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DESIGN AND FABRICATION OF HEXACOPTER FOR SURVEILLANCE

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Abstract – Unnamed Aerial System (UAS) has gained much prominence in recent years and its eclectic applications has mushroomed remarkably because of their ability to operate in dangerous locations-plagued with insurgency- while keeping an operational safe distance. UASs have numerous applications which includes acquisition and relay of data, surveillance, search and rescue operations because of its safety and cost effectiveness. The problem posed in this paper is the improvement of the time of flight and maintaining minimum aircraft weight. In this paper various UAS were considered and a hexa-copter was chosen.

1.INTRODUCTION

Drones are very handy devices with a plethora of applications. Its functions were first utilized solely for military purposes; either for gathering intelligence or target practice. Now drones have metamorphosed to be readily available commercial products which have found usefulness in various fields ranging from photography to delivery of medical aids. The number of civilian drones now outnumbers military drones by a landslide hence showing the versatility of its application and its importance.

There is a need to examine such a disaster-stricken area before undertaking necessary rescue and help measures. Military officers often have to patrol dangerous areas in order to search for any potential threat, illegal activity or intrusion within the borders of a country that can put the lives of citizens in jeopardy. Such areas involve very high risk to human life. He has to overcome fatal natural obstacles like steep mountain slopes, forceful water currents, hostile and barren desert areas and other such areas.

The first challenge is to create a live aerial video feed and the second is to integrate a gripper to the set-up. This technology can be used for search and rescue, firefighting, law enforcement, military, performing pick and place operations, and news reporting by being able to deploy aerial correspondence much faster than conventional helicopters. The end result of producing a digital video signal will allow for future expansions such as UAS sentience, target tracking and video compression.
In agriculture, drones can be used through aerial imagery to detect stresses in crops through spectral signatures which can be used to identify when a crop is thriving, stressed by drought or under attack by viruses and for land mapping. It can also be used for cost-effective and accelerated planning and design and construction of particular farm projects. Another category of UASs are fixed winged UASs .These are popular when it comes to large size and long distance applications primarily used by the military. Fixed wing UASs have enhanced payload carrying and delivering capabilities. Fixed wing UASs are usually remote controlled and majority of them do not support vertical take-off and landing (VTOL).

2. MODELLING AND DESIGNING OF HEXA-COPTER

Hexacopter- Hexacopters use six separate arms, each with a rotating propeller in order to achieve stable flight. Recent technological developments in microprocessors have made possible the complex, dynamic control systems necessary for the stability of flight of a hexacopter. Given an easily expandable platform and a high maneuverability in the air, hexacopters have proven effective for many common UAS applications as is highlighted in an article in Popular Mechanics Magazine.

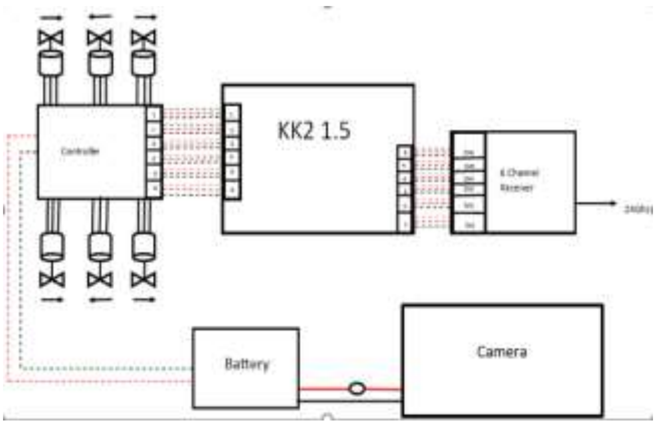
2.1 CONCEPTUAL DESIGN

Before considering the conceptual design, the functionality requirements of the drone must be recognized. Since this research focuses are on the design of a basic UAV, it must be able to:

- The UAS must be able to perform basic drone movements; the pitch, yaw, roll and throttle.
- The UAS must be able to receive and act on signal from a transmitter.
- The UAS must be able to hover at reasonable height above the ground.

In conceptual design several design alternatives are considered and the best alternative was chosen. It was determined that a hexacopter with a base station was the best approach to solve the problem. The four design alternatives that were considered are HEXACOPTER, QUADCOPTER, RC HELICOPTER and RC AIRPLANE.

2.2. BLOCK DIAGRAM



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2.3. FABRICATION AND EQUIPMENT

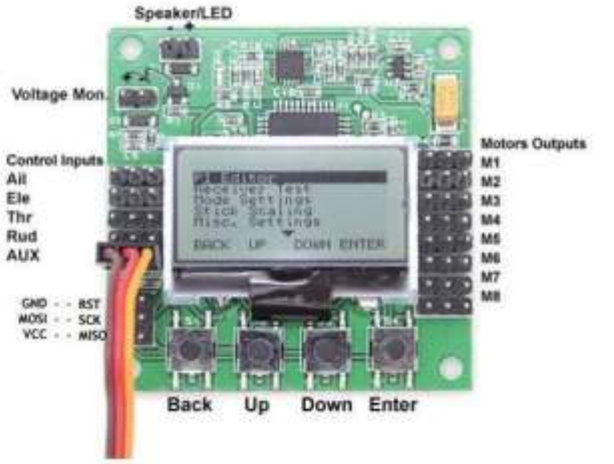
Materials are selected considering availability, formability and cost. A combination of foam, fiberglass, carbon rods and toughlon is used. This combination satisfies the criterions of high strength and light weight. Epoxy is used as the matrix in the epoxy/fiberglass composite for the fuselage. Foam is used to construct wing and tail, where carbon rods are placed inside to provide structural strength. Hot wire cutting is used to form the shape of the wing and tail. Sandpaper is used to smooth the surface and toughlon is applied as a protective layer. Fiberglass is a lightweight, high strength material, easily formed using molding process.

Equipment required for the UAS are DC electric motor, battery, electronic speed controller (ESC), servos, and radio FM transmitter-receiver. The battery is a 300 W lithium-polymer battery weighing about 0.6 kg. Servos are used for control surfaces (2 for the ailerons, 2 for the elevators and 1 for the rudder). Propeller motor is the Turnigy sk 5055 550 kV. It provides a maximum thrust of 6 kg and is capable 580 RPM. Total cost of the aircraft is RM2605.

2.4 COMPONENTS

A. KK 2.1.5 MULTIROTOR CONTROL BOARD

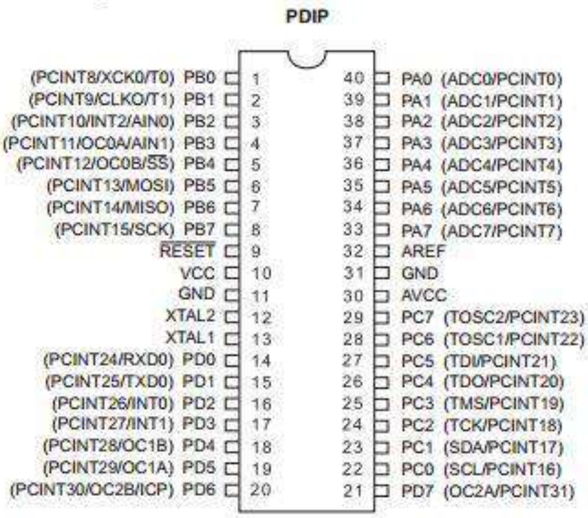
KK2.1 Multi-Rotor controller manages the flight of (mostly) multi-rotor Aircraft (Tri-copters, Quad-copters, Hexa-copters etc.)The Controller performs stabilization of quad-copter during flight and to do this, it accepts the signals from the onboard sensors such as Gyroscope, Magnetometer, and Accelerometer and transfers these signals for processing in Atmega324PAprocessor which then sends a Stabilization control signal to Electronic Speed Controllers(ESC)which controls and adjusts the rotational speed of motor. Control board also uses signals from a radio Transmitter (Tx) via a receiver (Rx) and passes these signals together with stabilization signals to the Atmega324PA via the aileron, elevator, throttle and rudder user demand inputs. Once processed, this control information is sent to the ESCs which in turn adjust the rotational speed of each motor to control flight orientation.



B. ATMEGA644

- High-performance, Low-power Atmel® AVR® 8-bit Microcontroller
- Advanced RISC Architecture
- High Endurance Non-volatile Memory segments
- JTAG (IEEE std. 1149.1 Compliant) Interface
- Peripheral Features Such as 8-channel, 10-bit ADC Differential mode with selectable gain at 1x, 10x or 200x – Byte-oriented Two-wire Serial Interface.

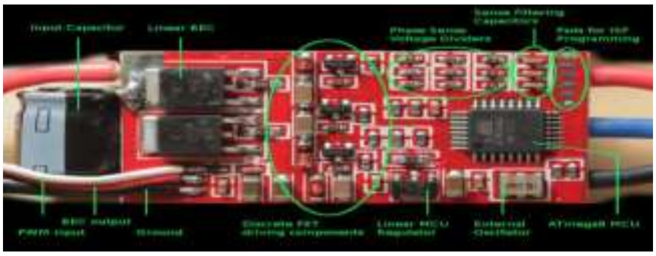
Pinout ATmega644



C. Brushless Electronic Speed Controller

An Electronic speed controller is an electronic device used to control the speed of rotation and direction of electric motors. A Brushless Electronic Speed Controller is a type of

Electronic speed controller which produces tri phase Limited voltage AC from a DC power source to drive a brushless DC motors.



Specifications

- Output: 20A continuous; 25Amps for 10 seconds
- Input: 30A continuous; 35Amps for 10 seconds
- Input voltage: 2-4 cells Lithium Polymer / Lithium Ion battery or 5-12 cells NiMH / NiCd
- BEC: 5V, 2Amp for external receiver and servos
- Max Speed: 2 Pole: 210,000rpm; 6 Pole: 70,000rpm; 12 Pole: 35,000rpm
- Weight: 22gms
- Size: 47mm x 27mm x 12mm

D. Brushless DC motor

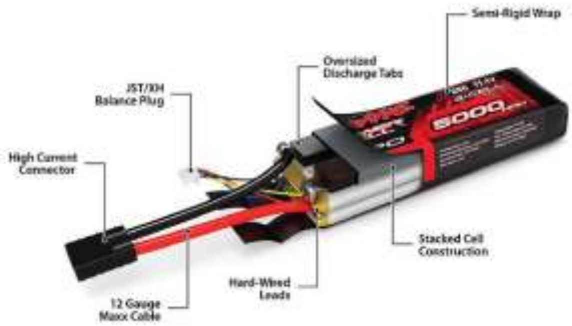
Brushless DC motor is a type of synchronous motor that is powered by a DC source and an inverter/switching circuitry which converts DC to limited voltage AC.

E. Printed Circuit Board Frame

Features

- Manufactured from quality glass fibre and polyamide nylon.
- Integrated Printed Circuit Board connections for easy soldering of the ESCs
- Pre-threaded brass sleeves for all of the frame screws.
- Colored coded arms for orientation and keeping the flight of the hexa-copter in the right
- Direction.
- Spacious mounting tabs on main frame bottom plate for easy camera and gripper mounting.

F. Lithium Polymer Battery



Specifications

- Current Capacity (C) = 3.3A
- High energy density - potential for yet higher capacities.
- Does not required prolonged priming when used. One regular charge is all that's needed.
- Relatively low self-discharge and is less than half that of nickel-based batteries.
- Low Maintenance.
- Specialty cells can provide very high current to applications such as power tools.

G. Digital Camera

- Resolution 1600 x 1200 pixels
- Focus and zoom Fixed, 16x digital
- Power supply & dimensions
- Input supply voltage 7 – 32 V DC (< 6W power dissipation)
- Dimensions and weight 86 x 68 x 47 mm, 160g

3. CONCLUSION

In this paper we have presented that the mechanical structure, design and also explained the features of every component. Such a design will be a best solution for the problems which are mentioned above like surveillance, package delivery, sprinkling of waters etc. The principals involved are realized and proven accurately .An optimal motor and propellers orientation design is proposed to obtain the rolling, pitching and yawing movements. A few flight tests have been carried out to verify the finding.

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