Tele Measurement and Recording of CO Concentration, Temperature and Humidity for Hazardous Area

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Abstract

The hazardous area is an area that is very dangerous for humans to enter. Besides, the area should be monitored and controlled. This paper is only devoted to the types of hazards caused by carbon monoxide (CO) gas, temperature and humidity. For this aim, in this paper a tele measurement and monitoring system has been design and fabricated. This system able to measure and send the data to terminal point or monitoring point wirelessly. This system is equipped with three sensors for measuring the three parameters which indicate dangerous conditions of an area. There are the concentration of CO gas, temperature and humidity which are measured using a CO sensor, a temperature sensor and a humidity sensor respectively. The recorded data in the measuring terminal will send to the monitoring terminal using Radio Frequency (RF) communication system. For visualization of the recorded data, the Graphical User Interface (GUI) is developed. Based on the experimental test, the developed system is functioning well and able to perform the tele measurement process for CO concentration, moisture and temperature.

Keywords: Hazardous Area, Tele Measurement, Wireless, Graphical User Interface (GUI)

1. Introduction

Air pollutant is a substance in the air that can have adverse effects on humans and the ecosystem. The substance can be solid particles, liquid droplets or gases. A pollutant may be of natural

origin or man-made. Pollutants are usually produced from a process, such ash from a volcanic eruption and soot from motor vehicle exhaust which contains of carbon monoxide (CO) gas [1,2]. Based on report by the World Health Organization (WHO), air pollution can affect human body organs and systems, including heart disease, lung cancer, pneumonia, difficulty in breathing and coughing due to aggravated asthma [3,4]. Apart from that, Malaysia is suffering from haze situation almost every year. An effective precaution step needs to be taken before the situation becomes worse.

This paper presents an Automatic Tele Measurement [5-7] and Recording of CO concentration [8,9], Temperature and Humidity; which can give an early warning if the air quality in the area being observed is potentially unhealthy for outdoor activities. Data transmission from an exposed area of the base station is done using Radio Frequency (RF) module [7], which does not require an Internet connection and a cellular network. The regularly recorded data is displayed using a graphic user interface (GUI) on a remote monitor, allowing us to monitor the potentially harmful area from the safe area.

2. Methodology

The tele measuring system developed in this paper consists of hardware and software part. The system architecture based on each components function is shown in Figure 1.

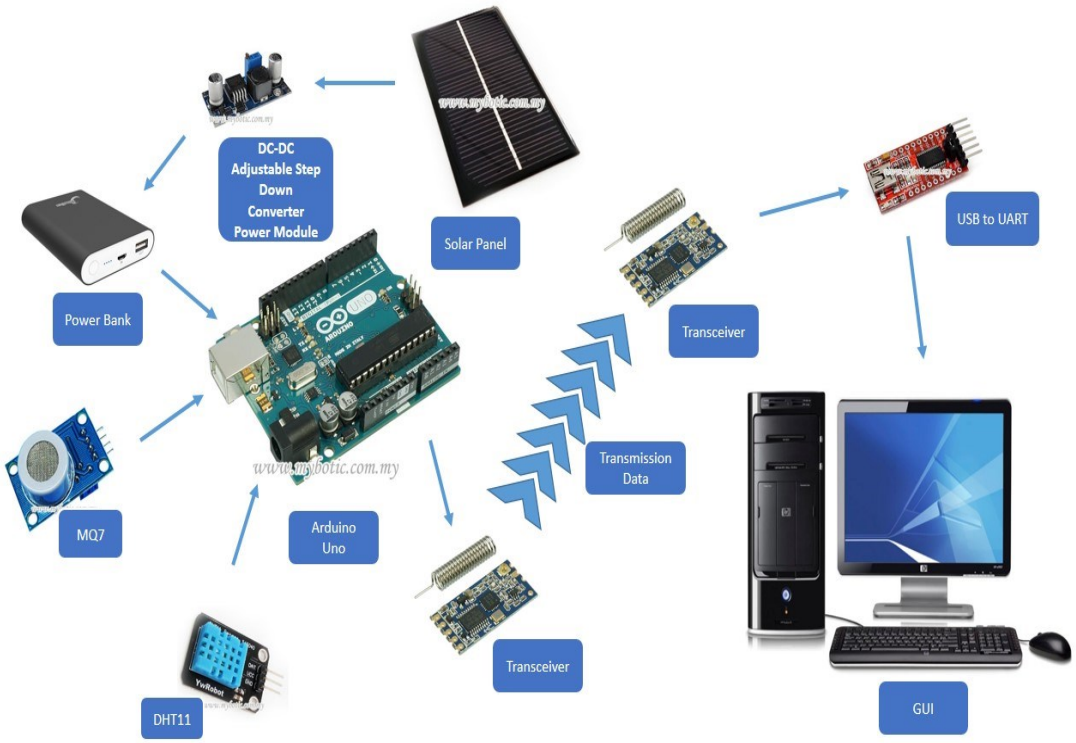


Figure 1. System architecture based on each components function

The system is equipped with several sensors that are CO concentration sensor, temperature sensor and humidity sensor of the surrounding area to be transferred to the Arduino UNO microcontroller. Arduino UNO processes the data received and transmits them to the RF transmitter. The RF receiver reads the value received from the remotely located RF transmitter and displays it on a computer monitor as an output, using the GUI.

The software programmed on this system functions like a human nerve system that will receive information and send commands to each section for a specific purpose, according to the input received. In order to start the programming, the flowchart is developed to provide a general idea on how the programmed system works. The system should read analog data from CO sensor (SN MQ-7 sensor) [9], temperature and humidity sensors (DHT11 sensor) [10]. Each of sensors will calibrate first in order to correct the accumulated error at the sensor output.

After calibration, the data will be transmitted from the RF Transceiver module to another RF Transceiver which is connected to the PC. These data are displayed on serial monitor and GUI. ChibiOS is a real-time operating system which is used to enable multitasking in the software development. Figure 2 shows the programming flow chart for division of thread.

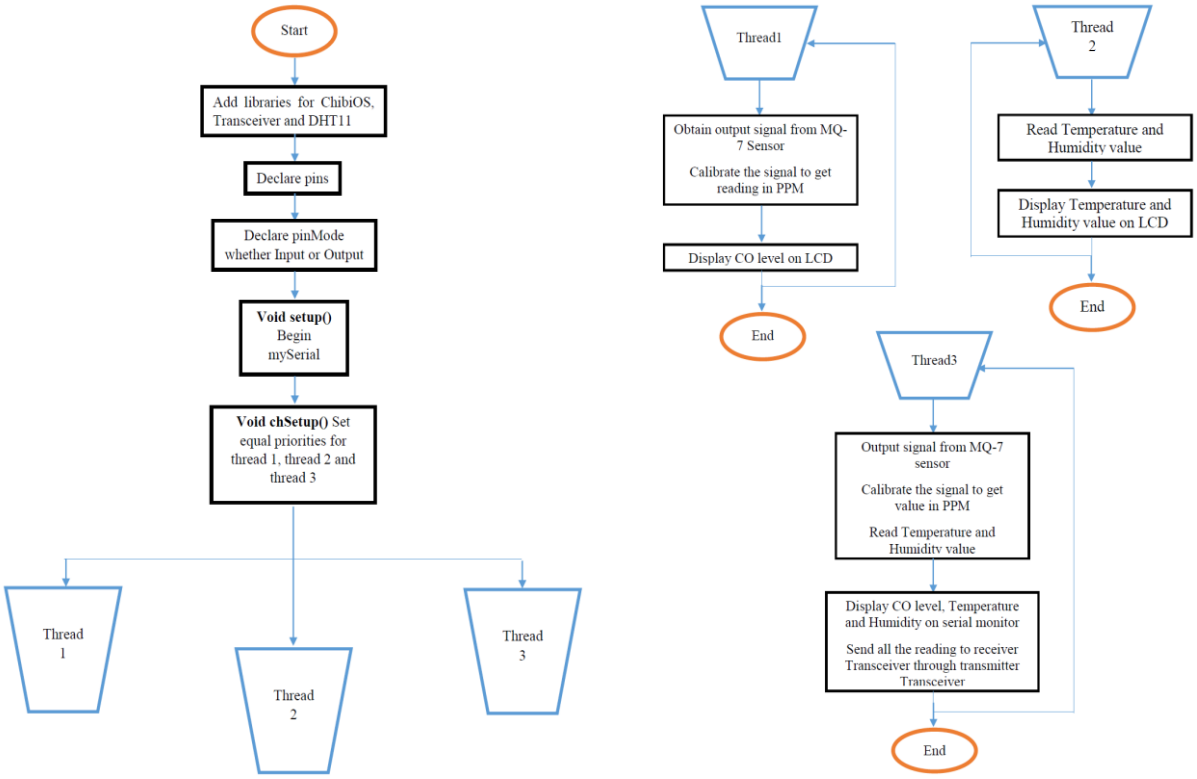


Figure 2. Programming flowchart for division of thread.

The tele measurement system developed consist of two station, first processing station (receiver) where the data are received and processed and the second is the measuring station (transmitter) where the sensors are installed for measuring the data and sending to receiver [5-7]. Communication between two stations or terminals are done using RF system. The hardware components used for this project are listed in detail in Table 1.

Table 1. Hardware components

COMPONENT	MODEL	UNIT(S)
Arduino	Arduino Uno R3	1
Carbon Monoxide Sensor	SN-MQ7	1
DHT11 sensor	MR003-005.1	1
Transceiver Module 1km	RF UART	2
USB TO UART Converter	FTDI232	1
Solar Panel	SC-9V-330mA	1
DC-DC Adjustable Step Down Converter Power Module	IC LM2596T	1

Figure 3 and 4 show the measuring terminal and processing terminal respectively.

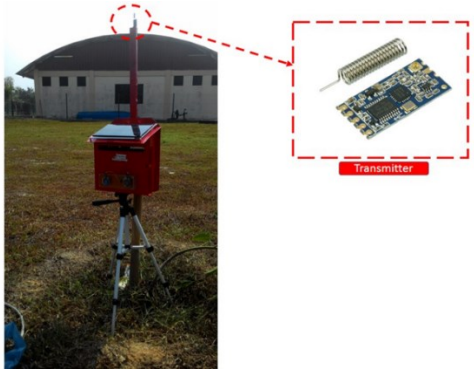


Figure 3. Measuring terminal

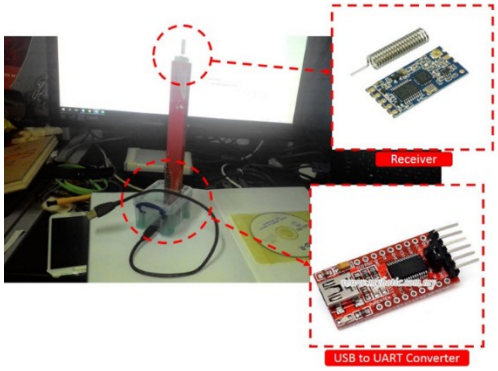
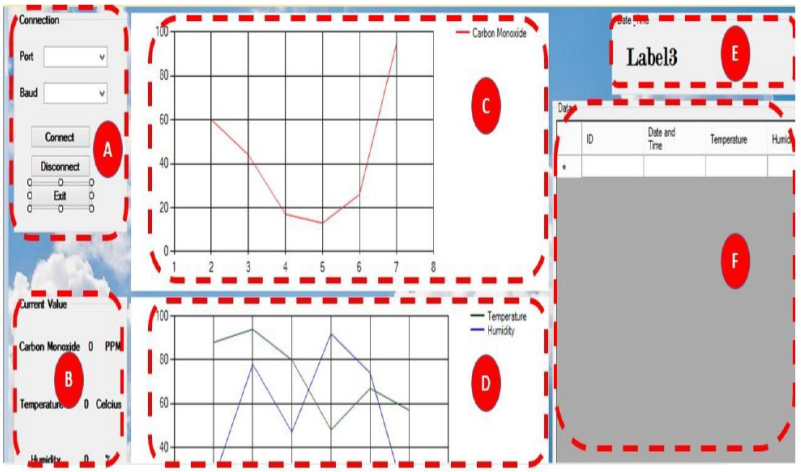


Figure 4. Processing terminal

The GUI is developed using Visual Basic Software by first dragging the features required and then altering the codes of each features by using code view option. The Figure 5 below illustrates the completed GUI.



A = Shows the status of the communication port and baud rate selector
B = Current Values of the temperature, humidity and carbon monoxide
C = Graph of the carbon monoxide
D = Graph of the Temperature and Humidity
E = Time and Date
F = Data logging

Figure 5. Graphic User Interface Application

3. Result

Tests have been done in the central campus of UTHM. The process terminal is installed in Faculty of Civil and Environmental Engineering (FKAAS) building, while the measuring terminal the first is installed around Research Management Center (RMC) building and the second is in around library area as shown in Figure 6.

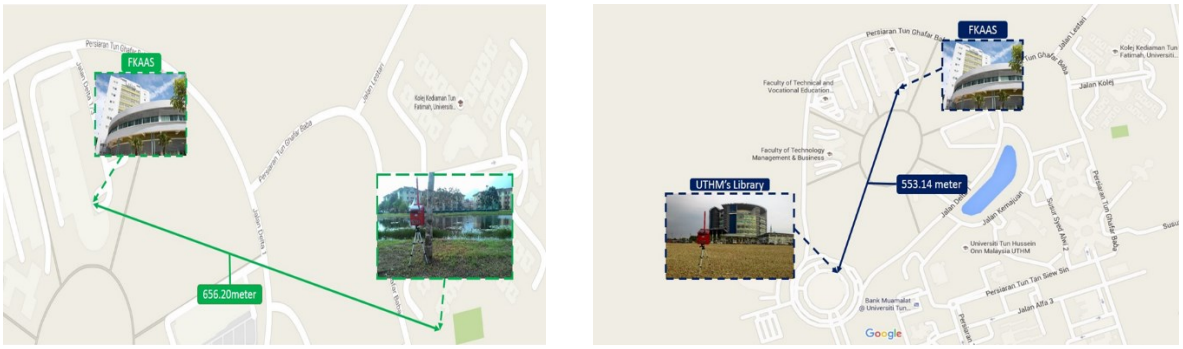


Figure 6. (a) The measuring terminal around RMC building, (b) The measuring terminal around library area

The test data recorded for each of measuring point are shown in the following figure.

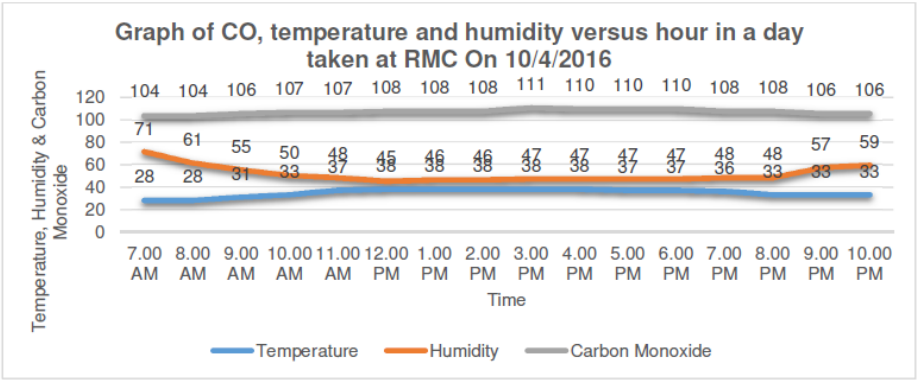


Figure 7. Graph of CO, temperature and humidity versus hour in a day taken at RMC.

Based on Figure 7 above, the developed device demonstrated the recorded on the April 10, 2016 from 7:00 am to 10:00 pm with a distance of 656.20 m from FKAAS building. An average reading of the CO observed is 107 parts per million (ppm) with a maximum reading is 111 ppm and minimum reading is 104 ppm in the morning. The maximum reading of CO above is obtained at three different locations read from 1:00 pm to 3:00 pm. This may be due to smoke produce by the wood factory that produces smoke from the combustion actively. The minimum reading of CO was usually read in the morning and at night. This is due to the less combustion activity.

The maximum humidity obtained is 75% at 7:00 am while the minimum reading obtained is 33% at 6:00 pm. The average reading of the humidity is approximately 43%. The lower humidity reading is approximately 33% to 35% at 11:00 am to 5:00 pm, the temperature is between 35˚C to 38˚C.

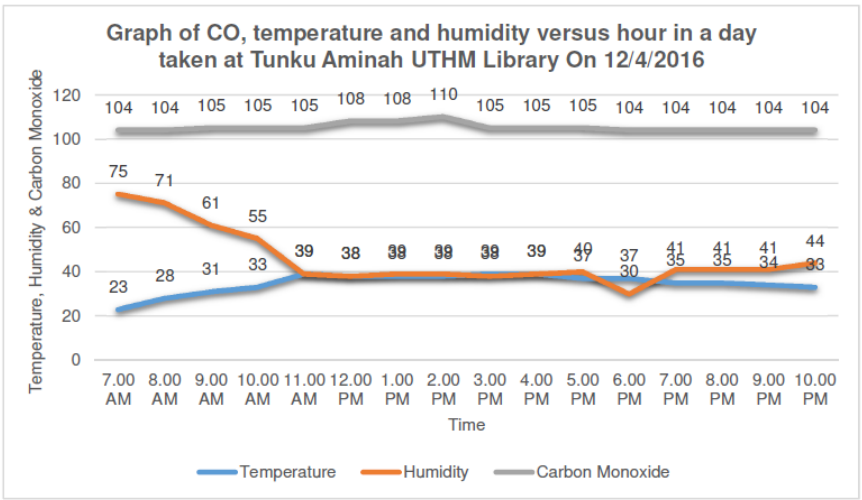


Figure 8. Graph of CO, temperature and humidity versus hour in a day taken at library

Figure 8 above displays the reading of the CO, humidity, and temperature on April 12, with the measuring devices at Tunku Aminah UTHM Library. The data shows an average reading is 105 ppm with the maximum reading is 110 ppm and minimum reading is 104 ppm.
The average reading of the humidity is 48%, the maximum and minimum percentage of humidity are approximately 71% and 45% respectively. The lower humidity is approximately 45% to 47% at 1:00 pm to 6:00 pm with temperature is between 37˚C to 38 ˚C.

4. Conclusion

The device developed has been tested in two different distances and different conditions. The results show that the device developed able to measure the CO concentration, temperature and humidity for the two location. The highest CO concentration (111 ppm) is read around RMC this is because near to industries areas. The humidity reading is higher in the morning as the cool morning air particles is closer to each other, therefore intensity of water vapour is higher.

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