Land Survey using Quadcopter and GPS

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Abstract— Present Land surveying Technologies use very high sophisticated instruments in order to measure distance, area, etc. accurately. The limitations of this instruments is that they require more man power, sometimes setting up of instruments like Total Station, Digital Theodolite take time, in some cases it is also require to move bulky and heavy instruments from one place to another for the point locations. These limitations can be overcome by using a Flying Drone which will have a GPS on it to give locations of point of land which has to be surveyed.

Key words: Quadcopter, GPS, X-bee, Latitude & Longitude, Flight Controller, BLDC Motor, ESC, Land Survey

I. INTRODUCTION

Present land surveying techniques which are currently used in India require more humans, more time and costlier instruments in order to measure the area of particular land. To reduce these limitations authors proposed concepts of "land surveying using quadcopter and GPS". A quadcopter a flying machine which has four equally spaced rotors, usually arranged at the corners of a square body. A Quadcopter is a multicopter lifted and propelled by four rotors. In this project we aimed to build a Quadcopter which can balance itself while flying. This quadcopter also consists of manual control system (transmitter-receiver). For this project work author decided to build the quadcopter frame in a simpler way having symmetrical four arms on which a motor with a propeller is mounted on every arm. GPS Module (SIM28ML) used in here to obtain the location of quadcopter in terms of latitude and longitude. To find the area the quadcopter will be travelled on the edge of land and obtain some points on the edge as done in normal surveying using staff locations. The locations of these points will be given by GPS module live through X-bee Transmitter and receiver on one station. This obtained locations in terms of latitude and longitude will be processed to find area of the land.

The quadcopter with angular precision by illustrating how the spin of the four rotors should be varied simultaneously to achieve correct angular orientation along with standard flight operations such as taking-off, landing and hovering at an altitude. [1]. Some designs are with vision system using camera, tracking the object using image processing & also calculating distance between unmanned air vehicle & ground target to control the UAV using computer [2]. Also some quad-copters are designed to the map or monitoring the areas in danger zones, disaster areas, etc. These systems were designed with payload of GPS, CCD cameras, laser scanner mounted on it [3]. Use of Quad-copter (UAVs) for Border Security with GUI System, Designing an unmanned air vehicle which will monitor the border area, difficult location, movie shooting etc. from long distance. GPS is used to track the position of intruder or our troops or vehicles. This GPS data will be received by ARM9 processor and conveyed to observer or controller via X-bee [4]. The Global Positioning System (GPS) has proven invaluable for a multitude of civilian applications. Each application demands specific performance from the GPS receiver, and the associated requirements often vary widely [5]. Quadcopter UAV with live video streaming and GPS based land surveying system along with height stabilization using ultrasonic sensor. It is achieved using Arduino Uno microcontroller along with GPS module for position logging. The coordinates will be stored on an external memory device (like SD card). Later the logged data from memory device is extracted and processed with the help of simulation software on a system, wherein the actual positional coordinates are used to plot the measured area on a map virtually. Based on these data the actual area is calculated. A video camera and wireless controller is used to guide the Quadcopter in the desired path [8].

GPS receiver when GPS position fixes are available and by the rate gyro's bias drift when GPS position fixes are not available. Furthermore, results show that the accuracy of the GPS position fixes has a significant impact on the relative contributions that each dead-reckoning navigation sensor error makes [7]. Acquisition is the first step in the signal processing section of a Global Position System (GPS) receiver. It detects the presence of a GPS signal received by antenna and provides estimates of code phase and Doppler frequency to the tracking loops. Three acquisition methods in frequency-domain processing are compared, i.e., namely radix-2, split-radix-2/4 and split-radix 2/8 FFTs. The expectancy of the split-radix algorithm is increasing the acquisition efficiency. It is shown that the split-radix-2/8 FFT can save 25% of data loads and stores compared with split-radix-2/4 FFT. The modified Tone detector is applied to enhance the probability of detection finally; the acquisition functions are developed in software architecture running on PC [9]. Wireless building automation is one of the emerging technologies nowadays. Currently, Infra-Red, Radio Frequency, Wi-Fi and Bluetooth are been used for this purpose but they have numerous disadvantages associated with them such as high complexity and higher power consumption the use of low cost, low power, easy to use, efficient and reliable technology called Zigbee that is based upon IEEE 802.15.4 standard for Building Automation [6]. Active alarming system for predicting a collision between two or more vehicles using GPS and IEEE 802.15.4 MAC/PHY specification compatible system on chip The IEEE 802.15.4 standard is designed for low rate wireless personal area networks and we investigate its applicability in a VANET through two series of tests [10]. GPS is playing in very important role in our modern mobile societies. The soft-GPS receiver includes two portions: hardware and software. In hardware portion, an antenna, filter, down-converter from RF (Radio Frequency) to IF (Intermediate Frequency), and an ADC (Analog to Digital Converter) are included. In software portion, signal processing such as acquisition, tracking and navigation that runs on general purpose processor is included [11]. The Quad-Copter can be controlled by radio

transmission or operate under the guidance of limited autonomous protocols. Flight stability of the Quad-Copter is achieved using five degrees of freedom inertial measurement unit (IMU). Sensor data is integrated and processed using a proportional–integral–derivative controller (PID controller), a feedback loop maintained by an on-board Atmel microcontroller [12]

This system can be also used for other applications apart from surveying land such as Land Mapping, Transportation Planning, Building Info Management and Wet Land Mapping. This all applications in general need the location of points on the land which can be located by our GPS and the calculation of area or other parameters can be done on the basis of the coordinates obtained.

II. QUADCOPTER FOR LAND SURVEY WITH GPS

Quad Copter consists of 4 Motors whose speed is controlled by Electronic speed controllers with the help of flight controller. The controlling signal and power is received by the ESC and depending on the signal the power supply through ESC to motor is varied, in order to change its speed.

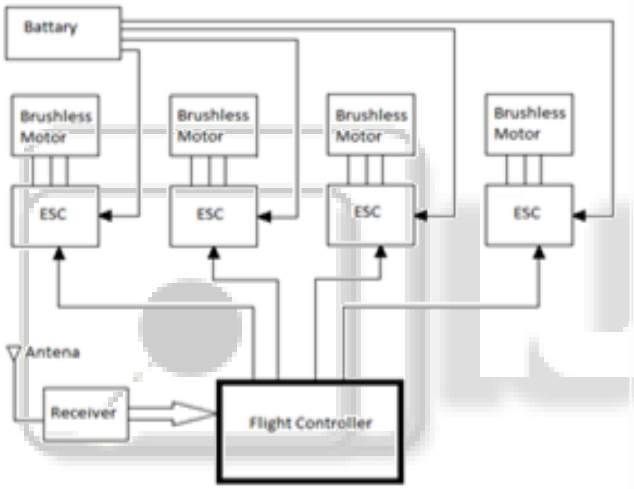

Fig. 1: Quadcopter

A. K.K 2.2.1 Flight Controller Board

The control board has Gyros, inputs and outputs built into the board. The LCD and buttons are used for programming the board. This board is use to stabilize and control the flight of the Quadcopter.

Fig. 2: GPS Module

Fig. 3: Flight Controller

B. Electronic Speed Controller (ESC)

ESC controls the speed of BLDC motor. The inputs to ESC are signal from Flight controller and Power supply, according to the signal from flight controller the ESC modulates the power supply to the BLDC motor, thus varying the speed of motor.

C. BLDC Motor

D2830-11 1000kv Brushless Motor Specs: 7.4~11.1 V 1400 rpm/V, Max Pull: 780 gm., Weight: 50 gm., Max power: 205 watt, Esc: 30 A, Mounting Hole Bolt Circle: 16mm or 19mm.

D. Power Supply

Power supply required is 11.1v, 9v & 5v dc for BLDC motors, GPS & X-bee respectively.

E. GPS Module (SIM28ML)

The accuracy obtained from this method depends on the duration of the observations, but is typically about 1 part per million (1 millimetre per kilometre) so a difference in position can be measured over 30 kilometres with an uncertainty of about 30 mm, or about 100 mm over a 100 kilometres. Because the GPS satellites are in a very high orbit (20,000 km) the ends of the GPS baseline can be hundreds, or even thousands of kilometres apart and still observe the same satellites.

F. X-Bee Module

Zigbee CC2500 is used as a media for communication between quad copter & pc. Zigbee uses RF link with carrier frequency 2.4 GHz. It is bidirectional with data anti-collision protection.

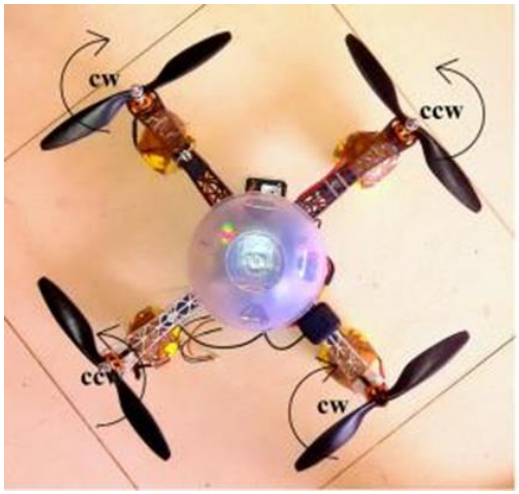

Fig. 4: System Assembly

Fig. 5: X-bee s1

G. System Assembly

It is used to fly the unit & take to position where we want. It consists of motors, base, Propellers. The payload of our copter assembly will contain Flight controller kit, GPS receiver, Video Camera, Power supply, etc.

III. Measurement of Area

To measure the area of a given land, the quad copter will be travelled to the starting point of the land, this can be any point on the edge of the land which has to be surveyed. Location of that point will be capture in terms of latitude and longitude coordinates. Now the quadcopter will be moved to the next point on the edge of the land and the location of that point will be captured. Similarly the required point location will be captured on the edge of land to get accurate area of that land. In this way system will obtain a table of locations respectively of each point. This obtained coordinates can be used to find area by various means. The data from the GPS module is transferred to the ground station through Zigbee transmitter and receiver. The received data is fed to the computer through serial communication. The data obtained at one port of the computer is fetched and processed to give out the coordinates of the point on the land. In this copter is used to calculated the plot area of SITCOE, Yadrav. To do this we flew the quadcopter on the edge of the plot and captured some points on the edge of the plot through software Image capture (ref fig.6) this obtained coordinates were than transferred to the excel sheet for calculation of area.

IV. Conclusion

The results obtained (ref fig.7) show that the system built can be successfully implemented for the measurement of area and distance. The overall Project was carried out to reduce the cost and make human efforts less in surveying the land, which is achieved through this project. Further upgrading to this project will involve advance Flight controller and GPS Module which will provide much higher accurate results.it is observed that increase in the accuracy and stability of flight will increase the cost of the system, but will provide the best results.

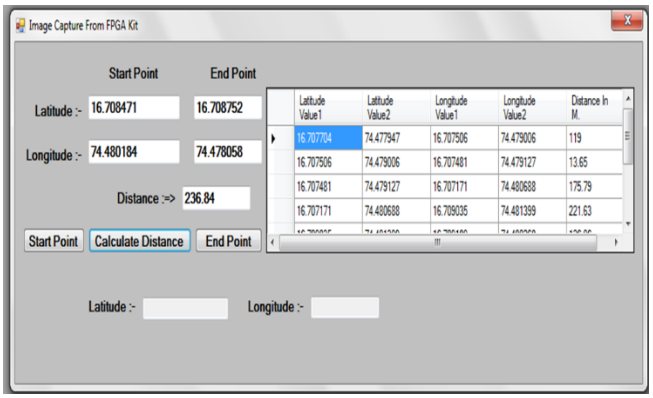

Fig. 6: Plotting of Points and calculating area using Excel Sheet

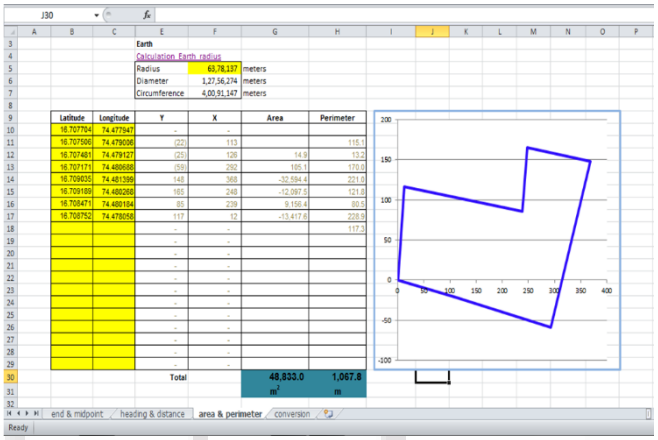

Fig. 7: Readings taken to measure Area of Land

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