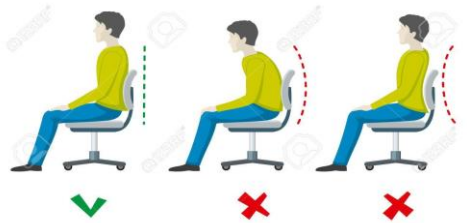
Atlas

A Posture Monitoring and Correcting Device

Introduction

The Problem



- Prolonged sitting can induce fatigue in muscles, and the effect can be worsened if proper posture is not maintained..
- A strong medical connection has been established between poor posture and chronic back/ neck pain..

The Competition

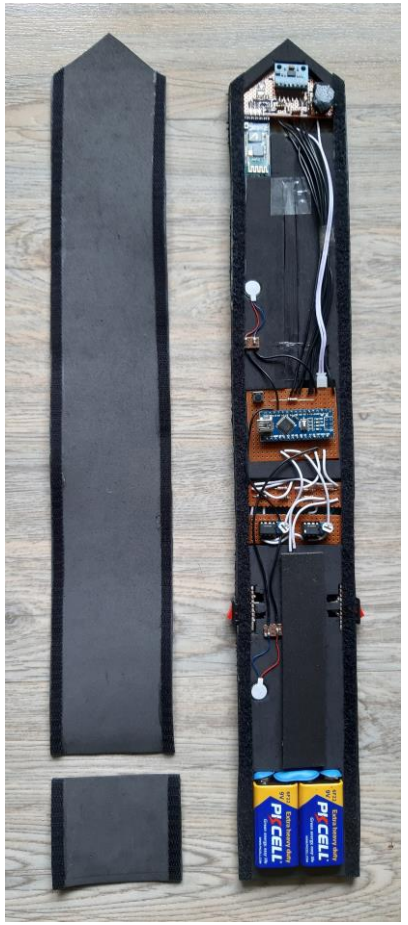
- Most devices do not have a sufficient amount of physical parameters to accurately monitor the posture (Lumo Lift/ Upright Go etc.)
- Some devices are limited in their application environment, and are not versatile (Darma Smart etc.)

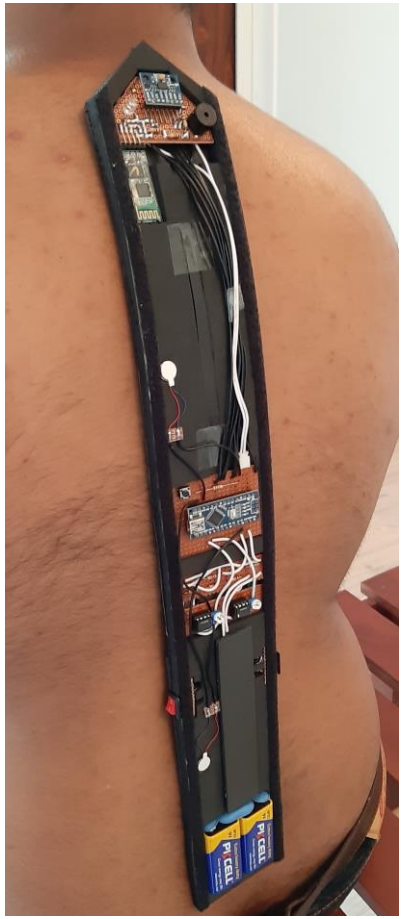
Lumo Lift

Darma Smart

The Solution - *Atlas*

- In this project, we attempted to design and fabricate a device which can fulfill the aforementioned shortcomings





Methodology

Approaching the Task

1. Literature Survey
2. Expert Interviews: Collaborating with the Department of Physiotherapy, Faculty of Allied Health Sciences, University of Peradeniya.
3. Virtual modeling of the device
    - Solid Modeling using Solidworks
    - Electrical Modeling using Proteus
    - Programming using Arduino and MIT App Inventor

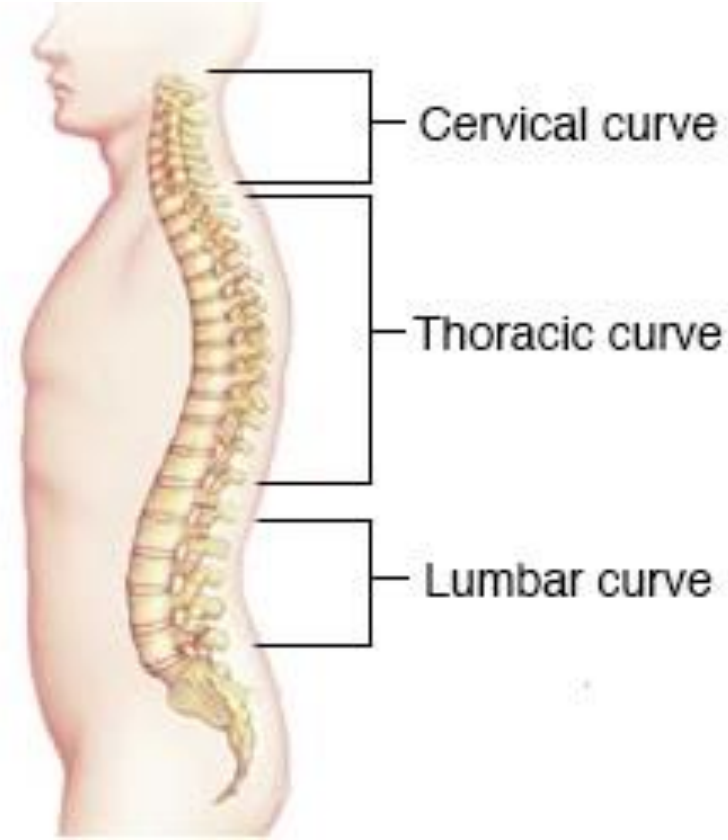
    } Figures and source code given in technical report
4. Fabrication of prototype
5. Real world testing

Physiological Background

- The human spine has natural curves to it, as shown in the figure below..

- The Cervical curve is present in the neck region, the Thoracic curve is present in the upper back, and the Lumbar curve is present in the lower back..

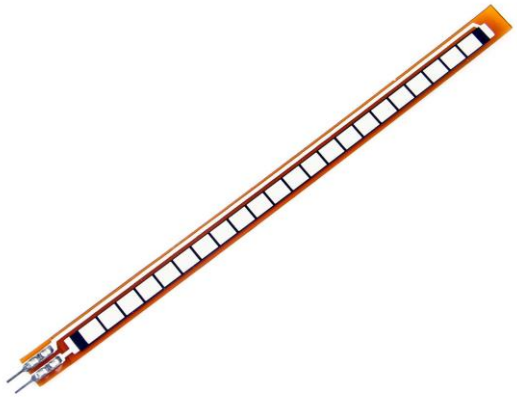
- To identify a posture accurately, all three of these parameters should be considered..



Main Components of *Atlas*

- **Arduino Nano**: The microcontroller used in *Atlas*, chosen due to its small size and good performance

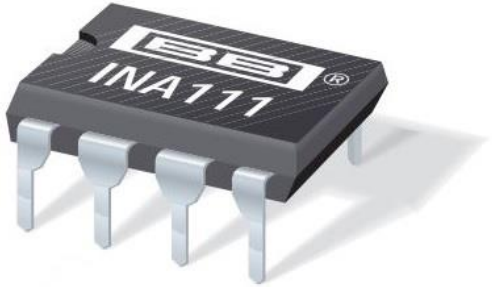
- **Flex Sensor**: A type of sensor capable of detecting curvature variations and bending, used to monitor the spine curves



Main Components

- **ADXL345 Accelerometer**: An angle sensor to measure the inclination of the upper back

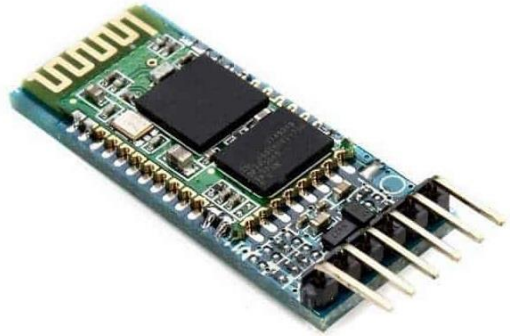
- **INA111 Instrumentation Amplifier**: An amplifier to magnify the readings from the flex sensors



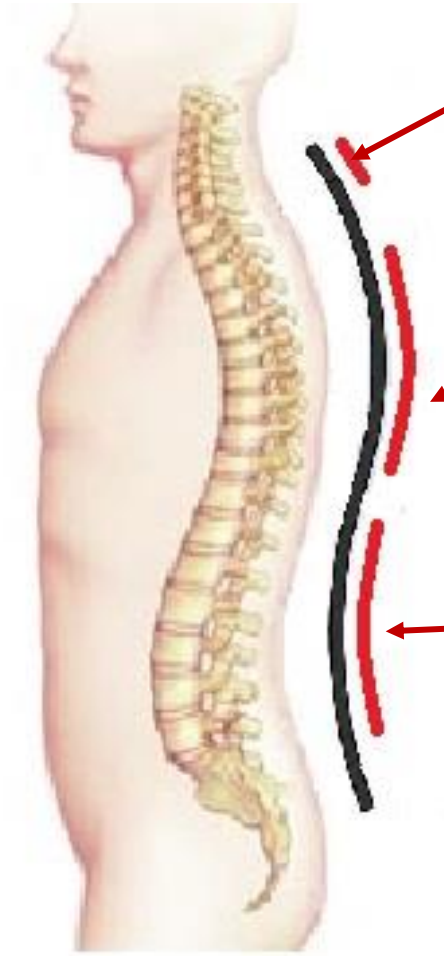
Main Components

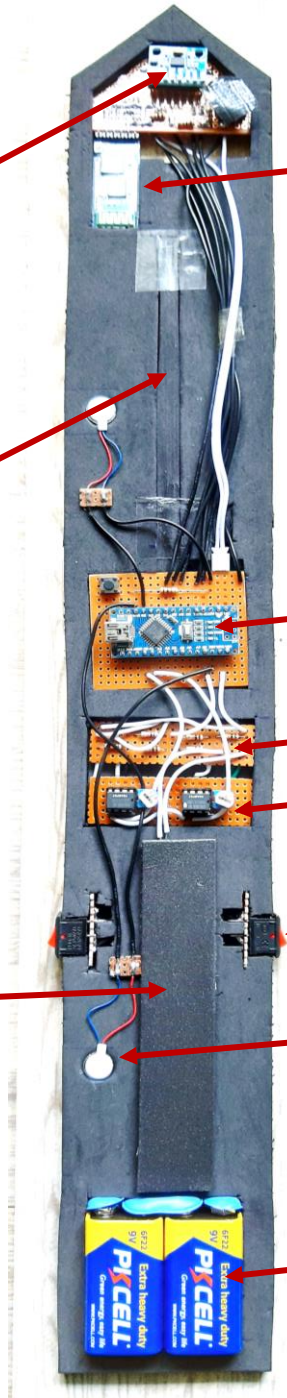
- **Vibration Motor**: A small unbalanced load DC motor to provide haptic feedback via vibrations

- **HC-05 Bluetooth Module**: A networking module to enable data transfer between *Atlas* and a smartphone



Device Internal Layout





Accelerometer

Flex Sensor 1

Flex Sensor 2

Bluetooth Module

Arduino Nano

Whetstone Bridge

Amplifiers

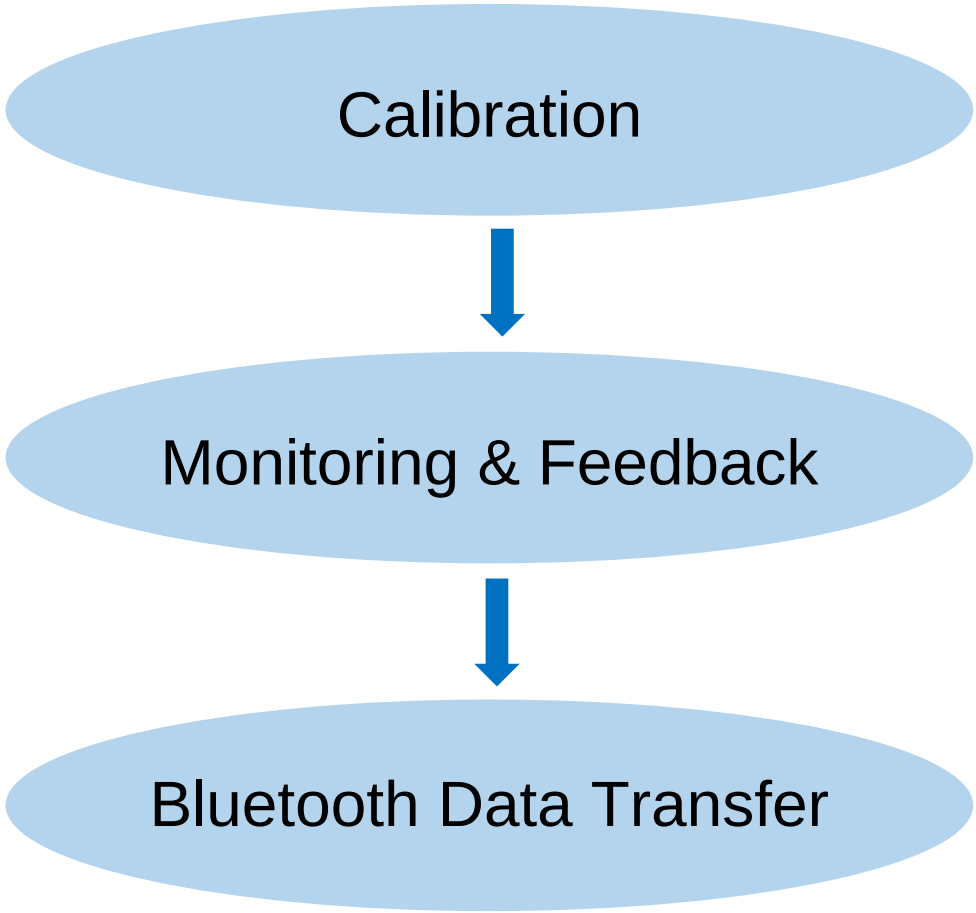
Power Switch

Vibration Motor

Battery

Operating Process of *Atlas*

The operation of the device can be broken down into 3 main steps.



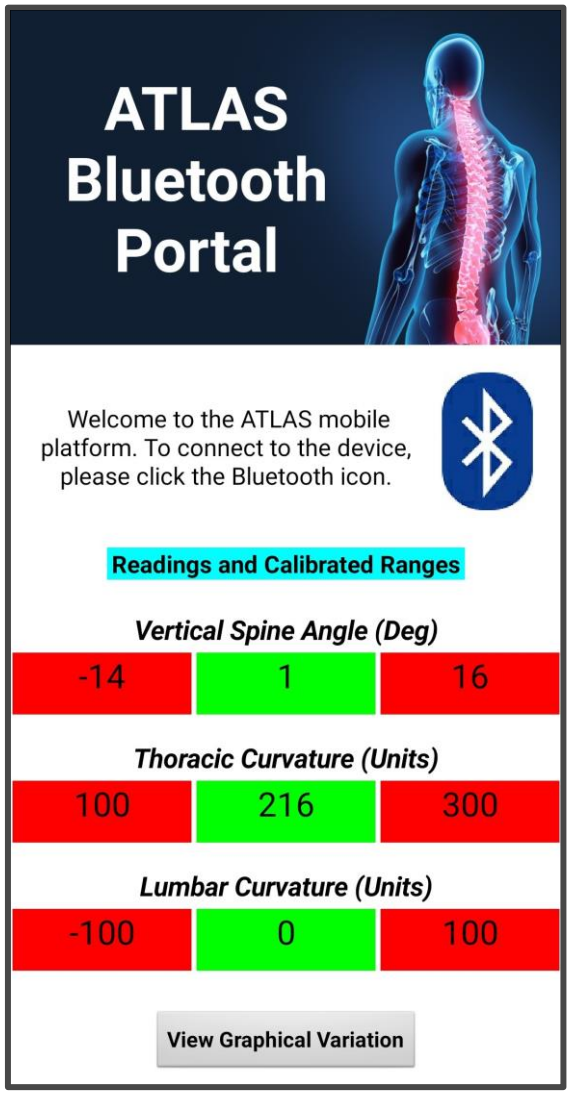
When the calibration button on Atlas is pressed, the current orientation of the device is saved, and the threshold limits are set

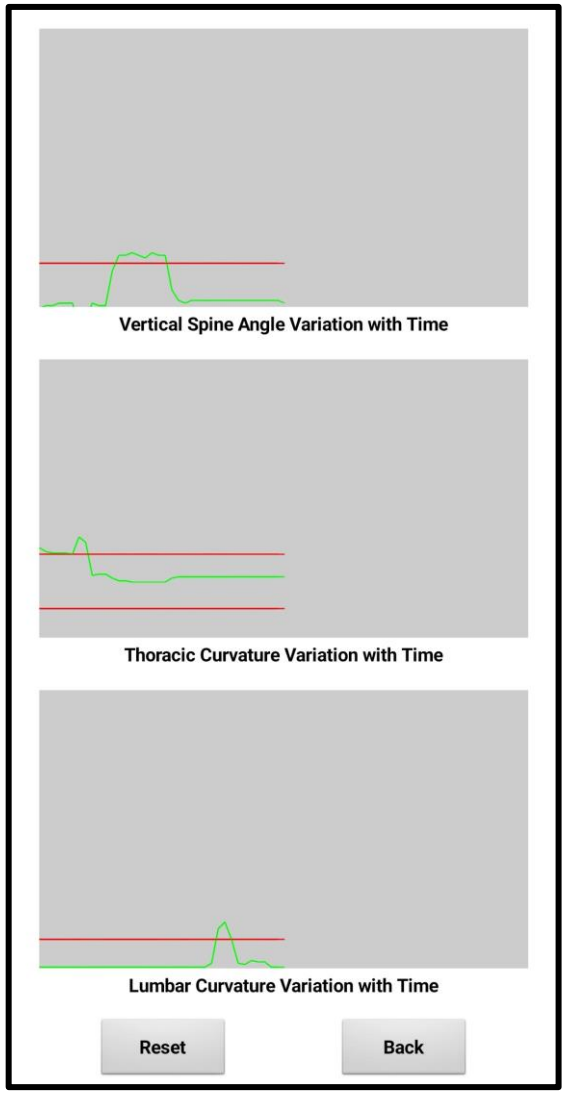
The real time sensor values are read and compared against the threshold limits continuously, and haptic feedback is provided when these limits are exceeded

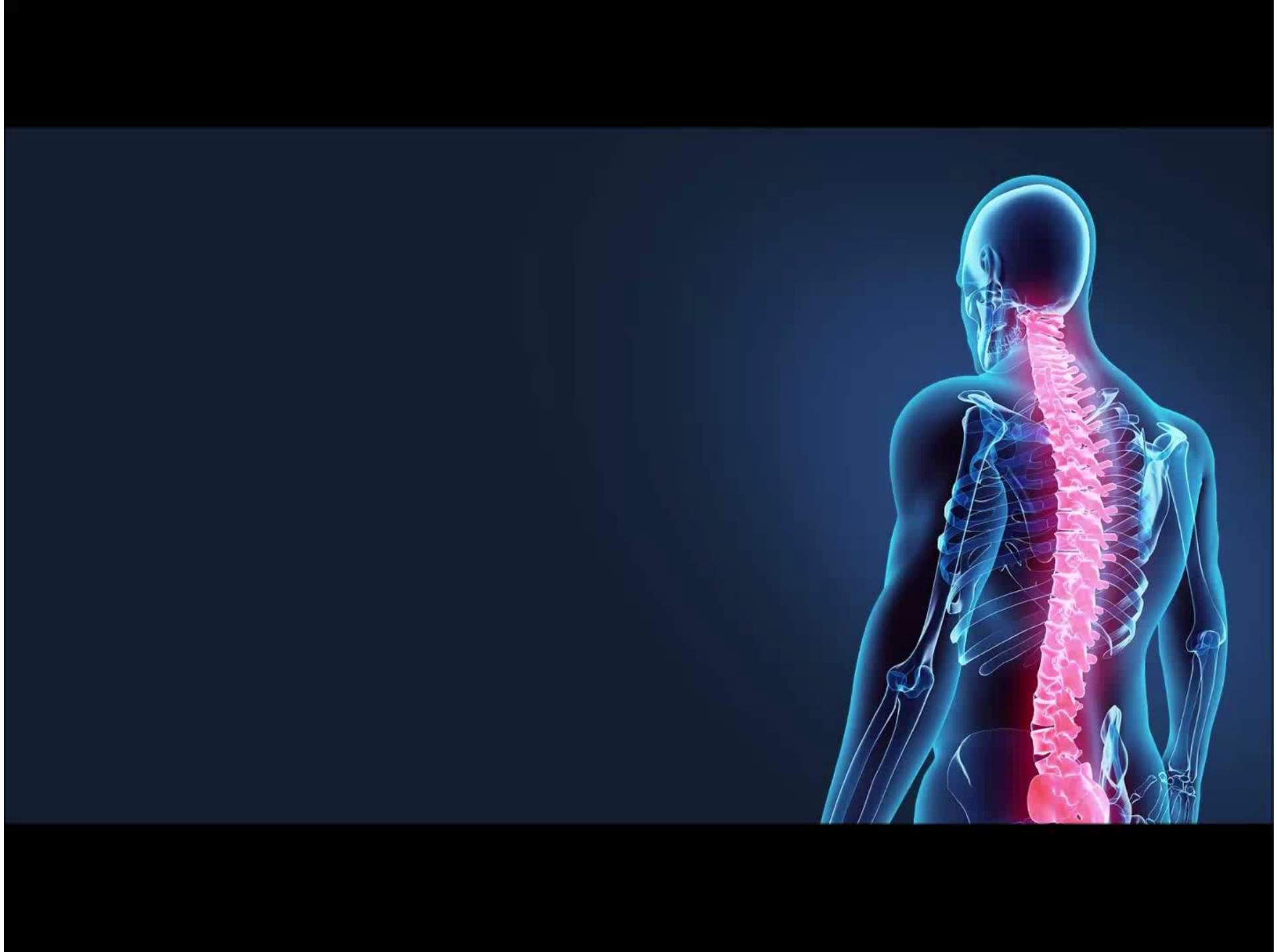
The sensor values and threshold limits are periodically transmitted to the designated smartphone, where the user can track them

Atlas Bluetooth Application

- The Bluetooth portal for Atlas was developed to enable the user to interface with the device..
- The application displays the sensor values, the threshold limits and the time variation of the sensor values..
- The application interface is shown in the figures..







Observations & Findings

- The device is capable of remembering a calibrated posture, in terms of the three sensor readings..
- However, a proper medical grade elastic material for the device body could have significantly improved the device performance..
- The used alternative material was relatively stiff..
- This decreased the sensitivity of the flex sensors, and made the adhesion of the device to the body difficult..
- Overall, the device shows potential of being a practical and accurate posture improving tool..

Future Aspects

Possible Features & Improvements

- Device Housing Material

  A suitable medical grade rubber material should be used in order to adhere to medical standards and regulations..

- Size and Weight

  Smaller electronic circuitry and more intricate fabrication methods could be used to reduce the device size and weight..

Possible Features & Improvements Contd.

- Intracorporeal Energy Harvesting

  Since *Atlas* is a wearable device, implementing a method of harvesting and storing the body energy would be extremely beneficial.

  Two possibilities exist,

1. Thermoelectric energy harvesting : Absorbing thermal energy from the body

2. Piezoelectric energy harvesting : Absorbing energy from movements of the body

Atlas as a Consumer Product

- *Atlas* would initially be aimed towards healthy office employees who spend most of their workday sitting..
- These users should be aware of the health risk they are exposed to, and should be actively looking for a solution..
- The haptic feedback system, Bluetooth portal and the expected increased accuracy could be the main selling points..
- However, significant further modifications in terms of device size, battery life, mode of application and cost would be necessary to ensure market feasibility..

Thank You

Q&A