KAUNAS UNIVERSITY OF TECHNOLOGY

FACULTY OF MECHANICAL ENGINEERING AND DESIGN

Smith Rathinaraj

DESIGN OF AUTOMATIC SAFETY PLATFORM

Master's Degree Final Project

Supervisor

Prof. Dr. Inga Skiedraite

KAUNAS, 2017

KAUNAS UNIVERSITY OF TECHNOLOGY

FACULTY OF MECHANICAL ENGINEERING AND DESIGN

"Design of Automatic Safety Platform"

Master's Degree Final Project

MECHATRONIC ENGINERRING (621H73001)

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(Title of study programme, code)

"Design of Automatic Safety Platform"

Final project

DECLARATION OF ACADEMIC INTEGRITY

8 June 2017

Kaunas

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Head of Production engineering Department

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MASTER STUDIES FINAL PROJECT TASK ASSIGNMENT
Study programme MECHATRONICS

The final project of Master studies to gain the master qualification degree, is research or applied type project, for completion and defence of which 30 credits are assigned. The final project of the student must demonstrate the deepened and enlarged knowledge acquired in the main studies, also gained skills to formulate and solve an actual problem having limited and (or) contradictory information, independently conduct scientific or applied analysis and properly interpret data. By completing and defending the final project Master studies student must demonstrate the creativity, ability to apply fundamental knowledge, understanding of social and commercial environment, Legal Acts and financial possibilities, show the information search skills, ability to carry out the qualified analysis, use numerical methods, applied software, common information technologies and correct language, ability to formulate proper conclusions.

1. Title of the Project

Design of Automatic Safety Platform / Automatinės saugios platformos kūrimas

2. Aim of the project

The main aim of this study is to analyze the train safety systems for passenger and implement the better safety system for passengers while they boarding over the train

3. Tasks of the project

1) To design the Automatic safety platform device and assemble all designed parts
2) Design the circuit for operating a motor and get an output of motor drive direction
3) Calculate the stress analysis for slider
4) To Design the transmitter and receiver circuit and make a demo model of ASP system

4. Specific Requirements

The ASP slider have 900mm length it will cover the 609.8mm space in-between platform and rail car

5. This task assignment is an integral part of the final project.

6. Project submission deadline: 2017 June 8^{th}.

Task Assignment received

(Name, Surname of the Student) (Signature, date)

Supervisor

(Position, Name, Surname) (Signature, date)

Smith Rathinaraj. **“Design of Automatic Safety Platform”.** Master's Final Project / supervisor Prof. Dr. Inga Skiedraite; Faculty of Mechanical Engineering and Design, Kaunas University of Technology.

Study field and area: Manufacturing and production Engineering, Technological Sciences

Keywords: automatic safety platform; trains; control of ASP

Kaunas, 2017. 51 p.

SUMMARY

The main aim of this project is to design a safety system for passengers to board and alight the train. Automatic safety platform system (ASP) is introducted in this project which will cover the gap in between train plaform and rail car. This system will be appropriate for all type of train cars and platforms.

The Automatic safety platform will fixed near the train door and it will cover the space between platform and train car automatically. TXHT12E transmitter circuit and TXHT12D receiver circuit is using for sensor part of this system. Microcontroller ATMEGA 328p is involved in this system for making this system automatic and Controlling the all mechinacal and electrical part operation.

Mechanical parts of this systems are enclosure,slider,rack and gear. Encloser is used for protect the all electrical and mechanical components of this system. Slider which is used for passengers board and alight the train and this slider will cover the sapce between platform and train. Slider will withstood upto 500 Mpa pressure. Rack and gear is fixed with the slider for operating the movement of slider operation.

Smith Rathinaraj. Automatinės saugios platformos kūrimas. Magistro baigiamasis projektas / vadovas doc. dr. Inga Skiedraitė; Kauno technologijos universitetas, Mechanikos inžinerijos ir dizaino fakultetas.

Mokslo kryptis ir sritis: Gamybos inžinerija, Technologiniai mokslai.

Reikšminiai žodžiai: automattinė saugi platforma; traukiniai; ASP valdymas.

Kaunas, 2017. 51 p.

SANTRAUKA

Pagrindinis šio projekto tikslas yra sukurti saugią sistemą keleiviams įlipti ir išlipti iš traukinio. Automatinė saugios platforma sistema (ASP) yra aprašoma šiame projekte, ši sistema uždengs tarpą tarp traukinių platformos ir vagono. Ši sistema tinkama visokiausių tipų traukinių vagonams ir platformoms.

Automatinė saugi platforma bus tvirtinama prie traukinio durų ir veikdama automatiškai padengs tarpą tarp platformos ir traukinio vagono. Šios sistemos kontrolei bus naudojamas TXHT12E siųstuvas ir TXHT12D imtuvas. Mikrovaldiklis ATMEGA 328p šioje sistemoje atsakingas, kad projektuojama sistema automatiškai veiktų ir valdytų visas mechaninių ir elektrinių dalių veikimą.

Mechaninės dalys šios sistemos yra korpusas, slankiklį, laikiklis ir pavara. Korpusas skirtas apsaugoti visas elektrines ir mechanines dalis kuriamos sistemos. Slankiklį naudojamas keleiviams įlipti arba išlipti iš traukinio ir jis skirtas uždengti tarpą tarp platformos ir traukinio. Šliaužiklis atlaiko net iki 500Mpa spausimą. Laikiklis ir pavara yra fiksuoti kartu su slankikliu užtikrinant slankiklio judėjimą.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

A section of pathway in the train station is called as railway platform or train station platform on which passengers might board and alight the train. Most of the accidents occur in between the platform and the train while passenger's board or alight the train. The accident happens frequently because passengers fall in between the platform and train and getting stuck between the doors [1] because there is a gap in between platforms and the train car.

Since these days rail doors have been a gradual development. There are two types of rail car exist which are automotive railcar door system and hand-operated door panels linking carriages. Some types of automated door are Pneumatic control using door operating system and push button using door operating system.

Automatic Safety Platform (ASP) is one of the Mechatronic safety systems which is introduced in this project. This system will be designed for passenger comfort and safety while passengers board and alight the train. The ASP safety system will appropriate for both automated doors and hand operated. The ASP systems consist of sensors, actuators, and microprocessor which are integrated as one system.

The purpose of this prototype enhances the comfort and safety of the passenger who uses the train as the main mode of transport. ASP device will cover the gap in-between train car the platform thus preventing the passenger from not getting injured on the train track. This method will cover the gap between platforms and train by using an ASP slider.

The main aim of this thesis is to analyze the train safety systems for passenger and implement the better safety system for passengers boarding and alight from the train.

The tasks of work are

1. To design the Automatic safety platform device
2. To design the control algorithm and control circuit
3. To calculate the stress analysis for slider
4. To design the transmitter and receiver circuit and make a demo model of ASP system

1. REVIEW OF TRAIN DOORS AND PLATFORM

Some of the rail station platforms classified by three types which are Bay platform, side platform and Island platform. A bay platform is consist of one track on the bay and each sides of platform covered on the one track. Passengers can board and alight on each sides of the platform in one rail car. Island platform is also known as center platform which is one platform positioned in between two tracks. This type of platform used in hill station and rural areas. Side platform is referred as two train positioned next by next and platforms are positioned one side to the train car. Passenger can alight or boarding in one side.

1.1. TRAIN STATION PLATFORM AND ITS SAFETY

The platforms are differentiate in several types each platform has a variable size and heights on the platform. Passengers might collide each other while boarding or getting down on the train, this may result in several injuries for the passengers. These collisions are occurred because of the gap normally 609.8 mm in-between platforms and the train car [1]. Figure 1 shows there is no safety system for cover the gap in between railway platform and train car.

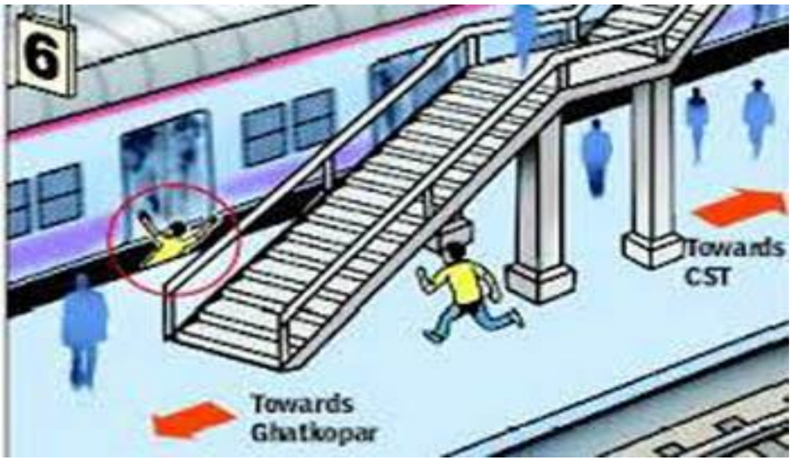

Fig. 1. Side Platform without safety device [2]

1.2 NON-AUTOMOTIVE RAILCAR DOOR SYSTEM

This system is operated manually while the passenger can open and close the door by hand, the door will open at 75 degrees of forward and backward normally. Approximate length of the door is 900mm and is operated in locomotive rails. From the Fig.2 is represents train steps placed under the door.

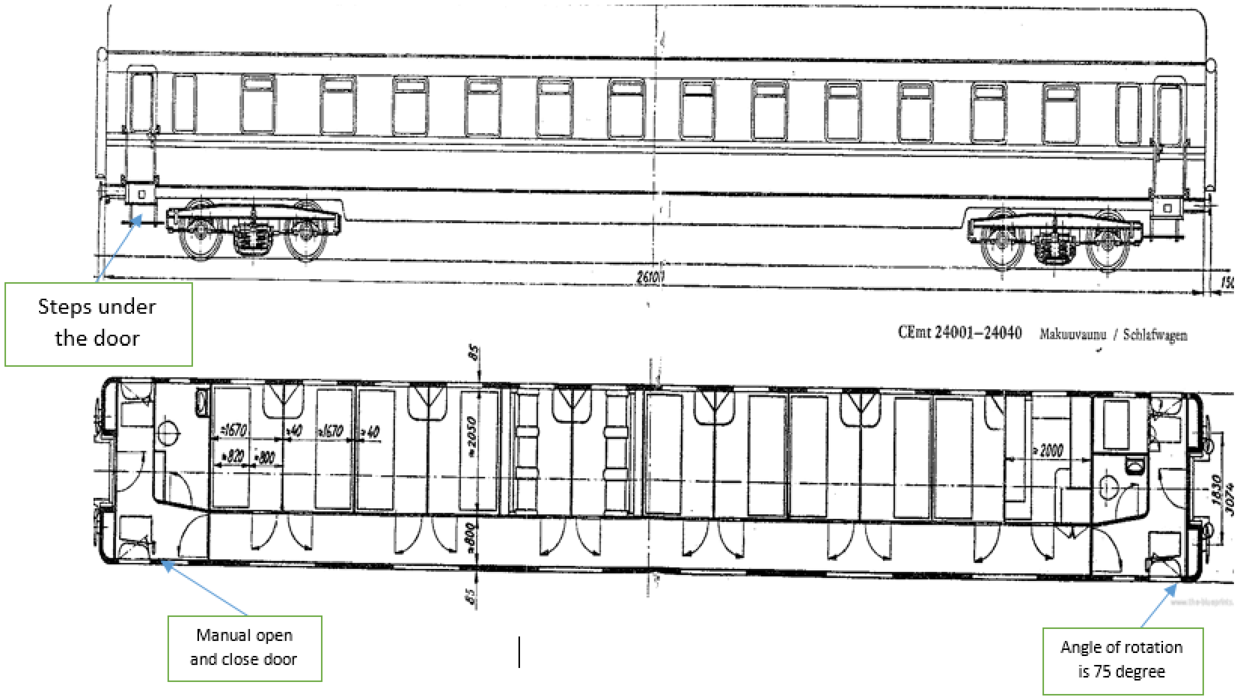

Fig. 2 Manual Door Control [3]

1.3 AUTOMOTIVE DOOR CONTROL

The Automotive door control system rail car door is closed automatically by dragging the doors using the movable base tracker. The movable base is coupled to a drive system configured to translate to the movable base [4]. Close and open automotive doors are working as a conveyor type method but with a movable tracker implemented controlling the movement of the door. The Fig.3 represents movement of automotive door with movable track.

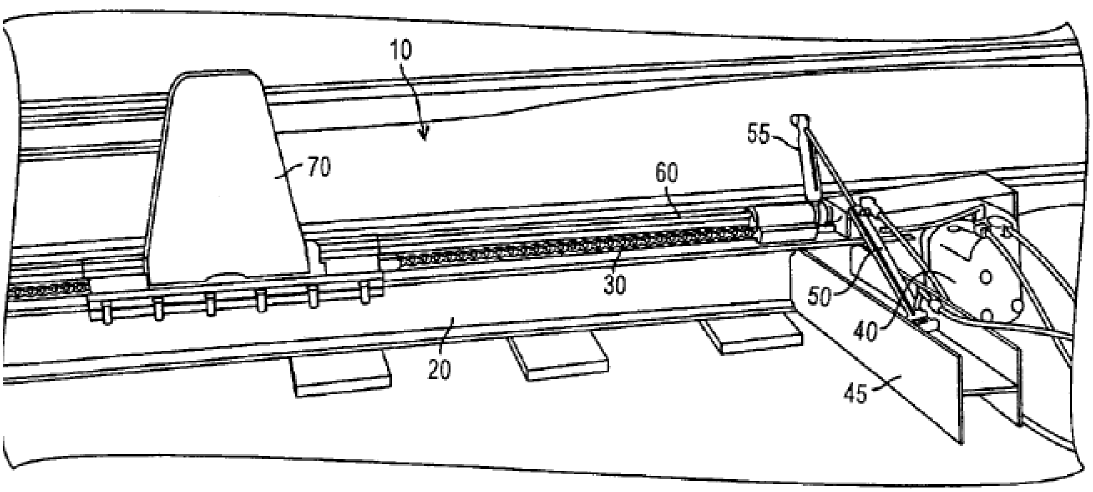

Fig. 3 Automatic Door Method [4]

Tracking movement is moving step by step from the door starting point to the ending point in the various level to reach the maximum point is calculated when the train enters into the platform. Drive chain is attached to the underside of the rail car door is mentioned in Fig.4.

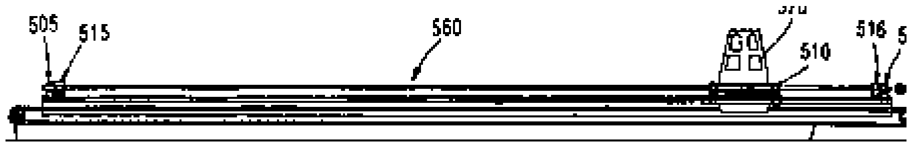

Fig. 4. Attachment with Drive Chain [5]

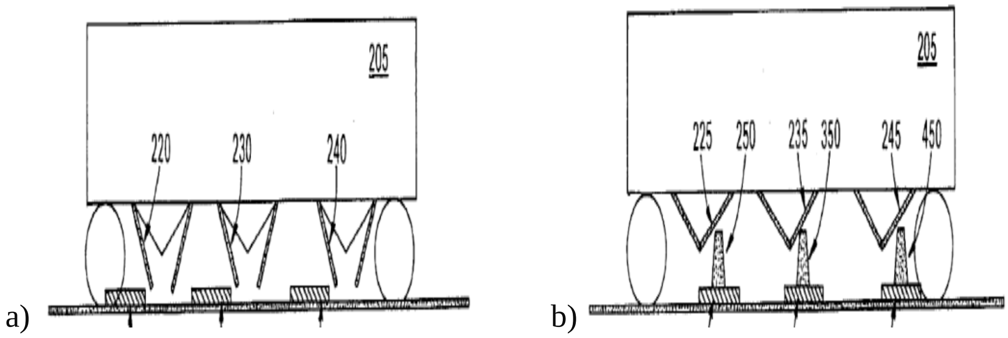

Fig. 5. Door closing: a) towards right side and b) door is in closed position [5]

From the Fig.5a represents the rail car door is linearly translated to its rightward direction (i.e.) door movement to rightward direction. When the position of the door is closed by imparting the linear translation force, the rail car door should act through the respective rotatable membrane. The Fig.4b which represents the automated door is closed. when passengers boarding or alight from the train.

2. POWER SUPPLY IN RAIL CARS

Rail power supply is one of the main .requirement for passenger usage in the railcar. The power supply is directly getting an energy from the train itself. Therefore three power supply systems are existing to provide a passenger for illumination, fan, air-conditioning and other miscellaneous. Power generation classified by three types of rail cars are self-generation technique, end on generation technique and head on generation technique [4]. In this Fig.5 shows that classification of three types of power generation technique available in rail car.

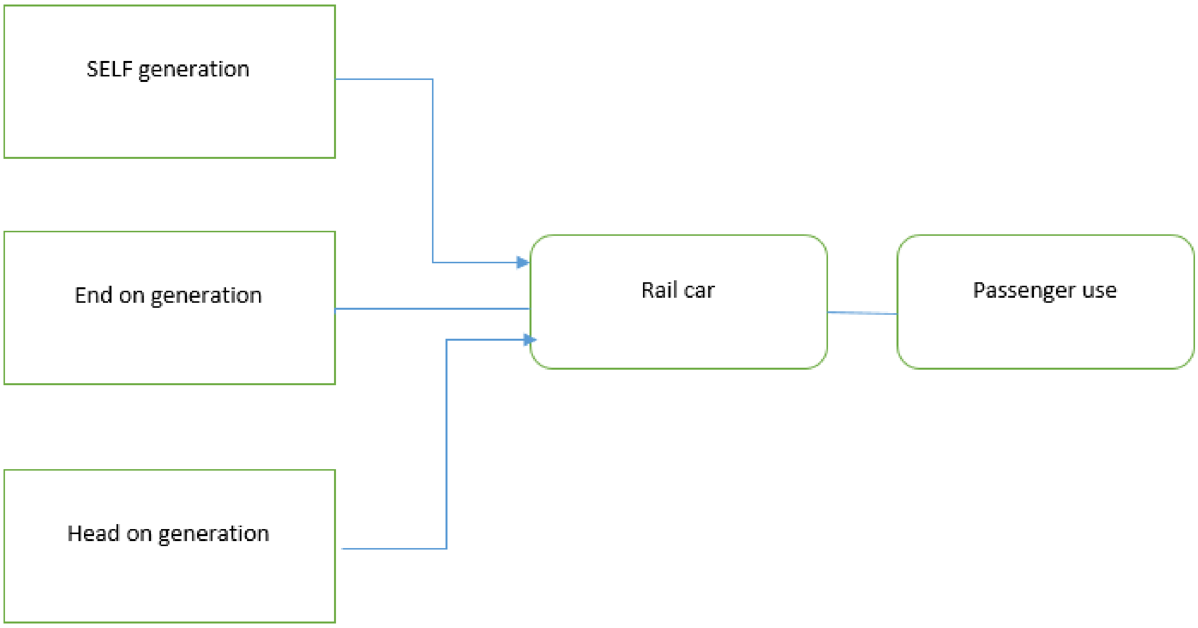

Fig.6. Classification of Power supply

SELF-GENERATION

The alternator which is coupled with directly to the coach wheel through a pulley belt driver is shown in the (Fig. 6).

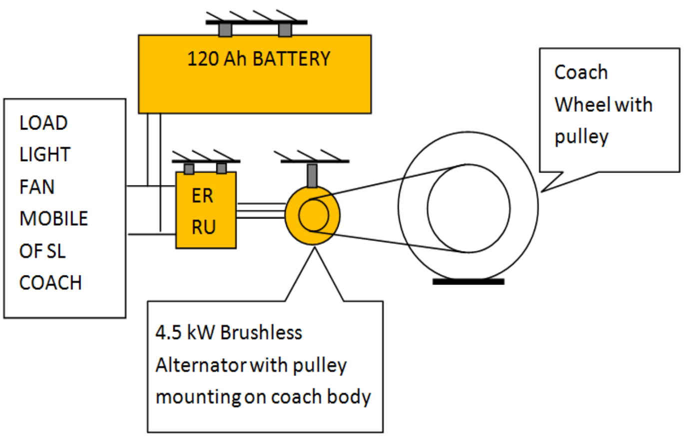

Fig.7. Self-generation in rail car [6]

Brushless alternator has slotted with rotor field and three phase winding housed on the stator. Because of the residual magnetic field (RMF) and variable reluctance, three phase voltage is induced [6].when the voltage is rectified by voltage rectifier and fed in to the field winding at this process time the full voltage is generated. Then the rectifier converts AC to DC and Regulating Unit (ERRU) is used to convert three phase power into regulated DC 120V output [4]. The 120 voltage is stored in DC battery and supplies to the rail car. From fig.6 which represents that self-power generation in rail cars.

END ON GENERATION

The end on generation which provides a power supply in every coach has two DG sets capacity of watts 750KW in every rail car with 100% spare capacity. The three phase AC power is supplied at 750V to all coaches through 2 no's of parallel inter-vehicle coupler [7]

HEAD ON GENERATION

In this generation power has tapped from the locomotive and fetch to the train through every inter coach coupler. The features in this system support higher load up to 24 coach train (mix of SL and AC) is around 250kW and 21 all-AC coach train is around 1000kW [6].To convert single phase into three phases 2x500kVA inverter is provided on Electric Locomotive [8].

3. DESIGN OF PROPOSED ASP DEVICE

The Proposal method of ASP device is mainly designed for passenger comfort and safety while passenger boarding the train from railway platform. This system will work for all types of rail cars. That means it will work in automotive railcar door system and hand-operated rail car door system. The power source for operating the Asp device is driven from the self-generation method from a rail car. Manual operated rail door system and ASP device socked are designed shown in the Fig.8. The Asp system will fix inside the socket, when the train reaches the station ASP slider will open with the help of motor rotation and slider will close after the train departs from the station.

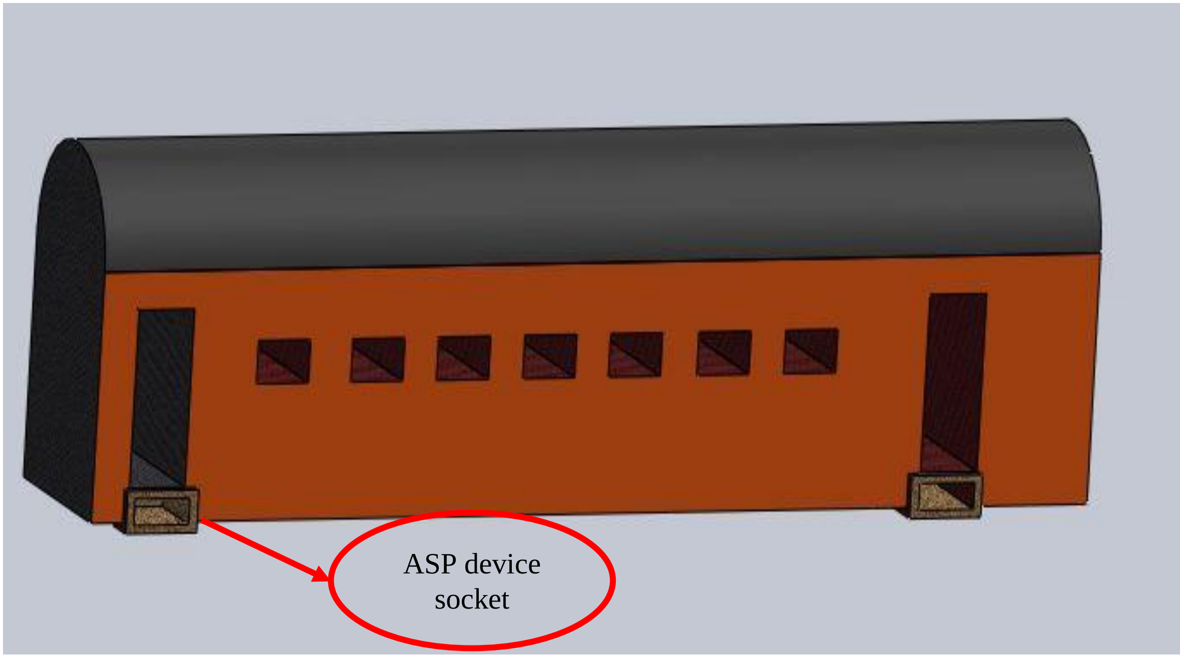

Fig.8. Train car with ASP socket

Under the rail car door, the ASP device will be fixed inside the socket for hand operated door compartment. The material of ASP device is light weight, strongest and cheapest. The physical material of aluminum is used for making a body of the enclosure and stainless steel is used for constructing a slider body. The ceramic material is additionally used for slider gripper and slider safety curve gripper (Appendix 1). Synchronous Dc motor which is mainly treated for operating the ASP slider forward and reverse.

3.1. MECHANICAL PARTS OF ASP SYSTEM

To build an ASP device requires a several mechanical parts. For making a enclose body requires a 2000 series of 2014 aluminum steel, ASP slider which is made up of AISI 304 stainless steel, racks and gear which is made by using AISI 304 stainless steel and the slider gripper which is made by using ceramic material. In this Fig.9 shows that over view of mechanical parts (Appendix 2).

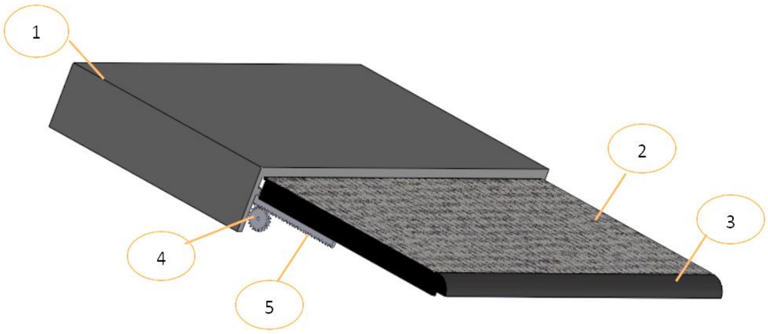

Fig .9. ASP device mechanical parts are: 1 - aluminum enclosure, 2 - Ceramic gripper 3 - Ceramic curve end 4-Gear, 5- Rack

3.2 ENCLOSURE AND FIXING PART

The enclosure which is used for protect mechanical parts and make position for placing the components. Enclosure is made up of aluminum steel and the total length of the enclosure is 2500 mm. It can cover all the type of train like automated train car type and non-automated train car type where the height of enclosure is 304.6mm.

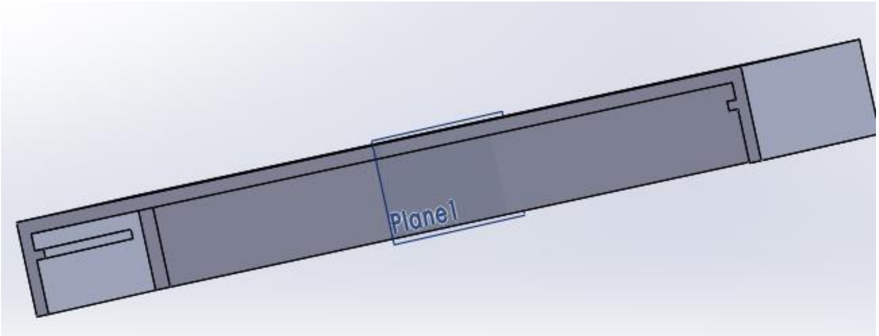

Fig.10. Enclosure with balancing bit

The Fig.10 represents the front view of the enclosure. The open space will be fixed by the slider which is used for the passenger can alight from the train car.

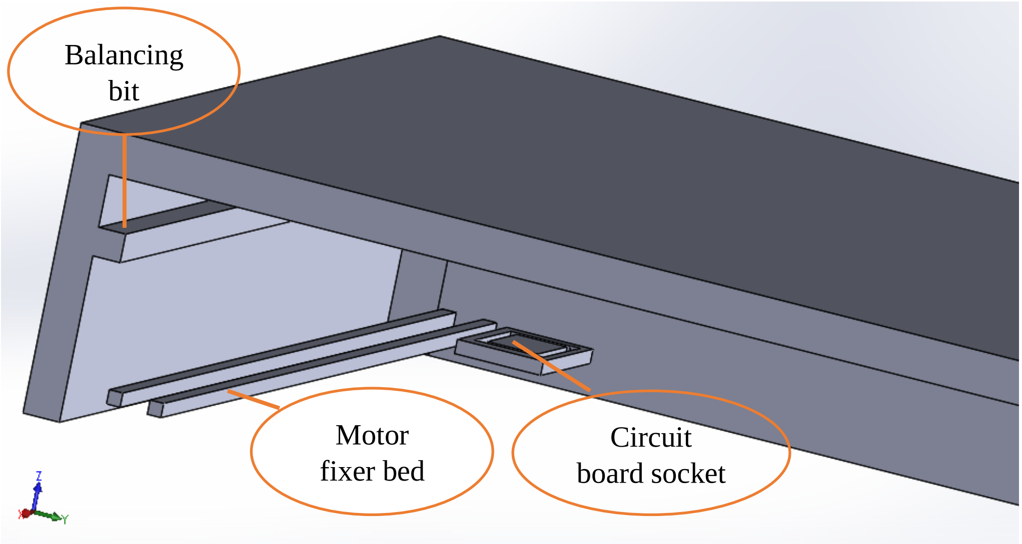

Fig.11. Enclosure with motor socket and circuit board socket

The Fig.11 represents the enclosure with motor socket and circuit board socket for placing a circuit boards and motor. The 10mm breadth balancing bit is used for balancing the slider and slider can move freely. Here 900mm length and 15 mm thickness of the motor bed is used for fixing the motor. Circuit board will place on the 100x100mm circuit board socket.

3.3 ASP FOOT SLIDER

This foot slider plays a major role in the system, it can help the passenger for boarding and alight from the train. The length of the slider is 1218mm, breadth of the slider is 918mm and thickness of the plate is 10 mm. The thickness of Ceramic gripper is 7mm and ceramic safety curve end is 70mm. Foot slider diagram and dimension are shown in the Fig.12

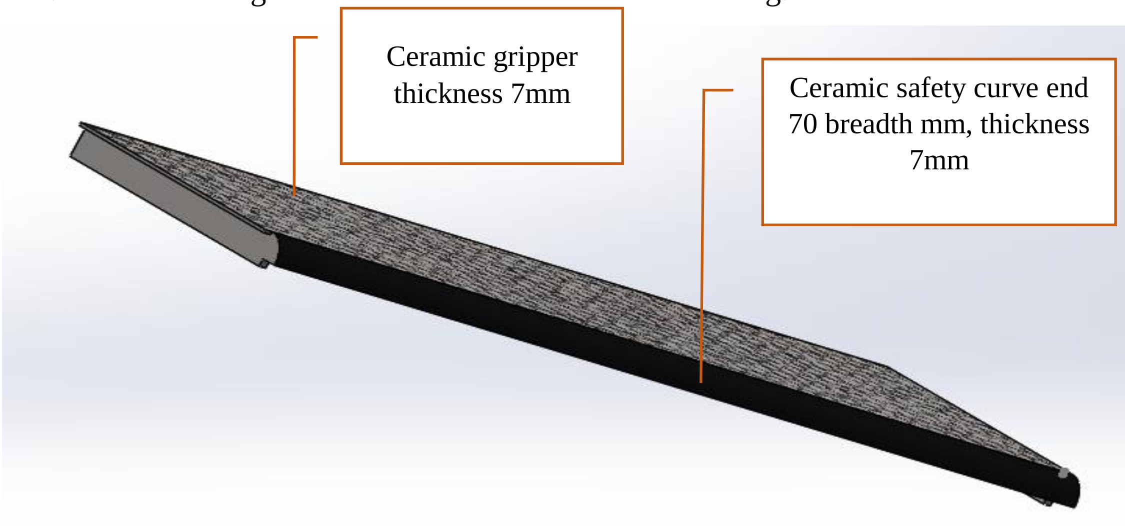

Fig.12. ASP foot slider

3.4 RACK AND GEAR

Rack and gear system is the heart of slider and the motor and gear system is connected to the slider. Here the thickness of rack and gear is 14mm and length of the rack is 919.4mm which is corresponding to the enclosure bottom fixture.

Calculation for angular velocity [26]:

$$\omega = \frac{\theta}{t} \tag{1}$$

Where ω-angular velocity, Position of gear angle =θ, Time per sec = t, Rpm=1500

Hence angular velocity of degree in one rotation

$$\omega = \frac{360\ X\ 1500}{60} = 9000\ \mathrm{deg/sec}$$

Calculation of angular velocity in radian per sec [26]

$$\omega = 2\pi \frac{\boldsymbol{Rpm}}{\boldsymbol{t}} \tag{2}$$

Where Radian per sec =2π, Angular velocity =ω`

$$\omega = \frac{2\ \pi X\ 1500}{60} = 157\ \mathrm{rad/sec}$$

Linear Velocity of slider movement from gear [26]

$$v = \omega \times r \tag{3}$$

Where Linear velocity =L, Angular velocity =ω**,** Radius of circular path = r

V= 7916.81 KMph

The calculation of motor angle and gear angle is fixed at the same degrees, where the rotation of angle is proven by the speed of motor Rpm. The slider will reach the train station platform with in one sec and hence it is proved by the calculation of angular velocity and linear velocity.

3.5 ASSEMBLY OF ASP PARTS

Asp system circuit boards *7* are placed inside the aluminum encloser and the rack and gear have fixed on the left side as shown in below diagram. In order to produce grip for the passenger the Ceramic material is placed up on the slider which is mentioned in gray color of the slider surface.When ASP deploy the slider ,the curved end of the slider body which is made up of ceramic is mainly used to not get hurt while passengers boarding or alight from the train. The motor is fixed with the gear is represented in the black color which is shown in the given fig.10. The red color board is mentioned as a circuit board scocket. The assembly of Automatic Safety Platform (ASP) shown in the Fig.13.

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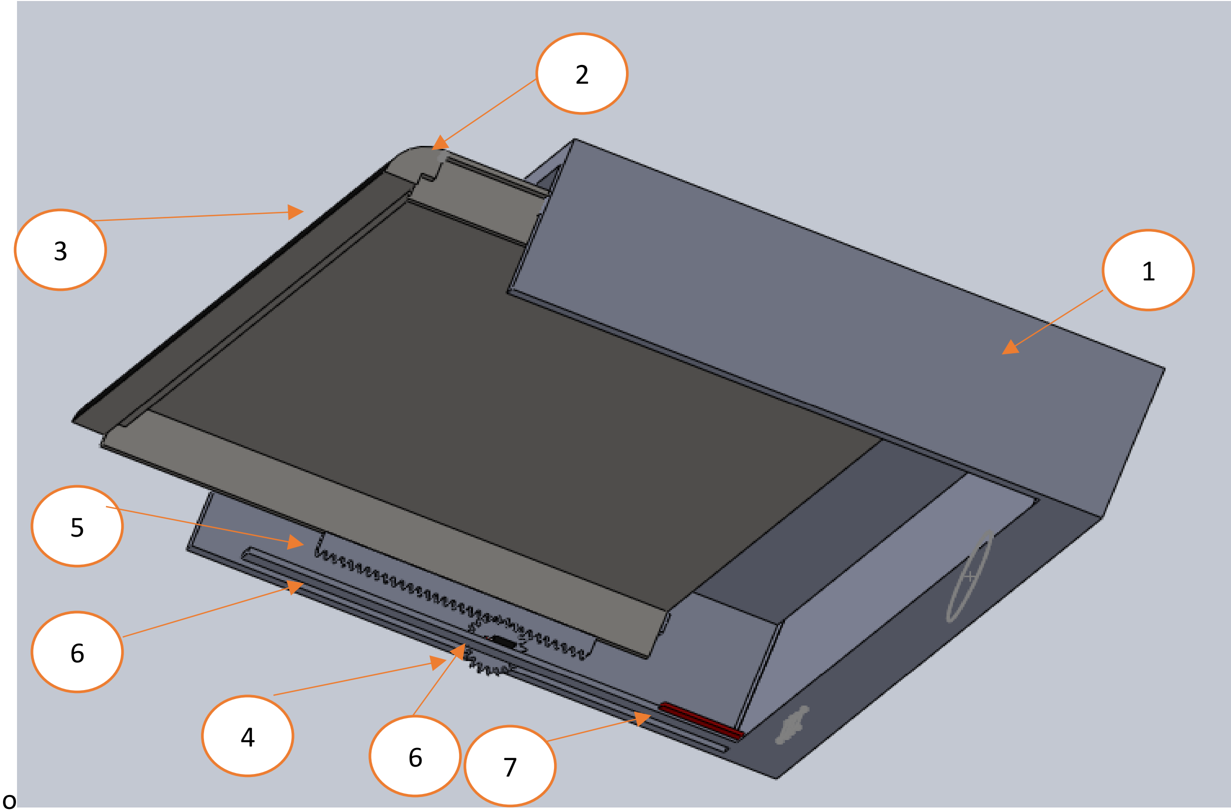

Fig.13. Full assembly of ASP kit

Dimension of ASP parts

1. Aluminum Enclosure length 2500mm,breadth 1219mm,height 304.8mm.
2. Slider length 1218mm, breadth 918mm, thickness 10mm and gripper thickness 7mm, length of the gripper is 2410 and breadth which is 250mm.
3. Ceramic curve end thickness is 7 mm and angle is 35 degree.
4. Thickness of gear is 14 mm.
5. Thickness of the rack is 14mm and length of the rack is 919.4mm.
6. Motor fixable bed length is 900mm and thickness 15mm.
7. Circuit board socket length is 100mm, breadth is 100 mm and thickness is 15mm.

3.6 CALCULATION OF MOTOR SPEED

The ASP system can operate by using a Synchronous Dc motor with 1500 rpm which is enough to deploy the APS system while train enters the platform

Table 1 Motor units

No	Units	Oberavation
1	RPM sync	Synchronous speed
2	Fq	Frequency (per cycle /per sec)
3	P	Poles of motor

The motor required voltage is 110V which is driven from the self-generation technology of compartment in the train. This four pole motor operating frequency is 50 Hz which should be enough to run the motor.

$$RPM\ sync = \frac{120 \times \mathrm{Fq}}{\mathrm{P}} \tag{4}$$

$$RPM\ sync = \frac{120 \times 50}{4}$$

$$RPM\ sync = \frac{6000}{4}$$

$RPM\ sync$ =1500

3.7 CALCULATION FOR NORMAL STRESS IN SLIDER PLATE

Normal stress

$$\sigma = Fn/A \tag{5}$$

where σ = normal stress ((Pa) N/m^2, psi), F_n = normal component force (N, lb_f), A = area (m^2, in^2)

There fore

$$\sigma = 4.471X10^{-5}$$

Displacement of the slider

Where Length Lx = 2419mm, Width Ly = 260mm, Thickness h = 10mm, Young's modulus E = 195,000 mpa

$$w_{max} = w\left(\frac{L_x}{2}, \frac{L_y}{2}\right) = c_1 \frac{P^{min}(L_X, L_y)^4}{E_h^3} \tag{6}$$

Where Wmax = 39mm

Stress of the slider in bending moment

$$w_{max} = w\left(\frac{L_x}{2}, \frac{L_y}{2}\right) = c_1 \frac{P^{min}(L_X, L_y)^4}{E_h^3} \tag{7}$$

σ_{max} = 500MPa

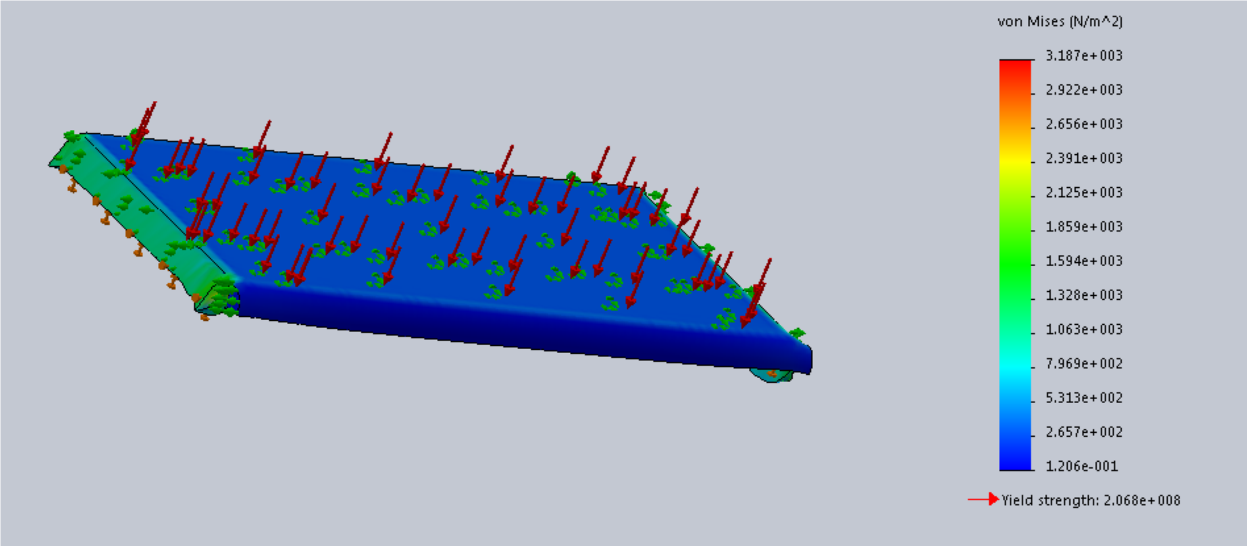

Fig.14. Stress analysis load up to 500Mpa

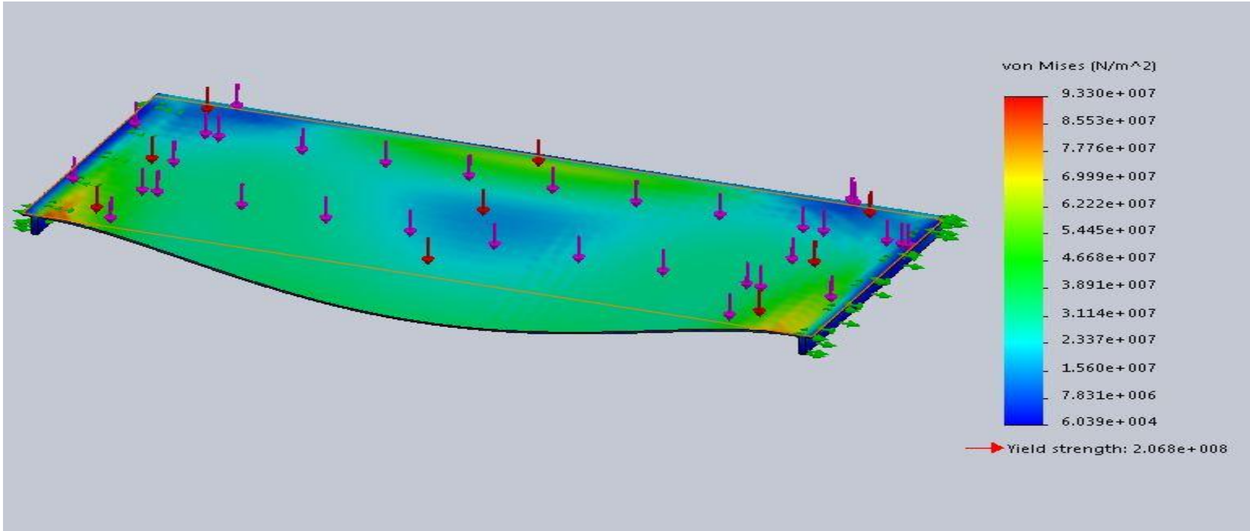

Fig.15. Stress analysis load more than 2000Mpa

Calculation of the stress which is applied to AISI 304 stainless steel slider can with stand until 500Mpa it shows in the Fig.14. Where Fig.15 which represents that maximum bending moment of the slider is around 2000mpa. The strength is comparatively four times better than other steel where young's modulus ratio is up to 195000 Mpa. This material is more than enough for the passenger safety.

4. CONTROL SYSTEM AND ALGORTHIM

Control board is the main part of this system. By using an AT8MEGA 328P microcontroller and relay controller, the mechanical operation takes place in the motor movement. RF signal operation performs in base station transmitter and ASP system receiver controls the operation by using TXHT12E transmitter board and TXHT12D receiver board. Control system algorithms steps are detailed below.

4.1 CONTROL ALGORITHM

The algorithm which represents the control system operation is shown the Fig.16 and the steps are:

Step 1

Start the process. Pop the signal from the base station.

Step 2

Read the receiving signal using the transmitter.

Step 3

The transmitter will send a signal to the receiver, the receiver will send a signal to the microcontroller, micro controller will enable input from pin no 2.

Step 4

The motor rotates forward when the signal from pin no 2 reaches to pin no 8.

Step 5

Wait for the Passenger to board the train.

Step 6

The output pin no 8 will be low when the motor rotates off.

Step 7

Wait for the train door to close after passenger boards the train.

Step 8

When the motor rotates reverse the output pin no.8 is high.

Step 9

The routine operation checks the loop from RF signal receiver.

Step 10

When the opeartion stops there is no power supply for ASP Microcontroller.

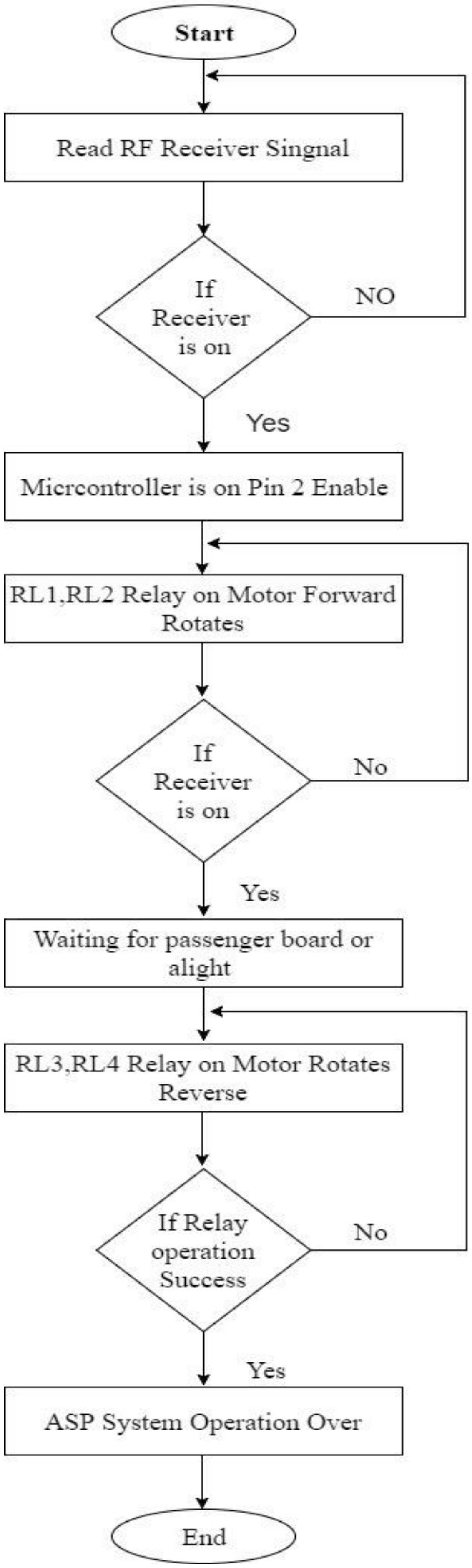

Fig.16. algorithm of control system

4.2 CIRCUIT CONTROL OPERATION

When the input signal is given from the base station to the train, so that the train should stop in the platform or run in the track as decided by the train control station. The train will stop in the planned station when the input signal from the base station is sent via the transmitter to the train. When the receiver is placed on the train, the Transmitter sends RF signal to the receiver which receives the signal and gives input to the ASP control board. The transmitter operation is performed in the base station and Receiver operation is performed in the ASP device. When the ASP device receives the signal from the transmitter after that ASP device will automatically deploy the slider.ASP device can also be operated manually. Control board maintain the whole operation of ASP Mechanical movement and sensor control.

Input and Power Supply Control

When ASP device is introduced, it requires a very low power consumption for every component inside the control board. The requirement of power supply and its components are given below.

Table 2 Power supply requirement

No	Components and devices	Power supply Required
1	Transmitter board	Needs 9V for total operation
2	Receiver board	Requires 9V for give input to Microcontroller
3	Microcontroller	5V is enough to give a command for all electronic and mechanical movement
4	Relay control	Requires a 12V Dc for drive the motor
5	Synchronous Motor	Requires 110V DC power supply

The main source of the power supply is elicited from train self-generation method which is one of the three modes of the generator. These are elongated in rail car power generation. The control board operation and mechanical movement are enough to use a self-generation method. It is very reliable and can generate power supply of 120V externally. The DC voltage is stored in battery and supplies to the rail car.

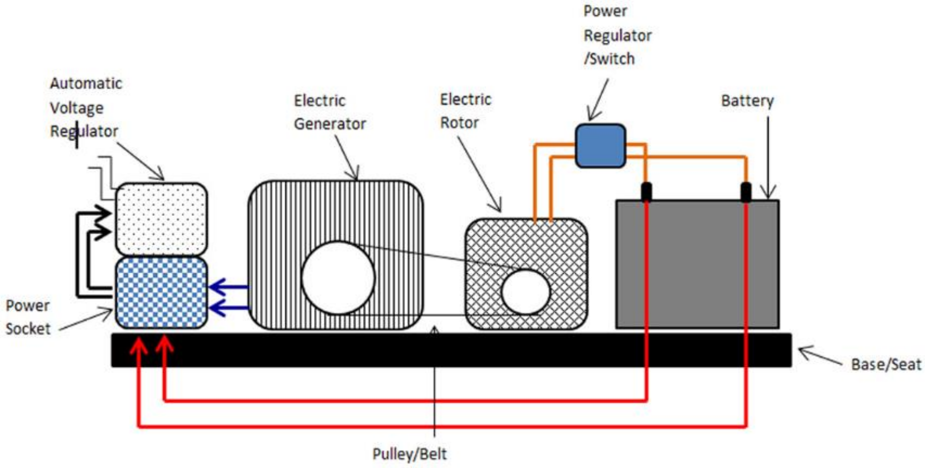

Fig.17. Self generation to load battery [6]

The alternator is coupled directly to the coach wheel through a pulley belt driver and the electrical rotor is connected to the battery through power regulator switch. The power regulator is used to start and regulate the speed of the rotor. The battery which is connected to the power socket takes power from the power socket to charge the battery and continuous spin for the rotor. The output power supply from battery gives power supply to ASP circuit controller and activates the microcontroller and split the power supply for electrical and mechanical movement. From the Fig.17 which represents self-generation power supply will give input for motor operation and RF control boards.

Transmitter Board Operation

The communication between platform and train is HT12E transmitter and receiver operates voltage from 2.2V to 12V. It has 38 KHZ carrier output for simulation of this circuit for operating maximum voltage up to 9V which is enough to transmit the signal to receiver end [9]. The 1cm lengths of wire on both ends is comprised for testing the antennas. When separated by 3 meters indoor and outdoor there is no fault which is tested and proved by real time simulation of this thesis. By increasing the wire of antenna, inches by inches or centimeter the ranges will increase depends up on the height of the antenna which is digitally called as an encoder.

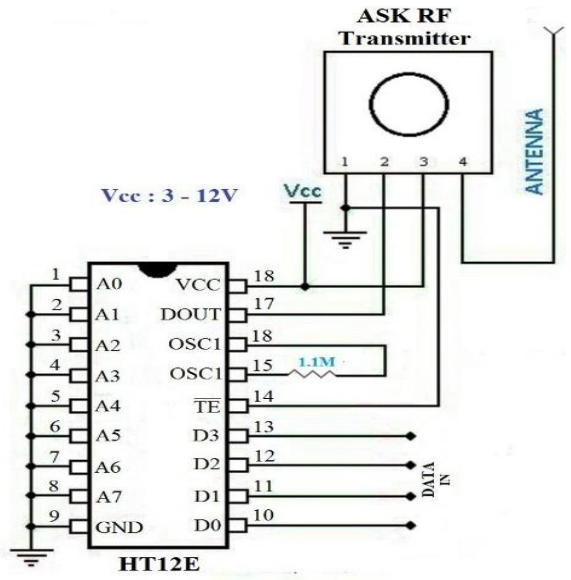

Fig.18. HT 12E Transmitter circuit [9]

The HT12E transmitter or encoder circuit sends the data which will be parallel to give a signal to D0-D3 that is called data output. Give a power supply as an input for 18th pin VCC up to 3V to 12V [9]. Here 9V maximum power supply is enough to get the output as a serial data which is given to Amplitude shift keying (ASK modulator) RF Transmitter [9]. Where A0 – A7 called as Address inputs which can be used to provide data security and it connected to GND which is the negative power supply of 12 V. It should be connected to the ground digitally (Logic ZERO).In this Address pins A0-A7 should match with receiver side address pins A0-A7 for transmission of the signal. Signal will be transmitted only when the Transmit Enable pin (TE) is digitally low which is called zero [10] . The frequency of transmitter need a 433MHZ and also the frequency of receiver side needs the same 433 MHZ for signal communication medium [9]. It operates voltage of 9V and it proved by practically by using proteous ISIS .HT 12E Transmitter circuit operation schematic is shows the Fig.18.

Receiver Board Operation

The HT12D circuit is used for the receiver end. The operating voltage of receiver board is 2.2V to 12V which has 38 KHZ carrier output. In this simulation of this circuit for operating maximum voltage up to 9V which is enough to pop the signal from transmitter and receiver will gives the output for microcontroller [9]. This HT12D Receiver or Decoder will convert the received serial data to 4 bit parallel data D0 – D3. In this Address pins A0-A7 should match with transmitter side address pins A0-A7 for receiving the signal [10]. Were 12V vcc is given in the power supply of 18th pin of receiver HT12D IC and 17th pin is used to connect and give a latch for the microcontroller. The microcontroller which is connected to ic voltage regulator in the pin number of 17 for not shorting the microcontroller due overlap of the power supply.

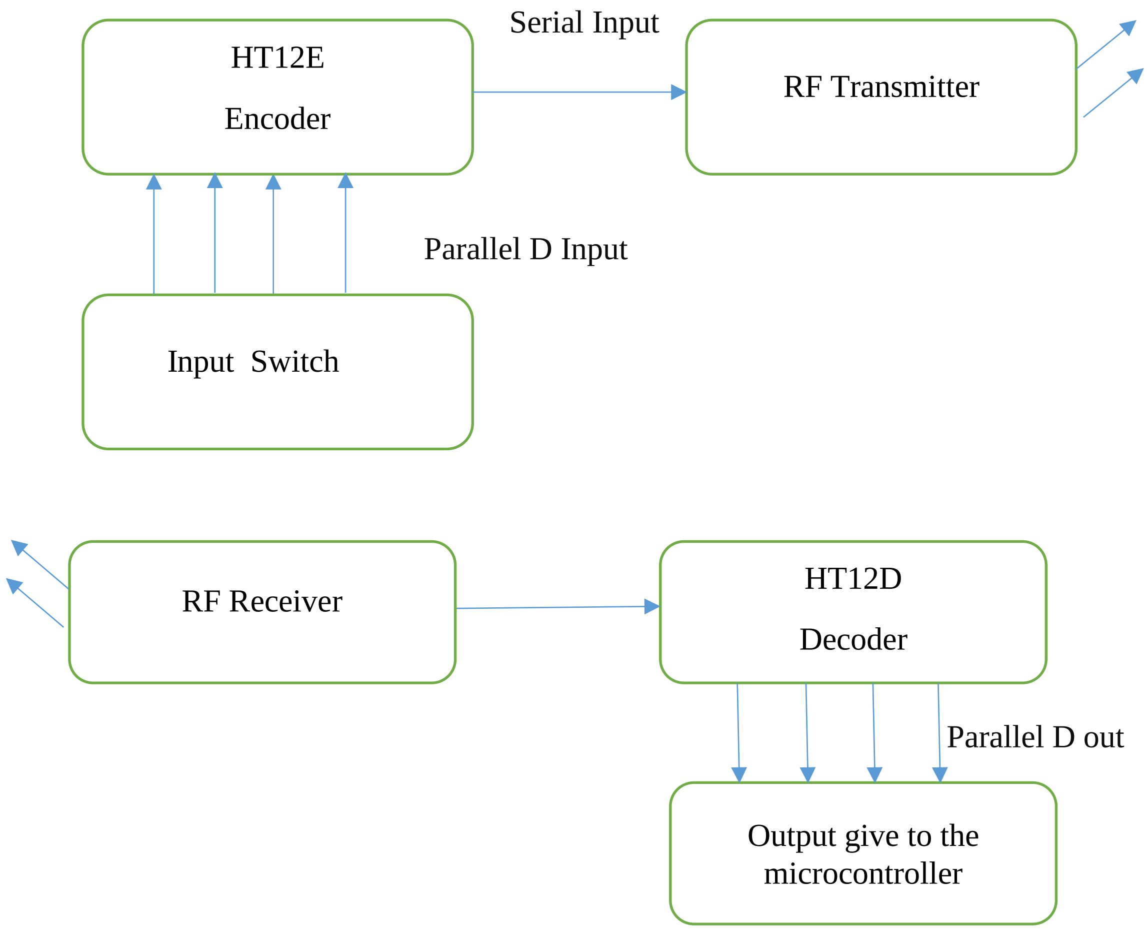

Fig.19. Transmitter and Receiver Block

The Fig.19 represents that a trigger input which perfom to the encoder and gives data input parellel while encoding the singnal with the carrier frequency for transmitting the data as serial output which is digitally mentioned as 0s and 1s. RF transmitter sends the signal to a receiver with the carrier signal. It receives the RF signal to give as a serial out to the decoder. The operation of neglating the carrier signal by using HT12D decoder gives a data output to the micrcontroller as it in digital language.

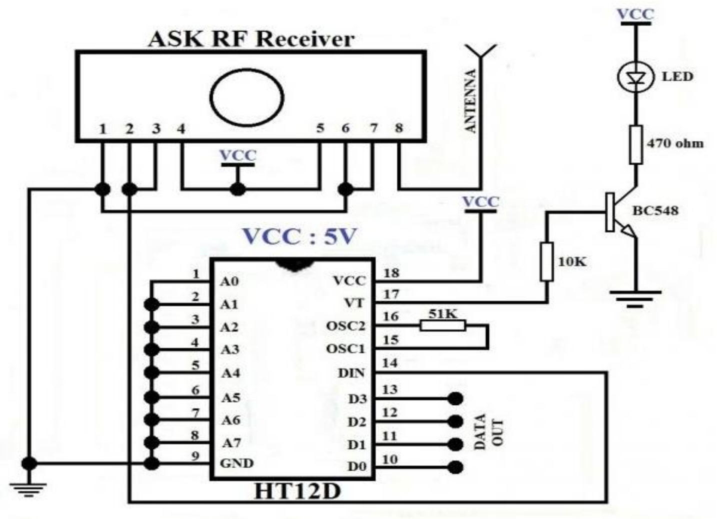

Fig.20. HT12D Receiver circuit [9]

The ASK demodulator receives the signal from HT12E ASK modulator via antenna through the circuit connection which is sown in the Fig.20. Where 51KΩ resistor will provide the needed resistance for the internal oscillator of the HT12D [10]. While receiver had a 433 MHZ frequency as like transmitter side also need a same 433 MHZ for signal communication medium for operating voltage of 9V [10]. This operation has been proved practically by using proteous ISIS simulation.

Table 3 Features of transmitter and receiver

No	Features	Ranges
1	Transmitter Frequency	433.92 MHZ
2	Transmitter supply voltage	2.4 to 12V
3	Transmitter output power	3V~6V
4	Receiver frequency	433 to 434 MHZ
5	Receiver typical sensitivity	105Dbm
6	Receiver current supply	3.5mA
7	Receiver operating voltage	3V to 12V

4.3 AT MEGA 328P OPERATION

The ardunio microcontroller is one of the famous controllers in micro controller family were power source is required for only 5V. Therefore receiver gets the signal from the transmitter and gives a digital pulse to the microcontroller input as a latch. The digital input is connected with a pin number PD2 in 328p controller, the microcontroller reads the input and correspondingly gives an output to the microcontroller which depends up on already preprogrammed by user needs.

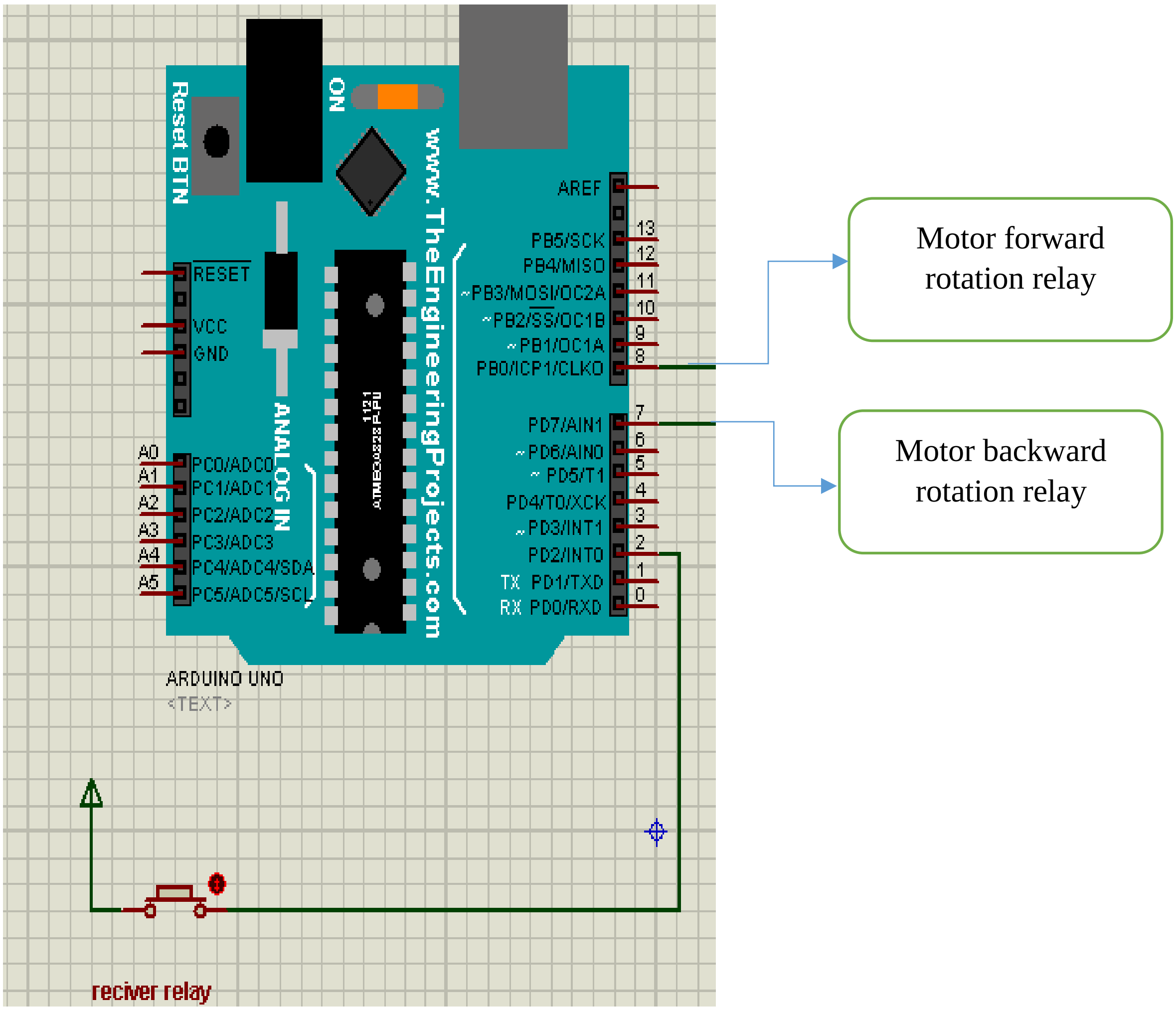

Fig.21. Receiver latch with microcontroller

The Figure.21 which represents circuit design is plotted and simulated by proteous circuit design software the pin PB0 is connected along with two channel relay for forwarding rotation of the motor and one more two channel relay which is connected for motor backward rotation from the pin number PD7. The motor connection has connected with microcontroller output. The motor has fixed with gear which is connected with rack ,where the rack is molded with open and close ramp slider.

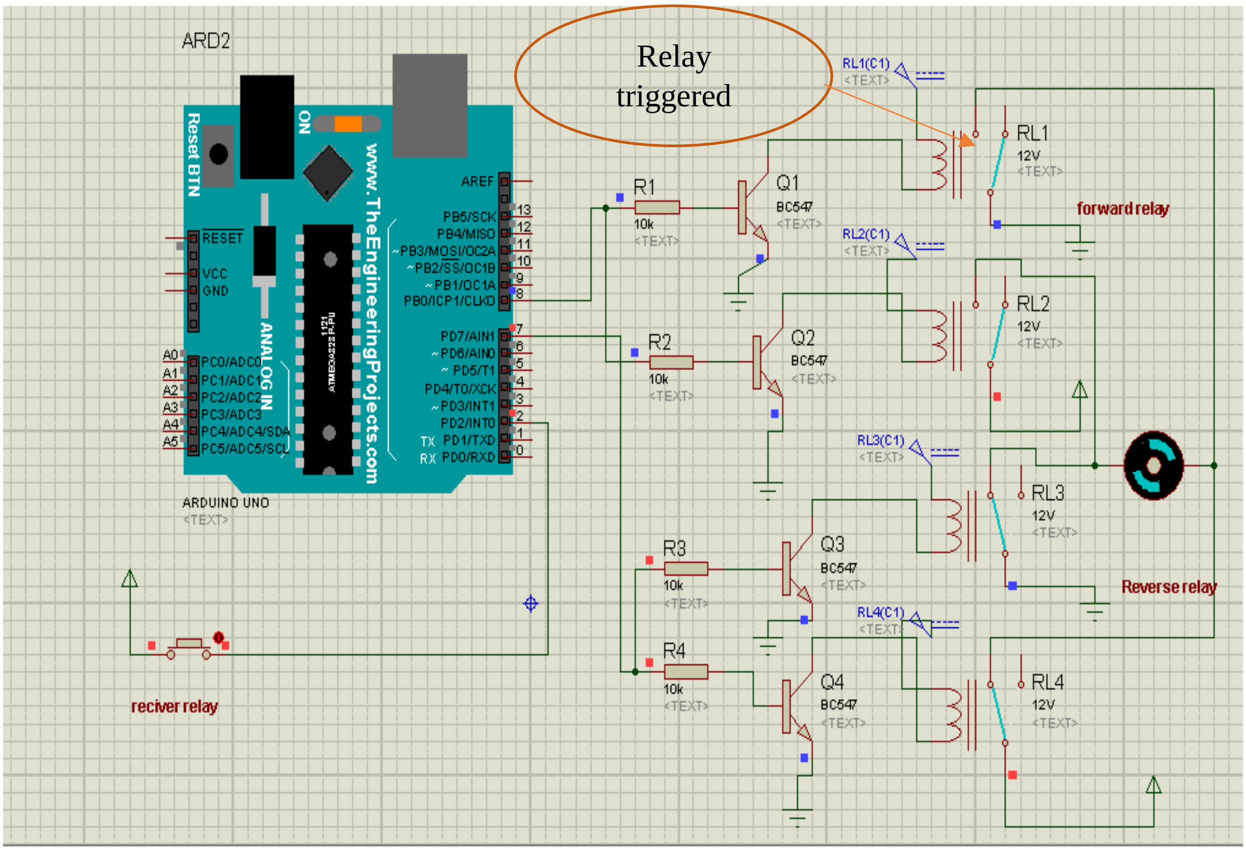

Fig.22. Microcontroller with forwarding relay

Here 12V DC externally gives the power supply for operating the relay in order to get a command from the microcontroller. Were microcontroller is programmed by using Keil c coding which represents the train when stops in the platform after getting a signal from the transmitter. The receiver will give input to the microcontroller to deploy the ASP system with help of motor rotation and then opened ramp is waiting for passenger to enter the train. The train gets the signal from train station whether the train is going to move or stop from the platform. Hence ASP system will close with help of motor rotation by commanding a microcontroller operation. In this circuit forward rotation of motor that is ASP will deploy the ramp while train arrives on the platform.

The resistor is used for attenuate the unwanted power and gives a constant power supply to the circuit and BC547 Q1 and Q2 transistor which are connected in parallel with this circuit. The above figure shows that Q1 transistor is connected with RL1 relay and a Q2 transistor which is connected with the RL2 relay. Therefore RL1 relay which is connected with motor supply positive end and RL2 relay is connected with the motor power supply negative end. This operation of forwarding motor runs and hence proved by the motion of motor rotates is mentioned in blue color in this experiment, in this Fig.22 shows that working principle of forward relay triggered.

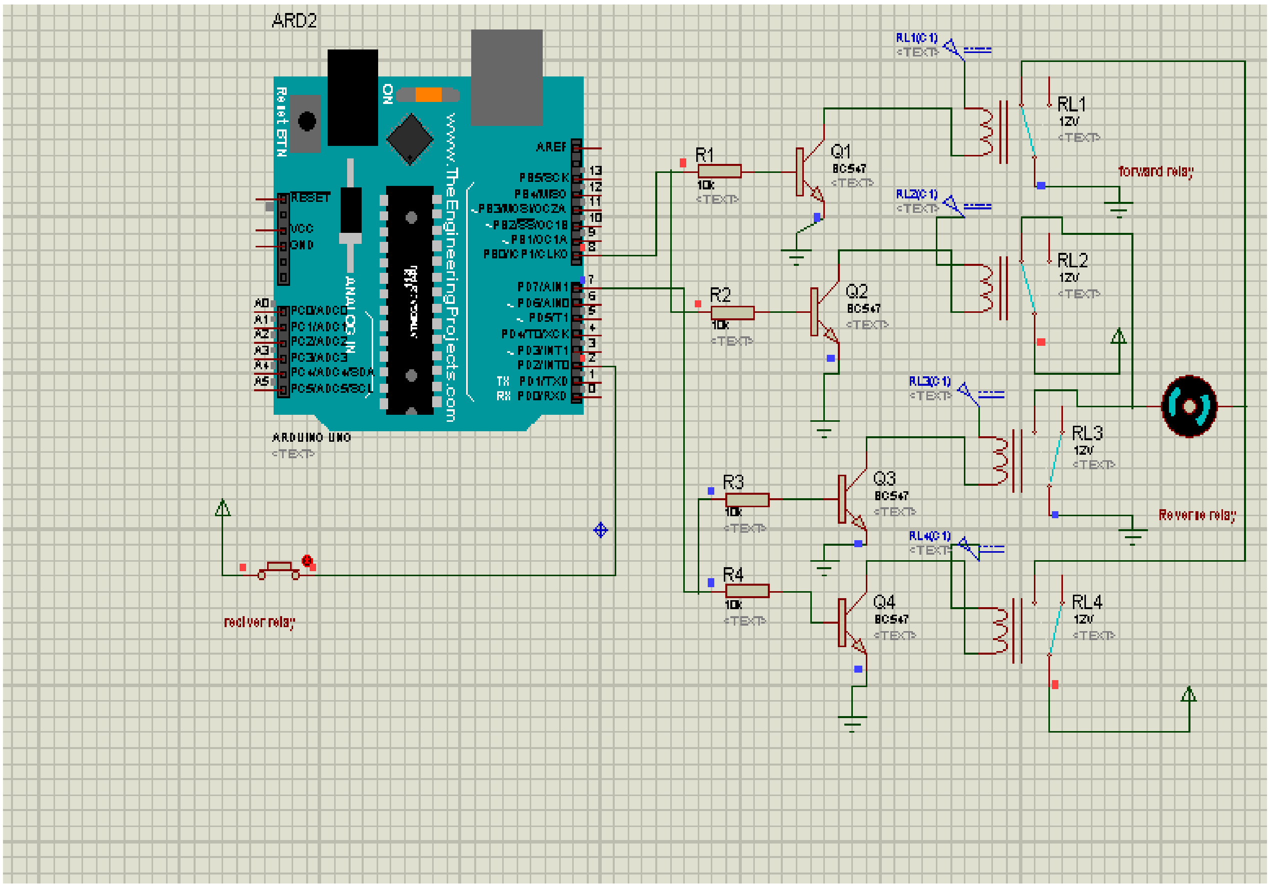

Fig.23. Microcontroller with reverse relay

The Figure.23 which represents motor spins in reverse direction where relay RL3 and RL4 will latch therefore RL1 and RL2 will be in ideal position. In another way two channel relays will turn off in this section and except all other operations are same as compared than the forward operation of motor spins. The main difference of this circuit which is Q3 and the Q4 transistor will activate in this section. The operation of reverse rotation motor which is successfully proved in this circuit.

The graphical representation of the output is mentioned. When the motor starts rotating the logic is 1 and it may be forward or reverse direction. The output of the graph represents where four channel relay is connected with the motor. Channel A and D starts rotating forward and it represents yellow and green color line. After this operation starts, channel B and C respond for the motor reverse rotation operation which is highlighted in the blue and red line of the graph. If the digital logic is 0 it shows it is an ideal position that means the motor is in off position.

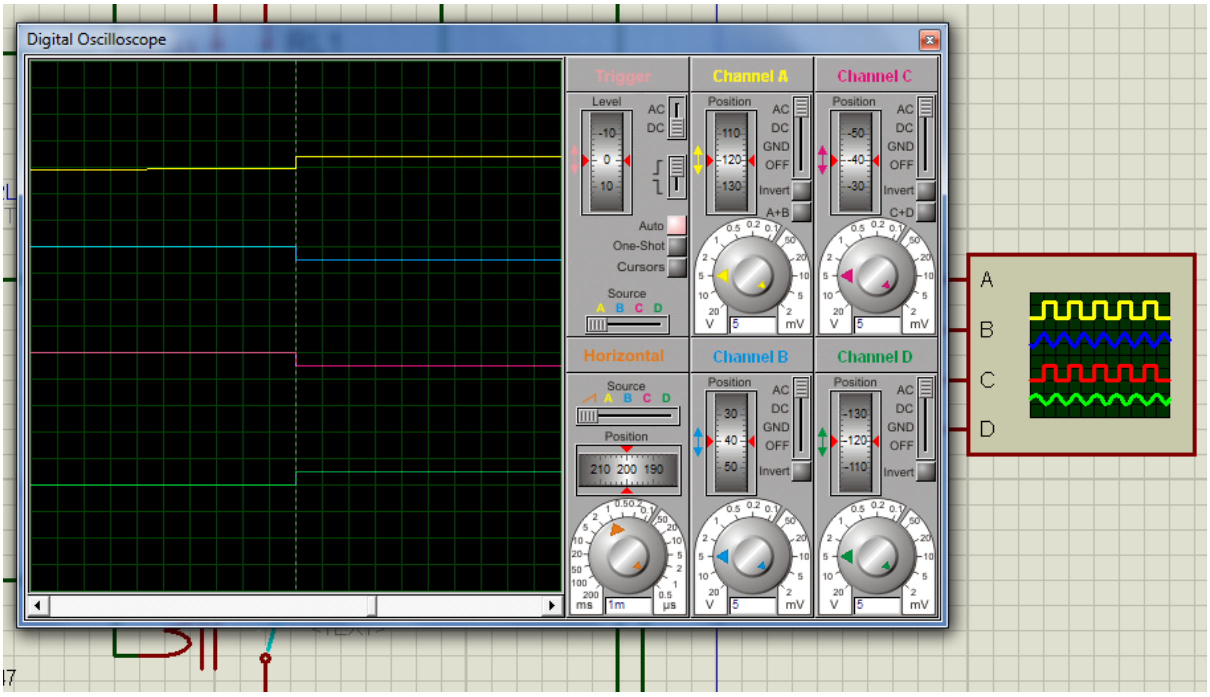

Fig.24. Graphical representation of motor movement

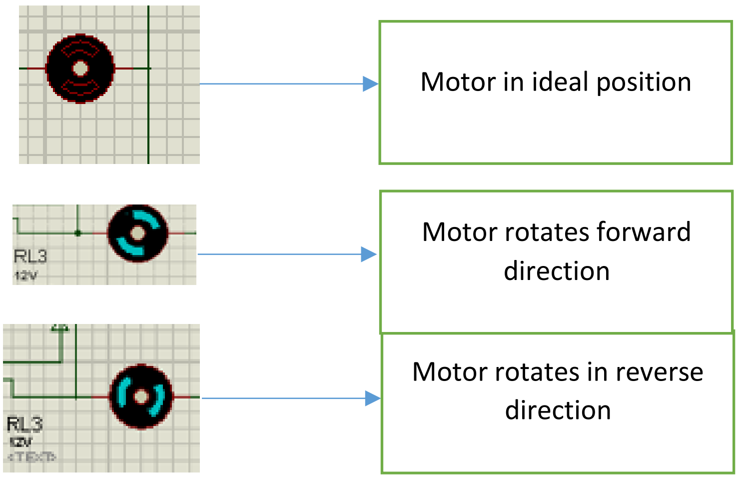

Fig.25. Motor movement analysis

The train stops in the platform after getting a signal from the transmitter. The receiver will give input to the microcontroller for deploying the ASP system with help of motor rotation and then opened ramp is waiting for the passengers to enter the train. When train receives the signal it moves from the platform. Therefore ASP system will open and close with help of all these motor states by commanding a microcontroller operation, the Fig.24 shows that motor movement analysis by using protesous simulation.

A combination of microcontroller and electronic circuit board . The circuit boards are placed in the ASP system where all are the electronic compnents and microcontroller are fixed on the same board.These operations are proved successfully and shown above in motor movement of all three positions.

4.4 MICROCONTROLLER 328P SPECIFICATION

This microcontroller has a huge performance Microchip 8-bit AVR RISC-based microcontroller and it combines with 32KB ISP flash memory. It can read and write simentaniously and it has especially 1KB EEPROM, 2KB SRAM, 23 general purpose I/O lines, and 32 general purpose registers [10]. The Timer and counters have three flexiable estimate the modes, internal and external interrupts,serial programmable USART, a byte-oriented 2-wire serial interface [21], SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages). It has programmable watchdog timer with internal oscillator and five software selectable for power saving modes [21]. The device operates at 1.8-5.5 volts.

4.5 RELAY WORKING PRINCIPLE

Relay operation which acts as a switch it gives a trigger for the motor rotation, were operating voltage 12V is given for the relay.In this experiment, four channel relay is used. One of the two channels is used for motor forward rotation and another two channel is used for the motor backward rotation. Regulator IC gives the power source for the relay. The inner section of relay diagram shown in the Fig.25.

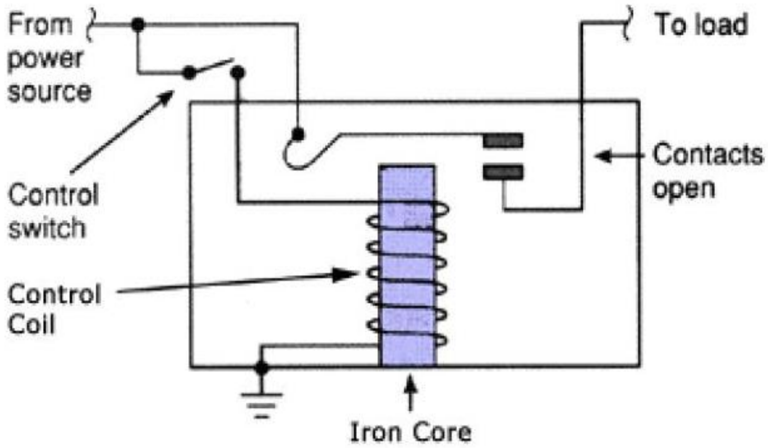

Fig.26. Relay operation [12]

An iron core is surrounded by a control coil, the power source is given to the electromagnet through a control switch and through contacts to the load [12].The current starts to flow through the control coil were EMF energize and intense the magnetic field. When iron core getting energized upper and lower arms attracted while open contact will close to give a source for the load (i.e. load is mentioned here as a motor) [22]. After motor operation stops relay will de-energized when the contacts were closed, then the contact moves to the opposite and make an open circuit.

5. MATERIALS USED PRODUCT OF DESIGN

APS system the selection of materials are strongest and weightless. It exist in various markets. The material chosen for encloser is aluminum alloy steel which is strongest and weight less material but is not stronger than titanium alloy steel. In this method of the system aluminum steel is enough to make an encloser. A slider is made by using AISI 4130 steel. the top of the slider bunched with ceramic gripper which will give grip for the slider, Especially Nano structured material are used in this system to make a sliding foot rest.

5.1 PROPERTIES OF CERAMIC MATERIAL

The invention of newest material is updated in the Nano technology world. This material is made up of Nano scale struts crisscrossed ceramic material which seems like struts of a tiny Tower. This material is very strong and light enough to float through the air like a feather [13]. It is used for making a part of aero plane ,trucks and it is used to making battery electrodes. In conventional materials, strength, weight, and density are correlated. For example ceramics are strong and heavy, so that they can't be used as structural materials where weight is critical.

Matrix Bonding

The ceramics is chemically inifiltrating B_4C into aligned carbon nanotubes sheets (CNTs). It fabricates a novel CNT/B_4C compensation of fracture strength which approaches the theoretical maximum of B_4C matrix [14]. The bonding which is strongly bonded in tube-matrix interface and amorphous, crack-free B_4C matrix [15].

5.2 ALUMINUM PROPERTY

Aluminum alloy is used in this research instead of stainless steel which is one of the reason is the enclosure should be weightless and strongest material, aluminum alloy is enough to make an enclosure for AFS system. It absorbs a vibration in rail and thermal conductivity is much better than the stainless steel. Aluminum alloy 2014 is one of the most popular alloys in the 2000 series it can easily machine in certain temperature and is having a high hardness aluminum.

Specification of 2014aluminum Alloy

The 2014 wrought aluminum alloy can use in the commercial, civil aircraft, were AFS system had use this aluminum alloy mainly it can easily machine in certain temperature and is having a high hardness aluminum. This aluminum alloys containing 2 to 30 wt% of Al_2O_3 and Sic particles in the size range of 1 to 142μm were prepared. Were compensation of 2014 aluminum alloy were described here [23]. Si 0.50-1.2, Fe 0.7, Cu 3.9-5.0, Mn 0.4-1.2, Mg0.20-0.8, Cr 0.10, Zn0.25, Ti 0.15.were density is 2.80 g/cm^3 [25] . Young's modulus 73 GPa, Electrical conductivity 34 to 50% IACS. Ultimate tensile strength 190 to 480 MPa [24], Thermal Conductivity is 130 to 190 W/m-K, Thermal Expansion is 23 μm/m-k [23].

5. 3 PROPERTIES OF STAINLESS STEEL

A steel which is made up of iron alloy added the cardinal percent of chromium and some of other alloys are combined with the iron is stainless steel. Stainless steels are do not rust in salt water and it is highly resistive with concentrated acids. The usage of stainless steel is small compared with that of carbon steels but exhibits a steady growth, in Contrast to the constructional steels [18]. Use of most common widely used stainless grades are the austenitic 18/9 type sheets of steel, i.e. AISI 304 and 304L, which form more than 50% of the global production of stainless steel [18].Here using the grade of stainless steel is AISI 304 this type of steel is not hard to enable but it is enough to make a slider for ASP system

Physical Property

In terms of physical properties, stainless steels are markedly different from carbon steels in some respects. It appreciable differences between the various categories of stainless steels [20]

Table 4 physical property [20]

No	Property	Ferritic stainless steel
1	Density (${}^{g}/{}_{cm}{}^{3}$)	7.9-8.2
2	Young modulus (Mpa)	195,500
3	Thermal Expansion 200-600°c	17-19
4	Thermal conductivity 20°c	12-15
5	Heat capacity 20°c	440
6	Resistivity	850
7	Ferro magnetism	Nil

6. PROTOTYPE OF ASP DEVICE

Asp demo model is created by using an LM sheet board. This sheet board is made by a combination of wood and mica and it is used for placing a whole circuit board and compact disk. The dimension of the board is 10x10 cm and the circuit boards are placed above the LM Sheet board and compact disk drive is placed below the board. The compact drive is used for model setup of the open and closed ramp. List of the components is involved in making demo systems those are given below.

1. Transmitter Circuit
2. Receiver Circuit
3. Two four channel relay circuit
4. Lm sheet boards
5. At mega microcontroller
6. Three 9V Lion batteries
7. Two 12V adapter

6.1 MODEL OF BASE STATION CIRCUIT

This circuit is made up of double-layered PCB board, the transmitter components are fixed on the PCB board and circuit connections are plotted below the PCB board. The black and red wire which gives the power supply as an input for 18th pin, red wire is positive input and the black wire is connected to the ground.

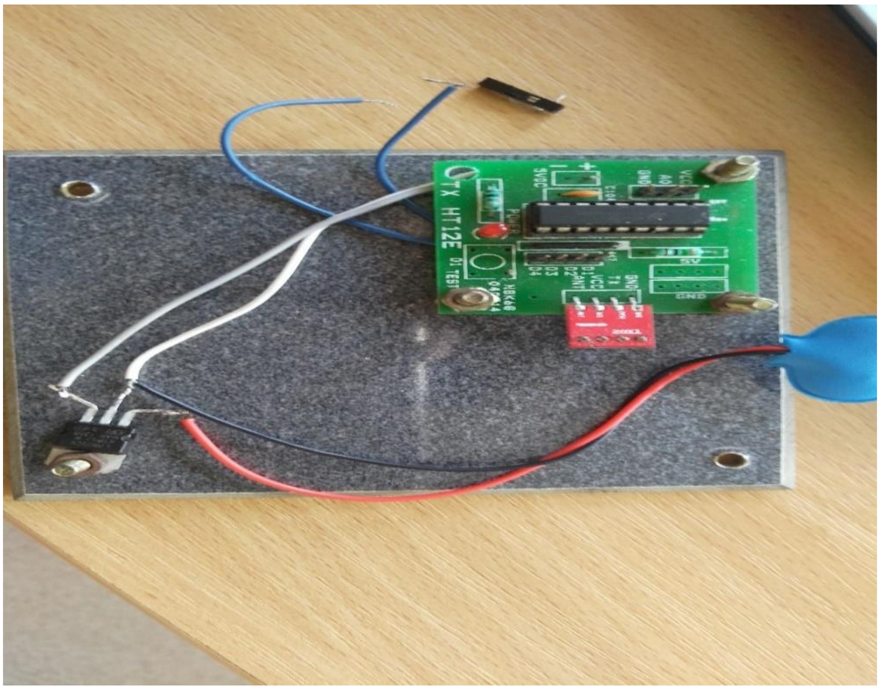

Fig.27. Base station demo kit

The input power supply which exists from the 9V battery, red and black wires are connected through IC voltage regulator. It will split the power supply for the TXHT12E board. Blue color wires are connected to D1 and D2 which is used for trigger input that will give an input for Train ASP receiver circuit. The base station demo circuit and connection are shown in the Fig.27.

6.2 MODEL OF ASP DEMO KIT

The construction ASP model kit which is made by using an LM sheet board, this board contains three types of a circuit placed over the LM sheet board. Here compact body disk is placed under the LM sheet board, the compact disk is mainly framed for the model of ASP foot slider.
Types of circuit placed in ASP kit are given below

1. Receiver circuit
2. Microcontroller circuit
3. Two four channel relay circuit

Receiver Circuit

TXHT12D it is a one type receiver circuit, the brown and black wire is connected to an input power supply. For input power supply is led from the 12V DC adaptor. The power supply, is given to the brown and black wire which is connected to IC voltage regulator. This regulator IC which split the power supply and attenuate the power source at maximum 5V through receiver circuit. The receiver will activate after getting a power source where input signal gets from the transmitter. were transmitter sends the signal to a receiver with the carrier signal .

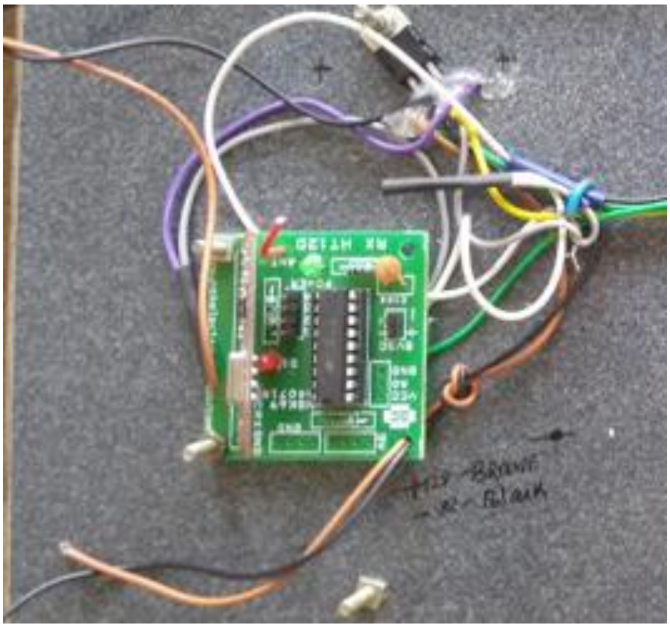

Fig.28. TXHT12D Receiver Connection

After receives the rf signal to give as a serial out to the decoder. The operation of neglating the carrier signal using TXHT12D decoder then it gives a data output to the D0 and D1,where violet and a white color wire connected with D0 and D1 pin to give an input signal for micrcontroller as in digital language.

Microcontroller Connection

ATMEGA328P microcontroller gets a signal from the receiver and it is connected along with the relay circuit for operating the motor. Input power source is led from the IC voltage regulator. Here 12V DC adaptor is connected through IC voltage regulator for protecting the microcontroller kit and IC will distribute the pulsating 5V DC to the microcontroller kit. The microcontroller performing as a commander for the relay operation and ASP motor control movement. In terms of the input signal is fetch from the receiver and to give as input called digital signal for microcontroller pin PD2-INT0 after getting the signal for the microcontroller, it will give a signal to relay via PB0 and PD7 pin. The microcontroller gives a signal to the forward relay from PB0 pin after two second delay the forward relay signal will stop and then attenuate the signal for a PD7 pin that is reverse relay will on. Finally reverse relay operation done after two second delay both signal will terminate, relay circuit will shut down. Then it will wait for microcontroller command. This microcontroller operation will be coded by using c language, a platform for the software is ARDUINO genuine. The connection of wire color code and program for the microcontroller given the Fig.28.

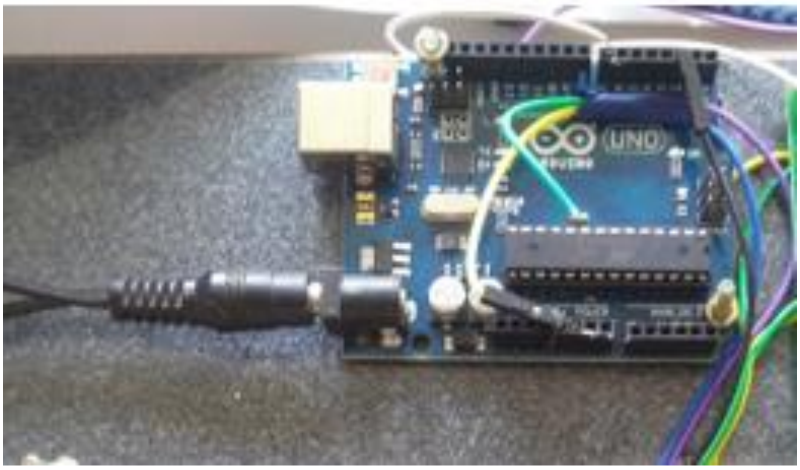

Fig.29. ATMEGA 328p connection

Color coding for wire connection are shown in Table 5.

Table 5 Wire color connection

No	Color of wire	Pin connection of Microcontroller
1	White + Black	Connected with the second pin
2	Green + violet	Connected with ground
3	Yellow + Blue	Positive 5 V
4	Only white	3rd pin for forwarding relay
5	Light violet	1^{st} pin for reverse relay

Program for microcontroller is:

```
// assign variable pin numbers:
 int button Pin = 2;     // assign pushbutton pin
 int led Pin1 =  7;      // assigning  the LED pin no1
 int ledPin2 =  8;      // assigning  the LED pin no 2
// changing the variable:
int PbuttonState = 0;         // reading the variable for push button
void setup() {
  // LED pin initilizating as OP:
  pinNode(Led Pin1, OUTPUT);
  pinNode(Led Pin2, OUTPUT);
  // initialize the pushbutton pin as an input:
  pinNode(PbuttonPin, INPUT);
}
void loop() {
  // read the value of the pushbutton status:
  Button State = digital Read(PbuttonPin);
  // check the pushbutton is latch or not.
```

```
// if it is, the Pbutton state will HIGH:
if (Pbutton State == HIGH)
{
  delay(2000);
  // LED will on:
  Digital Write(Led Pin1, HIGH);
  delay(2000);
  digital Write(Led Pin1, LOW);
   delay(2000);
  digital Write(Led Pin2, HIGH);
   delay(2000);
   digital Write(Led Pin2, LOW);
    delay(2000000);
}
}
```

The microcontroller operation and program were successfully tested and executed in ASP demo kit operation. The program was written for ASP foot slider with two sec open and close operation, this operation assumed and programmed for passengers boarding and alighting from the train. The program is fetched from the internet for reference and changed the variable for ASP demo kit microcontroller operation.

6.3 RELAY CIRCUIT OPERATION

The relay which is acting as a switch and it gives trigger for the motor rotation, the operating voltage 12V is given for the relay.Four channel relay is used for this opeartion, one of the two channels is used for motor forward rotation and another two channel is used for the motor backward rotation. The input signal is fetched from the microcontroller and relay will receive the signal via pin number 3 and pin number 1.Relay circuit connections are shown in the Fig.30.

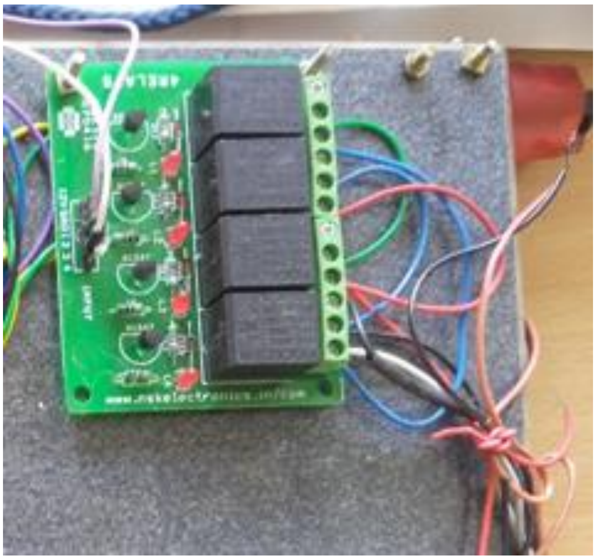

Fig.30. Relay circuit

After getting a signal from the microcontroller then the relay will drive the motor as forward and reverse. Blue and green wire is connected with Pin number 3, it will activate the motor in forwarding direction, white and black wire connected with pin number 1, and it will activate the motor in reverse direction.

6.4 ASSEMBLY OF ASP DEMO KIT

The whole circuit kit assembled in one 10x10 cm compact Kit where receiver circuit is fixed in corner of the leftside on LMsheet board, ardunio micrcontroller fixed on top of the LMsheet board.Four channel relay which is fixed and connected next to the microcontroller right side. Full view of connection and assembly are represented the Fig.31.

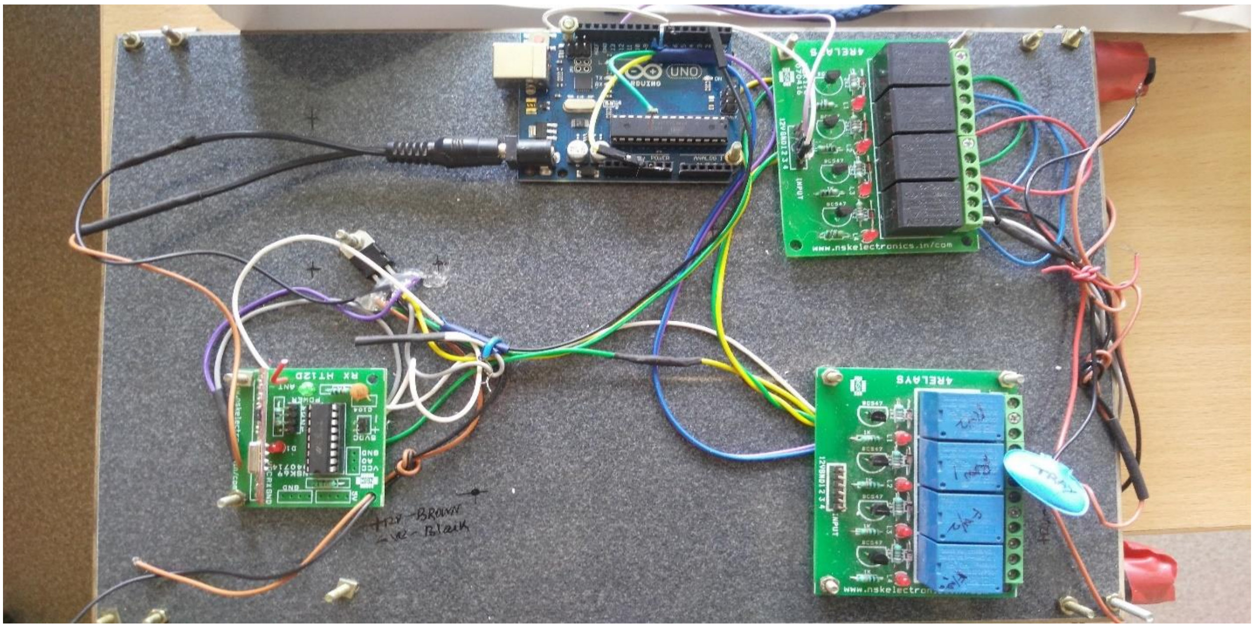

Fig.31. Full Assembly of ASP kit

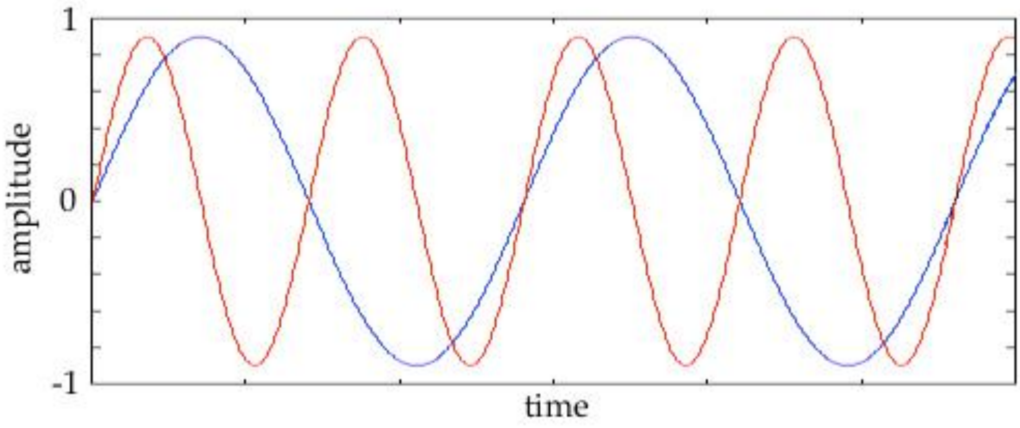

Fig.32. Graphical representation of Motor Rotation

The full assembly of connection was succesfully connected and executed the ouput as a graphical representation and realtime demo. The blue color line represnts motor forward rotation and the red color line represents motor reverse rotation is shown in the Fig.32.

7. FUTURE IMPLEMENTATION

To implementing the Manifold Automatic Safety Platform (MASP) device will appropriate for all types of trains cars and platforms. But have to change similar mechanical design depends upon the type of platform for implementing in real time. The Automatic safety platform (ASP) device will cover the space inbetween platfrom and train cars for passenger boarding and alighiting the train,this system will fixed under door enterance. The MASP system will used for not only passenger boarding alighting the train it will used for passenger may fell down without their knowledge on the train train track. This system will cover the space inbetween whole train compartment and whole train station platform. MASP system shown in the Fig.33.

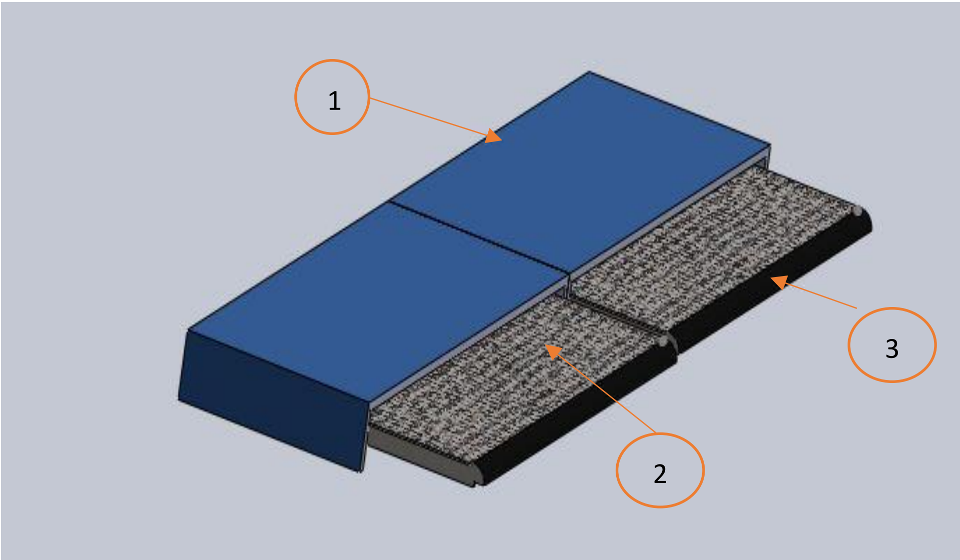

Fig.33. Manifold ASP system

MASP parts outer view

1. Enclosure
2. Slider
3. Slider curve hinge

Components prposing

The MASP system will additionaly add some sensors for passenger convinence those are

1. IR sensor : It is used for sensing the passengers boarding or not.
2. Piezo electric sensor: For adjusitng the gap inbetween slider hinge and platform hight.
3. Servo motor for slider : It is used for tilting the slider up and down.

CONCLUSIONS

1. This mechanical parts of automatic safety platform device are designed aspect train door dimension and distance between train car and platform. Therefore Enclosure which is made by using 2014 aluminum and the dimensions of the Asp enclosure are length is 2500mm, breadth is 1219mm and height is 304.8mm.ASP slider which plays a major part in this system which is made by using AISI 304 stainless steel and dimensions of the sliders are length is 1218mm, breadth is 918mm and thickness of the plate is10mm.
2. Control system input and output operation is led from Microcontroller ATMEGA 328P. The input analog signal is driven from the base station circuit and gives an analog input to the microcontroller. Microcontroller drives the circuit and convert analog signal into digital signal as an output. The output is shown in the graphical representation of square wave.
3. ASP slider is used for hold in the passengers for boarding and alighting the train. The analysis result of slider can with stand up to more than 1000 kg at single time. Theoretical analysis are proved that is slider can withstood up to 500Mpa.
4. The physical property of ceramics, stainless steel, and aluminum are reviewed in this study with reference to journal paper. Prototype model of ASP system was designed and successfully get an output in this project.

REFERENCES

[1] Sehchan Oh, Gilgong Kim and Hanim Lee, "a monitoring system with ubiquitous sensors for passenger safety in railway platform," *sensors and passenger safety ,* may 2007.

[2] Prahaar, "e-paper," Train platforms and safety system, 13 feburary 2014. [Online]. Available: http://epaper.timesofindia.com.

[3] P. sen, Subinay Dasgupta, Arnab Chatterjee, P.A.Sreeram and Mukherjee, "Rail Networks," Vols. Rev.E67,036106, 2003.

[4] D. p.Marchiori, San Antonio melvin gary clark and Gary Clark, "Automative rail door system," *Train doors and safety,* may 2005.

[5] M. marietta, "Materials of automative door system," San Antonio ,TX (us), march ,4 ,2004.

[6] M. k. jain, "Indian rail car coaches and powersupply," Indian railways and powersupply, 22 march 2014. [Online]. Available: https://www.railelectrica.com/energy-efficiency-of-rail-transport.

[7] Y. Xi-jun, Yang Xing-hua, Lei Huai-gang and Guan Hongfei, "theoretical analysis and experiomental study of a novel bridless partial active PFC," in *Internationalo conference on electrical machines and systems*, 2008.

[8] A. Kharel and Saroj Rangnekar, "Energy resources," in *Maul;ana Azad National institute of technology*, Bhopal, 15 Feburary ,2011.

[9] Dr.park, "power control monitoring," West Lafayette USA, 2003.

[10] J.-M. (. park and Kaigui Bian, "Electrical and computer engineering," in *Virginia Tech*, Blacksburg Virginia, 10 may 2017.

[11] A. W.Bigelow, Michale j.Merchant, Eirini velliou, David welch, David j.Brenner and Karen j, "Kirkby Automated microbeam observation," TX (US), 12 August 2016.

[12] K. Bourac, "Inhternational journalist based in relays and switches," in *Guest contributor*, sanfrancisco ,california, may 2013.

[13] H. lLan, Yongge cao, Zhonghua deng and Zhuguang Liuefi tang , "structure of matter," in *chinese acdemy of sciences*, Fuzhou China, 27 october 2016.

[14] B. gu, Henry helvajian and Alberto piquesan , "ceramic structure," San francisco , california ,united states, Feburary 13 ,2016 .

[15] K. Li, Yingchao Yang, Zhanjun gu, Jane Y, Gyula eres , Litong Zhang, Xiaodong Li and Zhengwei , "ceramic property," in *pan version of record online,* 23 sep 2013.

[16] O. schulze and Jurgeon Hoffmeister and phillp Nusskern, "Aluminum alloy properties," in *version of record online*, 29 jan 2014.

[17] A. jabal, Gharyan, Tiptur and Tumkur, "Aluminum alloy specifications," in *India Kalpataru institute of technology*, karnataka India, 24 january 2011.

[18] R. stal, "properties of steel," MNC Handbok nr 4, stockholm sweden , june 2009.

[19] H.Nordberg and K.Fernheden, "Nordic symposium," in *Mechanical properties of stainless steels,* Avesta research foundation, may 2014.

[20] M. szala, Karolina Beer-leech and Mariusz walczak, "Physical properties of stainless steel," in *Materials engineering* , 36 Nadbystrzuka street Lubin Poland, june 2013.

[21] A. Gibb, "Design and the arduino microcontroller," *New media art design* , no. pratt Institute, phD thesis, 2010.

[22] B. osoba, Bivas saha, Liam dougherty and Jane Edgington, "IEEE," *INternational electronic devices meeting,* pp. 26.8.1 -26.8.4, 2016.

[23] K. yue, mabao liu and guolio wang, "statical analysis of the accelerrated life testing," in *Annual realiblity and maintainability symposium*, 2009.

[24] Qing-fen, yan -jiee liu and sheng-yuan yan, "analysis of steel property," Horbin china, 11 april 2009.

[25] C. srinivasan, Susobhit sen, Anjan Kumar and Chenchu saibabu, "Advance in energy conversion technologies," in *International conference*, India , 2014.

[26] D. Aeyels, "Systems and control letters," in *control dydtem*, june 2000, pp. 59-63 volume 6.

APPENDIX

Appendix 1

Computational model of ceramic bonding

The mechanical effectiveness of this strategy, though, depends strongly on the architecture of the resulting cellular material (i.e., the topology of the introduced porosity).Fabrication of additive manufacturing of macro scale cellular material. Where the single phase and hybrid with unprecedented dimensional control on the unit-cell and sub-unit-cell features, potentially producing architectures with structural hierarchy from the Nano to the macro-scale [14]. Where the computational basics of phase field method operate on a microscopic length scale providing microstructure. The stress analysis evolving dynamic fracture forming applied load in this analysis.

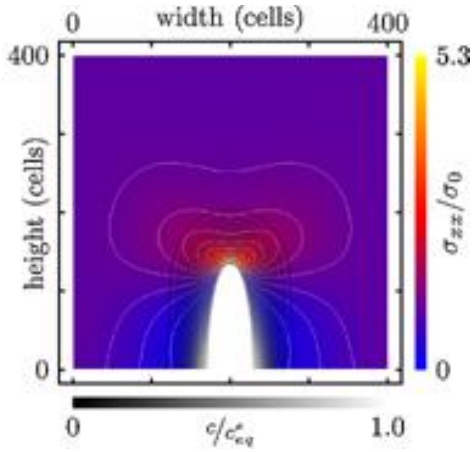

Figure 1 Computational model [14]

Hardness testing of ceramics

When the performance of hardness testing is depends on surface density enable to adjust a definite carbon in depth of carbon powder profile in powder of metallurgical components. For micro mechanical surface treatment [10] .where open pours microstructure is transferred into a densified graded porous near surface layer for avoiding even in opposition to external forces like gravity (i.e.) capillary effect of open pours. Strengthen of hardness testing depends up on open pours microstructure treatment

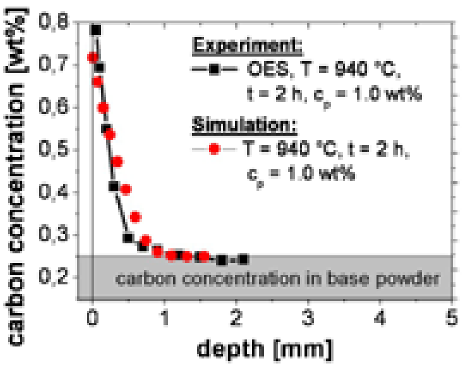

Figure 2 strengthen of carbon profile [15]

The Nano ceramic material is used to make for sliding foot rest it is one of the most reason is chosen for light weight and strongest material it shapes crisscrossed matrix it can able balance a tones of weight in research proved. The shape which is combination of matrix can absorb a weight and it gives a load to near load shells it seem like dividing a load each and every rows and column of shells.

Merits of using Aluminum alloy

1 **Strength to weight ratio**: Aluminum is typically not as strong as steel, but it is also almost one third of the weight. This is the main reason why aircraft are made from Aluminum[16]

2 **Corrosion:** Aluminum has a high oxidation and corrosion resistance mainly due to its passivation layer. When aluminum is oxidized, its surface will turn white and will sometimes pit [17]

3 **Thermal Conductivity:** Thermal conductivity is much better than stainless steel.

4 **Workability:** Aluminum is fairly soft and easier to cut and form. Due to its resistance to wear and abrasion

5 **Thermal property:** aluminum alloy 2014 matrix-TiB_2 composites using an exothermic reaction process at 850 °C using K2TiF6 and KBF_4 salts [17].

6 **Electrical conductivity:** It is very powerful electrical conductivity.

Types of aluminum steel using

S.no	Types of series	properties
1	1000 series	It is pure aluminum concentration of aluminum is 99%,it can work hardened
2	2000 series	It is combined with copper ,It can used in the commercial, civil aircraft,70%miltary application use this type of series And is very economical.
3	3000 series	In this alloy concentrated with manganese and it is a non-heat treatable wrought alloy
4	4000 series	This series concentrated with silicon and its called as silumin it is used for variety of welding wire and brazing wire application.
5	5000 series	This series alloyed with a magnesium and it can used for chemical ,food container, storage tanks
6	6000 series	This series are alloyed with magnesium and silicon.it is easy to weldable.it can used for architectural application
7	7000 series	In this series highly concentrated with zinc.it can used in aerospace application also
8	8000 series	In this series concentrated with aluminum-Lithium alloy

Appendix 2