DESIGN AND FABRICATION OF SMART DUSTER

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Abstract : This project was selected by us by taking into some consideration of comfort and saving the time consumed while erasing the black board or white board. At the time of erasing the black board it is seen that the teachers cover mouth with cloth by one hand, and erase by the other hand. For long length black board consume more man power and some potential of the teacher get loss. So we decided to implement our course and some extra knowledge and with the help of mechanical and electronic concept our project theme is made. This project can clean the blackboard and whiteboard automatically with rope ad pulley mechanism and automated by automation by the using of limit switches.

IndexTerms **- Rope and pulley, Limit switches, board cleaning system, toggle mechanism.**

I. INTRODUCTION

In school and colleges the black board is used for teaching purpose. In some school and colleges has started e-learning and projector learning, but effective understanding of the students is only done by teaching on blackboard or white board.

While conducting a lecture teachers need to erase the whole black board by two to three times per lecture. And at the time of erasing the blackboard, chowk dust is directly came into their nose and mouth and due cause of this the respiratory organ of the teachers get affected.

In one single lecture, it is seen that the whole blackboard is erase by the teacher two to three times. And calculating the average time required to erasing the blackboard in one lecture is nearly equal to 5to 10 minutes. In every college and school near about six to seven lectures are conducted in one day. So we can save 35to70 minutes in whole day and this time can use to giving extra knowledge to students rather than the specified syllabus of respected board or university.

In this machine we use the rope and pulley mechanism to run the duster in longitudinal movement and automated by the limit switches, micro-processor and micro-controller for systematic running purpose.

1.1 PROBLEM IDENTIFICATION AND PROJECT OBJECTIVE

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.

- The time consumes in hand erasing is more.
- The problem of dust in hand erasing affect the human being.

Hand erasing requires human power thus wastage of human energy.

1.2. OBJECTIVE

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. This machine will provide with three selectable modes to erase the whiteboard with only a single key. This machine was created as a convenience to the user to erase the blackboard.

Second objective is to enhance the efficiency and accuracy of the movement of duster machine. This purpose of this objective is to make the movement of this machine accurate although has been used many time. Another purpose of this objective is to make the machine work faster and smoothly. This aims to prevent users from bored waiting for the cleaning process to be done. It is also to avoid wasting time there.

1.3 LITERATURE SURVEY

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 [1] has explained that the machine can operate in three selectable opera table 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.

Mr. Sunil R. Kewate, Mr Inzamam T. Mujawar, Mr. Akash D. Kewate, Mr.Hitesh R. Pant [2] 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.

S.nithyananth, A.Jagatheesh, K.Madan, B.Nirmalkumar [3] 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 up to the limit of its travel.

Dong Yeop Kim, Jae Min Lee, Jongsu Yoon, Tae-Keun Kim, Bong Seok Kim, and Chang-Woo Park [4] 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 senor 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. 1 is the sensor for obstacles has shorter stroke to sense only obstacles which is closer than ordinary wall.

Mojtaba Khaliliana,, Ali Abedi, Adel Deris Zadeh [5] is explaning 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 Mat lab software is built and simulated. The results show that the control technology is simple and effective and accuracy is considerably high.

Gaurav Gangurde [6] has also performed on this topic and has used the mechanism of rack and pinion for cleaning the blackboard & whiteboard with the help of D.C 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. This 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 require the sprinkler system.

2. Design methodology

2.1 Conventional method

The most common method of erasing the blackboard is to use a hand-held eraser and to manually erase the blackboard as required. Cleaning of the blackboards 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 heretofore to improve the materials used in eraser, although such improvements still require manual manipulation of the eraser in the erasing of the blackboard.

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fig 2.1 Conventional method of erasing black board

Some attempts have also been made to mechanize erasers, but the prior known mechanical or automatic blackboard erasers since they include complicated mechanical connection and driving elements. In this fast growing world automatic techniques are most adopted thus to reduce the time and energy. In this project an advanced technology is used for automatic erasing the board.

This chapter will discuss on the methodology employed and consideration to be taken account for this project. This chapter is the important part of this project to realize the Automatic Duster Machine. It begins with the process flowchart that will be showed in the next section followed by mechanism structure, circuit design, and software that will be used. Before this step begins, some research had been done on it. The selection of part is most important to start the project. What kind of part or materials suitable for the
design of the mechanism must be determined? This chapter will also describe the selection of brain for this machine which is a microcontroller and the actuators part of machine which is motor.

2.2 Construction

Construction of mechanism part of duster machine is the most important. Without a good or suitable material it will cause inaccuracy of movement of the machine. In the construction of automatic blackboard duster the board is supported on an aluminium frame. The frame is fixed to the wall through the L-shape channels by using of screw. In the frame the guide way is provided at the upper and bottom side of the frame. The slider frame is attached through this guide way. The motor paced at left side of the frame and other pulley is attached to the right side of the frame. As shown in fig. four sensors are placed for automatic movement of slider (duster). In four sensors, two sensors are placed at slider, and remaining two on the top corners of the frame right and left respectively.

fig.2.2 Construction of frame and board

2.3 Parts used in automatic blackboard duster

1. Blackboard
2. Motor
3. Bearings
4. Duster
5. Aluminium frame
6. Circuit of Machine

2.3.1 Blackboard

A blackboard or chalkboard is a reusable writing surface on which text or drawings are made with sticks of calcium sulphate or calcium carbonate, known, when used for this purpose, as chalk. Blackboards were originally made of smooth, thin sheets of black or dark grey slate stone. Modern versions are often green because the colour is considered easier on the eyes

A blackboard can simply be a piece of board painted with matte dark paint (usually black or dark green). A more modern variation consists of a coiled sheet of plastic drawn across two parallel rollers,

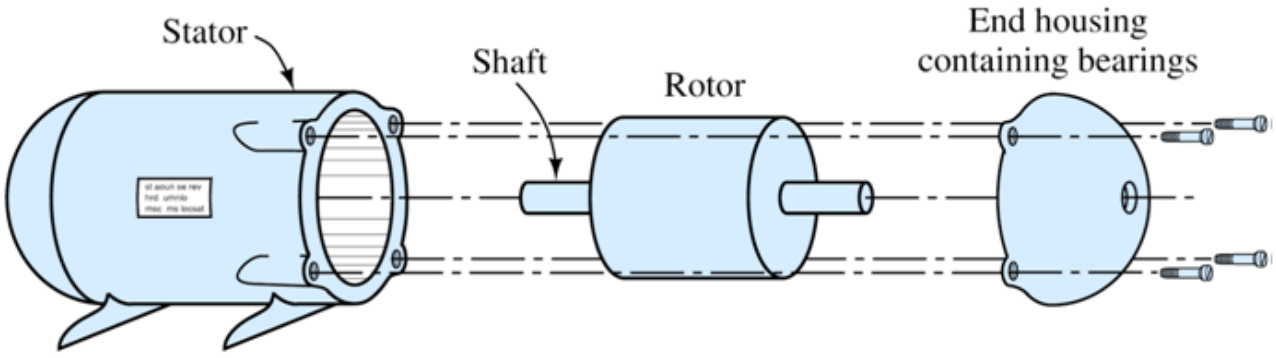
which can be scrolled to create additional writing space while saving what has been written. The highest grade blackboards are made of rougher version porcelain enamelled steel (black, green, blue or sometimes other colours). Porcelain is very hard wearing and blackboards made of porcelain usually last 10–20 years in intensive use. Lecture theatres may contain a number of blackboards in a grid arrangement. The lecturer then moves boards into reach for writing and then moves them out of reach, allowing a large amount of material to be shown simultaneously.

fig.2.3 Blackboard

The chalk marks can be easily wiped off with a damp cloth, a sponge or a special blackboard eraser consisting of a block of wood covered by a felt pad. However, chalk marks made on some types of wet blackboard can be difficult to remove. Blackboard manufacturers often advise that a new or newly resurfaced blackboard be completely covered using the side of a stick of chalk and then that chalk brushed off as normal to prepare it for use.

2.3.2. Motor

A DC motor relies on the fact that like magnet poles repel and unlike magnetic poles attract each other. A coil of wire with a current running through it generates an electromagnetic field aligned with the centre of the coil. By switching the current on or off in a coil its magnet field can be switched on or off or by switching the direction of the current in the coil the direction of the generated magnetic field can be switched



180°

fig 2.4 An electrical motor consist of cylindrical rotor that spins inside a stator.

A simple *DC motor* typically has a stationary set of magnets in the stator and an armature with a series of two or more windings of wire wrapped in insulated stack slots around iron pole pieces (called stack teeth) with the ends of the wires terminating on a commutator. The armature includes the mounting bearings that keep it in the center of the motor and the power shaft of the motor and the commutator connections. The winding in the armature continues to loop all the way around the armature and uses either single or parallel conductors (wires), and can circle several times around the stack teeth. The total amount of current sent to the coil, the coil's size and what it's wrapped around dictate the strength of the electromagnetic field created. The sequence of turning a particular coil on or off dictates what direction the effective electromagnetic fields are pointed. By turning on and off coils in sequence a rotating magnetic field can be created. These rotating magnetic fields interact with the magnetic fields of the magnets (permanent or electromagnets) in the stationary part of the motor (stator) to create a force on the armature which causes it to rotate. In some DC motor designs the stator fields use electromagnets to create their magnetic fields which allow greater control over the motor. At high power levels, DC motors are almost always cooled using forced air.

The commutator allows each armature coil to be activated in turn. The current in the coil is typically supplied via two brushes that make moving contact with the commutator. Now, some brushless DC motors have electronics that switch the DC current to each coil on and off and have no brushes to wear out or create sparks.

Different number of stator and armature fields as well as how they are connected provide different inherent speed/torque regulation characteristics. The speed of a DC motor can be controlled by changing the voltage applied to the armature. The introduction of variable resistance in the armature circuit or field circuit allowed speed control. Modern DC motorsare often controlled bypower electronics systems which adjust the voltage by "chopping" the DC current into on and off cycles which have an effective lower voltage.

Since the series-wound DC motor develops its highest torque at low speed, it is often used in traction applications such as electric locomotives, and trams. The DC motor was the mainstay of electric traction drives on both electric and diesel-electric locomotives, street-cars/trams and diesel electric drilling rigs for many years. The introduction of DC motors and an electrical gridsystem to run machinery starting in the 1870s started a new second Industrial Revolution. DC motors can

operate directly from rechargeable batteries, providing the motive power for the first electric vehicles and today's hybrid cars and electric cars as well as driving a host of cordlesstools. Today DC motors are still found in applications as small as toys and disk drives, or in large sizes to operate steel rolling mills and paper machines

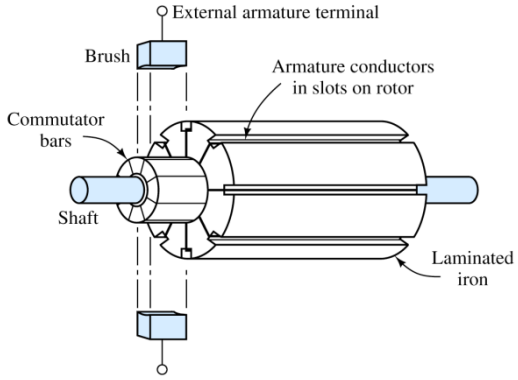


fig 2.5 Rotor assembly of DC machine

If external power is applied to a DC motor it acts as a DC generator, a dynamo. This feature is used to slow down and recharge batteries on hybrid carand electric cars or to return electricity back to the electric grid used on a street car or electric powered train line when they slow down. This process is called regenerative braking on hybrid and electric cars. In diesel electric locomotives they also use their DC motors as generators to slow down but dissipate the energy in resistor stacks. Newer designs are adding large battery packs to recapture some of this energy.

2.3.3 Bearings

Wear resistance and fatigue strength of aluminium based bearing materials are higher than classical bearing materials and they can be used at elevated temperatures. The alloys based on aluminium have superior qualities like corrosion resistance, higher thermal conductivity, high fatigue strength, co-adaption with steel Shafts, light in weight, low cost, and workability. But, beside from the advantages mentioned above, the engineering applications for some aluminium alloys are restricted because of their poor surface properties and low resistance to abrasion. However the required tribological and mechanical properties are developed by adding alloys and applying heat treatment.

The biggest consideration about bearing material is its wear resistance. Current developments in engine technology have seen the launch of advanced materials. So, aluminium-based alloys are introduced in bearing industry because of its high wear resistance. Aluminium based bearing materials are used in several applications like crank shaft bearings in automotive industry, internal combustion engines etc. Advancement in the efficiency of IC engines has caused growth in the consumption of aluminium alloys like Al–Si. The target of this analysis is to suggest new Aluminium based bearing materials that have higher grade qualities than classical bearing materials and to study the tribological properties of these alloys experimentally with and without lubrication. Accordingly, three different aluminium alloy based bearing materials were prepared, experimented and the results were analyzed.

fig. 2.6 Aluminium section bearing

2.3.4. Duster

Duster is a soft resin material used for rubbing/erasing the blackboard/whiteboard. The Witten material that is on the board should be removed from there to write something new to express our view. There are different types of duster that are used some needed water for erasing and some without of water.

2.3.5 Circuit of machine

Microcontroller (AT89S52) Circuit

The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density non volatile memory technology and is compatible with the industry standard 80C51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non volatile memory programmer. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications. The AT89S52 provides the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, Watchdog timer, two data pointers, three 16-bit timer/counters, a six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry. In addition, the AT89S52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port, and interrupt system to continue functioning. The Power-down mode saves the RAM contents but freezes the oscillator, disabling all other chip functions until the next interrupt or hardware reset.

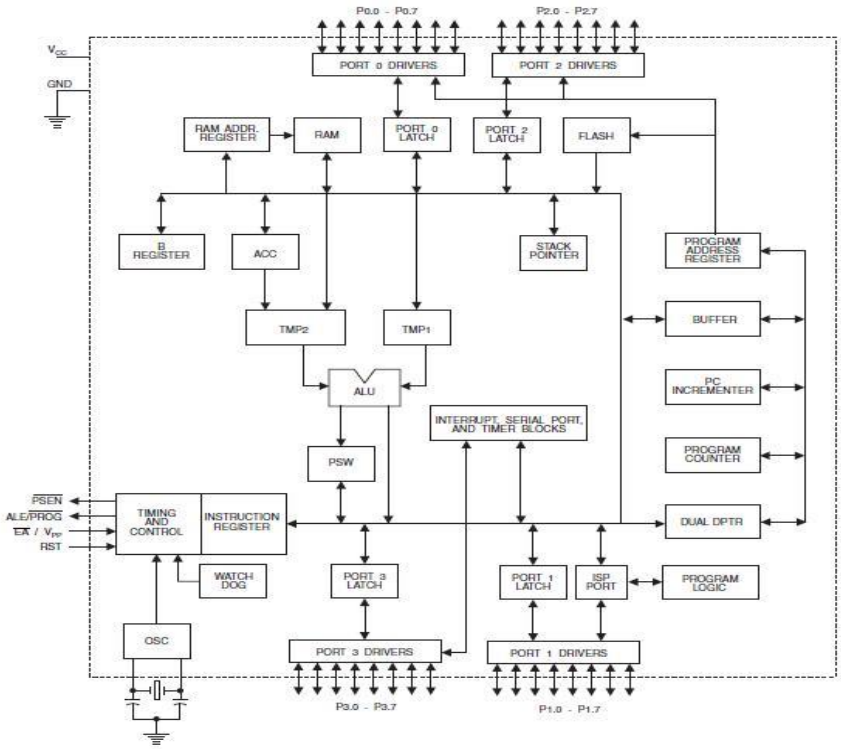


Fig 2.7 Block Diagram of AT89S52

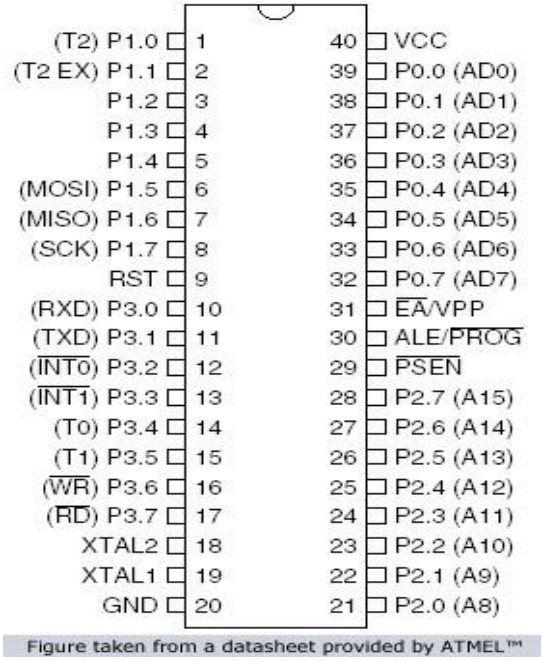


fig. 2.8 Pin Configurations of AT89S52

2.3.6 Design Calculations

For the purpose of design the following calculations has been carried out

DC geared motor:

Voltage=12 V, Load current (I) =4.6 Amp.
Speed (N) =100 RPM.
Torque=30 kg-cm (2.943 N-m).
Power=55.2 Watt.
Velocity = $2\pi ND/60$
Where,
N=Speed of the motor (revolution per minute),
D=diameter of pulley (meter)
$V=2*\pi*100*0.04/60$
V=0.4188 m/sec.
Time required cleaning the board:
t=length of board/velocity
=2.4384/0.4188
=5.8223 sec.

2.4 Specifications

Specification of the whole assembly of the automatic black board duster is as follow

2.4.1 Blackboard

Table 2.1. Blackboard specification

Dimensions	8×4 ft
Weight	10 kg

2.4.2. Motor

Table 2.2. Motor rating

Type	DC
Ampere	4.6
Volt	12

2.4.3. Quantity of parts

Table 2.3 Quantity of parts used

Sr. No	Parts	Quantity
1	Blackboard	1
4	Motor	1
5	Duster	1
6	Frame	1
7	Bearing	4

2.4.4 Duster

Table 2.4 Duster dimension

Length	4.5 ft
Width	4 inch

2.5 Working

This system uses rope and pulley. The one pulley is connected to the dc motor to drive the pulley, and the second pulley is hinged at other end of the black board frame and carries the rope and forming a closed loop. The rope is hinged at one end to the slider (duster). And rope through the next pulley again wounded to first pulley. When the motor is starting its rotation then wounded rope is release and carries the (slider) up to its extreme position. When motor is starting the rotation in clockwise direction the slider moves left to right and motor rotating in counter clockwise direction the slider moves right to left movement. By the using of sensors the slider comes to right end position the sensor sense the slider and send signals to the microprocessor and change the direction of rotation of the motor and slider became move in left end position in two or three complete slide the black board is completely clean.

3.1 Advantages

This topic will discuss the benefit of Duster Machine to user. Every development of product must Give some feedback to the user. This product was fabricated to help people especially teachers and Lectures. So the benefit of Duster Machine is:

1. Reduce tiredness of teachers.
2. Install automation in operations reduce time.
3. Easy and fast operation with maximum wiping area.
4. Problem of dust can be reducing.
5. Maintenance cost is less.
6. Simple in construction and operating.

4.1 Result

By doing this project we can reduce the manpower used in erasing the blackboard. It can erase the entire blackboard in two to three times. By using rope pulley mechanism we reduce the noise produced by the wire mechanism. It also helps in reducing the flow of the dust particle near to the man working there.

5.1Conclusion

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 AUTOMATIC BLACK BOARD DUSTER MACHINE is an alternative machine that can help lecturer, teacher and student to keep their board clean by using this machine.

6.1Future scope

In the present time not everything is automatic but seeing towards progress of present technologies, 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 vacuum blower can be arranged.

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.

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.

7.1Reference

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