Easy Accessibility to Trains From Low Level Platform

Sanket Nawale
SSVPSs BSD College of Engineering Dhule
North Maharashtra University Affiliated
Dhule, Maharashtra,India
Sanketnawale101@gmail.com

Abstract – Modern express trains in India face the problem of having a higher floor level than the current platform level. It is also seen in new rakes and coaches that there is a substantial gap in between the train floor and the platform. This proves to be a challenge to some people who needs to climb a set of near vertical exterior steps to reach the train floor level from the platform level. Accidents occur when people misstep and fall down in the gaps too. Simple solutions can eliminate this problem. In India, the floor height of express and long-distance trains is not compatible with the platform height and changes. In most cases, the distance increases beyond comfort limit of the passengers. The problem becomes more prominent when people struggle to climb abroad and get down from trains on to the platforms because of steep exterior steps which often lead to accidents and injuries. This is mostly seen with small kids, women, elderly, people with arthritis and others and also while moving heavy luggage in and out of the train. In all the above cases, a simple construction of platform risers and gap fillers can make a huge difference. So from above problems, the solution is to make a folding step mechanism which will be fill the height and the gap between the platform and the AC 3-Tier Sleeper Coaches.

Keywords– platform-train-interface,ROQ.

I. INTRODUCTION

Many transit agencies and researchers recognize that the platform-train-interface (PTI) accidents are an important safety concern; however there has been relatively little research in this area. Incidents that involve the gap between the platform and train are not necessarily only dependent on the gap size. In fact literature review suggests that there may be many other contributing factors that could impact boarding and alighting safety. Various studies from around the world have considered portions of this overarching problem of gap safety in various rail transit modes. Presently, Indian Railways (IR) AC 3-Tier Sleeper Coaches of ICF design to CSC-1722 have a floor height of 1320 mm from rail level and have a customized design of complete entraining/ detraining arrangement including door with fixing arrangement, footsteps and door handle compatible with platform of height 760mm to 840mm from rail level in such a way that passenger during entraining from platform to coach floor uses a vertically straight parallel foot-steps and similarly during detraining from coach floor to platform.

.Fig 1.Problem in accessibility to Platform.

The solution will include the design and mechanism of operation of a convenient method of train access from low level platforms in a failsafe mode. The things we should particularly look at opportunities of easy retro-fitment and seamless integration in the current design of coaches serving different age groups and physical capabilities. The solution will include the design and mechanism of operation of a convenient method of train access from low level platforms in a failsafe mode.

The things we should particularly look at opportunities of easy retro-fitment and seamless integration in the current design of coaches serving different age groups and physical capabilities. Often, cases of accidents like falling of passengers during entraining/detraining due to the horizontal as well as vertical gaps between platform and coach floor of the trains are reported. Due to space constrains as per Diagram-1D and Diagram-2 of Indian Railway Schedule of Dimensions (IRSOD) followed for Indian Railways coach design, and due to coach behavior in dynamic conditions, the horizontal gap between platform and coach floor can't be disturbed, but redesigning of complete entraining/detraining arrangement including door with fixing arrangement, footsteps and door handle compatible with platform may be exercised. IR is desirous to review, exercise and upgrade this existing design of complete entraining/detraining arrangement compatible with platform for AC 3-Tier Sleeper Coach of ICF design to CSC-1722 in such a way that a system (as per ergonomic comfort) between platform and coach floor can be

provided for passengers comfort for entraining/detraining in AC 3-Tier Sleeper Coach of ICF design to CSC-1722.

- Retrofit ability.
- Ease of use.
- Maintainability.
- Adherence to presently provided overall dimension and space Envelope, under all circumstances.
- Ruggedness to withstand repeated rough usage with people and heavy luggage and vibrations due to dynamic forces up to a level of 3g.
- Able to cater to all Genders and Ethnic Groups.
- Aesthetically pleasing and passenger friendly.

II. RESEARCH METHODOLOGY

Survey Conducted: This is a real time survey carried out by project team at Green Park, Dhule, Dhule city has a railway terminus, which is connected to nearest railway junction at Chalisgaon. A passenger train runs between the two stations four times a day. The train also carries reserved coaches for Mumbai and Pune, which are connected to another train from Chalisgaon onwards.

Observations: On a railway, the platform height refers to the height of a railway platform Above Top of Rail (ATR). A related term is "train floor height" which is the height of the floor of the rail vehicle. Worldwide, there are a large number of incompatible standards for platform heights and train floor heights. When raised platforms are in use, the train width must also be compatible, to avoid both large gaps and mechanical interference which causes equipment damage. Differences in platform height (and platform gap) can pose a risk for passenger safety. Platform ramps, steps, and platform gap fillers together with hazard warnings such as "mind the gap" are used to reduce risk and enable access. Platform height affects the loading gauge, and must conform to the structure gauge physical clearance specifications for the system.

The average gap between a local's footboard and the platform is 14 to 18 inches, with an average step in houses and offices measuring 5 to 8 inches, the killer gap is as large as three to four steps. The gap between the train and platform is expressed as vertical and horizontal gaps, as shown in Figure 1.2. The horizontal gap is measured from the platform vertical edge to the front face of the tread plate. The vertical gap is measured from the platform horizontal edge to the top face of the tread plate. These gaps are influenced by platform construction, tolerances, movement of the track and the type of train in operation. Even though these gaps are not desired, it is not practicable to attain a zero gap. A certain clearance should be included in the platform design to accommodate for variations in track and train to avoid moving trains hitting the platform. Since the gaps are unavoidable, the following two tasks are essential to mitigate this platform gap issue:

Firstly, it is very important to know the optimum gap for easy access by passengers.
Secondly, suitable gap-closing solutions should be deployed into the platform system
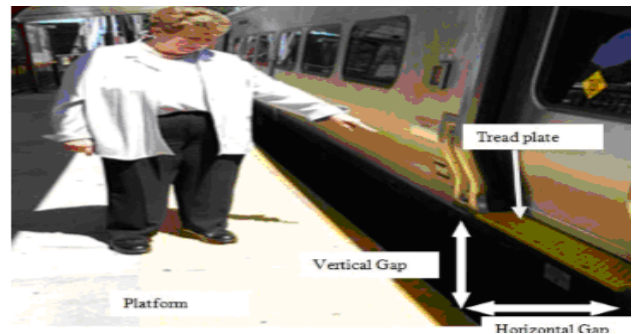

Fig 1.2 Horizontal Vertical Gaps.

There has been much research and field study done to find out the acceptable gap settings for different kinds of passengers. In a field study for the Significant Steps project, 120 people, including people with disabilities and people without disabilities, were used in the study to board and alight with different gap settings. The study finally concluded that the acceptable stepping distance parameter (when the step height from the platform and the gap width are added together — H+V) should not exceed 200 mm, and that a stepping distance of 300 mm is unacceptable.

Accessibility standards: Considering the importance of having optimal platform gaps, several government organizations have developed accessibility standards, and these are discussed below.

- In Europe the Rail Vehicle Accessibility (Non-Interoperable Rail System) Regulations 2010, under Schedule 1, Part 1.1.2, states that, for wheelchair independent access, the vertical gap should be less than 50 mm and the horizontal gap less than 75mm.
- In United States According to the Americans with Disability Act (Accessibility Guidelines for Buildings and Facilities), clauses 10.3.1.9 and 10.3.2.4, the vertical gap between vehicle floor and platform should be less than 5/8 of an inch (15.875 mm), and the horizontal gap should be less than 3 inches (76.2 mm) for new constructions. The vertical gap between vehicle floor and platform should be less than 1.5 inches (38.1 mm), and the horizontal gap should be less than 3 inches (76.2mm) for existing constructions.

Factors affecting platform-to-train gaps: In order to effectively address the platform gap issues, it is essential to study and analyze the factors that determine the gap and its dimensions. The various factors identified by Significant Steps research are briefly discussed here
Step height is the distance between the tread plate and the platform measured vertically from the platform to the top of the tread plate. Generally, vehicle floor heights are kept

higher than platforms for safety margins that can accommodate variances in platform heights due to vehicle suspension displacements. This particular factor can be further explored in order to reduce the gap in terms of step height distance.

Step thickness has an effect if the gap is measured from the bottom of the tread plate. However, this factor is not an influential one, as the vertical gap is measured to the top of the tread plate.

Train floor height is one of the important factors, as the tread plate placement is in relation to the floor height. This has a major effect on the gap between the train and the platform. Optimization of the train floor height can be helpful in reducing the vertical gap between train and platform

The kind of suspension used to absorb or isolate the vibration and impact loads from the wheel–rail interface also plays an important role. The softer the suspension, the more vertical displacement the vehicle will experience on the train load. The train-to-platform gap can be reduced by optimizing the suspension system without sacrificing customer comfort.

The smaller the diameter of the vehicle's wheels, the lower it will ride, providing a shorter stepping distance, assuming that the train floor is above platform height. Smaller wheels will result in quicker wear (as there are more revolutions)

The low level platform height is 810 mm (Stephensen 1994). The new high level platform height is 1050 mm — the lower the platform, the greater the stepping distance. Existing EMU trains have a tread plate height of 1100 mm, and considering tolerances, wear and track settlement, the platform will always be slightly lower than the tread plate for consistent access of passengers (Stephensen 1994)

The standard minimum horizontal distance between the centreline of the track and the platform is 1550 mm (Stephensen 1994). If this distance is greater, then the stepping distance is greater. This is known as the offset of the platform. A greater offset may be required to allow rolling stock to pass the platform at high speed. If all rolling stock using the line stopped at the station, it may be possible to provide a smaller offset.

The greater the radius of curvature of the track, the more the train is 'thrown' off its centre line (curvature is measured as a radius from the theoretical centre of the arc). When considered alongside the door position, the stepping distance can be greater on convex curved platforms when the doors are at the vehicle ends (outboard), and on concave platforms when the doors are towards the centre of the vehicle (inboard).

The greater the speed that trains are permitted to travel, the greater the vehicle sway from the centre line. Therefore, at platforms where trains are permitted to pass at high speed, allowance has to be made for greater vehicle sway, meaning that the platform edge has to be further back, resulting in a greater stepping distance.

When trains travel around curves, the ends and the centre of the trains are 'thrown' outside the track centre line. The same is true if the train is stationary at a curved platform. The position of the train doors will impact on the stepping distance. To achieve the best compromise, it is preferable for the doors to be over the bogies (wheels). The amount of throw that the vehicle experiences at the doorway affects the stepping distance.

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Accidents due to platform gap in India:
  Year 2015- 40(Death), 26 (Injured)
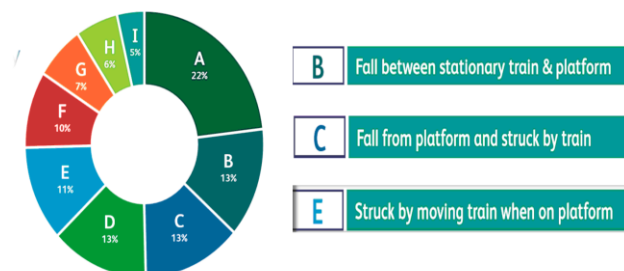 Year 2016- 13 (Death), 19(Injured)
Graphical statistics:

Fig .3. Pie Chart.

As we can observe from graphical form the accidents due to gap of the platform and train itself is 37%

III. SYSTEM DEVELOPMENT

1. Generalized block diagram of system:

As in the above block diagram we can visualize a train Engine and a coach, here at a starting side of engine there is a station side sensor which is a primary sensor (ultrasonic sensor) which detects the arrival of the station side on which side the station is and according to it the side steps will be powered to open. The secondary sensor is placed on starting of the coach which will detect the

height and the distance gap between station ,according to the gap and the distance measure by the secondary ultrasonic sensor gird the folding steps of the coach will be powered to open automatically

The whole hardware panel is to be mounted in the Train engine as well as there is a manual switch which will be access by the train driver, in case there is an emergency to open the steps the driver will turn on the switch which will power on steps to open in emergency.

2. Detailed parameters of the system:
- Sensing
- processing
- controlling

for sensing we are using ultrasonic sensor as mentioned in block diagram, processing is carried by pic16f887a controller, which will control the power steps via DC motor for each step grid there is a set of two motors required to open the power steps

As well as there is manual control given to the driver of train to power up the steps by a single switch in emergency

For sensing we are using ultrasonic sensor HC-SR04

Features: Hc-SR04 Ultrasonic Distance Measuring Module Can Provide 2Cm-400Cm Non-Contact Distance Sensing Function, The Range Accuracy Is Up To 2Mm The Module Includes Ultrasonic Transmitter, Receiver And Control Circuit. Adopt Io Port Trig To Trigger Ranging, It Needs 10Us High Level Signal At Least, Module Can Send 8 Of 40 KHz Square Wave Automatically, And Will Test If There Is Any Signal Returned, If There Is Signal Returned, Output One High Level Signal Via Io Port Echo. The Duration Of The High Level Signal Is The Time From Transmitter To Receiving With The Ultrasonic. Testing Distance = Duration Of High Level Time X Sound Velocity (340M/S) / 2. Net Weight: 8G/ 0.28Oz Size: 45 X 20 X 15Mm/ 1.77 X 0.79 X 0.59In. Color: Blue Operating Voltage: Dc 5V. Operating Current: 15mA
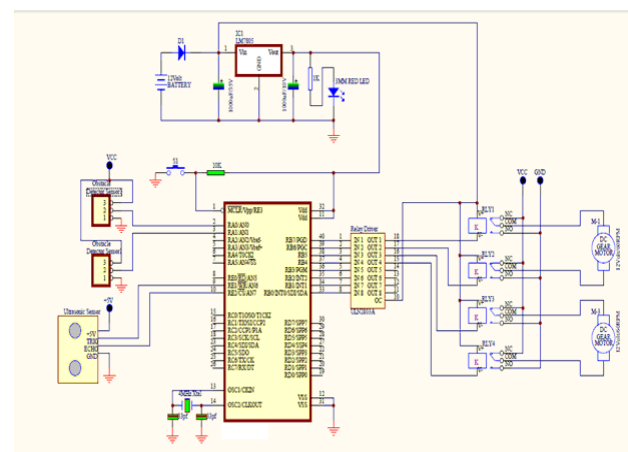
3. Designing for hardware

Fig.4. Circuit diagram.

Power supply: In this system 12VDC battery is used as a supply for both controller and relay i.e. 12v dc motors, for controller we need 5VDC supply for that case we have make it to 5v by using LM7085 regulating IC which generates 5V regulated supply and led is just an indication of the output

Controller: This system arduino uno The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. Pinout Added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible both with the board that uses the AVR, which operate with 5V and with the Arduino Due, which operate with 3.3V. The second one is a not connected pin, that is reserved for future purposes.

- Stronger RESET circuit.
- Atmega 16U2 replace the 8U2.
- Microcontroller ATmega328
- Operating Voltage 5V
- Input Voltage (recommended) 7-12V
- Input Voltage (limits) 6-20V
- Digital I/O Pins 14 (of which 6 provide PWM output)
- Analog Input Pins 6
- DC Current per I/O Pin 40 mA
- DC Current for 3.3V Pin 50 mA
- Flash Memory 32 KB (ATmega328) of which 0.5 KB used by bootloader
- SRAM 2 KB (ATmega328)
- EEPROM 1 KB (ATmega328)

Clock Speed 16 MHz The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts. The power pins are as follows: VIN. The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin. 5V.This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it. 3V3. A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA. Ground pins. The ATmega328 has 32 KB (with 0.5 KB used for the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

Ultrasonic sensor:HC-sr04 ultrasonic distance measuring module can provide 2cm-400cm non-contact distance sensing function, the range accuracy is up to 2mm.the module includes ultrasonic transmitter, receiver and control circuit. Adopt Io port trig to trigger ranging, it needs 10us high level signal at least, module can send 8 of 40KHZ square wave automatically, and will test if there is any signal returned, if there is signal returned, output one high level signal via Io port echo. The duration of the high level signal is the time from transmitter to receiving with the ultrasonic. It will sense the height and gap between station and train, this signal is provided to microcontroller for further processing

Relay driver: ULN2003A relay driver IC is used in our system to increase the current carrying capability for relay because the microcontroller provides the output from port pin is just near about 5v and the relay need 12 v to recognize the input as the input signal it operates on 12v supply.A relay is an electromechanical switching device that allows a high power circuit to be controlled by a small input current, using an electromagnetic coil to operate a set of changeover switches. When a supply voltage is connected to the coil, current flows and a magnetic field will be produced that attracts the armature to close one set of contacts and/or open another set which in turn switch a load on/off. On de-energizing the relay, the magnetic flux in the coil collapses and produces a fairly high voltage in the opposite direction. This resulting voltage can damage the driver transistor and thus a reverse-biased diode is connected across the coil to short-out the spike when it occurs.

DC Motors: DC Motors fall into the category of Electrical motors that converts electrical energy into mechanical energy. There are several kinds of DC Motors. They work on the principle that when a current carrying conductor is placed in a magnetic field, it experiences a torque and has a tendency to move which is known as the motoring action. If the direction of electric current in the wire is reversed then the direction of the rotation is also reversed. When magnetic field and electric

field interact they produce a mechanical force which causes the direction of rotation of this motor to change and is given by Fleming's left hand rule which states that if the index finger, middle finger, and thumb of your left hand are stretched mutually perpendicular to each other and if the index finger represent the direction of the magnetic field, middle finger represents the direction of the electric current the then the thumb represents the direction.

V. FUTURE SCOPE

This paper is a small scale effort but the same can be implemented with enormous results in a large scale that will benefits Indian railways and passengers . This steps can be made with the help of smart hydraulics not only this with the help of aerodynamics we can make this steps much more compact than this steps. We can also make this with the help of mechatronics of spring through mechanism there is research which is going in Japan on this folding step mechanism for trains.

- Future scope of this type of project is very bright because it is very useful in railways to reduce accident.
- It gives smooth Accessibility to low level platforms

VI. CONCLUSION

A number of technical design factors that are related to platform-train-interface (PTI) safety have been discussed based on stakeholder input and an extensive literature review. From the background information available some useful conclusions could be made. As previously discussed, platform size and shape can have a significant impact on safety. In general, as the size of the platform increases the possibility of crowding is reduced and thus overall safety improves.

It was also determined that straight platforms present fewer problems in relation to horizontal gaps than curved platforms. It should also be noted that curved platforms are more often a problem on legacy systems and not recently constructed lines. Certain gap mitigation technologies have started to be used more frequently, and these include; gauntlet tracks, movable platforms, and rubberized platform edges. In each case, the gap fillers need to be approved by the host railroad for compatibility. Which technology is employed is largely a function of mode type and specific platform characteristics. Through the literature review and interviews it was found that horizontal gaps tend to present more significant problems than vertical gaps between the platform and train.

VII. ACKNOWLEDGMENT

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AUTHOR PROFILE

Sanket Nawale Electronics and telecommunication Engineer(2018)