

DEVELOPMENT OF RESCUE OPERATION DRONE: RESCUE AID DELIVERY MECHANISM DESIGN

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ABSTRACT

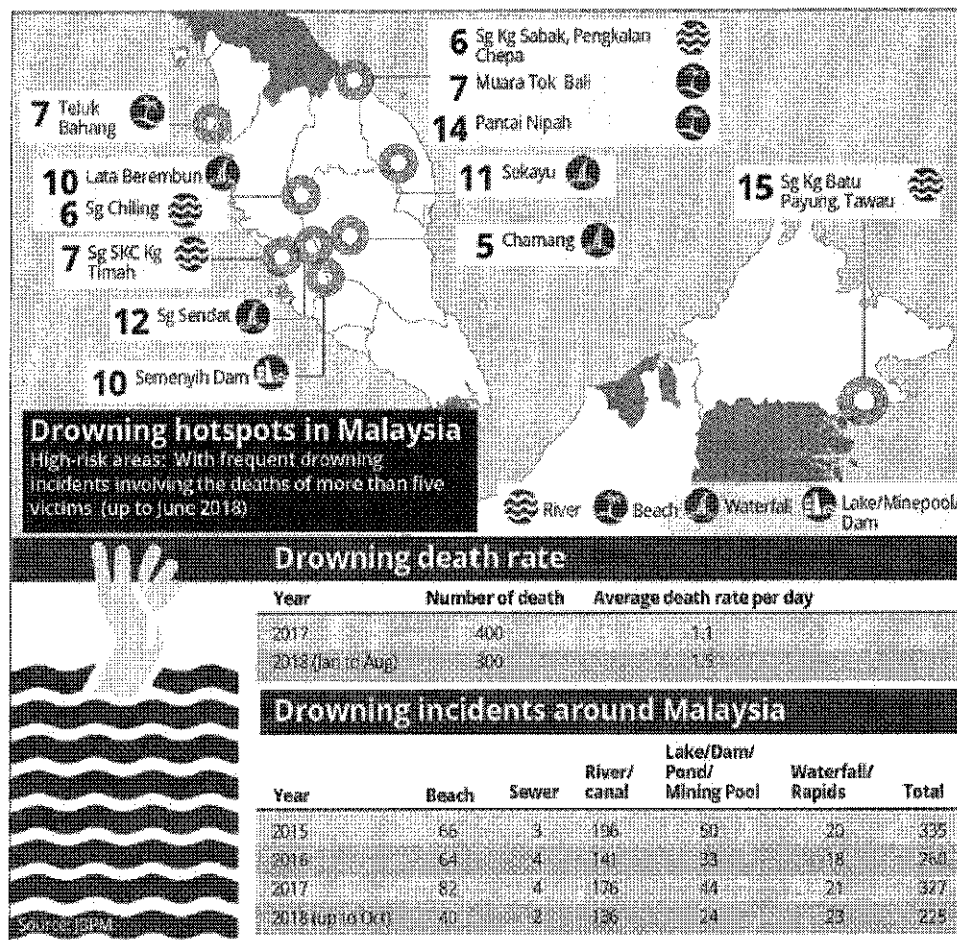
Abstract: Drone is an unmanned aircraft, at early stage drone most associated with the military operation. However, drones nowadays are widely used by civilians in a wide range of purposes. In this study, cover the development of the design mechanism of rescue aid delivery drone. The design of aid delivery mechanism capable to carry the load with up to 4kg employed magnetic mechanism concepts. The Rescue Operation Drone (ROD) classified into two main parts, namely drone trust and delivery mechanics. The specification of drone brand Tarot FY690S made by carbon fibre for the body frame and the propeller. It also equipped by Inflight four flight controller model AT10 2.4GHz 12 channel Transmitter and R12DS Receiver. The drone designed with six motor or hexacopter with 2 kg thrust capability. Hexacopter motor proposed to be used, with ability rotation 10 rpm and connect to delivery mechanism attached with a magnet. Total of four life jackets and other floating aids item can be flown at one time. The rescue aid delivery equipped by a camera that use to locate the victims connected with video transmitter to the controller. The design process was aided by inventor design computer software, and load strength was calculated accordingly to the engineering requirement. This study was successfully designed and will be fabricated and test in the field.

Keywords:

drone, rescue operation, aid item, aid delivery mechanism

1. INTRODUCTION

The problem that arises before the outbreak of the idea to produce this product is based on the statement drowning cases increases throughout the years. Drowning is the process of experiencing respiratory impairment from submersion/immersion in liquid [1]. It is the third leading cause of accidental death, contributing 7% of all injury-related deaths [2]. The World Health Organization (WHO) states that every hour more than 40 people die from drowning, which is 372,000 deaths per year [3]. Malaysian Fire and Rescue Department (JBPM) statistics showed that at least one person dies every day from drowning in Malaysia. The JBPM data indicate that, on average, up to 400 drowning deaths are recorded every year and that is considered to be alarming. The statistics shows river/canal is the most drowning cases occurred, and followed by beach. JBPM stated most of the cases is due to unfamiliar with the water conditions and did not take heed of the weather forecast [4].



[The Star, 16 Dec 2018]

While drowning, the lungs filled with water, and the air sacs inside your lungs to act like a sponge, so it will cause the body denser than the surrounding water and sink to the bottom. In the short term, victims have the tendency to float since their lungs are still full of air rather than water. Lack of oxygen or chemical changes in the lungs may cause the heart to stop beating which is called cardiac arrest. The flow of blood will stop and followed by the transport of oxygen to the brain. The diagnosis of acute heart failure (cardiac arrest) should be made as soon as possible without delay. One should aware that after 3 to 5 minutes there is irreversible damage to brain cells after which each resuscitation is less successful because of progressive brain death [5].

Rescue operations have been evolved throughout the decades[6]. Technologies are used to help in saving more victims. In this era of globalization, various methods of rescue operations have been adopted. This has led to the need for the rescue of the victims in the water to be renewed as the number of drowning victims was at a level of concern[7].

Rescuers should not risk themselves unnecessarily and try to give help from a safe position, using a boat, or by giving flotation object or towing from a distance.

Boats and helicopters are the most vehicles used to save drowning people[8]. The faster and easier way to rescue the victim in the water needs to be discovered. Drones are the fastest way to reach the site and be the very first responder. Including drones in the rescue mission is one of the solutions to deliver a floating object as the first aid for drowning to survive longer before the rescue team arrives. Avoiding the occurrence of a more drowning death, a Rescue Operation Drone: Rescue Aid Delivery mechanism design is invented that can reach victims in water faster than other methods. Life jackets and other floating aids item is attached to the drone, and it drops a cable to do the delivery to be reached by victims. It also equipped with a camera to locate the aid right to them.

2. METHODOLOGY

The concepts are applied in this project will focus on the delivery mechanism that will be invented with a drone and work together for the rescue mission. The design process starts with identifying needs and demand, problem definition, customer need, product specification, concept generation, concept evaluation, and preliminary design[9,10]. The project is focused on the design and development of rescue operation drone and equipped with rescue aid delivery mechanism and a camera to deliver aids item to be reached by victims in the water.

Product Design

Sketch of the project is required to be carried out to demonstrate the appearance of the project done. Designing for this project is by using Autodesk Inventor which is the best way to do 3D modelling and analyze the stress that occurs to each part. This drone will use the X-axis as flight base for the easier controlling and balance to the drone. Technical drawings in detail are made along with the dimensions. Selection of an appropriate design is made to ensure materials and component fulfil the project requirements.

A Drone has its own calculation to choose the right motor to be used. Selecting the right motor is very important because it can lift your drone and have a suitable acceleration. If we fail to choose the right motor, the drone cannot be lifted and the motor

can be broken. So this calculation is worldwide use for choosing the right motor for a drone.

Firstly, the total thrust for a drone to lift it up need to be known. This is very important since it against gravity[9]. The AUW (All Up Weight) must be times with 2 to know the total thrust we need.

Example :

$$\begin{aligned} \text{AUW} &= 1200 \text{ g} \\ \text{Total thrust} &= 1200 \times 2 \\ &= 2400 \text{ g} \end{aligned}$$

The total thrust is already known. Next, the thrust for each motor needs to be calculated. This is important for selecting the right motor for a drone. The total thrust must be divided with the number of motors to be used.

Example:

$$\begin{aligned} \text{Number of motor use} &= 6 \text{ unit} \\ \text{Total thrust} &= 2400 \text{ g} \\ \text{Thrust for each motor} &= 2400 / 6 \\ &= 400 \text{ g} \end{aligned}$$

Thus, for a motor need a thrust of 400 g to lift up the drone. The motor with a thrust around 420 to 460g for this drone must be choosen because it can be a very stable drone when it fly up. If the thrust exceeding 460g, the drone will accelerate and flies very fast. It also can be a racing drone with exceeding thrust it gets. The drawing of the drone for the project is shown in Figure 1 below.

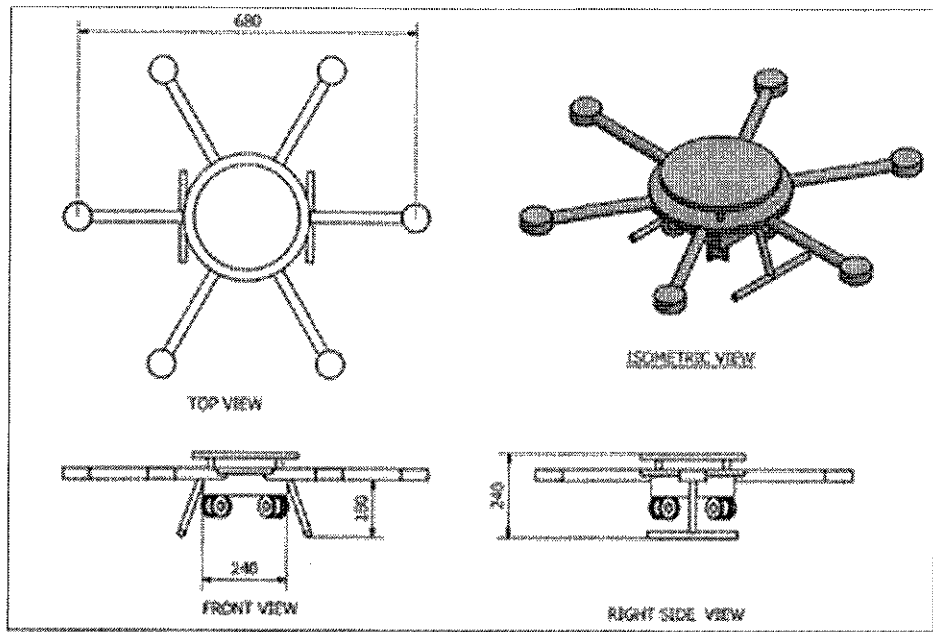


Fig. 1 The drawing of the drone for the project

For the delivery mechanism, a suggestion for using steel tape of normal measuring tape as the cable. The tape moves downward by using low RPM motor and attached to a magnet that will hold the life jacket. The life jacket can be delivered to the drowning victim accurately with the help of the magnet as the victim can easily grip the life jacket. Then, the idea illustrated by using Autodesk Inventor. The drawing one of four of the delivery mechanism attached to the drone is shown in Figure 2 below.

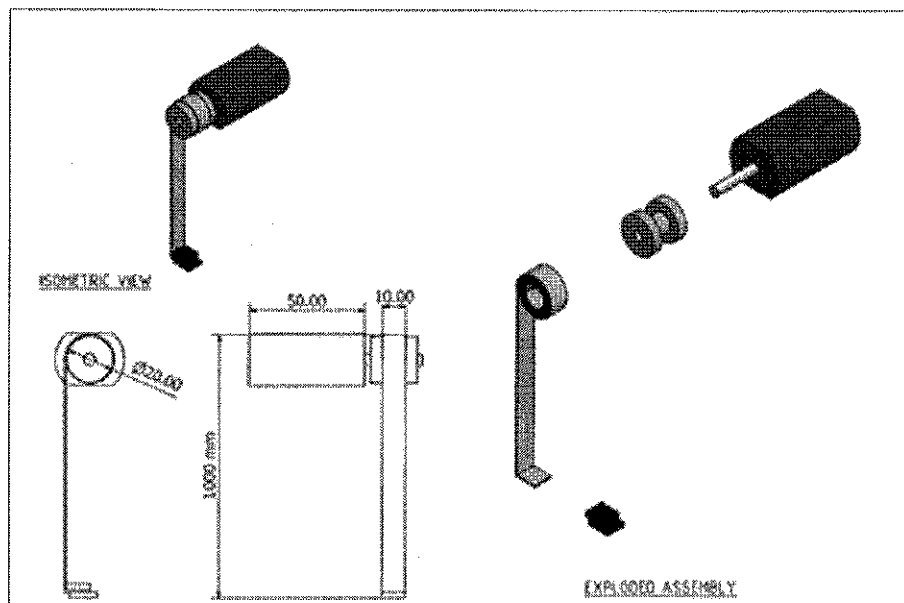


Fig. 2 One of four of the delivery mechanism attached to the drone

Figure 3 below shows the complete project drawing as the delivery mechanism attached to the drone.

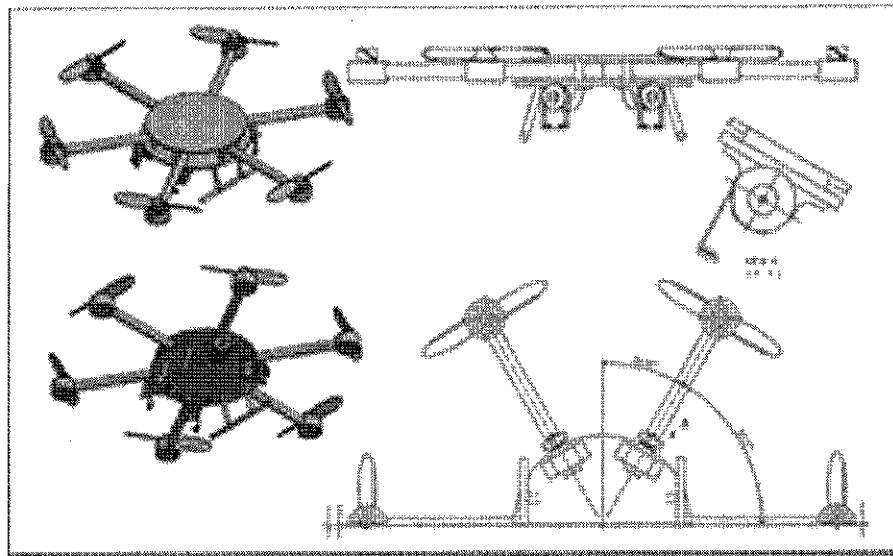


Fig. 3 The delivery mechanism attached to the drone

Product Development

The selection of materials and parts should be made according to the selected design. The project development is from the base to the electronics and mechanical parts. There are two parts of the project which is the drone and the delivery mechanism.

The drone is built within the base. The body or the structure and the propeller of the drone are made of carbon fibre from Tarot FY690S body frame to give more strength and stability. The completion of electronic components is needed in this drone for the flight controller. The flight controller is the nerve centre of a drone. Inflight 6 flight controller is needed. This board has to connect to Electronic Speed Controller (ESC) to send programmed information to motors. The drone is controlled by using Radio Frequency Controller (RF) which the controlling is through radio frequency. This signal refers to a wireless electromagnetic signal used as a form of communication. Model AT10 2.4GHz 12 channel Transmitter and R12DS Receiver must be used as a controller.

A design of a total of six motor hexacopter drone are assemble with 2 kg thruster motor type (750KV Brushless Motor). Because from the theory, this type of motor is better to uplift the drone since the body material of the drone is made of carbon fibre and it is not quite heavy.

A suggestion for using DC motor that can rotate 10 rpm and connect with the steel measuring tape that is attached with magnet for delivery mechanism. The life jackets can be delivered to the victim with the help of the magnet as the victim can easily reach the life jacket.

3. RESULTS AND DISCUSSIONS

Market review

A survey questionnaire as the preliminary study for the development of Rescue Operation Drone: Rescue Aid Delivery Mechanism Design has been conducted to 30 respondents in Polytechnic Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor randomly.

Table 1 The survey result of Rescue Operation Drone: Rescue Aid Delivery Mechanism Design

NO	ITEM	AGREE	DISAGREE
1	Does drone help in the rescue operation?	93.3	6.7
2	Does the aids item such as life jacket need immediately to rescue victims in the water?	96.7	3.3
3	Does the aids item such as life jacket delivered need to be reached by victims?	90.0	10.0
4	Does 'Rescue Operation Drone: Rescue Aid Delivery Mechanism Design' is needed for rescue operation?	90.0	10.0

The result showed that 93.3% of respondents were agreed that drone help in the rescue operation. There are 96.7% of respondents agreed that the aids item such as life jacket need immediately to rescue victims in the water. While 90% of respondents agreed that the aids item such as life jacket delivered need to be reached by victims. Then 90% agreed that 'Rescue Operation Drone: Rescue Aid Delivery Mechanism Design' is needed for rescue operation.

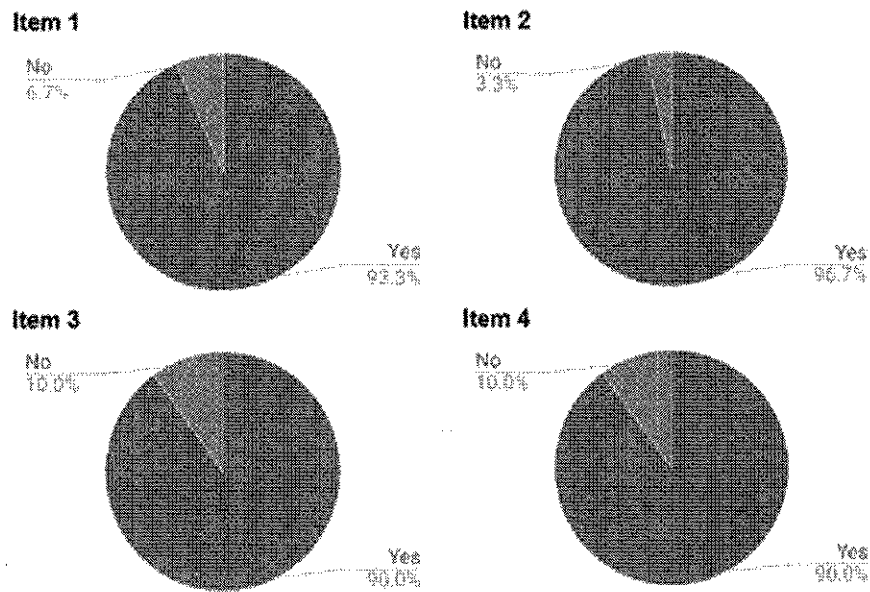


Fig 4 Result of the comparative analysis of the questionnaire

4. CONCLUSIONS

From the survey, majority agree that drone is needed in the rescue operation. This rescue drone can bring along 4 aids item at one time and can deliver the aids item to be reached by victims. The mechanism used to make sure that the aids item can be reached by victims is the attachment of magnetic steel measuring tape to the aids item. The drone is also equipped with a camera and a screen monitor to locate victims and deliver the aid item. Therefore, the development of 'Rescue Operation Drone: Rescue Aid Delivery Mechanism Design' is a necessity to improve in rescue mission.

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