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Quad Copter Controlling Using Android Mobile Devices

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ABSTRACT: A quad copter is a multi chapter that is lifted and propelled by four rotors. Quad copters are classified as rotorcraft, as opposed to fixed-wing aircraft, because they lift is generated by a set of revolving narrow-chord airfoils quad copters generally use symmetrically pitched blades; these can be adjusted as a group, a property known as 'collective', but not individually based upon the blade's position in the rotor disc, which is called 'cyclic'. Control of vehicle motion is achieved by altering the pitch and/or rotation rate of one or more rotor discs, thereby changing its torque load and thrust/lift characteristics.

KEYWORDS: application areas, system design, system architecture, quad copter controller, electronic speed controller, external interface requirements

I. INTRODUCTION

Now days in this 21st century electronic devices such as Computer, Mobile Phones and Tablets are being a part of human life. So, in addition to this we are trying to connect the digital world with the physical world. In this paper we are trying to implement a new concept in which appliance can be controlled by the android phone application from anywhere through the internet or Wi-Fi, for controlling home appliance we provide Wi-Fi connectivity and GPRS. This paper is mainly divided into two phases. The first phase is to demonstrate the Android application and second phase is to control the appliance.

A quad copter, also called a quad rotor helicopter, quad rotor, is a multi copter that is lifted and propelled by four rotors. Quad copters are classified as rotorcraft, as opposed to fixed-wing aircraft, because their lift is generated by a set of revolving narrow-chord airfoils. Unlike most helicopters, quad copters generally use symmetrically pitched blades; these can be adjusted as a group, a property known as 'collective', but not individually based upon the blade's position in the rotor disc, which is called 'cyclic'. Control of vehicle motion is achieved by altering the pitch and/or rotation rate of one or more rotor discs, thereby changing its torque load and thrust/lift characteristics.

Early in the history of flight, quad copter configurations were seen as possible solutions to some of the persistent problems in vertical flight, torque-induced control can be eliminated by counter-rotation and the relatively short blades are much easier to construct. A number of designs appeared in the 1920s and 1930s. These vehicles were among the first successful heavier-than-air vertical takeoff and landing (VTOL) vehicles. However, early prototypes suffered from poor performance, and latter prototypes required too much pilot workload, due to poor stability augmentation and limited control authority. More recently quad copter designs have become popular in unmanned aerial vehicle (UAV) research. These vehicles use an electronic control system and electronic sensors to stabilize the aircraft. With their small size and agile maneuverability, these Quad copters can be flown indoors as well as outdoors. There are several advantages to quad copters over comparably-scaled helicopters.

First, quad copters do not require mechanical linkages to vary the rotor blade pitch angle as they spin. This simplifies the design and maintenance of the vehicle. Second, the use of four rotors allows each individual rotor to have a smaller diameter than the equivalent helicopter rotor, allowing them to possess less kinetic energy during flight. This reduces the damage caused should the rotors hit anything. For small-scale UAVs, this makes the vehicles safer for

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close interaction. Some small-scale quad chapters have frames that enclose the rotors, permitting, flights through more challenging environments, with lower risk of damaging the vehicle or its surroundings. Due to their ease of both construction and control, quad copter aircraft are frequently used as an amateur model aircraft project.

II. APPLICATION AREAS

A. Research Platform:

Quad copters are a useful tool for university researchers to test and evaluate new ideas in a number of different fields, including flight control theory, navigation, real time systems, and robotics. In recent years many universities have shown quad copters performing increasingly complex aerial man oeuvres. Swarms of quad copters can hover in midair, information, autonomously perform complex flying routines such as flipping, darting through hula-hoops and organize themselves to fly through windows as a group.

There are numerous advantages for using quad copters as versatile test platforms. They are relatively cheap, available in a variety of sizes and their simple mechanical design means that they can be built and maintained by amateurs. Due to the multi-disciplinary nature of operating a quad copter, academics from a number of fields need to work together in order to make significant improvements to the way quad copters perform. Quad copter projects are typically collaborations between computer science, electrical engineering and mechanical engineering specialists. Because they are so maneuverable, quad copters could be useful in all kinds of situations and environments. Quad copters capable of autonomous flight could help remove the need for people to put themselves in any number of dangerous positions. This is a prime reason that research interest has been increasing over the years.

B. Millitary and law enforcement:

Quad copter non manual aerial vehicles are used for surveillance and reconnaissance by military and law enforcement agencies, as well as search and rescue missions in urban environments. One such example is the Aeryon Scout, created by Canadian company Aeryon Labs, which is a small UAV that can quietly hover in place and use a camera to observe people and objects on the ground. The company claims that the machine played a key role in a drug bust in Central America by providing visual surveillance of a drug traffickers compound deep in the jungle (Aeryon won't reveal the country's name and other specifics).

C. Commercial:

The largest use of quad copters has been in the field of aerial imagery, although, In the USA, it is currently illegal to use remote controlled vehicles for commercial purposes. Quad copter UAVs are suitable for this job because of their autonomous nature and huge cost savings. Capturing aerial imagery with a quad copter is as simple as programming GPS coordinates and hitting the go button. Using on-board cameras, users have the option of being streamed live to the ground. Many companies have used this for real estate photography for industrial system inspection. Various organizations are taking advantage of the quad copter’s closed-circuit television capabilities and ability to provide an eye in the sky to the action below.

D. Literature survey

In this paper design an android controlled quad copter which consists various advantages for military and space survey. Generally quad copter consists of a one mechanical device with wings controlled by remote. But instead of remote in this paper design a quad copter with android base controls. Typical android will consists of GUI applications used for handling various operations.

In this paper implement a live video streaming, message passing via mike, image processing concept for capture and detection of images in the proposed system. Quad copter will consists of one wireless camera with SD card and mike. The initial motivation of this project was to create a flyer for surveillance purposes. In deciding on the quad-copter, the Group measured the differences. The quad-copter was intended to be a UAV (Unmanned Aerial Vehicle) with autonomous subsystems. It does, however, have a small payload capacity that could be applied to the emergency delivery of low Weight supplies to remote locations. Some point a consensus arose to build a robot, then a robot with sensors and autonomous capabilities, and finally the consensus shifted from a mobile ground robot to a flyer. At first, there were concerns about the technical difficulties involved in designing and building a flyer, however,

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the idea of a flyer generated enough excitement that ultimately the challenge was accepted. The quad-copter was intended to be a small light weight hover-capable vehicle that could be controlled over a custom wireless system.

III. THEORY OF WORK

In this paper Quad copter uses four propellers, each controlled by its own motor and electronic speed controller. Using accelerometers, we are able to measure the angle of the Quad copter in terms of X, Y, and Z and accordingly adjusts the RPM of each motor in order to self stabilize its self. The Quad copter platform provides stability as a result of the counter.

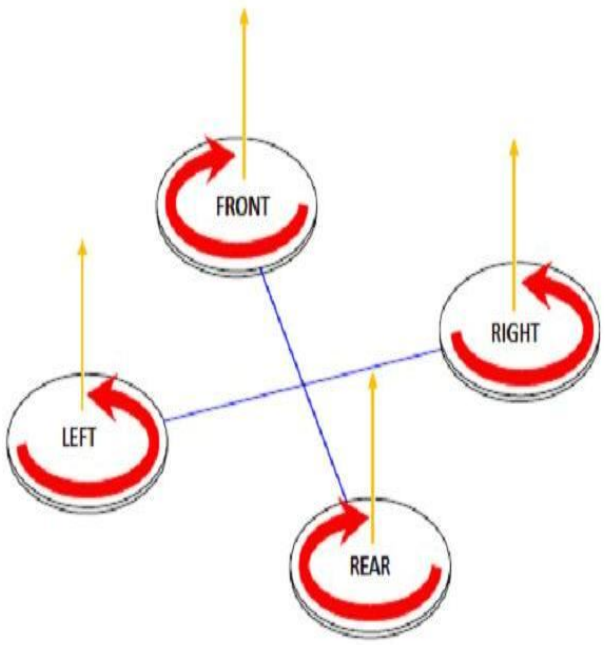

Fig. 1: Take-Off Motion

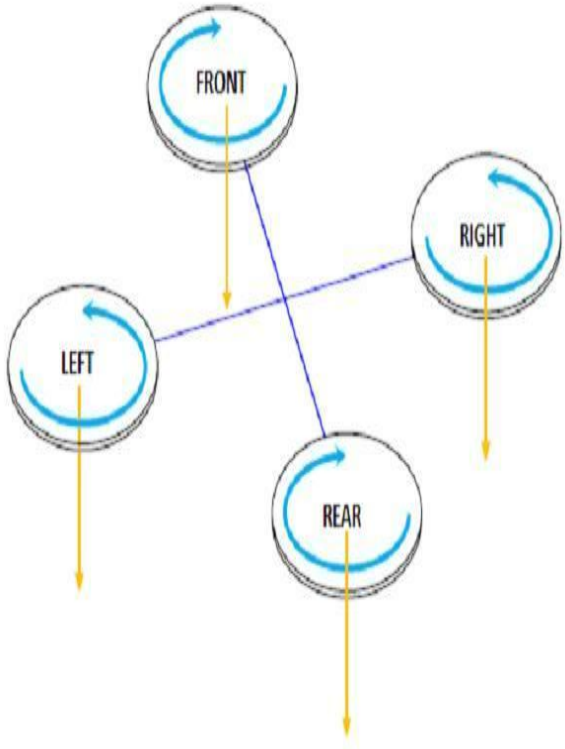

Fig. 2: Landing Motion

A. FORWARD AND BACKWARD MOTION MECHANISM

Forward (backward) motion is controlled by increasing (decreasing) speed of rear (front) rotor. Decreasing (increasing) rear (front) rotor speed simultaneously will affect the pitch angle of the Quadcopter.The forward and backward motions of Quadcopter are represented in Figure 3 and figure 4 respectively.

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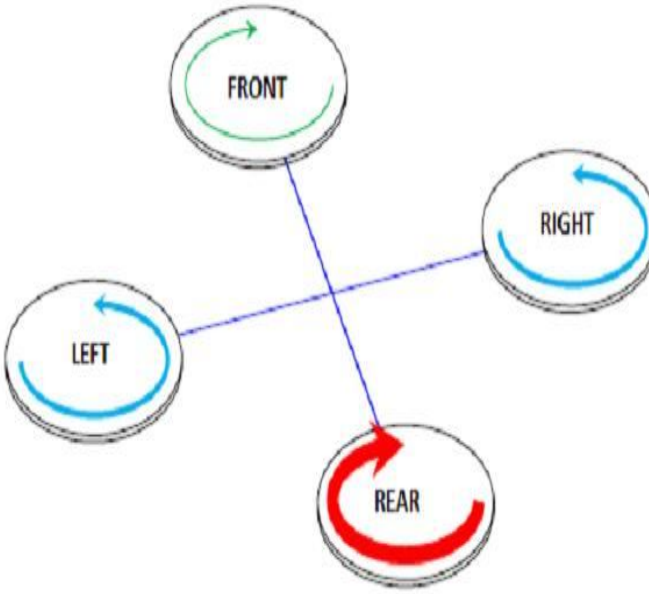

Fig. 3: Forward Motion

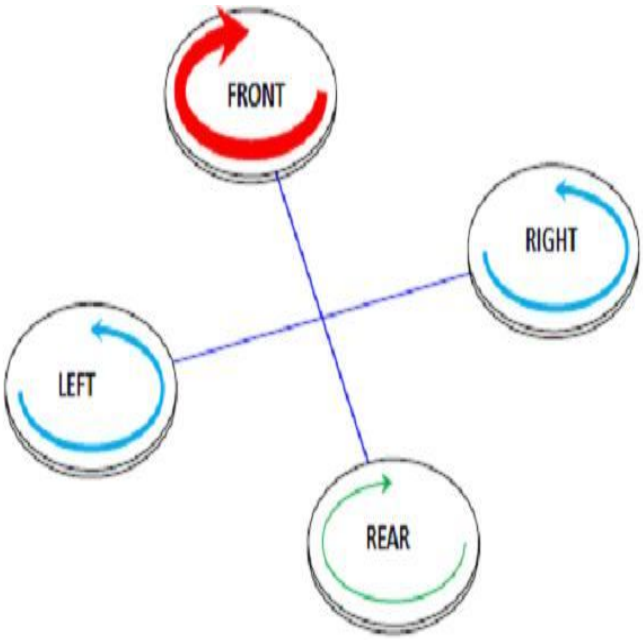

Fig. 4: Backward Motion

B. Proposed work converted to concept:

Quad copter will consists of a weight up to 500-600 grams. We will use a wireless network for flying and other video streaming and message passing purpose. All the controls of quad copter will present on android phone. Languages used for designing of quad copters are Java & C as front end. Our proposed system will consists of little bit assembly programming. We can view and store data on our android phone as well as on laptop. The typical quad copter is controlled by remote devices. So there is more threat to failure and hacking. Because of that reason in this paper design an android controlled quad copter which will not easily hack by unknown third party and definitely provided by more security. In security module we are going to provide a particular IP address in application so more security may be provided.

IV SYSTEM DESIGN

A. Higher level design:

Higher level design somewhat consists of working of class and sequence diagram. As considering sequence diagram a particular sequence of program will be followed.Firstofall user sends some requests to android cell phone then cell phone invokes the events such as start, stop, fly & capture image etc. Finally quadcopter will responds to the event.

B. Lower level design:

Lower level design consists of actual logic of our project. Main intension our project is to create a quadcopter for surveillance purpose.Quadcopter design must be self-stabilized or can carry appropriate payload. It consists of design of propeller with respect rotor.Quadcopter consists of wireless camera with mike which will be useful for image capture ,live video streaming and message passing. Then captured images and data will be stored at android cell phone or particular laptop. We can set a SD-card so immediately captured data will be stored on that card.

C.System design:

This product is an application for Android platform with a controller interface for a RC quad copter. Depending on the chosen game mode GUI items vary. The interface will consist of two analog buttons for

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maneuvering the vehicle and the video stream sent by the internal camera on the Android has many useful API functions to make such an interface. Image and video capturing will be based on figuring out one object from another. It also depends on the battery time of the vehicle, which is assumed to be 15 minutes. The users will also have to have an internet connection to submit their videos and images.

Typical user will handle or control the quadcopter by giving the instructions via android smart phone like fly, capture the image and record the video. User is an essential thing during the final testing and maintenance phase of quad copter design. The quadcopter is a four rotor toy helicopter. It has an onboard camera which sends camera data to mobile phones, namely Android devices and laptop. The quadcopter has many motions sensors. They are located below the central hull. A camera aiming towards the ground provides with ground speed measures for automatic hovering and trimming.

V. SYSTEM ARCHITECTURE

Quad copters and other drone-type devices are being put to good use by researchers, conservationists, game wardens, and wildlife biologists, as their small size and ability to maneuver in hard-to-reach places make them a great choice for remote observation or monitoring. Particular android GUI will control all the actions performed by quadcopter.

A. Block diagram:

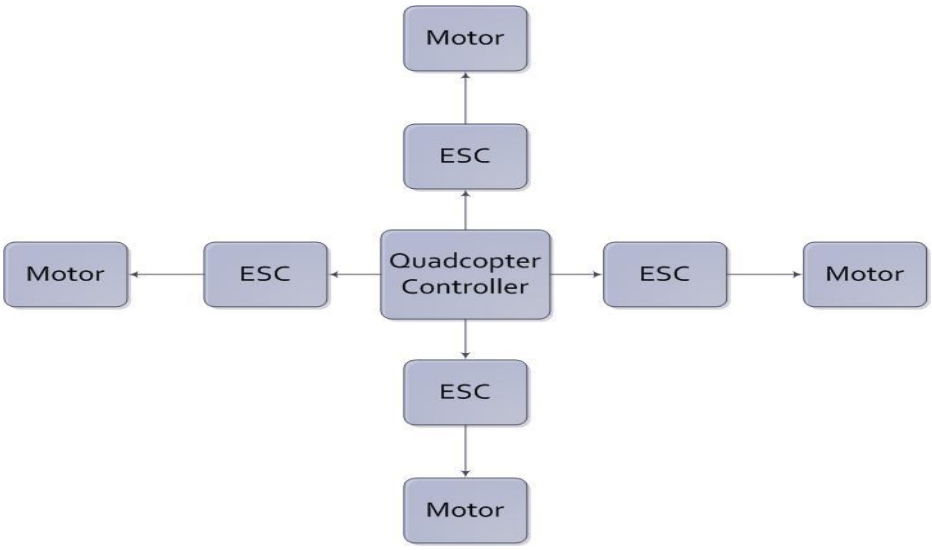

Fig 5. Block diagram of UAV

In the last few years UAV (Unmanned Aerial Vehicle) systems became very attractive for various commercial, industrial, public, scientific and military operations. The tasks include pipeline inspection, dam surveillance, infrastructure maintenance, inspection of flooded areas, volcano observations and so on. The prototype consists of a light weight carbon fiber/ Aluminum frame attached to which are four motors that receive power from electronic motor controllers that allow communicate with the microprocessor, which will in turn control the speed of each individual motor. This design, while simple in theory, gives us a very robust and flexible platform when implementing various design elements. Using a four brushless motor Quadcopter design we are able to change directions, elevation, and tilt rapidly by simply manipulating how much voltage goes into the motors while the UAV is in the air.

Quad copter is an aerial vehicle which is operated to fly independently. The use of four rotors allows each individual rotor to have a smaller diameter. Quadcopter operated by a thrust that produce by four motors that attached to its body. These motors are controlled by means ESC (electronic speed controller). Signals from processor go to

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ESC's which in turn controls the speed of motor. In this design we are using four brushless motors which are able to make the fly and to change its direction. Each of the rotors on the Quadcopter produces thrust and torque. Given that the front and rear motors both rotate counter-clockwise and other two rotate clockwise. We have implemented a multiple-axis accelerometer and gyroscope to allow for multiple degrees of freedom when reading information regarding the status of quad copter.The power distribution in this system is done by a high capacity Li-Po battery of 2650mAh giving adequate power supply.

VI. QUADCOPTER CONTROLLER

The heart of the Quad copter is the controller. Here we are using 8-bit AVR ATmega48PA microcontroller. The ATmega48PAis a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, theATmega48PA achieves throughputs approaching 1 MIPS (million instructions per second) per MHz allowing the system designed to optimize power consumption versus processing speed.

The AVR core combines a rich instruction set with 32 general purpose working registers. All the32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The ATmega48PA AVR is supported with a full suite of program and system development tools including: C Compilers, Macro Assemblers, and Program Debugger/Simulators, In-Circuit Emulators, and Evaluation kits.

VII.ELECTRONIC SPEED CONTROLLER

An electronic speed control or ESC is an electronic circuit with the purpose tovary an electric motor's speed, its direction and possibly also to act as a dynamic brake. Brushless ESC systems basically drive tri-phase brushless motors by sending sequence of signals for rotation.

Regardless of the type used, an ESC interprets control information not as mechanical motion as would be the case of a servo, but rather in a way that varies the switching rate of a network of field effect transistors, or FETs. The rapid switching of the transistors is what causes the motor itself to emit its characteristic high-pitched whine, especially noticeable at lower speeds. It also allows much smoother and more precise variation of motor speed in a far more efficient manner than the mechanical type with a resistive coil and moving arm once in common use.

Fig.6: Electronic Speed Controller

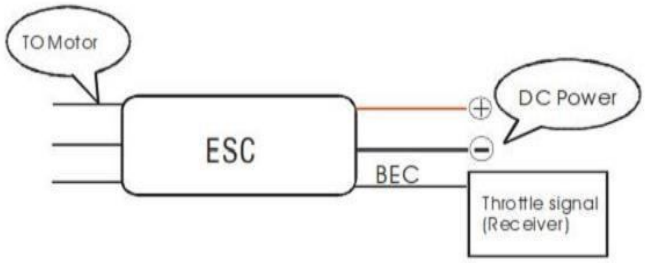

Fig. 7. Schematic of ESC

A. Features:

1. Safe startup mode: When switch on power, ESC won't be started no matter throttle rocker at which positions, safe and reliable.
2. Low volts protection: When input volts lower than setted value,ESC will reduce or shut down the output automatically, protecting battery Effectively.
3. Over volts protection: When input volts higher than rated volts, it emit warning tone, and stop working, self-protecting effectively.
4. Over-heat protection: When the temperature is over 100 Celsius degree, the ESC will reduce the output power, protecting ESC effectively.

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5. Battery type: Li-xx (Li-ion or Li-poly) / Ni-xx (NiMh or Nicd).

6. Startup mode: normal / soft / super-soft, default is normal startup.

7. Transmitter compatibility: Throttle is being settable, compatible with all transmitter.

8. Security: If lost signal in normal use, the ESC would shut down output, prevent the loss caused by lost control.

9.

B.Brushless DC Motor:

Brushless DC electric motors are synchronous motors which are powered by a DC electric source via an integrated inverter/switching power supply, which produces an AC electric signal to drive the motor (AC, alternating current, does not imply a sinusoidal waveform but rather a bi-directional current with no restriction on waveform); additional sensors and electronics control the inverter output amplitude and waveform (and efficiency) and frequency (i.e. Rotor speed).The motor part of a brushless motor is often a permanent magnet synchronous motor, but can also be a switched reluctance motor, or induction motor.

Fig. 8: Brushless Out runner DC motor

Brushless motors may be described as stepper motors; however, the term stepper motor tends to be used for motors that are designed specifically to be operated in a mode where they are frequently stopped with the rotor in a defined angular position. Brushless motors offer several advantages over brushed DC motors, including more torque per weight, more torque per watt (increased efficiency), increased reliability, reduced noise, longer lifetime, elimination of ionizing sparks from the commutator, and overall reduction of electromagnetic interference (EMI).

VIII. EXTERNAL INTERFACE REQUIREMENTS

A. User interface:

User will handle quad copter and its actions by android consisting particular GUI. Typical user will give instructions to the quad copter via GUI designed on android smartphone.

B.H/W interfaces:

1. Android smart-phone
2. Arduino kit
3. ATMEGA-328
4. Battery pack with 9 volt
5. ESC
6. Wi-Fi connectivity with 2.4 GHZ

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7. Wireless camera

C.S/W inferface:

1. JAVA ME
2. ADT ANDROID
3. ARDUINO-1.0.1
4. OPENCV-2.4.8
5. ANDROID NDK

D.Communication interface:

Communication requirements consist of android smartphone, which will consist GUI designed for performing particular operation. Android will provided with GSM and WI-FI applications with 2.4 GHZ to perform image capturing, video recording and flying operations. Quad copter will consist wireless camera with mike. So communication may be done through user, android and quad copter by using these devices. Battery pack with 9 volt will keep quad copter flying maximum 15 minutes in the air.

IX. SIMULATION RESULTS

The simulation studies involve the deterministic small quad copters generally use symmetrically pitched blades; these can be adjusted as a group, a property known as 'collective', but not individually based upon the blade's position in the rotor disc, which is called 'cyclic' . Control of vehicle motion is achieved by altering the pitch and/or rotation rate of one or more rotor discs, thereby changing its torque load and thrust/lift characteristics.

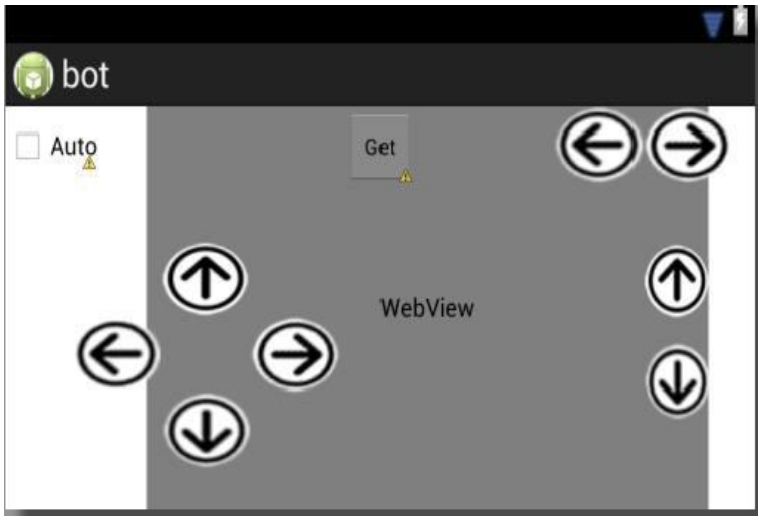

Fig.9: Application file

X. CONCLUSION

The overall goal of this paper to create a sustainable and flexible platform for an UNMANNED AERIAL VEHICLE (UAV) using a Quad copter design profile. The platform which we have created is capable of sustained autonomous flight. While this in essence proves to be short of our ultimate goal, the group is proud to have created proven and solid platform for later development. Our platform can be outfitted with additional sensors (cameras, IR sensors, wireless technology) to expand the overall usefulness and flexibility the Quad copter design.

Given the stable platform produced by this group, further research and development can and should be done to improve the functionality of our design. This paper has increased our interests in robotics and autonomous design, knowledge which will serve useful throughout our professional careers. We feel that this form of thinking and engineering will be prevalent in the modern world and beyond as new applications are found which will test the limits

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BIOGRAPHY

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