SenseNet - Unwrapping the Future

An Engineering Project in Community Service

Phase – II Report

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Bonafide Certificate

Certified that this project report titled **" SenseNet- Unwrapping the Future"** is the bonafide work of "20BAI10041 Avrodeep Saha, 20BAI10280 Chahak Garg, Varun Ram S 20BAC10038, Jigar Sharma 20BAC10025, Rachit Goyal 20BCG10066, Om Mani Tripathi 20BCG10076, Prerna Singhal 20BCG10087, Amit Rathore 20BCE11115" who carried out the project work under my supervision.

This project report (Phase II) is submitted for the Project Viva-Voce examination held on …………..

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Comments & Signature (Reviewer 1)

Dr. Soumitra 12.05.23

Comments & Signature (Reviewer 2)

Content

1. INTRODUCTION

A human life is generally divided into five stages: infancy, childhood, adolescence, adulthood and old age. In each of these stages an individual finds himself in different situations and faces different problems. Old age is one of the unavoidable, undesirable and problem ridden phases of life. According to several researches, problems of aging usually start to appear after the age of 65 years. Some of the biggest and most common problems of old age include weakness in eyesight, losing the ability to walk properly due to developing wrong postures, and the danger of several attacks is always there.

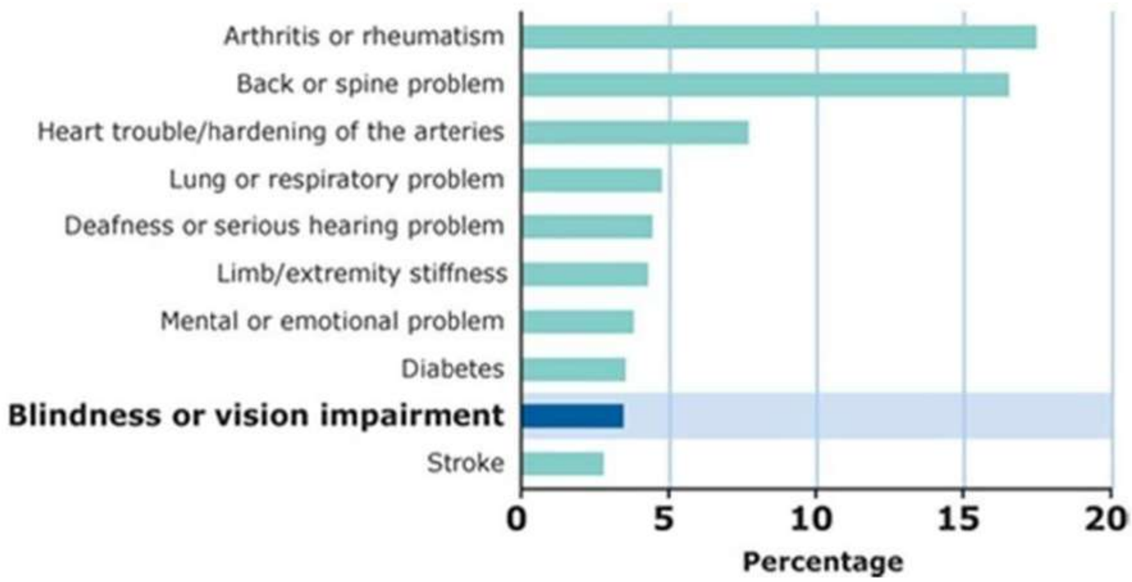


Fig 1.1: Percentage of people suffering from different health issues (taken from a sample of 1000)

1.1 Motivation

Some of the motivations behind the development of SenseNet include:

1. To provide older individuals with a tool to help them manage their health and wellbeing as they age: As individuals get older, they may face a range of challenges and difficulties related to their physical and cognitive abilities. Sensenet may have been developed as a way to address these challenges and help older individuals maintain their independence and quality of life as they age.

2. To improve healthcare outcomes for older individuals: By providing real-time monitoring and alerts, as well as access to various health-related resources, Sensenet may be able to help older

individuals stay informed and take action to address any potential health issues that may arise. This could potentially lead to better healthcare outcomes for older individuals.

3. To reduce the burden on the healthcare system: By providing older individuals with the tools and resources they need to manage their own health, Sensenet may be able to help reduce the burden on the healthcare system and lower the cost of healthcare for older individuals.

4. To provide older individuals with a sense of independence and control: By giving older individuals the resources they need to manage their own health, Sensenet may be able to help them feel more independent and in control of their own well-being.

1.2 Objective

Sensenet is designed to help older individuals manage their health and well-being by providing real-time monitoring and alerts, as well as access to various health-related resources. Some of the objectives of Sensenet include:

- **Declining vision:** By providing visual assistance, such as object and person recognition, Sensenet may be able to help older individuals navigate their environment and interact with others more easily

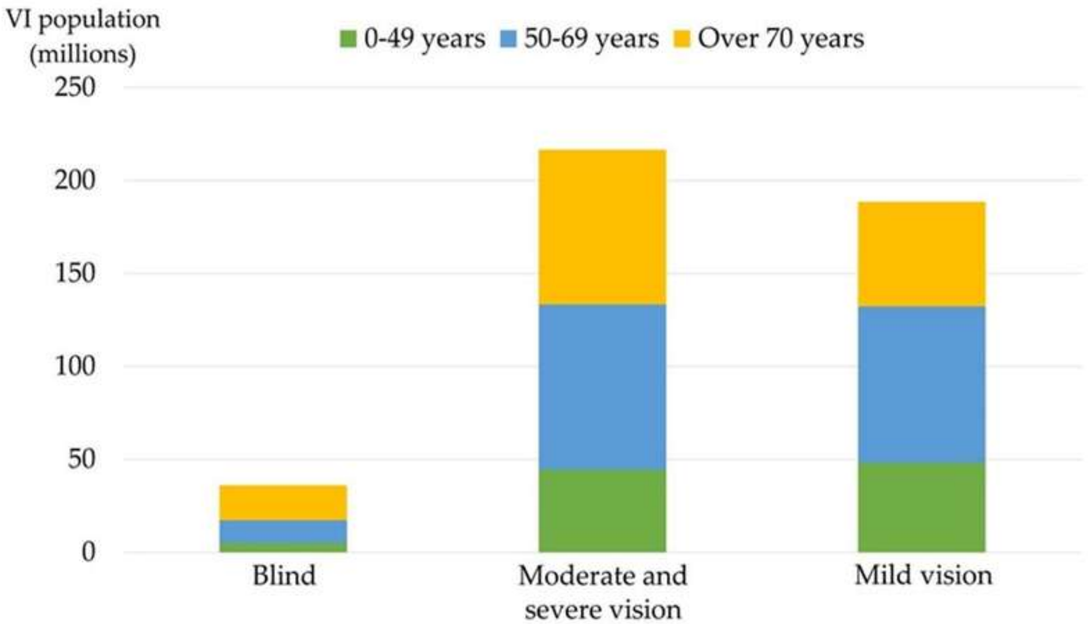


Fig 1.2: Graph showing statistics on Vision issues

- **Difficulty in walking:** A posture checker or other device that helps to maintain good posture and balance may be able to help older individuals reduce their risk of falls and other accidents.

- **Health issues:** A health monitor or other device that tracks vital signs and alerts individuals to potential health concerns may be able to help older individuals stay informed and take action to address any issues that may arise.

2. EXISTING WORK / LITERATURE REVIEW

2.1 Some devices in the market

The existing works are:

1. Upright GO-2 Posture Corrector
    - The Upright GO is a strapless device that attaches to the upper back. It comes with a free smartphone app that allows people to generate a customized training program with daily goals to improve posture.
    - Using multi-sensor technology, the Upright GO vibrates whenever a person slouches or changes position to remind them to correct their posture.
    - Users can adjust the device's sensitivity, training time, and vibration intensity and track their progress in the Upright App.
    - After a person has reached their daily goals, they can switch off these vibrations.
    - This allows the device to continue recording posture without reminding the person to correct themselves.
    - The product's manufacturer says this device can improve a person's posture in 2 weeks.
    - This product includes the Upright GO posture device, a case, a USB charging cable, and a user manual.
        - **List price**: Approximately around $80
        - **Pros:** May improve posture in 2 weeks
        - **Cons**: Relatively expensive
        - **Remarks:** This product is not affordable for a section of the crowd who genuinely need it.

2. ComfyBrace Posture Corrector
    - The ComfyBrace Posture Corrector is a traditional brace that helps relieve chronic back pain.
    - The manufacturer states that the brace takes pressure off of key areas, thereby reducing back, neck, shoulder, and clavicle pain.
    - This product fits people with chest sizes 30–43 inches (in) and works over or under most items of clothing.
    - The manufacturer recommends wearing the brace for 5–10 minutes per day at first before starting to wear it for 1–2 hours at a time.
        - **List price**: Close to $28
        - **Pros**: Has adjustable chest sizing
        - **Cons:** Some reviewers state it chafes under clothes
        - **Remarks**: It is not very comfortable to wear, and there have been multiple other efficiency criticisms from users.

3. Copper Compression Posture Corrector
    - The manufacturer specializes in copper-infused fabric. The website states that copper is antimicrobial, which means that it kills bacteria, viruses, and fungi.
    - This helps prevent odor while wearing the products.
    - The fabric is also moisture-wicking and dries quickly, making the brace appropriate for use during exercise.
    - The Copper Compression Posture Corrector is a posture corrector that offers lumbar support.
    - It has a fully adjustable wrap that goes around the lower back and stomach to give that extra support. The wrap attaches to the upper back brace, which has secured adjustable straps.
    - According to the manufacturer, the product uses targeted pressure to simultaneously straighten the spine and compress the lower back muscles.
    - The company says it prevents slouching and promotes healing.
    - This product comes in three sizes and fits people with 26–42-in waists. The company that makes this product says a person can wear it under any type of clothing.
        - List price: Close to $20
        - Pros: moisture-wicking fabric
        - Cons: some reviewers state it has uncomfortable straps
        - Remarks: Product Is relatively cheaper, however reviewers felt uncomfortable wearing it.

2.2 Research Papers

1) **Paper name -** *The effect of postural correction on muscle activation amplitudes recorded from the cervicobrachial region*

Authors name – Linda McLean

Publisher: Journal of Electromyography and Kinesiology

Date of publishing – 27 April 2005

Summary and Findings:-

Posture had a statistically significant effect on muscle activation amplitudes. Postural correction from habitual or slouched postures did not increase the level of muscle activation required in any muscles studied when seated computer work was performed. Correct posture in sitting required less muscle activity than forward head posture. In standing, postural correction significantly increased the level of muscle activation required to sustain posture as compared to habitual and slouched postures, but not forward head postures. In any case, the clinical relevance of these amplitude changes may be negligible due to the low levels (<7.5% MVE) of activation required. Over a long-duration task, however, these differences may be relevant in terms of muscle irritation and/or fatigue in the neck, shoulder and/or jaw regions. Based on these findings, to correct standing cervico brachial posture, clinicians might consider a graduated approach in order to minimize any risk of patients developing muscle soreness or injury related to overuse when trying to develop improved postural alignment during daily activities.

2) **Paper name -** *Wearable sensor device for posture monitoring and analysis*
Authors name – Gizem Ozgul & Fatma patlar Akbulut
Publisher: International Advanced Researches and Engineering Journal
Date of publishing – 15 April 2022

Summary and Findings:-
Our study's primary motivation is to use accurate information to do physiological characteristic analyses and use accurate evaluation procedures to assess these data in order to improve the quality of life for people with postural abnormalities. Health-conscious individuals believe that in order to "correct" their posture and, to a significant extent, neck pain, headaches, and particularly lower back pain, they must also exercise more. For balance, a precise posture is essential. Not only in daily life but also in the workplace, good posture is essential. For instance, maintaining equilibrium when participating in any sport will improve one's skills and even lengthen the activity. Medical history could be one of the physical causes of poor posture. To remedy negative outcomes in these situations, skilled treatment and diagnosis are required.

3) **Paper name -** *IoT based Smart Posture Detector*
Authors name – Greeshma, Niharika pentapati,Shivangi Gupta,Roopa Ravish
Publisher: Department of Computer science and Engineering, people's Education Society University , Bangalore, India
Date of publishing – 01 June 2019

Summary and Findings:-

The world's expanding technology is quickly changing how people live their lives. A huge rise in sedentary lifestyles has been brought about by industrialization and urbanization in the modern world. People who engage in technology are frequently observed giving up proper posture and hunching over for extended periods of time. The third most frequent cause for people to see the doctor, according to statistics, is back pain. Maintaining good posture is essential for living a healthy lifestyle. However, humans often make compromises when it comes to one of the most fundamental aspects of what makes them human—the capacity to walk upright. By introducing a wearable device that detects a person's posture and transmits real-time data to a phone using Bluetooth, the purpose of this study is to offer a workable solution to this problem by using an app.The posture is noted, and it assigns a grade of Good, Okay, or Bad. Additionally, it provides data and general suggestions on how it may be improved.

3. TOPIC OF THE WORK

3.1 System Design / Architecture

The entire project consists of three parts (for now), eye module, posture correction module and health tracking (through smart watches).

The project consists majorly the following components along with their system architecture:

1) Eye Module:

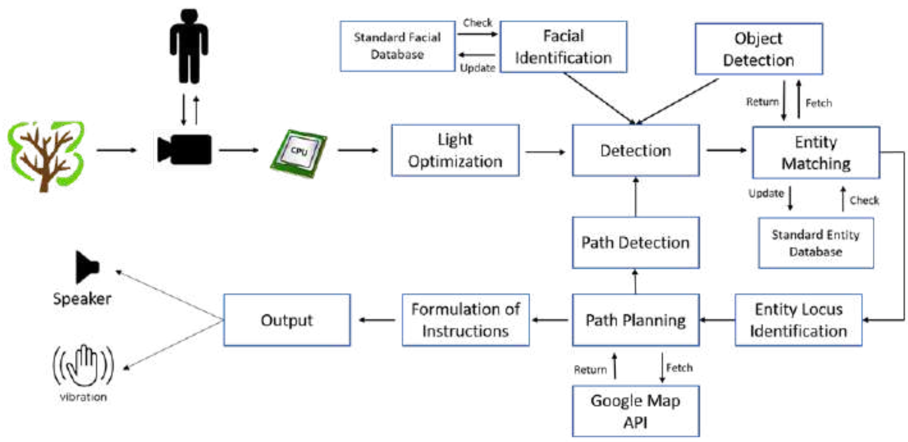


Fig 3.1: Architecture of the Eye module

2) Posture Detection Module

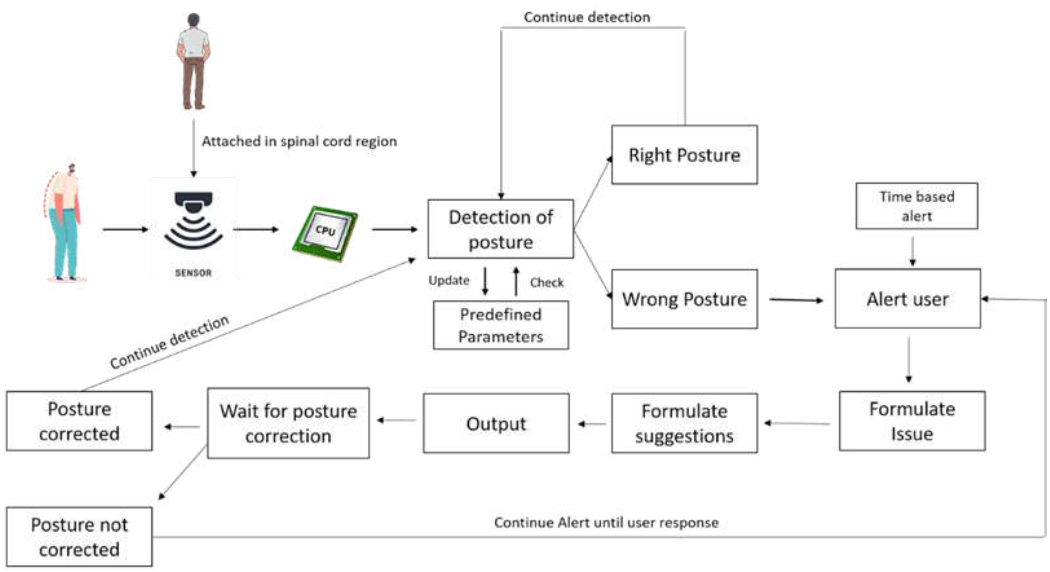


Fig 3.2: Architecture of the Posture Detection Module (Hardware)

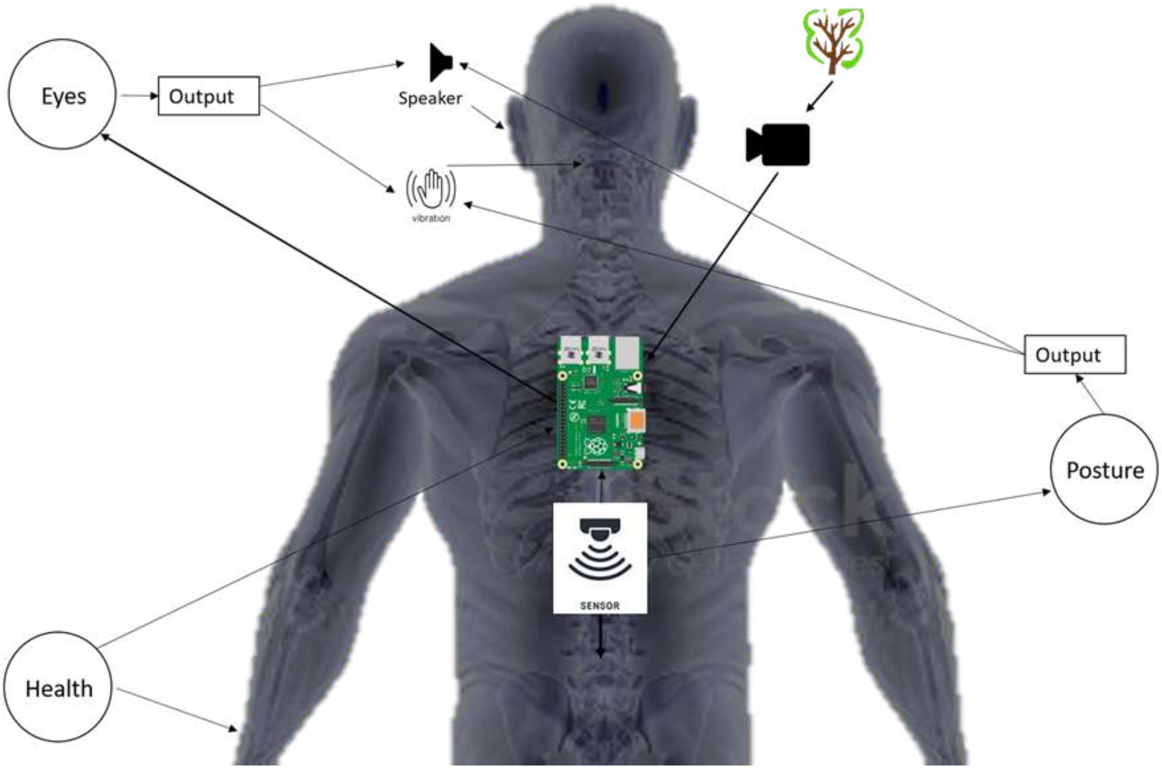


Fig 3.3: Placing the overall system on the human body.

3.2 Working Principle

Background:

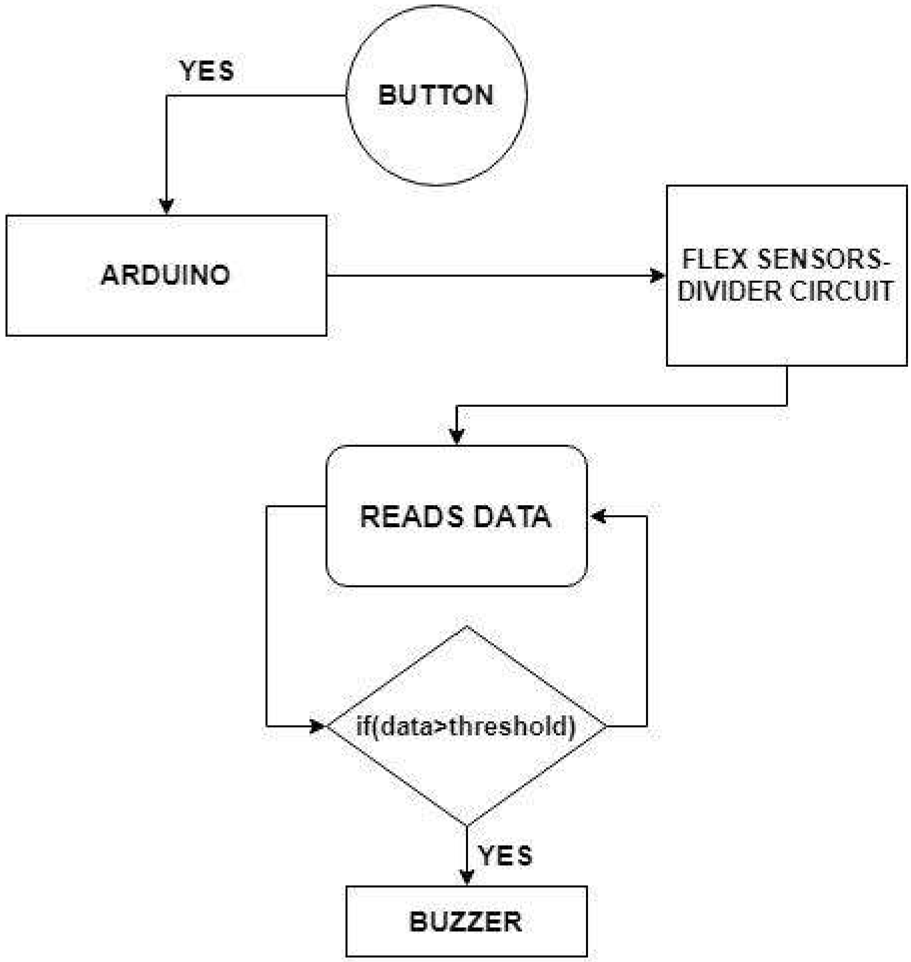
SenseNet as the name suggests Sense and Net is a device that intends to create a network of major senses for better coordination. Although Human body is designed for perfection in coordination, this artificially intelligent technology provides an extra edge to assist the senses.

The working principle of this SenseNet is divided into three major phases –

Phase I – SenseNet for Individuals of all age groups who face the common postural deformity. To maintain a healthy lifestyle and avoid complications including back pain, spinal dysfunction, joint degeneration, rounded shoulders and a potbelly. So, here SenseNet senses the body posture and focuses on helping you in keeping yourself in perfect posture.

Phase II – SenseNet for the Older Generation prevents Kyphosis and assists you as your secondary eye. The foundational stage of Kyphosis is generally the Round Shoulders. So, if we prevent rounded shoulders, we reduce the chances of Kyphosis to 41%. So, SenseNet monitors your posture and alerts you if you tend to loosen your back. Also, presbyopia and cataracts become noticeable issues in old age due to which vision and movement are hindered. So, the smart sense of SenseNet assists you in uncovering the world with your intelligent assistant device.

Phase III – For the final and the most premium phase, we have SenseNet for Visually Impaired people, which demands the best accuracy. It creates a network with the smart glasses for vision and movement, a spine device for the body posture.This keeps the data of the person by creating a sensory network.



3.3 Materials Used:

- ❖ **Hardware Requirements (Posture Corrector)-**
  - ➢ Sensors – Flex Sensors
  - ➢ Microcontroller board - Arduino UNO
  - ➢ Buzzers and LEDs
  - ➢ Arduino IDE
- ❖ **Software Requirements –**
  - ➢ 1. Deep Learning Algorithms -
    - ■ Facial Recognition Module
    - ■ Object Detection Module
    - ■ Path Detection and Google Map API Integration
  - ➢ 2. Additional benefit for tracking postural deformity using PoseNet

3.4 Working Breakdown –

The smart glasses work on the Deep Learning principle where it performs face recognition, objection detection and path detection and helps old aged people or blind people to find their way with the help of smart sense.

Also, the posture correction device is the major focus of the project which works on the IoT based sensors and additionally uses deep learning sense for tracking progress. The main working principle of an accelerometer is that it converts mechanical energy into electrical energy. When a mass is kept on the sensor which is actually just like a spring it starts moving down. Since it is moving down it starts experiencing acceleration. That acceleration then gets converted into an amount of electric signal which is used for measuring variation in the position of the device. The accelerometer can be found with both analog forms analogue as well as digital form devices. Not just like any other device would work, it happens to look like a simple circuit for some larger electronic device despite its simple appearance, it consists of many different varieties of parts which of course have their own functions and work in many ways.

The PoseNet intends to track progress using inbuilt camera of Laptop/Phone on which App is installed and the user needs to stand or sit in front of it so, that his coordinates can be tracked and this coordinate is then kept in a database which can find the elevation or depression from ideal postural coordinates using mathematical principle of Distance Formula.

Smart detection of heart rate and SpO_2 is one of the features of this device kit again holding the sensors and IoT. A smart sensor is a device that takes input from the physical environment and uses built-in compute resources to perform predefined functions upon detection of specific input and then process data before passing it on.

3.5 Results and Discussion

The hardware and software implementation results are discussed separately as follows:

(i) Software Implementation Results

Our software is a smart AI assistant designed to provide assistance to blind people. The purpose of the software is to help blind people navigate their surroundings more easily and independently. The software uses a combination of facial detection using Siamese network, path detection using TensorFlow modules, and object detection using YOLO algorithm to provide assistance to the user.

1. Technologies Used:

   The software was developed using Python programming language, OpenCV library for computer vision, TensorFlow for machine learning, and Flask framework for web development. We used the Siamese network for facial detection, TensorFlow modules for path detection, and YOLO algorithm for object detection.

2. Facial Detection:

   We used the Siamese network for facial detection, which is a deep learning algorithm that compares two images and determines whether they are of the same person or not. We trained the network on a large dataset of facial images to ensure high accuracy. The network is able to detect faces in real-time and provide audio feedback to the user.

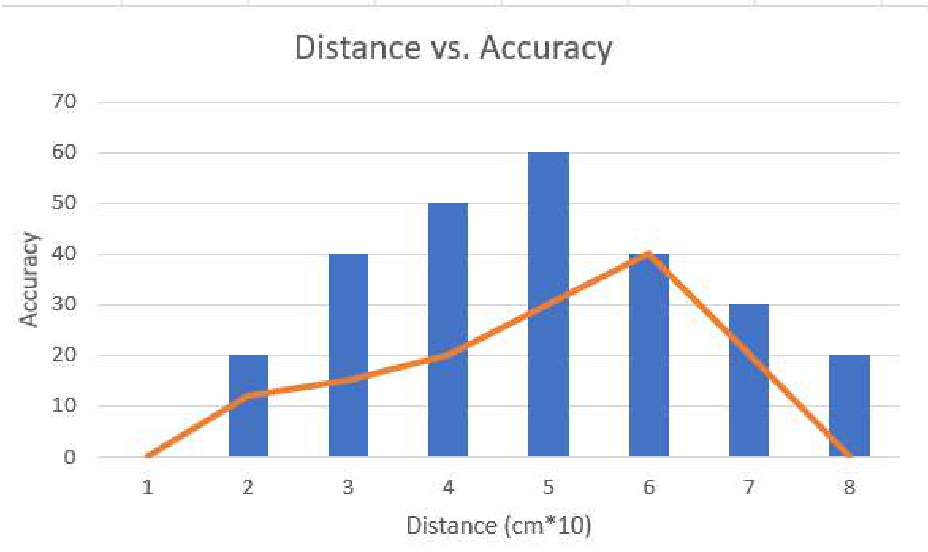


Fig 3.4 : The Distance vs Accuracy Graph

3. Path Detection:

   We used TensorFlow modules for path detection, which is a machine learning algorithm that can detect the user's path and provide audio feedback to the user. We trained the algorithm on a dataset of images of different paths to ensure high accuracy. The algorithm is able to detect the user's path in real-time and provide audio feedback to the user.

   Indications-

   Stop:

Fig 3.5 Recommendation to Stop

Moving Left:

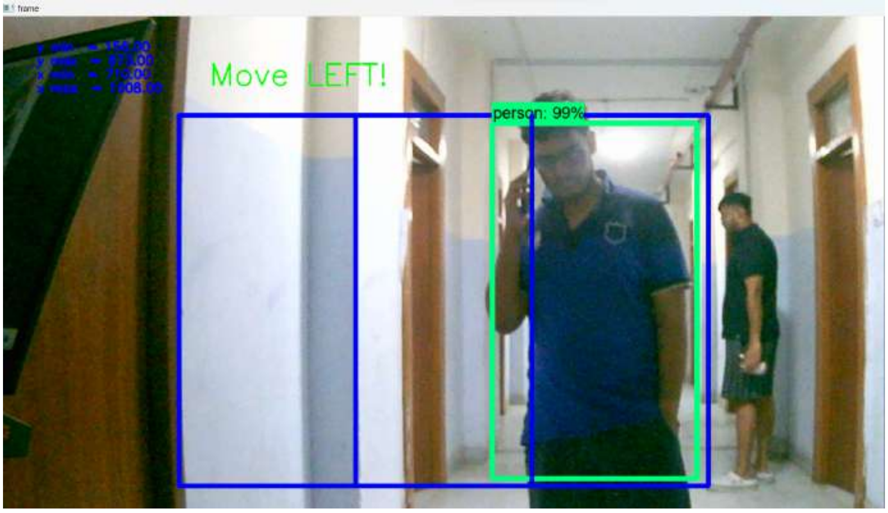


Fig. 3.6 Recommendation to Move Left

Moving Right:

Fig 3.7. Recommendation to move right

4. Object Detection:

   We used the YOLO algorithm (Tiny YOLO) for object detection, which is a deep learning algorithm that can detect objects in the user's surroundings and provide audio feedback to the user. We trained the algorithm on a large dataset of images of different objects to ensure high accuracy. The algorithm is able to detect objects in real-time and provide audio feedback to the user.

Performance on the COCO Dataset

Model	Train	Test	mAP	FLOPS	FPS	Cfg	Weights
SSD300	COCO trainval	test-dev	41.2	-	46		link
SSD500	COCO trainval	test-dev	46.5	-	19		link
YOLOv2 608x608	COCO trainval	test-dev	48.1	62.94 Bn	40	cfg	weights
Tiny YOLO	COCO trainval	test-dev	23.7	5.41 Bn	244	cfg	weights

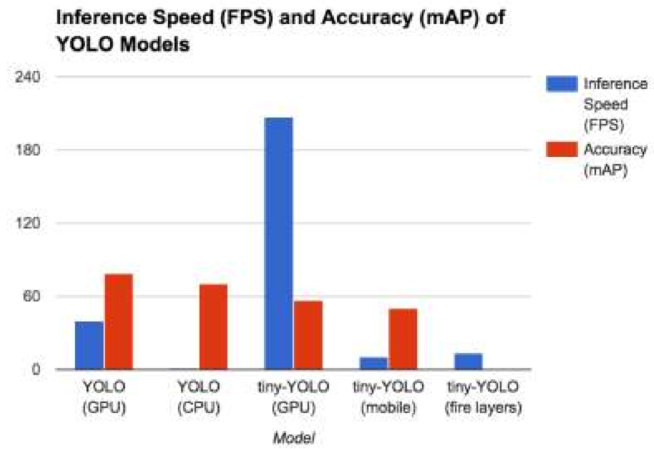


Fig 3.7 (a) Performance on COCO Dataset, (b) Inference speed vs Accuracy

5. Technical Details:

   In addition to the technologies used, we also implemented several technical details to improve the performance and accuracy of the software. These include:

   - **Pre-processing:** We pre-processed the images before feeding them into the algorithms to improve the accuracy of the detection. This included resizing the images, converting them to grayscale, and applying filters to remove noise.
   - **Post-processing:** We applied post-processing techniques to the output of the algorithms to improve the accuracy of the detection. This included non-maximum suppression to remove overlapping detections and thresholding to remove false positives.
   - **Audio feedback:** We used text-to-speech technology to provide audio feedback to the user. This allowed the user to receive real-time feedback on the detection results.

6. Performance:

   The software has been tested extensively, and the results show that it has a high accuracy rate for facial detection, path detection, and object detection. The software is also fast and efficient, with minimal lag time between detection and feedback.

Fig 3.8. Performance and Progress Evaluation

7. User Feedback:

   Blind users (Test Users) who have used the software have provided positive feedback, stating that the software has helped them navigate their surroundings more easily and independently. They have also provided suggestions for improvement, such as adding more languages and improving the chatbot's responses.

(ii) Hardware Implementation Results

Phase 1: Mere Flex Sensor Approach

In the first phase of the mere flex sensor approach, we have not used any feedback element and merely calculated the bend from the flex sensor and the respective change of resistance. This approach was the preliminary step before the Buzzer and LED based approach.

Felx_simplesketch.ino

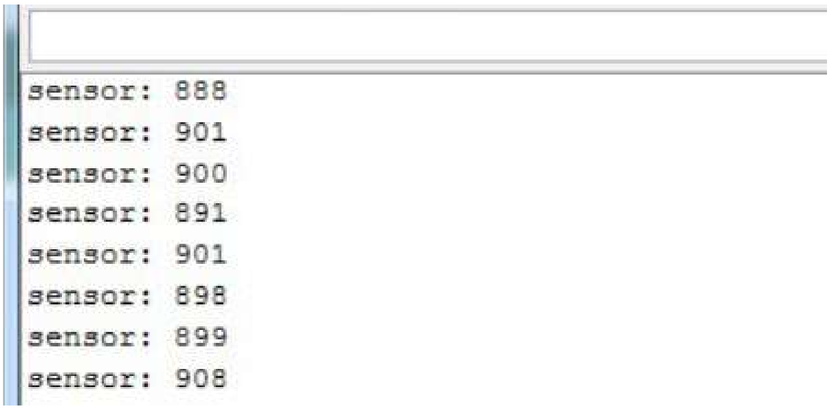
```
const int flexPin = A0;
const float VCC = 5;
const float R_DIV = 47000.0;
const float flatResistance = 25000.0;
const float bendResistance = 100000.0;
void setup() {
  Serial.begin(9600);
  pinMode(flexPin, INPUT);
}

void loop()
{

  int ADCflex = analogRead(flexPin);
  float Vflex = ADCflex * VCC / 1023.0;
  float Rflex = R_DIV * (VCC / Vflex - 1.0);
  Serial.println("Resistance: " + String(Rflex) + " ohms");
  float angle = map(Rflex, flatResistance, bendResistance, 0, 90.0);
  Serial.println("Bend: " + String(angle) + " degrees");
  Serial.println();

  delay(500);
}
```

Output

```
Sketch uses 6450 bytes (19%) of program storage space. Maximum is 32256 bytes.
Global variables use 232 bytes (11%) of dynamic memory, leaving 1816 bytes for local variables. Maximum is 2048 bytes.
```

Fig 3.9 (a) Code for the Mere Flex Sensor Approach, (B) Implementation on hardware

The raw value change was something like this:



```
sensor: 888
sensor: 901
sensor: 900
sensor: 891
sensor: 901
sensor: 898
sensor: 899
sensor: 908
```

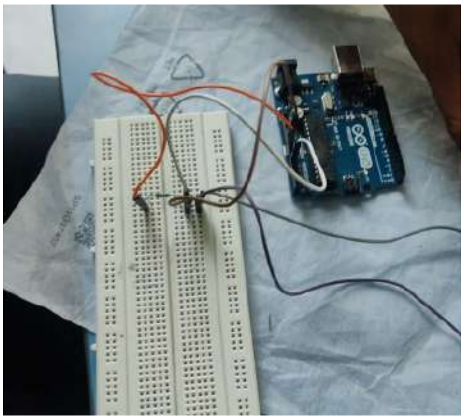
Fig. 3.10. Output for the mere flex sensor approach

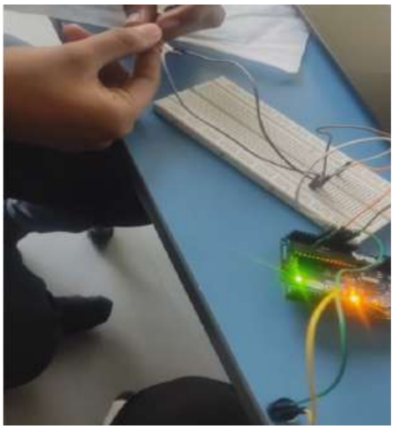
Phase 2:Buzzer based Approach

In this approach, we have integrated the Arduino and the flex sensor with a Buzzer that would buzz when the bend angle is greater than a certain value. In our case study, the value was chosen to be 220 degrees which also served as the threshold for buzzing. Here, the Flex Sensor was connected to the A0 pin of the Arduino and the Buzzer was connected to pin 5.

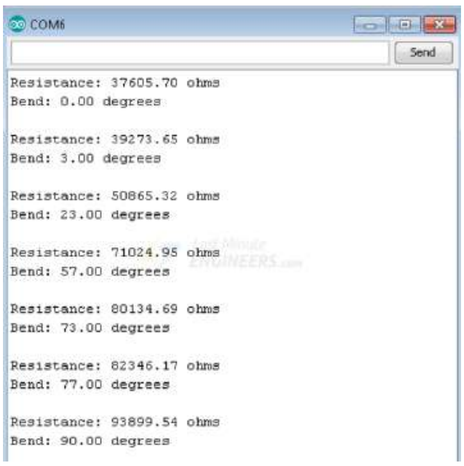

```
int flexs = A0;
int flexdata = 0;
int buzzer = 5;

void setup()
{
  Serial.begin(9600);
  pinMode(flexs, INPUT);
  pinMode(buzzer, OUTPUT);
}
void loop()
{

 flexdata = analogRead(flexs);
Serial.print("flex value;");
Serial.print(flexdata);
Serial.println("");
if( flexdata < 220)
{
  analogWrite(buzzer, 150);
}

if( flexdata > 220)
{
  analogWrite(buzzer, 0);
}

  delay(1000);

}
```

Fig. 3.11 (a) Code for Buzzer based approach, (b) Implementation 1, (c) Working final





Here are the changes in resistance values for different bend values which were recorded on another window within the Arduino IDE. This serves as the primary output for our understanding.




```
Resistance: 37605.70 ohms
Bend: 0.00 degrees

Resistance: 39273.65 ohms
Bend: 3.00 degrees

Resistance: 50865.32 ohms
Bend: 23.00 degrees

Resistance: 71024.95 ohms
Bend: 57.00 degrees

Resistance: 80134.69 ohms
Bend: 73.00 degrees

Resistance: 82346.17 ohms
Bend: 77.00 degrees

Resistance: 93899.54 ohms
Bend: 90.00 degrees
```

Fig. 3.12 On Screen Output for the Buzzer based approach

Phase 3: LED based Approach

In this approach, we used 5 LEDs connected to 10k ohm resistors. The LEDs are expected to glow when the flex angle exceeds a given threshold. The primary result here was that the LEDs had high value (Digital 1) when the flex sensors exceeded the bent limit.

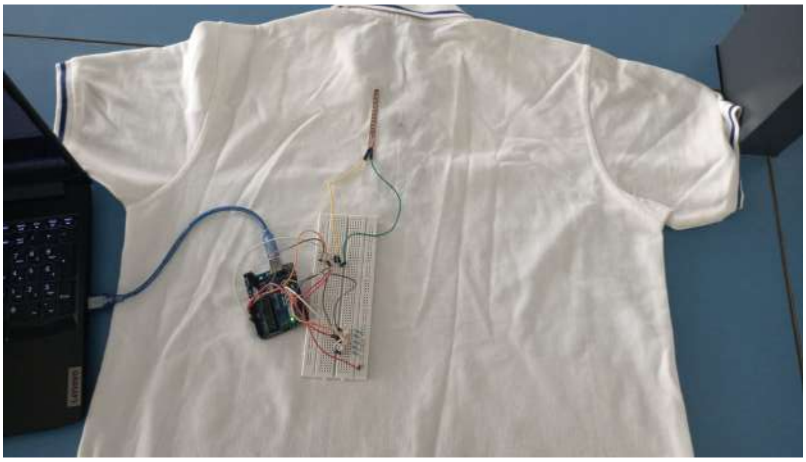


Fig. 3.13 Usage of the Hardware on the T shirt

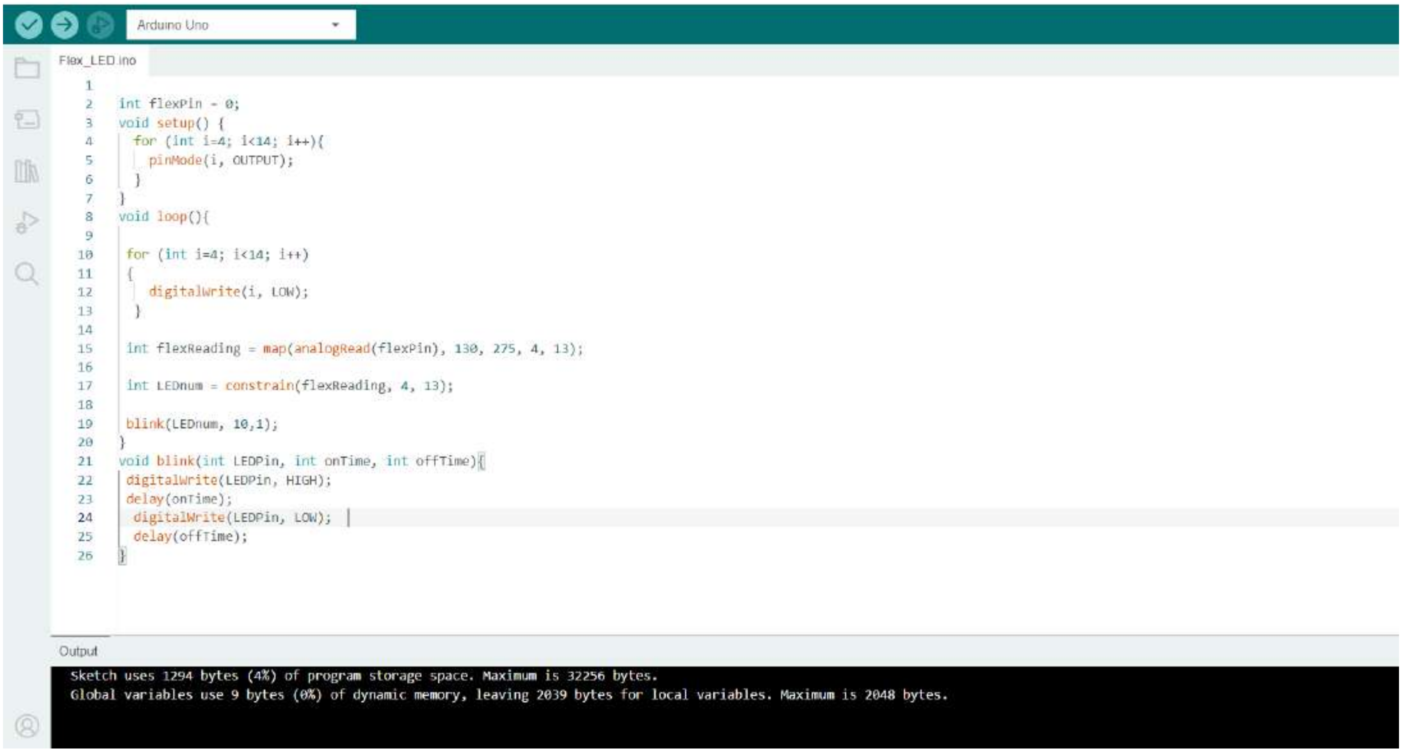


Fig. 3.14 Code for the LED based approach

3.6 Individual Contribution of Project stakeholders

Member 1: Avrodeep Saha (20BAI10041)

Role: AI Developer (Path Detection, Text and Speech Conversions, Modularization)

As a Path Detection Engineer in the project, I spearheaded the development of path detection functionality and played a pivotal role in delivering a high-quality, user-friendly product. I pioneered the modularization of the project for improved scalability and maintainability, and innovated the text-to-speech conversion feature for enhanced accessibility along with my teammate Chahak Garg (20BAI10280). To ensure seamless integration of path detection functionality, I collaborated with cross-functional teams and optimized the path detection module for real-time performance. I also streamlined the path detection algorithm for improved accuracy and efficiency, and demonstrated exceptional problem-solving skills in overcoming technical challenges. Overall, my contribution significantly contributed to the success of the project, and I am proud to have played a key role in developing a product that can make a positive impact on people's lives.

Member 2: Chahak Garg (20BAI10280)

Role: AI Developer (Object Detection, Text and Speech Conversions)

As the Object Detection Engineer in the project, I orchestrated the development of object detection functionality using Tiny YOLO, and optimized the algorithm for improved accuracy and efficiency. I also directed the training of the object detection model for optimal performance, and collaborated with teams across different departments to ensure the smooth integration of object detection functionality with other project components. In addition to my technical contributions, I demonstrated exceptional problem-solving skills in overcoming technical challenges, and worked closely with my teammate Avrodeep Saha (20BAI10041) to develop the text-to-speech conversion feature, which greatly enhanced the accessibility of the product. My ability to communicate effectively and collaborate with others was instrumental in the success of the project, and I am proud to have contributed to the development of a product that can make a change.

Member 3: Varun Ram S (20BAC10038)

Role: Hardware and IOT Engineer - Working with flex sensor and microcontroller

My primary contribution and role in this project was to extrapolate literature review papers related to different sensors and hardware equipment that are used for Human Posture correction. I had collaborated with Team Member 4(Jigar Sharma 20BAC10025) and Team Member 8(Amit Rathore 20BCE) for working and researching with the hardware. I also reviewed both the approaches used for the posture correction, ie. Buzzer based feedback approach and LED based feedback approach. I was also involved in palcing the hardware on a comfortable physical wearable device (A flexible loose T-shirt) in our case. The hardware that was connected together with the proposed circuit diagram and the code for the same was written from scratch on the Arduino IDE. After writing the code, it had to be uploaded on the Arduino board following which software debugging and hardware interrupts had to be dealt with. As a hardware+IOT Engineer, this project helped me to understand the art of integrating hardware and software and also how we can use hardware components for Electronics and Biomedical applications in an efficient way. This project also gave me exposure to Embedded Machine learning (Hardware + ML) which is in the tables of top trends for the upcoming decades.

Member 4: Jigar Sharma (20BAC10025)

Role: Hardware Engineer - Integration of Hardware Components

My primary role was to contribute towards the integration of all the components required to make sure that our device is functioning well. I did it with two of my team members Varun Ram S (20BAC10038) and Amit Rathore(20BCE11115) for working on the IOT part after integration of hardware components together. I integrated the flex sensor on an Arduino board and also a buzzer and led light was connected in order to show the output. The hardware was connected according to the circuit which I researched in various research papers and web articles. After the integration of hardware, we wrote the code for Arduino in Arduino IDE. This role helped me a lot to get hands-on experience in working with embedded systems.

Member 5: Rachit Goyal (20BCG10066)

Role: NLP Engineer - Chat GPT integration

My primary role was to research and integrate chat gpt with our device. One of the primary contributions involved integrating ChatGPT's technology with the device's existing software and hardware systems, ensuring that ChatGPT's technology is compatible with the device's hardware, this would involved testing the software on different hardware configurations, identifying any compatibility issues, and resolving those issues to ensure that ChatGPT can operate effectively on the device. I also contributed in testing ChatGPT's technology on the device, identifying any bugs or errors, and resolving those issues to ensure that the software runs smoothly.

Member 6: Om Mani Tripathi (20BCG10076)

Role: Researcher and Collaborator

My responsibilities was to research the software and hardware on the existing work/tools which are available in the market. I ended up reviewing the Research papers and finding out some of the best posture detection tools which are available in the market. We came to know that the posture detection which are available in the market are a bit high in cost and also uncomfortable to wear. The issues were like high cost, poor quality of belts, etc. Also worked on the research of the tools/technologies which the existing tools use and finding the best possible tool which we can use in our hardware device.

Member 7: Prerna Singhal (20BCG10087)

Role: Computer Vision Engineer - Face Detection integration

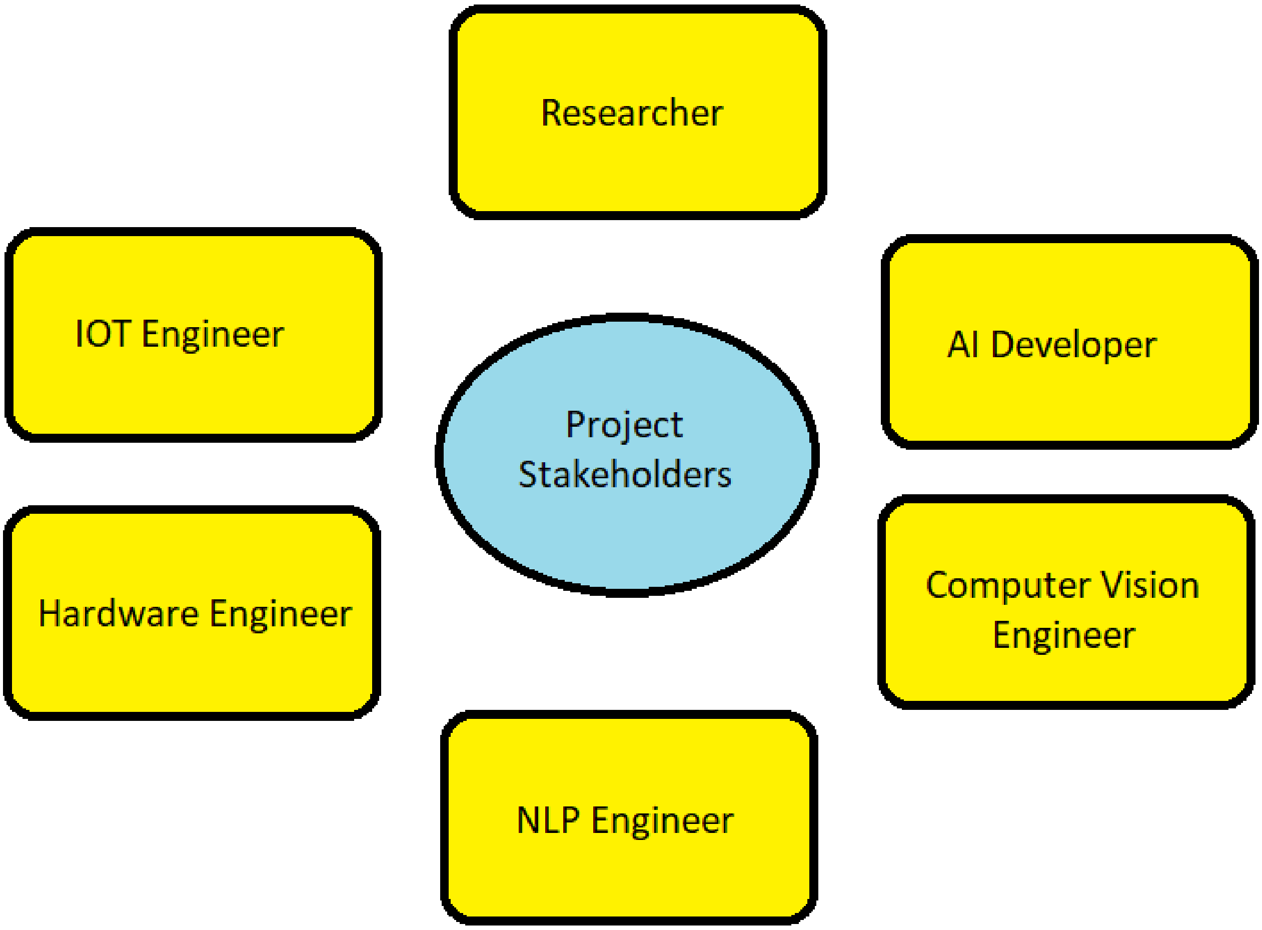
My main contribution focused on developing and implementing the software that enables the device to detect and recognize human faces. designing and implementing the software that enables the device to analyze image and video data and identify human faces. I designed and implemented the algorithm that enables the device to analyze images and identify human faces. I also developed software that interfaces with the device's camera or other sensors to collect images and process it for face detection. I also contributed to testing the software on different devices and in different lighting conditions, identifying and resolving any bugs or errors, and validating the accuracy and reliability of the face detection system. Finally, I optimized the face detection module for performance, so that it can run efficiently on the device's hardware and deliver accurate results in real-time.

Member 8: Amit Rathore

Role: IOT Engineer - Working with the code for microcontroller

My primary contribution to the project and role was to Finding and assembling the necessary hardware components was part of my job as an integration for a project using flex sensors and LEDs, along with design. For the study report, I also completed research analysis and a literature review. In addition to integrating the hardware and performing research, I created code to link the flex sensors with the microcontroller board linked with Arudino and control the LEDs based on sensor output. I wrote the code, collaborated with Member 3(Varun Ram 20BAC10038) on software, assembled hardware, and contributed to research overall in my work.

Team Overview:



4. CONCLUSION

After conducting a thorough analysis of the Sensenet posture correction device, it can be concluded that this device has the potential to be an effective tool for improving posture and reducing the risk of musculoskeletal disorders.

The Sensenet device uses advanced sensors and algorithms to detect and correct poor posture, providing real-time feedback to the user. It is user-friendly, lightweight, and can be worn comfortably for extended periods of time.

The device's app also provides users with detailed insights into their posture habits, allowing them to track their progress over time and make necessary adjustments.

Overall, the Sensenet device shows promise as a valuable tool for individuals seeking to improve their posture and reduce the risk of associated health problems. Further research and user testing may be necessary to fully assess its effectiveness and potential impact on long-term health outcomes.

5. RECOMMENDATIONS

Some of the recommendations suggested by the project team include:

- Research and examine the various sorts of stance revision gadgets accessible on the lookout. This could incorporate back supports, pose corrector shirts, and wearable innovation gadgets.
- Searching for logical proof supporting the viability of stance adjustment gadgets. This could include investigating concentrates that have been directed on the advantages of utilizing such gadgets and their effect on spinal wellbeing.
- Analyzing the various brands and models of stance amendment gadgets, considering their highlights, cost, and client surveys.
- Consider the moral ramifications of advancing the utilization of stance remedy gadgets. For instance, does it add to a culture of body disgracing and the possibility that actual appearance is a higher priority than wellbeing?
- Examine the likely downsides of utilizing stance rectification gadgets, like the gamble of reliance on the gadget and the chance of causing muscle shortcoming after some time.

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[1]] R. M. Shubair and A. Al-Merri, “Robust algorithms for direction finding and adaptive beamforming: performance and optimization,” in The 2004 47th Midwest Symposium on Circuits and Systems, 2004. MWSCAS ’04, vol. 2, Jul. 2004, pp. II–589–II–592 vol.2

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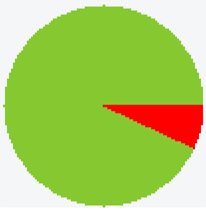

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1. INTRODUCTION A human life is generally divided into five stages: infancy, childhood, adolescence, adulthood and old age. In each of these stages an individual finds himself in different situations and faces different problems. Old age is one of the unavoidable, undesirable and problem ridden phases of life. According to several researches, problems of aging usually start to appear after the age of 65 years. Some of the biggest and most common problems of old age include weakness in eyesight, losing the ability to walk properly due to developing wrong postures, and the danger of several attacks is always there. 1. 1 Motivation Some of the motivations behind the development of SenseNet include: 1. To provide older individuals with a tool to help them manage their health and wellbeing as they age: As individuals get older, they may face a range of challenges and difficulties related to their physical and cognitive abilities. Sensenet may have been developed as a way to address these challenges and help older individuals maintain their independence and quality of life as they age. To improve healthcare outcomes for older individuals: By providing real-time monitoring and alerts, as well as access to various health-related resources, Sensenet may be able to help older individuals stay informed and take action to address any potential health issues that may arise. This could potentially lead to better healthcare outcomes for older individuals. To reduce the burden on the healthcare system: By providing older individuals with the tools and resources they need to manage their own health, Sensenet may be able to help reduce the burden on the healthcare system and lower the cost of healthcare for older individuals. To provide older individuals with a sense of independence and control: By giving older individuals the resources they need to manage their own health, Sensenet may be able to help them feel moreindependent and in control of their own well-being. Objective Sensenet is designed to help

older individuals manage their health and well-being by providing real-time monitoring and alerts, as well as access to various health-related resources. Some of the objectives of Sensenet include: Declining vision: By providing visual assistance, such as object and person recognition, Sensenet may be able to help older individuals navigate their environment and interact with others more easily. Difficulty in walking: A posture checker or other device that helps to maintain good posture and balance may be able to help older individuals reduce their risk of falls and other accidents. Health issues: A health monitor or other device that tracks vital signs and alerts individuals to potential health concerns may be able to help older individuals stay informed and take action to address any issues that may arise. Principle – The smart glasses work on the Deep Learning principle where it performs face recognition, objection detection and path detection and helps old aged people or blind people to find their way with the help of smart sense. Also, the posture correction device is the major focus of the project which works on the IoT based sensors and additionally uses deep learning sense for tracking progress. The main working principle of an accelerometer is that it converts mechanical energy into electrical energy. When a mass is kept on the sensor which is actually just like a spring it starts moving down. Since it is moving down it starts experiencing acceleration. That acceleration then gets converted into an amount of electric signal which is used for measuring variation in the position of the device. The accelerometer can be found with both analog forms analogue as well as digital form devices. Not just like any other device would work, it happens to look like a simple circuit for some larger electronic device despite its simple appearance, it consists of many different varieties of parts which of course have their own functions and work in many ways. The PoseNet intends to track progress using inbuilt camera of Laptop/Phone on which App is installed and the user needs to stand or sit in front of it so, that his coordinates can be tracked and this coordinate is then kept in a database which can find the elevation or depression from ideal postural coordinates using mathematical principle of Distance Formula. Smart detection of heart rate and SpO2 is one of the features of this device kit again holding the sensors and IoT. A smart sensor is a device that takes input from the physical environment and uses built-in compute resources to perform predefined functions upon detection of specific input and then process data before passing it on. Results and DiscussionThe hardware and software implementation results are discussed separately as follows: Software Implementation ResultsOur software is a smart AI assistant designed to provide assistance to blind people. The purpose of the software is to help blind people navigate their surroundings more easily and independently. The software uses a combination of facial detection using Siamese network, path detection using TensorFlow modules, and object detection using YOLO algorithm to provide assistance to the user. Technologies Used:The software was developed using Python programming language, OpenCV library for computer vision, TensorFlow for machine learning, and Flask framework for web development. We used the Siamese network for facial detection, TensorFlow modules for path detection, and YOLO algorithm for object detection.Facial Detection:We used the Siamese network for facial detection, which is a deep learning algorithm that compares two images and determines whether they are of the same person or not. We trained the network on a large dataset of facial images to ensure high accuracy. The network is able to detect faces in real-time and provide audio feedback to the user. Path Detection:We used TensorFlow modules for path detection, which is a machine learning algorithm that can detect the user's path and provide audio feedback to the user. We trained the algorithm on a dataset of images of different paths to ensure high accuracy. The algorithm is able to detect the user's path in real-time and provide audio feedback to the

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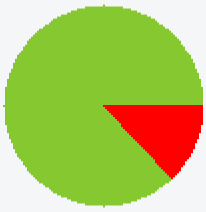

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3.2 Working Principle

Background:

SenseNet as the name suggests Sense and Net is a device that intends to create a network of major senses for better coordination. Although Human body is designed for perfection in coordination, this artificially intelligent technology provides an extra edge to assist the senses.

The working principle of this SenseNet is divided into three major phases –

Phase I – SenseNet for Individuals of all age groups who face the common postural deformity. To maintain a healthy lifestyle and avoid complications including back pain, spinal dysfunction, joint degeneration, rounded shoulders and a potbelly. So, here SenseNet senses the body posture and focuses on helping you in keeping yourself in perfect posture.

Phase II – SenseNet for the Older Generation prevents Kyphosis and assists you as your secondary eye. The foundational stage of Kyphosis is generally the Round Shoulders. So, if we prevent rounded shoulders, we reduce the chances of Kyphosis to 41%. So, SenseNet monitors your posture and alerts you if you tend to loosen your back. Also, presbyopia and cataracts become noticeable issues in old age due to which vision and movement are hindered. So, the smart sense of SenseNet assists you in uncovering the world with your intelligent assistant device.

Phase III – For the final and the most premium phase, we have SenseNet for Visually Impaired people, which demands the best accuracy. It creates a network with the smart glasses for vision and movement, a spine device for the body posture.This keeps the data of the person by creating a sensory network.

3.4 Working Breakdown –

The smart glasses work on the Deep Learning principle where it performs face recognition, objection detection and path detection and helps old aged people or blind people to find their way with the help of smart sense.

Also, the posture correction device is the major focus of the project which works on the IoT based sensors and additionally uses deep learning sense for tracking progress. The main working principle of an accelerometer is that it converts mechanical energy into electrical energy. When a mass is kept on the sensor which is actually just like a spring it starts moving down. Since it is moving down it starts experiencing acceleration. That acceleration then gets converted into an amount of electric signal which is used for measuring variation in the position of the device. The accelerometer can be found with both analog forms analogue as well as digital form devices. Not just like any other device would work, it happens to look like a simple circuit for some larger electronic device despite its simple appearance, it consists of many different varieties of parts which of course have their own functions and work in many ways.

The PoseNet intends to track progress using inbuilt camera of Laptop/Phone on which App is installed and the user needs to stand or sit in front of it so, that his coordinates can be tracked and this coordinate is then kept in a database which can find the elevation or depression from ideal postural coordinates using mathematical principle of Distance

Smart detection of heart rate and SpO2 is one of the features of this device kit again holding the sensors and IoT. A smart sensor is a device that takes input from the physical environment and uses built-in compute resources to perform predefined functions upon detection of specific input and then process data before passing it on.

3. 5 Results and Discussion

The hardware and software implementation results are discussed separately as follows:

(i) Software Implementation Results

Our software is a smart AI assistant designed to provide assistance to blind people. The purpose of the software is to help blind people navigate their surroundings more easily and independently. The software uses a combination of facial detection using Siamese network, path detection using TensorFlow modules, and object detection using YOLO algorithm to provide assistance to the user.

Technologies Used:

The software was developed using Python programming language, OpenCV library for computer vision, TensorFlow for machine learning, and Flask framework for web development. We used the Siamese network for facial detection, TensorFlow modules for path detection, and YOLO algorithm for object detection.

Facial Detection:

We used the Siamese network for facial detection, which is a deep learning algorithm that compares two images and determines whether they are of the same person or not. We trained the network on a large dataset of facial images to ensure high accuracy. The network is able to detect faces in real-time and provide audio feedback to the user.

Path Detection:

We used TensorFlow modules for path detection, which is a machine learning algorithm that can detect the user's path and provide audio feedback to the user. We trained the algorithm on a dataset of images of different paths to ensure high accuracy. The algorithm is able to detect the user's path in real-time and provide audio feedback to the user.

Object Detection:

We used the YOLO algorithm (Tiny YOLO) for object detection, which is a deep learning algorithm that can detect objects in the user's surroundings and provide audio feedback to the user. We trained the algorithm on a large dataset of images of different objects to ensure high accuracy. The algorithm is able to detect objects in real-time and provide audio feedback to the user.

Technical Details:

In addition to the technologies used, we also implemented several technical details to improve the performance and accuracy of the software. These include:

Pre-processing: We pre-processed the images before feeding them into the algorithms to improve the accuracy of the detection. This included resizing the images, converting them to grayscale, and applying filters to remove noise.

Post-processing: We applied post-processing techniques to the output of the algorithms to improve the accuracy of the detection. This included non-maximum suppression to remove overlapping detections and thresholding to remove false positives.

Audio feedback: We used text-to-speech technology to provide audio feedback to the user. This allowed the user to receive real-time feedback on the results.

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In the first phase of the mere flex sensor approach, we have not used any feedback element and merely calculated the bend from the flex sensor and the respective change of resistance. This approach was the preliminary step before the Buzzer and LED based approach.

The raw value change was something like this:

In this approach, we have integrated the Arduino and the flex sensor with a Buzzer that would buzz when the bend angle is greater than a certain value. In our case study, the value was chosen to be 220 degrees which also served as the threshold for buzzing.

Here, the Flex Sensor was connected to the A0 pin of the Arduino and the Buzzer was connected to pin 5.

Here are the changes in resistance values for different bend values which were recorded on another window within the Arduino IDE. This serves as the primary output for our understanding.

In this approach, we used 5 LEDs connected to 10k ohm resistors. The LEDs are expected to glow when the flex angle exceeds a given threshold. The primary result here was that the LEDs had high value (Digital 1) when the flex sensors exceeded the bent limit.

CONCLUSION

After conducting a thorough analysis of the Sensenet posture correction device, it can be concluded that this device has the potential to be an effective tool for improving posture and reducing the risk of musculoskeletal disorders.

The Sensenet device uses advanced sensors and algorithms to detect and correct poor posture, providing real-time feedback to the user. It is user-friendly, lightweight, and can be worn comfortably for extended periods of time.

The device's app also provides users with detailed insights into their posture habits, allowing them to track their progress over time and make necessary adjustments.

Overall, the Sensenet device shows promise as a valuable tool for individuals seeking to improve their posture and reduce the risk of associated health problems. Further research and user testing may be necessary to fully assess its effectiveness and potential impact on long-term health outcomes.

5. RECOMMENDATIONS

Some of the recommendations suggested by the project team include:

Research and examine the various sorts of stance revision gadgets accessible on the lookout. This could incorporate back supports, pose corrector shirts, and wearable innovation gadgets.

Searching for logical proof supporting the viability of stance adjustment gadgets. This could include investigating concentrates that have been directed on the advantages of utilizing such gadgets and their effect on spinal wellbeing.

Analyzing the various brands and models of stance amendment gadgets, considering their highlights, cost, and client surveys.

Consider the moral ramifications of advancing the utilization of stance remedy gadgets. For instance, does it add to a culture of body disgracing and the possibility that actual appearance is a higher priority than wellbeing?

Examine the likely downsides of utilizing stance rectification gadgets, like the gamble of reliance on the gadget and the chance of causing muscle shortcoming after some time.

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