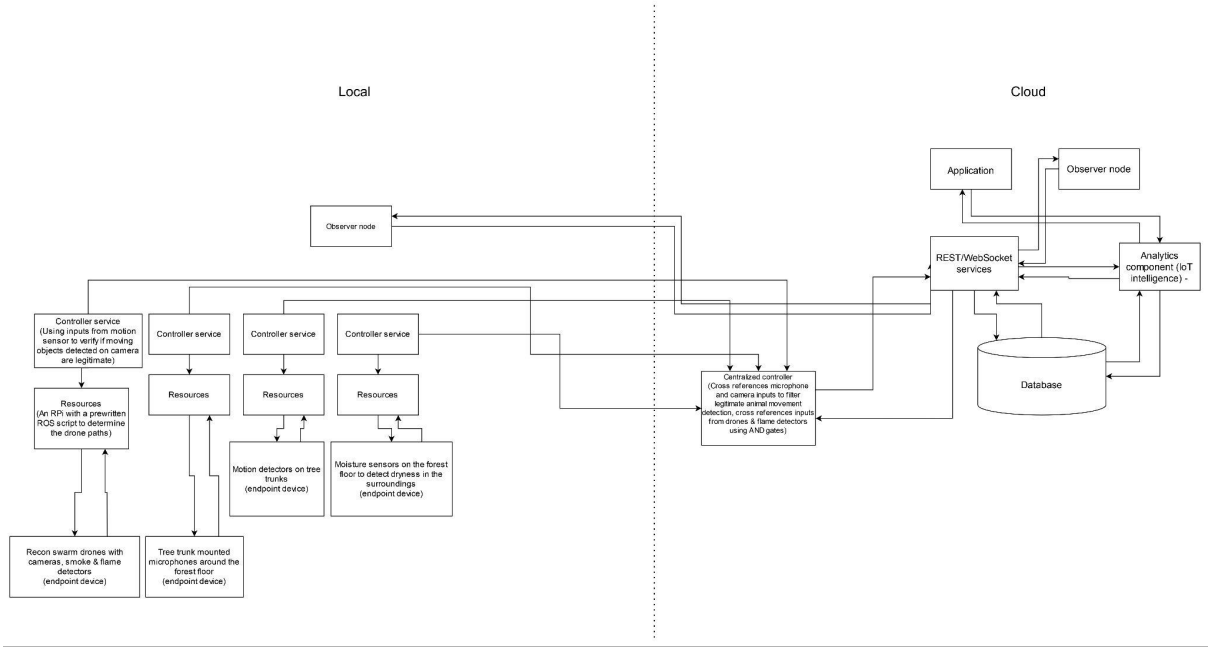
Team clapForKrishna - IoT System Flow Diagram



System purpose:
To aid with maintenance of a single forest by controlling fires, deforestation and surveying animal movements as these are the main factors determining the ecological health of a forest.

IoT Level 6: Used centralized cloud based controller

Devices used:

1) ESP32 (For sending data from sensors to central server through WiFi)
2) 1080p cameras
3) Microphone with LM393 IC (potentiometer set to desired sensitivity)
4) HC-SR501 PIR motion sensor
5) HL-69 soil moisture sensor
6) MQ2 smoke detector
7) IR receivers as flame sensors
8) WiFi repeaters (To connect all the devices) extending from the forest till the nearest station. Placed smartly to cover all devices while using the least number of repeaters.
9) Centralised server(eg: Raspberry Pi, Nvidia Jetson Nano etc..)

Walkthrough:

- So we will be tracking various natural/artificial phenomena happening over a closed forest.
- Starting off, using an autonomous drone swarm(pre-set paths which cover every single part of the forest), we have eyes all over the forest, traversing a predetermined set of paths. Smoke detectors attached on the drones will be looking out for any forest fire possibilities.
- Since the smoke detector can be unreliable and give false alarm over smog and other factors, we will be also using a Flame sensor which will be attached on the bark of the trees. We will be implementing an AND gate on the smoke and flame sensor to verify if there's actually a fire break-out.
- Next up, to counter Deforestation, we will be using microphones attached to trees, to detect any chainsaw sounds. For other causes like fire etc. we will be monitoring if we are still receiving input from the sensors attached to the tree. If not, drones will be sent out to verify if the tree is still present.
- If the tree is present then the authorities are alerted and will be sent to check if the device is still there and repair it.
- We are using the Centralised controller for integrating all the Climate Monitor sensors.
- The observer nodes take care of reading pings from the individual sensors to ensure they are in working condition.

Analytics component:

The drone systems collect a series of images using the on-board cameras and are also fitted with smoke/flame detectors to detect high rising fires/smoke plumes. Motion information, audio and moisture data is also collected from a network of ground level sensors numbering in the hundreds.

The analytics component works on cross referencing potentially conflicting data points to filter out bad flags.

All DL models referenced here are mostly just for image processing, use neurons with a linear model and are sequential in nature.

Case 1 : Fire detection

- Here, the relevant points to consider are the drone camera feeds, smoke detector inputs, audio and moisture data.
- Using only a deep learning algorithm taking an input from the camera feeds may not have a high enough testing accuracy and can hence be a source of expensive false alarms.
- The same applies to a similar algorithm to analyze audio feeds to detect fire crackling sounds.
- Therefore, checking for the presence of smoke as well as dryness of air in the region of interest can greatly improve detection accuracy

Case 2 : Deforestation

- Here, the relevant points to consider are the drone camera feeds, audio & motion data
- Using a DL algorithm here to detect machinery sounds / axe strikes may not be sufficiently accurate
- Therefore, backing it up with pictures of cleared land and movements in the area will be desirable

Case 3 : Animal movement

- Here, the relevant points to consider are the drone camera feeds, motion detector inputs, and audio feeds.
- Surveillance by drone can provide the paths taken by the resident animal life around their territories.
- This data can be further verified by confirmation from ground level motion detectors and audio feeds of their produced sounds.
- Constant surveillance by such a system can detect irregularities in their movement to detect potential hazards such as poachers and impending natural disasters.

Consistent use of the system can help accumulate the relevant behavioural data of the forest in the database, which can be used to retrain and improve the accuracy of the DL models implemented in this section