" I hereby declare that I have read through this report entitle "Data Acquisition System for air conditioning system in FKE for analysis" and found that it has comply the fulfillment for awarding the degree of Bachelor of Electrical Engineering (Mechatronic)"

Signature :……

Supervisor's Name :Mr. Zamani Bin Md. Sani

Date :…….

DATA ACQUISITION SYSTEM FOR AIR-COND IN FKE FOR ANALYSIS

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A report submitted in fulfillment of the requirement for the degree of Mechatronic

Faculty of Electrical Engineering

University Technical Malaysia Malacca

YEAR 2012

I declare that this report entitle “Data Acquisition System for air conditioning System in FKE for analysis” is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : ……

Name : LOH WUI FOON

Date : 1/7/2012

Special dedicated to my family and friends

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Projek Abstrak

Pada masa kini, tahap suhu yang paling sesuai untuk belajar, kerja, atau aktiviti-aktiviti lain adalah standard pada 24 ° C. Oleh itu, semua pejabat kerajaan telah diarahkan untuk mengurangkan suhu udara bersyarat kepada minimum 24 ° C untuk tujuan mengurangkan penggunaan tenaga electrik. Walau bagaimanapun, dengan 24 ° C sebagai seting suhu mesin penghawa dingin, kita mendapati bahawa kegagalan untuk mencapai suhu yang ditetapkan, di mana 24° C. Toleransi perubahan suhu di dalam bilik adalah terlalu tinggi. Oleh itu, kita perlu untuk menyiasat punca masalah untuk mengatasi perubahan suhu atau mencapai seting suhu optimum dalam ruang tertentu. Untuk menyelesaikan masalah ini, kita perlu belajar lebih banyak terhadap reka bentuk sistem aliran udara dan mengumpulkan data suhu sebagai bahan sokongan untuk memeriksa kes-kes kewujudan kebocoran atau lain-lain punca yang mungkin. Selain itu, dari data yang dikumpulkan, kita boleh mengetahui tetapan seting yang optimum untuk penghawa dingin yang boleh menyediakan suhu bilik yang terbaik. Projek ini adalah untuk membentukan sistem rekod data yang mudah alih untuk menyimpan data suhu di dalam bangunan FKE. DAQ tersebut adalah direka dengan pelbagai jenis komponen seperti mikropengawal PIC18F42, sensor suhu LM35, RTC DS1307, dan SD-Card. Sensor suhu adalah digunakan untuk mengukur perubahan suhu dalam bilik yang tertutup. RTC digunakan untuk megesan masa walaupun mikropengawal tidak dihidupkan. SD-Card dipakaikan untuk menyimpan maklumat suhu dan menghantar maklumat tersebut dari mikropengawal ke

computerdengan bantuan pembaca kad. Akhirnya, mikropengawal berfungsi sebagai kawalan utama yang digunakan untuk mengawal system keseluruhan. Litar asas yang dibinakan dilindungi oleh perumah yang direkakan dengan solidworks mengikut dimensi yang sebenar. Perumah tersebut juga membekalkan permukaan yang senang dipegang dan kemudahan yang senang seperti pemasangan SD-Card dan penukaran bateri baru. DAQ mudah alih tersebut diletakkan dalam bilik tertutup yang dipilih untuk mengumpulkan maklumat suhu. Maklumat suhu tersebut akan dikaji dan mengesankan puncanya supaya dapat membuat penambahbaikan. Akhir sekali, sasaran penambahbaikan suhu sekeliling dalam bangunan FKE sudah dicapaikan, iaitu suhu bilik di sekitar 23 - 24°C, dimana suhu yang paling selesai untuk aktiviti harian dalam pejabat dan bilik darah.

Project Abstract

The standard temperature, 24°C is a comfort level of temperature to study, work or others activities. Therefore, all the government offices had been ordered to reduce the air-conditional temperature to a minimum 24°C for the purpose of reduces energy consumption. However, with the 24°C as air-conditional temperature setting, we found out that we are failed to achieve the desired temperature. The tolerance of the temperature change in the room is too high. Therefore, we have to investigate for the source of problem to overcome the temperature change or achieve the optimum temperature setting. In order to figure out the problem, we need to study more on the design of air flow system and collect the temperature to check whether there are leakages or other possible root causes. Besides, from the data collected, we can find out the optimum setting for the air conditioning which can provide the best room temperature. The project is to develop a portable data acquisition system to record and save the data for the temperature in FKE building to analysis. The developed portable DAQ is integrated by microcontroller PIC18f452, temperature sensor LM35, RTC DS1307, and SD-Card. The temperature sensor is used to measure the surrounding temperature in a closed room. The RTC is used for time tracking which allow functioning in power off mode. The SD-Card is used for data storage and data transfer from microcontroller to computer by the assist of card reader. Finally, microcontroller is function as main control which is used to control the overall system. The basic circuit is protected by a prototype housing which is

designed with solidworks according to the actual dimensions of the board. The designed housing also provided the features of comfort holding and friendly user for SD-Card removing and battery exchanging purposes. The developed portable DAQ is allocated at selected closed room for further improvement. From the data collected, we are able to determine the root cause for the failure of air distribution system in FKE building. Several improvements had been conducted to solve the temperature output issues. Finally, the target of improvement is achieved where the output temperature is around 23 – 24°C, which is the comfort and standard temperature for daily activities in offices and classrooms.

Chapter 1 Introduction

1.1 Project Overview

This project is about to develop a portable data acquisition system (DAQ) to record the temperature change in a close system (room). The microcontroller (C) will be use as the base system with PIC18F452 as the main controller and integrated with the temperature sensor, LM035. The PIC will be programmed to record the temperature change per minute in the room along 3 days time. The DAQ also installed with a LCD 16x2 to display the current temperature and also the real time. Furthermore, the SD-Card is included in the design as the memory support and transferring tool for the developed portable DAQ. Last but not least, with regards to the feature of portable, an external battery of 9V is added as the power source of the main circuit.

1.2 Project Objective

To develop an equipment with the ability to record the temperature changes in a room for 3 days time by using the circuit integrated with temperature sensor (LM035), microcontroller PIC 18F452, Real Time Clock (DS1307) and SD-Card.

- To find out the source of problem for the unstable temperature output in the building.
- To analyze the collected information base on the setting adjustment to achieve the optimum room temperature.
- To collect the data of measured temperature for problem analysis.

1.3 Project Scope

The device is design a portable DAQ module which able to record the room temperature in every minute. Collecting data is the main objective for the project, where problem solving for air conditional system will be carried out if there are any obvious solutions from the collected data. Besides, this experiment only use in FKE building.

1.4 Problem Statement

Recently, we had been informed that the temperature in room is frequently out of control range, where sometime it goes too high and sometime it goes too low. Therefore, we are planning to investigate for the source of problem. However, there are no support data for us to proceed with the investigation. So, a portable data acquisition system to record the temperature is designed to record the room temperature in every minute 3 days time. With the support equipment, we can use the collected data to analysis for the root cause. Currently, there are two main issues for the temperature problem including the design of the structure for air flow system and the incorrect setting for the air–conditional system.

Chapter 2 Literature Review

2.1 Introduction

This chapter will explains the source of idea for design, concept, specification and other information that related to the project. This information is obtained from the researches on the portable data acquisition system. The information is divided to two parts; first part is refers to the available DAQ in the market, these information will help to develop and improve the new design DAQ through the project; the other part stand of the survey on the components to used, which components can be improved or removed from the previous DAQ. Besides, all the theories of all components and compatible software that are used in this project will also be discussed in this chapter.

2.2 Literature Review

A literature review is to summarize on the information that related to the selected area of study. This review will roughly describe for the requirements, process and the results from the journal. From the literature review, we can reuse or enhance the design and also shorten the problem troubleshooting on hardware by referring to the previous journals. All technical issues and idea will be emphasized through this review to identify and evaluate the reliability and relevancy of this project.

2.2.1 Portable DAQ

Data Acquisition System (DAQ/DAS) is a device or equipment that uses to measure and record the real world physical conditions. For portable DAQ, the basic function is still maintained, and this equipment had been improved with the feature of mobility, an external battery source is used to replace the power supply for the whole circuit. However, there is limitation for the usage of power in battery, improvement in duration of usage is needed by consider the power consumption for every device included in the main circuit.

DAQ usually consists of multiple components such as microcontroller/microprocessor, multiplexer, sensors, RTC, LCD, and external memory. Microcontroller in DAQ acts like a brain where it controls the whole system and I/O peripherals. These components are connected to the main controller via bus connection.

The capacity of DAQ is depends on the memory used in the design. There are plenty lot of memory types in the market, memory selection is based on the amount of data stored. The data collected will be temporarily stored into the memory of DAQ, it will then transferred to computer by using the communication bus such as serial bus, parallel bus, USB bus, or SD-card etc..

For a portable DAQ, the design is important especially for the complexity, weight, size and last but not least, safety purpose. The ideal portable DAQ for most users is compact, light-weight DAQ as it can be carried to every way easily.

2.2.2 Design of DAQ

2.2.2.1 PV power station remote monitoring system data acquisition device

J.M.Xiao and the group were developed a data acquisition system to monitor and control the photovoltaic system. For the past, this system is generally needed to continuously monitoring the data shown in equipment. Therefore, a large part of the current constructions of photovoltaic power station are in the environment that is failed for long-term duty. In this design, telephone lines and RS-232 bus is use to transfer data, with the existing telephone network, remote monitoring application has replace the staff on duty in PV power station. At the same time, the man-power resources in this station are greatly reduced. The DAQ is use to monitoring the DC current, AV voltage, temperature testing, parameter collecting, real-time monitoring, remote monitoring and finally storing all the data in the PV power station. (J.M.Xiao, 2011) [1]

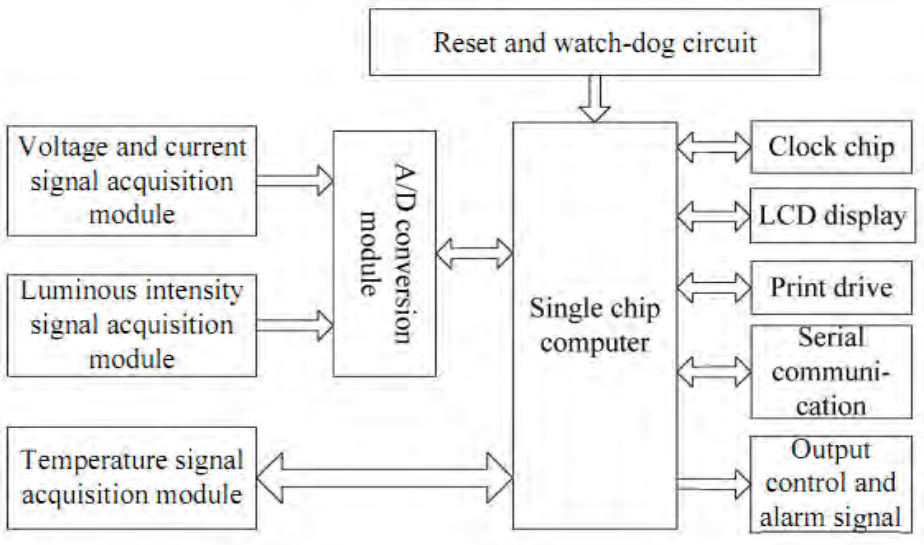

Figure 2-1 System Hardware Structure for PV DAQ

2.2.2.2 Battery-Operated Data Acquisition System

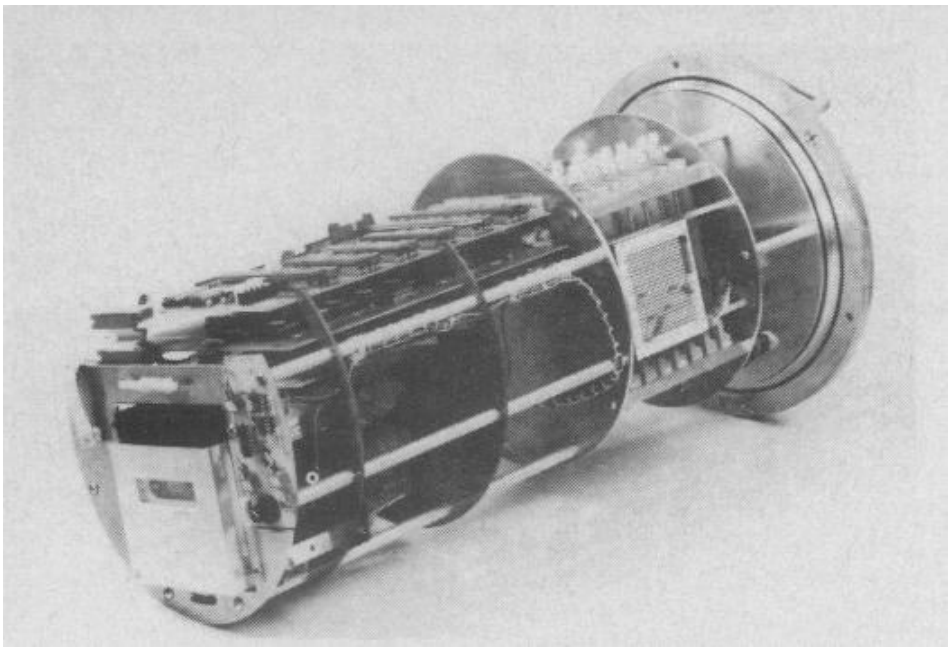

Figure 2-2 Battery-Operated DAS

R.M.Williams had developed a microprocessor-controlled data-acquisition system powered by external battery. This equipment is used to support the research programs examining the processes of material transport. The criteria required for the system included continuous function, long-term measurements, and short-term observations for high-frequency characteristics. Battery-Operated DAS is controlled by microprocessor with the advantages of minimize power consumption, support for multiple tasks, data processing and programmable device. CMOS technologies are integrated in this equipment because of the low power consumption. Besides, the DAS is equips with memory EPROM and RAM, analog multiplexer, ADC, crystal clock, and magnetic tape. (R.M.Williams, 1983)[2]

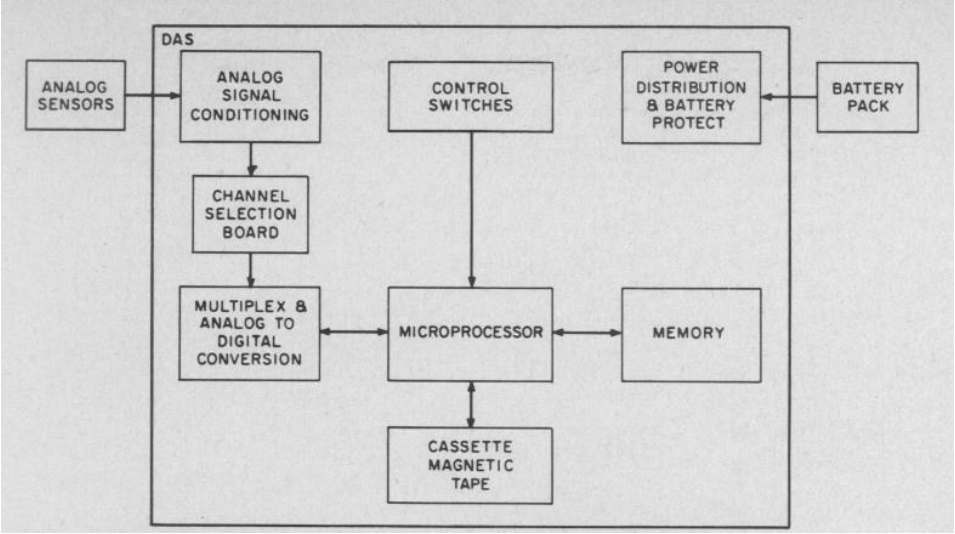

Figure 2-3 Block diagram for Battery-Operated DAS

2.2.2.3 Microcontroller-based Data Acquisition System for Solar Radiation

R.Mukaro, had invented a low-cost battery operated microcontroller-based data acquisition system to overcome the difficulty to collect the quantitative information on global solar radiation and other environmental parameters as research material. This equipment is used to monitor the solar radiation continuously and the improvement for this system is regardless of hardware changes. The device communication between the device and computer is through RS-232 serial link, recorder data is transferred to computer for subsequent analysis. The main controller used in this equipment is STT62E20 microcontroller which is driven by 8MHz crystal oscillator. The data collected is stored in a serial EEPROM before uploaded to computer. The schematic for this design is simple and run in offline mode to reduce the cost consumption and get rid of network problems. (Mukaro, 1999) [3]

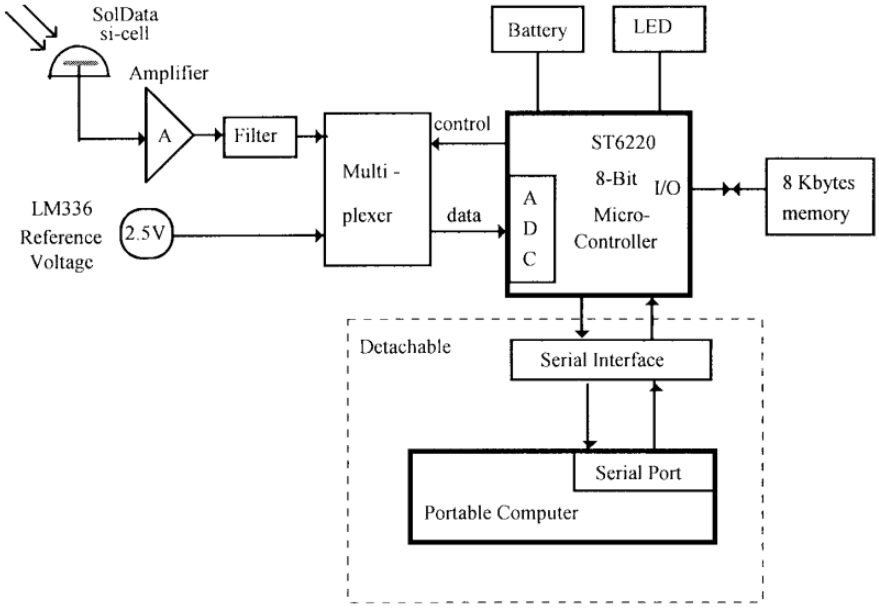

Figure 2-4 Block Diagram for Mukaro's DAS

2.2.2.4 Data Acquisition System for Capturing Dynamic Transient in Control Valve

There are also DAQ developed to predict for the effect or behavior of a system. A.Helling had constructed a mathematical function in his DAQ to capture the dynamic transients in a control valve. The dynamic mathematical model will be used in a simulator to predict the behavior of the device. Neural Networks (NN) and fuzzy logic systems (FLS) are included in this modeling. This DAQ is integrated with sensors, transducers, transmitters, process hardware and some software for data management. There are two construction methods for this system, which is internal DAQ card and external DAQ card. For external DAQ, the device is communicating through parallel port and Universal Serial Bus (USB) ports. In additional, the loop current is converted to voltage by determined the value of sense resistor. The loop receivers have an internal conversion accuracy of 0.1% and operation temperature up to 70 degree Celsius. This is an ideal device to be installed in System Control and Data Acquisition (SCADA) and Resistor Temperature Devices (RTC). (Armold Helling, 2004) [4]

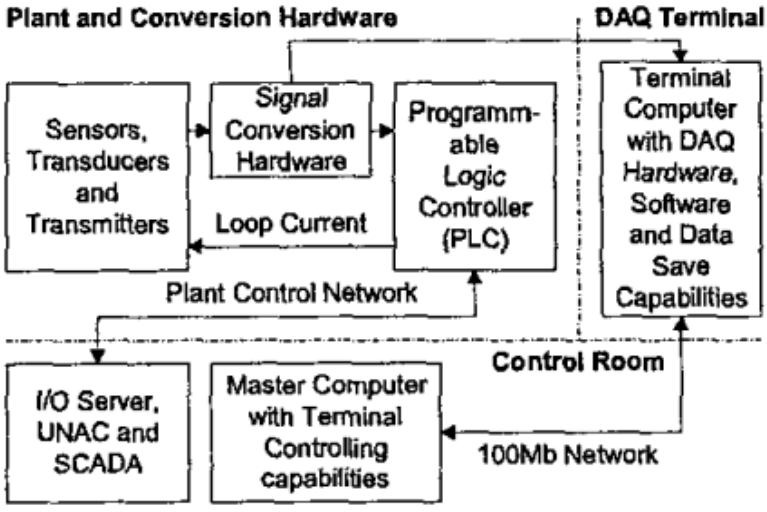

Figure 2-5 DAQ setup configuration