

Design and Development of Board Cleaning System

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Abstract - This technique was selected by us by taking into consideration some comfort for Teachers while cleaning the blackboard. It is seen that while doing this they often have to cover their mouth with one hand while cleaning the black-board by the other. By thinking over it we realized that we can really do something for them. So we decided to implement our course study and some extra knowledge and with the help of electrical and mechanical concept our project came into picture. The project Design and Development of Board Cleaning System can clean the blackboard and whiteboard automatically with rack and pinion mechanism and reduces the time consume in hand erasing. This project basically works on combined principles of mechanical and electronics. The growth of technologies requested higher performance machine in order to fulfill human needs and market. This project is implemented to make human work easier and can reduce the use of human power because of its potential applications. This appertains to new and useful improvements and more particularly to an apparatus whereby blackboards and whiteboard can be cleaned in an easy and convenient manner.

Keywords - Rack and pinion, sensor, board cleaning system, toggle mechanism, water sprinkler.

I. INTRODUCTION

Design and Development of Board Cleaning System is a system that is generally used to clean board automatically with the help of duster. By the use of this automatic system we can save time and energy. It is a new technology that is generally used now a day. A system for cleaning the blackboard and whiteboard wherein a duster is mounted for longitudinal movement on the board and has a motor mounted thereon that is mechanically interconnected to a drive assembly for producing the movement of the duster in an erasing operation. It will use the rack and pinion mechanism to convert the rotary motion of motor into linear motion of pinion.

The principal object of the present automatic blackboard duster is to provide an attachment for blackboards in the form of a power driven erasing apparatus which can be set in operation by the throw of a switch, thus eliminating the drudgery of manually cleaning blackboards. The utility model relates to teaching aid. The prior board has no automatic cleaning function, a teacher wastes time in writing and erasing, and the use is not ideal. The structure is simple; the use is convenient, clean and sanitary; and the effect of saving time is good.

For teaching purpose generally boards are used. For effective learning board is the basic thing in classroom. The powder obtained from the chalk piece while erasing the blackboard causes problem to the respiratory organ when inhaled by human. Those who are allergic to dust cannot sit near the blackboard. Other than this there are more problems related to the dust or chalk powder like hair loss, burning of eyes etc. For cleaning the board manual work has to be done by the teacher which is time consuming while taking classes. Moreover chalk dust not only harm the human but also the machines such as projectors when exposed to chalk dust there could be heat production in it.

II. LITERATURE REVIEW

This section includes background and various systems for cleaning the whiteboard and blackboard. Different research papers are referred to study the different systems and different mechanisms.

S.Joshibaamali And K.Geetha Priya has explained that the machine can operate in three selectable operatable modes. In the first mode, it cleans the left side of the board. In the second mode it cleans the right side of the board. 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. Infrared transceiver is used to detect horizontal direction of motor. Four limit switches are used to detect the boundary of the board. A dsPIC30F401 microcontroller which was programmed in C language is used as the main controller in the machine[1].

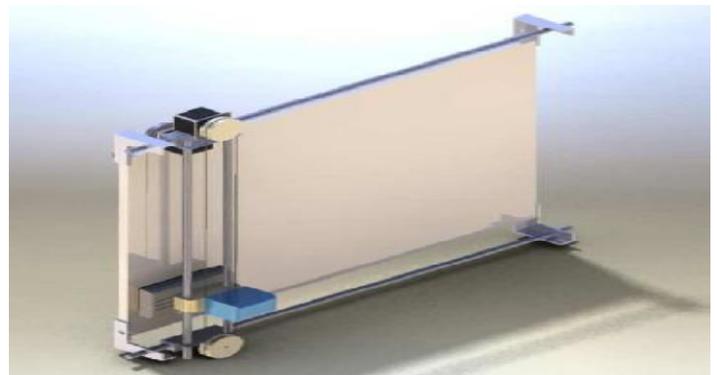


Fig.1 Automatic duster machine with three selectable modes.

Mr. Sunil R. Kewate, Mr Inzamam T. Mujawar, Mr. Akash D. Kewate, Mr.Hitesh R. Pant has explained in their paper that the design and principles of sliding type wipe mechanism and

also carried out the implementation and experimentation for motion analysis. The paper puts forward a kind of mechanism design scheme, the mechanism can automatically detect the blackboard chalk stains, and erase the font, keep the blackboard clean. The further research work will be based on computer processing i.e on two parts of information processing unit and motion control unit. This system consists of two motors, three guide rails, and three sliders. The construction of mechanical structure is slider 1 and slider 2 are connected by cross guide rails C and is installed on them, can be moved in parallel with the slider 3, power driven provided by two motors A, B. Motor A drives the left and right movement of cross rail beam C and motor B drives the vertical movement of slider 3 (wipe system) to rub the blackboard surface for cleaning by moving the wipe system along the rail C together. The sensor is fitted at right most of the blackboard to sense the right end position and signal passed to return the wipe system along the rail C in original position[2].

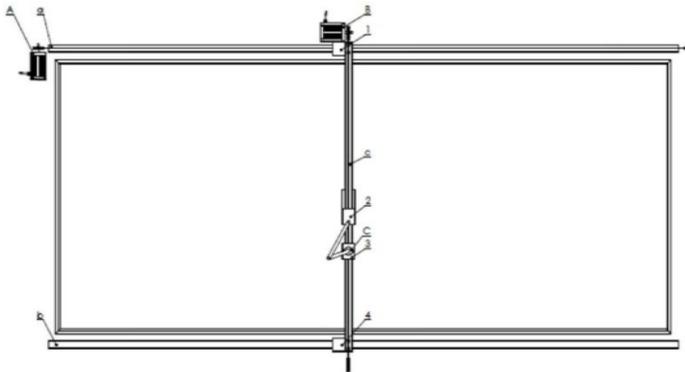


Fig.2 Blackboard erasing mechanism

S.nithyananth, A.Jagatheesh, K.Madan, B.Nirmalkumar has explained about rack and pinion mechanism with the application of steering mechanism. This mechanism is used in automobiles to convert the rotation of steering wheels from left to right or right to left. A rack and pinion is generally used to convert the rotational motion into linear motion. Pinion engages teeth on rack. In the steering mechanism the author is trying to tell that the rotational motion applied to pinion will cause rack to slide upto the limit of its travel[3].

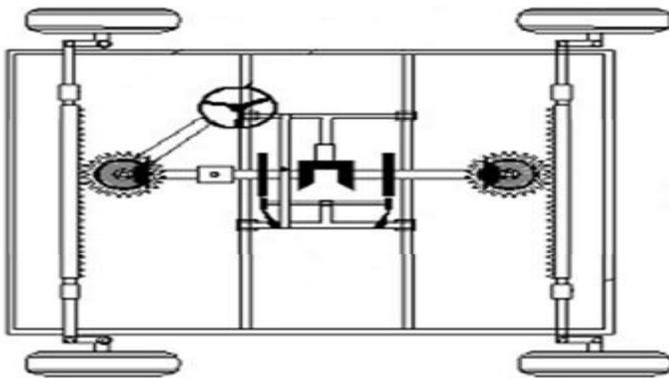


Fig.3 Rack-pinion with steering mechanism.

Dong Yeop Kim, Jae Min Lee, Jongsu Yoon, Tae-Keun Kim, Bong Seok Kim, and Chang-Woo Park have researched a gondola typed robot system for wall shape recognition using limit switch. In this the author 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 are attached to other place of the gondola, the sensor data is need to send to this limit switch module process algorithm. The main point of the limit switch module is that two limit switches have different purpose and setting. Fig. 4 is the limit switch for wall that has longer stroke and senses the window areas. Fig. 4 is the sensor for obstacles has shorter stroke to sense only obstacles which is closer than ordinary wall.

Limit Switch Scenarios: In this case the gondola is on ordinary wall. Only the limit switch for wall is on. The limit switch for obstacle is off. Based on these two limit switch sensor values, we can decide that the robot is on

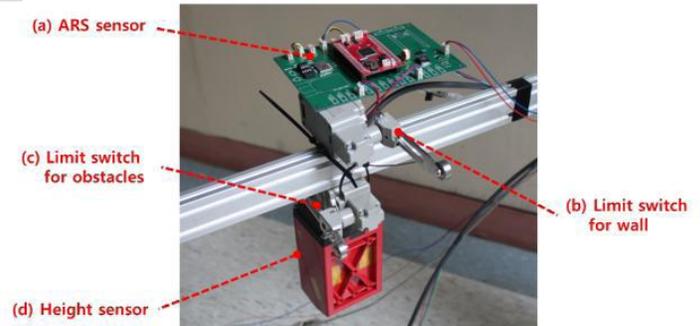


Fig 4. Limit sensor module

ordinary wall. Because ordinary wall is recognized, the paint nozzle on gondola is on. Note that the painting procedure is executed when the gondola goes down. Therefore , limit switch installation is set to satisfy it.

Mojtaba Khaliliana,, Ali Abedi, Adel Deris Zadeh is explaining that in classical methods only average torque of the stepper motors is controlled which could causes high speed and torque ripple. To control the torque instantaneously and improve the performance of the hybrid stepper motor, direct torque control strategy is used in this paper. Then by taking model reference adaptive system scheme, which uses hybrid stepper motor itself as the reference model, speed of the motor is estimated. The sensorless control of hybrid stepper motor based on MRAS with Matlab software is built and simulated. The results show that the control technology is simple and effective and accuracy is considerably high[5].

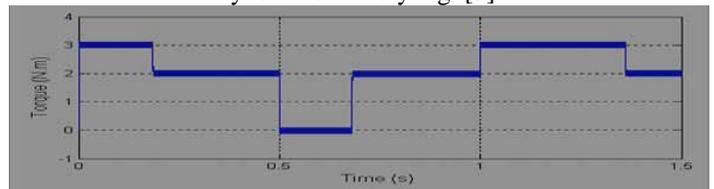


Fig. 5. Torque response vs Time.

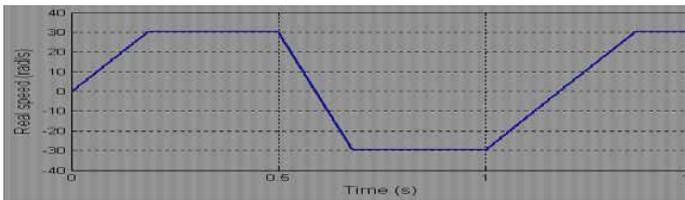


Fig. 6. Real speed vs Time.

III. OBJECTIVES

There are two main objectives of doing this project.

- ▣ First objective is to design a low cost and user friendly whiteboard or blackboard cleaner machine which can erase the board with a single key pressed.
- ▣ Second objective is to enhance the efficiency and accuracy of the movement of duster. The purpose is to make the movement of this machine accurate even if it has been used multiple times. Another important purpose is to make the machine work faster and smoothly.

IV. PROBLEM STATEMENT

To Design and Develop a board cleaning system which can overcome the problems related to chalk dust, discomfort for the teacher and wastage of time while erasing the board.

V. METHODOLOGY

System uses the rack and pinion mechanism for cleaning the blackboard and whiteboard with the help of the DC geared motors. The motors will drive the pinions which will convert the rotary motion of pinions into linear motion on the rack carrying the connecting strip with duster attached to it by bearing arrangement. DPDT switch and limit switch are also going to play minor role in this system for stopping the pinion and rotating one gear clockwise and another anti-clockwise. A small water sprinkler is also going to be used to spray the water on the blackboard. With the help of wiper motor the pressure will be created for sprinkling the water on blackboard. Which will save energy, time and eliminate the load on the motor. Toggle mechanism is used in back connecting strip to adjust the clearance between pinion and rack. White board does not requires the sprinkler system.

SIDE VIEW AND FRONT VIEW

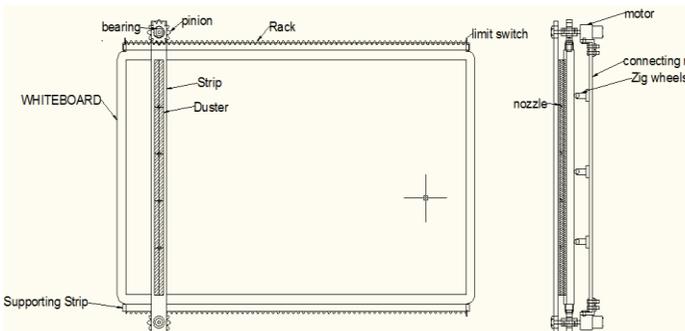


Fig.8 Automatic Whiteboard cleaning system.

3D MODEL IN CATIA

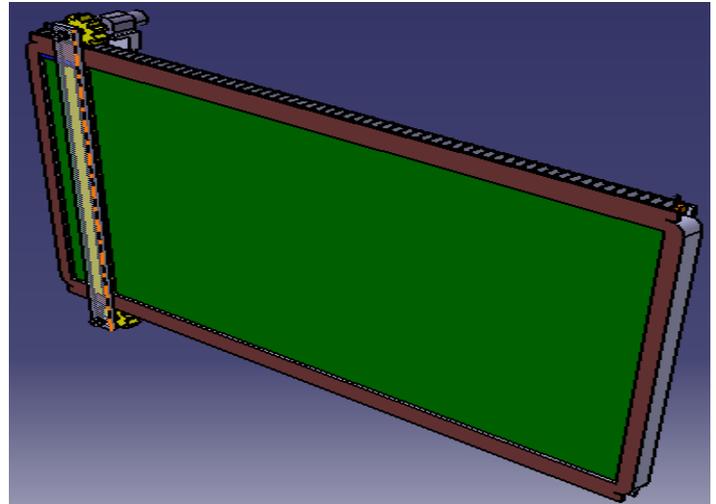
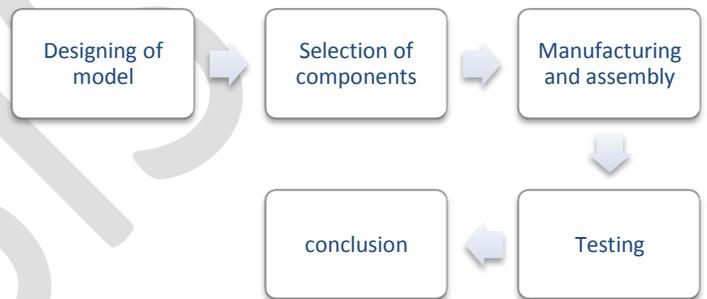


Fig. 9. 3D View of Blackboard cleaning system

STEPS



SPECIFICATION OF COMPONENTS

SR.NO.	COMPONENTS	MATERIAL
1)	BOARD	WOODEN
2)	RACK	MILD STEEL
3)	PINION	PLASTIC
4)	DC GEARED MOTOR	STANDARD
5)	LIMIT SWITCH	STANDARD
6)	STRIP	ALUMINIUM
7)	ROLLER BEARING	STANDARD
8)	BALL CASTER	MILD STEEL
9)	DUSTER	SPONGE

VI. CALCULATIONS

For the purpose of design the following calculations has been carried out. Which is not exactly matching with the actual performance.

DC geared motor: Voltage=12 V, Load current(I)=9.5 Amp, Speed(N)=100 RPM, Torque=10 kg-cm(98.1 N-cm), Power=114 Watt .

Forces acting on pinion:

i) Tangential force(F_t):

$$\text{Power/Velocity}$$

$$\text{Velocity}=\text{Angular velocity}*\text{Radius}$$

$$\text{Angular velocity } (\omega)=2\pi N/60$$

$$2*\pi*100/60=10.47 \text{ rad/sec .}$$

$$\text{Velocity}=\omega*\text{radius}$$

$$=10.47*0.018$$

$$=0.188 \text{ m/s}$$

$$F_t=114/0.188=606.38 \text{ N}$$

ii) Radial force (F_r):

$$F_r= F_t*\tan\phi$$

$$=606.38*\tan (20)\dots\dots\dots(20^\circ \text{ full depth involute})$$

$$=220.70 \text{ N}$$

iii) Resultant force (F):

$$F_t^{1/2} + F_r^{1/2}=645.29 \text{ N}$$

iv) Actual force with friction:

$$=\mu*F\dots\dots\dots(\text{Friction between MS and Plastic}(\mu)=0.3)$$

$$=0.3*645.29$$

$$=193.58 \text{ N}$$

v) Time required to clean the board:

$$t=\text{length of board/velocity}$$

$$=0.78/0.188$$

$$=4.14 \text{ sec.}$$

VII. SCOPE

In the present time not everything is automatic but seeing towards progress of present technology's , In future everything will be operated automatically . So this project will serve as one of the advanced technology in future and will be installed in every college, school, etc. Seeing towards our basic version, there are some ideas for the Design And Development of Board Cleaning System. In future if this project is taken to the next stage then for collecting the dust from duster a vaccume blower can be arranged.

1) *Operate in schedule* – this machine can be set up the time. It can operate automatically when we set up the time we want it work.

2) *Eye of machine* – we can make this machine operate with detection of dirty in whiteboard. Machine knows the location of dirty and erases it automatically.

VIII. CONCLUSION

In new era of technology, people want something new in their life. They want every single thing they look in front of their life look sophisticated. People want something that can improve their lifestyle and help them to do their job by using the robot or machine. That is why development of machine and robot is now becomes quite popular and faster in marketing. So to help and give benefit to humankind the DESIGN AND DEVELOPMENT OF BOARD CLEANING SYSTEM is an alternative machine that can help lecturer, teacher and student to keep their board clean by using this machine.

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