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Quadcopter for Traffic Surveillance

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Abstract

This paper presents an approach for a self-navigating quad copter. It can greatly reduce the labour in commercial purpose. The UAV is capable of sustained without a human operator on board which can be controlled by autonomously. The main purpose of the project is to reduce the traffic in mostly rushed areas and in festival places (ganpati ralleys),where human cannot interfere or unable to watch on traffic situations so UAV will help to reduce the traffic by keeping eyes on it through video surveillance.
Keywords- Self Navigation, Return to Origin, Barometer based Altitude hold, GPS, Wireless, raspberry pi

I. INTRODUCTION

Quad copter also usually known as drone or Unmanned Aerial Vehicle (UAV) is either an autonomous or remote controlled aerial flying vehicle without a human on board. Quad copters have the VTOL (Vertical Take Off landing) characteristic unlike the other conventional flying objects or the Unmanned Aerial Vehicles which allows hovering at a particular point. They are highly suitable for environments (i.e. indoor or congested environment) where human access is at difficult situation. Quad copters are 6 degree of freedom unmanned air vehicles (UAVs) which generally use 4 rotary blades for propulsion.

The paper is divided into several sections. Section II represents the related works done regarding quad copters, section III describes about a flight dynamics, section IV gives the concept of its control system. Section V demonstrates about the sensors for balancing and tracking and also deals with wireless transmission. Section VI presents the design of autonomous robotic arm and Section VII represents the experiment and results obtained and finally the conclusion and future work is given in Section VIII.

II. RELATED WORK

Drones came into first use after World War II when unmanned jets, such as the Ryan Fire bee started field operation. The quad copter concept started as early as the 20th century and the earliest work were started by George DeBothezat and Etienne Oemichen . Their work failed due to lack of proper lifting power, instability, unresponsive and susceptibility to reliability issues. After putting efforts in recalculations and redesigning, the mentioned issues were overcome. Until the mid-1950s the quad copter designs done by Marc Adam got into its true shape and structure which was also the first quad copter designed to have flown forward successfully. Many hobbyists also give contribution to the designing of quad copter. Some of the successful work found are Arducopter, KK Multicopter, MultiWii, Microkopter, DJI Naza Lite and other various Open Source Projects. Early quad copters would typically have the engine sitting somewhere centrally in the fuselage of the copter, driving the 4 rotors via belts or shafts. Belts and shafts however are heavy and importantly, subject to breakage. As the 4 rotors of a quad copter are all slightly different from each other, a quad copter is not naturally stable, simply running 4 rotors at the same speed, while producing enough lift to hover the copter, does not produce stable flight. On the contrary, quad copters have to be constantly stabilized. In the absence of computers, this meant a monumental workload for the pilot. As a result, multicopter designs were abandoned in favor of single, or on rare occasions for very large transport helicopters, double rotor designs. With the advent of electric motors and especially microelectronics and micromechanical devices, a few years ago it became possible to build reliable and efficient multirotors. Modern multicopters have an electric motor mated to each rotor, sitting directly below or above it. A flight computer constantly monitors the orientation of the copter and corrects for instability by changing not the pitch of the rotors but simply the rpm of the individual motors/rotors. This fixed pitch design is much simpler than the complex swash plate mechanics that are required for single rotor helicopters. This design has proven to be hugely successful and most modern VTOL drones and hobby aircraft are now multicopters rather than single copters. The scaling up of this to aircraft that are able to carry people has only just begun and Krossblade is part of this development.

Fig. 1: Convert awing Test Quad rotor, March 1956

III. QUADCOPTER DESCRIPTION

Quad copters use four motors with four propellers to create thrust to give the aircraft lift. Two of the motors rotate counter clockwise and the other two rotate clockwise. This configuration causes the torque from each motor to cancel by the corresponding motor rotating the opposite direction.

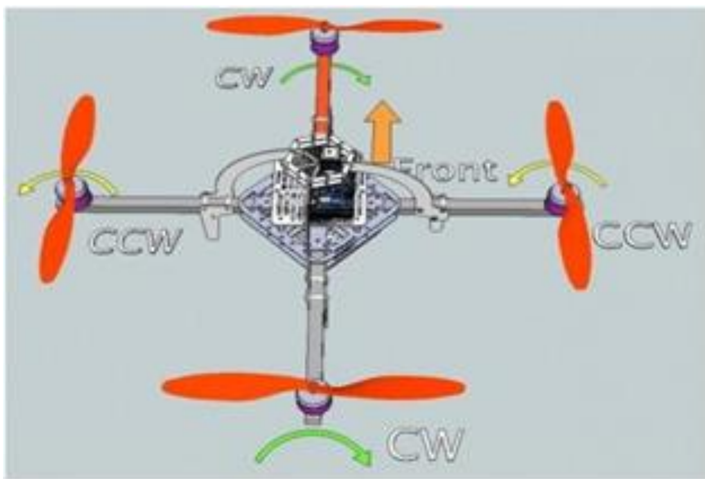

Fig. 2: Quad copter motor configuration

What is very different about quad copters from other vertical takeoff and landing aircraft (VTOL) is that in order to control pitch, yaw, and roll the pilot uses variable thrust between the four motors. We use fiber plastic body which have four rod of equal length for holding motors and in our project.

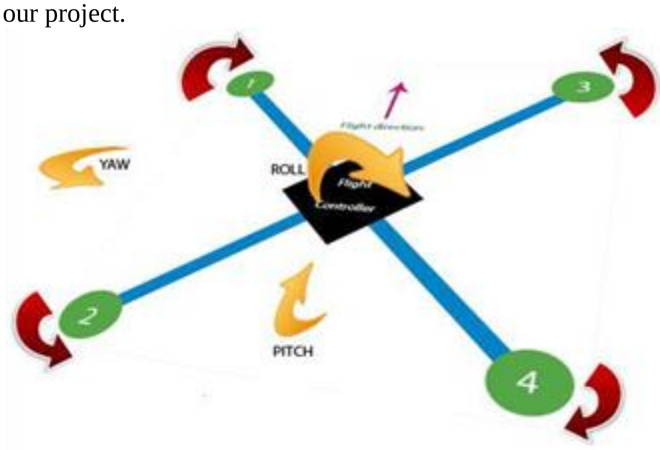

Fig. 3: Flight Dynamics

To achieve the desired autonomy, first and foremost a stable flight needs to be attained. The symmetrical design of the quad copter also allows an easy control in stabilizing the flight. To manipulate the thrust exerted by the motors, controllers are required which can be done by using a microcontroller. An electronic device called Inertial Measurement unit (IMU) is used which includes combination of the sensors– accelerometer, gyroscope and a barometer sensor. An IMU is used to determine the angular rotation as well as the linear acceleration of data that are given as input to a microcontroller. Each of these sensor devices can determine 3 axes of coordinates (x, y and z). For instance, combination of accelerometer and gyroscope will give number of different independent parameters that describe the state or configuration of the system which is called 6 Degrees of Freedom (6 DoF). A gyroscope is commonly used in quad copter control boards as it gives the angular rate around the 3 axes of space and to get the orientation of pitch and roll, a 3-axis accelerometer can be used.

IV. FLIGHT SYSTEM AND FLIGHT CONTROL

A. System

Quad copters propeller's having various dimension depends on thrust and weight it can carry. Each propeller is attached to the motors. The motors are chosen depending on the weight of the quad copter .motors capacity can be calculated by turns per volt and it is specifying by kV rating. The thrust that each motor will exert can be determined by the rule.
General rule of thumb is

Required Thrust per motor = (AUW x 2) / 4 (1)

Power is supplied by high capacity lightweight Lithium-Polymer batteries. They can supply high amount of current in short time which is required by the motors for the lift. Microcontroller which has at least 4 digital input/output pulse width modulation (PWM) is essential for the quad copter controlling. This microcontroller is connected to the motors through electronic speed controller (ESC). The microcontroller should also have an interface like Inter-Integrated Circuit (I2C) to connect to the IMU device so that the numbers of ports necessary to attach multiple sensor devices are reduced. Accelerometer is required to sense the orientation, position and velocity. Gyroscope utilizes angular momentum to determine orientation and change of direction. When the 3-axis accelerometer is combined with a 3-axis gyroscope, an output have maximum accuracy so that it's data is useful for better controlling of quad copter .We use DJI NAZA M-lite flight controller to control the quad copter as it have more accuracy and it is easy to use. Proposed designed block diagram as follows:

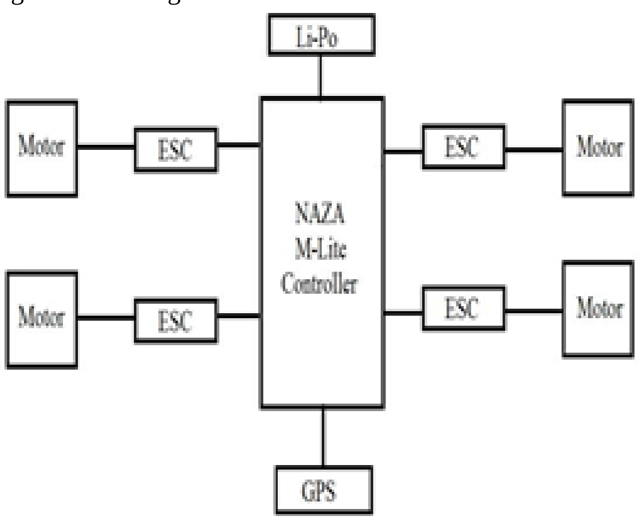

Fig. 4: Block diagram of proposed system

The NAZA M-Lite controller have accelerometer, gyroscope and barometer sensors are interface with controller. GPS sensor is added on interface to the controller. Monitors multiple satellites and determines the exact position of the receiver and its deviation from true time.

To control quad copter manually or autonomously it needs wireless transmission system. Transmitter, receiver and antenna are the basic parts of the transmission system .In this project we use 2.4GHz radio channel transmitter/receiver system for the communication with the quad copter controller.

A. Video Camera

There are many different options for the camera. One of the first solutions was to mount an IP camera to the fuselage of the quadcopter which would be able to produce a high resolution image with its own transmitter. The downside to using such a camera is the necessity to be connected to a network; the system would not be able to function without an internet connection and would not be useful in wilderness areas. CCTV cameras were also considered but were quickly discarded as they are generally too large and heavy for our application. Digital cameras and helmet cameras with Wi-Fi connectivity like the Samsung SMART and Go Pro series were investigated. The cameras were designed to have a separate device, such as a smartphone, act as a viewfinder for the camera. Potentially, our viewfinder could display the live video to the operator while the camera records. One detriment to this method is not being able to easily transmit the video to a computer for post analysis. Another detriment is the transmission distance of the Wi-Fi signal, though it is not documented on the products website, the transmission distance is likely not adequate for our purposes.

B. Video Analysis

In order to analyze the captured video the system will need to have the images in digital format. Since the most viable camera solutions record in analog format, we will need an AD converter to transform the video after it is received. There are many USB 2.0 converters that take a composite video feed and convert it into MPEG1, MPEG2 or MPEG4 encoded video using proprietary software.

C. Design of System

Fig. 5: Quadcopter

D. Software used in Project

1) raspberry pi
2) python programming system

V. CONCLUSION

The goal of this project was to an automated control system for the UAV, allowing the vehicle to fly without human intervention. The system would consist of GPS tracking for location tracking. The device could also be programmed to perform a systematic sweep over a large area for search and rescue purposes. Overall a computer controlled system will eliminate human errors and allow for safe, consistent flying. For future development, our motion tracking software will have the goal of being able to track multiple targets consisting of humans and vehicles.

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