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Unmanned Aerial Vehicle

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Abstract: Unmanned aerial vehicles (UAVs) are increasingly popular for civil applications due to their flight capabilities and mobility. This paper proposed an indoor patrol and surveillance system using unmanned aerial vehicles. The components were integrated successfully and the designed system was experimented in an indoor setup. Results has shown that the proposed system is suitable and feasible to be used as an autonomous patrol and surveillance agent for indoors use. An application is developed as proof of concept with detailed design that can take advantage of unmanned urban vehicle to be directly configured and controlled in real time. The advantages are numerous; it can be used for many purposes. For example, it can be used for observing critical and important area for intruder activities or to know the current state of any object of interest. Intrusion of terrorists and trespassers are adversely affecting the peace and harmony in the nation. The fatalities and disturbances caused by the latest Uri attack in Indian Army Camp show the necessity of an efficient border surveillance and intruder detection system for the effective monitoring and detecting the unauthorized movement of intruders across the national borders. Conventional border patrolling lacks an integrated multi-sensing system that coordinates various technologies for surveillance and detection of human intruder movement in the different border scenarios: flat surface movement, river/pond crossing and dry leaves movement.

I. INTRODUCTION

The concept of smart surveillance without or minimal human intervention is a main area of interest for so many decades in order to avoid and minimize the theft and malicious activities. Even though there exists an eventdriven surveillance camera, it might get into action because of the activities going in front of it, which may not be suspicious and requires a person to analyze the footage to confirm it.

This kind of surveillance system usually does not have a feature of alerting the owner and even if they do, it will be costlier and needs to use particular application to get the alert information. So, it is important to build a smart system which is much cheaper for implementation and that would not only require a minimal human intervention but also capable of assisting us in case of intrusion. Such system can be built easily if it can recognize the intrusion on its own and alert us in our absence. In traditional way of surveillance, the video recordable cameras are installed and are stored in an external storage disks to analyze them later if an event of theft or any crime occurs.

Multiple surveillance and detection technologies, which complement each other, are required for real-time monitoring of the border areas with high efficiency, precise accuracy, and minimum human support. In spite of huge investment and man hour spend, most of the surveillance system does not provide complete security because of the limited area of coverage i.e., they can't capture activities happening above the certain angle and beyond distance range.

Therefore, an unmanned aerial vehicle autonomously patrolling certain locations of buildings on a regular basis at a higher speed and frequency can either complement or replace patrols by security personnel and CCTV systems. The live camera view of the UAV is transmitted to the office to be monitored by security personnel. If any suspicious people or potential crimes is observed, the authority can override the autonomous control of the UAV to track the criminal using a remote-control joystick. As compared to CCTVs, a UAV can cover a larger area without any blind spots with much lower set up cost.

II. PROBLEM STATEMENT

In previous systems if more than one person intrudes then the system is unable to detect the multiple intruders. Many current systems require internet connection and if there is any network failure the whole system collapse giving threat to the safety. In current systems power consumption is very large giving high electricity consumption. There are lot of complications in capturing the videos and processing it.

Also there is a need for pre-processing of the images. Many existing systems need adaptive detection technique like ground/underground sensors making it difficult to trace the intruder.

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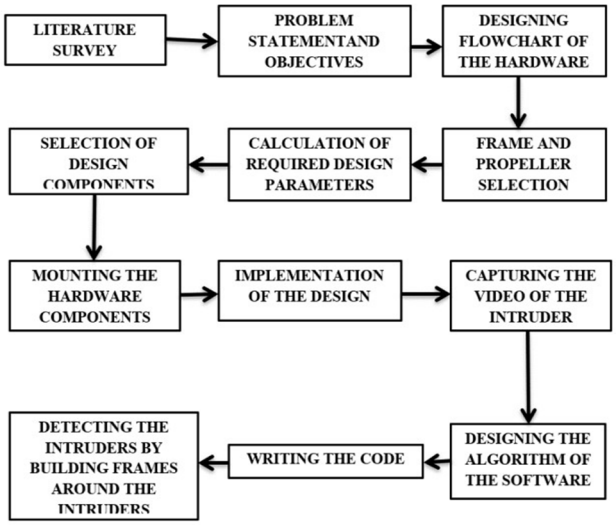
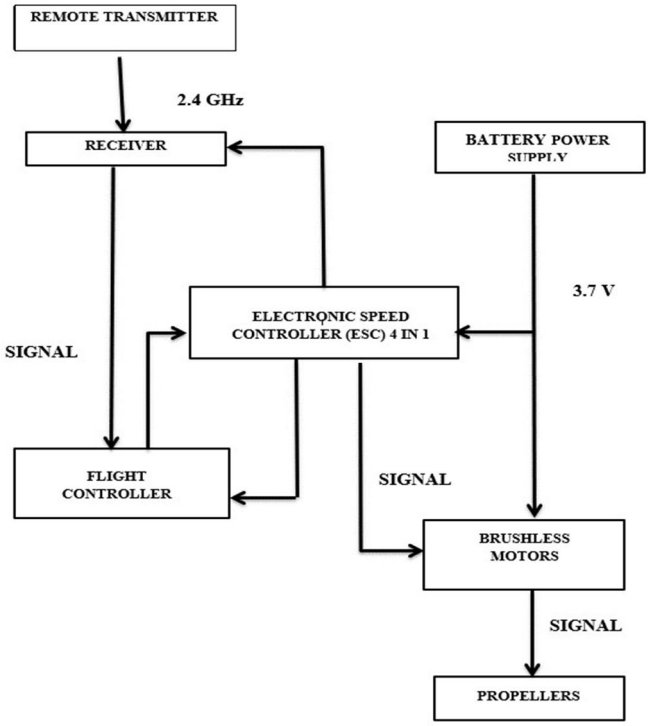
III. PROCEDURE ADAPTED



The following block diagram represents the procedure adopted. The hardware requirements are found out with the design and calculations. The accordingly the components are mounted and the implementation is done. The software programming is carried out with the implementation.

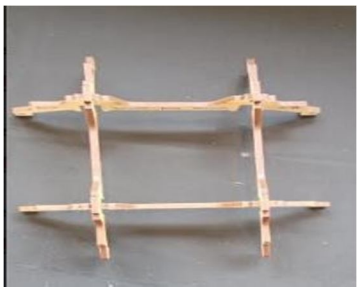
A. Methodology



This is the block diagram for our hardware. The main components here is the Electronic Speed Controller (ESC). We have used 4 in 1 ESC flight controller. The 4 brushless motors are connected to ESC via wires and the propeller are in turn connected to the motors which causes the propellers to spin. Remote transmitter transmits signal to the receiver tuning 2.4 GHz, Receiver in turn signals to the flight controller. After receiving signal the flight controller signals ESC. ESC signals receiver that the flight controller is ready and then after turning the UAV is ready to fly.

B. Components Used

1) Frame



The skeleton of the drone which all componentry is fixed to. The frame design is a trade-off between strength (especially when additional weights such as cameras are attached) and additional weight, which will require longer propellers and stronger motors to lift

2) Propellers

Size: 3”
Pitch: 2”
2*CW
2*CCW
Principally effect load the drone can carry the speed it can fly and the speed it can maneuvers. The length can be modified; longer propellers can achieve greater lift at a lower rpm but take longer to speed up/slow down. Shorter propellers can change speed quicker.

3) Battery

Battery capacity: 600 mAh
Voltage: 3.7 V
Weight: 20g
Battery type: lithium polymer
Input: DC 5V; 0.5 – 2.5 A
Output: DC 4.2 V; 2 A
Cells: 1
Size: 43mm*25mm*9mm

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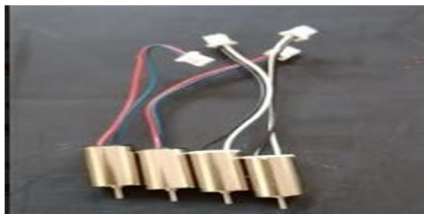
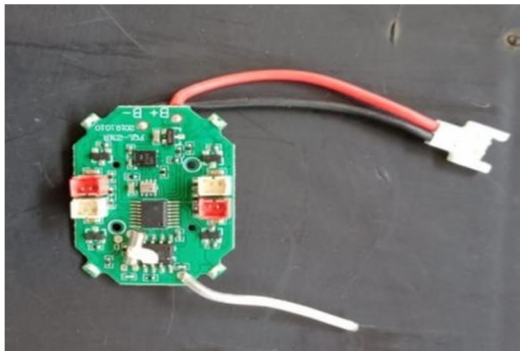
4) Motors



Stator size: 1306
Constant velocity: 4000Kv
Voltage: DC 3.7 V
Current: 0.8 A
RPM: 48000
Thrust: 450g
Motor diameter: 7mm
Motor length: 16mm
Weight: 150g
1 per propeller, drone motors are rated in "kV" units which equates to the number of revolutions per minute it can achieve when a voltage of 1 volt is supplied to the motor with no load. A faster motor spin will give more flight power, but requires more power from the battery resulting in a decreased flight time

5) Drone Main Board



A controller is a circuit board that manages the drone's flight. Put simply, the flight controller's job is to control the power, or RPM (Revolutions Per Minute), for each individual motor on the drone in response to the information received from the drone controller.

6) Transmitter Remote Controller

The transmitter combines the information signal to be carried with the radio frequency signal which generates the radio waves, which is called the carrier signal. This process is called modulation. This involves the transmitter and receiver staying within a fixed part of the 2.4GHz spectrum. The functional principle of a resistive pressure transmitter is very simple. The pressure sensor converts the mechanical pressure value into a proportional electrical signal.

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IV. DESIGN & CALCULATION

A. *Weights that will act on UAV*

1) Weight of propeller : 6*4 = 24g
2) Weight of the brushless motor : 150g
   (37.5*4)
3) Weight of the Lithium ion battery : 20g
4) Weight of the structure : 706g
5) Overall weight (approx.) : 900g

B. *Calculation of Thrust*

Calculations of static thrust are needed in order to ensure that the proper propellers and motors have been selected.
Static thrust is defined as the amount of thrust produced by a propeller which is located stationary to the earth. This calculation is important because UAV are very likely to perform at lower relative speeds to the earth. Also, it is important to note that the final calculations of static thrust are estimates and not actual values.

Thrust is always greater than the overall weight.

Weight

Power to Weight Ratio	2:1
Number of Motor	4
Total Thrust	1,800 Grams
Thrust per Motor	450 grams

Thrust

Drone Weight	800 grams
Battery Weight	20 grams
Equipment Weight	0 grams
Total weight	900 grams

Hence, thrust is 1,800

C. *Selection of Brushless Motors*

The motors selected are based on the previous calculations. The calculation has been done as per the thrust required and checking as per the allowable values are done. On these basis motors are selected.

1) Thrust required is 1,800 g. Thus we should select motor which produces approximately this thrust.
2) Thus for the above parameters from set of motors we have selected Brushless DC Motors.
3) Motor of stator size 1306 and thrust 450g is selected.

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D. Selection of Battery

From the concerned calculations a battery of around 0.5 – 2.5 A is needed.
So considering 2.5 A current we have chosen Lipo 600 mAh 3.7V.

The calculated Watt hours of battery is

Voltage	**3.7v**
Battery capacity	**600mah**
Watt-hours	**2.2wh**

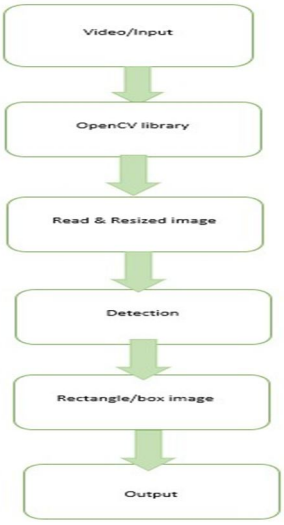
Thus as our calculations and required thrust we have selected the desired battery, and motors.
The hardware modelling is done accordingly step by step. The square frames selected are fixed firstly into each other.

V. WORKING

The selected brushless motors are then fixed on the four corners of the frame having two wires which would go into the 4 in 1 ESC flight controller. Propellers are connected to the brushless motors which cause the spin around and generate the thrust to enable drone to fly. The motors take power from the battery and signal the propellers to spin.
Next the four propellers are fixed upon the brushless motors. Two propellers are fixed such that the rotate clockwise and two anticlockwise.
The remote transmitter transmits signal to the receiver tuning 2.4 GHz. The blue and red lights provided in the flight controller indicate that the frequency of transmitter and receiver is tuning and is not stable. Once the light stop blinking it indicates that the frequency is tuned and the UAV is ready to fly. If it takes time for tuning then the remote transmitter should be taken towards the UAV.

VI. SOFTWARE METHODOLOGY

For detection of intruder or pedestrian, We have used an simple algorithms using opencv .By this we detect the intruder an alert the security for futher safety. OpenCV is an open-source library, which is aimed at real-time computer vision. This library is developed by Intel and is crossplatform. OpenCV is one of the most widely used libraries for Computer Vision tasks like face recognition, motion detection, object detection, etc. In this, we try to build a basic intruder/Pedestrian Detector for images and videos using Open CV. It is very important area of research because it can enhance the functionality of protection and security of individual or community.
Open CV has a built-in method to detect pedestrians. It has pertained HOG (Histogram of Oriented Gradients) & Linear SVM model to detect pedestrians in images and video streams



VII. CONCLUSION

Our objective is to design a system which would provide a helping hand to our country's security system. We aim to design an UAV which would be hassle-free and work efficiently. An enhanced software programming will be designed to detect the intruder. The system will detect an object in a sequence of frames using the object unique characteristics represented in the form of frames.

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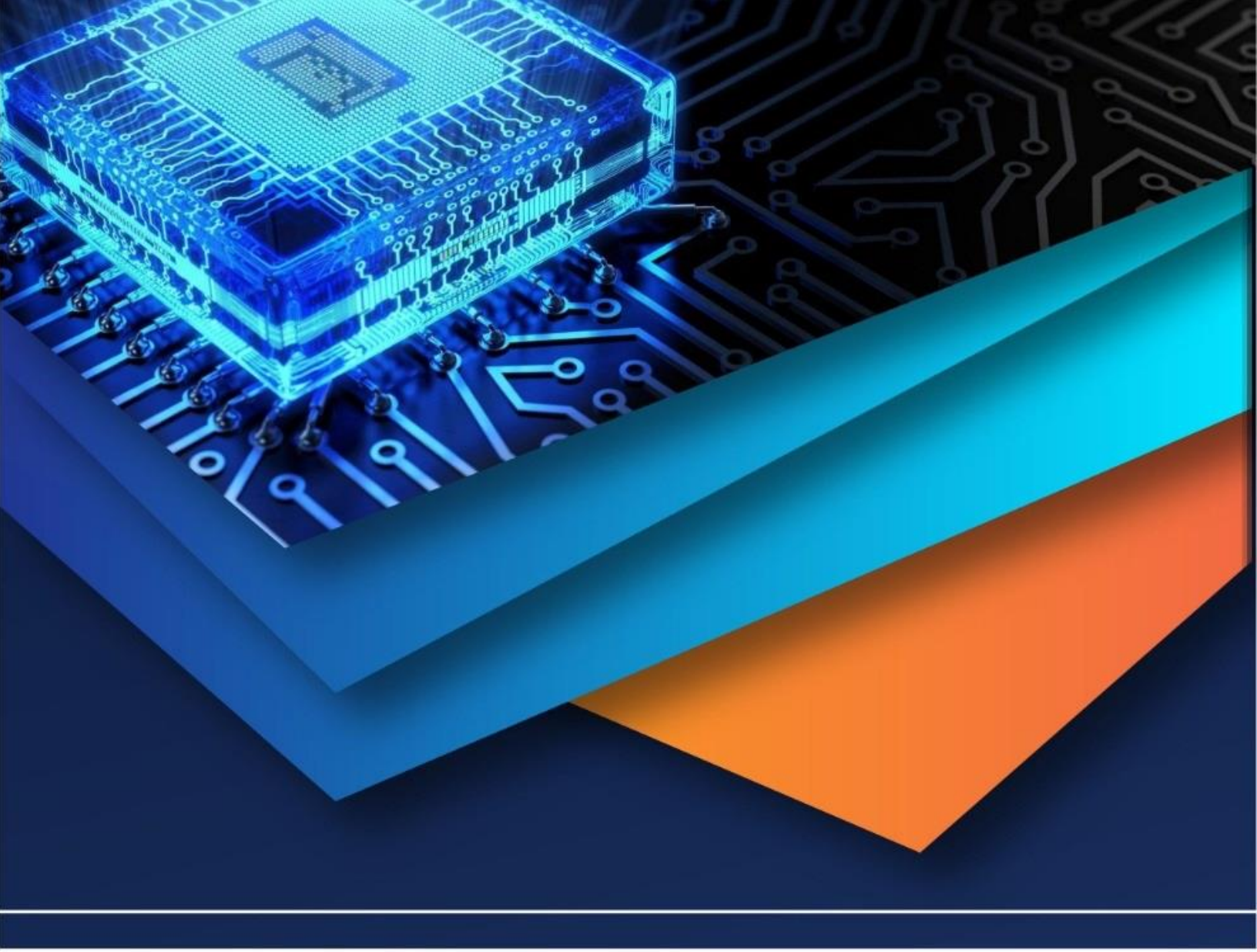

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