JOURNAL OF INFORMATION, KNOWLEDGE AND RESEARCH IN MECHANICAL ENGINEERING
ISSN 0975 – 668X| NOV 16 TO OCT 17 , VOLUME –04, ISSUE – 02

QUAD COPTER FOR BORDER SECURITY WITH GUI SYSTEM

[1]MISS. GIRIJA ANUSE, [2]PROF. SHILPA VIKAS SHINDE
[1,2] Department of Electronics and Telecommunication
Sinhgad institute of technology
Lonawala, Pune
[1]ganuse5689@gmail.com [2]sshilpa.sit@sinhgad.edu

ABSTRACT
The military use of unmanned aerial vehicles (UAVs) has grown because of their ability to operate in dangerous locations while keeping their human operators at a safe distance. The larger UAVs also provide a reliable long duration, cost effective, platform for reconnaissance as well as weapons [2]. They have grown to become an indispensable tool for the military. The question we posed for this concept was whether small UAVs also had utility in military and commercial/industrial applications. I postulated that smaller UAVs can serve more tactical operations such as searching a village or a building for enemy positions, surveillance [3]. Smaller UAVs, on the order of a couple feet to a meter in size, should be able to handle military tactical operations as well as the emerging commercial and industrial applications and performing surveillance near a friendly base.

KEYWORDS- Unmanned aerial vehicle (UAV), indispensable tool, surveillance

1. Introduction-

The UAV is an acronym for Unmanned Aerial Vehicle, which is an aircraft with no pilot on board. UAVs can be remote controlled aircraft (e.g. flown by a pilot at a ground control station) or can fly autonomously based on pre-programmed flight plans or more complex dynamic automation systems.

This work is motivated by base defense scenarios within the Talisman Saber biennial U.S./Australian military exercise [4], where UAVs are tasked with obtaining intelligence (e.g., location and imagery) about intruders. In these base defense scenarios, the UAVs have limited onboard processing capabilities and, thus, cannot autonomously detect intruders; the UAVs thus rely on UGSs for intruder detection, pursuit and interception [5]. The introduction of these aircraft removed the pilots from harm's way plus added the ability to remain in the target area for many hours at a time. These very successful UAVs represent a fundamental change in the way conflict is managed by the U.S.

This work considers the problem of path planning for a team of unmanned aerial vehicles performing surveillance near a friendly base. The unmanned aerial vehicles do not possess sensors with automated target recognition capability and, thus, rely on communicating with unattended ground sensors placed on roads to detect and image potential intruders [1]. This work is motivated by persistent intelligence, surveillance, and reconnaissance and base defense missions. The algorithm uses detections from the sensors to predict intruders' locations and selects the vehicles' paths by minimizing a linear combination of missed deadlines and the probability of not intercepting intruders [4]. A team of small unmanned aerial vehicles (UAVs) is tasked with patrolling a network of roads near a friendly base. Ground intruders (e.g., trucks) use the road network to reach the base and do not know of the presence of the UAVs. The UAVs patrol the roads to detect and take pictures of any intruders present

on the roads. However, small UAVs possess limited on board processing resources, and the current detection capability of small aircraft using electro-optical or infrared sensors is not sufficient to ascertain whether an intruder is present or not [1]; thus, the UAVs in this problem are assumed to not possess automated target recognition capabilities. Instead, intruder detection is performed by unattended ground sensors (UGSs) placed on the roads. These sensors measure a given property (e.g., weight of a vehicle driving by), perform classification on the measurement to decide whether it corresponds to an intruder or not and register the time of the detection if the measurement was classified as an intruder. The use of UGSs

in conjunction with UAVs enables the pursuit of an intruder along the road network, which is otherwise not possible solely using UAVs.

To maximize the coverage of the road network, the UGSs are placed far apart. The UGSs possess short-range communication devices, but have limited long-range communication capabilities; they require a line of sight to a dedicated communication device with a permanent power source. Placing communication devices to meet these requirements can be difficult depending on the terrain and conditions (e.g., contested environment). However, this problem can be circumvented by using mobile UAVs instead of immobile communication devices. The UAVs do not require the difficult placement of communication devices and power sources in the area, such that the line of sight is maintained between devices; instead, they act as mobile communication devices by querying UGSs directly below using a short-range communication device. Thus, it is assumed that the UGSs cannot communicate with one another, but only with UAVs directly overhead.

2. Relevance

UAVs for military use were reduced to practice in the mid-1990s when the Global Hawk [1] and the Predator [2] were developed. These were very large fixed wing aircraft with wingspans in the 50 – 100 foot range. Payloads for these large UAVs included radar, laser designators, cameras, and missile systems. The introduction of these aircraft removed the pilots from harm's way plus added the ability to remain in the target area for many hours at a time. These very successful UAVs represent a fundamental change in the way conflict is managed by the U.S. However, these UAVs are large and very expensive and they beg the question of whether smaller UAVs could also play a role in military applications. Likewise, on the other extreme, there is considerable work in micro UAVs some of which are bio-inspired designs. There are designs modeled after insects and birds, but just as the large military UAVs are too expensive, I felt that these micro-UAVs were too small to be practical and required technology that was not readily available to a senior design project group. It was therefore a vehicle in the one foot to one meter class size that caught my interest and is the basis for my project. Specifically, I am very interested in whether these smaller UAVs can be used not only for military applications but also for commercial and industrial use.

Although most of the large military UAVs are fixed wing aircraft, I felt that a small UAV should have greater maneuverability and versatility since it was likely to be useful for a broader range of applications than the larger or smaller versions. We were also motivated by the DARPA UAVforge [4] challenge which required a vertical takeoff UAV design. I selected the Quad copter design because of its maneuverability, stability, and large payload capacity. The UAV that we are building is a prototype unit that could be used for commercial use but is not rugged or robust enough for military use. Although we will meet the goal of producing a small UAV that could perform useful missions in both military and commercial arenas, time and funding constraints forced us to design a UAV to meet our functional requirements but not to meet harsh environmental conditions such as those encountered during military missions. However, our UAV design certainly could be re-implemented with newer and more robust technology which would allow it to be used for military functions.

The Quad copter configuration UAV will be capable of being remotely controlled to fly specific pre-determined missions. It is estimated to show the range of control and monitoring capabilities of such a platform. Such missions might include inspection of a difficult to reach location, rapid deployment video from the location of a fictitious campus incident, or surveillance video from a pre-planned route around campus. A scenario requiring autonomous flight would be a search and rescue situation where a building has collapsed and the search route is blocked by unknown objects that must be avoided during the search.

3. Literature Review

UAVs for military use were reduced to practice in the mid-1990s with the High-Altitude Endurance Unmanned Aerial Vehicle Advanced Concept Technology Demonstrator (HAE UAV ACTD) program managed by the Defense Advanced Research Projects Agency (DARPA) and Defense Airborne Reconnaissance Office (DARO). [1] This ACTD laid the groundwork for the development of the Global Hawk shown in Figure (1). The Global Hawk flies at altitudes up to 65,000 feet for up to 35 hours at speeds approaching 340 knots while costing approximately 200 million dollars. The wingspan is 116 feet and it can fly 12,000 nautical miles which is considerably greater than the distance from the U.S. to Australia. Global Hawk is designed to meet domestic needs including homeland security and has been demonstrated in drug interdiction. Global Hawks are also approved by the FAA to fly in U.S. airspace.

Fig. 1 –

Another very successful UAV is the Predator which was also created in the mid-1990s but has since been enhanced with Hellfire missiles. "Named by Smithsonian's *Air & Space* magazine as one of the top ten aircraft that changed the world, Predator is the most combat-proven Unmanned Aircraft System (UAS) in the world". [2] The original version of the Predator, built by General Atomics, can fly at 25,000 feet for 40 hours at a maximum airspeed of 120 knots. In addition to missiles, the Predator can carry cameras, high resolution all weather radar and laser designators. The Predator is a little smaller than the Global Hawk but still has a wingspan of 55 feet.

.

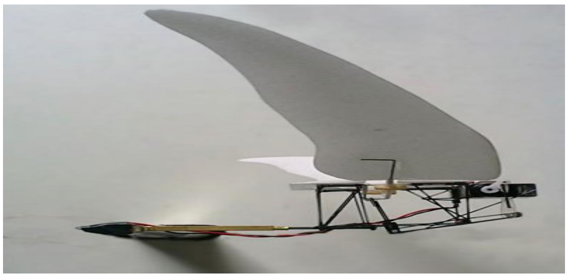

Figure 2: Micro Air Vehicle

At the very other extreme of size are the Micro Air Vehicles (MAVs) which are an interesting research focus area. There are many designs, some of which are bio-inspired such as the flapping wing version shown in Figure (2). [3] This design is being developed in Germany at the Biomimetics-Innovation-Centre and is inspired by a bird called the swift. Micro air vehicles are also modeled after various insects and generally use exotic designs and materials and are physically small. Additionally, although this design claims to be able to glide, the erratic motion caused by flapping wings could make this a difficult platform to operate a camera from. Although the designs in this class of UAV are fascinating, our interest was in attempting to produce a small UAV which could support a broad mission capability and these MAVs were dismissed as being too small.

In addition to reviewing very large and very small UAVs, we were also intrigued by the requirements of DARPA's UAVforge [4] competition which was posted around the time we started our project. The UAVforge challenge uses crowd sourcing techniques to design and build a micro-UAV that can take off vertically, go to a designated distant location, monitor the location for up to three hours, identify specific objects and then return home. We found this challenge interesting because, since it was a DARPA research project, it represented pushing beyond the limits of what a small UAV had ever achieved. The requirement for vertical liftoff also aligned with our thinking about the optimum form factor for a small UAV. Many of the deployed UAVs are fixed wing aircraft; however, we were looking for something more versatile that we believed could be built in small scale. The Quad copter, like other helicopter designs, is able to take off without a runway, take video from a fixed hovering position, and finally maneuver through tight spaces as required. The Quad copter also provides a superior payload capacity when compared to the helicopter and is a more stable platform. Since the Quad copter was a vertical liftoff design, it aligned well with both our team goals as well as the DARPA UAVforge goals and therefore it became our baseline form factor.

In addition to the military uses of the small UAV, we were interested in evaluating applications in the commercial and industrial sector. Our premise was that if smaller and cheaper UAVs become readily available, new markets and uses will emerge. Potential new markets in commercial and industrial applications include inspecting pipelines or even inspecting dangerous areas like a meltdown site at a nuclear power plant. Disaster relief or crop assessment seems also to be likely areas where small UAVs could be useful. We were also motivated by on-campus uses such as monitoring parking or quick-look video of an incident, or monitoring hard to reach locations, or exploration of a collapsed building or other dangerous location.

The state of the art in small UAVs seems to be a few hand launched vehicles used by the military and the amateur community represented by the DIYdrones [5] website. This technology is dedicated to open source development and distribution of information and technology related to UAVs. They have developed control modules, software, and various sensors that can be mixed-and-matched to build a low cost UAV. They also produce a low cost rudimentary Quad copter system that is available for purchase. The existence of this resource makes a Quad copter senior project feasible because some of the component parts can be reused instead of reinvented. It would not be feasible for a small three person team to create all the technology required for a Quad copter for a very limited budget and compressed time schedule. DIYdrones provides components for a quick baseline implementation that will allow us to focus on the problems of flight stability, payload management, and mission applications with more resources than if we had to reinvent the base technology. The DIYdrones components are also most importantly very low cost when compared to military alternatives and they are well documented and understood. For all these reasons, we decided to take the DARPA UAVforge as the starting point for performance metrics and the DIYdrones components as the baseline design and then test our hypothesis from that starting point.

4. Proposed Work

A. Scope:

This paper covers security applications of border monitoring, security & position detection of units by GPS. And activities are recorded time to time by use of wireless cameras.

B. Methodology:

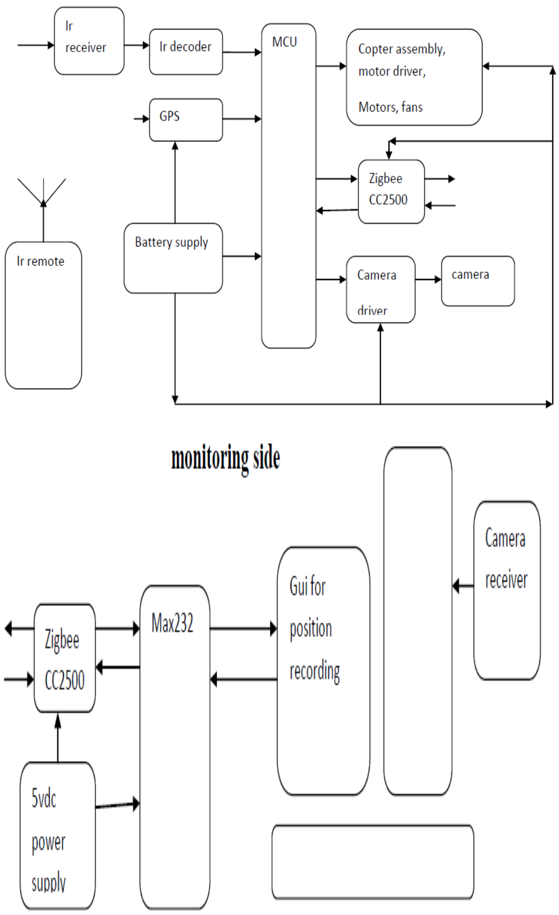

Fig. 3- Block diagram

C. Proposed work

1] MCU: (microcontroller unit)

It is the heart of system. All the controlling functions, data transmitting function are done by this unit. Following functions will be carried out by microcontroller unit.

1. Decode the signals from IR decoder & compare with stored value & make decision which function to be executed
2. Data from GPS will be received by MCU & send to server via zigbee.
3. To adjust the camera position.
4. To monitor battery voltage & check whether discharge or not & give information about battery status to server.

2] CC2500 zigbee module:-

Zigbee CC2500 is used as a media for communication between quad copter & pc. Zigbee uses RF link with carrier frequency 2.4 GHz. It is bidirectional with data anti-collision protection.

3] Camera:

It is used to take videos of the surrounding environment.

4] Copter assembly: It is used to fly the unit & take to position where we want. It consist of motors, base, fans.

5] Power supply requirement: power supply required is 5v dc/2A max. for all system.

6] IR receiver:

It is used to receive the signals from transmitter remote.

7] IR remote:

It is used to send commands to fly the copter.

8] Monitoring side:

1. At this side we will receive the data of position in terms of latitude & longitude given by GPS via zigbee cc2500.
2. This data is given to PC via a max232 ic which is TTL-CMOS, CMOS-TTL converter to PC
3. PC will contain GUI which will have map of area & through map we will plot position with the help of GPS data.
4. Through camera we are going to monitor the area also recording will be done.

D. Objectives of proposed work

- The primary objective of this paper is to detect intruders at borders so as to provide safety.
- To find the exact position of our units & also enemy units

5. Current Trends

U.S. authorities propose beefing up surveillance technology and patrols, including radar, underground sensors and drones along the Canadian border, rather than building fencing, roads or new border patrol stations to improve security. At about 6,400 kilometers, the non-militarized border between the U.S. and Canada is the longest in the world. India in talks to buy U.S. Predator drones, has eye on China, Pakistan.

India is in talks with the United States to purchase 40 Predator surveillance drones, officials said, a possible first step towards acquiring the armed version of the aircraft and a development likely to annoy Pakistan.

India is trying to equip the military with more unmanned technologies to gather intelligence as well as boost its firepower along the vast land borders with Pakistan and China. It also wants a closer eye on the Indian Ocean.

New Delhi has already acquired surveillance drones from Israel to monitor the mountains of Kashmir, a region disputed by the nuclear-armed South Asian rivals and the cause of two of their three wars.

6. CONCLUSION

Quadcopter and its GUI controller have been success fully constructed and developed.GUI controller is able to send the control signal to quadcopter controller and quadcopter controller can translate the command signals to maintain the stability and balance.Quadcopter is always being very useful in many application. Research and development of unmanned aerial vehicle (UAV) and micro aerial vehicle (MAV) are getting high encouragement nowadays, since the application of UAV and MAV can apply to variety of area such as rescue mission, military, film making, agriculture and others.

7. REFERENCES

1. A Real-Time Adaptive High-Gain EKF, Applied to a Quadcopter Inertial Navigation System, Transactions On Industrial Electronics, Vol. 61, No. 1, January 2014 (2013 IEEE)
2. See-and-Avoid Quadcopter using Fuzzy Control Optimized by Cross-Entropy WCCI 2012 IEEE World Congress on Computational Intelligence June, 10-15, 2012 - Brisbane, Australia
3. The attitude control of the four-rotor unmanned helicopter based on feedback linearization control Zhang Yaou1, Zhao Wansheng1, Lu Tiansheng 2 , Li Jingsong2 Issue 4, Volume 12, April 2013
4. Haptic Teleoperation of Multiple Unmanned Aerial Vehicles over the Internet Dongjun Lee, Antonio Franchi, Paolo Robuffo Giordano, Hyoung Il Son, and Heinrich H. B¨ulthoff 2011 IEEE International Conference on Robotics and Automation, Shanghai, CN
5. UAV-Borne 3-D Mapping System by Multisensor Integration Masahiko Nagai, Tianen Chen, Ryosuke Shibasaki, Hideo Kumagai, and Afzal Ahmed IEEE Transactions On Geoscience And Remote Sensing, Vol. 47, No. 3, March 2009
6. Trajectory Tracking for Unmanned Air Vehicles With Velocity and Heading Rate Constraints Wei Ren*, Student Member, IEEE,* and Randal W. Beard*, Senior Member, IEEE* IEEE Transactions On Control Systems Technology, Vol. 12, No. 5, September 2004
7. Visually Guided Landing of an Unmanned Aerial Vehicle Srikanth Saripalli*, Student Member, IEEE*, James F. Montgomery, and Gaurav S. Sukhatme*, Member, IEEE* Transactions On Robotics And Automation, Vol. 19, No. 3, June 2003
8. Coordinated Target Assignment and Intercept for Unmanned Air Vehicles Randal W. Beard*, Member, IEEE*, Timothy W. McLain*, Member, IEEE*, Michael A. Goodrich*, Member, IEEE*, and Erik P. Anderson IEEE Transactions On Robotics And Automation, Vol. 18, No. 6, December 2002