A Semi-Autonomos Drone for Surveillance and Security

VISHAL JANGRA*,[1], SUNIL[1]

*Corresponding author
[1]B-Tech, Dept. of Aerospace, Chandigarh University,
vishaljangra553@gmail.com*, sunildalal6714@gmail.com

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Abstract: *A semi-autonomous aircraft to provide a real time surveillance in combat and rescue operation. It will fly autonomously ahead of user to find out the threats like distant enemies and traps like landmines. It will provide data about their position and things or ammunitions they have. It will use infrared and thermal imaging for night vision and powerful metal detection to find landmines and other traps. All data can be transmitted directly to the user on a helmet display or wrist screen. It will also provide warning about its findings. For positioning the threats it will provide GPS coordinates of threat. User can also operates it using the control unit.*

Key Words: *drone, GPR, autonomous, flight, landmines*

1. INTRODUCTION

We have designed a drone for the armed forces with a multi-sensor configuration and we have used many techniques to create a complete unique solution to many different problems. We lose many soldiers every years as they defend us. Landmine are the major threat to border security forces because they are all buried and no one detects them without metal detectors. Traditional metal detectors have limitations such as that they can only detect metals only and have a very short range.

The person handling the traditional detector uses a rod on which the metal detector was mounted and to detect metals, the device is kept at a distance of 5-10 centimeters from the ground, where land mines are buried. But this SCOUT-1 EWD has a GPR (Ground Penetrating Radar) mounted on the drone which will be useful for detecting landmines. GPR can detect landmine buried from a height of 8-10 meters above the ground. GPR can not only detect the metal buried in the ground but it can also detect non-metals.

So, the SCOUT-1 EWD will fly ahead of user at a constant distance of 12-15 meters and at height of 8-10 meters during flight it will automatically scan the ground and detect the landmine if buried there.

This will decrease the danger to trigger the landmine on ground by the user. It has infrared sensor and night vision camera which help the user to see through the obstacle and during night, respectively.

When the SCOUT-1 EWD finds landmines or any other threat, it will send the signal to the user by the Bluetooth model and the Head-Mounted Display or the wrist screen will vibrate. SCOUT-1 EWD will also locate the threat and send the location coordinates through the GPS system.

2. OVERVIEW OF SCOUT-1 EARLY WARNING DRONES

A quad-copter with 120-150 minutes of endurance will have a couples of sensors like metal detector, thermal camera, infrared camera, ultrasonic sensor, an HQ camera and a GPS.

The drone will fly autonomously with 12-15 meters ahead of the user and at 8-10 meters height to provide a better view and tactical advance to the ground teams.

The GPR will detect landmines, the thermal camera will help the user to see through obstructions, the infrared camera will provide night vision and the ultrasonic sensor will be used to detect the flight path obstructions and will also provide distance from threats.

The HQ camera will be used for high- definition viewing of the battlefield in real time. The GPS unit will provide location and position of threat by sending geo-coordinate points. Which can be converted into actual location of threat by geocoding services apps (or by programing).

All data will be transmitted on head-mounted display or on the wrist screen using the Bluetooth data transfer network. The head-mounted display or wrist screen will vibrate when it locates the threat.

2.1 Land Mines Detection with Drones

There are variety of landmine types like Blast, Fragmentation, Bounding and anti-tank mines. But there is a similarity between all these landmines namely that all these are made of metal and all these need to be buried. There are different ways to detect all these landmines, too.

2.1.1 Conventional way (Prodders)

This technique is the simplest and most common technique used for metal detection. In this technique, the metal detector is mounted on a rod with handle and the system must hover in the search area.

But it is unable to detect the plastic mines and also it cannot differentiate between real landmines and metallic debris.

2.1.2 Acoustic sensor

In this technique, we release a supersonic wave or acoustic wave in the search area and if there are landmines than the wave comes back after being reflected by the landmine and detected by the sensor.

Using the difference amplitude of the initial release wave and the wave after reflection by the landmine, the sensor will locate the landmines in search area.

2.1.3 Landmine detection through GPR

Landmines can be detect through GPR (Ground Penetrating Radar). GPR can be a complete solution for the metal detector, it does not require many sensors to complete the process of the metal detection.

3. PROPOSED METHOD

GPR (Ground Penetrating Radar) is a complete solution to many problems. It does not require too many sensors, so it makes the drone light, so it will be reliable and a perfect technique for detecting landmines. It will not only detect landmines but it will also show the type of landmine.

Another reason to choose the GPR technique to detect landmines is that drones (having

GPR) can fly at height of 8-10 meters. So we don't need to fly close to ground to detect the landmines.

Ground Penetrating Radar (GPR) has a high electromagnetic radiation technique which help the GPR finding the object buried deep inside the ground. GPR includes a high impulse generator and two antennas, one antenna is used to transmit the signal and other antenna is used for receiving the signal [3].

3.1 Ultrasonic Sensors

Figure 1. Ultrasonic sensor

Ultra sonic sensors are used to measure the distance to the object. This sensor has two eyes: one is the Transmitter and other is the Receiver.

The working principle of ultrasonic sensor based on the high school formula is: **Distance = speed × time** [2]. The transmitter transmits an ultrasonic wave, than the wave strikes the object and reflects back to the receiver of the sensor, as shown in the figure below.

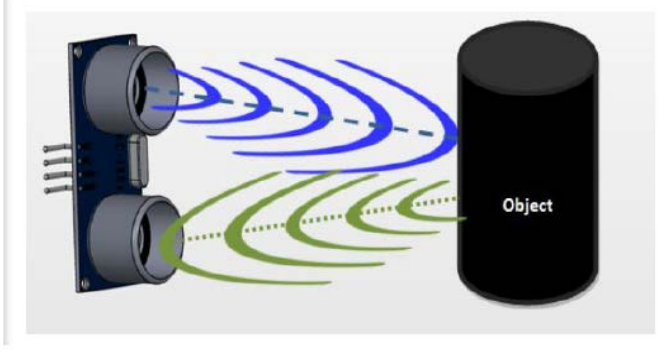

Figure 2. Working of ultra sonic sensor

The wave travels in the air and we know that the speed of sound in room conditions is 330 m/sec, and the sensor will calculate the whole time period for wave transmission and wave reflection. If we know the speed and time than we can easily calculate the distance.

So the importance of the ultrasonic sensor is that it will provide a stable height to the drone from the ground and a constant distance from the user. It will also prevents the drone from hitting with other objects.

3.2 Infrared Sensor and Thermal Imaging Sensor

The infrared sensor and the thermal sensor have a minor variant of 'infrared' but with differences in the spectral ranges. IR system uses the short wavelength infrared light to illuminate the required area.

Some of the infrared energy is reflected back to the camera and generates an image. Thermal imaging sensors use mid-range or long wavelength IR energy, these only sense the difference between the heats.

We used both infrared and thermal imaging (night vision). The infrared sensor will be used to locate the threats behind the obstacle (like walls, in houses etc.) because sometime enemies hide behind walls (as obstacle) so we can easily find out the location of the threat.

The night vision will be used to see during battle at night. Night vision uses the surrounding visible light and magnifies it and sends it back to the camera for image processing.

4. CONCLUSIONS

The SCOUT-1 Early Warning Drone will be useful in reducing the number of the accidents and loss of lives due to landmines and terrrorist attacks. It may not be able to reduce by 100% the risk of losing lives, but it may ease by 70% -80% the activity of our armed forces on the battlefield. It will help our soldiers defend themselves from enemies and to destroy them. It is easy to operate. We can use it in two ways. First of all, it will operated by itself i.e. Autonomously and second way to use of use being by remote control. This drone is a complete solution for our armed forces against threats. It is multi- functional and we can use it for several activities, also for the detection of landmines. Between year 1993 to 2018 in India we lost 3832 people, including civilians and soldiers.

1. Reduce the risk of losing lives because of landmines.
2. Help the soldiers find the threats at night and the ones camouflaged behind the obstacles.
3. It is easy to operate for the user.

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