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Automatic Protection System And Risk Mitigation In Railway Using PLC

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Abstract : *This Paper Presents An Automatic Railway Protection System By Controlling And Monitoring The Train Movements Using PLC. Nowadays Even Though Automation Plays A Vital Role In Almost All Areas But Still Railway Protection And Control System Is Not Completely Automated. Currently The Railway Network Protection Parameters Like Gate Control, Identifying Track Cracks, Track Collision, Grade Crossing, Traffic Light Indication Etc. Are Controlled Individually Either Manually Or Semi-Automatically By Their Respective Processes. Even Then A System To Control All Parameters Simultaneous Does Not Exist To Ensure Safety Operation And At The Same Time The Entire Control Is Given Only From Control Room Using Embedded Technology Which Is Tedious In Monitoring And Providing Required Control Under Critical Situations. To Overcome These Problems, The Proposed Research Provides Both Monitoring And Control Of All The Above Said Parameters With The Provision Of Issuing Automatic Control In The Locomotive Itself Using PLC*

Keywords - *Programmable Logic Controller (PLC), Automatic Protection, Level Crossing (LC), Track Crack, Collision, Grade Crossing, Anti-Collision*

I. INTRODUCTION

Indian Railways Is The World's Fourth Largest Railway Network In The World. Railway Safety Is A Crucial Aspect In Railway Operation. Railways Being The Cheapest Mode Of Transportation Are Preferred Over All The Other Means Available. To Avoid Various Accidents The Proposed Research Analyzes Few Vulnerable Areas Of Accidents And Helps To Find Out The Possible Ways To Reduce Number Of Accidents. The Accidents Occurring Are Mainly Due To Carelessness In Manual Operations Or Lack Of Skilled Workers. The Proposed System Describes Few Major Features Namely Anti-Collision, Automatic Gate Control, Accident Detection, Track Crack, Traffic Light Indication And Grade Crossing. The Anti-Collision System Will Avoid Collision Between Two Trains Or Train Hitting A Heavy Mechanical Object, Automatic Gate Control Will Reduce Accidents Occurring At Railway Crossing And Accident Detection Will Enable Immediate Help Needed After The Accidents Taking Place Without Human Interference.

Fire	Station Fire	Station Fire Is Defined As An Incident Involving Fires In Both The Public And Non-Public Areas Of The Station Including Disused Areas And Tenancies.
	Train Fires	Train Fire Is Defined As An Incident Involving Fire On Any Part Of A Train Both Internally And Externally.
Train Accidents	Derailment	Derailment Is Defined An Incident Where A Train Comes Off The Rails Due To An Unplanned Event
	Collision Between Trains	Collision Between Trains Is Defined As An Incident Where There Is An Impact Between Two (Or More) Trains.
	Collision Hazard	Collision Hazard Is Defined, As An Incident Involving An Impact Between A Train And Another Object Which Is Not Another Train.

Table : List Of Major Accidents

The Recommended Automatic Railway Protection Control System Provides The Overall Control For The Locomotive Considering Above Said Parameters With The Help Of Single PLC. The System Provides Control For Automatically Closing And Opening The Gate, ON/OFF Traffic Lights Indication For Status Of Gate Open And Close, Anti- Collision Of Two Trains At Same Track And Identifying Track Crack By Using Ultrasonic Sensors.

II. Literature Survey

Level Crossings (LC) Are Considered To Be A Safety Black Spot For Railway Transportation Since LC Accidents/Incidents Dominate The Railway Accident Landscape In Europe [1]. LC Safety Is A Major Concern For Railway Stakeholders And Transportation Authorities. The Principle Of Parallel Monitoring

Controls Some Key Operations Such As Train Tracking Interval, Interlocking And Train Speed Limit Protection [2].

The Current Railway System Converting The Manned As Well As Unmanned Railway Gate Into An Automated Railway Gate Controlling Unit. Automatically Switching Between Railway Tracks And Running The Train Automatically.[5]

Risk Assessment Assesses The Risk From Major Hazards With The Potential To Cause Fatality To Our Customers And Other Members Of The Public. This Includes Risks Imported To Our Operations Through The Activities Of Other Members, Such As Trains Corporation, Rail Line Corporation, And Station Corporation, Etc.[6] PLC Based Traffic Light Control System Controls The Traffic In Railway Track Using PLC [3].

Detection Of Fault In Railway Track With A PLC Based Automated Fault Detection System Completely Eliminates The Human Intervention For Detecting Faults. It Provides A High Speed Fault Detection System That Automatically Communicates The Predicted Railway Track Defects Information Immediately To The Concerned Railway Traffic Control Room By Using GSM System, Hence This Will Reduce The Accident Rates And Loss Of Precious Life.[7]

III. Methodology

Railway System Protection Using PLC/SCADA Deals With The Railway Network Protection Parameters Like Gate Control, Identifying Track Cracks, Track Collision, Track Changing And Traffic Light Indication.

IV. Proposed System

The System Block Diagram Depicts The Overall Functioning Of Proposed Automated Railway Protection System Using PLC. It Comprises Of Various Sensors Like Color Sensors, Ultrasonic Sensors Etc. For Sensing The Parameters To Be Controlled And Monitored For Avoiding Collision, Track Cracking, Gate Control, Traffic Light Control, Track Changing. All The Above Mentioned Five Parameters Are Sensed Simultaneously And Control Will Be Given By PLC Installed In The Locomotive.

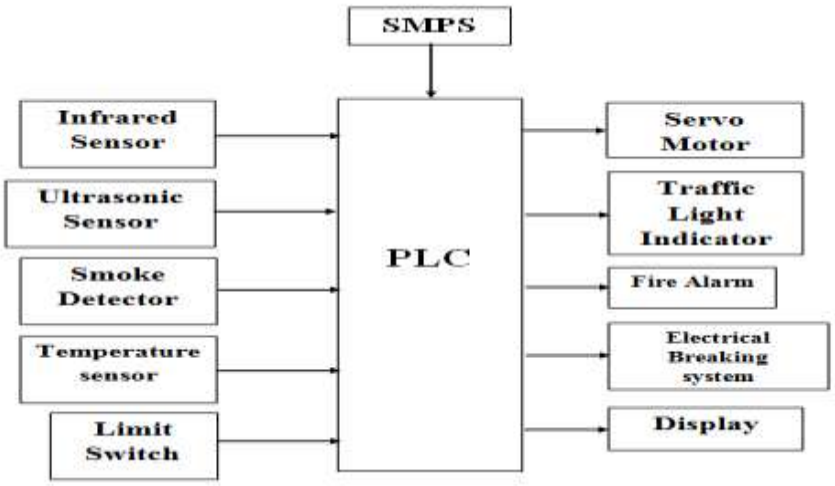

Figure 1: Functional Block Diagram Of Proposed System

V. Working

GATE CONTROL AND TRAFFIC LIGHT INDICATION

The Signal From Color Resistive Sensor Will Play Important Role In Gate Control And Traffic Light Control Process. When PLC Receives Signal From Sensor 1 Then It Produces The Output Based On Ladder Program Which Is Fed To Stepper Motor Driver For Closing The Gate. When The Gate Is In Closed Position, Traffic Light Indicate Green Signal For The Train.

Similarly When PLC Receives Signal From Receiver 2, It Indicates That The Train Has Passed Away And PLC Issue Control Pulse For Stepper Motor To Open The Gate Which Is Indicated By Red Signal For Level Crossers.

Figure 2: Automatic traffic light indication

(2) TRACK CRACK

Different Sensors Can Be Used To Sense The Track Cracks. Here Ultrasonic Sensor Is Used To Find Cracks In Railway Track. In The Areas Of Bends Or Curves, There Is A Gap Between The Rails Of Successive Different Paths. Even Though It Is A Small Gap, The Train Would Get Mislead And May Travel In A Different Path Which Leads To Collision In Most Of The Cases. Ultrasonic Sensors Are Used To Detect The Gap. When PLC Receives Signal From Sensor According To Program Written, It Produces The Required Control Signal For Electromagnetic Braking. It Is Used To Control Train Speed And Train Can Be Stopped Before 800 Meters To 1 Km In Order To Avoid Train Accidents**.**

(3) ANTI-COLLISION

Anti-Collision Will Be Implemented Using Obstacle Sensors Fitted On The Train Side. The Obstacle Sensor Senses The Obstacle Using Infrared LED And Infrared Detectors. The Signal Will Be Fed To PLC. As Soon As The Signal Is Received, PLC Will Take Necessary Action To Stop The Train. The Obstacle Sensor Essentially Is A Transceiver Which Helps To Transmit Signal To Programmable Logic Controller (PLC).

Using The Same Principle As For Gate Control, We Have Developed A Concept Of Automatic Track Switching. Considering A Situation Where In An Express Train And A Local Train Are Travelling In Opposite Directions On The Same Track, The Express Train Is Allowed To Travel On The Same Track And The Local Train Has To Switch On To The Other Track, Indicator Lights Have Been Provided To Avoid Collision.

Figure 3: Automatic Track Switching

Here The Operation Is Performed Using A Stepper Motor. In Practical Purpose, This Can Be Achieved Using Electromagnets. Collision Means Two Trains At The Same Track In Opposite Direction Or Same Direction. Most Of The Collisions Are Of The Types Of Running Train Colliding With The Standing Train Types. Here IR Sensors Are Used To Detect The Presence Of Train In Same Or Opposite Direction. Transmitting/Receiving Circuit Consisting Of IR LED Driver. IR Sensor Is An Electronic Instrument That Is Used To Sense The Object And Detect The Motion. IR Sensor Emits Narrow Beam Of IR Rays Which Is Used To Find The Presence Of Any Train Before The Running Train. If There Is Any Train Running Behind The Train, Receiving Circuits Receives IR Beams, It Is Also Capable Of Determining Relative

Velocity Between The Train And The Target. Those Signals Are Send To PLC. Then According To The Program, It Sends The Required Signal To Electromagnetic System. This Controls Train Speed Within Certain Distance**.**

(4) TRACK CRACK

Collision Process And Track Cracking Is Interfaced In Electromagnetic Braking System.

(5) FIRE PROTECTION

Fire Protection Is Provided With Smoke Detector To Avoid Any Further Damage To Human Beings And Also To The Train Itself. This Will Give Signal And Also An Alarm Which Is Located In Engine To Grab The Attention Of Train Driver To Stop The Train At Nearest Station.

VI. Plc Based Simulation

In This Project ABB's AC1131 Software Is Used For Development Of Ladder Diagram And Visualization Purpose. We Have Preferred PLC Instead Of Relay Control Panel Owing To Easier Wiring, Can Be Reprogrammed As Per Requirement, Less Space, More Input Output Devices Can Be Connected Using Modules And Extension, Easier Maintenance, Digital Functioning And Very Less Chances Of Hardware Failure.

VII. CONCLUSION

Nowadays The Railway Protection System Can Be Done Either By Manual Process (Or) By Semi-Automatic Process Using Embedded System Technology. The Intention Of The Proposed Is To Provide Control For The Above Discussed Parameters Like Track Change, Track Collision, Track Crack, Gate Control And Traffic Light Indication Using Single PLC Installed In Locomotive Itself. This Reduces The Drawback For Having The Control Unit In Each Compartment When Using Embedded System. With The Help Of SCADA The Entire Sequences Of Operation And It Can Also Be Monitored Easily By The Driver Hence Entire Control Action Can Be Assured Quickly. This System Provides A Remarkable Change In Railway System For Protection Purpose With Affordable Cost.

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