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SECURITY BASED RAILWAY TRAIN MANAGEMENT SYSTEM USING FPGA

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Abstract-FPGA implementation of wireless data transmission for controlling various DC motors to avoid accidents and to control traffic in railway management systems. An innovative transmission-based method for modeling railway train security control systems. The method addresses the problem of having to rely too much on security experience and of incurring excessive cost of validation and verification in the development of railway train control security. The implementation of sensor through the safe gate by controlling the roadway traffic.

Key words-**Formal method, Safety critical software, Transmission-based model**

I. INTRODUCTION

Railway train control systems are used to secured and manage the operation of trains over the railway infrastructure, including wayside signalling systems and train onboard controllers with components that communicate with each other. Train control systems typical safety critical systems since they prevent collision between trains and ensure the safety of train operations in general.

The importance of railway systems has effective and economic means of transportation is undeniable. With the ever growing concerns over the environmental impact of air travel, high speed trains are fast becoming the preferred alternative to airplanes. Consequently, safety of rail travel has become even more relevant than ever before. To ensure the safe operation of the modern day trains and to optimize their performance, advanced automatic train control systems must be employed. In these systems, the reliable and accurate measurement of position, speed, acceleration and relative distance from other trains etc. play a virtual role in ensuring fail safe operation and reducing the need for track side equipment. Most of the data are provided by various sensors such as odometer, inertial navigation systems (INS), radar, global positioning systems (GPS) etc.

Due to the development of more reliable and powerful electronic systems and computer technology, more and more train control functions are implemented by means of computer based control systems with difficult software logic. In recent years, with the increasing requirements placed on railway service quality, the scale and scope of train control system software have become ever greater, and it has become difficult to handle the complexity of this software. Conventional software development methods do not cope well with this challenge. As a result, system testing and verification have become very expensive. The development of advanced methods and techniques to ensure the correctness of the software logic is therefore a huge challenge for developers of train control systems.

The On-board computer systems sends the control commands resulting from analysing the sensor outputs to the actuators to control the train dynamics.to ensure smooth and safe operation, the information from the sensors must be processed in real time with high speed. To make the system architecture flexible, evolvable, scalable and reconfigurable to be implemented in an FPGA. Where necessary, hardware accelerators and custom-instruction can be used to accelerate certain tasks within an application. The goal to increase traffic throughput while same time increasing the availability and reliability of railway operation leads to a demand for more elaborate safety mechanisms in order to keep risk at the same low level that has been established.The traffic control is implemented by using safe gate concept which works to control both railway systems and roadway systems.

FPGA implementation is one of the important method for the development of railway systems. From the point of view of the system principle, train control belongs to transmission control systems, which computes the senses of arriving of train. During the past few decades, fixed methods have become efficient ways to deal with the system safety issue in software engineering and development. The related research focuses not only on the system specification of train control but also on creating system models and on design verification.

II.LITERATURE SURVEY

An innovative topology based method for modelling railway train control system is proposed in this paper. The method addresses the problems of having to confident on designers experience and of incurring excessive cost of verification and validation in the development of railway train control systems. Four concepts are discussed in the paper: The definition of basic topological units for modelling railway networks, based on the essential characteristics of these units. The topological space train moment authority concept. Thetopological space construct for train control logic interpretation. Topological space theorems for train control systems verifications.[1]

This paper clearly explained a complete model based development and verification approach railway control systems. For each control systems to be generated, the user needs a clear explanation of the application specific parameters in a domain specific language. This clear explanation is automatically transformed into an executable control system model expressed in systemC. This model is then compiled into object code. Verification is performed using three main methods applied to different levels. The domain specific description is validated w.r.t. internal consistency by static analysis. The systemC is verified the crucial safety model for bounded checking. The compiled model object code is verified to be input output equivalent to systemC. [2]

Traditionally train control and signalling systems have been lying heavily on manual operators. However, with the advances in technology, electronic systems have become not only cost wise to use but also increasing reliable to gain the confident of manual operators. The emphasis that multiple sensors have to be used to design reliable and unsafe control systems. The explanation about the information originating from various sensors must be proposed rapidly in real time. The proportion of a multiprocessor architecture for dealing with these issues. Also the proportion of measures to ensure redundancy in the architecture for unsafe operation. The FPGA as the implementation platform for ensuring flexibility and scalability of the system with the low possible cost.[3]

Many critical control systems are developed using fixed methods. When software applied to such systems is developed, the employment of fixed methods in the software requirements verification and specification will provide increased assurance for such applications. Earlier errors of overlooked need specification can be detected using the formal specification method. Also, the analysing and full verification to examine all reachable states using model checking to undertake formal verification are able to be finished. In this paper, we propose an eclectic approach to incorporate Z(Zed) formal language and 'statement MAGNUM', formal method tools using state chart. Also we applied the proposed method to train control systems for the formal needed specification and analysed the specification results.[4]

Railway urban systems are increasingly relying on information and communication technologies (ICT). This evolution makes security an important concern, in additional to the currant methodologyfocus on reliability and availability, maintainability and security. In this paper, we examine two examples of cyber intensive systems in urban railway environments a communications based on mobile app and train control system, that provides transit information to commuters and use them to study the validity of conducting safety analysis.We show the need for a cyber-physical perspective in-order to understand the cross-domain attackdefence and the complicated physical consequence of cyber breaches. We present security analyses conclusion from two various methods that are used in a safety and ICT security engineering domain respectively, and use them as concrete references to discuss the way to move forward.[5]

In this article we would like to present some recent applications of the B formal method to the development of securityin critical times, namely platform automatic screen door controllers. These SIL3/SIL4[1] complaint systems have their functional specification based in a formal model. This model has been proved, guaranteeing a correct by construction behaviour of the system in absence of failure of its components. The constructive process used during system specification and design leads to a high quality system which has been qualified by the French authorities. [6]

III.EXISTING METHOD

The method that has been proposed is a topology-based technique for the specification, development and verification of safety critical train control systems. This method can be easily applied not only by software experts but also by railway engineers. Compared with traditional methods of system development, this method results in fewer errors and less risk of poor specification description and control logic expression. It provides high degree of accuracy in the model implementation. The code developed using the methodology is sufficiently fast to satisfy the real-time system requirements. The method reduced the development complexity

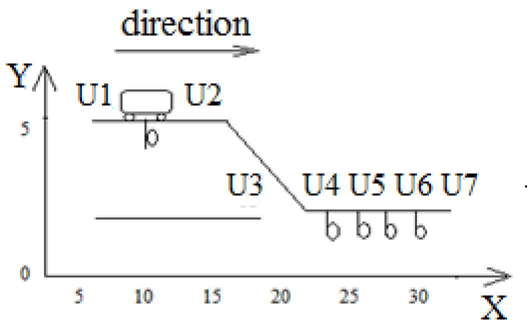

Fig.1-Graphical representation of traditional method.

and cost of system verification, which is the huge issue for a safety critical system. Compared to the traditional method this method uses graphical representation and thus reduces the complexity.

Moving block train control systems have not been discussed. It is based on topology (i.e.) multiple network connected together based on the railway system. In topology based railway system, here it uses the basic three building blocks namely plain-line track sections, points and signal. Plain-line track is that the length of the total railway track is measured and it is segmented based on the network connection. Thus in plain-line track the network is formed based on the distance of the track segmentation.

Signal topology is the devices arrangement on a computer network and how they communicate with one to another. How the devices are connected to the network via the actual cables that transmit data, or the physical topology. Physical topology defines how the systems are connected physically. Signal topology is also called as logical topology. Logical topology defines how the systems communicate across the physical topologies. Point topology is a topology where sets are considered open if they are empty or contain a particular, arbitrarily chosen, point of the topological space. This method is said to be difficult because of the rigorous mathematical way. Rigorous method refers to the proof and its mathematical practise. It is based on the geometric form, which is one of the failure occurrence part in railway control system.

IV.PROPOSED METHOD

In railway system to avoid the failure of network which leads to the collision between the trains, the transmission method is used. The data transmissions is occurs through transceiver. The transceiver is placed both on the gate and the train. The transceiver which is placed on the train acts as the transmitter for the very well first turn and receiver for the second turn. The transceiver fixed on the gate acts as the receiver for its first turn and as the transmitter for its second turn. By the activity of the transceiver the sensor starts sensing which leads to the control of both roadway and railway by avoiding accidents. In existing method the safe gate has not a major role whereas in this method the safe gate is very important for the control of the traffic in roadways for the security purpose.

Safe gate works based on the IR sensor and DC motor. In the traditional method the railway gate are operated manually hence the every movement of the train, the signal depends on the station controller.

Whereas in this method the sensor has been used for sensing the movement of the train and independent on station controller by automatic working of railway gate to avoid accidents and to control railway traffic. In topological railway control system the DC motor was not used but this method includes the operation of the DC motor for the controlling of the safe gate and divider for ON and OFF of the gate while the train arrives at that particular junction considering the limited distance. Divider is not considered on the traditional railway controller method. For the security purpose the divider is injected in this method before and after the arrival of train in that particular station and it depends on timing. The divider is activated automatically inbetween the signal transmission and the arrival of train. The divider is in OFF mode when the train reaches the particular junction.

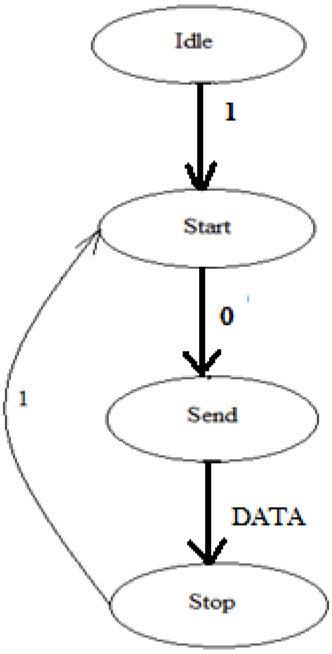

Fig.2-Transfer of bits from train to gate.

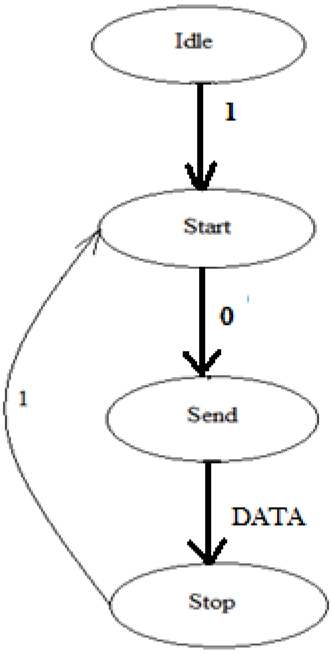

Fig.3-Transfer of bits from gate to train.

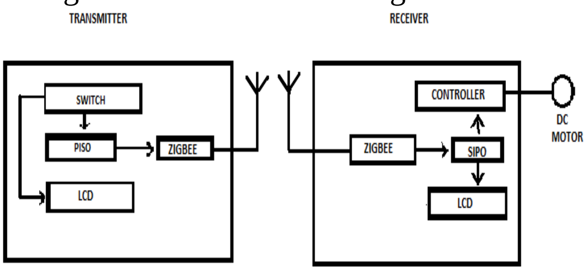

Fig.4-Block Diagram of Train Control Security System.

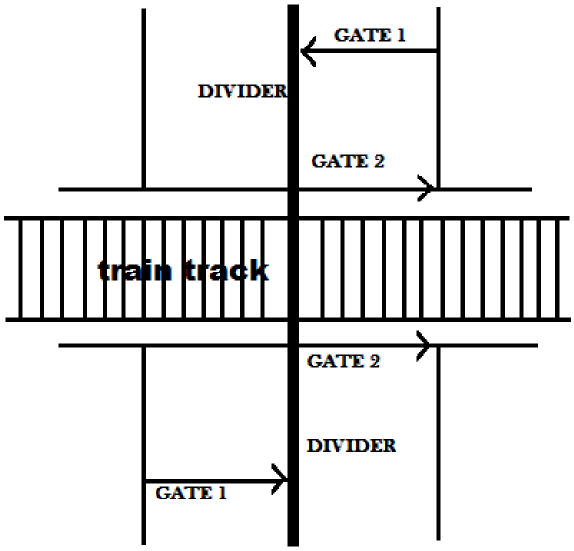

Fig.5-Railway track setup for security system.

Railway track setup in fig.5is fully based on security purpose. Two gates and dividers are fixed the transmitter of train engine is transmit the data the signal is received the gate1 is closed. And the IR sensor sense any vehicle is present or not.if vehicle is not present gate2 is closed. The information transmit to the train. The centre divider is opened. No changes doing in train moment.The train should be cross the level. The centre divider is closed. The gates are opened. The IR sensor sense if any vehicle is present in a particular time gate2 opened message is transmit to the train. Automatically the train reduce the speed and the train is stop.

V.SIMULATION METHOD

Using xilinx14.2 simulation software this software is supported WINDOWS operating system. this software working environment is differ. Dependson OS version. Xilinx software is user friendly.

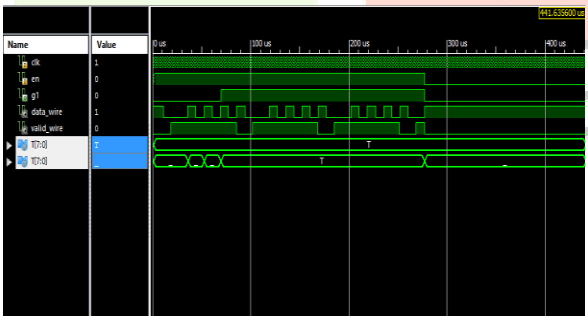

Fig 6-Simulation result for train to gate transmission and receiving

Above simulation is for train to gate transmission and receiving operation result. This coding is dumped into FPGA kit and zigbee is transmitted the information from train and received the information to gate.

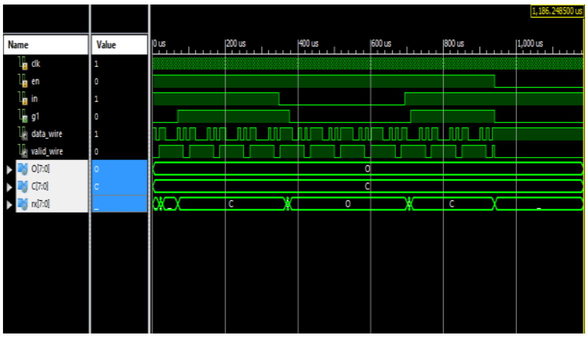

Fig.7-Simulation result for gate to train transmission and receiving.

Above simulation is for gate to train transmission and receiving operation result .This coding is dumped into FPGA kit and gate closed or opened information is passed using zigbee. Zigbee is transmitted the information from gate and received the information to train.

VI.RESULT&CONCLUSION

To avoiding the accident using the automatic level crossing the signal transmission and receiving is correctly processing the information's. Using dividers to reduce the traffic problems. It is highly secured method. All theinformations are correctly transmitted and received between the train and gate. The train passed the information "T" to the level crossing. The gate1 is closed. Particular timing delay the IR sensor sense in between the gates. If no vehicle is present the gate2 is closed. The centre divider is opened and the information passed to the train is "C". If any vehicles are present the gate2 is opened and the information passed to the train is "O". If train gets the information from the gate is "C" the train do not change the speed level it will come regular speed. If the train get the information from the gate is"O" the train reduce the speed level it will be stop. Gate opening and closing work is processed correctly. After the train crossing the level crossreverse process of divider is fixed in between the two gates. The gates are opened.

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