SCREEN TIME MANAGEMENT AND POSTURE CORRECTION USING AI

Group No 67

Team Members

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CERTIFICATE

This is to certify that the B. Tech project **"Screen Time Management and Posture Correction Using Artificial Intelligence"** prepared by **Sarthak Vats, Kalu Ram Khateek and Asit Kumar Sahoo** has been approved for submission to the Department of Humanities and Social Sciences, Indian Institute of Technology, Ropar's course on Human Geography and Societal Needs.

Department of Humanities and Social Sciences

IIT Ropar

DECLARATION

I thus declare that the report titled **"Screen Time Management and Posture Correction Using Artificial Intelligence"** presented by us, for the course on **Human Geography and Societal Need** in the **Second year of the B.Tech Programme at IIT Ropar**, is true and correct. We declare that this written submission contains our ideas as well as the ideas or words of others. In the event of other people's ideas or words, we have properly cited and referenced the original sources. Therefore, we affirm that our group has adhered to all principles of academic honesty and integrity.

Date: 25/04/2022

ACKNOWLEDGEMENT

Presentation, inspiration, and motivation have always been crucial to the success of any business effort. We began our endeavor with this in mind. At the outset of our report, we'd like to offer our heartfelt gratitude to all those who engaged with us to work as a team and complete this project despite the extraordinary circumstances. Without their ongoing support and advice, the report would not have been possible. We are grateful to everyone who came out to assist us by filling out our surveys and providing us with the information we needed. We'd also want to express our gratitude to our institute, **Indian Institute of Technology, Ropar**, for integrating the course **'Human Geography and Societal Needs'** in our curriculum, which allowed us to complete this project while also expanding our knowledge.

CONTENT

8. Approaches needed to Implement Intervention Plans.

9. Possible Constraints and Barriers to Implementation.

10. Expertise Available with each Student to Contribute in the Development of the Intervention.

11. Expected Outcomes.

12. Suggested Plan for Utilization of Outcome Expected from Work.

13. Conclusion

14. Contribution of each Student of the Group.

ABSTRACT

The current scenario is one of digitalization, development, and automation, all of which may be achieved by expanding user participation and workforce. As the number of people who spend time in front of screens grows, people are paying less attention to how they operate. A large portion of the adolescents used to sit in improper postures in front of screens for lengthy periods of time, keeping their eyes closer to the screens, causing a slew of difficulties for them. It is no longer true to state that some of the people do not move at all when working at their desks.

Increased digital screen time has been associated with an increase in scoliosis, Lordosis, and ankylosing spondylitis, as well as myopia and related visual diseases.

Musculoskeletal ailments generated as a consequence of prolonged working hours on digital devices

The number of Smartphone/Laptops users has gradually climbed over the world in recent years, particularly during the Covid-19 epidemic. According to recent research, smartphone/laptop users experience pain in the neck, shoulder, and thumb, with the severity of the symptoms rising with the length of time spent on the phone. Long-term smartphone/laptop use results in bad posture, including a forward neck position, slouched posture, and rounded shoulders. Poor posture can produce structural abnormalities, which can lead to respiratory difficulties and cardiovascular issues.[*Source*]

Over 76 percent of Indian computer workers reported musculoskeletal pain in different epidemiological studies. Several risk factors have been connected to the development of work-related musculoskeletal problems in employees who use computers often. Awkward/static postures, as well as the length of time spent in them, are recognized as major occupational risk factors. Poor posture and untreated muscle stiffness, according to doctors, create severe instances such as disc bulges, frozen shoulders, and cervical spondylosis. Because of the COVID-19 and WFH cultures that have been ingrained in society as a consequence of health safety requirements, it is critical to stress that this might be a further boon for the myopia problem, exacerbating posture-related troubles in adulthood if no controls or solutions are applied. [Source]

Definition of the Problem

1. Problem Statement

The number of individuals spending time in front of gadgets such as smartphones, tablets, and computers is increasing every day. A large percentage of today's youths used to sit in incorrect postures in front of screens for long periods of time, keeping their eyes closer to the screens, resulting in a variety of issues such as arthritis or joint problems, lower-back pains, eye syndromes, respiratory issues and mental problems, all of which can negatively impact their lifestyle in some direct or indirect ways.

2. Identification of the Problem

a) Methodology adopted for problem Identification

Primary Sources-

- We often notice a large number of people around us, whether students, working officials, or research scholars, working tirelessly in front of the computer without regard for their poor sitting posture or the fact that they are viewing the screen from a distance that is not optimal.

- With the onset of pandemic the education system is shifting towards the digitization process which comes with both pros and cons. Health related problems are one of the major issues faced by the folks!

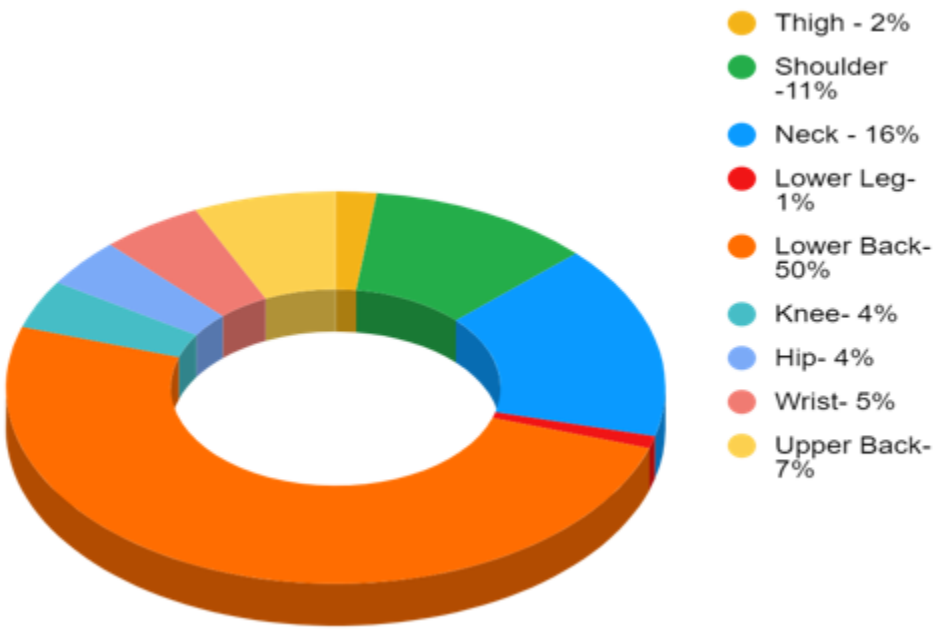
Secondary Sources-

- The major motivation comes from the most popular professional development platform ***LinkedIn*** where students usually post their models or projects related to Braille language, NLP, AI and deep learning.Then there is a curiosity that aroused in our mind that if we can develop something that can monitor the relentless postures of an individual during the working hours.

- A study reveals that Approximately **76%** of Computer professionals from India reported musculoskeletal discomfort in various epidemiological studies.

- A survey report published in Times of India reveals that average use of smartphones by an Indian is increasing by 2 hours everyday .

- Pie-chart showing prevalence of Low back pain w.r.t others body region among the software professionals.



Source:https://www.ijstr.org/final-print/july2013/Prevalance-Of-Work-Related-Low-Back-Pain-Among-The-Information-Technology-Professionals-In-India---A-Cross-Sectional-Study.pdf

b) Survey Conducted and Thorough Hypothesis derived from the statistics

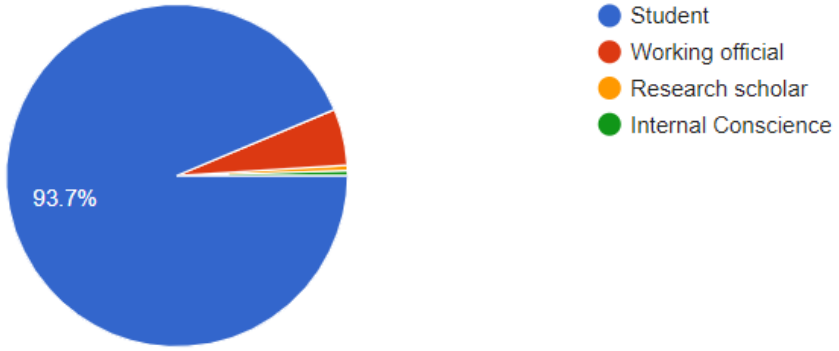
Our team conducted a survey that is basically a questionnaire to gather some authentic data from the students community and working officials in the area around us.

The main motive is to gather some statistical data to help us better understand and analyze the problem as well as to get a sense of how many people are getting affected by it!

Responses are as follows-

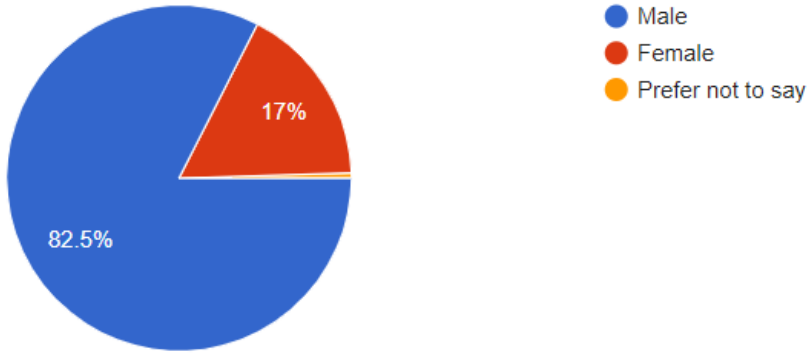
What describes you best?

206 responses



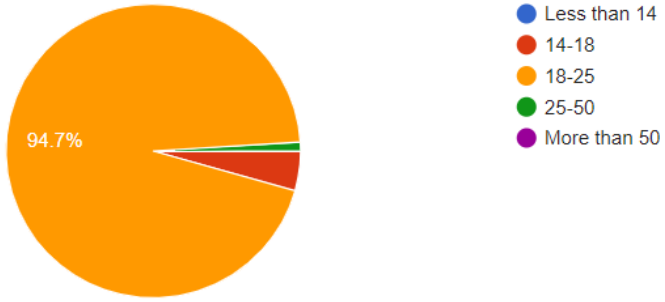
Gender

206 responses



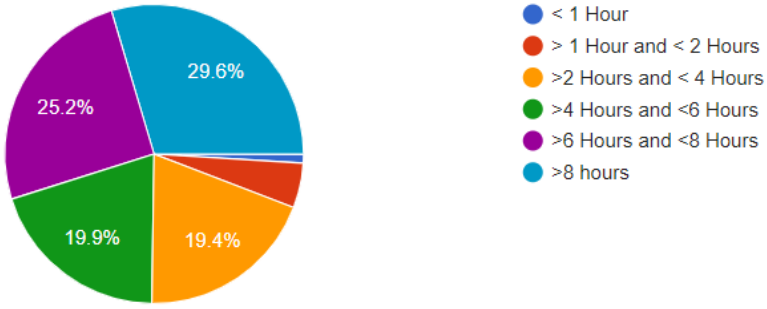
Kindly select your age group in years.

206 responses



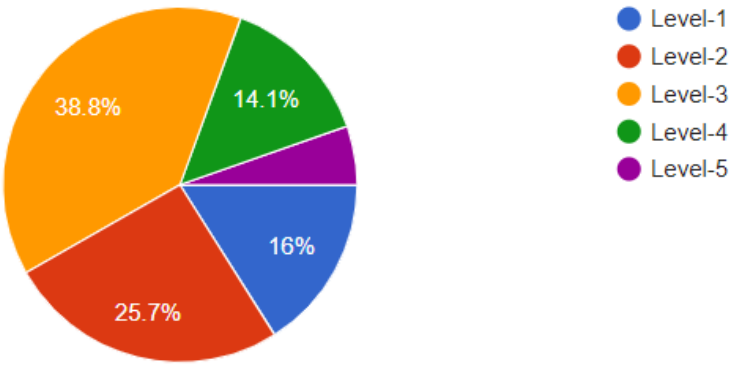
How much time on an average do you generally spend using Laptops/Smartphones for studies or jobs and other activities?

206 responses



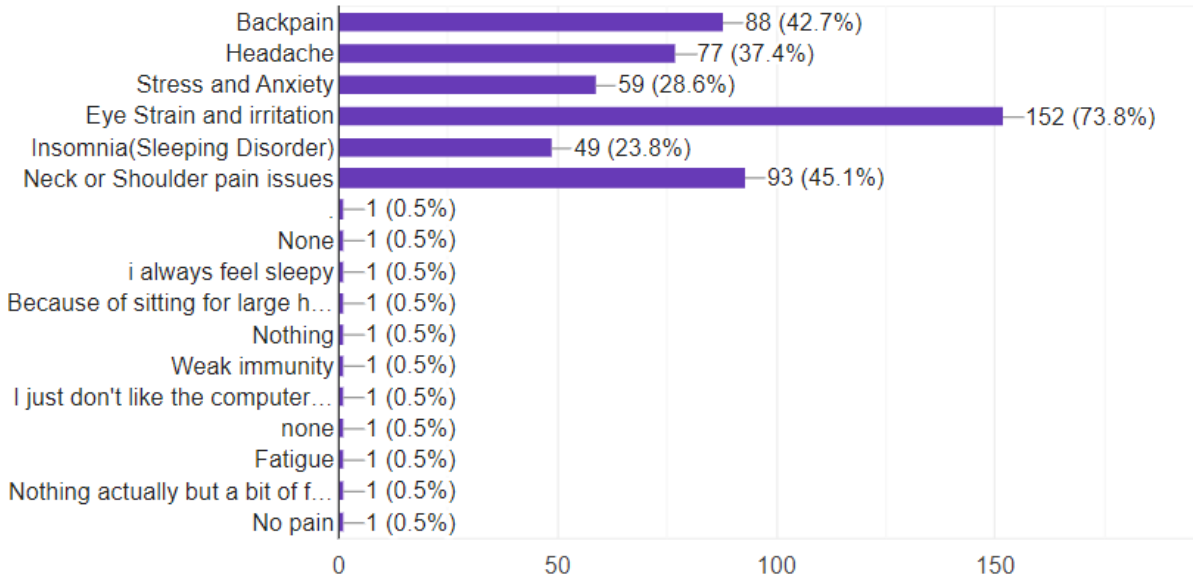
Severity Level of your problem (Level-1 being least affected and Level-5 being the most severely affected)

206 responses



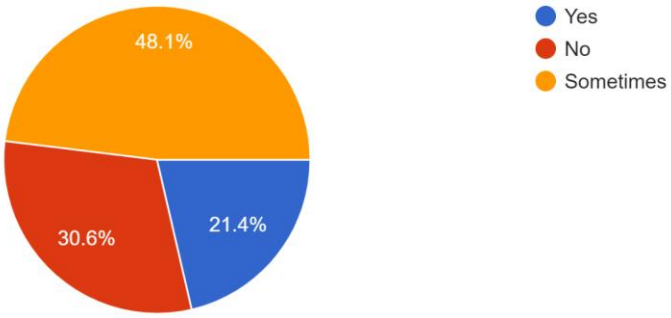
What issues do you encounter when working for lengthy periods of time in front of a screen?

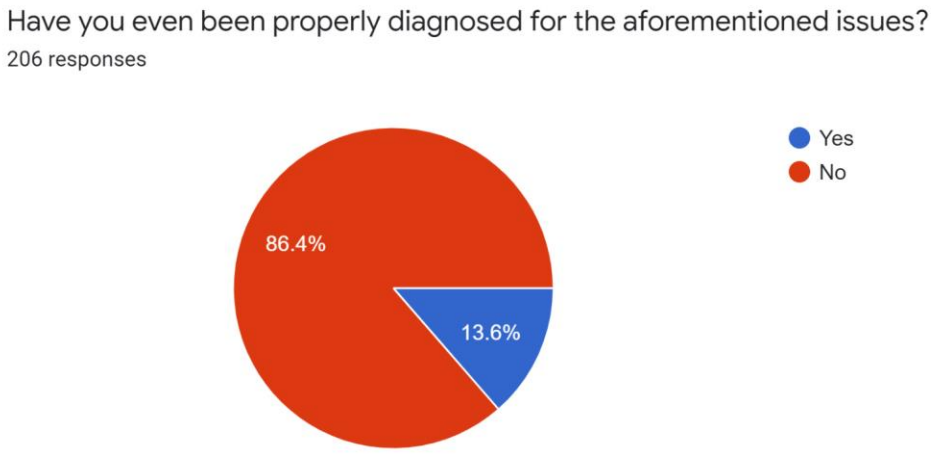
206 responses

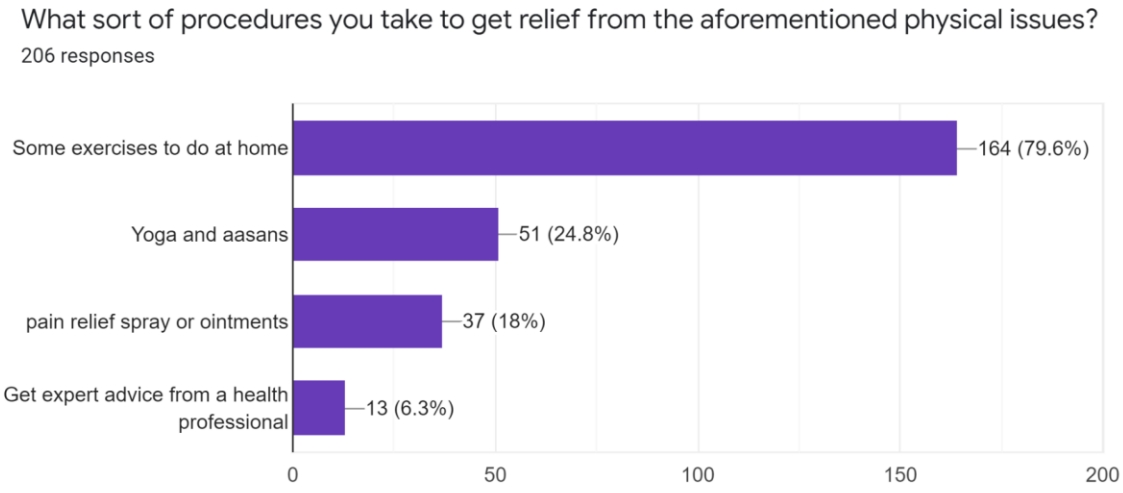


Do you take the aforementioned issues seriously?

206 responses







3. Detailed description of the identified problems

- With the rise of desk-based directed Jobs and the encouragement of online learning, more and more individuals are staying or sitting for extended periods of time.
- These prolonged hours of working at the desk has a negative impact on their postures and health. It raises serious posture and eyesight issues.
- Excessive watching and texting on handheld devices over a sustained period of time can lead to fatigue, repeated stress injury, and pain in the neck called- “test neck”.

- Research states that Incorrect postures can lead to a host of ailments including exacerbating arthritis, breathing difficulty.

4. Current developments in this domain

Some of the traditional methods that are still widely used for managing screen time and postures are called **passive methods**. These include ergonomic chairs, elastic bands, foot rests and some manual inputs like timers and reminders to stand up, move around, basically to take short breaks. However with the advancements in technology, there is a significant inclusion of AI - ML models to serve the intended purpose. Some of those are-

1. Smart Cervical Bands-
   An AI & IOT based Neck pain and Cervical Spondylosis(CS) healing system.It is proposed that the Internet of Things and a machine learning-based solution be used to alleviate CS and neck discomfort issues. A neckband contains a sensor with an accelerometer and gyrometer that monitors neck position and sends data to a Google cloud server for recording. In addition, if the user's neck is in an abnormal posture, alarms are generated and transmitted to the user. [*Source*]

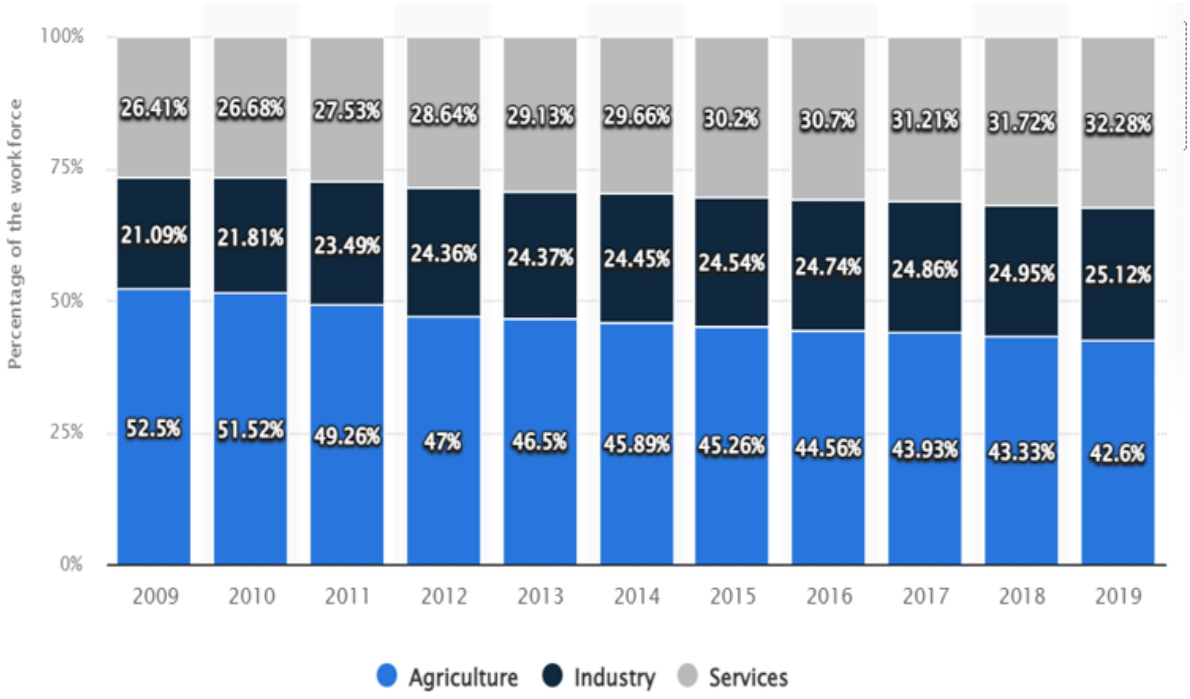
2. AI powered posture training Using LifeChair smart cushion-
   LifeChair is a smart cushion for the front of the chair that uses a revolutionary pressure sensing technology that was designed specifically for detecting human posture. It intends to alleviate the sedentary problem by actively correcting the user's posture. It conveys spatial information to the user, such as how to adjust their posture.[*Source*]

3. Real Time Intelligent posture corrective systems using Biomedical Mechanism-

   Biofeedback is a technique used to improve postural control and reduce rehabilitation time in both children and elderly. A biofeedback system uses a range of feedback modalities to connect with the human central nervous system. This study looks into the possibility of combining a real-time biofeedback system with artificial intelligence to improve the Posture. Vibrotactile actuators are used in the system to provide forewarning of inadequate postural control. [*Source*]

5. Need and significance of resolving the problem

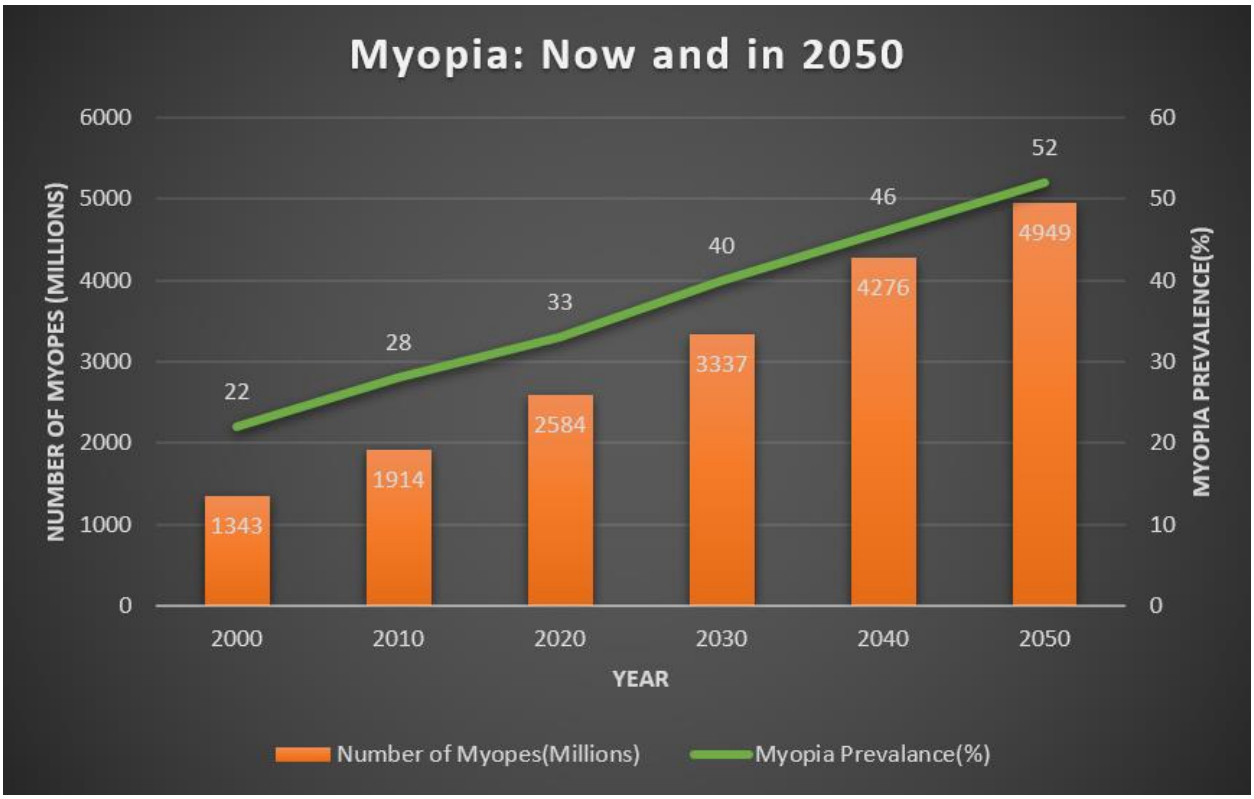
Working at a desk for long periods of time can lead to serious posture and eye problems. These problems may be exacerbated by incorrect equipment such as faulty chairs, inadequate spacing and improper placement of desks.



Source: India - Distribution of the workforce across economic sectors 2019 | Statista

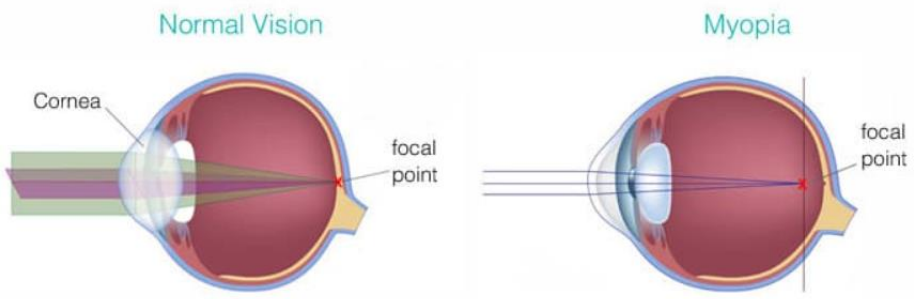
The aforementioned data shows an ever increasing trend in the number of population in the service sector. Most of their work demands screen exposure justifying the fact that the problem is targeting a broader section of the society .

Eye Disorders caused due to increased screen time:



Source: https://doi.org/10.1016/j.ophtha.2016.01.006

While glasses or contact lenses can help a child's vision, research suggests that serious eye problems put them at risk for a variety of problems later in life, including blurred/double vision, dry eyes, headaches, retinal detachment, glaucoma, and macular degeneration. One of the most serious risks is myopia, which most children and adults (mainly working officials) suffer from nowadays. The illustrations that follow show how a myopic eye differs from a normal eye.



Objectives pertaining to minimizing the Gap

With the rise in desk bound work and use of handheld devices, it is estimated that we spend more than half of the 80 percent sitting down[Biswas *et al., 2015*]. Specialists advise taking a 20-second break from closeup tasks every 20 minutes to glance at anything 20 feet away, keeping digital media 18 to 24 inches away from the face, and utilizing any digital device with correct posture.[Source]

We aid people in adhering to the rule by detecting eye movements and body posture with a web-cam assisted computer vision algorithm that reminds users to take breaks on time if they forget and suggests remedial action to achieve the posture recommended by experts.

Detailed Work Plan

In our concept, technology - the implementation of scientific experiments and the conclusions derived from them - plays a significant role. Computer vision techniques must be integrated with the user's existing equipment, which includes a laptop and cameras.
The systems consists of three main components-

1. **The Sensor**
2. **The AI based posture recognition module**
3. **Feedback Module**

In light of the foregoing, we suggest a non-data-sharing, secure computer vision, and artificial intelligence technique-based programme that works by exploiting existing webcam technology in desktop devices and instills the habit of taking regular breaks in the person's mental structure. Various computer vision algorithms like PoseNet(aforementioned), RMPE(Alpha Pose), DeepCut and OpenPoses, etc.. can properly map body posture.

How to Operate?

- After installing the software into your system and accepting the terms and conditions, the Webcam along with the Unimodal and bi-modal sensors (accelerometer & gyroscope) attached would be automatically turned.

- The upper body postures and motion are monitored as per the deep learning algos and neural technology. The body motions, eye-blinks, corneal contraction and lower-back alignments are observed.

- If the body continues to be in faulty posture for a specified time duration. After that time has elapsed, the information can be sent into a trained model that analyzes the posture and alerts users when they continue to be in an inappropriate position. If the operator gets up in between, the timer would automatically restart from the time it again gets back to his/her desk.

- A pop-up is generated on the working window itself stating that we are having an incorrect body alignment and suggests the correct one(as shown in fig.). If the body again tends to possess faulty alignment, then it would suggest that we are tiresome and require some breaks to rejuvenate.

- After turning off the software, it would generate a report for the User on a daily basis using data from both Eye and Posture Tracking.

These reports will assist the user in understanding their body's intrinsic responses after being exposed to hours of focused screen exposure and in taking appropriate action. It will also assist healthcare providers in better diagnosing, and treating any issues that may occur in future.

Physical Dimension (Concreteness, Matter) - The proposed method is based on Computer Vision, Machine Learning, and Orthopedic Science Theory and Concepts. Users would get real-time input on their posture, blink rate, and concentrate duration. With the information from the camera, the software would be able to make informed decisions about when to remind users to take breaks with pop-ups.

For eg.

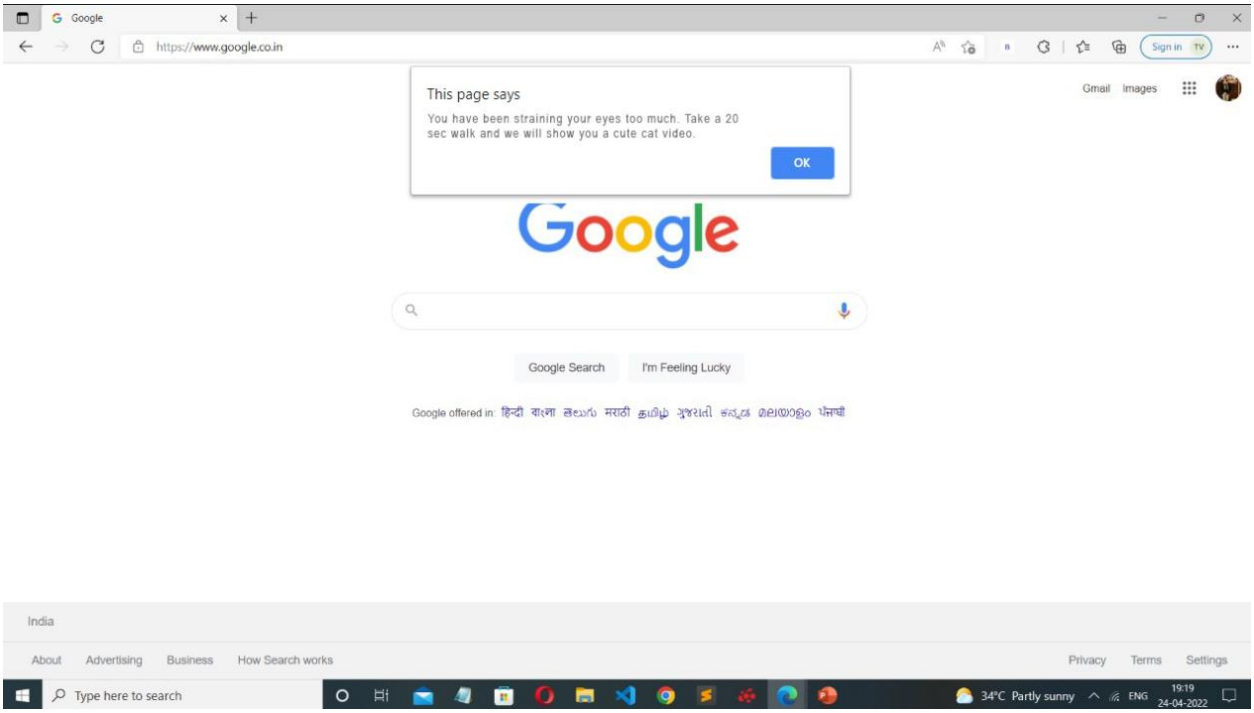
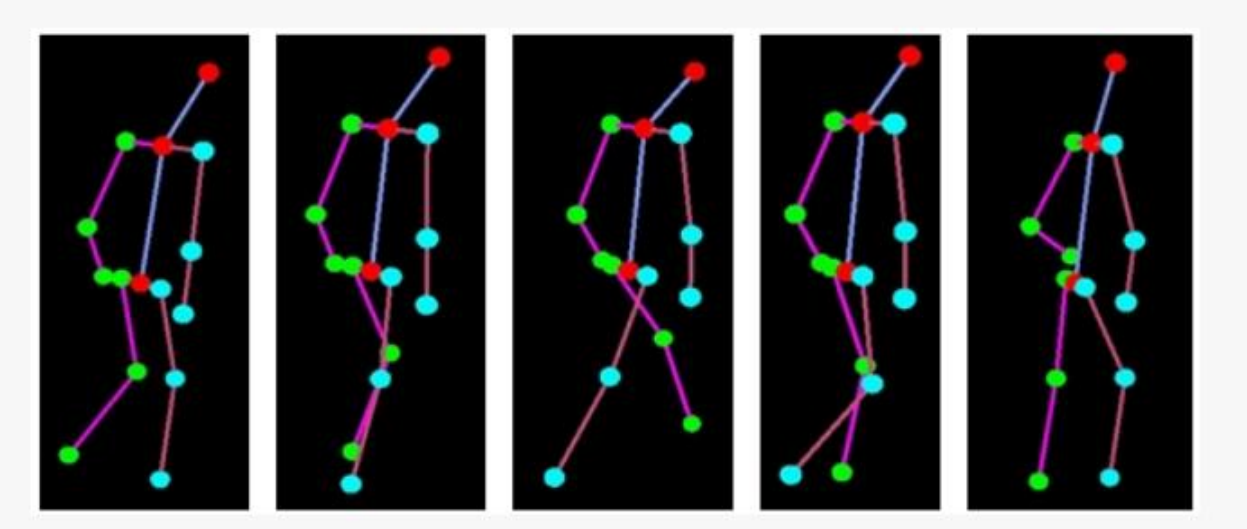


Fig. Showing how pop-up generated when the user is not resting his eyes

Tools and Techniques Perceived to be effective in Resolving the Issue

Technology-related feature:

1. **Posenet Technology**: Posenet is a term that applies to computer vision technologies for recognizing posture from various angles. It has a variety of applications, including posture control and action detection, and it makes use of Convolution Neural Networks to do so (CNN). It's a model that has already been trained for posture detection and falls under the category of Computer Vision. It performs activities like data preprocessing and applying the model to the data using TensorFlow. It's also been taught to calculate the score for the entire pose.



Source: http://www.ee.oulu.fi/~gyzhao/research/gait_recognition.htm

2. **Gazenet Technology:** It's a piece of technology that can be used to track and observe eye movement. Two convolutional layers with 2x11 kernel sizes are followed by three bi-directional Gated Recurrent Unit (GRU) layers and a fully linked layer at the conclusion of the network. Fixation, saccade 2.5, problem statement 17 and PSOs are all classified by the network. GazeGenNet, section 2.2.6, was used to train the network with synthetic data. It was tested against many state-of-the-art PSO detection algorithms, including the MNH, and it appeared to outperform them on numerous datasets.

Approaches that could be taken to Implement Interventional Plans

Our project uses both qualitative and quantitative approaches. We started with a qualitative method to identify the gap and severity of the problem, but our major focus is always on the quantitative approach because it is only after evaluating the true number and current statistics that it is possible to obtain an understanding of how it affects this segment of society.

Novelty of the Proposed Interventions

- The passive solutions adopted by the people are inefficient and don't guarantee that the User adopts appropriate posture after following them. They may slump up and forget to use these methods due to lack of self control and idleness.

- The solutions that have been discovered thus far involve the wearing out of some form of object (Cervical bands, Ergonomic chair, Lifechair ,braces, footrests, etc) which is somewhat cumbersome, whereas ours does not. Along with their work, the system would automatically monitor or keep an eye on their posture.

- Our technique emphasizes optimum eye-distance from the screen along with the proper body posture. It takes into account things like blinking rate, optimal corneal size, wet eyes, and so on. Such a solution hasn’t yet been incorporated into posture correction models!

- Our system would take a minimal amount from the users for its operation which is far lower than the amount spent on buying any posture-correction device. Therefore, our solution is cost effective.

Possible Constraints And Barriers to Implementation

1. There are some concerns regarding the User's privacy i.e. if the Software would record, store and analyze all their movements means their privacy is at risk. One major solution is to store the data in local systems or to leverage technologies like ***Blockchain*** so that no third party can have access to it.

2. There is a constraint of monitoring more than one individual sitting before the screens at the same time, as it may have some difficulties in identification or recognition. However, there are some more advanced technologies that can counter the constraint, but that require proficient expertise in the same.

3. Due to the fixed position of the camera, it becomes difficult to monitor lower back posture or body alignment properly. However, the problem can be resolved by installing an external fly rotational 3-D view digital camera.

4. As the result of our survey states that most of the users are not willing to pay to some trusted organization as they don't consider it worth solving or don't have faith in such AI based models. Therefore, proper marketing is indeed required to make our product scalable.

Expertise Available with Each Student to Contribute in the Development of the Intervention

- **Sarthak Vats (Leader)** has expertise in technical aspects. He has a bit of knowledge on Machine Learning and has a command of Algorithms. He will be further exploring the field of deep learning and neural networks in the summer break afterwards. He also has proficiency in marketing and channelizing the product required to grab the attention of investors and venture capitalists.

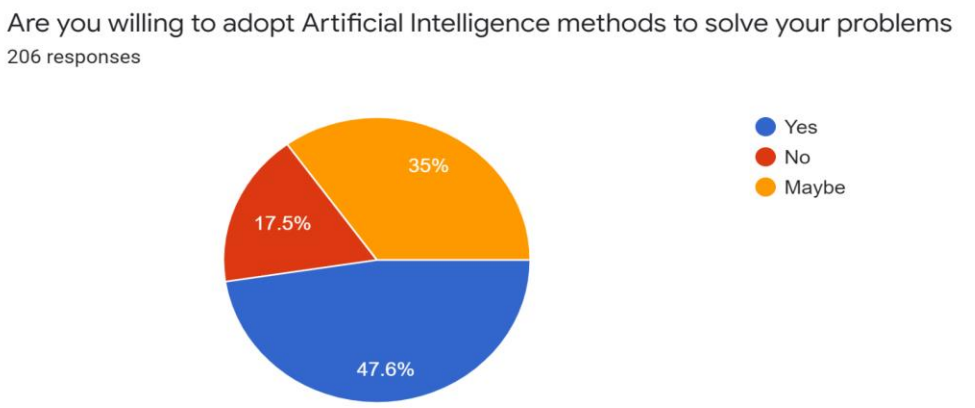
- **Asit Kumar Sahoo** has expertise in Data Analysis and Data Collection producing brainstorming ideas and drawing effective conclusions from it. He has a command on Algorithms, Programming and Editing skills. He will be exploring the field of Software Development and more specifically Artificial Intelligence (*its applications in the Real World*) in the Summer Holidays.

- **Kalu Ram Khateek** is a specialist in Programming and getting high-quality sources on a certain topic with relevant data. During the summer break, he will study Data Analysis and IoT with an emphasis on real-world problems. He has excellent problem-solving abilities, which enabled our team to come up with some novel solutions to the challenge.

Expected Outcomes

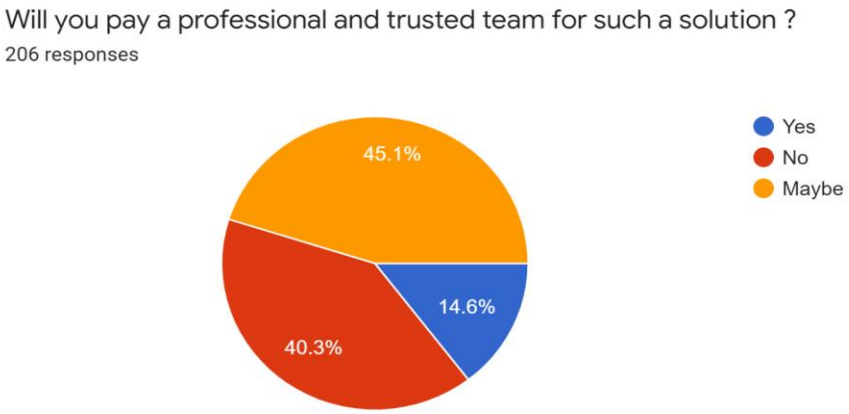
Ours is a system that can be scaled to show organizational statistics and can assist any government or non-profit organization in tracing and improving the community's health footprints, which has become a pressing need in today's world because most people do not consider improper posture to be a matter of concern.

According to our team's study, it is also justified that most people can go for some AI based solutions to these postures and eye related problems.



The above stated stats are the results of our own survey. These clearly justify that most people can go for some AI based solutions to these postures and eye related problems.

Now the question that comes in your mind is if people have trust or faith in AI based solutions on an organizational level?
Lets us look what we got from our study–



The results clearly show that most of the people are still reluctant to pay some fee for getting our well renowned services.

All these expected outcomes creates a curiosity to brainstorm with a lot more efficacious suggestions in the future.

Suggested Plan of Action for Utilization of Outcome Expected from the Work

- Social media can be leveraged as a platform to create health awareness on this issue as it has been proven to be a key factor in creating lifestyle impacts.

- We can build a health awareness challenge that asks users to check if they are maintaining correct posture when working long hours, whether their blinking rates are lowering, and challenges them to take a test using our software to determine these things.

- We may approach knowledgeable doctors and specialists to utilize and evaluate our software before recommending it to their patients and clients, in addition to directly reaching end users.It will add legitimacy to our product as it may leave a good impact on customers.

- We can also request that corporations reveal data on their employees' insurance claims in order to see if there is a link between the type of job and ocular/musculoskeletal health disorders.

- To establish credibility and trust among users, we can first provide our own reports and demos of how to use the programme to persuade them, as well as actively participate in answering any queries posed by users in social media posts.

- Our software might be improved and educated on data to compare a user's records to those of known patients and tell them how similar their records are to people who have Scoliosis, Lordosis, Kyphosis, Myopia, and other similar conditions.

- We may ask the government to test the software in real-world settings for a limited period of time. We can then collaborate on the data and extract insights into how employee spinal and ocular responses change over the course of a workday. This information could be used to make a case for the government to enact labor laws in the IT sector.

Contribution of Each Student of the Group to Complete the Assignment

- **KaluRam** gathered pertinent sources that allowed us to get a sense of current data. We were able to go deep and comprehend the situation owing to the data, which provided us with vital insights.

- **Sarthak and Asit** formulated solid hypotheses based on the information gathered and brainstormed ingenious ways.

- **All three members** took part in the survey's creation and attempted to disseminate it as widely as possible in order to obtain accurate findings. It led to effective conclusions for all three individuals.

- **Sarthak** mostly emphasized the technical aspects of how the sensors, monitoring system, and algorithm for generating effective feedback will operate.

- **Asit and KaluRam** came up with some innovative ideas for the project. Both members assessed the potential obstacles to developing the intervention and proposed some compelling strategies to overcome them.

- Finally the Editing and Presentation work was done by **Asit**.

CONCLUSION

Money and luxury seem to entice today's man. In this race, he has neglected to consider his own physical and mental well-being. As rightly said –

"It is health that is the real wealth, and not pieces of gold and silver." ~ **Mahatma Gandhi**.

As a society, we must prioritize physical and mental health so that we can operate efficiently in the respective domains, generate productive results, and achieve various goals as a whole. We have learned how essential health is to our lives throughout the last two years of Covid's unprecedented situation.In this way, our team made a little contribution to societal transformation. We think that our project, **"Screen Time Management and Posture Correction,"** will contribute to raising the standard of living for a large segment of the population and promoting health in our country.

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