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Advance Drone for Border Security and Surveillance

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Abstract- *The multicopter is Unmanned Air Vehicle (UAV) that may have many applications. As we are developing gradually from a century old design, modern multicopters are turning into small and agile vehicles. A number of multicopter configurations were studied for this project and finally quad rotor configuration was selected. Our present focus is on developing a suitable design configuration for a quadcopter. The design was started by the approximate load the quad copter should carry and weight of each component. Based on this weight of the quadcopter, the appropriate motors and corresponding electronic components were selected. The selection of components for the structure was based on weight, forces acting on them, mechanical properties and cost. First person view (FPV) was incorporated into the system to carry to surveillance with the help of IP camera. Since this quadcopter is specially designed an unconventional landing gear.*

Keywords- *Civil drones, Construction, Drones, Military drones, Unmanned Arial vehicles, Brushless motors, remote sensing, ESC wires*

I. INTRODUCTION

In this paper we have propose a border monitoring solution, which is consists of a Wireless Sensor Network (WSN) to detect and track intruder, and a set of lightweight (Unmanned aircraft vehicles) UAVs in the form of quadcopter that interact with the implemented WSN to improve the border surveillance, the tracking of intruder, the capture and transmission of real time video of the intrusion scene, and the response to hostage situations. An algorithm is used for the tracking mission by increasing the rate of detected intruders spotted by the quadcopter. All this together with the design of the electrical, Mechanical and software architecture of the proposed V-Tail quadcopter, we develop in this project powerless techniques to accurately localize terrestrial activities using PIR (passive infrared sensor). The developed V-tail type drone is tested to get valid and accurate parameters' values for the simulation. Drones for military use were started in the mid-1990s with the HAE UAV ACTD (High-Altitude Endurance Unmanned Aerial Vehicle Advanced Concept Technology Demonstrator) program managed by the Defense Advanced Research Projects Agency (DARPA) and (DARO) Defense Airborne Reconnaissance Office. Unmanned aerial vehicles (UAV) are also known as Drone. Basically, all kind these of drones are called as a flying robot. In combination of software programming, the flying machine/robots or drone may be remotely controlled or can fly autonomously by software controlled flight plans in their embedded systems. In this project, the basic purpose of UAV is to reduce the number of person deployed on the border as well as reduce the number of causalities caused during the war. The Night Vision Camera is used for tracking the border. PIR sensors are used for detecting the intruders. Once the intruder is detected it gives signal to the controller.

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II. LITRATURE SURVEY

Quadcopter UAV based Fertilizer and Pesticide Spraying System [1] this paper represents the detail about implementation of Agriculture wonder drone. Paper contains the detail about Quadcopter UAV and sprayer module and also mentioned about pesticide content to the areas that can't easily accessible for human beings. Author represents the used of multispectral cameras which is used to capture remote sensing images to identify the green field as well as the edges of crop area. For this particular purpose of drone Total pay load lift is of 8 kg. They used QGIS software for the purposed of analyzing the remote sensing images.

Border surveillance monitoring using Quadcopter UAV-Aided wireless sensor networks [2] in this paper, a border surveillance application using Quadcopter as tool is implemented for proactive and reactive responses as well as to detect the intruders. Technology used in this paper is RFID and WSN (Wireless Sensor Network).

UAV Traffic Patrolling via Road Detection and Tracking in Anonymous Aerial Video Frames [3] In this paper Quadcopter is used as Traffic Patrolling Drone. The start and end point of UAV are known. This work is achieved by anonymous streaming video captured from UAV for simulation purpose. Aerial Road Tracking technology is used in this paper.

Human Detection System using Drone for Earthquake Rescue Operation [4] Drone is used for recusing the victims trapped in the natural calamities like Earthquake, Floods, etc. with the help of (Passive Infrared sensor) PIR. PIR sensor detects and provides the information of the live humans. Technology to detect human and their motion is used.

Review on Application of Drones for Crop Health Monitoring and spraying Pesticides and Fertilizers [5] Drone is used for Health Monitoring of crops as well as for spraying different pesticides and fertilizers on the crops. The Spraying System in the proposed paper can be used for many other purposes. Spray Gun algorithm is used and implemented.

III. BLOCK DIAGRAM AND DRONE CONSTRUCTION

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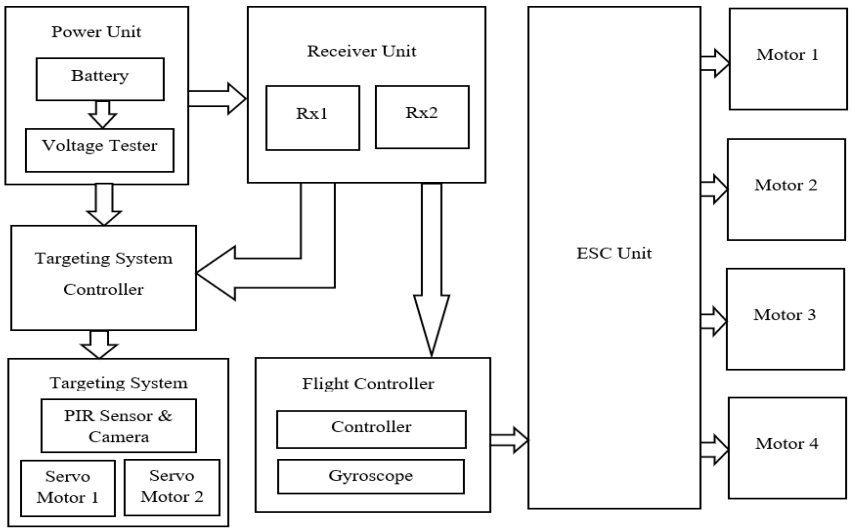

Fig. 1 Block Diagram of Proposed System of Drone

Drone is consists of two major systems:

1. Movement system
2. Control system.

Movement system Frame: The basic element of a drone is its frame, which should be light in weight. The separation of frame construction is mainly based on the number of arms. Due to the number of arms and the motors used, the drones are classified into:

1. Bicopters – two motors, 2. Tricopters – three motors, 3. Quadcopters – four motors,
4. Hexacopters – six motors, 5. Octocopters – consists of eight motors.

Generallyit is appreciated that the construction with more arms allows for a more stable flight. The frame of drone is made up of carbon cloth 3K.

Engine and Propellers: The next components of a drone are engine and propellers. The main propulsion system of a drone consists of these two components and is subjected to the highest loads; therefore their durability is very important. The propellers change a torque (derived from the engine) for a lifting the drone in the air. Due to the propeller system and flight direction are related to each other so it can be divided into the following types:

1. +: One is the leading propeller which consists of at least four propellers.
2. X: The most common construction, in which two propellers are leading (with an even number of propellers).
3. Y: Three arms stacked in the Y, where one or two arms will be leading.
4. V: Very rare arrangement in which two propellers lead onto outstretched arms.
5. H: A very rare arrangement where the construction is based on the H-shaped with two propellers leading.

All of the above-mentioned construction can be mounted with double propellers (at the top and in the bottom), which significantly increases the capacity of the drone, and does not require the addition of other arm. Double propellers mounted on a less number of arms increases the capacity of a drone this allows more lifting capacity and insuring the parallel engine in case of a failure. Thus, the own weight of multicopter is reduced, the material costs are falling and the drone can carry more load. The double propellers rotate in opposite directions, so balancing of the inertia force is done.

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The drone wings can also be divided on terms of rotation:

1. Clockwise (CW),
2. Counter clock Wise (CCW).

The wings are consists of carbon fiber, plastic or aluminum, and are joined to each other by lamination (also used for joining the drone extremities), which ensures optimum performance between the weight of the entire construction and mechanical durability. The wings size is very important. The larger diameter of the wings results in low speed of drone, which contributes to a reduction of drone volatility. The larger the wing blades, the greater aerodynamic lift is generated, also the pressure is exerted on the propeller hub increases and the force deforming propellers is getting bigger. The bigger propeller blades the stronger should be the engine to cope torque, which is required to keep propellers, into motion. It is very essential to balance each propeller before use, to minimize vibrations generated by the unequal operation of the system. It is very important to choose the engine and propellers in such a way that drones should lift a given load as long as possible. The brush motors are very commonly used for building drones. However, the experiences have shown that using brushless DC motors improves durability, efficiency and reduces the consumption of battery with moving parts. This allows the longer and less emergency work of the motors.

ATmega328p: It is a single-chip microcontroller created by Atmel in the mega AVR family. It is consists of modified Harvard architecture 8-bit RISC processor core. The8-bit AVR RISC-based microcontroller combines 32 KB ISP flash memory with read and write capabilities, 1KB EEPROM, 2KB SRAM, 23general purpose input-output lines, 32general purpose working registers, three flexible timer or counters with availability of compare modes, internal as well as external interrupts, serial programmable USARTwith a byte-oriented 2-wire serial interface, SPI serial port, 6channel 10-bit analog to digital converter (8-channels in TQFP and QFN/MLF packages). In addition to this, watchdog timer with on chip oscillator, and 5software selectable power saving modes. The device operates between 1.8volts to 5.5 volts. The device successfully achieves throughput of 1 MIPS per MHz.

Power of drone: LiPo battery Nominal voltage is the default, resting voltage of a battery pack. LiPo batteries get fully charged when battery reach at 4.2volts/cell, and their minimum safe charge is 3.0volts/cell. 3.7volts is pretty much in the middle, and that is the nominal charge of the cell or battery.

ESC controller: It is an electronic speed control in an electronic circuit with is used to control the speed of servo-motor as well as its direction; In short it is act as a dynamic brake. These controllers are very commonly used in motors, essentially providing an electronically-generated three phase electric power with the low voltage source of energy for the motor. It also allows much smoother and more precise variation in motor speed. For this a resistive coil and moving arm is commonly use.

BLDC motors: BLDC motor Brushless DC electric motor (BLDC motors, BL motors) also known as electronically commutated motors or synchronous DC motors are motors powered by DC electricity via switching power supply or an inverter, which produces an AC electric current to drive each phase of the motor via a closed loop controller. Then the controller will provide current pulses to the motor windings which use to control the torque as well as speed of the motor. The construction of a brushless motor system is similar to a permanent magnet synchronous motor (PMSM).

RF 2.4 GHz remote controller: RF2.4Ghz remote control is an embedded devices which is use controls drone motion. This is very similar to TVs and radios Infrared (IR) remote controls. Most of the cars now a day have a radio frequency (RF) remote key fob. In addition, Wireless keyboards as

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well as mice use RF links at 27 MHz or 2.4 GHz. Instead of IR we can also use one Node MCU. It is Less complicated and having inbuilt Wi-Fi module itself.

The PIR (Passive Infra-Red) Sensor: It is a pyro electric device that detects human or animal motion by measuring changes in the infrared levels emitted by surrounding objects. This motion is detected by checking for a high signal on a single input-output pin. When an object like a person, animal passes in front of the background, such as a wall, the temperature at that point in the sensor's field will rise from room temperature to the body temperature, and then back again to normal. After this sensor will converts this all resulting change in the incoming infrared radiation which results in change in the output voltage, and this triggers the detection of the object.

Ultrasonic sensor: This sensor creates the Ultrasound which can be used for measuring wind direction and speed (anemometer), tank or channel fluid level, and speed through air or water as well. For measurements of speed or direction, a sensor device uses multiple detectors and calculates the speed from the relative distances to particulates in the air or in the water. For measurement of tank or channel liquid level, as well as sea level (tide gauge), the sensor measures the distance (ranging) to the surface of the fluid.

Simulation Diagram

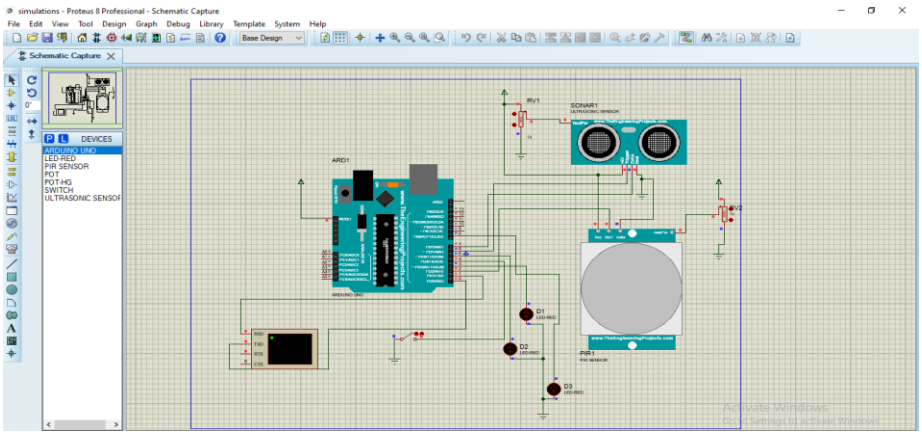

Fig. 2 Circuit Diagram in Protues Software

Simulation Results

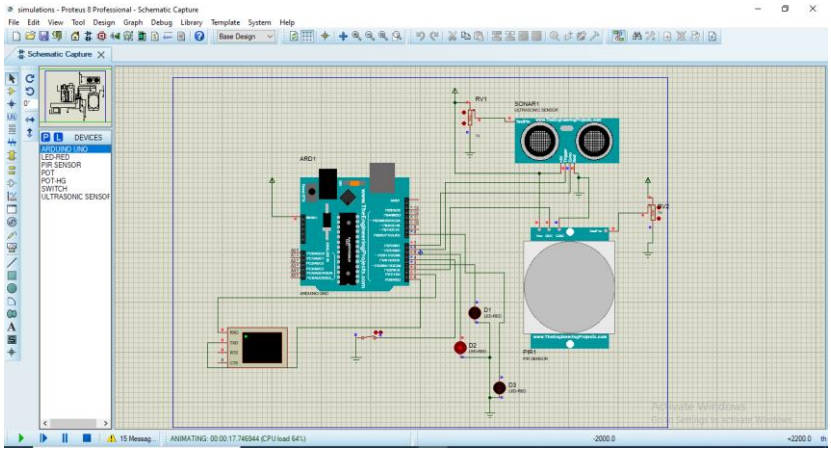

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Fig. 3 working of gun controller

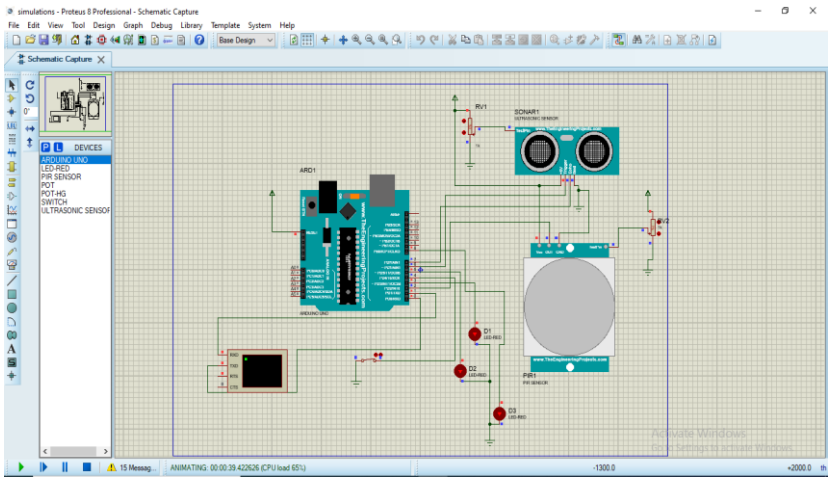

Fig. 4 Gun Controller, PIR Sensor, Ultrasonic Sensor in on Condition

Here Fig. 2 represents the circuit diagram for the working of Gun Controller, PIR sensor and Ultrasonic sensor. Fig3 shows the working of Gun Controller i.e. when the controller is active , the led in the simulation diagram turns ON (red) which means the trigger of the Gun is being operated. Fig4 shows the working of both the sensors along with the Gun controller when they are provided with the power supply. All three leds are turned ON i.e. turned into the RED.

VII. RISK INVOLVES IN USING OF DRONES

The uses of drones on a large scale contain a high risk. The main risk is that drone can fall from a great height, which may be due to:

1. Battery getting discharge.
2. Damage caused by weather conditions (low air temperature, precipitation).
3. Hitting to an obstacle (tree, building, high-voltage line).

These risks can be predicted; therefore the action should be taken to prevent their uprising. The battery status and other telemetry data, including temperature can be controlled remotely by the system. In case of exceeding the one of the case the alarm should be start. This will allow take the action, such as emergency recall the drone to a branch or base. However, the sensors and software that based on the flight path and on the detected obstacles should continuously update the route which will be responsible for the avoidance of all the obstacles.

VIII. CONCLUSION

In this project, a border surveillance application using quadcopter as a tool for the proactive and reactive response to failures and intrusions, to improve the quality of detection and tracking of intruders crossing a border supervised by a wireless sensor network will be implemented.

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Quadcopter is a kind of vehicle, which can be used for different applications. This paper represents the basic principles for quadcopter design as well as for current applications. In the future, quadcopter could be used for a variety of new applications such as safety inspections, perimeter patrols around prisons and thermal imaging to check for cannabis being grown confidentially and which are not easy to access their location. In addition to this, for detecting theft from cash machines, for railway monitoring, combat fly-posting as well as fly-tipping. Drones can also be used for abandoned vehicles and waste management. Do not intend to develop a perfect detection and firing mechanism but only research about possible economically feasible ways to combat these problems on borders. Such methods may be pursued and used for further research to prove their real case implementation.

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