

## **A REAL-TIME DATA ACQUISITION APPORACH OF ENVIROMENTAL ERGONOMIC PARAMETER USING LabVIEW**

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### **Abstract**

A safe and comfort workstation can increase the performances of the worker. Environment parameter is one of the factor that need to be monitor and display to create a safe and comfort work station. An acquisition system that can monitored and display these environment parameter need to be developed. In this paper, an acquisition system is developed to monitored and display three environment parameter which is sound, light and temperature. An acquisition system consists of sensor, data acquisition (DAQ), power supply board, computer and LabVIEW. Sensor will captured the environment parameter then DAQ convert the signal gained from sensor into computer. All the data from sensor and DAQ then will be program by using LabVIEW. An acquisition system has been test and able to captured all three environment data and test is conducted in the lab scale. It is hoped that with this acquisition system, a safe and comfort workstation can be provided to a worker and eventually can

increase workers performance and decrease worker's medical cost due to low accident and health problem among workers.

Keywords: Ergonomics, RULA, Risk factor, Mining.

### **Abbreviations**

DAQ	Data Acquisition
MSD	Musculoskeletal DIorder
RULA	Rapid Upper Limb Assessment
LabVIEW	Laboratory Virtual Instrument Engineering Work Bench

### **1. Introduction**

There are several factors that can boost company profit and workers performance is one of that factors. Thus, workers' performance is often been monitored by employer. Even though the employer monitored workers performance, but most of employer cannot identify the factor that can increase their workers performances. A safe and comfort workstation is one of the factor that affect workers performance. With a safe and comfort workplace, a worker can perform well in their work thus give benefit to employer [1]. But most employers unaware that they give an excessive stress to their worker thus decrease worker performance. Mainly, there are several causes of stress in workstation, which are physical environment, work organization and physico-social. Indoor air quality, noise, vibration, room temperature, inadequate lighting, excessive standing, poor seating, repetitive movement is example of physical environment [2]. The objective of this paper is to show the framework of development real-time data acquisition approach of environment ergonomic parameter using LabVIEW. Sound, lighting and temperature are the physical environment parameter proposed to be monitored and display by developed acquisition system. These physical environments are captured by specific sensor, and then acquisition system will display it through computer. With the display of the physical environment, workers are aware about their health condition and eventually create a safe and comfortable workstation. Thus, a system that can monitor and display this physical environment need to be developed to promote a safe and comfort workplace.

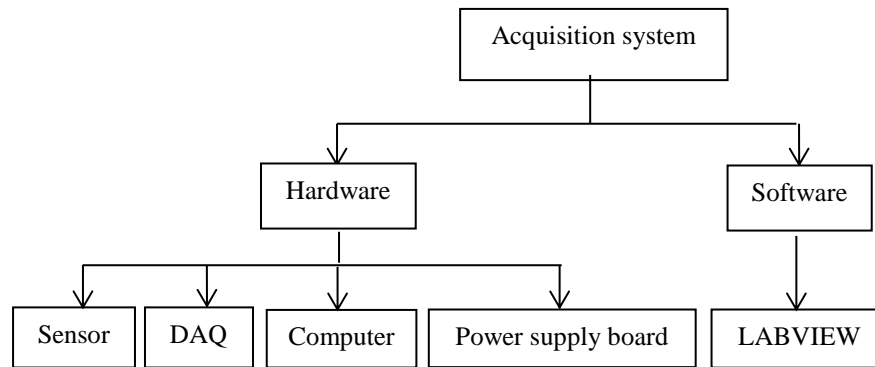
### **2. Overview of the Monitoring System**

Monitoring system has been used to monitor various type of parameter and has been applied to many fields such as in medical, power grid, agriculture, vehicle driver, meteorology and many other fields. [3-7]. But there is a few system that been developed to monitored environment parameter in workplace. There is a developed system that monitors and measure light intensity. This system is measure the light intensity in room so electricity can be used efficiently [8]. There is also system that use temperature sensor to monitor a room temperature in rabbit cage [9]. Since temperature is a critical parameter in certain industry, researcher also tries to develop a low cost temperature monitoring system. These low cost monitoring systems build by using AVR ATmega8 as a controller and compare three different sensors to test their sensitivity, range, durability and error [10]. These show that there is no single developed acquisition system that can capture

more than one environment parameter by using just a single system. It is crucial to monitor environment parameter because environment parameter gives significant impact to workers performance. Thus an initial step is currently undertaking to create an acquisition system to monitored and display all the environment parameter.

### 3. Data Acquisition Approach

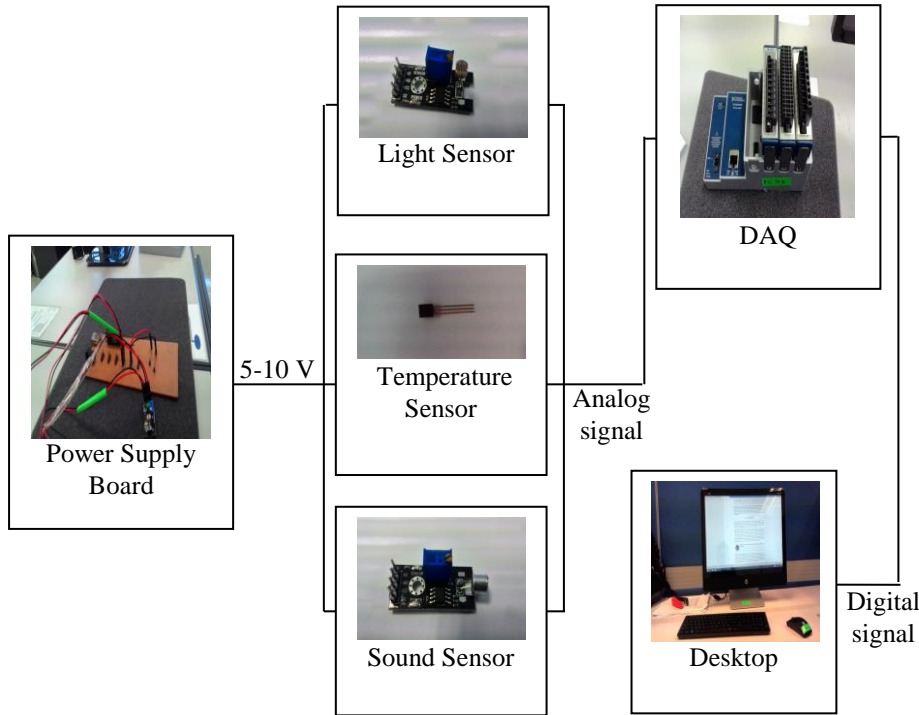
The proposed acquisition system used to measure and monitored the environment parameter. The acquisition system divided into software and hardware as show in figure 1



**Fig. 1. Component of acquisition system**

Hardware consists of equipment and electronic devices while software is more to computer program and information processor by using computer. Sensor, data acquisition (DAQ) and computer or laptop is the hardware of the acquisition system and LABVIEW is software of the acquisition system. Every hardware and software has its own role. Each of equipment and software is interdependent with each other to ensure acquisition system achieve its objective. In the previous paper, the framework of the acquisition system has been proposed. Based on that framework, the current acquisition system is developed [11]. The current acquisition system will measure the environment parameter by using sensor. The environment parameter will be measured is noise, lighting and room temperature. Each environment parameter will be captured by specific sensor. Signal expected come out from sensor is in analog signal but computer can read digital signal only. To convert signal from analog signal to digital signal, converter is required. Converter proposed to be used is data acquisition (DAQ). A NI cDAQ-9188 is the model of the proposed DAQ that will be used for the acquisition system. For the programming, proposed software is a LABVIEW 2014.

**Hardware.** Hardware of the system consists of several device and equipment. Each of the hardware devices and equipment has its function. Sensor is used to capture the environment parameter, DAQ used to convert signal and computer as a display device. In order for the system to achieve its objective, each of hardware devices needs to be connected as shown in figure 2

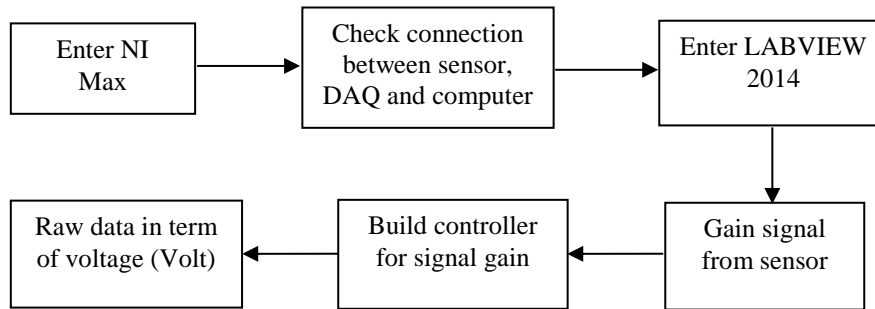


**Fig. 2. Hardware setup**

First, connect sensor with power supply board. Sensor can received only 5 to 10 V. If sensor received above 10V, the sensor will be damage. Voltage from wall plug is 240V, so power supply board will lower the voltage to around 5 to 10 V. Then, sensor connected to DAQ. DAQ has multiple pin that can be connected. Choose one pin to be connected with sensor. DAQ will convert the analog signal to digital signal since desktop and laptop only can read digital signal. DAQ then connected to desktop by using internet cable. Digital signal that come out from DAQ will be read by desktop through an internet cable as an Ethernet connection.

**Software.** Software is a part of the system where the programming processes take place. For this system, the software proposed is LABVIEW 2014. LABVIEW 2014 is the one of the latest software developed by National Instrument (NI).

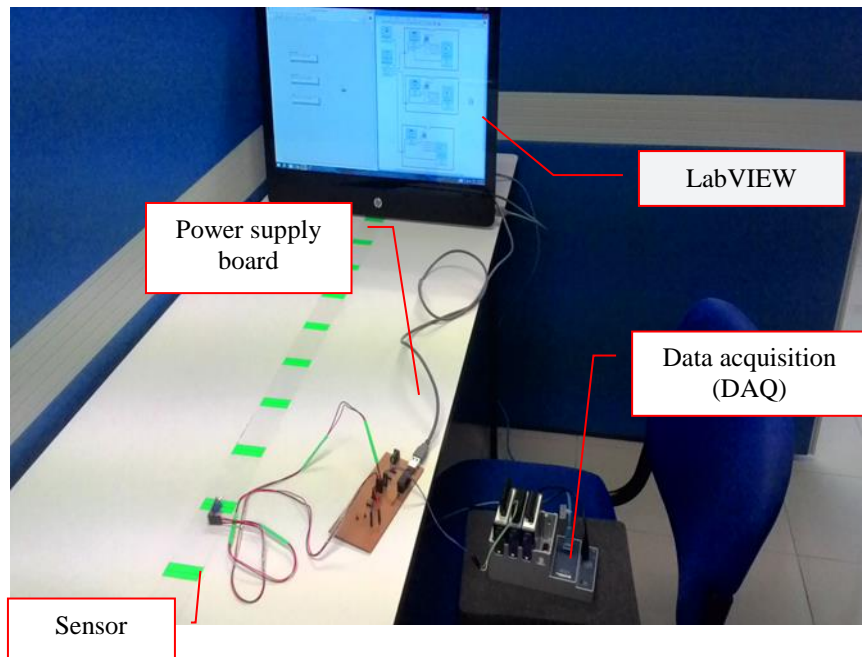
**Programming.** Programming of this system is done by using LABVIEW 2014 and NI Max. Connection between sensor, DAQ and computer is check through NI Max and the LABVIEW 2014 used to display and processes the signal gain from sensor. Step of the programming is shown in figure 3



**Fig. 3. Programming step**

Firstly is to check the connection between sensor, DAQ and computer by using NI Max. In NI Max, click on reserve chasis to connect DAQ with computer then run a self testing to show the connection between sensors and DAQ. Then enter LABVIEW 2014 and gain signal from sensor. Signal from sensor is gained through a DAQ Assist in Block Diagram. Signal come out from DAQ Assist is in term of voltage. Then controller is build to filter the signal gain from sensor and also to eliminate the unnecessary element in the signal. Finally, the result that came out from the controller then is display in voltage.

**Full Setup.** After the hardware and the software setup has been finalize, the next step is to full setup the acquisition system. In the full setup of the acquisition system, the hardware and software will complement each other to enable the acquisition system to display the environment parameter. Figure 4 show the final and full setup of the acquisition system.



**Fig. 4. Full setup of the acquisition**

**4. Result and Discussion**

An experiment was conducted to obtain the raw data and result. Each of environment parameter has a different procedure, but done in at a same place. An experiment is done in a controlled environment where certain element is manipulated and controlled.

**Temperature.** For the temperature, the experiment is conduct by manipulated the number of air condition and controlled the period of time between number of air condition. The period of time is set to be 1 hour. Table 1 show the raw data obtain from the experiment.

**Table 1 Raw data for temperature**

No Of Air Condition	Voltage ( V )						Average
0	0.300214	0.300281	0.300311	0.300263	0.30024	0.300262	
1	0.297395	0.297376	0.297342	0.297363	0.29743	0.297381	
2	0.243926	0.243913	0.243861	0.243864	0.243952	0.243903	
3	0.226753	0.226554	0.226755	0.22657	0.226602	0.226647	

From table above, it show that the voltage decreases when number of air condition is increase. When the temperature is decrease, the resistance produce by temperature sensor is increase thus lower the output voltage.

**Lighting.** Experiment for lighting is conduct on three different sessions which is on morning, afternoon and evening. Number of lamp is manipulative element in this experiment and control element is time period between sessions. Time period between sessions is set to every 4 hour. Table 2 shows the data obtain the experiment.

**Table 2 Raw data for lighting**

Session / number of lamp	Sensor output (Volt)		
	Morning	Afternoon	Evening
0	4.2470658	4.24742	4.004525
4	4.2264116	4.223384	3.970979
8	4.1771152	4.198694	3.9461276
12	4.1566072	4.168484	3.9208194
16	4.127551	4.143006	3.8845254
20	4.1204486	4.117726	3.8774938

From table above, as the number of lamp increase, output voltage is decreasing. Also voltage on morning and afternoon is almost similar, but at evening, the output voltage is much lower compare to morning and evening.

**Sound.** In experiment to gain a raw data for sound, a speaker is used as a sound source. Number of speaker and sound volume is a controlled element and manipulated the distance between the speaker and the sensor. Number of speaker

used is two speakers and sound volume is set at 50 percent. Raw data is recorded at every 10cm from the sound source. Table 3 show the raw data obtain from experiment.

**Table 3 Raw data for sound**

Distance (cm)	Sensor output (Volt)	
	One speaker	Two speaker
10	3.6794	3.65404
20	4.24621	4.15159
30	4.58559	4.67503
40	4.85627	4.85372
50	4.86652	4.95722
60	4.96300	5.09138
70	5.06074	4.95861
80	4.98901	4.90118
90	4.89867	4.91658
100	4.98403	5.00009

From table above, as the distance between sensors increasing, output voltage also increasing. But when the distance reached 70cm, the output voltage remains consistence without any significant changes. By using one speaker and two speakers does not give any different as the voltage output almost the same.

### 5. Further Work

The current acquisition system is underdevelopments because there are some part of the acquisition system currently still has room for improvement. Firstly, additional measuring parameter will be added to the acquisition system. Apart from current environment parameter, humidity and worker body posture also need to be monitor by acquisition system. Secondly, the data obtained from each sensor also will be display in SI unit. The sensor output which in voltage will convert to SI unit by using mathematical formula. Each parameter has specific formula to convert from voltage to SI unit. After that, software that will show all the data in SI unit will be developed. Finally, the acquisition system will undergo an evaluation. To evaluate the acquisition system, a comparison between acquisition system and conventional method will be done. By comparing the acquisition system and conventional method, a percentage error and accuracy of the acquisition system can be measured.

### 6. Conclusion

An acquisition system that can capture and display the environment parameter has been developed. Lighting, sound and temperature are the environment parameter that can be monitored by developed acquisition system. The setups of acquisition system consist of hardware and software and constructed as shown in figure 5. With the developed acquisition system, a safe and comfort workstation can be provided thus boost the worker performance. A safe and comfort workstation also

benefit employer. With a safe workstation can reduce worker's medical cost due to low accident and health problem among workers.

#### **ACKNOWLEDGEMENTS**

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