ETAPE LIQUID LEVEL SENSOR WITH GSM SYSTEM

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Specially dedicated to
my supervisor, family and friend who have encouraged, guided and
inspired me throughout my journey of education

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ABSTRACT

In many instances, handling of liquid especially when level indication is an important parameter to the system has to be given much consideration. Liquid handling offers many challenges for measurement and control. One of the critical tasks is to make sure that the liquid does not overflow which may result in catastrophic consequences especially if the liquid happens to be high pressure liquid, hot water and chemical. In industries, it is very common that the method used for measuring the liquid level is by using the direct contact method such as using a probe to measure the level of water in tank. With such liquids, non corrosive method to monitor the level of the liquid is much preferred. There are various techniques which can be used to achieve this. This project is to study the various possible methods in the earlier stages and to do some comparisons and their pros and cons. The final project is to design and implement the most intelligent, reliable and practical Wireless GSM liquid level detection system for storage tank. The final outcome is to design a Wireless GSM liquid level detection system preferable that employs optical technique to highlight the advantages of using wireless field device and principle which is the data will be notified to the control room by using LCD display and to the technician by using a GSM system.

ABSTRAK

Pengukuran paras cecair adalah aspek utama untuk banyak aplikasi dalam industri pemprosesan. Dalam banyak keadaan, pengendalian cecair terutamanya apabila tanda paras satu parameter adalah penting untuk sistem harus diberi pertimbangan yang banyak. Pengendalian paras cecair menawarkan banyak cabaran didalam pengukuran dan kawalan. Salah satu tugas yang kritikal adalah untuk memastikan bahawa cecair itu tidak melimpah yang boleh mengakibatkan kesan-kesan bencana terutamanya jika cecair itu bertekanan tinggi, air yang panas atau cecair kimia. Dalam industri, ia adalah sangat umum bahawa kaedah yang digunakan untuk mengukur tahap cecair dengan menggunakan kaedah probe. Jenis kaedah ini memerlukan sensor yang mempunyai hubungan secara langsung dengan cecair. Dengan itu, kaedah seperti ini digunakan untuk memantau tahap cecair. Terdapat pelbagai teknik yang boleh digunakan untuk mencapai matlamat ini. Projek ini adalah untuk mengkaji pelbagai kaedah yang mungkin dalam peringkat awal lagi dan melakukan beberapa perbandingan dan kebaikan serta keburukan mereka. Di akhir projek ini akan mereka bentuk dan melaksanakan Wayarles GSM cecair yang paling pintar, dipercayai dan praktikal tahap sistem pengesanan bagi tangki simpanan. Kesudahan yang baik adalah untuk mereka bentuk sistem wayarles pengesanan tahap cecair lebih baik dengan menggunakan teknik optik untuk menyerlahkan kelebihan menggunakan bidang peranti wayarles dan datanya akan dimaklumkan kepada bilik kawalan dengan menggunakan paparan LCD dan kepada juruteknik dengan menggunakan sistem GSM.

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CHAPTER 1

INTRODUCTION

1.1 Background

Nowadays, people are chasing for latest technology because technology makes people life perfect and simple. Level measurement is one of the most common types of measurement undertaken and is used significantly in many process systems. Liquid Level Sensors are sensors used to measure the level of liquid in a particular place. The sensors measure the level of the liquid to ensure that the volume of the liquid remains within defined parameters. Liquid Level Sensors are able to detect if a space has too much liquid and is going to overflow or if there is too little liquid. The most important area is the need to determine the amount of liquid in a tank especially at power plant, in order to control and regulate the process. In the waste water industry for example, level measurement is used in maintaining the levels in chemical tanks. In this type of application, a level measurement device would monitor the level of chemical and the device would send out a data to control room when the tank is full or reaches certain of level.

In continuously with the level monitoring method used, the device measures level on a constant basis and displaying on the LCD and directly to the mobile phone or transmitting the actual level of the liquid in a tank as it changes. By knowing the area of the tank will allows an operator or user to calculate back how much liquid is present at any given time. This is extremely useful information in managing inventory or in gauging process performance. The technician will check the tank immediately if the tank in emergency condition.

All the measured values will be directly notify at the control room by displaying the values on a LCD. At the same time, a GSM device will react as a medium for transmit the values to the technician by informing with short message service (SMS).

1.2 Problem Statement

In power plant, handling of storage tank which contain liquid is very important especially if the liquid happens to be high pressure liquid, hot water and chemical. There are many bad incident happens involved these items handling. Those liquid may harm the human body: Basically, the conventional method of measuring liquid level is by using a dipstick or calibrated float. However, this kind of method is not suitable in some situations for example, sometimes a sealed container cannot be opened, or its contents cannot to be exposed.

This Liquid Level Sensor is a great way to measure the level of a liquid. It has a resistive output that varies with the level of the fluid. It does away with clunky mechanical floats, and easily interfaces with electronic control systems. The sensor's envelope is compressed by the hydrostatic pressure of the fluid in which it is immersed. This results in a change in resistance that corresponds to the distance from the top of the sensor to the surface of the fluid. The sensor's resistive output is inversely proportional to the height of the liquid: the lower the liquid level, the higher the output resistance; the higher the liquid level, the lower the output resistance.

1.3 Objective

The main objective of this project is to develop a liquid level measuring system for a liquid tank. It is a device that can measure the level of liquid inside the tank using liquid level sensor and the liquid level can be display to the user through a display panel and mobile. This project looks into researches based on the e-tape liquid level sensor as non-corrosive sensor. In this project, the study of the e-tape liquid level sensor describes a few of the advantage in data measurement such as good accuracy and continuous measurement. The software codes are also need to be develop for the PIC 16F877A which is to control the LCD display and connecting with the GSM device by using MAX232

1.4 Scope of Project

The scope of this project is to learn and understand the basic of wireless field device. The wireless field device is used to monitoring the level of the liquid in the storage tank. It also helps to ensure that the project is heading in the right direction to achieve its objectives listed as below:

1. To study the relationships between powers transmit, water level and time.
2. To construct and study the hardware of the circuit until it performs as desired.
3. To develop software codes that can allow the circuit to detect liquid level, sending the data to the LCD display and mobile.

Basically, this project is divided into two parts:

1. **Hardware design:** The hardware for the liquid level measuring system can be dividing into four functional units such as the capacitive sensor circuit, the PIC circuit, LCD display and the GSM device. It consists of the operation of capacitive sensor in order to transmit and detect the level of liquid and the operation to control the display.

2. **Software design:** The program for the liquid level measuring system essentially detect the level of fluid. The sensor's envelope is compressed by the hydrostatic pressure of the fluid in which it is immersed. The display of the measurement is obtained on the LCD display. The program functions are to connect the capacitive sensor circuit, LCD display and GSM device by using PIC 16F877A.

1.5 Project Methodology

This project focus more on study case and the project development based on non-corrosive method to detect the liquid level. The project methodology shows the step by step taken to complete the project. The methodology includes the planning, the development of the design and the management of the project.

CHAPTER 2

LITERATURE REVIEW

This chapter presents the details about literature review of Wireless Liquid Level Detection using Capacitive Sensor. Its consist the review of capacitive sensor, PIC Microcontroller, LCD display, MAX 232 and GSM device related with this project.

2.1 Sensor Review

To make the objectives of this project successful, some step must be used as a starting step. First step should be taken is doing a research on sensor that suitable in this project and the selected sensor is e-tape liquid level sensor.

2.1.1 E-Tape Liquid Level Sensor.

The eTape liquid level sensor is a solid state, continuous (multi-level) fluid level sensor for measuring levels in water, non-corrosive water based liquids and dry fluids such as powders. The eTape liquid level sensor is manufactured using printed electronic technologies which employ additive direct printing processes to produce functional circuits[1].

The eTape liquid level sensor dimensional measurement requires three basic components

- A probe that applied changes in continuous liquid level.
- Driver electronics to convert these changes in resistance into voltage changes. In this project, PIC16F877A is functioning as a driver.
- A device to indicate the resulting voltage change. LCD display and GSM system perform as a wireless field device to indicate the result of measurement.

The eTape sensor's envelope is compressed by hydrostatic pressure of the fluid in which it is immersed resulting in a change in resistance which corresponds to the distance from the top of the sensor to the fluid surface. The eTape sensor provides a resistive output that is inversely proportional to the level of the liquid: the lower the liquid level, the higher the output resistance, the higher the liquid level, the lower the output resistance.

2.1.2 Methods of applying sensor

The eTape liquid level sensor is easy to install. Connect to the eTape by attaching alligator clips or by soldering leads to the crimp pin connectors with low temperature solder. The inner two (pins 2 and 3) are the sensor output. The outer pins (pins 1 and 4) are the reference resistor which can be used for temperature compensation. Suspend the eTape sensor in the fluid to be measured. To work properly the sensor must remain straight and must not be bent vertically or longitudinally. Double sided adhesive tape may be applied to the upper back portion of the sensor to adhere the sensor to the inside wall of the container to be measured. Only apply tape to the upper back portion of the sensor as shown in the figure below. If adhesive tape is applied to any other portion of the sensor it may not work properly. The vent hole located above the max line allows the eTape to equilibrate with atmospheric pressure. The vent hole is fitted with a hydrophobic filter membrane to prevent the eTape from being swamped if inadvertently submerged[1].

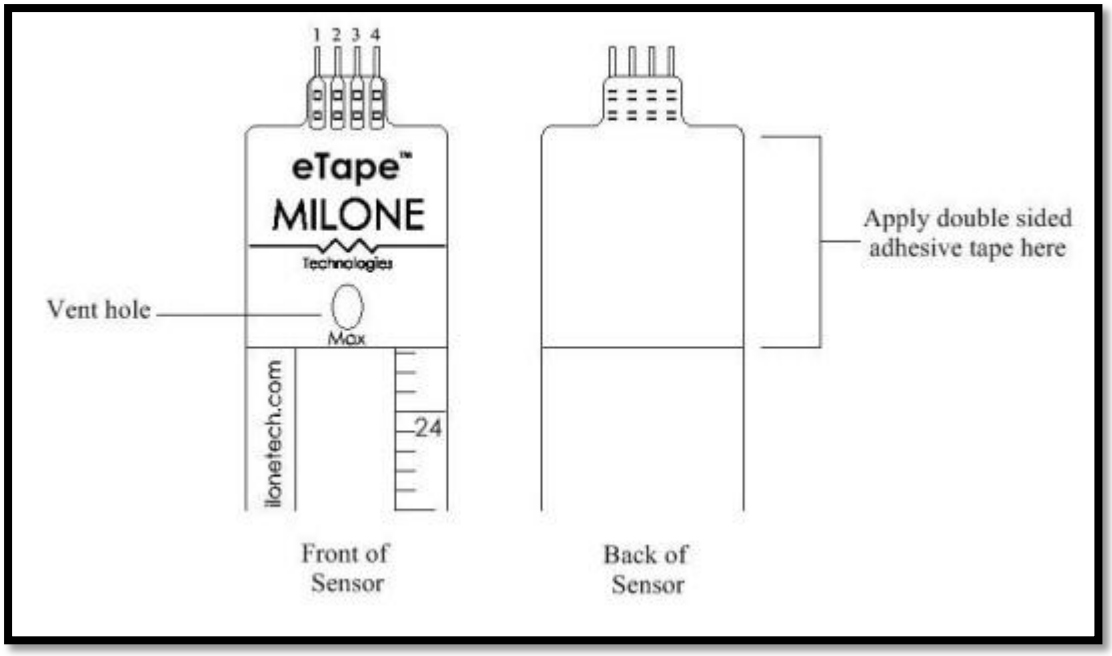

Figure 1: Methods of applying sensor[1].

2.1.3 Sensor Specifications

- **Sensor Length:** 10.1 ″ (257mm)
- **Thickness:** 0.015 ″ (0.381mm)
- **Width:** 1.0 ″(25.4mm)
- **Active Sensor Length:** 8.4 ″ (213mm)
- **Sensor Output:** 1500Ω empty, 300Ω full, ±10%
- **Resistance Gradient:** 140Ω / inch (56Ω/cm), ±10%
- **Resolution:** <0.01″ (0.25mm)
- **Actuation Depth:** Nominal 1″ (25.4mm)
- **Reference Resistor (Rref):** 1500Ω, ±10%
- **Connector:** Crimpflex Solder Tabs
- **Temperature Range:** 15 - 150 F
- **Power Rating:** 0.5 Watss(VMax = 10V)

2.1.4 Sensor Output

The eTape can be modeled as a variable resistor(300Ω-1500Ω ±10%). The typical output characteristics of the eTape sensor are show in the figure below.

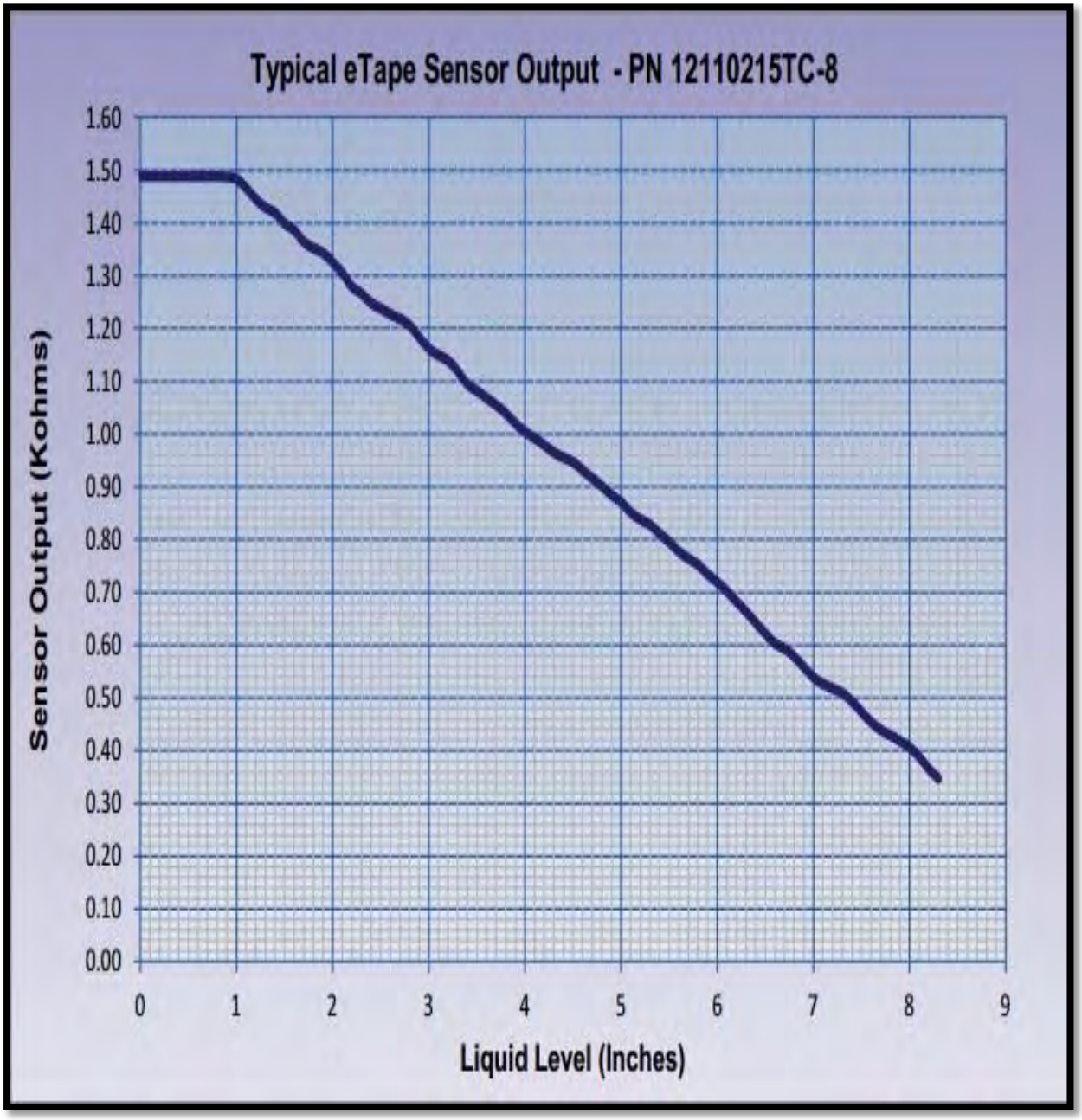

Figure 2: Sensor output versus Liquid level (inches)[1]

2.1.5 The Advantage of eTape Liquid Level Sensor

- Easy installation.
- Accurate data measurement.
- Continuous measurement.
- Long lasting.
- Custom lengths to fit any application.

2.2 PIC Microcontroller

Microcontroller PIC16F877A is one of the PIC Micro Family microcontrollers which are popular at this moment. PIC16F877A is using flash memory technology, which allows the PIC to write and erase for thousand times. The RISC bit microcontroller is much better compare to the other 8-bit microcontroller especially at speed and the code compression. Digital electronics knowledge is essential in order to understand the way microcontroller works. However, with the existing off latest microcontroller like peripheral interface controller (PIC) PIC16F877A from microchip, microcontroller works by writing programming code using C language. Everything becomes east by learning C programming and uses it to program the microcontroller. This is the examples of microcontroller [2]:

- PIC 26F870
- PIC 16F871
- PIC 16F872
- PIC 16F873A
- PIC 16F874A
- PIC 16F876A
- PIC 16F877A
- PIC 16F887A

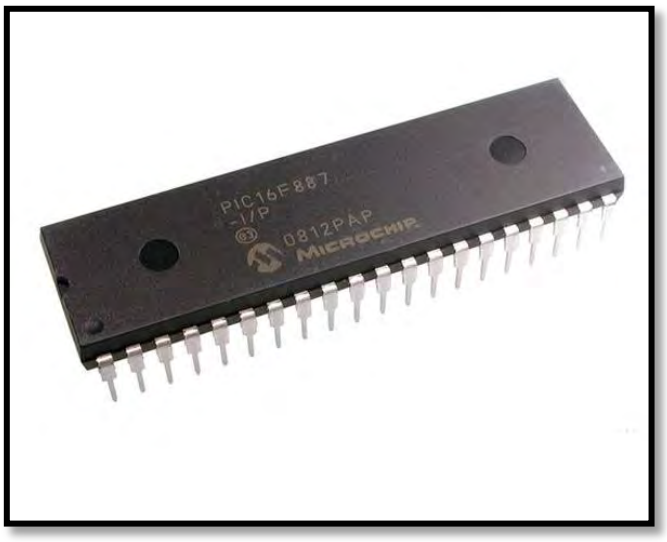

Figure 3: PIC16F877A[2]

Microcontroller Features:

- 100,000 erase/write cycle Enhanced lash program memory typical
- 1,000,000 erase/write cycle Data EEPROM memory typical
- Data EEPROM Retention > 40 years
- Self-reprogrammable under software control
- In-Circuit Serial Programming (ICSP) via two pins
- Single-supply 5V In-Circuit Serial Programming
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving Sleep mode
- Selectable oscillator options
- In-Circuit Debug (ICD) via two pin