Cervical Proprioception Motion Analyzer

Technical Specifications

Department of Engineering and Physics
ENGR 4201. Senior Design
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Customer Needs

Based on information gathered from Physical Therapists, the team determined there were four quintessential needs:

- Ease and speed of operation for therapists
- Comfort and security for patients
- Clarity and accuracy of provided information for insurers and therapists
- Compliance with legal and industry standards

Technical Requirements

1. Ease of use and speed of operation for therapists
    1.1. Mean time for new therapists to run Cervical Position Error (CPE) test shall not exceed 10 minutes (double standard CPE time).
    1.2. Proportion of therapists able to make diagnosis exclusively using the device and within 40s of completing device cycle shall exceed 50%
2. Comfort and security for patients
    2.1. Hardware shall not significantly impede movements across an 80 degree Range of Motion (RoM) of the neck about all rotational axes.
    2.2. Weight of any device attached to the patient will be less than 10 lbs.
3. Clarity and accuracy of provided information
    3.1. Device shall measure angular head position across an ideal 80° and acceptable 60° RoM in either direction with error of less than 5%.
    3.2. Device shall measure angular velocity up to an ideal 60° per second and an acceptable 50° per second with an error of less than 5%.
    3.3. Hardware (if present) position shall shift less than 5° on the patient's head during 60° per second rotational speed.
    3.4. Data shall be saved to file while immediately displaying therapist-defined output
4. Compliance
    4.1. Device shall not require Personal Protective Equipment (PPE) for operation
    4.2. Shall not emit sound louder than 60 dB
    4.3. Any data transmission shall comply with relevant FCC and medical device regulations

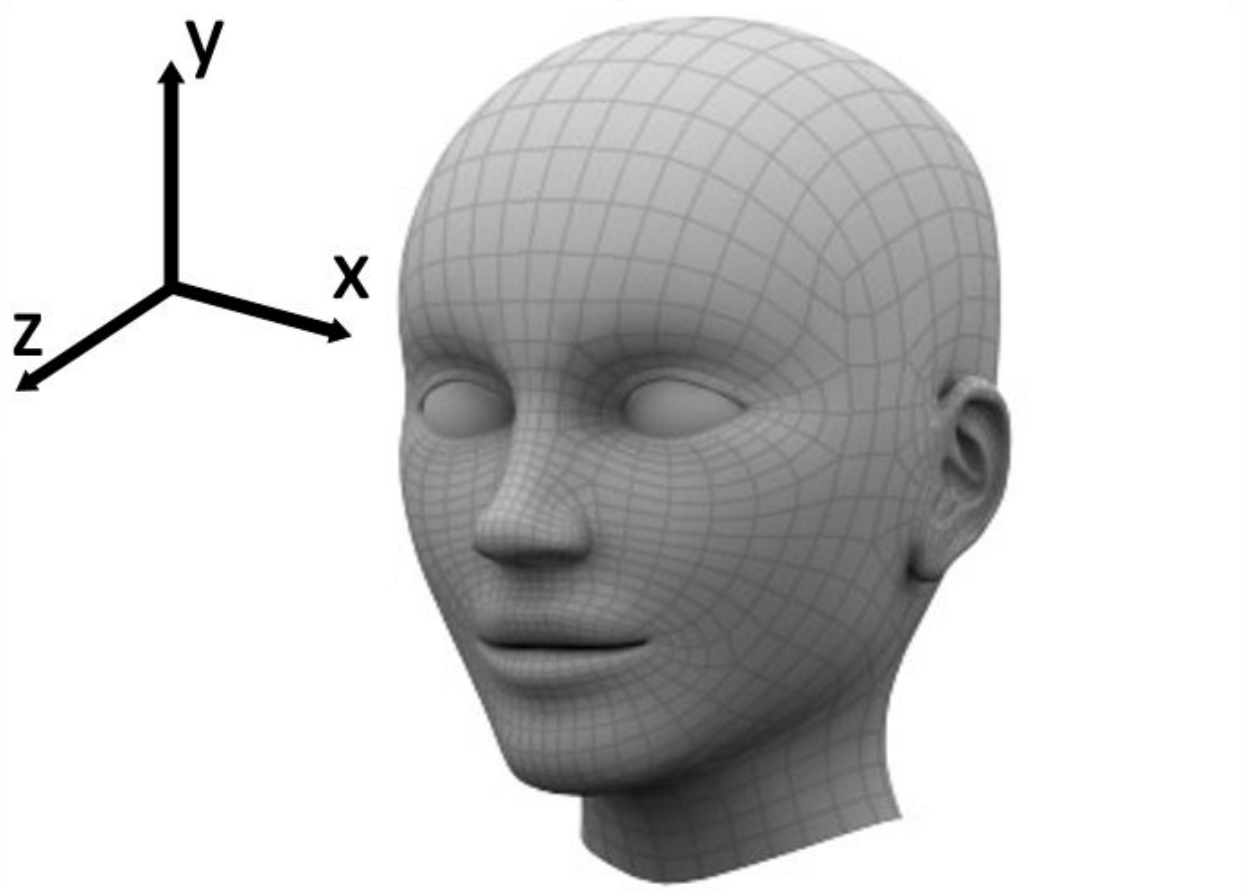

Figure 1. Defined Coordinate Axes for Human Head Motion

Needs Matrix

	Ease and speed of operation for therapists	Comfort and security for patients	Clarity and accuracy of provided information	Compliance with legal and industry standards
Mean time for new therapists to run Cervical Position Error (CPE) test shall not exceed 10 minutes (double standard CPE time)	●			
Proportion of therapists able to make diagnosis exclusively using the device and within 40s of completing device cycle shall exceed 50%	●			
Hardware shall not significantly impede movements across an 80 degree Range of Motion (RoM) of the neck about all rotational axes		●	●	
Weight of any device attached to the patient will be less than 10 lbs		●		
Device shall measure angular head position across an ideal 80° and acceptable 60° RoM in either direction with error of less than 5%			●	
Device shall measure angular velocity up to an ideal 60° per second and an acceptable 50° per second with an error of less than 5%			●	
Hardware (if present) position shall shift less than 5° during 60° per second rotational speed			●	
Data shall be saved to file while immediately displaying therapist-defined output	●		●	
Device shall not require Personal Protective Equipment (PPE) for operation				●
Shall not emit sound louder than 60 dB		●		●
Any data transmission shall comply with relevant FCC and medical device regulations				●

Prototype Demonstration Rubric

Technical Specification	Weight	100	80	60	30	0
Mean time for new therapists to run Cervical Position Error (CPE) test shall not exceed 10 minutes (double standard CPE time)	0.05					
Proportion of therapists able to make diagnosis exclusively using the device and within 40s of completing device cycle shall exceed 50%	0.05					
Hardware shall not significantly impede movements across an 80 degree Range of Motion (RoM) of the neck about all rotational axes.	0.05					
Weight of any device attached to the patient will be less than 10 lbs.	0.05					
Device shall measure angular head position across an ideal 80° and acceptable 60° RoM in either direction with error of less than 5%.	0.25					
Device shall measure angular velocity up to an ideal 60° per second and an acceptable 50° per second with an error of less than 5%.	0.25					
Hardware (if present) position shall shift less than 5° on the patient's head during 60° per second rotational speed.	0.05					
Data shall be saved to file while immediately displaying therapist-defined output	0.1					
Device shall not require Personal Protective Equipment (PPE) for operation	0.05					

Shall not emit sound louder than 60 dB	0.05					
Any data transmission shall comply with relevant FCC and medical device regulations	0.05					
Total	1.00					

The process of showing how the prototype will actually work in words. The patient will be seated a specified distance away from a CPE testing target by the physical therapist for evaluation. At this point, the device will be checked for calibration needs according to the patient's bodily needs. These could be torso height, head shape, or any slouching tendencies. The device will then be calibrated if necessary. If no calibration is needed, the physical therapist will somehow initiate the data collection process. The device will then continuously measure the angular position and angular velocity of the patient's head until the data collection process has been stopped by the physical therapist. The data will then be processed and displayed somehow to the physical therapist. Then, they will make assessments and develop treatment plans or get a sense for how effective the patient's existing treatment plan is.