Implementation Of Ultrasonic Sensor And Fuzzy Logic On Safety And Control Drone System (QUADCOPTER)

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ABSTRACT

The development of drone users continues to increase, even though the government has issued Regulation of the Minister of Transportation of the Republic of Indonesia Number 90 of 2015 on the drone usage requirements, but it is still necessary to develop a better drone control system to reduce the risk of accidents caused by user negligence. This research is very important because it is related to safety caused by drone control. In addition, it is also necessary as a reference for the development of drone systems that pay attention to the safety of drones, users, others and the environment. If the research is successful, it will be easier to control so it can minimize the loss caused by drone accident.

This research begins with building a quad copter control system that can detect objects around it. Where the object interferes with or obstructs the movement of quad copter. Once the Object is detected a method is needed to determine the direction of motion to avoid it. The method used is fuzzy logic, with ultrasonic sensor as its input.

From the experimental results and the implementation can be concluded that Quadcopter can meet the purpose to avoid obstacles, from ultrasonic sensor test the consistent distance that can be detected in the sensor is 0 - 460 cm. The overall system test result is 75% successful.

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1. INTRODUCTION

Drones are Unmanned Aerial Vehicles (UAVs) that would operate under remote/autonomous control without any pilot on-board. It shown on figure 1. This operation relies mostly on human involvement. The very first application of this device was within military missions and now they have their permanent position in the military arsenal (Nisser and Westin 2006). Some peaceful applications of these devices are in border patrol; search, rescue and damage investigations during/after a disaster (e.g. hurricane, katrina or earthquake); locating forest fires or frost conditions in farmlands; monitor criminal activities; mining; advertising; scientific surveys and secure pipelines and offshore oil platforms (Nisser & Westin 2006, Anand 2007) (Irizarry, J., Gheisari, M., & Walker, B. N. 2012).

Drone does become a new phenomenon. Currently, in the UK, there are already more than 2 million drones that fight for space to fly. The average is a drone designed for the next few years, such as drone delivery and others (Yoga Hastyadi Widiartanto, 2016). The cheapness of drone technology or drone aircraft made unmanned objects more affordable, so anyone can buy and operational. The Consumer Technology Association estimates 700,000 drones sold globally by 2015 (Dina Lathifa, 2016). In America drones sales reach 100,000 units annually and are expected to reach millions by 2018 (Aislan Gomide Foina, 2015). It shown on figure 2.

Figure 1. Drone

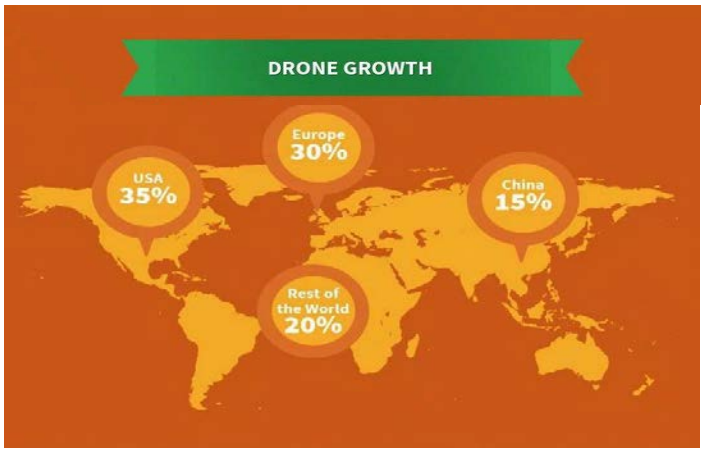

Figure 2. Drone User Deployment Progress

In Jakarta there has been a drone incident involving police investigation in July 2015. Police secured a multirotor drone that crashed and crashed in the area of Menara BCA, Jalan MH Thamrin, Central Jakarta, and examined the owner. The FFA (Federal Aviation Administration) said the near-collision incidents reported by pilots increased dramatically in the US. In 2014, the pilot reported there were only 238 reports of near-collision due to a drone aircraft that was too close to a manned aircraft. However, that number increased to 650 to 9 August 2015. (Prasetyo Eko, 2016). In the event of an accidental incident on the drone, in addition to causing drone damage and damage to the owner, the incident also potentially injures others, damages the facility and disrupts the public interest. Therefore, skills required in the operation, in building drone control system should also consider the safety factor of users and the environment. A drone control system that can detect nearby objects and avoid them automatically to reduce the risk of collision incidents.

2. RESEARCH METHOD

There are some related research which becomes reference technology development quadcopter drone. One of them is research (m. Latif and Hairil Budianto, 2014) researching on the system of basic motion maneuvers, as well as testing terhadadap quadcopter sensors Accelerometer and gyroscope. So it still needs further development mainly how to introduction to surrounding objects, just as would be done in the research plan.

(Andi Darmawan, 2012) discusses how to build automatic control system for the take-off and landing on a drone quadcopter type. One of the sensors used in the study is an ultrasonic sensor. These sensors serve to measure the distance to the Mainland quadcopter, its placement is at the bottom of the body quadcopter.

(Yunifa Miftachul Arif, 2013) Researching on the control system of the robot Hexapod MSR-H01 Use ATMega 128 Microcontroller. A study conducted in the Unfortunate discusses how Hexapod robot control system so that it can run automatically without crashing objects based on ultrasonic sensor input. The object referred to in the study is the barrier object objects that are in front of a hexapod robot. How the placement of the sensors on a hexapod robot.

(Mohammed Al Rashid, paradise and Derisma,2016) researching on Robot Automatic Floor Dryer Using the Fuzzy Method discuss on the application of fuzzy logic on a Wheeled Robot that can move Floor Dryers automatically. Research on fuzzy logic is used to determine the direction of motion of the robot based on ultrasonic sensor input.

The research on fuzzy logic, which was incorporated in the programming of ultrasonic sensor input gain microcontroller, further determined the direction of motion of the robot by means of providing a combination of movement on the right and left of the Dc motor. So that the resulting movement forward, backward, right turn, left turn and stop. Model implementation

of fuzzy logic on such research can be used as a reference as a determinant of the direction of motion of the drones based on ultrasonic study on input.

3. RESULTS AND DISCUSSION

This research was planned to be divided into 3 stages include stage of study literature, stage design, and the final stages of the process. The block diagram is shown on figure 3.

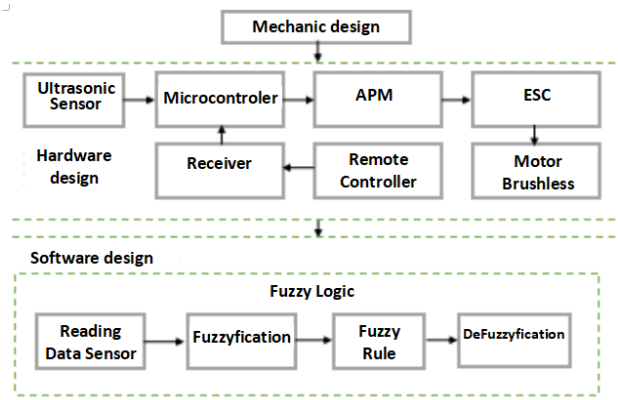

Figure 3. Block Diagram Research

Processing in the Fuzzy it will pass through several stages, namely:
a. Input Crisp
Input a distance from the Ultrasonic sensors include proximity, distance, and the distance in the define as follows:
Near: 0 cm object distance ≤ 125 <
Medium: 100 cm object distance ≤ 175 <
Far: 175 cm object distance ≤ 200 <
b. Fuzzyfication
After getting input from sensors, then conducted the process of fuzzifikasi to get the value of the degrees of membership input. The membership functions of input variables are divided into three, namely sensors, left, middle and right sensor sensor. Any variable input consists of three sets of functions, that are near, and far away.

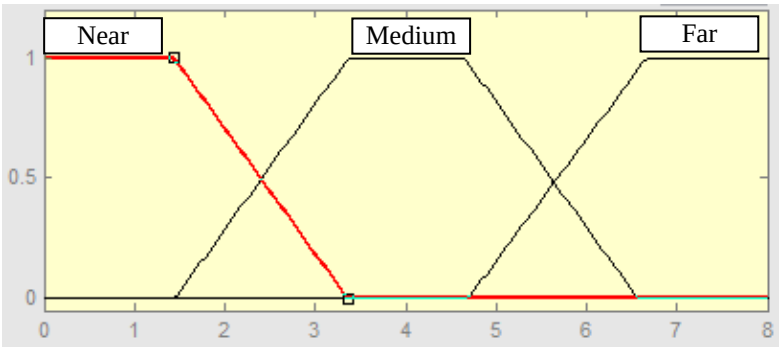

Figure 4. Membership Function

Membership function in Figure 4 are:
Given the following example case, suppose the value of distance towards object generated by the sensors left of 80 cm, 151 cm in the middle of the sensor, and the sensor is right side of 150 cm.
If the distance of the object from the left sensor is of 80 cm, then the value of Fuzzy membership at tipa-each set is:

- Set the Fuzzy close,
- Fuzzy Set medium,
- Set Fuzzy far away,

If the distance of the object from the middle sensor is 151 cm, then the value of Fuzzy membership at tipa-each set is:

- Set the Fuzzy close,
- Fuzzy Set medium,
- Set Fuzzy far away,

If the distance of the object from the sensor right is of 150 cm, then the value of Fuzzy membership at tipa-each set is:

- Set the Fuzzy close,
- Fuzzy set medium,
- Set Fuzzy far away

a. *Rule Base*

The rules are Fuzzy on penghindar quadcopter snag as many as 27 of the rules. These rules can be seen in table 1.

Tabel 1. *Rule Base*

Rule	Right Sensor	Middle Sensor	Left Sensor	Research
1	Near	Near	Near	Back
2	Near	Near	Medium	Turn Left
3	Near	Near	Far	Turn Left
4	Near	Medium	Near	Back
5	Near	Medium	Medium	Turn Left
6	Near	Medium	Far	Turn Left
7	Near	Far	Near	Forward
8	Near	Far	Medium	Forward
9	Near	Far	Far	Forward
10	Medium	Near	Near	Turn Right
11	Medium	Near	Medium	Turn Right
12	Medium	Near	Far	Turn Left
13	Medium	Medium	Near	Turn Right
14	Medium	Medium	Medium	Back
15	Medium	Medium	Far	Turn Left
16	Medium	Far	Near	Forward
17	Medium	Far	Medium	Forward
18	Medium	Far	Far	Forward
19	Far	Near	Near	Turn Right
20	Far	Near	Medium	Turn Right
21	Far	Near	Far	Turn Right
22	Far	Medium	Near	Turn Right
23	Far	Medium	Medium	Turn Right
24	Far	Medium	Far	Turn Right
25	Far	Far	Near	Turn Right
26	Far	Far	Medium	Turn Right
27	Far	Far	Far	Forward

1. Implementation

Process test system is a process to test the system from quadcopter to avoid hitch automatically. This test is conducted to find out whether the system is in compliance with perencanaaan or not. The first test performed on the sensor and then conducted testing of the system as a whole.

In early testing of Ultrasonic Sensor used is the type HC-SR04 which can only detect the distance of the obstacle as far as 135 cm as shown in Figure 5 On the second test, Ultrasonic Sensors are diigunakan is the SRF04 type can detect hitch so far 462 cm as shown in Figure 6.

Middle Ultrasonic : 138 cm
Duration : 8013

Middle Ultrasonic : 137 cm
Duration : 7972

Middle Ultrasonic : 139 cm
Duration : 8072

Middle Ultrasonic : 138 cm
Duration : 8030

Middle Ultrasonic : 139 cm
Duration : 8075

Middle Ultrasonic : 137 cm
Duration : 7979

Middle Ultrasonic : 137 cm
Duration : 7979

Middle Ultrasonic : 138 cm
Duration : 8052

Figure 5. Ultrasonic Sensor test results of HC-SR04

In Figure 5. Visible results testing Ultrasonic sensors SR04-HC inconsistent i.e. sensor can only detect an obstacle as far as 139 cm.

Middle Ultrasonic : 462 cm
Duration : 26849

Middle Ultrasonic : 462 cm
Duration : 26848

Middle Ultrasonic : 462 cm
Duration : 26847

Middle Ultrasonic : 462 cm
Duration : 26853

Figure 6. Ultrasonic Sensor test results SRF04

Look at Figure 6 trial results the SRF04 ultrasonic sensor can detect the obstacle as far as 462 cm. From the results of testing sensors ultrasonic sensors then the previously used is the SRF04 ultrasonic.
quadcopter can avoid obstacle in accordance with Rule Base on table 2 that has been specified.

Table 2. Rule Base Turn Left

Rule	Right Sensor	Middle Sensor	Left Sensor	Result
1	Near	Near	Medium	Turn Left
2	Near	Near	Far	Turn Left
3	Near	Medium	Medium	Turn Left
4	Near	Medium	Far	Turn Left
5	Medium	Near	Far	Turn Left
6	Medium	Medium	Far	Turn Left

In table 2 there are 6 State quadcopter will Turn Left. One is when the right sensor: Near: Far Left, sensor and sensor: Near the middle. as shown in Figure 7.

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Ultrasonic Pulse1 : 47
Ultrasonic Pulse2 : 46
Ultrasonic Pulse3 : 200
Middle sensor : Near
Right sensor : Near
Left sensor : Far
Final Result : Turn Left
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Ultrasonic Pulse1 : 47
Ultrasonic Pulse2 : 47
Ultrasonic Pulse3 : 200
Middle sensor : Near
Right sensor : Near
Left sensor : Far
Final Result : Turn Left
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Ultrasonic Pulse1 : 47
Ultrasonic Pulse2 : 46
Ultrasonic Pulse3 : 200
Middle sensor : Near
Right sensor : Near
Left sensor : Far
Final Result : Turn Left
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Figure 7. Trial results Rule Base Turn Left

CONCLUSION

From the results of the experiment and implementation that has researchers do, you can deduce that can fulfill the purpose Quadcopter to avoid obstruction, Ultrasonic distance sensor test of consistent detection sensor that is 0-

460 cm, Mediumkan of 4 attempts to fly 3 times 1 time successful and failed, and a match between the Rule Base and the results of the experiment keseluhan the system is 75% successful.

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