January – February 2020
ISSN: 0193-4120 Page No. 13788 – 13793

Armed Unmanned Aerial Vehicle

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Abstract

The emergence of Unmanned Aerial Vehicle (UAV) has created a very important need due to their features including stability, long range communication, their robustness and their compact size. All these creates suitable opportunities that are needed to be fulfilled. A single UAV can be deployed for various missions such as surveillance in unknown areas, structural monitoring, and in imperative need even show offensive behavior. The armed UAV's plays an important role in the defense and security application of the country. Another purpose for the UAV can be a certain monitoring in a warzone climate. In this research paper we have presented how the UAV can be applied in such scenarios. The UAV will detect the target object and compare it with the database stored in the memory of raspberry pi and whenever the target is detected, it will send the image of the target to the operator. who can manually send the signal from transmitter, to trigger the grenade from the UAV. For the UAV, the platform used is DJI NAZA mLite and for the enemy object detection it is Anaconda Software.

Keywords; *Unmanned Aerial Vehicle, NAZA-M Lite Controller, Raspberry Pi 3B*

I. INTRODUCTION

A. History

The Unmanned Aerial Vehicle(UAV) has been originated from the beginning of World War I. Developed till cruising missiles like tomahawks and harpoons (no head missiles basically) and now the current family of the UAV Drones. A very old tactic used in an Austrian attack was the use of unmanned balloons with loaded explosives, some of them managed to drop but some of them were redirected from path dude to wind flow. [1]

During World War I came the advent of low radio control techniques, the Royal Flying Corps' Ruston Proctor Aerial Target was utilized in 1916. The concept was to build a small and simple yet effective aircraft packed with explosives and be guided to the target according to the User. [2]

World War II bought more of these unmanned aerial munitions including torpedoes which were built on the same radio-controlled(RC) principle.

Cold War was another event that brought along another ingenious application of the UAV which was in ISTAR (Intelligence, Surveillance, Target Acquisition, and Reconnaissance) Systems. [3]

B. Classification

In terms of Roles performed by the UAVs in military areas there can be the ISTAR, UCAV, multi-purpose, Radar communication relay, aerial supply delivery, and R&D.

• ISTAR UAVS

ISTAR is the acronym for information, surveillance, target acquisition, and reconnaissance. It's a method that joins sensory peripherals together to improve

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the functionality of UAV in the Warzone environment to provide aid in combat/battle force and manage the intel acquired. Again the ISTAR was succeeded by the IMINT (Imagery Intelligence) which used satellites for a broad display of the warzone. [4,5]

Fig. 1: The Iranian Mohajer-6 ISTAR Drone (Courtesy of UAV Road Map December 2002 edition)

• UCAVs

Abbreviation for Unmanned Combat Aerial Vehicles, UCAVs are essential in the eradication of the designated target. The other purpose of UCAVs was to bring the decrement in the risk factors of human pilots being behind the enemy lines. With their covert design and acute precision, the UCAVs can be capable of nullifying targets deep in the Battlefield with minimal collateral damage. [4,5]

Fig. 2: The Russian Okhotnik-B Combat Drone(UCAV) (Courtesy of UAV Road Map December 2002 edition)

• MULTIPURPOSE UAVs

As the name suggests they are combination of both ISTAR and Combat UAVs. Launched in 2002 their complexity was a tough engineering challenge. [4,5]

C. Peripherals Description

• Raspberry Pi Model 3B

The Model used here is the third generation/iteration of the raspberry pi. It is an ARM-based low-cost and a powerful credit card-sized single-board computer that is applicable in many applications. While preserving the original board format Raspberry Pi Model 3B provides a 10x faster performance compared to the first generation.

Addition to this, it also features LAN and Bluetooth connection making it perfect for UAV Communication. [6]

Fig. 3: Raspberry Pi 3B and Pi-Camera

• DJI NAZA-M Lite Controller

The NAZA-M Lite Controller is an All-in-One Design based Controller System which has inherited the high reliability and stability of its former NAZA-M. It also consumes lesser space and UAV Weight distribution is also balanced.

It will offer the Pilot to operate the UAV in GPS Mode (Most reliable/stable), Altitude Mode, Manual Mode and can also adjust according to the flight environment and conditions. The controller also comes with a GPS Module for further stabilization.

Fig. 4: The NAZA-M Lite Controller

January – February 2020
ISSN: 0193-4120 Page No. 13788 – 13793

• Li-PO Battery

The Lithium Batteries are preferred over here as they are used in most of the electrical devices today. With a higher discharge rate and a high weight vs stored energy ratio, they can be utilized for the task substantially. The charging issue is a tedious one and is not a negligible issue. [7]

Fig. 5: The standard issue 5000mAh LI-PO Battery

• Raspberry Pi-Camera

The Raspberry Pi-camera is a standard-issue camera that will be capturing the HD videos at 1920*1080 resolution. It provides enough convenience for use for typical usage operating on the UAV. The camera uses its own dedicated CSI Interface, designed especially for camera interfacing.

II.PROPOSED UAV DESIGN

The need for various applications in our Military Domain brings us to a Standard Issue UAV which comprises of data acquisition and processing unit for various feeds it will be capturing. It also includes an attacking initiative that is a grenade launching mechanism with high accuracy. The operation between the transmitter and receiver units works on the ISM 2.4 GHz band that is available to all. Moreover, the UAV has a superb feature of Home-Location landing where it will return to its take-off point whenever the connection between transmitter and receiver breaks.

A. Improved design parameters

The main aim was the building up of a UAV which will provide more stability and least vibration which may tend to occur due to the other peripherals (mainly the Brushless DC Motors). The Stability is increased with the use of the GPS Module on the UAV which drives on nominal ratings. The vibrations are also needed to be reduced significantly because they tend to jitter the live feed from the camera which is installed on the UAV. We have used an Anti-Vibration Shock Absorber to bring down those vibrations in the feed. The Grenade Launching mechanism is installed beneath the UAV. This mechanism uses a servo motor that is attached to a small baton that is used for gripping on the grenade. The servo motor is connected to the controller which will allow the operator to manually operate on the Servo Motor.

Fig. 5: Exterior display of the UAV

III. SOFTWARE IMPLEMENTATION

The UAV operates on the DJI NAZA-M Lite controller that needs to be programmed on application software DJI NAZA-M Lite Assistant version 1.00 which is very user-friendly with a configurable property and it also provides a clear graphical display of the calibration including but not limited to the Transceiver, Gimbal, GPS Module, and more.

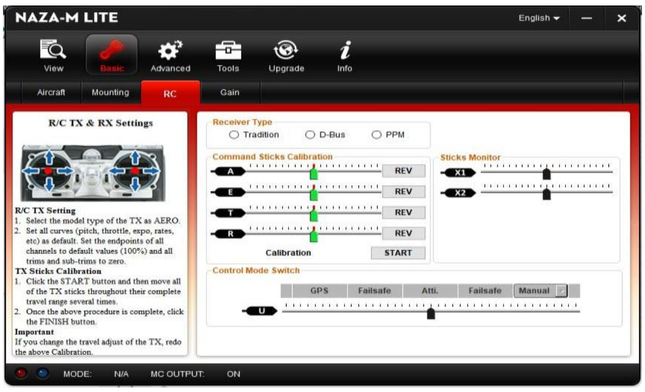

Fig. 6: Main Window of NAZA-M Lite Assistant

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(Courtesy of Naza-M Lite Assistant Software)

A typical RC Transceiver Calibration is displayed here in Figure 1 which can be checked while configuring with the transmitter. As for the Control Mode switch, it is preferred to use GPS mode for most stable operation. The Altitude mode allows the flight operation at a designated altitude.

The extra hardware for example Gimbal can also be configured via the software including its position relative to the altitude and the UAV.

Before altering with the various settings first of all the Operator has to select the orientation of the UAV in the software, for example, QuadrotorX or QuadRotorI.

The Controller location and orientation can also be configured with the Mounting settings. The UAV has Four types of movements that is Pitch, Roll, Yaw, and Vertical whose GAIN can be individually configured as per Operator's desire and ease.

With the Software we can also configure the motor speed from lowest to highest. Another feature of the software is the battery level indicator which will have protection levels set as per Operator's desire. The Battery used in the UAV was the 3S LIPO Battery with 5000mAh 12V Rating.

Another key feature of the Software is that in case of a misconnection between transmitter-receiver interface the UAV will safely return to the home location from where it took off.

IV. OBJECT DETECTION ALGORITHM

The script for the algorithm is loaded in python language and with the aid of Jupyter notebook in Anaconda, it is executed. For the deep learning, the program uses Keras Libraries which will train the algorithm with succeeding operations on it. As the program deals with images the Numpy package is used which includes a Powerful N-dimensional array object and it also features the various processing tools in-built.

The test image is loaded from the designated directory and its pixel size is limited to 64*64 for faster processing. The Pi-Cam takes in the feed and sends it to the Raspberry Pi (Server) and shoots them forward to PC Client that is the Anaconda from there the Convolutional Neural Networks.[7]

A general CNN will consist of an input and output layer as well as many hidden layers inside. The hidden layers of a CNN typically comprise of multiple convolutional layers, pooling layers, fully connected layers, and normalization layers.[8]

In the Object detection each step executed is listed here:

1. Convolution: It is used to bring down the size of the image captured with next to none loss in its quality. It also helps in the sharpening of the image and edge detection of the image using multiple Kernels that are used to filtering the image.

2. ReLu Layer: The ReLu layer is one type of Kernel that works on maximum value function. Basically, it will bring down the image into binary values ie black and white.

3. Pooling: It is a type of image transformation where it will bring down the number of parameters when the images are too large. To bring down the dimension of the image Down Sampling is used which will also retain information. Again MAX Pooling is used which will train the program for images captured in a tilted position which is needed for the spatial invariant property of a CNN.

4. After Flattening and Full Connection the whole CNN Process is completed to train the Program.[9]

After the above process is finished training the Program the object detection and identification can be applied on the field for various test benches.

V. RESULT

We are designing a UAV system which will be used specifically for the defense purpose where one can

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carry lethal payload like a grenade and drop them upon the targets specified, with the help of Convolutional Neural Network (CNN).

Using live feed from the camera the UAV will be able to detect and send photographs of unidentified objects and comparing it with the one uploaded which will be enemy trucks, tanks and after confirmation with the data uploaded on the system will drop the grenade on it.

VI. CONCLUSION

The current hardware/software integration is designed to be Operator-friendly. The grenade dropping is executable while hovering in mid-air. The program was executed successfully for binary object detection (Enemy Truck and Tank) which is performed on the basis of Convolution Neural Networks. The Operator will be able to observe the designated target on his/her screen. The Operator can manually trigger the grenade drop that is on the transmitter itself.

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January – February 2020
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