes the relation of the bits, parallel port output pins and the value of those bits.

Pin	2	3	4	5	6	7	8	9
Bit	D0	D1	D2	D3	D4	D5	D6	D7
Value	1	2	4	8	16	32	64	128

For example if you want to set pins 2 and 3 to logic 1 (led on) then you have to output value 1+2=3. If you want to set on pins 3,5 and 6 then you need to output value 2+8+16=26. In this way you can calculate the value for any bit combination you want to output.

4.4 Parallel Port Programming in Borland C Compiler

The following examples are short code examples how to write to I/O ports using C languages. In the examples I have used I/O address 378h which is one of the addresses where parallel port can be.

The typical parallel port I/O address configurations seen on PCs with ISA bus:

LPT1: 3BCh, LPT2: 378h, LPT3: 278h

LPT1: 378h, LPT2: 278h

LPT1: 378h

outp(0x378,n);

or

outportb(0x378,n);

Where N is the data you want to output. The actual I/O port controlling command varies from compiler to compiler because it is not part of standardized C libraries.

Here is an example source code for Borland C compiler:

```
#include <stdio.h>

#include <dos.h>

#include <conio.h>

/********************************************/

/*This program set the parallel port outputs*/

/********************************************/

void main (void)

{

clrscr();            /* clear screen */

outportb(0x378,0xff); /* output the data to parallel port */

getch();             /* wait for keypress before exiting */

}
```

4.5 Mains Power Controlling with Parallel Port

It is possible to control mains voltage through parallel port with a suitable circuit. When controlling mains voltage, you need to be very careful and know what you do to do it safely. Mains voltage can kill if you get in touch with it, and bad mains controlling circuit can burn down your house.

First idea for controlling mains power is to use one of the circuit above to control a relay that then controls the mains power. This suits for many applications as long as the relay is rated for the mains power switching applications and for the current rating of your applications. The relay contact is used to switch the phase/live wire going to the equipment. A properly designed circuit should have in addition to the relay (plus parallel port interface circuit) also a properly sized fuse that will cut the power going through the relay in case of short circuit or overload at the equipment being controlled. The fuse here is used to protect the relay against overload. A relay will work on applications where the device is turned on and off quite rarely. If you are switching the device on and off often, the normal relay will suffer of limited mechanical and electrical age, and in some applications also on noise caused by sparks that are formed when relay contacts open and close. Those sparks can cause radio frequency noise.

Another component suitable for mains voltage controlling is a solid state relay. The circuit show below describes how to control a solid state relay from PC parallel port. The solid state relay controls the mains voltage.

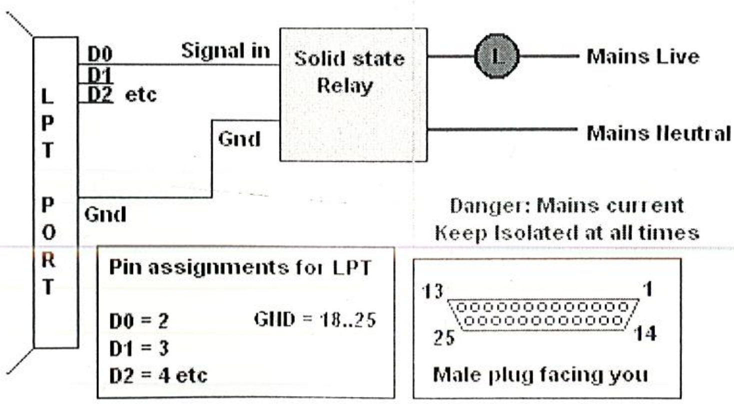


Figure 4.5 *Mains connected with parallel port*

The relay for this application should be some rated for the mains voltage you used and the current your controlled equipment (marked with L on the picture) takes. The solid state relays designed for mains operation provide the needed isolation between the control input and mains side. The solid state relay should be used according the manufacturer application notes and your local electrical equipment codes. You should keep the mains side and low voltage side isolated in all cases (even on equipment damage case). You should also put a properly rated fuse in series with the solid state relay so protect the relay against overload. A proper size fuse will not protect the solid state relay against overheating of the load tries to take too much current through the relay. The fuse might not be able to protect the relay again short circuit damages (if you short-circuit the load, you generally loose the solid state relay and the fuse).

Many solid state relays can be controlled directly to parallel port without extra components. You need to select a solid state relay that is voltage controlled and the control voltage range can take the voltage that printer port outputs (5V or somewhat less). For reliable operation you should select a relay that can operate at down to 3V input voltages and does not take too much control current (a SSR that takes only few milliamperes is preferred because current output capacity of parallel port is usually limited to that). To guarantee that the operation is reliable with the direct connection, be sure to measure that the control voltage entering the SSR is within the specified operating range when the relay is controlled to parallel port (you can measure this without mains power applied to the rest of circuit, safer o measure in this way). Controlling a solid state relay with lower than specified control voltage can lead unreliable operation of solid state relay, and can even cause some solid state relays fail when heavily loaded.

CHAPTER 5

RESULTS AND DISCUSSIONS

5.1 The Smart Card

As shown in the figure the circuit of the transmitter unit contains a trimmer capacitor due to which it cannot be implemented on a breadboard. To make the circuit easy to mount we have used a special designed printed circuit board (PCB). This PCB is available in the market as remote switch PCB. While soldering the circuit must read the manual for soldering the trimmer and the IFT circuit, these can destroy due to overheat.

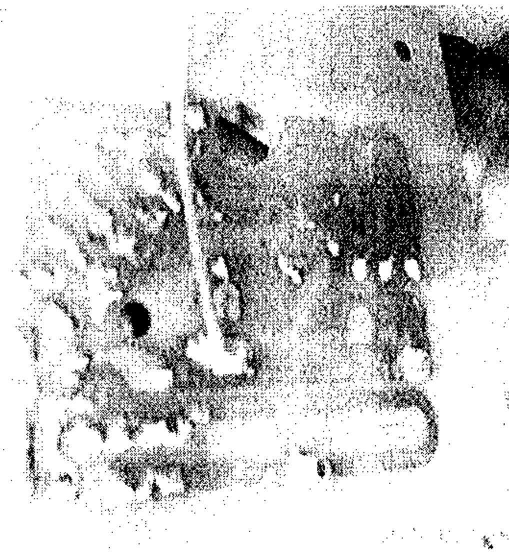


Figure 5.1(i)

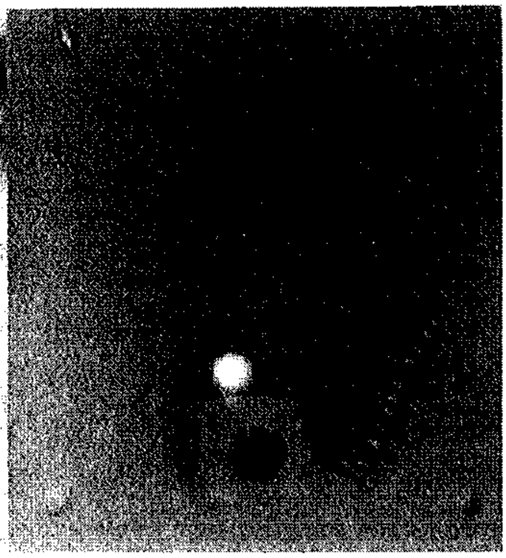


Figure 5.1(ii)

Figure 5.1(i) *Shows the PCB layout of the card in including the soldered components.*

Figure 5.1(ii) *Represents the circuit which includes a wire antenna; glowing LED proves that the circuit is in working mode and transmitting the RF signal to the receiver.*

5.2 The Receiver Unit

The figure below shows the implemented circuit of the receiver unit which is further connected to the computer through the relay switch. Starting from left we have a bridge rectifier, a power amplification circuit and an LC tank circuit basic oscillator that receives the variable frequencies from different from different tags of smart cards.

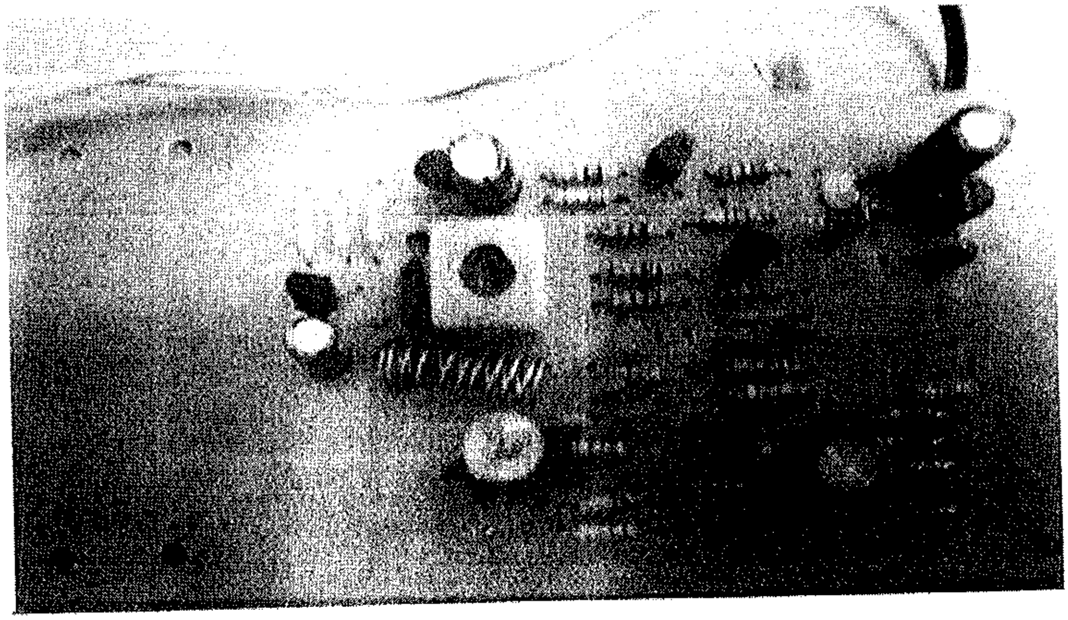


Figure 5.2 *Receiver unit*

The two LEDs shown here are used for the power on and signal verification. Three pin ICs represents transistors. The spring shown above acts as an antenna same as in the case of transistor unit. This circuit is also mounted on a printed circuit board to make the implementation easy and to reduce the chances of error because any error in the circuit can result in damage to the interface and can destroy the motherboard of the system.

5.3 Initializing the System

To run project we need to first install the port drivers. Then run the program and connect the wires. We will see a led glowing in the receiver unit which justifies that the connections are good and the unit is ready to operate. The monitor screen shows the options available.

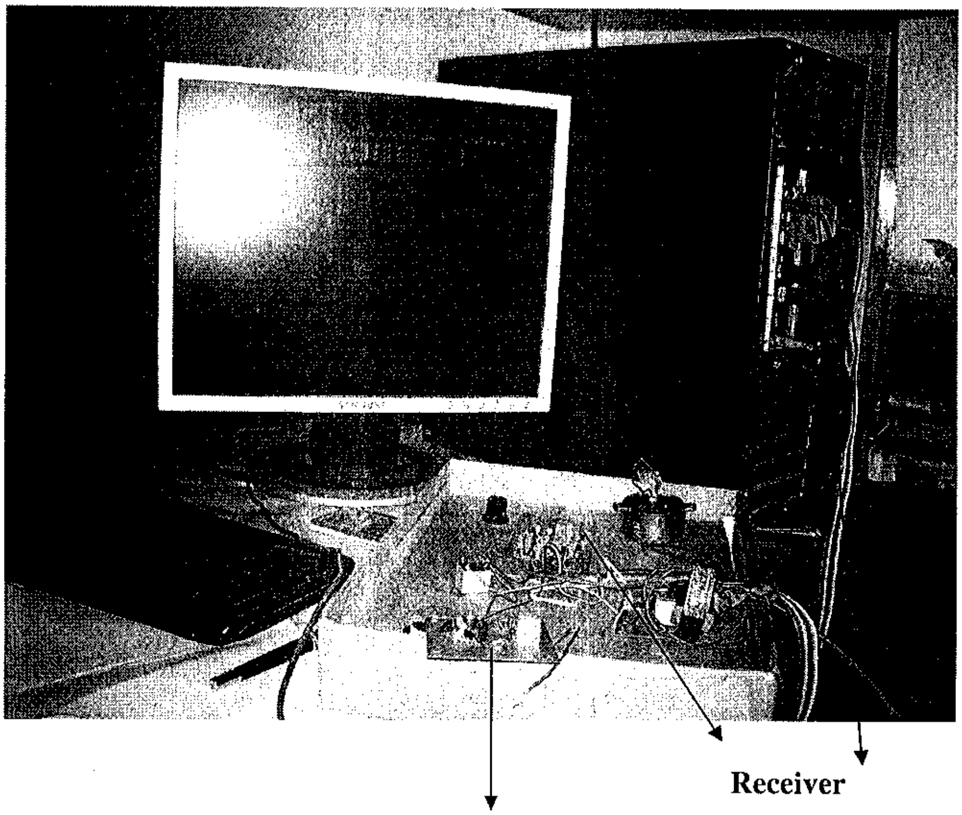


Figure 5.3 *Model connected with system*

5.4 Creating an Account

The figure below is a snapshot of the project when interfaced with a computer. This page is an introductory page to our system. In system page we have created an id with name "vivek bansal" then we entered a balance of rupees 10. The minimum balance which a person can have is rupees 5 because this is the maximum toll on this toll road. Now this account has a balance of rupees 10 to travel.

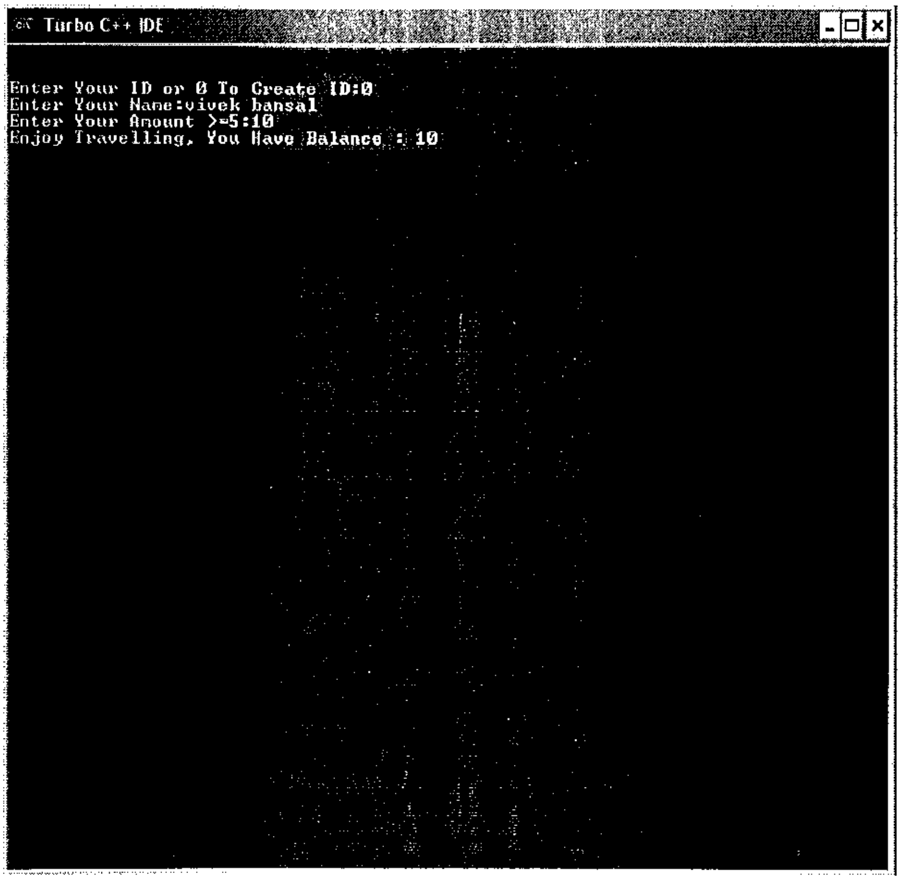


Figure 5.4 *Snapshot of creating an account*

5.5 Working of Project

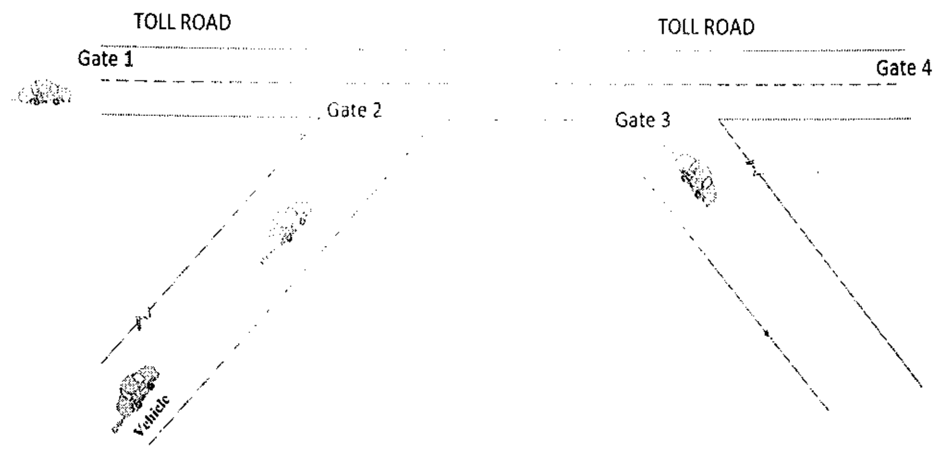


Figure 5.5(i) *Prototype of the toll road*

This is the prototype of the working model in which horizontal road depicts as toll road and other are the links to the toll road. Gates represents as the toll plazas for entering the toll road. These are the 4 toll plazas which are represented by knob on the working model. Money is deducted according to distance travel on the toll road.

When vehicle enters on toll road from toll plaza 1 then it will check whether the tag has enough money to travel on the toll road or not. If it doesn't have enough money then it will ask to recharge the tag otherwise the gate will open and record the date and time of entry. When the vehicle leaves the toll road then money will be deducted according to the distance between the toll plazas where it has entered and left the toll road. Like in our model we have different fares which are shown in the table below

Entering Gate	Leaving Gate	Total Fare in Rs.
Gate 1	Gate 1	5
Gate 1	Gate 2	1
Gate 1	Gate 3	2
Gate 1	Gate 4	3
Gate 2	Gate 3	1
Gate 2	Gate 4	2
Gate 3	Gate 4	1

Table 5.5 *Total fare according to distance travelled*

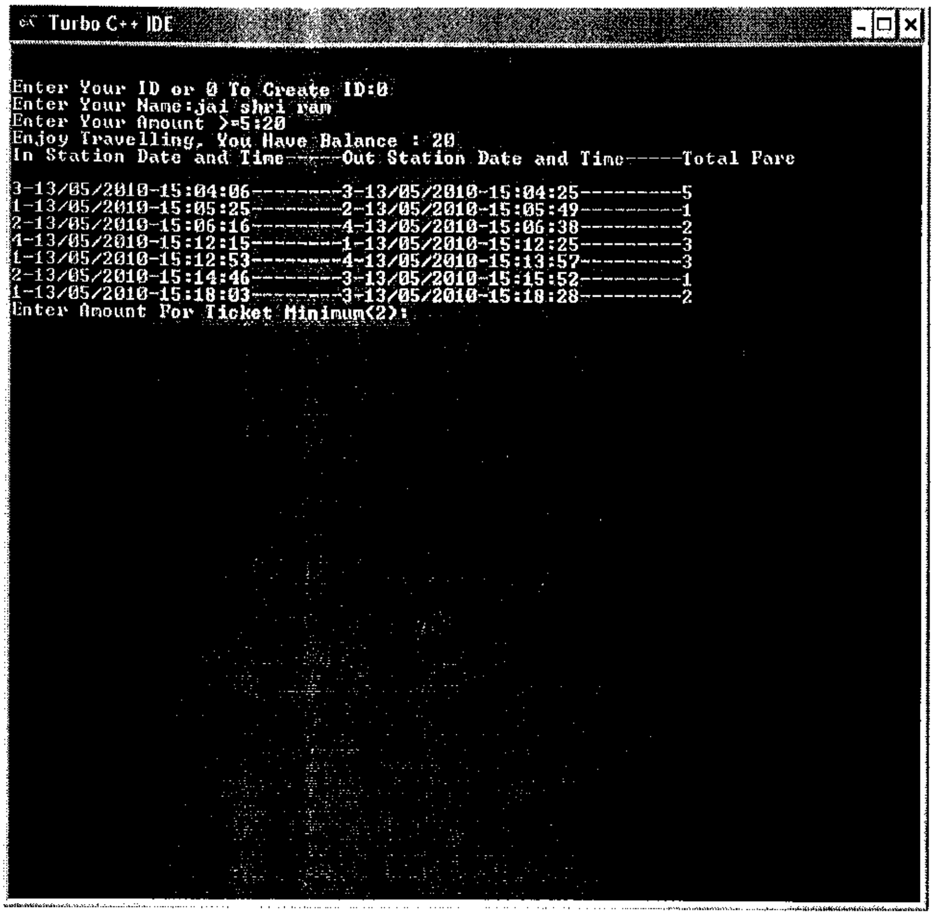
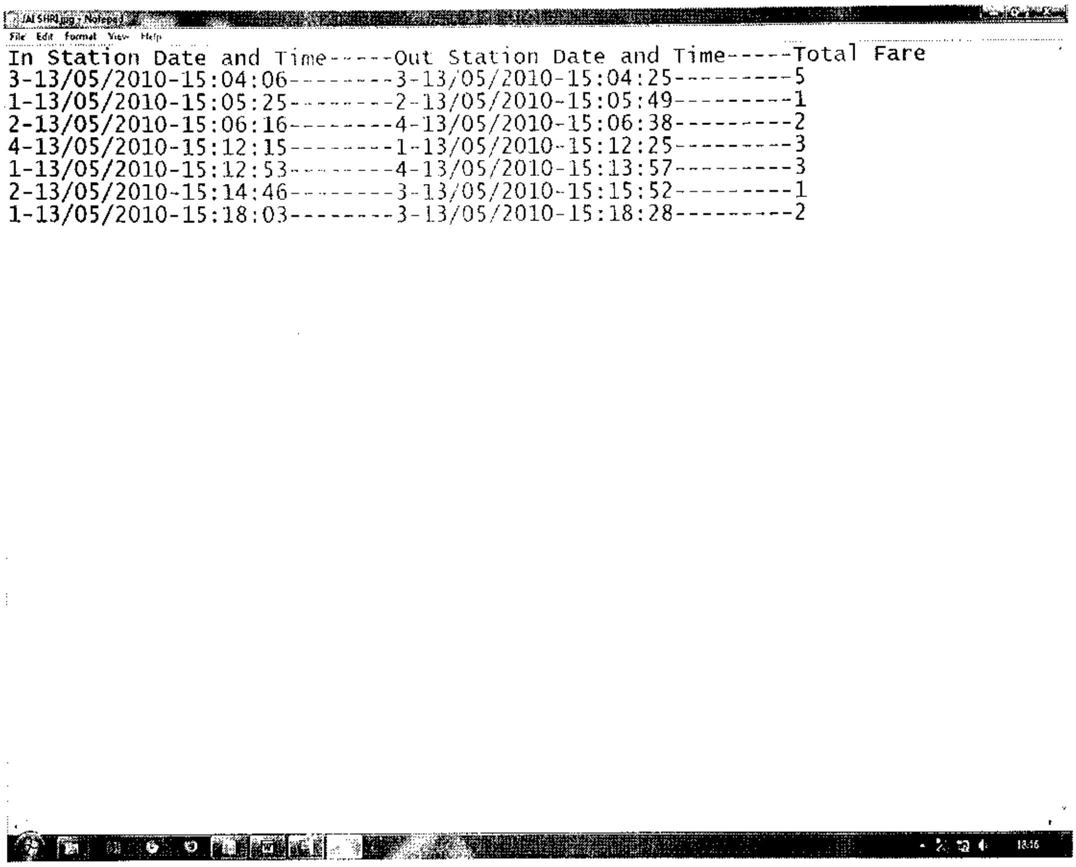


Figure 5.5(ii) *Snapshot of the record travelling*

The above snapshot depicts the deduction of money from the account of a particular user. Initially account balance is Rs. 20 and it travels through different toll plazas until there is a minimum balance in the account. After that it asks to recharge the account. When the vehicle enters and leaves the toll road, the time and date of entry is recorded. All the entries are recorded in a text file. The snapshot of the text file is shown below



```
In Station Date and Time-----Out Station Date and Time-----Total Fare
3-13/05/2010-15:04:06---------3-13/05/2010-15:04:25---------5
1-13/05/2010-15:05:25---------2-13/05/2010-15:05:49---------1
2-13/05/2010-15:06:16---------4-13/05/2010-15:06:38---------2
4-13/05/2010-15:12:15---------1-13/05/2010-15:12:25---------3
1-13/05/2010-15:12:53---------4-13/05/2010-15:13:57---------3
2-13/05/2010-15:14:46---------3-13/05/2010-15:15:52---------1
1-13/05/2010-15:18:03---------3-13/05/2010-15:18:28---------2
```

Figure 5.5(iii) *Snapshot of travelling record text file*

Figure above is the text file of all the entries of a particular user. This text file will be saved in the system server automatically. This is very important to keep a track of every user in order to maintain the account of the user. So we can save the time and the toll plaza where he has entered the toll road and the time and place where he has left the toll road, and the money deducted from the account each time.

CHAPTER 6

PROGRAMMING

```
#include<stdlib.h>
#include<string.h>
#include<stdio.h>
#include<conio.h>
#include<dos.h>

int id,amt;
char *name;
struct time tin,tout;
struct date din,dout;
struct ticket
   {
    int id;
    char name[21];
    int amount;
   }tkt;

char station(int sta)
 {
  switch(sta)
       {
        case 63 :return '1';
        case 255:return '2';
        case 95 :return '3';
        case 111:return '4';
        case 119:return '5';
        default :break;
       }
 }

void updateamount()
   {
```

```
    struct FILE *fl;
    fl=fopen("Ticket.Dat","r+b");
    if(id>1)
        fseek(fl,((id-1)*sizeof(tkt)),0);
    tkt.id=id;
    strcpy(tkt.name,name);
    tkt.amount=amt;
    fwrite(&tkt,sizeof(tkt),1,fl);
    fclose(fl);
 }

void writeid()
  {
    struct FILE *fl;
    fl=fopen("Ticket.Dat","a+b");
    tkt.id=id;
    strcpy(tkt.name,name);
    tkt.amount=amt;
    fwrite(&tkt,sizeof(tkt),1,fl);
    fclose(fl);
  }

int findid(int i)
  {
    struct FILE *fl;
    if((fl=fopen("Ticket.Dat","rb"))==NULL)
    return 0;
    while(fread(&tkt,sizeof(tkt),1,fl)!=0)
          {
           if(tkt.id==i)
             {
              amt=tkt.amount;
             strcpy(name,tkt.name);
             break;
            }
```

```
        }
fclose(fl);
return tkt.id;
  }

void indoor()
   {
        outportb(0x378,17);
        delay(5000);
        outportb(0x378,18);
        delay(5000);
        outportb(0x378,0);
        gettime(&tin);
        getdate(&din);
   }

void outdoor(int in,int out)
     {
        struct FILE *file;
        char *str,*sid;
        outportb(0x378,20);
        delay(5000);
        outportb(0x378,24);
        delay(5000);
        outportb(0x378,0);
        gettime(&tout);
        getdate(&dout);
        strcpy(str,name);
        itoa(id,sid,10);
        strcat(str,sid);
        strcat(str,".txt");
if((file=fopen(str,"rt"))==NULL)
   {
   puts("In Station Date and Time---Out Station Date and Time---Total  Fare");
   file=fopen(str,"wt");
```

```
  fputs("In Station Date and Time---Out Station Date and Time---Total Fare",file);
  fclose(file);
  }

file=fopen(str,"at");

fprintf(file,"%c-%02d/%02d/%04d-%02d:%02d:%02d--------%c-%02d/%02d/%04d-
%02d:%02d:%02d---------%d\n",
station(in),din.da_day,din.da_mon,din.da_year,tin.ti_hour,tin.ti_min,tin.ti_sec,
station(out),dout.da_day,dout.da_mon,dout.da_year,tout.ti_hour,tout.ti_min,
tout.ti_sec,abs(((int)station(out)-(int)station(in))==0?5:((int)station(out)-
(int)station(in))));

fclose(file);

printf("%c-%02d/%02d/% 04d-%02d:%02d:%02d--------%c-%02d/%02d/%04d-
%02d:%02d:%02d-------
%d\n",station(in),din.da_day,din.da_mon,din.da_year,tin.ti_hour,tin.ti_min,tin.ti_sec,
station(out),dout.da_day,dout.da_mon,dout.da_year,tout.ti_hour,tout.ti_min,
tout.ti_sec,abs(((int)station(out)-(int)station(in))==0?5:((int)station(out)-
(int)station(in))));

amt-=abs(((int)station(out)-(int)station(in))==0?5:((int)station(out)-(int)station(in)));
updateamount();
}


void main()
 {
  unsigned char ch,ch1;
  int i;
  clrscr();
  amt=0;
  id=0;
  name[0]='\0';
  puts("************ Ticket System ************\n");
  printf("Enter Your ID or 0 To Create ID:");
```

```
scanf("%d",&id);
  if(id==0)
    {
     printf("Enter Your Name:");
     fflush(stdin);
     gets(name);
     printf("Enter Your Amount >=5:");
     scanf("%d",&amt);
       if(amt<5)
         {
          puts("Amount Must Be > 4.");
          getch();
          exit(0);
         }
     id=findid(0)+1;
     writeid();
    }
else if(findid(id)!=id)
    {
     puts("ID not found.");
     getch();
     exit(0);
    }

if(amt<5)
  {
   printf("Enter Amount For Ticket Minimum(%d): ",5-amt);
   scanf("%d",&i);
    amt+=i;
     if(amt<5)
         {
          puts("Amount Must Be > 4.");
          getch();
          exit(0);
         }
```

```
 updateamount();
 }
else
 printf("Enjoy Travelling, You Have Balance : %d\n",amt);
 ch1=0;
 while(1)
   {
      ch=inportb(0x379);
      if(ch1==0 && (ch==63 || ch==255 || ch==95 || ch==111 || ch==119))
              {
              indoor();
              ch1=ch;
              }
     else if(ch1!=0 && (ch==63 || ch==255 || ch==95 || ch==111 || ch==119))
              {
               outdoor(ch1,ch);
               ch1=0;
               }
      if(kbhit())
      ch=getch();
       if(ch==27)
       break;
       ch=0;
      delay(50);
      outportb(0x378,0);
        if(amt<5)
           {
             printf("Enter Amount For Ticket Minimum(%d): ",5-amt);
             scanf("%d",&i);
             amt+=i;
               if(amt<5)
                   {
                     puts("Amount Must Be > 4.");
                     getch();
                     exit(0);
```

```
            }
         updateamount();
       }
    }
  outportb(0x378,0);
}
```

CHAPTER 7

CONTROVERSIES WITH RFID

7.1 Technical Problems with RFID

RFID has been implemented in different ways by different manufacturers; global standards are still being worked on. It should be noted that some RFID devices are never meant to leave their network (as in the case of RFID tags used for inventory control within a company). This can cause problems for companies.

Consumers may also have problems with RFID standards. For example, Exxon Mobil's Speed pass system is a proprietary RFID system; if another company wanted to use the convenient Speed pass (say, at the drive-in window of your favorite fast food restaurant) they would have to pay to access it - an unlikely scenario. On the other hand, if every company had their own "Speed Pass" system, a consumer would need to carry many different devices with them.

7.2 RFID Reader Collision

Reader collision occurs when the signals from two or more readers overlap. The tag is unable to respond to simultaneous queries. Systems must be carefully set up to avoid this problem; many systems use an **anti-collision protocol** (also called a **singulation protocol**. Anti-collision protocols enable the tags to take turns in transmitting to a reader.

Reader collision occurs in RFID systems when the coverage area of one RFID reader overlaps with that of another reader. This causes two different problems:

- Signal interference
  The RF fields of two or more readers may overlap and interfere. This can be solved by having the readers programmed to read at fractionally different times. This technique (called time division multiple accesses - TDMA) can still result in the same tag being read twice.

- Multiple reads of the same tag

  The problem here is that the same tag is read one time by each of the overlapping readers. The only solution is to program the RFID system to make sure that a given tag (with its unique ID number) is read only once in a session.

7.2 RFID Tag Collision

Tag collision occurs when many tags are present in a small area; but since the read time is very fast, it is easier for vendors to develop systems that ensure that tags respond one at a time.

Tag collision in RFID systems happens when multiple tags are energized by the RFID tag reader simultaneously, and reflect their respective signals back to the reader at the same time. This problem is often seen whenever a large volume of tags must be read together in the same RF field. The reader is unable to differentiate these signals; tag collision confuses the reader.

Different systems have been invented to isolate individual tags; the system used may vary by vendor. For example, when the reader recognizes that tag collision has taken place, it sends a special signal (a "gap pulse"). Upon receiving this signal, each tag consults a random number counter to determine the interval to wait before sending its data. Since each tag gets a unique number interval, the tags send their data at different times.

7.3 Security, Privacy and Ethics Problems with RFID

The contents of an RFID tag can be read after the item leaves the supply chain.

An RFID tag cannot tell the difference between one reader and another. RFID scanners are very portable; RFID tags can be read from a distance, from a few inches to a few yards. This allows anyone to see the contents of your purse or pocket as you walk down the street. Some tags can be turned off when the item has left the supply chain.

7.4 RFID Tags are Difficult to Remove

RFID tags are difficult to for consumers to remove; some are very small (less than a half-millimeter square and as thin as a sheet of paper) - others may be hidden or embedded inside a product where consumers cannot see them. New technologies allow RFID tags to be "printed" right on a product and may not be removable at all.

7.5 RFID Tags can be Read without Your Knowledge

Since the tags can be read without being swiped or obviously scanned (as is the case with magnetic strips or barcodes), anyone with an RFID tag reader can read the tags embedded in your clothes and other consumer products without your knowledge. For example, you could be scanned before you enter the store, just to see what you are carrying. You might then be approached by a clerk who knows what you have in your backpack or purse, and can suggest accessories or other items.

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