

Preliminary Application of a Helicopter Toy for Environment Monitoring

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Abstract. This paper presents a result of an experimental study by using a helicopter toy for monitoring several environment parameters such as temperature, humidity, and air quality. A microcontroller board named Arduino was embedded in the helicopter. This board controlled various sensors. The data captured by the sensors was sent to the receiver by using a serial communication provided by a pair of XBee Pro.

1 Introduction

Researches in using aero vehicles for many purposes have been done by several researches. For example, the application of unmanned aero vehicles (UAV) has been studied and implemented in [1]. Other researches focussed on how to control the aero vehicles, such as used Android to control the quadcopter. Hanafi, et al. [2] highlighted the use of graphical user interface (GUI) to control the quadcopter. Whilst, Varshnev [3] concentrated on how to handle gesture controlled aero vehicle and obstacle avoidance occurred in its path.

This research was actually the part of an integral project for utilizing UAV to do monitoring several environment parameters. However, to ease in getting results for further development of the whole system, the implementation of monitoring environment was the main priority. This goal was to get the proper hardware needed so the problem weight of the hardware could be known in advance.

2 Material and methods

To implement this project, an experimental project was conducted. The experiment was accomplished by embedding the sensors in a helicopter toy. Figure 1 shows the block diagram of the system developed in this project. The outputs of sensors were read by the Arduino and sent to the receiver through XBee Pro. In this case, the graphical LCD was used to display the information gathered from the helicopter. Some materials were used to implement this project. Therefore, the explanations of all materials will be given first.

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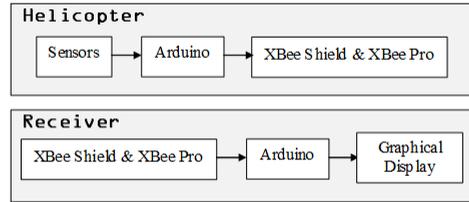


Fig. 1. Block diagram of the system.

2.1 The helicopter

To accelerate the result achievement in this research, a helicopter toy was used. The consideration of choosing this aero vehicle was the cost. This toy was relatively cheap compared to a quadcopter. Besides, because its size was big enough, it was possible to embed many devices, including the microcontroller board, the sensors, and other equipment.

2.2 The arduino board

The Arduino board was chosen as the main controller because it was powerful, cheap, and easy to program. Besides, many sensors were available for this board. Arduino board is an open source singleboard-based microcontroller [4]. Actually, there are many kinds of Arduino boards. In this project, Arduino Uno was used. This board was selected because it provided the various shields. One of the requirements in this system was XBee Pro, which needs a special shield as shown in Figure 2.

2.3 The XBee Pro

The XBee and XBee-PRO OEM RF Modules were engineered to meet IEEE 802.15.4 standards and support the unique needs of low-cost, low-power wireless sensor networks [5]. It can be used indoor and support up to 100 m. For outdoor application, the XBee Pro with 60mW output can handle communication up to 1,500 m.



Fig. 2. Arduino, XBee shield and XBee Pro.

2.4 The humidity and temperature sensors

For measuring the humidity and the temperature of the environment, a sensor named DHT11. A module consisting this sensor is shown in Figure 3(a). This sensor can measure the humidity between 20 and 90% RH with the accuracy of +5% RH. Measurement for temperature is between 0 and 50°C with the accuracy of +2°C. Communication between this sensor and the Arduino is accomplished by using one-wire serial bus.

2.5 The dust sensor

The dust sensor named GP2Y1010AU0F (Sharp Optical Dust Sensor) was used for measuring air quality. It will report the dust density in mg/m^3 Figure 3(b) shows this sensor.

2.6 The MQ-4 sensor

MQ-4 (Figure 3(c)) is one type of MQ family sensor. The MQ-4 sensor is useful for detecting methane and compressed natural gas (CNG). It can detect gas concentration from 200ppm to 10,000ppm.



Fig. 3. Three sensors used in the experiment.

2.7 The CLCD

A graphical liquid crystal display (GLCD) is useful for displaying charts and also texts. The display shown in Figure 4 has 64x128 pixels.



Fig. 4. The GLCD.

3 Experimental research and discussion

The helicopter toy and the receiver used in the experiment were shown in Figure 5. All sensors were located in the lower part of the helicopter.



Fig. 5. The helicopter toy used in the experiment.

Figure 6 shows how to connect all sensors to the Arduino board. The dust sensor is obtained by reading the pin A0. The pin 2 is used to control the LED pin of the sensor.

How to program this sensor can be achieved at [6-7]. According to [7], the dust density can be obtained by using the following command:

$$\text{density} = 0.172 * \text{voltage} + 0.0999;$$

In this case, the voltage is the value on the pin A0. The DHT sensor was connected to the Arduino by utilizing the analog pin A1. Whilst, the output of the MQ-4 is monitored on the pin A2 by using the following command:

```
mq_value = analogRead(A2);
```

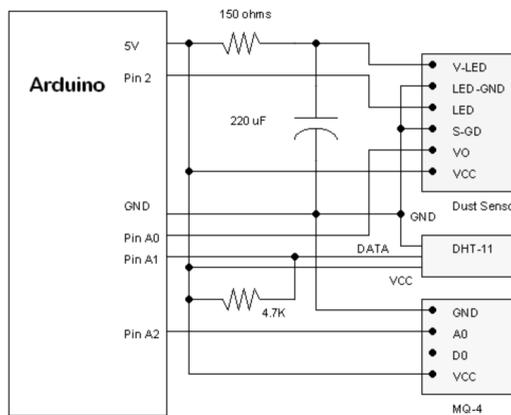


Fig. 6. The connection between the DHT sensor and the Arduino board.

To ease in programming the DHT-11 sensor, a library named DHT is needed. This library is available at www.hobbyist.co.nz/?q=documentations/wiring-up-dht11-temp-humidity-sensor-to-your-arduino. This library has a class named dht. The fragment of code to get the temperature and the humidity is as below:

```
dht DHT;  
DHT.read11(A1);  
float humidity = DHT.humidity;  
float temperature = DHT.temperature;
```

Sending the sensor data is handled by the XBee Pro of the transmitter part. The data has a format as follows:

```
T=value,H=value,Q=value,G=value
```

In this case, T represents the temperature, H represents the humidity, D represents the air quality, and G represents the gas concentration.

On the receiver part, the XBee shield will read those data every two seconds and then the data is parsed and displayed to the GLCD. To program the GLCD, a library named U8glib is used. This library can be downloaded freely at https://github.com/olikraus/U8glib_Arduino.

Testing was done several times by flying the helicopter manually using a remote control to the targeted area and monitoring the output of sensors in the GLCD. The maximum

distance was tested not more than 0.5 km although XBee could handle until 1.5 km. At the range, it was easy to see the helicopter. The results shown that all sensors could function as expected on that range.

Based on the results, the helicopter can be used to monitor the environment parameters remotely. It is useful for ad hoc measurements in certain places such as in agriculture area or in the dangerous area for human such as the mining to detect certain parameters.

4 Conclusions

The communication used in monitoring the environment monitor by using XBee Pro gave satisfied results. Therefore, it is expected that the communication channel can be used for handling some additional sensors. Besides, the helicopter is still able to bring some sensors because the total weights of all equipment needed for monitoring the environment parameters are tolerable. Based on the performance, it is possible also to equip the helicopter with a light camera and GPS module sensors as well. Therefore, for next future implementation, the use of a camera to capture the view of environment and a GPS module to record the geographical position in latitude and longitudes will be the priorities. An SD card is also possible to include to record the data.

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