GUI Controlled Aerial Drone

Kartik Panicker, Vaibhav Murkute, Deepak Padhi, Akash Narkhede

Abstract— The aim of this project is to create a flying machine that is capable of obeying users commands through a dedicated and customized environment that user uses to simulate and control the flying machine. It also empowers the user to guide the machine through difficult terrains and altitudes and perform reconnaissance and ambush operations. Basically a robust framed flying engine that possess high end futuristic adaptations to the existing frame to strengthen the military's tactile stance on enemies. To develop an aerial drone capable of performing advanced flight tactics and wireless control through an interface made in MATLAB GUI. The project shall be known for its user customized control environment and remote data surveillance similar to reconnaissance operations led by the military forces.

Index Terms— Closed loop system, Graphical User Interface (GUI), Hardware programming, Microcontrollers, Quadcopter sensors.

I. INTRODUCTION

The project concerns about development of an aerial drone capable of being controlled with the help of a Graphical User Interface provided as a side packet installment in MATLAB software as well as using LABVIEW which is a visual programming language that controls the data stream flow. This ensures creation of a dedicated, user customized software for flying the drone by sitting remotely and operating in a standalone PC or laptop. The main body of aerial drone has a microcontroller which is responsible for generating control signals according to the user desired flight position information provided by the GUI. The body also possess wireless control system and a controller unit to manage power supply and generation of three phase current signals for the rotors. A closed loop system has also been employed to ensure robustness and stability of the drone at high altitude and unpredictable and unforbidable circumstances which ensures sturdy and certain flight position. Moreover future adaptations also concerns about development of a wireless camera whose live streaming can be witnessed by the user on a remote laptop by the concept of virtual terminal.

II. PAST ROBOTICS DEVELOPMENT ON SIMILAR GROUNDS AND IMPROVEMENT IN DESIGN

US Defense forces have a research and development wing named as DARPA. In recent years world has witnessed

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remarkable achievements in the field of robotics dedicated for defense forces which ensure the tactile strength of the forces also reinforcing the military might. DARPA has been one such institution. Hence it has been our endeavor being engineering graduates to build an aerial drone that is capable of reinforcing the military might of the very country, many folds. So we are developing this drone to make it agile, stealthy good enough for leading an ambush operation on enemy targets, where casualty of the INDIAN ARMY has to be kept minimum and reaching difficult terrains and altitudes to take tactile decisions towards enemy's stances. This is the main aim, to make the opponent feel our presence as formidable. A prebuilt model of similar structure was being made, but it implemented open loop system wherein the user cannot control the flying drone, rather he/she can make it trigger to an oncoming target. This was a very crucial step where we are planning to give it a closed loop system in MATLAB GUI such that every motion of the drone rests with the user.

III. RESOURCES USED

Hardware components used in this project are as following:

A. ARDUINO UNO

The Arduino Uno is a microcontroller board based on the ATmega328.It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller.

Figure 1. Arduino Microcontroller Board

1. .Electronic Speed Control Units (ESC)

It is an intermediator circuit responsible for driving high RPM BLDC motors. It takes PWM input from the microcontroller and replicates the same at the other end with distorted phases in 120 degrees so as to empower a three phase BLDC motor. Meanwhile it changes the frequency

from 500Hz to 3-5KHz.It also has an inbuilt battery eliminator circuit to supply onboard components.

Figure 2. Electronic Speed Controller (ESC)

2. Brushless DC Motors (BLDC)

Brushless DC electric motor (BLDC motors) also known as electronically commutated motors (ECMs, EC motors) are synchronous motors that are powered by a DC electric source via an integrated inverter/switching power supply, which produces an AC electric signal to drive the motor.

3. Li-Po Battery

The Lithium polymer battery is responsible for powering up the 13000RPM BLDC motors with 5A current and 11.1 V supply.

4. XBEE 2.4GHz Wireless Modem

XBEE is a wireless modem by DIGI, under ZIGBEE 802.15.4 protocol to communicate between two wireless radios. It works on 2.4 GHz carrier frequency. It adopts Frequency Hopping Spread Spectrum technique (FHSS).
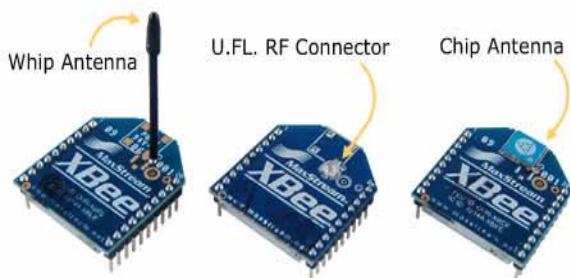

Figure 3. XBee Modules

5. USB Adapter for ZigBee

These are USB to FTDI convertor boards with Headers for ZigBee's basement. It also has pins fabricated for Breadboard mounting purposes.

6. IMU GY-80

It is a multi-sensor board. It has:
-Gyroscope
- Accelerometer
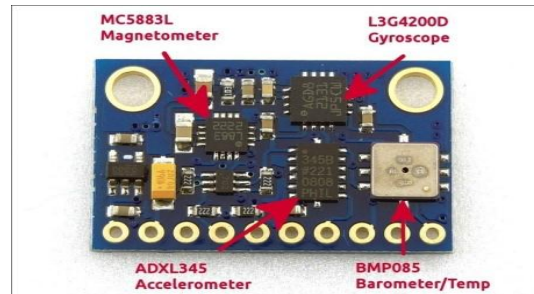- Barometer
- Magnetometer
- Temperature Sensor

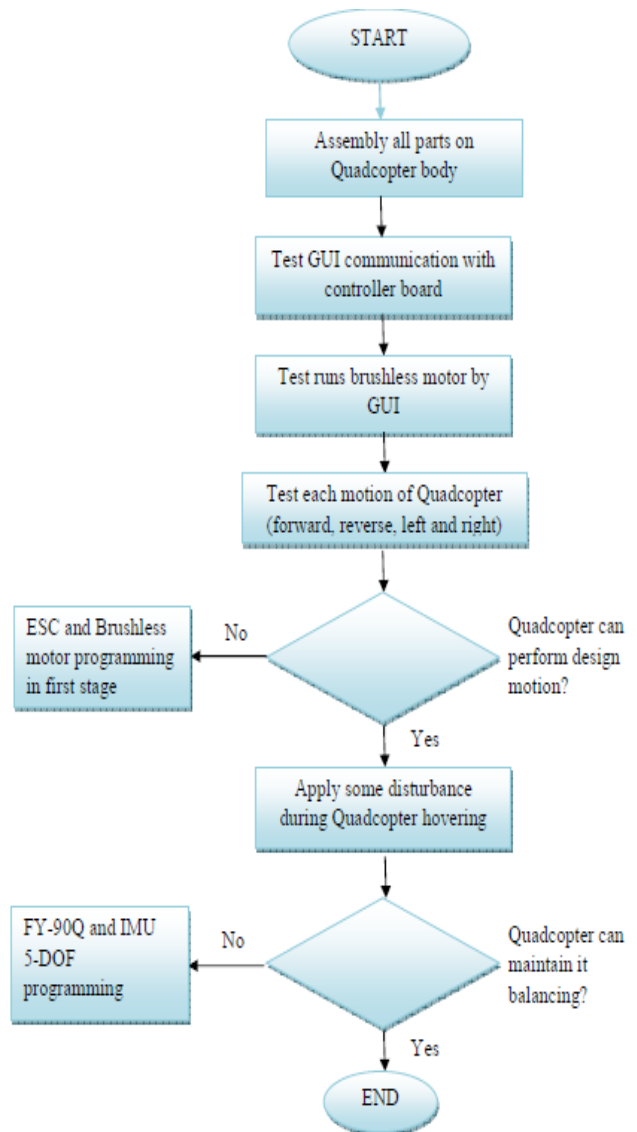Figure 3. IMU GY-80 Board

IV. HARDWARE IMPLEMENTATION

Figure 4. Flow chart of Quadcopter design.

We can use IMU-GY80 multi-sensor board in place of FY-90Q controller for gathering stability related sensor-data for a quadcopter and flight-control stabilization.

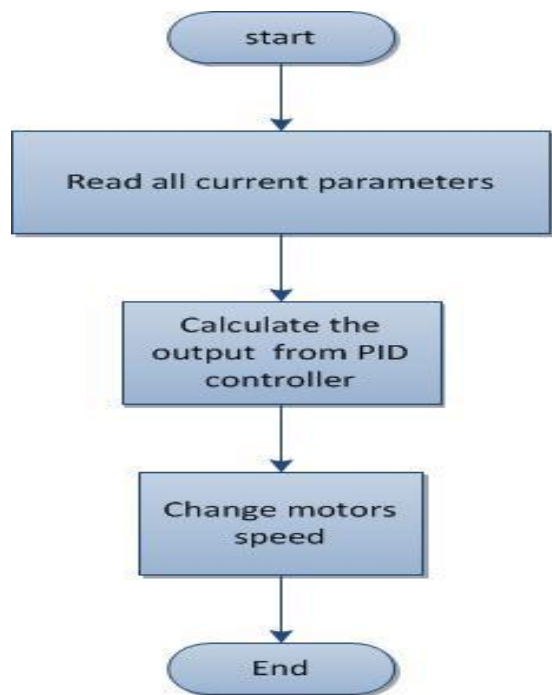Flight-Control procedure for a quadcopter can be well understood by the following flow diagram:

Figure 5. Flight control procedure
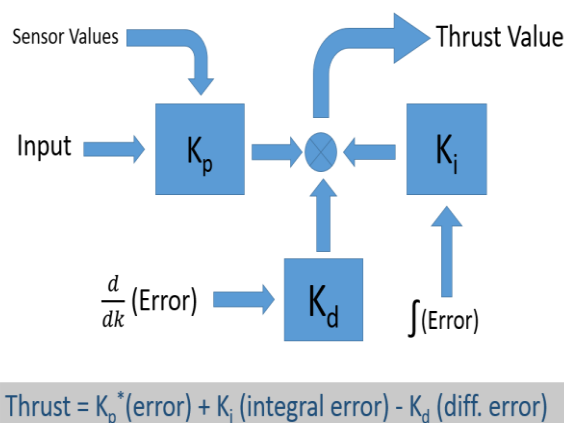

Figure 6. PID control system

Various Sensors in IMU GY-80 board read the current status of quadcopter's position and alignment in air and those sensor values are operated for quadcopter's stability by the PID controller.

V. SOFTWARE IMPLEMENTATION

MATLAB stands for mathematical laboratory which is powerful tool for making GUIs and doing calculations.

Every BLDC motor is connected to an ESC. AN ESC stands for electronic speed control unit that gives 3 phase PWM signals to the BLDC motors to control the rotation of the motor.

This output PWM can be controlled using 50Hz pulse signal. It expects 5 to 10% duty cycles that dictates output throttle from the min to max. Input throttle thus must be having T_{ON} of 100usec and 200usec marks the maximum throttle. Thus a GUI is made in a MATLAB and Arduino is linked with MATLAB as a software controlled slave. Thus, any action performed in MATLAB can be completely replicated in Arduino. And this entire procedure is made wireless. Now, the GUI is responsible for initializing the BLDC value and linking them to the Arduino board. Also, after this, there are 4 scroll bar that may values between 1000 to 2000. Thus each motor is allocated a scroll bar. Apart from this individual push button switches are employed to manipulate thrusts in each motor distinctly. In Arduino's server program, the program checks for input values (command signals from the user) if available, the action is taken accordingly. Also, then each angle value from the user is tallied with the sensor. Thus, a closed loop PID control system has been established that governs the positioning of the motor in 3-D space. Also, PID is responsible for manipulating and alerting the quadcopter's stances against any unwanted external disturbances.

Thrust = K_p*(error) + K_i (integral error) – K_d (diff. error).

VI. CONCLUSION

We have implemented a quadcopter that can be distantly controlled by a User Interface interactive program. The intention is to build a GUI and give command signals to the Arduino that will be in command of the quadcopter. A PS2 controller (Gamepad) can also be used to implement the control feature to directly maneuver the quadcopter. The on screen measure is directly translated into values that refer to angle information. Any sort of disturbances are tackled in the PID to smoothen the movement and stay adamant to external disturbances. This way any remote user can log into the PC and run the code in the host and run the quadcopter to different places. Of course a visual feedback will be provided to have direct sight. FPV 5.8GHz is used for the same.

ACKNOWLEDGEMENT

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