

FABRICATION OF REMOTE CONTROLLED MOTORIZED SCISSOR JACK

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ABSTRACT

Scissor jack is mechanical equipment used to lift up heavy loads. The power screw mechanism included in a scissor jack is design to lower the amount of force needed to lift the heavy loads. The operation of a scissor jack starts by using a z shaped crank that is mounted to a small hole on the mechanism. After rotating the crank, the screw jack rotates and acts like a gear mechanism. The lifting section consists of arms. The turning of screw operates the arms in such a way that it lifts up very gently. Now the arm rotates very gently and force needed to lift the vehicle is divided into parts and user can lift very heavy objects with comparatively very less force. Also the weight of the load is not enough to push the scissor down, since it would require very large force. Thus it allows us to lift heavy loads like cars by just using human strength, so this system is further improved by making it motorized by just pressing a button for lifting and lowering and it is a weight transferring unit in industries by its portable nature.

Keywords: Scissor jack, Power screw mechanism, Motorized Scissor jack.

I. INTRODUCTION

Scissor jacks are mechanical devices and have been in use since 1930s. A scissor jack is a device constructed with a cross-hatch mechanism, much like a scissor, to lift up a vehicle for repair. It typically works in a vertical manner. The jack opens and folds closed, applying pressure to the bottom supports along the crossed pattern to move the lift. When closed, they have a diamond shape. Scissor jacks are simple mechanisms used to handle large loads and reduces the amount of force required by the user to drive the mechanism. Most scissor jacks are similar in design, consisting of four main members driven by a power screw [1]. A scissor jack is operated simply by turning a small crank that is inserted into one end of the scissor jack. This crank is usually "Z" shaped. The end fits into a ring hole mounted on the end of the screw, which is the object of force on the scissor jack. When this crank is turned, the screw turns, and this raises the jack. The screw acts like a gear mechanism. It has teeth (the screw thread), which turn and move the two arms, producing work. Just by turning this screw thread, the scissor jack can lift a vehicle that is several thousand pounds. A scissor jack has four main pieces of metal and two base ends. The four metal pieces are all connected at the corners with a bolt that allows the corners to swivel. A screw thread runs across this assembly and through the corners. When opened, the four metal arms contract together, coming together at the middle, raising the jack.

A. Scissor Jack Need for automation

- To achieve mass production.
- To reduce human effort.
- To increase the efficiency of the jack.
- To reduce the work load.
- To reduce the production cost.
- To reduce the production time.
- To reduce the material handling.
- To reduce the fatigue of workers.

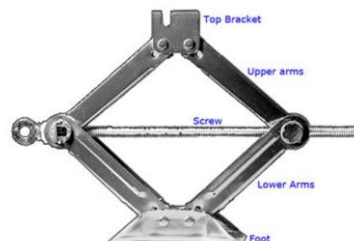


Fig.1 Scissor Jack

II. FAILURES IDENTIFICATION IN SCISSOR JACK

To study the failure modes of scissor jack, it is tested under various conditions for failure analysis.

A. Failure I:

Failure I:
The scissor getting w

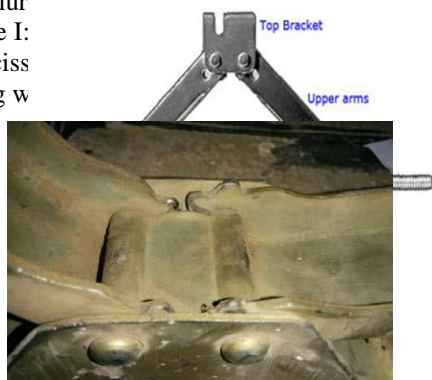


Fig.2 Teeth wear of lower arm

both links at lower end. Due to this the jack over and over again, the teeth starts toppled from the actual position as shown in below.



Fig.3 Teeth wear of upper arm

B. Failure II: Screw Failure

This failure is caused after using the jack for certain amount of time. Due to excessive use and high impact on the screw, it starts getting wear. Due to this jack gets toppled from its actual position as shown below



Fig.4 Toppled scissor jack due to arm teeth failure

Failure of screw and arm teeth



Fig. 5 Failure of screw and arm teeth

C. Failure III: Jack head failure:

After certain duration and use of jack the head of jack starts bending due to the fatigue load acting continuously again & again over the head as shown in the figure below. This defect occurs due to improper design of shape and geometry of existing head design.



Fig.6.Failure of jack head due to improper design

III. DEVELOPMENT OF MOTORIZED SCISSOR JACK

For overcoming the conventional scissor jack failures develop the motorized scissor jack which consists of following components.

- i. DC Gear motor
- ii. Arduino system
- iii. Microcontroller
- iv. L293D motor driver IC
- v. bluetooth module

A. DC Gear motor

DC motor basically consist two main parts. The rotating part is called the rotor and the stationary part is also called the stator. The rotor rotates with respect to the stator.



Fig.7. DC geared Motor

Microcontrollers can't drive the motors directly. So we need some kind of drivers to control the speed and direction of motors. The motor drivers will act as interfacing devices between microcontrollers and motors. Motor drivers will act as current amplifiers since they take a low current control signal and provide a high current signal. This high current signal is used to drive the motors. Using L293D chip is the easy way for controlling the motor using microcontroller. It contains two H-bridge driver circuits internally. This chip is designed to control two motors. L293D has two sets of arrangements where 1 set has input 1, input 2, output 1, output 2, with enable pin while other set has input 3, input 4, output 3, output 4 with other enable pin.

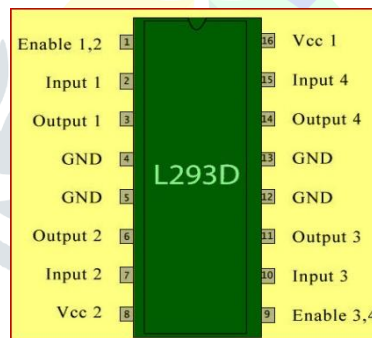


Fig.8 DC motor interfaced with L293D microcontroller

L293D has two set of arrangements where one set has input 1, input 2, output 1 and output 2 and other set has input 3, input 4, output 3 and output 4, according to above diagram, If pin no 2 and 7 are high then pin no 3 and 6 are also high. If enable 1 and pin number 2 are high leaving pin number 7 as low then the motor rotates in forward direction. If enable 1 and pin number 7 are high leaving pin number 2 as low then the motor rotates in reverse direction.

B. Arduino system

Arduino boards are able to read analog or digital input signals from different sensors and turn it into an output such as activating a motor, turning LED on/off, connect to the cloud and many other actions.

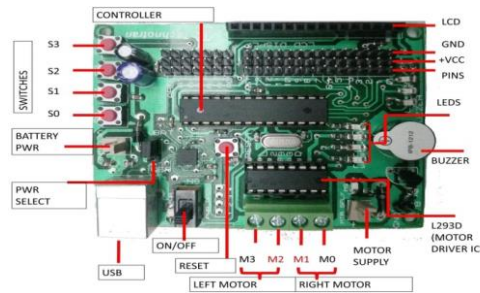


Fig.9.Aurduino board

C.L293d motor driver IC

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC. The L293d can drive small and quiet big motors as well, check the Voltage Specification at the end of this page for more info.

The L293 and L293D devices are quadruple high current half H-drivers. The L293D is designed to provide bi directional drive currents of up to 1A at voltages from 4.4 to 36 V. The L293D is designed to provide bi directional drive currents of up to 600-m A at voltages from 4.5V to 36V. Both devices are designed to drive inductive loads such as relays, solenoids, DC and bipolar stepping motors as well as other high current/high voltage loads in positive supply applications.

Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo-Darlington source. Drivers are enabled in pairs with drivers 1 and 2 enabled by 1,2 EN and drivers 3 and 4 enabled by 3 and 4 EN. The L293 and L293D are characterized for operation from 0°C to 70°C.

D.Bluetooth Module HC-05

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication. This serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature).

The Bluetooth module HC-05 is a MASTER/SLAVE module. By default the factory setting is SLAVE. The Role of the module (Master or Slave) can be configured only by AT Commands. The slave modules cannot initiate a connection to another Bluetooth device, but can accept connections. Master module can initiate a connection to other devices. The user can use it simply for a serial port replacement to establish connection between MCU and GPS, PC to your embedded project, etc.

IV APPLICATIONS

Generally scissor jacks are used in auto garages. Now we made it as motorised scissor jack this has more advantages than that of normal scissor jack. application in various sectors are

- Automobile Industries
- Auto Garages
- Small Scale Industries

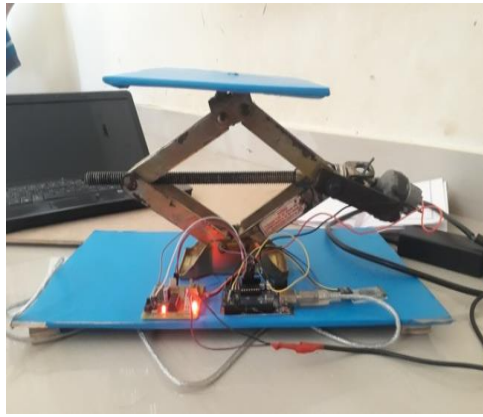


Fig. Final prototype of automatic scissor jack

V MOTORIZED SCISSOR JACK

By assembling above components motorized scissor jack is developed as shown in figure.10. Motorized scissor jack which is Bluetooth control by giving inputs as required to lift the load and to lower the load and to position the load.

VI CONCLUSION

Scissor jacks are the ideal product to push, pull, lift, lower the load and position loads of anything from a couple of kilograms to hundreds of tonnes. The need has long existed for an improved portable jack for automotive vehicles. It is highly desirable that a jack become available that can be operated alternatively inside from the vehicle or location off the safety off the road on which the vehicle is located. Such a jack should desirably be light enough and compact enough so that it can be stored in a automobile trunk. It can be lifted up and carried by most adults to its position of use and yet it be capable lifting the load up to 4000-5000 pound vehicle off the ground. Further it should be stable and easily controllable by a switch so that jacking can be done from position of safety. It should be easily movable either to a position underneath the axle of the vehicle or some other reinforced support surface designed to be engaged by the jack. Thus, the product has been developed considering the above requirements. This particular product motorised scissor jack will prove to be beneficial in lifting and lowering the loads.

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