RESEARCH PAPER | Engineering | Volume : 4 | Issue : 6 | June 2014 | ISSN - 2249-555X

Design and Implementation of UAV Based Explosive Detection and Surveillance

KEYWORDS: Multicopter , APM Planner, Proteus, surveillance, detection system

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ABSTRACT *With the growth in modern embedded technology, the present scenario concentrates on UAV(Unmanned aerial vehicle) vehicles. An octo copter, also called a octo rotor helicopter, is a multicopter that is lifted and propelled by eight rotors. These vehicles use an electronic control system and electronic sensors to stabilize the aircraft. With their small size and agile maneuverability, these octocopters can be flown indoors as well as outdoors. This system can be used for surveillance and other purposes. With the current scenario of terrorist activities and blasts, it is necessary to design a system which can be used for automated surveillance. The proteus and APM Planner software is used for the design, controlling and implementation of explosive(bomb) detector circuit and octocopter respectively. The algorithm is developed to control and interface the bomb detector circuit with the octocopter.*

I Introduction

In a current trend with advanced technology, automated systems have less manual operations, flexibility, reliability and accuracy. The ever increasing demand in all fields prefers automated control systems. Especially in the field of electronics automated systems are giving good performance. In the present scenario of security breach, unmanned systems plays very important role to minimize human losses. So this robot is very useful to do operations like detecting bomb, obstacle and fire. In the present day, security and safety has been the main concern, especially in a public gathering, densely populated areas, Borders, Military Bases and thick forest. In order to tighten the security system, many intelligent systems are used to detect metals and explosives. Present system only offers Surveillance and explosive detection on terrain (land), which covers less area with respect to time which could prove fatal in critical conditions as the time is the main constraint whereas the drone can cover a overwhelmingly large area within the same time. Our focus is to develop an Unmanned Ariel Surveillance System (drone) which detects and locates the Explosive present (if any) and this information is sent to the control base and further actions may be executed by the trained professionals[1,2].

II Methodology

The existing Surveillance system is based on 2-axes movement (ground) which makes it less reliable in different terrain or conditions, it is appreciable to use a 3-axes movement (aerial) for larger coverage of area making it more reliable and independent of terrain factors. Fig 1 and Fig2 shows the difference of terrain robot and designed layout of proposed octocopter. It can be mainly implemented to enhance the security in a mammoth public gathering, cultural fairs (like Dasara) which serves our main purpose. It can also be used to detect land mines in borders and military bases[3,4].

Fig1: Design layout of proposed octocopter

The proposed octocopter composed of the following components as shown in figure 1

A. BLDC(Brush Less DC Motor) motor, 10.5V,RPM 1120/v, weight 76 gms

B. Aluminum frame of size 1"x1"

C. RC Receiver 2.4 GHz

D. Propeller 10x4.5

E. Battery 3 cell 11.1V

F. Ardupilot 2.5 Mega Board

G. ESC (Electronic Speed Controller) 30 Amp BEC 2A/5V.

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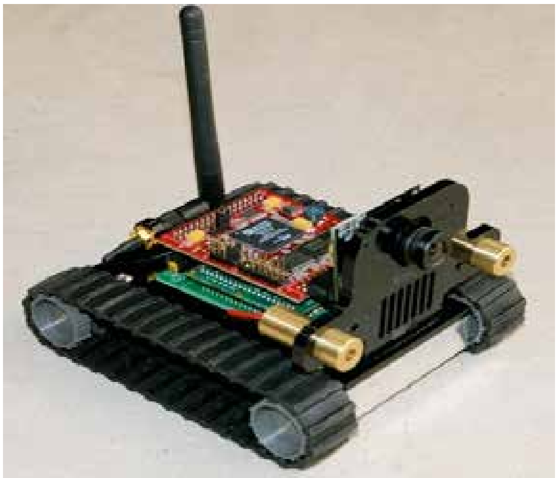

Fig2: Terrain robot

Design of the system:
There are various factors which are to be considered for designing the system. The materials used for the making of frame depend mainly on strength, weight and cost. We are using 1'x1' aluminum square tubes because its light weight and less cost. The selection of the BLDC motors depends on the thrust required. The size of propellers also play an important part in producing the thrust. The Fig 3 shows the plot of thrust v/s propeller speed for two different lengths of propellers. Hence the selection of propellers should be done keeping in mind the thrust required. By combining the BLDC and the propeller we can obtain the required thrust. The frame can be constructed in three different ways namely octo +, octo X, octo V8 configuration. We are using V8 configuration as its construction is simple and other devices can be easily placed when compared to other frame types where separate facilities have to be made in order to place different devices. The calibration should be done properly without disturbance in controller. If there is any change the controlling gets difficult and UAV may get crashed. Fig 4 shows the calibration of the directions in UAV main board.

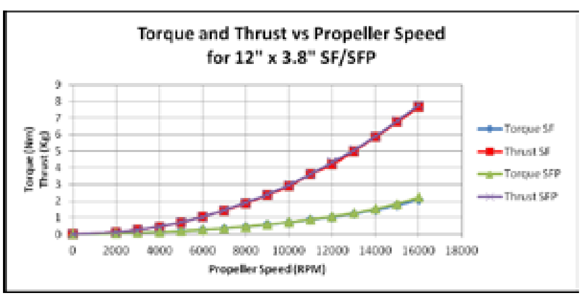

Fig3: Plot of Thrust v/s Propeller Speed

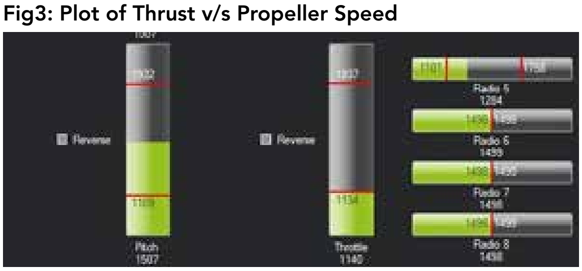

Fig4: Calibration of directions using RC controller

The selection of the battery should be done carefully by considering the current drawn by the motor and the total power required for the motor. If motors are connected in parallel with battery, the total load handling capacity of battery should be more than that of number of motors used and their total load. Fig 5 shows the plot of current drawn by the same motor for different propeller lengths.

Propeller		Throttle			
		0%	50%	75%	100%
11"x7"	Amp Draw(A)	0	17.3	26.1	31.0
	Thrust(Kg)	0	0.74	1.43	1.54
12"x3.8"	Amp Draw(A)	0	20.7	32.0	36.0
	Thrust(Kg)	0	1.26	1.58	179

The above table shows the variation of current drawn by the same motor by use of two different propeller sizes and also total thrust can get from the percentage of throttle.

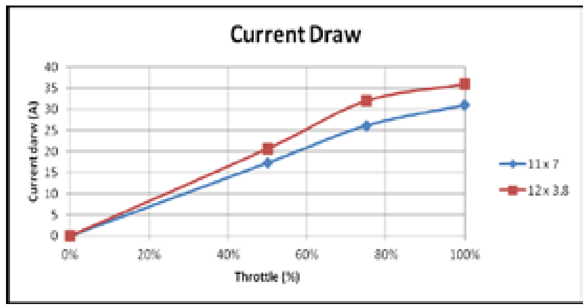

Fig5: Plot of current drawn v/s throttle

The various methods of bomb detection are namely using dogs, trace detections, Silicon nano wires for trace detection of explosives, Neutron activation, X-ray machines, Spectrometry, Gas chromatography, etc.

IR based proposed bomb detector system
Though these methods have great accuracy in detecting explosives all these systems are two dimensional. As time is a constraint in detection of explosives and cannot be used during run time, hence the above artificial methods have to be interfaced with an UAV so that security and safety can be improved. The algorithm is build to analyze step in functions, controlling and detecting operations of the entire octocopter based bomb detector system. Fig 6 shows the circuit diagram of detection system which has been simulated in proteus software

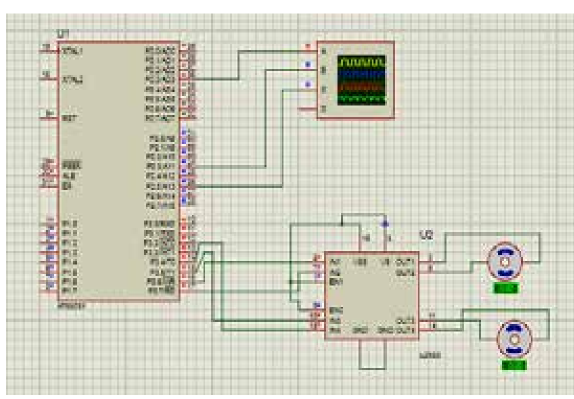

Fig 6 : Circuit Diagram of bomb detection system

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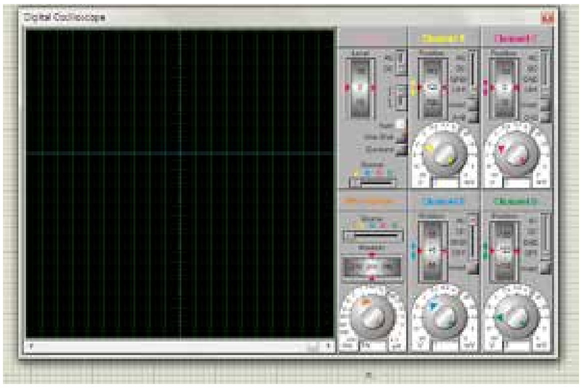

Fig 7: Waveforms of activated signals IR sensors

Fig 7 shows the waveform of activated signals IR sensors.. Fig 8 and 9 shows the IR proximity sensors that sends and receives the signal when it falls on the explosive material respectively.

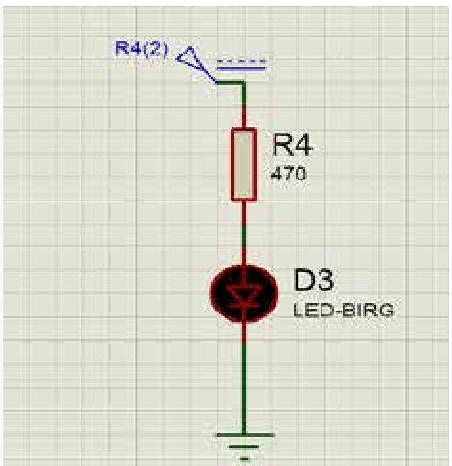

Fig 8 Sender circuit

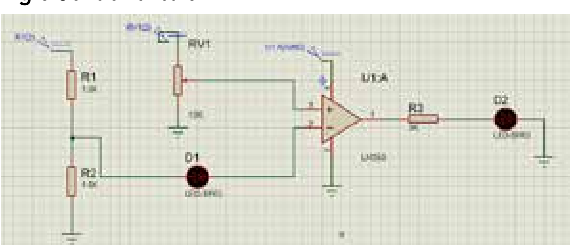

Fig 9 Receiving circuit

III Results and Discussions

The UAV is brought to the desired location. Using Radio Control it is made to hover. Using the remote control it is made to maneuvered throughout the desired area and if there is any presence of explosive materials the module detects its presence and locates the position of the explosive material and sends the location to the display unit using the GPS transmitter. Based on this location manual disarming or disposal of the explosive can be achieved. Hence contributing to the better security. By using software(APM planner) we can send the UAV to the desired location without any manual operations.

Fig.10 shows the input and output signal of the throttle by using APM mission planner software. Figure 11 shows the throttle response of motors 1,3,5 and 7. Similarly Fig 12 shows the throttle response of motors of 2,4,6 and 8.

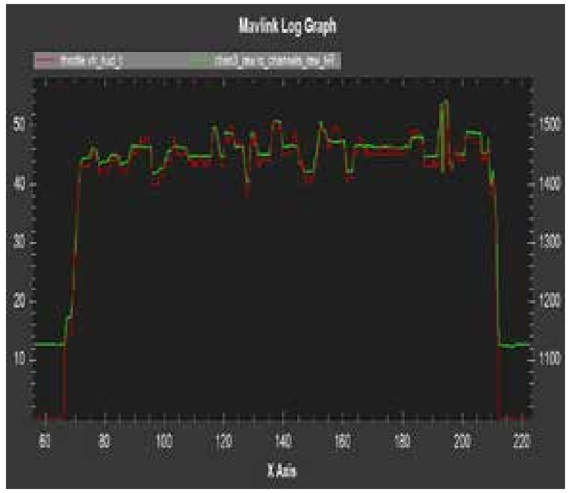

Fig 10 Throttle input and output signal

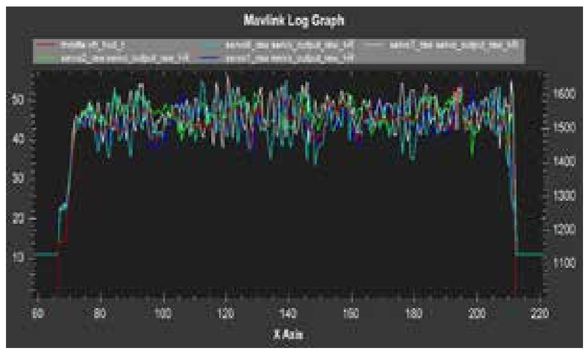

Fig 11 Motors 1,3,5 and 7 throttle response

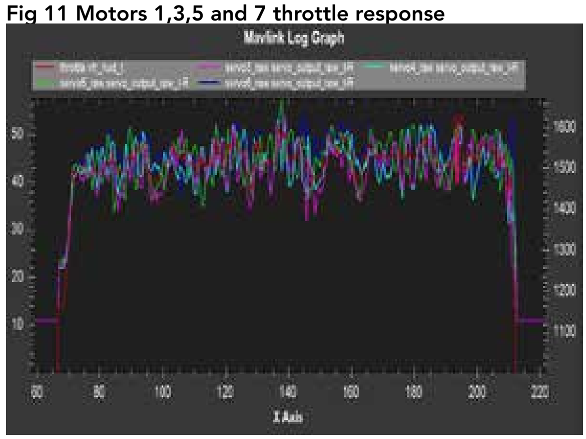

Fig 12 Motor 2,4,6 and 8 throttle response

IV Application

It can be carried to any location. It has less weight compared to any other available devices. Controlling action is much easier than any other devices and it can be made fully automated through certain software.

V Conclusion

By considering all the above mentioned factors that is correct motor selection, correct propeller size and other important factors, the good UAV can be designed of required thrust. The detection of various types based on requirements is interfaced with the main board and can used of required tasks.

Since this system is unmanned and can controlled both by remote assistance and also by preprogrammed, minimum human losses can be achieved.

Volume : 4 | Issue : 6 | June 2014 | ISSN - 2249-555X

If the system is not designed properly by not having the proper motor design or the battery, the system may get unstable or flight time is reduced drastically.

REFERENCE

1.Michael, F.A. (2011). Materials selection in Mechanical Design (4th Edition) Elsevier Ltd. | 2. Zhang, X.T. (2010). UAV design and manufacture. National University of Singapore. | 3. Chan, K.R. (2012). Uanmanned Aerial Vehicle Structure and Propulsion. National University of Singapore. | 4. Jan, G., Petr, K. & Pavel, S. (2012). Multicopter Potentialities. VSB-Technical University Ostrava, Ostrava, Czech Republic. |