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Flying Drone Wi-Fi Communication

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Abstract: ***There are millions of users who often use Internet. Internet is the most common and easy way to communicate even for long distances and high data transfer rate. Most of mobiles that are coming to the market are Smart Phones in which we can communicate not only by cellular network but also by using Wi-Fi (wireless fidelity). An effective utilization of Wi-Fi can even reduce the use of cellular network. From this why we can't provide free Wi-Fi by reducing the limitations. The major limitation of Wi-Fi is to have a broadband connection. The use mobile Wi-Fi hotspot devices, uses 2G/3G network provided by the Internet Service Provider (ISP), and transmits Wi-Fi signals. There should be a Platform to carry the device to any place here use of a Quadcopter (DRONE) an unmanned aerial vehicle will be effective. So that we can establish communication in any region where cellular network is available and no need of broadband connection. The use of this device in ad media and publicity sector is very useful and we will be having many advantages than compared to existing methods.***

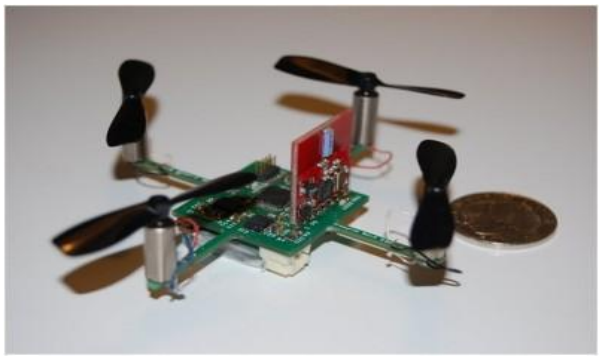
Keywords: micro device, drone, wireless flying drone, wireless, Wireless Fidelity (Wi-Fi), Drone, Quadcopter, RC Transmitter, Electronic Speed Controller (ESC).

I. INTRODUCTION

The advancement in the technologies related to wireless communication has led to the emergence of several engineering designs to aid the human requirements. Today as we are observing that the use of smart phones is increasing day by day. Along with this the service providers are also increasing the charges in tariff plans. So there is a need to search for an alternative way of communication. The replacement of mobile phone with some radio devices id not advisable as it further needs investment of money and knowledge to operate a new device. So the suitable use of existing smart phone will be effective. The word suitable means with a minimal changes we can obtain more economical output. In any smart phone along with the cellular communication there is also another way of communication inbuilt i.e., Wi-Fi communication though which we can connect to internet. The internet connection will fetch you many applications like voice call, video call, messaging, sharing, etc., over internet. This might sound odd to freshers but it's widely being used in many countries. There might be a doubt that who will provide free and secure Wi-Fi. Yes, it's true because the Quadcopter and Wi-Fi device are costly and a normal man might not be able to purchase, but an organization which needs publicity about their products will be able to invest money. Actually they invest lot of money in Television advertisements and Newspaper ads which might not be useful because only a few might see and rest avoid. This will not happen with Flying Drone Wi-Fi because we arrange a system such that when the user access the Wi-Fi provided he will be first redirected to the predefined webpage. So there is no loss of money and it's a onetime investment.

II. BUILDING A QUADCOPTER

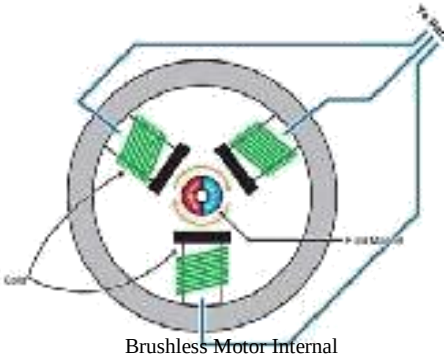
In short terms a QuadCopter is what the name says a 'copter'-like device with four rotors (quad). You might have seen before, as they are being commercialized for police and monitoring use. You can also find them as toys, the AR Drone or even universities have been playing with them, developing swarms with them. QuadCopters can be found and built in many different sizes.



All from the tiny ones that isn't much larger than a CD ROM and up to Quad Copters with a motor-to-motor length of more than a meter.

A. Brushless motors:

Brushless motors are a bit similar to normal DC motors in the way that coils and magnets are used to drive the shaft. Though the brushless motors do not have a brush on the shaft which takes care of switching the power direction in the coils, and this is why they are called brushless. Instead the brushless motors have three coils on the inner (center) of the motor, which is fixed to the mounting. On the outer side it contains a number of magnets mounted to a cylinder that is attached to the rotating shaft. So the coils are fixed which means wires can go directly to them and therefor there is no need for a brush.

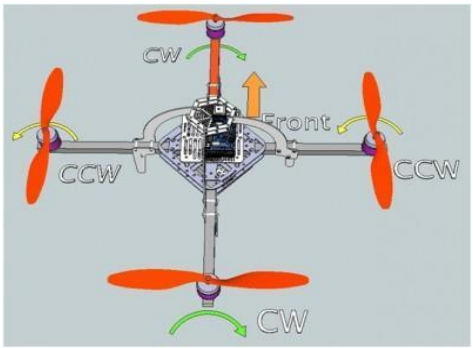


Brushless Motor Internal

The reason why Quad Copters use brushless motors instead of normal DC motors is the much higher speeds and less power usage for the same speed. The brushless motors are more efficient as there is no power lost as there is in the brush-transition on the DC motors.

B. Propellers:

On each of the brushless motors there are mounted a propeller. In the pictures, the 4 propellers are actually not identical. If you have a look at the picture provided you will notice that the front and the back propellers are tilted to the right, while the left and right propellers are tilted to the left



Quadcopter plus Configuration

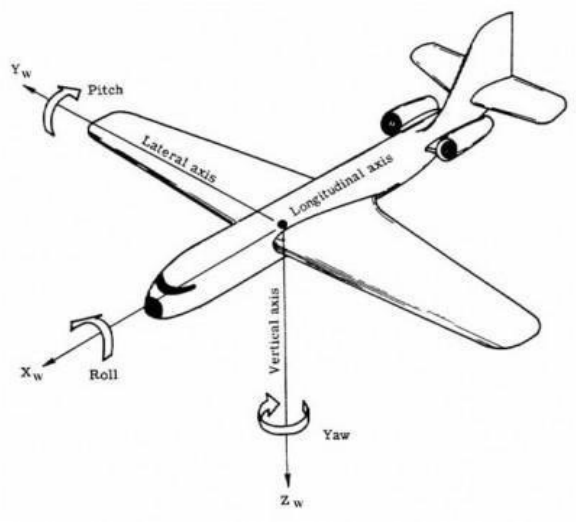
The reason for this is that the motor torque of and the law of physics will make the QuadCopter spin around itself if all the

propellers were rotating the same way, without any chance of stabilizing it. By making the propeller pairs spin in each direction, but also having opposite tilting, all of them will provide lifting thrust without spinning in the same direction. This makes it possible for the QuadCopter to stabilize the yaw rotation, which is the rotation around itself. The propellers come in different diameters and pitches (tilting).

In this Quadcopter we prefer a Quadcopter with 12" propellers as we require lot of thrust to move the Wi-Fi device which is an added weight to the Quadcopter.

C. Roll, Pitch and Yaw:

Roll, Pitch and Yaw are some well used terms from the aircraft terminology. The terms are used to describe the objects orientation around each of its axis. Have a look at the picture below and you will understand the terms.



D. Electronic Speed Control (ESC)

As the brushless motors are multi-phased, normally 3 phases, you can't just apply power to it to make it spin. The motors 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 motors can be very "power-hungry".

Turnigy PUSH 18A ESC

In this case we got the Electronic Speed Controllers, known as ESC's. The ESCs is simply a brushless motor controller board with battery input and a three phase output for the motors. For the control it is usually just a simple PPM signal (similar to PWM) that ranges from 1ms (min speed=turn off) to 2ms (max speed) in pulse width. The frequency of the signals does also vary a lot from controller to controller, but for a QuadCopter it is recommended to get a controller that supports at least 200Hz or even better 300Hz PPM signal, as it should be possible to change the motor speeds very quickly to adjust the QuadCopter to the stable position. It is also possible to get ESCs that is controlled thru One Wire of I2C. These tends to be much more expensive though, but sometimes it is also possible to "mod" other ESCs to add the I2C feature.

E. Battery:

Battery, the power source for the whole device. For the battery two types can be used, whereof one of them is highly recommended. The NiMH and the LiPo. The mostly recommended is LiPo battery. LiPo batteries can be in packs of everything from a single cell (3.7V) to over 10 cells (37V). The cells are usually connected in series, making the voltage higher but giving the same amount of amp-hours. For a brushless motor with a Kv-rating of 1000, this gives us a maximum of 12000 rounds per minute. This number is totally fictive as the battery voltage will drop immediately to around 11.1V (at fully charged state) when current is being drained. Anyways, this gives us a good idea about how fast the propellers will be spinning! Another thing to be-aware of when selecting the right battery is the discharge rate, formerly known as the C-value. The C-value together with the battery capacity indicates how much current you are able to source from the battery. The calculations follow this simple rule:

MaxSource = DischargeRate x Capacity

Frame Construction

Every part in a Quad Copter design works together and the frame is the one joining all of them. The frame can be designed in many ways with many different kinds of materials. The important things are to make it rigid and to minimize the vibrations coming from the motors.

A Quad Copter frame consists of two to three parts which don't necessarily have to be of the same material:

- The center part where the electronics and sensors are mounted
- Four motor brackets connecting the motors to the arms
- There are three kinds of materials that I recommend using for a QuadCopter frame
- Carbon Fiber - the most rigid and vibration absorbent
- Aluminium, Plywood or MDF

F. IMU – Inertial Measurement Unit

The Inertial Measurement Unit is the sensor system of the Quad Copter. The main purpose of the Inertial.Measurement Unit is to calculate the orientation of the quad – the three orientation angles, Roll, Pitch and Yaw. These angles are then fed into some controlling electronics that uses those angles to calculate the required changes in the motor speeds. The IMU consists of at least 6 sensors, also known as 6DOF. These sensors should be a 3-axis accelerometer and a 3-axis gyroscope. Sometimes another sensor, a 3-axis magnetometer, is added for better Yaw stability.

Sparkfun 9DOF Stick

The accelerometers measures acceleration as the name indicates. Now you would think,

"Why the heck do we need to measure acceleration to know the orientation?", but yet again there is another law of physics – the gravity. The gravity is actually a downwards acceleration towards the center of earth, which to all objects makes a downward force keeping the objects on the surface. The accelerometer is actually measuring force, so the downwards gravity acceleration will also be measured by the accelerometer. As the accelerometer sensor can measure the acceleration in three directions we can actually calculate how the accelerometer is oriented against the surface.

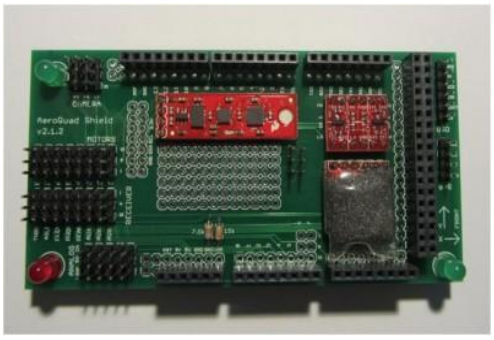
Why isn't the accelerometer then enough to measure the orientation?

The problem lies in the way the accelerometer works, because it isn't very stable. If only the accelerometer were used to calculate the orientation even the smallest movements of the accelerometer will mess up the orientation. So if mounted on a Quad Copter with vibrating motors it will be no good.

Instead we use a gyroscope to address this problem. A gyroscope measure angular velocity, in other words the rotational speed around the three axes. The output of a gyroscope is given in radians per second or degrees per second. With both the accelerometer and gyroscope readings we are now able to distinguish between movement/vibration going up, down, left or right or rotation of the sensor, which is what we would like to know.

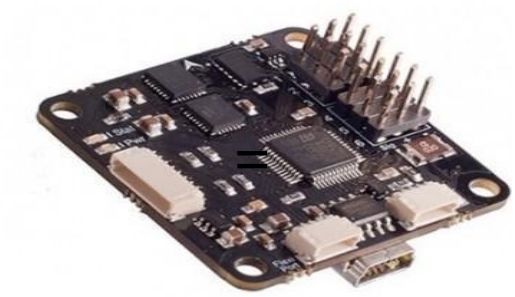
III. CONTROLLING ELECTRONICS

QuadCopters can be programmed and controlled in many different ways but the most common ones are by RC transmitter in either Rate (acrobatic) or Stable mode. You can either buy an already commercial available controller board or build one yourself. Someone is also doing a mix-up by buying some of the parts, like an Arduino and the sensors but then they make the shield and some of the software themselves.



AeroQuad Mega Shield

The OpenPilot is a more advanced board which contains a 72MHz ARM Cortex-M3 processor, the STM32. The board also includes a 3-axis accelerometer and 3-axis gyroscope. Together with the board comes a great piece of software for the PC to calibrate, tune and especially set waypoints for your QuadCopter if you have installed a GPS module – which I will be talking more about in the next section.



OpenPilot ARM Cortex M3 Board

As said earlier Quad Copters are usually controlled in either Rate (acrobatic) or Stable mode. The difference is the way thecontroller board interprets the orientational feedback together with your RC transmitter joysticks. In Rate mode only the Gyroscope values are used to control the Quad Copter. The joysticks on your RC transmitter are then used to set the desired rotation rate of the 3 different axes. In this mode you can control your Quad Copters speed of rotation around the 3 axis, though

if you release the joysticks it doesn't automatically re balance. This is useful when doing acrobatics with your QuadCopter as you can tilt it a bit to the right, release your joysticks, and then your QuadCopter will keep that set position.

For the beginner the Rate mode is a bit hard to start with so instead you should start with the Stable mode. In the Stable mode all the sensors are used to determine the QuadCopters orientation in the air. This orientation is then used to calculate the speed of the 4 rotors to keep the QuadCopter balanced, being plan with the surface. The joysticks on your RC transmitter are then used to set the desired angle for the different axes. So if you would like to move your QuadCopter forward a bit you should simply tilt one of the joysticks so the desired Pitch angle will be changed. When releasing the joysticks the angle will be reset and the QuadCopter will be stable again.

IV. WI-FI HOTSPOT

A hotspot is a site that offers Internet access over a wireless local area network (WLAN) through the use of a router connected to a link to an Internet service provider. Hotspots typically use Wi- Fi technology. Typically we find these hotspots in coffee shops and some eat streets. We can consider these examples as age old because now we can find this Wi-Fi hotspot technology even in our smart phones and many other smart devices like ipod, ipad, phablet, etc.,

In the present world everything is sharing likewise if we share internet in common with some other devices it is known as hotspot, which uses Wi-Fi technology to transfer data.

TABLE I

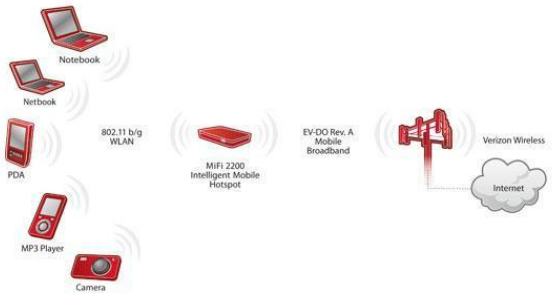
THE EVOLUTION OF THE 802.11 STANDARDS

Protocol	Year Introduced	Maximum Data Transfer Speed	Frequency	Highest Order Modulation	Channel Bandwidth	Antenna Configurations
802.11a	1999	54 Mbps	5 GHz	64 QAM	20 MHz	1×1 SISO
802.11b	1999	11 Mbps	2.4 GHz	11 CCK	20 MHz	1×1 SISO
802.11g	2003	54 Mbps	2.4 GHz	64 QAM	20 MHz	1×1 SISO
802.11n	2009	65 to 600 Mbps	2.4 or 5 GHz	64 QAM	20 and 40 MHz	Up to 4×4 MIMO
802.11ac	2012	78 Mbps to 3.2 Gbps	5 GHz	256 QAM	20, 40, 80 and 160 MHz	Up to 8×8 MIMO; MU-MIMO

There are certain international standards for Wi-Fi communication which are given by IEEE.

The 802.11 family consist of a series of half-duplex over-the-air modulation techniques that use the same basic protocol.Mi-Fi is used as a name for wireless routers that act as mobile Wi-Fi hotspots. It's nothing but 'My Wi-Fi'. It's a special compact wireless router which allows you to connect to wireless internet broadband services using your cellular or mobile phone carrier's 3G/4G network.

Mi-Fi gives you a portable Wi-Fi network that you can access from anywhere. A Mi-Fi is extremely simple to use, basically turn it on and your wireless Wi-Fi devices will connect to it.



The range of this device is not specific and it depends on which IEEE standard the device is manufactured. Most of the devices working range is 46 Meters to 96 Meters indoor and outdoor ranges respectively.

V. CONCLUSION

This paper mainly explains about building a Quadcopter and about Wi-Fi hotspot (Mi-Fi device). From this theoretical analysis if we are able to place a Mi-Fi device on a Quadcopter and let it operate then we can establish a secure and free Wi-Fi communication anywhere on the globe. This is a conceptual prototype developed from the idea of sharing internet with friends. If this is implemented there will be many advantages like we can use this device in ad media applications and as it is an unmanned vehicle it can be used in rescue operations to establish communication with hostages and victims.

A GPS unit can be used to measure speed and use that in the calculation of the movement. It is especially also useful if you would like to make your own UAV (Unmanned aerial vehicle), which needs to know its' exact position.

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