AUTONOMOUS QUADCOPTER WITH IMAGE OBJECT DETECTION METHOD AS A SENDER OF ASSISTANCE FOR COVID-19 PATIENTS

Muhammad Luthfi Hakim[1], Sigit Yatmono[1], Ariadie Chandra Nugraha[1], Moh. Khairudin[1]
[1]Electrical Engineering Education Dept., Universitas Negeri Yogyakarta, Indonesia
Email: luthfihakim93@uny.ac.id

Abstract - In its development, image processing is very helpful for solving problems that are often faced by humans in general. Image processing is used for technological purposes, especially in the field of computer vision. In this research, the image processing system is applied as a QR code detector in a quadcopter. The quadcopter will detect the presence of a QR Code, after the Qr Code is detected the mechanical system on the quadcopter will drop objects, in this case, medicines for Covid-19 patients, at a predetermined point. The steps needed to complete this research are the design and assembly of the quadcopter, black-box testing, and direct testing of the quadcopter sending medicinal aid. The design and assembly process is carried out in the robotics laboratory of Yogyakarta State University. The black box testing process is used to test the performance of the software in the quadcopter, which uses 3 different types of Qr Code. The experimental testing process is used to test the electronic and mechanical circuits in the quadcopter, whether the circuit can work properly or not. The software used in this research is python IDLE 3.6. The black box testing results show that the system is functioning optimally, where the quadcopter can detect all existing Qr Codes. Whereas in the experimental results, the quadcopter can drop objects at predetermined locations. Based on this test, it can be concluded that a quadcopter can be applied to send medical aid to Covid-19 patients without being controlled/automated.

Keywords: Quadcopter, Image Processing, Black box testing, Qr Code, Python IDLE 3.6, Covid-19.

1. Introduction

Industry 4.0 requires us to develop IoT (Internet of Things) based technology, one of which is in the unmanned aircraft industry, or what we know as a quadcopter. Currently, the use of quadcopter has been widely used, including: as a mapping, civil/commercial platform, agriculture, business, and others. One of the studies on the use of quadcopters in the business world was conducted by Vyas, this research uses quadcopters to deliver packages that have been purchased from online sites [1]. Kim also researched simulating logistics delivery using a quadcopter, research shows that the proposed model provides an excellent operational plan in terms of optimization and computation time. [2].

Quadcopters are also used in various aspects, including technology, safety and regulations, privacy rights, and even war and peace [3]. The rapid development of technology at this time also made several researchers apply quadcopters to the agricultural industry, Ju modeling with a new approach to the Ramadge - Wonham theory, this modeling resulted in control, movement, and obstacle avoidance objectives. [4]. Still, in the agricultural industry, quadcopters are also used as pesticide sprayers, where the research was conducted by Sassu.

The type of quadcopter used is the DJI Phantom 4 Pro, with a maximum weight that can be lifted is 3 kg. Meanwhile, in this study, the weight of the pesticides used was <1 kg [5].

Based on the above study, the authors feel the need to develop a quadcopter application in the health sector, especially for handling patients with Covid-19 who are carrying out self-quarantine. According to research conducted by Rothan, the transmission of the covid-19 virus can be through interactions between one human and another [6]. The COvid-19 virus can also be transmitted from the surface of the work environment, the method of transmission can be through the transmission of respiratory droplets, aerosols, and indirect transmission [7].

The solution to this problem can be done by applying a quadcopter for health purposes, namely by making a quadcopter to send food packages, medicines, and other assistance for Covid-19 patients who are undergoing self-quarantine. The system aims to avoid direct contact with Covid-19 patients.

The process of making a quadcopter is carried out in several stages, namely: design and manufacturing, black-box testing, and testing the performance of the quadcopter in sending packages.

2. Manufacturing Quadcopter

The assembly process is carried out by making a series of electronic systems first (Figure 1), which aims to facilitate the assembly process. Figure 1 shows the electronic circuit in operating a quadcopter to send assistance to Covid 19 patients who are undergoing self-quarantine.

Some of the items needed to create and run a quadcopter to send Covid 19 patient assistance are Mini PC Battery, Mini PC, Main Battery, Motor, ESC, Flight controller, Receiver, Servo Dropping Payload, optical flow, Camera, Power Module, Step Down, Lidar, Flip - flop module, LED Indicator, wi-fi Module, Router and Ground Control statistics.

All these components are assembled so that they can become a complete electronic component unit. Figure 2 shows the installation of supporting components such as the frame and propeller.

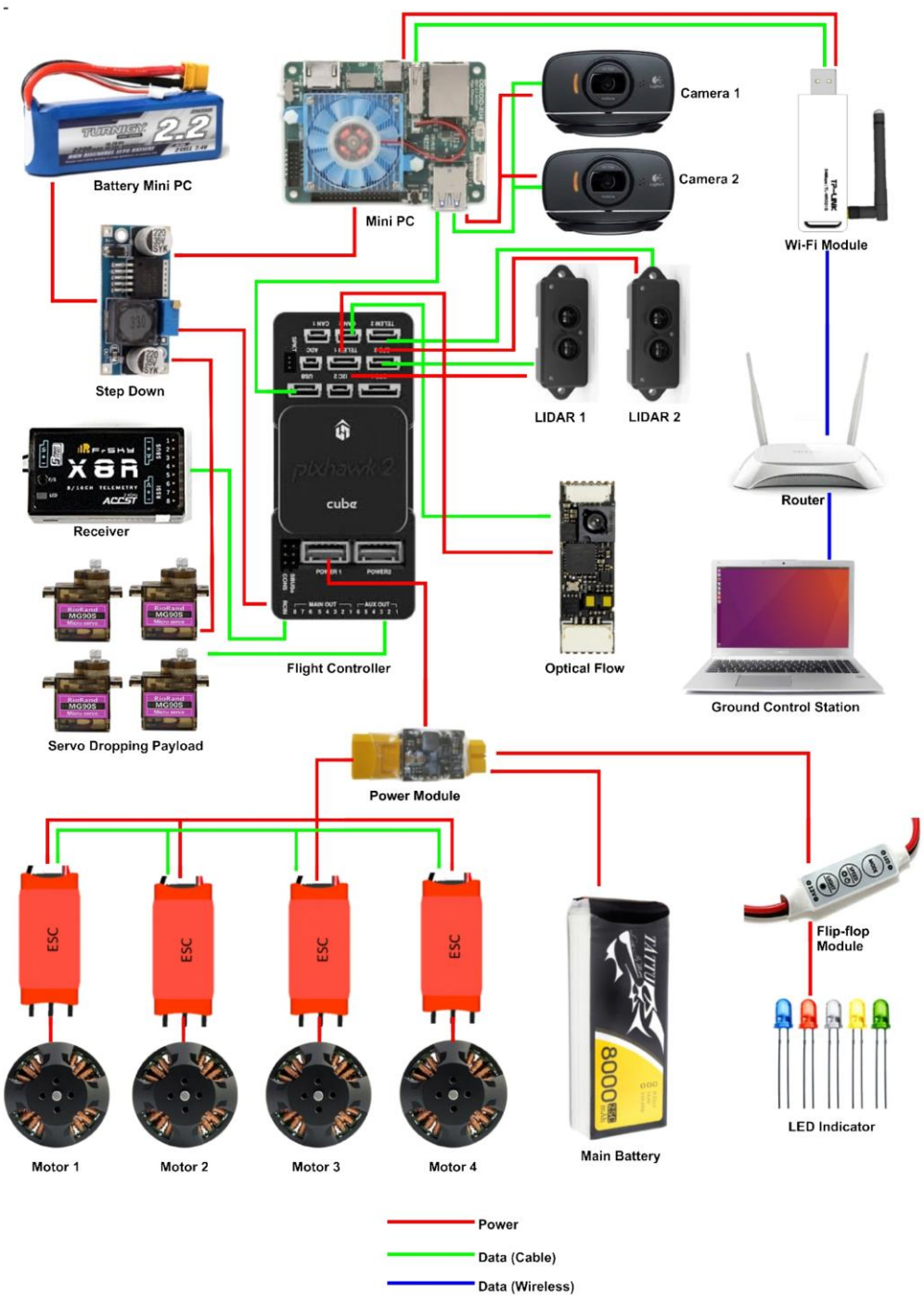

Figure 1. The quadcopter electronics circuit

Figure 2. Assembly of the frame and propeller

Figure 3. Quadcopter Unit

Figure 3 shows the completed assembled quadcopter unit. Furthermore, the quadcopter will undergo several performance tests to determine the quality of the electronic system and all its supporting components. One of the methods used is the black box testing system.

3. Black Box Testing

Software testing is a series of activities that aim to identify errors from the software. In addition, this test aims for constraint estimation, quality assurance, verification, and validation. Software testing can also be used to confirm the quality of the system utilizing systematic software testing, another goal is to identify the correctness and completeness of the software, and finally find errors that are still missing [8].

According to Khan, the purpose of software testing is the more efficient the test shows that the better the performance of the software is easier to control, the testing can be done more optimally and automatically, a successful test is a test that can find unknown problems, and a process to find and the completeness and correctness of the software [9].

One of the techniques used to find errors is black-box testing. This test is a test that aims only to test the fundamental aspects of a system, but there is no relationship with the structure of the internal system. The advantages of black-box testing are: black-box testing is a simple test, has a high level of efficiency for large segments, and the test case stage is rapidly developed. The types of black-box testing can be seen in Figure 4.

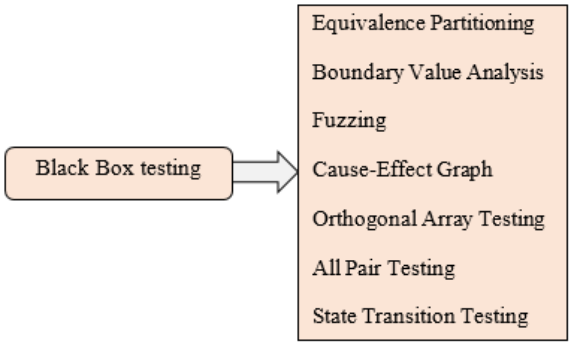

Figure 4. Types of testing Black box testing [9]

According to Dhawan, software testing aims to analyze and check unit devices in determining errors and to conduct checks regarding the difference between actual conditions and expected behavior. [10]. One of the studies on black-box testing was carried out by Fadilaharsa, it can be concluded that if the user states that the function is following what the user understands, then the application features are functioning properly. In other words, black-box testing has an important role to play in knowing the performance of the software that has been created [11].

Research on black-box testing using boundary value analysis was also carried out by Mustaqbal, where the results showed that the functionality test of the software was running well [12]. This research will be carried out by testing the functionality of the Qr Code detection system, where black box testing is selected to determine the performance of the Qr Code detection system.

3.1. Black Box Testing Method

Black box testing is an assumption that this test does not know the algorithm and content of the software. This test aims to determine the performance of the system, or it can also be called a test of the functionality of the system that has been created [13]. In this study, black-box testing was carried out

to determine the functionality of the Qr Code detection system. The schematic of black-box testing can be seen in Figure 5.

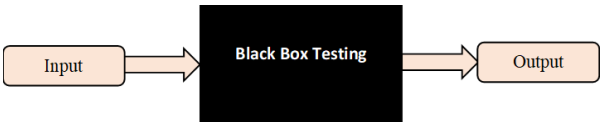

Figure 5. Black box testing scheme

Testing was carried out on 4 types of Qr Code, where 3 types of Qr Code were included in the software and 1 Qr Code was not included in the software (Table 1). The system is introduced with the object / Qr Code to be tested (A, B, and C). The process of object recognition using image processing methods has also been carried out by Khairudin [14]. In this study, image processing is used to detect the presence of a QR code. By detecting the QR code, the quadcopter can correct the position of the QR code.

Table 1. Black-box Testing

No	Qr Code	The number of tests (times)	Information
1	A	3	included
2	B	3	included
3	C	3	included
4	D	3	not included

This study aims to test the performance of the Qr Code detection system, where the output will show that the Qr Code will be detected or cannot be detected by the Qr Code detection system. Each test is carried out three times to determine the performance of the Qr Code detection system. The software used in this research is python idle 3.6. The Qr code detection system is installed on the quadcopter, then the quadcopter will detect the presence of the Qr Code. Figure 6 shows the data retrieval to determine the performance test of the Qr Code detection system.

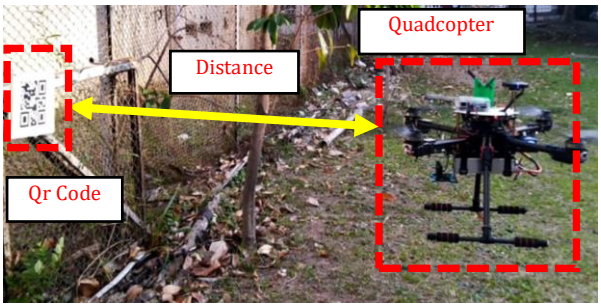

Figure 6 Functionality test data retrieval scheme

3.2. Black Box Testing Result

The black box testing process is carried out using Qr Code, whereas many as three Qr Codes have been inputted into the software and one Qr Code is not entered into the software.

The Qr Code detection system in the quadcopter will detect if the Qr Code being tested is from the three Qr Codes that have been inputted. On the other hand, the Qr Code detection system in the quadcopter cannot detect when the Qr Code used is not of the three types of Qr Code that are inputted. The results of the black box testing on Qr Code A show that the system can detect the presence of the Qr code (Figure 7).

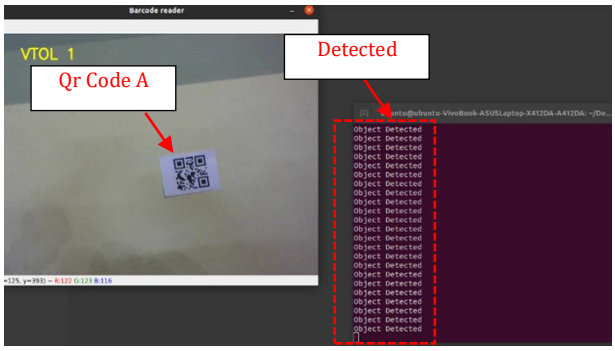

Figure 7 Monitor display of detection results on Qr Code A

The results of the black box testing on Qr Code B are shown in Figure 8, wherefrom the image it can be seen that the Qr Code detection system can detect the presence of Qr Code B. Figure 9 shows the black box testing test carried out on QR Code C, where the test results try to show that the system can detect the presence of Qr Code C.

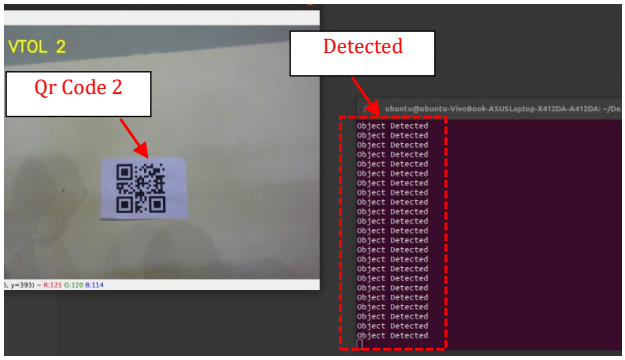

Figure 8 Display results monitor detection results on Qr Code B

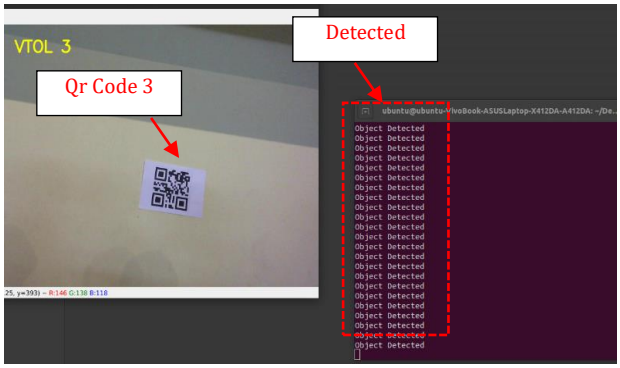

Figure 9 Display results monitor detection results on Qr Code C

The results of the black box testing on Qr Code D are shown in Figure 10, wherefrom the image it can be seen that the Qr Code detection system cannot detect the presence of Qr Code 4. This happens because Qr Code D is not inputted into the software, so it cannot be detected by the system.

The black box testing of the three Qr Code shows that the three Qr codes can be detected by the detection system and conversely one Qr Code cannot be detected because Qr Code D is not inputted into the software, so it can be concluded that the functionality test of the Qr Code detection system is optimal. . Judges also conducted experiments regarding the maximum vertical and horizontal distance of the quadcopter in detecting the presence of the QR Code. The results of this study show that the maximum vertical distance to detect QR Codes is 115 cm, while the vertical distance is 155 cm [15].

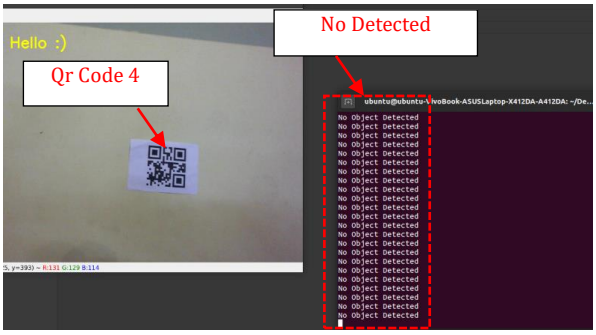

Figure 10 Display results monitor detection results on Qr Code D

4. Experimental Testing

After the black box testing trial phase is complete, the next step is to test the object drop (payload) on the quadcopter. Technically, at this stage, the quadcopter will fly with the assistance mission (payload), based on the path that has been made (Figure 11). The quadcopter will detect the presence of QR Code 1, 2, and 3, then the quadcopter will drop the payload according to the location that has been made. In principle, the quadcopter will move towards the dropping terrace (DT) automatically with odometry. Arriving at the DT, the camera will detect the presence of a QR Code, after the Qr Code is detected it will send a command to the servo to drop the payload.

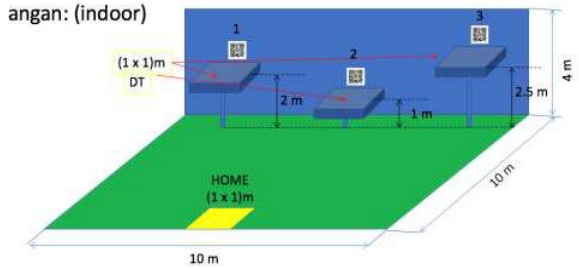

Figure 11. The quadcopter movement flow [16]

Figure 12. Quadcopter movement sends assistance

Figure 12 shows the initial position of the payload when it will be dropped. The quadcopter is seen flying with a stable lift and thrust.

In Figure 13, it can be seen that the payload has fallen, between the fall site and the quadcopter. Then the payload falls exactly at the specified location (Figure 14). The process continues at fall locations 2 and 3.

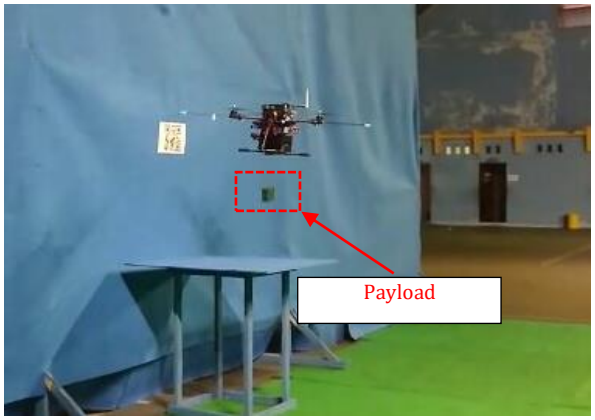

Figure 13. The quadcopter drops the payload

Figure 14. Payload dropped on site

Based on the quadcopter application in dropping the payload, it can be used to deliver drugs, food, and clothing to Covid-19 patients to prevent physical contact between patients and doctors. This method can also reduce the transmission of Covid-19 because in principle there is no direct contact.

5. Conclusions

A study on the use of a quadcopter as a sender of assistance to Covid-19 patients using the image processing method of image detection Qr Code. The results are shown as follows:

1. The black box testing results show that the system is functioning optimally, where the quadcopter can detect all existing Qr Code objects.
2. The experimental results show that the quadcopter can drop objects at predetermined locations, so it can be concluded that the electronic and mechanical circuits are working properly.

Acknowledgments

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