1. Introduction

1.1 Background of Project

The weighing scale technique started since 1974 is used toonly measure the quantity of product. In this technique weight object is kept on one side and weight is kept on other side. This system is very bulky it does not store the data and the result is approximated which consist inaccuracy. Cost of such system is more as PLC system is used. The system is not reliable and it may collapse. If any of the component fails the system cannot be repaired. So to make it advanced we are designing a new system named as '**Weighing Automation with Data Acquisition System'**which will not only measure the quantity of product but also stores the data.To store the data we are using SD card and this data will be stored in excel format. Later the data can be fetched through USB whenever required.

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1.2 Project Objective

The objective of this project is to design a system that will not only weigh an object but also stores the weighed data. The specific objectives that have to be achieved are as follows,

1.To design a system that will not only weigh an object but also stores the weighed the data.

2.Using Arduino Mega 2560 we are designing a PLC system which is the basic part of our project

3. A single computer can handle the overall working of the machine.

Block Diagram:

2.1 Main Board:

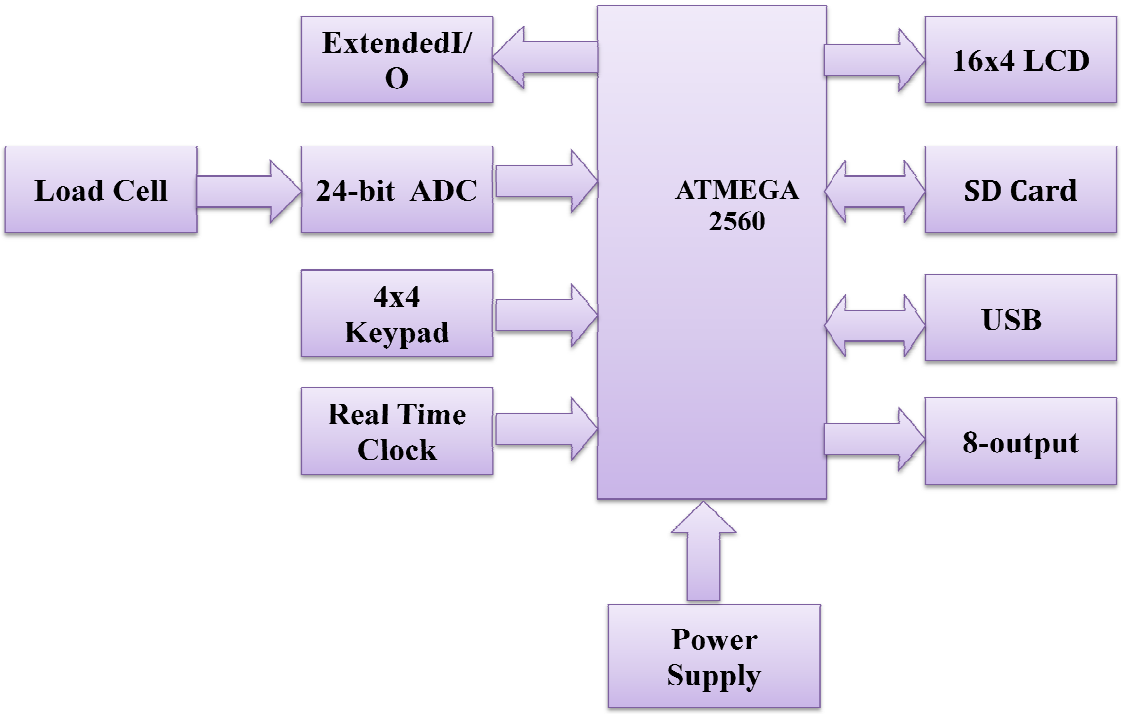


Figure 2.1 Block Diagram of Main Board

2.1.1 Description:

Arduino mega 2560: Arduino is a microcontroller which is a heart of our project.It runs only on one program again and again.It can be powered with an external batter pack.It is very simple to interface sensors and offer electronic components to Arduino.It provides a onboard storageand itrequires only one USB port to connect to the computer.There are also some advantages of Arduino that it has low cost and it is just plug and play device meansif the device is running it will run the program and if the power is disconnected it will simply stop.Themain thing is if the supply is suddenly disconnected the data willbe stored and you can resume with your work.

Extended I/Os: This are sensors.

Load cell: It is a sensor or transducer that converts load or force acting on it into an electronic signal

ADC: Theoutput of load-cell in the form of analog so is to convert in Digital we use ADC.It has a 8-bit resolution

Keypad: Input weight through keypad.

RTC: It is a real time clockwhich displays the date and time.

LCD: Whatever the data entered through keypad will be displayed on the LCD.

SD card: The data will be stored in the SD card in the excel format.

USB: If sometimes we require the data then we can fetch it through USB.

Outputs: It consist of relays.

2.2Extension Board:

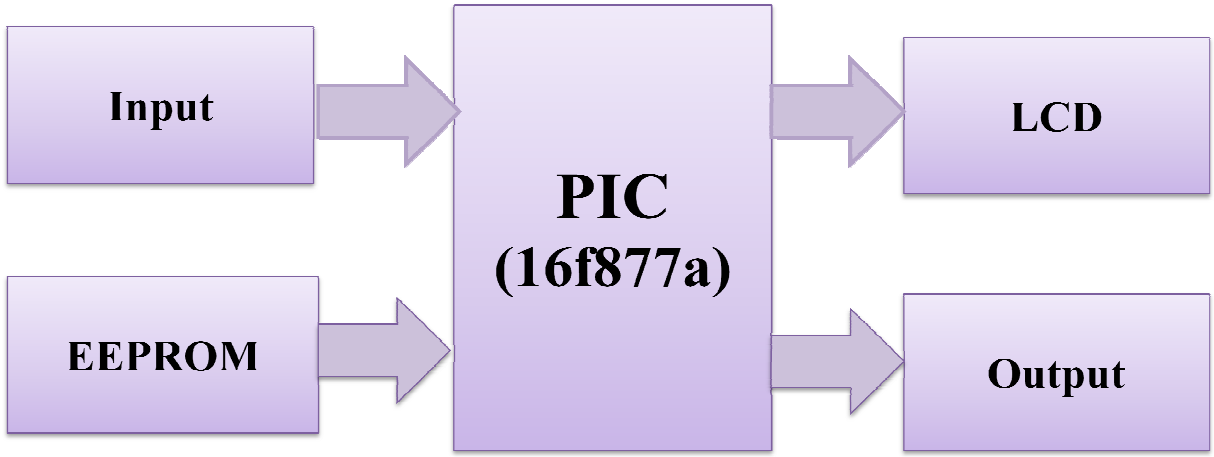


Figure 2.2 Block Diagram of Extension Board

2.2.1 Description:

Extension board is used to extend the I/O's. It work as a function of PLC to extend the I/O's and so by using PIC it becomes less expensive.

3.1 WORKING:

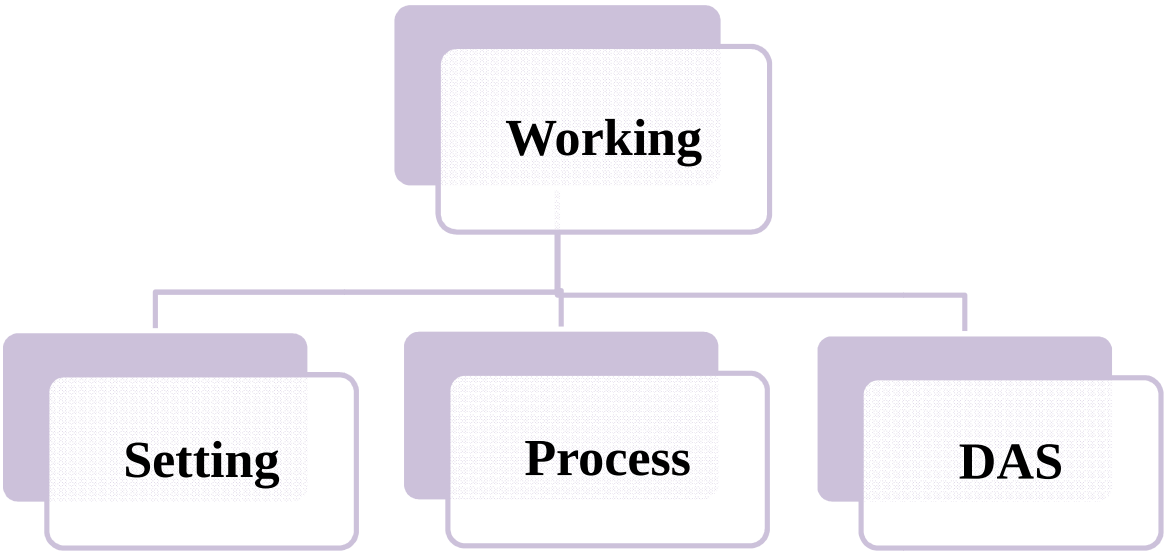


Figure 3.1 Working of overall system

3.1.1 Setting:

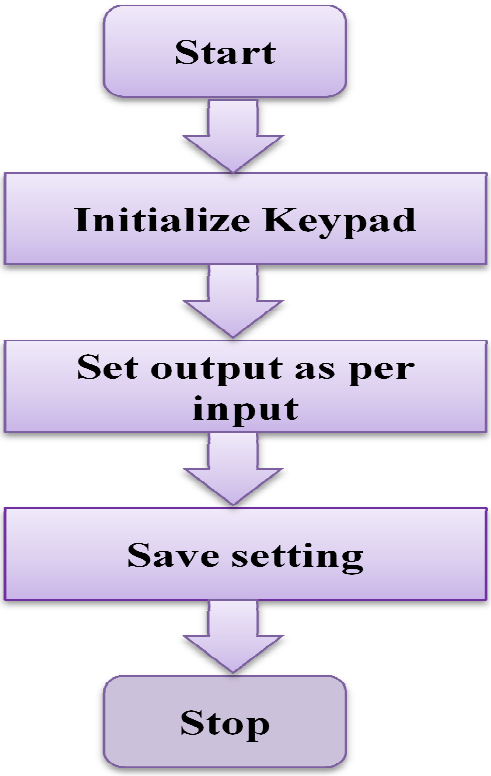


Figure 3.1.1 Flowchart of Setting

Firstly we have to decide how much quantity is needed for particular material. The quantity has to be put through keypad i.e. the keypad is provided to enter how much amount of material is to be needed to be mixed in that particular mixture. Then set output as per input means quantity can be decided as per our need. e.g. if we have a chocolate industry so we need to have ingredients according to need of it. So we have to set it and then after performing this, save data into internal EEPROM.

3.1.2 Process

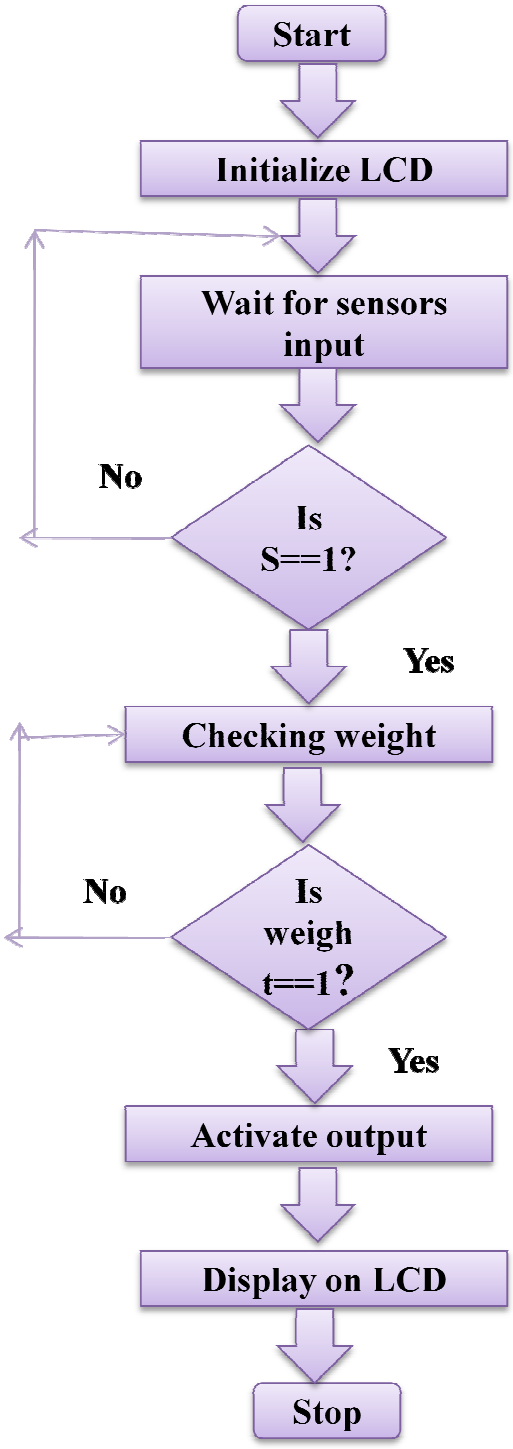


Figure 3.1.2 Flowchart of Process

In this, firstly we have to initialize LCD to display the contents which we are entering through keypad. On LCD weight, date and time will be displayed. After initializing LCD we will wait for sensor input means if there is any object detected on load cell, then the sensor will be on and it will check for that particular weight what we entered previously. If there is no any object detected then it will simply again wait for object till sensor is off. After sensor is on, it will check for weight. If weight is fully loaded which we wanted then it will activate the output. Otherwise ,it will check for weight until full weight is satisfied.Activating output means it is giving an acknowledgement to input sensor to turn offnow. Because our requirement of weight is fulfilled now. After this process the data will be now available on LCD i.e date and time.

3.1.3 Data Acquisition System:

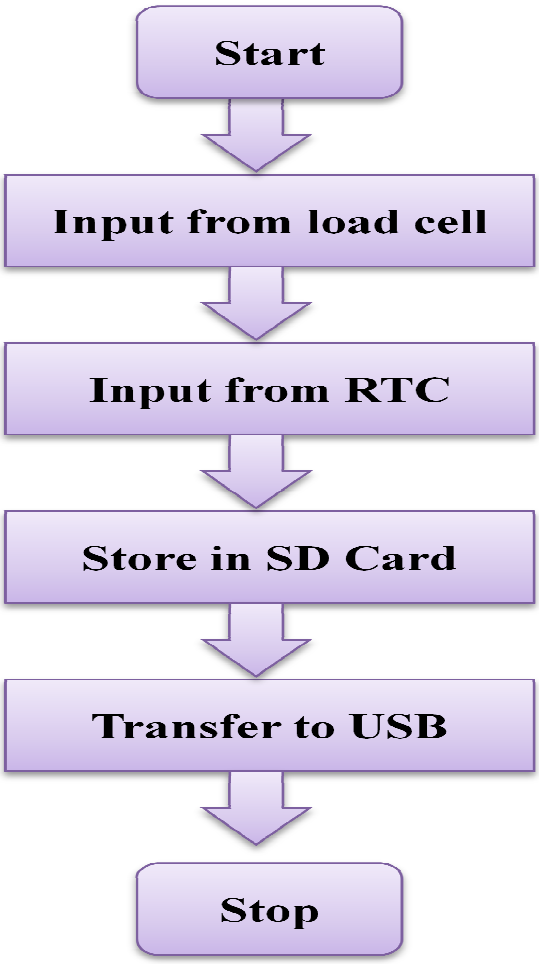


Figure 3.1.3 Flowchart of Data Acquisition System

It takes input of load cell, then actual weighing process begins. Then input is taken from RTC.RTC is real time clock which gives information about time and date at which weighing is done. Further the process information or data is stored in SD card in excel format. In our system it is possible to fetch data through USB whenever required and process of DAS ends.

4.1 Arduino Mega2560:

The heart of our project is Arduino Mega 2560. The Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header,and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

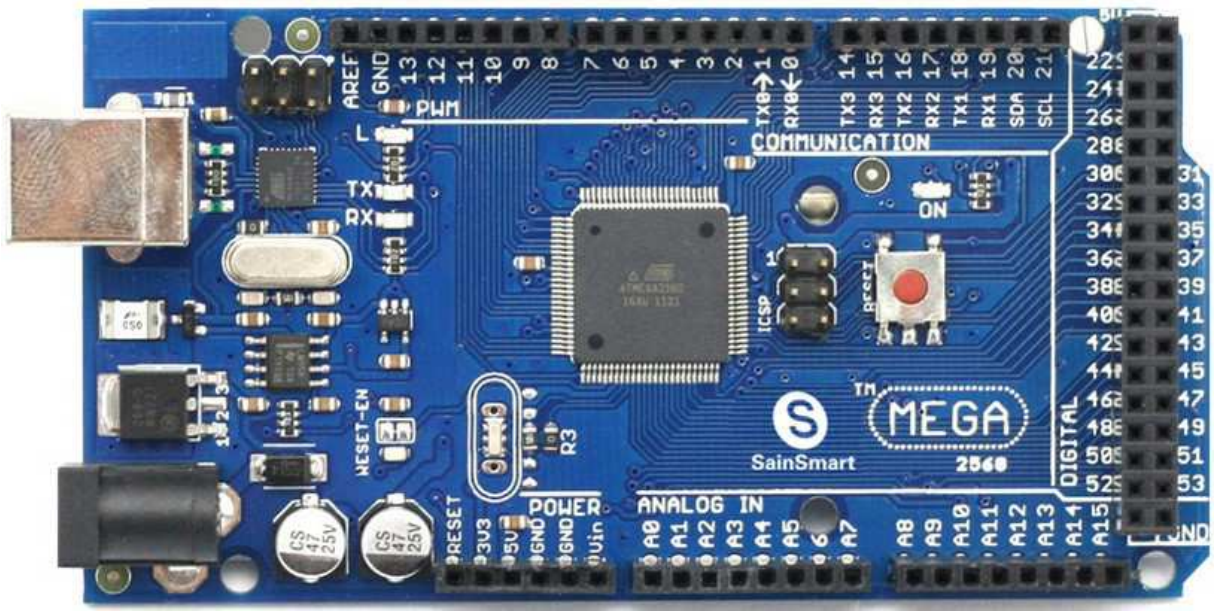


Figure 4.1 Arduino Mega2560

4.1.1 Features

- USB over-current protection
- Physical characteristics and shield compatibility
- Automatic reset
- Clock speed: 16MHz
- 16x10 ADC
- Memory:

  Flash memory: 256KB

  SRAM: 8KB

  EEPROM: 4KB

4.2 SD Card Module:

The Arduino SD card shield is a simple solution for transferring data to and form a standard SD card. The pin-out is directly compatible with Arduino, but can also be used with other microcontrollers. It allows you to add mass storage and data logging to your project

Figure 4.2 SD card Module

4.2.2 Features

- Breakout board for standard SD Card.
- Contains a switch to select the flash card slot
- Sits directly on a Arduino
- Also be used with other microcontrollers

4.3 Load cell module (HX711):

HX711 is a precision 24-bit analog-to-digital converter (ADC) designed for weigh scales and industrial control applications to interface directly with a bridge sensor. The input multiplexer selects either Channel A or B differential input to the low-noise programmable gain amplifier (PGA). Channel A can be programmed with a gain of 128 or 64, corresponding to a full-scale differential input voltage of ±20mV or ±40mV respectively, when a 5V supply is connected to AVDD analog power supply pin. Channel B has a fixed gain of 32. On-chip power supply regulator eliminates the need for an external supply regulator to provide analog power for the ADC and the sensor. Clock input is flexible. It can be from an external clock source, a crystal, or the on-chip oscillator that does not require any external component. On-chip power-on-reset circuitry simplifies digital interface initialization. There is no programming needed for the internal registers. All controls to the HX711 are through the pins.

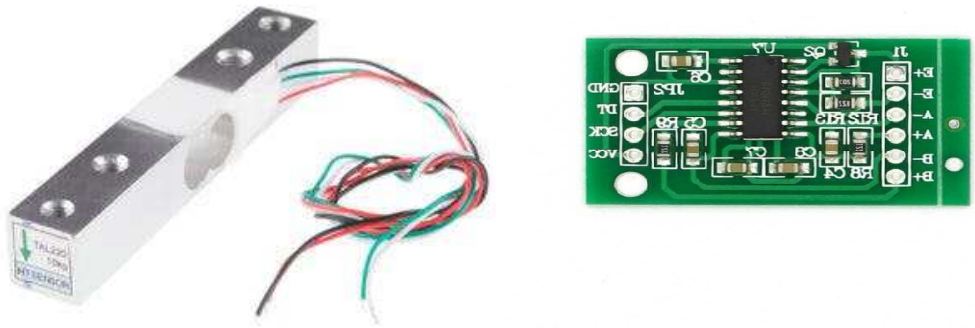


Figure 4.3 HX711

4.3.1 Features:

• Two selectable differential input channels

• On-chip active low noise PGA with selectable gain of 32, 64 and 128

• On-chip power supply regulator for load-cell and ADC analog power supply

• On-chip oscillator requiring no external component with optional external crystal

• On-chip power-on-reset

• Simple digital control and serial interface: pin-driven controls, no programming needed

• Selectable 10SPS or 80SPS output data rate

• Simultaneous 50 and 60Hz supply rejection

• Current consumption including on-chip analog power supply regulator: normal operation < 1.5mA, power down < 1uA

• Operation supply voltage range: 2.6 ~ 5.5V

• Operation temperature range: -40 ~ +85℃

• 16 pin SOP-16 package

4.3.2 Applications:

• Weigh Scales

• Industrial Process Control

4.4 Alphanumeric Keypad:

An alphanumeric keypad is a keyboard that contains both numbers and letters on the same keys. Typically, they are found on telephones and cellular phones. They also can appear on laptops, ATMs or any device where both numbers and letters are equally necessary. On phones, the number "1" is typically devoid of any letters; each of the other keys contain only three letters in alphabetical order.

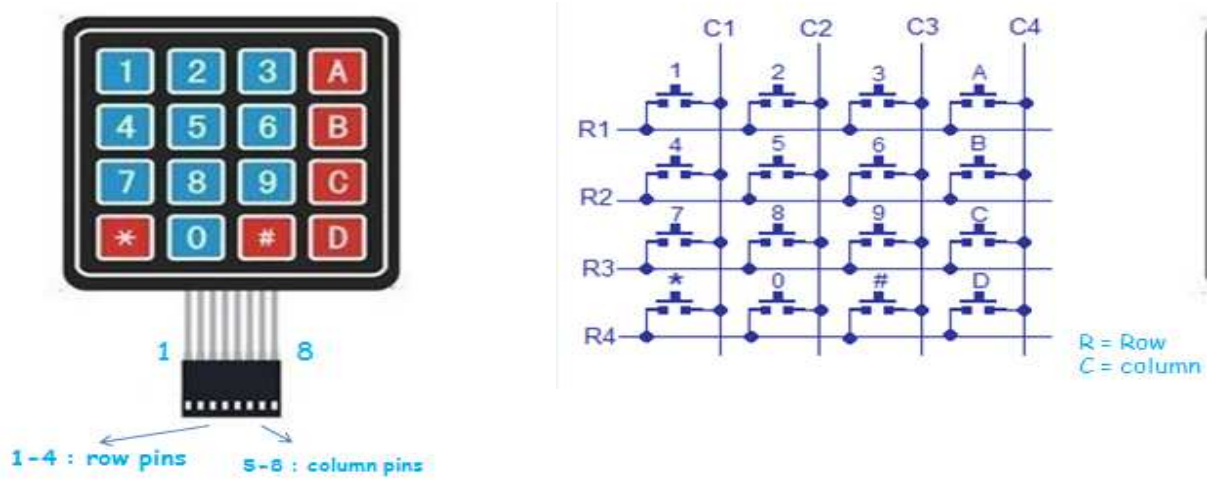


Figure 4.4 Alphanumeric Keypad

4.5 LCD (16x4):

A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals.LCD's are used in a wide range of applications including LCD televisions, computer monitors, instrument panels, aircraft cockpit displays, and indoor and outdoor signage. Small LCD screens are common in portable consumer devices such as digital cameras, watches, calculators, and mobile telephones, including smart phones. LCD's consume much less power than LED and gas-display displays because they work on the principle of blocking light rather than emitting it.

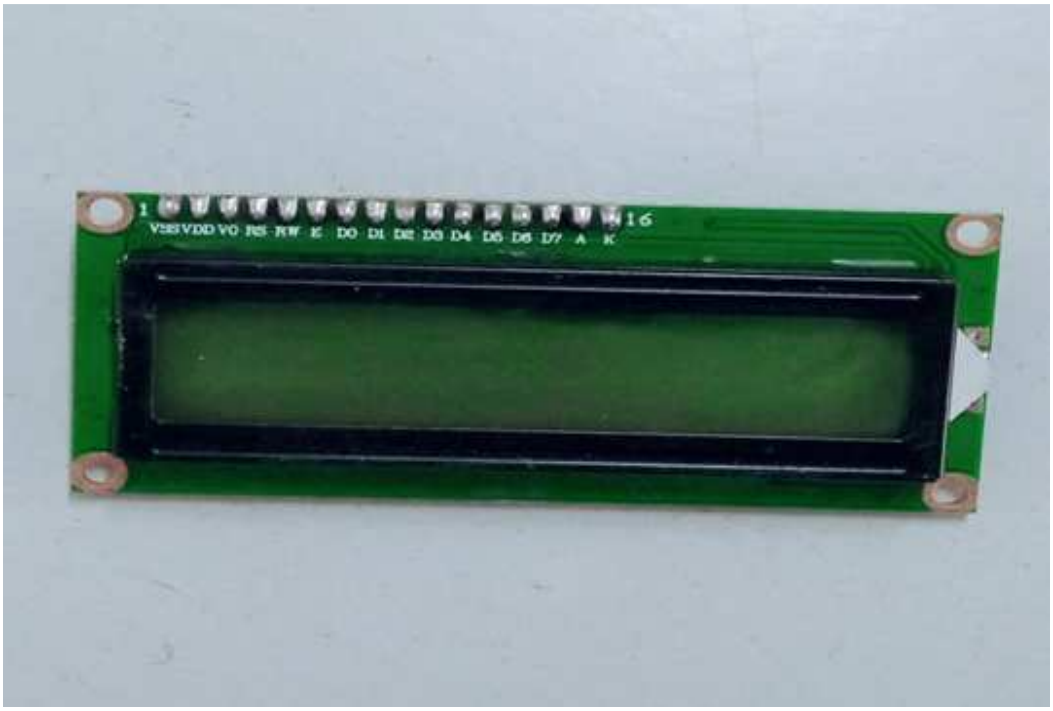


Figure 4.5 LCD 16x4

4.5.1 Description:

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	V_{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight V_{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

Figure 4.6 Description of LCD

4.6Real Time Clock:

A **Real Time Clock** (**RTC**) is a computerclock (most often in the form of an integrated circuit) that keeps track of the current time.Although the term often refers to the devices in personal computers, servers and embedded systems. RTCs are present in almost any electronic device which needs to keep accurate time.

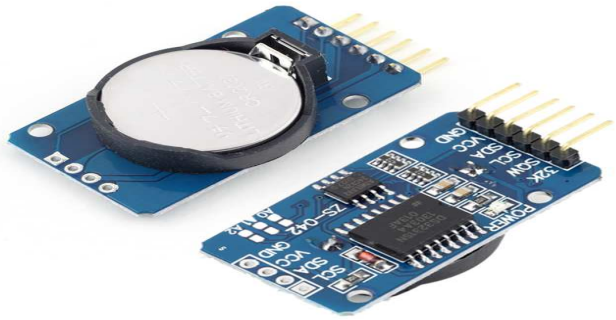


Figure 4.6 Real Time Clock (IC DS3231)

4.7 Relay:

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal.

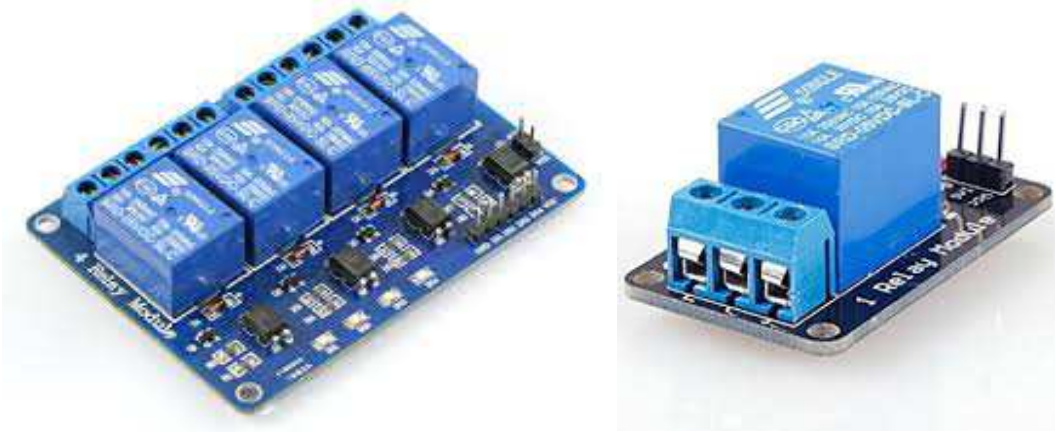


Figure 4.8 Relay

A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays". Magnetic latching relays can have either single or dual coils. On a single coil device, the relay will operate in one direction when power is applied with one polarity, and will reset when the polarity is reversed. On a dual coil device, when polarized voltage is applied to the reset coil the contacts will transition.

4.8 PIC16F877a:

The PIC microcontroller PIC16F877a is one of the most renowned microcontrollers in the industry. This controller is very convenient to use, the coding or programming of this controller is also easier. One of the main advantages is that it can be write-erase as many times as possible because it use FLASH memory technology. It has a total number of 40 pins and there are 33 pins for input and output. PIC16F877A is used in many PIC microcontroller projects. PIC16F877A also have many application in digital electronics circuits.PIC16F877a finds its applications in a huge number of devices. It is used in remote sensors, security and safety devices, home automation and in many industrial instruments. An EEPROM is also featured in it which makes it possible to store some of the information permanently like transmitter codes and receiver frequencies and some other related data. The cost of this controller is low and its handling is also easy. Its flexible and can be used in areas where microcontrollers have never been used before as in coprocessor applications and timer functions etc.

Figure 4.8 PIC16F877a

4.8.1 Description:

As it has been mentioned before, there are 40 pins of this microcontroller IC. It consists of two 8 bit and one 16 bit timer. Capture and compare modules, serial ports, parallel ports and five input/output ports are also present in it.

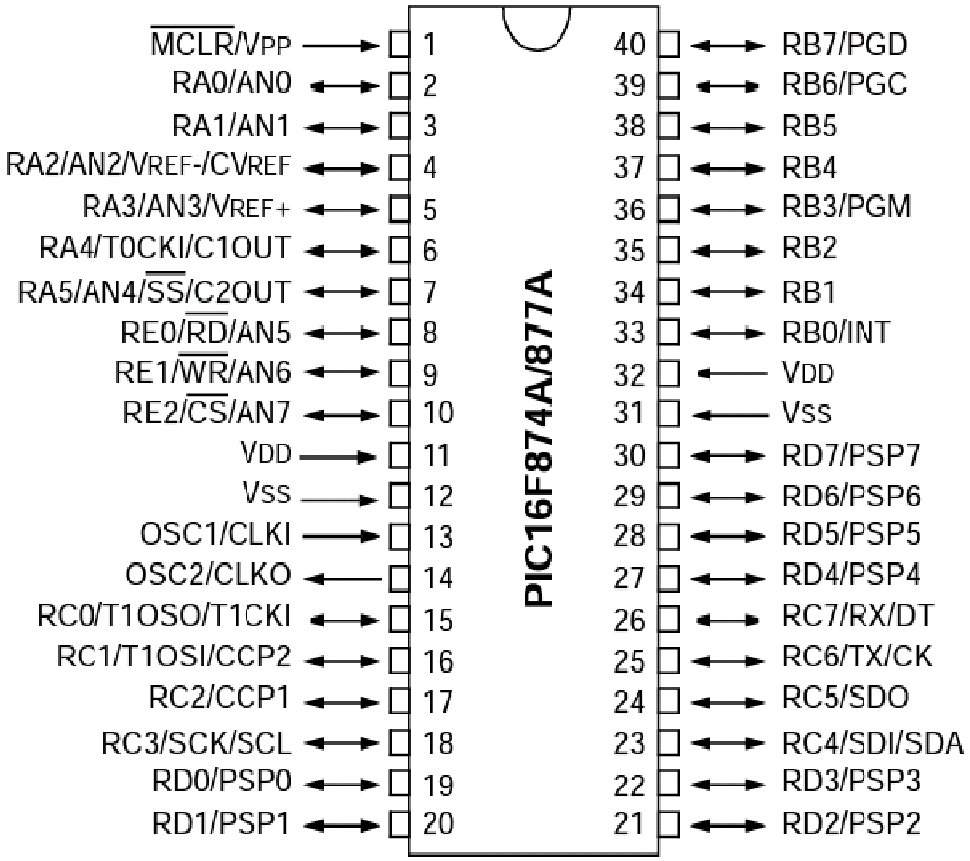


Figure 4.8.1 Pin Description of 16F877a

4.8.2Features

- 2 PWM 10-bit
- 256 Bytes EEPROM data memory
- LCD
- 25mA sink/source per I/O
- Self Programming
- Parallel Slave Port

4.9IC24C64(EEPROM):

EEPROM is user-modifiable ROM that can be erased and reprogrammed repeatedly through the application of higher than normal electrical voltage. Unlike EPROM chips, EEPROMs do not need to be removed from the computer to be modified. However, an EEPROM chip has to be erased and reprogrammed in its entirety, not selectively. It also has a limited life - that is, the number of times it can be reprogrammed is limited to tens or hundreds of thousands of times. In an EEPROM that is frequently reprogrammed while the computer is in use, the life of the EEPROM can be an important design consideration.

A special form of EEPROM is flash memory, which uses normal PC voltages for erasure and reprogramming. The 24C64 are electrically erasable PROM devices that use the standard 2-wire interface for communications. The 24C64 contain a memory array of 64K-bits (8K x 8). Each device is organized into 32 byte pages for page write mode. This EEPROM operates in a wide voltage range of 1.8V to 5.5V to be compatible with most application voltages designed this device family to be a practical, low-power 2-wire EEPROM solution. The 24C64 maintains compatibility with the popular 2-wire bus protocol, so it is easy to use in applications implementing this bus type. The simple bus consists of the Serial Clock wire (SCL) and the Serial Data wire (SDA). Using the bus, a Master device such as a microcontroller is usually connected to one or more Slave devices such as this device. The bit stream over the SDA line includes a series of bytes, which identifies a particular Slave device, an instruction, an address within that Slave device, and a series of data, if appropriate. The 24C64 has a Write Protect pin (WP) to allow blocking of any write instruction transmitted over the bus.

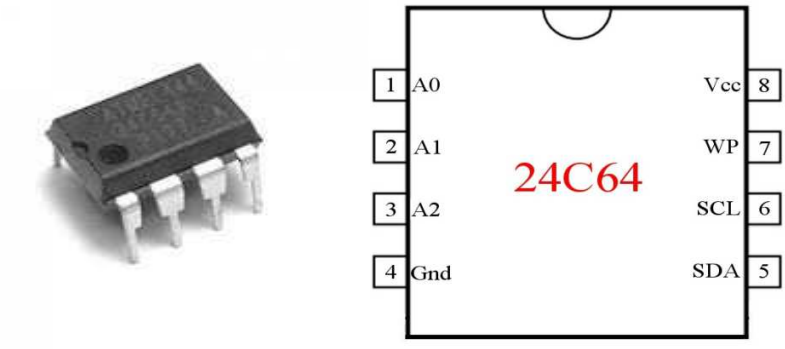
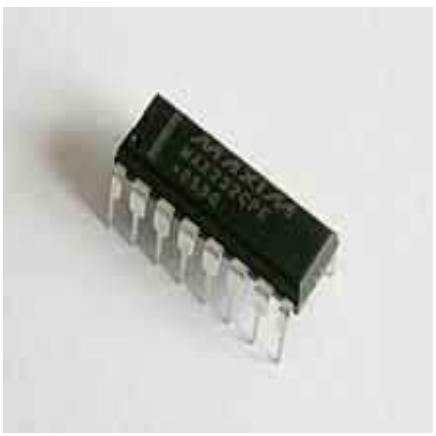


Figure 4.9 IC24C64(EEPROM)

4.10MAX232:

RS232 standard: Information being transferred between data processing equipments (DPE) and peripherals is in the form of digital data i.e., transmitted either in serial or parallel mode. Parallel communication port is mainly used for connection between test instruments, printers and computers while serial is often used between computer and other peripherals.

Serial transmission involves sending of data 1 bit at a time over a single communication lines. In Contrast parallel communication requires at least as many lines as the bits in the word being transmitted (for 8 bit word 8 lines are needed). Serial transmission is beneficial for long distance communication while parallel is designed for short distance or when very high transmission rates are required



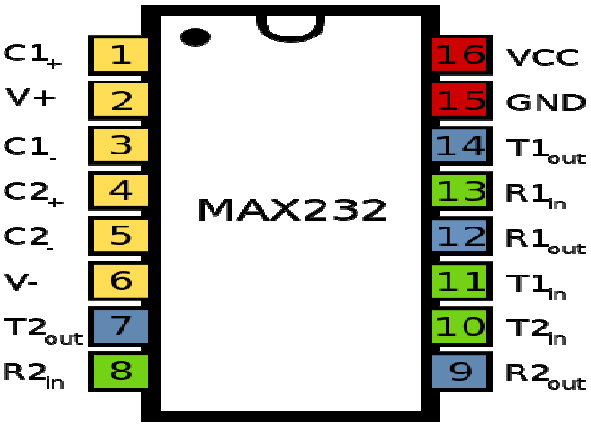


Figure 4.10 Max232

4.10.1 Features

1.Operates from single +5V power supply.

2. Low power receive mode in shutdown.

3. Multiple drivers and receivers.

5.1 Proteus Software Schematic of Main Board

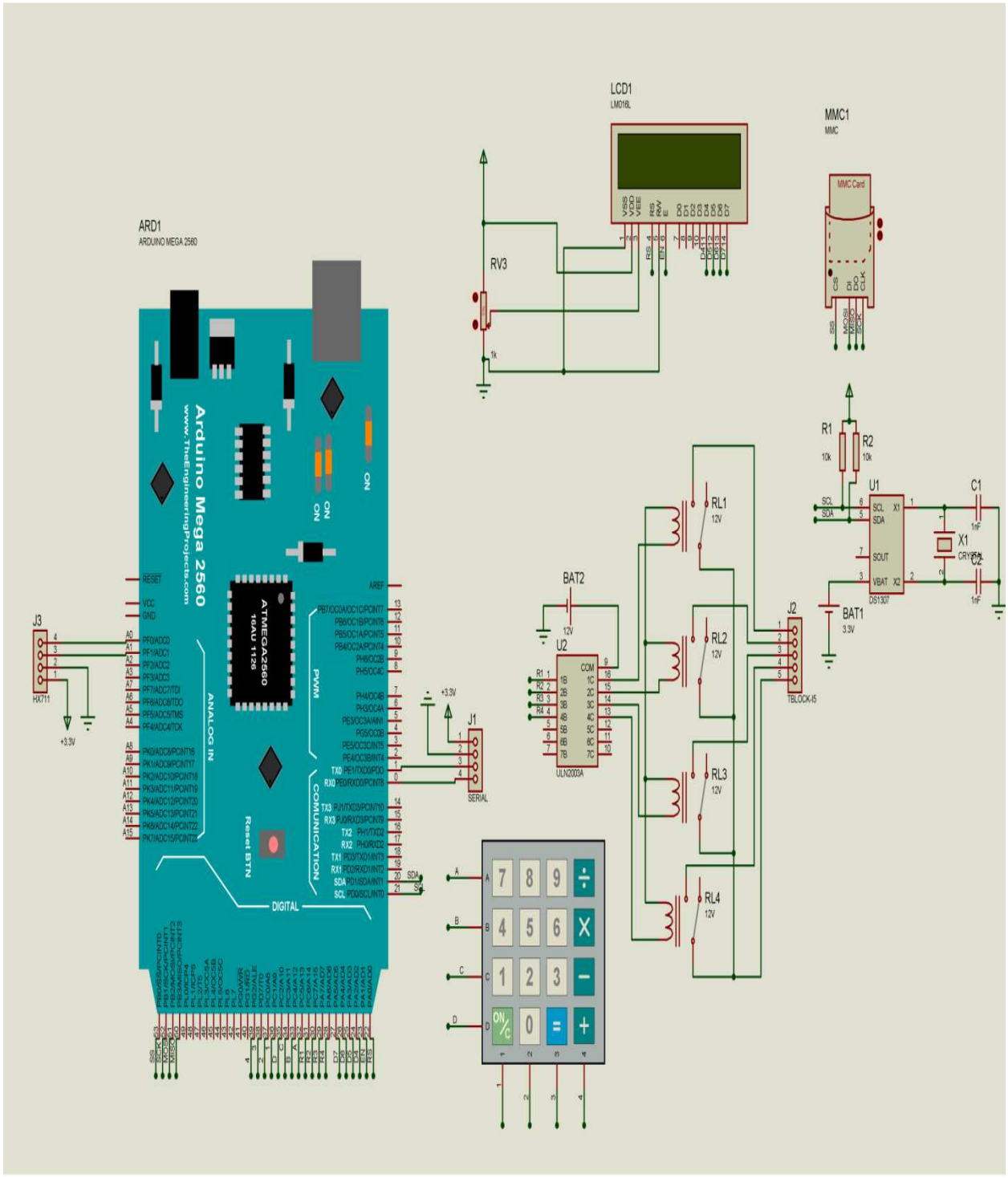


Figure 5.1 Proteus Software Schematic of Main Board

5.2 Proteus Software Schematic ofExtension Board

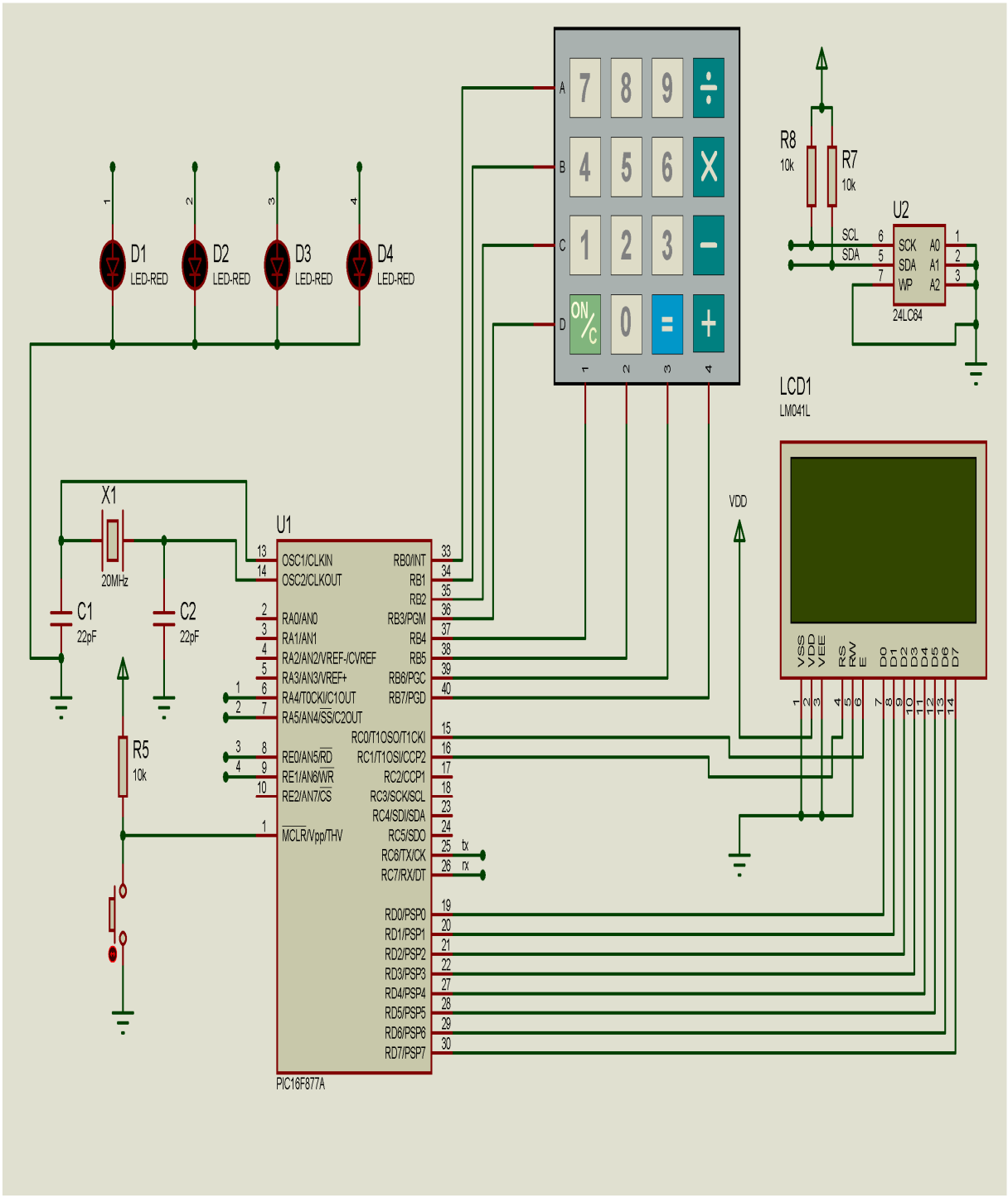


Figure 5.2 Proteus Software Schematic of Extension Board

6.1 Main Board

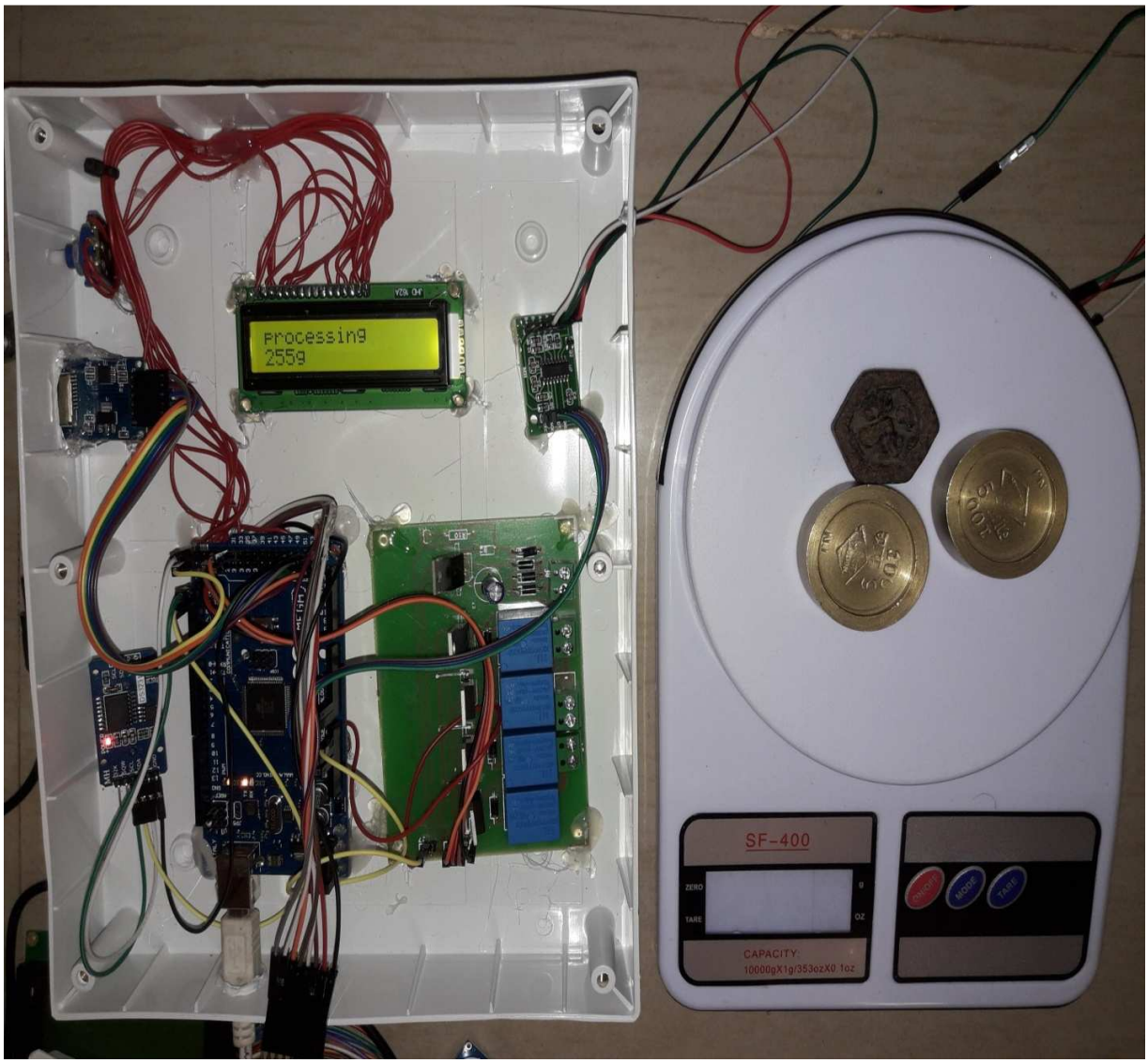


Figure 6.1 HardwareDesign of Main Board

6.2 Extension Board

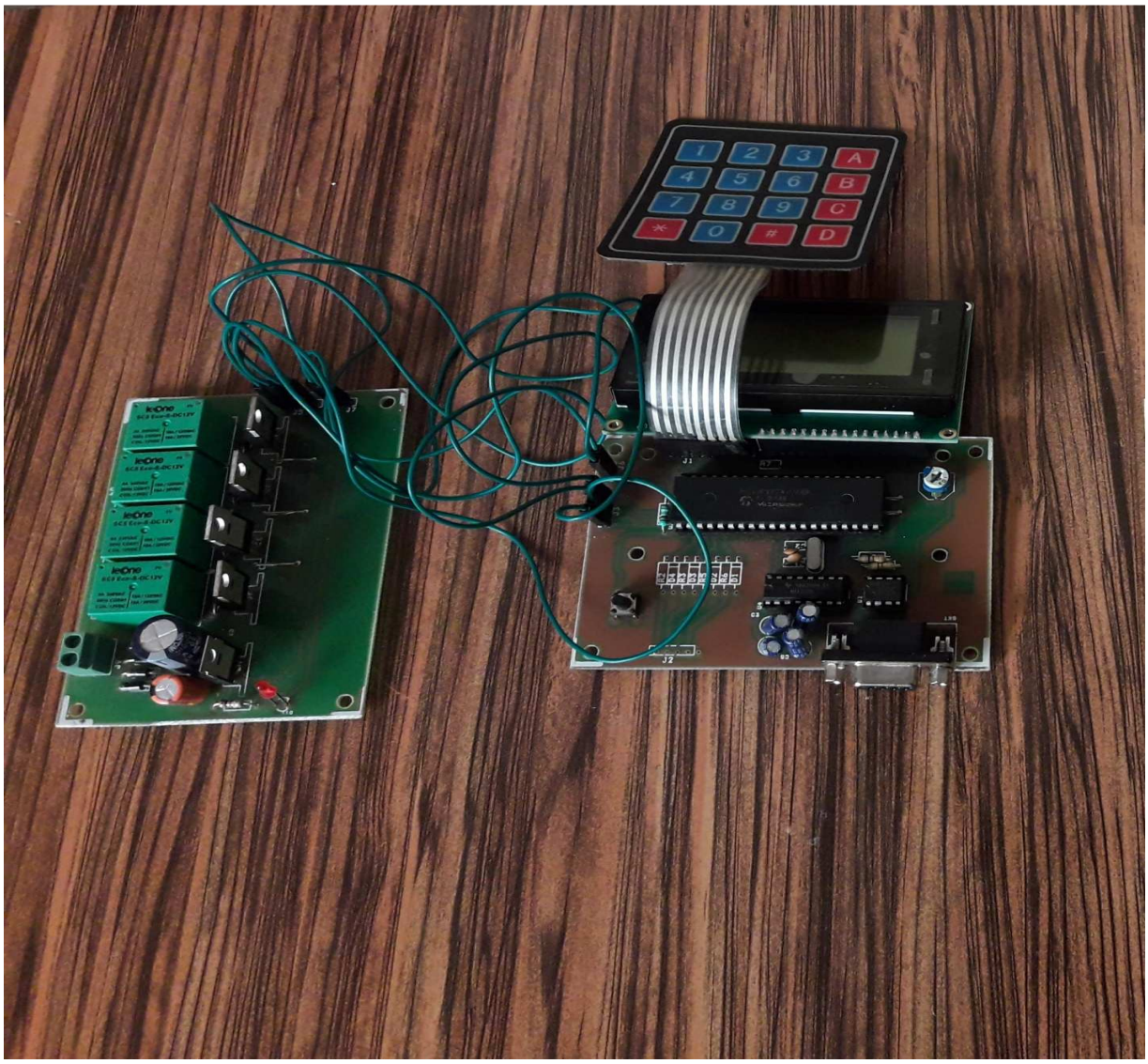


Figure 6.2 Hardware Design of Extension Board

Power Supply turned on.

1. Then LCD will show the name of the project

2. Then it will calibrate the object

3. It will display on the LCD to put the weight which is specified in program(we set 100gm)

4. LCD will show ‘SET’ and ‘PROCESS’ commands

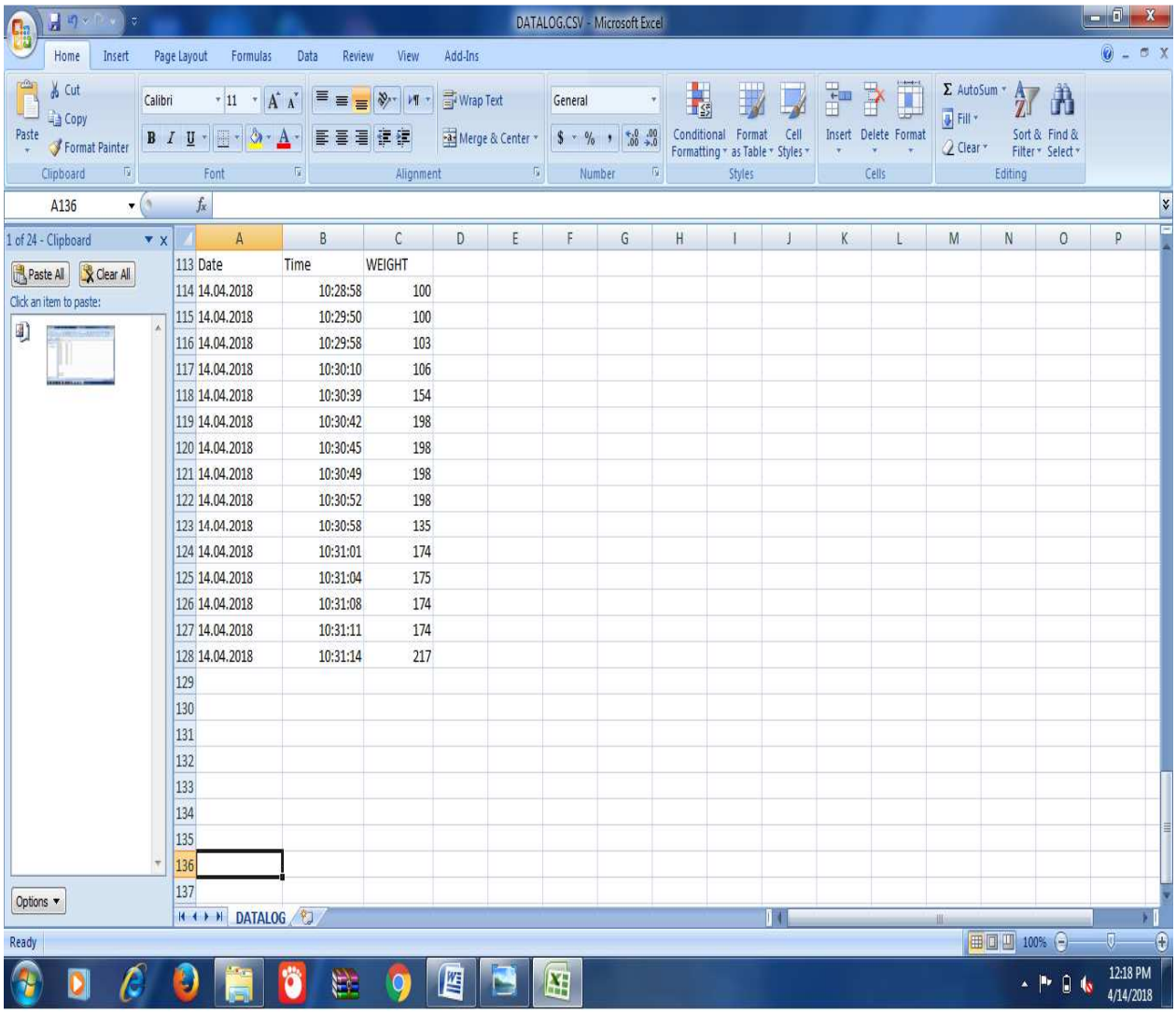
5. Now select ‘SET’ and enter the weight through keypad

6. Now select ‘PROCESS’ and processing will start. That particular weight will be calibrated as 100gm.

Result of any object

We take object of 100gm which is showing accurate weight on display without error.

Data stored in excel format



	A	B	C
113	Date	Time	WEIGHT
114	14.04.2018	10:28:58	100
115	14.04.2018	10:29:50	100
116	14.04.2018	10:29:58	103
117	14.04.2018	10:30:10	106
118	14.04.2018	10:30:39	154
119	14.04.2018	10:30:42	198
120	14.04.2018	10:30:45	198
121	14.04.2018	10:30:49	198
122	14.04.2018	10:30:52	198
123	14.04.2018	10:30:58	135
124	14.04.2018	10:31:01	174
125	14.04.2018	10:31:04	175
126	14.04.2018	10:31:08	174
127	14.04.2018	10:31:11	174
128	14.04.2018	10:31:14	217
129			
130			
131			
132			
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134			
135			
136			
137			

Features

- Alpha Numeric Keypad
- Standard load cell inputs
- Pulse/Counter inputs
- High resolution, high speed
- 16x4 LCD display
- Serial port interface
- Fast processor
- Digital calibration for load cell
- Automatically stores Data
- Real Time Clock

Advantages

- Low cost
- High accuracy
- Non-skilled workers can work
- Reliable
- Data acquisition

Applications

Weighing machines have several uses. It is used all over the world for many purposes. In many places like shops, malls, industries, airport, jewellery, courier office and scientific laboratories use this weighing machines.

References

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