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The Bionic Limb Movement Using Bluetooth Armband Myo Sensor

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Abstract : The useful parts in human body are hands and legs, which are useful for daily activities in human life. Hand is the main part of body do perform several activities in daily life, for fine movements and even basic activities like eating, catching, pinch, etc. movements are carried out by hand.

The Bionic Hand or Bionic Limb is the metallic arm or robotic arm which can be attached to disabled persons or those who don't have limb or arm. The bionic limb consists of six
servo motors which are used to perform the handy activities like pinch, zoom, clinch, wave in, wave out etc. The bionic limb operates on the movement of muscles i.e. muscle contraction and muscle extraction. The muscle signals are detected by the Bluetooth Arm Band which has inbuild detection ability and gesture control, then these signals are provided to arduino to control Servo motors.

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I. INTRODUCTION

A new era of robotics has changed the human life, which are useful to perform the easiness of work mostly useful in household activities and even some activities which human may not be able to perform. Besides Robotics many researchers have introduced the concept of bionics. Bionic Human is nothing but the human which has lost his body part accidentally or disabled persons like handicapped, those persons are implanted with bionic parts. The bionic part which is mostly useful we can say bionic hand which can be attached to humans. Once implanted the disabled persons or those who have lost their body parts can perform daily activities. The bionic parts plays important role in daily life it is used to replace the function and role of missing body parts.

Losing a hand accidentally or paralysis or the disabled persons have difficulty in performing daily activities like eating, driving, wearing clothes and fine activities like holding pen, operating electronic devices etc. So bionic plays important role, Where these humans can perform such activities with almost error ratio of 20%.

Researchers are trying to develop bionic arm, this bionic arm will work via myo electric signals, these signals are gained due to muscle contraction or extraction. In this study we are going to use Bluetooth Myo Arm Band Sensor, which gains the myo electric from the muscle movements and then these signals are transmitted via Bluetooth to the processors for further processing.

Various Algorithms can be used for processing like binary control algorithm, root mean square algorithm, Back propagation algorithm. Back Propagation Algorithm is considered to be best from many of researchers because it has almost average error ratio of 17%.

All of these processes will produce a new function that is similar to real human hands, but there are still some shortcomings regarding the method of introduction of signal.

II. PREVIOUS WORKS

According to Previous Researches conducted by some Scientist's we can use the previous results for the development of bionic limb. As per due lack of nano technologies in previous researches, the design of the model was huge as per the actual human arms, some consists of springs and hydraulics.

The research conducted by Cahyo Setiawan suggested the use of spring on finger parts, so that as finger gets pulled a repulsive force will get generated to gain the fingers previous position or to the rest. To design the whole hand structure hydraulics were also used so that whole hand movement will be possible mostly it was designed to perform weighted works like driving car, lifting heavy things, etc. As it had many of the drawbacks the person was not able to balance the load of the hydraulic arm, the heaviness of the model laid the humans to discard the model.

In the spring model it was easier to perform the balancing of the arm as it was lighter as compared to hydraulic model, but there were too drawbacks in this model, as

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spring generates repulsive force, so clenching movement was more difficult.

As per previous researches, the earlier research uses the myo technology. The human nerves generates the EMG signal which can be detected via any type of myo sensor and perform the activities based on the signal. As the EMG signal is the complex system. The EMG signal depends on the muscle movement and the physical ability of each human as its different. The person who has lost his hand or arm can even make use of these technology as the brain stimulates the nervous signal which can be detected through electrode placed on human body and transmit the overall signal to the myo sensor.

According to research by Suresh M., Krishnamohan P. G. and Mallikarjun S. Holi, the EMG signal is the sum of the disposal of all motor units in the range of pick-up electrodes. Nervous system always controls muscle activity(contraction/ relaxation). Therefore, the EMG signal is a complex signal, which is controlled by the nervous system and depends on the nature of the anatomy and physiology of muscle.

According to the study by Nomiyasari, EMG is a bioelectric recording instrumentation used to determine the signal caused by skeletal muscle activities. This muscle is one of human organs that move the skeleton. Skeletal muscle has the nature of conscious, unconscious, and irregular because these activities depend on the will of the user. In general, the working principle of the skeletal muscle is relatively similar to the heart muscle, with the difference is the origin of the stimulus.

III. METHODOLOGY : SYSTEM ARCHITECTURE :

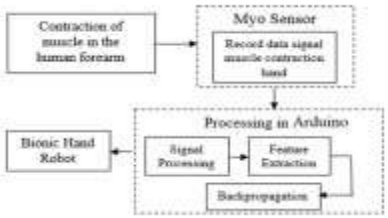

Fig. 1.1 System Architecture

A) DETECTION OF ECG SIGNALS

In, this study first we are going to detect the ecg signals generated by the human nerves. To detect the ecg signal we require myo sensor and the electrodes which are attached on the human body in form of patches. The persons who have lost their body part or disabled persons are able to generate the ecg signal which can be detected by the myo sensor. For detection of the ecg signal we require the exact position of nerves which generate the high ecg gains as shown in above diagram we require the position of each fingers which generate exact ecg signals and these ecg signals are send to the Bluetooth myo gesture control armband for further operations.

As, compared to other sensors the Bluetooth Arm Band has inbuild gestures which can processed through arduino or any other processor, the inbuild gestures are clinch in, clinch out, pointing, wave in, wave out, etc. So, first step consists of detection of ecg signals which can be gained by attaching patches on human nerves to the exact position. Following fig 1.2 shows the how the detection of ECG Signals are done.

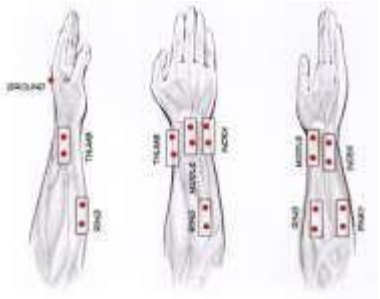

Fig.1.2 Detection of ECG Signals

B) FEATURE EXTRACTION

Feature extraction needs to be done in order to get the features of input signal each movement. In this research, researchers implement RMS method to obtain signal features each movement. RMS (root mean square) is "squared and then averaged, then squared root). RMS is carried out to identify the characteristic features of each movement. If RMS value of each channel has been found, then the next step is to find the minimum and maximum values of the RMS value. The minimum and maximum values are used to normalize the data to all channels with the range of value 670 between 0 and 1.the following diagram shows the feature extraction from muscle to get the signals.

Fig.1.3 Feature Extraction

$$RMS = \sqrt{\frac{\sum_0^n Xn^2}{N}}$$

Where:
RMS = value of RMS (*root mean square*) Xn = nth data
N = the number of signal

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C) BACK PROPAGATION

Back propagation artificial neural network is one model of the popular network on artificial neural networks. This network model many used to be applied in the resolution of a problem related to the identification, prediction, pattern recognition, classification and so forth. In practice repeatedly, this algorithm will produce a better performance. This means that the "weight of interconnection" ANN getting closer to weights that should be. Another advantage of this back propagation artificial neural networks is its ability to learn (adaptive) and immune to error (Fault Tolerance) with that advantage, the artificial neural networks can create a system that will withstand damage (robust) and consistently worked well. Thus, in this research only using back propagation artificial neural networks method as a method for pattern recognition and classification.

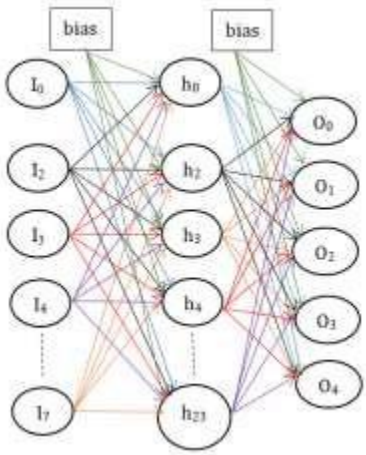

Fig. 1.4 Back Propagation

IV. RESULT

A) WAVE IN MOVEMENT

From Fig. 1.5, it shows a demonstration of wave in motion. When a user's hand is doing a wave in, then the robot will also be doing the same movement. In this case, when the user's hand is doing wave in, the robot is also doing wave in.

Fig. 1.5 Wave-In Movement

B) RELAXING MOVEMENT

Testing phase of bionic arm robot movement is the end result of the aforementioned steps. At this test, the bionic arm robot is already integrated with a PC that is used to process the signals that have been recognized by back propagation. At this stage, the arm robot receives data that has been processed on the PC and recognized by back propagation as a desired movement pattern.

From Fig. 1.6, it shows a demonstration of relaxing movement. When the user's hand is not moving or in a state of relaxation, the robot will perform relaxing motion.

Fig. 1.6 Pointing Movement

C) POINTING MOVEMENT

From Fig. 1.7, it shows a demonstration of pointing movement. When a user's hand is
pointing, the robot will duplicate its movement. In this case, when the user's hand is pointing

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Fig. 1.7 Pointing Movement

ADVANTAGES

- Allows for easier communication with technology with faster result
- Lower cost of processors for better transition to everyday life
- Simple gesture for an easier use for everyone
- Convenient to carry

DISADVANTAGES

- Difficult to adapt
- More space for movement
- Limited Functions
- Unwanted Actions could occure by unnecessary gesture

V. CONCLUSION

From the results of the RMS of each movement respectively, it is obtained quite different patterns. These patterns distinguish between each movement and will be used as input of back propagation and classification. The test result of wave in is about 100%,relaxing is 65%,and pointing is 75%.

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