AUTOMATIC AND MANUAL CONTROLLED MULTI-APPLICATION QUADCOPTER

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ABSTRACT

A Quadcopter also called a quadrotor helicopter or quadrotor is a multirotor helicopter that is lifted and propelled by four rotors. Quadcopters are classified as rotorcraft, as opposed to fixed-wing aircraft, because their lift is generated by a set of rotors (vertically oriented propellers).Quadcopters generally use two pairs of identical fixed pitched propellers; two clockwise (CW) and two counter-clockwise (CCW). These use independent variation of the speed of each rotor to achieve control. By changing the speed of each rotor it is possible to specifically generate a desired total thrust; to locate for the centre of thrust both laterally and longitudinally; and to create a desired total torque, or turning force. Quadcopters differ from conventional helicopters which use rotors which are able to vary the pitch of their blades dynamically as they move around the rotor hub. In the early days of flight, quadcopters (then referred to either as 'quadrotors' or 'helicopters') were seen as possible solutions to some of the persistent problems in vertical flight; torque-induced control issues (as well as efficiency issues originating from the tail rotor, which generates no useful lift) can be eliminated by counter-rotation and the relatively short blades are much easier to construct. A number of manned designs appeared in the 1920s and 1930s. These vehicles were among the first successful heavier-than-air vertical takeoff and landing (VTOL) vehicles. However, early prototypes suffered from poor performance and latter prototypes required too much pilot work load, due to poor stability augmentation and limited control authority.

Keyword: - *Quad copter, quad rotor*

1. Introduction

Quad copters are a useful tool for university researchers to test and evaluate new ideas in a number of different fields, including flight control theory, navigation, real time systems, and robotics. There are numerous advantages to using quadcopters as versatile test platforms. They are relatively cheap, available in a variety of sizes and their simple mechanical design means that they can be built and maintained by amateurs. Due to the multi-disciplinary nature of operating a quadcopter, academics from a number of fields need to work together in order to make significant improvements to the way quadcopters perform.

The idea is to make this unmanned vehicle to be operated by itself i.e. GPS controlled and object avoiding system using Arduino Uno including manual control ,by the integration of Arduino with the receiver system of the quadcopter we can ensure the avoidance of objects in the projectile path of the quadcopter or the flight path and GSM module is interfaced in order to ensure the safety(the idea of GSM is that when there is any particular security issue the drone itself can contact the people or institute mentioned in the GSM module.

1.1 Existing system and its disadvantages

Improving the mechanics, aerodynamics, and reliably of Multicopters is an active research area, the basics of quadcopter design is a solved problem. Instead of building in a quadcopter, the focus of this project was to explore what could be done with an autonomous quadcopter. Currently, the main constrain on multicopters is their battery life, which can limit the flight time to as little as 10 minutes. This problem extends to all multicopters and often is invariant of the scale of the machine a prototype nano-quadcopter that fits in the palm of your hand, can

achieve 7 minutes of flight time with its 170mAh Li-Po battery, which is comparable to the 5-7 minute flight time of the quad copter used for this project 3DRobotics Arducopter with the recommended 2200mAh Li-Po battery. Just as gas stations extend the range of an automobile, one solution is to provide designated recharging areas for these multicopters.

1.2 Proposed theory

Since the goal of this project was to explore the use of quadcopters rather than design a Quadcopter, it was determined that it would be best to choose a pre-existing quad copter that was affordable and relatively-easy to construct since most amateur UAV uses, myself included, can be expected to have access to soldering tools, but not welding or laser-cutting equipment. This meant that the quadcopter chosen would either be fully assembled or be part of a kit. Another major constrain considered was the size of the quadcopter. While small quadcopters have the advantage of being easy to transport and lower priced, it was essential that the platform chosen be able to accommodate any additional hardware, sensors, and their power sources without over-burdening the quadcopter.

- Obstacle avoidance and Crash flight,
- Autonomous take-off and landing,
- Automatic control based on GPS location,
- Includes manual control with automatic control function,
- Can be used in various fields like agriculture, safety and security measures, surveillance, commercial purpose and gaming
- Mainly focused on the application in the field of women's safety.

2. WORKING AND PROCEDURE

In the design a quadcopter is controller using the ArudCopter ArduPilot Mega 2.5, an autopilot board that handles that stabilized flight, integrates the local sensors such as GPS, sonar and battery monitoring as well as radio communication. This quadcopter was chosen for it size, payload capacity, preexisting community and open-source software. The quadcopter's flight is controlled using a ground station computer over a 915 MHz communication link using a 3D Robotics radio,which was chosen based on its compatibly with the APM 2.5 .

The quadcopter is controlled using a command prompt interface by the program MAVProxy which initiates a MAVLink communication link to the quadcopter over the radio. The MAVProxy program was chosen for its support of control scripts and extra modules . This ground station computer can change the mode of the quadcopter to be flown under manual control using a USB gaming controller to emulate an RC controller and by setting the flight mode of the quadcopter to Stabilize. It can also switch to any one of the enabled flight mode from the terminal, such as Return-to-Launch, Position Hold, Altitude Hold, Land,(chart1) etc.

An Android Smartphone is placed on the bottom of the quadcopter and the video feed of the phone is accessible at the phone's local Wi-Fi IP address using a free app called IP webcam. This camera system was chosen because it is very easy to interface with, is supported by SimpleCV and would likely work with any Smartphone running a similar application. The quadcopter is able to sense the location it must land at using a custom MAVProxy module mavpoxy_android.py that I wrote. This module uses the computer vision library SimpleCV to search for large red rectangles in a separate thread from MAVProxy. A simple red square was chose as the target because this feature is simple to detect but was unique enough in all of the environments tested to avoid misidentification. This program also writes a log file that timestamps when commands are executed for debugging purposes. If a large red rectangle is detected in the center of the video, an RC override command is set to cause the quad copter to enter the flight mode LAND, which will cause the quad copter to quickly descend to the ground and will slow down the motors as the quadcopter detects it is no longer moving and level on the ground. With this system a flying quad copter could be triggered to land in a relatively small area, allowing for it to manually recharged (as shown in chart1).

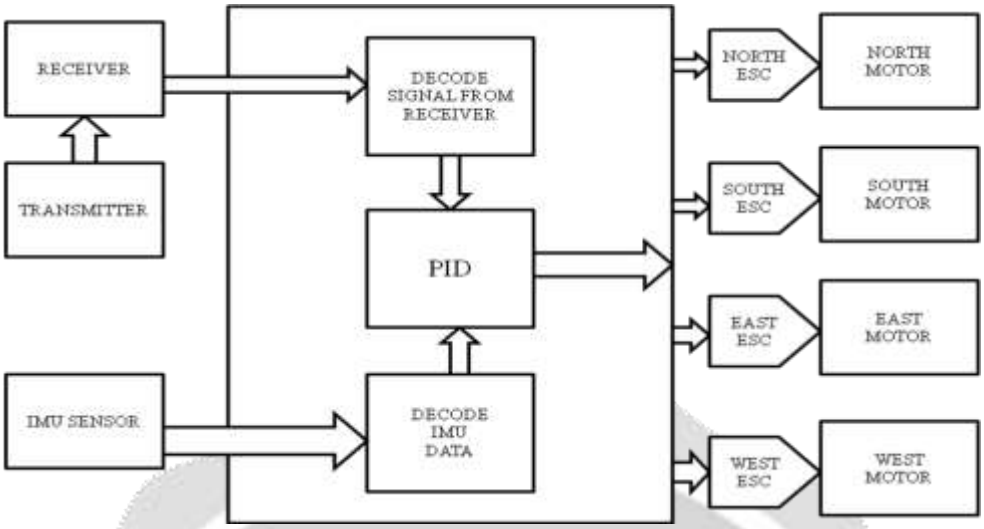

Chart -1: Block diagram of quad-copter

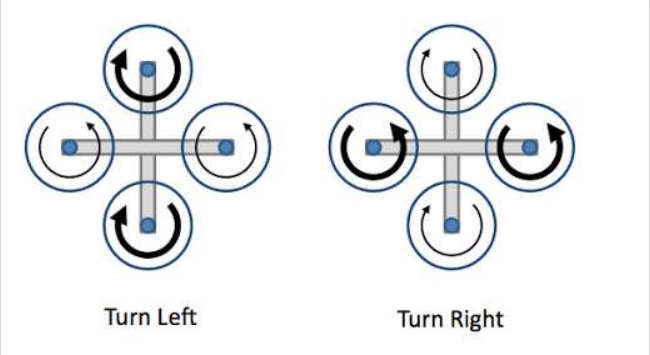

Fig -1: Directional movement of four rotors.

One of the first major design choices made was choosing the type of multicopter to be used in this project. A quadcopter platform was chosen because in general they are capable of hovering in place, robust, well balanced for the amount of lift they generate, and are widely used in the UAV community.

Since the goal of this project was to explore the use of quadcopters for multipurpose and want to include more than two module system in the copter itself, it is necessary to built it by our own design rather than buying a kit that will not fit according to our requirement(chart2).

Another major constrain considered was the size of the quadcopter. While small quadcopters have the advantage of being easy to transport and lower priced, it was essential that the platform chosen be able to accommodate any additional hardware, sensors, and their power sources without over-burdening the quadcopter and use of the sensors and modules

In small quadcopter is challenging and the size of the quad must allow us to use all the defense kit we need. A different technologies and architectures of UAV'S in defense field is implemented in the present .designing it for a the use of a single personal is more complicated as the user must know how to control it even if it is autonomous. Designing includes the following modules and sensor work

1. Sensors that collect data (sensors that are attached to the quadcopter to avoid the obstacles that are in the path of the quadcopter);
2. Microcontrollers that process, analyze and wirelessly communicate the data

3. System that identifies the voice of the victim(voice recognition system) (chart2)which is a single user type can be configured by the only the user.

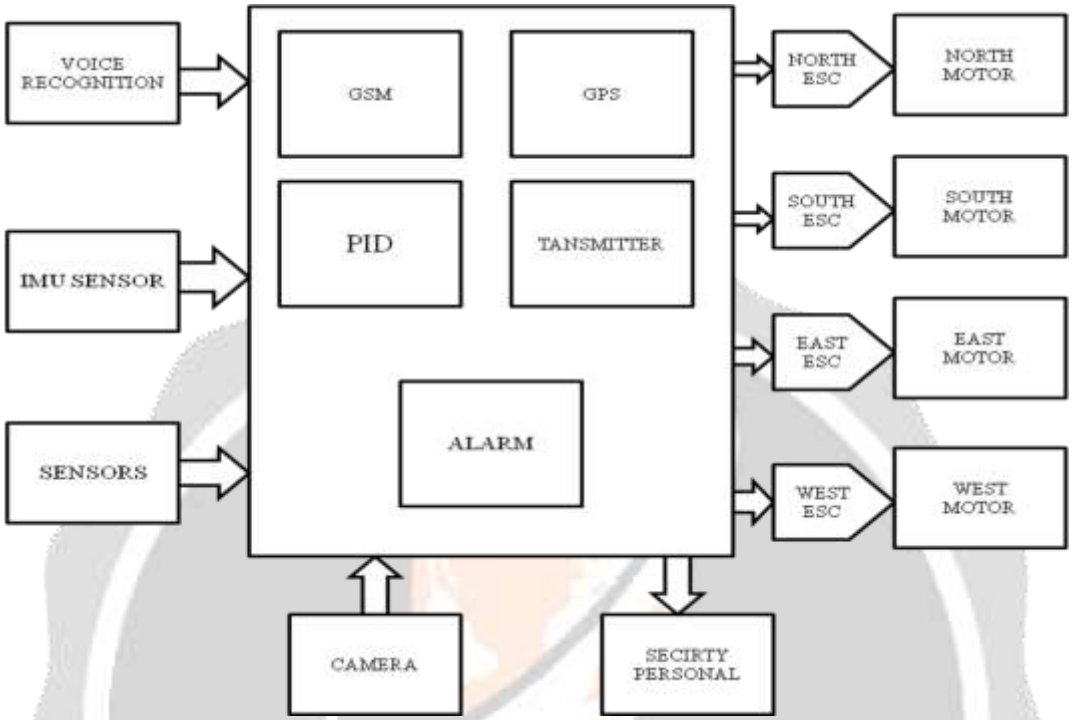

Chart -2: Block diagram of the safety drone system

3. USED IN DEFENCE FOR WOMEN

As the women identifies the threat and activates the drone the drone lifts at 10ft high and 10feet distance from the women and it follows her and cover her in the distance of 10 feet. Which is preloaded in the microcontroller.This kind of interaction is achieved in this implementation.The modules that are being incubated in the quad may increase the weight of the drone, which requires the high thrust motors and this distance provide a good and 100% communication with the devices that interacts with her. With the appearance of the Drone concept, elements, such as sensors and sensor networks, are becoming available and applicable in all fields of human activity, thus providing conditions for the creation of expert systems that can operate anytime and anywhere. Following these trends, an indispensable application of it is in safety, where the application can be found in defense more and other components to achieve this height and movement and other activities

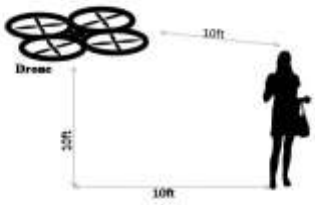

Fig- 2: Real time interaction in the site.

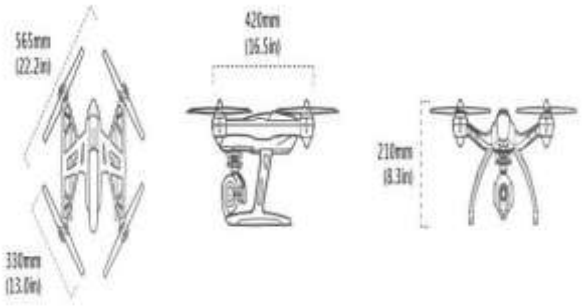

Fig-3: .Real time measurements of the drone

4 HARDWARE AND SOFTWARE COMPONENTS

4.1 HARDWARE COMPONENTS

1. Standard propellers:

It converts rotary motion from an engine or other mechanical power source, to provide propulsive force. It comprises a rotating power-driven hub, to which are attached several Radial airfoil -section blades such that the whole assembly rotates about a longitudinal axis. The blade pitch may be fixed, manually variable to a few set positions, or of the automatically-variable "constant-speed" type.

2. Brushless motors:

synchronous motors powered by DC electricity via an inverter/switching power supply which produces an AC/bi-directional electric current to drive each phase of the motor via a closed loop controller. The controller times commutation (hence rpm) and creates current waveforms (hence torque).

3. Main body or Frame:

Frame is the main supporting structure of a motor vehicle to which all other components are attached, comparable to the skeleton of an organism.

4. Electronic speed controller:

It converts the PWM signal from the flight controller or radio receiver, and drives the brushless motor by providing the appropriate level of electrical power. BEC stands for Battery Elimination Circuit

5. Flight controller or control board:

Flight controller (FC) is a small circuit board of varying complexity. Its function is to direct the RPM of each motor in response to input. A command from the pilot for the multi-rotor to move forward is fed into the flight controller, which determines how to manipulate the motors accordingly.

6. Arduino uno:

Arduino is an open-source project that created microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices. The project is based on microcontroller board designs, produced by several vendors, using various microcontrollers.

7. GPS module

The Global Positioning System (GPS) is a satellite-based navigation system made up of a network of 24 satellites placed into orbit by the U.S. Department of Defense.GPS was originally intended for military applications, but in the 1980s, the government made the system available for civilian use.

8. Transmitter and Receiver:
An RF module (radio frequency module) is a (usually) small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. This wireless communication may be accomplished through optical communication or through radio frequency (RF) communication. For many applications the medium of choice is RF since it does not require line of sight. RF communications incorporate a transmitter or receiver.

9. Battery and Battery monitor:
It is any electronic system that manages a rechargeable battery (cell or battery pack), such as by protecting the battery from operating outside its Safe Operating Area, monitoring its state, calculating secondary data, reporting that data, controlling its environment, authenticating it and / or balancing it.

10. Camera and Trans-receiver:
Camera and Trans-receiver are used to capture the image of the back of the car as a proof that car has passed through the particular toll and Trans-receiver sends the captured image to database for storing purpose.

11. **IR Sensors:**
An infrared sensor is an electronic instrument which is used to sense certain characteristics of its surroundings by either emitting and/or detecting infrared radiation. Infrared sensors are also capable of measuring the heat being emitted by an object and detecting motion. Infrared Radiation.

12. UV Sensors:
Ultrasonic sensors are devices that use electrical–mechanical energy transformation to measure distance from the sensor to the target object. Ultrasonic waves are longitudinal mechanical waves which travel as a sequence of compressions and rarefactions along the direction of wave propagation through the medium. Apart from distance measurement, they are also used in ultrasonic material testing (to detect cracks, air bubbles, and other flaws in the products), Object detection, position detection, ultrasonic mouse, etc.

13. Landing gear:
Landing gear is the undercarriage of an quadcopter and may be used for either takeoff or landing. For aircraft it is generally both. For aircraft, the quadcopter supports the craft when it is not flying, allowing it to take off, land, and taxi without damage.

14. Voice transmitter.
The voice transmitter sends the audio data that has been received and this acoustic signal is being loaded into the microcontroller for the verification and the security purpose where it has been coded in the controller of the drone. It is widely used in the spy technologies and smart devices.

15. Alarm
The alarm is a device which creates a continuous sound with high frequency which alerts all the people or the residents nearby.

16. **Voice receiver**
The receiver can be in the mode of Bluetooth or zigbee module that is being connected to the arduino or the control board.The control board is itself a APM follower.

17. Global system for mobile (GSM)
GSM is a digital mobile telephony system that is widely used in all the areas which uses a variation of the time division multiplexing access (TDMA) and is mostly used for mobile data communication and other research purposes.

4.2 SOFTWARE COMPONENTS

ARDUINO IDE:

A program for Arduino may be written in any programming language for a compiler that produces binary machine code for the target processor. Atmel provides a development environment for their microcontrollers, AVR Studio and the newer Atmel Studio.

The Arduino project provides the Arduino integrated development environment (IDE), which is a cross-platform application written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one-click mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus.\

A program written with the IDE for Arduino is called a sketch.[40] Sketches are saved on the development computer as text files with the file extension .ino. Arduino Software (IDE) pre-1.0 saved sketches with the extension .pde.

The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

Fig-4: Arduino IDE wrokspace

2. MISSION PLANNER

Mission Planner is a ground control station for Plane, Copter and Rover. It is compatible with Windows only. Mission Planner can be used as a configuration utility or as a dynamic control supplement for your autonomous vehicle. Here are just a few things you can do with Mission Planner. Load the firmware (the software) into the autopilot (APM, PX4...) that controls your vehicle.

Setup, configure, and tune your vehicle for optimum performance.
Plan, save and load autonomous missions into you autopilot with simple point-and-click way-point entry on Google or other maps. Download and analyze mission logs created by your autopilot. Interface with a PC flight simulator to

create a full hardware-in-the-loop UAV simulator With appropriate telemetry hardware you can. Monitor your vehicle's status while in operation.
Record telemetry logs which contain much more information the on-board autopilot logs.
View and analyze the telemetry logs.
Operate your vehicle in FPV (first person view)

Fig-5: Mission planner

4. CONCLUSIONS

The technology of this may be used in many field and many application is applied in this field, the use of this technology in the safety and defense may change the visualization of the technology involving in the human path. Personalized, timely and convenient. All of this significantly improves this field by increasing the availability and quality of the drone technology followed with radically This paper discusses of economical, technological, security and application aspects of applying Drone technology in security of women. It also presents solutions on the affordable prototyping platform for drone based on automation unit: one used existing arduino, and the second is based on principals for creating a custom solution – solution built from a scratch by creating our own environment. Using proposed solution is shown that applying technology based on Drone significantly can reduce risk of threats for women, but is also shown that there are elements (security and technology) for future improvement and consideration.

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