Flood Rescue Drone

Problem Statement:

Floods are the most lethal of natural disasters in India. Many people die because they are not visible to rescue operators and get buried in after flood debris. So, there is a great need of some modern technology to recue the people stuck in flood areas.

Proposed Solution:

- **Introduction**

We want to use drone technology in identifying people trapped in flood pools and debris from an eagle's point of view. We would deploy drones in flood-hit areas and with the help of Object detection algorithms we will be able to detect people in that area and as a result, we can then send rescue teams to save them. Also, necessary medication can be delivered using these drones because during floods roads get blocked and the air is the only open medium to travel. So, we have devised mechanisms to deliver food to base camps without the need to even land them. With this technology, we can also provide necessary food items if needed.

- **Methodology**

Two things need to be solved in this problem statement –

1. Flying aspect of the drone (There are three ways in which we can operate the drone) –

a. Autonomous flight by Mission Planner.

We would be operating the drone autonomously. We can plan missions on Mission Planner by giving it wave points along with other instructions needed during the mission. We have worked on drone technology and made simulations using the ROS package.

b. Flight planning using code.

For complicated paths if we want specific paths for special situation, we can use different programming codes based on the situation to get an optimum path according to the requirement.

c. Manual Flight.

The manual mode would only be used, if necessary, in areas where it cannot be operated autonomously.

Also, along with simulation, we are close to prototyping this project in physical mode.

2. YOLO V2 Object detection model (Working out on the object detection model)

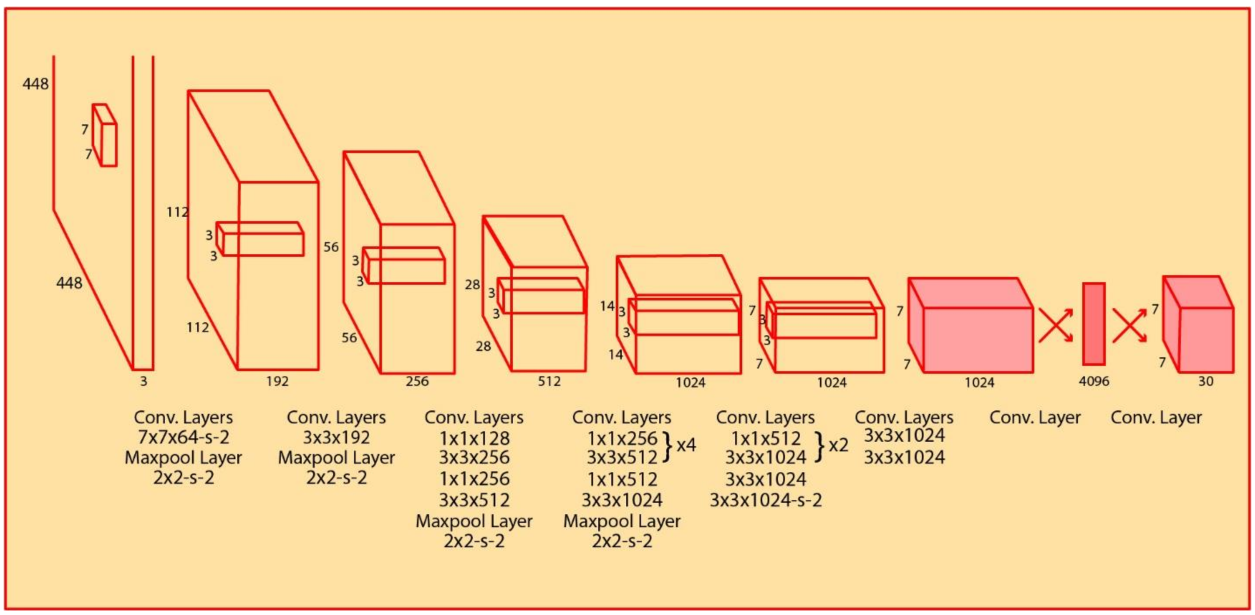
Why did we choose YOLO as our object detection model?

YOLO stands for *You Only Look Once*. In practice, it runs a lot faster than faster RCNN due to its simpler architecture. Unlike faster RCNN, it's trained to do classification and bounding box regression at the same time.

Benefits of YOLO -

- It's Fast and Good for real-time processing.
- Predictions (object locations and classes) are made from one single network. Can be trained end-to-end to improve accuracy.
- YOLO is more generalized. It outperforms other methods when generalizing from natural images to other domains like artwork.

Yolo V2 Algorithm Diagram



- **Other Features**

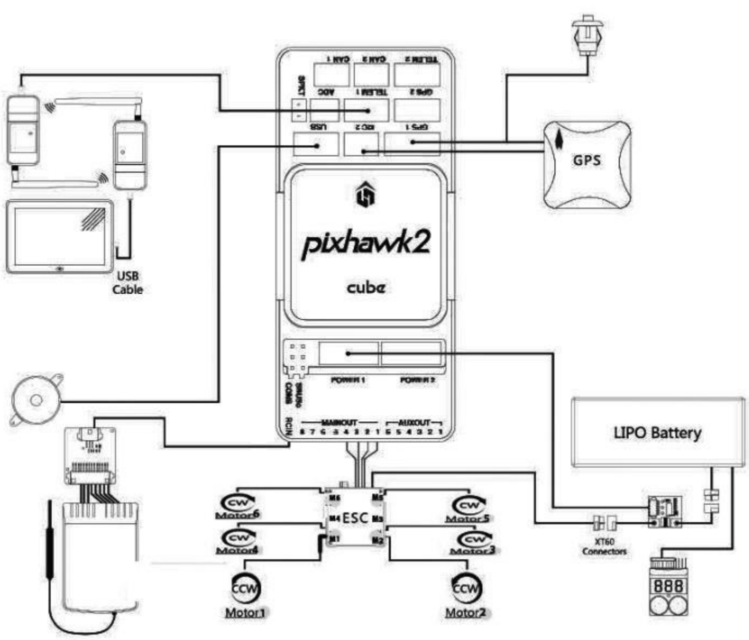
Our team has designed delivery mechanisms in Solid works software. The mechanism that is used uses the Geneva mechanism to deliver food and medication stably with the help of chords and pulleys from the drone. As a result, we do not have to land the drone on the ground. The camera would be mounted on a very stable gimbal to resist high-speed wind movements so that the imagery doesn't get disturbed. The 3D design of the gimbal is also available.

<u>Data Insights:</u>

Drone Specification:

- Drone Copter Frame – Tarrot T960 (Hex Copter Frame)
- BLDC Motor – T motors 5212 kV
- ESC – 40 Amps
- Telemetry – 2.4 GHz
- Receiver and Transmitter – Fly Sky FS–i6-6-Channel
- Flight Controller – Pixhawk Cube
- Pixhawk PPM Encoder Module – 8 PWM (pulse width modulated) signals into one PPM (pulse position modulation) signal.
- Battery – 2 batteries of 18000 mAh each
- Camera
- Gimbal and Drop Mechanism (Geneva Mechanism)

Flight controller used and circuit diagram



Battery Calculations:

Operating voltage= 22.2V (nominal) to 25.2 (maximum)
i.e. 3.7 x 6 to 4.2 x 6 V Thus, 6S Lippo battery will be optimal Capacity: For Tarot-5212 motor, We used MATLAB script to obtain the motor characteristics:

Current as a function of throttle:
$f(x) = -4.5637 \times 10^{-7}.\, x^4 + 8.9964 \times 10^{-5}.\, x^3 - 0.0016x^2 + 0.0260x + 0.005$
(Bi-quadratic expression was chosen because it gave the least standard error of 0.0545 calculated by polyval function)

$Average\ current = 9.3570$

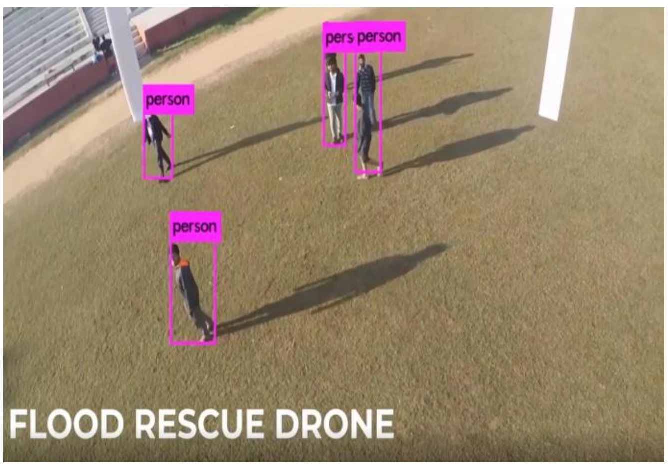
$$Battery\ capacity = \frac{(Avg.\ Current\ drawn\ by\ motors\ and\ components) \times (flight\ time)}{(battery\ discharge)} \times 1000$$

$$= (9.3570 \times 6 + 2) \times \left(\frac{30}{60}\right) \times \frac{1}{0.8} \times 1000$$

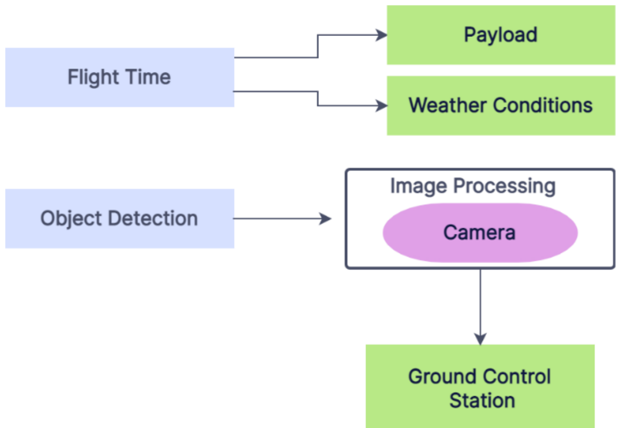
$$= 36406.25\ mAh$$

Test Results:

At 67 FPS, YOLOv2 can give a mAP of 76.8 while at 40 FPS the detector gives an accuracy of 78.6 mAP, better than the state-of-the-model such as Faster R-CNN and SSD while running significantly faster than those models. We are using autonomous drone in our project to detect people so to escape human error.



Using the above drone specifications, we would get an estimated flight time of about 30 minutes.



<u>Conclusion:</u>

By integrating drone technology with object detection, we are able to solve our problem statement. We have conducted test of drone in physical mode also which have revealed positive results. By using innovation in mechanical engineering, we were also able to create delivery mechanism in a unique manner. **Over 1,500 Indians lost lives to floods every year in last decade. So by using such technological innovations we can help out to reduce human loss and create a great impact on mankind.**

<u>Links:</u>

Video link of Object Detection Model –

https://drive.google.com/file/d/1FIawCDXWLdOEyeKXos7jgFgKnw74z3AV/view?usp=sharing

3D model of Delivering Mechanism –

https://drive.google.com/file/d/18fwDPWzj6Z5zeRhdO9dD_byIV3KWlhqm/view?usp=sharing

3D model of Gimbal –

https://drive.google.com/file/d/16z23JsQgTVNOc5AYhXUpcv6SuWWndT66/view?usp=sharing

ROS Simulation Video –

https://drive.google.com/file/d/1_WfRrWgilKe0bvCyMPu7kqAfJhdrwVCS/view?usp=drivesdk

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