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Upper Arm Exoskeleton Using Robotic Arm for Physiotherapy

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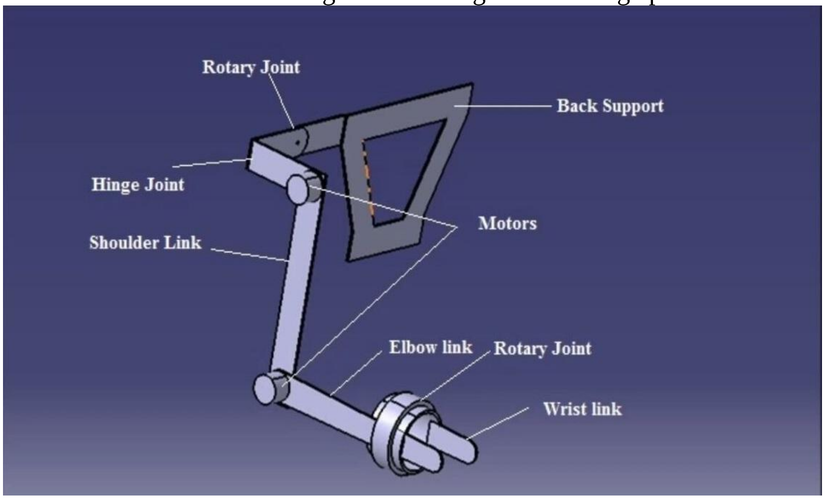
Abstract—

Stroke is a major cause of disability in worldwide and also one of the causes of death after coronary heart disease. Many devices had been designed for hand motor function rehabilitation that a stroke survivor can use for bilateral movement practice. This paper deals with the rehabilitation of upper arm by an Arm exoskeleton. This can be used for physical therapy and to assist the user with routine activities. Ultimately, the user should feel as if they are in control of their arm without too much effort while providing smooth movements depending on the direction that is desired.

Keywords—Arm Exoskeleton, Stroke, Servomotor,emg signals,aluminium frames

I. INTRODUCTION

An exoskeleton is a supporting structure on the outside of a body. The name stems from the words exterior and skeleton. The stroke could cause a deficiency in various neurological areas and mainly it causes disability in the motor system. A general state in most of the stroke survivor is paralysis of one side of the body. The purpose of this project was to develop an active arm brace that can be used for physical therapy and to assist the user with routine activities. The Exoskeleton involves the automatic Push button system through which the input signals are given to Arduino board and the processed signals are given to motors for further movement of the exoarm. This processing is done by attaching a shaft encoder to control the limit of the angles for the movement of motor. The outer exoskeleton is made up of Aluminium Frames. The Aluminium frames are designed according to the average person measurements.



II. PREVIOUS PROPOSAL

1. Exoskeleton by the help of EMG Signals:

This system implements a threshold method in which a positive and negative threshold voltage is set in software. The signals of the bicep and triceps are analyzed to determine which direction the brace should be moved. If the difference of the two signals goes above the positive threshold voltage the brace is pulled in an upward direction. If it goes below the negative threshold then the brace is moved in a downward direction. The brace is moved by a pulley system which is placed in a backpack (with the rest of the electrical components) which the user wears.

2. Exoskeleton by Voice control:

Then the system was replaced by voice control of exoskeleton which involves the signal dragged from the pre recorded voices for the motor function. The system involves a microphone attached to the user and the Arduino board which gets the input signal from the user. The signal is compared with the prerecorded voices and based on the program the motor movements work. This is used to give the therapy for the patients.

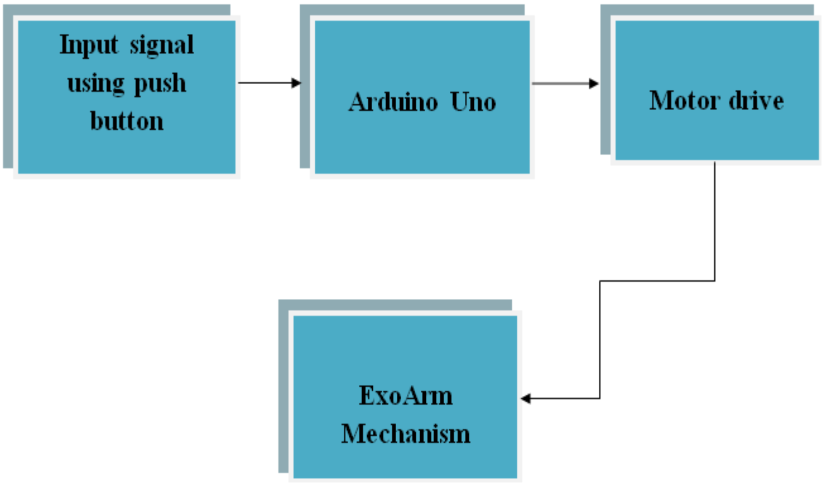
III. ISSUES IN PREVIOUS WORK

1. The signals driven by the muscle contraction is not convenient since the muscle movements were not promising in many stroke recovered persons and some persons suffered from muscle contraction and expansion.
2. Next the voice control implement failed in many cases since the prerecorded voice accent differed from the user voice and fails to perform the required movements for the therapy.
3. Finally, the automatic push button mechanism seems to be promising for the input signal function which recovers these problems.

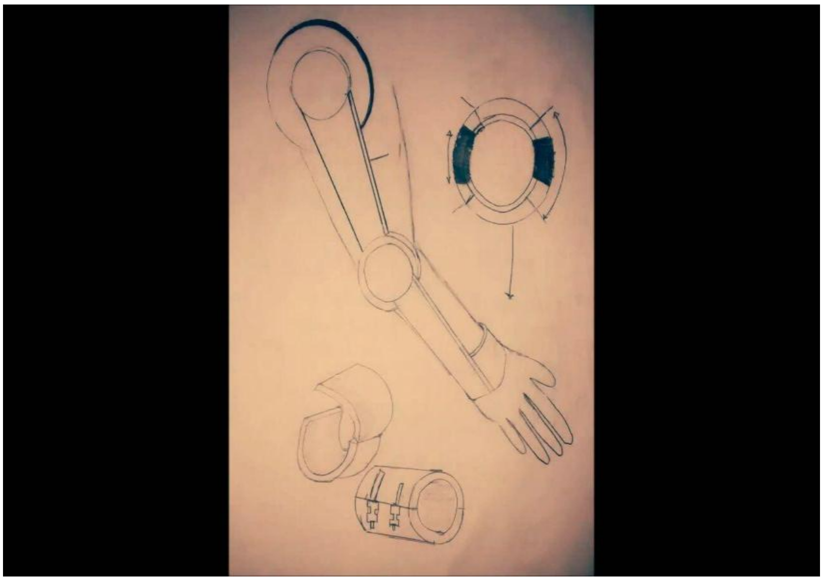
IV. CURRENT PROPOSAL

The current idea imposed on the automatic switch button which acts as a trigger and given to the Arduino board for processing. This output is given to the motor by motor drive and the motor movements are controlled by a shaft encoder. The block diagram given explains the working of the device. This is programmed in the Arduino platform and the simulated in Proteus to get the required result.

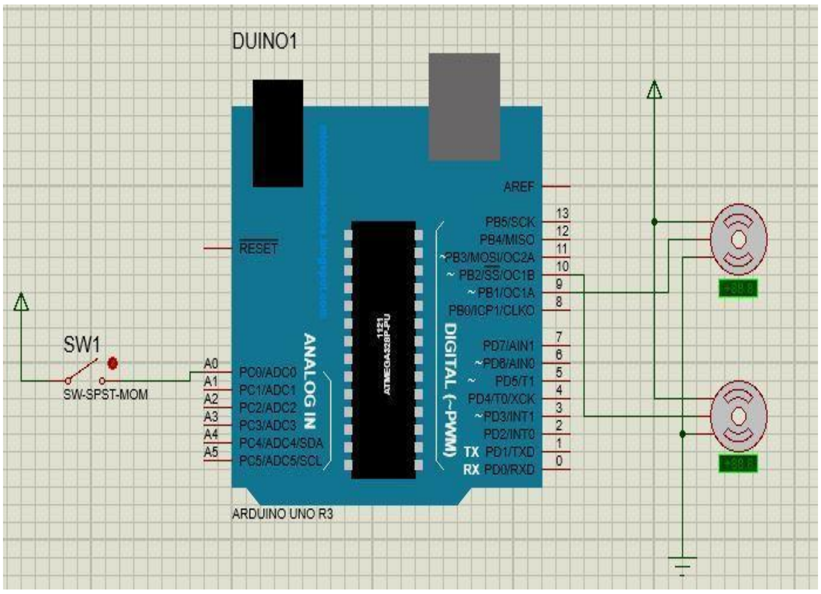
BLOCK DIAGRAM



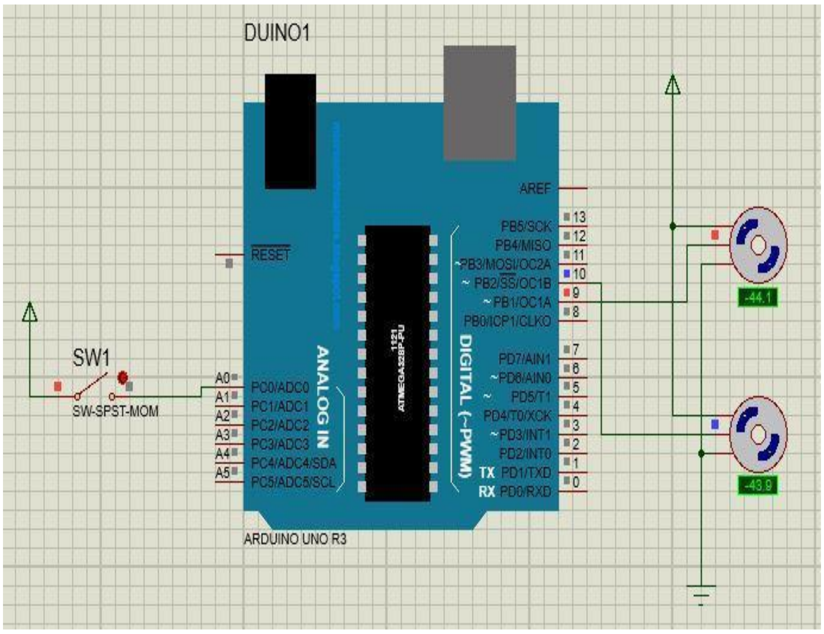
OUTPUT DESIVGN



SIMULATION RESULTS



The final simulation results came out to be the motor response. When the switch SW1 is pressed, the signal is given to the Arduino Uno. The signal is processed and the motor runs according to the process. The Arduino is preprogrammed and the simulation is done and the respective results are given. In addition to this, the shaft encoder is used to control the motor movements.



V. CONCLUSIONS

Finally this project output is expected to be useful in the field of Biomedical to rehabilitate the stroke recovered patients. The device is used as a therapy for the patients and hopefully to the recovery of the patients. This project device can be used by the patient itself and can be a user friendly. This exoskeleton design and control system can be improved and added to in order to design an exoskeleton of the arm with more degrees of freedom including wrist and shoulder movements.

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