A WIRELESS ENVIRONMENTAL MONITORING SYSTEM

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Abstract - This paper presents a design of a wireless environment monitoring system which consists of a transmitter, receiver and graphical user interface (GUI) program as a monitoring display. This real-time monitoring system is developed to monitor the voltage, temperature and relative humidity of a room. It is suitable to be implemented for a server room or any electronic laboratory device room where a good physical and environmental condition is required. The transmitter can be placed remotely about a maximum of 50 meters away from the receiver. The frequency used is 433MHz. This system provides efficient data measurement of the environmental condition where the user can easily monitor remotely all the related information.

Keywords – environment monitoring, voltage temperature, relative humidity.

I. INTRODUCTION

In today's environment, wireless is a conclusion to minimize the cost to send data from one point to another. Wireless communication by definition is the transfer of information over a distance without the use of electrical conductors or wires. The distances involved may be short (a few meters) or long (thousands or millions of kilometers). Wireless channel operates through electromagnetic radiation from the transmitter to receiver. It uses some form of energy (e.g. radio frequency, infrared light, laser light, etc) to transfer the information. The main things of wireless communication are transmitter and receiver.

A transmitter is a collection of one or more electronic devices or circuits that convert the original source information to a form more suitable for transmission over a particular transmission medium[1]. The transmission medium or communication channel provides a means of transporting signals between a transmitter and a receiver and can be as simple as a pair of copper wires or as complex sophisticated microwave, satellite or optical fibers communications systems. System noise is any unwanted signals that interfere with the information signal. A receiver is collection of electronic devices and circuit that accept the transmitted signals from the transmission medium and then convert those signals back to their original form [1].

The measurement of voltage, temperature and relative humidity that can be viewed remotely using the appropriate sensors is not only important in many industrial processes but also crucial for environmental monitoring. In this project, the environmental monitoring system is targeted to be implemented for a server or any electronic laboratory devices that are sensitive to the environment condition. This monitoring system is used to monitor the environmental condition of the room where the server or electronic devices are placed. It is necessary to prevent the server or electronic devices from overheating and moisture condition. The voltage sensor is used to monitor the voltage supplied to the transmitter board from battery or adaptor. This additional sensor is used to detect any interruption to the power supply like insufficient voltage (for battery) or power trip (for adaptor). The measurement result can be viewed from computer in graphical form.

II. METHODOLOGY

A. Process Flow

Fig 1 shows the flowchart of this project. In this project, the system comprises three main components which are transmitter board, a receiver board and a computer with a graphical user interface program.

B. Simulation and Hardware Process

a. Transmitter board

Fig 2 shows a block diagram of the transmitter board. The transmitter board comprises a wireless transmitter module 433MHz, a power supply module, a voltage regulator, a voltage detection sensor, a temperature sensor, a humidity sensor, a microcontroller (PIC16F886) and a 2x16 LCD. A C programming language is used to program the microcontroller.

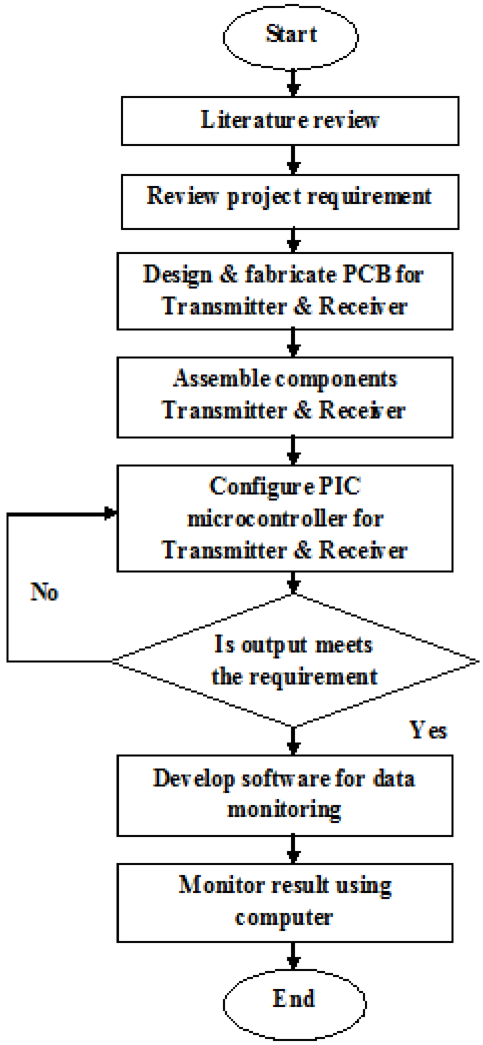

Fig 1: Flowchart of monitoring system development

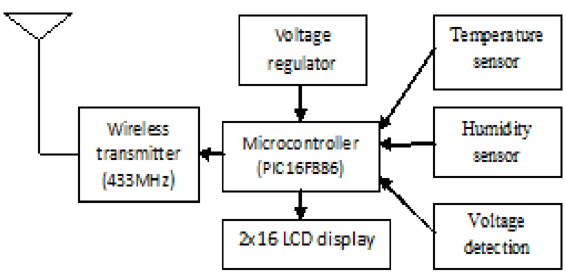

Fig 2: A transmitter board block diagram

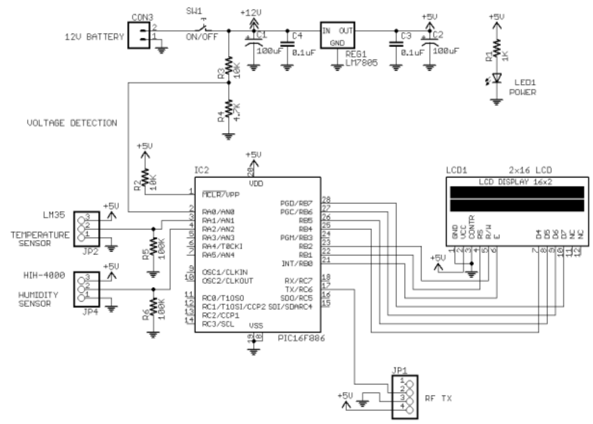

Fig 3: A transmitter board schematic diagram

The schematic diagram of the transmitter board is shown in Fig 3. The Eagle Layout Editor is used to design the schematic and PCB board diagram. The analogue outputs of the sensors are connected to a microcontroller through an analog digital controller (ADC) for digital signal conversion and data logging. A liquid crystal display (LCD) display is also connected to the microcontroller to display the measurements value.

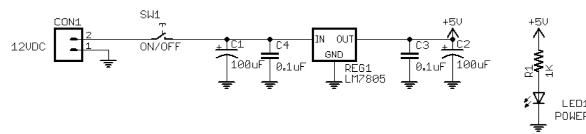

Fig 4: A transmitter board power supply module

Fig 4 shows a power supply module that power up the transmitter board. It uses either 12V or 9V to supply power for system operation (microcontroller, sensor and LCD display). The voltage regulator (LM7805) is used to provide a stable 5V output from the 12V or 9V input (microcontroller is support up to maximum 5V only). Electrolytic capacitors (100uF) are used to store charge needed to moderate output voltage. The ceramic capacitor (0.1uF) is a bypassing capacitor and used to reduce the noise on power supply lines. Power indicator (LED1) is used to indicate the power condition. The on/off switch is used to power on and off the system.

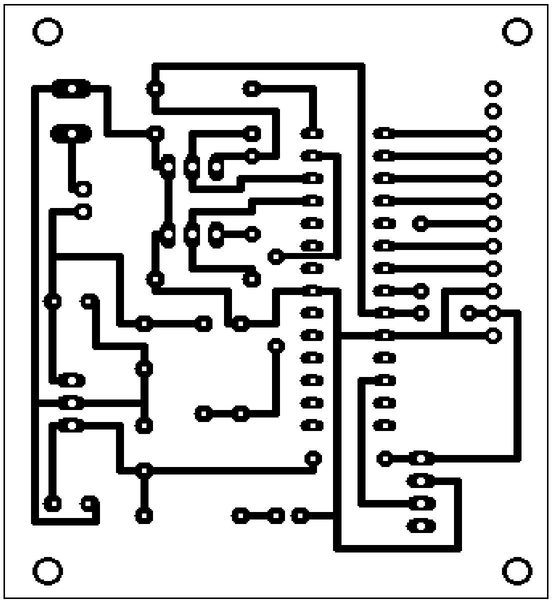

Fig 5: A transmitter board PCB layout

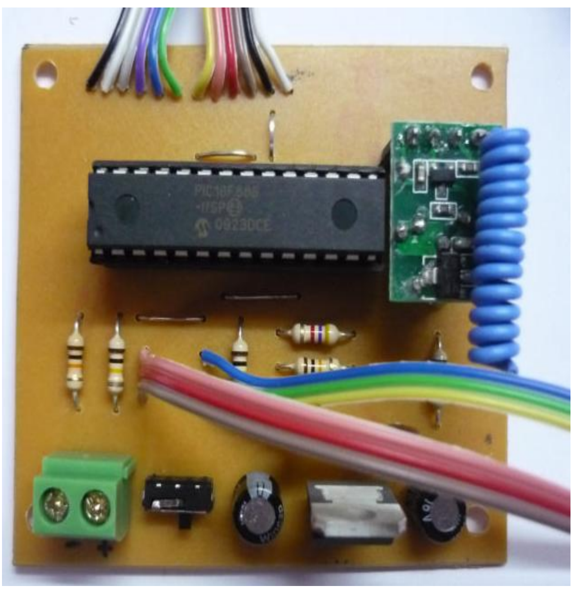

Fig 6: A transmitter board

b. Receiver board

A block diagram of the receiver board and schematic diagram are shown in Fig 7 and Fig 8 respectively. The receiver board includes a wireless receiver module 433MHz, a power supply module, a microcontroller (PIC16F886) and RS232 interface. A C programming language is used to program the microcontroller. Fig 9 shows a power supply module that power up the receiver board. It uses either 12V or 9V to supply for system operation.

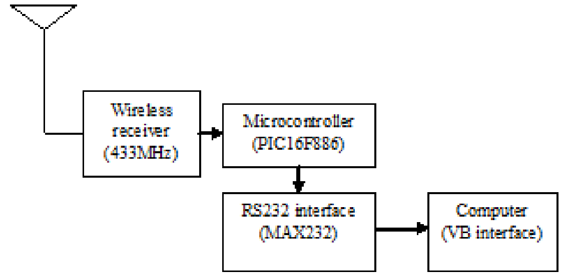

Fig 7: A receiver board block diagram

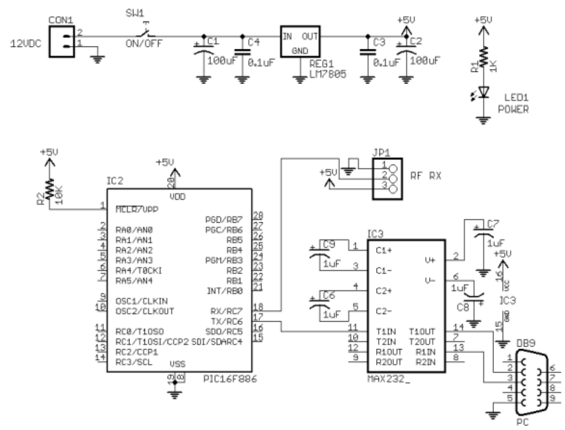

Fig 8: A receiver board schematic diagram

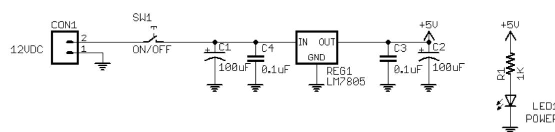

Fig 9: A receiver board power supply module

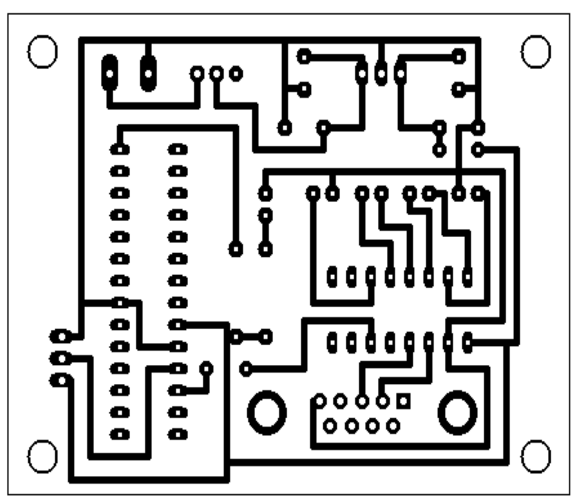

Fig 10: A receiver board PCB layout

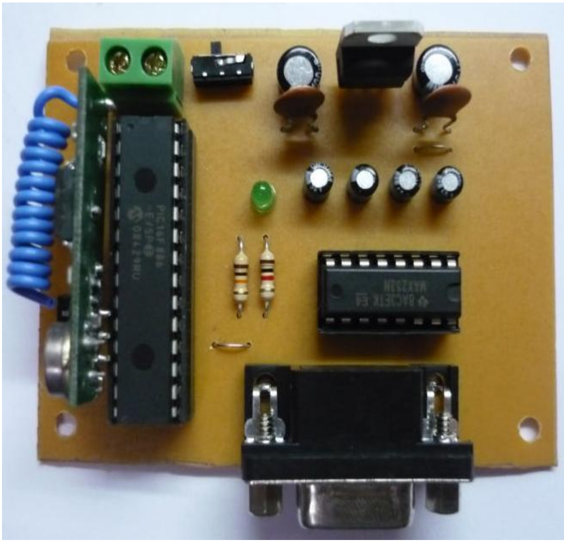

Fig 11: A receiver board

c. PC graphical user interface

For analysis, the data can be transferred to a computer with a graphical user interface program through a universal serial bus (USB) link. The computer communication (COM) port is used to communicate between the microcontroller of the receiver and the computer using the USB to serial cable. The microcontroller will send the data through the MAX232 IC and convert it into the RS232 format and received by the computer. Visual Basic 6.0 is used to create the interface to collect and display the voltage, temperature and relative humidity sensor values. The complete system set up is shown in Fig 12.

III. RESULTS AND DISCUSSION

Fig 13 below shows the GUI display at initial condition (before starting the monitoring process). The measured value will appear in graph forms on computer in terms of voltage, temperature and relative humidity. The results are updated every second. After configuring which COM port to use, click on the connect button and it will show a real-time result as in Fig 14.

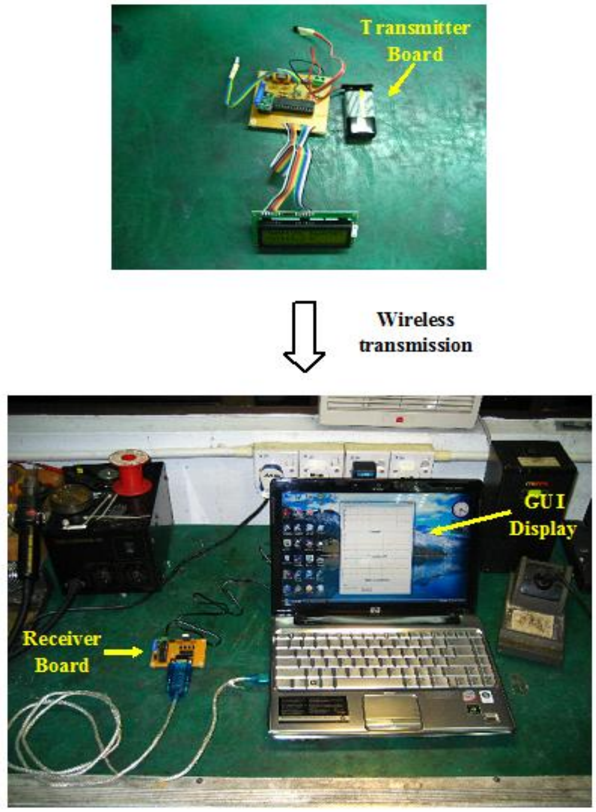

Fig 12: A complete system set up

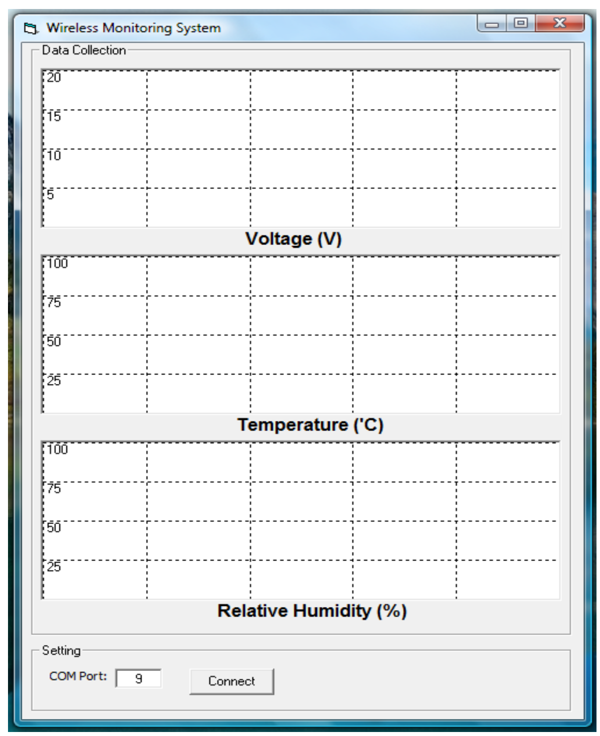

Fig 13: A GUI display before monitoring start

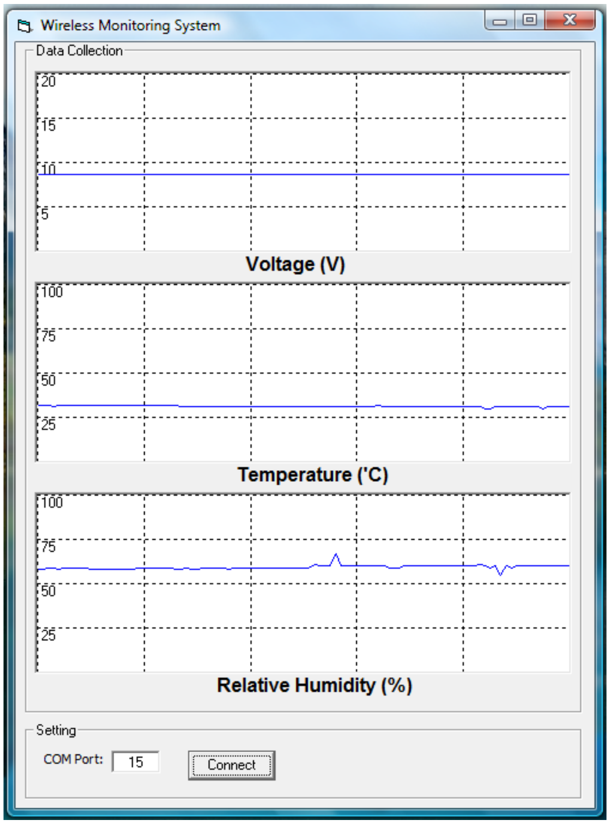

Fig 14: A GUI display with measured value

The results from the graph of Fig 14 should match with the measurements displayed on the LCD as shown in Fig 15.

Fig 15: A LCD display on transmitter board

The LCD displayed the measured value detected by the temperature, relative humidity and voltage sensor on the transmitter board.

IV. CONCLUSION

The wireless environmental monitoring system which can measure the voltage, temperature and relative humidity is successful designed and has been tested to provide accurate results as compared to the measured value from LCD on the transmitter board. It shows that the data can be monitored remotely from as far as 50 meters away from the transmitter board. It is suitable to be implemented for monitoring server room or any electronic device laboratory.

V. FUTURE DEVELOPMENT

There are some recommendations for future development of this project like adding barometer sensor that used to measure the atmosphere pressure value, the enhancement of the transmission range so that the distance between a transmitter and a receiver can be increase, the improvement of the graphical user interface with more details parameter such as date, time and sampling interval for data retrieval for further analysis and adding an alarm system that triggered when the measured value reached the threshold value to warned the user.

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