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Development of New Smart Design to Erase the Classroom Blackboard of Schools/Colleges

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ABSTRACT: *The traditional blackboard chalk dust is a common problem in the traditional blackboard-eraser-chalk architecture. It is generally known that erasers for cleaning the black boards in school rooms soon become saturated with chalk dust and have to be cleaned. In the past, this has usually been done by clapping the erasers together. This operation produced a great deal of dust that is rather objectionable both from the standpoint of health and cleanliness. For this reason, the design is based on the traditional blackboard-eraser-chalk called intelligent wipe chalk system, its connotation of "smart" includes moving, positioning, wipe. The design is able to achieve automated clean the blackboard and collect dust in one stroke. In this paper, it introduces 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.*

Keywords:*Blackboard eraser institution, intelligent, wipe system, mechanical structure, sensor, motion analysis etc.*

I. INTRODUCTION

This invention relates to automatic chalkboard erasers and comprises three guide rails, and three sliders with powering and controlling with sensor. The device is comprised of a rail mounted to the top periphery edge of an existing chalkboard having the cleaning apparatus attached there to and extending from the top to bottom edge of the board. The device is comprised of an adjustable frame and sponge which is trimmed at the time of installation to fit the adjusted frame size The effectiveness of a teacher or lecturer using blackboard in his presentation to a class or audience is materially affected to his disadvantage by the necessity of stopping blackboard work from time to time to erase and this stoppage becomes progressively greater disadvantage as the size of the board and the expanse of coverage thereof increases. While some attempts have been made to provide automatic chalkboard erasers, still such devices have not proven particularly successful and therefore are not generally used or available. Consequently, an object of the present invention is to provide a novel chalkboard eraser with powering means and controls whereby the user may at will drive the wipe system eraser in either direction at once and at a desired distance across a board which it is desired to clear. Another object is to provide an automatic chalk-board eraser with convenient means for removing accumulated chalk dust. [1] The traditional blackboard chalk dust is a common problem in the traditional blackboard-eraser-chalk architecture. It is generally known that erasers for cleaning the black boards in school rooms soon become saturated with chalk dust and have to be cleaned. In the past, this has usually been done by clapping the erasers together. This operation produced a great deal of dust that is rather objectionable both from the standpoint of health and cleanliness. There are two separate issues buried in the question of chalk dust safety. In one sense, the main ingredients of this dust are considered to be *non-toxic*, which simply means they do not pose a threat when ingested. In another sense, this material can and does accumulate in the human respiratory system, which means it can create long-term health problems due to overexposure. In short, swallowing a piece of white chalkboard chalk won't kill a person, but breathing in the dust for a number of years can create or trigger respiratory problems. Therefore, it is necessary to have the provision for automatic cleaning of the blackboard and also the provision for collecting the dust so that it cannot permit to fly in the atmosphere of the school room. The various improved blackboard eraser structure came into being, but these improvements not fundamentally solve the problem and it is being too costly and difficult to spread.[2] For this reason, the design is based on the traditional blackboard-eraser-chalk called intelligent wipe chalk system, its connotation of "smart" includes

moving, positioning, wipe. The design is able to achieve automated clean the blackboard and collect dust in one stroke. In this research paper, concept 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. In this paper, it introduces the design and principles of sliding type wipe mechanism and also carried out the implementation and experimentation for motion analysis.

II. SURVEY TAKEN FOR THE CONCEPT DEVELOPED AND SUGGESTED MEDICAL REPORT

A survey was conducted in the Shivaji High School, Amolakchand Mahavidyalaya, Govt. Polytechnic & Govt. Residential Women's Polytechnic, Yavatmal. The opinion of teachers was taken on questionnaire in which the teachers were asked to fill up the answer. This report is based on the questionnaire and its findings come out. as shown in fig..1. Some of the senior teachers of the above-mentioned institutions were surveyed and their opinion on the whole is summarized as below:

Consumption of Chalks: a) Science Stream: 3 - 4 per Period, b) Non-science Stream: 1 - 2 per Period

In survey, almost 90% of the teachers were facing problems due to Chalk Dust and majority agreed that it happened due to improper way of cleaning the school blackboard.

In survey, it is observed that about 33 to 40% of the teachers were ignorant of the problems caused by the Chalk Dust.

While conducting survey, almost all the teachers about 90% agreed, that the Chalk Dust released during cleaning of chalkboard by the duster eraser in the class resulted in the loss of concentration and various other reactions from the students sitting in the front row.

In survey it is found that almost all the teachers agreed to the need of the instrument for cleaning the school blackboard, so as to confine the dust released in the process.

The frequency of cleaning the school blackboard varied according to the consumption of chalks.

A survey was made in the various colleges, and the opinion of the various teachers was taken about the dust hazards due to the chalk dust, Most of the teachers in the favour of the instrument, which can erase the school blackboard with dust spilling. The survey was also conducted to find out the ill effects of the dust spilling. This survey was conducted under the guidance of Dr. Dilip Deshmukh, a chest and TB specialist of the TB hospital of Yavatmal.The survey consisted of finding the frequency of cleaning school blackboard, chalk consumption, and the medical survey, which consisted of taking the Peak Expiratory Flow Rate of the teachers. Three readings were taken, one normal, second after exposing to the chalk dust and the last one after fifteen minutes. The senior teachers from Amolakchand Mahavidyalaya, Yavatmal and J.D.I.E.T., Yavatmal were examined.

Findings come out-The readings of the P.E.F.R showed an average drop of about 9.08%, The average P.E.F.R variation was in the range of 4 to 12 percent. The teachers were not feeling good when they were exposed to the chalk dust. Nine teachers were examined, four were from the A.M.V and the rest of the teachers were from engineering College in Yavatmal. It is observed that there is definite drop in P.E.F.R. in almost all the persons, exposed to chalk dust. The obstruction in the airways is of acute type, which was reversible after 15 to 20 minutes. As the obstruction was not more than 20% the persons were not asymptomatic. Particles between 0.1 to 2 microns are in diameter nearly all reach the alveoli most of those bellow 0.1 microns settle on bronchial epithelium by the process of diffusion. Deposition is list in 0.4 to 0.5 ranges and about 80% of particles in this size may be breathed out. If a person is exposed to1000 parts of dust in one ml. of air, then he may retain 0.5% of dust in one year. The working environment does not contain 1000 parts of dust in one ml of air throughout the teaching period, but the environment does have sufficient quantity of chalk dust particles when the duster is cleaned. Prolonged exposure to chalk dust with obstruction in airway can produce respiratory problems in a sensitive person. [2]

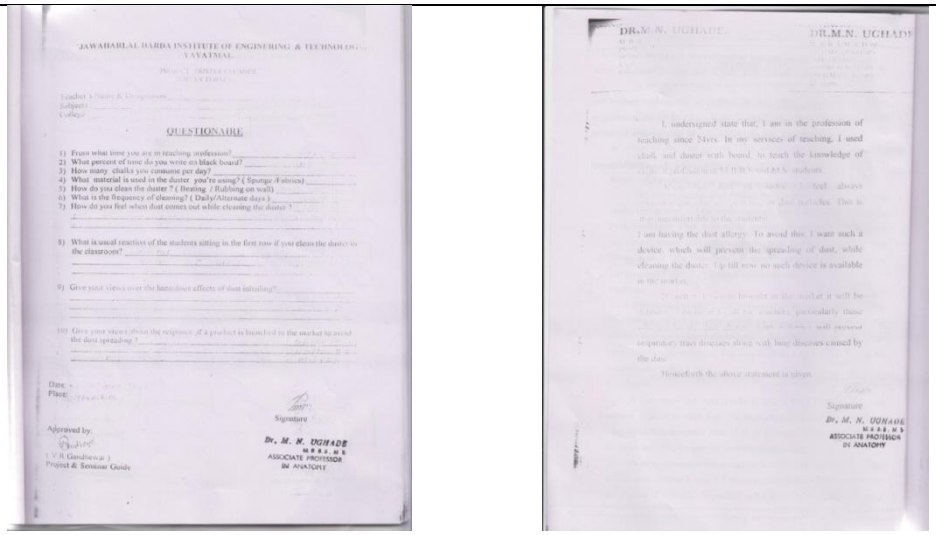

Fig. 1. Scan copy of filled questionnaire and chalk dust report letter from doctor

III. CONSTRICTION AND WORKING PRINCIPLE OF SCHOOL CLASSROOM BLACKBOARD ERASING MECHANISM

The slider type wipe mechanism consists of two motors, three guide rails, and three sliders. The brief construction of mechanical structure is that slider 1 and slider 2 are connected by cross guide rails C and guide rail C 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.

The process is carried out as follows: The power of cross guide rail C comes from the motor A, the rail transfers the power. Motor A forward and reverse rotation, drives the cross guide rail C forward or back movement. Motor A forward and reverse rotation, at the same time drives the slider 3 upward and downward movement. The method is able to reach the special position, and then eraser cleans the blackboard and then sensor at the end sense the position and cleans the blackboard in second stroke. Motor B is installed in cross guide rail internal provides power for Slider 3, pushes the slider 3 up-and-down along the rail C. Slider 3 is a combination of the movement of Cross guide rail C along with wipe system, performs wipe. When the wipe is finished, A motor work and B motor stop, blackboard eraser returns to the original position, waiting for the next wipe. The further research work will be based on computer processing i.e on two parts of information processing unit and motion control unit. In future work, when the eraser begins to wipe, Cross guide rail C is at the left-most of the blackboard, and eraser on the top. Cross guide rail C and eraser back to the original position after wiping completed. Before the eraser to wipe, CCD camera takes pictures of the entire blackboard. In the program am, the stains are contained in the rectangle. By computer processing, the Program determine the coordinates of the stains PC can calculate the upper left corner of the rectangle's coordinates, this is the coordinate which the eraser should be reached. Then motors release pulse signal, motors rotate a certain number of turns, eraser arrives at the designated location. The black board surface is as the X-O-Y plane as shown in fig.2.[7,8]

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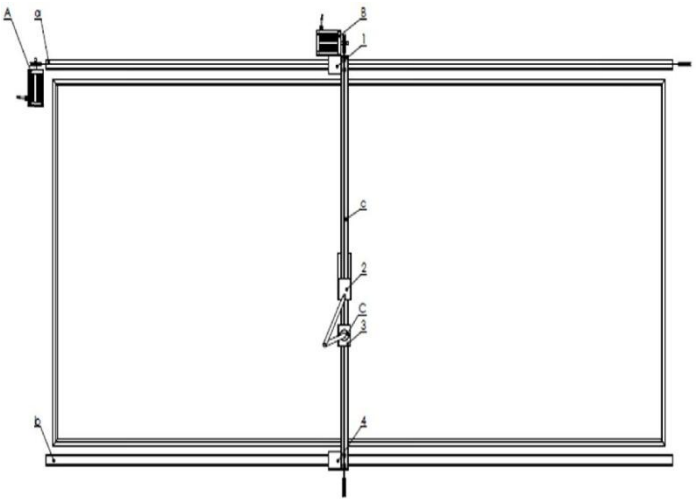

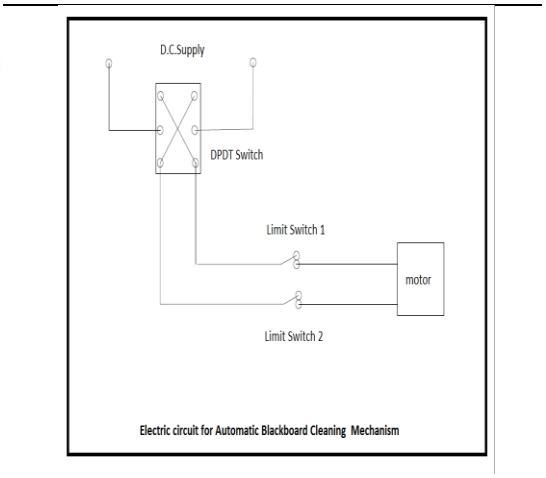

A-Motor for horizontal sliding of cross guide rail C, B- Motor for Vertical sliding wipe system

Fig. 2 School class room blackboard erasing machine mechanism and its operating circuit

IV. DESIGN METHODOLOGY

4.1 Selection of Motor-Minimum pressure required to clean black board=1200 N/m^2
Area touching blackboard is given by $a = 0.05 \times 0.60 = 0.03\ m^2$, μ=coefficient of friction=0.5,
Rn = P xA=36N, F = $\mu \times R_N$ =18N, this force is given to slider with help of strings. Strings are wound to motor with pulley of 20 mm radius. Torque required by motor= 18×0.02=0.36N-mm, Power required with 3000RPM = 113.04W =0.15HP, Selecting standard motor of 3/16 HP (0.1875 HP) from that available in market. [4, 6]

4.2 Selection of Nylon string- ***Stress*** $\sigma ny = 75Mpa$, Force required to pull the slider F= 18 N

$\sigma ny = \frac{F}{\pi d^2}$, 75 $= \frac{18}{\pi d^2}$, d=1.15, Diameter of string =1.25mm

4.3 Design of Screw-Shearing force acting on Screw F=$W \times e$=1.962 x450 =882.9

Now,Ssy for aluminum = 207 MPa, $\sigma_{sy} = \frac{207}{3.5} = 59.17\ MPa$

Now, $\sigma_{sy} = \frac{F}{A} = \frac{F}{\frac{\pi}{4} \times dc^2}$ = dc = 4.35 ≈ 5 mm , therefore, screw diameter = 5mm

4.4 Design of cross guide rail – Total Mass =Mass of Sliding bar + Wet sponge + Four roller wheels

Maximum Bending Moment acting on cross guide rail = $\frac{W \times x}{4}$ = 441.5N.mm, Where, x= Length of Cross guide rail = 900mm, for rectangular cross section, I=$\frac{20 \times t^3}{12}$, y = t/$_2$,$\sigma = \frac{483}{Nf} = 138\ MPa$,

We know,

$\frac{M}{I} = \frac{\sigma}{y}$, $t = 0.97\ mm \approx 1\ mm$,For C channel cross section, $I = \frac{1 \times (11)^3 + 1 \times (11)^3 + 20 \times (1)^3}{12} = 223.5$

$y = \frac{A_1 \times y_1 + A_2 \times y_2 + A_3 \times y_3}{A_1 + A_2 + A_3} = 3.118\ mm$, From relation, $\frac{M}{I} = \frac{\sigma}{y}$, $\sigma = 13.59\ MPa$, this stress is less than allowable stress. The design components drawing are shown in fig.3. [3, 5]

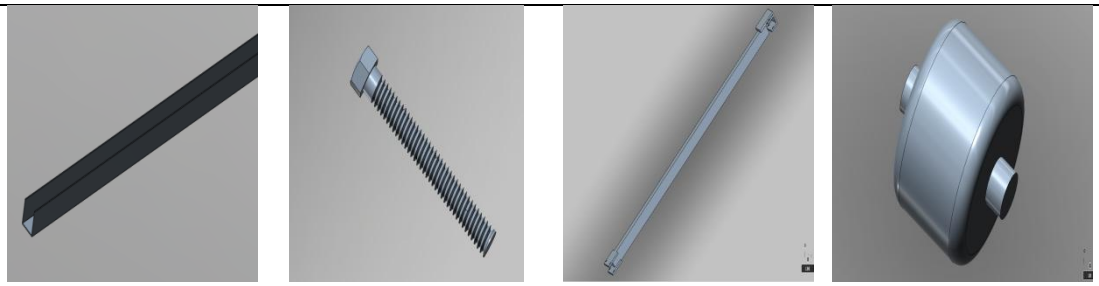

Fig. 3 Cross guide rail, screw, sponge holder, sliding roller for blackboard Erasing machine mechanism

V. CONCLUSION

Compared with manually wipe, smart wipe has a good effect and runs smooth with good reaction speed. The rate of rotation of the motor can be set in accordance with the requirements of the wiping speed to suit the requirements of different occasions. The smart eraser has a simple structure, easy to operate, easy to obtain raw materials, manufacturing equipment simple process. Its Control functions, and less susceptible to interference, high reliability, ease of use, can make products with high performance and low cost. The product is suitable for large, medium and small institutions, the promotion of certain significance.

VI. ACKNOWLEDGEMENTS

"Completing a task is never a one man‟s effort. Several prominent people in production, academics, and administrative field have helped in the development of School blackboard Erasing Machine Mechanism for this present research work. Their collective support has led in successful design and development of this work. To name them all is impossible."I am thankful to colleagues, at, Government College of Engineering, Awasari, Pune, and various other institutions for cooperation provided by them. Special thanks to the Principal and teaching staff of GCOEAR, Awasari, for needful support and encouragement for making successful.

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