SenseNet - Unwrapping the future

Group - 95

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Review: Phase-2 - Final Review

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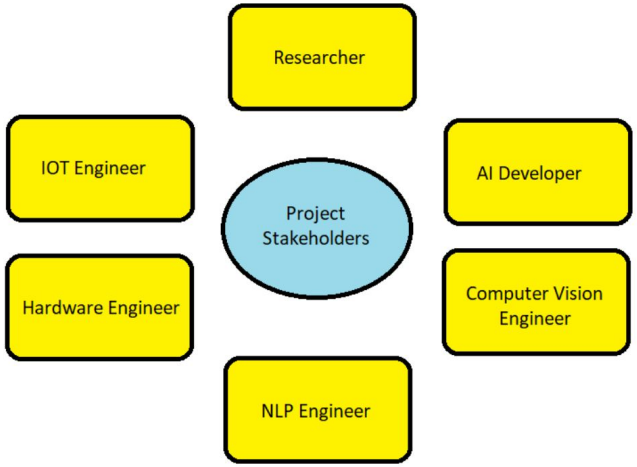


Introduction

- As we age, our bodies may experience changes such as declining vision and hearing, and decreased strength and flexibility, which can make it harder to engage in activities and maintain independence.

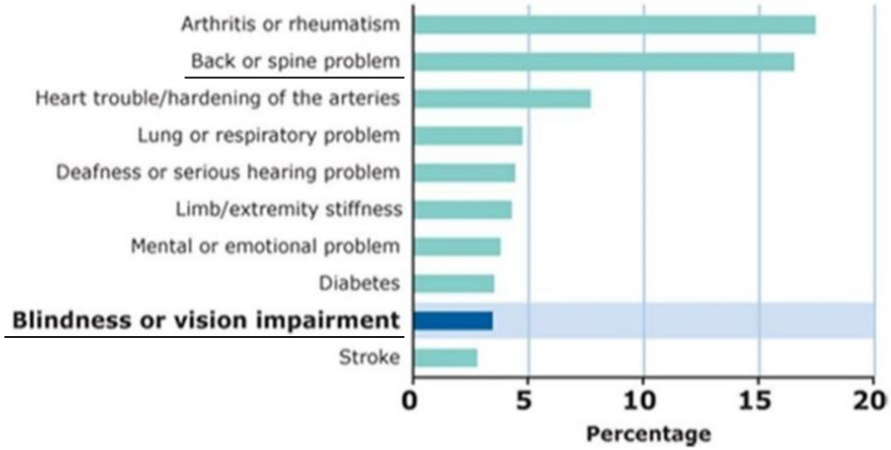
- Older people may be at increased risk of chronic health conditions and diseases such as heart disease, cancer, and diabetes.

- Older people may face financial challenges due to reduced income or increased medical expenses.

Motivation

- Older people have to face many issues, which makes them needy for an all-time support. They become dependent on other people.

- This innovative tool was specifically designed to support older individuals in managing their health and wellbeing, so they can continue to enjoy all the things they love and maintain their independence.



Link

Objective

The main objective of sensenet is to help older people become more independent by providing them support in declining vision, posture checking and health tracking.

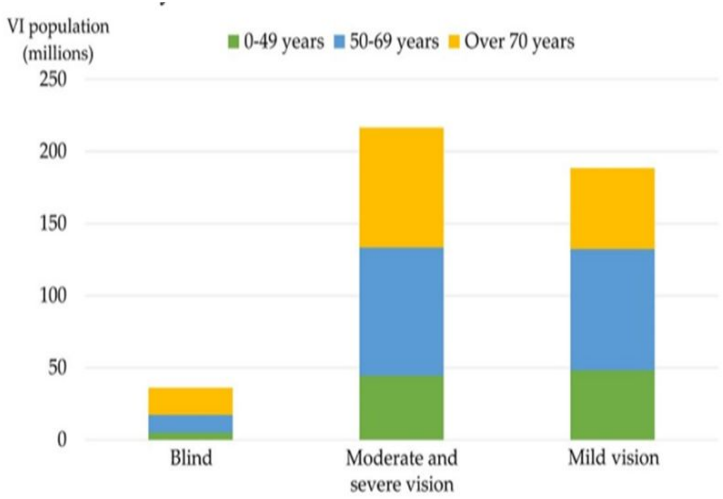
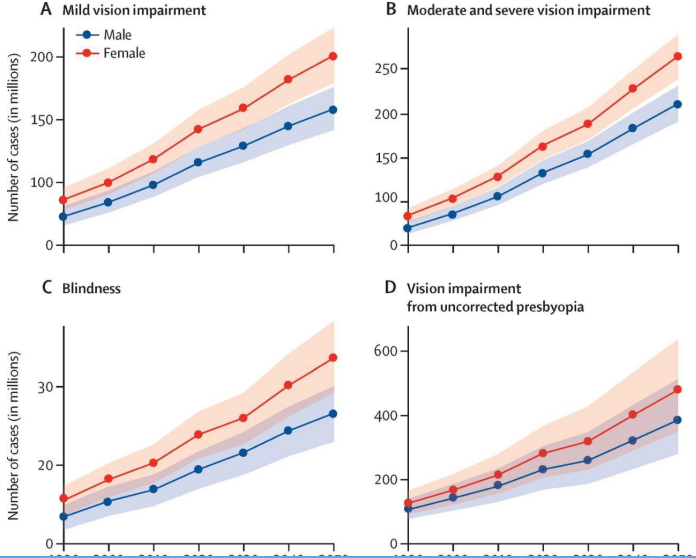


Fig 1.2: Graph showing statistics on Vision issues



Research paper 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.

Research paper 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.

Existing work

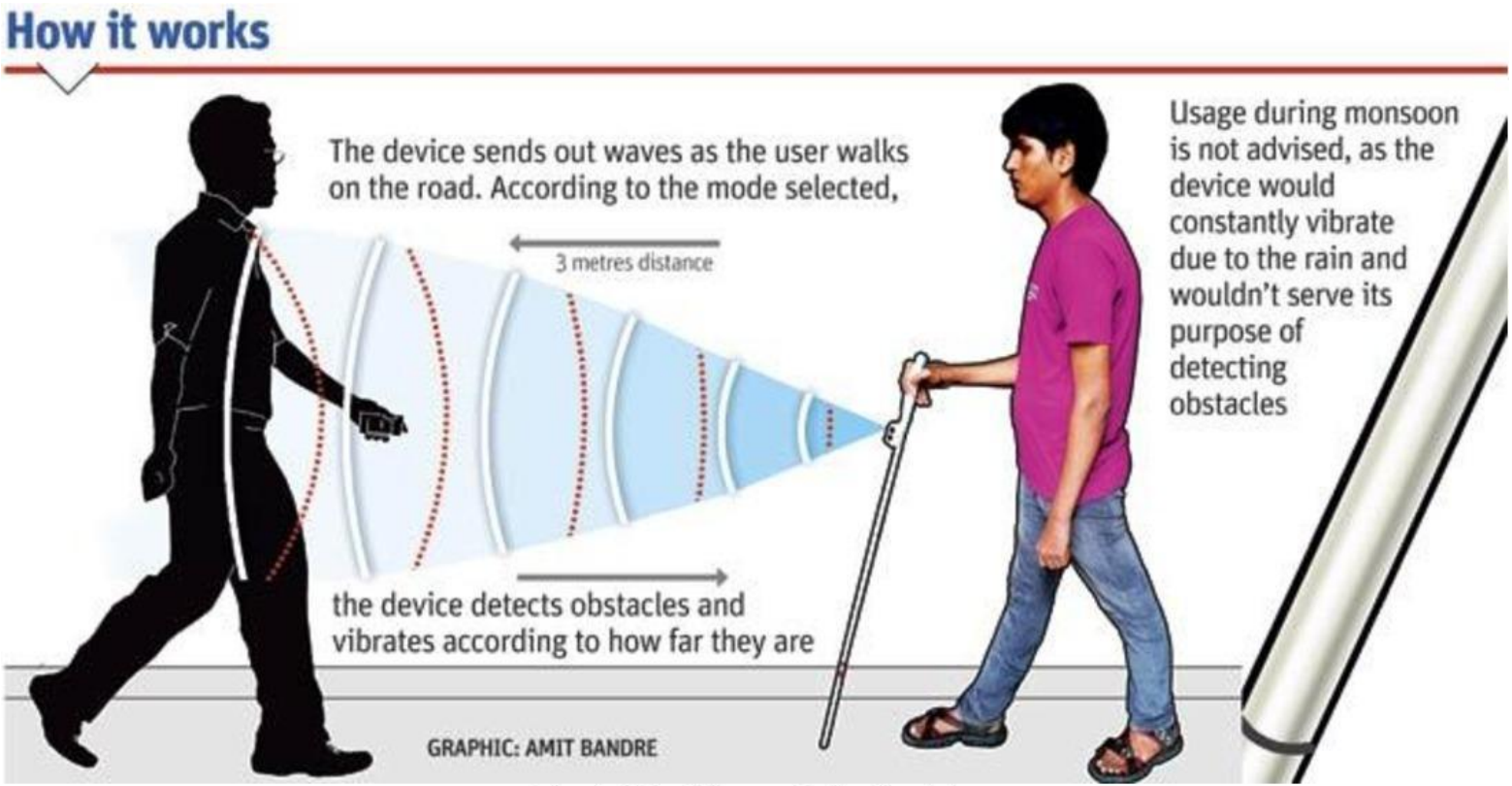


Fig 1 Working of blind stick

Existing works

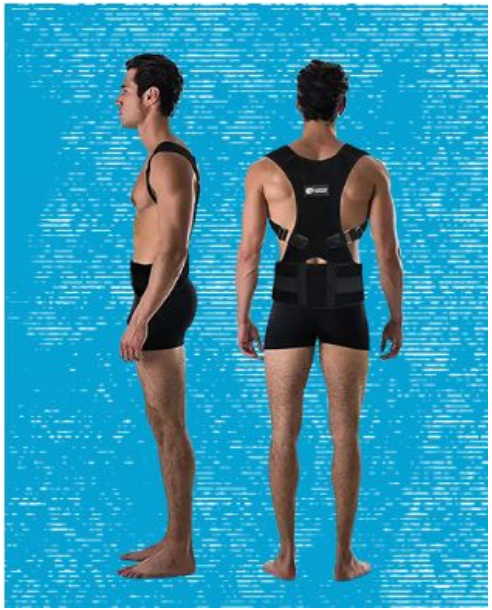
- Upright GO-2 Posture Corrector
  - It helps to improve your posture in 2 weeks.
  - This corrector also have a App connected to it to track the progress.
  - The con of this work is that it’s very costly. It costs around 80$.

Existing work

- Comfy-Brace Posture Corrector
  - It has a adjustable chest sizing.
  - This product also fits with chest sizes of 30-43 inches and it works under most items of clothing.
  - The con is some reviewers states that it chafes under clothes.

Existing work

- Copper Compression Posture Corrector
  - This corrector offers the lumbar support.
  - It also have a moisture-wicking fabric.
  - The con is some reviewers states that it has the uncomfortable straps.



NOVELTY

Inspired from common issues faced by people.

- Body Posture Bend Notifier - Vision Assistance - Health Updates Tracking

- Sensory Network - intends to cover major functioning

- Existing devices:
  -> only covers individual functionality
  -> no network formed
  -> smart watch/app integration not available
  -> no premium focus functionality for older gen or blinds

NOVELTY

Inspired from common issues faced by people.

- Body Posture Bend Detection
  Connected with your mobile or web app
  Tracks progress at app
  Additional feature:
    -> App uses device’s camera
    -> Uses Deep Learning Technique
    -> Tracks progress using camera

  Existing devices - vibrates only - no progress tracking - no app connectivity

NOVELTY

Inspired from common issues faced by people.

- Vision assistance allows one to maintain proper distance from obstacle -
  Existing Ultrasonic Vision assistance beeps:
  ->Cannot differentiate between help or obstacle
  ->Our Vision Assistance uses camera to detect obstacle
  ->Approximate distance calculation or prediction
  ->Direction Sensing included
- In our Vision Assistance -
  ->Input accepted
  ->Search for your desired thing (eg - bench, shop etc)

Materials required

Hardware Requirements -

For Vision Assistance -

- Camera - For Face recognition, Object Detection, Path Detection
- Speaker - For the audio output from the device

For Posture Device -

- Flex Sensors

Software Requirements -

- Deep Learning Algorithms -
  - Facial Recognition Module
  - Object Detection Module
  - Path Detection and Google Map API Integration
- Additional benefit for tracking postural deformity using PoseNet
- Web/Mobile App

Expected results

★ Cure the deformity - constantly reminding when posture gets bent.

Additional benefit is to track the progress.

★ Artificial eye assistant using various deep learning techniques.

Assisting old age people and premiumly blinds.

★ SpO2 and Heart Rate are also focused here to cover the network of basic health.

So, this device kit is a full-fledged sensory network kit helping one to improve posture, assist in seeing and getting track of one’s health.

General Sensors used in Posture corrector devices

Posture corrector use a variety of sensors to track body position and movement. Some sensors are listed below:

1. **Accelerometers:** To detect changes in position
2. **Gyroscopes:** To measure rotation and angular movement. They used to detect changes in body position and movement.
3. **Magnetometers:** It is used to detect the changes in orientation and movement.
4. **Strain gauges:** These sensors measure the deformation or strain of a material. They can be used to detect changes in body position and posture.

General components used in posture corrector

The various components of posture correctors includes:

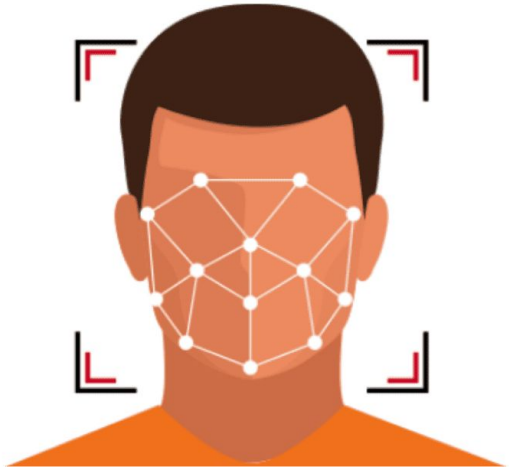
1. **Straps:** It is used to keep the device in place.
2. **Back Brace:** It supports the spine and helps to maintain proper posture.
3. **Padding:** To provide comfort and reduce pressure points.
4. **Fasteners:** To adjust the fit and support level
5. **Breathable materials:** Many devices uses the breathable materials, such as mesh or moisture-wicking fabrics to help prevent overheating and discomfort.

Upright go-2 posture corrector

- Sensors used in this:
  - These are two built in sensors used in this device.
  - These sensors detect your posture in real-time and give you the feedback you need to correct your posture.
  - These built in sensors comes with the gyroscope for more precise training and accuracy.
  - It uses while sitting, walking and physical activity.
- This device automatically stores and syncs the detailed posture activity for 30 days.
- The device is also splash-proof, Immune to sweat, rain and water splashes.

Face Detection

- Facial detection is the process of identifying and locating faces in an image or video.
- Traditional approaches to facial detection include Haar Cascade Classifiers, Viola-Jones Algorithm, and Histogram of Oriented Gradients (HOG) features.



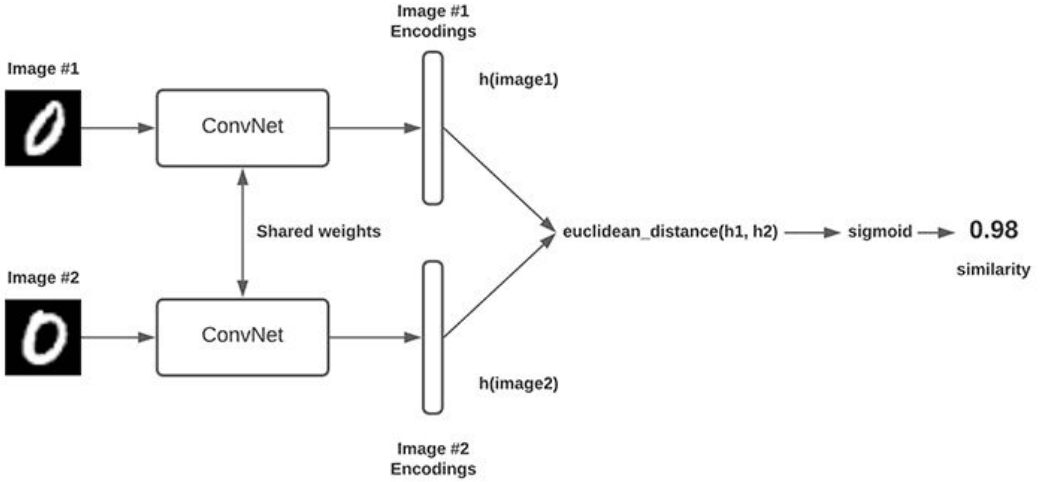
Siamese network and its advantages

- A Siamese Network is a neural network architecture that consists of two identical sub-networks that share the same weights. It is used for tasks such as similarity matching and recognition.

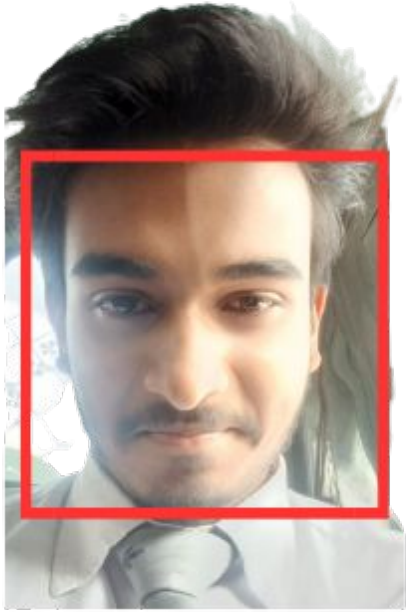
- One of the advantages of the Siamese Network is its ability to handle image variations, such as pose, lighting, and expression, by learning a similarity metric between pairs of images.

Siamese network architecture for facial detection

The Siamese Network architecture for facial detection consists of two identical sub-networks that take two face images as input. The output of each subnetwork is a feature vector that represents the input face image.



Training Process



Why we used Siamese network?

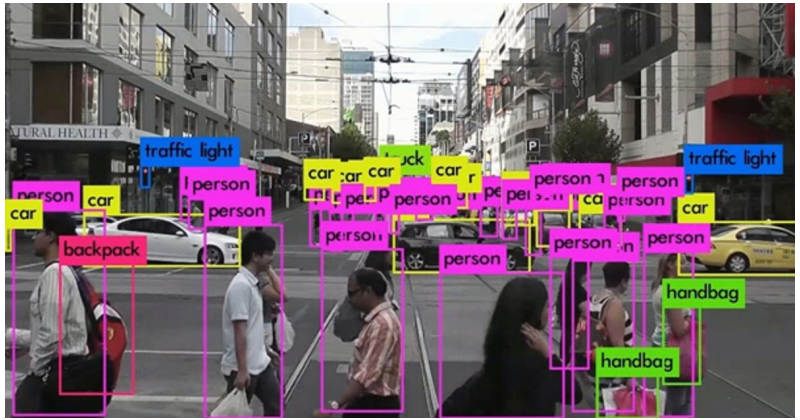
- The performance of the Siamese Network for facial detection is evaluated using metrics such as accuracy, precision, recall, and F1 score.
- The Siamese Network outperforms traditional approaches to facial detection in terms of accuracy and robustness to image variations.
- Further research can be done to improve the performance of the Siamese Network for facial recognition and other related tasks.

DEMO

Object Recognition

- Object detection is a computer vision technique used to locate and identify objects within an image or video. It involves using a machine learning algorithm to identify and classify objects in an image, and then drawing bounding boxes around them.

- There are several popular object detection algorithms, including YOLO (You Only Look Once), SSD (Single Shot Detector), and Faster R-CNN (Region-based Convolutional Neural Network). These algorithms use deep learning models, typically trained on large datasets, to accurately detect objects in real-world scenarios.



Object detection has numerous practical applications, including self-driving cars, surveillance systems, robotics, and image and video search.

YOLO V4

YOLOv4 (You Only Look Once version 4) is a state-of-the-art object detection algorithm developed by Joseph Redmon and his team at the University of Washington. It builds on the success of previous versions of YOLO, improving the accuracy and speed of object detection in real-world scenarios.

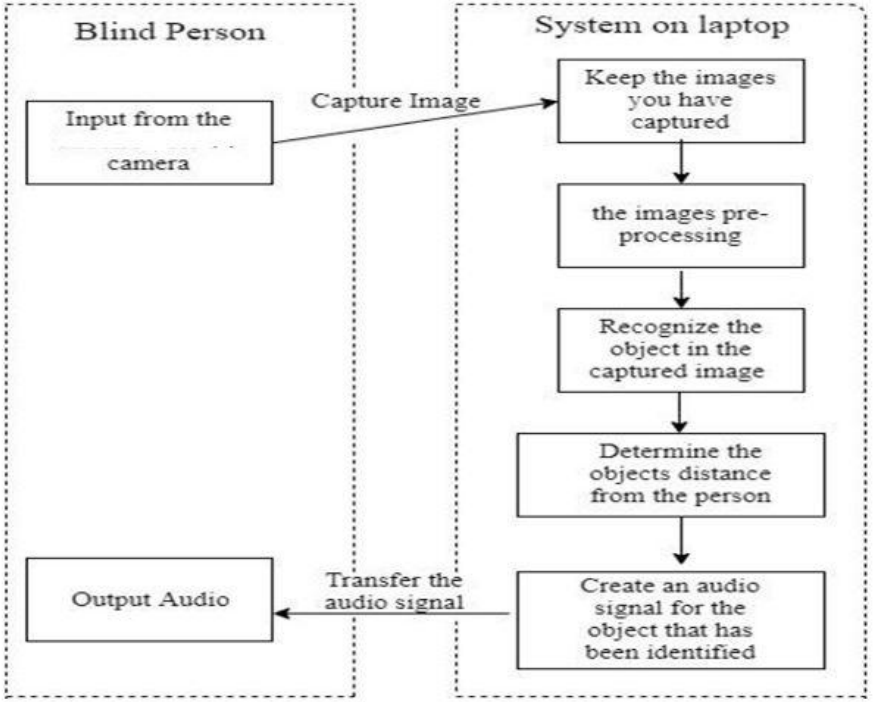


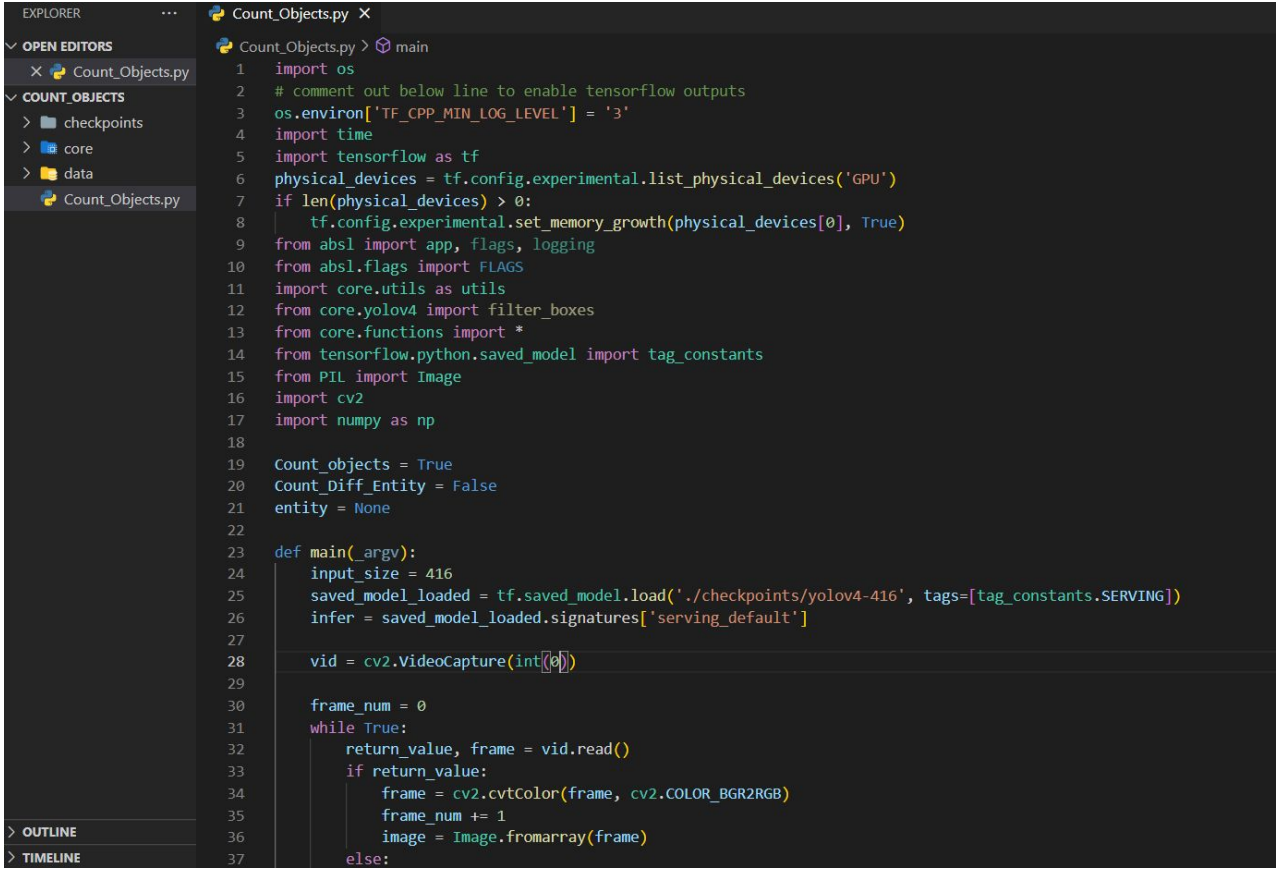
Fig 1. System Methodology

YOLOv4 has been shown to achieve state-of-the-art performance on several benchmark object detection datasets, including COCO (Common Objects in Context) and PASCAL VOC (Visual Object Classes). It has numerous practical applications, including in self-driving cars, surveillance systems, robotics, and more.

ADVANTAGES OF YOLOv4

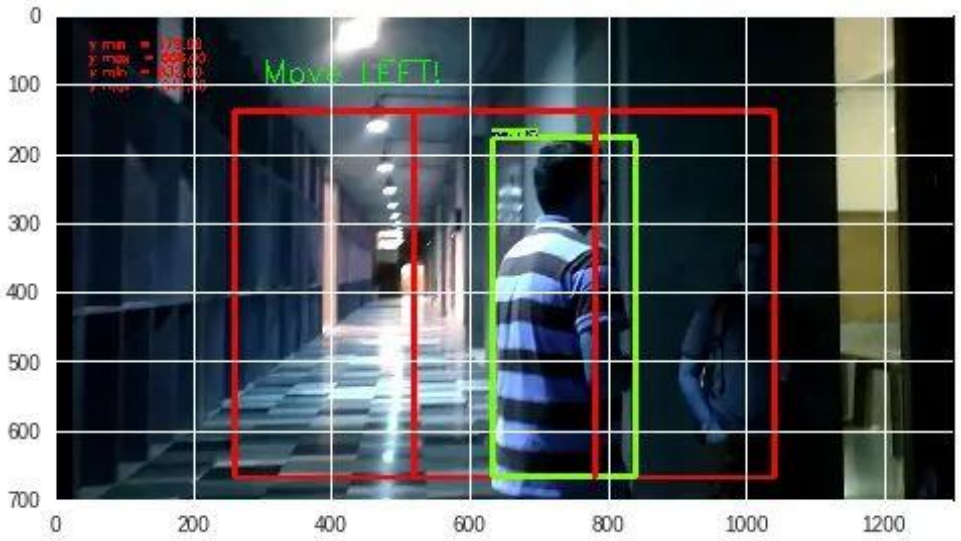
- Some of the key features of YOLOv4 include:
- Improved backbone network architecture: YOLOv4 uses a larger, more complex backbone network architecture, called CSPDarknet53, which improves the detection accuracy and reduces false positives.
- Data augmentation techniques: YOLOv4 uses a variety of data augmentation techniques, including mosaic augmentation, random shape augmentation, and more, to improve the performance of the model on a variety of image sizes and shapes.
- Improved training strategies: YOLOv4 uses a variety of advanced training strategies, including a self-adversarial training technique and a focal loss function, to improve the robustness and generalization of the model.
- Faster inference speed: YOLOv4 achieves faster inference speed than previous versions,advanced optimization techniques and improved implementation.

IMPLEMENTATION



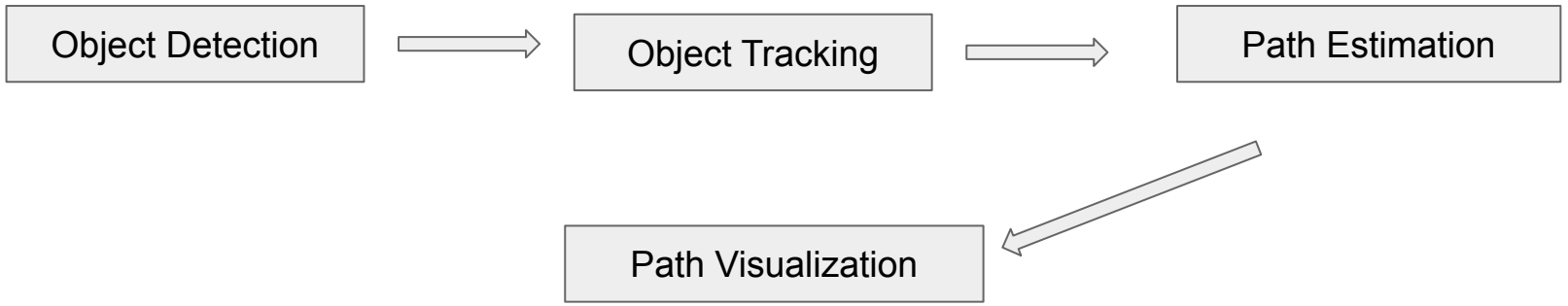
PATH DETECTION

Path detection can refer to different things depending on the context, but one common application is in computer vision and robotics where path detection is used to identify the path or trajectory of an object or vehicle. This can be useful for autonomous navigation or tracking applications.

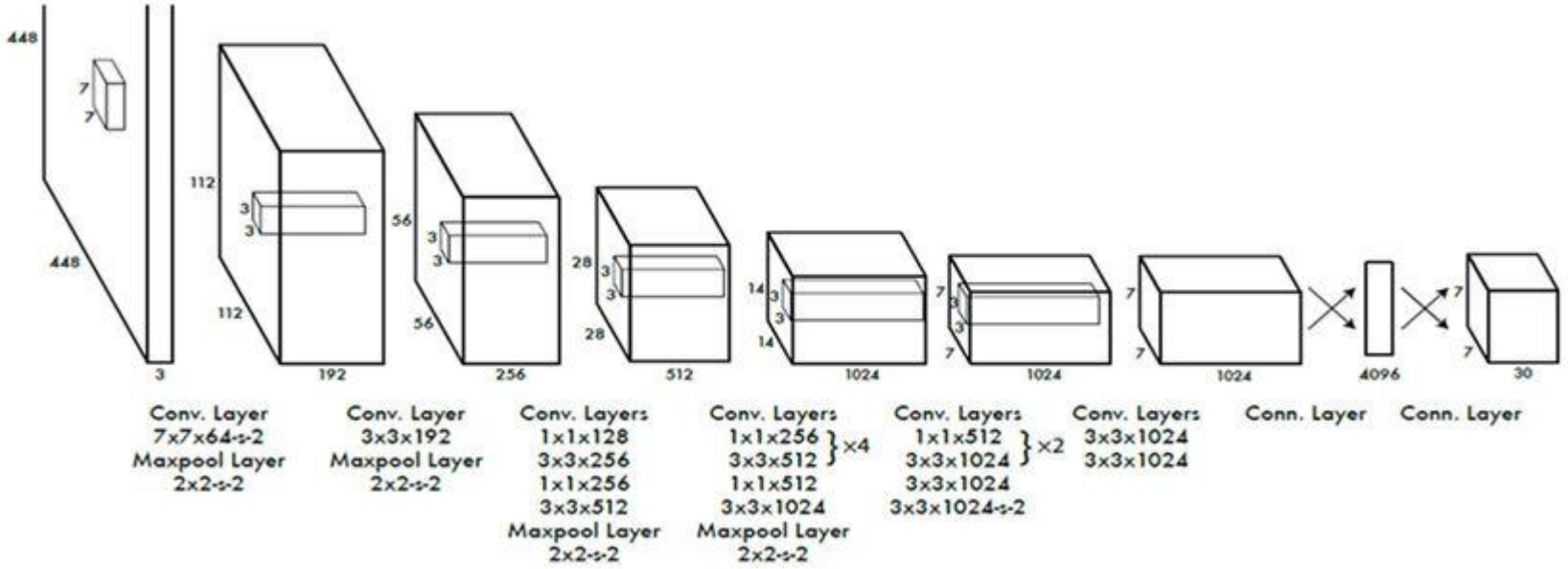


Algorithm used - YOLOv4

While YOLOv4 is primarily an object detection algorithm, it can also be used for path detection by tracking the movement of detected objects over time. Here is an overview of the steps involved in using YOLOv4 for path detection:

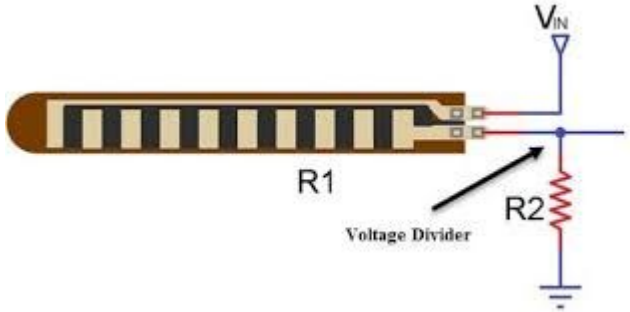


ARCHITECTURE



COMPONENTS USED FOR SPINAL POSTURE DEVICE

- Arduino UNO
- ADC0804 IC
- Flex Sensor
- Resistors and capacitors
- Breadboard or perf board.
- 5V Buzzer



Note: Components can vary slightly, an alternate of similar configuration may be used in case of any unavailability

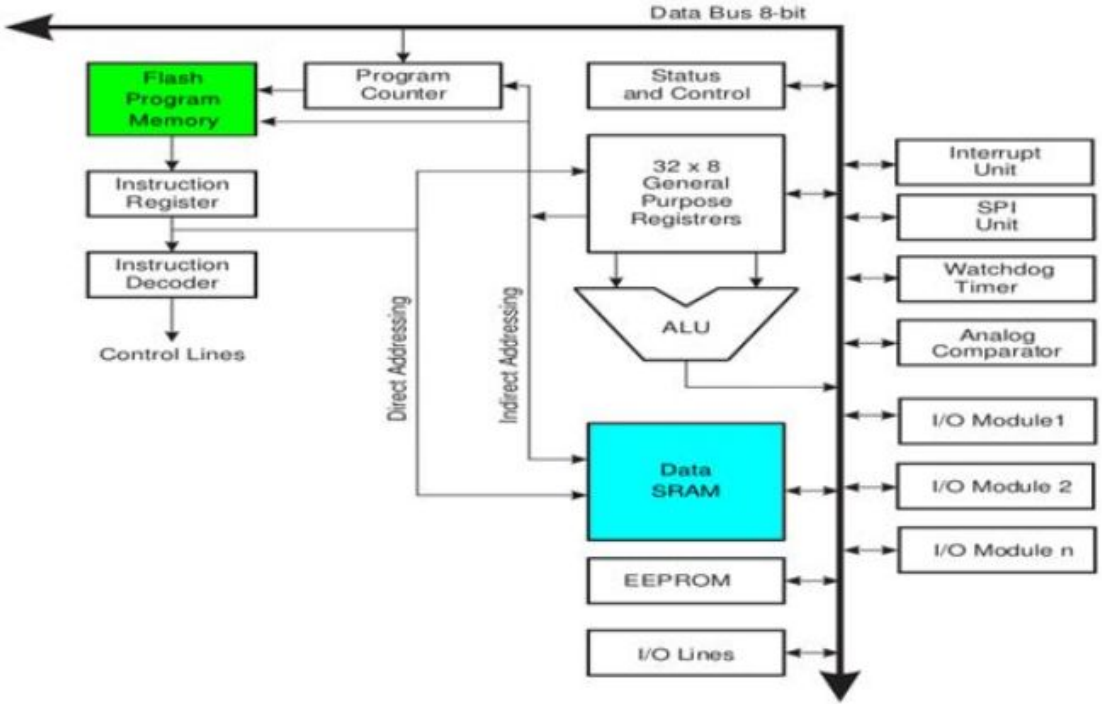
FLEX SENSOR SPECIFICATIONS

FLEX SENSOR is basically a **VARIABLE RESISTOR** whose terminal resistance increases when the sensor is bent.

- Operating voltage of FLEX SENSOR: 0-5V
- Can operate on LOW voltages
- Power rating : 0.5Watt (continuous), 1 Watt (peak)
- Operating temperature: -45°C to +80°C
- Flat Resistance: 25K Ω
- Resistance Tolerance: ±30%
- Bend Resistance Range: 45K to 125K Ohms(depe bend)

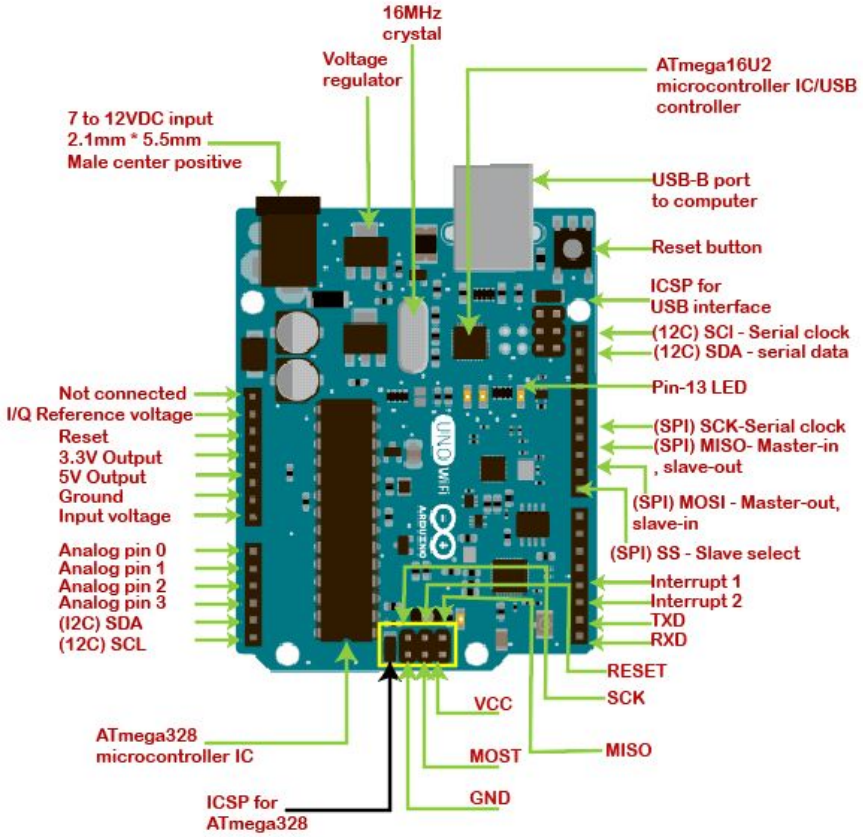
Link to Data Sheet:
components101.com/sensors/flex-sensor-working-circuit-datasheet

Architecture of ARDUINO



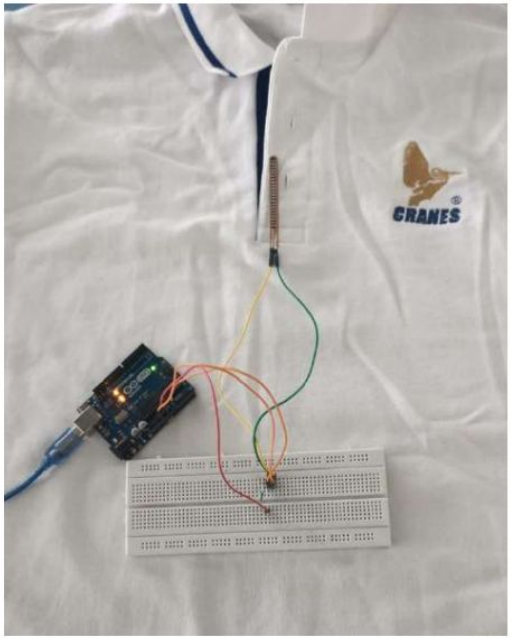
Arduino Architecture

PIN DIAGRAM


16MHz crystal
Voltage regulator
ATmega16U2 microcontroller IC/USB controller
7 to 12VDC input 2.1mm * 5.5mm Male center positive
USB-B port to computer
Reset button
ICSP for USB interface
(12C) SCl - Serial clock
(12C) SDA - serial data
Pin-13 LED
Not connected
I/Q Reference voltage
Reset
3.3V Output
5V Output
Ground
Input voltage
(SPI) SCK-Serial clock
(SPI) MISO- Master-in , slave-out
(SPI) MOSI - Master-out, slave-in
(SPI) SS - Slave select
Analog pin 0
Analog pin 1
Analog pin 2
Analog pin 3
(I2C) SDA
(12C) SCL
Interrupt 1
Interrupt 2
TXD
RXD
RESET
SCK
VCC
MOST
MISO
GND
ATmega328 microcontroller IC
ICSP for ATmega328

APPROACHES USED

1) Simple flex Sensor Approach

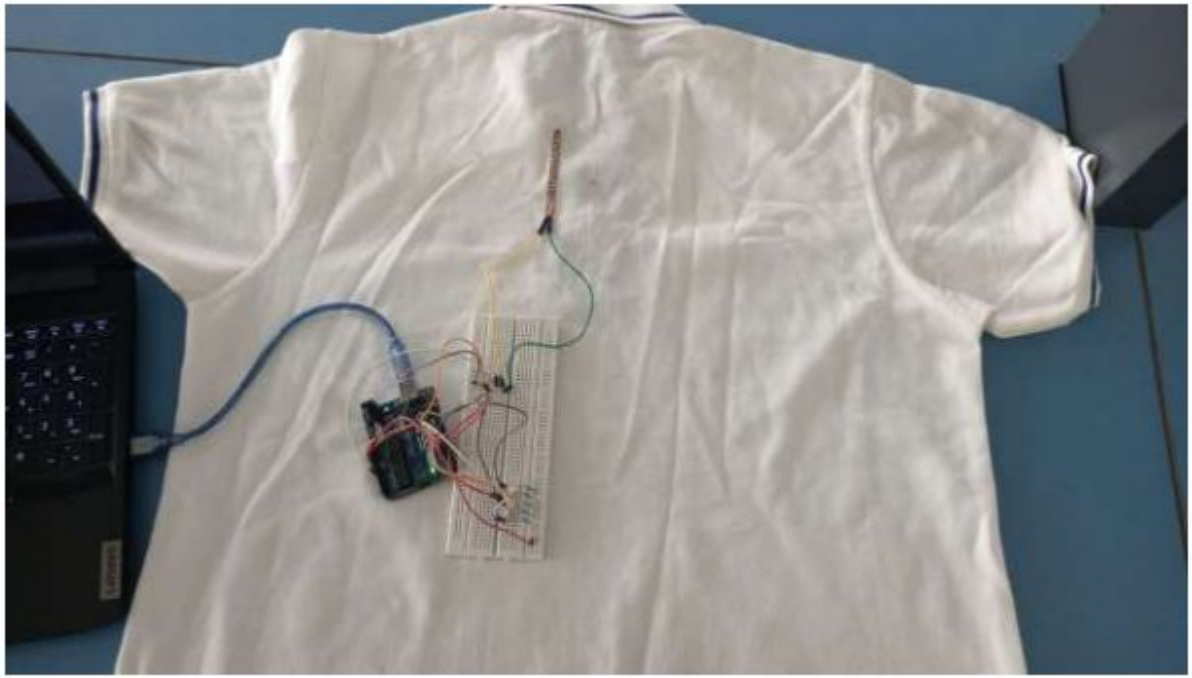


Felx_simplesketch.ino

```
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);
}
```

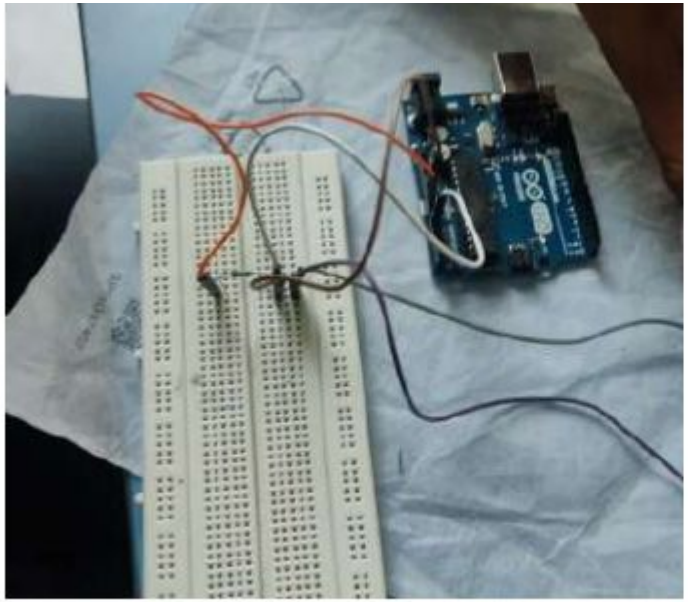
APPROACHES USED

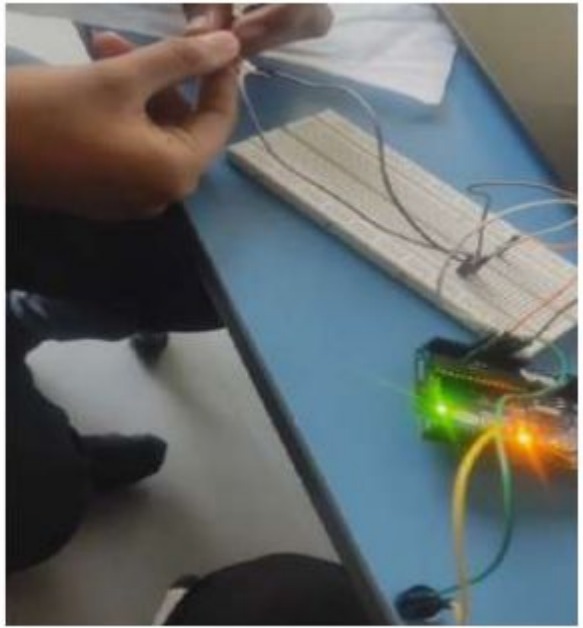
2) LED based Approach



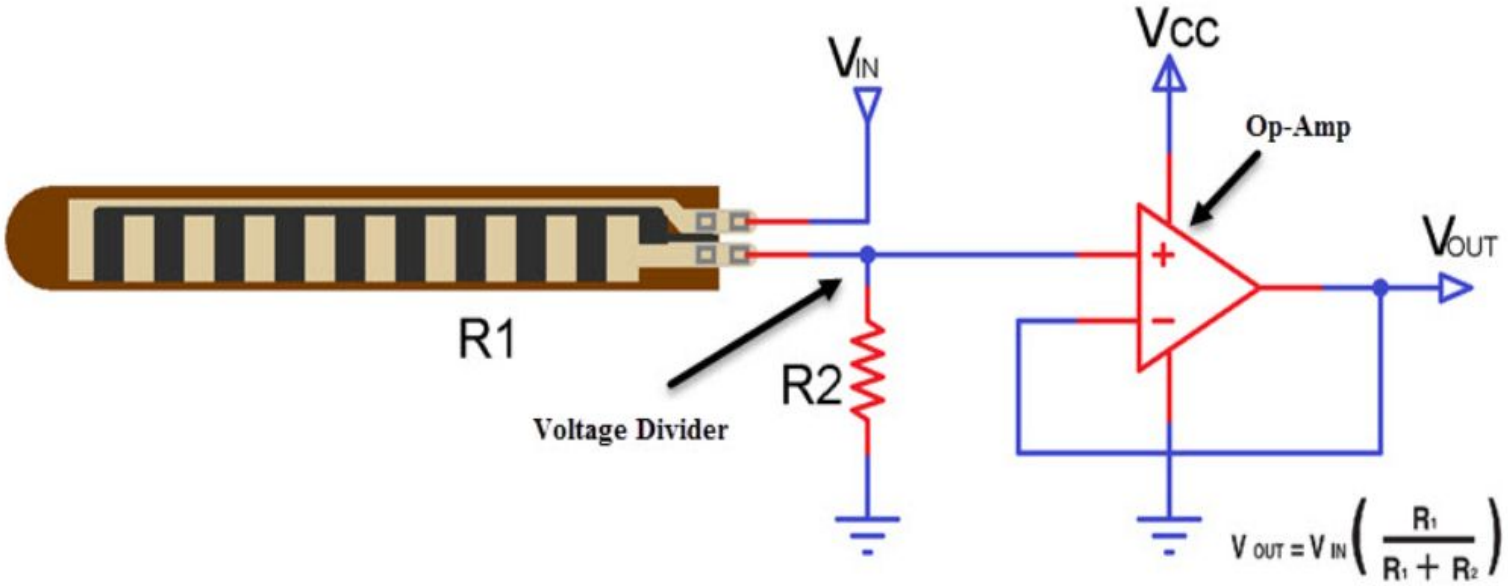
APPROACHES USED

3) Buzzer based Approach (Demonstration)





MATHEMATICS AND CIRCUITRY BEHIND THE APPROACH



THANK YOU!!!!