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Advanced Security System For Railways Using ARM7

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Abstract- In this paper we have discussed about the automotive control and communication systems of the train using High Performance Multi-core Embedded Processors (MCEP). This method has been developed based on the disadvantages of the existing system 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. As Wireless Sensor Nodes (WSN) and High- energy laser based ultrasonic approach are available in the recent techniques, Train Automation (TA) can be resourcefully done for managing train parameters and monitoring any abnormal conditions in real-time without delays and accidents. All parameters will be processed, controlled, and managed at Electric Locomotive Engine (ELE) with help of advent of wireless technologies. To speed up the operations, all received data will be quickly processed by Multi-core Embedded Processors (MCEP) with help of Multi-core Embedded Software. From the point of view of energy efficiency, train automation is an interesting approach to 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, TA will be a wonderful one with help of MCEP.

Key Words -Multi-core Embedded Processors (MCEP), Wireless Sensor Nodes (WSN), Train Automation (TA), Train Parameters, and Electric Locomotive Engine (ELE).

I. INTRODUCTION:

Train automation (TA) 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, 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 pipelining 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 Freescale MPC8641D, the dual-core Broadcom BCM1255, the quad-core Broadcom BCM1455, and the dual-core PMC-Sierra RM9000x2 [1].

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 [2].

II. LITERATURE REVIEW:

A. Existing Methods:

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 modern trains have come up with latest technologies to runand control trains, MCEP interfaced with other methods will definitely give robust and precise operations and control trains, MCEP interfaced with other methods will definitely give robust and precise operations and control trains, MCEP interfaced with other methods will definitely give robust and precise operations.

B. Proposal 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.

a) 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.

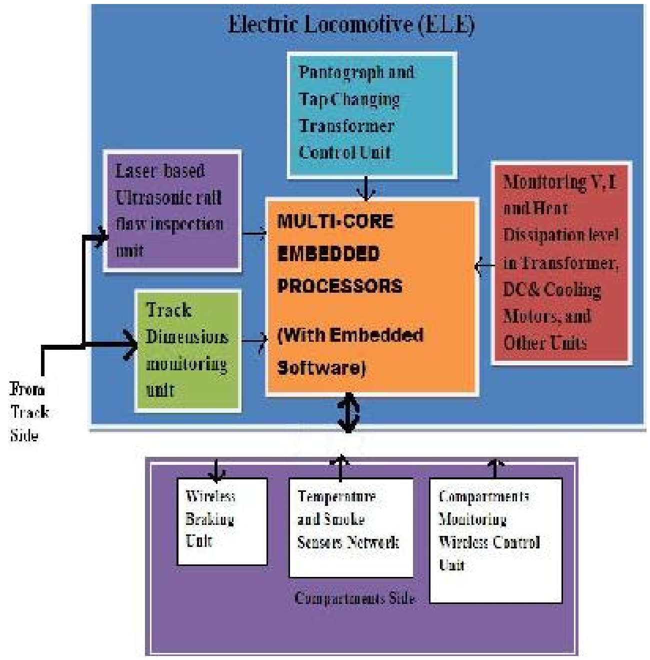


Figure 1. Block Diagram Representation of Proposed System

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

III. 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 [3].

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 [4].

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 arealso 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 [5].

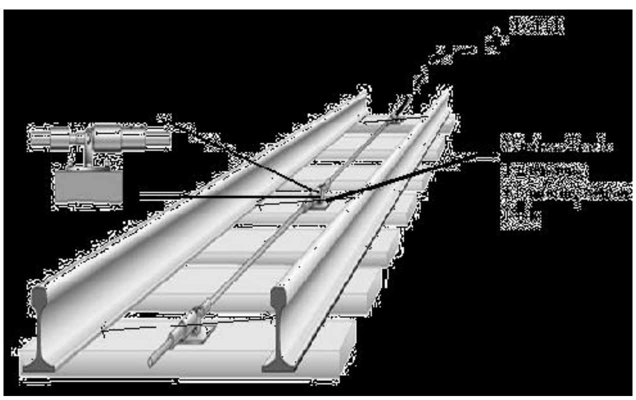
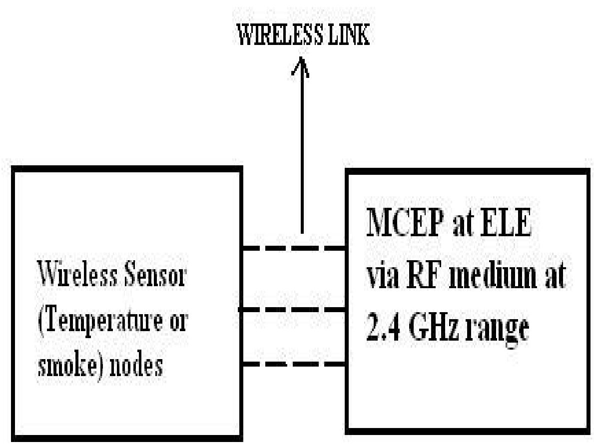


Figure 2. Fig.2: Railroad Track Dimensions Monitoring System

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[6]. Fig.4 shows Wireless Temperature and Smoke Sensor node at compartment.



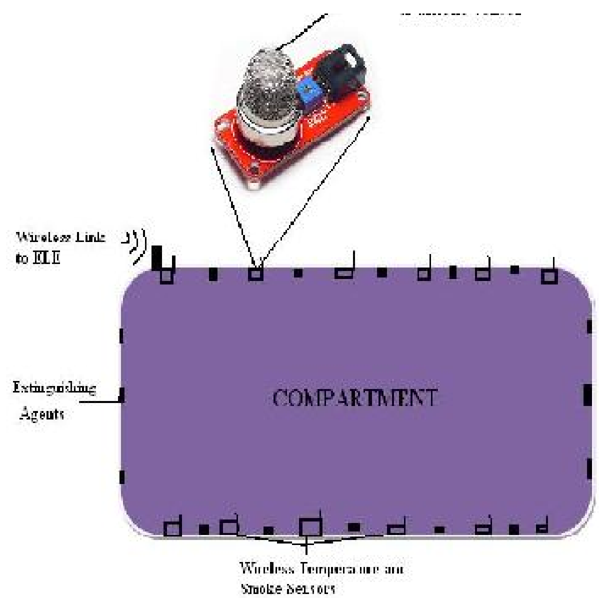


Figure 4. Wireless Temperature and Smoke Sensor node at

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. SOFTWARE MODULE OF THE SYSTEM:

Advent of Real-time Multi-core Embedded Operating Systems like eT-Kernel Multi-Core Edition, QNX Neutrino, VxWorks version 6.8 RTOS (Real Time Operating Systems), Nucleus RTOS, and Enea OSE etc.., tasks execution speed can be considerably increased in MCEP. Multi-core architectures have a single processor package that contains two or more processor execution cores or computational engines, and deliver with appropriate software fully parallel execution of multiple software threads.

Hyper-Threading Technology enables additional threads to operate on each core. Programming languages for Multi-core Processors can also be done using Object-Oriented Programming languages. MCEP encourages multi-processing based on highest priority. Owing to priority consideration of each task, task should be prioritized uniquely [7]. NI LabVIEW also gives right platform to design an embedded system based on MCEP.

V. 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.

VI. CONCLUSION:

Train Automation (TA) will be done using MCEP, Wireless Sensor nodes, and Ultrasonic Laser-based sensors etc. In the point of view of reducing human errors, MCEP are indispensable part to design an embedded system with more reliable and less power consumption for train control operations. This proposal gives better accuracy, very fastest operation in Real-time where the human life is very important. This proposal does not require locomotive driver and coach guard for this operation. Therefore future work will focus on design optimization for Cost Reduction and functional improvements of the system with the help of advanced sensor systems and power harvesters.

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