Optimizing Ultrasonic and Barometric Sensor for Quadcopter's Altitude-Hold Using YoHe V1.2 PID and KK V2.0 Board

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***Abstract*—This paper is part of research on stabilizing quadcopter altitude in 'Altitude-Hold' mode by utilizing the commercial KK v2.0 and customized YoHe v1.2 PID board. YoHe v1.2 PID board uses two sensors: the ultrasonic sensor and barometric sensor. Both sensors are used together to determine and maintain a quadcopter at a certain altitude. The purposes of this paper are: first, to analyze the sensors and to optimize them on 'Altitude Hold' mode and the second is to provide an explanation of the quadcopter system configuration, especially for using YoHe v1.2 PID board along with KK v2.0 board. The relative error comparison graph showed the accuracy of ultrasonic sensor is better for a lower altitude. On the other hand the accuracy for barometric sensor are better for higher altitude. The relative error graph also showed that ultrasonic sensor is suitable for altitude below 175 cm and barometric sensor above 175 cm. This height will be used for YoHe v1.2 PID to choose which sensor is used as an input sensor for determining quadcopter altitude. The results of this experiment will be embedded in the programming code to YoHe v1.2 PID board expecting both of these sensors can work together and complement.**

Keywords—Altitude Hold; Barometric sensor; KK v2.0; PID; Quadcopter; Ultrasonic sensor; YoHe v1.2

I. INTRODUCTION

The quadcopter is a multi-rotor helicopter that is lifted and propelled by four rotors. Quadcopters are classified as rotorcraft because the lift is generated by vertically oriented rotor's propellers. The quadcopter platform is built with integration mechanical and electronic system. The structural frame, propulsion system, external sensors as well as the flight multi-rotor control board are included in the platform [3]. The mathematical model for quadcopters [4] is a useful tool for university researchers to test and evaluate new ideas in a number of different fields, including flight control theory, navigation, real time systems, and robotics.

In Manual-Mode, controlling the attitude and altitude of the quadcopter is carried out by a user with remote Radio Controlled (RC) Transmitter (TX) on its throttle, pitch, roll and yaw lever gimbal. The radio signal will be received by the RC Receiver (RX) for controlling quadcopter motion in six degrees of freedom movement [8].

In Auto-Mode, to self maintain quadcopter in a certain level height of altitude, an 'Altitude Hold' mode is used. In this mode, the quadcopter needs a control system to control throttle input signal value received from the RC Receiver automatically.

This control system is realized by using commercial KK v2.0 multi-rotor control board as the main controller, along with custom-designed YoHe v1.2 PID board as an altitude stabilizer control board which is contained PID, Fuzzy PID and Type-2 Fuzzy algorithm and program [1][2]. This system will produce a new throttle signal value to self-maintaining quadcopter in a certain altitude according to the altitude error value (the difference between the set point altitude with its actual current altitude).

The YoHe v1.2 PID is used as an altitude stabilizer control board for self-maintaining quadcopter in a certain height of altitude. To sense its altitude, YoHe v1.2 PID board is equipped with two sensors, which are ultrasonic sensor SRF-05 and barometric sensors BMP085. Fig. 1. shows this Yohe v1.2 PID and its sensors. The sensors are expected to be able to work independently and complementary. With these optimized sensors, YoHe v1.2 PID board can decide which sensor will be used as the basis for maintaining quadcopter altitude.

The specification of quadcopter used in this experiment is: frame X-Copter F450, X2212-980kv SunnySky motors, ESC Turnigy Plush 30 A, flight controller KK v2.0, propeller 1045, and the LiPo battery Turnigy 3-cell 2200 mAh 25C.

The experiment with YoHe v1.2 PID and quadcopter specified above had been done before and obtained the best value for its parameters. The best parameters obtained for PID, Fuzzy PID and Type-2 Fuzzy parameters are produces the best oscillation level. These parameters will be used and embedded in YoHe v1.2 PID board. Experiment obtaining these best parameters are discussed in other paper [1][2].