Design and Implementation of Voice and Motion controlled Autonomous Drone

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Abstract-*Voice and Motion controlled Autonomous Drone controlled by Radio frequency communication. The purpose of this project to explore the available technologies to control drones and distinctive means in which they are used to support enhanced voice command and control of drones. Voice command and Motion Sensor Data are mapped to both significantly increase the Human and drone interface. Algorithm written inside flight controller allows to receive voice command and motion sensor data through Radio Receiver and concerted to achieve an aim or deal with respective command. This project is broken in to 2 task: Implementation of Voice Recognition and Motion detection and Design of Autonomous Drone.*

Keywords-Natural language command(NLC), inertial measurement unit(IMU), Kalman filter.

I. INTRODUCTION

Drones are becoming progressively ubiquitous, natural language command(NLC)is making it more and more areas of everyday life. Drones have been successfully deployed by Army, Navy and Marine units in safety and security because of its Fully autonomous features like position hold, path tracking, Surveying & Mapping, Aerial imaging.

Combination of natural language command i.e. voice recognition and motion control combination makes control on drone more effectively. Voice recognition is the proficiency of a machine or program to receive and perform dictation, or to understand and carry out spoken natural commands. Motion detection capability of sensors can be used reliably to determine movement of body with reference.

II. MOTION DETECTION

In this section by using accelerometer and gyroscope data fusion, hand motion is detected in the form of angle and direction of rotation.

A) IMU Sensor capabilities

The IMU sensor is a predominantly designed to measure linear acceleration and tilt rate. In this project IMU6050 sensor is used which having 3-axis gyroscope and a 3-axis accelerometer on the same silicon die with an onboard Digital Motion Processor(DMP) which processes. IMU6050 performs accelerometer and gyroscope data fusion using 6-axis complex Motion Fusion algorithms. User programmable range for accelerometer and gyroscope is ±2g, ±4g, ±8g, and ±16g and ±250, ±500, ±1000, and ±2000 °/sec (dps) respectively.

B) Data Acquisition

In this section Raw data from IMU sensor is obtained and data is filtered using kalman filter and filtered data is transmitted using RF device. Interfacing of IMU sensor with microcontroller is shown in Fig. 1.

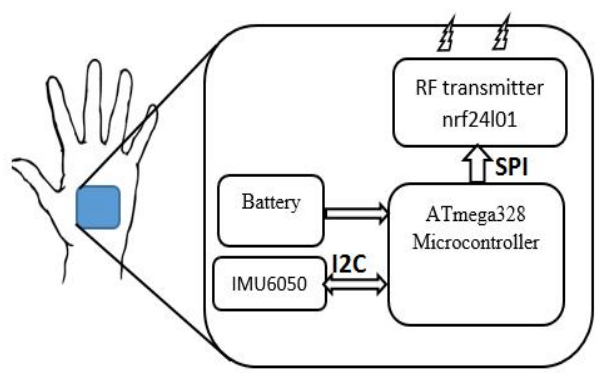

Fig. 1. Block diagram of IMU sensor interfacing with microcontroller.

IMU sensor having 16-bit accurate analog to digital conversion(ADC) hardware for each channel and therefore it uses I2C bus to communicate with microcontroller. IMU sensor used as slave with ATmega328 which is ultra-low power and execute 20 MIPS at 20 MHz.IMU sensor connected with atmega328 and RF transmitter is fixed on hand with 1000mAh single cell li-po battery of 3.7 Volt provide ten hours' backup. When power is on IMU start calibrating with hand position as reference. Calibration will take five seconds.

After five Seconds sensor start to giving data to microcontroller and main program in controller is start executing. By tilting hand in X and Y direction drone also flying in front, back, left and right direction.

Fig. 2. Shows an angular rotation is zero and Drone is parallel to ground plane after power on angular rotation is zero and Drone is parallel to ground plane. Green and Red line in graph shows there is zero degree of hand orientation in X and Y plane.

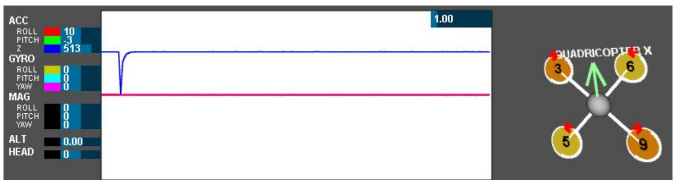

Fig. 2. 0^0 degree of Hand orientation in X and Y plane.

In Fig. 3. Green line graph shows that when hand is tilted in X plane by 45-degree drone is also tilted in X plane and red line indicate zero degree of orientation in Y plane so drone flays in forward Direction.

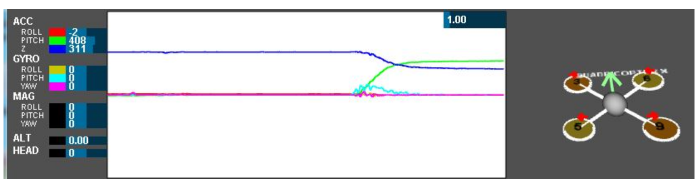

Fig. 3. 45^0 degree of Hand orientation in X plane and 0^0 in Y plane.

By tilting hand in X and Y plane drone can be controlled in four directions. The nRF24L01 chip of NORDIC Corporation is employed as the RF transmitter module interfaced with microcontroller to transmit IMU mapped data to ground station.

III. VOICE RECOGNITION

In this section,smartphone app used to recognize voice. Smart phone having amazing capability to interpret our utterances as text and also it can transmit recognized voice command as text over Wi-Fi, Bluetooth or even now cloud also. In this project Google speech recognizer is used and converted text is transmitted over Bluetooth to ground station. Fig4. Shows voice recognition by using smart phone.

Fig. 4. Voice Recognition

IV. GROUND STATION

Fig. 5. Shows that RF module fixed on hand transmit motion sensing data to ground station. RF module used as transceiver in Ground station. RF module used in motion detection having fixed address. RF module interfaced with atmega328 in ground station which receive data from RF module used in Motion detection. At the time of receiving data microcontroller checks the address of RF module to increase security and avoid data from other external RF module. Bluetooth module interfaced with microcontroller using UART protocol to receive voice command from smart phone.

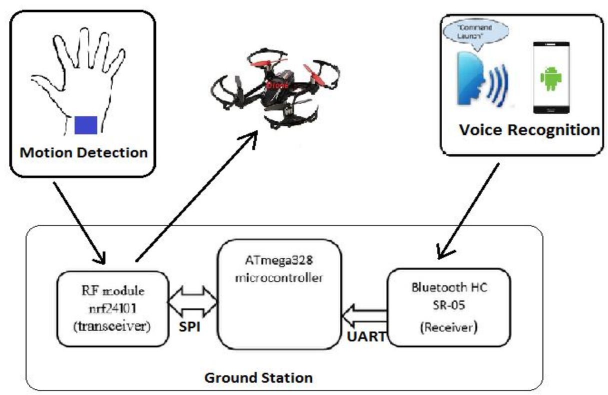

Fig. 5. Block diagram of Ground station

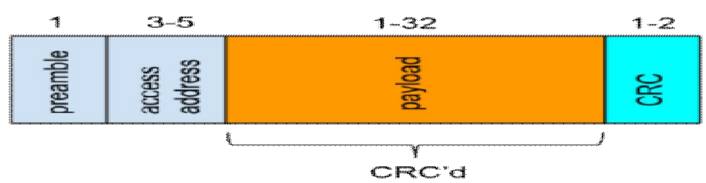

Fig. 6. nrf24 Shock Bust frame format

Ground station convert received voice command and motion sensor data to data packets format. Packets are transmitted through RF module. Fig. 6. Shows nRF24 Shock Bust packet structure.

- 1 byte of preamble
- 3-5 byte of access address
- Variable size of payload from 1-32 bytes
- 2 byte of CRC

V. DESIGN OF AUTONOMOUS DRONE

Over the past ten year, technology world looking for how to transform the manual control of Drone to Automated. Drones are controlled manually by changing input PWM signal of each actuators. while controlling manually human errors may cause problem in application field like safety and security, threat comes from sources like terrorism and other illegal activities.

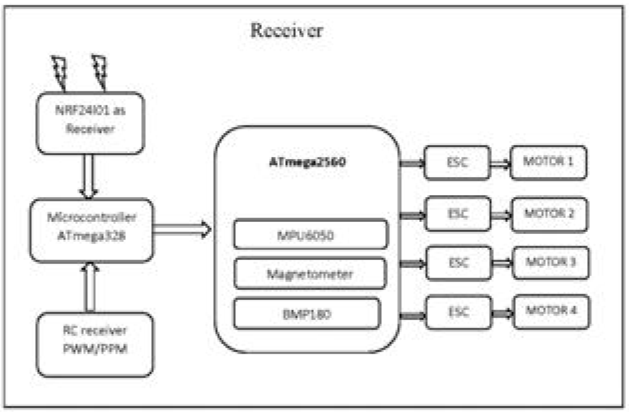

Fig. 7. Shows block diagram of Design and implementation of Drone.

Whole drone system is controlled by ATmega2560 microcontroller with co-controller ATmega328. RF module nrf24l01 is used as receiver for packets from ground station. RC receiver receives PWM or PPM signal from RC remote for manual controlling. MPU6050 sensor along with magnetometer and pressure sensor BMP180 form the ten degree of freedom system (10 DOF). Output of 10 DOF sensors input for ATmega2560 through I2C protocol. ATmega2560 with 10DOF form flight controller which gives position and direction feedback in form PWM to four actuators.

VI. CONCLUSION

Natural language like voice and hand motion make the improvement in controlling Drone. This paper represent implementation of voice and motion operated drone with help of smart phone and combination of accelerometers and gyroscopes. Future work will attention to ameliorate range of transmitter and filtering IMU data.

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