



AUTOMATIC TOLL COLLECTION AND ROAD TRACKING SYSTEM



A PROJECT REPORT

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**KUMARAGURU COLLEGE OF
TECHNOLOGY
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BONAFIDE CERTIFICATE

Certified that this project report titled “ **AUTOMATIC TOLL COLLECTION AND ROAD TRACKING SYSTEM**” is the bonafied work of “**DILIP KUMAR E, KALAIYARASAN M, RAMKUMAR R**” who carried out the project work under my supervision.

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LIST OF ABBREVIATIONS

PIC	Peripheral interface controller
RISC	Reduced Instruction Set Computer
EEPROM	Electrically Erasable Programmable Read Only Memory
SRAM	Static Random Access Memory
LED	Light Emitting Diode
LCD	Liquid Crystal Display
IDE	Integrated Development Environment
API	Application Programmable Interface
COM	Component Object Model
ICS	In Circuit Simulators
RFID	Radio Frequency Identification
SDA	Serial Data Line
SCL	Serial Clock Line
ALU	Arithmetic and Logic Unit

ABSTRACT

This project describes a system which does the job of detecting, billing and accounting for vehicles as they pass through a tollgate using Radio Frequency Identification (RFID) as the identification technology. RFID is an auto identification technology which uses radio frequencies to identify objects remotely and it can be read over a considerable distance so that its contents identify the vehicle and enhance a transaction to be undertaken with respect to the specific tag identity taking advantage of radio frequencies ability to travel longer ranges with better data capacities and high speed attained with maximum accuracy. The load cell platform is described in the project is used to determine the weight of the vehicle and Traffic Sign Recognition is a technology by which a vehicle is able to recognize the traffic signs put on the road e.g. speed limit or turn ahead. Automatic road-signs recognition is becoming a part of Driver Assisting Systems which role is to increase safety and driving comfort.

CHAPTER 1

1.1 INTRODUCTION

Embedded System is a combination of hardware and software. Embedded technology plays a major role in integrating the various functions associated with it. This needs to tie up the various sources of the Department in a closed loop system. This proposal greatly reduces the manpower, saves time and operates efficiently without human interference. This project puts forth the first step in achieving the desired target. With the advent in technology, the existing systems are developed to have in built intelligence. Three modules are there in this project. GSM module is used to send vehicle load information to the user. RF transmitter and receiver are used to send the road status to the drivers about school zone is there and hospital zone is there that information.

RFID is the special type wireless card which has inbuilt the embedded chip along with loop antenna. The inbuilt embedded chip represents the 12 digit card number. RFID reader is the circuit which generates 125KHZ magnetic signal. This magnetic signal is transmitted by the loop antenna connected along with this circuit which is used to read the RFID card number. In this project every vehicle has one RFID card when the vehicle reaches the toll collection.

RFID reader senses the card number and sends it to microcontroller. So the controller identified the vehicle number then the vehicle move to load cell platform.

The load cell platform is used to determine the weight of the vehicle. Sometime the vehicle may not be stand in the correct position. Now the microcontroller activates the load cell to determine the weight of the vehicle. Then the signal from the load cell is amplified and given to ADC.

ADC is nothing but analog to digital converter which converts the analog signal from load cell to corresponding digital signal and given to microcontroller. Now the microcontroller decides the amount for that particular then the related information is given to printer. From the printer we can get amount bill for that corresponding vehicle. If the RFID in the vehicle is not valid, the microcontroller activates the alarm driver circuit. Now the alarm makes the sound for authentication fail.

1.2 OBJECTIVES:

- Collect the toll automatically.
- Automatic weighing vehicles.
- Road sign identification by means of command given.
- After collecting the amount automatically billing and location will send to mobile.

CHAPTER 2

HARDWARE DESCRIPTION

2.1 CIRCUIT DIAGRAM AND BLOCK DIAGRAM:

2.1.1 HIGHWAY TOLL COLLECTION AND WEIGHT UNIT CIRCUIT DIAGRAM

HIGHWAY TOLL COLLECTION USING RFID

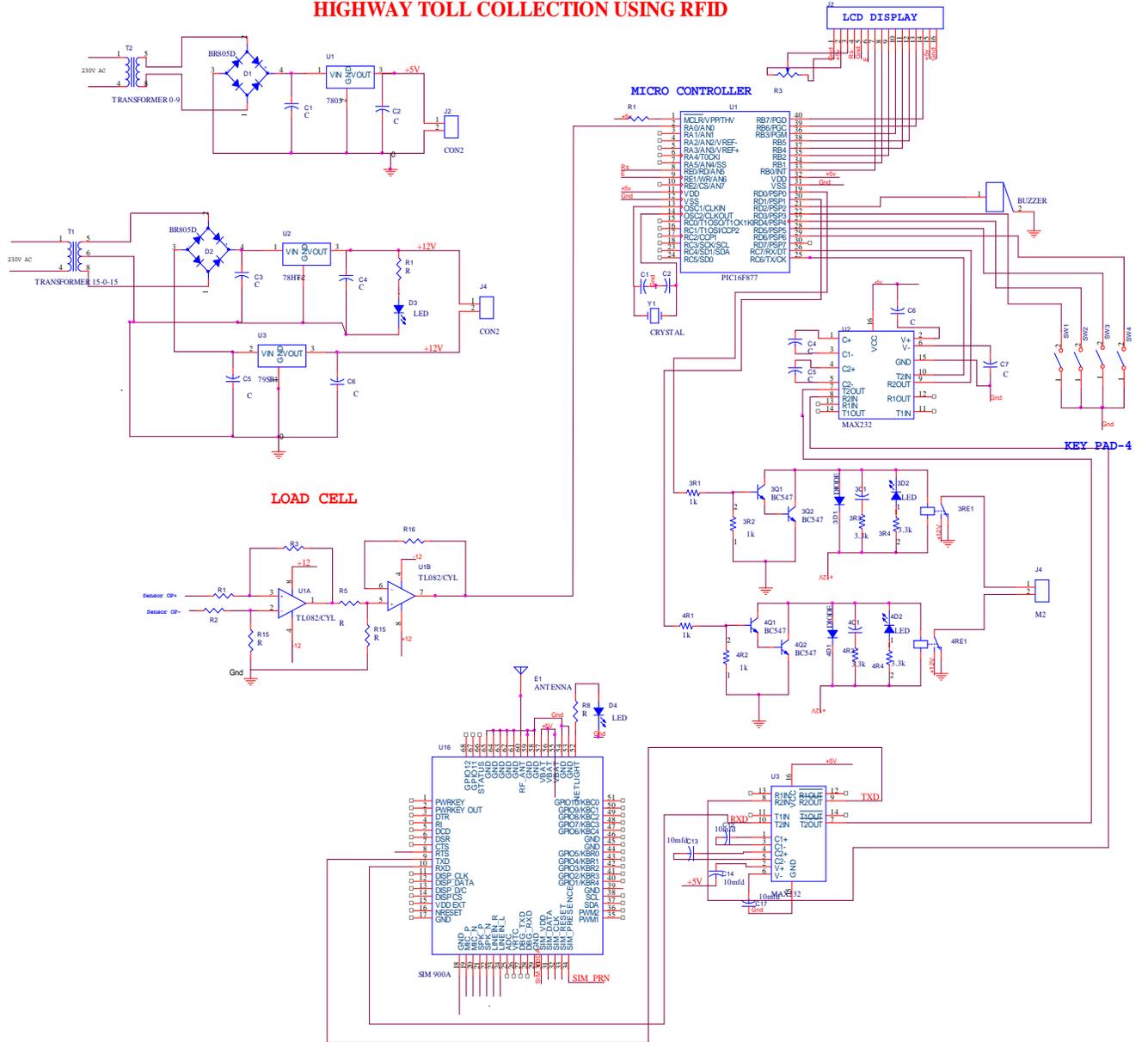


Fig: 2.1 Circuit diagram of toll gate unit

2.1.2 TOLL GATE SECTION BLOCK DIAGRAM:

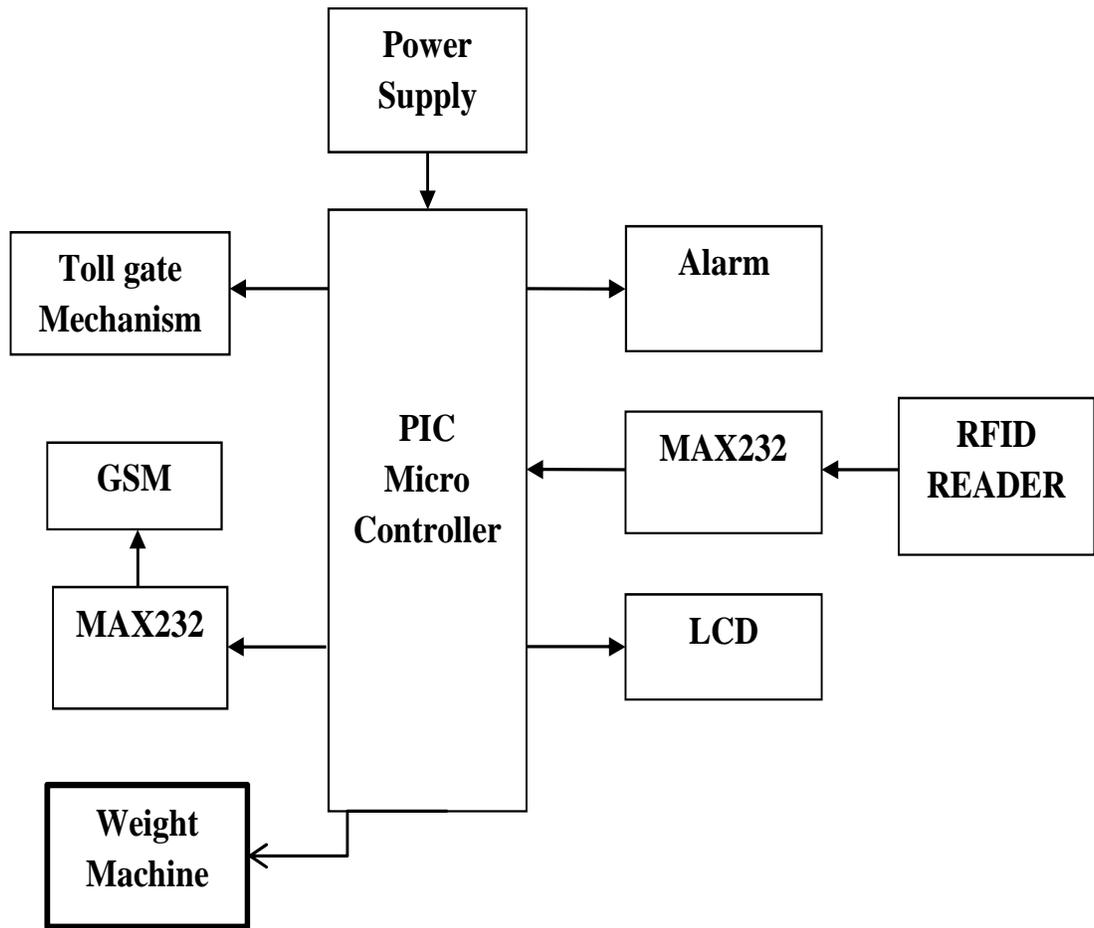


Fig: 2.2 Block diagram of Toll gate unit

2.1.3 VEHICLE UNIT:

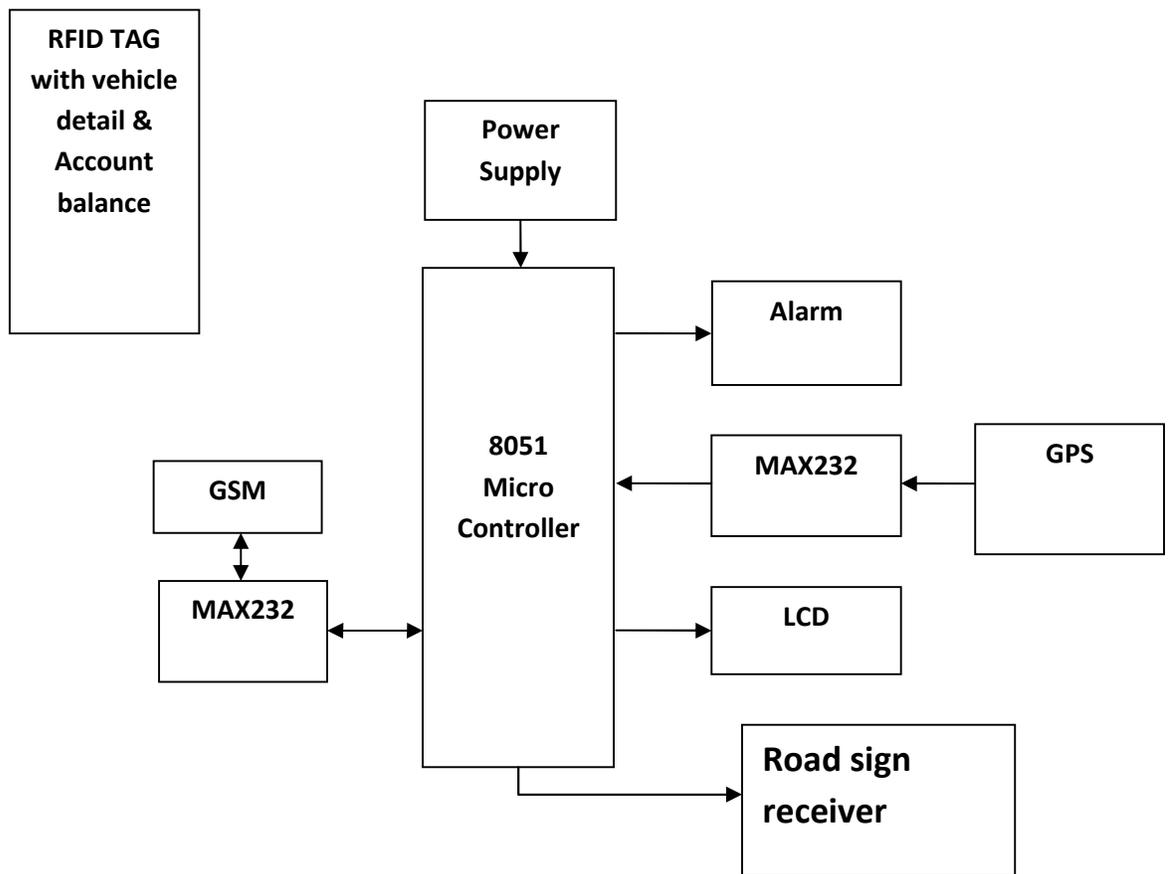


Fig: 2.3 Block diagram of Vehicle unit

2.1.4 ROAD SIGN UNIT CIRCUIT DIAGRAM

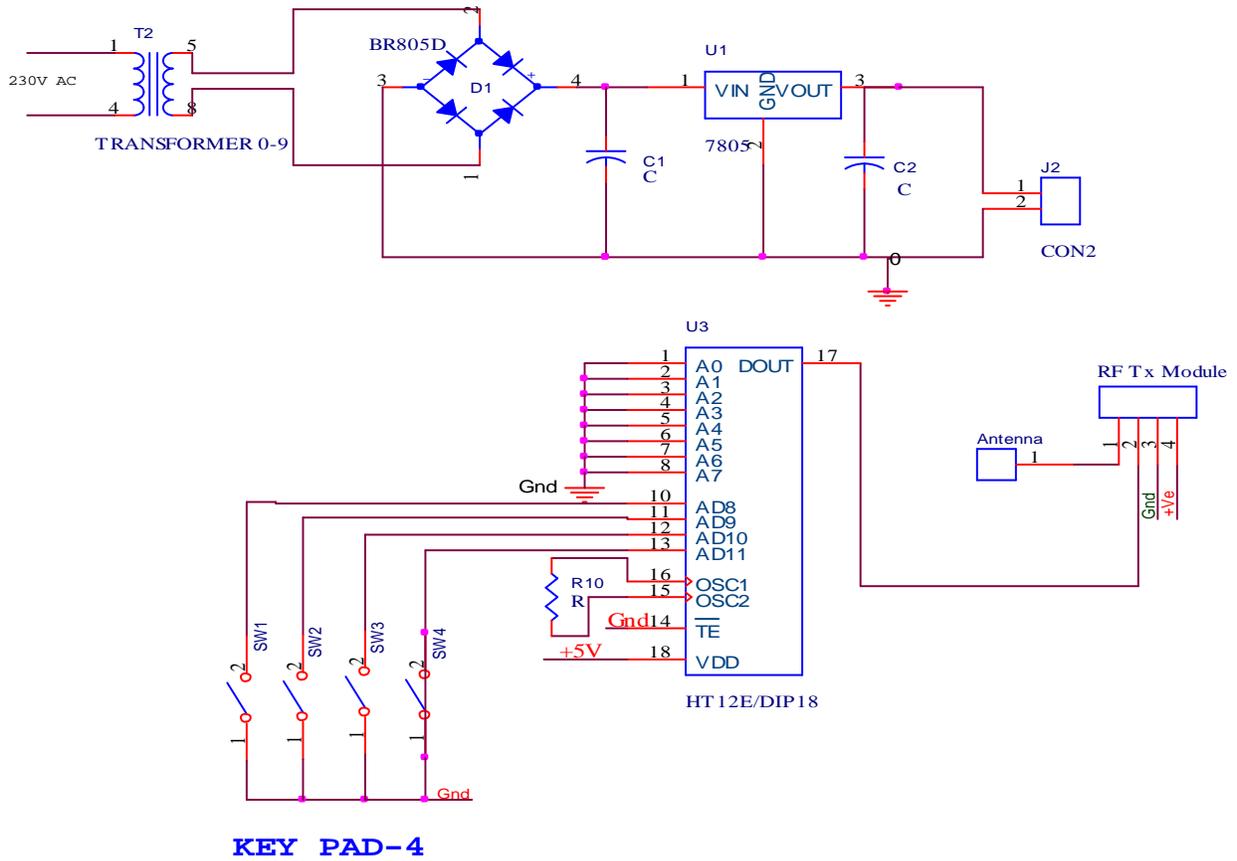


Fig 2.4 Circuit diagram of road sign unit

2.1.5 BLOCK DIAGRAM OF ROAD SIGN UNIT:

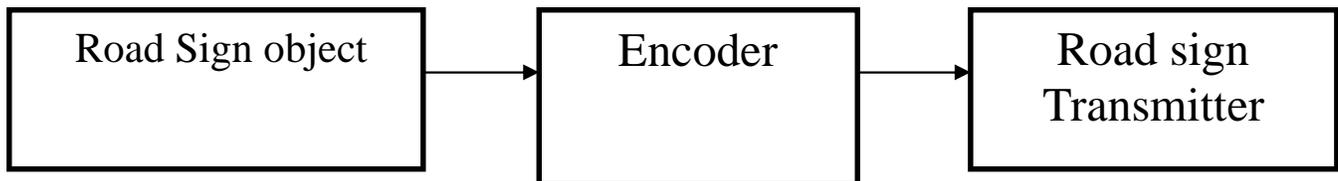


Fig: 2.5 Block diagram of Road Sign unit

2.2 BLOCK DIAGRAM EXPLANATION

2.2.1 PERIPHERAL INTERFACE CONTROLLER

2.2.1.1 INTRODUCTION:

The Peripheral Interface Controller (PIC) contains an ALU, which does arithmetic and logic operations, the RAM, the EEPROM (Flash Memory), the data EEPROM, and the “W” register. The “W” register is not a part of the register-file but is a stand-alone, working register (also called an “accumulator”). The ALU, the RAM, the “W” register, and the data EEPROM each manipulate and hold 8-bit-wide data, which ranges in value from zero to 255 (or, in hexadecimal, from 0x00 to 0xFF).

The program EEPROM (Flash Memory) works with 14-bit-wide words and contains each of the user’s instructions. It is not uncommon for microcontrollers to have different sizes of data memory and program memory (in the PIC: 8-bits for data and 14-bits for program words). More than that, the key is that the data and program memories occupy separate spaces. This allows access to each at the same time.

This document contains device specific information about the following devices:

- PIC16F873A
- PIC16F874A

- PIC16F873A/876A devices are available only in 28-pin packages, while PIC16F874A/877A devices are available in 40-pin and 44-pin packages. All devices in the PIC16F87XA family share common architecture with the following differences:
- The PIC16F873A and PIC16F874A have one-half of the total on-chip memory of the PIC16F876A and PIC16F877A
- The 28-pin devices have three I/O ports, while the 40/44-pin devices have five three I/O ports.
- The 28-pin devices have five A/D input channels, while the 40/44-pin devices have eight A/D input channels.
- The Parallel Slave Port is implemented only on the 40/44-pin devices.

2.2.1.2 PIN DIAGRAM:

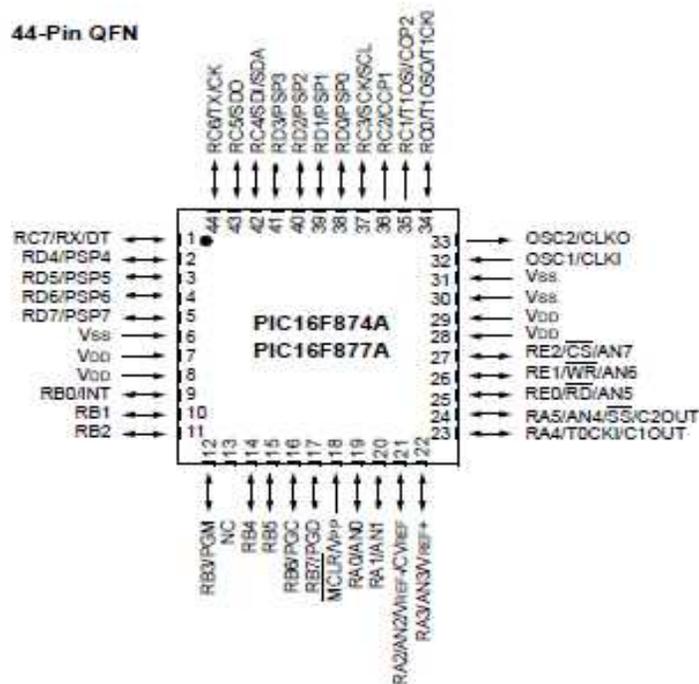


Fig 2.6 Pin Diagram for PIC 16F877A

2.2.1.3 ARCHITECTURE PIC16F877A:

The PIC (Peripheral Interfacing Controller) microcontroller has been introduced by the microchip technology. While PIC16F874A/877A devices are available in 40-pin and 44-pin packages.

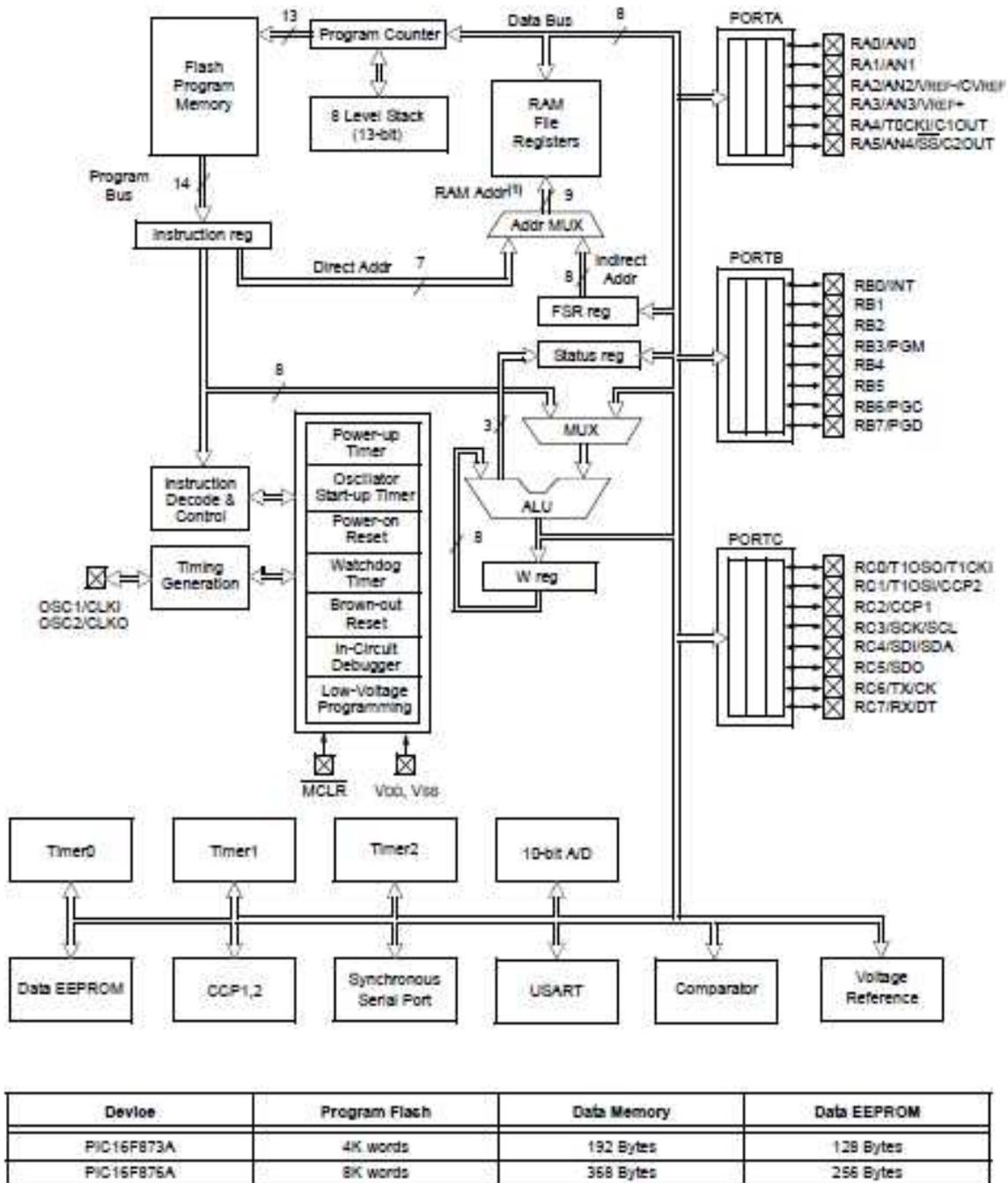


Fig 2.7 Architecture of PIC 16F877A

To write an EEPROM data location, the user must first write the address to the EEADR register and the data to the EEDATA register. Then the user must follow a specific write sequence to initiate the write for each byte. The write will not

initiate if the write sequence is not exactly followed (write 55h to EECON2, write AAh to EECON2, then set WR bit) for each byte.

Interrupts can be disabled during code segment. Additionally the WREN bit in EECON1 must be set to enable write. This mechanism prevents accidental writes to data EEPROM due to errant (unexpected) code execution (i.e., lost programs). The user should keep the WREN bit clear at all times, except when updating EEPROM. The WREN bit is not cleared by hardware after a write sequence has been initiated, clearing the WREN bit will not affect this write cycle. The WR bit will be inhibited from being set unless the WREN bit is set. At the completion of the write cycle, the WR bit is cleared in hardware and the EE Write Complete Interrupt Flag bit (EEIF) is set. The user can either enable this interrupt or poll this bit. EEIF must be cleared by software.

The steps to write to EEPROM data memory are:

1. Write the address to EEADR. Make sure that the address is not larger than the memory size of the device.
2. Write the 8-bit data value to be programmed in the EEDATA register.
3. Clear the EEPGD bit to point to EEPROM data memory.
4. Set the WREN bit to enable program operations.
5. Disable interrupts (if enabled).
6. Execute the special five instruction sequence:
7. Write 55h to EECON2 in two steps (first to W, then to EECON2)
8. Write AAh to EECON2 in two steps (first to W, then to EECON2)Set the WR bit

9. Enable interrupts (if using interrupts).
10. Clear the WREN bit to disable program operations.
11. At the completion of the write cycle, the WR bit is cleared and the EEIF interrupt flag bit is set. (EEIF must be cleared by firmware.) If step 1 is not implemented, then firmware should check for EEIF to be set, or WR to clear, to indicate the end of the program cycle.

2.2.1.4 MEMORY ORGANIZATION:

A microcontroller is a complete computer system on a single chip. It is more than just a microprocessor: It also contains a Read-Only Memory (ROM), a Read-Write Memory (RAM), some input/output ports, and some peripherals, such as, counters/timers, analog-to-digital converters, digital-to-analog converters, and serial communication ports.

The internal view of a typical microprocessor and is composed of three things: an arithmetic/logic unit (ALU) which performs calculations on data. A set of registers which hold the user's data and the system's data; and a control unit which orchestrates everything and interprets and executes the user's instructions. As far as the microprocessor is concerned, it assumes that there are sets of data memories and program memories (RAM and ROM) in the system.

Table 2.1 PIC16F877A Pin out Descriptions

Pin Name	PDIP Pin#	PLCC Pin#	TQFP Pin#	QFN Pin#	I/O/P Type	Buffer Type	Description
OSC1/CLKI OSC1 CLKI	13	14	30	32	I I	ST/CMOS ⁽⁴⁾	Oscillator crystal or external clock input. Oscillator crystal input or external clock source input. ST buffer when configured in RC mode; otherwise CMOS. External clock source input. Always associated with pin function OSC1 (see OSC1/CLKI, OSC2/CLKO pins).
OSC2/CLKO OSC2 CLKO	14	15	31	33	O O	—	Oscillator crystal or clock output. Oscillator crystal output. Connects to crystal or resonator in Crystal Oscillator mode. In RC mode, OSC2 pin outputs CLKO, which has 1/4 the frequency of OSC1 and denotes the instruction cycle rate.
MCLR/Vpp MCLR Vpp	1	2	18	18	I P	ST	Master Clear (Input) or programming voltage (output). Master Clear (Reset) Input. This pin is an active low Reset to the device. Programming voltage input.
RAD/AN0 RAD AN0 RA1/AN1 RA1 AN1 RA2/AN2/VREF-/CVREF RA2 AN2 VREF- CVREF RA3/AN3/VREF+ RA3 AN3 VREF+ RA4/T0CKI/C1OUT RA4 T0CKI C1OUT RA5/AN4/SS/C2OUT RA5 AN4 SS C2OUT	2 3 4 5 6 7	3 4 5 6 8	19 20 21 22 23 24	19 20 21 22 23 24	I/O I I/O I I/O I I O I/O I I O	TTL TTL TTL TTL ST TTL	PORTA is a bidirectional I/O port. Digital I/O. Analog input 0. Digital I/O. Analog input 1. Digital I/O. Analog input 2. A/D reference voltage (Low) input. Comparator VREF output. Digital I/O. Analog input 3. A/D reference voltage (High) input. Digital I/O – Open-drain when configured as output. Timer0 external clock input. Comparator 1 output. Digital I/O. Analog input 4. SPI slave select input. Comparator 2 output.

Legend: I = Input O = output I/O = input/output P = power
 — = Not used TTL = TTL Input ST = Schmitt Trigger Input

The only thing the microprocessor has to do is run a cycle of getting new instructions and executing them from the memories. Both the RAM and the ROM are organized as indexed sets of data words, where each “index” is the “address” of its corresponding data. Both the data and its address codes are numbers represented in binary or hexadecimal.

The RAM is a read-write memory which can rapidly read and write the data. It is a volatile memory which means that it loses its memory when power is removed (turned off). The ROM is for program memory and is “read-only” except in modern variants, such as Electrically Erasable Programmable Read Only Memory (EEPROM) and Flash Memory, which allow data words to be written as well as read.

The writing of an EEPROM is not the same as a RAM since the data-writing time of the EEPROM is about ten thousand times as long as the data-writing time of the RAM. The ROM and its variants are non-volatile memories that preserve their memories when the power is removed (turned off).

2.2.1.5 SPECIAL FEATURES:

- Timer0: 8-bit timer/counter with 8-bit pre scalar
- Timer1: 16-bit timer/counter with pre scalar, can be incremented during Sleep via external crystal/clock
- Timer2: 8-bit timer/counter with 8-bit period register, pre scalar and post scalar
- Two Capture, Compare, PWM modules
 - Capture is 16-bit, max. Resolution is 12.5 ns

- Compare is 16-bit, max. Resolution is 200 ns
- PWM max. Resolution is 10-bit
- Synchronous Serial Port (SSP) with SPI™ (Master mode) and I²C™ (Master/Slave)
- Universal Synchronous Asynchronous Receiver Transmitter (USART/SCI) with 9-bit address detection
- Parallel Slave Port (PSP) – 8 bits wide with external RD, WR and CS controls (40/44-pin only)
- Brown-out detection circuitry for Brown-out Reset (BOR)

2.2.1.6 HIGH-PERFORMANCE RISC CPU:

The features of RISC CPU,

- Only 35 single-word instructions.
- All single-cycle instructions except for program branches, which are two-cycle
- Operating speed: DC – 20 MHz clock input DC – 200 ns instruction cycle
- Up to 8K x 14 words of Flash Program Memory, Up to 368 x 8 bytes of Data Memory (RAM), Up to 256 x 8 bytes of EEPROM Data Memory
- Pin out compatible to other 28-pin or 40/44-pin PIC16F877A.

2.2.1.7 STATUS REGISTER:

The Status register contains the arithmetic status of the ALU, the Reset status and the bank select bits for data memory. The Status register can be the destination for any instruction, as with any other register. If the Status register is the destination for an instruction that affects the Z, DC or C bits, then the write to

these three bits is disabled. These bits are set or cleared according to the device logic. Furthermore, the TO and PD bits are not writable, therefore, the result of an instruction with the Status register as destination may be different than intended. For example, CLRF STATUS will clear the upper three bits and set the Z bit. This leaves the Status register as 000u u1uu (where u =unchanged). It is recommended, therefore, that only BCF, BSF, SWAPF and MOVWF instructions are used to alter the Status register because these instructions do not affect the Z, C or DC bits from the Status register.

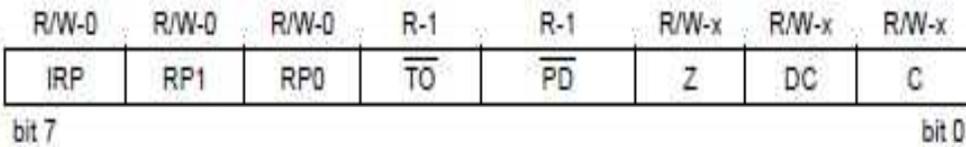


Fig 2.8 Status Register (ADDRESS 03h, 83h, 103h, 183h)

Bit 7 **IRP**: Register Bank Select bit (used for indirect addressing)

1 = Bank 2, 3 (100h-1FFh)

0 = Bank 0, 1 (00h-FFh)

Bit 6-5 **RP1:RP0**: Register Bank Select bits (used for direct addressing)

11 = Bank 3 (180h-1FFh)

10 = Bank 2 (100h-17Fh)

01 = Bank 1 (80h-FFh)

00 = Bank 0 (00h-7Fh)

Each bank is 128 bytes.

Bit 4 **TO**: Time-out bit

1 = after power-up, CLRWDT instruction or SLEEP instruction

0 = A WDT time-out occurred

Bit 3 **PD**: Power-down bit

1 = after power-up or by the CLRWDT instruction

0 = by execution of the SLEEP instruction

Bit 2 **Z**: Zero bit

1 = the result of an arithmetic or logic operation is zero

0 = the result of an arithmetic or logic operation is not zero

Bit 1 **DC**: Digit carry/borrow bit

1 = A carry-out from the 4th low order bit of the result occurred

0 = No carry-out from the 4th low order bit of the result

Bit 0 **C**: Carry/borrow bit (ADDWF, ADDLW, SUBLW, SUBWF instructions)

1 = A carry-out from the Most Significant bit of the result occurred.

0 = No carry-out from the Most Significant bit of the result occurred.

2.2.1.8 I²C BUS (Inter Integrated Circuit):

The I²C module provides an interface between the TCI648x/C6472 device and other devices compliant with the I²C-bus specification and connected by way of an I²C-bus. External components attached to this 2-wire serial bus can transmit and receive up to 8-bit wide data to and from the device through the I²C module.

The I²C allows connection of up to 128 individually addressable devices using only two bi-directional lines: clock (SCL) and data (SDA). The only additional hardware required is a pull-up resistor for each of the lines. Each of the connected devices can be either a master or slave device. Only master devices are allowed to drive the clock line.

The I²C protocol and EFM32 I2C module provide several mechanisms for handling bus conflicts and contention

At the physical layer both SCL and SCA lines are in open-drain, hence the pull-up resistors. Increasing the number of devices on the I2C bus will also increase the line capacitance and thus reduce the slew rate. The slew-rate can be controlled by changing the drive strength in the GPIO module for the I2C pins. The size of the pull-up resistors can be calculated as a function of the maximum rise time allowed for the given bus speed and the estimated bus capacitance.

2.2.1.9 FUNCTIONAL BLOCK DIAGRAM:

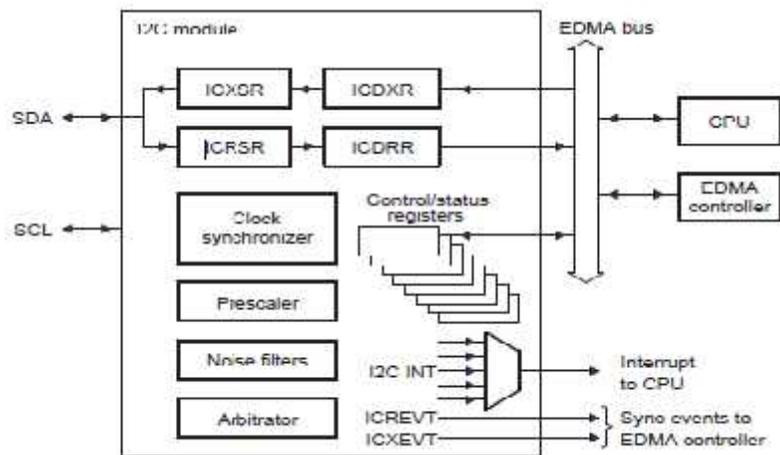


Fig 2.9 Block diagram of I²C

2.2.1.10 DATA TRANSFER – SCL (SERIAL CLOCK):

- Master sets SCL = 0 and generates pulse for each data bit
- 8 pulses for data bits are followed by one pulse for acknowledgement bit
- After acknowledgement.

- Master tries to generate next byte's first pulse.
- Slave can hold SCL low _ master switches to wait state.

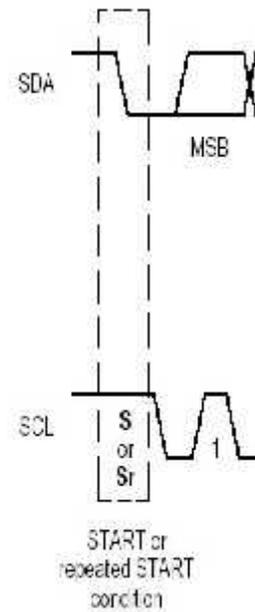
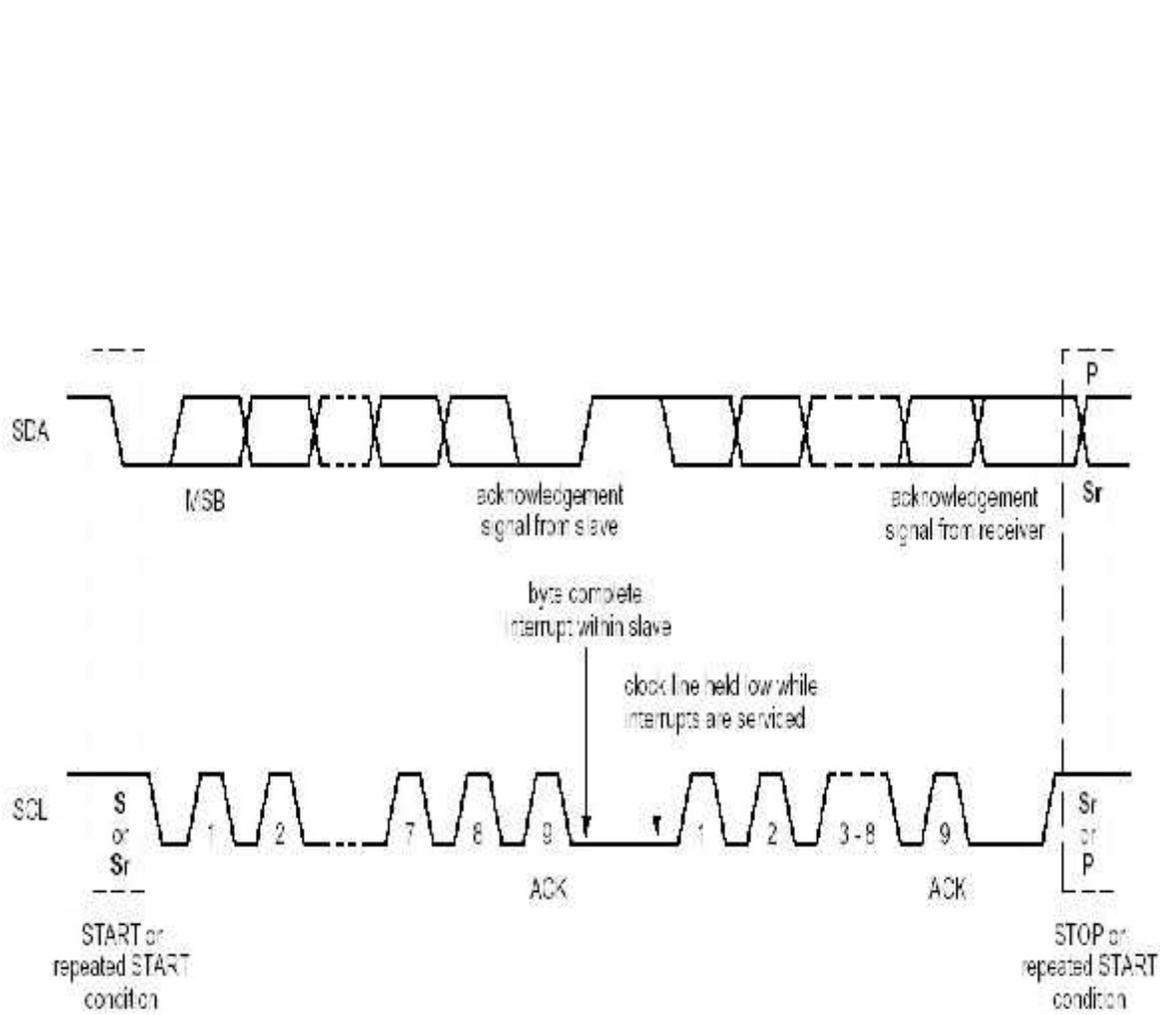


Fig
2.10
Serial
clock

clock data

2.2.1.11 DATA TRANSFER -SDA (SERIAL DATA):

Data bits are generated by transmitter as SCL pulses

- Transmitter releases SDA
- Receiver must hold SDA low in order to ack. received data
- Slave must release SDA after ack. bit (allows master to end frame)

Fig 2.11 Serial Data

2.3 RF TRANSMITTER AND RECEIVER

2.3.1 RF TRANSMITTER:

Whenever the high output pulse is given to base of the transistor BF 494, the transistor is conducting so tank circuit is oscillated. The tank circuit consists of L2 and C4 generating 433 MHz carrier signal. Then the modulated signal is given LC filter section. After the filtration the RF modulated signal is transmitted through antenna.

ENCODER:

In this circuit HT 640 is used as encoder. The 3¹⁸ encoders are a series of CMOS LSIs for remote control system application. They are capable of encoding 18 bits of information which consists of N address bit and 18-N data bits. Each address/data input is externally ternary programmable if bonded out. It is otherwise set floating internally.

Various packages of the 3^{18} encoders offer flexible combination of programmable address/data is transmitted together with the header bits via an RF or an infrared transmission medium upon receipt of a trigger signal. The capability to select a TE trigger type further enhances the application flexibility of the 3^{18} series of encoders.

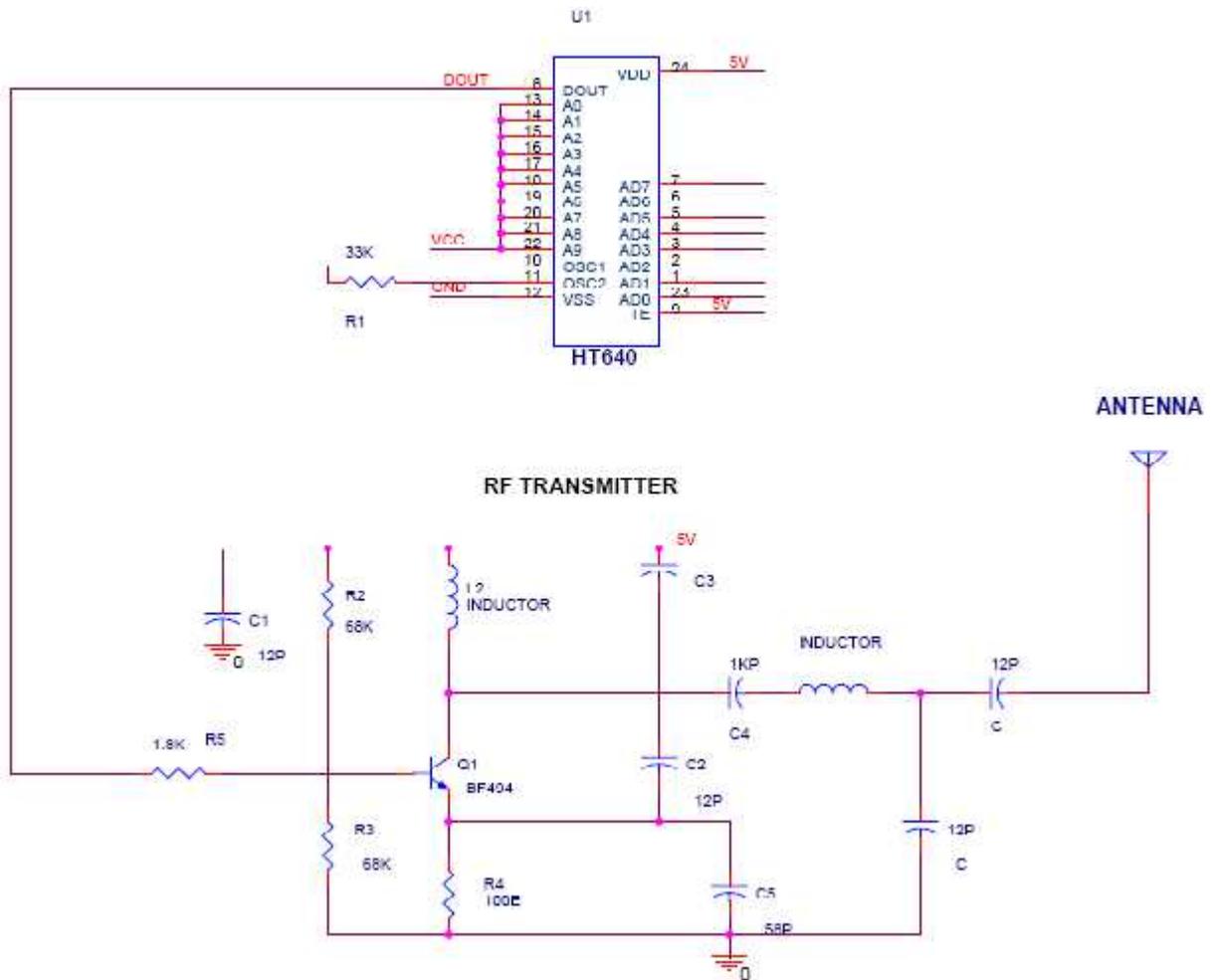


Fig 2.12 Circuit Diagram of RF Transmitter

2.3.2 RF RECEIVER:

The RF receiver is used to receive the encoded data which is transmitted by the RF transmitter. Then the received data is given to transistor which acts as amplifier. Then the amplified signal is given to carrier demodulator section in which transistor Q1 is turn on and turn off conducting depends on the signal. Due to this the capacitor C14 is charged and discharged so carrier signal is removed and saw tooth signal is appears across the capacitor. Then this saw tooth signal is given to comparator. The comparator circuit is constructed by LM558.

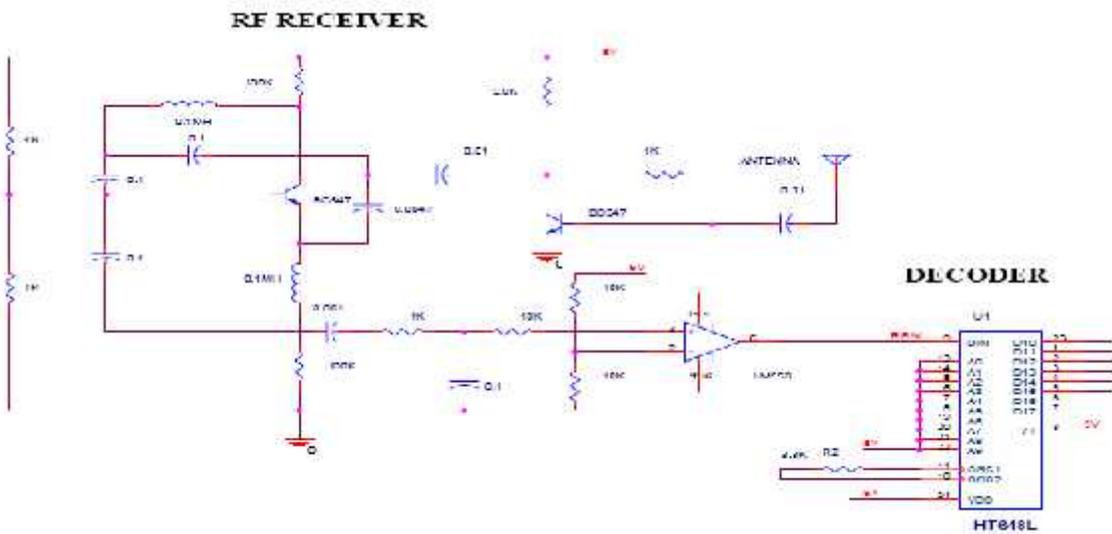


Fig 2.13 Circuit Diagram of RF Receiver

DECODER:

In this circuit HT648 is used as decoder. The 3^{18} decoder are a series of CMOS LSIs for remote control system application. They are paired with 3^{18} series of encoders. For proper operation a pair of encoder/decoder pair with the same number of address and data format should be selected. The 3^{18} series of decoder receives serial address and data from that series of encoders that are transmitted by a carrier using an RF or an IR transmission medium. It then compares the serial input data twice continuously with its local address. If no errors or unmatched

codes are encountered, the input data codes are decoded and then transferred to the output pins. The VT pin also goes high to indicate a valid transmission.

The 3^{18} decoders are capable of decoding 18 bits of information that consists of N bits of address and 18-N bits of data. To meet various applications they are arranged to provide a number of data pins whose range is from 0 to 8 and an address pin whose range is from 8 to 18. In addition, the 3^{18} decoders provide various combinations of address/ data numbering different package.

In this circuit the received encoded signal is 9th pin of the decoder. Now the decoder separate the address (A0-A9) and data signal (D0-D7). Then the output data signal is given to microcontroller or any other interfacing device.

2.3.3 APPLICATIONS

- Automotive Remote entry systems
- Automotive alarm systems
- Gate and garage door openers
- Wireless Data Transmission / Sensor Network
- Electronic Door locks
- Burglar alarm & Security System

2.4 MAX 232

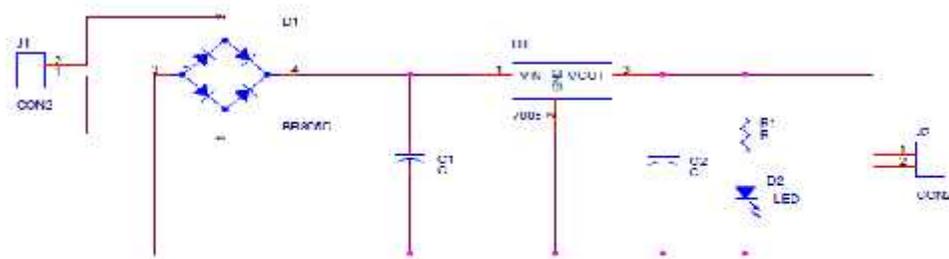
The MAX232 is an IC, first created in 1987 by Maxim Integrated Products, that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The MAX232 is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals.

The drivers provide RS-232 voltage level outputs (approx. ± 7.5 V) from a single + 5 V supply via on-chip charge pumps and external capacitors. This makes it useful for implementing RS-232 in devices that otherwise do not need any voltages outside the 0 V to + 5 V range, as power supply design does not need to be made more complicated just for driving the RS-232 in this case.

The receivers reduce RS-232 inputs (which may be as high as ± 25 V), to standard 5 V TTL levels. These receivers have a typical threshold of 1.3 V, and a typical hysteresis of 0.5 V.

2.4.1 VOLTAGE LEVELS

It is helpful to understand what occurs to the voltage levels. When a MAX232 IC receives a TTL level to convert, it changes TTL logic 0 to between +3



and
+15
V,
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TTL logic 1 to between -3 to -15 V, and vice versa for converting from RS232 to TTL.

2.5 POWER SUPPLY:

Power supply is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others.

Fig 2.14 Circuit Diagram of Power Supply

This circuit converts 240V AC into +5V DC.

EXPLANATION:

- Potential transformer
- Rectifier
- Filter
- Regulator

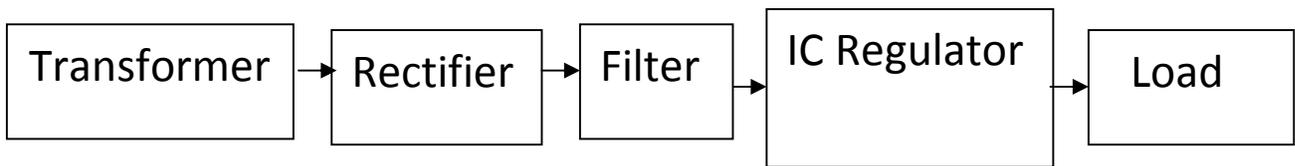


Fig: 2.15 Block diagram of power supply

Transformer:

The transformer will step down the power supply voltage (0-230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier which is constructed with the help of op-amp. The advantages of using precision rectifier are it will give peak voltage output as DC rest of the circuits will give only RMS output.

Rectifier:

The rectifier is device which converts Alternating current into some DC form. The output of the rectifier is in pulsated DC form. There is some semiconductor devices used to convert AC to pulsated DC named diodes. Normally we are using PN junction diodes in rectifiers. These diodes allow the current flow to it when the

incoming voltage is higher than or equal to 0.7 V. otherwise it will act as an open circuit.

Filter:

The next section of the power supply is filter section. That is nothing but capacitor. The capacitor is used as a filter to convert Pulsated DC to pure DC. We can utilize the capacitor's charging discharging characteristics and convert the pulsated DC to pure DC.

Voltage Regulator:

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustably set voltage. The regulators can be selected for operation with load currents from hundreds of mille amperes to tens of amperes, corresponding to power ratings from mille watts to tens of watts.

All electronic circuits need DC power supply either from battery or power packs units. It may not be economical and convenient to depend upon battery power supply. Transformer involves converting 240 volt AC supply into step downed required AC voltage. A rectifier utilizes unidirectional conduction device like a

vacuum diode or PN junction diode. It also consists of filter to remove the pulsating AC component.

Then it will feed into regulator. The regulation of power supplies is done by incorporating circuitry to tightly control the output voltage and/or current of the power supply to a specific value. We can add more than one regulator according to our needed voltage to get the different output voltages. From this, we can get the regulated +5V and +/-12V DC supply.

Advantage:

- Small size and less weight.
- Less expensive
- High reliable and versatile
- Reduced man power

2.6 RELAY DRIVER:

A relay is a switch worked by an electromagnet. It is useful if we want a small current in one circuit to control another circuit containing a device such as a lamp or electric motor which requires a large current, or if we wish several different switch contacts to be operated simultaneously.

When the controlling current flows through the coil, the soft iron core is magnetized and attracts the L-shaped soft iron armature. This rocks on its pivot and opens, closes or changes over, the electrical contacts in the circuit being controlled it closes the contacts.

The current needed to operate a relay is called the pull-in current and the dropout current in the coil when the relay just stops working. If the coil resistance R of a relay is $185\ \Omega$ and its operating voltage V is $12V$, the pull-in current I is given by $65mA$.

Relay driver circuit is used for on / off control of relay, it acts as a switch, normally open relay is used. Relay function is derived by controller unit. Relay working current is $40\ mA$.

When the controller unit output is low relay should be in off condition. When the controller unit output is high, relay should be ready for doing specified function.

RELAY DRIVER-1

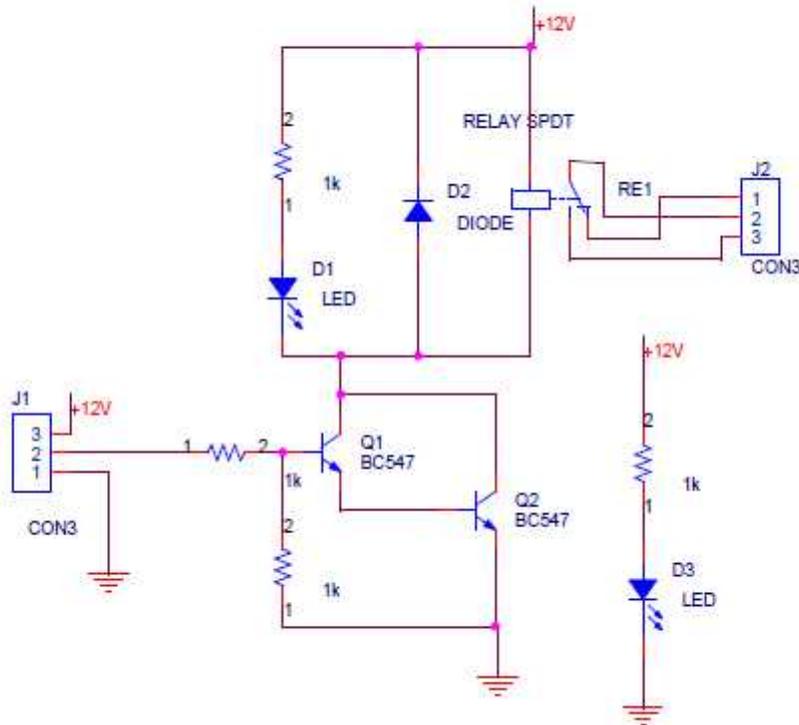
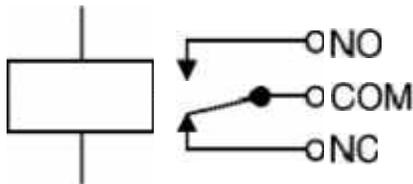


Fig: 2.16 Circuit diagram of relay

For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical.

The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Most ICs (chips) cannot provide this current and a transistor is usually used to amplify the small IC current to the larger value required for the relay coil. The maximum output current for the popular 555 timer IC is 200mA so these devices can supply relay coils directly without amplification.

Relays are usually SPDT or DPDT but they can have many more sets of switch contacts, for example relays with 4 sets of changeover contacts are readily available. Most relays are designed for PCB mounting but you can solder wires directly to the pins providing you take care to avoid melting the plastic case of the relay. The animated picture shows a working relay with its coil and switch contacts. You can see a lever on the left being attracted by magnetism when the coil is switched on. This lever moves the switch contacts. There is one set of contacts (SPDT) in the foreground and another behind them, making the relay DPDT.



The relay's switch connections are usually labeled COM, NC and NO:

- **COM** = Common, always connect to this; it is the moving part of the switch.
- **NC** = Normally Closed, COM is connected to this when the relay coil is **off**.
- **NO** = Normally Open, COM is connected to this when the relay coil is **on**.

Circuit description:

Generally the relay circuit is designed to control the load. The load may be motor or any other load. The load is turned ON and OFF through relay. The relay ON and OFF is controlled by the pair of switching transistors (BC 547). The relay is connected in the Q2 transistor collector terminal. A Relay is nothing but electromagnetic switching device which consists of three pins. They are Common, Normally close (NC) and normally open (NO).

The relay common pin is connected to supply voltage. The normally open (NO) pin connected to load. When high pulse signal is given to base of the Q1 transistors, the transistor is conducting and shorts the collector and emitter terminal and zero signals is given to base of the Q2 transistor. So the relay is turned OFF state.

When low pulse is given to base of transistor Q1 transistor, the transistor is turned OFF. Now 12v is given to base of Q2 transistor so the transistor is conducting and relay is turned ON. Hence the common terminal and NO terminal of relay are shorted. Now load gets the supply voltage through relay.

2.7 LCD INTERFACING

LCD INTERFACING WITH MICROCONTROLLER:

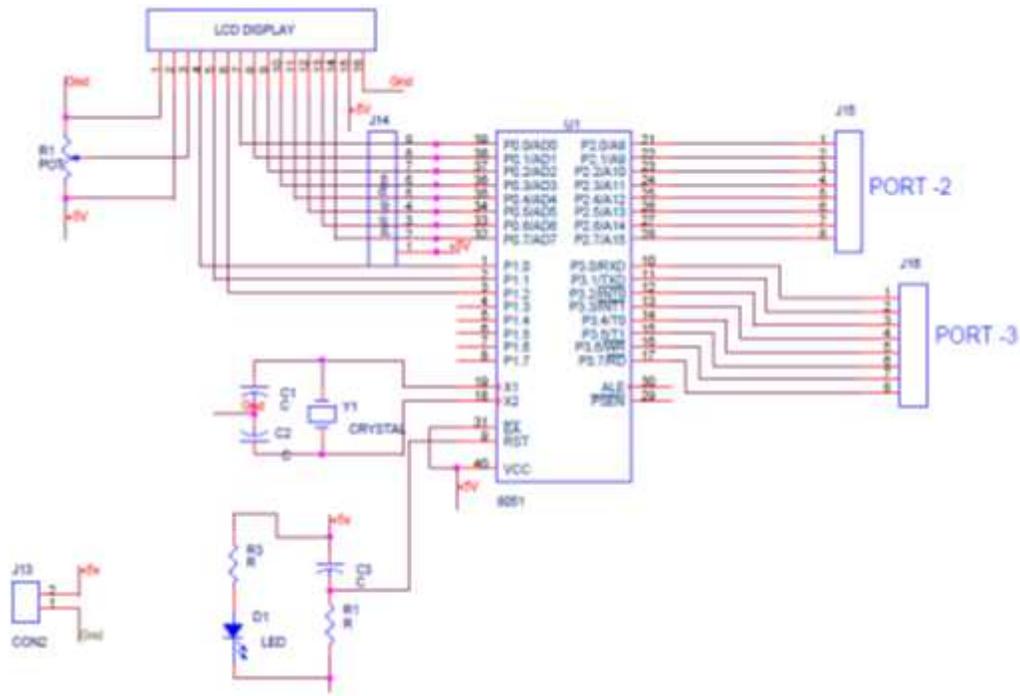


Fig: 2.17 Circuit diagram of LCD interfacing

Operation:

The power supply given to the controller is +5v, AND it WILL operate in +5v only. Here we are interfacing LCD display with the controller. It is a 40 pin controller. It consists of 4 ports namely port0, port1, port2 and port3. Each ports have 8pins.

LCD data line is taken from the port0 (0-7) for data line given to LCD. For LCD control line is taken from the port1 (0-2). Here in part we are using trim pot variable resistor. This resistor is used for adjustment of LCD brightness.

An LCD consists of two glass panels, with the liquid crystal material sandwiched in between them. The inner surface of the glass plates are coated with transparent electrodes which define the character, symbols or patterns to be displayed. Polymeric layers are present in between the electrodes and the liquid crystal, which makes the liquid crystal molecules to maintain a defined orientation angle.

One each polarizers are pasted outside the two glass panels. These polarizers would rotate the light rays passing through them to a definite angle, in a particular direction. When the LCD is in the off state, light rays are rotated by the two polarizers and the liquid crystal, such that the light rays come out of the LCD without any orientation, and hence the LCD appears transparent.

When sufficient voltage is applied to the electrodes, the liquid crystal molecules would be aligned in a specific direction. The light rays passing through the LCD would be rotated by the polarizers. LCD's are lightweight with only a few millimeters thickness. Since the LCD's consume less power, they are compatible with low power electronic circuits, and can be powered for long durations.

The LCD does not generate light and so light is needed to read the display. By using backlighting, reading is possible in the dark. The LCD's have long life and a wide operating temperature range.

2.8 RFID SYSTEM

Radio frequency identification (RFID) is a general term that is used to describe a system that transmits the identity (in the form of a unique serial number) of an object wirelessly, using radio waves. RFID technologies are grouped under the more generic Automatic Identification (Auto ID) technologies. The barcode labels that triggered a revolution in identification systems long time ago are inadequate in an increasing number of cases. They are cheap but the stumbling block is their low storage capacity and the fact that they cannot be reprogrammed.

A feasible solution was putting the data on silicon chips. The ideal situation is contactless transfer of data between the data carrying device and its reader. The power required to operate the electronic data carrying device would also be transferred from the reader using contactless technology.

Before RFID can be understood completely, it is essential to understand how Radio Frequency communication occurs. RF (Radio Frequency) communication occurs by the transference of data over electromagnetic waves. By generating a specific electromagnetic wave at the source, its effect can be noticed at the receiver far from the source, which then identifies it and thus the information RFID tag which contains the tagged data of the object generates a signal containing the respective information which is read by the RFID reader, which then may pass this information to a processor for processing the obtained information for that particular application.

Thus, an RFID System can be visualized as the sum of the following three components:

- RFID tag or transponder
- RFID reader or transceiver
- Data processing subsystem

An RFID tag is composed of an antenna, a wireless transducer and an encapsulating material. These tags can be either active or passive. While the active tags have on-chip power, passive tags use the power induced by the magnetic field of the RFID reader. Thus passive tags are cheaper but with lower range (<10mts) and more sensitive to regulatory and environmental constraints, as compared to active tags.

An RFID reader consists of an antenna, transceiver and decoder, which sends periodic signals to inquire about any tag in vicinity. On receiving any signal from a tag it passes on that information to the data processor. The data processing subsystem provides the means of processing and storing the data.

RFID systems can also be differentiated based on the frequency range it uses. The common ranges are Low-Frequency (LF: 125 - 134.2 kHz and 140 - 148.5 kHz), High-Frequency (HF: 13.56 MHz) and Ultra-High-Frequency (UHF: 868 MHz - 928 MHz).

Low-frequency systems have short reading ranges and lower system costs. They are most commonly used in security access, asset tracking, and animal

identification applications. High-frequency systems, offering long read ranges (greater than 90 feet) and high reading speeds, are used for such applications as railroad car tracking and automated toll collection. However, the higher performance of high-frequency RFID systems incurs higher system costs.

APPLICATIONS OF RFID TECHNIQUE:

There are two main area of applications, defined broadly as proximity (short range) and vicinity (long range).

Long range or vicinity applications can generally be described as track and trace applications, but the technology provides additional functionality and benefits for product authentication.

RFID enables greater automation of data collection process. Most companies spend considerable effort in knowing what's in their warehouse. RFID will help them dig deeper and much more easily, tracking to the detail of even each unit, long after it has left the factory or warehouse.

RFID allows all this data to be transferred securely. Companies use independent suppliers, data from each of them can be carried on tags and uploaded to the Company's central system.

Imagine the control that the Company will have on a product's life cycle. The creation of successes and defeats can be better understood. There have been numerous instances when companies had to recall the entire product due to a fault in a minor component. RFIDs can make such recalls much more focused.

There would be better data about post production performance. A car could have individually tagged components. Data could be collected everywhere, accident sites, repair shops, even the garage. Even inside the factory, tags could enable faster and focused fault tracing.

The Just in Time(JIT) practice followed by many companies, where components are used when they are delivered and delivered just before being needed, can lead to out of stock situations. RFID will eliminate the problem.

Some other areas where passive RFID has been applied in recent past are:

- Person Identification
- Food Production Control
- Vehicle Parking Monitoring
- Toxic Waste Monitoring
- Valuable Objects Insurance Identification
- Asset Management
- Access Control

2.9 GSM

The standard developed by the European Telecommunications Standards Institute to describe protocols for second-generation 2G digital cellular networks used by mobile phones. As of 2014 it has become the default global standard for mobile communications - with over 90% market share, operating in over 219 countries and territories.

2G networks developed as a replacement for first generation 1G analog cellular networks, and the GSM standard originally described a digital, circuit-switched network optimized for full duplex voice telephony. This expanded over time to include data communications, first by circuit-switched transport, then by packet data transport via General Packet Radio Services and Enhanced Data rates for GSM Evolution or EGPRS.

Subsequently, the 3GPP developed third-generation 3G UMTS standards followed by fourth-generation 4G LTE advanced standards, which do not form part of the ETSI GSM standard.

2.9.1 NETWORK STRUCTURE:

The network is structured into a number of discrete sections:

- Base Station Subsystem – the base stations and their controllers explained
- Network and Switching Subsystem – the part of the network most similar to a fixed network, sometimes just called the "core network"
- GPRS Core Network – the optional part which allows packet-based Internet connections.

2.9.2 BASE STATION SUBSYSTEM:

GSM cell site antennas in the detaches Museum, Munich, Germany

GSM is a cellular network, which means that cell phones connect to it by searching for cells in the immediate vicinity. There are five different cell sizes in a GSM network macro, micro, Pico, femto, and umbrella cells. The coverage area of each cell varies according to the implementation environment. Macro cells can be regarded as cells where the base station antenna is installed on a mast or a building above average rooftop level.

Cell horizontal radius varies depending on antenna height, antenna gain, and propagation conditions from a couple of hundred meters to several tens of kilometers. The longest distance the GSM specification supports in practical use is 35 kilometers (22 mi). There are also several implementations of the concept of an extended cell where the cell radius could be double or even more, depending on the antenna system, the type of terrain, and the timing advance.

Indoor coverage is also supported by GSM and may be achieved by using an indoor Pico cell base station, or an indoor repeater with distributed indoor antennas fed through power splitters, to deliver the radio signals from an antenna outdoors to the separate indoor distributed antenna system. These are typically deployed when significant call capacity is needed indoors, like in shopping centers

or airports. However, this is not a prerequisite, since indoor coverage is also provided by in-building penetration of the radio signals from any nearby cell.

2.9.3 GSM CARRIER FREQUENCIES:

GSM networks operate in a number of different carrier frequency ranges separated into GSM frequency ranges for 2G and UMTS frequency bands for 3G, with most 2G GSM networks operating in the 900 MHz or 1800 MHz bands. Where these bands were already allocated, the 850 MHz and 1900 MHz bands were used instead for example in Canada and the United States. In rare cases the 400 and 450 MHz frequency bands are assigned in some countries because they were previously used for first-generation systems.

Most 3G networks in Europe operate in the 2100 MHz frequency band. For more information on worldwide GSM frequency usage, see GSM frequency bands.

Regardless of the frequency selected by an operator, it is divided into timeslots for individual phones. This allows eight full-rate or sixteen half-rate speech channels per radio frequency. These eight radio timeslots or burst periods are grouped into a TDMA frame. Half-rate channels use alternate frames in the same timeslot. The channel data rate for all 8 channels is 270.833 Kbits and the frame duration is 4.615 Ms.

The transmission power in the handset is limited to a maximum of 2 watts in GSM 850/900 and 1 watt in GSM 1800/1900.

2.9.4 VOICE CODECS:

GSM has used a variety of voice codecs to squeeze 3.1 kHz audio into between 6.5 and 13 Kbits. Originally two codecs named after the types of data channel they were allocated, were used, called Half Rate (6.5 Kbit/s) and Full Rate (13 Kbit/s). These used a system based on linear predictive coding (LPC). In addition to being efficient with bitrates, these codecs also made it easier to identify more important parts of the audio allowing the air interface layer to prioritize and better protect these parts of the signal.

As GSM was further enhanced in 199 with the Enhanced Full Rate (EFR) codec a 12.2 Kbit/s codec that uses a full-rate channel. Finally, with the development of UMTS, EFR was refactored into a variable-rate codec called AMR-Narrowband, which is high quality and robust against interference when used on full-rate channels or less robust but still relatively high quality when used in good radio conditions on half-rate channel.

2.9.5 SUBSCRIBER IDENTITY MODULE (SIM):

One of the key features of GSM is the Subscriber Identity Module, commonly known as a SIM card. The SIM is a detachable smart card containing the user's subscription information and phone book. This allows the user to retain his or her information after switching handsets. Alternatively the user can also change operators while retaining the handset simply by changing the SIM. Some operators will block this by allowing the phone to use only a single SIM, or only a SIM issued by them this practice is known as SIM locking.

2.9.6 PHONE LOCKING:

Sometimes mobile network operators restrict handsets that they sell for use with their own network. This is called locking and is implemented by a software feature of the phone. A subscriber may usually contact the provider to remove the lock for a fee utilizes private services to remove the lock or use software and websites to unlock the handset themselves.

2.9.7 GSM SERVICE SECURITY:

GSM was designed with a moderate level of service security. The system was designed to authenticate the subscriber using a pre-shared key and challenge-response. Communications between the subscriber and the base station can be encrypted. The development of UMTS introduces an optional Universal Subscriber Identity Module (USIM) that uses a longer authentication key to give greater

security as well as mutually authenticating the network and the user, whereas GSM only authenticates the user to the network .

The security model therefore offers confidentiality and authentication, but limited authorization capabilities, and no non-repudiation.

2.9.8 GSM OPEN-SOURCE SOFTWARE:

Several open-source software projects exist that provide certain GSM features:

- Open BTS develops a Base transceiver station
- The GSM Software Project aims to build a GSM analyzer for less than low cost

2.9.9 ISSUES WITH PATENTS AND OPEN SOURCE OF GSM:

Patents remain a problem for any open-source GSM implementation, because it is not possible for GNU or any other free software distributor to guarantee immunity from all lawsuits by the patent holders against the users. Furthermore new features are being added to the standard all the time which means they have patent protection for a number of years.

The original GSM implementations from 1991 may now be entirely free of patent encumbrances, however patent freedom is not certain due to the United States' "first to invent" system that was in place until 2012. The "first to invent"

system, coupled with "patent term adjustment" can extend the life of a U.S. patent far beyond 20 years from its priority date.

2.10 BUZZER:

A buzzer is a signalling device, usually electronic, typically used in automobiles, household appliances such as a microwave oven, or game shows. It most commonly consists of a number of switches or sensors connected to a control unit that determines if and which button was pushed or a preset time has lapsed, and usually illuminates a light on the appropriate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound.

Initially this device was based on an electromechanical system which was identical to an electric bell without the metal gong which makes the ringing noise.

Often these units were anchored to a wall or ceiling and used the ceiling or wall as a sounding board. Another implementation with some AC-connected devices was to implement a circuit to make the AC current into a noise loud enough to drive a loudspeaker and hook this circuit up to a cheap 8-ohm speaker. Nowadays, it is more popular to use a ceramic-based piezoelectric sounder like a Son alert which makes a high-pitched tone.

Usually these were hooked up to "driver" circuits which varied the pitch of the sound or pulsed the sound on and off.

CHAPTER 3

SOFTWARE DESCRIPTION

3.1 EMBEDDED C

3.1.1 INTRODUCTION:

Embedded C is a set of language extensions for the C Programming language by the C language Standards committee to address commonality issues that exist between C language extensions for different embedded systems. Historically,

embedded C language programming requires nonstandard extensions to the C language in order to support exotic features such as **fixed-point arithmetic**, multiple distinct **memory banks**, and basic **I/O** operations. In 2008, the C language Standards Committee extended the C language to address these issues by providing a common standard for all implementations to adhere to. It includes a number of features not available in normal C language, such as, fixed-point arithmetic, named address spaces, and basic I/O hardware addressing.

Embedded C language uses most of the syntax and semantics of standard C language, e.g., `main ()` function, variable definition, data type declaration, conditional statements (`if`, `switch`, `case`), loops (`while`, `for`), functions, arrays and strings, structures and union, bit operations, macros, etc.

3.1.2 NECESSITY:

During infancy years of microprocessor based systems, programs were developed using assemblers and fused into the EPROMs. There used to be no mechanism to find what the program was doing. LEDs, switches, etc. were used to check for correct execution of the program. Some 'very fortunate' developers had In-circuit Simulators (ICEs), but they were too costly and were not quite reliable as well. As time progressed, use of microprocessor specific assembly-only as the programming language reduced and embedded systems moved onto C language as the embedded programming language of choice. C language is the most widely used programming language for embedded processors controllers.

Assembly is also used but mainly to implement those portions of the code where very high timing accuracy, code size efficiency, etc. are prime requirements. As assembly language programs are specific to a processor, assembly language didn't offer portability across systems. To overcome this disadvantage, several high level languages, including C language, came up. Some other languages like PLM, Modula-2, Pascal, etc. also came but couldn't find wide acceptance. Amongst those, C language got wide acceptance for not only embedded systems, but also for desktop applications.

Even though C language might have lost its seen as mainstream language for general purpose applications, it still is having a strong-hold in embedded programming. Due to the wide acceptance of C language in the embedded systems, various kinds of support tools like compilers & cross-compilers, ICE, etc. came up and all this facilitated development of embedded systems using C language. Assembly language seems to be an obvious choice for programming embedded devices. However, use of assembly language is restricted to developing efficient codes in terms of size and speed. Also, assembly codes lead to higher software development costs and code portability is not there. Developing small codes are not much of a problem, but large programs/projects become increasingly difficult to manage in assembly language. Finding good assembly programmers has also become difficult nowadays. Hence high level languages are preferred for embedded systems programming.

3.1.3 ADVANTAGES:

- It is small and simpler to learn, understand, program and debug.

- Compared to assembly language, C code written is more reliable and scalable, more portable between different platforms.
- C compilers are available for almost all embedded devices in use today, and there is a large pool of experienced C programmers.
- Unlike assembly, C has advantage of process or independence and is not specific to any particular microprocessor/**microcontroller** or any system. This makes it convenient for a user to develop programs that can run on most of the systems.
- As C combines functionality of assembly language and features of high level languages, C is treated as a 'middle-level computer language' or 'high level assembly language'.
- It is fairly efficient.
- It supports access to I/O and provides ease of management of large embedded projects.

3.2 MP LAB IDE

3.2.1 INTRODUCTION:

Integrated Development Environment (IDE) is an application that has multiple functions for software development. MPLAB IDE an executable program that integrates a compiler, an assembler, a project manager, an editor, a debugger, simulator, and an assortment of other tools within one Windows application. A user developing an application should be able to write code, compile, debug and test and application without leaving the MPLAB IDE desktop.

3.2.2 FEATURES:

- Provides a new Call Graph for navigating complex code
- Supports Multiple Configurations within your projects
- Supports Multiple Versions of the same compiler
- Support for multiple Debug Tools of the same type
- Supports Live Parsing
- Import existing MPLAB IDE projects and use either IDE for the same source
- Supports hyperlinks for fast navigation to declarations and includes
- Supports Live Code Templates

CHAPTER 4

CONCLUSION

The RFID Automatic tollgate system designed could automatically detect the identities of the vehicles and performed the billing in accordance to the identity of each vehicle as pre-recorded in the database.

The system could automatically open and close the gate as well as automatically emailing the owners of the vehicles. These are the major achievements met in the project, among other objectives also achieved which include tracking of the vehicles and remote database collection.

The whole system is very convenient and saves much time. However when there is no reliable source of power the system just becomes a white elephant and is of no use unless if a solar power supply is installed on site.

CHAPTER 5

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