

## ABSTRACT

Human factor and ergonomic, (HF&E), is a practice of making the user, equipment and the environment suit one another. According to the International Ergonomics Association, it is technically defined as the scientific discipline concerned with the interactions between humans and other elements. By using the appropriate method, this information of the elements could be obtained. Acquiring the data of the elements requires a system that could capture and visualize it to the end user. Data acquisition system (DAQ) captures the real world physical condition and converts it into digital numerical value where it could be manipulated. However, obtaining the physical data for the environment is tedious at times where the data acquired must be manually keyed in from a measuring device or user must be presence using various devices. Manual extraction is also a time consuming process. Apart from that, people unable to notice the ergonomic level of their workplace when no monitoring system is present. To overcome this problem, this project is proposed by first studying on the available ergonomic parameters. Besides this, the project focuses on analyzing the available ergonomic acquisition approach technology in the market as well as developing an ergonomic acquisition platform. The chosen environmental factors are light and temperature in the laboratory. The DAQ equipment used for the project is National Instrument, NI CompactDAQ™ 9184. The graphical user interface (GUI) utilizes LabVIEW software to display the parameters. For the purpose of the study, a validation test is conducted in UTeM CIM lab. Light sensor module (SN-LIGHT-MOD) and Temperature sensor (LM 35), all of which are from Cytron Technologies are used. From the studies done, humidity, temperature, light and sound are part of an important ergonomic parameter. This project successfully provided a functioning GUI. The GUI provided ergonomic light and temperature reading in the lab. It is hope with the developed GUI, the project can be improved by expanding the parameter that could be measured by the platform and a feedback system.

## ABSTRAK

Faktor manusia dan ergonomik, (HF&E), adalah suatu praktis untuk menyesuaikan pengguna, peralatan dan persekitaran antara satu sama lain. Mengikut International Ergonomics Association, secara teknikalnya praktis ini diberi definasi sebagai disiplin saintifik yang mengambil berat interaksi antara manusia dengan elemen lain. Dengan menggunakan kaedah yang tertentu, informasi elemen ini boleh diperolehi. Memeroleh data untuk elemen memerlukan suatu sistem yang mampu menangkap dan memaparkan visual elemen tersebut kepada pengguna. Peranti perolehan data (DAQ) menangkap kondisi fizikal dunia sebenar dan menukar kondisi tersebut ke dalam bentuk angka digital di mana maklumat tersebut boleh dimanipulasi. Memeroleh data fizikal persekitaran tersebut merupakan suatu perkara yang kadangkala melecehkan di mana data perlu dimasukkan secara manual ke dalam peranti pengukur. Di samping itu, orang ramai tidak sedar akan tahap ergonomik di tempat kerja apabila tiada sistem pemantau diwujudkan. Bagi mengatasi masalah tersebut, projek ini diusulkan dan langkah pertama adalah untuk mengkaji parameter yang wujud di dalam persekitaran ergonomik. Selain daripada itu, projek ini memberi perhatian dalam mengkaji pendekatan yang digunakan oleh alat peranti yang terdapat di pasaran dan juga mereka bentuk suatu platform alat peranti perolehan ergonomik. Faktor persekitaran yang telah dipilih bagi projek ini adalah kelembapan, pencahayaan, bunyi dan suhu di dalam makmal. Alatan DAQ yang digunakan untuk projek ini adalah National Instrument, NI CompactDAQ™9184. Perisian LabVIEW digunakan untuk memaparkan parameter di dalam antara muka pengguna grafik (GUI). Bagi tujuan kajian, projek ini di jalankan di UTeM CIM lab. Module sensor cahaya (SN-LIGHT-MOD) dan sensor suhu (LM 35) daripada Cytron Technologies digunakan. Projek ini berjaya menghasilkan sebuah GUI yang berfungsi. GUI ini telah dapat memberi bacaan bagi cahaya dan juga suhu.

## **DEDICATION**

To my beloved parents, my father Abdullah bin Yusof and my mother Aminah binti Mahran whom have given undivided love and support.

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## ABBREVIATION

|      |   |   |
|------|---|---|
| HF&E | - | Human Factor and Ergonomics                 |
| DAQ  | - | Data Acquisition                            |
| COM  | - | Common terminal                             |
| COG  | - | Centre of gravity                           |
| VDU  | - | Visual display unit                         |
| %RH  | - | Relative humidity                           |
| CCM  | - | Cycling chilled mirror dew point hygrometer |

# CHAPTER 1

## INTRODUCTION

This chapter gives the introduction on the subject of the project. A general overview on the field of study for this project.

### 1.1 Background

Human factor and ergonomic, (HF&E), is a practice of making the user, equipment and the environment suit one another. HF&E is also known as comfort design, user-friendly design and functional design. It is common not to place a degree HF&E to a design unless there is a need to do so. Sometimes good design are unnoticed (with an exception for a brilliant design) but a poor design could be spot much easily. According to the International Ergonomics Association is technically defined as the scientific discipline concerned with the interactions between humans and other elements. Further definition defines it as a profession that applies theory, principles, data and methods to design in order to optimize human wellbeing and overall system performance.

HF&E is generally separated into 3 major groups. Physical ergonomics, cognitive ergonomics and organizational ergonomics. Physical ergonomics deals with the human physiology, anatomical, health and safety. Cognitive ergonomics focus on the human mental ability such as memory, perception, motor skill and reasoning. This abilities affects how human interact with the elements around them. Organizational ergonomics is the field where optimize sociotechnical system, policies and process are prioritize. Satisfying all of these major groups would result in an optimized working environment. The degree of ergonomics level in general ranges from how the work

should be done to how you should seat on a chair. Ergonomics studies involve taking data on factors that would allow a person to stay focus in his job in his current working condition. For example working in the office involves taking into account the type of chair, the sitting position, the distance from the computer and the footrest. Generally speaking it takes account the details big or small that would contribute to the sustainable or increasing efficiency of the human working condition. Among the details that contribute to ergonomic condition, the environment have an impact on human capabilities to work. This study for environment ergonomic is important as the environment as a whole have to be altered or manipulated to fit the needs for efficient condition.

Hence this is where the job of attaining information on the environment is crucial. By using a data acquisition system, DAQ, the real world physical condition could be convert into digital numerical value where it could be manipulated. Usually DAQ convert analogue value into digital analogue for processing. It is a process of measuring an electrical or physical phenomenon such as voltage, temperature, sound or humidity with a computer. It has 3 basic component, which are the sensors to detect physical condition, DAQ measurement hardware, and a computer with a programmable hardware. With the help of PC-based DAQ system, processing power, productivity, display and connectivity capabilities could be used to provide a more flexible, powerful and cost-effective measurement solution.

Obtaining the necessary data for the system could be an inconvenience sometimes as the reading have to be manually keyed into the system. This project is proposed to help make the task of obtaining the relevant data easier through automatic acquisition. The project will use NI CompactDAQ as the data acquisition platform.

## **1.2 Problem Statement**

Obtaining data for the environment is a tedious process where the data acquired is manually keyed in by taking reading from a measuring device in order to get an



ergonomic information. Apart from that the acquisition requires several devices and user have to be present during the acquisition. Manual extraction is not only tedious but also a time consuming process. People are unable to notice the ergonomic level of their workplace when no monitoring system is present. An automated data acquisition platform that uses a PC-based DAQ can provide the solution.

### **1.3 Objectives**

The objectives of the project are as follows:

- i. To identify the available ergonomic parameters.
- ii. To analyse the available ergonomic acquisition approach technology in the market.
- iii. To design and develop the ergonomic acquisition platform.

### **1.4 Scope**

In order to achieve the objectives, there are still certain limitation to just how wide the breadth of the project goes. The scope of the project are:

- i. While there are various factors in ergonomics, the project focus on the environment factors specifically on light and temperature in the laboratory.
- ii. The data acquisition (DAQ) equipment used in the project is the NI CompactDAQ™-9184, National Instrument.
- iii. This project will utilize the LabVIEW software for acquiring the parameters.
- iv. The setup of this project is on a laboratory scale where it will be implemented in UTeM CIM lab.

## **1.5 Organization**

This report is organized as follows:

Chapter 1 discuss on background of ergonomics, the problem statement, objectives, scope and how the project is organize to give an overhead view of the project.

Chapter 2 discusses on research that have been done regarding the topic of ergonomics, methods of conduct, implementation of the concept and equipment used for collecting information on ergonomics parameter.

Chapter 3 describes the methodology including the overall flow chart and also Gantt chart for the project plan.

Chapter 4 will find details on acquired performance test, system development from designing phase up till implementation of DAQ platform on a laboratory set up environment.

Chapter 5 summarizes the entire project and gives the conclusion based on the experiment that will be conducted either it was a success and were the objectives met or failed. Apart from that, improvement for this project for the future will also be discussed in this chapter.

## **CHAPTER 2**

### **LITERATURE REVIEW**

Chapter 2 shows the literature that is used as the reference for the project. The information are based on the relevancy with the proposed project. The literature review is taken from journal, article, books and online resources.

#### **2.1 Data acquisition system**

Development on science and technology has showed the embedded computer technology is an important part of computer field is related with people's lives and has received major interest in the area of research and as well as application. Data acquisition (DAQ) is a type of instrumentation system or devices united by some form of regular interaction of an interdependence (A course in electrical and electronic measurements and instrumentation, 2001). This group of devices operate in unison according to a form of control. Data acquisition, which is an important branch of computer applications, is an integrated application of technology, based on sensors, signal measurement, data processing end embedded systems (Wang Jiannong, 2011).

Data acquisition has become widely used in the field of industrial automation and also scientific research where the actual performance of data acquisition system becomes the key that decides the performance of production line and the quality of the output. It is vital to understand the significance of data acquisition system and the characteristics of the device itself by testing the actual environment.

DAQ not only can discover the problems and hidden dangers of the actual data acquisition but also can provide test data and theoretical basis for improving the design of system (Liu Jialei, 2010). Traditional performance quantitative methods of data acquisition system are as follow (S Chilingaryan, 2009): standard voltage is generated by signal generator, and then this signal is acquired by ground test equipment and

software, the signal is compared by hand, repeat experiment obtains the effective accuracy of data acquisition.

Today, signal are able to be detected by using various devices. For example, analogue signal are used in communication and even medical. With rapid development in the circuitry industry, complex circuits are now able to be operated with greater accuracy and ease by using digital conversion DAQ at a relatively lower cost. The system in DAQ consist of:

1. Analogue system. This system handles information in analogue form. Analogue signals are a continuous function. Example is a plot of voltage against time.
2. Digital system. A digital quantity consist of discrete or discontinuous pulses where the time relationship contains information about the magnitude and nature of the measured entity.

### 2.1.1 Analogue DAQ

There are two ways that data acquisition measures and record analogue signals:

- Signals which originate from measurement of electrical quantities. This can be in the form of a.c. or d.c. voltages, frequency or resistance.
- Signals from the use of transducers.

The analogue signal would undergo a signal conditioning where amplification would take place and a multiplexer is used which acts as a switching device to allow the input to be sampled. An analogue data-acquisition system consist some or all of the following elements:

- **Transducers.** It is desirable that the an emf, obtained would be proportional to the quantity being measured which acts an input to the DAQ

- **Signal Conditioning Equipment.** This includes any equipment that assists in transforming the transducers output to the required magnitude or form necessary to the DAQ. This includes signal amplifying, refining or selecting certain position of the signals.
- **Multiplexer.** The term multiplexing is used in the process of sharing a single channel with more than one output. A multiplexer accepts multiple analogue inputs and connects them sequentially to one measuring input. This is done either by sharing time or frequency of the transmission between the individual quantities.
- **Calibrating Equipment.**
- **Integrating Equipment.** It is often that the integral of summation of a quantity is to be determined. There is a method involving the use of an analogue integrating circuit. Another method is the utilization emf from the conditioning equipment placed to a saturable core reactor in the resonant circuit of an oscillator.
- **Visual Display Devices.** Visual aid is required for continuous monitoring of the input signals.
- **Analog Recorders.**
- **Analog Computers.** Transducers and sensors data can be recorded and also reduced to desired form.
- **High Speed Cameras and TV Equipment.** For cases where the test operators are unable to view the equipment being tested, closed circuit TV are used and sometimes the application of high speed cameras for a complete visual record.

### 2.1.2 Digital DAQ

Digital Data acquisition system include some or all of the following components:

- **Transducers.** This allows the conversion of physical quantity into an electrical signal.
- **Signal Conditioning Equipment.**
- **Multiplexer.**

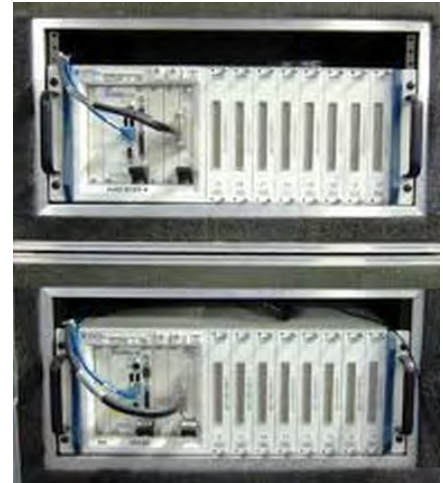
- **Signal Converter.**
- **Analogue to Digital Converter (A/D Converter).** An A/D converter converts an analogue voltage to its equivalent digital form. This allows the output to be display or recorded in a digital recorder. The data could be fed to digital computer for data reduction and processing. ADC operation are defined with a few parameters
  - *N Bits* - Defines how many binary bits represent the analog digital output.
  - *V<sub>min</sub>* - The minimum analog voltage to be converted to digital output.
  - *V<sub>max</sub>* - The maximum analog voltage to be converted to digital output.

It essentially divides the analog range ( $V_{min}$  to  $V_{max}$ ) into  $2^N$  levels. Each level has a corresponding digital value from 0 to  $2^N - 1$ . The ADC takes input voltage, finds the closest discrete analog level and assigns the corresponding digital count to the ADC output.

- **Auxiliary Equipment.** This includes devices use for system programming functions and digital data of signals.
- **Digital Recorders.**
- **Digital Printers.** This device allows for high quality of hard copy of records and reduce minimize the labour cost by interfacing the printer with an electronic instrumentation system.

### 2.1.3 DAQ Models

Data acquisition research that has been conducted along the years such from applied vehicle network-based, to wireless remote data acquisition system for mobile application, design of on-line interactive data acquisition and control system for embedded real time application, and even development of low cost data acquisition system for space shuttle solid rocket booster program. Various model of DAQ system have emerge from the growing prospect in application of DAQ. Figure 2.1 shows the DAQ platform examples.



**Figure 2.1** : DAQ platforms

### 2.1.3.1 National Instrument (NI)



**Figure 2.2** : National Instrument (National Instrument, 2014)

#### (a) Introduction

National instruments have been founded in 1976. Just last year in 2013, its annual revenue was \$1.17B. The company operates in nearly 50 countries. The cooperation between engineers and scientist has allowed NI to come up with various products to market and overcome difficult technological roadblocks.

#### (b) DAQ characteristics

NI is capable of providing flexible but powerful technology solutions for daily task to complicated research challenges. This expands nearly to every industry, from healthcare and automotive consumer to electronics and particle physics (NI website). NI has started its operation in the ASEAN country where it first set its base in Singapore in 1994. The company has successfully expanded to the neighbouring

ASEAN country such as Malaysia, Thailand, Philippines and Vietnam. National Instrument provides software such as NI LabVIEW and modular cost-effective hardware. Below are samples of NI DAQ devices:

➤ **Low-Channel-Count, Single DAQ Devices**



**Figure 2.3:** Low-Channel-Count, Single DAQ Devices  
(National Instrument, 2014)

The buses include USB, Ethernet, PCI, PCI Express, and WiFi.

➤ **Medium-Channel-Count, Modular DAQ Systems**



**Figure 2.4 :** Medium-Channel-Count, Modular DAQ Systems  
(National Instrument, 2014)

Includes in portable form and includes direct sensor connectivity. Available on USB, Ethernet, and WiFi as well as with stand-alone options.