The healthcare industry is facing a growing emphasis onhealthcare management instead of conventional diseasemanagement [1]. SITTING is one among the most commonpostures [2-7] of human beings in life and reported that peoplesit for six hours each day. Current healthcare informationmodules are designed for monitoring the posture for low backpain patients. Chronic Low Back Pain (CLBP) is a prominentcause of disability dominant in similar parts across variouscountries and cultures [2]. One in five adults suffers fromCLBP annually. In industrialized cultures, chronic pain is fastbecoming the greatest health problem which embraces lowback pain costs of US$100-$200 billion annually [4]. About75% to 85% of workers nonappearance is credited to recurrentand chronic back pain [6]. Presently some of the methods likee-cushion and SQUID Bio magnetometer system are proposedas the solution of spinal cord injury. In real time, wirelessnetworks are used to transmit the medical data with securedprotection on cloud service. In this process, the private medicaldata cannot be disclosed by an individual in the middle attack.Thus, the collected data would not be threatened and can bemade use of consistent refuge plan by healthcare serviceprovider (HSP). The Advanced Encryption Standard (AES) isused to refuge the framework on system [5]. The healthcareapplications could support the privacy easily [8-20]. Theframework advanced for a module embattled by low powermicrocontroller within real time embedded operating system.The classification of spinal cord is shown in the Figure 1.Figure 1. Classification of spinal cord.The following are the related work on the field of healthcarelumbar spine posture analysis. Chhikara et al. [1] observed thatIMPAIRED (In-House Monitoring Low back Pain RelatedDisability) concept will enable accurate assessment of chronicLBP patients, monitors the treatment effects on patients,checks on whether patients follow treatment plans andobjective assessment of the clinical effectiveness of current andoriginal treatments. The key advantage is that the product willhave an integrated approach towards disability assessment andISSN 0970-938Xwww.biomedres.infoBiomedical Research 2018; Special Issue: S118-S123S118Special Section: Computational Life Sciences and Smarter Technological AdvancementBiomed Res 2018 Special Issue

1. SUMMARY

The growing technology in the world is rapidly transforming the way people lead their lives.

Industrialization and urbanization have brought an enormous increase in sedentary lifestyle to the

modern world. Indulged in technology, people are often found abandoning their good posture and

being hunched over for really long hours.

Good posture is of utmost importance for leading a healthy lifestyle and it is said that back pain

is the third most common reason for people to visit the doctor. Having poor posture has been

found to be a main cause of lower back pain as it impacts the transverses abdominis muscle.

Maintaining a good posture and changing one’s position from time to time is considered to

significantly improve and maintain one’s health.

The aim of this paper is to provide a feasible solution to this problem by presenting a wearable

device that recognizes the posture of the person. It records the posture and classifies it as Good

or Bad. It also gives the statistics and overall feedback of how it can be improved.

Figure 1. Seating positions for good/bad posture

2. PROBLEM DEFINITION

A large number of the working population have office jobs that require long hours of sitting, and

students spend most of their time on laptops devices leaning forward and these habits lay

significant strain on the neck and back. Therefore, we introduce a smart monitoring system that

is used to enhance the quality of life by providing the support needed to maintain good posture

and keep the body moving.

The system will consist of a wireless wearable device that can be attached to a person’s back

and is used to alert the user in case of an unhealthy postural situations, such as sitting with a

hunchback or remaining idle for long periods of time. The user will acquire awareness of their own

posture using vibrational and sound feedback, and correct it when necessary. Furthermore, the

text message “GOOD POSTURE” or “BAD POSTURE” will appear on the display in front of the

user, depending on the position.

This paper details the introduction draft with details about 5 base paper and 1st draft paper and all the drafts will

listed in the bottom

Accelerometer is a device used to measure changes in acceleration. It is one of the most important

sensors used in a variety of electronic gadgets. In our project, for measurements we will use one axes,

i.e. Y axis. The accelerometer is given a power supply of 5V and it gives analogue output. This

analogue output needs to be converted to digital so that it can be displayed on the LCD. For this

conversion, the ADC unit of microcontroller is used.

This file contains the summaries of bp1-5 and dpaper1 and the dp2 updates for the introductions

applicability to multiple patient groups through relativelyminor modifications.Ladenbauer et al. [11] developed an innovative approach tohave a root fiber with implanted electrodes to excite lumbarposterior. The cathode position determines the entry of theposterior root fibers at the spinal cord portions which arecategorized by 1) A strong curvature of the fiber, and 2) Aborder between anatomical structures with significantlydifferent conductivities. Efficient excitation of the differentstructures with simple noninvasive method on rehabilitationwith motor disorders helps in identifying the position of thespinal cord. Hu et al. [21] presented the benefits of both lowcost sensor and wireless sensors. The circuits wereincorporated into the sole of the cushion. The designed systemsubjected on power and reliability and could be improvedthrough modifications of the data sampling rate,communication frequency and the analysis algorithms runningon the handset. The smart cushion for back prevention basedon similar frame works was also being used.Bai et al. [19] observed that the accelerometer sensor could beused to design and implement a fall monitor with mobilitydetection. The design was based on the smart phone whichcould be carried anywhere including out of doors. The GPS inthe smart phone was used to detect where the fall had takenplace. The acceleration values of X, Y and Z axis were used forthe static state analysis of the falling position. Theexperimental results showed an overall accuracy of smartgadget over various sitting positions to be 75.9%. Xu et al. [18]developed a textile-based sensor used to analyze the sittingposture of human. The experimental results showed upto 89%of accuracy and concluded that the monitoring of postureswere more economical and comfort for the people.Samiei-Zonouz et al. [15] observed that the growing powerfulembedded sensors such as accelerometers, gyroscopes,microphones, and cameras were useful for monitoring ofvarious parameters in different applications. The design andimplementation of systems for monitoring the human postureusing a smartphone-centric software with acceleration sensorwhich was suitable for healthcare applications. The positionand the activity monitoring

Ideas to incorporate:

- back pain sources

Draft 1:

Back pain is a prevalent and distressing issue that affects individuals irrespective of age or profession. It manifests in two primary forms: chronic and acute back pain. Chronic back pain develops gradually or suddenly and persists for more than 12 weeks or occurs regularly.Often associated with systemic or rheumatic conditions such as arthritis or fibromyalgia. Increased usage of smartphones, laptops, computers and other modern electronics for longer periods of time has led to 15-19% people suffering from upper back pain and 60-70% people suffering from lower back pain. Pregnancy, major accidents are the secondary causes which leads to back pain. Woman ‘s after their pregnancy struggles to regain their back posture and feels difficult to walk . About 70-80% of the people suffering from back pain find faults in their posture. Chronic back pain can significantly impact daily functioning and overall well-being. In contrast, acute back pain arises suddenly and typically lasts for a shorter duration, usually afew weeks or days. Commonly triggered by injuries like muscle strains or ligament tears resulting from activities such as heavy lifting or sudden movements, acute back pain can cause considerable discomfort and limitations in mobility. Both chronic and acute back pain can have profound effects on an individual's quality of life, leading to reduced productivity, mobility restrictions, and emotional distress. Effective management and treatment strategies for back pain may include a combination of medication, physical therapy, lifestyle modifications, and, in severe cases, surgical interventions tailored to meet the unique needs and circumstances of everyone. By addressing the [Type here] underlying causes and providing targeted interventions, individuals experiencing back pain can improve their overall well-being and quality of life.

**Base paper 1: (https://www.researchgate.net/publication/330040902\_A\_wearable\_embedded\_device\_for\_chronic\_low\_back\_patients\_to\_track\_lumbar\_spine\_position)**

The healthcare industry is facing a growing emphasis onhealthcare management instead of conventional diseasemanagement [1]. SITTING is one among the most commonpostures [2-7] of human beings in life and reported that peoplesit for six hours each day. Current healthcare informationmodules are designed for monitoring the posture for low backpain patients. Chronic Low Back Pain (CLBP) is a prominentcause of disability dominant in similar parts across variouscountries and cultures [2]. One in five adults suffers fromCLBP annually. In industrialized cultures, chronic pain is fastbecoming the greatest health problem which embraces lowback pain costs of US$100-$200 billion annually [4]. About75% to 85% of workers nonappearance is credited to recurrentand chronic back pain [6]. Presently some of the methods likee-cushion and SQUID Bio magnetometer system are proposedas the solution of spinal cord injury. In real time, wirelessnetworks are used to transmit the medical data with securedprotection on cloud service. In this process, the private medicaldata cannot be disclosed by an individual in the middle attack.Thus, the collected data would not be threatened and can bemade use of consistent refuge plan by healthcare serviceprovider (HSP). The Advanced Encryption Standard (AES) isused to refuge the framework on system [5]. The healthcareapplications could support the privacy easily [8-20]. Theframework advanced for a module embattled by low powermicrocontroller within real time embedded operating system.The classification of spinal cord is shown in the Figure 1

The following are the related work on the field of healthcarelumbar spine posture analysis. Chhikara et al. [1] observed thatIMPAIRED (In-House Monitoring Low back Pain RelatedDisability) concept will enable accurate assessment of chronicLBP patients, monitors the treatment effects on patients,checks on whether patients follow treatment plans andobjective assessment of the clinical effectiveness of current andoriginal treatments. The key advantage is that the product willhave an integrated approach towards disability assessment an applicability to multiple patient groups through relativelyminor modifications.Ladenbauer et al. [11] developed an innovative approach tohave a root fiber with implanted electrodes to excite lumbarposterior. The cathode position determines the entry of theposterior root fibers at the spinal cord portions which arecategorized by 1) A strong curvature of the fiber, and 2) Aborder between anatomical structures with significantlydifferent conductivities. Efficient excitation of the differentstructures with simple noninvasive method on rehabilitationwith motor disorders helps in identifying the position of thespinal cord. Hu et al. [21] presented the benefits of both lowcost sensor and wireless sensors. The circuits wereincorporated into the sole of the cushion. The designed systemsubjected on power and reliability and could be improvedthrough modifications of the data sampling rate,communication frequency and the analysis algorithms runningon the handset. The smart cushion for back prevention basedon similar frame works was also being used.Bai et al. [19] observed that the accelerometer sensor could beused to design and implement a fall monitor with mobilitydetection. The design was based on the smart phone whichcould be carried anywhere including out of doors. The GPS inthe smart phone was used to detect where the fall had takenplace. The acceleration values of X, Y and Z axis were used forthe static state analysis of the falling position. Theexperimental results showed an overall accuracy of smartgadget over various sitting positions to be 75.9%. Xu et al. [18]developed a textile-based sensor used to analyze the sittingposture of human. The experimental results showed upto 89%of accuracy and concluded that the monitoring of postureswere more economical and comfort for the people.Samiei-Zonouz et al. [15] observed that the growing powerfulembedded sensors such as accelerometers, gyroscopes,microphones, and cameras were useful for monitoring ofvarious parameters in different applications. The design andimplementation of systems for monitoring the human postureusing a smartphone-centric software with acceleration sensorwhich was suitable for healthcare applications. The positionand the activity monitoring of human parts had its applicationin the field of medical advice, context awareness, calorie-burning guides, etc. The obtained results were demonstratedand presented instead of using distributed wearable sensorsover the human body; a smartphone incorporating itsembedded sensors (i.e., acceleration sensors) was utilized forperforming posture and activity monitoring. The proposedmodule uses non-radiative sensors to detect the voluntarymovement of lumbar spine which transfers the data to the userthrough wireless communication. The vibrator motor intimatesthe improper sitting position of the person. The androidapplication records the analyzed data from the sensor and alertsthe people about their position

------------------------------------------------------------------------------------------------------------------------

**Base paper 2:(https://www.scirp.org/journal/paperinformation?paperid=82471)**

There are an estimated 4.77 billion mobile phone users in the world as of 2017. This number is expected to grow to 5.07 billion by 2019 [[1](https://www.scirp.org/journal/paperinformation?paperid=82471#ref1)] . Many useful services are now implemented on smartphones and the number of such applications is continuously increasing. Consequently, smartphones have become multi-utility devices that are utilized for many functions besides the basic function of communication and are therefore being operated for prolonged periods of time. The extended and frequent usage brings with it health risks associated with physical stresses imposed on the users of these devices when incorrect body postures are adopted while operating these devices. A large number of patients exhibiting such health problems have familiarized medical practitioners with these issues and considerable research has been conducted in analyzing and understanding the underlying causes and finding solutions. Most smartphone users, however, remain unaware of these health risks. Creating awareness and educating the extremely large and increasing number of users on these health concerns is a challenging proposition that is difficult to be effectively implemented. It is therefore necessary to find a more practical solution.

The basic health problem related to smartphone’s usage relates to Cervical Spine Stress arising from the prolonged declination of the neck while viewing the screen of the smartphone. A ground-breaking study by Kenneth K. Hansraj, Chief of Spine Surgery, New York Spine Surgery and Rehabilitation Medicine revealed that while the standard weight applied on the spinal cord is normally 10 - 12 lbs. when the Cervical Spine is colinear with the spinal cord it rises steeply to 60 lbs. when the user’s neck is declined at 60 degrees from the body’s longitudinal axis [[2](https://www.scirp.org/journal/paperinformation?paperid=82471#ref2)] . The Cervical Spine connects the Spinal cord to the brain and is a crucial pathway for carrying signals between the brain and the rest of the body. These signals control almost all the bodily functions and hence any damage to this area can result in a condition termed in Text Neck and cause very serious health damage. In extreme conditions, the debility can develop into extreme curvature of the upper portion of the spinal cord, known as Kyphosis [[3](https://www.scirp.org/journal/paperinformation?paperid=82471#ref3)] . Kyphosis is a severe spinal affliction that can cause hindrance in even daily activities. Various studies have shown that tilted or hunched back posture leading to less energy level and known to affect depression or happiness levels [[4](https://www.scirp.org/journal/paperinformation?paperid=82471#ref4)] . Children and senior citizens are most vulnerable owing to their weaker cervical musculature.

------------------------------------------------------------------------------------------------------------------------

**Base paper 3(https://www.researchgate.net/publication/357810208\_WEARABLE\_POSTURE\_MONITORING\_SYSTEM\_WITH\_EMPHASIZE\_TO\_SPINE):**

The growing technology in the world is rapidly transforming the way people lead their lives. Industrialization and urbanization have brought an enormous increase in sedentary lifestyle to the modern world. Indulged in technology, people are often found abandoning their good posture and being hunched over for really long hours. Good posture is of utmost importance for leading a healthy lifestyle and it is said that back pain is the third most common reason for people to visit the doctor. Having poor posture has been found to be a main cause of lower back pain as it impacts the transverses abdominis muscle. Maintaining a good posture and changing one’s position from time to time is considered to significantly improve and maintain one’s health. The aim of this paper is to provide a feasible solution to this problem by presenting a wearable device that recognizes the posture of the person. It records the posture and classifies it as Good or Bad. It also gives the statistics and overall feedback of how it can be improved.

A large number of the working population have office jobs that require long hours of sitting, and students spend most of their time on laptops devices leaning forward and these habits lay significant strain on the neck and back. Therefore, we introduce a smart monitoring system that is used to enhance the quality of life by providing the support needed to maintain good posture and keep the body moving. The system will consist of a wireless wearable device that can be attached to a person’s back and is used to alert the user in case of an unhealthy postural situations, such as sitting with a hunchback or remaining idle for long periods of time. The user will acquire awareness of their own posture using vibrational and sound feedback, and correct it when necessary. Furthermore, the text message “GOOD POSTURE” or “BAD POSTURE” will appear on the display in front of the user, depending on the position.

------------------------------------------------------------------------------------------------------------------------

**Bp4:(****A Review on posture monitoring systems)**

The young people suffer from many back problems caused by leaning for long hours to their computer, tablets and phones. A recent study shows that looking down to the phone is equivalent to placing a 60 pound weight on one’s neck [1]. In fact tilting the head down to check Facebook or write a message on your smartphone leads to a stress of the spine. The continually use of the computers and smartphones without a survey to maintain straight posture causes many backs diseases such as low back pain, kyphosis and pain in the neck. The kyphosis or roundback of the spine can occur at any age specially during adolescence. This disease is an excessive spine curve because of abnormal rounding of upper back. This spine disorder can lead to breathing problems. The severe Kyphosis, significant deformation of the spine, may need a surgical treatment. According to a medical research the majority of patient cases can cure and prevent severe Kyphosis by making exercises to improve the sitting posture and maintain a spine straight [2]. Thus many researches are triggered to implement and develop systems to help person to monitor and improve their posture. These systems are composed of three main elements. The first component collects the information to define the spine shape. The second one analyzes the collected information. The third element is a feedback system to alert the user in case of bad posture. The function of the three components are based on the collected information. For this reason the systems proposed in literature used different types of information to define the human posture according to the used technologies. Many posture monitoring systems are based on the vision cameras [3]–[6]. These systems provide real time images to monitor the person’s posture over time. The systems compare the photos of the current posture with the photos of the correct posture and send alert to the user wrong posture. A recent research proposes a sitting posture monitoring system using Kinect IR depth camera [7]. the system collects the visual data and provides alert in case of the bad posture. These systems help users to improve their posture and correct the sitting behavior. However these systems threaten the personal privacy because of use of visual information. Recently the sensing technologies have known an evolution and spread of use in different fields specially in medical and Health care systems. The sensors are characterized by portability, low cost, ease of use and tiny size [8]. In addition these tiny devices provide a variety of information that can be useful to define the person posture. In literature many researches proposes posture monitoring systems for sitting person using the sensors that provide different information to define the spine shape. The information provided by the sensors save the human privacy. In this work we present an overview about the sitting posture monitoring systems with focus on the information needed to define the spine shape using the sensing technologies. We classify the posture monitoring systems based on the type of information required to identify the person’s posture and we analyze the technologies used and the systems architecture. This paper consists of four sections. In section II, we describe the existing sitting posture monitoring systems and in section III, we compare the different characteristics of the sitting posture monitoring systems. Section IV, we conclude the study with the prospects for future work.

**Base paper 5:(**[**https://www.mdpi.com/1424-8220/18/1/208**](https://www.mdpi.com/1424-8220/18/1/208)**)**

Ergonomic information provided for the seated person plays a crucial role in improving the sitting posture by changing the habits and attitude of the seated person [[1](https://www.mdpi.com/1424-8220/18/1/208" \l "B1-sensors-18-00208),[2](https://www.mdpi.com/1424-8220/18/1/208" \l "B2-sensors-18-00208),[3](https://www.mdpi.com/1424-8220/18/1/208" \l "B3-sensors-18-00208),[4](https://www.mdpi.com/1424-8220/18/1/208" \l "B4-sensors-18-00208),[5](https://www.mdpi.com/1424-8220/18/1/208" \l "B5-sensors-18-00208)]. A study by Robertson et al. [[1](https://www.mdpi.com/1424-8220/18/1/208" \l "B1-sensors-18-00208)] reported that musculoskeletal risk was lowered after 16 months by training seated persons with an ergonomic posture. Other studies by Choobineh et al. [[2](https://www.mdpi.com/1424-8220/18/1/208" \l "B2-sensors-18-00208)] and Menendez et al. [[3](https://www.mdpi.com/1424-8220/18/1/208" \l "B3-sensors-18-00208)] further showed that ergonomic interventions could reduce musculoskeletal symptoms and discomfort. Another study by Taieb-Maimon et al. [[5](https://www.mdpi.com/1424-8220/18/1/208" \l "B5-sensors-18-00208)] reported that posture risk was lowered after three weeks in an experiment with a camera showing the sagittal posture of the seated person.

A recent combination of IT technology and various sensors has enabled a sitting posture monitoring system (SPMS) to assess the posture of the seated person in real-time and to improve sitting posture. Previous studies on SPMSs can be classified according to two purposes. The first purpose is to determine whether or not a person is seated on the office chair, which is used mainly to monitor seat occupancy [[6](https://www.mdpi.com/1424-8220/18/1/208" \l "B6-sensors-18-00208),[7](https://www.mdpi.com/1424-8220/18/1/208" \l "B7-sensors-18-00208),[8](https://www.mdpi.com/1424-8220/18/1/208" \l "B8-sensors-18-00208),[9](https://www.mdpi.com/1424-8220/18/1/208" \l "B9-sensors-18-00208)]. The second purpose is to detect various sitting postures in order to identify bad sitting postures; this is commonly implemented by inserting pressure sensors into the backrest plate and seat plate [[3](https://www.mdpi.com/1424-8220/18/1/208" \l "B3-sensors-18-00208),[8](https://www.mdpi.com/1424-8220/18/1/208" \l "B8-sensors-18-00208)].

Recent advances in machine learning have led to the use of machine learning algorithms in many studies. Machine learning algorithms have the advantage of minimizing errors by training themselves through optimization and tuning and have recently been used in various areas, such as fall detection [[10](https://www.mdpi.com/1424-8220/18/1/208" \l "B10-sensors-18-00208)], classification of wrist-motion directions using electromyography [[11](https://www.mdpi.com/1424-8220/18/1/208" \l "B11-sensors-18-00208)], and classification of sitting postures [[12](https://www.mdpi.com/1424-8220/18/1/208" \l "B12-sensors-18-00208),[13](https://www.mdpi.com/1424-8220/18/1/208" \l "B13-sensors-18-00208),[14](https://www.mdpi.com/1424-8220/18/1/208" \l "B14-sensors-18-00208),[15](https://www.mdpi.com/1424-8220/18/1/208" \l "B15-sensors-18-00208)]. Of these previous studies, the study by Zemp et al. [[14](https://www.mdpi.com/1424-8220/18/1/208" \l "B14-sensors-18-00208)] measured data on seven sitting postures using a total of 17 pressure sensors and obtained a maximum classification rate of 90.9% with several classifiers. The study by Meyer et al. [[13](https://www.mdpi.com/1424-8220/18/1/208" \l "B13-sensors-18-00208)] developed a textile pressure sensor to measure sitting posture data and obtained a maximum classification rate of 84% using a Naïve Bayes classifier. Furthermore, the study proved that by obtaining data by attaching sensors to the backrest, as well as to the seating plate, the classification was more effective than by attaching sensors to the seating plate exclusively. The study by Zhu et al. [[12](https://www.mdpi.com/1424-8220/18/1/208" \l "B12-sensors-18-00208)] measured the data according to the sitting posture on the seat plate and backrest plate using two sensor sheets with 42 × 48 pressure-sensing elements, and further classified the sitting postures using several classifiers. The study by Ma et al. [[15](https://www.mdpi.com/1424-8220/18/1/208" \l "B15-sensors-18-00208)] inserted 12 pressure sensors into the seat plate and backrest plate and obtained a maximum classification rate of 99.48% for five sitting postures using several classifiers.

Several studies on sitting posture estimation have proposed SPMSs based on various sensors and have rarely been commercialized because of the high cost of the measuring devices. The prices of products could increase because of the measurement of all loads applied to the sensors that were attached to both the backrest plate and seat plate [[7](https://www.mdpi.com/1424-8220/18/1/208" \l "B7-sensors-18-00208)], or by attaching the sensor covering the whole load transfer range [[9](https://www.mdpi.com/1424-8220/18/1/208" \l "B9-sensors-18-00208)]. Thus, a new sitting-posture estimation method with a lower cost and fewer device elements is required. In particular, when a new method uses machine learning algorithms, it requires a posture estimation algorithm with higher accuracy according to the individual’s characteristics than the decision tree estimation method using the typical body weight ratio (BWR). This study proposes an algorithm with high posture-estimation accuracy by comparing various machine learning algorithms with a posture estimation method using the decision tree obtained through experiments.

**Draft 2.1(inputting main sentences):**

SITTING is one among the most commonpostures [1.2-7] of human beings in life and reported that peoplesit for six hours each day. As a result back pain is a prevalent and distressing issue that affects individuals irrespective of age or profession. Back pain is the third most common reason for people to visit the doctor[3.?]. About 70-80% of the people suffering from back pain find faults in their posture[d1?]. Chronic back pain develops over time as a result of increased usage of digital electronic that encourage a sedentary posture for longer periods of time and has led to 15-19% people suffering from upper back pain and 60-70% people suffering from lower back pain[d1?]. The most comon is mobile phones. There are an estimated 4.77 billion mobile phone users in the world as of 2017. This number is expected to grow to 5.07 billion by 2019 [2.[1](https://www.scirp.org/journal/paperinformation?paperid=82471#ref1)] . Many useful services are now implemented on smartphones and the number of such applications is continuously increasing further promoting a sedentary lifestyle. A recent study shows that looking down to the phone is equivalent to placing a 60 pound weight on one’s neck [4.1]. Industrialization and urbanization have brought an enormous increase in sedentary lifestyle to the modern world. Back pains are often associated with systemic or rheumatic conditions such as arthritis or fibromyalgia[d1?]. Besides prolonged sitting hours, pregnancy and major accidents are the common secondary causes which leads to back pain. Chronic Low Back Pain (CLBP) is a prominentcause of disability dominant in similar parts across variouscountries and cultures [1.2]. One in five adults suffers fromCLBP annually. In industrialized cultures, chronic pain is fastbecoming the greatest health problem which embraces lowback pain costs of US$100-$200 billion annually [1.4]. About75% to 85% of workers nonappearance is credited to recurrentand chronic back pain [1.6]. The continually use of the computers and smartphones without a survey to maintain straight posture causes many backs diseases such as low back pain, kyphosis and pain in the neck. The kyphosis or roundback of the spine can occur at any age specially during adolescence. This disease is an excessive spine curve because of abnormal rounding of upper back. This spine disorder can lead to breathing problems. The severe Kyphosis, significant deformation of the spine, may need a surgical treatment.[4.?]According to a medical research the majority of patient cases can cure and prevent severe Kyphosis by making exercises to improve the sitting posture and maintain a spine straight [4.2]. A ground-breaking study by Kenneth K. Hansraj, Chief of Spine Surgery, New York Spine Surgery and Rehabilitation Medicine revealed that while the standard weight applied on the spinal cord is normally 10 - 12 lbs. when the Cervical Spine is colinear with the spinal cord it rises steeply to 60 lbs. when the user’s neck is declined at 60 degrees from the body’s longitudinal axis [2.[2](https://www.scirp.org/journal/paperinformation?paperid=82471#ref2)] . The Cervical Spine connects the Spinal cord to the brain and is a crucial pathway for carrying signals between the brain and the rest of the body. These signals control almost all the bodily functions and hence any damage to this area can result in a condition termed in Text Neck and cause very serious health damage. In extreme conditions, the debility can develop into extreme curvature of the upper portion of the spinal cord, known as Kyphosis [2.[3](https://www.scirp.org/journal/paperinformation?paperid=82471#ref3)] .|Chronic back pain can significantly impact daily functioning and overall well-being. Commonly triggered by injuries like muscle strains or ligament tears resulting from activities such as heavy lifting or sudden movements, acute back pain can cause considerable discomfort and limitations in mobility. Both chronic and acute back pain can have profound effects on an individual's quality of life, leading to reduced productivity, mobility restrictions, and emotional distress|[d.?].Various studies have shown that tilted or hunched back posture leading to less energy level and known to affect depression or happiness levels [2.[4](https://www.scirp.org/journal/paperinformation?paperid=82471#ref4)] .A study by Robertson et al. [5.[1](https://www.mdpi.com/1424-8220/18/1/208" \l "B1-sensors-18-00208)] reported that musculoskeletal risk was lowered after 16 months by training seated persons with an ergonomic posture. Other studies by Choobineh et al. [5.[2](https://www.mdpi.com/1424-8220/18/1/208" \l "B2-sensors-18-00208)] and Menendez et al. [5.[3](https://www.mdpi.com/1424-8220/18/1/208" \l "B3-sensors-18-00208)] further showed that ergonomic interventions could reduce musculoskeletal symptoms and discomfort. Another study by Taieb-Maimon et al. [5.[5](https://www.mdpi.com/1424-8220/18/1/208" \l "B5-sensors-18-00208)] reported that posture risk was lowered after three weeks in an experiment with a camera showing the sagittal posture of the seated person. Therefore it is vital for appropriate spinal posture care to be taken which is exactly what our design hopes aims to achieve.. Multiple systems have been implemented.|Thus many researches are triggered to implement and develop systems to help person to monitor and improve their posture. These systems are composed of three main elements. The first component collects the information to define the spine shape. The second one analyzes the collected information. The third element is a feedback system to alert the user in case of bad posture.|[4.?] Our design primarilyy focuses on the analysis of collected information. The review further elaborates on the various sensors used for the purpose of monitoring among which sensor-based monitoring is reported to provide more patient privacy & security

**Draft 2.2:(basic ordering)**

SITTING is one among the most common postures [1.2-7] of human beings in life and reported that peoplesit for six hours each day. As a result back pain is a prevalent and distressing issue that affects individuals irrespective of age or profession with a report of back pain being third most common reason for people to visit the doctor[3.?]. About 70-80% of the people suffering from back pain find faults in their posture[d1?]. Back pain develops over time as a result of sedentary postures encouraged by increased usage of digital electronic for longer periods of time and has led to 15-19% people suffering from upper back pain and 60-70% people suffering from lower back pain[d1?]. The most common activity performed while sitting is using mobile phones. There are an estimated 4.77 billion mobile phone users in the world as of 2017. This number is expected to grow to 5.07 billion by 2019 [2.[1](https://www.scirp.org/journal/paperinformation?paperid=82471#ref1)] . with Many useful services are now implemented on smartphones and the number of such applications is continuously increasing further promoting a sedentary lifestyle. A recent study shows that looking down to the phone is equivalent to placing a 60 pound weight on one’s neck [4.1]. Besides prolonged sitting hours, pregnancy and major accidents are the common secondary causes which leads to back pain. [SHRINK CLBP & KYPHOSIS] Chronic Low Back Pain (CLBP) is a prominentcause of disability dominant in similar parts across variouscountries and cultures [1.2]. One in five adults suffers fromCLBP annually. In industrialized cultures, chronic pain is fastbecoming the greatest health problem which embraces lowback pain costs of US$100-$200 billion annually [1.4]. About75% to 85% of workers nonappearance is credited to recurrentand chronic back pain [1.6]. The continually use of the computers and smartphones without a survey to maintain straight posture causes many backs diseases such as low back pain, kyphosis and pain in the neck. The kyphosis or roundback of the spine can occur at any age specially during adolescence. This disease is an excessive spine curve because of abnormal rounding of upper back. This spine disorder can lead to breathing problems. The severe Kyphosis, significant deformation of the spine, may need a surgical treatment.[4.?]According to a medical research the majority of patient cases can cure and prevent severe Kyphosis by making exercises to improve the sitting posture and maintain a spine straight [4.2].[FURTHER SUMMARIZE THE FOLLOWIN] A ground-breaking study by Kenneth K. Hansraj, Chief of Spine Surgery, New York Spine Surgery and Rehabilitation Medicine revealed that while the standard weight applied on the spinal cord is normally 10 - 12 lbs. when the Cervical Spine is colinear with the spinal cord it rises steeply to 60 lbs. when the user’s neck is declined at 60 degrees from the body’s longitudinal axis [2.[2](https://www.scirp.org/journal/paperinformation?paperid=82471#ref2)] . The Cervical Spine connects the Spinal cord to the brain and is a crucial pathway for carrying signals between the brain and the rest of the body. These signals control almost all the bodily functions and hence any damage to this area can result in a condition termed in Text Neck and cause very serious health damage. In extreme conditions, the debility can develop into extreme curvature of the upper portion of the spinal cord, known as Kyphosis [2.[3](https://www.scirp.org/journal/paperinformation?paperid=82471#ref3)] .|Chronic back pain can significantly impact daily functioning and overall well-being. Commonly triggered by injuries like muscle strains or ligament tears resulting from activities such as heavy lifting or sudden movements, acute back pain can cause considerable discomfort and limitations in mobility. Both chronic and acute back pain can have profound effects on an individual's quality of life, leading to reduced productivity, mobility restrictions, and emotional distress|[d.?].Various studies have shown that tilted or hunched back posture leading to less energy level and known to affect depression or happiness levels [2.[4](https://www.scirp.org/journal/paperinformation?paperid=82471#ref4)] .A study by Robertson et al. [5.[1](https://www.mdpi.com/1424-8220/18/1/208" \l "B1-sensors-18-00208)] reported that musculoskeletal risk was lowered after 16 months by training seated persons with an ergonomic posture. Other studies by Choobineh et al. [5.[2](https://www.mdpi.com/1424-8220/18/1/208" \l "B2-sensors-18-00208)] and Menendez et al. [5.[3](https://www.mdpi.com/1424-8220/18/1/208" \l "B3-sensors-18-00208)] further showed that ergonomic interventions could reduce musculoskeletal symptoms and discomfort. Another study by Taieb-Maimon et al. [5.[5](https://www.mdpi.com/1424-8220/18/1/208" \l "B5-sensors-18-00208)] reported that posture risk was lowered after three weeks in an experiment with a camera showing the sagittal posture of the seated person. Therefore it is vital for appropriate spinal posture care to be taken which is exactly what our design hopes aims to achieve.. Multiple systems have been implemented.|Thus many researches are triggered to implement and develop systems to help person to monitor and improve their posture. These systems are composed of three main elements. The first component collects the information to define the spine shape. The second one analyzes the collected information. The third element is a feedback system to alert the user in case of bad posture.|[4.?] Our design primarilyy focuses on the analysis of collected information. The review further elaborates on the various sensors used for the purpose of monitoring among which sensor-based monitoring is reported to provide more patient privacy & security

**Draft 2.3:(sentence structuring)**

Sitting is one among the most common postures [1.2-7] of human beings in life and reported that peoplesit for six hours each day. As a result back pain has become a prevalent and distressing issue that affects individuals with a report of back pain being third most common reason for people to visit the doctor[3.?]. About 70-80% of the people suffering from back pain find faults in their posture[d1?]. Chronic Back pain develops over time as a result of sedentary postures encouraged by increased usage of digital electronic for longer periods of time and has led to 15-19% people suffering from upper back pain and 60-70% people suffering from lower back pain[d1?]. The most common activity performed while sitting is the use of mobile phones with an estimated 4.77 billion mobile phone users in the world as of 2017. This number is expected to grow to 5.07 billion by 2019 [2.[1](https://www.scirp.org/journal/paperinformation?paperid=82471#ref1)] and with many useful services are now implemented on smartphones and the number of such applications is continuously increasing further promoting a sedentary lifestyle. It is further distressing to note that a recent study shows that looking down to the phone is equivalent to placing a 60 pound weight on one’s neck [4.1]. In Correlation, another study reported of development of Kyphosis from a condition named Text Neck when 60 lbs of force on the neck[2...]. This disease is an excessive spine curve because of abnormal rounding of upper back. which can lead to breathing problems that may eventually require a surgical treatment.[4.?]Chronic Low Back Pain (CLBP) is another prominentcause of disability dominant in similar parts across variouscountries and cultures with One in five adults suffers fromCLBP annually[1.2]. In industrialized cultures, chronic pain is fast becoming the greatest health problem which embraces lowback pain costs of US$100-$200 billion annually [1.4]. [FURTHER SUMMARIZE THE FOLLOWIN] .Acute back pain, Commonly triggered by injuries like muscle strains or ligament tears resulting from activities such as heavy lifting or sudden movements, can cause considerable discomfort and limitations in mobility. Back pain can have profound effects on an individual's quality of life, leading to reduced productivity, mobility restrictions, and emotional distress|[d.?].Various studies have shown that tilted or hunched back posture leading to less energy level and known to affect depression or happiness levels [2.[4](https://www.scirp.org/journal/paperinformation?paperid=82471#ref4)]. The poor posture health also translates to work productivity with About75% to 85% of workers nonappearance being credited to recurrent and chronic back pain [1.6]. Despite its prevalence, simple preventive measures can prevent similar the development of these disorders. According to a medical research the majority of patient cases can cure and prevent severe Kyphosis by making exercises to improve the sitting posture and maintain a spine straight [4.2]. A study by Robertson et al. [5.[1](https://www.mdpi.com/1424-8220/18/1/208" \l "B1-sensors-18-00208)] reported that musculoskeletal risk was lowered after 16 months by training seated persons with an ergonomic posture. Other studies by Choobineh et al. [5.[2](https://www.mdpi.com/1424-8220/18/1/208" \l "B2-sensors-18-00208)] and Menendez et al. [5.[3](https://www.mdpi.com/1424-8220/18/1/208" \l "B3-sensors-18-00208)] further showed that ergonomic interventions could reduce musculoskeletal symptoms and discomfort. . Another study by Taieb-Maimon et al. [5.[5](https://www.mdpi.com/1424-8220/18/1/208" \l "B5-sensors-18-00208)] reported that posture risk was lowered after three weeks in an experiment with a camera showing the sagittal posture of the seated person. Therefore it is vital for appropriate spinal posture care to be taken care of which is exactly what our system’s design aims to achieve.. Multiple systems have been implemented to accomplish this purpose.|These systems are composed of three main elements with data collection, data analysis and feedback being the components|[4.?] Our system incorporates all of these components but with a focus on the analysis of collected information.

**DRAFT 2.4(chatgpt and further changes):**

Sitting is one of the most common postures in daily life [1.2-7], with studies indicating that people spend around six hours sitting each day. Consequently, back pain has become a widespread and troubling issue, now ranking as the third most common reason for individuals to seek medical attention [3.?]. Approximately 70-80% of those experiencing back pain attribute it to poor posture [d1?]. Chronic back pain develops gradually due to sedentary behavior, often exacerbated by prolonged use of digital devices. This has resulted in 15-19% of people suffering from upper back pain and 60-70% from lower back pain [d1?].

The most frequent activity while sitting is using mobile phones, with an estimated 4.77 billion users worldwide as of 2017. This number was projected to increase to 5.07 billion by 2019 [2.1]. As more essential services are integrated into smartphones, and with the growing number of mobile applications, this has further promoted a sedentary lifestyle. Alarmingly, a recent study reveals that looking down at a phone is comparable to placing 60 pounds of pressure on the neck [4.1]. Correspondingly, another study highlighted that a condition known as "Text Neck," caused by 60 pounds of neck pressure, can lead to Kyphosis [2...?]This disease is an excessive spine curve because of abnormal rounding of upper back. which can lead to breathing problems that may eventually require a surgical treatment.[4.?].

Chronic Low Back Pain (CLBP) is another significant cause of disability, affecting similar populations across various countries and cultures, with one in five adults experiencing CLBP each year [1.2]. In industrialized nations, chronic pain is rapidly becoming the foremost health issue, contributing to annual low back pain costs of $100-$200 billion [1.4].

Acute back pain, which often results from injuries like muscle strains or ligament tears due to activities such as heavy lifting or sudden movements, can also lead to considerable discomfort and mobility limitations [d.?]. Back pain significantly affects an individual’s quality of life, reducing productivity, limiting movement, and causing emotional distress. Studies have found that slouched or hunched posture not only reduces energy levels but also negatively impacts mental well-being, such as happiness and depression [2.4]. Poor posture also affects workplace productivity, with approximately 75% to 85% of worker absenteeism being attributed to recurrent or chronic back pain [1.6].

Despite its prevalence, simple preventive measures can effectively mitigate these disorders. According to medical research, most cases of severe Kyphosis can be treated and prevented through exercises aimed at improving posture and maintaining a straight spine [4.2]. A study by Robertson et al. [5.1] found that musculoskeletal risk decreased after 16 months of ergonomic posture training for seated individuals. Further studies by Choobineh et al. [5.2] and Menendez et al. [5.3] demonstrated that ergonomic interventions could reduce musculoskeletal discomfort and related symptoms. Additionally, research by Taieb-Maimon et al. [5.5] showed that posture risk diminished after three weeks of an experiment using a camera to display the seated individual’s sagittal posture. Therefore, maintaining proper spinal posture is possible and essential, which is the goal of our system’s design.

Several systems have been developed to address this issue, comprising three main components: data collection, data analysis, and feedback [4.?]. Our system incorporates all these elements, with a particular focus on analyzing the collected data while in a seated position.