

# **SOCIETY OF AUTOMOTIVE ENGINEERS**

## **AERO DESIGN CHALLENGE 2021**

### **APPLICATION REPORT**

Submitted by



**OSPReY**

**ADC20210128**



**TKM COLLEGE OF ENGINEERING KOLLAM**

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## ANNEXURE B

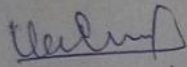
2021 SAEISS AERO DESIGN CHALLENGE

## STATEMENT OF COMPLIANCE

## CERTIFICATION OF QUALIFICATION

Team Name	OSPREY
Team ID	ADC20210128
College/University	TKM College of Engineering
Faculty Advisor	AHANMAD VAZIM
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As Faculty Advisor, I certify that the registered team members are enrolled in collegiate courses. This team has designed, constructed and/or modified the radio controlled airplane they will use for the SAE Aero Design Challenge 2020 competition, without direct assistance from professional engineers, R/C model experts or pilots, or related professionals.



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Signature of Faculty Advisor

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Note: A signed scanned copy of the statement should be included in your Design Report Page 2

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## CHAPTER 1: LITERATURE REVIEW

### *Are women safe in India?*

In a recent survey on Safety of Women, a study was released that ranked India as the most dangerous place because of its high incidences of sexual violence, lack of access of precautionary security measures. Problems may come from any direction such as women walking on the road, after the work, going to super market or for many other reasons for which they go alone. People at home are not sure of their return safely. Our design mainly focuses on the safety of Women 24x7 by using fixed wing UAVs to avoid the crime against women.

In a journal by Mason and Shoshana Magnet (2012), the authors seek to place questions of surveillance technologies into a theoretical framework that foregrounds the challenges that new surveillance technologies pose to anti-violence movements. In WHO report (2013), violence against women is a global public health problem, 35% of women worldwide have experienced either physical or sexual intimate partner violence or non-partner sexual violence. A journal published by Nicole Westmarland and Mariann Hardey (2013) discuss on protecting women's safety. The main purpose of their study is to explore the use of smartphones in relation to domestic and sexual violence.

In a project by V.Thoovayan on women security (2014), proposes an automated highly reliable women security device which consists of the advanced sensors embedded in a wearable dresses. It monitors the heart beat-rate, temperature and vibration in body through sensors to check for uneasy situation. A journal published by Archana Naik, Monika Monu(2014), proposes a portable device as a belt which is automatically activated based on the pressure difference crosses over the threshold in unsafe situation. A GPS module track the location and sends the emergency messages and also activates a siren to call out for help and also generates an electric shock as self-defence.

A Journal published by M. Monisha and G. Pavithra(2016)proposes the advanced automatic technique to predict the unsafe situation based on the female emotion. At a higher altitude, camera is placed to obtain the body movements as well as to provide the surveillance. It checks the gender based on the facial features to identify at least one female to activate the system using Facial Expression Reorganization System. The system is able to capture and store the face expression of suspect as for the evidences.

## CHAPTER 2: SCOPE

The design helps to support the gender equality by providing a safe environment to women in the society, and allows them to work till late nights. Anyone before doing any crime against the women will be deterred and it helps in reducing the crime rate against the women. The existing system proposed for women safety using drones has not been implemented yet. Several women safety mobile applications have been developed and available in the app store but none have been utilized efficiently mainly due to lack of immediate assistance and awareness among the citizens. The drones are emerging technology which are widely used for surveillance but integration of mobile application or a GPS pendant with a drone controlled through the base station (connects people with police authorities) has not been implemented in India as the technological change or new requirement from user to enhance the functionality of product may require new version to introduce. New features which enhance the system functionality can be added without any major changes to the entire system, some of which are:

**School Children Safety:** As the school children safety are major concerns for parents as well as school management due to the recent incidents of child crimes like children missing, abuse etc. The UAVs monitor the child safety when they are travelling to school by walk or any sort of vehicle. Once they reach the school the device (GPS pendant in ID cards) gets deactivated by school authority and message could be sent to parents that their child has reached the school safely. At return journey again the device could be activated by school authority and when they reach home, an acknowledge message can be sent to the school when parents deactivate the device.

**Vehicle Safety System:** The safety of four wheeler cars and motorbikes is a major concern in the society due to the increase in the crime rate of stolen vehicles. An android mobile device, a hardware circuit with a switch and a GSM modem embedded should be installed in the vehicle, so that whenever a missing case is reported, UAVs could help in easily tracking its location.

**Indoor safety:** The design could be used to detect the spy camera placed at hotel, changing room and inform the user about the same, and hence provide safety from capturing the offensive photograph or videos using camera detectors. Hidden camera detector is a radio frequency receiver, which picks up electromagnetic signals that are broadcasted from electronic device such as spy camera. By moving this detector, we are able to alert the user about the hidden camera. It lights up when it receives a strong frequency

In future the functionality of the equipped UAVs can be generalized to various real time problem assistance such as immediate medical assistance, surveillance of a particular area, control of mob through smoke bomb added to the UAV. An army of drones could be deployed for the practical purpose.

## **CHAPTER 3: ADVANTAGES**

- Reduced response time for any incident with patrol vehicles, dash-cam enabled vehicles, UAV etc.
- Improved awareness and security through laws and programs, safety through structured and strengthen outreach programs for citizens.
- Reduced crime rates due to continuous monitoring and immediate response.
- Tracking of the accused becomes easier due to the capturing of the live location which is stored in database for later use.
- Provides surveillance, monitoring and management of the crime scene.

## **CHAPTER 4: CHALLENGES**

- The design will be restricted to those using mobile phones where majority of rural people lack knowledge.
- The speed at which the UAV reaches the location cannot be compromised.
- The misuse of this technology may deter this from being a practicality.

## CHAPTER 5: MISSION PROFILE & PROCEDURE

Panic button on the mobile application clicked by Victim.

A signal from the mobile app sent to the control center.

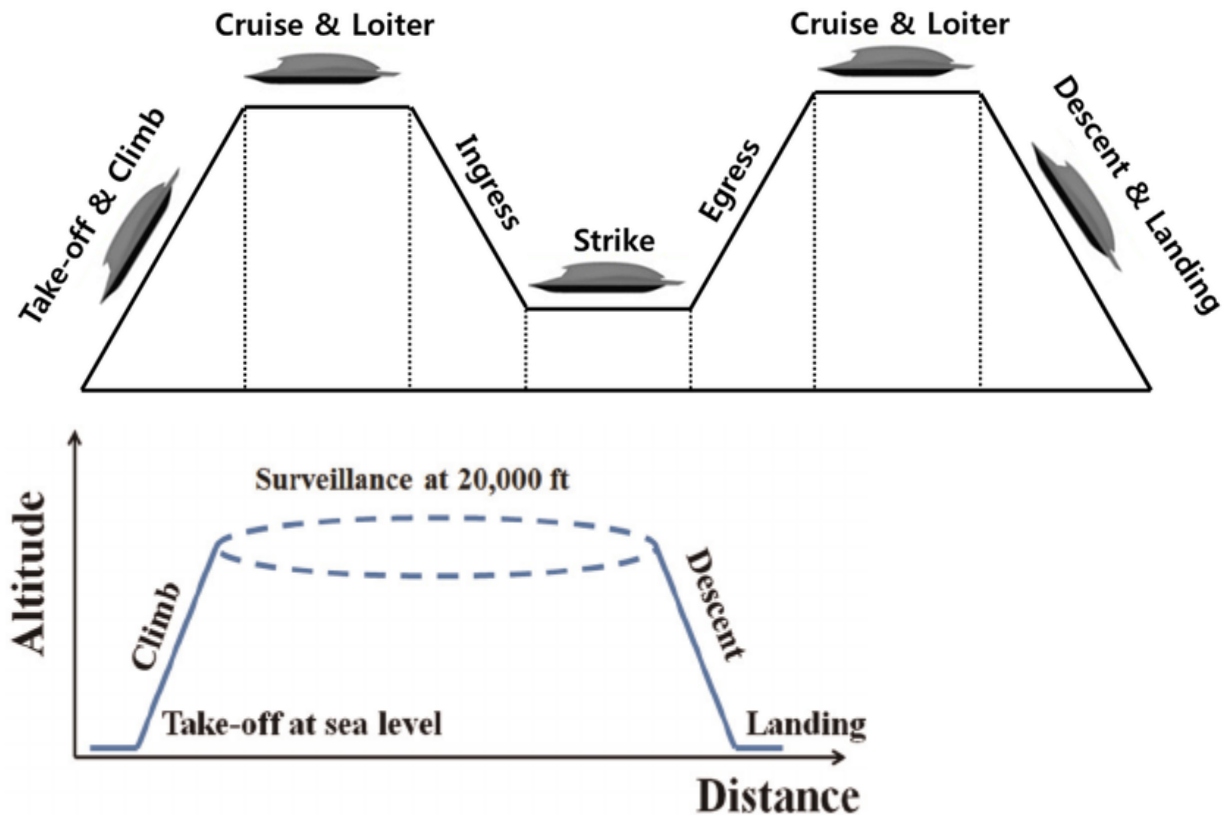
Location of victim found by GPS on victim's phone.

UAV launch from nearest service point.

GPS coordinates sent an emergency alert message to nearest police station.

UAV reaches the target place along with camera and buzzer.

The mission of the UAV includes take-off, acceleration and climb, cruising at subsonic speed, loitering, striking a target, cruising at top speed, and landing.



The **taking-off** UAV is attached to the sledge. During take-off, the sledge with plane is accelerated by a linear electrical driver. During landing/recover operation the procedure is reversed and the air plane is intercepted and halted by the sledge. The system needs 20-meter runway to assure the operation of small UAVs.

The aircraft should be launched straight into the wind as to maximize the initial airspeed of the aircraft. The goal of the takeoff controller is to maintain the course towards the wind and ascend the aircraft in a controlled fashion. While it is primarily only in the beginning of a takeoff that it is of great importance to launch straight into the wind it is desirable, from the point of view of the operator, for the aircraft to maintain its course making it easier to plan the takeoff and avoid any obstacles.



**Surveillance** is the close observation of the person, in this case the molester and the woman. Here the method of surveillance is camera observation. Aircrafts can be equipped with various types of surveillance equipment that can collect high definition video and still images day and night. A major development for security and surveillance industries is the recent design of a tactical gimbal for a tactical drone capable of keeping a moving target of interest at the center of the image plane. A region-of-interest that encloses the target's image is generated through the combination of a visual object detector and a visual object tracker.

The proposed solution combines a fast and reliable deep learning visual object detector and tracker, suited for low computational power implementation with built-in capabilities to guarantee convergence of the target image to origin of the image plane even to the extent of human face detection and tracking.

**Landing** should always be done towards the wind and preferably straight into it, if there is side-wind present the aircraft will approach the landing area slightly sideways and should, at last possible moment, align itself in the direction it moves before touchdown. The main controllers during the approach and flare are the elevator and the throttle that both have an impact on the angle of attack which in turn also affects the velocity of the aircraft. In broad terms landing consists of four stages, where the first stage concerns aligning the aircraft with the landing area and position itself for the next stage. The second stage, the approach, descends the aircraft towards the touchdown point in a constant glide slope. The third stage, the flare, concerns with the last adjustments before touchdown with the goal of reducing the vertical speed, transition to a desired touchdown attitude and aligning the aircraft in the direction of the aircraft velocity vector. The fourth stage concerns with stopping the aircraft on the ground. In a belly landing the high friction between the aircraft and the ground will inevitably slow the aircraft to a complete stop in such a short amount of time that there isn't much room for adjustments after touchdown. A runway landing on the other hand is more delicate, taking much longer to slow down and requires much more care after touchdown, making sure that the aircraft stays on the runway and doesn't fall over.

## CHAPTER 6: COST & SPECIFICATIONS

- Smart bracelet
  - A) Pulse Rate Sensor
  - B) GSM Module
- Women Safety App : SURAKSHA
- UAV
  - C) GPS Module.
  - D) Camera
  - E) Buzzer
  - F) Raspberry pi

SL.NO	COMPONENTS	SPECIFICATION	COST
A.	Pulse Rate Sensor  (Heart rate detector)	<ul style="list-style-type: none"> <li>• It works in four frequencies range from 1.2GHz to 1.6GHz.</li> <li>• It works with either a 3V or 5V Arduino.</li> </ul>	Rs.120.00
B.	GSM Module  (SIM900A GSM Module with SMA Antenna)	<ul style="list-style-type: none"> <li>• Quad-Band 850/ 900/ 1800/ 1900 MHz</li> <li>• GPRS multi-slot class 10/8</li> <li>• GPRS mobile station class B</li> <li>• Dimensions: 48.5* 50 * 13 mm</li> <li>• Weight: 3.4g</li> <li>• Control via AT commands (GSM 07.07, 07.05 and SIMCOM enhanced AT Commands)</li> <li>• Supply voltage range: 3.4 ... 4.5 V</li> <li>• Low power consumption</li> <li>• Operation temperature: -30 °C to +80 °C</li> </ul>	Rs.799.00
C.	GPS Module  (Ublox NEO-6M GPS Module)	<ul style="list-style-type: none"> <li>• Operating temperature range: -40 TO 85°C</li> <li>• UART TTL socket</li> <li>• Rechargeable battery for Backup</li> <li>• The cold start time of 38 s and Hot start time of 1 s</li> <li>• Supply voltage: 3.3 V</li> <li>• Configurable from 4800 Baud to 115200</li> </ul>	Rs.320.00

		Baud rates. (default 9600) <ul style="list-style-type: none"> <li>• SuperSense<sup>®</sup> Indoor GPS: -162 dBm tracking sensitivity</li> <li>• Separated 18X18mm GPS antenna</li> <li>• 5Hz position update rate</li> </ul>	
D.	Camera	(Raspberry Pi Infrared IR Night Vision Surveillance Camera Module 500W webcam) <ul style="list-style-type: none"> <li>•Supported Video Formats: 1080p @ 30fps, 720p @ 60fps and 640x480p 60/90 video</li> <li>•Fully Compatible with Raspberry Pi 3 Model B.</li> <li>•Small and lightweight camera module.</li> <li>•Plug-n-Play camera for Raspberry Pi 3 Model B.</li> </ul>	Rs.1,190.00
E.	Buzzer	INEKO 5Pcs 3-24V Small Enclosed Piezo Electronic Buzzer Alarm 95DB w/Wires	Rs.229.00
F.	Raspberry Pi (Raspberry pi pico)	<ul style="list-style-type: none"> <li>• 1 mm × 51 mm form factor</li> <li>• RP2040 microcontroller chip</li> <li>• Dual-core Arm Cortex-M0+ processor, flexible clock running up to 133 MHz</li> <li>• 264KB on-chip SRAM</li> <li>• 2MB on-board QSPI Flash</li> <li>• 26 multifunction GPIO pins, including 3 analogue inputs</li> <li>• 2 × UART, 2 × SPI controllers, 2 × I2C controllers, 16 × PWM channels</li> <li>• 1 × USB 1.1 controller and PHY, with host and device support</li> <li>• 8 × Programmable I/O (PIO) state machines for custom peripheral support</li> <li>• Supported input power 1.8–5.5V DC</li> <li>• Operating temperature -20°C to +85°C</li> </ul>	Rs.229.00

**TOTAL COST: Rs.2,887.00**

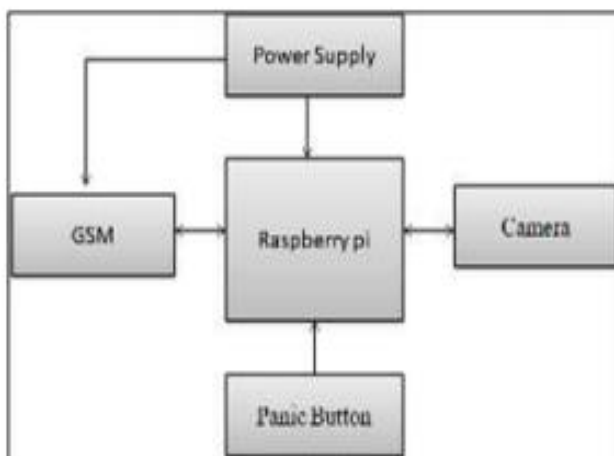
## CHAPTER 7: DETAILED DESCRIPTION & WORKING

**Women Safety Android App “Suraksha”** helps notify friends, family members and control room, if the situation takes picture of the surrounding (both front and back camera), with just a push of a button.

**Working:** User has to install the App on their android phone and register using respective Aadhar IDs and add close family and friends’ mobile numbers and Email Ids which will be used to alert when user raises an alarm.

It will send all the details related to your location with just a tap of a button. GPS tracking device helps you to track people in real-time. The app will send an SMS to a preconfigured number along with your location.

The app will also click two pictures with the front and rear camera, which are directly uploaded to the server.



**Buzzer** which is fixed in UAV alerts the nearby pedestrians of the alert situation.

**Working:**

Immediately starts to make siren sound when it gets the signal from the app or bracelet.

**Camera** captures the images and videos of crime scene and molester.

**Working:**

Focus light and HD camera video shooting.

On approaching the location, drone will shoot pictures followed by continuous video shooting which will be transmitted to the nearest police station. The camera also has the provision of infrared imaging system to enable night vision.

**GSM module** will send the message to relatives and also to the police. So, the relatives and the police can reach to women to help her immediately.

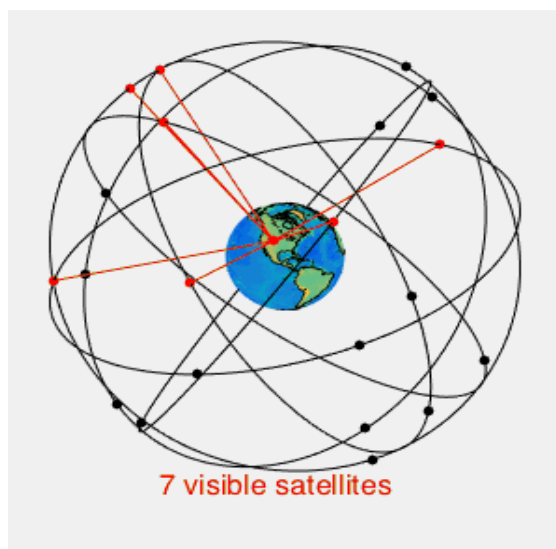
**Working:**

When women sense danger the button is to be pressed, thus sends emergency message using GSM to saved contacts & police control room.

Whenever switch is pressed the current location is send through GSM to receiver side. In this the smartphone is not required like other systems, without smartphones the device operates. Whenever the women feel unsafe, by pressing switch of the device, she can get help.

**Raspberry pi** is integrated with a pulse sensor, GPS module, and a GSM module. When a woman is in danger the alert will send manually to the concerned authorities.

**GPS module** is used to track the current location of victim with the help of latitude and longitude of receiver. GPS receiver needs to receive data from at least 4 satellites for accuracy purpose. GPS receiver does not transmit any information to the satellites. This GPS receiver is used in many applications like smartphones, Cabs, Fleet management etc.



## Working:

GPS receiver uses a constellation of satellites and ground stations to calculate accurate location wherever it is located.

These GPS satellites transmit information signal over radio frequency (1.1 to 1.5 GHz) to the receiver. With the help of this received information, a ground station or GPS module can compute its position and time.

## CHAPTER 8: CODE AND ALGORITHM

### Android App Code:Suraksha

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.suraksha.womensafetyapp"
    android:versionCode="1"
    android:versionName="1.0" >
    <uses-sdk
        android:minSdkVersion="8"
        android:targetSdkVersion="18" />
    <uses-permission android:name="android.permission.ACCESS_FINE_LOCATION" />
    <uses-permission android:name="android.permission.INTERNET" />
    <uses-permission android:name="android.permission.SEND_SMS" />
    <uses-permission android:name="android.permission.READ_PHONE_STATE" >
    </uses-permission>
    <application
        android:allowBackup="true"
        android:icon="@drawable/ic_launcher"
        android:label="@string/app_name"
        android:theme="@style/AppTheme" >
        <activity
            android:name="com.suraksha.womensafetyapp.MainActivity"
            android:label="@string/app_name" >
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />
```

```
<category android:name="android.intent.category.LAUNCHER" />
</intent-filter>
</activity>
<activity
    android:name="com.suraksha.womensafetyapp.Register"
    android:label="@string/title_activity_register"
    android:parentActivityName="com.suraksha.womensafetyapp.MainActivity" >
    <meta-data
        android:name="android.support.PARENT_ACTIVITY"
        android:value="com.suraksha.womensafetyapp.MainActivity" />
    </activity>
    <activity
        android:name="com.suraksha.womensafetyapp.Display"
        android:label="@string/title_activity_display"
        android:parentActivityName="com.suraksha.womensafetyapp.MainActivity" >
        <meta-data
            android:name="android.support.PARENT_ACTIVITY"
            android:value="com.suraksha.womensafetyapp.MainActivity" />
        </activity>
    <service android:name="com.suraksha.womensafetyapp.BgService" />
    <activity
        android:name="com.suraksha.womensafetyapp.Instructions"
        android:label="@string/title_activity_instructions"
        android:parentActivityName="com.suraksha.womensafetyapp.MainActivity" >
        <meta-data
            android:name="android.support.PARENT_ACTIVITY"
            android:value="com.suraksha.womensafetyapp.MainActivity" />
        </activity>
    <activity
        android:name="com.suraksha.womensafetyapp.Verify"
        android:label="@string/title_activity_verify"
        android:parentActivityName="com.suraksha.womensafetyapp.MainActivity" >
```

```
<meta-data
android:name="android.support.PARENT_ACTIVITY"
android:value="com.suraksha.womensafetyapp.MainActivity" />
</activity>
</application>
</manifest>
```



## **CONCLUSION**

Our design is a real time model which enhances the security and safety of the environment. Although many Women Safety Application are present none provide Immediate Assistance nor enabled with drone services. Implementation of fixed wing UAVs enhance the efficiency of the System as they are smaller in size which means able to fly into areas which were not possible before and can capture landscape using 360-degreerotation, Time Lapse and have Aerial Views. Anyone before doing any crime against the women will be deterred and it helps reducing the crime rate against the women. The system can provide useful evidences, since the system can do audio-video recording of incidences which can act as the evidences. Our proposed application can truly be a great boon to the society.