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Quad copter Control Using Android Smartphone

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ABSTRACT

This research paper is based on develops a wireless quadcopter project operated by android system. We operate quadcopter using Graphical User Interface and commands given by user via wireless communication system. Quadcopter is a small aerial vehicle that is lifted and propelled by four rotors which is operated by user from the base station through wireless communication. We found that quadcopter can serve more tactical operations like finding a village, searching an enemy location etc. It is specially used in military applications such as for surveillance and gathering information. We mounted an android smartphone on quadcopter which will contain inbuilt application such as camera & GPS. The CAMERA and GPS is used with specially designed software. And output of CAMERA and GPS is to be visualized on desktop or laptop screen.

Keywords – Quadcopter; Components; Android Controlling system.

1. INTRODUCTION

Quadcopter or quad rotor aircraft is one of the major focuses of active researches in recent years. Quadcopter is also called as unmanned aerial vehicle (UAV).The military use of unmanned aerial vehicles (UAVs) has grown because of their ability to operate in dangerous locations while keeping their human operators at a safe distance. The larger UAVs can provide a reliable long/duration, cost effective, platform for reconnaissance and surveillance as well as weapons.

Now a day's electronic devices such as Laptop, 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 quadcopter can be controlled by the android smartphone application from anywhere through the internet or Wi-Fi, for controlling and communicating we provide Wi-Fi connectivity and GPRS.

Fig.1 Android Smartphone Mounted On Quadcopter.

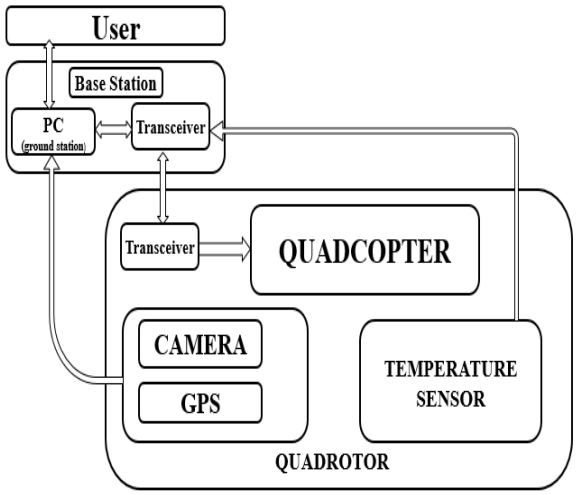

Fig.2 System Architecture

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2. SYSTEM ARCHITECTURE

2.1 COMPONENT

2.1.1 QUADCOPTER

A quadcopter is also called as quadrotor helicopter, is a multirotor helicopter that is lifted and propelled by four rotors. Quadrotor is a VTOL (vertical take-off and landing) rotary UAV. The first term Quadcopter is used by the French engineer Étienne Oehmichen in 1924. Today quadcopters are small in size, electrical and used in many applications such as in mining detection, aerial photography, for military reconnaissance and surveillance. Quadcopters are classified as rotorcraft, as opposed to fixed-wing aircraft, due to its lift is produced by a set of revolving narrow-chord aerofoils. Unlike most helicopters, generally quad copters also 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 modifying the pitch and/or rotation rate of one or more rotor discs, thereby changing its torque load and thrust/lift characteristics.

We mounted an android smartphone on quadcopter which will contain inbuilt application such as camera & GPS. The camera and GPS is used with specially designed software. And output of camera and GPS is to be visualized on desktop or laptop screen

2.1.2. ANDROID SMARTPHONE

Android Smartphone is mounted on quadcopter whose camera will capture the photograph and live streaming used to transmit the signals for operating the quadcopter. Signals are used to provide the velocity to quadcopter, angle by which it is flying successfully and height of quadcopter from ground level.

Android Smartphone Characteristic

CPU & GPU	Quadcore1.5GhzKrait, Ardeno320
Sensors	Accelerometer, Gyro, Proximity, Compass & Barometer
Memory	16GB(ROM), 02GB(RAM)
Network	GSM/HSPA/LTE
Battery	Non-Removable Li-po 2100mAh
WLAN	Wi-Fi 802.11 a/b/g/n dual band, hotspot DLNA
Connectivity	Bluetooth v4.0, A2DP USB-micro USB, v2.0(Slim port)

2.1.3. LAPTOP

We use laptop with as a database for storing the photographs taken by the quadcopter and also used for live Streaming done by the camera mounted on system. Also Global Positioning System (GPS) from smartphone which satellites orbiting the planet send out signals which are picked up by the GPS window software that is install in laptop processed by the GPS receiver to provide geographic coordinates. In general while take-off & landing of quadcopter, its live video streaming and actual position/venue can be visualized in two different windows of laptop. In one window the output of camera (live video streaming) and in another window the output of GPS (actual venue) can be visualized.

Laptop Characteristics

- → Processor : Intel(R) corei3(TM) 4005U
- → RAM : 4GB
- → ROM : 1TB
- → Operating System : 64-bit Windows7 Ultimate

2.1.4 QUADCOPTER CONTROLLER

The heart of the quadcopter is microcontroller. Here we are using 8-bit AVR ATmega328 microcontroller. The AVR ATmega 328 is an 8-bit RISC-based high performance microcontroller. At receiver the ATmega328 microcontroller is connected. The receiver is then connected to display. The ATmega328 achieves throughputs approaching 1 MIPS (million instructions per second) per MHz allowing the system designed to optimize power consumption versus processing speed. Also the ATmega328 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC Architecture. By executing powerful instructions in a single clock cycle,

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 ATmega328P 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.

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Features of AVR ATmega 328

1. Advanced RISC Architecture
→ 131 Powerful Instructions – Most Single-clock Cycle Execution
→ 32 x 8 General Purpose Working Registers
→ Fully Static Operation
→Up to 16 MIPS Throughput at 16 MHz
→ On-chip 2-cycle Multiplier
2. Non-volatile Program and Data Memories
→ 32K Bytes of In-System Self-Programmable Flash Endurance: 10,000 Write/Erase Cycles
→ Optional Boot Code Section with Independent Lock Bits In-System Programming by On-chip Boot Program True Read-While-Write Operation
→ 1024 Bytes EEPROM
Endurance: 100,000 Write/Erase Cycles
→ 2K Byte Internal SRAM
→ Programming Lock for Software Security
3. Peripheral Feature
→ Real Time Counter with Separate Oscillator
→ 8-channel, 10-bit ADC
→Byte-oriented Two-wire Serial Interface
→ Programmable Serial USART
→Master/Slave SPI Serial Interface
→ On-chip Analog Comparator
4. Operating Voltages
→ 2.7 - 5.5V for ATmega32L
→ 4.5 - 5.5V for ATmega32
5. Speed Grades
→ 0 - 8 MHz for ATmega32L
→ 0 - 16 MHz for ATmega32
6. Power Consumption at 1 MHz, 3V, 25°C for ATmega32L
→ Active: 1.1 mA
→ Idle Mode: 0.35 mA
→Power-down Mode: < 1 µA

2.1.5 TEMPERATURE SENSOR

The DS1820 temperature sensor is the digital thermometer which measure temperature from -55°C to +125°C .It has an alarm function with non-volatile user programmable upper and lower trigger points. The sensor can be work on parasite power mode. Thus the power mode requires only two pins for operation (DQ and GND).The DS1820 can derive power directly from data line which eliminates the need for an external power supply.

2.1.6 RF TRANSMITTER

The Temperature sensor will be on the quadcopter which will be very far from the Receiver.RF transmitter is used for communication between transmitter and receiver section.ST-TX01-ASK transmitter module is used for the transmission purpose. The ST-TX01-ASK is an ASK Hybrid transmitter module. The transmitter module is connected to the microcontroller unit. Data pin is connected to microcontroller unit. While the power is given through the external battery. The transmitted signal is then received by the base station.

Characteristics of ST-TX01-ASK Transmitter
Frequency Range: 315 / 433.92 MHZ.
Supply Voltage : 3~12V.
Output Power : 4~16dBm
Circuit Shape : Saw

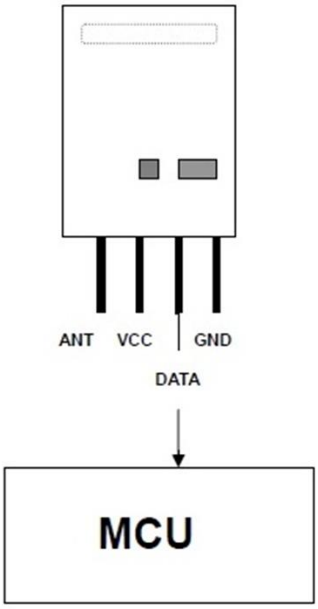

Fig.3 ST-TX01-ASK Transmitter is connected to the microcontroller unit.

2.1.7 RF RECEIVER

The ST-RX02-ASK is a receiver module used as a RF receiver for receiving the signal from transmitter. The ST-RX02-ASK is an ASK Hybrid receiver module. It is an effective low cost solution for using at 315/433.92 MHZ and also it is a Low power consumption device. Receiver is connected to the microcontroller. Microcontroller can process the received signal and pass it to the display ATmega328 connected with RF receiver and LCD.

Characteristics of ST-RX02-ASK
Operation temperature range: – 20℃～＋70℃
Operation voltage : 5 Volts.

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Available frequency at	: 315/433.92 MHz
Typical sensitivity	: -105dBm
Supply Current	: 3.5mA
IF Frequency	: 1MHz

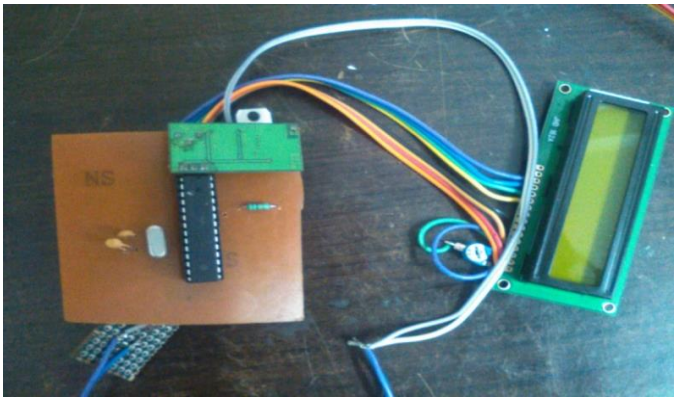

Fig. 4Arran Fig.4 Arrangement of ST-RX02-ASK receiver, ATmega 328 microcontroller & ST-TX01-ASK Transmitter.

3. APPLICATIONS

1. Quadcopter can be used in military applications such as for surveillance and reconnaissance.
2. At border quadcopter can be used to detect intruders, land mines, enemy troops etc. keeping our soldier at safe distance.
3. Quadcopter can also be used for video shooting of movies or collecting evidences for reporters keeping them at safe distance
4. It serves more tactical operations like finding a village, searching an enemy location etc.
5. It can be also useful for disaster management at the time of flood, land slide, earthquakes, for finding the persons were people cannot reach.
6. It is 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.

4. THEORY OF WORK

The quadcopter can be controlled from base station through wireless communication due to android smartphone is mounted on quadcopter whose camera will capture the photograph and live streaming is done. Also Global Positioning System (GPS) of smartphone which satellites orbiting the planet send out signals which are picked up by the GPS window software that is install in laptop. In laptop while take-off & landing of quadcopter, its live video streaming and actual position/venue can be visualized in two different windows of laptop. In one window the output of camera (live video streaming) and in another window the output of GPS (actual venue) can be visualized.

5. CONCLUSION

From this research we will recommend the solution to our system that quadcopter can be controlled from base station through wireless communication. The live video streaming where quadcopter is landing can be visualized in one window of laptop whereas the actual position/venue can be visualized in another windows of laptop.

Thus quadcopter we will be able to monitor the border with a distance & guide our soldier with safety & provide security to selected area. Quadcopter can also be used for disaster management at the time of floods, earthquakes, landslide, in laboratories where it is difficult for person to reach. This quad-copter will also be able to video shooting of movies or collecting evidences for reporters keeping them at safe distance.Quadcopter will be capable of surveillance by live recording the video and geographical studies and climate change.

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