WASTE LEVEL SENSOR

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Dedicated to my family, specially to my beloved mother, father, brother and sisters, my lecturers and lastly my friends

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Alhamdulillah, thank to Allah S.W.T because of his blessing and truth, I finally finish my final year project successfully. In completed this project, I was met with many people that help me a lot until I successfully write this thesis. There are many problems occur during my project work. But this not a big matter cause I have many reference from my senior and other lecturer from my faculty.

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Finally, my project would not be carried out smoothly without the continuing support and encouragement given by my lecturers, and my friends. I would like to express my sincere gratitude to them especially for their helping during the time in need.

ABSTRACT

This project details the process used to develop the waste level sensor. In particular waste level sensor was using the PING ultrasonic distance sensor to sense the level of the waste. As sensor detected the waste level from the top of the tank, the data will be transmitted to the Visual Basic through the PIC16F877A microcontroller.

The aims of this project are to measure industrial waste level and convert it to digital signal and model the waste level by using microcontroller to measure the waste level. The aim was also to measure industrial waste level by using Liquid Crystal Display. The measurement will be transmit and receive distant level signal by using The Ping ultrasonic distance sensor.

Other than that, this water level sensor also can be applied in industry where the chemical liquid in the tank can be measured. So that if the chemical liquid is going to overflow, the Visual Basic will display the status of the waste level thus the quality of the environment can be improved immediately.

The Waste Level Sensor consists of a hardware platform that is controlled by a microcontroller. The prototype developed for this project is functional and the results of all the testing undertaken have been successful.

ABSTRAK

Projek ini menceritakan mengenai sesuatu proses yang digunakan untuk menghasilkan pengesan paras buangan bahan kimia. Pengesan yang digunakan dalam projek ini adalah jenis Sensor Jarak Ultrasonik PING yang akan mengesan paras buangan bahan kimia. Apabila sensor mengesan paras buangan bahan kimia tersebut dari atas tangki, data akan dihantar ke Visual Basic melalui mikropengawal PIC16F877A.

Matlamat projek ini adalah untuk mengukur paras buangan bahan kimia dan menukarkannya dalam isyarat digital dan memodelkan paras sampah dengan menggunakan mikrokontroller untuk mengukur tahap buangan bahan kimia. Matlamat projek ini juga adalah untuk mengukur tahap buangan bahan kimia industri menggunakan paparan kristal cecair yang mana pengukuran akan dihantar dan menerima isyarat tahap jauh menggunakan Sensor Jarak Ultrasonik PING.

Selain daripada itu, pengesan paras buangan bahan kimia ini juga boleh diaplikasikan dalam industri dimana cecair kimia di dalam sesebuah tangki dapat diukur. Jadi apabila cecair kimia ini mencapai aras limpahan air, Visual Basic akan memaparkan status paras buangan bahan kimia, dengan itu kualiti alam sekitar akan terjamin.

Tangki pengesan paras buangan bahan kimia ini mengandungi perkakasan yang dikawal oleh mikropengawal. Prototaip bagi projek ini telah berfungsi dan hasil dari ujikaji yang dijalankan menunjukkan keberkesanan projek ini.

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CHAPTER I

INTRODUCTION

1.1 Overview

Level sensors detect the level of substances that flow, including liquids. The substance to be measured can be inside a container or can be in its natural form for example river or lake. The level measurement can be either continuous or point values. Continuous level sensors measure level within a specified range and determine the exact amount of substance in a certain place, while point-level sensors only indicate whether the substance is above or below the sensing point. This project used continuous level sensor that is Parallax PING ultrasonic distance sensor.

The Parallax PING ultrasonic distance sensor provides precise, non-contact distance measurements from about 2 cm (0.8 inches) to 3 meters (3.3 yards). It is very easy to connect to BASIC Stamp® or Javelin Stamp microcontrollers, requiring only one I/O pin. The PING sensor works by transmitting an ultrasonic (well above human hearing range) burst and providing an output pulse that corresponds to the time required for the burst echo to return to the sensor. By measuring the echo pulse width the distance to target can easily be calculated and the height of waste level will be calculated by using Visual Basic Programming.

1.2 Project Objective

The main objectives of this project are:

i. To measure industrial waste level and convert it to digital signal.

ii. To model the waste level by using microcontroller to measure the waste level.

iii. To measure industrial waste level by using LCD display. The measurement will be transmit and receive distant level signal by using The Ping ultrasonic distance sensor.

1.3 Problem Statement

Monitoring on industrial waste water discharge had been implemented across the country since decades but is usually confine to site. Monitoring and controlling industrial process maybe a tedious task where a person must be employed on site in order to monitor an industrial process which is a waste of money and time should there be no problem on site. Environmental Quality Act, 1974 and the Environmental Quality (Sewage and Industrial Effluents) Regulations, 1979, require all Industries with known point source of waste water discharge to install monitor and report flow measurement of wastewater discharges from an industrial outlet.

But, nowadays people are neglecting about these waste. There are many industrial waste produce by the industry. So, in order to keep our country clean from all the waste, a sensor that can detect and measure the industrial waste level will be produce. It will convert to digital signal. By using microcontroller, the waste level will be control and convert in term of 7-segment display. This project is the improvement of previous project and one of the projects made by my supervisor to detect industrial waste level.

Various types of waste level system that available in market nowadays, but this system alone with the traditional system can't overcome the intrusion problem. To make this system more efficient and useful for industry, it should be upgraded to be more efficient. This project is designed with the monitoring system to make the users easy to monitor the level of industrial waste. Waste monitoring system is a safe option to monitoring waste levels as it doesn't require climbing on top of the tank and reaching in to make measurements. All it involves is monitor the waste level on the LCD display, displaying the level of the waste.

1.4 Project Scope

The scope of work will include designing a circuit that will measure waste levels that measures physical parameters with an analog voltage output using PIC microcontroller and sense by The Ping ultrasonic distance sensor. It will also include development and analyze The Ping ultrasonic distance sensor. Then, I need to simulate the circuit using many techniques to sensor, testing and troubleshooting. Finally, the project write-up will begin.

1.5 Methodology

Figure 1.1 shows the methodology of the project from start till finish. Further explanation will be at Chapter III.

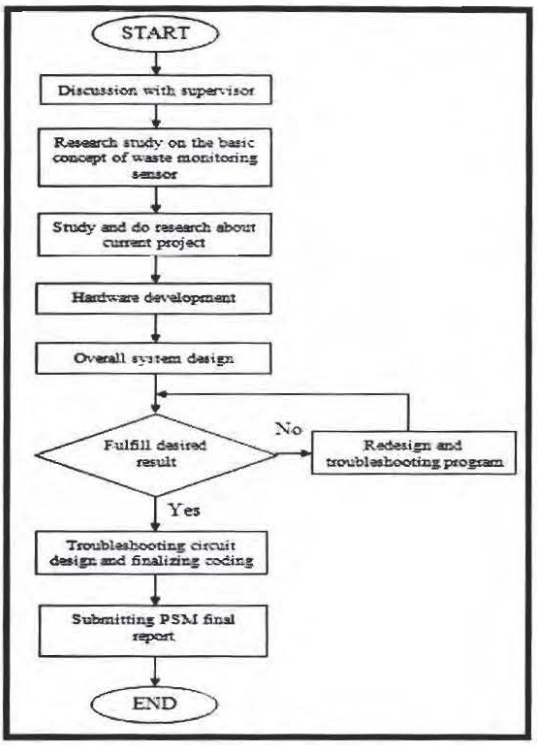

Figure 1.1: Methodology of the project.

1.6 Thesis Outline

Chapter 1 gave an introduction about the project as well as problem statement, objective and project scope for project.

Chapter 2 is a literature review where the main part of waste level sensor will be described and understanding all components that will be used for this project. The purpose of this chapter is to provide an overview the scope of study for this project.

Chapter 3 is methodology section where the methods or steps that have been used to approach the waste level sensor will be explained thoroughly.

Chapter 4 is the result and discussion where all the preliminary result of the analysis will be shown. Discussion and observation of the outcome of the research in relation to evidences obtained from project and theories will be made in this chapter.

Chapter 5 is conclusion for this project, which describe the overall project based on the observation of the result obtained and summarize the entire project. This chapter also discusses the recommendation for future planning.

CHAPTER II

LITERATURE REVIEW

This chapter consists of some information about water level sensor and also an overview of the literature that has been published in relation to the waste level sensors.

2.1 Components Used in Waste Level Sensor

2.1.1 Microcontroller PIC16F877A

PIC is a family of Harvard architecture microcontrollers made by Microchip Technology, derived from the PIC1650 originally developed by General Instrument's Microelectronics Division. The name PIC was originally an acronym for "Programmable Intelligent Computer".

PICs are popular with developers and hobbyists alike due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, and serial programming (and re-programming with flash memory) capability.

The PIC architecture is distinctively minimalist. It is characterized by the following features with separate code and data spaces (Harvard architecture). It also has a small number of fixed length instructions.

Most instructions are single cycle execution (4 clock cycles), with single delay cycles upon branches and skips. It has a single accumulator (W), the use of which (as source operand) is implied (i.e. is not encoded in the opcode). All RAM locations function as registers as both source and/or destination of math and other functions.

Other than that, this microcontroller has a hardware stack for storing return addresses also has a fairly small amount of addressable data space (typically 256 bytes), extended through banking. Data space mapped CPU, port, and peripheral registers.

The program counter is also mapped into the data space and writable (this is used to synthesize indirect jumps). Unlike most other CPUs, there is no distinction between "memory" and "register" space because the RAM serves the job of both memory and registers, and the RAM is usually just referred to as the register file or simply as the registers.

This PIC is particularly suited to implementation of fast lookup tables in the program space. Such lookups are O(1) and can complete via a single instruction taking two instruction cycles. Basically any function can be modeled in this way. Such optimization is facilitated by the relatively large program space of the PIC and by the design of the instruction set, which allows for embedded constants.

To summarize, a microcontroller contains (in one chip) two or more of the following elements in order of importance:

i. Instruction set.
ii. RAM.
iii. ROM, PROM or EPROM.
iv. I/O ports.

v. Clock generator.
vi. Reset function.
vii. Watchdog timer.
viii. Serial port.
ix. Interrupts.
x. Timers.
xi. Analog-to-digital converters.
xii. Digital-to-analog converters.

PIC stands for 'Peripheral Interface Controller', general instrument as small, fast, inexpensive embedded microcontroller with strong input/output capabilities. The PIC16F877A is CMOS Flash-based 8 bit microcontroller. It packs into 40-pin package with 3 ports for input/output which are Port A, Port B, Port C and Port D. In this project, PIC16F877A will be use. PIC16F877A is in either baseline core or mid-range core devices in the PIC's family core architecture. PIC16F877A also have enhanced core features, eight-level deep stack, and multiple internal and external interrupt sources.

PIC18F877A has been chosen because of its USART (Universal Serial Asynchronous Receiver Transmitter) function. In this project, USART is used to communicate between hardware and PC serial port. The details explanation of USART function will be discussed in the next sub-chapter.

Besides, this microcontroller also has input/output port just enough for the project application. Figure 2.1 shows Pin Diagram for PIC16F877A.

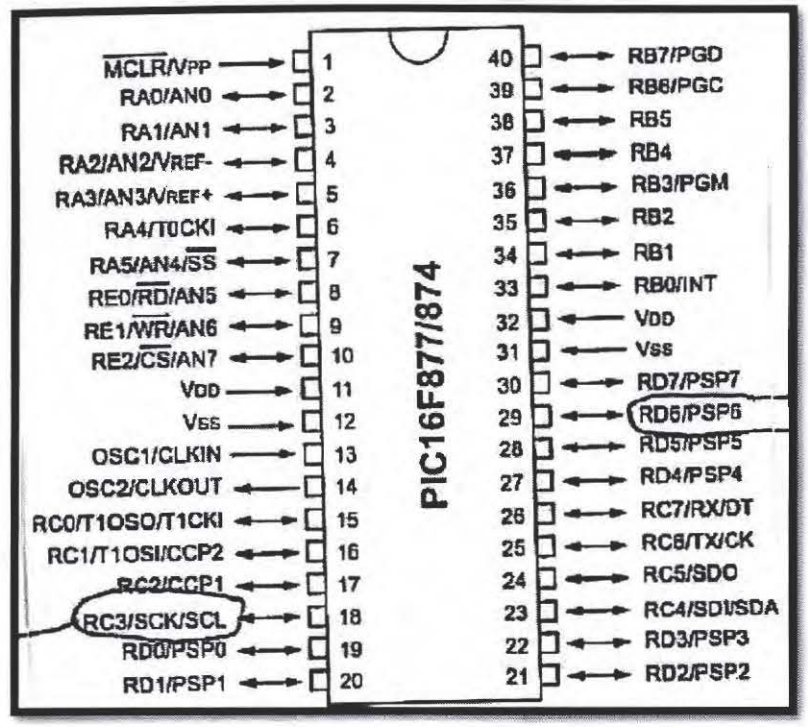

Figure 2.1: Pin Diagram of PIC 16F877A.

2.1.2 Ultrasonic Sensor

Ultra means "beyond" and sonic means "sound". Ultrasonic refers to sound waves that have higher frequency than the human audible range. The sound waves whose frequency lies above the audible frequency of 20 kHz are called Ultrasonic waves. Ultrasonic sensors can detect small objects at considerable distances. They are able to disregard disturbing backgrounds and functions in fog, dust, dirt or extreme lighting is possible. They can detect any soft and hard materials.

No correction factors have to be applied and color does not matter. In this project used two ultrasonic sensors. One is ultrasonic transmitter and the other is ultrasonic receiver. They transmit and receive the signal with 40 KHz frequency.

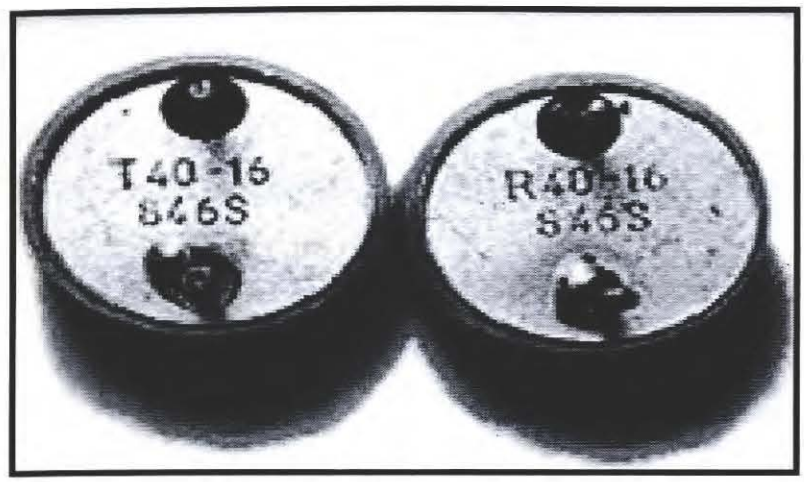

Figure 2.2: Ultrasonic Sensor.

Ultrasonic sensors (also known as transceivers when they both send and receive) work on a principle similar to radar or sonar which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object.

This technology can be used for measuring: wind speed and direction (anemometer), fullness of a tank and speed through air or water. For measuring speed or direction a device uses multiple detectors and calculates the speed from the relative distances to particulates in the air or water. To measure the amount of liquid in a tank, the sensor measures the distance to the surface of the fluid. Further applications include: humidifiers, sonar, medical ultrasonography, burglar alarms and non-destructive testing.

Ultrasonic sensors are used to detect the presence of targets and to measure the distance to targets in many automated factories and process plants. Sensors with an on or off digital output are available for detecting the presence of objects, and sensors with an analog output which varies proportionally to the sensor to target separation distance are commercially available.