

POLYTECHNIC SEBERANG PERAI

ELECTRONIC ACCURATE DISTANCE METER

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Laporan ini dikemukakan kepada Jabatan Kejuruteraan Elektrik sebagai memenuhi sebahagian syarat penganugerahan Diploma Kejuruteraan Elektronik (Komunikasi).

JABATAN KEJURUTERAAN ELEKTRIK

JUNE 2016

DECLARATION

Here I declare that this project is based on my own work with the help of information from sources that are told in confession. I also declare the results of my project was never produced by any other students as well as from other institutions.



.....
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ABSTRACT

Electronic Accurate Distance Meter is prototype that implements a distance measurement system using the ultrasonic waves. This prototype system is controlled by Arduino Mega. Aim of this project it helps to facilitate more accurate measure distance without any problem. With this project without the help of others to measure the distance. The project implements the distance measurement and obstacle detection technique where by the distance measurement and obstacle will reflect back the ultrasonic wave induced by the ultrasonic transceiver which then indicates the surface object and distance of the obstacle. When ultrasonic distance measuring something issued the LCD display shows the distance object. An Arduino Mega microcontroller is used to control the distance and receive data from ultrasonic sensor and removing the LCD display. As the result, this project shows in a little LCD display the distance to the nearest object it can find, usually the floor, the ceiling and two walls. So it can be so helpful to hang the picture and a shell. In conclusion, it easier for the public to measure distances accurately.

Key Words : Arduino Mega, Ultrasonic sensor, LCD, Potentiometer.

ABSTRAK

Electronic Accurate Distance Meter, adalah protaip melaksanakan sistem pengukuran jarak menggunakan gelombang ultrasonik. Sistem prototaip ini dikawal oleh Arduino Mega. Tujuan untuk projek ini ia membantu untuk memudahkan mengukur jarak tanpa sebarang masalah. Dengan projek ini tanpa memerlukan bantuan orang lain untuk mengukur jarak. Projek melaksanakan pengukuran jarak dan halangan teknik pengesanan mana pengukuran jarak dan halangan akan mencerminkan kembali gelombang ultrasonik disebabkan oleh transceiver ultrasonik kemudiannya menunjukkan objek permukaan dan jarak halangan. Apabila jarak ultrasonik mengukur sesuatu yang dikeluarkan paparan LCD menunjukkan objek jarak. Arduino Mega pengawal mikro digunakan untuk mengawal jarak dan menerima data dari sensor ultrasonik dan mengeluarkan paparan LCD. Keputusannya, projek ini menunjukkan dalam LCD sedikit memaparkan jarak ke objek yang terdekat ia boleh mencari, biasanya lantai, siling dan dua siling. Kesimpulannya, ia boleh berguna untuk menggantung gambar dan cangkerang. Dalam kesimpulan, ia lebih mudah untuk orang ramai untuk mengukur jarak.

APPRECIATION

Alhamdulillah, thanks to Allah by His grace s.w.t that provide good health throughout this project. Thank you for the support of friends, family members on the guidance given during this project. In addition, thanks also to the supervisor Mdm. Norzilawati was very helpful and gave us tips about the project and provide tutoring in implementing this project.

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BAB 1

1.0 INTRODUCTION

Measuring is a certain size, amount, or degree of (something) by using an instrument or device marked in standard units or by comparing It with an object of known size. Many of the tools that people rely on are often taken for granted. The tape measure is one of the most utilized tools in home improvement, as well as many work environments. Measuring tape is a flexible ruler. It consists of a ribbon of cloth, plastic, fiber glass or metal strip with linear- measurement markings. It is a common measuring tool. Sometimes error occurred while reading a tape measure. For that reason the project of electronic accurate distance meter had been build. This project can be replaced to tape measure because the function of this project is similar. This project helps to measured with probability to get the right and accurate value. This project had been program by using arduino mega.

1.2 Problem Statement

There are many problems when measuring something by using measuring tools such as measuring tape. The problem that can be identified is too hard to read the value. It is hard and takes time to read the value especially for those who are dim. It is also easy to make a mistake while taking readings at measurement tape. This problem always happens often. By using measuring tape, it is also easy to cut the finger when retracting it. This would be dangerous and cause harm to themselves. Besides, the measuring tape also can only be measured in a straight line and needs help from others while measuring.

1.3 Objective of project

The purpose of these projects is to design and create a suitable electronic distance measuring device. The objectives of the projects are

- i. To design a distance meter by using Arduino Mega.
- ii. To integrate ultrasonic sensor with Arduino Mega.
- iii. To inform user about the total by displaying on Liquid Crystal Display (LCD).

1.4 Scope Project

Project scope is the combination of objectives and requirements necessary in order to make sure that project run in the limited boundary. The scope of this project are :

- Purposed the usage of Liquid Crystal Display (LCD) for displaying result.
 - Limitation of the distance meter you can measure.
- This project will consist of using an ultrasonic device to measure the distance from the sensor to get the distance accurate.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will discuss about the related project what that have done. Distance measurement is the activity of obtaining and comparing in real world. It is one of the important functions in science, engineering and astronomy to business activities. There are many types of distance measurement systems use in environment from normal rulers to interferometer. In application, basic concept of electronic distance measurement system is adopted in many areas like aviation, navigation and many more. In aviation, direct feedback system is required for linear positioning and motion control application. One of the good examples for distance measurement in navigation in GPS system using satellite. So, there is no doubt about the usefulness of distance measurement technology in environment. (Ultrasonic Distance Meter by Pawar Pritti Arun Department of electronic & Tele-Communication Engineering SVETRI 'S College of Engineering, Pandharpur)

2.2 Related Project

Several, article and journals have been studied in understanding ultrasonic sensors and several methods for distance measurement. The related project that been researched :

This project about the Ultrasonic Based Distance Measurement. They using ultrasonic transducer, microcontroller and LCD. The technique of distance measurement using ultrasonic in air include continuous wave and pulse echo technique. In the pulse echo method, a burst of pulses is sent through the transmission medium and is reflected by an object kept a specified distance. The time taken for the pulse to propagate from transmitter to receiver is proportional to the distance of object. For, contact lens measurement of distance, the device has to rely on the target to reflect the pulse back to itself. (Vidyadhar Kamble, Dipesh Makwana, C.Chandramouli by Ultrasonic Based Distance Measurement System)

Besides, Home automation means seamlessly integrating a network of electronic devices inside of a home. The programmed system provides homeowners with control over how each device acts and how it interacts with other home electronic devices. Homeowners set the instruction for each device and they program the timing for the delivery of each instruction. Home automation devices offer consumers four primary. (N.Avinash, P.Surya Kannan, O.L.Bhavan, P.Sreekanth, T.Srinu, by Arduino Based Home Automation Including Ultrasonic Distance Sensor,)

Next, this project do the measurement system which uses ultrasonic transmitter and receiver units mounted at a small distance between them and a Philips P89C51RD2 microcontroller based system. They use ultrasonic sensor also quite for most of the common applications. (by A.K.Shrivastava, A.Verma, and S.P.Singh, Distance Measurement of an object or Obstacle by Ultrasound Sensors using P89C51RD2)

Furthermore, Rajan P.Thomas used the proposed technique was to develop a device based a highly that can be used to measure the distance of the target with high precision using ATmega16a as a processor. Focus has been given lower rangers considering the range of 1cm to 2.5cm with the precision of ± 0.1 cm using standard ultrasonic transducer HC-SR04. For contact lens measurement of distance, the device has to rely on the target to reflect the pulse back to itself.(Rajan P.Thomas, Range Detection based on Ultrasonic Principle)

Moreover, this project do the smart cars requires new sensors that are able to measure distance in the range of a few centimeters to a few meter. Parking aids, as well intelligent suspensions and headlight leveling, are some examples of features that requires a distance measurement to be performed with contactless sensors. The sensor has been designed in order to satisfy typical requirements in the automotive field measured distance in the field range of 0.1-0.3 m and standard uncertainty of 1mm in the temperature range of 0°C to 40°C. Measurement of distance.(Alessio Carulla and Macro Parvis, Ultrasonic Sensor for distance Measurement Automotive Applications).

2.3 Types Of Distance Measurement

2.3.1 Ultrasonic Transducer

Ultrasonic transducer uses the physical characteristics and various other effects of ultrasound of a specific frequency. It may transmit or receive the ultrasound of a particular strength. These, are available in piezoelectric or electromagnetic versions. The piezoelectric type is generally preferred due its lower cost and simplicity to use. (H.He and J.Liu , 2008).

2.3.2 Liquid Crystal Display (LCD)

A 16x2 Liquid Crystal Display is a low power, low cost, basic electronic display. A 16x2 LCD means it can display 16 character per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen , setting the cursor position , controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character(measured distance) to be displayed on the LCD.

2.3.3 ATmega16a Microcontroller

The AVR ATmega16 is a lower CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instruction in a single clock, the AVR ATmega16 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed. (Morgan and Claypool Publishers)

2.4 Conclusion

In conclusion, this chapter about they were using ultrasonic transducer , IR Sensor, ultrasonic transmitter to detect the distance. Besides, some of them using the microcontroller to process the input how to get the distance or also using the arduino Atmega 2560. But many of them using the arduino Atmega 2560 because it is easy to use. They also using the LCD to get the distance on the LCD .

CHAPTER 3

METHODOLOGY

3.1 Introduction

Methodology includes a philosophically coherent collection of theories, concepts or ideas as relate to a particular discipline or a field of inquiry. Methodology refers to more than a simple study about the project to the scientific method. This is why scholarly literature often includes a section on the methodology of the researchers. Each step of project is a process to complete the project. Every step must be followed one by one and must be done carefully. If some error occurs it can make a project probably could not operate or do not look neat and perfect. Before the project finish, various processes need to be done according to proper procedures to ensure that projects do not have any problem.

For this among the measures the work done in preparing project to have is done. For this chapter it have a block diagram , flowchart, process of designing circuits, circuit board trace, soldering process in circuit board and programming process in programs and so on.

3.2 Hardware Implementation

This section will explain about the hardware components which used in the project. The hardware components are used 4 ultrasonic sensor, Liquid Crystal Display (LCD), battery 9V, switch, Potentiometer and Arduino ATmega 2560 microcontroller.

3.2.1 Ultrasonic Sensor HC-SR04

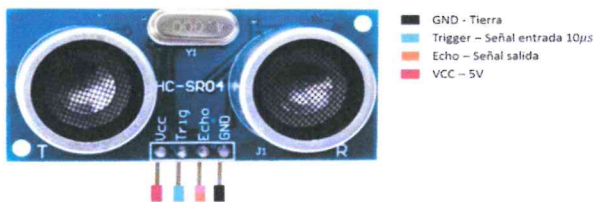


Figure 3.1 Ultrasonic Sensor HC-SR04

Ultrasonic Sensor, HC-SR04 measures the distance of a target using sonar burst, HC-SR04 gives reliable, accurate and stable readings in range detection. The functional range for the sensor works about 2cm to 4cm. This sensor's is effectively not be affected by sunlight or black material. The sensor can operates about 5V with working a current 15 mA. Furthermore, the dimension about 45mm x 25mm x 15mm which is easy and small to fit any machines.

Table 3.1 HC-SR04

Parameter	Min	Typ.	Max	Unit
Operating Voltage	4.50	5.0	5.5	V
Quiescent Current	1.5	2	2.5	mA
Working Current	10	15	20	mA
Ultrasonic Frequency	-	40	-	kHz

In first step, trigger pin of SR04 must be high for at least 10 μ s to initiate the sensor to transmit an ultrasonic burst 40 kHz. Then, the sensor will wait for the ultrasonic burst to reflect back to the receiver part. After that, the echo pin will be high and the sensor will calculate the time period between emitting and receiving ultrasonic burst. The distance in centimeter= Time/58 and the speed of sound can be utilized which is 340m/s

The timing diagram of HC-SR04 is shown:

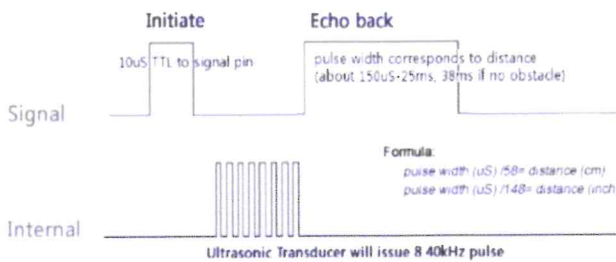


Figure 3.2 Timing Diagram Of HC-SR04

3.2.2 Liquid Crystal Display (LCD)



Figure 3.3 Liquid Crystal Display (LCD)

The LCD (Liquid Crystal Display) is an electronic display module and find the wide range of application. The 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules have seven segments and other multi segment LEDs. The LCD are economical, easily programmable, have no limitation of displaying and so on. Besides, it is very useful to do the project. A 16x2 LCD means it can display 16 character per line and there are 2 such lines. In the LCD each character is displayed in 5x7 pixel matrix. The LCD has two register, namely, command and data.

Pin description:

No.pin	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V-5.3V)	Vcc
3	Contrast adjustment ; through a variable resistor.	Vee
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 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 Vcc (5V)	Led+
16	Backlight Ground (0V)	Led-

3.2.3 Arduino Atmega 2560

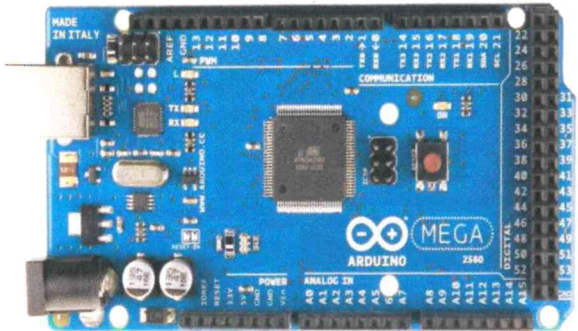


Figure 3.4 Arduino ATmega 2560

The Arduino ATmega 2560 is a small, complete and breadboard friendly board based on the ATmega 2560. Besides, this Arduino has many pins so easy to do the project. The Arduino ATmega has the features it operating voltage (logic level) 3.3V or 5V. It also has digital I/O Pins 54 of which 15 provide PWM output. The analog input has 16 pins and also DC current per I/O Pin 40 mA. It also has big flash memory 256KB in the Arduino ATmega 2560. Besides, it has SRAM 8 KB and EEPROM 4KB (ATmega2560). It has a clock speed of 16 MHz. Moreover, the Arduino ATmega 2560 has low power consumption and low cost.

The power of pins are as follows;

- **VIN.** The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). It can supply voltage through this pin, or, it supplying voltage via the power of jack, access it through this pin.
- **5V.** The regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board regulator or to be supplied by USB or another regulator 5V supply.
- **3V3.** A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA
- **GND.** Ground pins.

3.2.4 Potentiometer

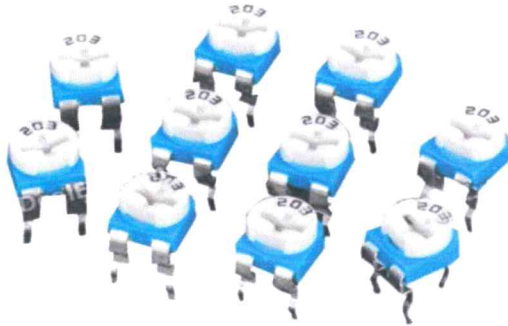


Figure 3.5 Potentiometer

The potentiometer is an electrical component with a variable resistance. It may refer to an instrument that measure as unknown emf or voltage by comparing it to a standard emf. It is functioning as a null instrument it permits precision measurement by adjusting a value of circuit. Besides, with the potentiometer it can display in the LCD is because can adjusting value of circuit element until a number was display.

A potentiometer is also referred to as a variable resistor or pot. They have three terminals, where the one in the middle is known as the wiper, and other two are known as ends. The wiper is a movable contact where resistance is measured with respect to it and either one of the end terminals.

3.3 Software Implementation

For software implementation, an Arduino platform is used to program ATmega328 through the Arduino UNO board using processing language. Then the arduino ATmega 2560 process the ultrasonic sensor in the process language. The arduino atmega

2560 is the control the ultrasonic sensor to get the distance. Lastly, it also control the LCD to get the output of distance.

3.4 Block Diagram

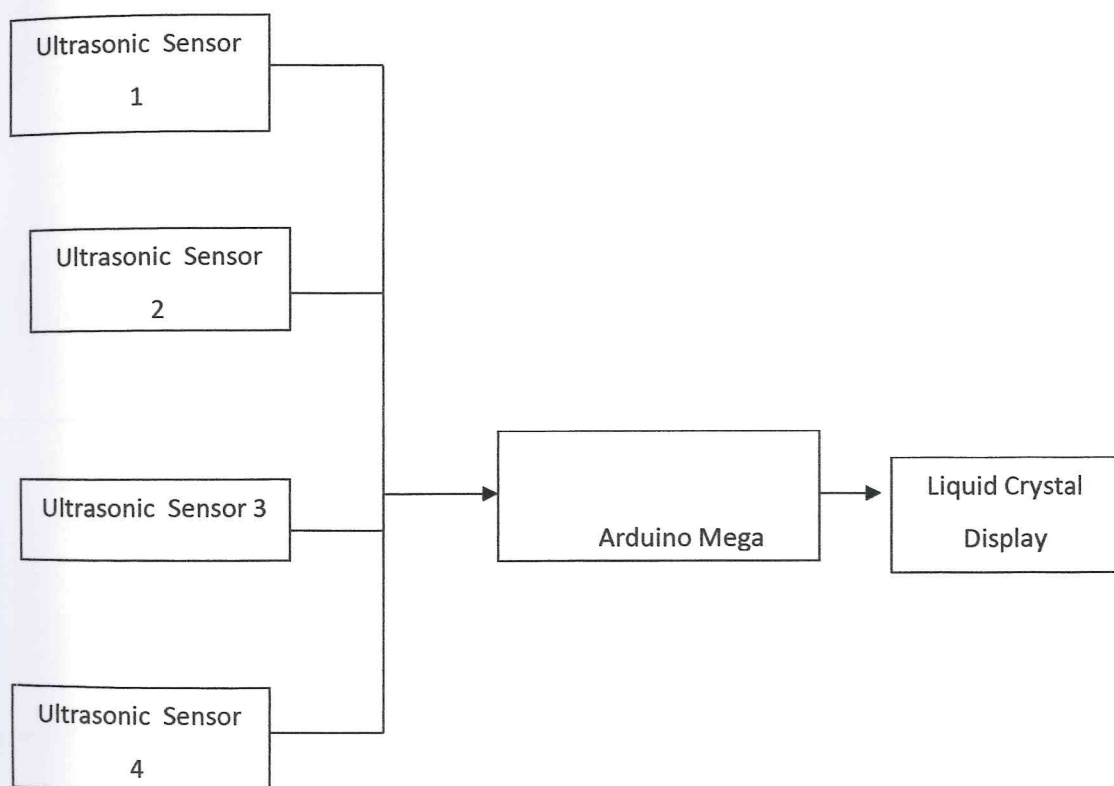
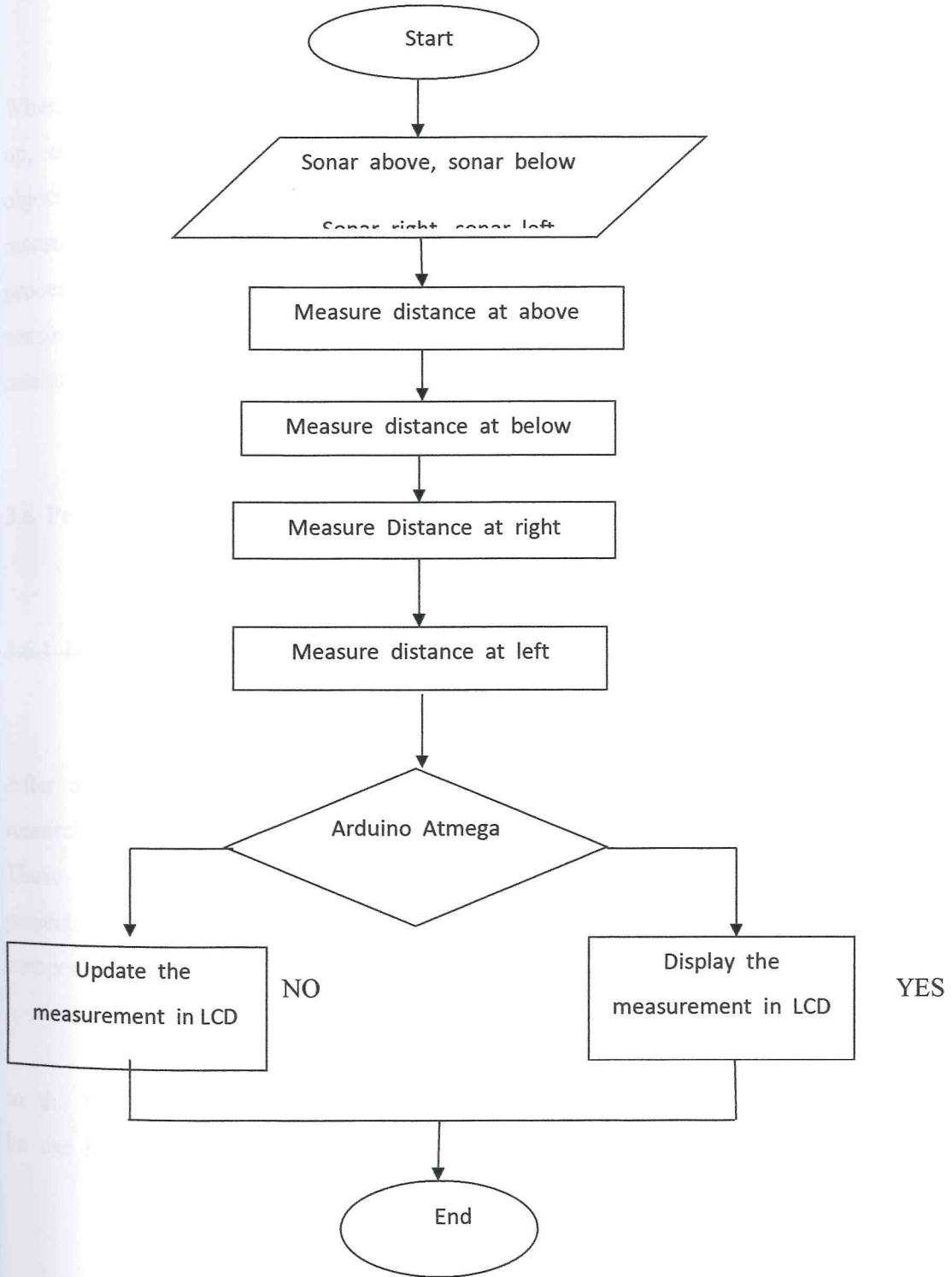


Figure 3.6. Block Diagram Of Electronic Accurate Distance Meter

For this project It using the ultrasonic sensor 1 it to detect the distance above while the ultrasonic sensor 2 measuring the distance below. Next, the ultrasonic sensor 3 measures the distance gauge on the left and the ultrasonic sensor 4 using the right to get the data. This project it use the microcontroller a known as Arduino Mega will be used to get distance measurement from data ultrasonic sensor. After the process it released data on the LCD. LCD shows all data measuring the distance in centimeter.

3.5 Flowchart Of Electronic Accurate Distance Meter



Explanation flowchart of Electronic Accurate Distance Meter

When the project runs all ultrasonic sensors have the ultrasonic sensor each as, up, down, left, and right. Firstly, ultrasonic sensor to measure the distance or objects on the other side also measure the distance. When all ultrasonic sensor measure the distance information data sending to arduino mega. Arduino mega process all the ultrasonic sensor data to the output data. After it processes the sensor data it displays on the LCD display to produce data information has been measures.

3.6 Process of the Circuit Designing

3.6.1 Design the Circuit

After decide what kind to do the project to built. This project need to make the research about the circuit, electronic component that to use, hardware and so on. These thing actually can help to create the designing circuit. For example, this project must know the size, foot of component, polarity of the component, the component method compilation and etc to make a circuit diagram.

In the first step in Circuit Designing process is make a circuit diagram that can be use in the next process. Among, steps in the circuit diagram are;

- i. Before the circuit is produced, the things that needs to project emphasized are the position of symbol and components used in the

Schematic circuit. Once known the entire production circuit, the circuit can be drawn using software, namely PCB Wizard

- ii. Then, make sure that the connection of the component is correct.
- iii. Lastly, runs the simulation of the circuit was designing.

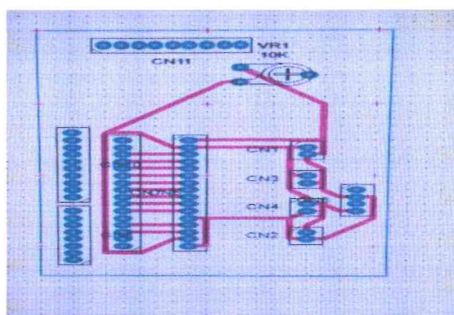
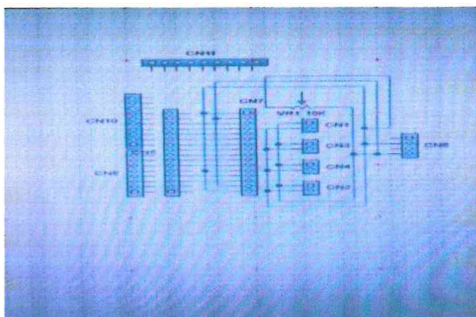


Figure 3.8 Electronic Accurate Distance Meter