UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF MEASURING DEVICE WITH MEMORY USING MICROCONTROLLER

This report submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Robotic and Automation) with Honours.

by

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Robotic and Automation) with Honours. The member of the supervisory is as follow:

……

(Project Supervisor)

ABSTRAK

Kertas ini berkaitan dengan alat pengukur yang digunakan untuk pereka dalaman dan orang biasa. Masalah yang mereka hadapi adalah bahawa mereka perlu melakukan pelbagai kerja hanya untuk mengukur dan merekodkan data yang diukur. Pembangunan alat pengukur digital yang dapat mengukur jarak dan menyimpan data pada masa yang sama akan membuat kerja mereka lebih mudah. Pengesan ultrasonik yang biasanya digunakan untuk mengesan halangan digunakan untuk peranti mengukur dan PIC16F877A digunakan sebagai pengawal mikro dan peranti untuk menyimpan data. Hasil eksperimen ditunjukkan dalam kertas ini secara terperinci. Hasil eksperimen pertama menunjukkan jarak yang diukur oleh pengesan ultrasonik tidak sama dengan ukuran sebenar tetapi selepas membuat beberapa pengiraan, satu formula telah dihasilkan dan telah ditambah ke dalam program. Akhirnya, jarak yang diukur oleh sensor ultrasonik adalah sama dengan ukuran sebenar. Malangnya, aplikasi 'simpan data' tidak boleh dilakukan kerana kesilapan pada bahagian pengaturcaraan. Kesimpulannya, alat pengukur digital tidak sepenuhnya mencapai objektif yang dirancang.

ABSTRACT

This paper is related to the measuring tool that is used for interior designer and general people. The problem they are facing is that they must do multiple works just to measure and record the data measured. The development of digital measuring tool that can measure distance and save data at the same time will make their work more convenient and easier. Ultrasonic sensors, which are usually used to detect obstacle are developed for the measuring device and PIC16F877A is used as microcontroller and device to save data. Detailed of the experimental result are shown in this paper. The first experimental result show the distance measured by ultrasonic sensor is not same with the actual measurement but after making some calculation, a formula is been produced and is been added to the program. Finally, the distance measured by ultrasonic sensor is tally with the actual measurement. Unfortunately, 'save data' function cannot be done because of the error on the programming part. Conclusion, the developed digital measuring tool has not completely achieved the objective planned.

DEDICATION

To my beloved mother, Roziah Binti Shariff and my inspired father, Mohd Nor Azam Bin Shuib, my supportive sibling, Umair Bin Mohd Nor Azam and Zuhair Bin Mohd Nor Azam. This dedication also to my supervisor, Mr Ab Wafi Bin Ab Aziz, the house member of Ukhuwwah Fillah and my fellow friends that supported me in completion of my final year project.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

PIC	-	Peripheral Interface Controller
I/O	-	Input / Output
IC	-	Integrated Circuit
ROM	-	Read-Only Memory
LCD	-	Liquid Crystal Display
IR	-	Infrared
ADC	-	Analog to Digital Converter
MCU	-	Microcontroller Unit
GPS	-	Global Positioning System
EEPROM	-	Electrically Erasable Programmable Read-Only Memory
USB	-	Universal Serial Bus
PWM	-	Pulse-Width-Modulated
RC	-	Resistor-Capasitor
MB	-	Mega byte
CPU	-	Central Processing Unit
SD	-	Secure Digital
LED	-	Light Emitting Diode
HDMI	-	High-Definition Multimedia Interface
DVI	-	Digital Visual Interface

SoC	-	System On Chip
GPU	-	Graphic Processing Unit
SDRAM	-	Synchronous Dynamic Random Access Memory
OTP	-	One-Time Programmable
TTL	-	Transistor-Transistor Logic
ICSP	-	In Circuit Serial Programming
UART	-	Universal Asynchronous Receiver/Transmitter

CHAPTER 1

INTRODUCTION

1.0 Project Background

In this sophisticated era, many have to upgrade what they use, whether in technology, expertise, or equipment used. Distance measuring equipment are available, such as a tape measure may force someone to do the work over two or three times. With today's technology, it is a loss if a society is to continue to use old equipment. Development of distance measuring device equipped with storage systems using a microcontroller will assist and facilitate the work of measuring the distance as well as to store the data in the measure itself.

This project will use *Peripheral Interface Controller* (PIC) that can be programmed to give instruction and to control that measurement device. PIC developed and marketed by Microchip Technology, is inexpensive microcontroller units that include a central processing unit and peripherals such as memory, timers, and input/output (I/O) functions on an integrated circuit (IC) (Lee et al. 2004). The PIC 16F877A is a microcontroller based on PIC16F87x. It has 256-byte of read-only memory (ROM). This microcontroller also has three input/output port which is suitable for the development of distance measurement device.

Sensor selection is vital in this project development. Ultrasonic sensor is the sensor that had been used in this project. Ultrasonic sensor is a sensor that transmits a short ultrasonic pulse and the time for return is then measured (Christensen et al. 1998). So, this sensor will make the device suitable for indoor and outdoor

measurement. The used of this sensor for this project is to measure a distance of an object. 5 volt of battery will be used for this project to make it portable and easy to bring to anywhere. All the reading of distance measured will be display on the Liquid Crystal Display (LCD) which is a standard display device for hand-held embedded system. This LCD can display 16 characters in the two lines which is enough to display the distance's reading until 5 significant figures and above. There are three push buttons on that device.

1.1 Problem Statement

Nowadays, measuring tool is important for the people especially for interior designer or general people. The problem they are facing today is that they must do multiple works just to measure and record that measured data. Besides, there is possibility that the paper which has the reading on it missing or misplace. In addition, there is always has an error to read the reading on that measuring tool because of the parallax error. This problem will make people do the same job two or three times. So, I can say this product will be helpful to solve the problem.

1.2 Objectives

a) To develop digital measuring tool that can measure distance and save data.
b) To test the accuracy of measuring tools.

1.3 Work Scope

a) The data can be stored up to five (5) data of distance measured.
b) The accuracy of measurement has one percent (0.1%) of error.
c) The measuring range is cover from 5cm to 4m.
d) To develop hardware model for the tool.

CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

Literature review is the first step to understand the ideas to develop the measurement device using microcontroller with memory. This chapter will briefly detail about the previous idea and project about the distance measurement device and what component had been used in the previous project. In addition, this chapter will also describe about type of microcontroller and sensor that will be chosen in this project and the factor why it is been chosen.

2.1 Previous Project Work

This part will explain roughly about the previous project which is related to the actual project that will be developed. The project that chosen in this part are Smart Distance Measurement Systems Using IR sensor, General – Purpose Wireless Distance Sensor, and Development of Noncontact Height Measurement Device Fabricated Using Microcontroller HT46R232 as Foundation.

2.1.1 Smart Distance Measurement Systems Using IR Sensor

This journal is describing about the development of distance measurement system using infrared (IR) sensor. PIC microcontroller (PIC16F877A) is been used in this project as the main component. They also

use the general IR sensor, a 16x2 LCD display to display the distance reading and power supply unit (Hubballi et al. 2015). While the software that they use is Kiel complier, embedded c, and multisim which used for simulation. Figure 2.1 shows the block diagram of distance measurement system.

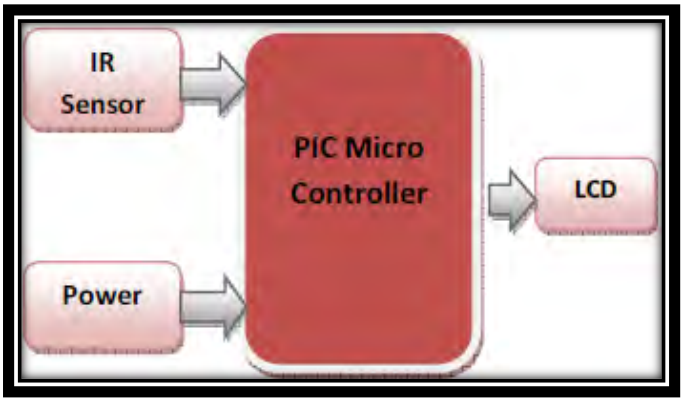

Figure 2.1: Block Diagram of Distance Sensor

There are three main unit of working system which is a sensor unit, an analog to digital converter (ADC) which is inbuilt in PIC MCU and the LCD module (Meier 2014). The shorter the distance between sensor and the object, the bigger the intensity of IR radiation will be receive by the receiver and vice versa. The reflected ray that is received by receiver will send the signal to microcontroller and convert the analog signal to digital signal using the formula given below where Vpp value is refer to intensity of IR that is received by receiver.

$$\text{Value} = (\text{Vpp}) / (4.87*10\text{^}-3)$$

By utilizing these digital values, the module is customized by utilizing keil compiler what's more, embedded c. The outcome is appeared by utilizing LCD screen in centimeters. Figure 2.2 shows the position of the sensor and distance of the object that is measured while the sensor is connected to MCU and out will be displayed on the 16x2 LCD display.

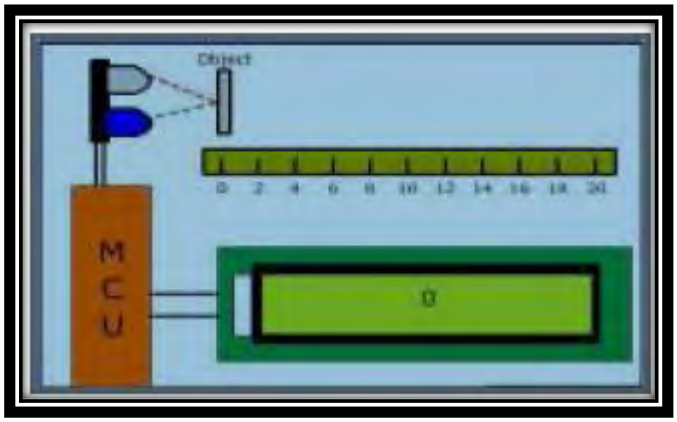

Figure 2.2: Position Sensor and Distance of Object Measured

Although the infrared sensor are much more cheaper but this sensor only fit for recognizing object within the scope of 10 to 15cm and it is also not accurate because it is easily sense radiations from the sun that will caused the correctable or non-correctable blunders at yield. In addition, signal misfortunes may happen at amplifier circuit if we use analogue IR sensor. However, the power utilization of IR sensor is lesser than ultra-sonic sensors and the transmitter and receiver of IR entirely basic.

2.1.2 General – Purpose Wireless Distance Sensors

Distance measurement device is implemented for car parking and it can be mounted on a car or in a parking deck (Meier 2014). So, the sensor that been used in this project is ultrasonic sensor and specifically is "XL – Maxsonar EZ3" which is shown in Figure 2.3. It can quantify separation from 20 cm up to 765 cm with a resolution of 1 cm and gives access to the estimation information through different interface (RS – 232 , analog, pulse width). The sensor will works at 42 kHz and it voltage can be supplied within 3.3 V and 5 V. The sensor's beam target in different sizes is delineated in Figure 2.4.

Figure 2.3: Ultrasonic Sensor XL-Maxsonar EZ 23

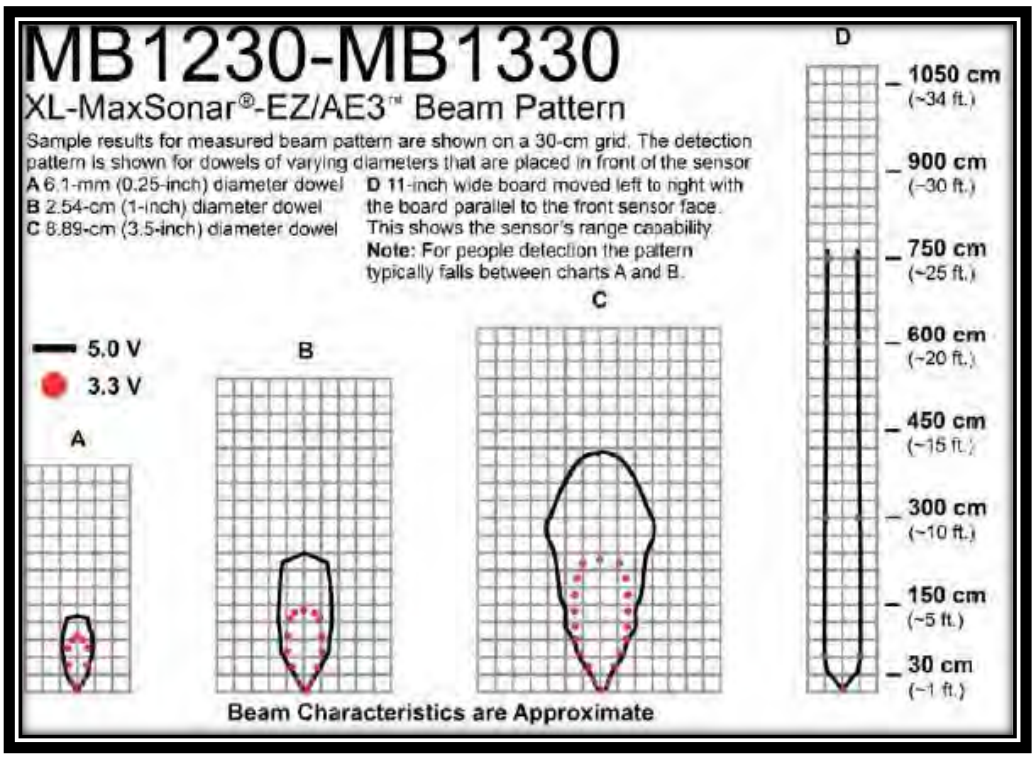

Figure 2.4: XL-MaxSonar Beam Pattern

The microcontroller that been used in this project is "Arduino Pro Mini" built by Sparkfun that is shown in Figure 2.5 due to the criteria for this project for example purpose of wireless distance sensor, the power consumption and the size (sensor device should be small). This sensor is

furnished with an ATmega328 CPU running at 8 MHz, can be powered at any voltage between 3.3 V and 12 V and it size just 18x33 millimeter.

Figure 2.5: Arduino Pro Mini

2.1.3 Development of Noncontact Height Measurement Device Fabricated Using Microcontroller HT46R232 as Foundation

This journal basically present about a device that can measure level, distance, and height specifically for employed in construction works (Shieh et al. 2013). The framework created in this study combines laser modules, ultrasonic sensor, inertial sensors and a HT46R232 microcontroller. Tangent theorem of trigonometric functions is also added by the system to the microcomputer controller for height computation. The improvements that have been added into the project are the uses of inertial accelerometer applications. One of the uses of accelerometer is when equipment cannot acquire a global positioning system (GPS) signal, it can be utilized to sense moving data and give signals to navigation equipment to complement the GPS signal errors.

The inertial accelerometer sensors is used with combination of laser point sensor to measure height where usually this type of measurement generally performed by optical measurement instrument. Both of the sensors