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Design and Fabrication of Automatic Board Erasing Mechanism

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Abstract: *Chalk dust is a common problem in traditional blackboard erasing method. It is frequently observed that teachers are covering their mouth with one hand while scrubbing the blackboard with the other. We recognised that problem and put a thought over it that we can actually help them. So we decided to put our course work and some extra knowledge into practice, and our project came to life with the help of electrical and mechanical concepts. The project Design and Fabrication of an Automatic Board Erasing Mechanism may clean the board automatically with horizontal and vertical motions, saving time while erasing by hand. The advancement of technology necessitated the development of higher-performance machines in order to meet human requirements and market demands. Because of its potential applications, this project is being implemented to make human work easier, to reduce the usage of human power and also to eliminate the hazardous effects of chalk dust from health point of view. This refers to new and beneficial enhancements, namely an instrument that allows the boards to be cleaned automatically in a simple and practical manner.*

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I. INTRODUCTION:

The traditional chalkboard cleaning method is somewhat tiresome and time consuming. The major attention is drawn towards the chalk dust which might have hazardous effects on human health like respiratory problems, irritation in eyes and many more. Also there is deprivation in quality of air in the classroom thus affecting the comfort of teachers and students. Design and Fabrication of an automatic Board Erasing mechanism might help to eliminate all the drawbacks and might enhance the comfort level for the teachers while teaching and also for students receiving the knowledge.

The primary goal of the current automatic board erasing mechanism is to erase the board in the form of a power-driven erasing equipment that can be turned on with the flip of a switch, avoiding the tedious task of manually cleaning blackboards. The model's utility is related to teaching help. The previous board did not have an automatic cleaning mechanism, thus a teacher would waste time writing and erasing. The structure is straightforward; the use is simple, clean, and sanitary; and the time-saving effect is positive. A system for cleaning the board in which a duster is installed on the board for longitudinal movement and has a motor mechanically attached to produce the duster's movement in an erasing operation. The creation and design of the board erasing mechanism is a technology that automatically cleans the board with the help of a duster. We can save time and energy by using this automated system.

II. LITERATURE REVIEW

S.Joshibaamali And K.Geetha Priya [1] explained that the cleaning process in three steps as first it cleans the left side of the board, second, it cleans the right side of the board and in the third mode, it cleans the whole area of the board. The machine uses two stepper motors to move duster in horizontal (x-axis) and vertical (y-axis) direction. To move the duster in up and down direction linear motor is used. The infrared transceiver is used to detect the horizontal direction of the motor.Four limit switches are used to detect the boundary of the board.

S.nithyananth et. al. [2] has explained about rack and pinion mechanism with the application of steering mechanism. In the steering mechanism, the author is trying to tell that the rotational motion applied to pinion will cause the rack to slide up to the limit of its travel.

Dong Yeop Kim et. al. [3] proposed a limit switch module as a mechanical sensor method. In this system, there are two limit switches. Their combination is translated to building wall shape information. The ARS sensor and the height sensor are used to mapping to 3D localization of the robot. If ARS sensor and height sensor is attached to another place of the gondola, the sensor data is needed to send to this limit switch module process algorithm.

PROBLEM DEFINITION

To Design and Fabricate an Automatic Board Erasing Mechanism to eliminate the drudgery of manual cleaning of boards, time wastage in cleaning and to minimize the hazardous effects of chalk dust from health point of view

OBJECTIVES

1. To design a low cost and user friendly cleaning mechanism
2. To achieve improvised efficiency and accuracy in horizontal and vertical movement of duster
3. To build a structure for providing comfort to teachers and minimize their manual cleaning efforts

III. METHODOLOGY

In the initial phase, we did the literature survey and its review. We did survey for concept development for better understanding of our topic. Further we did design and analysis of our project followed by mathematical calculations. After are the theoretical analysis and calculations, we did the CAD Modelling of our Automatic Board Erasing mechanism. The next step in our project was carrying out a market survey and thus estimating cost of our entire project. After completion of market survey and cost estimation, next step was procurement of material of required dimensions and manufacturing the mechanism as per our design. Final step was verification of results.

List of components in the setup

1. Blackboard
2. DC Motors
3. Mild Steel rods
4. Slider crank mechanism
5. Block
6. Duster
7. Rollers
8. DPDT switch
9. Pulleys

EXPERIMENTAL PROCEDURE

1. The belt drive mechanism is used to achieve the horizontal motion.
2. The guiding rails are inserted inside the duster and duster is placed against the board.
3. The guiding rails at the bottom are attached to rollers and are attached to a cube at the top which is further connected to the belt.
4. Slider crank mechanism is used for the vertical motion where the connecting rod is attached to the duster.
5. When we operated the DPDT switch the horizontal and vertical motors will start simultaneously.
6. The actuation of motor will lead to rotation of pulley and thus the belt will start moving.
7. The cube will move along with the belt carrying the rods and thus duster will start moving over length of the board.
8. Actuation of motor will result in rotation of crank thus transferring the motion to the duster via connecting rod and as a result, rotary motion of crank will convert into reciprocating motion of duster.
9. Thus both motions are achieved simultaneously for efficient and pressurized cleaning of the board

DESIGN THEORY

A] Method to implement the idea:-

Slider and Guiding rails mechanism:

This method can be implemented by using guiding rails. To and fro motion can be achieved by using DPDT switch and DC motor. It will require two linear actuators to achieve the desired motion. The vertical motion provided along with horizontal motion ensures sufficient application of pressure for efficient cleaning of board

B] Belt Drive mechanism (Horizontal motion):-

It is used for horizontal motion of duster with help of belt and pulleys. It is silent in operation and economical as compared to other drives. It permits high speed reduction and has the ability to absorb shocks

C] Slider Crank mechanism (Vertical motion):-

Vertical motion is achieved by using mechanism of single slider kinematic chain as in Reciprocating engine. Input from motor rotates the crank and the motion is transferred further to duster via connecting rod. It converts rotary motion of crank into linear motion of duster

D] Block (Horizontal motion transmitting mechanism):-

The block design is inspired from Dot matrix printer mechanism. The block is attached to the belt which will move to and fro along length of the board. Dimensions of the block are 112 mm x 100 mm x 107 mm

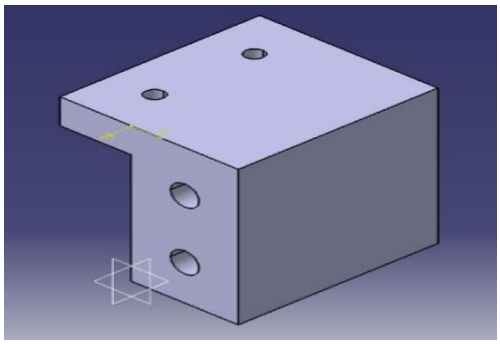

Fig. Block

MATHEMATICAL CALCULATIONS

A] Force calculations:

Dimensions of board- 152x91 cm ;
Dimension of duster- 61x8 cm
Minimum pressure required to clean the board = 1200 N/mm²
Perpendicular force, Fn = P×A = 58.56 N
Pulling force, F = μ×Fn = 29.28 N

B] Horizontal motor calculations:

Total travel distance= 1.524 m ;
Time needed for travel = 2 sec
Speed, N = 145.53 rpm
From standard motors available, motor selected:
N = 150 rpm; T = 4.7 Kg-cm

C] Vertical motor calculations:

Total travel distance= 0.48 m ; Time needed for travel = 1 sec
Speed, N = 59.99 rpm
From standard motors available, motor selected:
N = 60 rpm; T = 7.5 Kg-cm

D] Belt drive calculations:

Power transmitted by belt,
$P = \frac{2\pi NT}{60} = 7.24 \times 10^{-3}$ KW
Diameter of pulleys,
$d=D= \frac{(60\times1000\times v)}{\pi N} = 97.02$ mm ≈ 100 mm
Both pulleys are of same diameter therefore angle of wrap is 180 degree
Length of belt,
$L = 2C + \pi \times \frac{(D+d)}{2} + \frac{(D-d)^{-2}}{4C} = 3.362$ m

E] Slider crank calculations:

Radius of crank, $r = \frac{S}{2\pi} = 7.64$ cm;
Length of connecting rod, L = 47.941 cm

F] Weight analysis:

Weight of the setup = 58.86 N
Bending stress = $\frac{Mby}{I} = 13.942$ N/mm²
Permissible bending stress for mild steel considering factor of safety 2 is 45 N/mm²
Thus, actual bending stress < Permissible bending stress. Hence, design is safe

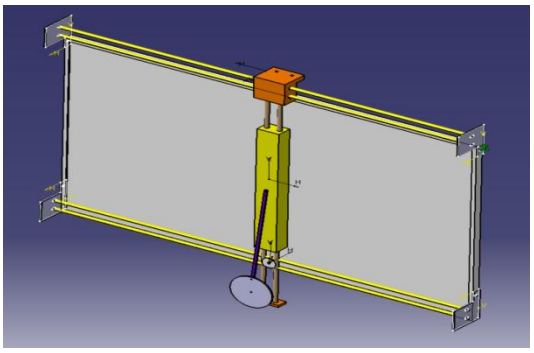

Fig. Isometric view of setup

FUTURE SCOPE

There is always some scope for improvement in any work. Use of sensors can be an ideal way for detecting chalk stains on the board and thus it would clean only the required part and thus would save time and power. Also the setup can be made more compact and weight can be reduced for improvising efficiency of mechanism. There is always room for more automation for achieving more human comfort.

IV. CONCLUSION

Traditional chalk board cleaning procedures are inconvenient and perhaps harmful to one's health. We attempted to develop and manufacture an automatic blackboard erasing mechanism using guiding rails to clean the board automatically in this project. Simultaneous horizontal and vertical motion of the duster is performed utilising a slider crank mechanism and belt drives DC motors.

Traditional cleaning methods resulted in difficulties such as poor air quality owing to dust and respiratory concerns. We attempted to find a feasible way for automatically wiping the board in order to reduce respiratory difficulties. We attempted to keep the structure as simple as possible while maintaining compactness. We have made every effort to make this project as cost-effective and simple to operate as possible, therefore decreasing human effort.

REFERENCES

[1]. V.B. Bhandari, "Design of Machine Elements", Mcgraw Hill Publications, Third Edition, 2007
[2]. F.B.Sayyad, "Theory of Machines 1", Techknowledge Publications, 2019
[3]. Mr. Sunil R. Kewate, "Development of new smart design to erase the classroom blackboard", IOSR Journal of mechanical and civil engineering (IOSR-JMCE)e-ISSN2278-1684, P-ISSN:2320-334X, 2014
[4]. Mr. Sumit Chavan, "Automatic white board cleaner", JCSE International Journal of Engineering, Vol 7, Issue -5 May 2019
[5]. Billie R Chrisp,"Automatic Chalkboard erasing apparatus" United State Patent,Filed July 7,1971,review on May 8,1973.