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Fire Ball Drone

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ABSTRACT

In a world where fire accidents are increasingly common and the brave first responders always risk their lives to save the lives of others. Unfortunately, history tells that these brave first responders do not survive most of the time. To save as many lives as possible, it is important to leave dangerous tasks to machines. One such device is a drone; it provides great maneuverability and doesn't risk any personnel. Drones can also gather information at greater speed, reliability and are also able to drop items. Thus, the solution mentioned below will help us solve this problem along with the functionalities mentioned below.

As unprecedented wildfires ravage India and much of the West, firefighters have taken innovative steps to try to keep up with the flames. An array of new and existing technologies has been pulled into the fray—including fireball-dropping drones and repurposed passenger jet to enhance ground-based, time-tested techniques.

Fighting fires still depends on cutting firebreaks, setting backfires, and spraying water. The best tools are often simple ones: water hoses, bulldozers, brush-clearing axes.

However, in an age where climate change is promoting more and bigger fires that consume millions of acres in a single season, the profession of firefighting must be quicker, safer, and cover greater ground even as a spreading pandemic makes the work that much harder.

Keywords: Unmanned aerial vehicle(UAV), Machine Learning, Fire Fighting, Object Detection, Flammable Gases, Temperature sensor, Flight Controller, Internet of Things, Panorama, Area Map.

Introduction

Project Definition

To design developed security monitoring instrument that can help in reaching far places very fast. This instrument will have smart controllers to control speed and direction of the Quad-copter while flying around. Security Quad-copter is very useful in saving time and money.

Project Objectives

Increase personal and property safety and security control.

Encourage the idea of substituting human guard by robotic surveillance device with more capabilities.

Monitoring contaminated facilities by taking live video for security purposes.

Demonstrate how to build your own security quad-copter in simple way.

Project Specifications

The project will be built with the following specifications:

- Assumes power system that operates on 11.1 V/ 5200 mA battery.
- Maximum flying time: 60 minutes continuously.

- 1.2 Km remote control
- BLDC: 11100 RPM
- Propellers are 10:45 inches

Product Architecture and Components

Our project is divided into 4 sub-systems which are as follows:

1. Hardware
2. Flight and sensors
3. Wireless control
4. FPV sub system

The execution of the project will take place is stages and at the sub system level. The project in a nutshell is the assembly, programming and test flight of a quad copter. Video feedback will also be included in the project

Applications

The security Quad-copter will have applications in the following areas:

1. Fire Brigade.
2. Large complexes.
3. Shopping malls.
4. Universities.
5. Hospitals.
6. Industry's
7. Power Plants
8. Use of hobbyist and enthusiast.
9. Forest Fire

Design Constraints

The smart security FPV has been designed with purpose of relaying back live video from the system. There are several engineering standards that have been followed during the design of the Quad-copter. These have been mentioned in the sections below

1.CE standard

CE marking on a product is the manufacturer's declaration that the product complies with the essential requirements of all the Directives/ Regulations that apply to it. It indicates to the appropriate bodies that the product may be legally offered for sale in their country.

The requirements for CE marking differ across all the Directives and Regulations and may also vary for different products within a Directive/Regulation. Depending on the product, CE marking may be as simple as formulating a technical file, or as complex as having to submit your products to regular independent scrutiny. Third party testing, systems assessment and technical file assessments may be mandatory, but sometimes the manufacturer's unverified claim is all that's asked for.

2. ASTM F963-11 standard

ATS IS A FULLY CPSC ACCREDITED LAB THAT PROVIDES TOY SAFETY
TESTING AND PRODUCT CERTIFICATION CONFORMING TO MANY INDUSTRY STANDARDS

Section 106 of the Consumer Product Safety Improvement Act (CPSIA) of 2008 requires toy safety testing to ASTM F963-11, which is the "Standard Consumer Safety Specification for Toy Safety" This requirement applies to all products that are imported into and manufactured in the United States and that are intended for children 12 years age and younger. ASTM F963-11 has several sections which address the mechanical hazards testing of toys. A large portion of the toy safety testing requires simulated use and misuse of a toy as though the child is playing with it to determine if any hazards present themselves. Other sections address the presence of chemicals in toys such as lead and other heavy metals. The applicable testing is based on the toy's design and age grade.

Key areas of testing and certification to ASTM F963-11 include the following, but are not limited to:

- Soluble (Heavy) Metals Analysis.
- Small Part Testing.
- Sharp Point Testing.
- Sharp Edge Testing.
- Magnet Testing.
- Strangulation Hazard Assessment.
- Seam Testing.
- Flammability Testing.
- Product Labeling

3. ISO 8124-1:2018 standard

The requirements in ISO 8124-1:2018 apply to all toys, i.e. any product or material designed or clearly intended for use in play by children under 14 years of age. They are applicable to a toy as it is initially received by the consumer and, in addition, they apply after a toy is subjected to reasonably foreseeable conditions of normal use and abuse unless specifically noted otherwise.

The requirements of this document specify acceptable criteria for structural characteristics of toys, such as shape, size, contour, spacing (e.g. rattles, small parts, sharp points and edges, and hinge-line clearances) as well as acceptable criteria for properties peculiar to certain categories of toy (e.g. maximum kinetic energy values for non-resilient-tipped projectiles and minimum tip angles for certain ride-on toys).

ISO 8124-1:2018 specifies requirements and test methods for toys intended for use by children in various age groups from birth to 14 years. The requirements vary according to the age group for which a particular toy is intended. The requirements for a particular age group reflect the nature of the hazards and the expected mental and/or physical abilities of a child to cope with them.

ISO 8124-1:2018 also requires that appropriate warnings and/or instructions for use be given on certain toys or their packaging. Due to linguistic problems which may occur in different countries, the wording of these warnings and instructions is not specified but given as general information in Annex B. It should be noted that different legal requirements exist in many countries with regard to such marking.

ISO 8124-1:2018 does not purport to cover or include every conceivable potential hazard of a particular toy or toy category. Except for labeling requirements indicating the functional hazards and the age range for which the toy is intended, this document has no requirements for those characteristics of toys which represent an inherent and recognized hazard which is integral to the function of the toy.

EXAMPLE 1 An example of such a hazard is the sharp point necessary for the proper function of a needle. The needle is a hazard which is well understood by the purchaser of a toy sewing kit, and the functional sharp-point hazard is communicated to the user as part of the normal educational process of learning to sew as well as at the point of purchase by means of cautionary labeling on the product's packaging.

Design Constraints: Quad-copter (4 motors)

A Quad-copter, or multi-rotor, drone, or Quad-rotor, is a simple flying mechanical vehicle that has four arms, and in each arm there is a motor attached to a propeller. Multicopters with three, six or eight arms are also possible, but work on the same principal as a Quad-copter. Two of the rotors turn clockwise, while the other two turn counter clockwise. Quad-copters are aerodynamically unstable, and require a flight computer to convert your input commands into commands that change the RPMs of the propellers to produce the desired motion. This is the short answer to the question of what is a Quad-copter.

Quad-copters differ from a helicopter or a fixed wing aircraft in the way they generate lift and control forces. For an aircraft the lift is generated by the wings, but in a Quad-copter the lift is generated by the propellers. A helicopter uses its main rotor to generate lift, but also have the ability to vary the pitch of the rotor blades to generate control forces.

The quad-copter concept is not new. Manned quad-copter designs appeared in the 1920s and 1930s, but these early concepts had bad performance, a high level of instability, and required a lot of pilot inputs. The advancement of electronic technology in flight control computers, coreless or brushless motors, smaller microprocessors, batteries, accelerometers, cameras, and even GPS systems made it possible to design and fly quad-copters. The simplicity of the quad-copter has made it a very effective aerial photography and video platform.

Quad-Copter Hovering:

Hovering takes place when the upward lift balances the downward force of gravity. To make the drone to higher, the lift force needs to be greater than the force of gravity. This is achieved by increasing RPM on all four propellers simultaneously, which produces more lift. To decrease the altitude, the RPM is decreased on all four propellers simultaneously. On your controller, this is accomplished by pushing the left stick up or down, which increases or decreases the rotor RPM, which makes your quad-copter go up or down.

In order to move the drone left, right, forwards, and backwards, we change the angle of the lifting force so it has a vertical and horizontal component. The vertical component still serves to keep the quad-copter in the air, while the horizontal component allows produces control thrust.

Quad-Copter Motion:

To make quad-copter move forward or backwards, we adjust the pitch using the right stick on the controller. What happens is that the front propellers decrease RPMs, while the back propellers increase RPMs. Now the lift force has a horizontal component which results in moving the quad-copter forward. The opposite happens to make your quad-copter go backwards. The front propeller RPM is increased, while the back propeller RPM is decreased.

To move your quad-copter move sideways, a similar change in RPM takes place, but this time it is on the left and right propellers. To make your drone move to left, you need to point the lift force slightly to the left. This is done by decreasing the RPM on the left rotors, and increasing the RPM on the right side. A similar change in the rotor RPMs takes place to move your quad-copter to the left.

Yaw Maneuvers:

Yaw is bit trickier to visualize. On a helicopter, have you ever wondered why there is a tail rotor? It is there in order to keep the body of the helicopter from rotating. If the main blades are rotating anti-clockwise, like in most helicopters, the fuselage will start rotating clockwise due to torque reaction. This is a consequence of Newton's Third Law of dynamics. The tail rotor balances out the torque reaction on the helicopter fuselage and prevents the fuselage from rotating.

On a quad-copter, if all four propellers rotated the same way, then the body of your quad-copter would rotate the opposite way. But it obviously doesn't. This is because two of the propellers rotate clockwise, and the other two rotate anti-clockwise. So one set of propellers produces a torque in one direction, but the other two propellers are producing a torque in the opposite direction. These cancel out, so your quad-copter does not rotate.

For a yaw maneuver, we do want the quad-copter to rotate. This is done by reducing the RPM on one set of rotors, while increasing the RPM on the other set of rotors. Now there is a net torque in one direction, so your quad-copter rotates. To produce the opposite rotation, the RPMs on the propellers is simply reversed. The direction of the yaw maneuver is controlled by the left stick on the controller.

Design Constraints: The controller

A typical quad-copter comes with a 4 channel controller that sends commands to the drone to affect its throttle, yaw, pitch and roll. The communications frequency used by most controllers is 2.4 GHz. This is also the typical frequency used for WiFi connections. Though it is unlikely that interference takes place, it may be something worth checking if you are experience communications lag or dropouts with your quad-copter.

The controller also has 4 trim buttons to allow you to make minor corrections to your quadcopter flight behavior. If you notice that with no control input, the drone drifts in a particular direction, applying trim for that control input in the opposite direction will remove the drift.

Design Constraints: Flight control system

Your quad-copter flies and moves by changing the RPMs of each propeller. So when you move a stick on your controller, this command needs to be converted into the proper commands each of the four motors on your quad-copter. This is done by the flight control system. The purpose of the flight computer is to simplify the coordination of the control of all four propellers needed to make your drone fly. The flight control computer has the ability to connect to several other devices and sensors. The primary device that it connects to is the remote-control receiver, which is linked to your remote transmitter.

In advanced quad-copter, the flight controller also has a transmitter to communicate with your controller, to provide two way communication. Typical sensors come with more complex quad-copters include GPS, gyro compass, and barometer.

Design Constraints: Propellers

There are four main forces that act on a quad-copter:

1) Gravity – this should be obvious to everyone. This is the force that pulls the quadcopter down due to its mass
2) Lift – this is the upward reaction force on the quad-copter due to the propellers
3) Thrust – this is the horizontal reaction force on the quad-copter due to the propellers
4) Drag – this is the backward force on the quad-copter due to air. Imagine being in a car, and putting your hand out the window. The air hitting your hand is trying to push back.

Design Methodology

Our project is divided into 4 sub-systems as shown if figure 1. Most of these UAVs are equipped with electric motors that contribute to the simplicity of operation and significantly reduce their noise signature. The propulsion systems of these small UAVs (batteries, motor, propeller, etc.) account for as much as 60% of the vehicle weight Therefore, optimization of the propulsion systems is extremely crucial. The electric propulsion system of a typical UAV includes the following components: propeller; electric motor; energy source, wiring, plugs,
and connectors [1].

Brushless DC motors also termed as BLDC motors are used in Quad-copters. These motors consist of a permanent magnet which rotates around a fixed armature. They offer several advantages over brushed DC motors which include more torque per weight, reduced noise, increased reliability, longer life time and increased efficiency.

Motor calculations: The motors should be selected in such a way that it follows following thrust to weight relationship [2].

Ratio=Thrust / weight =ma / mg =a / g

Thus, vertical take-off and vertical landing (VTOL) is possible only when, (a/g) > 1 or in other words, the total thrust to total weight ratio should be greater than 1 so that the quadcopter can accelerate in the upward direction [2].

Total Thrust = 2*(Total weight of Quad-copter)

Fig.2 VTOL of quad copter [7]

The electronic speed controller is selected based on its Ampere rating. This should be greater than ampere rating of the motor [3].

ESC rating = (1.2 to 1.5) × max. Ampere rating of motor

Max. Current withdrawal by motors= no. of motors * maximum current withdrawal by single motor. The discharge current of battery should be higher than the maximum current withdrawn by motors [3].

Product Subsystems and Components

This section details the 4 sub-systems of the project as mentioned above.

Product Subsystem1: Hardware

The hardware sub system consists of the following components:

1.Frame

Parts of the quad-copter frame

Color: White & Red
Frame arm size: 21.5 * 3.8 * 5cm / 8.5 * 1.6 * 2.0inch
Weight: 43g(Single)
Weight: 250g / 4pcs

Features:

The DJI F450 Flame Wheel frame arms are built from very strong materials, these arms are made from the ultra-strong PA66+30GF material which provides better resistance to damage on hard landings.

Specification:
Color: Black
Material: Fiber Glass & Plastic **PackageIncludes**:

Flame Wheel(2 Red,2 White) x4
F450 TOP Plate x1
F450 BOTTOM Plate x1
F-M3*8 Screws x16
F-M2.5*8 Screws x24

2.Battery

Li-Po battery used in the project

Features

- Gens ace Professional Li-Po Battery; Superior Japan and Korea Lithium Polymer raw materials.
- Quickly Recharged, Long Cycle Life (150 times minimum), up to 200Wh/kg energy density.
- Parameter: Weight: 0.39lb; Dimension(L*W*H):4.17*1.32*0.9in; Connector, XT60 Plug, Balancer Connector, JST-XHR.
- Applications: Specially Designed for 800MM Warbirds, EPP 3D plane, small heli, QAV180/210 Quad-copter, DJI Phantom FC40 Spare, Walkera E22.

Product Subsystem2: Flight and sensors

The second sub system consists of the following

1.Controller

KK-2.1 board

General information:

Kk2.1.5 Multi-rotor LCD Flight Control Board With 6050mpu And Atmel 644PA is next big evolution of the first generation KK flight control boards. The KK2.1.5 was engineered from the ground up to bring multi-rotor flight to everyone, not just the experts.

The LCD screen and built-in software make install and setup easier than ever. A host of multi-rotor craft types are pre-installed, simply select your craft type, check motor layout/propeller direction, calibrate your ESCs and radio and you're ready to go! All of which is done with easy to follow on-screen prompts! The original KK gyro system has been updated to an incredibly sensitive 6050 MPU system making this the most stable KK board ever and allowing for the addition of an auto-level function. At the heart of the KK2.1.5 is an Atmel Mega644PA 8-bit AVR RISC-based microcontroller with 64k of memory.

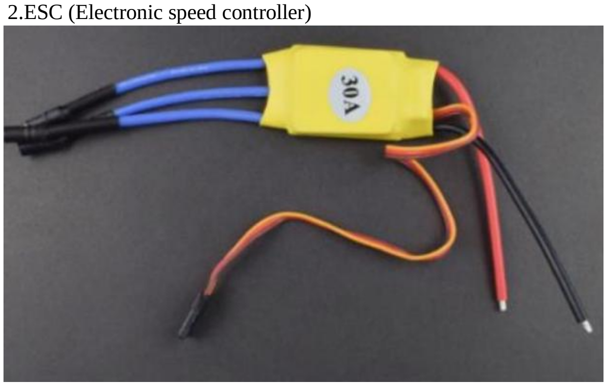
An additional polarity protected header has been added for voltage detection, so no need for on-board soldering. A handy piezo buzzer is also included for audio warning when activating and deactivating the board.The KK2.1.5 added polarity protection to the voltage sense header and a fuse protected buzzer outputs, in case something is accidentally plugged in incorrectly. The voltage sense line has been updated for better accuracy. The board is clearly labeled and the voltage sense line color has been changed to red for easy identification, making installation and connections a snap.If you're new to multi-rotor flight or have been unsure about how to setup a KK board then the KK2.1.5 was built for you. The 6 Pin USBasp AVR programming interface ensures future software updates will be quick and easy.

The KK gyro system has been updated to the incredibly sensitive 6050 MPU system making this the most stable KK board ever and adds the addition of an auto-level function. At the heart of the KK2.1 is the ATMEL Mega 644PA 8-bit AVR RISCbased microcontroller with 64k of memory. An additional header has been added for voltage detection, so now there is no need for onboard soldering. A handy piezo buzzer is also included with the board for audio warning when activating and deactivating the board, which can be supplemented with an LED for visual signaling. A host of multi-rotor craft types are pre-installed, simply select your craft type, check motor layout and propeller direction, calibrate your ESCs and radio and you're ready to go. All of which is done with easy to follow on-screen prompts. If you're new to multi-rotor flight or have been unsure about how to set up a KK board then the KK2.1 was built for you. The 6 Pin USB asp AVR programming interface ensures future software updates will be quick and easy.

Features:

1. Auto Level.
2. Standard 6 Pin AVR Interface.
3. 1520us(5 channels) Signal from the receiver.

2.ESC (Electronic speed controller)



Electronic speed controller that is used in the project

Description:

Item Name:30A SimonK Procedure Brushless ESC
Input Voltage: (2-3S Lixx red)
Drive Current: 30A (Max: 40A/10S)

Size 50x23x8
BEC:5V/3A
Weight: 25g

Features:

1) This hardware, with the Simon K firmware, gives you the perfect solution for mult-irotor use.
2) Highest efficiency 100% N-FET design.
3) Highest accuracy with Crystal Oscillator (Temperature won't affect the PWM operating range like other cheap ESC's).
4) No low voltage cut off, because any cutoff in a multi-rotor crash.
5) No over temp cutoff, because any cutoff in a multi-rotor crash.
6) Super high refresh rate, no buffering of the input signal, resulting in more than 490Hz response rate.
7) 16KHz motor frequency, giving fastest response of the motor, and quietest operation as well (no 8KHz squeal).
8) Super simple, foolproof operation! Nothing to program other than the throttle range.
9) It is suitable for RC helicopter and four axis planes.

3.Gyro and other sensors

The gyroscope and the sensors are built in into the KK board as can be seen in the sections above.

CHAPTER 1 **3.3.3 Product Subsystem3: Wireless control**

This sub system has the following components

1.FlySky FS-i6 2.4G 6CH AFHDS RC Transmitter With FS-iA6 Receiver

Tranmitter and receiver used in the project

Description:

Brand Name:Flysky
FS-i6 Specifications:
Channels: 6 Channels
Model Type: Glider/Heli/Airplane
RF Range: 2.40-2.48GHz
Bandwidth: 500KHz
Band: 142
RF Power: Less Than 20dBm

2.4ghz System: AFHDS 2A and AFHDS
Code Type: GFSK
Sensitivity: 1024
Low Voltage Warning: less than 4.2V
DSC Port: PS2;Output:PPM
Charger Port: No
ANT length: 26mm*2(dual antenna)
Weight:392g
Power: 6V 1.5AA*4
Display mode: Transflective STN positive type, 128*64 dot matrix VA73*39mm,white backlight.

Size: 174x89x190mm
On-line update:yes
Color: Black
Certificate: CE0678,FCC
Model Memories: 20
Channel Order: Aileron-CH1, Elevator-CH2, Throttle-CH3, Rudder-CH4,Ch 5 & 6 open to assignment to other functions.

FS-iA6 Specifications:

Channels: 6 Channels
Model Type: Fixed-wing/Glider/Airplane
RF Range: 2.40-2.48GHz
Bandwidth: 500KHz
Band: 142
RF power:less than 20dBm
RF.receiver sensitivity:-105dBm
2.4ghz System: AFHDS 2A
Code Type: GFSK
ANT length: 26mm
Weight:6.4g
Power:4.0-6.5V
Size: 40.4x21.1x7.35mm
Color: Black Certificate:

CE,FCCi-BUS port: NO

Data Acquisition port: NO

Features:

Works in the frequency range of 2.405 to 2.475GHz.This band has been divided into 142 independent channels each radio system uses 16 different channels and 160 different types of hopping algorithm.

This radio system uses a high gain and high quality multi directional antenna, it covers the whole frequency band. Associated with a high sensitivity receiver, this radio system guarantees a jamming free long range radio transmission

Each transmitter has a unique ID, when binding with a receiver, the receiver saves that unique ID and can accepts only data from the unique transmitter. This avoids picking another transmitter signal and dramatically increase interference immunity and safety.

This radio system uses low power electronic components and sensitive receiver chip. The RF modulation uses intermittent signal thus reducing even more power consumption.

AFHDS2A system has the automatic identification function, which can switch automatically current mode between single-way communication mode and two-way communication mode according to the customer needs.

AFHDS2A has built-in multiple channel coding and error-correction, which improve the stability of the communication, reduce the error ratio and extend the reliable transmission distance.

roduct Subsystem3: ***FPV***

The FPV sub system has not yet been implemented in this semester and will be done in the subsequent days.

Implementation

The project was implemented in the following steps:

Step 1:

Mount the FC on the frame with the LCD facing front and the buttons facing back. You can use the supplied antistatic foam container as a form of protective case for the Flight Controller on the craft.

Step 2:

Connect the receiver outputs to the corresponding left-hand side of the controller board. The pins are defined as:

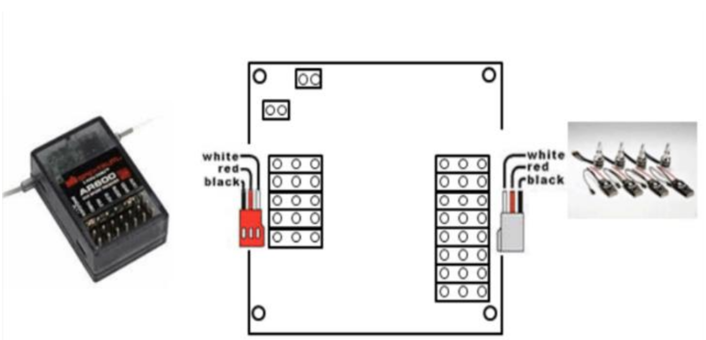
RECIEVER CHANNEL	FLIGHT CONTROLLER
Aileron	Aileron
Elevator	Elevator
Throttle	Throttle
Rudder	Rudder
AUX1	AUX

Table 2: Pin definition

Step 3:

Connect the ESC's to the right side of the Flight Controller Board. M1 is towards the front of the board and M8 is nearest to the push buttons. The negative (black or brown) lead towards the edge of the FC. The negative (black or brown) lead is connected to the edge of the Flight Controller.

The Flight Controller Board must always have a source of +5v from an ESC, either one of the motors ESC or from a separate unit feeding the Receiver. If each ESC has a BEC (normal unless OPTO types) then it may be necessary to remove the power feed from the other ESC, usually by cutting the power line (RED) Cable on the other ESC.



Completed wiring at step 3

Step 4:

Set up a new model on your transmitter and use a normal airplane profile and bind the Receiver to the Transmitter.

Step5:

Turn on the power and press the 'Menu' button, then using the 'Up' and 'Down' buttons highlight 'Receiver Test sub-menu and press Enter. Now move each channel on your transmitter and check that the displayed direction corresponds with the stick movements on the Flight Controller, if any are reversed, then go to your Transmitter and reverse that channel. Check that the AUX channel is showing "ON" when you activate the AUX Switch on your transmitter, if not, reverse the AUX channel on your transmitter. Use the trim or subtrim controls on your transmitter to adjust the channel values shown on the LCD to zero.

Step 6:

Scroll down to and enter the "Load Motor Layout" sub-menu and choose the configuration you want. If the configuration you want is not listed, use the "Mixer Editor" sub-menu to make one. See later for more on that.

Step 7:

Enter the "Show Motor Layout" sub-menu and confirm the following. Is the configuration correct? Are the motors and servos connected the correct output? Correct rotation direction?

Does the motor speed up when dropping the arm it is mounted on?

Step 8:

Enter the “Receiver test" and check for nominal values on each channel, move your Transmitter sticks around to ensure they are all working, including AUX1.

Enter the "PI Editor” sub-menu and check for correct PI gain values and use this menu option to adjust the PI gain settings. Use the PREV and NEXT buttons to highlight the parameter you want to change, then press the CHANGE button. To adjust both Roll and Pitch at the same time, see the "Mode Settings "sub-menu.

At this stage the propellers can be fitted to test the Flight Control board. Hold the craft (!) and then Arm it by give right rudder and zero throttle for a few seconds. It will beep and the RED LED will turn on. However, do-not arm it until you have put the multi-copter on the ground and stepped away 5 meters. After landing, place it in SAFE Mode by holding the rudder to left with zero throttle. It will beep and the RED LED will turn off, always do this before you approach the multi-copter. If the craft wants to tip over right away, check your connections and your custom-made mixer table if you have one. If it shakes and maybe climbs after it’s airborne, adjust the Roll and Pitch P gain down or if it easily tips over after its airborne, adjust up. If it drifts away, use the trims to keep the drift down. It will normally drift away with the wind.

Turn on the Self-leveling by holding right aileron while arming or disarming it. Turn it off by holding left aileron. Alternatively, you can assign this to the AUX channel. See below. Submenu descriptions.

Step9:

Enter the "Mode Settings" and check and adjust: "Self-Level": Determines how the selfleveling function will be controlled, either by STICK or an AUX Channel. "STICK MODE": Self-leveling is turned on by holding the aileron to the right when arming or disarming. Turn it off with left aileron. "AUX": Self- leveling is turned on/off by the AUX Channel. "Auto Disarm": If set to YES then Flight Control board will automatically disarm itself after 10mins of inactivity. "CPPM Enabled": Determine if the Flight Control Board is to use CPPM data input.

Step 10:

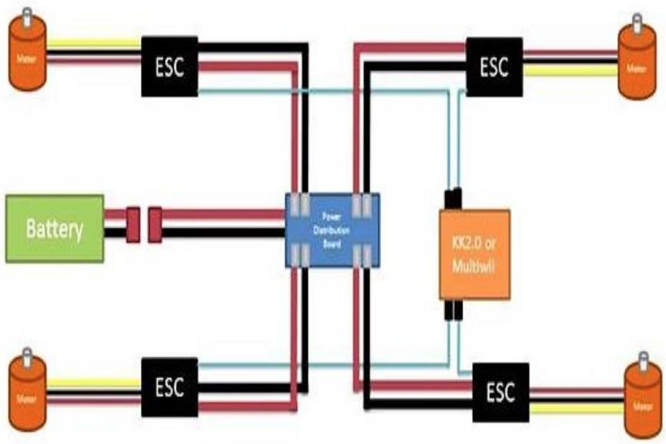
Enter the "Stick Scaling" option, where you can adjust the response from the stick to your liking. Higher number gives higher response and lower numbers the converse. This is similar to the endpoint or volume adjustment on your transmitter, where you can adjust your transmitter to adjust the stick response and use the stick scaling if you want more or less response from stick inputs.

Assemble and connect:

1. The motors and ESC's can be connected to each other via direct soldering or using Bullet Connectors of 4mm dimension.
2. The ESC's are then connected to the power distribution board, or in this case directly to the frame which has an inbuilt

power distribution board, by soldering (Make sure to know if the ESC's are supposed to be flashed or not, mine did not required to do so).

3. Once this is done, solder the battery wire to the frame.
4. Once all the soldering work is done, and the hardware is setup, connect the KK Board (again flashed with the latest firmware) with the ESC servo wires, and Receiver.
5. The motors and ESC's can be connected to each other via direct soldering or using Bullet Connectors of 4mm dimension.
6. The ESC's are then connected to the power distribution board, or in this case directly to the frame which has an inbuilt power distribution board, by soldering.
7. (Make sure to know if the ESC's are supposed to be flashed or not, mine did not required to do so.)
8. Once this is done, solder the battery wire to the frame.
9. Once all the soldering work is done, and the hardware is setup, connect the KK Board (again flashed with the latest firmware) with the ESC servo wires, and Receiver.



System and Analysis

Subsystem 1: Transmitter with KK board

Objectives: To verify if all channels are working on the copter transmitter and receiver

Setup:

1. Plug in the battery.
2. Power the KK board.
3. Turn or receiver and pair.
4. Open receiver software.

Results: All data from channels was received with 100% accuracy. This can be seen in the screenshot below

All channels were working on the copter

If your code is all correct and your connections are all good you should see the LCD screen on the board lit up, from where you can easily calibrate both the Accelerometer and Magnetometer.

Subsystem 2: Flight problems

1. ESC burnt multiple times.
2. Spinning.
3. Difficult to land smoothly.
4. Damage motors and broken arms, landing gears and propellers.
5. Battery got damaged in the process.

Overall Results, Analysis and Discussion

The system has been integrated and tested. And these are the following outcomes:

1. PI values had to be adjusted to avoid the ESC from burning.
2. PI Value for aileron is 60 for ideal flight.
3. Transmitter successfully configured.
4. ESC successfully programmed.
5. KK board successfully configured.

Technical Specifications of Fire Ball

Fire Extinguisher Ball is a round-shaped fire extinguisher that self-activates after about three to five seconds of fire exposure. It disperses non-toxic extinguishing chemicals, and it can extinguish fires within a three-cubic meter radius.

Fire Types

Our fire extinguishing ball can eliminate A, B, C, E and K class fires in conformity with EU standards.

A Class - Solid burning material
B Class - Liquid burning material
C Class - Fire involving combustible
E Class - Electric equipment
K Class - Kitchen fire

Technical Parameters

- Weight of extinguishing powder mixture: 1.3 +/- 0.2 kg
- Total weight of the agent: 1.5 + 0.2 kg
- NEC: 4.0 g
- Diameter: 150 mm
- Warning audio signal: 95 dB (Impulse Noise)
- Activation time: 3 - 10 seconds with flame
- Effective extinguish area: 1.3 kg - 3 cubic meter
- Long lifespan

Packaging

- piece in colour box: 175x175x175 mm
- 12 pieces in carton: 540x363x367 mm
- N. W&G.W: 20 kg / 21 kg
- Loading cap / 20 ft. container: 4608 pcs

- Loading cap / 40 ft. container: 10860 pcs

Dropping Mechanism of Fire Ball

- 3D printed
- Material- PLA
- Dropping time- 3 sec
- Rotation- 360°
- Attached to servo motor

In this section, you will analyses your project in terms of the following:

Contemporary Issues Addressed

The seventh and final event of the Drone Racing League, organized by the Saudi Federation for Cyber-security, Programming and Drones (SAFCSP), was a hit with the audience at King Abdullah Economic City in Jeddah on Friday.

Participants wore head-mounted devices that show live footage from the camera attached to their drones, which they fly across a course of obstacles as fast as possible.

The final participants come from a range of countries including Canada, the Netherlands, Germany and France. They are among the best drone racers in the field. Such drones in Saudi Arabia can used for better purposes such as the following:

1. Military.
2. Security.
3. Surveillance.

With the incentive already present for drone racers it should drive the use of drones in Saudi Arabia in various fields as mentioned above.

CONCLUSION AND FUTURE RECOMMENDATION

Conclusions

This project is a part of a two semester final design project. In the first semester we have achieved the following:

- Finalized the design.
- We acquired all the components.
- Assembled the frame.
- Paired the receiver and the transmitter.
- Paired the receiver with the KK board.
- Powered the KK board.
- Calibrated the sensors.
- Programmed the KK-2.1 board.
- Calibrated the ESC.
- Test the motors.
- Attempt the first flight.

In the second semester we have achieved:

- Overcome the issue of ESCs heating up
- Overcome the problem of motors spinning

- Perform multiple flight tests
- Enable the quad-copter to fly
- Good control of quad-copter while flying
- Take live video streaming
- Upgrade to frame

Future Recommendations

1. Use carbon fiber frame instead of plastic since it has better resistance against hard landing.
2. Order more than what you need since the components are not available locally.
3. Use KK 2.1 flight controllers since it is the easiest to use for beginners.

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