DRONE HUNTER AND FIRE USE FIRE EXTINGUISHER BALL-BASED IMAGE PROCESSING AND MACHINE LEARNING METHODS

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ABSTRACT

Burning activities are still common in Indonesia, but the handling by the government has not been able to maximize performance in extinguishing fires that are difficult to achieve with standard equipment. The drone that the author developed is named Zerologic which is designed to use a remote monitoring system with machine learning algorithms and image processing methods in finding hotspots using a webcam camera. This camera sends object data which is then processed on the Raspberry Pi 4 using the OpenCV Python software. Besides being designed to search for hotspots, this drone can also minimize the spread of smoke by using a fire extinguisher ball that functions as a fire extinguisher that will be carried directly by the drone. ZEROlogic drones are useful for making it easier for forest firefighters to handle forest fires by finding and extinguishing hotspots that are difficult to reach by humans. In addition to being able to search for and search for fire, this drone ZEROlogic goes directly to the hotspots.

Keywords: Drone; Fire Extingusher Ball; Image Processing; Machine Learning

1.   INTRODUCTION

Indonesia is included in the list of countries with a fairly high rate of forest fires. Reporting from the sipongi.menlhk.go.id page, the total recapitulation of forest and land fires in Indonesia in 2020 covers an area of 296,942 hectares. The application of the law due to forest fires is not clearly specified in Law no. 32 of 2009 concerning Environmental Protection and Management, thus providing flexibility for certain elements to burn forests [1][2][3][4]. In addition to irresponsible individuals, extreme weather is also a major factor in the occurrence of fires. Reporting from the news24.bisnis.com page, the dry season on the island of Borneo in 2020 lasts for five months with a peak in August. Fires do not only have an impact on land but also have a major impact on the environment, especially humans. It was recorded that as many as 291,807 people in South Sumatra

suffered from ARI disease and became the number one province in Indonesia most affected by forest and land fires [5][6][7][8].

Forest fires can be overcome by extinguishing the source of the fire directly and must be done quickly and correctly before the area spreads widely. But the facts obtained from the Kompas.com page, access to the location of the burned land is quite far and difficult to pass. The firefighters had to lay down the bushes to reach the hotspots. This requires firefighters to go directly to the fire area in order to reach the hotspot. Until now, fire extinguishers in Indonesia are low-tech computers. Therefore, technology is needed that can detect forest fires, so that 1omp is quickly extinguished and does not spread [9][10][11][12]. Not only a tool to find hotspots, another thing that is needed is technology that can make extinguishing effective so that it does not cause residual smoke that interferes with the respiratory system in humans, for example ARI.

With the development of the current era, there are tools to ease the work of firefighters that can reduce the risk of exposure above, namely by using drones. Drone is an unmanned aircraft that is controlled remotely using a computer or remote control, which is used to carry weapons and other payloads [13][14][15][16]. From existing innovations, the drone used for firefighting still uses water spraying technology to extinguish fires, which in this way is still less effective because it can cause air pollution. Forest fires produce carbon emissions that are released into the atmosphere [17][18]. Based on these field facts, the author took the initiative to develop innovations in the use of fire fighting drones. In this paper, a search and fire fighting drone is designed that can replace the human role in extinguishing the fire.

The drone, which the author gave the name ZEROlogic, with the latest innovation uses a remote monitoring system with machine learning algorithms and image processing methods in finding the center of the fire from above the forest with a radius of several meters by processing image images using a webcam camera [19][20]. This camera will send object color data to be processed on the Rasberry Pi 3 using the OpenCV Python software. In addition to being able to find the center of the fire, the drone is also designed to be able to extinguish fires in a method that can minimize smoke from burning. For this reason, the authors innovate to use Fire Extinguisher Balls, which are balls like fire extinguishers filled with fire suppression fluid but in the form of a ball with a foam sheath wrapped in PVC [21][22][23][24]. These Fire Extinguisher Balls react quickly to heat and fire so that when the drone drops the ball to a hotspot it will trigger a substance embedded in the ball and respond by spreading the dry chemical fire suppressant inside [25][26][27]. By utilizing mono amunium phosphate which is environmentally friendly and non-toxic, it can minimize the adverse effects of smoke from combustion[28][29]30].

2. LITERATURE REVIEW

2.1 Quadrotor Drone

Drones are aircraft without a pilot. The aircraft is controlled automatically through a computer program designed, or via remote control from a pilot on the ground or in another vehicle. Drones that have an automatic control system without an operator are called UAVs (Unmanned Aerial Vehicles) which are controlled manually or automatically by processing sensor data so that they can be used according to the user's wishes.

This drone uses a pixhawx as flight control, a brushless motor mounted on a 14-inch propeller as an actuator, GPS as a location indicator, and uses a lipo battery as its power source. Having a lift of 6 kg, it allows this drone to carry supporting components such as cameras, Rasberry Pi 3 and Fire Extinguisher Balls. Using a 22.2 mAh lipo battery, the drone has a flight time of 20 minutes at an altitude of 20 meters.

Figure 1. Quadrotor Drone
(Source : Courtesy of Goani Marind, et al)

2.2 Fire Extinguisher Balls

Fire Extinguisher Balls are fire extinguisher-like balls filled with fire suppression fluid but in the form of a ball with a foam sheath wrapped in PVC. This ball reacts quickly to heat and fire so that it can trigger the chemicals embedded in the ball to respond and spread the dry chemical fire suppressant inside By using Fire. With these extinguisher balls, smoke or pollution that is usually generated from combustion by using water spraying technology can be suppressed. This fire extinguishing technology with balls aims to avoid the adverse effects of smoke or pollution from combustion so that it can reduce the number of people with ARI disease.

Figure 2. Fire Extinguisher Balls

(Source : Courtesy of Goani Marind, et al)

2.3 Raspberry Pi 4 and The AMG8833

The Raspberry Pi 4 is a single board type for 4 computers. Basically the Raspberry Pi 4 will function like a brain that will receive and process data detected by the camera mounted on the drone body so that it can determine the image of the detected fire. While The AMG8833 is the next generation of the 8x8 thermal IR sensor from Panasonic. This sensor only supports I2C communication and has a configurable interrupt pin. This sensor can measure temperature in the range from 0°C to 80°C with an accuracy of +-2.5°C. The use of this sensor aims to keep the drone safe from the heat of the fire while flying.
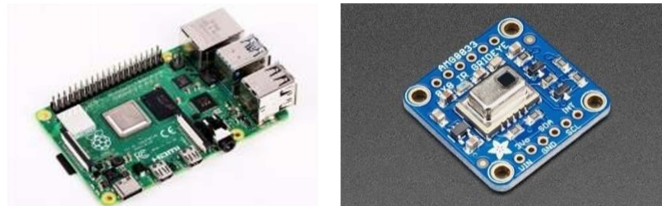
Figure 3. Raspberry pi 4 and AMG8833

(Source : Courtesy of Goani Marind, et al)

2.4 Logitech C930e Kamera Camera

The camera used in this system is the C930e webcam. The C930e's webcam intelligently adapts itself to improve visual quality in low light at various distances and incorporates a 2.4 GHz Intel Core 2 Duo processor. This camera functions to capture and transmit color data for fire objects to be processed on the Raspberry Pi 4.

Figure 4. Logitech C930e Web Webcam

(Source : Courtesy of Goani Marind, et al)

2.5 Machine Learnig

Machine Learning is part of Artificial Intelligence which was developed with the field of statistics to determine an automatic model from a set of data with the aim of giving computers the ability to learn (Advernesia, 2020). In this drone algorithm, the machine learning method serves to determine the presence of fire where the drone will be taught or given training to recognize fire correctly.

2.6 Image Processing

Image Processing is an activity to analyze images (images) so as to produce good information for making decisions. On the drone that the author proposes with this image processing algorithm, there is a process that is passed to achieve good image analysis, namely the first stage of taking pictures from the webcam camera for the intended image data database. The next process is matching the database that has been obtained with the images captured by the webcam camera in real-time, so that the program can compare the stored database images with the images captured by the webcam camera. If it matches the database, the resulting output is a command to match the ball's drop to the center of the detected fire.
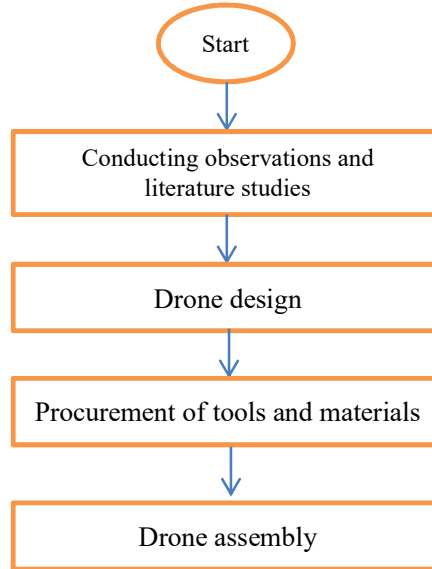

Figure 5. Image Processing
(Source : Courtesy of Goani Marind, et al)

3. EXPERIMENTAL

3.1 Implementation Stage

In the process of assembling this drone, it is carried out in their respective residences with the agreed division of tasks relying on remote communication such as the zoom application. The drone assembly process can take up to 4 months with a pre-designed schedule. Some of the steps that must be taken in this product are : Observing firefighters in handling forest and land fires to find out the problems that often occur. The next step is to do a literature study, look for references from books, local and international journals related to the materials and basis for making the ZEROlogic drone that looks for and extinguishes the fire. The drone design uses the Autodesk Inventor Professional 2018 application by paying attention to the size and precision of the layout of the components attached to

the drone body so that it can be used properly. The selection of electronic components and the procurement of supporting equipment are stages that must be carried out before the process of assembling the ZEROlogic search and fire extinguisher drone. The steps taken at the assembly stage are tool manufacturing, assembling electronic components and the programming process which consists of designing image processing algorithms and machine learning methods.

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   │ Conducting observations │
   │   and literature studies│
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   │      Drone design       │
   └────────────┬────────────┘
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   ┌────────────────────────┐
   │ Procurement of tools    │
   │      and materials      │
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   ┌────────────────────────┐
   │     Drone assembly      │
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Figure 6. ZEROlogic Drone Flowchart

(Source : Courtesy of Goani Marind, et al)

4. RESULTS AND DISCUSSION

After the drjone assembly is complete, it is continued with the testing phase of the tool which aims to find out whether the drone can run well or not. The tool revision stage is carried out if there is an error in the tool that has been made which we can find out in the previous trial stage. If the trial is successful, the drone will be introduced to the community by practicing the use of the tool by the writing team. During socialization, the writing team also monitored regularly to see the level of effectiveness of the tool's work and the level of public interest in the tool. The evaluation stage is carried out to see the level of success of the tool and see the shortcomings of the tool that has been made. The final report is made after all stages are completed so that the results obtained from the manufacture of the tool can be explained in detail.

5. CONCLUSION

ZEROlogic drones are useful for making it easier for forest firefighters to handle forest fires by finding and extinguishing hotspots that are difficult to reach by humans. In addition to being able to search for and search for fire, this drone ZEROlogic goes directly to the hotspots.

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