International Journal of Scientific Engineering and Research (IJSER)
ISSN (Online): 2347-3878
Index Copernicus Value (2015): 62.86 | Impact Factor (2015): 3.791

Brain Wave Controlled Drone

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Abstract: ***Imagine a future where we can move anything with just our mind. The brain communicates through electrical signals and this is what allows us to interface the brain to electronic devices. Every movement of an individual is activated by the neurons in the brain. With the right tools and recent advancements in both brain imaging technologies and cognitive neuroscience, it is possible to read and record these processes .This has led to the rapidly growing field of brain computer interfaces (BCI). BCIs are systems that can bypass standard channels of communication (i.e., muscles and thoughts) to provide undeviated communication and control between the human brain and physical devices by interpreting different patterns of brain activity into commands in real time. The BCI even helps unblessed people to make use of devices and applications through their mental activities. People who are suffering from paralysis can communicate with the help of these new innovations. Stephen Hawkings is a famous example who uses Swift key's language model/predictive technology which let others to understand about him. In this paper we are building cost effective drone and the main concept of this, is to let anyone hover the drone with his/her concentration or meditation level. The drone can be used from small applications in sports like drone racing up to large applications like military warfare. It works on the concept of Electroencephalogram (EEG). EEG is basically a procedure which is used to track and records brain wave patterns. The EEG signals are captured from user's brain activity using EEG sensor which is placed on the user's forehead. The hovering of drone is then decided based upon the process signal.***

Keywords: Brain Computer Interface, Neuromuscular disorder, Electroencephalogram, Brain Sensor, Stephen Hawkings

1. Introduction

The human brain is made up of billions of interconnected neurons, the patterns of interaction between these neurons are represented as thoughts and emotional states. Every interaction between neurons creates an electrical discharge. However, the activity generated by hundreds of thousands concurrent discharges aggregates into waves which can be measured. Different brain states are the result of different patterns of neural interaction creating different signals of different amplitude and frequencies such as Alpha (7.5-12.5Hz), Beta (12.5-30Hz), Gamma Waves (40-100Hz), Theta (4-7Hz) and Delta waves (1-4Hz). [1] Beta Waves are associated with concentration whereas when a person relaxes it results in the formation of Alpha waves. Here a drone is controlled automatically according to the brain signal. [2] The brain signals are collected using a brain wave sensor [3]. Using these signals it is possible to lift the drone in air. The brain wave sensor consists of three main parts. They are dry electrodes, signal conditioning circuit and inbuilt Bluetooth Transmitter. Dry electrodes are used to absorb the brain waves. This signal is analog in nature. For further processing these analog signals should be converted to digital form. Signal conditioning stage will do this conversion. The Bluetooth transmitter converts this digital signal into packet of data and is transmitted to drone. Attention (concentration) of user above threshold value is used to lift the drone.

2. Methodology

The user firstly wears the Brain Sensor Head-set. This head-set basically sense the brain signals. It consists of an electrode positioned in frontal position of the user's scalp. The electric activities of brain are sensed by the electrode and the corresponding values are recorded. The brain waves are firstly collected from 'Brain Wave Sensor Head-set' which are analog in nature. So, the analog signals are converted to digital signals using signal conditioning circuit .These signals are mapped at a rate of 512 SPS (samples per second). [5], [6]. The recorded values are then transmitted via Bluetooth and thus make the drone lift from the surface. The signals are transmitted by inbuilt Bluetooth module connected to the Microcontroller. The Microcontroller process the signal and forward the signal to ESC (Electronic Speed Controller) which thus moves the brushless motors according to programming and lift up the drone.

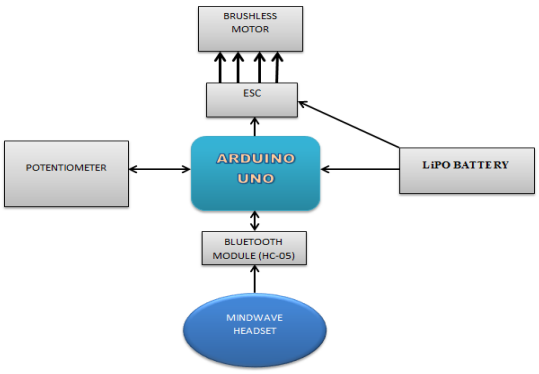

Figure 1: Block Diagram Neural Controlled Drone

3. Brain Computer Interface System

Figure (2) shows the detection of brain waves by brain wave sensor and transmission of raw data in the form of Bluetooth packets [4].

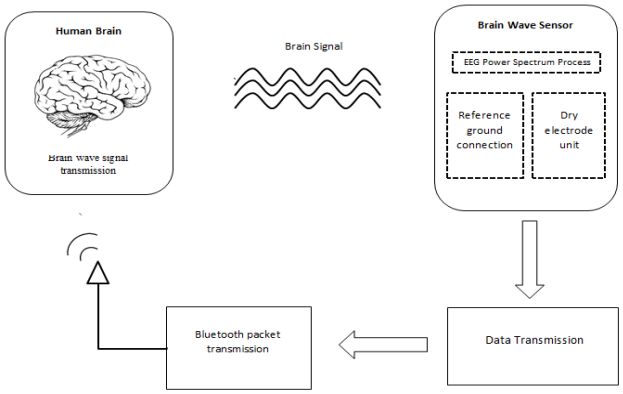

Figure 2: Block Diagram Brain Interface System

4. Hardware Module

4.1 Bluetooth Module

It is a class-2 Bluetooth module having serial port profile, which can configure as either master or slave. A drop in replacement for wired serial port connection, transparent usage. We can use it simply for a serial replacement connection between MCU, PC and to our embedded project etc.

Specification

1) Bluetooth protocol: Bluetooth specification v3.0+EDR.
2) Frequency: 2.4 GHz, 15M band.
3) Modulation: GFSK (Gaussian frequency shift keying).
4) Emission power < 5dBm.
5) Profiles: Bluetooth serial port.
6) Power Supply +5VDC 50mA.

4.2 Brain Sensor

Brain wave sensor safely measures and outputs the EEG power spectrums (alpha waves, beta waves, etc.). It senses attention, meditation and eye blinks. The device consists of a headset, an ear-clip, and a sensor arm. The headset's reference and ground electrodes are on the ear clip and the EEG electrode is on the sensor arm, resting on the forehead above the eye (FP1 position).

4.3 ATMEL Microcontroller (8 BIT)

The Microcontroller used here is ATmega328P. It uses low power has high performance and feature 128Kb self-programming flash programming memory. It features 44 pin package. Specification also include 8KB SRAM, 2048- Byte EEPROM, external bus interface, 4-channel DMA controller, 8-channel event system, and up to 32 MIPS throughput at 32MHz .

4.4 ESC (Electronic Speed Controller)

An electronic speed control or ESC is an electronic circuit with the purpose to vary an electric motor's speed, its direction and possibly also to act as a dynamic brake. Here the ESC provides 3 phase ac supply to the brushless motors.

4.5 Brushless Motors

Brushless DC electric motor (BLDC motors, BL motors) also known as electronically commutated motors (ECMs) are synchronous motors powered by DC electricity via a witching power supply which produces a bi-directional electric current to drive each phase of the motor via a closed loop controller. The brushless motor used here has rating of 2300kV.

4.6 Battery

Lithium polymer battery is used to power the drone. The specifications of battery are;

• Capacity: 1800mAh
• Voltage: 11.1V
• No. of Cells: 3

5. Software Module

The open source Arduino software (IDE) makes it easy to write code and upload it to the board. It runs on windows, Mac OS X, and Linux. The environment is written in java and based on processing and other open source software.

6. Applications

6.1 Virtual Reality

Virtual Reality is the latest innovative technology. Controlling the drone with mind can be used in virtual reality and provide a feeling to the user that he/she is present at that particular place.

6.2 Video Games

Video games have started to use EEG technology, equipping gamers with sleek headsets that claim to read the gamer's mind and translate their thoughts into machine-readable instructions. Gamers can use their minds to drive a virtual car and create musically-inspired brain-wave art.

6.3 Search and Rescue

In search and rescue operations the drones can be controlled with mind and monitor the affected area. When firefighting, for example, you can determine the proportion of particular gas present using sophisticated measuring equipment and react appropriately.

6.4 Drone Racing

Drones are controlled with the thoughts of user and racing competitions can be arranged for entertainment purposes.

6.5 Inspections

The expenditure spent on inspection by sending employes at sites can be saved with a MC-Drone by inspecting Wind turbines, power lines, and pipelines. No need to engage an

external contractor.

6.6 Security

Protect the public with MC-Drone! Many authorities worldwide are already using our aerial platform e.g. to help coordinate security operation.

7. Conclusion

The Brain Computer Interface (BCI) helps people to make use of the devices and applications through their mental activities. Thus by brain computer interface (BCI) people can control anything like wheelchair, drones, robots etc. with their brain. The proposed system uses an EEG to overcome the previous challenges and to achieve higher accuracy and Stability.

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Author Profile

Himanshu Salhotra is currently doing B.E in Electronics and Communication from Model Institute of Engineering and Technology, Jammu. He is doing his major project on Brain Wave Controlled Drone.