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3D Printed Arm Using ThinkGear Technology

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Abstract— Electro Encephalo Gram (EEG) used prosthetic arm can help as a powerful support for severely disabled people in their regular activities, especially to aid them to move their arm voluntarily. The project aims to develop and engineer a prosthetic arm which will be controlled directly by human being's brainwaves. These brainwaves will be sensed by using EEG technology. To acquire EEG signal, several small and flat metal discs called electrodes are attached to the scalp. The signals detected by the scalp electrodes are amplified and then transmitted to arduino. The intelligence in this technology is to build an algorithm which will grasp the current activity of human brain and convert them into plan of actions which will be processed by the prosthetic arm. The scheme uses a single electrode pair acquisition scheme, microcontroller based prosthetic arm module. The key lies in the mapping of the EEG signal to the prosthetic arm to achieve the objective.

Index terms— Mindwave headset, ThinkGear technology, Servomotors, Bluetooth module HC-05, Arduino uno, 3D printing

I. INTRODUCTION

In India, there are about 5 million disabled people (in movement/motor functions). For disabled people with severe neuromuscular disorders such as brainstem stroke, brain or spinal cord injury, cerebral palsy, multiple sclerosis or amyotrophic lateral sclerosis (ALS), we must provide basic communication capabilities in order to give them the possibility to express themselves. One solution that has been developed over time: Brain Computer Interface (BCI) [3] systems. A BCI is a non-muscular communication channel that enables a person to send commands and messages to an automated system such as prosthesis, by means of his/her brain activity. Early prosthetics were simple. They were frequently only small digits that were immovable, or more famously, pegs and hooks. Later advances enabled the movement of the prosthesis, but they looked very different from a human hand. They were claws that would not have looked out of place on industrial robots. As technology advanced, the hands became more natural. However, they still required cables and harnesses to be attached to the working arm to pull them. Myoelectric prostheses were developed, providing more freedom of movement and more movement in general. However, myoelectric prostheses are very expensive. In addition, they rely upon the nerves of the arm to be undamaged. Myoelectric is useless if the nerves be damaged. But The electrical signals are be received at the source. By reading the electrical signals and brainwaves directly from the cranium, the major drawback of expensive myoelectric prostheses can be avoided entirely. However, reading of electrical signals directly from the brain requires multiple unwieldy electrodes to be placed on or in the brain. The most spread acquisition technique is EEG, and it represents a cheap and portable solution for acquisition. The EEG [1] technique assumes brainwaves recording by electrodes attached to the subject's scalp. EEG signals present low level amplitudes in the order of microvolts and frequency range from 1 Hz up to 100 Hz. Specific features are extracted and associated with different states of patient brain activity, and further with commands for developed applications. Using EEG one more drawback can be eliminated (i.e. dangerous surgery can be avoided for invasive method where electrodes are placed inside of brain called implants). The electrical waves will be sensed by the brain wave sensor (EEG headset) and it will convert the data into packets and transmit through Bluetooth medium. Receiver receives the data and it is processed by the micro-controller. Then the control commands will be transmitted to the robotic arm to process and perform the actions.

II. LITERATURE SURVEY

Ambroise Pare, in 1529 was the first person to have introduced prosthetics as lifesaving. It could give hope to the life of the disabled. In 1812, the Amputee community saw the first prosthetic arm to be operated by the muscles of the opposite shoulder. Here users must control their body into unnatural positions to trigger certain motions. In 1870s, scientists discovered motor cortex. They applied electricity to the brain of dogs which caused their limbs to move.

In 1924, Berger recorded human brain activity by means of EEG. In 1950s, EEG Headsets were introduced. At the University of Washington in 1969, monkeys were taught to move a dial using the nerve impulses recorded from their brains. It was the first brain-machine interface. Then in 1982, electrical firing of neurons in the motor cortex was shown to predict in which way a monkey's limb was moving. This discovery formed the basis for thought-controlled robots.

In 1998, doctors implanted a single electrode into the brain of a paralyzed person who could not speak. He then was able to select messages from a computer menu. In 2014, Ohio doctors launched an attempt to "reanimate" a paralyzed man's limb by means of thought control. His brain signals then activated the electrodes on his arm, which made it move.

III. PROPOSED METHOD

The scheme uses a single electrode pair acquisition scheme [2], microcontroller based prosthetic arm module. The proposed system consists of several distinct components, including:

A. Neurosky Mindwave Headset

The Mindwave Headset which is provided by Neurosky Technologies [6], and those signals will be transferred by using Bluetooth which is there in the Mindwave headset, for this Mindwave headset need to give power using an AAA battery. The Mindwave headset comes with Power switch, a sensor tip, flexible ear arm and a ground connection Ear clip. In this Headset they use Non-invasive sensor that won't cause any pain to the User who were the headset. After inserting an AAA battery switch on the Mindwave headset using the power switch the LED indicator will blink and if the Red color light not blinking the headset is powered on but not connected to with the computer's Bluetooth. If the Blue color not blinking that means the headset is powered on and connected. If the red or blue color blinks it shows that the Battery getting low. The Data transmitted by the Mindwave headset will be received by the Bluetooth device connected to the Arduino. And then all these data will be analysed or processed by the Arduino. The Servomotors connected to the PWM out the Arduino will operated according to the wave obtained by the Arduino that is sent from the m Mindwave headset.

B. Arduino Uno

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input or output pins(of which 6 can be used as PWM outputs), 6 analogy inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, and ICSP header and are set button. It contains everything needed to support the microcontroller. An Arduino board consists of an Atmel 8- , 16- or 32-bit AVR microcontroller with complementary components that facilitate programming and incorporation into other circuits. An important aspect of the Arduino is its standard connectors, which let users connect the CPU board to a variety of interchangeable add-on modules termed shields. Some shields communicate with the Arduino board directly over various pins, but many shields are individually addressable via an I²Cserial bus—so many shields can be stacked and used in parallel.

C. Bluetooth Module HC-05

HC-05 [6] module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mm x 27mm.

D. Servomotors

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. Servomotors are not a specific class of motor although the term servomotor is often used to refer to a motor suitable for use in a closed-loop control system. Servomotors are used in applications such as robotics, CNC machinery or automated manufacturing.

E. Prosthetic Arm

Prosthetic arm consist of 5 servo motors used to move the fingers of the arms. The microcontroller will help to control the servo motors. The fingers are controlled by attention and meditation levels. When the predefined levels are acquired the microcontroller will take the respective actions to move the fingers of the prosthetic arm. The block diagram representation of the above stated components are given below figure1.

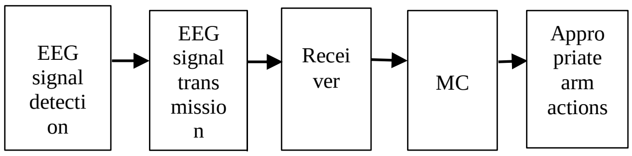

Fig 1: Proposed system arrangement.

IV. PROPOSED ALGORITHM

After switching on the Mindwave headset it will get paired with the Bluetooth module connected to the Arduino. The signals received by the Bluetooth module is possessed by the Arduino. Two types of data can be measured by the Neurosky mindwave headset i.e. Attention level and Meditation level. These levels will be received by Arduino which will help in controlling the prosthetic arm actions. The Arduino should continuously analyze the incoming brainwaves and map them into the appropriate actions. The schematic representation of the above described project flow is given below figure 2.

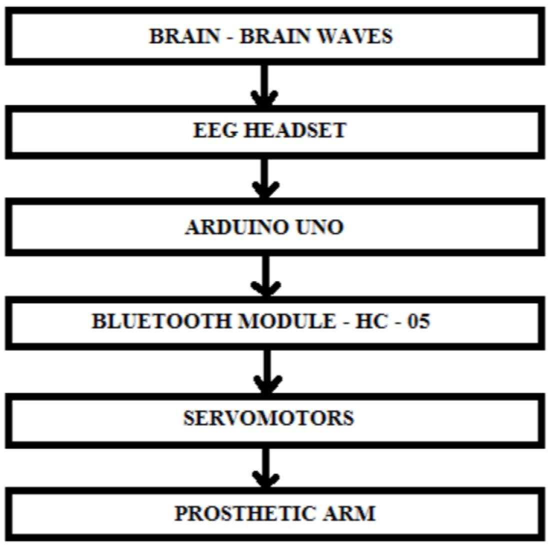

Fig 2: Project flow

V. 3D PRINTING

3D printing is a classic disruptive technology according to the disruption pattern identified by Harvard Business School professor Clayton Christensen. It is simpler, cheaper, smaller and more convenient to use than traditional manufacturing technology. Current 3D printing technology is "good enough" to serve markets that previously had no manufacturing capability at all (e.g., small businesses, hospitals, schools, DIYers). However, the technology is not expected to flourish in traditional manufacturing markets for a number of years, so it is unlikely that an entire commercial passenger airplane will be 3D–printed any time soon. Still, traditional manufacturers need to take notice; there are many examples of "good enough" technologies that eventually disrupted and dominated their industry, including transistor radios and personal computers.

3D printing started with plastics, but today there is an astounding and growing range of printable materials that includes ceramics, food, glass and even human tissue. Commercially available machines print in a range of plastics or metals. These printers generally work in one of two ways: a material (e.g., various plastics) is melted and extruded through a tiny nozzle onto the build area, where the material solidifies and builds the object up layer by layer; or a bed of powdered material (e.g., plastic, various metals) is laid down, layer by layer, and selectively fused solid. Usually some post-production work is required, such as cleaning the excess powder, baking to achieve strength or hardness, or dissolving support structures in a solution. Researchers, organizations and hobbyists have modified the underlying methods to dramatically broaden the range of possibilities.

The changes surrounding 3D printing are significant; we are only scratching the surface of what the ultimate impact will be. The glimpses of disruption seen today suggest wholesale change in the future. Customized, no-ship manufacturing will one day be as common as desktop printing. When that happens, and factories without factory floors are the norm, it will be hard to imagine how companies and consumers once lived without 3D printing.

Today 3D printing is being used in many areas for both prototyping and direct digital manufacturing.

VI. APPLICATIONS

A. Use in Day to Day life

People who are physically challenged having various physical illnesses are the main focus behind developing the project. They can make use of the robot arm in order to take control over various actions which are impossible for handicapped people.

B. Medical and Healthcare

This project also aims to provide a helping hand for handling various hazardous chemicals in medical industry or to provide more accuracy for performing any healthcare based actions.

C. Military and Industrial Use

The robot arms are very useful in military bases in order to handle heavy loads and to handle dangerous weapons and to perform transportation from one place to another. Also, this project includes the industrial use in order to perform accurate tasks which human beings lacks in some tasks but by using their brains as the brain activities have the accuracy which will provided to robots.

VII. RESULTS

The diagrams given below shows the working of the proposed system i.e. the opening and the closure of the arm according to the detected brain waves:-

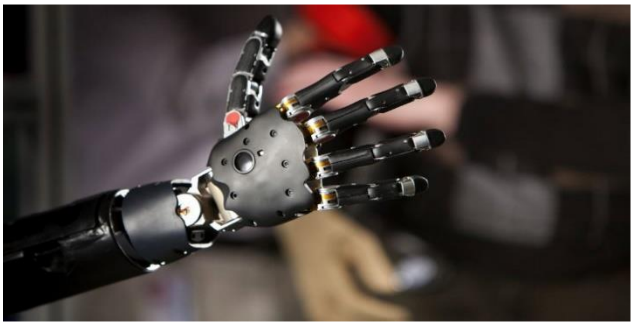

Fig 3: Arm in opened condition.

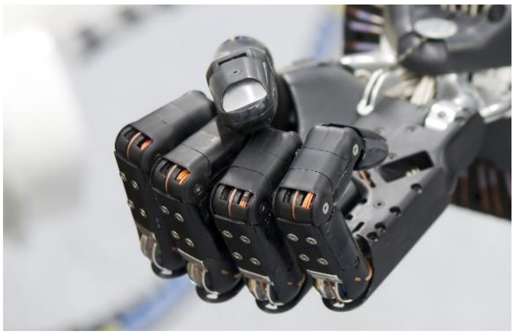

Fig4: Arm in closed condition.

VIII. CONCLUSION

Through this project, we take had helped the disabled peoples to lead an independent life with the help of their own brain waves. We had developed a wireless technology by using a Bluetooth module for sending the brain waves instead of the existing wired technologies and surgeries are also avoided by implementing this technology. Also this is a low cost technique compared to currently available techniques.

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