Design and Analysis of Self Adjusting Monitor

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Abstract- *In the IT sector, working at a computer can cause back, neck and shoulder pains, headache, and eye strain and overuse injuries of the arms and hands. The self-adjusting monitor is not only makes user sit in the correct position but also helps improving the workspace. This monitor basically uses a camera and a motion tracking program device to detect user and adjusts itself to its calibrated position. This program is done using raspberry pie chip to track the user and is compatible. The Self adjusting monitor tracks the targets/user with the help of a pixy cam and adjust the screen with the help of gear, lead screw mechanism and stepper motors.*

Keywords- Monitor, Self-adjustment, User tracking, Raspberry pi, face detection, stepper motors, gear mechanism.

I. INTRODUCTION

Self-Adjusting Monitor is a monitor which can be used by every computer user. This monitor basically uses a camera and a motion tracking program device to detect user and adjusts itself to its calibrated position. This program is done using raspberry pie chip to track the user and is compatible. We tried to keep it compact to hide all the wiring and electronics behind clamp. This monitor can easily install in any workplace.

1.1 Motivation

In the IT sector, working at a computer can cause back, neck and shoulder pains, headache, and eye strain and overuse injuries of the arms and hands. This can be avoided with proper furniture better posture and good working habits. So we came up with "Self Adjusting Monitor" to adjust the screen at correct position with respect to the users comfort.

1.2 Reasons to use Self Adjusting Monitor

One question many people ask is why not a self-adjusting chair which is readily available and can be manufactured cheaply. The self-adjusting chair only increases the comfort level rather than making the user sit in the correct position. Due to this, muscles can become painful. This is known as 'over use injury'. Symptoms of this injuries include pain, swelling, and stiffness of the joints, weakness and numbness. The self-adjusting monitor is not only makes user sit in the correct position but also helps improving the workspace. The reasons behind this idea are as follows:

- It adjusts itself according to the position of the operator sitting in front.
- It checks all the calibrating factors like height, angle and distance of user from the screen using sensors.
- Then it adjusts itself in order to get the screen at comfortable position for the user.
- It reduces the probability of user to have any Musculoskeletal Disorder.

II. LITERATURE REVIEW

Dharmender Aswal et.al. [2015] had presented a case study for implementation of the stepper motors. A stepper motor (or step motor) is a brushless DC electric motor that divides a full rotation into a number of equal steps. The motor's position can then be commanded to move and hold at one of these steps without any feedback sensor (an open loop controller), as long as the motor is carefully sized to the application.

Omar Yaseen Ismal et.al. [2016] published a study on Development of an omnidirectional mobile robot using embedded colour vision system for ball following. Three Omni-wheels mobile robot is developed by using a low cost embedded colour vision system (CMUcam5 Pixy) for tracking and following a ball. The ball detection is done by distinguish its colour from the environment. A suitable design, of the robot is offered considering a number of practical factors. CMUcam5 Pixy gives the robot the ability to detect many of multi coloured objects at the same time. The robot motion is controlled due to the kinematics analysis and the path planning. The velocity PI algorithm is used to control the robot wheels' speeds. The robot sensors (i.e. CMUCAM 5 camera, and encoder) data are collected and processed then, transmitted to a laptop by the wireless communication. A Graphical user interface (GUI) is designed by using Mat-lab program in this project. This GUI is displaying the transmitted robot data such as the ball distance and the robot velocity in order to support studying the robot performance. The robot shows a positive performance after the demonstration. The designed robot can be used later for developing a self-located small sized Robo-Cup competition.

Mohamed Sherif Sirajudeen et.al. [2015] published a study based on knowledge of computer ergonomics. Ergonomics is the science of designing the job to fit the worker. Neglect of ergonomic principles results in inefficiency and pain in the workplace. The objective of this research is to assess the knowledge of Computer Ergonomics among Computer Science Engineering and Information Technology Students in Karnataka. In this Cross-sectional study, 177 Computer Science Engineering and Information Technology Students were recruited. A questionnaire is used to gather details regarding Personal characteristics, Computer Usage and Knowledge of Ergonomics. Descriptive statistics was produced for Personal characteristics and Computer usage. The distribution of responses to the items related to Ergonomic knowledge was presented by percentage of the subjects who answered correctly. The results shows that Majority of the subjects were unaware of ergonomics (32.8% correct responses), cumulative trauma disorders (18.6% regarding Personal characteristics, Computer Usage and Knowledge of Ergonomics. Descriptive statistics was produced for Personal characteristics and Computer usage. The distribution of responses to the items related to Ergonomic knowledge was presented by percentage of the subjects who answered correctly. The results shows that Majority of the subjects were unaware of ergonomics (32.8% correct responses), cumulative trauma disorders (18.6% correct responses), healthy postures related to elbow (34.4% correct responses), wrist & hand (39.5% correct responses), Level of Monitor (35% correct responses), Position of mouse (47.4% correct responses) and Mini breaks (42.9% correct responses). This research highlighted the necessity of Ergonomic training regarding healthy postures and the measures to reduce the risk of musculoskeletal disorders for the students.

III. WORKING

The Self adjusting monitor tracks the user sitting in front of the screen with the help of a pixy cam which sends the coordinates to the raspberry pie chip. Chipset sends the commands to the motors attached and adjust the screen with the help of gear and lead screw mechanism.

3.1 Motion mechanism

a) Tilt Motion:

The Tilt motion is controlled with the help of bevel gear which are capable of handling high loads. A stepper motor is attached to one bevel gear and the second gear is attached to the clamp of the monitor which helps monitor to tilt according to the movement of the user. The steppers are high torque motors so they can give smooth tilt motion.

b) Forward-Backward Motion:

The forward-backward motions are controlled with the help of sliding wheels which are controlled by a stepper motor and lead screw. The stepper motor is attached to lead screw which rotates inside a threaded sleeve. This sleeve is attached to the table. As the lead screw rotates, sleeve moves in back and fro direction thus the table moves in forward backward motion.

c) Up & Down Motion:

The Up & down motions are controlled with the help of which are controlled with a lead screw and two involute spur gears. The lead screw is threaded with one spur gear and other spur gear is attached to another stepper motor. The spur gears are meshed with each other.

3.2 Object detection

The 3-axis motion of the monitor is controlled by the data received from the pixy cam which is mounted on top edge of the monitor. The camera mounted, gives the data to the raspberry pi (micro-controller) which is a motion tracking and object detection program. The programme uses python language.

IV. DESIGN AND ANALYSIS

Our aim was to build a Pilot model of the automated adjustable mechanism of moving monitor. We designed the model using solid works designing software as in the figure. We did analysis for many dimension in SolidWorks before drafting out the proper dimensions which helped us to know what must be the dimension of the components like lead screw and gears. And then we finally assembled all the designed components in SolidWorks software.

4.1 Design

The top view gives us the idea of the alignment of the parts like Helical Pair of Gears, Monitor, Lead Screw, etc. It gives us the representation of the monitor's rotation movement about Y Axis. The side view gives us the idea of the alignment of Monitor, Supports, and Main Lead Screw. It gives us the representation of monitor's lateral movement along Z axis. The front view of the monitor provides a user view, in which the design shows the aesthetics of the monitor if viewed from

the viewer's perspective. It gives us the representation of the monitor's lateral moment along Y axis.

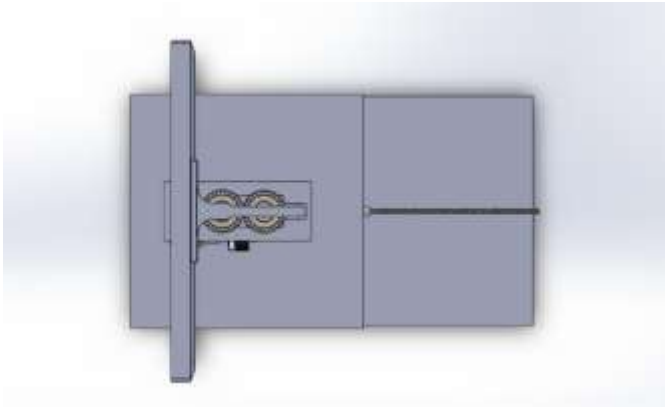

Fig-1: Top view of the model

Fig-2: Side view of the model

Fig-3: Front view of the model

4.2 Analysis

As seen from the images the monitor is supported by the Main Lead Screw and a support rod in a linear bearing. The support rod & linear bearing provide necessary opposing force to the bending moment produced & also help in smooth transition.

Due to eccentric loading of monitor, the lead screw is subjected to a strong bending moment. To counter the failure caused due to bending, the thickness of the lead screw was optimized to increase the number of compression layers & hence reduce the number of layers under tension.

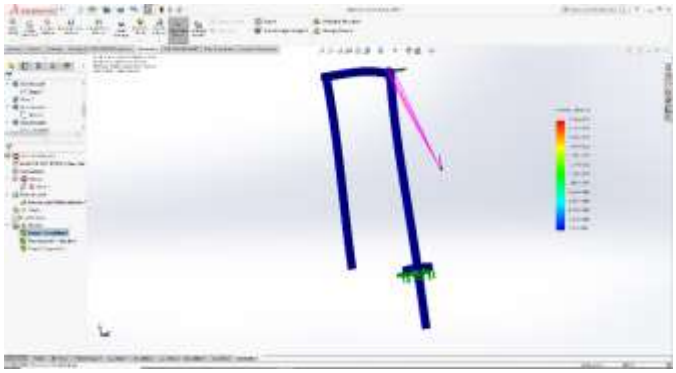

Fig-4: Stress Analysis of lead screw

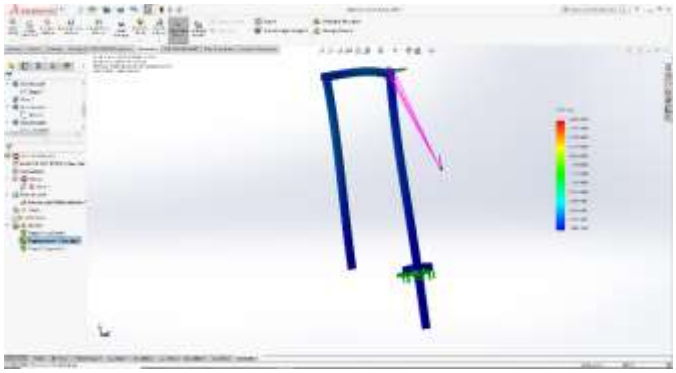

Fig-5: Displacement Analysis of lead screw

V. CONCLUSION

Machine detects the user position and make adjustments in the position of screen using three degree movement mechanism with the help of simple programmable chipset and stepper motors.

Physical problems like muscle and joint pain, overuse injuries of shoulder, arm, wrist or hand due to inappropriate operating of computers will be reduced by using this mechanism.

In future, this technology can be used for all available user interfering screens and monitors in not only offices but also in operation theaters of hospitals, schools, manufacturing industries, Garages, etc.

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