Design of distance sensing and distance using quadcopter drone based on face recognition method

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Abstract. With the development of communication and automation technology at this time, the Robot is widely used as a tool to assist the task of long-distance operations in the army combat unit. Especially for tasks that require high mobilization and tasks that have a relatively high level of danger, therefore the use of Unmanned Aerial Vehicles for remote sensing is developing very rapidly both in the field of civilian and military defense equipment. So in this study the researchers will develop the use of UAVs, especially in the type of quadcopter drones for remote sensing enemy areas. In this case, enemy surveillance still uses a lot of personnel, so monitoring the area requires a large amount of personnel. Conditions like this that can require high concentration and will drain personnel and logistics. The use of this remote sensing robot can minimize the use of TNI AD personnel directly, because in the sensing it is replaced by the role of visualization on the drone and has the ability to determine recognize the enemy by adding a face recognition system, so that later the tool is able to recognize enemies by detecting captured faces by the drone’s camera.

1. Introduction
With the development of communication and automation technology at this time, the Robot is widely used as a tool to assist the task of long-distance operations in the army combat unit. Especially for tasks that require high mobilization and tasks that have a relatively high level of danger, therefore the use of Unmanned Aerial Vehicles for remote sensing is developing very rapidly both in the field of civilian and military defense equipment. So in this study the researchers will develop the use of UAVs, especially in the type of quadcopter drones for remote sensing enemy areas.

Previously on existing research in the International Journal of Innovative Technology and Exploring Engineering 2020, entitled "Face Detection and Recognition for use in Campus Surveillance". Regarding cameras that are able to recognize faces to be used as a campus attendance and minimize the misuse of campus employee identity. This research will raise the same theme as face recognition but it will focus more on the implementation of the quadcopter drone to detect enemies on the battlefield. Determine recognize the enemy by adding a face recognition system, so that later the tool is able to recognize enemies by detecting captured faces by the drone’s camera.

This final project is expected to make it easier to carry out the task of soldiers in the battlefield and better know the strength and strategy of the enemy that will be faced in order to achieve an operational task in battle.
“Face recognition is an important part of the capability of human perception system and is a routine task for humans, while building a similar computational model of face recognition” [1]. Over the most recent couple of decades, facial recognition has been considered the standout among the most imperative applications compared to other biometric-based systems. The facial recognition process can be stated as follows: given a database consisting of many face pictures of known people, one inputs a face picture, and the process aims to verify or determine the identity of the person in the input image” [1,2].

“Video surveillance are increasingly in demand in modern day academic systems. A more creative and strategic interface which helps in detecting and recognizing known and unknown persons inside the campus. Face recognition is a computer technology being used in a various kind of applications which finds human faces in digital images” [3].

“With the aid of a regular web camera, a machine is able to detect and recognize a person’s face; a custom login screen with the ability to filter user access based on the users’ facial features will be developed” [3].

“In the video, the face of a man is captured by a video camera and a special filter processes the image. Next, the task of selecting special points (FFE – Face Feature Extraction) on the image is automatically solved, after which these points (and the distances between them) form a standard by which the comparison is made” [4].

2. Basic theory

2.1. Theory review

Face Recognition Is a biometric method to identify someone based on their face photo. Biometric methods use biological properties to identify people. The human eye can naturally recognize people by seeing it. However, it recognizes people who are known far more easily than perfect strangers. In addition, the concentration range for the human eye is limited. As a result, it is not useful in longer surveillance tasks or comparing hundreds of images to find a match with a photo. Therefore, a computerized method has been developed for facial recognition. Facial identification is important for security, surveillance, and in forensics. Currently, the technology is used by police, forensic scientists, governments, private companies, the military and casinos. The police use face recognition to identify criminals. The company uses it to secure access to restricted areas. Casinos use face recognition to eliminate cheating and dishonest money counters. Finally, in the United States, nearly half of states use computerized identity verification, while the National Center for Missing and Exploited Children uses techniques to in missing children on the Internet. In Mexico, a voter database is compiled to prevent vote fraud. Face recognition technology can be used in a number of other places, such as airports, government buildings, and ATMs (automatic teller machines), and to secure computers and cellphones. Computerized face recognition is based on taking face pictures, extracting features, comparing them with images in a database, and identifying matches. Because the computer cannot see the same way as the human eye, it needs to convert images into numbers that represent various facial features. Set of numbers that represent one face compared to numbers that represent another face.

2.2. Unmanned Aerial Vehicle (UAV)

Unmanned aerial vehicle is a flying vehicle that has the ability to operate without a pilot in the vehicle. UAV is an unmanned aerial vehicle which one of its operations is controlled remotely. UAVs can be, aircraft or helicopters that use a self-contained navigation system. Basically an aircraft, or helicopter can be considered to be an aerial vehicle that can carry out useful missions and can be controlled remotely or have the ability to fly automatically. The US Department of Defense defines the UAV as an air vehicle that does not carry a pilot, uses aerodynamic properties as lift, has the ability to fly autonomously or can be controlled remotely, can be developed, and is able to carry a deadly non-lethal payload.
2.3. Raspberry Pi
This is an SBC (Single Board Computer) computer that is the size of an atm card developed by the Raspberry Pi foundation in the United Kingdom. This product is called Raspberry Pi by its maker, Eben Upton, with the intention to trigger the teaching of basic computer science in Raspberry Pi schools using the online system. A chip (SoC) from Broadcom BCM2853, also includes an ARMv10 processor, 700 MHz-1GHz processor speed and 4 GPUs, Raspberry Pi Model B has 512 MB of RAM, or to store data like a computer, laptops usually use hard drives but this Raspberry Pi only uses a memory card that is commonly used for data storage on both Symbian-based mobile phones, which use Android. Following Figure Raspberry Pi Model B.

![Raspberry Pi Model B](image)

**Figure 1.** Raspberry Pi model.

3. Material and methods

3.1. Tool design

3.1.1. System diagram blocks. The text should be set to single line spacing. Block Diagram System can be seen in the picture below.

![Block system diagram](image)

**Figure 2.** Block system diagram.
3.1.2. System flow chart

![System flow chart](image)

**Figure 3.** System flow diagram.

3.1.3. Research variable

a. Independent variable
   - Pi Camera. Used to capture images in realtime in the UAV, the image will be processed in Raspberry Pi so that it can detect enemies using face recognition.
   - Image. In this case the reception of image data will be very influential to get precise face recognition results.

b. Dependent variable
   - Face recognition. Influenced by the capture of images from the camera and data processing, used to determine the detection of enemies.

3.2. Hypothesis

The hypothesis in this study is that it can detect the presence of enemies using face recognition which is implemented on quadcopter drones.
3.3. Tools and materials
In this study using the appropriate tools and materials, namely:
- The laptop
- Quadcopter Drones
- Camera Pi
- Raspberry Pi

4. Results and discussion
The image capture data obtained by the drone is as follows:

![Figure 4](image1.png)

**Figure 4.** Example of a face recognition photo.

![Figure 5](image2.png)

**Figure 5.** Examples of facial feature training templates used and (b) the resulting typical detections [2].
From the photo above, the grayscale scale can be taken as follows:

| i  | n1 | hi  | n  | i  | n1 | hi  | n  | i  | n1 | hi  | n  |
|----|----|-----|----|----|----|-----|----|----|----|-----|----|
| 36 | 1  | 0.003922 | 255 | 178 | 2  | 0.007843 | 255 | 227 | 1  | 0.003922 | 255 |
| 37 | 2  | 0.007843 | 204 | 1  | 0.003922 | 261 | 1  | 0.003922 |
| 42 | 2  | 0.007843 | 209 | 2  | 0.007843 | 215 | 1  | 0.003922 |
| 38 | 3  | 0.011765 | 186 | 2  | 0.007843 | 248 | 1  | 0.003922 |
| 46 | 1  | 0.003922 | 212 | 3  | 0.011765 | 245 | 1  | 0.003922 |
| 60 | 1  | 0.003922 | 190 | 3  | 0.011765 | 277 | 1  | 0.003922 |
| 69 | 1  | 0.003922 | 230 | 1  | 0.003922 | 256 | 1  | 0.003922 |
| 41 | 1  | 0.003922 | 223 | 2  | 0.007843 | 266 | 1  | 0.003922 |
| 65 | 1  | 0.003922 | 220 | 3  | 0.011765 | 299 | 1  | 0.003922 |
| 71 | 1  | 0.003922 | 219 | 2  | 0.007843 | 281 | 1  | 0.003922 |
| 66 | 1  | 0.003922 | 236 | 1  | 0.003922 | 304 | 1  | 0.003922 |
| 79 | 1  | 0.003922 | 235 | 3  | 0.011765 | 278 | 1  | 0.003922 |
| 85 | 1  | 0.003922 | 244 | 1  | 0.003922 | 293 | 1  | 0.003922 |
| 86 | 2  | 0.007843 | 216 | 2  | 0.007843 | 252 | 1  | 0.003922 |
| 101 | 1  | 0.003922 | 232 | 1  | 0.003922 | 231 | 1  | 0.003922 |
| 91 | 1  | 0.003922 | 217 | 2  | 0.007843 | 197 | 1  | 0.003922 |
| 105 | 2  | 0.007843 | 255 | 224 | 2  | 0.007843 | 255 | 172 | 1  | 0.003922 | 255 |
| 96 | 2  | 0.007843 | 241 | 2  | 0.007843 | 140 | 1  | 0.003922 |
| 90 | 1  | 0.003922 | 218 | 3  | 0.011765 | 133 | 1  | 0.003922 |
| 123 | 2  | 0.007843 | 210 | 2  | 0.007843 | 128 | 1  | 0.003922 |
| 111 | 1  | 0.003922 | 226 | 1  | 0.003922 | 134 | 1  | 0.003922 |
| 109 | 1  | 0.003922 | 211 | 1  | 0.003922 | 125 | 1  | 0.003922 |
| 95 | 1  | 0.003922 | 228 | 1  | 0.003922 | 116 | 1  | 0.003922 |
| 106 | 2  | 0.007843 | 237 | 2  | 0.007843 | 114 | 1  | 0.003922 |
| 104 | 1  | 0.003922 | 206 | 3  | 0.011765 | 99 | 1  | 0.003922 |
| 118 | 1  | 0.003922 | 199 | 1  | 0.003922 | 100 | 1  | 0.003922 |
| 117 | 1  | 0.003922 | 189 | 2  | 0.007843 | 77 | 1  | 0.003922 |
| 108 | 1  | 0.003922 | 192 | 2  | 0.007843 | 76 | 1  | 0.003922 |
| 94 | 1  | 0.003922 | 185 | 5  | 0.019608 | 50 | 1  | 0.003922 |
| 112 | 1  | 0.003922 | 188 | 3  | 0.011765 | 45 | 1  | 0.003922 |
| 130 | 2  | 0.007843 | 229 | 2  | 0.007843 | 28 | 1  | 0.003922 |
| 146 | 2  | 0.007843 | 233 | 1  | 0.003922 | 31 | 1  | 0.003922 |
| 119 | 1  | 0.003922 | 179 | 2  | 0.007843 | 29 | 2  | 0.007843 |
| 122 | 1  | 0.003922 | 200 | 2  | 0.007843 | 19 | 1  | 0.003922 |
| 136 | 1  | 0.003922 | 196 | 1  | 0.003922 | 16 | 2  | 0.007843 |
| 131 | 1  | 0.003922 | 205 | 1  | 0.003922 | 22 | 1  | 0.003922 |
| 132 | 1  | 0.003922 | 207 | 1  | 0.003922 | 18 | 2  | 0.007843 |
| 110 | 1  | 0.003922 | 182 | 1  | 0.003922 | 15 | 1  | 0.003922 |
| 113 | 1  | 0.003922 | 201 | 3  | 0.011765 | 12 | 1  | 0.003922 |
Table 1. Cont.

| i  | n1  | hi     | n  | i  | n1  | hi     | n  | i  | n1  | hi     | n  |
|----|-----|--------|----|----|-----|--------|----|----|-----|--------|----|
| 152| 1   | 0.003922 | 166| 2  | 0.007843 | 8   | 2  | 0.007843 | 166| 2  | 0.007843 |
| 170| 1   | 0.003922 | 176| 3  | 0.011765 | 10  | 1  | 0.003922 | 176| 3  | 0.011765 |
| 193| 6   | 0.023529 | 174| 2  | 0.007843 | 5   | 6  | 0.023529 | 174| 2  | 0.007843 |
| 202| 2   | 0.007843 | 187| 1  | 0.003922 | 6   | 2  | 0.007843 | 187| 1  | 0.003922 |
| 214| 2   | 0.007843 | 145| 1  | 0.003922 | 4   | 7  | 0.027451 | 145| 1  | 0.003922 |
| 142| 2   | 0.007843 | 183| 1  | 0.003922 | 3   | 3  | 0.011765 | 183| 1  | 0.003922 |
| 194| 4   | 0.015686 | 184| 1  | 0.003922 | 7   | 2  | 0.007843 | 184| 1  | 0.003922 |
| 198| 4   | 0.015686 | 191| 1  | 0.003922 | 2   | 4  | 0.015686 | 191| 1  | 0.003922 |
| 163| 1   | 0.003922 | 213| 1  | 0.003922 | 1   | 5  | 0.019608 | 213| 1  | 0.003922 |
| 181| 1   | 0.003922 | 222| 1  | 0.003922 | 0   | 13 | 0.05098  | 222| 1  | 0.003922 |
| 208| 3   | 0.011765 | 180| 2  | 0.007843 |      |    |      |      |      |    |

The histogram scale obtained is as follows:

![Histogram](image)

**Figure 6. Histogram.**

### 4.1. Expected results

- Can detect the presence of enemies with the face recognition method.
- Displays the results of monitoring from the camera into a smartphone / tablet so simplify the enemy reconnaissance process.
- Mapping enemy distribution areas.

![Drone quadcopter](image)

**Figure 7. Drone quadcopter.**
Detection Target Testing Results

The testing process is carried out by means of the camera detecting the target and the data will be processed in a raspberry pi then it will be recognized as a target by robot. Following the test results from the maximum distance of the target detection of face recognition robots are shown in table 2.

### Table 2. Testing results.

| Test | Distance | Result | Remarks       |
|------|----------|--------|---------------|
| 1    | 10 m     | Detected | Face Detected |
| 2    | 15 m     | Detected | Face Detected |
| 3    | 20 m     | Detected | Face Detected |
| 4    | 25 m     | Detected | Face Detected |
| 5    | 30 m     | Detected | Face Not Detected |
| 6    | 35 m     | Detected | Face Not Detected |

From the test results at a distance of 10 meters to 25 m the robot can still detect the target well. At distances above 25 meters the robot cannot recognize the target.

5. Conclusion

From the results above it can be concluded that:

- The robot can detect faces with a maximum distance of 25 meters
- The robot can detect faces according to data already embedded in the database
- Robots can detect faces with a minimum level of data accuracy reaching 48%
- “In this paper we have developed a system for face detection and recognition using opens. It is used to detect and recognize human faces. The images of the persons are the datasets which are defined and trained before recognizing” [3]
- “Haar cascade algorithm is used for detection” [3]
- “For better face recognition and detection small features can be improved. In the coming future, as technology advances, more advance features will be added to the system” [3].

References

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