

# PHYSIOROBO: A Framework/Structure for Neck Physiotherapy

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**ABSTRACT:** To promote the health services research in neck rehabilitation we gathered information about Neck physiotherapy process, techniques and their outcomes. Neck pain is common but sometime it may cause some serious problem, the proper treatment can overcome this cause. Physiotherapy is one of the most trustable and effective treatment for neck pain. Existing studies indicate that the machines available for neck physio are very high in cost and may be uncomfortable during therapy and they are only used in the presence of physiotherapist. Through this research we are introducing the wearable, low-cost and automated neck framework/structure which would be completely helpful for physiotherapist to give the neck physiotherapy. Even this model can also be operated by the patient itself without any need of therapist. Results show that this automated framework is beneficial for minor and medium level of back pain.

**KEYWORDS:** Physiotherapy, automated neck movement, gyro sensor and servo mechanism, Arduino

## I. INTRODUCTION

Physical therapy is the science of blending physiology with exercises and applying these principles to the body when any injury is sustained. Neck pain is common; it can limit a person's ability to participate in normal activities and is costly. Exercise therapy is a widely used treatment for neck pain.

Here we are going to propose a framework for Neck physiotherapy which can help in rehabilitate the normal function of the neck via exercises. There are some machines available like TENS (Transcutaneous Electrical Nerve Stimulation). It is used as a pain relieving medication but is less likely to be effective if it is used on its own. As electrical current sensation is different from patient to patient according to their body it may be uncomfortable sometime. Ultrasound is very commonly used as an active therapeutic tool in physiotherapy but it is mainly used for chronic pain condition it could not be used for acute pain condition like wry neck. In my framework I will try to design one automated, portable, light weight, comfortable, wearable structure which would be helpful to give the 2 DOF automatic neck movement in the normal range of motion. By using this the patient itself can take the advantages of physiotherapy without any need of physiotherapist. It can be easily operated by the patient itself.

In many situations like COMA patient, which is a state of unconsciousness, the person fails to respond normally to painful stimuli, light, or sound and does not initiate voluntary actions. In this situation the regular movement of body part is must otherwise the body parts become stiff so here from the help of this framework the patient's relative can also give the movement to the patient.

This would be same for the bed rest patient which cannot be able to stand from the bed by any mean of injury. If his/her hand is working it can also use this by its own.

This project is surely become beneficial for hospital purposes, for physiotherapist, for rehabilitation centres etc.

## II. MECHANICAL DESIGN OF PHYSIOROBO

Some predicted designs are shown here for designing the PhysioRobo.

These designs are designed by personal imaginations.

When we designed this many points we take into account like availability of all the devices we were going to implement, comfort ability of frame work, it must be light weighted, should not be hectic with the patient, safety features of whole frame work, and reliability of this framework.

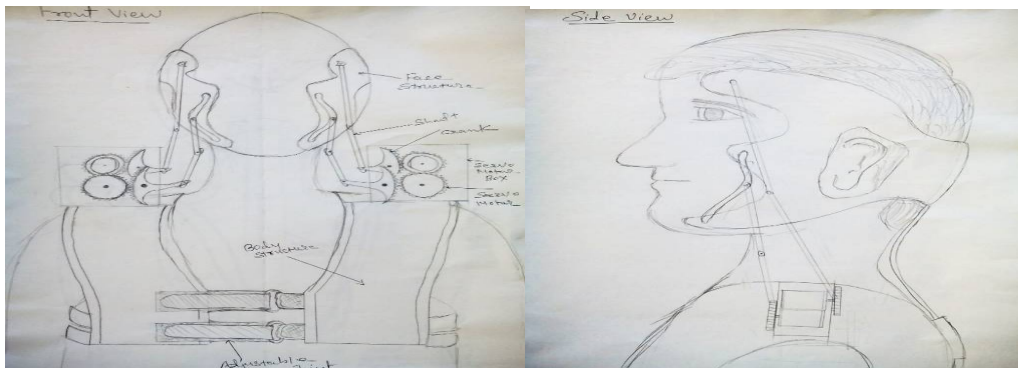


Fig1. Shows the front view of mechanical design Fig2. Shows the side view of mechanical design

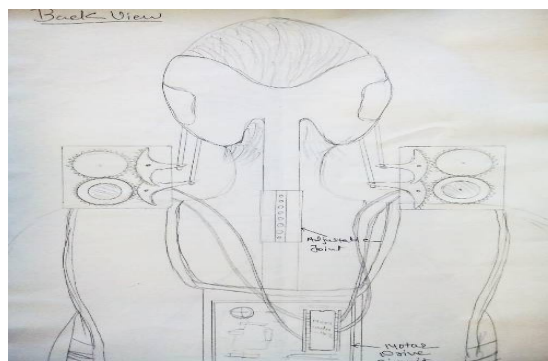


Fig3. Shows the back view of mechanical design

## III. MATERIAL AND METHODS

The working of this frame work is based on passive method. Passive method includes the exercise which is done by the machine on the stationary subjects (human body). Here the human body remains stationary and the proposed frame will automatically give the neck movement to the stationary body.

The material I used here is polypropylene plastic for adjustable face and chest frame. Under the plastic frame work we placed a Soft foam to make it more comfortable. Velcro is used for getting proper fitting over the human body so that it can work properly and the frame will not get disturb even though the subject get move from one place to another.

This material is only used for making the wearable supporting structure. After the completion of this structure the next step would become the automation part. For automation I used four S3003 FUTABA servo motor for moving this mechanical structure as per our need. Arduino will be used for programming purpose .here I am using Arduino because it can run up to six motor at a time u can also use PIC controllers according to your need. We were using four motors because we only worked for 2 degree of freedom as the degree of freedom increases the no. of motors increase.

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Remote system will contain two modes. For controlling the rotation of motors we had a remote system which includes four different switches.

1. First switch is used for reset purpose. If the Patient feel any emergency he/she can reset the whole system by using this switch.
- 2 Second switch is used for mode and angle selection. Here we had two modes (A&B). Mode A is selected only for the normal range of motion.
3. Third switch is used for angle selection
4. Fourth switch is used for varying the angle according to patient's need



Fig4.Adjustable frame of face and chest structure

### EXPERIMENTAL SETUP

Twenty three male/female subjects with the history of neck pain and the patient suffering from the acute and chronic neck pain participated in the experiment.

The subjects were asked to sit in the chair as they feel comfortable in all the way. There upper body part (including chest) and the face were fixed by the supporting structure and the subject were sited placing their hands on their laps.

Under the guidance of the physiotherapist we first know the problem faced by the subject and what was the condition of their neck movement. Then by knowing their range of motion, related to the neck, we set the required angle for giving the neck movement, and start the process of servo motors. Here for the feedback we used gyro sensor for measuring the angle properly as a safety point of view.

After the completion of the process we took the feedback of physiotherapist and all the subjects who participated and made a final conclusion.

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## IV. HUMAN BASED PROTOTYPE

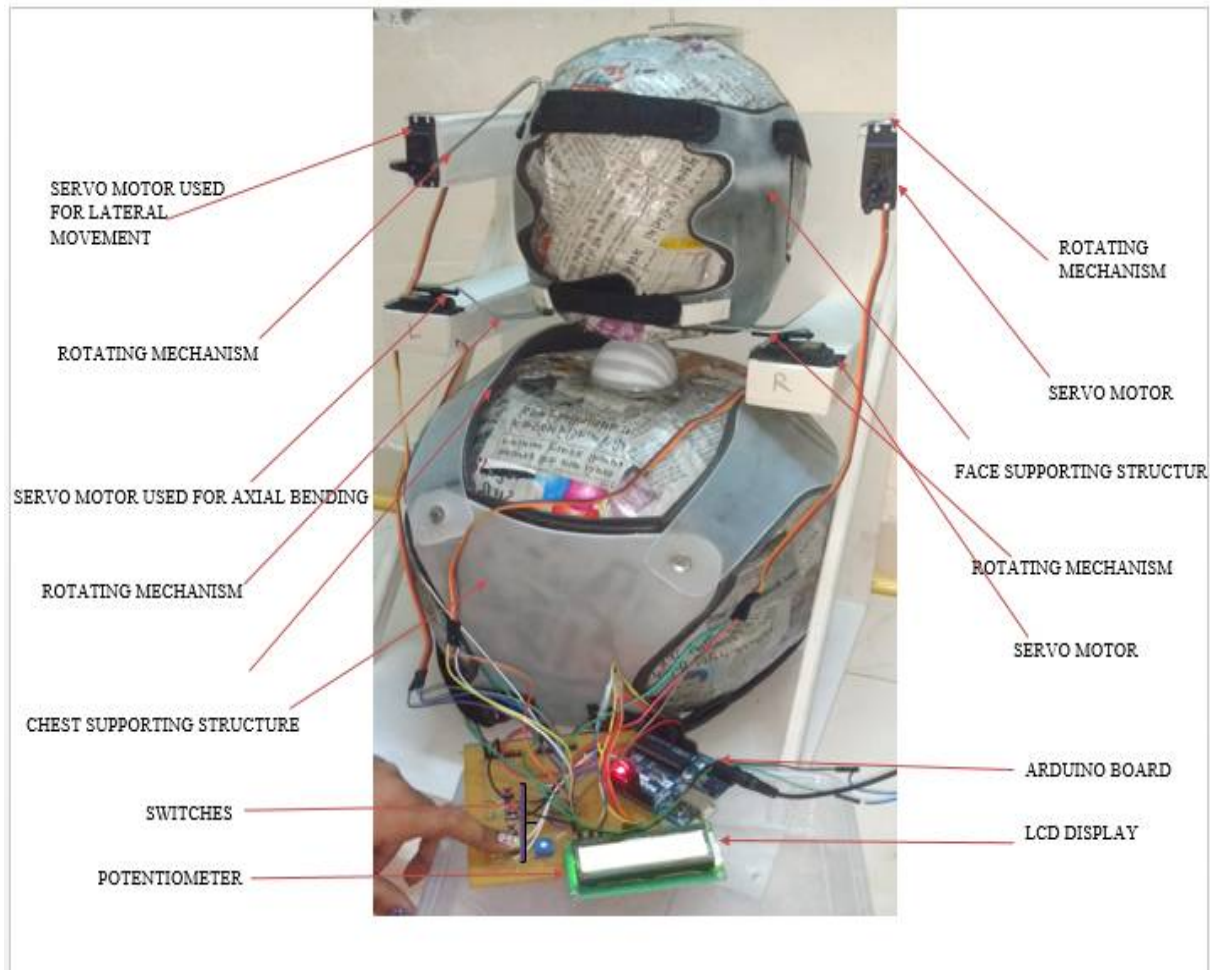


Fig5.shows all the components used in human body prototype

## V. RESULT

Here we have the feedback of 23 patients. These patients had different levels of their neck pain and we applied this PhysioRobo to each and every patient and according to that patients had given us their feedback related to this therapy. We have total nine different questions in this feedback form and they are as follows:

1. Level of pain....
  - Minor
  - Medium
  - High
  - Very high
  
2. Comfortable level of wearing this framework is.....
  - Good

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- Very good
  - Not comfortable
3. Is it worked well for you?
- Yes
  - No
4. Level of effectiveness in retrieving neck pain is....
- Excellent
  - Very good
  - Good
  - Not appropriate
5. Have you ever been taken any automated therapy for your neck pain?
- Yes
  - No
6. What worked well for you?
- Manual therapy
  - Automated therapy
7. Is there anything that could have been done better....
8. Overall your experience was....
- Excellent
  - Very good
  - Good
  - Bad
  - Very bad
9. Please give any suggestions related to this project so that it would be more helpful for us to improve the therapeutic use of this PhysioRobo in neck physiotherapy (if any).

### 10. TABLE SHOWS THE RESULT OF PATIENT'S FEEDBACK

NO. OF PATIENTS	AGE/GENDER	1	2	3	4	5	6	7	8	9
PATIENT1	28/Male	Medium	Good	Y	Good	Y	Automated therapy	Good in neck pain	Very Good	Good project made by you it is useful for us

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PATIENT2	72/Female	High	Good	Y	Good	N	Manual therapy	No	Good	Good
PATIENT3	52/Male	Medium	Good	Y	Good	N	Automated therapy	After therapy pain is reduce	very Good	This is helpful for neck pain
PATIENT4	58/female	Medium	Good	Y	Good	N	Automated therapy	This machine is useful for me	Good	I can operate this machine by myself
PATIENT5	63/Male	High	Good	Y	Good	N	Manual therapy	This machine is not good for pain	Good	---
PATIENT6	41/Female	Minor	Good	Y	Good	N	Manual therapy	Useful in reducing pain and can be used by me	Good	This is a good project
PATIENT7	38/Male	Very High	Good	Y	Good	N	Manual therapy	Make it more effective	Good	Make it more effective
PATIENT8	52/Female	Minor	Good	Y	Good	N	Automated therapy	After using this I feel relief in my pain	Good	This machine is good
PATIENT9	48/Female	Minor	Good	Y	Good	N	Automated therapy	It can be used in home so it is good	Good	Everything is good

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## VI. CONCLUSION

Conclusion summarized below are based on the result which we got after the experiment and the feedback given by the patients and physiotherapist. We can clearly see that from out of 9 subjects 5 subjects feel that automated therapy is more beneficial for them in retrieving their neck pain. Comfortable level of wearing this structure is good. This frame work is advantageous for the neck pain patients and as we can see that till now most of the patients have never taken any type of automated therapy for the neck pain. So this is a good area of research. Patients are also happy to see that they can be used it at their home easily.

### Disadvantages

This frame work is only beneficial for the patient who had minor or medium level of neck pain.

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