UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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DEVELOPMENT OF MICROCONTROLLER-BASED DATA ACQUISITION SYSTEM FOR ENVIRONMENTAL MONITORING

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Electrical Engineering Technology (Industrial Power) (Hons.)

by

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FACULTY OF ENGINEERING TECHNOLOGY

2015

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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TAJUK: **MICROCONTROLLER-BASED DATA ACQUISITION SYSTEM FOR ENVIRONMENTAL MONITORING**

SESI PENGAJIAN: **2015/16 Semester 2**

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I hereby, declared this report entitled "Microcontroller-Based Data Acquisition For Environmental Monitoring" is the results of my own research except as cited in references.

Signature : .....

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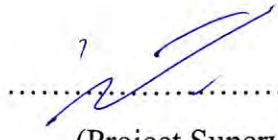
APPROVAL

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 (Industrial Power) (Hons.). The member of the supervisory is as follow:



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(Project Supervisor)

ABSTRACT

PC-Based Environmental Monitoring is an electronic device used for the remote operation of monitoring system. Wireless connection has been popular tool in system monitoring. The problem is sometimes user might need device to help them to obtain the certain reading without risking the safety and health. The objective of this project is to develop a system that able to help the user to obtain the reading without risking their safety and health. Another objective is to design a system that able to record the reading for further processing. The method used for this project is by studying the previous project. In the literature review, we are able to identify the component needed and how the system designed. The achievement of PC-Based Environmental Monitoring is divided into two parts. Firstly, the PC-Based Environmental Monitoring is able to function properly as a reading system. Secondly, microcontroller is able to process the data from the sensors and send it through the HC-05 module. Data obtained will be process and displayed by a graphical user interface created. In conclusion, PC-Based Environmental Monitoring is developed to give the user the power to obtain the reading without getting access to the reading point. In this project, PC-Based will be develop in order to bring our data acquisition system out of the dark ages technology with one cool wireless system.

ABSTRAK

Sebuah pembaca gas "wireless" adalah alat elektronik yang digunakan untuk operasi pemantauan jarak jauh. Sambungan "wireless" telah menjadi alat popular dalam sistem pemantauan. Ia menjimatkan masa dan mengurangkan risiko pengguna untuk mengambil bacaan. Mereka boleh mendapatkan bacaan dari jauh. Sistem "PC-Based Environmental Monitoring" terdiri daripada dua bahagian, pembangunan perkakasan dan pembangunan perisian. Sistem "PC-Based Environmental Monitoring" menggunakan sistem operasi unik dengan menggabungkan operasi mudah dengan teknologi penghantaran Bluetooth melalui HC-05 modul tanpa wayar. Ia mempunyai penghantaran pada julat 30 kaki. Pada bahagian penerima, ia mempunyai ciri-ciri untuk membaca data menghantar menerusi modul Bluetooth melalui "Visual Basic". "PC-Based Environmental Monitoring" dibangunkan untuk memberi pengguna kuasa untuk mendapatkan bacaan tanpa mendapat akses ke titik membaca. Dalam projek ini, pembaca gas mudah alih akan dibangunkan untuk membawa sistem perolehan data daripada teknologi zaman lampau dengan satu sistem "wireless". Pencapaian "PC-Based Environmental Monitoring" dibahagikan kepada dua bahagian. Pertama, pembaca gas mudah alih dapat berfungsi dengan baik kerana sistem pembaca gas mikropengawal mampu memproses data dari "sensor" dan hantar melalui modul HC-05 itu. Data akan diproses dan dipaparkan di perantara muka grafik yang telah dibuat.

DEDICATIONS

Specially dedicated to:

My supervisor, Mr Ahmad Idil Bin Abdul Rahman

All Faculty of Engineering Technology staff

My parents

My siblings

My friends

Thank you for your support.

One – Punch.

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I would like to take this opportunity to express my deepest gratitude to my project supervisor, En. Ahmad Idil Bin Abdul Rahman who was persistently and determinedly assisted me along the progress of the project. It would have been difficult to complete this first half of the project without enthusiastic, insight and advice given by him.

My outmost thanks also go to my family who has given me support during my academic years. Without them, I might not be able to finish the project. I have gained a lot of help and support from friends and staffs in the Faculty of Engineering Technology. I want to take this opportunity to say thank you to them for their advice and idea that help me with the project.

Thank you so much. Your sincere help will be remembered for life.

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LIST OF SYMBOLS AND ABBREVIATIONS

PC	=	Computer
IR	=	Infra-Red
GUI	=	Graphical User Interface
PLC	=	Programmable Logic Control
SCADA	=	Supervisory Control and Data Acquisition
RF	=	Radio Frequency
AM	=	Amplitude Modulation
DC	=	Direct Current
IC	=	Integrated Circuit
PIC	=	Peripheral Interface Controller
ADC	=	Analogue-to-Digital Converter
UART	=	Universal Asynchronous Receiver/Transmitter
USB	=	Universal Serial Bus
LED	=	Light Emitting Diode
ASCII	=	American Standard Code for Information Interchange

CHAPTER 1
INTRODUCTION

1.1 Background

A wireless gas reader is an electronic device used to measure reading certain type of gas from a distance. The measure of a reading from a distance as by transmitted instruction or coded signals. In this project, wireless gas reader will be developed in order to bring our measurement devices out of the technology dark ages with one cool wireless gas reader.

Wireless gas reader has been a popular device in the industry. PC-Based Environmental Monitoring used to measure and record the reading of a certain gas type from a distance. This device operated by using Bluetooth module controlled by the microcontroller. Which are the most common, the Bluetooth connection are easier to use because it does not require line of sight and do not have to be aimed at the device. The PC-Based Environmental Monitoring also can be connected from another room. This device will continuously send measured data to a PC or laptop acted as slave. This PC-Based Environmental Monitoring will communicate to their respective PC or laptop via wireless module (HC-05 bluetooth module).

Before the wireless gas reader is introduced, the examiner has to keep going back and forth to the acquire place to takes the reading from the point. They also need to bring a paper and pen in order to record the measured data obtained by the gas reader. PC-Based Environmental Monitoring is developed to give the examiner the power to takes the reading from a better place. This will give the examiner more free time and save energy rather than going to the desired place that only to take the reading of a certain gas.

1.2 Problem Statement

There are four problem statement carried out in this project. First, the old ways to retrieve the data required the user to bring their laptop in order to obtain the reading. For example, the controller is placed on the high ground. This makes the data acquisition harder for the user to obtain the reading. Secondly, certain place is hazardous or dangerous. This is one of the biggest threats for the user as this might risk their health. The user might have to prepare special equipment in order for them to enter such places. This could be troublesome for them to bring such equipment to the place. Those things might waste their time and energy. Furthermore, existing data acquisition system using line-in-sight connection such as Infra-red (IR). Infra-red is a wireless system that required line-in-sight connection between the transmitter and receiver. For data acquisition system, this is one of the problems since the user require data taken for some period. The connection will be disconnected if there is obstacle or interference during the connection. Lastly, the existing gas reader system does not have any graphical user interface that user friendly with the user. The measuring or reading data is hard to obtain because there no graphical user interface included with the controller. Some of the controller only included display on the microcontroller itself. With the graphical user interface, this will solve most of the user problem.

Hence by doing this project, students are able to come out with this problem statement:

- The old ways to retrieve the data required the user to bring their laptop in order to obtain the reading.
- Some places might be dangerous or hazardous.
- Existing data acquisition system using line-in-sight connection such as Infra-red (IR).
- Existing gas reader system does not have any graphical user interface that user friendly with the user

1.3 Objective of Project

There are four objectives of this project:

1. To build the carbon monoxide, temperature and humidity device by integrating the software and the hardware (electronic devices).
2. To design and build a lower cost carbon monoxide, temperature and humidity devices, so that it can be affordable for all level of society.
3. To design and build up a system that will able to transmit data to the user laptop or PC and store the data.
4. To design a graphical user interface (GUI) that user friendly to the user.

1.4 Scope of Project

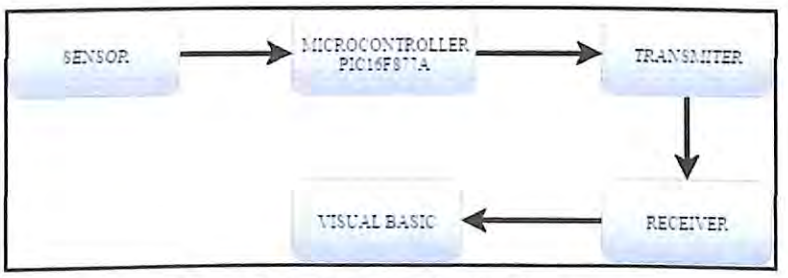

Figure 1.1: System Block Diagram

This project consists of two parts that are gas reader device and the graphical user interface. In the gas reader part, it has several parts such as oscillator, microcontroller, power supply, gas reading sensor and the HC-05 module (transmitter). The graphical user interface consists of Bluetooth dongle or inboard Bluetooth module, graphical user interface and computer or laptop.

Several gas sensors are used to obtain the gas reading. The function of the gas sensor is to obtain the certain gas reading in a certain point. The data from the sensor will be sending to the microcontroller. The microcontroller will process the data and send it to the transmitter bluetooth device. The data from receiver Bluetooth dongle will be received by the computer. The data in the computer will be manipulated by using visual basic programming. The gas reader can function well depending on the programming that has been developed.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

A literature review is a summary of previous research on a topic. The purpose of a literature review is to convey what knowledge and idea have been established on a topic and what are the strengths and weaknesses. In the other words, it can bring a various idea and method to glorify this project. It also become a study case for this project to overcome with the new idea and different design compared to the previous project. Literature review has been conducted prior to undertaking this project to obtain the information on the technology available and the methodologies that used by the other researchers on the same topic around the world. This chapter provides the summary of literature reviews on key topics related to the wireless gas reader system. Otherwise, from the literature review references it can develop the contents to this research. Below is a few listing that has been done from the previous project. This chapter focuses on the related fields and knowledge pertaining to the accomplishment of the thesis itself. Reading includes such as reference books, papers, journal articles, websites, conference articles and any documentation concerning the related applications and research works.

2.2 Review of the Previous Project

2.2.1 Wireless Gas Detector System

Derived from the journal "Wireless Gas Detector System Using Microcontrollers, PLC and SCADA System for Monitoring Environmental Pollution" by Iman Morsi and Mohamed Mansour Mohamed Mostafa. This project

combines 3 parts in 1 system. Collecting data using microcontroller, controlled and monitored by using programmable logic controller PLC Step 7-200 from Siemens and Supervisory Control and Data Acquisition SCADA systems respectively.

Experiment setup:

- Transmitter Circuit
- Receiver Circuit
- PLC and SCADA system

2.2.1.1 Operation

Transmitter Operation:

This project consists of 3 parts. First part is the transmitter circuit, second part is the receiver parts and lastly the PLC and SCADA system used to monitor and analyse the result obtained.

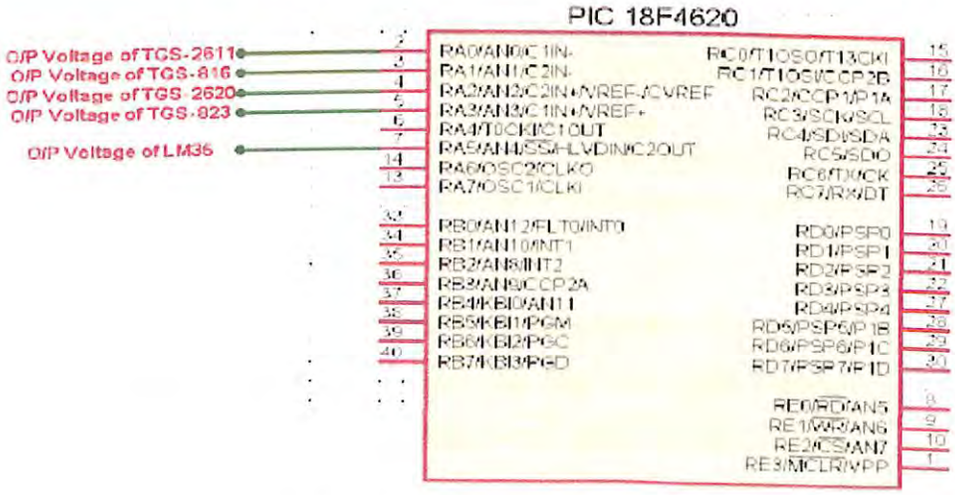

Figure 2.1: Transmiter Circuit
(Source: <Wireless Gas Detector System Using Microcontrollers, PLC and SCADA System for Monitoring Environmental Pollution> 25/04/15)

In the transmitter parts, the data taken from the sensor will be processes before send it to the receiver. The input reading which is from the sensor will be send to the receiver by HC-05 module. The data obtain will be in the scale of the reference voltage to the sensors. The transmitter microcontroller will send the data in binary to the receiver microcontroller. Figure 2.1 show the several sensors connected to the microcontroller.

Receiver Operation:

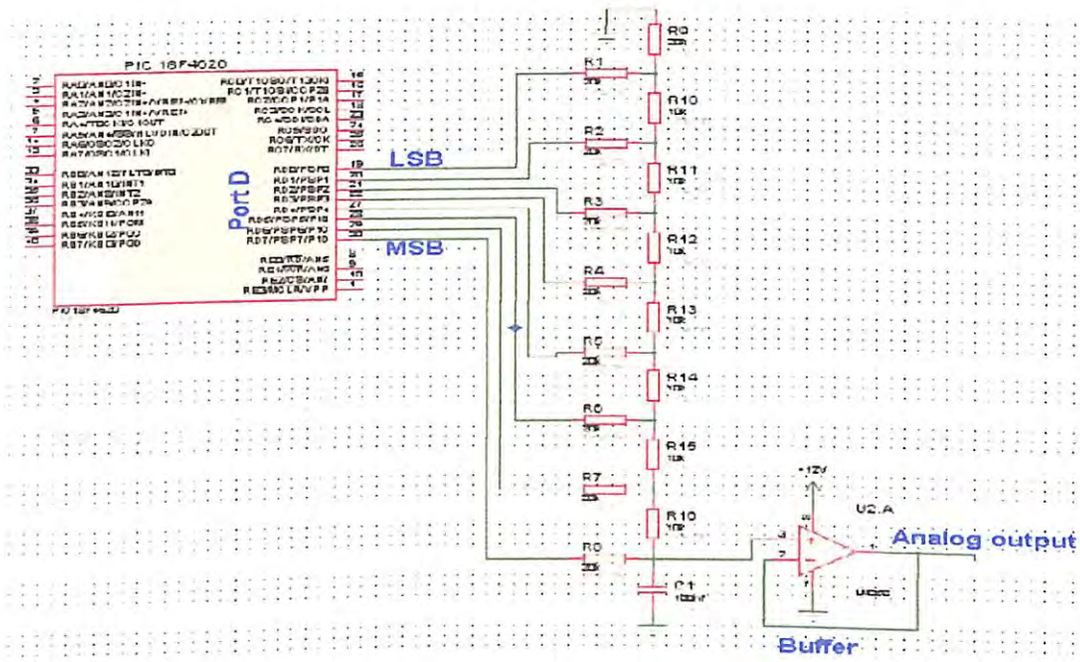

Figure 2.2: Receiver Circuit
(Source: <Wireless Gas Detector System Using Microcontrollers, PLC and SCADA System for Monitoring Environmental Pollution> 25/04/15)

Received data will be passing through the resistor circuit in order to change the data from binary to analogue. This has been done because PLC can only read data from analogue source only. Converted data will be sending to the PLC for the next process. Each analogue input will have to pass thru this part since the project requires more than 1 sensor. Figure 2.2 show the digital to analogue circuit from the microcontroller to the PLC system.

PLC and SCADA System:

Figure 2.3: Displayed data on SIMATIC touch panel
(Source: <Wireless Gas Detector System Using Microcontrollers, PLC and SCADA System for Monitoring Environmental Pollution> 25/04/15)

Figure 2.3 shows the data displayed on the SIMATIC touch panel. The data received earlier by the microcontroller will be process by the PLC before displaying it on the panel. By using SIMATIC touch panel, user is able to analyse the data clearly by using graphical viewing on the data.