

Smart Duster

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Abstract: Being a part of the society, education is one of the most important part in everyone's life. When we entering in education field blackboard and chalk piece are an indispensable part of a classroom, no matter how advance our classrooms have become. Cleaning the board with a duster generates a fine suspension of chalk dust in the zone of the board, which is constantly inhaled by the teacher as well as the students near the board. Though this doesn't appear serious, prolonged inhalation will result in breathing trouble. Therefore, automation of the board erasing process is tried along with a mechanism for suction kit, which suppresses the scattering of chalk dust particles in air. It is planned to install the smart duster in our college class rooms on a step by step basis.

Keywords: smart duster, suction kit, suppressing chalk dust suspension

1. Introduction

Even we lead to the digital platform traditional chalk and board is the integral part of the education life. The black board and chalk piece is almost used in every educational field in the world. Cleaning the board using a duster / black board eraser is essential for continuing the writing process and this involves rubbing a foam / sponge surface against the board surface. This cleans the board but also creates a fine dispersion and suspension particles of chalk powder around the atmosphere nearer the board, which is certain to be inhaled by the teachers and in many cases students who occupy seats near the black board suffer some inhalation problems. The work also stated that teachers were at the maximum risk of inhaling the chalk dust and the maximum particle

concentration occurs in the classroom while erasing the board with the help of duster, some scientist stated that the suspended chalk dust contains calcium and traces of aluminium, iron, magnesium and silicon by using fast neutron analysis and X-ray fluorescence technique in a standard class room atmosphere. The output of this study is that when concentration levels of the chalk dust suspension reaches a safe limit; occupants of the class room especially the teacher are exposed to serious health hazards. Inhaling the chalk dust through breathing does not pose any serious problem, but prolonged inhalation proves to be hazardous.

There have shown that teachers exposed to prolonged chalk dust environment are at a serious risk of developing pulmonary function complication and the authors urge such teachers to

shift to white board and marker. This device is expected to improve the air quality in class rooms, thus minimizing breathing related health problems to students and especially teachers. This operation produced a great deal of dust that is rather undesirable both from the point of view of health and cleanliness. The design is able to make automated clean the blackboard and collect dust in different strokes.

2. Design and construction of the smart duster

The purpose of our work is to keep the teacher or student present near the board and also away from the board while it is being erased, in order to reduce the inhalation of chalk dust particles which are suspended in the air around the board while it is erased. Maximum concentration of dispersion occurs while board is rubbed. That's why it makes a good sense to make a try in blackboard cleaning operation. The smart duster consist of the long horizontal and vertical x axis, y axis respectively also consist of the z axis in which it includes the actuator for the real operation. In order to cover the entire board in a continuous process the external frame is provided to stand the running DC motor. The casing is provided with notch on the surface which facing the duster, enabling suction action to suppress the air suspension of chalk dust. The dust collection is done using an exhaust fan with the attachment of suction kit and is collected in a separate chamber. The design and construction of various parts of the smart duster are as follows.

A. Control Power Supply

CPS consist of the step down transformer, diodes, capacitor, regulator ICs, electromagnetic relay board and toggle switches. 230V AC power supply given to the transformer, it converts 230V into a 12V AC with help of step down transformer. After that this 12V AC is given to the bridge rectifier, it converts 12V AC into pulsating DC. But we want pure DC so we use filter. The capacitor used as a filter. The pure DC is given to the ICs and it gives constant DC output i.e. 7805 and 7812. The output of IC 7805 given to the relay and the output of IC 7812 given to the DC motor.

B. Rack and Pinion

A standard rack and pinion is used as a means of controlling the current position if the eraser. The rack is connected to the duster casing on one end and is in mesh with the pinion. The

pinion is operate using a standard 12V motor and the pinion in turn drives the rack. By controlling the position of the duster motor enables controlling. To overcome problems related to rust and lubrication plastic gears of high strength and durability are used.

A schematic arrangement of the position of rack and pinion is shown in figure below.



Fig. 1. Rack and pinion arrangement

C. Frame

The casing is the most crucial and important part of the fabrication. It gives the support to the blackboard and the whole system. It runs along the entire long horizontal length of the black board. The casing holds an exhaust fan within itself. The surface of the casing facing the board, which holds the duster, has one pinhole which make easy the suction of chalk dust into the chamber where the dust is deposited. From the outer side of the cleaner kit the dust can be easily removed by manually.

D. Motor Drives

It can be used to run two dc motors with the same ICs. So it is possible to control speed and the direction. Also there is an automatic shutdown is present. It regulates the motor of x-axis and y-axis. Also consist of the over temperature protection and high noise immunity.

E. Cleaner kit

A standard exhaust fan is used for the purpose of sucking the chalk dust out of the eraser through the small chamber of the casing. And this case is easily removable so that it can remove the chalk dust easily when case is full. The exhaust fan is run at the 50% speed at the normal operation but this speed is increased when it comes in a contact with the board. As in operation, dust is regularly in the cleaning process there is no saturation of the dust over a board as well as on duster. As operation is a bit noisy, the fact that the cleaner need not be operated always while the board is rubbed comes in handy. On an average the duster needs to be cleaned twice a day at the most depending upon the use of the board. This can be done during end of each class as well as during lecture.

F. DC Gear Motor

Standard 12V DC gear motor is used for driving the pinion. The motor drivers are connected to the motor which rotates in forward as well as reverse direction, on reaching top or bottom extreme of the board. The motor is rigidly fixed on to the metal

frame above the black board, according to the motor RPM the motor operation work. More the speed of the motor fast the cleaning work will have done. A photo of the DC motor used in the setup is shown below.

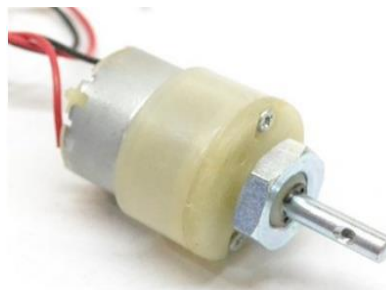


Fig. 2. DC Gear Motor

G. Microcontroller 8051

It is an 8-bit microcontroller in built with 40 pins Dual Inline Package (DIP). Microcontroller 8051 is a Central Processing Unit. Operation of this microcontroller is fully static and design of this microcontroller is expandable externally up to 64 kilo bytes. The 8051 microcontroller contains a nonvolatile flash program memory that is parallel programmable. It is a single chip 8-bit microcontroller manufactured in advanced CMOS process and it is a derivative of the 80C51 microcontroller family. It contains 4 level priority interrupt and 6 interrupt sources.

3. Result and Discussion



Fig. 3. Hardware setup

A schematic representation of the whole assembly is shown below. The casing consisting of multiple erasers mounted together moves up and down, erasing the entire area of the black board in a single stroke. Erasing process will be repeated until a desired quality of cleaning is achieved. With the installation of the smart duster in one of our college class rooms, erasing board has become very efficient. Also the chalk dust suspension

appears to have reduced compared to manual board cleaning. The cleaning quality is uniform throughout the entire area of the board since it is done mechanically in a single stroke. It was observed that if suction kit was used every time while rubbing the board, dust dispersion in the air around appears far lesser, then without operation of the vacuum cleaner kit. All these observations indicate that such a smart duster system is very suitable and is very much necessary for all educational institutions, and it serves to minimize time and effort. Also they reduce the dispersion of chalk dust in the air, protecting the teacher as well as the students from its harmful effects.

4. Conclusion

After using of the system in a class the following conclusions are as follows

1. The smart duster is very efficient in the board cleaning process, saving effort as well as time. Comparing with

manual erasing, smart duster has smooth with good reaction speed. The suspension of fine chalk particles appears to have reduced due to a suction kit present.

2. The smart duster has a simple in construction, Easy to operate, its operational process is simple.
3. The smart duster was designed by using low cost material so the price of the system is less.

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