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Obstacle Detection using Ultrasonic sensor in MAV (Micro Air Vehicle)

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Abstract: *This paper demonstrates the obstacle detection using ultrasonic sensor in Micro Air Vehicle (MAV). The sensor measures the distance range up to 400 cm or 4 m theoretically. In the presence of many obstacles in front of ultrasonic sensor, nearer obstacle was detected initially. However, the ultrasonic sensor can be used for detecting the obstacle based on colour and size and hence collision can be avoided. An algorithm has to develop for avoiding collisions. This algorithm was embedded on an ARDUINO Uno that acts as the control board. The flight control board receives the message from the ARDUINO board to control the servos. The quad copter servo motors are controlled in the presence of any obstacle adjacent to the ultrasonic sensor.*

***Keywords:** Ultrasonic sensor, Arduino Uno board, LED.*

1. INTRODUCTION

MAV is a class of miniature UAVs that has a size restriction and it is autonomous. It can be as small as 15 centimetres. MAV development is driven by commercial, government, research, and military purposes. The Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back. By recording the elapsed time between the sound wave being generated and the sound wave bouncing back, it is possible to calculate the distance between the sonar sensor and the object.

2. HARDWARE AND SOFTWARE

2.1 Ultrasonic Sensor

Ultrasonic sensor (HC-SR04) utilizes sonar to measure the range of an object. Its range is to find the distance of any object from 2 cm to 400 cm. This sensor uses sonar to detect the objects. This sensor widely used in robotics to built the robots, aircrafts, in order to avoid the obstacle. The hardware component consists of both ultrasonic transmitter and receiver module. The sensor module consists of 4 pin namely: trigger, echo, power supply and ground.

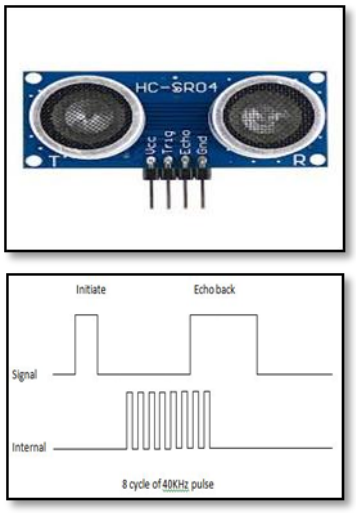

Fig 2.1: (a) Ultrasonic sensor HC-SR04,
(b) Working principle of Ultrasonic Sensor [4]

The figure 2.1 shows ultrasonic image and working principle of ultrasonic sensor. The distance between the source and target of echo pin and time taken to reflect back from echo pin considered. The ultrasonic sensor requires a pulse of high (5V) for 10μS. This sequentially initiates the ultrasonic sensor and it sends 8 cycles of 40 kHz. Then, it waits to receive the reflected ultrasonic signal from the obstacle. To obtain the distance of the object the width of echo pin is measured as follows: Time=Width of Echo pulse in microseconds or the speed of the sound may also be considered

- Distance in centimetres = Time / 58, Distance in inches= Time / 148.

2.2 LED

Light emitting diodes (LEDs) are semiconductor light sources. The light emitted from LEDs varies from visible to infrared and ultraviolet regions. They operate on low voltage and power. LEDs are one of the most common electronic components and are mostly used as indicators in circuits. They are also used for luminance and optoelectronic applications. Based on semiconductor diode, LEDs emit photons when electrons recombine with holes on forward biasing. The two terminals of LEDs are anode (+) and cathode (-) and can be identified by their size. The longer leg is the positive terminal or anode and shorter one is negative terminal.

Fig 2.2 Red and Green LED

2.3 ARDUINO UNO Board

- **HARDWARE**

Arduino board designs use a variety of microprocessors and controllers. It consists of 14 input/output pins, 6 analog inputs, 16 MHz crystal oscillators, USB connections, a power jack and reset button. The Arduino Uno is microcontroller is based on the Atmega328. Arduino board does not require any extra programmer to load a new code; instead USB cable can be used. The ATmega328 supports SPI and I2C pins for communication with many peripheral devices.

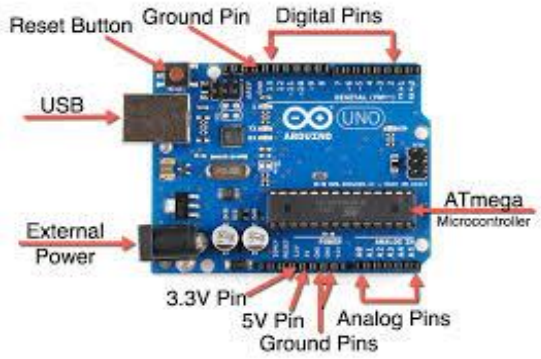

Fig 2.3: Arduino Uno board [6]

The Arduino Uno can power via the USB connection or with an external power supply. However, the pin may supply less than 5 V and the board may be unstable. If using more than 12 V the voltage regulator may over heat and damage the board. The Arduino Uno power pins are Vin, 5 V, 3 V and GND.

- **SOFTWARE**

Arduino Uno is open source project to which any hobbyist can connect for Atmega chips. In this software code can be written in either C or java script. A program is written on the IDE Arduino is called a sketch.

Arduino programs are divided into 3 parts

- Structure
- Values
- Functions

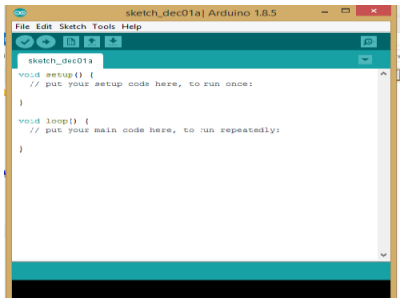

Fig 2.4: Sketch window for Arduino IDE

The fig 2.4 shows sketch window used to write the code for Arduino IDE. The header files can be included in this window. The Arduino Uno board is renamed with a specified name and saved in the Arduino file. It is compiled, if any errors are occurred it is corrected and this corrected and this code is further uploaded to the Arduino Uno board.

3. IMPLEMENTATION

The implementation of ultrasonic sensor with Arduino Uno board is described. Initially, the algorithm was developed to find the obstacle for one ultrasonic sensor. The Algorithm was written in c code using Arduino IDE sketch window. The code is verified and uploaded to the Arduino board. The measured distance can be seen through the serial monitor of IDE.

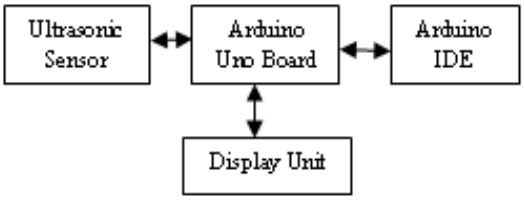

Fig 3.1: Block diagram of ultrasonic

The figure 3.1 shows the block diagram of ultrasonic sensor connected with Arduino board. The algorithm has developed to find the distance of an obstacle in the IDE software. Once the algorithm is developed, the code is verified and uploaded to the board using IDE software. The LED is connected with Arduino to glow if any obstacle is present or not. In practical, the ultrasonic sensor measures the distance range up to 400 cm and the angle is 30 degree and operating voltage from 3.3V to 5V.

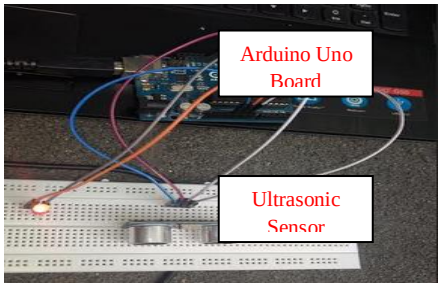

Fig 3.2: Connection between Arduino Uno board and ultrasonic sensor

3.1 Algorithm for obstacle detection with one sensor

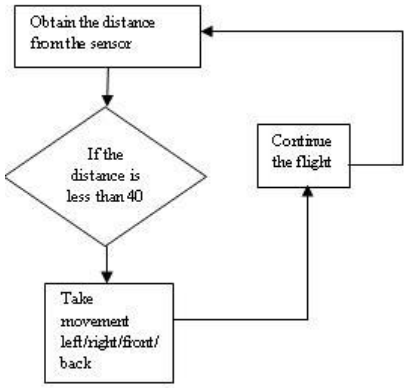

Fig 3.3: Algorithm for obstacle detection

4. RESULTS AND DISCUSSION

Initially a single ultrasonic sensor was connected to flight control board. Before connecting to Mission planner initial settings were done to obtain the result from ultrasonic sensor. The cut-off voltage was set to 0.03 V and maximum range up to which the ultrasonic sensor can detect was also mentioned in mission planner software. The results were obtained by telemetry of 915 Mhz. Ultrasonic sensor was connected to the analog pin of the flight control board. MAV was connected to mission planner a flight test was conducted for 5 minutes. Ultrasonic sensor displayed voltage and distance on the mission planner software. A graph was plotted taking distance versus voltage.

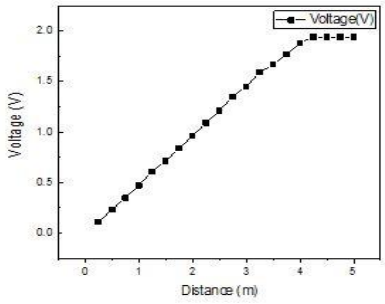

Fig 4.1: Ultrasonic sensor Voltage Versus Distance

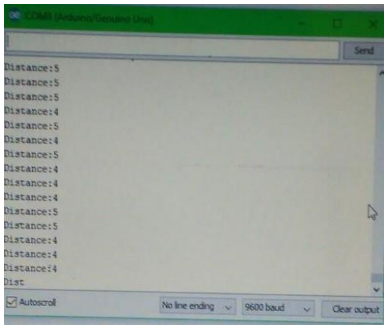

Fig. 4.2: Serial Plotter showing Distances

5. CONCLUSION

One Ultrasonic sensor was connected to Arduino control board and the distances were measured by moving the obstacle. And the mission planner software showing the voltage and distance of ultrasonic sensor were captured. The sensor which measures the distance up to 315 cm with 5V.The distance was captured through serial monitor of Arduino IDE software.

For both indoor and outdoor environment the ultrasonic sensor gives the best result for obstacle detection.

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REFERENCES

[1] Rajan P Thomas, Jithin K K, Hareesh K S, Habeeburahman C A, Jithin Abraham," Range Detection based on Ultrasonic Principle", February 2014.

[2] Shridevi A Mali1, G Sravanthi2*, Siva Subba Rao P3, Raja S3,Sushma S J1, A R Reddy2, Rohith P Maben3, "An Algorithm For Obstacle Avoidance Controller Using Ultrasonic Sensor For Mini Aircraft Applications" International Journal of Engineering Technology, Management and Applied Sciences, , Volume 5,Issue 3,March 2017.

[3] G Sravanthi1, Shridevi A Mali2, Siva Subba Rao P3, Intelligent Landing Technique Using

[4] Ultrasonic Sensor for Mav Applications, International Journal Of Pure And Applied Mathematics, Volume 114, No. 12 2017.

[5] Kirtan Gopal Panda, Deepak Agrawal, Arcade Nshimiyimana, Ashraf Hossain, "The effects of environment on accuracy of ultrasonic sensor operates in millimetre range", 20 February 2016.

[6] "Arduino Uno" https://en.wikipedia.org/ Wiki/Arduino accessed on 14/10/2017.

[7] H. He, and J. Liu, "The design of ultrasonic distance measurement system based on S3C2410," Proceedings of the IEEE International Conference on Intelligent Computation Technology and Automation, Oct. 2008.

[8] P. Riseborough, "Automatic Take-Off and Landing Control for Small UAV's".