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Train Accident Prevention Control by Multi Core Embedded Processor

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***Abstract*— The main objective of this proposal is to avoid the train accidents using High Performance Multi-core Embedded Processors (MCEP).This method will overcome the difficulties faced by the existing methods such as detecting cracks at rails, monitoring distance between rails, compartments monitoring, fire and smoke monitoring in compartments, and controlling of motors, transformers, pantograph etc. by manual operations. From the point of view of energy efficiency, the challenges of traffic fluidity control, energy efficient driving, regenerative braking, and managing power consumption in electrical devices in trains. To reduce human errors and get the fast response, MCEP will be a wonderful one.**

***Index Terms*— Multi-core Embedded Processors (MCEP), Train Parameters, and Electric Locomotive Engine (ELE), Proteus (simulation).**

I. INTRODUCTION

MCEP will strongly enhance the safety, speed, and control characteristics of train in real time without requiring of physical manpower. Due to advent of Wireless communication technologies and high speed Powerful Processors, Automation will be done to satisfy flexibility, reliability, efficiency of trains. Generally, Multi core processor is an integrated circuit to which more than two processors have been attached for enhanced performance, reduced power consumption, and more efficient simultaneous processing of multiple tasks. Ideally, a dual core processor is nearly twice as powerful as a single core processor. In practice, performance gains are said to be about fifty percent: a dual core processor is likely to be about one-and-a-half times as powerful as a single core processor. Multi-core processing is a growing industry trend as single core processors rapidly reach the physical limits of possible complexity and speed. Companies that have produced or are working on multi-core products include AMD, ARM, Broadcom, Intel, and VIA. Due to the parallel processing, speed of operation will be very fast like pipe lining operation to get required results in real-time. Multi-core processors are widely used across many application domains including general-purpose, embedded, network, digital signal processing (DSP), and graphics. Although there is failure in the one processor, the tasks will be quickly exchanged with other processor without much delay. It is very useful for Embedded Applications. Until now, multi-core processors for the desktop and server markets have garnered the lion's share of media attention. But multi-core is also taking root in the embedded industry, with the introduction of processors such as the dual-core Free scale MPC8641D, the dual-core Broadcom BCM1255, the quad-core Broadcom BCM1455, and the dual-core PMC-Sierra RM9000x2. Wireless Sensor Network consists of spatially distributed autonomous sensors to cooperatively monitor physical or environmental conditions, such as temperature, smoke, sound, vibration, and pressure etc.. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance. Utterly, the train automation could be done for Train Protection and assurance, Train Operation, Train Supervision and Communication

II. LITERATURE REVIEW

Monitoring fire accidents at coaches and other abnormalities will be tracked and processed with single processor or controller may give output with more delay as well as slow response. Monitoring electrical and thermal parameters level in ELE manually will not be an efficient methods. Detecting cracks at rails and checking track dimensions manually cannot provide excellent results. Although the modem trains have come up with latest technologies to run and control trains, MCEP interfaced with other methods will definitely give robust and precise operations.

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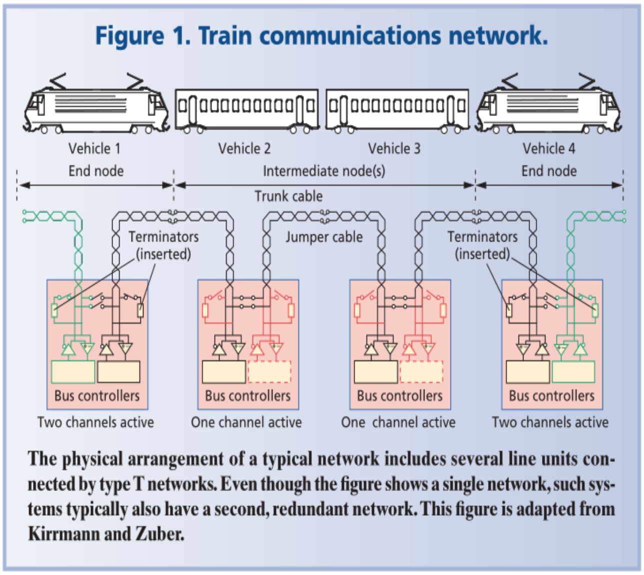

Fig.1:Existing System Model

III. PROPOSED SYSTEM

This proposed system gives the efficient way of automating trains using MCEP along with other modules to reduce human operational errors, power consumption, high reliability, and fast operation without delay. It consists of hardware and software modules to execute the train operations.

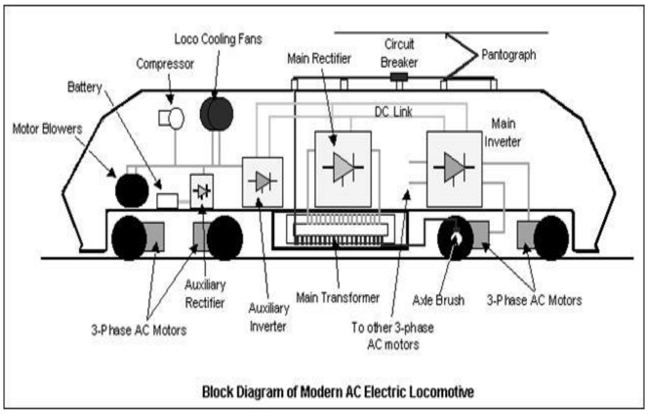

Fig.2: Block Diagram of Electric Locomotive

System Architecture:

The system consists of many functional units such as Laser-based Ultrasonic rail flaw inspection unit; Track Dimensions monitoring unit; Electrical machines control unit; Monitoring of Electrical and Mechanical Characteristics at ELE and Monitoring of compartments presence in wireless mode; and Multi-core Embedded processors central unit etc.

Fig.3: Block Diagram Representation of Proposed System

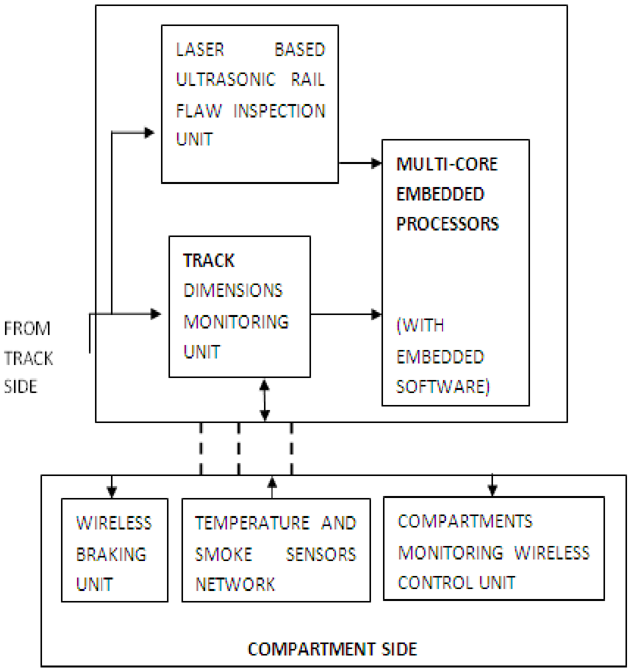

Fig.3: Block Diagram Representation of Proposed System

Here MCEP plays vital role i.e. it is heart of this proposed system. Every functional unit could be interfaced with MCEP using wired and wireless mode. Fig.1 shows Block Diagram Representation of Proposed System.

HARDWARE MODULES OF THE SYSTEM:

A. Multi-core Embedded Processors (MCEP):

Many number of Embedded processors have been fabricated on a single silicon die i.e. Chip. Big job will be divided into more number of tasks with priority. Each task will utilize the corresponding processor and execute their application in real-time quickly. Owing to MCEP, if there is any failure in one processor, automatically running task will easily switch over into other processor without delay. As a result, overall efficiency and response of the system will be increased.

B. Non- Contact Laser-based Ultrasonic rail flaw inspections Control unit:

In fact, train derailments caused by broken rails still occur. Defect monitoring may be affected by rail surface condition, railhead geometry, defect geometry and orientation, electrical and/or mechanical noise introduced into the transducer, and inadequate transducer-to-rail surface coupling. To avoid this problem, Non- Contact Pulsed Laser-based Ultrasonic rail flaw inspections Method is available. In particular, this method, consisting of a pulsed laser and an air-coupled transducer will be mounted at the front side of ELE. It has the following advantages: 1) Flexibility to discover cracks that are not detectable with methods currently available to the railroad industry;2) Inspection is non-contact and remote;3) Presence of oxides or oil on the rail surface enhances laser generation;4) Inspection speed can be higher than with contact methods. This unit output will be fed to one of the input of MCEP for further processing.

C. Railroad Track Dimensions monitoring unit:

Track monitoring system helps to maintain the safety of railroad tracks by monitoring settlement, twist, and distance between two rails. The systems are installed when nearby construction activities, such as tunneling or excavation, may affect the safety of the tracks. Fig.2 shows Railroad Track Dimensions Monitoring System View. The systems are also installed on tracks that pass through areas endangered by landslides or washouts. Due to availability of Track Settlement Sensors and Track Twist Sensors, this system will monitor the track in real-time and then data will be wirelessly transmitted to MCEP for further processing to alert train controls.

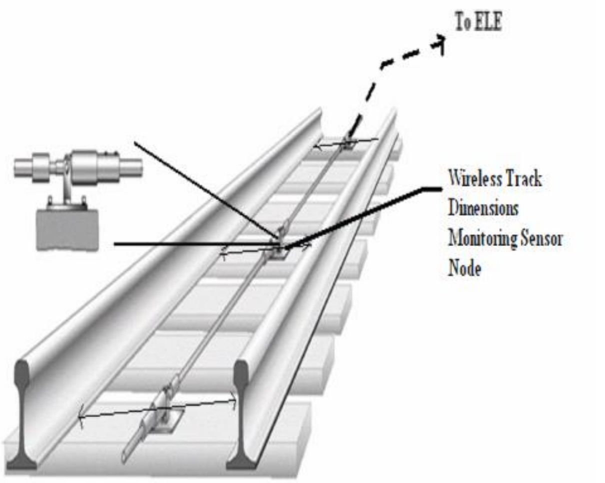

Fig.4: Railroad Track Dimensions Monitoring System View

D. Temperature and Smoke Monitoring Unit:

Using Wireless Temperature and Smoke Sensor nodes at coaches, Locomotive will stop automatically if there is any fire accidents and smokes arrival in the compartments. These nodes consist of sensors, RF transceiver, Microcontroller, and Power harvester i.e. solar batteries. Fig.3 shows block diagram representation of motes at compartments. Here motes are called as wireless sensor nodes. The microcontroller always checks the threshold value in real-time, if there is any smokes , quickly sends data to receiver part of MCEP unit for further processing. Fig 4 shows Wireless Temperature and Smoke Sensor node at compartment.

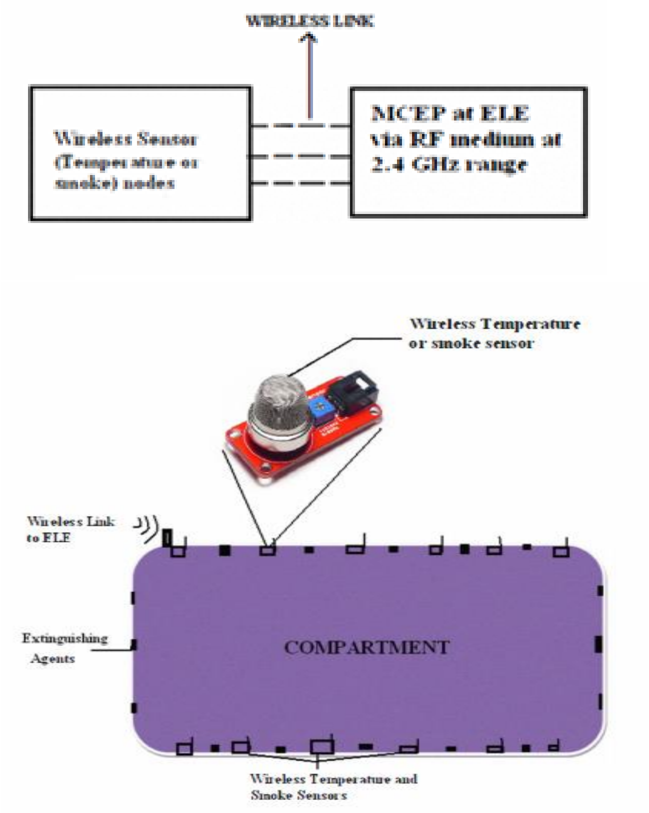

Fig. 5: Wireless Temperature and Smoke Sensor node at Compartment (Top View)

E. Miscellaneous Control Units:

The Pantograph, DC Series Motors, Tap-Changing transformers will be automatically operated and controlled by MCEP. Without presence of Loco pilots and Coach Guards, braking both loco and compartments in real- time and Voltage/Current level monitoring will be done using MCEP with help of respective sensors placed at corresponding places. Using radio module, compartments will be monitored using distance or proximity sensor nodes at two compartments linking point. Railway bearing acoustics monitor at loco uses advanced acoustic technology to monitor axle bearing defects with real-time analysis and trending software built-in allowing for optimum rail network performance. If there is any defects in bearing, loco will be stopped. Heat dissipation will be monitored using temperature sensors in ELE.

IV. OVERALL PROPOSED SYSTEM OPERATION:

All train parameters, rail flaw inspection and other parameters could be controlled by advent of MCEP. If there is any problems such as flaw in rails; track dimensions problems; more heat dissipation in motors and transformers; any faults at braking axle; smokes arrival and fire accidents in coaches; coaches monitoring, all data related to that problems will be wirelessly sent to MCEP for processing to get right response. RF transceiver used in each coaches and MCEP to transmit and receive data in real-time. Due to fast and parallel processing, all operations of train from starting to end can successfully be controlled in real-time. Railway signaling will be wirelessly transmitted to Loco Engine Control unit to get either Running or waiting state.

V. SIMULATION RESULTS:

There are IR sensors with built in circuits which provide a binary output, and there are those which provide an analog output or a multiple bit output. The sensors with a binary output are only good for detecting the proximity of an obstacle, and not the range. By that I mean that the sensor can only tell you when an obstacle is within a certain distance (we will call it the threshold distance). This is fine for most robots which only need to know when an obstacle is right in front of it . This is the cheapest sensor. Ultrasonic sensors use sound instead of light for ranging, so ultrasonic sensors (Some people call it sonar) can be used outside in bright sunlight. These sensors are amazingly accurate, though they may be thrown off by a sound absorbing obstacle, like a sponge. The only real issue that arises is the “ghost echo” issue. As you can see below, the walls bounce off in a strange pattern causing a ghost effect. The detection of Cracks can be identified using IR rays with the IR transmitter & receiver.IR receiver is connected to the Signal Lamp or Electrified lamp with the IR sensor. CAN controller is connected to the main node and it send the information via GSM and transmit the message to engine and to the nearest station. The detection of Cracks can be identified using IR rays and IR sensor.IR receiver is connected to the signal lamp and to the CAN controller. The electrified lamp is nothing but it sides of the tracks the electric lamp which is current flowing for the engines transportation.

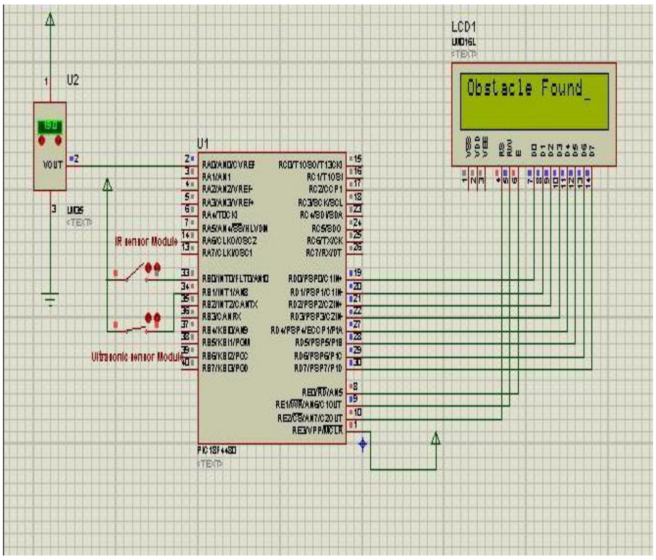

Fig. 6: Simulation results of Train Accident Prevention

VI. HARDWARE MODULE:

The IR sensor is placed under the track and it is used to monitor the cracks found in the tracks and predicts it. By this way accident that occurs from track side can be avoided.

The ultrasonic sensor is placed on Electro Locomotive Engine and it will be used to sense the flaws and obstacle present on the opposite side of the train. By this way accident that occurs from flaw side can be avoided. The temperature sensor is used to detect the temperature and display it on the LCD display. The gas sensor is used to detect the smoke and instructs to stop the train. By this way occurring from compartment side can be avoided.

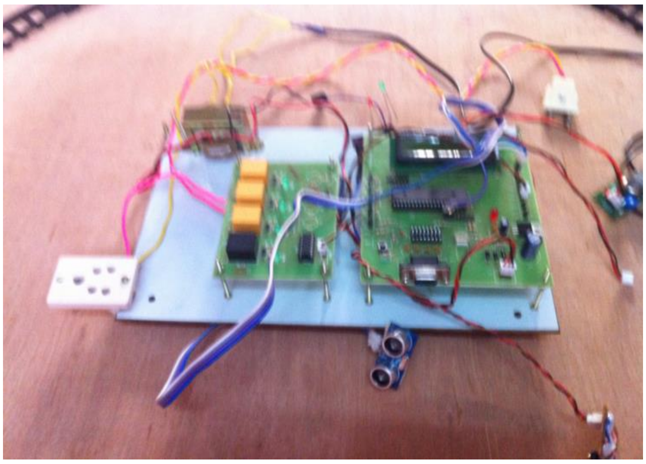

Fig.7: Overall Hardware Module

VII. CONCLUSION:

In existing methods Zigbee has been used for wireless communication but it is quite costly and hence we use RF signal wireless communication purposes. It is lesser in cost and can be used for long-transmission purposes and therefore, hence RF wireless transmission system is more efficient and hence it has been used by the MCEP.

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