

Rapid Entire Body Postural Analysis Assessment Device for Computer Operators using IOT

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ABSTRACT

The reason for this paper is to review one of body postural analysis tool using REBA, the way it is implemented, its uses and the drawbacks. There are lot of research which has showed how REBA is used for analysing the posture of jobs in number of industrial, health care jobs and other professional settings. Also in industries where computer is used extensively, packers and movers industries, workshops in school, real estate, workshops in sawmill , retail sector, manufacturing industries, fire-fighters and for emergency medical technicians and odontological services.

Due to wrong sitting postures there is vulnerability to MUSCOSKELETAL disorders. ‘Rapid Entire Body Postural Analysis Assessment Device for Computer Operators using IOT’ is a device which will be used for monitoring the sitting posture and that too for computer operators in particular. There is lot of importance given to monitoring the posture and notifying the working person who would be using the device. The device will help in correcting the sitting posture and avoid the MUSCOSKELETAL disorders and other diseases.

INDEX TERMS: REBA (Rapid Entire Body Assessment), Ergonomics, Musculoskeletal, postural analysis, sitting posture.

I. INTRODUCTION:

In Industries and Services, the Musculoskeletal problems are one of the very commonly found disorder raising from the tasks performed as part of the occupation in all the countries. The productivity is decreasing day by day and the quality of life as well. The salaries are increasing and at the same the medical cost for maintaining the health are also increasing. The different risk factors' are causing these disorders, and many factors are responsible. These responsible factors are grouped as

- Psychosocial factors
- Individual factors
- Physical factors

The Physical load during the job is determined using the

- Movement of body
- body posture analysis
- repetitive and tasks where force is required
- the amount of load over muscle

The Ergonomic verification of WMSDs (Work-Related Musculoskeletal Disorders) is a way of

evaluating the risk associated with tasks while executing the job. And these are the risks of causing a variety of issues to muscles, nervous system, joints in the bones and muscles, firstly to the upper limb and then to the lower back, during execution of the activities that are part of the job.

II. MOTIVATION

There are lot of study going for different industries like small scale industries where manual interventions of the humans are involved.

In the IEEE reference paper [1], there is a detailed study about how the working posture of the workers will lead to the MUSCOSKELETAL disorders and there is discussion about different ways of monitoring and avoiding it.

As I am working in the IT Industry and I myself have got severe back pain and neck pain due to continuously sitting in front of the computer systems for more than 9 hours per day. Even though many feel that it is an easy job which doesn't involve much physical exercise. But due to wrong postures there is vulnerability to MUSCOSKELETAL disorders.

So the motivation to help the people (and myself) working in the IT industry guys, lead to this project where there is lot of importance is given to monitoring the posture and notifying the working person using our ‘Rapid Entire Body Postural Analysis Assessment Device for Computer Operators using IOT’. And also as the data will be saved on a server, it can be used for further analysis and the way of mitigating the risks involved.

III. RELATED WORK

In Section II, we have discussed the motivation for this paper. As alluded in that section, most of the work on postural analysis has been done in different small scale industries. And there are different approaches to identify the wrong posture and identify the severity of the disorder. We use REBA and use it to identify the wrong posture and severity associated with it.

We look into many of the related works wherein the postural analysis is carried out and the how the different approaches would be suitable in analyzing the posture.

In [1], author discusses about the working posture in polishing industry, issues faced by the workers, analysis based on it and a tool to tackle the issues. The awkward posture which is found during the execution of the task related to the job is considered as the physical factor and is the cause of injury. The workers in the polishing process are working in the wrong postures like squatting and stooping when they are trying to reach the whole area of the product that has to be polished. This study is aimed at determining how much of risk is arising from polishing process and what are the ways of improving the polishing process in the polishing industry. The discomfort of the polishing working process is indicated using Nordic Body Map Questionnaires. The REBA is used to provide the postural analysis of observational assessment quickly and easily for whole activities. When the REBA score of 8 to 10 and the action level is 3, the assessment of the working posture indicates a high level of risk and it means that it needs immediate attention and improvement is necessary. The application simulation tools which were used in the process showed that there is a decrease in the level of risk shown by assessment scores of REBA, which is between 2 to 3 which indicates the level of risk is low. So it could be understood that this tool could be used as alternative solutions for reducing the risk of polishing process in workplace. So we would like to use this concept in our project for monitoring the sitting posture of the IT professionals and to improve the ergonomics.

In [2], Postural analysis tool using Rapid upper limb assessment (RULA) and Rapid entire body assessment (REBA) were used for assessment. The assessment indicates that the workers are working above the secure limit and that is they are prone to risks. This study here shows the assessment of work posture of the workers who are engaged in various activities of small scale and other industries. The evaluation of posture was done by the RULA and REBA. The worksheet was used for the assessment. The REBA method identified that few of the workers were under lower levels of risk and majority are at higher risk levels. And the RULA method determined that the majority/many of the workers were under higher risk levels and is candidates for immediate change. This research shows that; there is a limited/less exposure to ergonomics awareness and understanding in small scale industries. Evaluation using postural analysis by RULA and REBA indicates that the workers are working above the secure limit. The major percentages of the workers are having awkward postures. Thus the workers are under moderate to high risk of musculoskeletal disorders.

In [3], authors present analysis of eight various methods that are used for determining risk factors for WMSDs. The Ergonomic Workplace Analysis

developed by the FIOH (Finnish Institute of Occupational Health), the JSI (Job Strain Index), the OCRA index, the QEC (Quick Exposure Check), ACGIH's HAL (Hand Activity Level) threshold limit values method, the EN 1005-3 standard, the RULA (Rapid Upper Limb Assessment) and the REBA methods were all used to assess 224 workstations involving 567 tasks in different industrial sectors. The results are compared by using three risk categories like low, moderate, high. And the data is also gathered using video and measurements which are taken at the workstations. A questionnaire was also given for the employees participating in the study. Various methods vary in their analyses for the same workstation as per the findings. The EN 1005-3 was used to assess threats for the shoulder was the most conservative and has identified that more than 85% of the working environment is at higher risk level. As per QEC method only 35% of the work environments are at higher risk level when compared to RULA which is at 76%. As per HAL method the 37% of work environments are the lower risk level when it is compared with 9% of JSI. The Correlation was highest between JSI and HAL and between RULA and REBA. The RULA, REBA and FIOH standards did not classified work environment as low risk.

In [4], authors propose a case study where the two different tools are used for assessing the working environment and the results are compared. The two tools used are REBA and New Zealand Manual Handling Hazard Control Record. The two tools are used for assessing, planning and implementing changes in the retail industry for the manual practices that are used for day-to-day activities. All the practices that were used in the retail industry are examined and assessed using these two tools. Both the tools were used to review the most dangerous tasks after they were revised to improve and also the work methods, to determine the usefulness and effectiveness of these tools. This method used to analyze generated lot of debate regarding the loopholes, benefits and use of each tool. The tool's worthiness appears depending on the reason for assessing and predicting the result. The REBA is more useful if specific ergonomic or biomechanical changes are being used to reduce the risk injury related to work.

From the analysis it can be concluded that REBA is more specific and useful compared with the other tool and it help in reducing the musculoskeletal disorders.

In [5], authors discuss what the risks are causing musculoskeletal disorders while working using the Ergonomic methods.

In [6, 7], authors discuss about postural analysis for fire-fighters, Emergency Medical Technicians (EMTs) and school workshop. Identify the severity of the postural stress in these fields.

The works that were mentioned above are not linked directly to what we try to propose or achieve with this paper. But, we try to take a note from the work done in above field to apply to our requirement and to arrive at the solution.

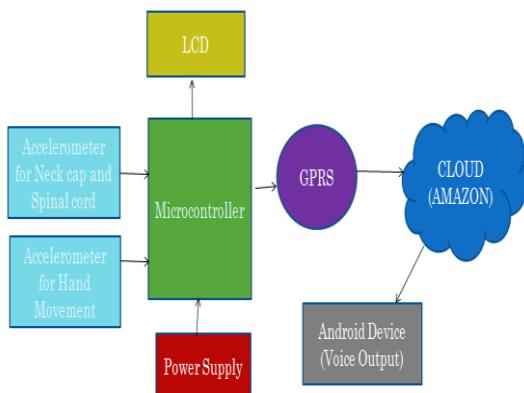
IV. EXISTING SYSTEM

Human body is meant more of walking around and requires less sitting time. If there is variation in this process, then it will tend to different disorders relating to change in eye pressure, or pain in the neck region or spinal cord. There is no system in the current scenario that monitors changes in the sitting posture of the human body while working or relaxing.

V. PROPOSED SYSTEM

REBA will be used as a method for analysing the sitting posture. Ergonomics aims to create comfortable, safe and productive workspaces by bringing human abilities and limitations into the design of a workspace, including the individual's body size, skill, speed, strength, sensory abilities (vision, hearing), and even attitudes. The device will provide the regular notifications about the wrong posture and will try to make the user correct his posture. Notifications will help the user to make the changes to his posture as and when required.

A. Architecture



B. Description

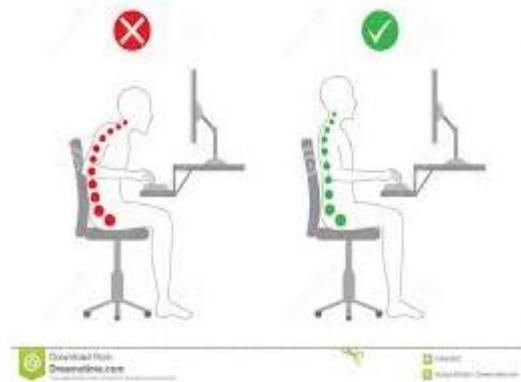
There are lots of embedded systems that are having noticeable different patterns as per their

usage and functionalities. The control unit of the project is the microcontroller which is at the centre of the above diagram. There is a program which is embedded in the microcontroller which will help the microcontroller while taking action as per input data coming from the sensors that are attached to the user. This project consists of Renesas microcontroller, Accelerometer, LCD, GPRS, Amazon Cloud and an android device.

- Accelerometer is mounted on Neck cap. The outputs of these accelerometers are given to the ADC unit of the microcontroller. Based on the program embedded within the microcontroller the voltages generated by the accelerometer are displayed on the LCD.
- If the person wearing these devices is sitting for a long time, also then a voice output will be generated until the person changes from sitting position to standing position or doing some physical activity. Voice output indicating change in position is activated on a periodically basis from time-to-time.
- Even sitting posture is corrected using this equipment. Say the person wearing this device is bending more rather than sitting upright, then also a voice output will be generated insisting him to sit upright.
- Accelerometer is placed on the back of the palm. When the palm is twisted more towards the right or left side the accelerometer generates an output voltage. This output voltage is fed to the microcontroller. From the microcontroller the processed information is sent to android device via cloud.
- In android devices an application is created. On receiving information sent by cloud, a voice output is generated from the android device using the application created.
- For demo purpose LCD is used to display the changes in output voltages of accelerometer and any event occurring.
- The device can be registered with the Amazon Cloud and all the readings are captured on Amazon Cloud. The information collected from many devices or many samples can be used for further research and analysis.

C. Problem Statement

- All the internal process of the body will slow down as a reason of body remaining in a sitting posture for a longer duration. This will be a cause for the decrease in the energy level. Also it may lead to fatigue, uneasy, depressed and tired. The slouching will lead to compressing and constricting of the body. When in the slouching posture, the lungs and heart will be working hard to circulation of oxygen and pumping the blood. This will lead to unwanted stress on the muscles and also the internal organs. Breathing is made easier with the chest broad and shoulder wide open while sitting. The Sitting posture makes the heart and lungs compressed and even intestines are constricted. Due to which digestion will not be comfortable and cause a lot of issues. The digestive distress maybe a cause of your sitting posture and the time you are spending in sitting position every day. The digestive problems like hernias and acid-reflux are because of slouching.



- The digestive system is weakened by the poor posture. It may also lead to the belly pouch that is common in women. All women with different sizes and weight, either heavy or thin, are affected by the slouching and poor sitting habits.
- The most noticeable effects of poor posture are back, shoulder and neck pain. When you are sitting at the desk for longer time in a slouched position, it will lead to lot of stress on the upper body. Because the body is not supported properly. Below are the details about the main pain areas:

Neck – 54%
Shoulder – 37%
Lower back – 65%
Wrist – 34%

- The poor posture may lead to the dislocation in the spinal cord and may be a cause of severe pain. The main reason for joint stress is also the poor posture. The Joints are connected by the connective tissues and these tissues provide support and cushion. When the spinal cord is misaligned or dislocated the weight or stress needs to be distributed again which will compensate the slouching posture of the body. This will result in joints to bear more loads that may not be possible for it to handle. Slowly this leads to pain and as the time passes the tissues that are surrounding the joints are degraded.

D. Methodology

- Block Diagram
- Hardware testing as per project
- Test Code preparation for Peripherals
- Logic Development as per project
- Final Testing of the project as per Conditions

E. Application of proposed system

- This type of system helps to eliminate hunchback effect occurring due to much bending of the spinal cord.
- Helps eliminate poor moods such as depression and stress resulting from slouched position.
- Energy levels are also increased since internal processes of the body are well maintained, thereby eliminating moods like irritation, tiredness or aggravation.
- Sitting upright position with chest and shoulder broad makes breathing easier.
- Digestive distress occurring due to improper posture can also be eliminated by using this technique.

VI. SYSTEM CONFIGURATION

At present, the paper targets at implementing the Device using IOT and Android mobile devices and we have following software and hardware requirements to implement our proposed device.

Software Specification:

- 1) Embedded C
- 2) Cubesuite+ Tool
- 3) Renesas Flash Programmer tool
- 4) Android Developer Kit

Hardware Specification:

- 1) RL78 RENESAS Microcontroller
- 2) LCD
- 3) Accelerometer
- 4) GPRS
- 5) Android Device

VII. FUTURE WORK

Current proposal is based on REBA standard and would be used for monitoring and correcting the sitting posture of the people using computers. Another method can also be used to design the device. Going further, most of the units can be fabricated on a single chip along with microcontroller thus making the system compact thereby making the future system more effective.

And this proposed device can be further enhanced and used for other purpose apart from monitoring the sitting posture. Even blinking of the eyes can also be monitored and proper notifications can be sent to the user.

VIII. CONCLUSION

From the literature survey, the project can be designed using structured modelling and will be able to provide the desired results. It can be successfully implemented as a Real Time system with certain modifications.

Our proposed device will help in having a better working environment and improve the posture of the employee and individual using it.

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