DESIGN AND IMPLEMENTATION OF QUADCOPTER USING ARDUINO FOR CLEANING AND PAINTING HIGH RISE BUILDINGS

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Abstract

High rising buildings have become a common architecture nowadays. Quadcopter easily find both commercial as well as residential buildings rising for 16 floors. Such buildings need maintenance similarly like any other buildings. The commercial buildings especially at such high rises comprise of layouts containing glass panes. These panes become dirty over time due to dust accumulation but without any means to clean them effectively. the system where in use of a quadcopter for spray painting or water spraying application in order to clean or paint such high rising buildings. The system where in a quadcopter is substituted for the human in performing such dangerous tasks. The quadcopter will be set to a suitable position with its Ultra Sonic Signal in contact to the building. The quadcopter is then allowed to mark a grid of its own and follow the grid to complete that particular task. In this way the human overseeing the task would only need to keep check of what's happening and would not have to worry about controlling the quadcopter.

Keywords—*Quadcopter; Ultrasonic Signa; Spray Painting; Building*

I. INTRODUCTION

Tall buildings have become one of the most common part of the world. Most of these buildings have glass walls. Such buildings need maintenance superior than any other buildings. Most of the commercial and residential buildings have more than 15 floors. . The commercial buildings especially at such high rises comprise of layouts containing glass panes. These panes become dirty over time due to dust accumulation but without any means to clean them effectively. The system where in use of a quadcopter for spray painting or water spraying application in order to clean and paint such high rising buildings.

The quadcopter is substituted for the human in performing such dangerous tasks. The quadcopter will be set to a suitable position with its ULTRA SONIC SIGNAL in contact to the building. The quadcopter is then allowed to mark a grid of its own and follow the grid to complete that particular task. In this way the human overseeing the task would only need to keep check of what's happening and would not have to worry about controlling the quadcopter. This will reduce the risk of human to stand in such height and paint. Painters painting at very tall building can sometimes be become nauseated or become unconscious due to low oxygen density and dangling stage can be reduces at a very huge rate.

Modified The objective of our proposed project is to reduce the risk faced by human while painting and cleaning in very tall buildings without any safety measures to his life. The main thing to be considered in maintenance of tall buildings is cleaning the glass windows mounted on the walls. This process is carried out manually with a threat of life to the workers. In order to reduce this risk we propose a system that can be used to replace the human painters. This can be achieved by introducing a quadcoter that can automatically trace the existence of the building and that can clean as well as paint the building without any human power.

II. EXISTING AND PROPOSED SYSTEM

First, Our traditional method makes use of a person tying himself with safety ropes to the top of the building and working his way to the bottom by adjusting the length of the rope. There is no safety measure that can be give to the person. In some cases the workers hang the rope along with the wall and in some cases the rope is drawn from the top of the building. The worker has to carry the cleaner and paint equipments along with him in the rope.

We propose a system where in a quadcopter is substituted for the human in performing such dangerous tasks. The quadcopter will be set to a suitable position with its ULTRA SONIC in contact to the building. The quadcopter is then allowed to mark a grid of its own and follow the grid to complete that particular task. In this way the human overseeing the task would only need to keep check of what's happening and would not have to worry about controlling the quadcopter.

A. Advantages of the Proposed System

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III. LITERATURE REVIEW

Unmanned Aerial Vehicles (UAVs) have gone through a global boom in recent years due to their increasing accessibility. Quadcopters in particular, with four rotors, have favorable characteristics for many applications such as infrastructure inspection, asset monitoring and surveillance, due to their ability to hover and take-off and land vertically. Events such as the 2011 Christchurch earthquake have benefited from their use inside dangerous seismic locations. However, UAV localization remains a significant challenge, especially in confined or GPS denied locations. Positioning the aircraft relative to another object is a common task that is difficult to achieve. Here, an autonomous quadcopter controller is presented that is able to track and maintain a desired relative location to a static object.

This is achieved with a monocular vision system with the entire computational processing completed on board the UAV. As a consequence, the UAV is designed to operate in infrastructure free environments, providing increased efficiency, autonomy and safety. Visual control of small-scale UAVs in the past has been limited by real-time computer processing performance. Much research has therefore focused on off-board processing by a ground station with wireless control of the UAV. On-board visual closed-loop control was initially explored with flight stabilization objectives. Optical flow techniques such as apply themselves well to stabilization as they measure relative motion and are computationally lightweight.. An overview of hardware requirements for on-board image processing with emphasis on stabilization is given in . Subsequent research has achieved on-board visual tracking of objects, but restricted to overhead translational control present overhead tracking, with an application to assist landing and take-off actions. On-board monocular visual systems have also been used on UAVs for simultaneous localization and mapping with a helicopter . Similar research has also been conducted with stereo camera systems which have a more significant computational requirement. Initial off-board ground mounted stereo cameras were used in and focusing on a quadcopter to remotely control it from a ground computer. In, a forward-facing stereo camera is mounted on a quadcopter to achieve closed-loop control, again with processing on a ground station. Only very recently, UAVs have emerged which are able to perform stereo processing on board. The UAV presented in [13] features a forward-facing stereo camera for obstacle avoidance, however still requiring visual markers for navigation. The UAV in has two sets of stereo cameras for robust on-board control.

The approach used in this paper is unique in the fact that it presents closed-loop object tracking control with a low-cost on-board monocular vision system and a simply defined target object. The paper demonstrates the feasibility of this approach and issues relating to dynamic coupling. The system proposes the integration of a computing board that is powerful enough to handle all image processing and flight control processes onboard on a small scale quadrotor. With the possibility of performing all computational processes onboard without the requirement for a constant data link to a ground station, our design brings the vision of having a fully autonomous quadrotor MAV significantly closer. Another major contribution is the hardware IMU-camera synchronization of our system. This allows us to be able to measure the USB image transmission delays in our system precisely. As a result, we are able to do visual pose estimation with the synchronized IMU measurements with improved efficiency and robustness. This algorithm is evaluated and compared to a vision only marker based pose estimation algorithm. In addition, we further advance the state-of-the-art by integrating a vision based obstacle detection system onto the

MAV system. The stereo computer vision system produces a high detailed depth map, that gives more detailed information about the obstacle compared to basic sensors as infrared or sonar. The capabilities of the system are furthermore demonstrated by vision only autonomous way point based flights. The flight accuracy is compared to Vicon ground truth.

Autonomous drones that can operate without human input can be used in environments that are potentially dangerous to humans or in an everyday environment without the need to a pilot. n. The team used an AR drone to autonomously fly into a room through a 1mx1m window, search for a flash drive, retrieve it and then exit through the same opening.

The device used 4 SONAR sensors to allow the drone to map its position in a room, using the telemetry from the sensors the drone creates a 3 dimensional cube and then constantly updates this map when the drone moves as well as storing its traversed path. The AR drone built in camera is used for image processing to act as the drones vision. In total the AR drone as outfitted with "Xbee, Microcontroller, 2 servos, Magnetic pickup mechanism and 4 SONARS". Some of these additions will be of interest to me in designing my project test prototype. They use a driver called "The AR Drone Brown Package" which as part of the "Robot Operating System" Library . This allows them to give commands to the drone to allow it to move as well as get back telemetry and camera images. The system is split into two components, the first is the drone and the attached sensors all connected to and Arduino. The second component of the system is a cluster of computers that does all the computational processing of the data and issues commands to the drone over the Xbee wireless connection.

To The multi rotors or quadcopter is a device which is designed to fly and even carry small objects with it. Being specific the quad-copter is small in size it is not as big as our conventional helicopters; currently it is not designed to carry humans. The important function of quad-copter is that it can fly anywhere and it can be controlled by humans. And we are using this application of it very firmly. Actually the quadcopter is easily available in the market as a toy but it has to be controlled by wireless remote and it has too many restrictions as it cannot fly on its own you will have to continuously keep an eye on it. a little distraction and you could lose it. Hence we have come across with a technology which will drive the quad-copter on its own. The motivation of developing this technique was taken from the autopilot system which are available in aircraft but even there the system cannot drives the aircraft to the destination completely it has to be monitored by the pilot.

In this system one have to just provide the location's coordinates to the system and then it will trace the location of the destination and then the system will fly itself to the destination. The quad-copter is being used as a flying object as it has better stability and it can easily carry the package with itself. The need of this project is sincerely observed in the military applications and even for commercial use and medical emergencies. As the key importance is that the transporter can fly and use the traffic fewer mediums to transport that is air and it proves to be very efficient for the applications which have critical time limits. In medical applications if there is a emergency with a patient important medication can be parceled with the quad-copter to patients location no matter where the location of the patient is the quad copter will deliver its parcel to it and can save life. It can be even used in the events of natural calamities to provide help for the people trapped. And it can also used to track people trapped by implementing some panel of sensors onto it. So if it is applicable in day to day life it will be proved as most convenient means of transporting the parcels and packages. Also its GUI is so flexible and user friendly that any one can use this device to accomplish the task of parcel delivering. Also the software is equipped with full parameters which are continuously transmitted from the quadcopter to computer. The computer will continuously display the data from the copter so that we can control the system more safely and easily and will allow us full control in charge to make a secure flight.

*IV.*COMPONENT DESCRIPTION

Here cleaning the glasses mounted on tall buildings are taken as application. High rising buildings have become a common architecture nowadays. We can easily find both commercial as well as residential buildings rising for 16 floors. Such buildings need maintenance similarly like ay other buildings. The commercial buildings especially at such high rises comprise of layouts containing glass panes. These panes become dirty over time due to dust accumulation but without any means to clean them effectively. We propose a system where in we make use of a quadcopter for spray painting or water spraying application in order to clean or paint such high rising buildings.

A. PROTEUS

The proteus is an procedural programming language. It is created in 1998 by Simone Z anella. The proteus incorporates many functions derived from several other languages. C, basic... assemble, clipper. It is especially versatile in dealing with strings having hundreds of dedicated functions. This makes it one of the richest language for text manipulation. Proteus owes its name to a greek god of the sea(proteus),who took care of neptune's crowd and gave response; It was renowned for being able to transform himself, assuming different shapes.

Proteus have released version 2 of our real- time graphical warehouse dashboard, an activity monitoring tool for warehouse operation managers.The Dashboard gives managers a picture of their warehouse operation at a glance,as it comprises of different dials and gauges representing the differing areas of activity in the warehouse. Once connected to the warehouse management database , proteus dashboard dynamically updates by constantly refreshing data ,at the rate specified by the user. Charges are registered on the dashboard immediately, altering the views accordingly.

The dashboard has also been designed to have a message display, which display action manager message and alerts; alerting the warehouse manager to any discrepancies or completed tasks. Dashboard users are also able to view historical statistical timing data. This data can be viewed for the entire warehouse by specific year, month and day, or for a specific operator.The dashboard can be seen in operation on the proteus stand at the logistics link series of exhibitions, the first for 2008 being held at sandown park on 5th & 6th February, with a future two exhibitions held later in the year

B. ULTRA SONICS SENSOR

Ultrasounds are sound waves with frequencies higher than the upper audible limit of human hearing. Ultrasound is no different from 'normal' (audible) sound in its physical properties, except in that humans cannot hear it. This limit varies from person to person and is approximately 20 kilohertz (20,000 hertz) in healthy, young adults. Ultrasound devices operate with frequencies from 20 kHz up to several gigahertz.

Fig:1 Ultrasound is used in many different fields

Ultrasonic devices are used to detect objects and measure distances. Ultrasound imaging or sonography is often used in medicine. In the nondestructive testing of products and structures, ultrasound is used to detect invisible flaws. Industrially, ultrasound is used for cleaning, mixing, and to accelerate chemical processes. Animals such as bats and porpoises use ultrasound for locating prey and obstacles. Scientist are also studying ultrasound using graphene diaphragms as a method of communication

An ultrasonic transducer is a device that converts AC into ultrasound, as well as the reverse, sound into AC. In ultrasonics, the term typically refers to piezoelectric transducers or capacitive transducers. Piezoelectric crystals change size and shape when a voltage is applied; AC voltage makes them oscillate at the same frequency and produce ultrasonic sound. Capacitive transducers use electrostatic fields between a conductive diaphragm and a backing plate.The beam pattern of a transducer can be determined by the active transducer area and shape, the ultrasound wavelength, and the sound velocity of the propagation medium. The diagrams show the sound fields of an unfocused and a focusing ultrasonic transducer in water, plainly at differing energy levels.

Fig:2 piezoelectric materials

Since piezoelectric materials generate a voltage when force is applied to them, they can also work as ultrasonic detectors. Some systems use separate transmitters and receivers, while others combine both functions into a single piezoelectric transceiver.Ultrasound transmitters can also use non-piezoelectric principles. such as magnetostriction. Materials with this property change size slightly when exposed to a magnetic field, and make practical transducers. A capacitor ("condenser") microphone has a thin diaphragm that responds to ultrasound waves. Changes in the electric field between the diaphragm and a closely spaced backing plate convert sound signals to electric currents, which can be amplified.

C. QUADCOPTER

Headings A quadcopter, also called a quadrotor helicopter or quadrotor, is a multirotor helicopter that is lifted and propelled by four rotors. Quadcopters are classified as rotorcraft, as opposed to fixed-wing aircraft, because their lift is generated by a set of rotors (vertically oriented propellers).Quadcopters generally use two pairs of identical fixed pitched propellers.

Two clockwise (CW) and two counter-clockwise (CCW). These use independent variation of the speed of each rotor to achieve control. By changing the speed of each rotor it is possible to specifically generate a desired total thrust; to locate for the centre of thrust both laterally and longitudinally; and to create a desired total torque, or turning force.

On a traditional helicopter the propeller blade spins at a constant speed. Changing thrust is achieved by adjusting the propeller pitch mechanically. This pitch mechanism is complex and expensive. Other movement (e.g. Yaw) is achieved by the small tail rotor

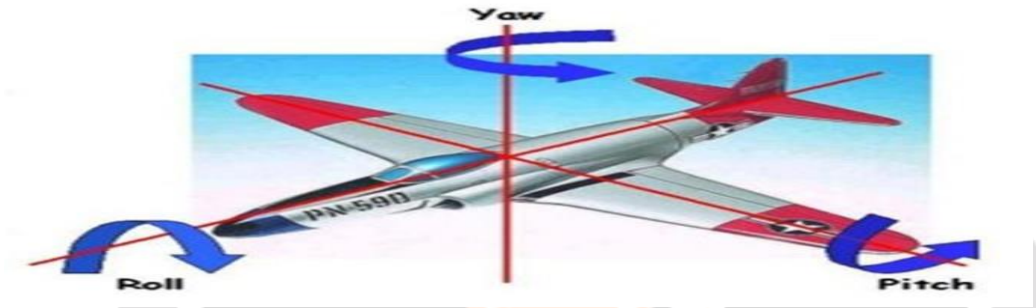

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Fig:3 Quadcopters

Quadcopters has four motors which uses four fixed pitch propellers. Mechanically this is very simple compared to what the helicopter has. Along with the compact electric motors powered directly by battery, the simplicity makes small size model quadcopters more popular in RC hobby. But when it comes to full size aircraft, things gets more complicated in the such as whether to have four engines in quadcopter.

For the quadcopter to maintain balance, each individual motors must adjust speed to change thrust. If motors on one side are spinning faster, it will generate more thrusts and the quad will tilt to the other side. Because quadcopter relies on changing the speed of the propellers to make yaw, roll and pitch movements (3 dimension movements), how fast it can change the motor RPM (rotation per minute) determines how agile the quadcopter is.

As mentioned, when quadcopter is making movements, the rotation speed of the propellers and motors need to change. Helicopters's varying-pitch propeller mechanism is a more efficient solution, because it takes more energy to slow down / speed up propellers than keeping the motor and propeller at a constant speed. Basically, to be more controllable and stable, the more frequent the motors change speed, and therefore the less efficient it will get.

When disaster happens such as loss of power or motor failure, quadcopters might spin around or flip sideway, because the quadcopter can only be balanced effectively when all four motors are working. On the other hand, helicopters tend to just glide down to the ground vertically.

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*V.*BLOCK DIAGRAM

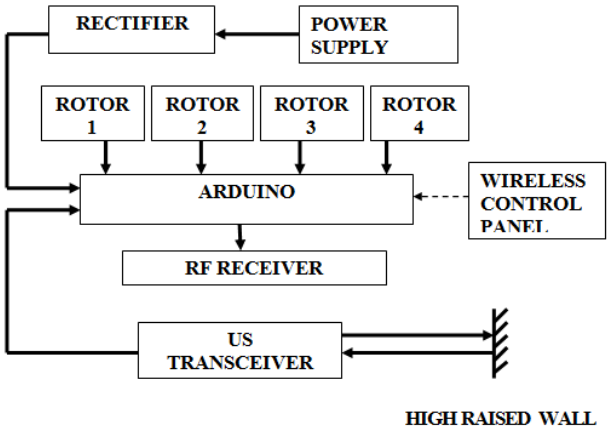

Fig:4 block diagram

A. *FLYING MECHANISM*

Basically a Quadcopter is a quadrotor helicopter that is liftedand propelled by four rotors. Unlike helicopters they use symmetrically pitched blades. 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. Check the image below for the principle behind the quad's motion. The motors 1 and 4 rotate in CW direction while 3 and 2 rotate CCW thus creating a downward thrust which lifts the quad. By varying the speed of the 4 rotors various movements are possible. There are three important terms mentioned above namely the YAW , ROLL and PITCH which we must have a clear concept of before understanding the quad's movement.

Each rotor produces both a thrust and torque about its center of rotation, as well as a drag force opposite to the vehicle's direction of flight. If all rotors are spinning at the same angular velocity, with rotors one and three rotating clockwise and rotors two and four counterclockwise, the net aerodynamic torque and hence the angular acceleration about the yaw axis, is exactly zero, which mean there is no need for a tail rotor like on conventional helicopters. Yaw is induced by mismatching the balance in aerodynamic torques.traditional helicopter the propeller blade spins at a constant speed. Changing thrust is achieved by adjusting the propeller pitch mechanically. This pitch mechanism is complex and expensive. Other movement (e.g. Yaw) is achieved by the small tail rotor

V.*RESULTS AND DISCUSSION*

A. *INPUT SIMULATION*

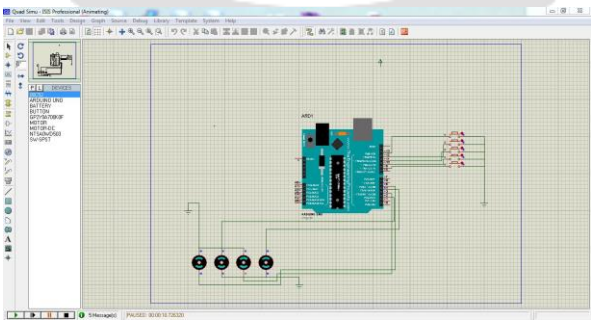

Fig:5 input simulation page

From the above figure, when the circuit is not simulated the esc value is said to be zero and power will not be given to any of the motors. Table Styles.

B. OUTPUT SIMULATION

From the result figure given above it can be proved that when the device is simulated a power supply is given to the ESC and the motors start to calibrate. Once calibration is done the device is ready to fly. When the first switch is presses the motors 1 and 3 rotate in same direction and motors 2 and 4 rotate in opposite direction. This produces an upward thrust and makes the flight to fly.

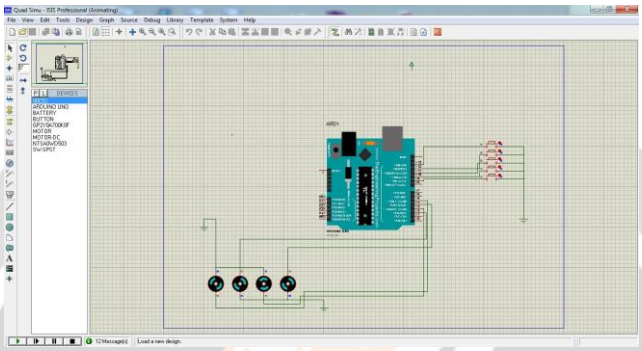

Fig:6 output simulation page

Labels: The specifications of the rotor are following

- Continuous Current given to ESC = 30A
- Instantaneous current to ESC = 40A
- BEC output = 5V/2A
- Volts given to BLDC = 7.4V – 11.V
- Rotation per minute (RPM) = 700- 1500

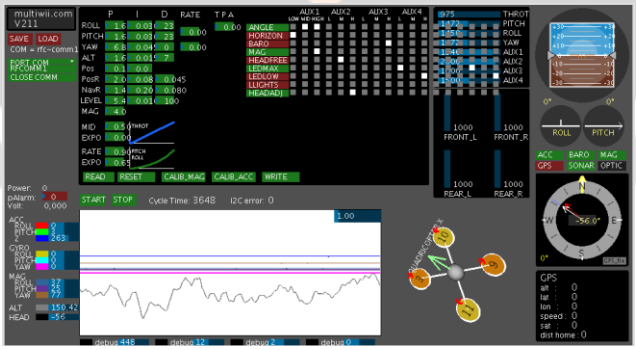

Fig:7 inertial moment unit

The above figure is the result of Inertial Moment Unit when the Quadcopter is in ground and is slanted to -56.0 degree. The pitch of the z- axis alone varies as it is titles to some direction.

- Angle = -56.0 deg
- Pitch (z- axis) = 263
- Gyrometer reading = 0
- Yaw = 77 units
- Speed of motor 1 = 3*100 rpm
- Speed of motor 2 = 10*100 rpm

- Speed of motor 3 = 9*100 rpm
- Speed of motor 4 = 11*100 rpm

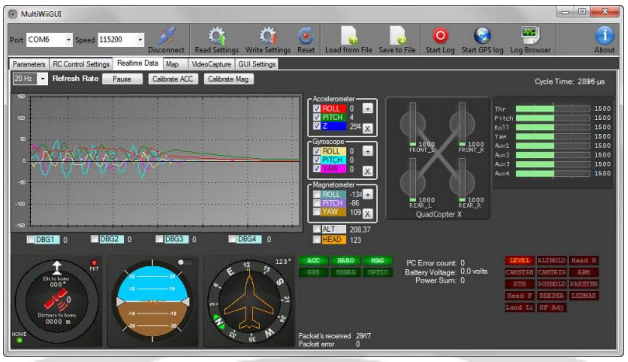

Fig:8 real time data

From the above figure the real time data that are used in day to day life are calculated. These data are very useful and can be easily understood by all. These data are used to calculate and control the flight using IMU. Testing shows that the estimator is fast and can track the angle very accurately. The drifting rate gyros takes care of the short term accuracy with almost no noise, while the noisy accelerometers takes care of the long term accuracy and corrects the drift.

V.CONCLUSION

Thus by using this project we can substitute a device for a man to clean tall buildings. By this the risk factors arising for the cleaners who hang on over a height of 100 meters and above to clean glass mounts can be reduced heavily. Our system will save time and also save the lives of many human.

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