Combined IoT and Cloud Computing Solution for Railway Accident Avoidance

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Abstract - *Cloud computing and Internet of Things (IoT) are two different technologies that are both unidentical to each other but are already part of our life. Their acceptance and use are expected to be more and more pervasive, which makes them an important components of the Internet's future. Cloud computing and IoT integrated together form an astounding combination which can be seen as an provider for large number of application scenarios With the increase in number of passengers and trains frequency railways is trying to provide more efficient and accident immune system.*

***Key Words*: IoT, railway, Cloud computing, RaspberryPi2.0, LM393, RTOS, Python, Wi-Fi.**

1. INTRODUCTION

An automatic train protection is one that helps to anticipate collisions with speed restrictions and applying brakes. To boost the system availability within the available The Internet of Things is a system that allows various physical devices, smart devices, vehicles also called as "connected devices" that are interconnected with each other via internet. IoT consists of various softwares, sensors that enables to collect and exchange data

It enables the connected devices to collect data and exchange them. IoT creates direct unification of the existing physical world into the computer systems. IoT provides the capability that enables the objects to be remotely monitored, controlled and sensed across the network due to which there is improved efficiency, accuracy, less human intervention and more reliability as a result there are economic benefits as well.

The 'thing' word used in IoT could be an object that have the ability to collect and transfer data over a network without manual intervention or assistance. Internet of things can connect different devices that are embedded in various systems to the internet. These devices have been assigned IP addresses to uniquely identify them.

Eg.Automobiles with built in sensors to track their location.

The connectivity then helps us capture more data from more places, ensuring more ways of increasing efficiency and improving safety and IoT security.

The organizations can be benefitted a lot by IoT as they can help them in improved process efficiency, utilization of assets and productivity. With the ability to connect various devices or objects using sensors and connectivity, they can prove to be beneficial from real time insights and analytics., which would help them make smarter decisions.

Here in this methodology, initially the railway tracks are integrated with modulated power supply, which transfers a specific encoded data through the railway tracks. We connect number of sensors in various distances to read that specific encoded data and then decode it, the decoded data then compared with encoded data to observe any data loses which further indicates the damaged tracks in between two junctions, so based on the comparison between encoded and decoded data, we can get the track status between two junctions. In this track status can be updated to the 'Smartliving' IoT platform using Raspberry Pi.

2. EXISTING APPROACH

Following are some of the methodologies used in railway protection but lacks in providing appropriate solution in real time when there is fault within the rail track:

1) Zig-Bee based anti-collision system is made But it only effective in averting accidents when two trains are on same tracks. The automation provided by ZIGBI an IEEE 802.15.4-based specification is only for shorter range of communication. The communication that is performed through ZIGBI is through gate levels. If the signals are not getting transmitted correctly, then it unable to sense the trains in the same track. Thus it cannot be implemented for train protections because of shorter distance limitation.

2) Infrared(IR) sensors have limitations as they are capable of covering distance of 10 to 30 meters and it supports maximum of two devices. They are mainly suitable for short range and one to one data exchange. Since tracks are geographically spread in large, IR may not serve the purpose of cost efficiency and usability.

3) The Anti Collision Device system (ACD)used by Konkan Railway also lacks in communication capability between the trains and the control centers or stations which would lead of inefficient monitoring, hence it has been later decommissioned from the railways.

business space a safety analysis is must. That can be done by simulation of automatic train protection that will in turn provide a style of automatic train protection for radio- based train system. Not all accidents are caused by loco pilot's(Railway Driver's) negligence. All the above methodologies are designed keeping in view the locopilot's mistakes.

Indian railways is planning to implement a Train Protection Warning System(TPWS) on total of approximately 7900 on the main lines across the country, from this 3300 km has already been budgeted.

The TPWS technology meant to avoid accidents that are meant by the failure of the loco pilot is currently being implemented. This technology is being implemented on 68km long rail line near Chennai Arakkonam section and the facility was inaugurated at Ambattur station on pilot basis by French firm Thales which is a major player in rail transport market which also provides effective signaling and supervision to telecommunications for mainline rail and metro system.

But the cost of implementing TPWS is about 80lakhs per Km which is very difficult for the railways to bear. Therefore they are moving towards TCAS(Train Collision Avoidance System) technology. This technology is designed by the Research Designs and Standards Organization(RDSO), and this system has been successfully tested on 250km long track in the Secunderabad division. The above mentioned methods of problem identification mostly focuses on the problems that can occur due to signal fault or due to negligence caused by the loco-pilots.

But what about the problems that can be created intentionally to create a major accident such as removing of tracks to create an accident or any defect in the rail tracks that is unknown to the railway authorities and the loco pilot.

Example: Kanpur railway accident which was caused due to intentional damage created in railway track.

This damage was not known to the railway loco pilot in the real time, else the accident could have been avoided.

The above technologies would fail to recognize such situation and would create a devastating accident.

2.1 Proposed System

In order to make the railway loco pilot and the concerned railway authorities aware of the damages in railway tracks at real time, the proposed methodology can be used.

In this paper we have proposed IoT based railway calamity avoidance system using cloud computing technology.

Figure 2 describes proposed architectural model how to connect sensors on tracks and integrate with Raspberry Pi

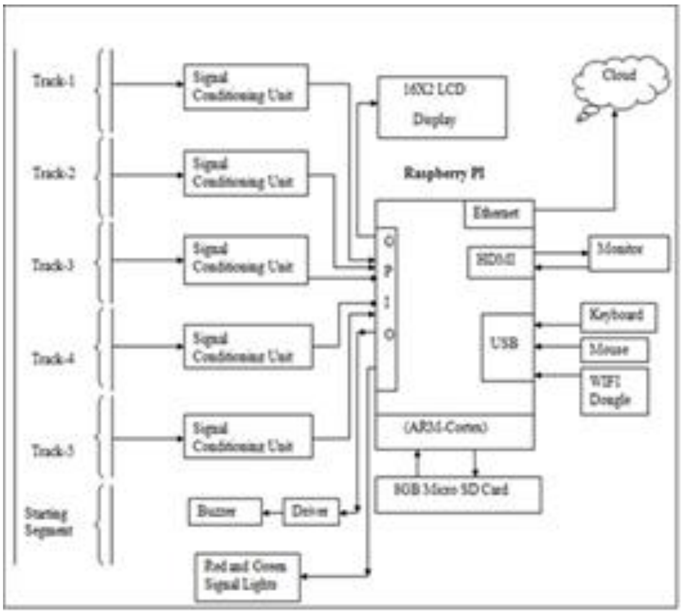

Figure 1. Proposed System Architecture.

In this system we have taken tracks (copper railings) and divided into five segments namely T1,T2,T3,T4,T5 for prototyping purpose (Figure 1). Each segment is interconnected. Now modulated power supply through regulator is given to tracks via wires. Voltage will be passed through end of the each segment.. If given voltage is less than the comparator's reference voltage (modified according to given voltage), then it indicates some breakage in the track of ongoing segment as shown in Figure 3. Through signal conditioning unit it will be detected and sent to Raspberry Pi and time to time status is updated in 'smart living' IOT based cloud (Figure 5). Here, the cloud system automatically sends SMS to concerned railway authorities mobile via WAY2SMS or any other messaging app. In addition to that red Led will glow, and Buzzer will be in on state. The Track status can be seen in LCD display for convenience(Fig.2). A LED Monitor can be installed in the driver's cabin which will enable him to view if there is any damage to the tacks just before the few kilometers enabling him ample time to stop the train.

3. IMPLEMENTATION

This accident avoidance system is based on cloud computing technology that uses IoT and Internet to communicate.

I. Raspberry Pi

We use center tapped step down transformer to convert 230v AC to 12v AC and full wave rectifier to convert into DC(16V-18V),5V regulation is maintained to give to components using IC7805, dual comparator output's is given to Raspberry Pi through GPIO's (general purpose input output pins),it consists of ARM cortex-Quad core processor, 1GB RAM, 40 GPIO'S, Camera Serial Interface (CSI), Digital Serial Interface (DSI), 3.5Mh audio I/O 4USB ports, one 10/100 Ethernet, one HDMI, one micro SD card slot extendable up to 32GB. In this memory card Raspberry an OS is loaded and python code is dumped.

II. Dual Comparator

Coming to comparator (LM393) unit, comparator will compare the voltage of track with reference voltage, it will produce analog output, so signal conditioning unit is used to convert into pure digital value, and it is given to Raspberry Pi 2.0.

III. WIFI Module

Here python language coding will be used to connect IoT and Cloud together. This connection can be done through internet(using Wi-Fi or Local Area Network)

IV. LCD, Buzzer, LED

A Seven segment LCD display will be used which will show the status of the tracks. Here First track segment is shown 'OK' but the remaining track segment is showing damage. The status shown in the LCD screen can be used my maintenance staff during repairing of tracks. If there is any damage to the track then a RED LED will glow in locopilot's cabin. Also a buzzer can be used in order to alert in case of any breakage detection.

Fig 2. Track Status on LED Screen

V. Smart Living Cloud

We will create an account in 'SmartLiving' cloud and will add Raspberry Pi device with it. Along with it we will also need to add their assets that are required to sense input information. In order to know that from which device the input is coming client id will be created for the authorities. Along with it asset id, asset name will be created to distinguish between different assets that will be sensing information.

For example, if there are five assets attached for five segments of tracks of which a separate asset id and separated asset name will be created. This information generated will be mentioned in the python code. Here each input sensing device is interconnected to the Raspberry Pi module. Each module sends the sensing information to the Smartliving cloud and if there is any damage to the tracks then the alert message will be send to the concerned railway authorities and locopilot's cabin.

4. OUTCOME/RESULT

With the SmartLiving IoT Platform you can connect Raspberry Pi to their cloud services, then automate them with simple "when-then" rules. With the help of The SmartLiving IoT platform you can visualize the data with unambiguous user interface. It will check and monitor the status of the tracks. If any track was damaged a message will be sent to the locopilot's cabin and other concerned railway authorities.

5. CONCLUSIONS

In this paper, a configuration is proposed that can avoid the accidents that can be caused because of the damaged tracks. Since with the expansion of railways and huge increase in number of trains the major problem rising is the maintenance of the tracks. With the higher frequency of trains running on tracks the chances of developing damages in the tracks are very high. Solely depending on manual work is time taken and sometimes can also be life risky. Also with the limited number of employees it is very difficult to identify the problem and solve it in limited time. Since the railway networks are very widely expanded

with limited workforce therefore the chances are very high that tracks fractures may get unnoticed. If these damage gets ignored then a major mishap could occur. IoT and cloud computing are two major advancements in the technology that can help solve this problem. This technology is not only reliable but also cost effective as compared to manual expenses.

Since this technology would cost a good amount therefore it can be implemented in the regions where the train frequency is very high as they are very prone to develop fractures. For example in Cities. In rural areas where trains frequency is very less and thus chances of rail fracture is very low, manual work may suffice..

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