Modeling of Semaphore Signaling using PLCC in Railways

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Abstract— Railway is the most economical mode for transport in the India. Signaling in the railways plays a vital role to direct the trains in a right way at a right speed towards the destination. A single miscommunication in the signaling may lead to catastrophe in railways. This design tries an approach to improve the mode of communication (signaling) using PIC microcontroller and to avoid the train collision using power line carrier communication and semaphore signaling. The location of the train is detected at various parts of same track and it transfers through GSM technology to the controller. When two trains travel in same track the current location of the trains is sent to the control station. The warning signals and controlling signals to the train can also be transferred to the loco pilot using Power Line Carrier Communication (PLCC) providing proper signal alerts to the pilots can guide the pilots to avoid train collision.

Key words: Microcontroller, Semaphore, PLCC (Power Line Carrier Communication), Track Sensors

I. INTRODUCTION

Today train is the most widely used transport system, but accidents are occurring due to collision and most of the accidents are due to signal failure. The goal of this system is to improve the mode of the communication (signaling), which leads to successfully avoid the train collision by semaphore signaling using Power Line Carrier Communication (PLCC). Train can collided due to human error and usage of faulty equipment.

To avoid the train collision, in case of two trains approaching in the same track at the same time oppositely, with high speed which leads to collision. PLCC technology uses advanced modulation techniques which imposes the data signal of high frequency over the low frequency power signal. The system ensures the reliability and accuracy of the train location using sensor modules.

RTOS are provided for the use of semaphores for signaling, when the first train is start on the track, a signal is set as high priority (1) and the signal for the other train has low priority (0).

II. LITERATURE SURVEY

In Ji chan Maeng *et al*[1] describes the APIs (Application Programming Interface) that can capture of typical RTOS services for specific application. When multiple tasks are running and it share the same resource with an interrupt programming it blocks the signals and executes the priority basis high priority tasks executes at first through the ISR service. Semaphore pattern, which is subject to transforms rules. It handles some APIs that access shared resources are often accessed by several concurrent threads. The implementation is developed by automated tool transPI specific tool performs integrated model based set.

Xi Fang, *et al* [2] 'Smart Grid – The New and Improved Power Grid: A Survey 'Power Line Communications (PLC): PLC is a technology for carrying data on a conductor also used for electric power transmission.it is used for remote metering and load control applications. PLC in Smart Grid (SG) is still research one. The SG could use many different communications technologies, PLC is the wired technology that has deployment cost comparable to wireless technologies. Technically, in PLC power electronics are used to manipulate high-voltage waveforms for signal and information oriented applications.

In Ramesh.*et al*[3] designed system with the case with all modes of high-speed travel of train there are different rail conditions (wear, corrosion etc.), there are a significant number of potential defects possible and the task has to be performed with some speed. This analysis is detecting the cracks in the track. These deficiencies are not controlled at early stages they might cause huge economic problems affecting the rail network (unexpected requisition of spare parts, handling of incident and/or accidents). The main part of the work was to carry out a feasibility study on two methods for detection of cracks and Avoidance of the collision between the rails. The detection of cracks can be quickly done by ultrasonic waves or sensor.

In Vishnu Krishnan *et al*[4] proposes a cost effective solution to the problem of railway track crack detection utilizing Zigbee control assembly which tracks the exact location of track damage which then mended immediately so that many lives will be saved. Train Collision Avoidance System (TCAS) and Anti-collision Device (ACD) are used in this system. The sensor network is a wireless network formed by a group of sensors deployed in same region, which can be used to measure the air pressure, temperature, acceleration, etc. Sensors can transmit signals via radio signal.

In Kiruthiga.M *et al*[5] explains in this project, it is proposed to develop automatic railway gate operation to prevent accidents at unmanned gate and automatic closure of unmanned gate. It is also developed to prevent collision of trains running on same track. Automatic closure of unmanned gate reduces the time for which the gate is being kept closed and provides safety to the road users by reducing the accidents. The collision of trains running on same track is also prevented by employing IR Transmitter-Receiver system at each sections of the station and passes the information to a master control room via Zigbee / GSM MODEM.

A. Existing Anti-Collision Device (ACD):

The ACD system take inputs from GPS satellite system for position updates and network among themselves for exchanging information using their data radio modems and then it takes decision. The system works based on infra-red

waves. It consists of an emitter, sensor module and reflector, an emitter and sensor module installed on one train and the reflector is installed on the opposite train. Sensor module senses the presence of train & the reflector reflects the infrared waves back to the sensor and it activates the alarm.GPS signals sometimes will not perform accurate due to obstacles and network problem. We can overcome this problem in proposed system.

III. PROPOSED SYSTEM

The proposed system is designed in such a way to overcome the difficulties discussed above. The sensors are fixed before the traffic signaling point at a specified distance before and after the station. The sensor sends the data about the location of the trains. The data's obtained are analyzed depending upon the distance of the train which is nearest to the station is given first priority. This system works depending upon the priority of trains nearest to the station. This system includes Sensor module. Signal center, Control section and pilot area. Sensor module detects the location of the train.

The traffic signal is opened for the nearest train and the train occupies the track in the station. The signal for the train which is waiting is opened to use another track. At that time the traffic signal is closed for the train which occupies the track in the station. An alert SMS is given to the pilot who is waiting for signal regarding the availability of the track in the station.

Once the signal is blocked for the train in the station, the signal for the train which is waiting opened .Now the next train can used the regular track to travel. Now both the trains can occupy the tracks that are provided in the station. When the train enters the track the RTOS (Real Time Operating System) detects that event as (1) and the semaphore is an active state until the next train is in waiting state (i.e.) event as (0).

IV. BLOCK DIAGRAM

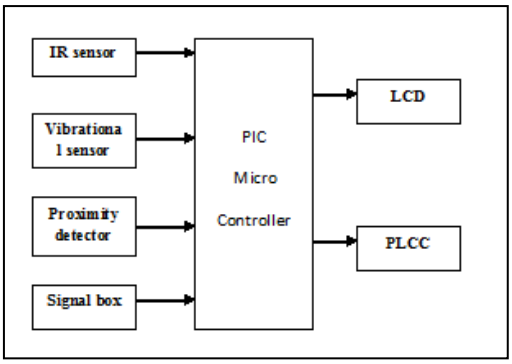

Fig. 1: Block Diagram of Proposed System Transmitter Module

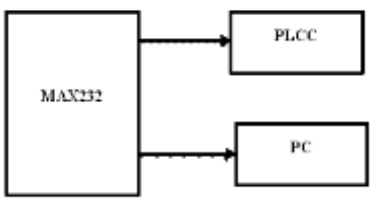

Fig 2: Block Diagram of Proposed System Receiver Module

In this design IR sensors are used to find the cracks in the railway tracks. Proximity detectors are used for communication purpose in Global Positioning System and also vibrational sensor plays the role to indicate the arrival and departure of trains to the control station. Maximum sensors have to fix in a specific distance from the station. These sensors signals from the various parts controlled by microcontroller and sent to control station through PLCC.

Depends on the status of the sensor signals, signaling will be provided to the train. Signal boxes are placed in the interlocking of the tracks.

A. Hardware Implementation:

This system was designed using microcontroller and all sub components controlled through pic microcontroller. Power line carrier communication transmit the signals at high voltage stage also which has coupling capacitor to overcome the damage of power lines and its frequency range is 100Hz to 50KHz. Coupling capacitor offers the high impedance to power frequency& low impedance to the carrier frequency and attenuation is not much while transmitting which offers by thicker cross section. In this PLCC cross talks are practically avoided and noise level is reduced and for network extra lines can be avoided.

In this module pic microcontroller is connected to the PLCC modem and it is interfaced with LCD display. Depending upon the sensors signal, LCD displays the track status. This transmitter section communicates the signal to receiver module through USART communication. Receiver module implemented by MAX232 IC.

B. PIC Microcontroller:

PIC microcontroller is used in the hardware module it supports USART communication. USART can perform both transmit and receive the data. The most common use of the USART in asynchronous mode, it is used to communicate to a PC via serial port RS-232 protocol. A driver module is required to interface to RS-232.PIC MCU (Micro Control Unit) should not be directly manages this voltage level.

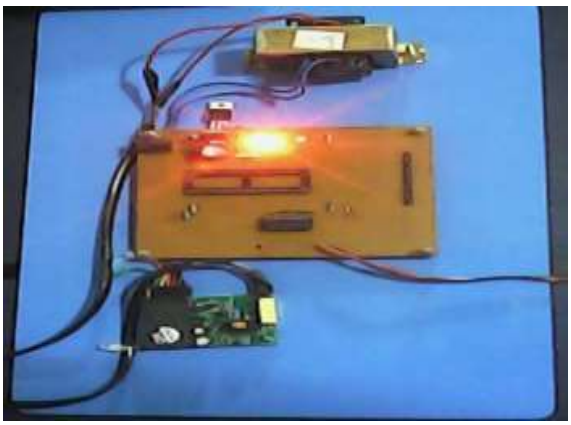

Fig. 3: Receiver Module

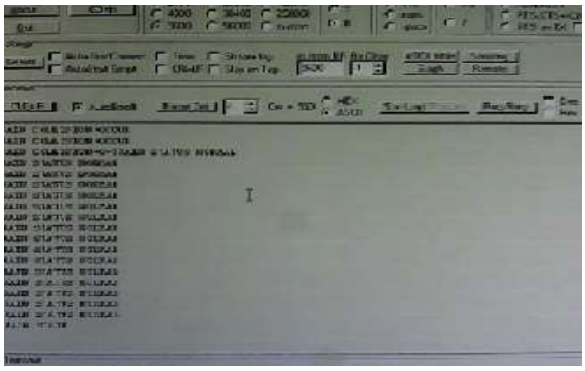

Fig. 4: MPLAB Output

Fig. 5: LCD Output

V. SOFTWARE IMPLEMENTATION

A. *Algorithm:*

1) Step1: start the program
2) Step2: if the track is free set as high priority 1 the train can move on
3) Step3: LCD displays track status is normal.
4) Step4: else the track is engaged set as low priority 0 train has waiting state.
5) Step5: LCD displays train collision can occur and indication will be provided.
6) Step 6: stop the program.

B. *Flowchart:*

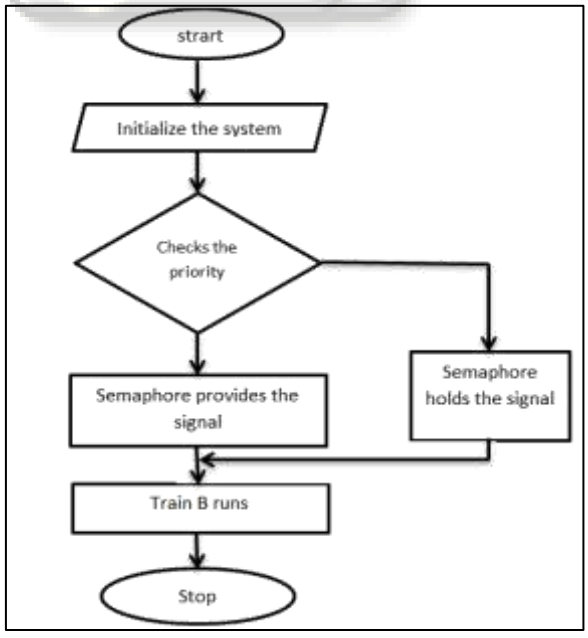

Fig. 6: Flow Chart

VI. SIMULATION RESULTS

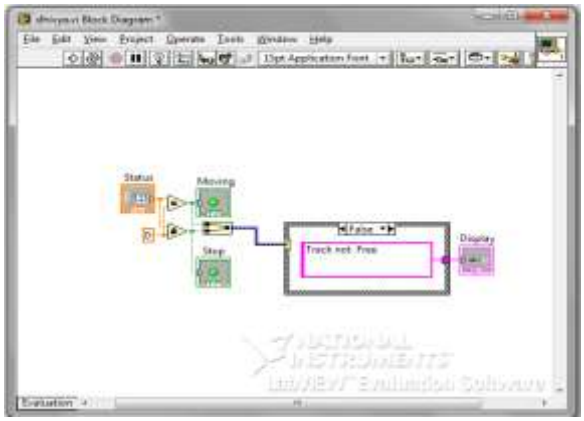

Fig. 7: Block Diagram in LabVIEW

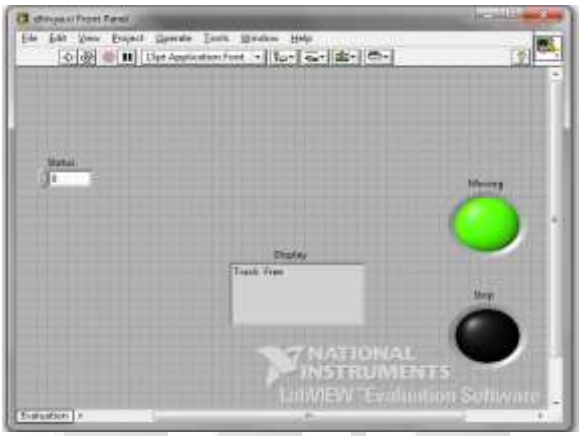

Fig. 8: Front panel in LabVIEW

The station 1 and station 2 status are displayed in LabVIEW components from various signal received from the sensors which are fixed in various parts. These information are provided to control room. Here it indicates that station 1 is engaged with train and information on the other station also provide at same time. If the track is free LED will glow. Based on the status of the track (Engaged or free). The train will make its schedule.

A. *ARM Processor Results:*

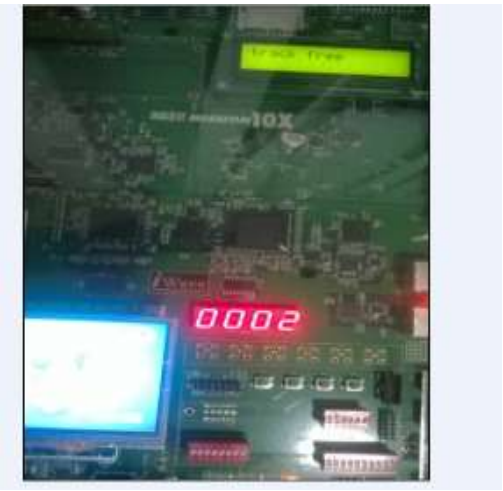

Fig. 9: Track Free Out In ARM Kit

Fig. 9: Track Engaged Output in ARM Kit

In the ARM 8 kit, the control panel consists of whole stations status such as train id and number, train location, arrival and departure time. When selecting an option 1, it represents the Status of station1 in this ARM kit control panel contains as mentioned above details. If the track is engaged with train means it displays in LCD module as track engaged. Otherwise LCD displays track free then only the signal will be provided train can move on. We can check each stations status through this system easily.

VII. RESULTS COMPARISON

In ARM processor kit, if the track is free, it indicates the Green color in GLCD (Graphical LCD) and the indication message is displayed in LCD. If the track is engaged with train, it indicates the red color in GLCD and the message is displayed in LCD. So by comparing both the LabVIEW and Eclipse software, LabVIEW is used to identify the status of station by using the LED. By using the Eclipse software, the status of the station is represented using the color representation of GLCD.

VIII. CONCLUSION

The Proposed system deals with efficient way to avoid train collision using semaphore signaling in railways. it maintains the various control signals through PLCC which avoids complex cable usage. It is used deluge number of sensors on the long track which senses the status and sends the status to the control station. Thus the received signals are analyzed and resend to the train operator for ease control of train. The simulation work has been done using LabVIEW and the proteus designed by using PIC microcontroller. The future expansion of the system will be prevent the major train collisions and can save the life.

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