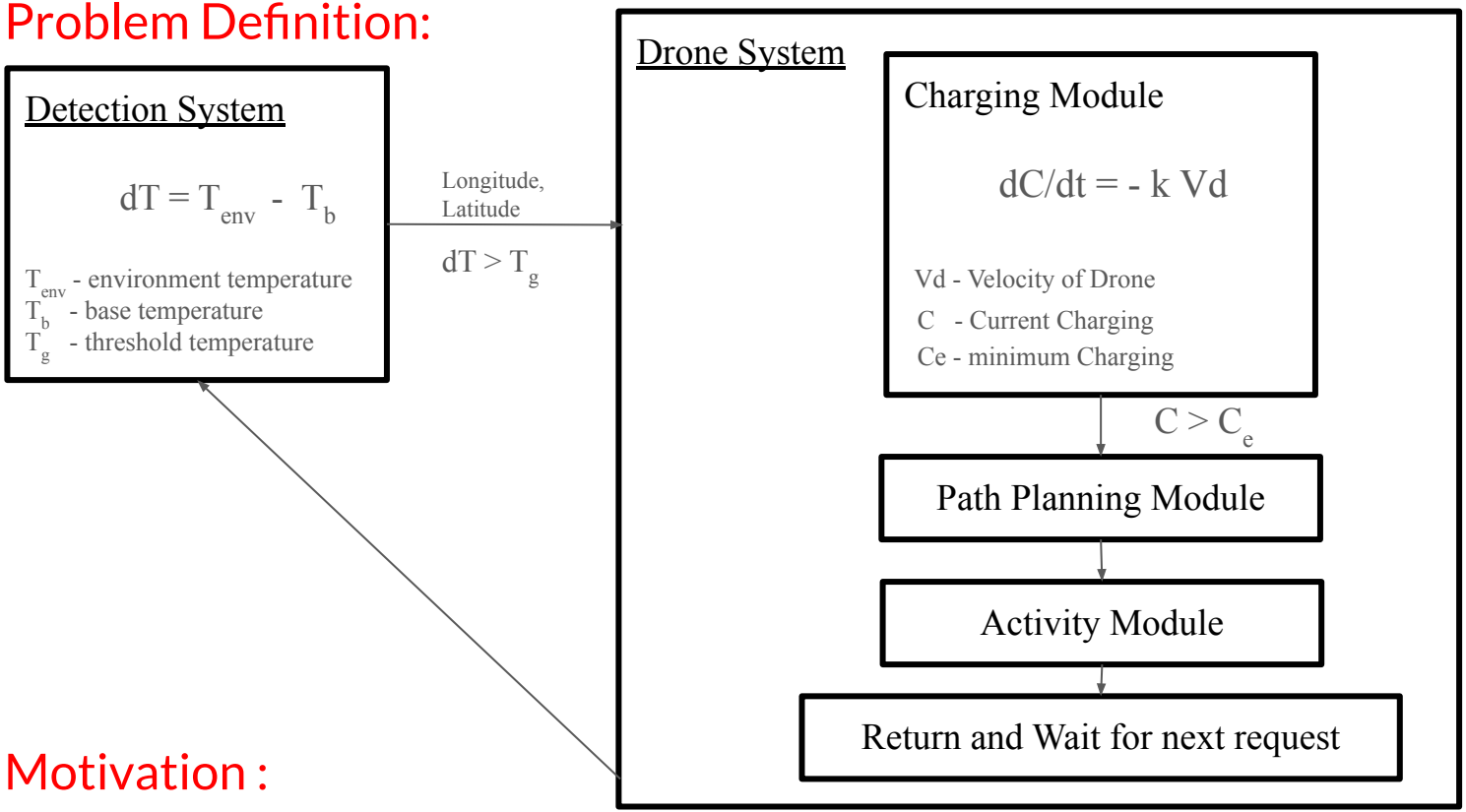
Problem Definition:



Motivation :

- The recent wildfires have inspired us to explore the option of having the drones as first responders to reach the impacted destination and perform initial screening. We imagined a framework consisting of mesh network of sensors and drones which can be adapted to different settings as required.

Approach:

Developed Mathematical model → Used **STL**

↓

Path planning without environment → Developed simple navigation control strategy ignoring environmental challenges

↓

Introduced Environment → Use of AirSim (tried Webots)

↓

Obstacle Detection and Avoidance → Used the depth camera sensor available to detect and avoid obstacles. **PID** based velocity controller was developed for navigation.

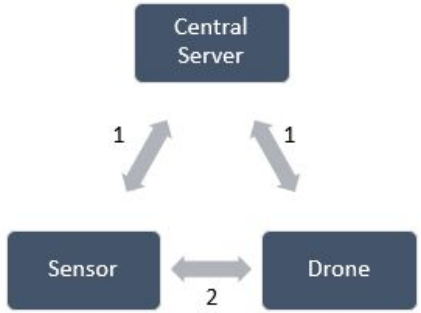
↓

Path Planning → Developed path planning algorithm that ascends as long as there is an obstacle in drone's sight.

↓

Performing activity → The drone hovers over the destination and performs the required screening (hovering for now).

System Design:

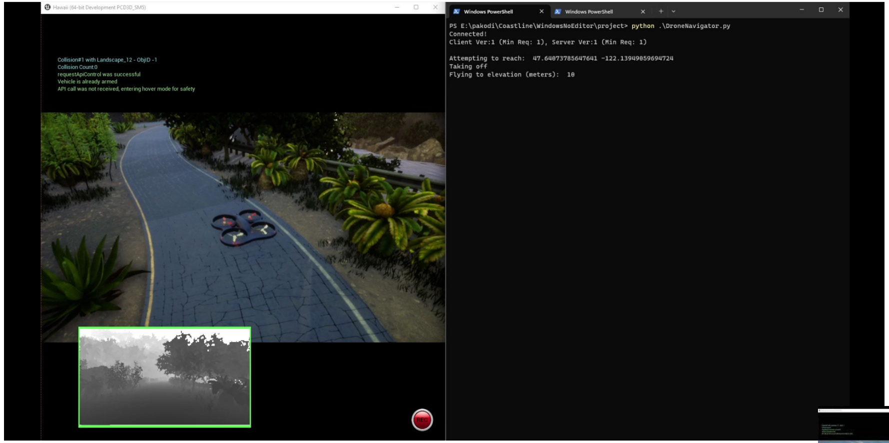


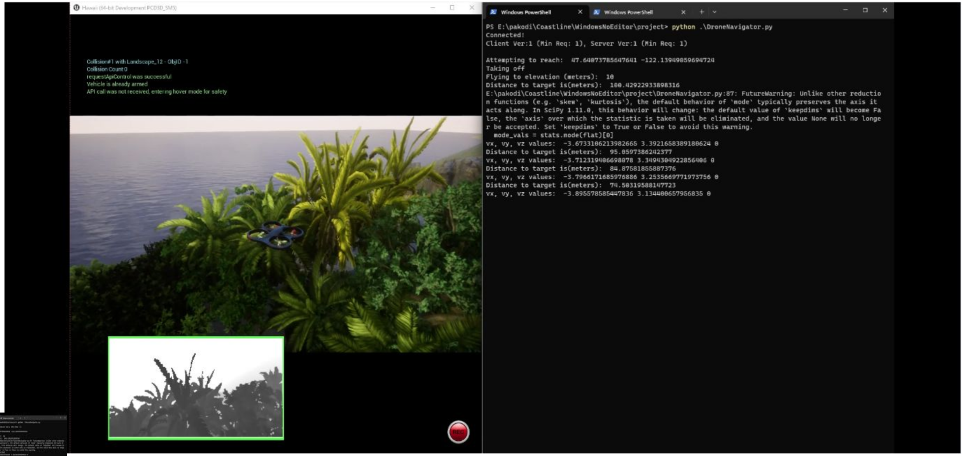
- Having a centralised server in the loop enables easy scaling to multiple drones (scheduling/ planning) in future.

Ensuring safety requirements:

- Attend to every request.
- Drone never runs out of battery as we ensure it has enough charge to perform the activity before starting.
- Drone will constantly monitor its charge during the flight and falls back if required.

Figures :


Hawaii (64-bit Development PCD3D_SM5)
Collision#1 with Landscape_12 - ObjID -1
Collision Count:0
requestApiControl was successful
Vehicle is already armed
API call was not received, entering hover mode for safety
Windows PowerShell
Windows PowerShell
PS E:\pakodi\Coastline\WindowsNoEditor\project> python .\DroneNavigator.py
Connected!
Client Ver:1 (Min Req: 1), Server Ver:1 (Min Req: 1)
Attempting to reach: 47.64073785647641 -122.13949059694724
Taking off
Flying to elevation (meters): 10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Distance to target is(meters): 100.42922933898316
E:\pakodi\Coastline\WindowsNoEditor\project\DroneNavigator.py:87: FutureWarning: Unlike other reductio
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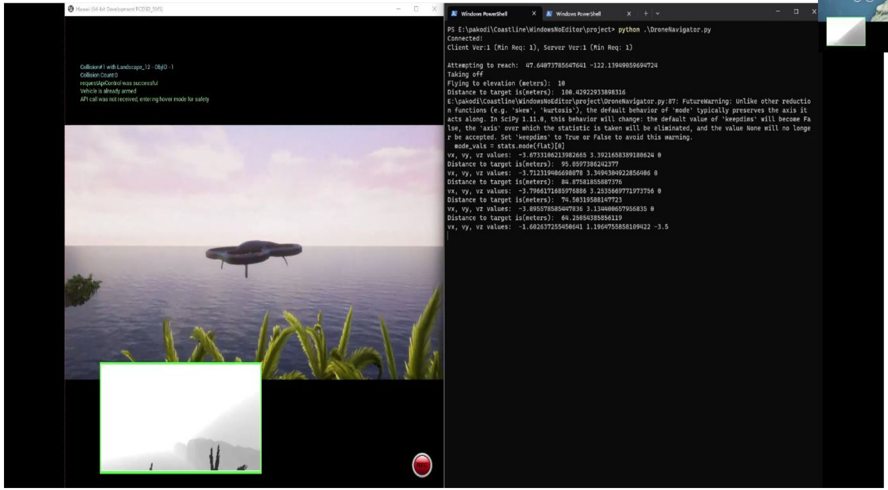
mode_vals = stats.mode(flat)[0]
vx, vy, vz values: -3.6733106213982665 3.3921658389180624 0
Distance to target is(meters): 95.0597386242377
vx, vy, vz values: -3.712319406698078 3.3494304922856406 0
Distance to target is(meters): 84.87581855887376
vx, vy, vz values: -3.7966171685976886 3.2535669771973756 0
Distance to target is(meters): 74.50319588147723
vx, vy, vz values: -3.895578585447836 3.134400657956835 0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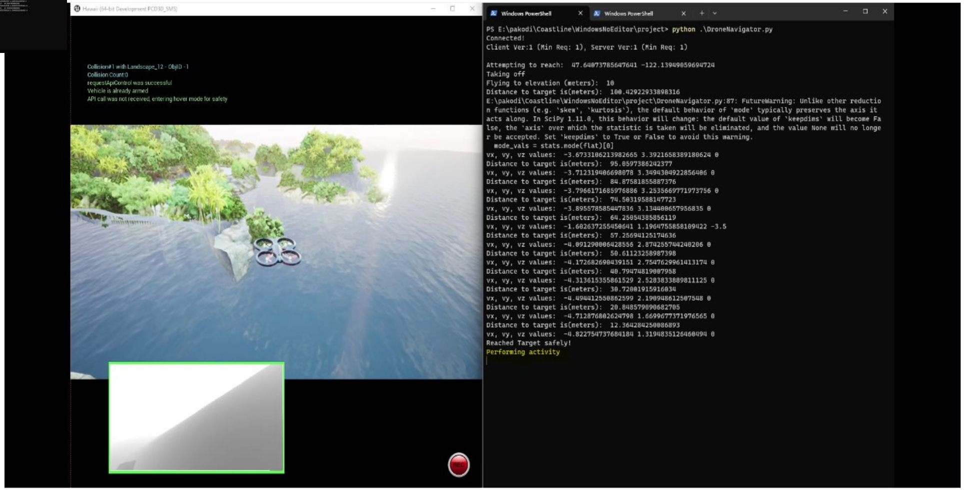
Distance to target is(meters): 64.25054385856119
vx, vy, vz values: -1.602637255450641 1.1964755858109422 -3.5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Distance to target is(meters): 64.25054385856119
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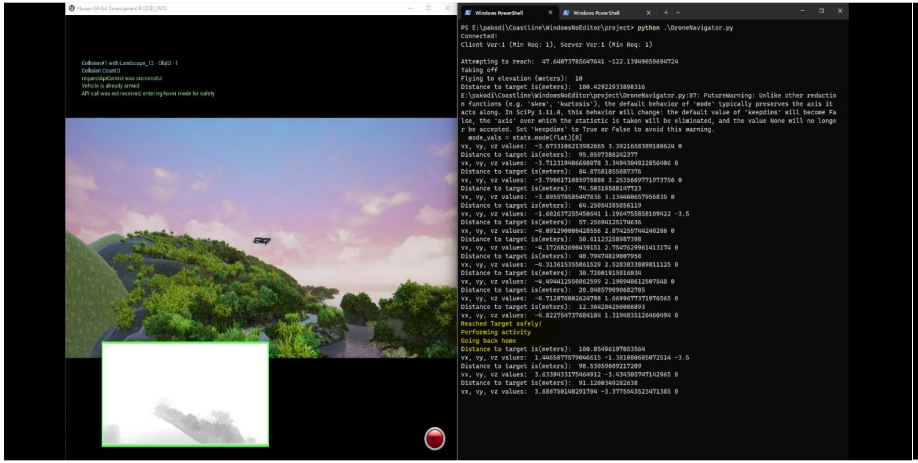
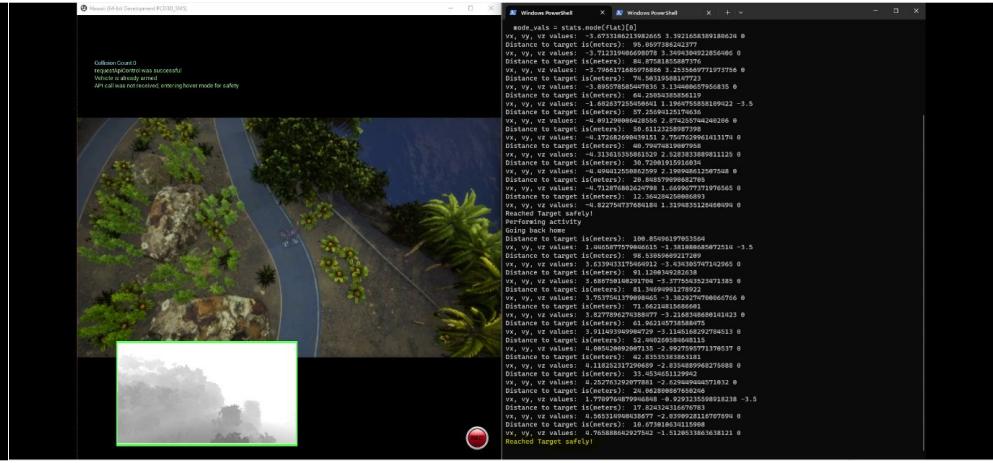
Distance to target is(meters): 57.25694125174636
vx, vy, vz values: -4.091290006428556 2.874255744240206 0
Distance to target is(meters): 50.61123258987398
vx, vy, vz values: -4.172682690439151 2.7547629961413174 0
Distance to target is(meters): 40.79474819007958
vx, vy, vz values: -4.313615355861529 2.5283833889811125 0
Distance to target is(meters): 30.72001915916034
vx, vy, vz values: -4.494412550862599 2.1989486125075 48 0
Distance to target is(meters): 20.848579090682705
vx, vy, vz values: -4.712876802624798 1.6699677371976565 0
Distance to target is(meters): 12.364284250086893
vx, vy, vz values: -4.822754737684184 1.3194835126460494 0
Reached Target safely!
Performing activity





Limitations :

- Our project assumes only one drone in the network to ease out scheduling complications.
- We assume that altitude of drone has no effect on the charge depletion rate.
- Naive path planning algorithm
- Our obstacle detection strategy could be improved.
- Our PID controller could be improved to handle descend when not required
- We assume that our depth sensor is completely accurate
- We don’t consider network failures/ challenges