

Design and Analysis of Emergency Rescue Vehicle

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Abstract— Traffic accidents are a result of the convergence of hazards, malfunctioning of vehicles and human negligence that have adverse economic and health impacts and effects. Unfortunately, avoiding them completely is very difficult, but with quick response to rescue and first aid, the mortality rate of inflicted persons can be reduced significantly. Smart and innovative technologies can play a pivotal role to respond faster to traffic crash emergencies comparing conventional means of transportation. For instance, Rescue Emergency Drone (RED) can provide faster and real-time crash site risk assessment to emergency medical services, thereby helping them to quickly and accurately assess a situation, dispatch the right equipment and assist bystanders to treat inflicted person properly. To conduct a research in this regard, the case of a traffic roundabout that is prone to frequent traffic accidents. Emergency Disaster Management Simulation (EDMSIM) has been used to verify the response time of RED from a fire station of the town to the presumed crash site. The results of the study demonstrate the robustness of RED into emergency services to help save lives.

Keywords: Rescue Emergency Drone, Emergency Disaster Management Simulation

I. INTRODUCTION

One of the leading causes of non-natural deaths in the world is traffic accidents. According to statistics of the World Health Organization, in recent years almost 1.25 million people lost their lives worldwide due to traffic accidents, while as many as 20-50 million people suffered injuries, and unfortunately many of them are disabled for rest of their lives.

In the event of a traffic accident, it is vital that a seriously injured person receive medical attention within minutes of the event. Emergency management services need to be well prepared to provide immediate medical help to save lives and enable that person to contribute to the welfare of society again. Some medical experts term the first 60 minutes as the “golden hour” in trauma injuries and emergency medical service (EMS).

It is important to note that average response time to emergencies in the European Union is 10 minutes. And the first 10 minutes according to some experts are termed as ‘Platinum Time’ in response to accidents.

Though every injured person’s severity of injury and initial medical treatment, along with the minimum time required to save their life may differ, achieving this minimum time is crucial. However, a severely injured person suffering either a brain or chest injury must be treated within first few minutes. For example, a cardiac arrest victim must be given first aid within 3-5 minutes, as failure to be treated within this time reduces the chances of survival to as low as 8%.

II. APPLICATION OF RED FOR RESCUING INJURED PERSONS

For the application of an appropriate RED, we considered a system that is either being used or developed for emergency and rescue purposes. The following four RED are considered.

- Camcopter S-100
- Aeryon Lab’s Sky-Ranger
- DJI Phantom 4
- Drone Ambulance



Fig. 1: Camcopter S-100



Fig. 2: Aeryon Lab’s



Fig. 3: DJI phantom 4



Fig. 4: Drone ambulance

Red	Speed	Range
Camcopter S-100	222 Km/H	200 Km
DJI Phantom 4	72 Km/H	4.96 Km
Aeryon Labs	50 Km/H	3 Km
Drone Ambulance	100 Km/H	12 Km

Table 1: SPEED AND RANGE OF EMERGENCY RED

A. Limitations, Discussion & Future Perspectives

Beyond Visual Line of Sight (BVLOS) drones are not approved for flight operations yet in Denmark. It is important to know the acceptability of public towards drones. For this a comprehensive study of risk perception of drones in Denmark needs to be carried out before integrating them into emergency services.

A scientific survey in Esbjerg town should be conducted to determine the risk perception of RED in the public's mind as well as their acceptability towards this new technology and its incorporation into the emergency services.

III. EMERGENCY DRONE



An emergency drone also known as Ambulance Drone is a flying robot (unmanned aircraft) that basically carries a toolbox that contains essential supplies. The goal of the emergency drone is to automatically deliver first aid kits to victims in a short period of time.

A. First Aid and Emergency Kit

An emergency Kit or a first aid kit includes a number of supplies and equipment that can be used to provide medical services to victims. There are currently a wide variety of emergency kits. Their contents are arranged based on the experience and knowledge of those putting them together. The international standard governing first aid kits require them to be identified with the ISO symbol (ISO 7010).

- 1) Alcohol or non-alcohol antiseptic wipes
- 2) Band-Aids
- 3) Cotton Balls
- 4) Cotton Swabs
- 5) Iodine
- 6) Bandages
- 7) Hydrogen Peroxide
- 8) Gauze
- 9) Saline
- 10) Dressings & Eyewas

IV. WORKING PRINCIPLE

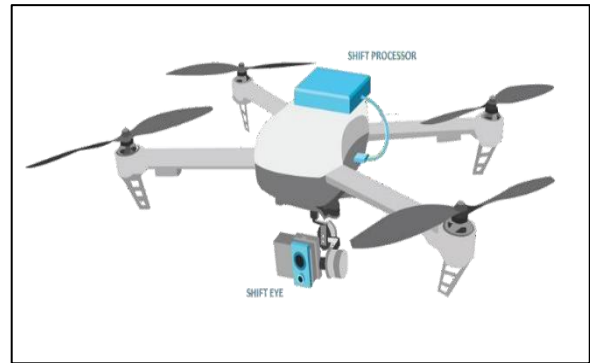


Fig. 4: Ambulance Drone

Using such a system, an Ambulance drone would be capable of finding the location of the phone. This information could be immediately transmitted to emergency responders. On top of that, the Ambulance drone could also be equipped with an audio or video communication system so that the person who receives it could talk to a doctor for assistance.

The first minutes after an accident are critical and essential to provide the right care to prevent escalation. Lifesaving technologies such as an Automated External Defibrillator (AED), medication, Cardiopulmonary Resuscitation (CPR) aids can be designed compact enough to be carried by a drone.

Drones use rotors for propulsion and control. You can think of a rotor as a fan, because they work pretty much the same. Spinning blades push air down. Of course, all forces come in pairs, which means that as the rotor pushes down on the air, the air pushes up on the rotor. This is the basic idea behind lift, which comes down to controlling the upward and downward force. The faster the rotors spin, the greater the lift, and vice-versa.



Fig. 5: Hub with aluminium rails



A. The components/sensors used are as follows:

Arduino UNO: Arduino Uno is a microcontroller board based on the ATmega328P. The Arduino Uno is used in order to drive the transmitter module ECG (Electro-Cardio Gram) sensor: AD8232 is used as the ECG sensor in the prototype. This sensor tracks the electrical activity of the heart. Generally, ECG waveforms seem noisy. The AD8232 sensor

acts as an operational amplifier which yields a good signal without noise. The pulse rate is indicated by an LED.



Fig. 6: ECG Electrodes

B. Advantages:

- Drones and flying robots are relatively small and fast.
- This gives them the ability to respond and deliver emergency equipment faster than any ground transportation.
- the researchers conducted 18 consecutive flights with the drone, with an average flight distance of 3.2 kilometers.
- They compared the dispatch and travel time of the drone with the dispatch and travel time of a traditional ambulance.

4.3 Disadvantages:

- Due to the low battery durability, drones have a short flying time, and this requires them to come back to the starting point every 30 minutes.
- Being relatively low weight and having a considerable amount of electronic and mechanical components, drones cannot fly in turbulent environments such as windy or rainy weathers.
- Governments may sometimes restrict the use of drones when there is an ongoing military operation.
- Drones are not allowed and blocked from entering restricted zones such as military facilities.

V. CONCLUSION

The prototype of “DRONE AMBULANCE” is developed in order to assist ambulances in saving human lives. The developed prototype takes less time to reach the emergency situation spot and helps to measure and transmit real time health parameters of the patient to the ambulance where they can be analysed in the Labview software. This prototype helps in a major irreplaceable contribution in saving the life of a patient and thus fulfils the purpose of “lifesaving”.

The incorporation of RED into the Fire and Rescue Services, the response time can be reduced in giving first aid (by providing first aid kits) or AED CPR guidance/assistance through live instructions to bystanders. Moreover, the assessment of the crash scene can be performed in a faster and more efficient way allowing to dispatch the appropriate vehicles such as fire truck, rescue truck, incident commander and ambulances to deal with the emergency effectively by saving time and precious resources.

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