

Obstacle Detection System using AR Drone Quadcopter with Ultrasonic Sensor

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Abstract

This paper proposes a simple approach to designing an obstacle detection system using ar-drone quadcopter with ultrasonic sensor. The detection system uses some of API to connecting the sensor system and quadcopter system. The result of sensor readings transmitted into quadcopter system through serial communication using node serial-port API. Node ar-drone has a function to convert the sensor reading into a command and would be executed using node.js to make the quadcopter move to avoid the obstacle object. The idea of this research is to make an obstacle detection system using low cost sensor for quadcopter. The result show the system can work successfully to detect and avoid the obstacle object.

I. Introduction

Unmanned Aerial Vehicle (UAV) are now widely used to conduct surveillance and reconnaissance in the military field. Besides the military, UAV also used by people for entertainment purposes such as aerial cinematography photo shoot. Academics and researchers are also using UAV to conduct experiments and develop new systems that can assist people in their daily work [1].

Behind the many of benefits of using UAV especially for quadcopter model, there is a lack of safety side. Quadcopter using the propeller in order to fly that can cause a physical hazard in the surrounding area when quadcopter crashed. Therefore, to avoid a dangerous incident that caused the quadcopter needs an intelligent system. Quadcopter intelligent systems can be created using sensor and camera in combination with an effective flying control mechanism [2].

The quadcopter navigation system generally using GPS data for positioning, but this system cannot be operated in indoors. At this time many ways that can be used for indoors navigation like using camera. However, the use of camera requires high computing in quadcopter systems and also is very sensitive to light. Ultrasonic sensor can be used for quadcopter indoor navigation system. Ultrasonic sensor is low cost sensor and having no problem in dealing with such problem on the camera.

This research was conducted on the development of intelligent system of quadcopter that can avoid obstacle using ultrasonic sensors based on open source github project [3] and then we analyzed the performance of it. In this research, instead of using Arduino Uno like in [3] we used Arduino Nano that has less weight than Arduino Uno. This system uses four ultrasonic sensors attached on the Arduino Nano, where the sensor data will be sent into the quadcopter mainboard via Arduino using serial communication. Node ar-drone, Node serialport and Node.js API installed on the quadcopter mainboard that will be used to read the sensor data and convert to a command and executed by the quadcopter mainboard to avoid the obstacle.

II. System Architecture

This obstacle detection system is designed in two parts: hardware and software. This system consists of three ultrasonic sensors that are connected to Arduino using serial port. The host computer is used to access a system in the quadcopter mainboard remotely using telnet.

The sensor systems will work in accordance with the conditions that already set. The results of sensor readings will be sent into quadcopter mainboard using serial communication. This algorithm implemented in quadcopter mainboard system using Java and node.js API. The purpose of this algorithm is to make quadcopter able to fly autonomously in accordance with the result of sensor readings.

This blind spot zone appears where the system cannot detect the obstacle object because of due to limited sensor reading resolution since the system only using three ultrasonic sensors.

The first step is to connecting host computer into quadcopter network to be able accessing the quadcopter system remotely via telnet. In the quadcopter systems user can access Node.js API to write the algorithm to make the quadcopter system can receive sensor reading data and converted into command and executed that command.

III. Performance Evaluation

The system ability to detect and avoid obstacles in this study were tested in several parts in order to analyze overall. API functions in the system are able to work well so quadcopter can receive and execute the command in accordance with the results of sensor readings. Sensor readings will be lack when detect a soft surfaces object like foamed material.

The response time for quadcopter to avoid the obstacles is very dependent with quadcopter stability and also the distance to the obstacle itself. Quadcopter has been flown with hover position and then each sensor will be given alternately obstacle object with different distances. Figure 1, figure 2 and figure 3 is a graph of testing result respectively for left sensor, right sensor and front sensor.

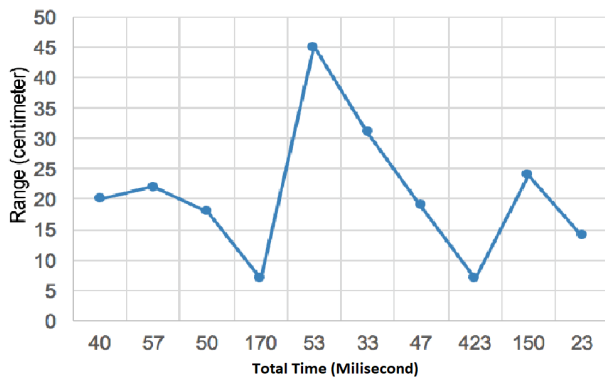


Fig 1. Right sensor reading results

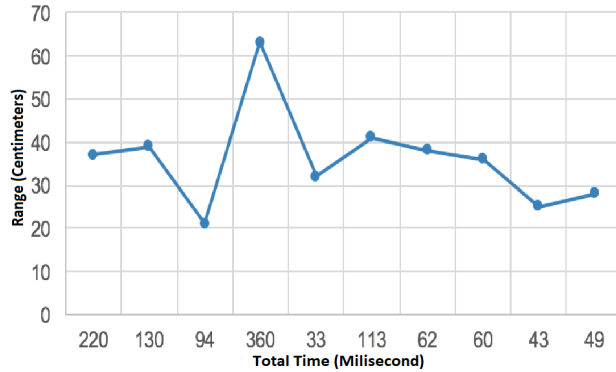


Fig 2. Left sensor reading results

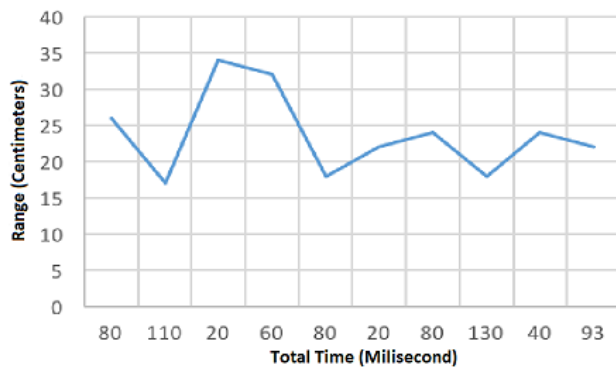


Fig 3. Front sensor reading results

IV. Conclusion & Future Works

In this paper, we study and design an obstacle avoidance systems using ultrasonic sensor for ar-drone quadcopter. This system function work properly to detect and make quadcopter avoid the obstacle. For further research, we consider to remove blind spot zone by adding more ultrasonic sensor.

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