ABSTRACT

Now a days there is a huge rush in the toll plazas in order to pay the toll tax. Therefore in order to reduce the traffic jam and to save time, & also to reduce the money loss of 300 cores / year. we have designed project for the automation in toll tax payment using RFID. We have made the automation of toll plaza using combination of microcontroller, RFID and Load cell technology.

This report explains the implantation of automation in toll plaza which is a step towards improving the monitoring of vehicles, travelling in predetermine routes.

The aim of our project is to design a system ,which automatically identifies an approaching vehicles and record vehicles number and time. If the vehicle belongs to the authorized person, it automatically opens the toll gate and a predetermined amount is automatically deducted from its account. This translate to reduced Traffic congestion at toll plazas and helps in lower fuel consumption. This is very important advantage of this system.

CONTENTS

CHAPTER 1

INTRODUCTION

1.1:-PROJCET STATEMENT

"Design and develop a Automatic toll plaza which is based On microcontroller, RFID technology and load cell to save the time at toll plaza And having cash free operation"

As the name suggests "*Automatic Toll Plaza*" the key theme of our project is the automation. So here we will just take the over look of what is mean by Automation.

So in very simple language the Automation means to replace the human being from the process with the machines .Means what presently the human is doing on the process now onwards the machines are going to do.

Before moving further we will just take the overlook of history of the toll plazas. So before the 90's decade the toll plazas were fully manual controlled. Means there are two people for opening & closing of the gate & another two are for reception of the money & data keeping etc.

But in 1995 when the Express ways had been developed the semi automatic toll plazas were launched in which data is stored in computers & gate operation is automatic, only two personals are required for single booth. But here we are going to see the human less toll plaza.

1.2 PURPOSE OF THE PROJECT:-

Here we are going to see some points regarding to purpose behind choosing this topic & what is the requirement of this type of the project in our day to day life.

- Avoid the fuel loss.
- Saving of time in collecting toll.
- Avoid financial loss.

- To monitor the traffic.

So, according to serve of Maharashtra Government carried out in Sept.2010,they have proposed to get the annual toll collection of 1500 corers/year .But in the present situation only 1200 corers of the toll value is collected. Means there is loss of 300 cores due to some human errors. So, we have to control this leakage.

Now the present system we have with us on the high ways takes 1 minute to complete the toll collection process for one vehicle. With this automatic process, it will take just 40 to 42 sec. to complete the whole process.

As there is reduction in time for completion of the process so indirectly there will be no traffic as such & as there is no traffic so no fuel wastage takes place & the purpose of designing the highways is achieved i.e. reduction in journey time & also the money loss will be reduced.

1.3 CONCEPT OF PROJECT:-

- ***Flow of project:-***
    - ❖ Detection of vehicle
    - ❖ Weighing
    - ❖ Display of toll
    - ❖ Payment through smart card

When the vehicle is going to enter into the toll plaza, the first aim is to detect the type & no. of the vehicle. For that purpose it has to first pass through the IR transmitter - receiver gate

Then we have here the RFID system. In this system the tag which is stickled at the front glass of the vehicle is detected by the RFID reader & the data is matched with the data base provided at every toll booth.

When further vehicle is going towards the Load cell plate it has to pass through the IR transmitter - receiver gate.

Which we are using to detect the exact location of the vehicle on the load cell plate because the load cell plate has one property that it can't weigh the objects which are not stable on the plate, So for detection of exact location & steadiness of the vehicle on the load cell plate we are using here the IR Transmitter Receiver gate.

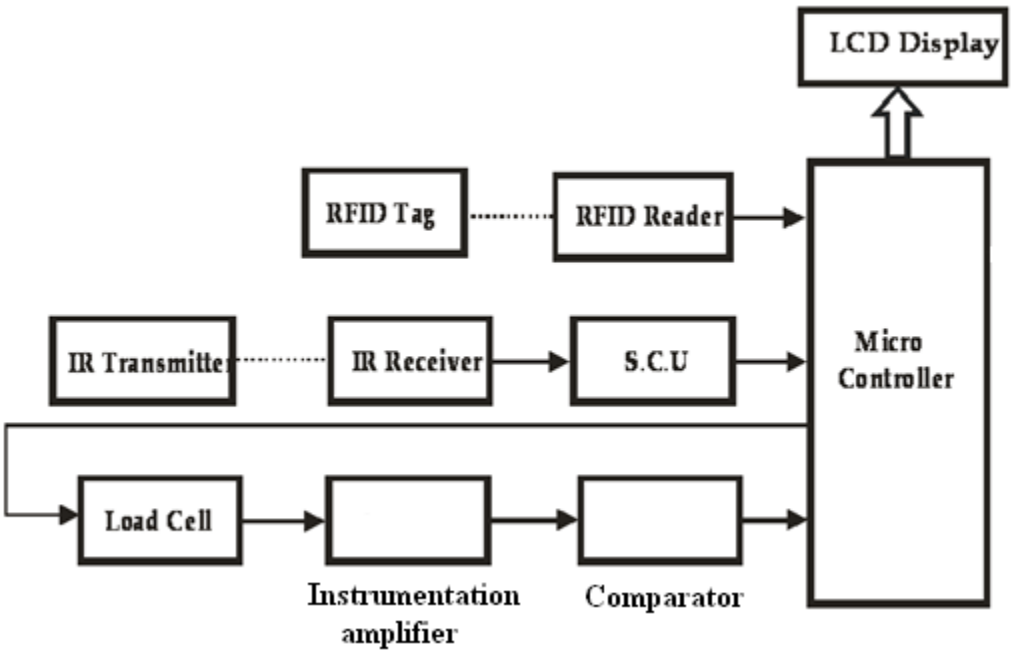
Now when the vehicle is at steady position on the load cell plate, it weighs the vehicle accurately & gives the analog signal to the controller which then displays the respective amount of the toll value.

Then the consumer has to just swap his smart card so that desired amount of toll will be deducted from his account. This is the simple concept of our project.

CHAPTER 2

INSTRUMENTATION

2.1 ENGINEERING BLOCK DIAGRAM AND DESCRIPTION:-



As you are able to see in the above fig. there is the engineering block diagram of our project that we have designed at the primary stage of our project.

So, the diagram consist of RFID tag, RFID reader, IR transmitter receiver, signal conditioning unit, micro controller, load cell, amplifier, ADC,LCD display.

Then what is the flow of the diagram? so, the flow starts from the RFID tag which is detected by the RFID reader & sends the data i.e. type & no. of vehicle stored in 12 digit code form in the tag to the controller to match with data base provided at booth.

Then the IR transmitter receiver assembly will detect the exact location of the vehicle on the load cell plate to actuate the weighing operation. The load cell then weighs the vehicle

accurately & transmits the analog signal through the instrumentation amplifier to comparator where it is compared with the stored data..

The controller then compares the signal with the stored value of respective toll & displays on LCD. So the consumer has to just sap his smart card so desired amount will be deducted from his account.

The signal conditioning unit is the device which converts the analog signal coming from analog sensor & digital signal from digital sensor will be converted to 0-5 v which is suitable for controller.

This is the simple working of our engineering block diagram that we have designed at the primary stage.

2.2 RFID BASICS:-

RFID stands for **Radio-Frequency Identification**. The acronym refers to small electronic devices that consist of a small chip and an antenna. The chip typically is capable of carrying 2,000 bytes of data or less.

Region	***Frequency (Hz)***	***Wavelength (m)***	***Energy (eV)***	***Size Scale***
Radio waves	$< 10^{9}$	> 0.3	$< 7x\ 10^{-7}$	Mountains, building

The RFID device serves the same purpose as a bar code or a magnetic strip on the back of a credit card or ATM card; it provides a unique identifier for that object. And, just as a bar code or magnetic strip must be scanned to get the information, the RFID device must be scanned to retrieve the identifying information.

RFID WORKS BETTER THAN BARCODES

A significant advantage of RFID devices over the others mentioned above is that the RFID device does not need to be positioned precisely relative to the scanner. We're all familiar with the difficulty that store checkout clerks sometimes have in making sure that a

barcode can be read. And obviously, credit cards and ATM cards must be swiped through a special reader.

In contrast, RFID devices will work within a few feet (up to 20 feet for high-frequency devices) of the scanner. For example, you could just put all of your groceries or purchases in a bag, and set the bag on the scanner. It would be able to query all of the RFID devices and total your purchase immediately.

RFID technology has been available for more than fifty years. It has only been recently that the ability to manufacture the RFID devices has fallen to the point where they can be used as a "throwaway" inventory or control device.

One reason that it has taken so long for RFID to come into common use is the lack of standards in the industry. Most companies invested in RFID technology only use the tags to track items within their control; many of the benefits of RFID come when items are tracked from company to company or from country to country.

1) HOW DOES RFID WORKS?

A Radio-Frequency Identification system has three parts:

- A scanning antenna
- A transceiver with a decoder to interpret the data
- A transponder - the RFID tag - that has been programmed with information.

The scanning antenna puts out radio-frequency signals in a relatively short range. The RF radiation does two things:

- It provides a means of communicating with the transponder (the RFID tag) AND
- It provides the RFID tag with the energy to communicate (in the case of passive RFID tags).

This is an absolutely key part of the technology; RFID tags do not need to contain batteries, and can therefore remain usable for very long periods of time (maybe decades).

The scanning antennas can be permanently affixed to a surface; handheld antennas are also available. They can take whatever shape you need; for example, you could build them into a door frame to accept data from persons or objects passing through.

When an RFID tag passes through the field of the scanning antenna, it detects the activation signal from the antenna. That "wakes up" the RFID chip, and it transmits the information on its microchip to be picked up by the scanning antenna.

In addition, the RFID tag may be of one of two types. Active RFID tags have their own power source; the advantage of these tags is that the reader can be much farther away and still get the signal. Even though some of these devices are built to have up to a 10 year life span, they have limited life spans. Passive RFID tags, however, do not require batteries, and can be much smaller and have a virtually unlimited life span.

RFID tags can be read in a wide variety of circumstances, where barcodes or other optically read technologies are useless.

- The tag need not be on the surface of the object (and is therefore not subject to wear)
- The read time is typically less than 100 milliseconds
- Large numbers of tags can be read at once rather than item by item.

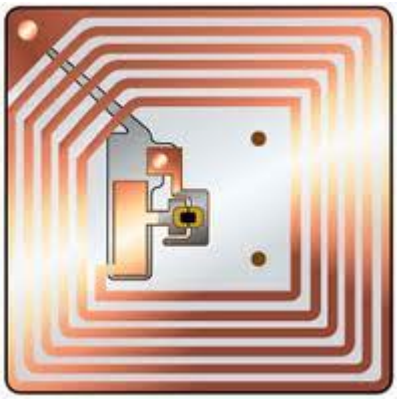
In essence, that's how RFID works.

2) RFID TAG:-

An **RFID tag** is a microchip combined with an antenna in a compact package; the packaging is structured to allow the RFID tag to be attached to an object to be tracked. "RFID" stands for Radio Frequency Identification.

The tag's antenna picks up signals from an RFID reader or scanner and then returns the signal, usually with some additional data (like a unique serial number or other customized information).

RFID tags can be very small - the size of a large rice grain. Others may be the size of a small paperback book.



ACTIVE TAG (ACTIVE RFID TAG)

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*** are:

- 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 $20 or more each
- The tag is physically larger, which may limit applications.

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.

PASSIVE RFID TAG (OR PASSIVE TAG)

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 tag then sends the information encoded in the tag's memory.

The ***major disadvantages of a passive RFID tag*** are:

- The tag can be read only at very short distances, typically a few feet at 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.

3) RFID READER:-

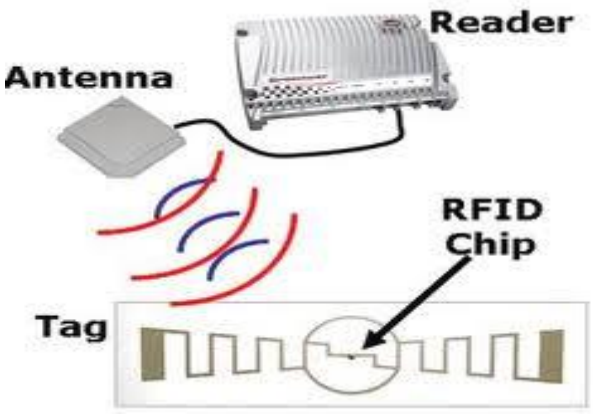
An **RFID reader** is a device that is used to interrogate an RFID tag. The reader has an antenna that emits radio waves; the tag responds by sending back its data.

A number of factors can affect the distance at which a tag can be read (the read range). The frequency used for identification, the antenna gain, the orientation and polarization of the reader antenna and the transponder antenna, as well as the placement of the tag on the object to be identified will all have an impact on the RFID system's read range.

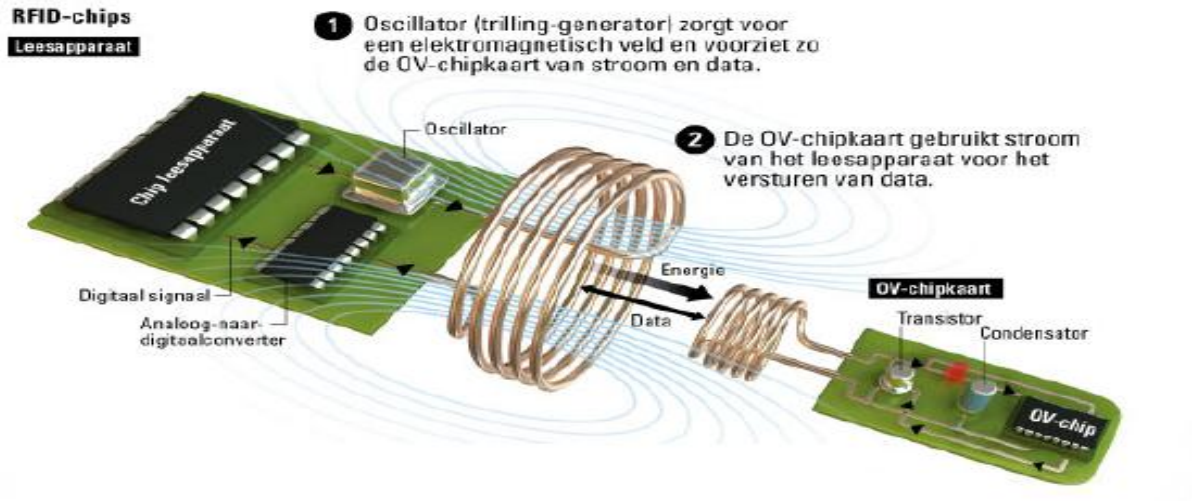
ANTENNA (RFID TAG ANTENNA)

The **antenna** in an RFID tag is a conductive element that permits the tag to exchange data with the reader. Passive RFID tags make use of a coiled antenna that can create a magnetic field using the energy provided by the reader's carrier signal.

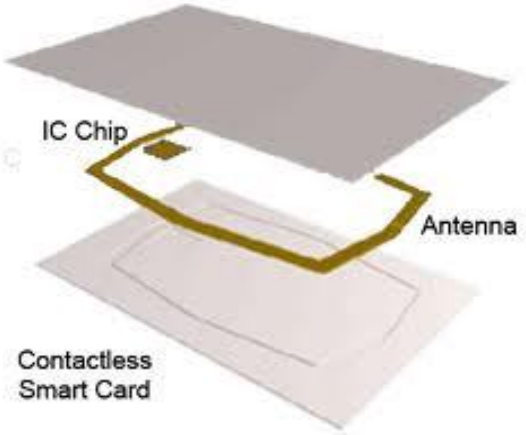
RFID SYSTEM



RFID STRUCTURE



RFID CARD



2.3 IR TRANSMITTER & RECEIVER:-

The IR Transmitter Receiver gate we are using in our project to detect the exact location & position of the vehicle on the load cell plate. Because one problem with load cell plate is that it is unable to weigh the moving object.

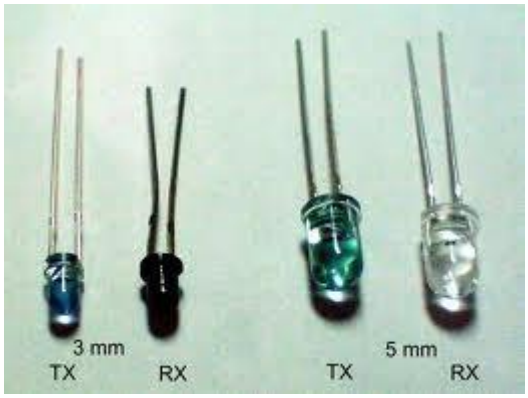
The IR transmitter is continuously emitting the IR rays towards the IR receiver. When the vehicle is going to come across the gate the rays are deflected from the vehicle & IR receiver doesn't get any signal.

The IR Receiver will give the replying signal to the controller to actuate the load cell plate as the vehicle is at exact location on the load cell plate.

Here for IR transmitter we are using IR LED's. The IR transmitter we may design in our home by just connecting desired value of resistance in +ve arm & another is grounded.

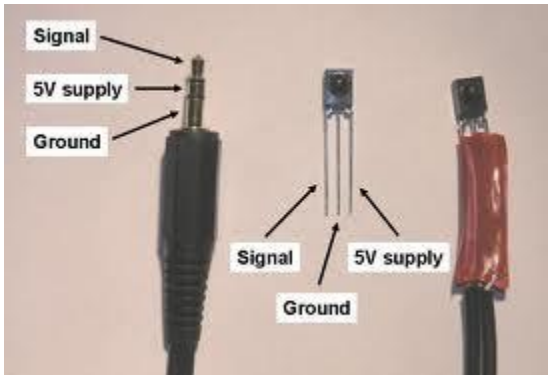
The IR receiver has three pins i.e. 5V supply, GND. Line, signal line.

IR TRANSMITTER –RECEIVER LED PAIR



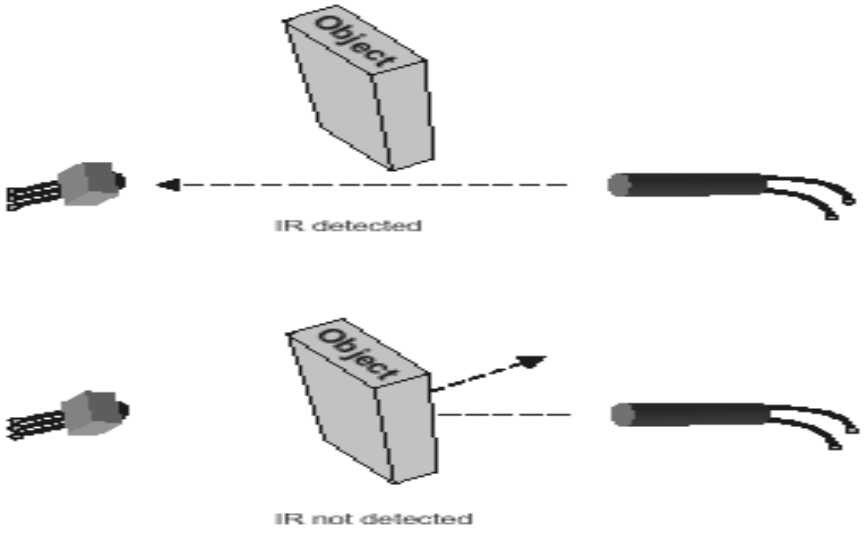
IR TRANSMITTER

IR RECEIVER



WIRING DIAGRAM FOR IR RECEIVER

region	Frequency(Hz)	Wavelength(m)	Energy (eV)
Infrared	**$3x10^{11}$ - $3.9x10^{14}$**	**$7.6x10^{-7}$ - 0.001**	**$2x10^{-4}$ - 0.3**



2.4 LOAD CELL:-

A load cell is a transducer that converts load acting on it into an analog electrical signal. This conversion is achieved by the physical deformation of strain gages which are bonded into the load cell beam and wired into a Wheatstone bridge configuration.

Here in our project we are using the strain gauge type load cell plate as it is very commonly & widely used load cell plate. We are concentrating on the canister type strain gauge as it has wide range.

Before strain gage-based load cells became the method of choice for industrial weighing applications, mechanical lever scales were widely used. Mechanical scales can weigh everything from pills to railroad cars and can do so accurately and reliably if they are properly calibrated and maintained.

The method of operation can involve either the use of a weight balancing mechanism or the detection of the force developed by mechanical levers. The earliest, pre-strain gage force sensors included hydraulic and pneumatic designs. In 1843, English physicist Sir Charles Wheatstone devised a bridge circuit that could measure electrical resistances.

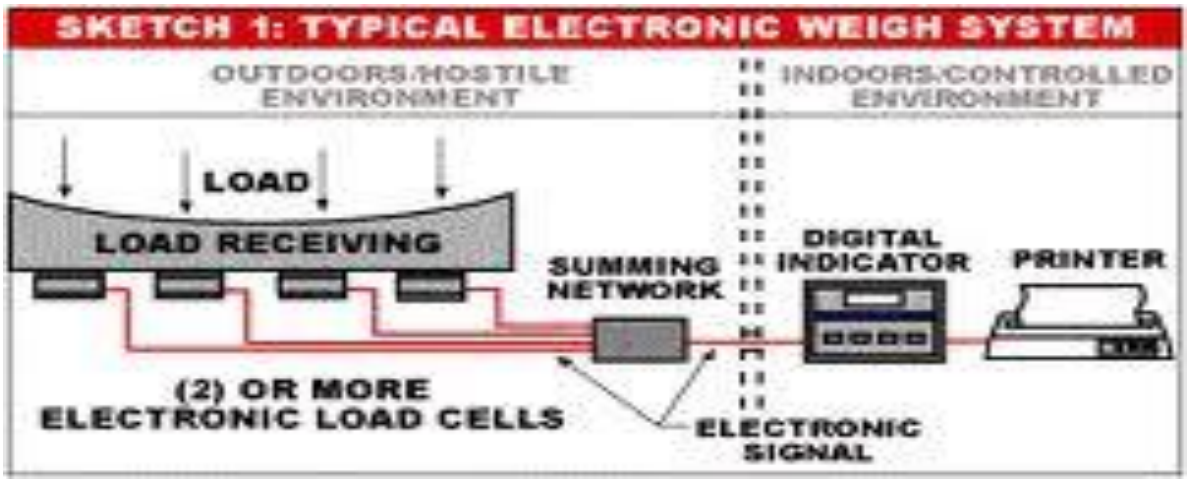
The Wheatstone bridge circuit is ideal for measuring the resistance changes that occur in strain gages. Although the first bonded resistance wire strain gage was developed in the

1940s, it was not until modern electronics caught up that the new technology became technically and economically feasible. Since that time, however, strain gages have proliferated both as mechanical scale components and in stand-alone load cells.

Today, except for certain laboratories where precision mechanical balances are still used, strain gage load cells dominate the weighing industry. Pneumatic load cells are sometimes used where intrinsic safety and hygiene are desired, and hydraulic load cells are considered in remote locations, as they do not require a power supply. Strain gage load cells offer accuracies from within 0.03% to 0.25% full scale and are suitable for almost all industrial applications.

Strain Gage Load Cells					
Bending Beam Load Cells	10-5k lbs.	0.03%	Tanks, platform scales,	Low cost, simple construction	Strain gages are exposed, require protection
Shear Beam Load Cells	10-5k lbs.	0.03%	Tanks, platform scales, off- center loads	High side load rejection, better sealing and protection	
Canister Load Cells	to 500k lbs.	0.05%	Truck, tank, track, and hopper scales	Handles load movements	No horizontal load protection
Ring and Pancake Load Cells	5- 500k lbs.		Tanks, bins, scales	All stainless steel	No load movement allowed

Button and washer Load Cells	0-50k lbs 0-200 lbs. typ.	1%	Small scales	Small, inexpensive	Loads must be centered, no load movement permitted



EXACT LOCATION OF LOAD CELL PLATE IN THE ROAD BED

2.5 PAYMENT MECHANISM:-

The payment mechanism we are using here is the smart card type mechanism. Here we are using the chip having the memory capacity of 4K.The memory has in it the stored amount of money value. When the switch is pressed for the payment the desired amount will be deducted from the memory & remaining amount is displayed on the LCD.

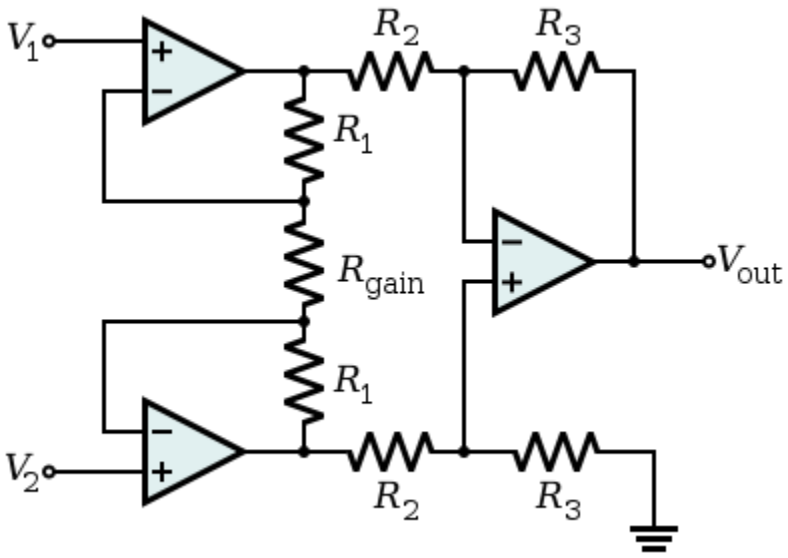
When the memory card gets nil it requires to recharge the card again to continue with the process.

2.6 GENERAL KEY COMPONENTS:-

MICROCONTROLLER 8051

In our project we are using the 89C51ED2 or 89C51RD2 chip as we are familiar with them. The controller has 40 pin structures having 4 ports i.e. 0,1,2,3.

INSTRUMENTATION AMPLIFIER



An **instrumentation** (or**instrumentational**)**amplifier** is a type ofdifferential amplifier that has been outfitted with input buffers, which eliminate the need for input impedance matching and thus make the amplifier particularly suitable for use in measurement and test equipment. Additional characteristics include very low DC offset, low drift, lownoise, very high open-loop gain, very high common-mode rejection ratio, and very high input impedances. Instrumentation amplifiers are used where great accuracy and stability of the circuit both short- and long-term are required.

Although the instrumentation amplifier is usually shown schematically identical to a standard op-amp, the electronic instrumentation amp is almost always internally composed of 3 op-amps. These are arranged so that there is one op-amp to buffer each input (+,−), and one to produce the desired output with adequate impedance matching for the function.[1][2]

The most commonly used instrumentation amplifier circuit is shown in the figure. The gain of the circuit is

$$\frac{V_{\text{out}}}{V_2 - V_1} = \left(1 + \frac{2R_1}{R_{\text{gain}}}\right)\frac{R_3}{R_2}$$

The rightmost amplifier, along with the resistors labeled R_2 and R_3 is just the standard differential amplifier circuit, with gain = R_3 / R_2 and differential input resistance = $2 \cdot R_2$. The two amplifiers on the left are the buffers. With R_{gain} removed (open circuited), they are simple unity gain buffers; the circuit will work in that state, with gain simply equal to R_3 / R_2 and high input impedance because of the buffers.

2X16 LINE ALPHANUMERIC LCD DISPLAY

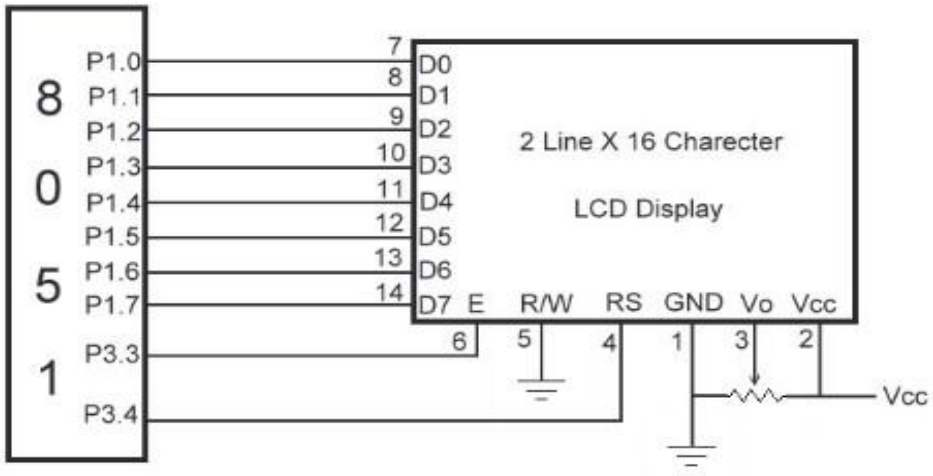
The most commonly used *ALPHANUMERIC* displays are *1x16* (Single Line & 16 characters), *2x16* (Double Line & 16 character per line) & *4x20* (four lines & Twenty characters per line).

The LCD requires 3 control lines (RS, R/W & EN) & 8 (or 4) data lines. The number on data lines depends on the mode of operation. If operated in 8-bit mode then 8 data lines + 3 control lines i.e. total 11 lines are required. And if operated in 4-bit mode then 4 data lines + 3 control lines i.e. 7 lines are required. How do we decide which mode to use? It's simple if you have sufficient data lines you can go for 8 bit mode & if there is a time constrain i.e. display should be faster then we have to use 8-bit mode because basically 4-bit mode takes twice as more time as compared to 8-bit mode.

When *RS* is low (0), the data is to be treated as a command. When RS is high (1), the data being sent is considered as text data which should be displayed on the screen.

When *R/W* is low (0), the information on the data bus is being written to the LCD. When RW is high (1), the program is effectively reading from the LCD. Most of the times there is no need to read from the LCD so this line can directly be connected to Gnd thus saving one controller line.

The *ENABLE* pin is used to latch the data present on the data pins. A HIGH - LOW signal is required to latch the data. The LCD interprets and executes our command at the instant the EN line is brought low. If you never bring EN low, your instruction will never be executed.


8051
P1.0
P1.1
P1.2
P1.3
P1.4
P1.5
P1.6
P1.7
P3.3
P3.4
7
8
9
10
11
12
13
14
D0
D1
D2
D3
D4
D5
D6
D7
2 Line X 16 Charecter
LCD Display
E
R/W
RS
GND
Vo
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6
5
4
1
3
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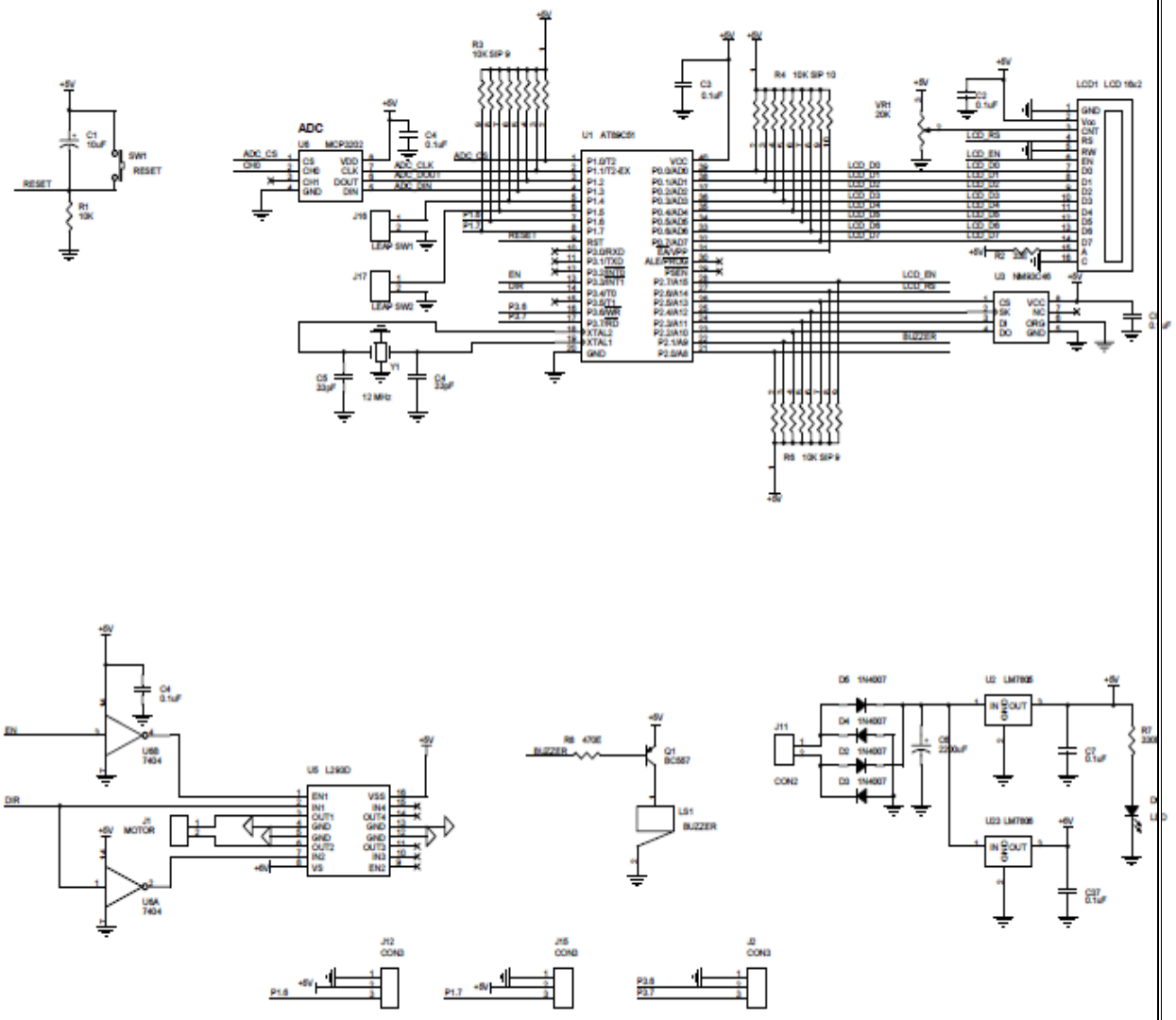
Vcc

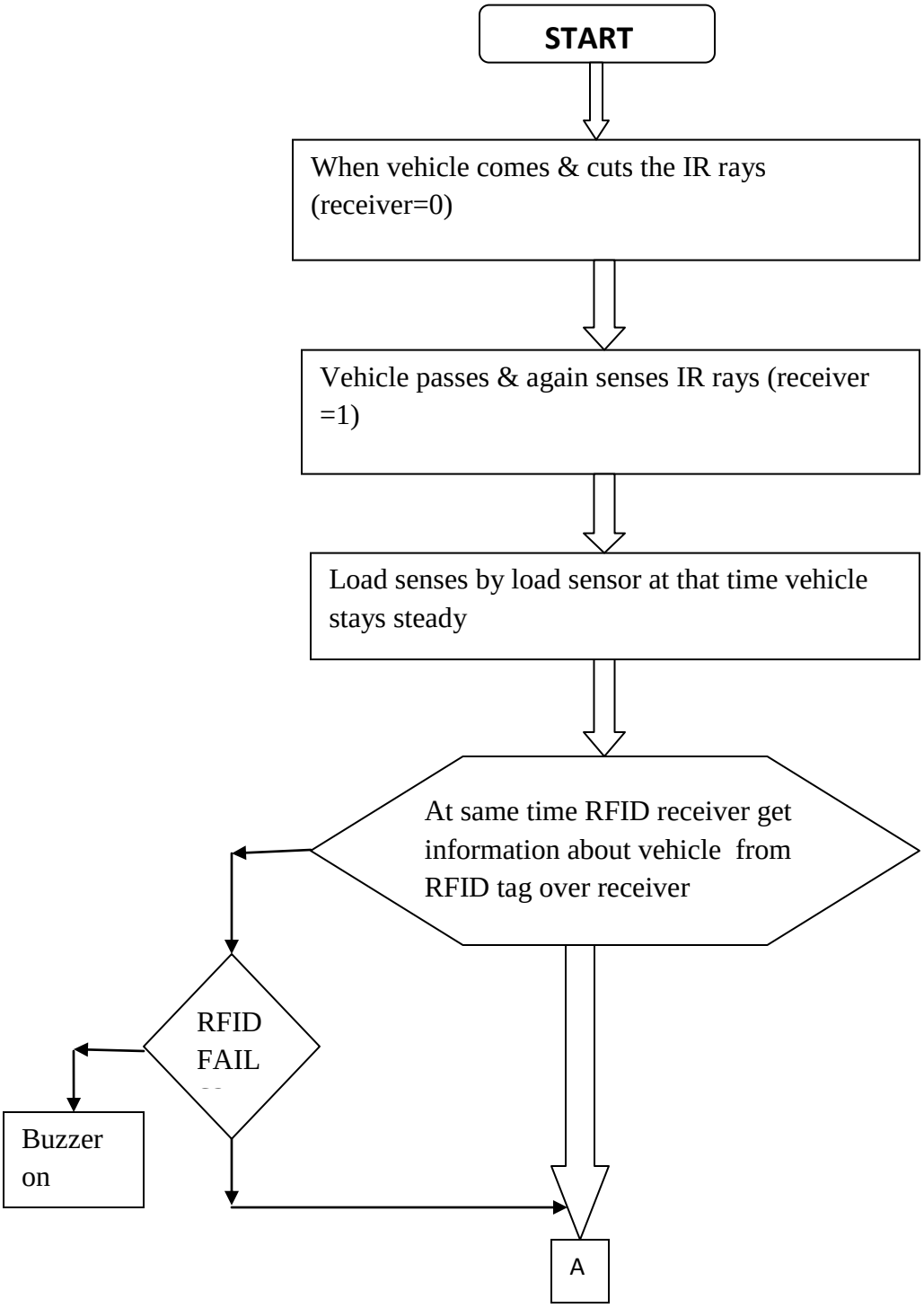
CHAPTER 3

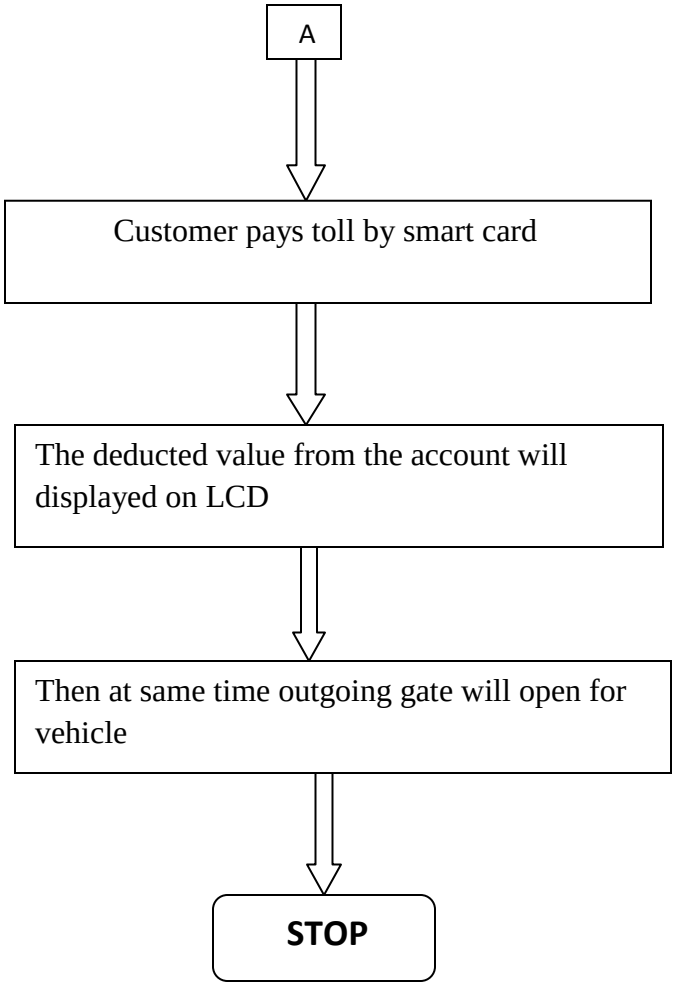
SOFTWARE DESIGN

3.1CIRCUIT DIAGRAM:-



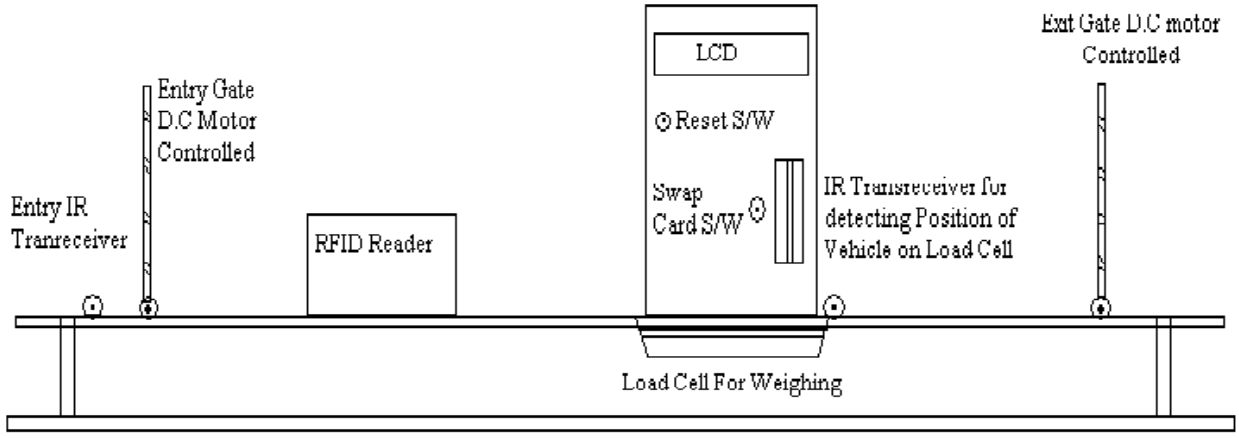
3.2 FLOW CHART:-




A
Customer pays toll by smart card
The deducted value from the account will displayed on LCD
Then at same time outgoing gate will open for vehicle
STOP

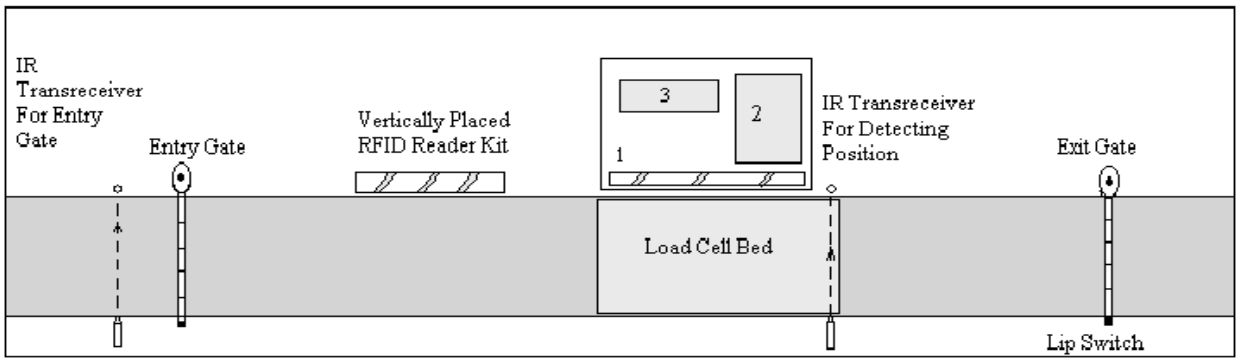
CHAPTER 4

HARDWARE DESIGN



SIDE VIEW

Top View



1-Vertically Placed Main PCB
2-PCB For Load Cell
3-Swap Card Memory

CHAPTER 5

TESTING AND RESULTS

- Whenever a IR rays at the entry gate get cut by the vehicle the gate opens & it remain open till the rays are mismatched.As the rays get connected again then the gate gets closed.
- From RFID tag we get information about vehical number which is sensed by the RFID reader which will then transmite the data to the controller.
- From laod cell we can get the load of vehical,from which we are detecting the type of vehicle that it may be the light vehicle or heavy vehicle.
- From both load cell & RFID we get the type of vehical and it's number.Then the toll amount will be displayed on the LCD.
- By smart card mechanism toll amount will be paid & at the same time exit gate will be opened automatically for the vehicle topass through.
- The whole time duration for payment of toll will be less than 1 min i.e approximately 40-42 sec.

CHAPTER 6

ADVANTAGES

- **Financial leakage control**

  As per survey it is clear that, for every year their will be the loss of 300crores of money from the gross toll collection value which is estimated up to 1500 crores.

  By utilizing fully automatic mechanism we can nearly able to control this financial loss.

- **Fuel saving**

  Due to automation of toll plaza their will be large reduction in the rush at toll plaza which will cause indirectly the saving of fuel.

- **Reduced man power**

  The basic aim of Automation concept is to reduce the man power & to increase the accuracy of the system. So we can able to achieve the same with our on built concept.

- **Reduced time for completion of process**

  The present system we have in work today consumes nearly 1 minute for each vehicle to complete the process of toll payment. With our automated toll plaza we can able to reduce the time consumption nearly up to 40-42 sec.which will be very important in today's era.

- **Cash free operation**

  Due to smart card mechanism that we have used for the payment. Their will be no necessity of hand to hand cash transaction. So causing reduction in money loss.

LIMITATIONS

- **Load sensing for long length vehicle becomes critical.**

  The load cell plate we can use in set up of project in actual is approximately 50 feet(15-16 meters).But if the vehicle having the length more than 50 feet come on the load cell plate then the system will not able to weigh the vehicle correctly.

  To overcome this problem we may keep the separate lane for such vehicles with fixed amount of toll amount.

- **If RFID fails whole system fails.**

  The RFID system we are here using for detecting the vehicle number means the vehicle identity which we are further using for storing into memory & also to display on the LCD.

  If the RFID fails to detect the correct identity of the vehicle the data regarding the vehicle will be wrong which will may create many problems & system fails because without vehicle identity load cell will not weigh the vehicle.

CHAPTER 7

CONCLUSION

By doing automation of toll plaza we can have the best solution over money loss at toll plaza by reducing the man power required for collection of money and also can reduce the traffic indirectly resulting in reduction of time at toll plaza.

In our project we have introduced the techniques such as Radio Frequency Identification.This technique will include the RFID tag & reader which in coordination with each other can be used to detect the vehicle identity.

The load cell plate which is introduced for weighing the vehicles so as to classify them in different catagories as light & heavy vehicles.

The IR Transreceiver is used for detecting the presence of vehicle at different locations which will act as the gate pass to the toll plaza.

By effectively utilizing these three techniques at different stages of our project we are able to represent the automation in toll plaza which will reduce the complete processing time by few seconds which is very important as well as helps to reduce money leakage in a very cost effective manner.

FUTURE SCOPE

1. **Implementation of automatic money debit system**

In our project now we are implementing the smart card mechanism for the payment of the toll amount paid by the vehicle owner.When the vehicle comes on the load cell plate for weighing ,at that time the vehicle owner has to swap his smart card in the debit machine.So, desired amount of toll amount will be deducted from the account of owner.

Here we can also implement the automatic debit system.In this system we have to treat the RFID card also as the smart card.In the RFID card we have now vehicle number in the code format.So,we can combine the RFID card with smart card as both are the different forms of basic principle of Bar code.

2. **Implementation of image processing for centralize data recording**

In our present concept we are only using the RFID system for vehicle detection.So we can extend the scope of this concept in other way for centralize data recording.For that purpose we can use the IR courten at the entry gate which is followed by the Camera which will be continuesly capturing the images of the vehicles entering into the toll plaza.And the third step the RFID is collecting the vehicle number.

Now when the vehicle passes through the IR courten it tresses the outline of the vehicle,in the next step the camera will take the image of the vehicle & followed by the RFID to record the data related to the vehicle.The load cell weighs the vehicle & classifies it into two categories as light & heavy vehicle respectively.The whole data collected together & sent to the centralize server which will store it for stippulated time.This application will help in detecting the vehicles in the crime cases like terririsom & smuglling of goods & it will also reduce the load on check posts.

CHAPTER 8

APPENDIX

8.1 DATA SHEET OF 89C51

8.2 DATA SHEET OF 7404

8.3 DATA SHEET OF LM358

8.4 DATA SHEET OF LCD JHD162A

CHAPTER 9

REFERANCES

WEBSITES:-

- www.irb.com
- www.scrib.com
- www.wikipedia.com
- www.google.co.in
- www.ieeexplorer.com

BOOKS:-

- ETC edition September 2007 by Steinar Furan.
- Documentary on IR receiver by Inisca Cristian & Coroiu Stefan.
- Auto identification & computing applications using RFID & smart technology by Judith Symonds & David Parry.