# **CervPro**

# **Cervical Proprioception Motion Analyzer**





Department of Engineering and Physics

ENGR 4201. Senior Design

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**September 25, 2020**

**Background**

Cervical Proprioception is a sense of head-neck movement and position in space. This phenomenon has been used by physical therapists to study the impairment within the cervical region and the brain. The results from study analysis are used to recommend preventive care, rehabilitation process and treatments methods for patients. Health care workers encounter car accidents victims, sports injuries, stroke and cervical spondylosis patients who must undergo this kind of test prior to other measures.

An increasing demand for this test method has raised concerns about the accuracy of the test data. One of the physical therapists added that system is more subjective. To learn this, they are currently using cervical joint position error (JPE). This is where a laser is mounted on the patient's head pointing a target situated 90cm away. The difference between the final and initial head position is an error that is measured for diagnosis purposes.

Cervical proprioception motion analyzer is designed to collect displacement, speed and neck twist angle. This eliminates subjectivity and provides a wide range of data for analysis. With the current technology, the data is auto-collected, shared over WiFi and documented with the help of a computer.

**Customer Needs**

The first customer to encounter are the physical therapists. They showed interest in a device that is easy and quick to operate. Aslo, the clarity and accuracy of the results are emphasized. Patients are concerned about the subjectivity of test methods. They worry of being recommended to perform unnecessary measures that arise from wrong results. Insurance companies are interested in reducing medical expenses. With an inaccurate decision for a treatment plan, the company will have to spend where it is not needed.

**Technical Requirements/Specifications**

For environmental concerns, the device would not use harmful laser light. Also, It doesn't produce a distracting level of noise. Its weight will not exceed 5% of head weight. It will be movable to allow a wide range of motion. Wireless transmissions technology will be employed which will be in the ISM range. The device can be easily worn by a patient.

The functionalities of the product are: Helmet position shall shift less than 5° when the head covers RoM 10x at 1Hz. Output error at distances of .5m, 1m, 2m, and 3m shall not exceed 5%. Output error at 1m and TBD frequencies for CPE, VOR x1 and 2 shall not exceed 5% . Output repeatability error at 1m and CPE frequency with 10 samples shall not exceed 5% . Data shall be saved to file while indicating therapist-defined output

The product ease of use. Mean time for new users to run CPE tests shall not exceed double standard CPE time. Proportion of users able to receive data from CPE test in less time than standard shall exceed 50%. The average of the inverse of the number of questions asked by a new user shall not exceed ⅓. Proportion of users able to make diagnosis exclusively and within 30s of completing device cycle shall exceed 50%

**Preliminary System Test Plan**

The plan to test the overall project will include working with Harding school of Physical Therapy and, if possible, local physical therapy clinics. The goal is to start the process quickly to find out the physical therapist response. With the data, it will help Harding’s Physical Therapy department to clarify on what they would like to be reported. The device performance will be tested on team members as control experiments. Also, other “health” individuals will be welcomed to be part of the test sample.

**Plan to Proceed**

The plan is to continue communicating with both Harding Physical Therapy School and local Physical Therapy clinics. This will enable the design team to determine the school requirements for educational purposes and the clinics needs for actual use. With the intellectual contribution obtained from them will help to decide on what is the best way of attaching the necessary equipment to the patient's head. Also, the team will learn exactly what data is needed in order to select the sensors. Currently, two non-visible lights, a gyroscope, and three accelerometers will provide all the data we have currently been told to collect.

More information will be needed to select the needed microcontroller. Also to look into data transfer from the headgear to another microcontroller; the total number of sensors will effect if we need to have a microcontroller on the headgear or if it has a sufficient amount of pins to receive the information as well as the needed memory to transfer the data. We are still examining the best way to have physical therapists to interact with the product.