Integrated Mobile ATV Drone with Gesture Control

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***Abstract*:- This article shows integrated mobile Drone using Gesture Control. First, we discussed the overall construction of Drone which consists of main elements like newly designed frame, motors, propellers, system of electronics for control and the communication system. A Drone's basic operation is to fly in the air but many environmental circumstances, poor connection or accidents restrict them from their main motive. A Drone will give the drone multifunctional access to whichever area it wants to enter. The Motor Controlled Drones are used in large scale in the videography and photography sector. Their reliability and mode of control makes it harder to enter the public services sector (like fire brigades, border guards, police or quick response teams). The gesture control system will allow controlling the Drone through various gestures operated by a hand controller glove which will ease the use and will provide better mobility of the controller [1]. Currently a lot of projects related to gesture-controlled drones are conducted using different communication systems and sensors. In this study, we present our newly designed drone which can operate on land and in air by flipping the propellers. This drone will be integrated with a motion controller to operate it via simple human gestures [2]. The Hand-Controller will consist of Arduino Uno and accelerometer. Xbee communication modules will be used for drone controllers [3]. Python programming language is used to communicate with the drone. The purpose of this work is to innovate and ease the use of drones. This project will lead to a unique controller for a drone and will prove to be useful in multiple fields. The main objective of this project is to make a controller for drones which is easy to use and will not require a skilled operator. This will make the process of controlling the drone very easy as it will be controlled by the motion of your hand. The controller will be a system of sensor's which will completely control the motion and operation of the drone.**

Keywords: Lilypad Arduino328; Xbee Communication;

1. INTRODUCTION

Drones, which consist of major 2-types, ATVs or UAVs are used on a large scale in professional, industrial and commercial level. These drones specialize in performing multiple functionalities like data collection, image capturing, location sensing, infiltration. Mostly drones are controlled by controllers of hand-held devices. The commands are sent through wireless channels such as Bluetooth or Wi-Fi modules. Drone is controlled distantly by radio waves or self-governing (with a foreordained course). Majorly, drones are controlled via Autopilot or APM's which act as a brain of the drone. A critical favourable position is the amazingly short response time with regards to charging and setting up the unit for a flight. This gestured-controlled quadcopter system will be compact and lightweight, offering greater mobility and ease-of-use over joystick-based system [4]. We hope that our system's simple, intuitive design will allow a user to learn how to pilot it in less than an hour.

The ATVs are multi-terrain drones which can be utilized basically in the formally dressed administrations - the military and the police. This work presents an attempt to add new control dimensions to the above cases by allowing more degrees of freedom (DOF) for controlling the drone [5]. Using gestures, the user can control the drone with their hand instead of conventional remote controls, as the hand gestures can be translated to digital commands by the sensor. Hence the sensor and the communication device would be the key piece to solving this part. In our research we found that the earlier projects failed to deliver lower latency and had data transmission problems. Also, the gyroscope used were causing a lot of noise [3]. This caused software-based interrupts in the communication between the Drone and the controller which impact greatly on its purpose. To eliminate these problems, we have come up with a solution which is discussed further.
This work can be divided into two parts:

- The closed loop control of the drone for agile and controllable maneuvers.
- A framework that translates the hand gestures into drone trajectories.
  >Drawbacks of existing methods: -

- Need to carry a heavy controller.
- Needs a skilled operator.
- High latency problems
- Data loss in Transmission

2.METHODOLOGY

2.1 Basic frame design: The material for the Chassis or Body Frame used in this project is A-level Acrylic sheet shown in Fig 1. The sheet provides Abrasion Resistant (AR1, AR2) and Non-Glare properties. It has the following properties: -

Table 1. A-level Acrylic sheet properties

Properties	unit	value
Tensile Strength	psi	10,000
Heat Deflection Temperature@264psi	^{0}F	195
Light Transmittance	%	92

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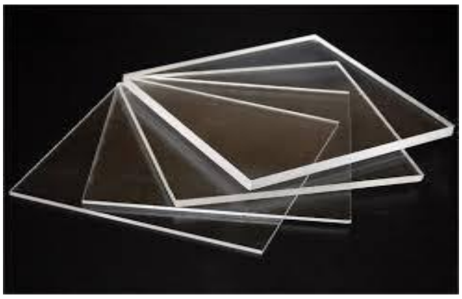

Fig.1 Acrylic Sheet

2.2 Brushless DC motor: To operate the Quadcopter high speed and reliable engines are needed for rapid response. As while operating in mid-air any engine failure can be devastating to the ATV drone as well as the people. Also, the motors should produce sufficient power to lift the drone and manipulate it. The motors must be vibration free for a stable flight. Hence brushless DC motors are used as they fulfil the requirements and are also necessary for ESC to locate the position of coils/stator. A brushless ESC control converts DC power source to a 3-phase Ac power output which is sent by the AC signals generated by the Esc's circuitry. Here the 3 wires of ESC are utilized and any 2 are energized at a time.

2.3 ESC: ESC is meant as Electronic Speed Control in an electronic circuit. It is used to change or manipulate the speed of electric motor, direction and apply dynamic brakes. It performs throttle in the drone terminology.
It consists the following components: -

- Positive Terminal
- Negative Terminal
- Servo Signal
- GND reference of PWM signal
- Solder pads and Solder jumpers

2.4 LiPo Battery: Lithium Polymer batteries are widely popular due to high output values, compact and lightweight design. Various reasons like lack of metal plate, no rigid plastic case makes it possible to construct a battery with a variety of shapes. This factor makes it favourable for ATV Drones.

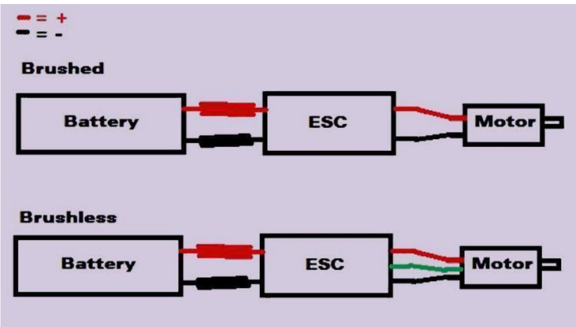

Fig 2. Connections of battery, ESC & motor.

2.5 Arduino Uno Shield: Arduino Uno containing ATmega328P is one of the most popular microcontroller boards. It has 14 computerized pins (6 for PWM) which can provide all needed pins for the ATV drone. It runs on Arduino software (IDE) where we can use C, C++ and python language programming. A shield is added on Arduino to support the Xbee Communication device which will transmit radio waves.

Fig 3. Arduino Uno and Xbee Shield

2.6 Xbee Communication module: Digi International produces Xbee modules which are used for radio communication widely. They have a wide variety based on frequency transmitted and maximum range possible. It generally has 2.4 Ghz transfer speed. They contain 2 modes of operation i.e. AT command mode and API mode also, the software makes the interface and configuration of modules easy but most importantly Xbee modules are famous for low latency which is our primary target.

2.7 Accelerometer: To input the gestures in the form of signals into the Arduino, an Accelerometer is used. We are using a 9-DOF accelerometer i.e. is MPU-9250 which provides a 3-pivot gyroscope, 3-hub accelerometer, 3-hub magnetometer and a Digital Motion Processor. It uses I^{2}C bus which provides an advantage over the other accelerometer and hence helps in reducing the software interrupts. For precision tracking of both fast and slow motions, the parts feature a user-programmable gyroscope with range ±250, ±500, ±1000, and ±2000°/sec (dps).

2.8 Flex Sensor: A low Resistance Flex Sensor FS-L-0055 is used to perform additional gestures where the fingers are bend in 90$^{0.}$ Flex Sensor is a sensor whose resistance changes after bending. It consists of 2 terminals (+ve & GND). Operating voltage: 0-5V, Bend Resistance range: 45k-125k Ohms, Resistance Tolerance: ±30%.

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3.DESIGN AND CIRCUIT

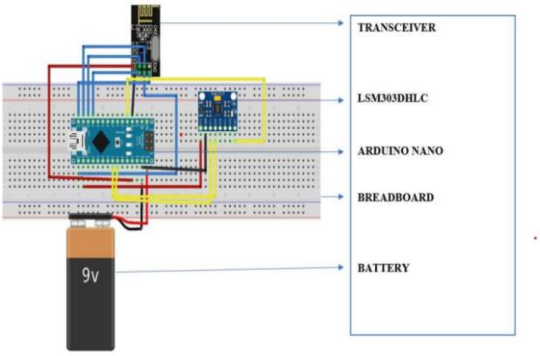

Fig 4. Electric Circuit

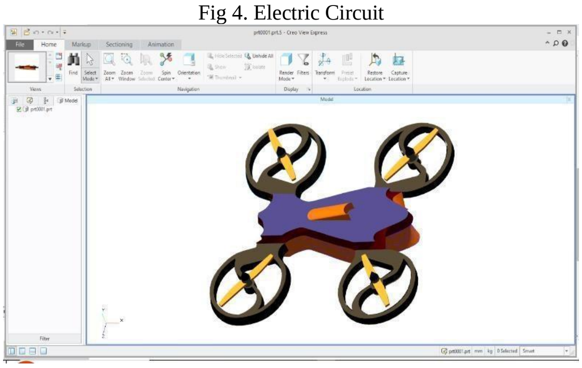

Fig 5. CAD model of Drone

Fig 6: shows the hand controller used for the program. This control system includes the embedded system where all the desired sensors and pic are burned in. The flow of work is as follows: 1. The sensors like accelerometer, gyroscope and IR are embedded in the system. 2. Pic is connected to the Arduino Nano 3.0 and programmed through ATMEGA328 through a breadboard. 3. Then those PIC's are burned in the system with desired drone program. In this trial we were unable to achieve the gestures in Y axis. So, we used an IR sensor which operates through an external switch. When the switch is pressed the drone starts moving in Yaxis until the switch is pressed again. Once locked in the Y-axis the gyroscope helps us to achieve other gestures. This trial was finalised accordingly.

Fig 7 actual drone used.

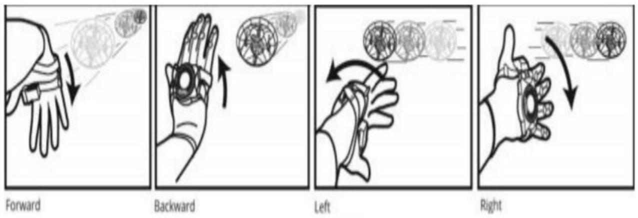

Fig 8. Shows us the basic gestures that a drone uses for its flight. The flight and landing it uses an IR sensor which needs to be manipulated through a separate switch on the controller.

4.LIST OF COMPONENTS USED IN PROJECT

Table 2. List of Components

Component	Qty	Model
Microcontroller	1	PIC using arduino mini 3.0
Battery	2	Lithium polymer
	1	Button cells
Accelerometer	1	MPU-9050
Motor	4	Brushless DC
Rotors	4	
ESC	4	
Shield	2	Arduino shield
Xbee Module	2	

5. RESULTS AND DISCUSSION

The gestures captured are relayed and translated into drone motion. These gestures relayed are converted into linear and angular displacements and stored in an array which translates the said gestures to practical motion and thereby giving us the desired output.

- Estimations based on hand positions are done and direction is sensed for displacement.
- Hand Gestures are defined.
- Different values of pitch, yaw and roll are calculated which are later converted from radians to degrees.

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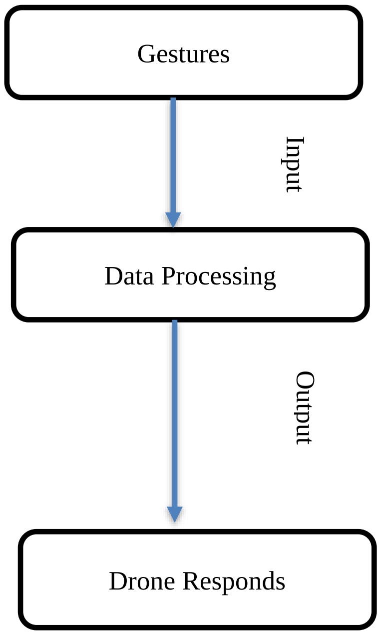

Fig.9 Sequence of Operations

6. SOFTWARE ANALYSIS

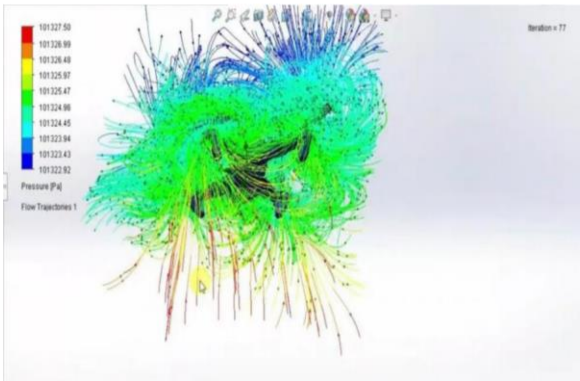

Fig 10. Flow Trajectory 1

Shows the flow of air trajectory 1 that is Z-axis. The design was appropriate considering the drone calculations and as seen all the pressure values are within the permissible range.

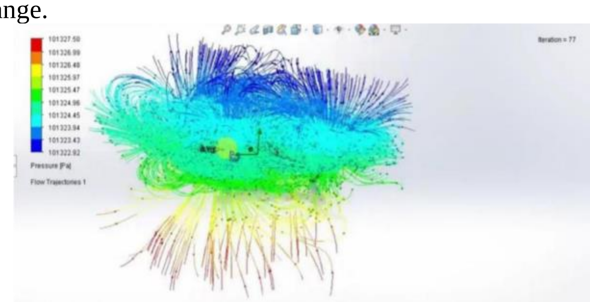

Fig 11. Flow Trajectory 2

Fig 11 shows the flow trajectory for X-axis and all the parameters are satisfied.

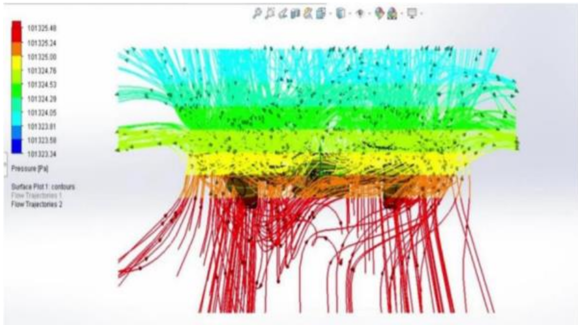

Fig 12 Flow Trajectory 3

Fig 12 shows the flow trajectory in Y-axis and as seen the pressure required against gravity is more but the flow of air in a suitable direction. Hence, this model satisfies the Design parameters of the drone.

6. CONCLUSION

This project has variable aspects in which it can be used. It can be used in civil and military work, it can be used on borders to monitor ambiguous areas, helping in ensuring safety of soldiers in difficult situations as well.

We have effectively made a framework that can precisely arrange the hand development and use them to fly the robot. The moves are gesture controlled so the expectation to absorb information is good and the sensor can control the robot right away. With this new controlling method rather than the customary conventional (controllers) a greater scope of innovation is put forward. Later on, we plan to ceaselessly improve the model via preparing it in various aspects.

Right now, our situation has just been on working for technical aspects, this implies that for testing including at open air areas, we needed to carry our PC to run our framework. This is clearly not the most advantageous thing, and as a final result we would not have any desire to deliver it thusly. To make our framework versatile and a helpful as could be expected under the circumstances, we need to port it to cell phones. This implies that we would keep a similar accurate usefulness, yet all in the palm of your hand.

7. FUTURE SCOPE

The project application can be expanded further depending upon usage, these could also be used in underground inspections of piping systems which will definitely reduce the risk involved in the same. An ATV with an equipped thermal sensing camera could fly the whole length of the pipeline while filming and thereby helping monitor real time footage.

This project may also be used for applications other than surveillance, for example in the agriculture industry this could bring a revolution by providing real time data that is gathered and processed and would result in helping the farmers in many ways. Drones can be used in many ways such as crop spraying, soil and field analysis, irrigation, insecticide or pesticide distribution, crop monitoring and crop health assessment, which definitely would help result in a higher yield productivity and in some unfortunate tragic cases, it could help farmers serve as evidence for insurance claims.

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