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DESIGN AND DEVELOPMENT OF AUTOMATIC HAND BRAKE RELEASE SYSTEM

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Abstract-Automatic Hand Break Release is nothing but one of the breaking systems in automobile at the time of vehicle switch off condition. In this breaking system pneumatic system operated one. In this project, the control unit is received the signal from the key switch at the time of vehicle start condition along with the driver seating set up with weighing sensor. The first time driver sit in his seat, and hence the load cell sensor sends the signal to the controller to release the break (Already wheel is on braking condition). The controller drives the signal to the 5/2 way solenoid valve which actuates the double-acting cylinder which releases brake locking assembly.The key switch is 'OFF' the solenoid valves is in reverse direction for applying the break.

***Index Terms*:** Ardunio, Microcontroller, solenoid valve, wheel drum brake assembly, etc,

I INTRODUCTION

Brakes are one of the most important safety systems in a motor vehicle.

The main function of brake system are to decelerate the vehicle, to maintain the vehicle's speed during downhill operation and finally to park the vehicle stationary either on a flat or slope road condition. The first two functions are related to the service brakes, while the last function is referred to the secondary or parking brakes.

Conventional parking brake actuation involves the human interference. Without pulling or pushing the lever, the parking brake will not work. Also, sometimes due to negligence or in emergency conditions, we humans often forget to apply parking brakes.

We have pleasure in introducing our new project "**AUTOMATIC HAND BREAK RELEASE",** which is fully equipped by automatic system. It is a genuine project which is fully equipped and designed for Automobile vehicles. This forms an integral part of best quality. This product underwent strenuous test in our Automobile vehicles and it is good.

Conventional hand brake unit involves the human interference. While not pull or pushing the lever, the hand brake won't work. Also, generally as a result of negligence or in emergency conditions, we have a tendency to humans usually forget to use parking brakes. This could result in rolling of auto just in case of slopes and collision with different vehicles in park. Constant enhancements in active safety and enhancements with relation to the dependableness and luxury of operation mean that mechanical handbrakes are progressively being replaced by mechatronics device systems.

OBJECTIVE OF PROJECT:-

Following objectives are going to be achieved from this work:

- To reduce the effort of the driver that leads in conventional one..
- To increase the comfort and safety for the driver by using modified parking brake system named as automatic handbrake for engagement and release system.
- In this modified system, we are going to control Handbrake automatically without manual interface.
- As when the ignition switch turned ON, handbrake must disengage and vice versa when ignition switch is OFF, handbrake must engage.
- System may work electro pneumatically using solenoid and pneumatic circuits.

II) CONSTRUCTION;

This Prototype model kit consists of following sections;

I) Hardware Unit

1) M.S. Fabricated base stand unit
   (a) Brake assembly with tyre unit and air cylinder set up
   (b) Load cell sensor with spring controlled driver seat unit
2) Pneumatic control unit
3) Arduino microcontroller (Electronic controller) unit.

Ii) Software Unit

Arduino IDE software

The following figure shows the fully assembled hand brake release Hardware unit ; 3D VIEW

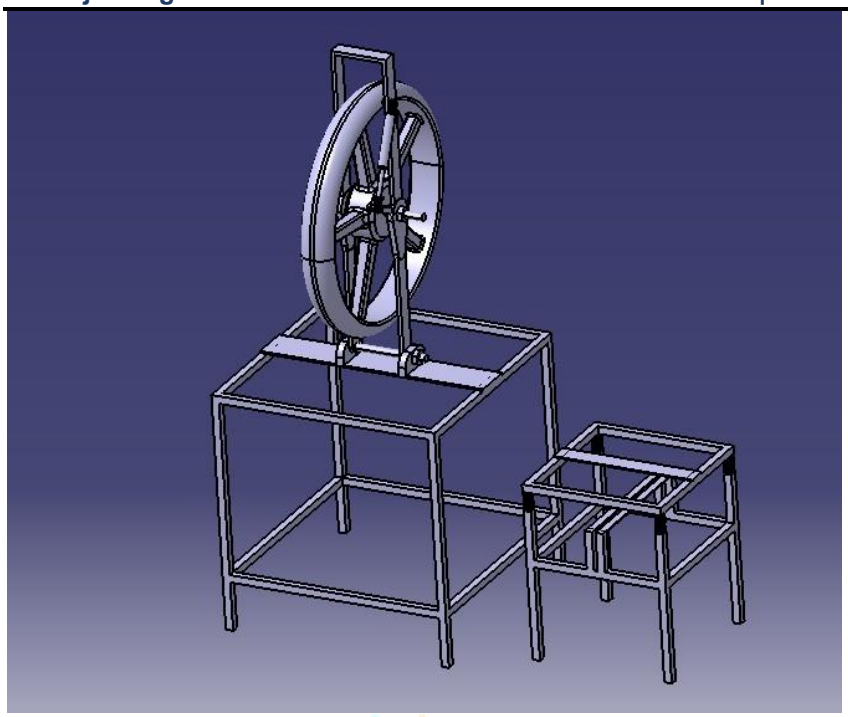


FIGURE 1.1 Hand brake release system

COMPONENTS DESCRIPTION;

This prototype model kit consists of the following parts,

2.1 Arduino Microcontroller
2.2 load cell with HX711 Module
2.3 Air Cylinder for braking control
2.4 M.S.Fabricated stand
2.5 Solenoid operated 5/2 way Directional Control Valve (DCV)
2.6 5V DC to 12V DC Drive Card fir solenoid and motor
2.7 5V DC and 12V DC Regulated Power supply
2.8 LCD display
2.9 tyre wheel with brake assembly

2.1. Arduino controller

Arduino is a microcontroller consist of both programmable circuit board and software or IDE (Integrated Development Environment) that runs on computer and used to write and upload computer code to the physical board. Most of the previous circuit boards, the ardunio is not needed a separate piece of hardware (called a programmer) to load new code onto the board through the USB cable.

The advantages of arduino is ready to use structure and complete package form, library of example of codes inside the software of arduino, effortless functions, large community.

The Arduino uno controller with pin details is shown in below figure 1

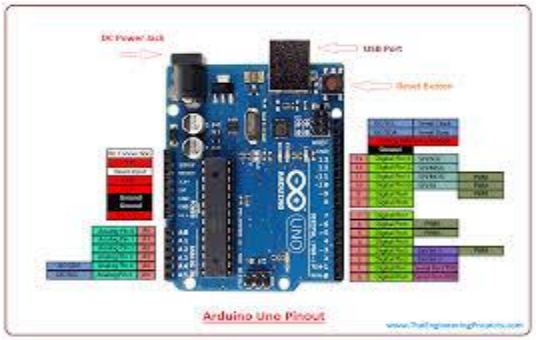


Fig -1 Arduino controller unit

2.2 Air Cylinder for braking control

In this unit, the rotating arm with is gripper is rais by a double acting air cylinder is (25X100 mm diameter size, stroke length). Double acting cylinder is actuated by 5/2 Directional control solenoid valve which is mounted in control panel. When the solenoid valve is ON, the brake unit will be released up by the movement of piston rod of the double acting cylinder.

The arrangement is shown in figure 3

Fig 3 Air cylinder for braking control

2.3 Solenoid Operated 5/2 way DCV

The 5/2 solenoid operated DCV is shown in figure 5. When the valve is turned ON, the 5/2 way DC valve directs the air to the air cylinder and the piston rod release the brake. When the valve is turned OFF, The piston rod is returned to original position and apply the braking control.

Fig -5 Directional Control valve

Fig -7 DC Motor with gear box

Valve Connectors;

The following figure shows the connector to connect the valve and cylinder through the polyurethane tube.

POLYURETHANE TUBE;

The following figure shows the polyurethane tube for connecting valve and cylinder and allowing the pressurized air through this pipe line.

2.8. 5V DC TO 12V DC Drive Card for solenoid and motor

The interface the 5VDC output signal from the Arduino controller to the optocoupler driver module to drive the 12V DC load of DC solenoid valve. The 5V signal from the microcontroller is fed into the input of the optocoupler interface circuit. Here 4N35 opto coupler of 6 pin IC and IRF 540N MOSFET is connected to the solenoid coil to handle the larger current drawn by the valve. The figure shows the circuit of 5V DC to 12DC Drive Card and Drive card module,

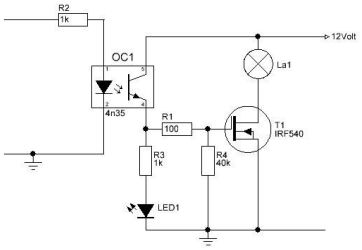


Fig -8 5V DC to 12V DC Drive Card circuit

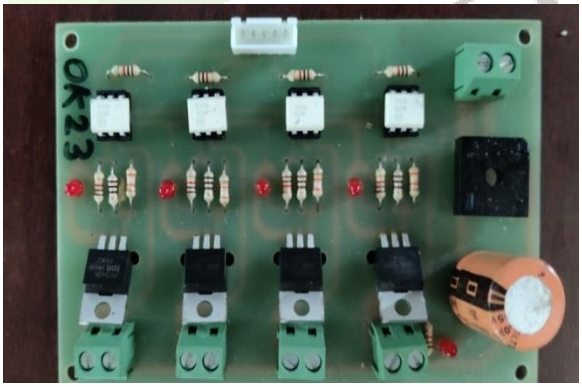


Fig -9 Drive card module

2.9 5V DC AND 12V DC Regulated Power Supply

One power supply module of 5VDC and 12VDC are arranged in the same module to supply the power to this prototype model kit.

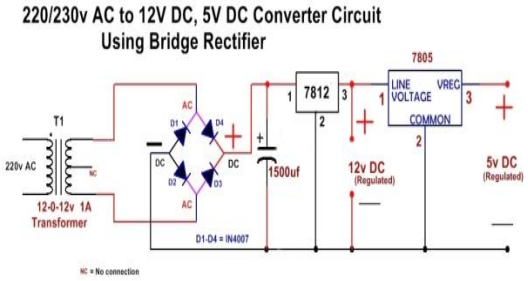


Fig -10 Regulated Power supply unit

In this power supply circuit 230VAC power supply is reduced to 12VAC by the step down transformer. This 12VAC power supply is converted to 12vdc by the bridge rectifier circuit using four IN4007 diodes. The 12VDC output from the bridge rectifier is connected to 7812 IC which outputs 12VDC and is further connected to 7805 IC. The 7805 IC supplies the 5vdc constant power supply.

Load Cell and HX711 Weight Sensor Module:

The following figure shows the load cell sensor arrangement set up under the driver seat

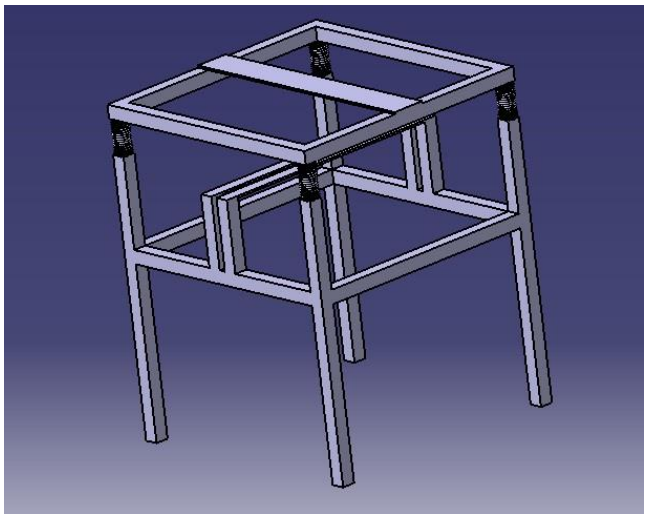
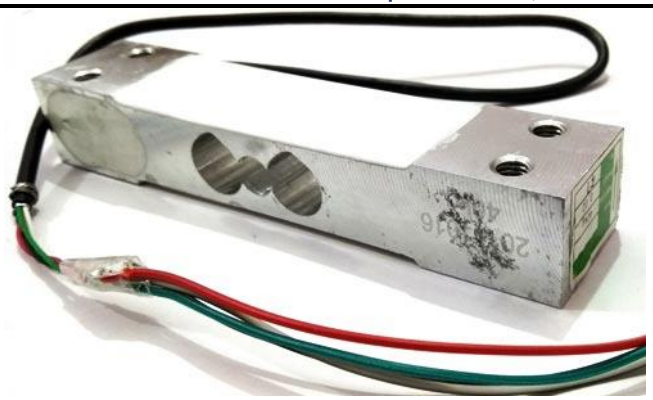


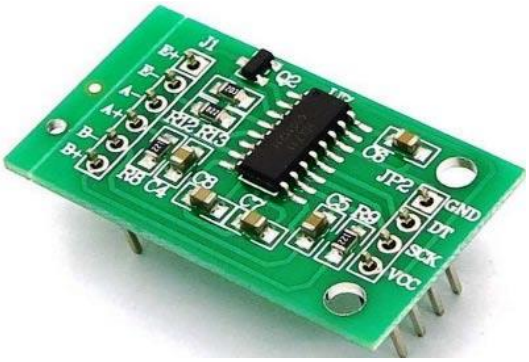
Figure ; loadcell with driver seat unit.

Load cell sensor unit;

Load cell is transducer which transforms force or pressure into electrical output. Magnitude of this electrical output is directly proportion to the force being applied. Load cells have strain gauge, which deforms when pressure is applied on it. And then strain gauge generates electrical signal on deformation as its effective resistance changes on deformation. A load cell usually consists of four strain gauges in a Wheatstone bridge configuration. Load cell comes in various ranges like 5kg, 10kg, 100kg and more, here we have used Load cell, which can weight upto 200kg.



Now the electrical signals generated by Load cell is in few millivolts, so they need to be further amplify by some amplifier and hence HX711 Weighing Sensor comes into picture. **HX711 Weighing Sensor Module** has HX711 chip, which is a 24 high precision A/D converter (Analog to digital converter). HX711 has two analog input channels and we can get gain up to128 by programming these channels. **So HX711 module amplifies the low electric output** of Load cells and then this amplified & digitally converted signal is fed into the Arduino to derive the weight.

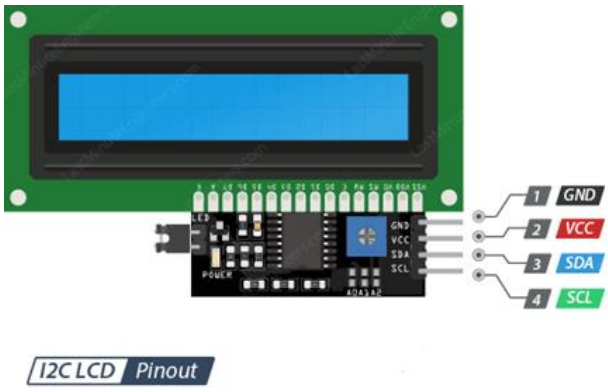


Load cell is connected with HX711 Load cell Amplifier using four wires. These four wires are Red, Black, White and Green/Blue. There may be slight variation in colors of wires from module to module. Below the connection details and diagram:

- RED Wire is connected to E+
- BLACK Wire is connected to E-
- WHITE Wire is connected to A-
- GREEN Wire is connected to A+

LCD Display;

An I2C LCD has only 4 pins that connect it to the outside world. The connections are as follows:



GND is a ground pin. Connect it to the ground of the Arduino.

VCC supplies power to the module and LCD. Connect it to the Arduino's 5V output or an external 5V power supply.

SDA is the I2C data pin. Connect it to the Arduino's I2C data pin.

III WORKING PRINCIPLE

This project consists of

1) Electronic control system
2) Pneumatic actuator unit

In this project ARDUINO microcontroller chip used as main processor, One number of weighing sensor (loadcell) is connected to microcontroller through the port 4,5 via HX711 Module ,When the sensor unit sends the signal to the controller . The control circuit is used to activate the solenoid valve. If the solenoid valve is activated, the compressed air passes to the Pneumatic Cylinder. The compressed air activates the pneumatic cylinder and returns the piston rod.

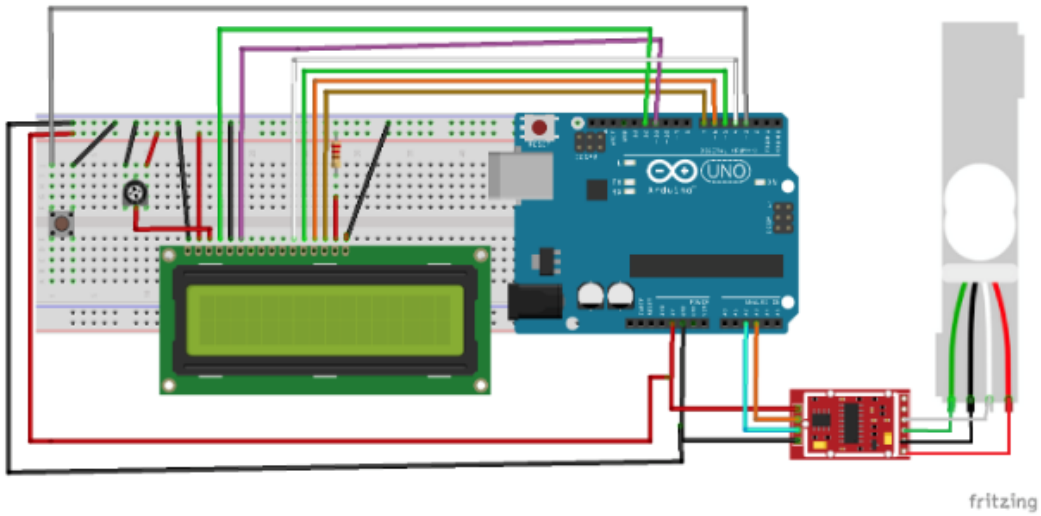
If the piston moves return, then the brake lock arrangement deactivated. The compressed air is drawn from the compressor in our project. The compressed air is flow through the Polyurethane tube.

2) Pneumatic actuator unit

This control system monitors the sensor signal and the control the 5/2 way solenoid operated directional control valve which in turn operate the double acting cylinder. This air cylinder piston pushes the bumper.

Circuit Explanation:

Connections for this project are easy and schematic is given below. . HX711 Module's DT and SCK pins are directly connected with Arduino's pin A0 and A1. Load cell connections with HX711 module are already explained earlier and also shown in the below circuit diagram.



In this project, we have used **Arduino** to control whole the process. **Load cell** senses the weight and supplies a electrical analog voltage to **HX711 Load Amplifier Module**. HX711 is a 24bit ADC, which amplifies and digitally converts the Load cell output. Then this amplified value is fed to the Arduino. Now Arduino calculate the output of HX711 and converts that into the weight values in kilograms. When weight exceeds the set value, the controller deactivates the brake lock by energizing solenoid valve which allows the air to the cylinder in order to release the brake lock.

IV .ADVANTAGES

A. The cost of this system is much lower than the similar systems used in high end cars which use electronic controllers which are way more expensive than this system.
B. If a driver is not confident on climbing a hill in stop and go conditions then he may use the system and find it very easy to park as well as start ascending on the hill.
C. Use of various sensors like proximity sensors make it is very easy to operate and modify the system. Increasing number of sensors in various different places can help and improve this system by engaging the handbrake and disengaging it in different conditions.
D. Number of sensors used can be reduced to reduce cost and the engaging and disengaging may be done for minimum conditions.
E. Manual interaction regarding the handbrake is completely reduced causing almost no error in operation of the handbrake.
F. Very fast engagement and disengagement as possible and there is no lag in operation of the handbrake.

DISADVANTAGES

A. In case of failure of Pneumatic system the whole hand brake system would fail.
B. Pneumatic system needs compressor which will consume power thus reducing the efficiency of the car overall
C. For manual override of the handbrake brake system buttons need to be provided which will increase the overall cost of the system
D. It is difficult to retrofit it to a current existing car model.
E. Use of sensors means the load created on the battery will be more.
F. In case of leakage in the pneumatic cylinder the handbrake mate disengage and the vehicle me start moving if it is parked on slope.

V. CONCLUSION;

Thus the use of conventional hand brake system can be eliminated using this system and the error occurring due to operator can be eliminated completely.

It can clearly be seen that this system is completely full proof and we may use this system in automobiles even in the lower price range as this system is not extremely expensive.

This can even allow using the system in high end cars instead of the expensive electronically controlled system they use for automatic parking brakes to reduce the overall cost of the vehicle.

Use of Pneumatic system allows fast engagement and disengagement of the handbrake and it makes the vehicles safer.

By using the system we have reduced the manual load on the operator and eliminated the error that operator may induce while operating the system

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