NIT Trichy's pragyan 2022 ®
AN ISO 9001 AND 20121 CERTIFIED ORGANISATION

scient
Student Center for Innovation in Engineering and Technology

PRAGYAN HARDWARE HACKATHON

Health Care and Life Sciences

Back-Up

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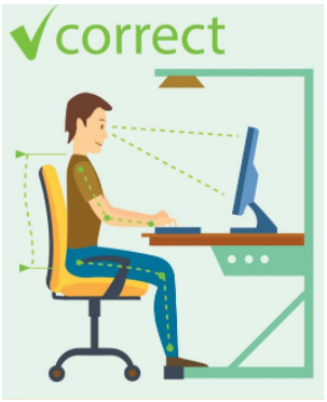
1. Project Abstract:

In today's world, where internet and cloud based solutions have come up for many of the services and products, most offices require people to sit and work in front of their PC for incredibly long hours. By doing so, subconsciously, people tend to slouch or change their posture and continue to work in a wrong posture. While this practice is seen as harmless at present, it can be one of the main reasons for back pain related health issues in the long run. Also, maintaining wrong posture can also cause various health problems like constipation, heartburn, acid reflux and incontinence according to a study by Harvard Medical School.

Most of the working population in their late 30s or 40s suffer from back pain related health issues such as Lumbago (lower back pain), Musculoskeletal disorder, Cervical Disc Herniation, Degenerative Spondylolisthesis, Lumbar Disc Herniation, Lumbar Spinal Stenosis. Most of these diseases are caused due to maintaining a wrong posture at an early age.

As prevention is always better than cure, our project targets the working population who have a desk job and sit for long hours at work. Video feed taken from the camera is fed into a machine learning model, which processes the video in real-time and checks if the person is sitting in a wrong posture or not. If they are found to be sitting in a wrong posture, a push alert is sent to the employee’s PC, thereby allowing them to correct their posture.



Keywords:

Musculoskeletal disorder, Posture, Slouching, Cloud, Machine Learning Model, Dataset, Convolutional Neural network, Key Points, Server, Notification, Posture Correction, Surveillance Camera, Lifestyle, Back pain, GPU, Camera.

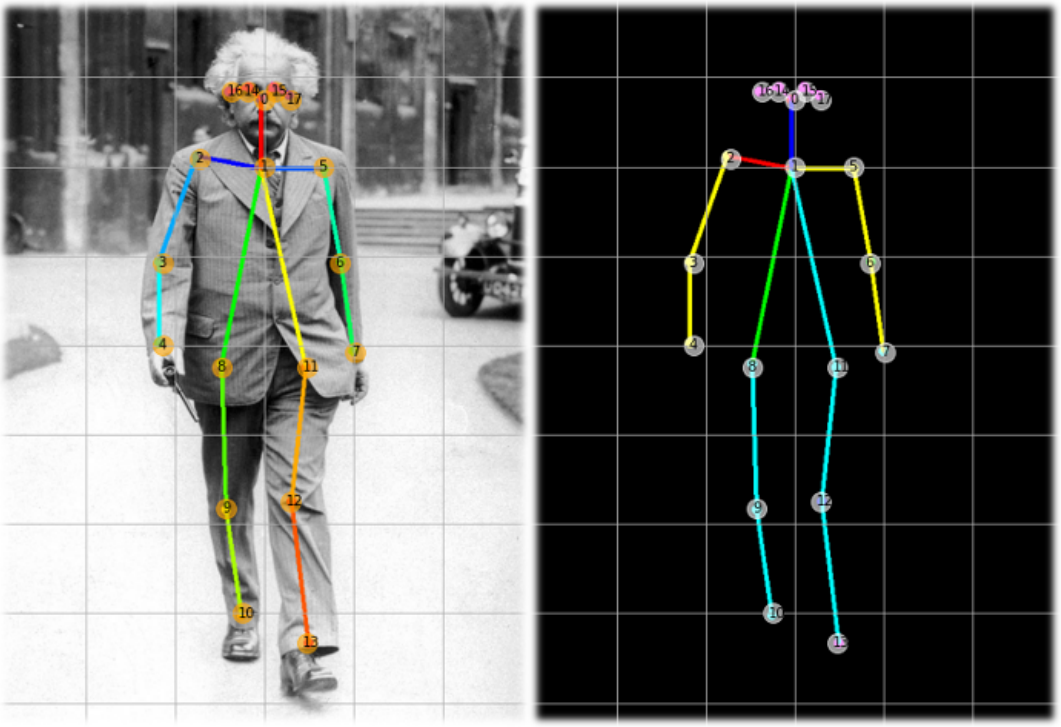
2. Proposed Design:

A. Objective:

Our main aim of the project is to check if an employee is sitting in a wrong posture/slouching and alert them via a push notification to the person’s PC so that they could correct their posture. Also, the ML model checks if the person is sitting for too long and alerts them to take short breaks.

The alerts and data is uploaded to the cloud, from where each employee can check how many times they slouch in a day, for how long they sit continuously and other such information
Collecting such information and uploading to the cloud also makes the machine learning model much more accurate as it can learn not just from the initial dataset but also from the information collected and stored in the cloud.

B. Proposed Solution:



Video feed from the camera fitted inside the office is taken and then sent to the server maintained in the office for processing, where a CNN model is present which identifies 18 key points in the human body - nose, neck, right shoulder, right elbow, right wrist, left shoulder, left elbow, left wrist, right hip, right knee, right ankle, left hip, left knee, left ankle, right eye, left eye, right ear, and left ear.

Then the angle between some of the points is calculated and checked if it exceeds the safe value. If it does, then it implies that the person is slouching/sitting in a wrong posture, and therefore a push notification is sent to the person's PC alerting them to correct their posture.

Alignment	**Point 1 (x1,y1) , point number in the diagram**	**Point 2 (x2,y2) , point number in the diagram**
Shoulder	Left shoulder, 5	Right shoulder, 2
Right arm	Right shoulder, 2	Right elbow, 3
Left arm	Left shoulder, 5	Left elbow, 6
Neck	Nose, 0	Neck, 1
Back bend (i)	Left hip, 11	Neck, 1
Back bend (ii)	Right hip, 8	Neck, 1

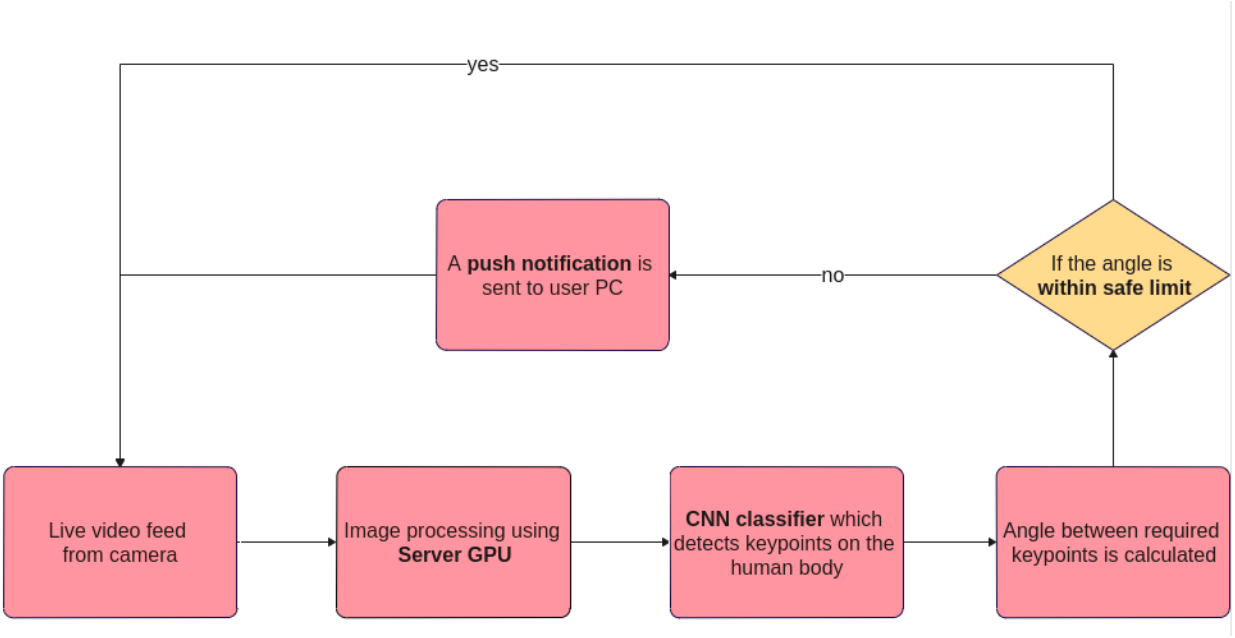
Angle is calculated by :

$$\text{angle} = tan^{-1}\left(\frac{y2-y1}{x2-x1}\right)$$

Where coordinates of point1 and point2 are given as (x1,y1) and (x2,y2) respectively.

Then the data and alerts are uploaded to the cloud from where the employee could see how often they slouch, how long they sit continuously and other related information which will be useful to them for correcting themselves.

Block Diagram



C. Components Required:

COMPONENTS	ROLE/FUNCTIONALITY:
Raspberry Pi NoIr Camera Module V2	To obtain the video feed of the employees.
GPU (Server GPU is used)	To run the ML model and process the video
Raspberry Pi 3	To send the video feed from camera to the server

3. Innovativeness of the Proposed Solution

No discomfort while working:

One of the popular methods for posture correction currently is wearable vests with back support. It may not be feasible for people to wear the vest while working, and it will be a discomfort for the person wearing it.

Our proposed solution does not interfere with the person working at any cost, while also providing reliable results and maximum comfort, allowing the person to work at peace.

Ease of setting up the project:

One of the main advantages of our project is that setting the whole thing up can be done quickly. The ML model is run on the existing server maintained by the office, and most of the offices already have a surveillance camera in place, which could be used to take the video feed and send it to the server for processing.

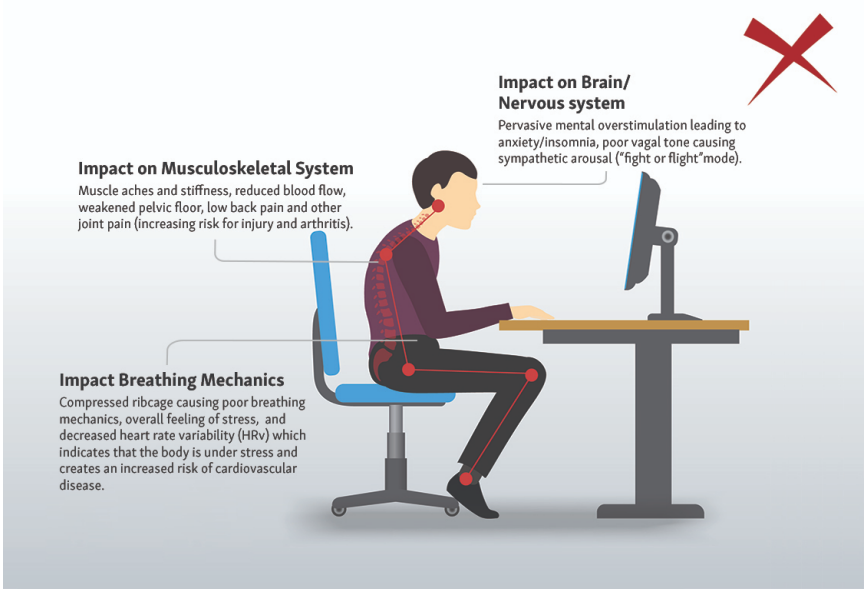
Cost of the project:

Since our project uses minimum hardware (only the Camera and Raspberry Pi 3 module for communication between the camera and the server), we have cut down the cost of the project by a significant amount enabling even small-scale companies or shops to avail this service. The camera module costs around Rs. 1750, and the Raspberry Pi 3 costs around Rs. 3000. The total cost estimate is Rs. 4750.

4. Impact of the proposed solution (Application)

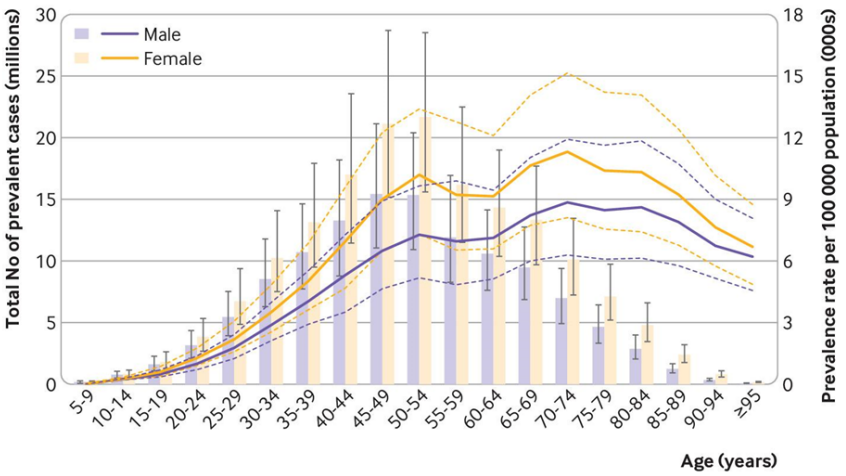
Data suggest that there is causal association between extensive computer use and neck pain.

Awkward postures and long duration repetitive work are reported to contribute to work related neck pain. Severe work-related musculoskeletal disorders can lead to permanent disabilities in workers, drastically affecting their ability to perform their work efficiently. Studies show that annual prevalence of neck pain among various communities worldwide ranges from 15 to 44%.



Further, musculoskeletal disorders are the most common causes of long-term sick leave and disability pension in several industrial countries. Due to this, and the obstruction posed by such disorders on day-to-day work, there is considerable economic impact. Lower back pain prevalence, estimated at 25.7%, costs $635 billion annually in the USA.

Global number of prevalent cases and age standardised point prevalence of neck pain per 100 000 population by age and sex, 2017.



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Hence, the impact of the proposed solution is expected to be widespread as it addresses one of the most common lifestyle challenges in the modern world. It will help people to correct their posture and will prevent back pain and related disease in the future due to poor posture.

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