# Quad Copter with Rover

## Shravankumar S. Jannam
Institute of Knowledge College of Engineering
sunny92j@gmail.com
## Siddhesh S. Tendle
Institute of Knowledge College of Engineering
siddhesh.tendle@gmail.com
## Prof. Sujit Wagh
Institute of Knowledge College of Engineering
waghsujit14@gmail.com

***Abstract: -*** *The implementation of an experiment named Quadcopter with attached rover is been described. Quadcopter is also referred to as Autonomous Flying Vehicle (AFV) or Unmanned Arial vehicle (UAV) are generally thought of as being costlier and difficult. An easy and low cost quadcopter would give an attractive alternative to several application. This research shows that the quad copter system can fly by maintaining its stability and balancing along with the rover attached to it. Rover is attached to quadcopter for navigating it along the ground. When battery is not sufficient to fly the copter at that time, rover can easily utilize the remaining battery by moving on the ground to complete its task. Maximum flying time of quadcopter is 8-9 minute by using 4000 mAh lithium polymer battery and flying time can be increased by enhancing battery capacity. The main applications of such drones could include: surveillance, air paramedics, search and rescue operation, space research and monitoring, etc.*

***Keywords:*** Unmanned aerial vehicle (UAV); Electronics speed controller (ESC); Rotation per minute (RPM); Brushless DC (BLDC); Milli Ampere Hour (mAh); Dual tone multiple frequency (DTMF).

## I. INTRODUCTION

In early 1920's quadcopter was first invented with four rotors and eight propellers. Further in 1930's the modification were made only on chassis of quad copter which were single rod chassis, square chassis, plus chassis and many more. Such types of chassis provide less stability which resulted into disbalance of drone. Further in late 1950's these problems were solved by inventing X shaped chassis which was more stable than previous once [13].

In the last few years the use of autonomous aerial drones has been increased due to the development and improvement of the control systems. This growth proves that these drones are very versatile in contrast to their low complexity. The advantage of such drones is that conventional helicopter is replaced by quadcopter where the mechanical design is simpler. Such selection of hardware provides very low moment of inertia and six degree of freedom.

Which results in good stability of the quadcopter. Quad copter is a small representation of unmanned Aerial vehicle [9]. Basically quadcopter is a multi-rotor copter that is lifted and propelled by four rotors. A Rover is a small robot which moves along the surface of ground [5]. A rover is also known as terrain vehicle and we are implementing this terrain vehicle to aerial vehicle that is quadcopter. A quadcopter with rover is a aero-terrain vehicle with four fixed rotors. Nowadays multi rotor drones provide vast platforms for aerial robotics, which are mostly used for surveillance and search-and-rescue applications. Our quadcopter will also consist of terrain robot which will be the part of aerial drone and it also differs from a mono copter. Generally it consists of a video camera on it for video shooting which will show the position of quadcopter and the detection of enemy. After detection, quadcopter will come down slowly and start moving on ground with the help of rover which is operated by the remote control. Controls of such drones are totally wireless [4]. Rover section will also consist of a camera through which we can monitor all the movement taking place.

## II. PROBLEM DEFINITION

The design of an electric stable and long lasting Quad drone capable of intelligence, surveillance and reconnaissance is the task. In order to design and build a high performance Quadcopter with such capabilities we

the design team aims for preliminary feasible goals such as medium level maneuverability and high stability. We will also emphasize on the design of the internal spacing in the fuselage to securely sustain a variety of electrical equipment on board the Quadcopter.

## III. QUADCOPTER COMPONENTS

We know that quad copter is a hover drone which is a small representation of an unmanned aerial vehicle (UAV). For implementation of such drones four fixed rotors are required with two distinct sets of propellers out of which two propellers are rotating in clockwise motion and other two propellers are rotating in counter clockwise motion [10].

### A. Quadcopter



Figure: 1. Quadcopter

The important part of the quad copter is its chassis on which various component are mounted. To make the light weighted quadcopter we used aluminum material and it also provides mechanical support to the quadcopter as it is rigid and tough.

### B. Quad Chassis



Figure: 2. Quad Chassis

The chassis for quadcopter has four arms placed in X shaped and the center plates are placed at its intersections. To make the chassis strong and rigid we have chosen the center plates of dimension 12x12cm and four arms of 12inchs each. The dimensions of chassis various as per designs.

### C. Controller Board



Figure: 3. KK 2.1 Board

There are different multi rotor controllers available in market which is a brain of multi rotor copters. The various upgraded versions of Arduinos are available such as Arduino pro, Arduino mega, Arduino Uno and many more. These Arduino are difficult to source and also they are very expensive. Besides these Arduinos there is another controllers known as KK boards and its different versions such boards can be easily source and has low cost.

The latest version of KK board is KK 2.1 multi rotor control board, this board consist of updated sensors, memory and header pins. The KK 2.1 Multi-Rotor controller manages the flight of multi-rotor Aircraft such as Tri copters, Quad copters, Hex copters, octa copter etc. Its purpose is to stabilize the aircraft during flight and to do this, it takes signals from on-board gyroscopes (roll, pitch and yaw) and passes these signals to the Atmega324PA processor, which in-turn processes signals according the users selected firmware (e.g. Quadcopter) and passes the control signals to the installed Electronic Speed Controllers (ESCs) and the combination of these signals instructs the ESCs to make fine adjustments to the motors rotational speeds which in-turn stabilizes the craft [11].

The KK 2.1 Multi-Rotor control board also uses signals from your radio system via a receiver (Rx) and passes these signals together with stabilization signals to the Atmega324PA IC via the aileron; elevator; throttle and rudder user demand inputs [11]. Once processed, this information is sent to the ESCs which in turn adjust the rotational speed of each motor to control flight orientation (up, down, backwards, forwards, left, right, yaw).

### D. Electronic Speed Controller
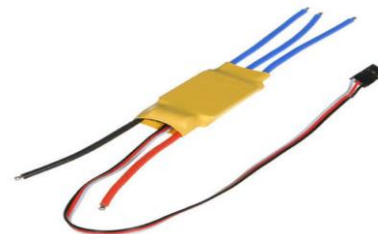
To control the speed of motors a specific



Figure: 4. ESC

device can be used which is known as electronics speed controller (ESC). ESC gives specific value to the motor to rotate the rotor at specific RPM. An electronic speed

control or ESC is an electronic circuit with the purpose to vary an electric motor's speed, its direction and possibly also to act as a dynamic brakeless are often used on electrically-powered radio controlled models [10]. An ESC can be a stand-alone unit which plugs into the receiver's throttle control channel or incorporated into the receiver itself. As the brushless motors are multi-phased, normally 3 phases. The motor requires some special phase-control electronics that is capable of generating three high frequency signals with different but controllable phases, but the electronics should also be able to source a lot of current as the motor can be very power full hungry [10].

### E. BLDC Motor

In multi rotor copter brushless DC motors are used. These BLDC motors are specifically design for multi rotor copter. As per the requirement we choose E-max 2220/07 BLDC motor which has three input out of which two input are used for battery connection and one input is used for signal from controller through ESC. The maximum RPM of this motor is 14500 RPM with no load at maximum of 12.4 V. The load bearing capability of this motor is 1.2 kg.


Figure: 5. BLDC Motor

ellers available in the market like two blade, three blade, four blade propellers, foldable propellers and many more which are available in different sizes. According to the motors specification we have to choose a particular size of propellers. To get maximum thrust to lift the quadcopter, the number of blades of propeller should be increased.

### G. Li Po Battery

Battery provides power to entire drone. To fly the quadcopter large amount of power is required, for that lithium polymer battery (Li-Po battery) is suitable [10]. Li-Po are type of rechargeable battery which are especially used for quad copter.Such Li-Po battery are light in weight and holds huge power in a small package. These batteries are specially design for multi rotor copters. As per the design of our drone, 4500mAh battery is required for its operation.

### H. Power Distribution Board

A power distribution unit is required to rout


Figure: 8. Power Distribution Board

e the power from Li-Po battery to four motors through electronic speed controller (ESC). This unit also route the power to KK 2.1 multi copter controller board through ESC.
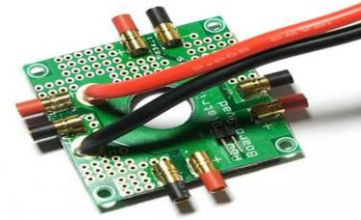
### I. Transmitter and Receiver

The new transmission module (MC 6S) is of


Figure: 9. Transmitter and Receiver

type FHSS (Frequency-hopping spread spectrum) and uses frequency hopping [12]. This technique has a high transmission reliability because it is insensitive to interference. His case, plastic is of type 'compact'. Its handling is excellent and his sleeves are

### F. Propellers

There are different types of prop


Figure: 6. Propeller sets

adjustable hardness. Ergonomics copy clearly Futaba models, all controls are easily accessible. The antenna is directional. 167x34mm LCD screen (black and white) is fairly well mixed and makes a pretty good readability in daylight. However, the definition of characters and graphics are fairly average (previous generation). Navigation is a conventional type. 6 keys allow access to

many menus, selection and settings. The assembly is pretty straightforward except for the fact that the direction of movement of the cursor is not always related to the key position in space.
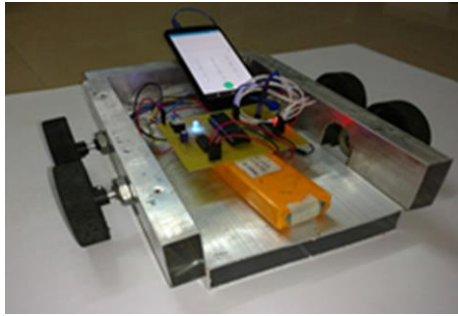
## IV. ROVER



Figure: 10. Rover

The Mobile operated spy camera robot has been designed in such a way that it can fulfill all the needs of military, police and also for personal security. It has countless application and can be used in different environments and scenarios. For instance, at one place it can be used by bomb disposal squad, while at another instance it can be used for handling mines. While another application can be to provided up to date information in hostage situation. The rover is operated by a mobile phone that makes a call to the cell phone attached to the rover. In the course of the call, if any button is pressed, a tone corresponding to the button is detected at the receiver end. This tone is called as 'Dual Tone Multiple Frequency' (DTMF tone). The rover detects this DTMF tone with the help of mobile phone mounted on the rover [5]. The robot is made for purpose by military operation spy robot for navigator in forest. The mobile operated robot is a very small application of DTMF technology [3]. Here, we are showing you the method of using the DTMF to operate robot because the robot is operated by mobile so the range of robot communication is not limited.

The tones are divide into two groups (low and high), and each DTMF signal uses one from each group. This prevents many harmonics from being misinterpreted as a part of signal.



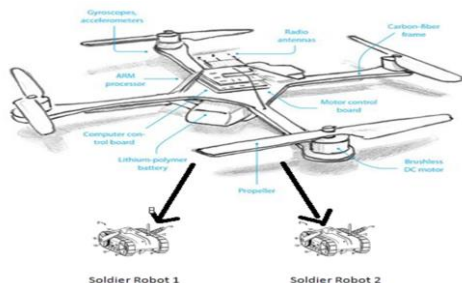## V. CONCEPT IN SKETCH

It consists of four brushless dc motor which will controlled by the ESC. The PWM signal from the microcontroller are given to ESC .ESC is used to control the speed and same voltage of each motor. Four propeller of fiber metal are connected to the four propeller each, will use for flying. As if we slow down the front motor and fast up the other three then the robot will move forward. If we rotate all four motor with equal speed the robot will go upward direction and goes downward if we slow down the same.

The robots will controlled by wireless system which we will can control it from various range. The quadcopter will control by the remote controller operated from the ground section. The quadcopter is also having ability of safe landing and launching by using stand near down to the lithium battery. The battery gives 11.1 volt 6.5 ampere rating to each four motor. The camera is mounted on the quadcopter which will gives us live information about enemy and soldier robot. Our quadcopter will also consist one separate terrain robot which will attached to their bottom of the quadcopter, after detecting the enemy by our robot, the quadcopter will come down and spy on enemy from ground. The main function of this quadcopter is that it has self-destroyable ability when it captured by the enemy of other nation. Mainly we are going to implement this project for military application and the surveillance purpose.

## VI. MAJOR ADVANTAGES

As the quad copter uses four motors it gives more stability than mono copter because it uses single motor which is difficult to operate. Quad copter does not use any mechanical linkage like conveyor belts, rubber belts or chains to rotate the motors so it is very easy to operate and also reduce risk of damage. Due to its small size it can provide close interaction to the objects of which detail information is needed. Quad copter possess high kinetic energy as it uses four motors and it is very quick in its operation as compared to mono copter and tri-copter. The quad copter is an aerial drone so it is necessary to operate wirelessly. Such drones can perform various operations faster than humans with more accuracy. They are very quick to capture detail information which cannot be captured or notice by human eyes.

## VII. APPLICATIONS

The most common and important application of quad copter is surveillance. Quad copter can be used by police department and anti-terrorism squad for public safety. Metrological department use quad copter for weather forecasting. Inspection and Surveillance Tasks in Nuclear Power Plants and Waste Storage Facilities can be monitor by such drones. Quad copter can be used for providing



Figure: 12. Concept in Sketch

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first aid kit in the disaster prone areas where human cannot reach easily. Space mission such as soil monitoring from various planet can be accomplished by using quad copter. Quad copter can travel to the places like forest zone and marshy regions where human can't reach easily. In the automotive industries quad copter are widely used for painting etc.. Quad copters are very useful at the time of search and rescue operations. Drones can be used for media and broadcasting purpose.

## VIII.   RESULT AND ANALYSIS

Experiment of engaging Rover to the Quadcopter has



Figure: 13 Quadcopter with Rover

been successfully implemented. Quadcopter successfully lift the Rover at the maximum height of 300 meters. Li-Po battery of 4500 mAh is sufficient to operate the drone. Flying duration of quadcopter with no load is approximately 13-15 minute and flying time with load attached to the quadcopter is 10-12 minute. when battery goes down during flight, drone comes down due to insufficient power after that same battery is used by rover to move on ground. Operating time of rover with low battery is approximately 15-20 minute. Operating rover with DTMF tone in mobile communication is successfully done.

## IX.   FUTURE ENHANCEMENT

We can design a Quad copter which has high payload capacity. If we want to supply gun, bombs and disposal packet to soldiers in war zones we can provide this by using flying robot. We can design a quad copter which has high Trans receiving range. If you want to send a quad copter to long distance where human beings are not able to reach then we can send quad copter by using high range transceiver module. We can invent fire proof quad copter, which can be used by the firefighting department to reduce life risks in burning infrastructures. In future Quad copter and rover can be detachable. By detaching rover from quad copter, we can use both these bots simultaneous but in different areas.

## Acknowledgement

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