

Real-Time Automated Blackboard Eraser Using Embedded System

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ABSTRACT: The project is about finding a real time solution for the problems caused by the chalk pieces used in the class room. To overcome the problems that are faced daily by the students and faculty, the project entitled 'Real Time Automatic Blackboard Eraser using Embedded System' has been suggested to automatically erase the blackboard. DC motors of three different types are used for the movement of the instrument. The instrument moves forward and backward erasing the board and collecting the dust automatically from the erasing material due to the rotation of the roller. These processes are automated using PIC16F877A microcontroller. Thus the device avoids the dust flow in the environment and thereby providing good solution for the problems faced by the student, faculty and other electronic equipments that are used inside the class room in a cost effective and time efficient way.

I. INTRODUCTION

Blackboards are used in the class room for teaching purpose. These blackboards form the basis for an effective learning in the class room environment. Chalk pieces are used to write on the blackboard. The chalk powder obtained from the chalk pieces while erasing the blackboard, when inhaled by human cause problems to the respiratory organ. The Asthma patients and those who are allergic to dust cannot sit near the blackboard. Based on the problems faced by the faculty and the students, a case study was made. The case study illustrated about major issues, caused by chalk dust which can accumulate in the human respiratory system and cause problems. Other than this there are few more issues like hair loss, burning of eyes etc. Manual work is needed to clean a board which further extends time consumption while taking classes.

Moreover chalk dusts not only harm the human but also the machines. Equipments that are used in the class rooms like projectors when exposed to the chalk dusts which is not heavy get easily settle on the equipments. This is one of the reasons for heat production in the equipments, when large amount of heat is produced the equipment may wear out before its actual life period ends. The Real Time Automated Blackboard Eraser can be used in the class rooms to avoid the above faced problems and to modernize the class rooms.

II. LITERATURE REVIEW

The common practice of erasing the blackboard is by using a black board eraser which is a hand held object, normally called as dusters and cleaning of the blackboard by a damp cloth is, of course, a technique that has long been employed but is only used when immediate use of the blackboard is not required. Some efforts have been made to improve the materials used in erasers, although such improvements still require manual manipulation of the eraser in the erasing of the blackboard.

The above mentioned erasing methods erases the board, at the same time releases the chalk dust in to the environment. The chalk pieces are made of lime stone and other chemical components which is harmful to health when exposed to larger content. The class room becomes untidy with those dusts. Though dust free chalk pieces are being manufactured they produce few amounts of chalk dust lesser than normal chalk pieces but still there are possibilities for the dust accumulation. Hence the automated blackboard eraser can be used to avoid the above problems and to reduce the manual work. The Fig 2.1 shows the untidy class room caused due to the chalk dust.

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Fig 2.1 Existing Method of Erasing Board

III. REAL-TIME AUTOMATED BLACK BOARD ERASER

The real time automated black board eraser is used to clean the board automatically and to absorb the dust produced during erasing the board. The model consists of a wiper motor which is used to move the entire erasing apparatus from one end to the other end for complete erasing of the board.

A DC Gear Motor is used to rotate the roller that is wound with the erasing material. This material is used to erase the board and get hold of the dusts after erasing. A scrubber is used to remove the chalk dust that gets settled on the rubbing material. The vacuum cleaner is used to absorb the chalk dust that fall inside the erasing apparatus.

The entire apparatus is placed parallel to the board placed at one end. The roller wound with eraser is placed at zero gap between the board and the eraser, so that it erases the board cleanly. The microcontroller PIC16F877A is used to automate the entire process. The circuit designed for the automation is fixed to the wall. The cables are connected using connectors.

DESIGN LAYOUT

The project provides a simple and automatic solution to automatically erase the black board. In this section the various objects and blocks as shown in Fig 3.1 are discussed.

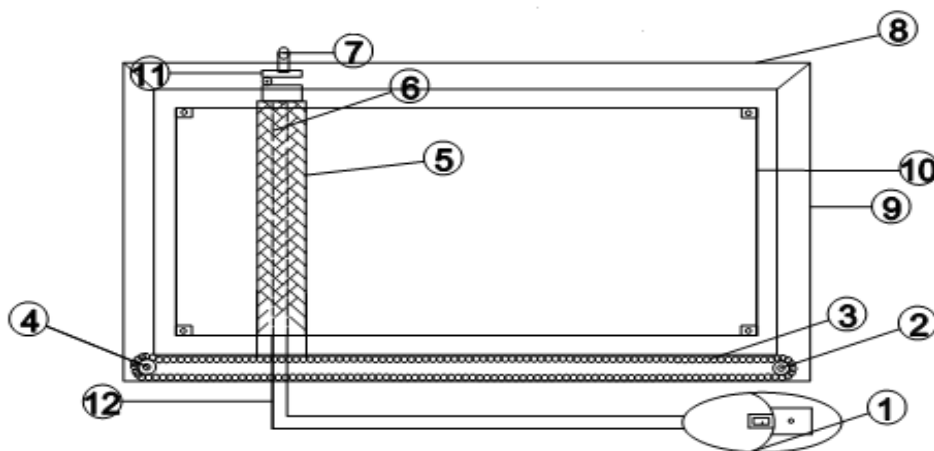


Fig 3.1 Real-Time Model of Automatic Blackboard Eraser

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1 Vacuum Cleaner

Vacuum cleaner is used to absorb the chalk dust that flutters in the environment while erasing the blackboard. These dusts are collected from the eraser apparatus

A conventional vacuum cleaner as shown in Fig 3.6. is actually made up of only six essential components: An intake port, which may include a variety of cleaning accessories

- An exhaust port
- An electric motor
- A fan
- A porous bag
- A housing that contains all the other components

When the vacuum cleaner is plugged and turned on. The electric current operates the motor. The motor is attached to the fan, which has angled blades.

As the fan blades turn, they force air forward, toward the exhaust port. When air particles are driven forward, the density of particles (and therefore the air pressure) increases in front of the fan and decreases behind the fan. This pressure drop behind the fan is just like the pressure drop in the straw when you sip from your drink. The pressure level in the area behind the fan drops below the pressure level outside the vacuum cleaner (the ambient air pressure). This creates suction, a partial vacuum, inside the vacuum cleaner. The ambient air pushes itself into the vacuum cleaner through the intake port because the air pressure inside the vacuum cleaner is lower than the pressure outside.

As long as the fan is running and the passageway through the vacuum cleaner remains open, there is a constant stream of air moving through the intake port and out the exhaust port. The key principle is friction.

Based on this principle the vacuum cleaners are used to suck the dust from the eraser housing and collect them in a bag

2 Wiper Motor

Wiper motor used is a DC motor. It is used to rotate the chain for the to and fro movement of the eraser apparatus. The motor is placed beneath the blackboard.

A wiper motor is a DC motor with two permanent magnets that serves as a field for the motor, arranged around the armature where the power is connected to the commutator of the armature with two brushes, the armature is a set of electromagnetic coils that is each connected to its own two segments in the commutator so that the power is connected to only one coil at a time to generate a magnetic field in the armature, this field will oppose the field of the permanent magnet field, where the one field will push the other away and make the motor to turn.

Powering the Motor

The standard voltage requirement for the wiper motor is 12 volts DC. The electrical system in a running automobile usually puts out between 13 and 13.5 volts, so it is safe to say that the motor can handle up to 13.5 volts with no problem.

The minimum required current for the motor is 1.6 amps at 70 rpm, 0.9 amps at 41 rpm and 4 amps to run it at 106 rpm. These current ratings are for the motor spinning with no load. As we add mechanical load, these numbers can increase dramatically, doubling or even tripling under a heavy load. When testing for torque, we found the motor to draw close to 14 amps in a stalled condition. This factor was taken into account when selecting a power supply. Since the motor will only use what it needs when it comes to current, 5amp power supply has been used.

Wiring the Motor

The wiper motor has a block with 5 electrical terminals. One terminal goes to ground (Common), one is for high speed, one low speed and two for a parking switch. During motor operation, the two terminals are connected to each other at about 90% of each rotation.

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The table 3.1 gives approximate speed, current draw and power supply hook-up information for counter clockwise motor rotation. As an example, if the motor has to rotate at 70 rpm, the positive (+) connection of the power supply is hooked to the High speed terminal of the motor and the negative (-) connection of the power supply to the Common terminal on the motor. And vice-versa for the clockwise rotation. Only two wires have been used in the project.

Table 3.1 Speed for the Current Drawn

RPM	Current draw*	+ Power Supply	- Power Supply
41	0.9 amps	Low speed	Common
70	1.6 amps	High speed	Common
106	4.0 amps	High speed	Low speed

3 Chain as a Conveyor

The chain made of iron that is normally used for the bicycle is used here as a conveyor for moving the housing from one end of the board to the other end. These chains are taken from the scrap as it can be reused. It can withstand high weight as it is made of iron.

4 Pre-Wheel

The chain requires a base for rotating freely which can hold its structure, hence pre wheel is used. These pre-wheels are a type of gear with teethes in them. These teethes can hold the chain by not making it to lose its grip while moving the assembly.

5 Eraser Apparatus

The eraser apparatus consists of roller that rotates with the help of a DC gear motor and a vacuum pipe that is connected with a vacuum cleaner.

6 Roller Wound With Eraser

The roller that is present inside the eraser housing is wound with the erasing material. This material is used for erasing the chalk board and also to get hold of the dust which falls when the scrubber touches the board. Due to the friction the chalk powders that are present in the material falls inside the housing, thus avoiding the chalk dust to fall out of the housing. These dusts that fall inside the housing are absorbed using vacuum cleaner.

7 DC Gear Motor

DC Gear Motor is used for the purpose of rotating the roller that is wound with the erasing material. Since it is a gear motor it produces high torque to rotate the roller with a zero gap between the erasing material and the board. The operating voltage of the DC motor is 12 Volt with the current rating of 2A.

In a gear motor, the magnetic current (which can be produced by either permanent magnets or electromagnets) turns gear that are either in a gear reduction unit or in an integrated gear box. A second shaft is connected to these gears. The result is that the gears greatly increase the amount of torque the motor is capable of producing while simultaneously slowing down the motor's output speed. The motor will not need to draw as much current to function and will move more slowly, but will provide greater torque. Hence 10rpm gear motor has been used in our project to provide greater torque for the roller rotation. The load is due to the friction between the roller and the blackboard when there exists a zero gap between them.

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8 Motor Base

The motor base denotes the base that holds the DC gear motor when the apparatus moves to and fro. As the DC gear motor is used for the rotation of the roller which has to be done throughout while erasing the board, the motor thus has to be moved along with it. Hence a base is placed on the frame to hold the motor.

9 Frame

Frame refers to the outer layer of the board, on which the board is attached. These frames in real time are made of wood. In the project it is replaced using iron frames.

10 Blackboard

The blackboards are used for writing the information by a staff or a student to convey the message visually as a script. The blackboard teaching is an effective way of teaching followed from the ancient days till today.

11 Wheel Attached To Motor Base

A wheel for the free movement of the eraser apparatus is attached to the base at which the DC gear motor is placed.

12 Vacuum Pipe

A vacuum pipe is used to connect the vacuum cleaner with the eraser apparatus. These vacuum pipes are long tubes that are made of plastic material. They are flexible so that the pipe can move along with the erasing apparatus.

BLOCK DIAGRAM

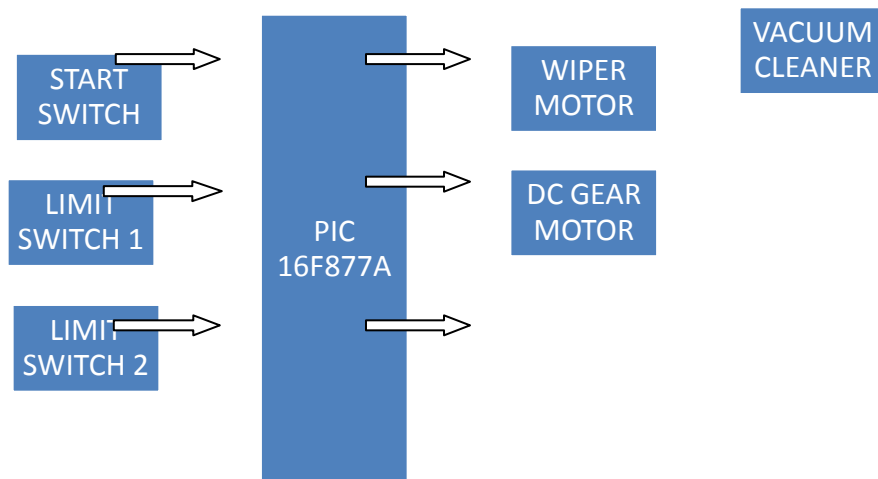


Fig 3.2 Block Diagram

The above block diagram shows the methodology adopted for the automation of the blackboard eraser. Description of the each parts are given below.

PIC Microcontroller 16F877A

PIC 16F877A is 8-bit microcontroller shown in Fig 3.3 is based on reduced instruction set computer (RISC) architecture. It has 8kX14-bits flash program memory, 368 bytes of SRAM, 256 bytes of EEPROM and Self-reprogrammable under software control.

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One of the main advantages is that each pin is only shared between two or three functions so it is easier to decide the pin function. The PIC16F877A microcontroller is used because of its low power and high performance Reduce Instruction Set Computer (RISC) with only 35 single word instructions to learn and provide 10 bit, up to 8 channels Analog-to-Digital Converter (A/D) module. The PIC has the characteristics of storing the program in the hexadecimal format, in the specially meant EEPROM which is of 256 byte length. This IC can be reprogrammed and erased up to 10,000 times.

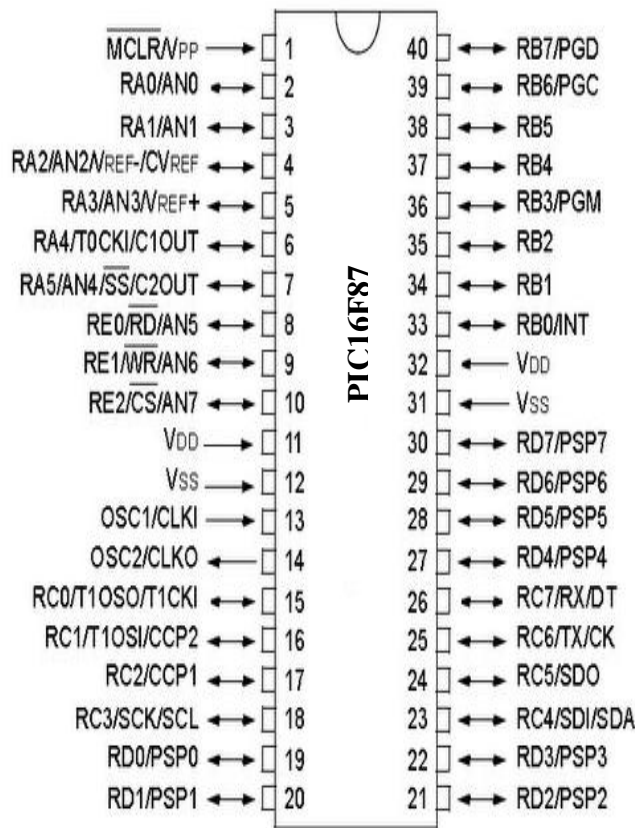


Fig 3.3 PIC Microcontroller

I/O Ports

The PIC 16F877A is a 40 pin DIP IC. There are 5 Ports namely, PORT A, PORT B, PORT C, PORT D and PORT E. Among these, PORT B, PORT C, and PORT D contain 8 pins, whereas PORT A contains 6 pins and PORT E contains 3 pins. Some pins for these I/O ports are multiplexed with an alternate function for the peripheral features on the device. In general, when a peripheral is enabled, that pin may not be used as a general purpose I/O pin.

IV. IMPLEMENTATION OF REAL-TIME AUTOMATED BLACKBOARD ERASER

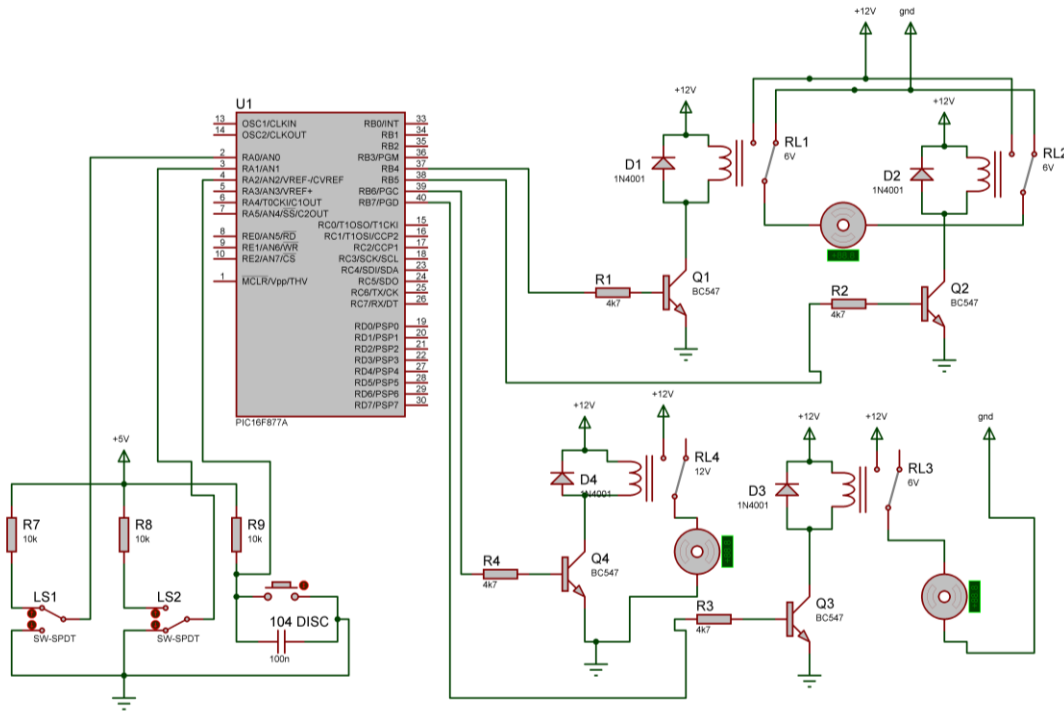


Fig 4.1 Circuit for the Automation of the BlackBoard

The circuit diagram consists of a PIC16F877A microcontroller, LS1, LS2, Push Button, Relay circuit and transistor BC547. The controller is programmed in such a way that when push button is pressed, it initially checks for the condition of the limit switches. The condition of the push button Logic 0 is satisfied only when any one of the limit switch, either LS1 or LS2 must be Logic 0. Only when these condition is satisfied, the controller works according to the program and hence the switching of the relay takes place. As the relay is switched the motor runs.

4.1 POWER SUPPLY

4.1.1 5 Volt Power Supply

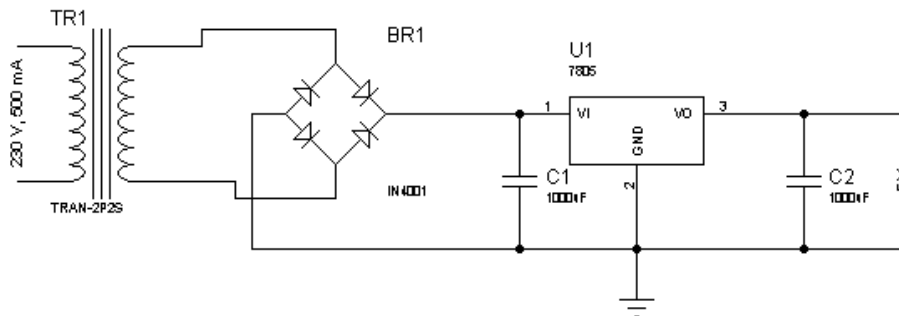


Fig 4.2 5 Volt Regulated Power Supply

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The 5 Volt power supply circuit consists of a transformer with single primary and secondary winding, bridge rectifier made of diodes IN4001, capacitors and a voltage regulator. The rating of the transformer used is 230 V, 500 mA with 12-0-12 V in the secondary, since the current rating for the controller is 20mA.

The bridge rectifier is used to convert AC to DC voltage. The VCC and VSS input for the controller should be 5 Volt DC.

To regulate the voltage and to filter the ripples voltage regulator 7805 and capacitor 1000uF has been used for the constant supply of the voltage.

4.1.2 12 Volt Power Supply

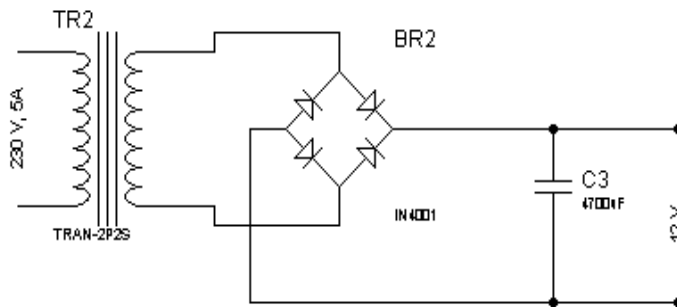


Fig 4.3 12 Volt Power Supply

The 12 Volt DC power supply is used to run the motors such as DC gear motor, Wiper motor and Vacuum cleaner. The rating of the transformer used is 230 V, 5 A with 12-0-12 V at the secondary end of the transformer. The capacitor used is 4700uF to withstand the current and voltage.

V. EXPERIMENTAL RESULTS

The experimental result of the proposed idea is shown in the fig 5.1 and fig 5.2. Fig 5.1 shows the prototype of the model exhibited.

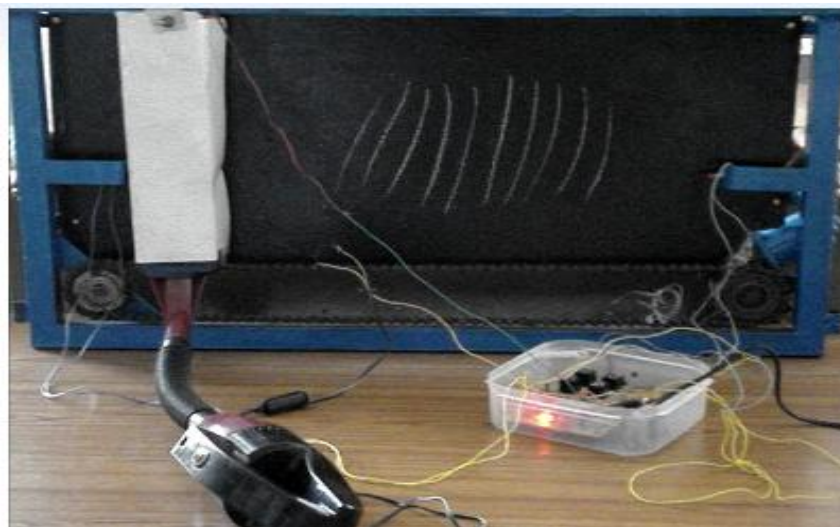


Fig 5.1 Snap Shot of Real-Time Model of Automated Blackboard Eraser

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Fig 5.2 shows the hardware implemented for the automation of the eraser.

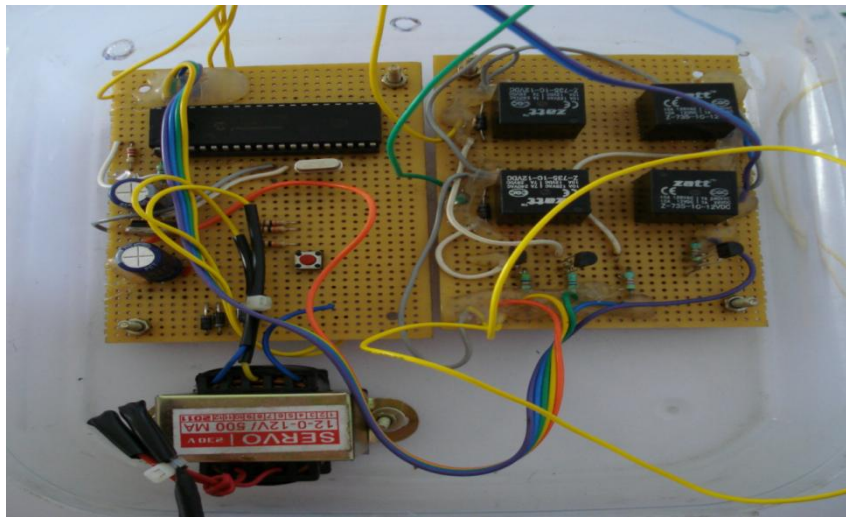


Fig 5.2 Circuit Design for Automated Blackboard Eraser

VI. CONCLUSION

The Real-Time Automated Blackboard Eraser Using Embedded System is used for erasing the blackboard automatically. Thus provides a better solution for the health hazards, time constraints and electric component damages in the class rooms.

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