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The Quadcopter

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Abstract**—** In civilian applications, the utilization of quadcopters increasing quickly. Still, this deployment experiences some difficulties like flying vibration and instability which lead to inaccurate data of onboard sensors. Determining the size of such inaccuracy assists in improving the future design and provides more precise understanding of data measured in copter applications. This work introduces an implementation of a quadcopter using recently developed hardware and software components. An aerial imagery system was applied as a case study to evaluate the performance of the implemented quadcopter. The quadcopter was assembled mainly from F450 Flame Wheel frame kit, Aurdo-Pilot Mega APM 2.6 controller and a Mission Planner as ground station software. The picked up images were stitched and then compared with the available Google Earth images. Also, the dimensions of targeted buildings and GPS coordinates of certain points were measured on the aerial images. The accuracy of aforementioned dimensions and GPS coordinates in comparing with the actual measurements has been investigated. The clarity and measurement errors found on the taken aerial images were such acceptable that make the quadcopter usage for photogrammetry is quite possible to monitor the changes taking place on the ground such as affected areas and under construction sites.

Keywords— quadcopter, APM2.6, autopilot, image stitching

I. INTRODUCTION

In the last few years, the market of Unmanned Aerial Vehicles (UAVs) began to increase noticeably [1]. This deployment is due to their light weight and replacement the human pilots in the case of risky missions [2]. Quadcopter is the famous one among the UAV types. The quadcopter popularity is owing to the capability of vertical take-off and landing (VTOL), indoor missions and all types of maneuver [3]. However, in civilian applications, the utilization of quadrotor systems has not reached its full scope. This is due to their relatively high cost, complexity of flight control and legal restrictions [4]. Generally, the UAV system is considered a multidisciplinary field as it involves: Air Vehicle, Controller, Communication, Navigation and Payload [5]. Hence, researchers dealt with these subsystems in different ways and levels. D. L. Figueiredo

[6] implemented and tested the APM 2.6 autopilot and the Mission Planner software of a UAV. The Vehicle was a fixed wing UAV. The testing verified the system flexibility and proper working in most environments. A navigation subsystem for a quadcopter was designed by W. Kinsner and et al. [7]. The design addresses the control autonomy of the Vehicle in the challenging environment and mutable payload. Mamdani Fuzzy controller has been selected in Matlab/Simulink design. The proposed UAV navigation perform acceptably in windy weather. Three reasons of errors in the stitching of aerial images was recognized by Saeed Y. and et al. [8]. These are: weak homograph, poor camera calibration and the deficiency of choosing the correct transformation model. This diagnosis assist in the mitigation of the effect of these errors. A depth map was used to choose the ground control points. A higher polynomial orders was exploited to correct the geometric distortion. A similarity transformation was utilized to avoid the deficiency of selecting the projection model. In other side, J. H. Chen and et.al. [9] proposed a stitching algorithm for indoor quadcopter images. The algorithm depends on the hierarchical image stitching method with the dominant image selection for the same scene. The experimental results show the reduction of motion parallax region in the mosaic. W. H. Robinson and et al. [10] found that there are three main challenges face the UAV search and rescue missions: the Mobility, the navigation and the data collection. A testbed structure based on MANET (Mobile Ad-Hoc Network) has been suggested to treat these challenges. Several aircrafts flying simultaneously were considered as nodes of the MANET. A UDP-like protocol was proposed to perform the communication, navigation and data collection among the nodes. Constantly, manufacturers introduce a new quadcopter models to handle the existing disadvantages. These models include a new structures, controllers, communications and software. Unfortunately, the variety of such subsystems creates technical problems such as mismatching and operational complexity. In this paper, a quadcopter mission has been implemented using off-the-shelf; recently developed components. The implemented quadcopter was evaluated through applying a simple photogrammetry application. A stream of aerial images was captured and then stitched for three different sites. The generated mosaic has been compared with Google Earth maps and actual dimensions of the targeted locations. After introducing the work in section I, presents a brief description of the hardware and software utilized in the work. illustrates the details of the implementation workflow, including system set up, software configuration and experimental flight. Section IV evaluates the quadcopter mission based on the accuracy of measurements and images that have been gained in the air

II. LITERATURE SURVEY

Sandeeep Khajure, Vaibhav Surwade, Vivek Badak, [1], proposed a design process by using metal rod for the quadcopter frame and in that design there is a possibility of increased vibration. Due to the vibration the quadcopter often gets imbalanced, hence we have designed our quadcopter by using the thick plastic material. It may reduce the weight and as well as vibration in the body of the copter. The quadcopter used the open source software in the work done by Nuryono Nuryono S. Widodo et al. [3] to reduce cost. They have discussed using open source software for 3D modelling of ground surface. In the work done by Sravan Kumar N et al. [2], a manually controlled quadcopter using the RC transmitter and receiver is discussed. In this design, the quadcopter is to be controlled manually and the flight controller parameters are obtained in trial and error method. According to the work by Moulesh Kumar et al. [4], for the navigating process they used Raspberry Pi 2. But Raspberry Pi board is not designed for real-time quadcopter control. Hence it is found to be more difficulty to navigate with this design. Anurag Singh Rajpoot et al. [7] designed quadcopter with arduino UNO board as the controller. But arduino board is not suitable for real time control of quadcopter. Hence the quadcopter requires tuned PID parameters. Also the flight characteristics of quadcopter is not good. In the work of Wael R. Abdulmajeed et al. [8] they used apm 2.6 controller which leads the quadcopter using onboard sensors. But it is not having the inbuilt compass required for navigation. Also it is designed as a manually controlled quadcopter. Here we have used arducopter APM 2.8 quadcopter, the latest version of APM series which has many sensors onboard. We also designed as an autonomous quadcopter.

III. OBJECTIVES

- Remotely monitor public area
- Make efficient drone
- Reduce costtime.

IV. METHODOLOGY

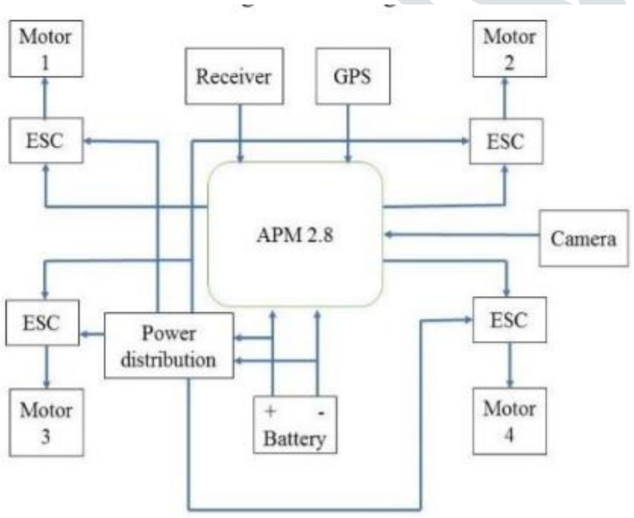

Fig:- System Architecture

Fig. 1 represents the block diagram showing the working of our project. The working of our project starts with the transmitter-receiver section. The first step is to turn on the APM 2.8 by Arm and Disarm in the controller. If Arm option is selected, then the Quadcopter is ready to work by turning on the APM 2.8, and if Disarm is selected, then the whole circuit goes off. The same transmitter-receiver module can be to control the quadcopter manually. Once this gets over, the GPS retrieves the current location of the quadcopter, and by using the ‗Mission Planner' software the predefined path is set by using way points. Then the APM 2.8 subtracts the location of current point (taken from the GPS) from the waypoint which is given by the Mission Planner software. After this step is done, according to the result, the quadcopter is made to move in desired direction with the help of Electronic Speed Control (ESC). The ESC is an interfacing device to control the speed of the motor by the inputs given by the controller. Based on the output of the subtracted position, the APM 2.8 module sends signals to all the 4 ESCs to move the quadcopter in particular direction Due to this, every motor has to carry ¼ of the weight of Quadcopter as opposed to Helicopter where the single motor carries the whole weight. Hence building a quadcopter with live control as well as autopilot capabilities that is versatile enough requires to tackle several problems. Then fitting the quad with a mobile camera that can be controlled from the ground station is done. We have used the motor as brushless motor, because they can achieve high torque. The aircraft must have an adequate payload capability as well as stabilization and localization capability. Alongside with the aircraft, there is a need for a camera that able to performs the image acquisition process at the right place and time. The movement of the quadcopter is controlled via 4 motors. Suppose if the quadcopter wants to move forward then the motor on the backward should rotate in a higher RPM than the front motors. This way the movement of the quadcopter is controlled. The surveillance process takes place with the help of mobile, which is placed in the quadcopter itself. Then a Personal Computer at the ground station is connected with the mobile in the quadcopter wirelessly. With the help of ―Alfred home security app‖, the video can be viewed from the ground station PC itself the quad stabilized. The system is powered by a 3-cell Li-Po battery which is connected to a power distribution cable that is used to feed power to the ESCs and also route 5V of power to the APM‘s power module with a 6 position cable. The 5V routed to APM are sufficient to run it along with all the on board sensors as well as the external GPS/compass module. Each ESC is connected to one of the motors through 3 bullet connectors, they act as a 3 phase power source for the motors and control the speed, direction of rotation and also can act as a dynamic brake for the motors. The inputs of those ESCs are connected to the output pins on the APM 2.8 board, to pins 1, 2, 3 and 4, the purpose is to control the speed of each motor, so we can effectively perform all 4 possible quad movements which are roll, yaw, pitch and accelerate along the common orientation. The external Ublox NEO-7 GPS module is connected to the APM board using old style GPS connection as well as a connection to feed it power from the APM. Mission planner software serves as the ground station for our system, it is also used for first time setup of the APM board, to load firmware and also used for our system‘s configuration. Mission planner is the ground station software in charge of autopilot, where we can set way points for our quad to carry out its mission. Mission Planner allows the usage of regular pc gaming joysticks as input which is what we plan to use for our system dynamic control. The RF transceiver connected to the APM itself should be connected to the 3dr telemetry port on the APM Reference. The video captured using the mobile camera attached with the quadcopter. The streaming video is viewed using Alfred Home security application in the computer.

V. CONCLUSIONS

In spite of the efforts spent by manufacturers, the effect of quadcopter vibration was appeared clearly in the vision quality of images, and accordingly affect the accuracy of measurements. Nevertheless, the results show that the aerial images can be used to measure lengths and areas at percentage error not exceeds 3.8% of the actual values. In addition, the new aerial images can be used to extract GPS location for specific points including the updated points that do not exist in the Google Satellite images, but with error within the range (0.1 - 5) meters. However, controlling the quadcopter maneuvers is not so easy to put it into wide scale civilian applications. It still requires several hours to learn how to install and control the robot. The produced aerial mosaic maps contain more accurate details than the Google earth do. Still, the aerial mosaic require more complicated stitching algorithm to get non blurred images.

VI. FUTURE SCOPE

New packages are entering image because the paintings efficiency and tolerance capacity of the drones have passed all expectancies. Recently India has also joined the picture by freeing its own drones. We can use our drone connected with digicam for surveillance of MIT Campus. Developments and modifications are continuously being carried out on the shape and internal electronics. The new "helicopter drone" released by the US army consists of a 1.8 giga pixel camera to provide clear ground pix even from excessive altitudes. The sensors carried in the drones also are being made sharper to provide higher aerial surveillance. Programming software program of the drone is being evolved such that the drone can take its very own selection in situations in which human errors is in all likelihood. The USA has continuously been using their fleet of drones over Pakistan and Afghanistan inside the fight in opposition to terrorism. Drones have usually risen to the event every time they have been needed. They are really an engineering spectacle, containing the fine of mechanical, electronics and software era. There simply might be a day when nowadays's technology tells their grandchildren that aircrafts were manned by human pilots.

VII. ACKNOWLEDGMENT

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