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AI & ML Powered Drone

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Abstract

The idea of using drones for surveillance help solve the issue of quickly tracking people without putting more lives at risk when circumstances are desperate, like terrorist attacks or natural calamities The layout includes a PI-CAM V2 camera on a quadcopter using GPS to quickly follow individuals over distance regions that are difficult to get swiftly by land and/or are dangerous for a human to accidentally reach. Detecting human's underneath is the crucial component in this situation terrorists concealed by debris in the event of a disaster walls.

Keywords*:* Surveillance, Tracking, Quadcopter, PI-CAM V2 camera, OpenCV, Artificial Intelligence, Object Detection.

1. Introduction

Unmanned aerial vehicles (UAVs), also referred to as "drones," have provided a wide range of applications during the previous ten years, including environmental sensing, sampling, and surveillance. Because they can visit places that humans would otherwise find difficult to get, UAVs are also seen as a crucial piece of technology. Robotics in general, and UAVs in particular, need artificial intelligence (AI) algorithms to be able to perceive and interact with the actual world in order to work autonomously and help people with daily tasks.

In this paper, we report the design and development of an AI based drone for object identification using Open-CV using various AI-Object detection algorithms.

2. Methodology

India has shared border of around 15,100 km with 7 countries. The border constantly faces problems like drugs smuggling, illegal migrations, terrorists' attacks. To solve this issue Indian soldiers, have to keep patrolling these areas which can be done by intelligent drones. Today Drones are used for surveillance, but the main drawback of these types of drones is that they manual observation by pilot or operator to detect the suspicious objects. Single board computers capable of running artificial intelligence can give drones abilities like, decision making, image processing and object detection. The surveillance system will consist of Data collecting centers Surveillance drones. Control room with ground station and data logging servers.

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Data collecting centers: - Main goal of the data collection centers is to detect any suspicious activity in the specified area and sending back the data to Control room when suspicious activity detected.
Control room with ground station and data logging servers: - These locations will be used for data logging and pilot control stations

3. Objectives

Create a secure environment with the help of drones and A.I. with minimum requirement of human interactions.
Ultimate aim is to provide an AI based surveillance system that will be helpful for securing border areas.
Protecting the lives of Indian soldiers on boundary line by using A.I. based surveillance drones.

4. System Overview

The system consists of the primary UAV platform, which is based on the ardupilot with raspberry-pi SBC as companion computer with PYMAVLINK. It also includes drone kit API for drone with 8 MP camera with SPI interface for real-time object detection with MJPG stream. A powerful ground station for computation purposes with high speed WLAN network. Ground station consist of a cuda accelerated OPENCV based object detection system with high performance Drone kit was used to for autonomous flight purposes.

OpenCV: -
(Open Source Computer Vision Library) is a software library for computer vision and machine learning. To facilitate the use of machine perception in commercial goods and to provide a common foundation for computer vision applications, OpenCV was developed. Businesses can use and alter the code of OpenCV with ease because it is a BSD-licensed product.

Fig 1 :- Working Prototype

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5. Components Used

ARCHITECHTURAL DIAGRAM

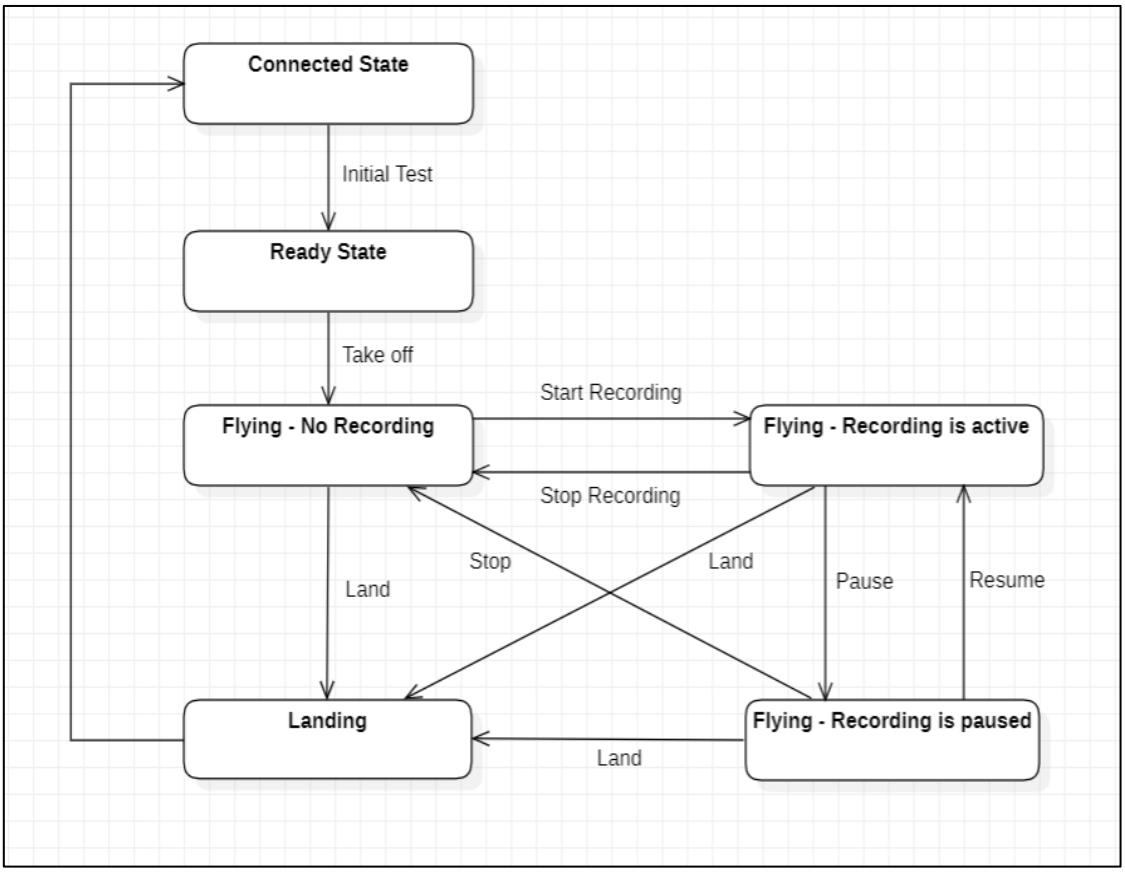

Fig 2: - Architectural Diagram

6. Phases

1.Connected Phase: In connected phase first the drone gets connected with the ground station (controller).

2.Ready Phase: - Once the drone gets connected to the ground station an initial test is performed to check whether the drone is working fine and ready to take off.

3.Flying Phase: - Once the drone is passing the initial test it takes off and switch to a new phase that is flying phase.

4.Capturing Phase: - In capturing phase drone capture the objects using the on-board camera.

5.Detection Phase: -While capturing the objects if it finds any object suspicious it will generate an alert and that alert will be sent the ground station

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6.Landing Phase: -Once the surveillance is done the drone is landed on the landing station and again it goes in connected phase.

7. Processes

1.Drone Building Process

Installed 2600KV motors with 920KV 2212 ready to sky motors and Mamba 405 with Pixhawk 2.4.8. Configured it according to the needs with PID tunings. Installed 1000mAh 2S 20C Orange Li-PO with 3000mAh 3s 30C orange Li-PO and Jetson Nano with Raspberry-pi and cooling-fan. Installed Bluetooth with ESP-8266. Added an extra 18650 battery for Raspberry-PI. Installed OLED-Screen. Done PID tunings and other optimizations for stable flight.

Result: High flight time, automated flight capabilities, very high flight stability, LOITER mode support with raspberry PI.

2.Flight Controller and Telemetry

Installed Mamba F405 MK2 mini flight controller with Pixhawk 2.4.8 flight controller.

Result: Open source Ardupilot flight controller with lot more feature than F405 ex. Open-source and fully configurable, MAVLink support and Telemetry 2 support.

Installed and configured NodeMCU (ESP8266). Result: Very High-Speed telemetry and drone Wi-Fi.

3.Video Streaming Process

To increase the data transfer rates and reduce the latency switched from 2.4 GHz to 5 GHz Wi-Fi. Created a python code for video streaming server used default IP address of the raspberry-pi as video streaming.

To optimize the stream used OpenCV API to change the resolution, framerate, bitrate, Auto-exposure, orientation, Buffer-size, Autofocus, zoom, camera roll and other required features of the raspberry- Pi camera.

Result: very low latency 720p 60FPS well optimized video streaming server without lag and stuttering.

4.Object Detection Process

As the Raspberry-Pi has very low computational power decided to use laptop as a processing station for object detection. Installed second windows-10 OS as a final deployment OS. Installed all the dependencies like CMake, latest Nvidia Drivers, etc.

Installed pip3, NumPy, putty, OpenCV with OpenCV-contribute CUDA CUDNN world, CMake, Anaconda, Visual Studio, Visual Studio Code, Latest NVidia drivers and other required dependencies. Optimized OpenCV python code for the use of CUDA and DNN drivers.s

Result: 60 FPS object detection with CUDA acceleration with latest Nvidia Drivers.

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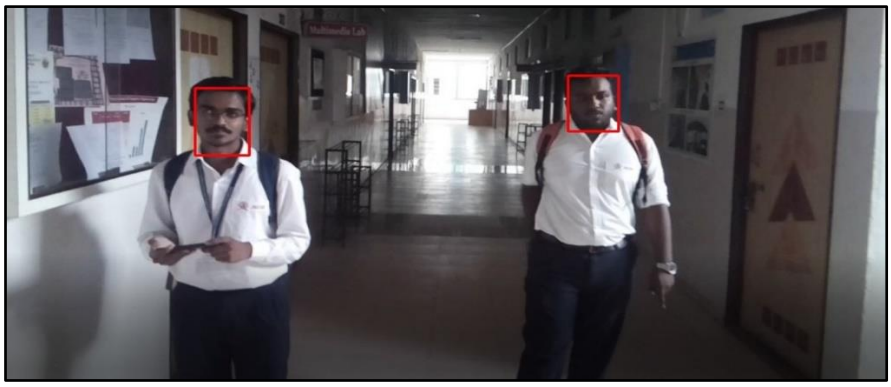

Fig 3: - Object Detection

8. Future Aspects

Future improvements may include the autonomous flight control of drone using artificial intelligence and machine learning. Building Drones equipped with lethal firearms, which are able to neutralise the target with manual control

9. Conclusion

In this research paper we conclude that, this is very strong, reliable and versatile system which can deployed in many places and many causalities can be avoided with it. This system will be useful for surveillance of country boundary line area as well as multiple areas where surveillance is required.

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