REALTIME RAILWAY MONITORING SYSTEM AND ALERT GENERATION SYSTEM USING IOT

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Abstract—The explosively growing demand of internet of things has rendered extensive advancements in the fields across sensors, radio access network, and hardware or software platforms for mass market applications. In spite of the recent advancements, limited coverage and battery for persistent connections of Internet of things devices still remains a critical impediment to practical service applications. In this paper, we introduces a cost-effective Internet of things solution consisting of device platform, gateway, Internet of things network, and platform server for smart railway infrastructure. Then, we evaluate and demonstrate the applicability through an in-depth case study related to Internet of things based maintenance by implementing a proof of concept and performing experimental works. The Internet of things solution applied for the smart railway application makes it easy to grasp the condition information distributed over a wide railway area. To deduce the potential and feasibility, we propose the network architecture of Internet of things solution and evaluate the performance of the candidate Radio Access Technologies for delivering Internet of things data in the aspects of power consumption and coverage by performing an intensive field test with system level implementations. Based on the observation of use cases in interdisciplinary approaches, we figure out the benefits that the Internet of things can bring.

Keywords—Internet of Things, Smart railway, Condition based maintenance, Power consumption.

Introduction

Railway has been playing a fundamental role of public transportation from nineteenth century, in which a steam locomotive began to be run. The railway was regarded as a core method to transport massive population moving along the determinant paths between the metropolitan cities. The basic technology of the railway as to be progressed and recently enables a high speed railway system which satisfies the public demand on traveling a far distance. The railway possesses the characteristics of high capacity and energy efficiency, and those merits motivate the governments of many countries to encourage and support the railway for public interest. Consequently, the governments consider the railway significant when they establish transport policies.

One of the important issues for railway operators is maintenance of their railway systems. The railway system consists of various entities like train vehicles, tracks, facilities, a curve formed by wire, rope, or chain hanging freely from two points that are not in the same vertical line and electrical devices by the side of a railway track. It is essential for the railway operators to guarantee that every entity of the railway system operates in good condition. Any operational faults are to be strictly prevented, because an unexpected fault may threat the safety of an massive passengers. Due to these fact the government forces the railway operators to fully engage themselves in conducting the maintenance. The operators are arranged a certain amount of budget on the maintenance of the whole railway system.

Unfortunately, the railway operators are recently facing a huge challenge in conducting the maintenance. Mostly, The railway entities exist in an outdoor environment in which an unfavorable for keeping the condition of them in a good state. Then, the railway systems in most of the countries have been several decades. At first, they were deployed

and the operators are necessarily required to monitor the deterioration of the systems more carefully.

The Condition Based Maintenance has become practical and will be able to evolve further by various enablers, such as sensing, information and communications technologies ([4]–[6]). Especially, many believe that the Condition Based Maintenance will take a step forward by combining itself with a concept of Internet of Things. The major part of the inspection is performed by a human effort which is inefficient in a cost perspective. The Internet of things allows things, which are specifically maintenance targets and staffs, to be connected and to interact with each other by exchanging information. Under the Internet of things concept, the staffs can be easily aware of the condition of the maintenance targets and make a decision of the maintenance actions without the harsh procedure of the direct inspection. To realize the IOT, the railway operators requires a full scale of the base infrastructures to let the things be physically connected. In fact, many of the railway operators already plan to have a railway communications system, which can play the role of the base infrastructure for realizing the IOT.

Currently, 66% of the European train lines employs Global System for Mobile Communications-Railway (GSM-R) [7], and the railway operators in South Korea are considering to deploy a railway communications system based on Long Term Evolution (LTE) ([8]-[9]). The original objective is to provide train control and group communication services, which utilize rather a small portion of the system capacity. Hence, the existing railway communications system is generally capable of providing additional services with its remaining system capacity. From the technical aspects, IOT technology consists of three phases, which are sensing, accessing, and processing phases. In the abstract, we aim to analyze the IOT can seize a business chance by considering its suitability to the railway maintenance. The IOT concept can make a synergy with the CBM procedure and it can be properly implemented in a railway environment. Based on the surveying the status and the use cases of the CBM impact of the IOT on the railway maintenance. Moreover, we provide a suitable solution of the IOT which can be utilized for the railway maintenance. We analyze the technical possibility and requirements of the IOT solution in detail, and evaluate the suitability of the existing Radio Access Technologies (RATs) by comparing their performances.

Existing System

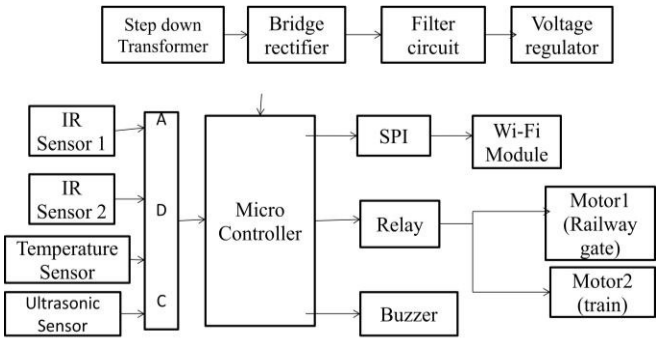
In existing system, the railway operators are focusing the efficient way to accomplish the maintenance and extend the life cycle of the railway system. One promising solution is to utilize a concept of Condition Based Maintenance ([1]-[3]). Under the concept of the Condition Based Maintenance, maintenance actions are performed based on the status of maintenance targets. Classically, a maintenance action was performed periodically regardless of the condition of the targets. Although this traditional approach may assure the safety of the railway system, it makes the operators waste the financial resource on repairing or replacing the railway entities even in normal condition. By inspecting the condition of the targets, the operators can perform the maintenance actions only for the defected targets, and can consequently increase the life time of the overall railway system.

In sensing period, various sensors and devices collect the information related things and equipments such as railway, train and other infrastructure. In accessing period, the collected data from the things can be efficiently delivered to IOT platforms by using various wireless IOT accessing technologies without human efforts. Then, a platform analyses the data and takes a measure in processing phase. Through an in-depth and interdisciplinary study, we deduce that the IOT is a key enabling technology for realization of smart railway.The drawback isLess accuracy. Sometimes, the signal will be cut-off and delay the transmitting information. The Cost is high.

PROPOSED SYSTEM

The system implements the sensor like IR sensor, Ultrasonic sensor, and temperature sensor.Any human or animals presented in track, ultrasonic sensor senses

and automatically the buzzer will on and also the train will stop automatically. The automatic railway gate controller makes use of two IR sensors placed at both sides of the gate placed at the particular distance. The sensor detects the arrival of train and automatically close the gate. The sensor at the other end detects the departure of the train and send signal to the microcontroller to open the gate again for public use. Temperature sensor are used here to monitor the crack formed in the railway track. Can be controlled by without human work. Easily working in dangerous place.



One of the approaches for improving the efficiency of the inspection process is to utilize a concept of IOT. The IOT is considered as a good solution to provide real-time monitoring services, because it is helpful for estimating the properties of maintenance targets at remote sites.

Today, The IOT technology has proposed to the recent studies, researches and various systems has to realized the IOT concept has to be launched. So, it is available for railway operators to select and apply those systems to the railway maintenance.

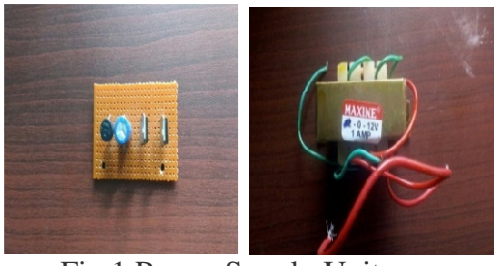


Fig.1.Power Supply Unit

In figure 1 shows, Power supply is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others.

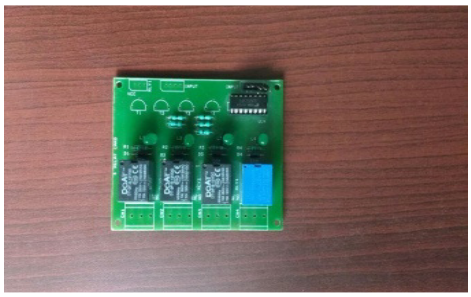


Fig 2.Relay

In figure 2 shows, Relays are simple switches which are operated both electrical and mechanical. Relays consist of an electromagnet. The switching mechanism is carried out with the help of the electromagnet.

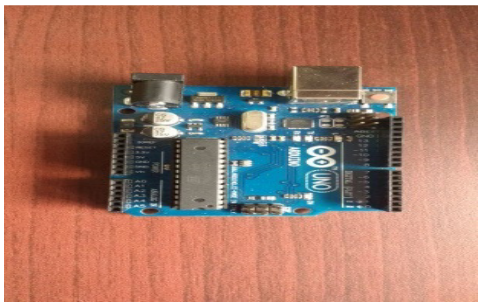


Fig.3.Arduino

In figure 3 shows, An Arduino is actually a microcontroller based kit using the components, owing to its open source hardware feature. The Arduino is a microcontroller board based on the ATmega328. It has 14 digital input or output pins, 6 analog inputs, 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header and a reset button.

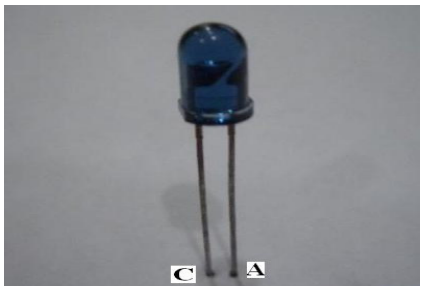


Fig.4.IR Sensor

In figure 4 shows, Infrared sensors are the most often used sensor by amateur robots. Be it a typical white/black line follower, a wall follower, obstacle avoidance, micro mouse, an advanced flavor of line follower like red line followers. It can be easily addressed and granular control can be exercised upon your robots performance if you have a good operational understanding of Infrared sensors.

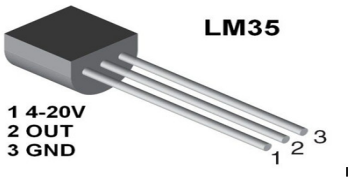


Fig.5.Temperature Sensor

In figure 5 shows, Temperature is the most measured process variable. A temperature sensor is used to convert temperature value to an electrical values. Temperature Sensors are the key to read temperatures and also control temperature in industrial applications.

Fig.6.Ultrasonic Sensor

In figure 6 shows, Ultrasonic sensors work on a principle which evaluates distance of a target by interpreting the echoes from ultrasonic sound waves. This ultrasonic module measures the distance accurately provides 0cm - 400cm with a gross error of 3cm.Its compact size, higher range and easy usability make it a handyrange and easy usability make it a handy sensor for distance measurement and mapping. The module can easily be interfaced to microcontrollers.

Fig.7.DC Motor

In figure 7 shows, A DC motor is any of a class of electrical machines that converts direct current electrical power into mechanical power in which the forces produced by magnetic fields. A DC motors are powered from existing direct current lighting power distribution systems.

Fig.8.Buzzer

In figure 8 shows, A buzzer is a mechanical, electromechanical, magnetic, electromagnetic, piezoelectric audio signaling device. A piezoelectric buzzer can be driven by an oscillating electronic circuit or other audio signal source.Beep or ring can indicate that a button has been pressed. A buzzer takes some sort of input and to produce the sound from metal clappers to electromechanical devices.The Serial Peripheral Interface (SPI) bus is a synchronous

serial communication interface specification used for short distance communication, primarily in embedded system. The interface was developed by Motorola. It include secure digital cards and liquid crystal displays. The SPI devices communicate in full duplex mode using a master slave architecture with a single master. The master device originates the frame for reading and writing. Multiple slave devices are supported through selection with individual slave select (SS) lines.

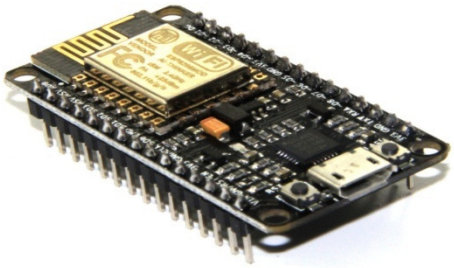


Fig.9.Node MCU

In figure 9 shows, Node MCU is an open source IOT platform. It uses the Lua scripting language. It is built on the ESP8266 SDK 0.9.5. It uses many open source project. It includes firmware which runs on the ESP8266 Wi-Fi SOC, and hardware which is based on the ESP-12E module.

EXPERIMENTAL ANALYSIS

The proposed IOT solution is the first approach dealing with interdisciplinary system level considerations in practical industry

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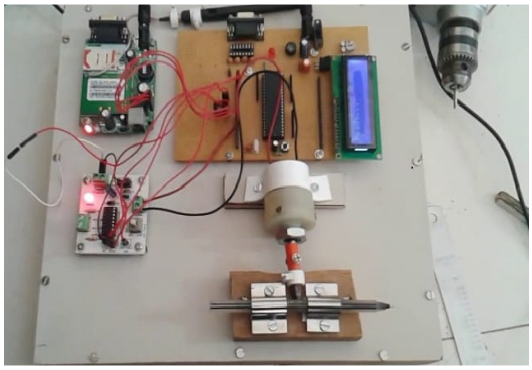


A device platform is to provide common functionality of various sensors. At the terminal side, it needs to have a flexible structure to interwork with various combinations of sensors.It is structurally more beneficial for the terminals to have a platform functionality that takes care of the common functions for all kinds of sensors.Moreover, the device platform can make it easier to replace the sensors which become out of order, and this contributes to reduce the Operational Expenditure (OPEX) of the IOT solution.

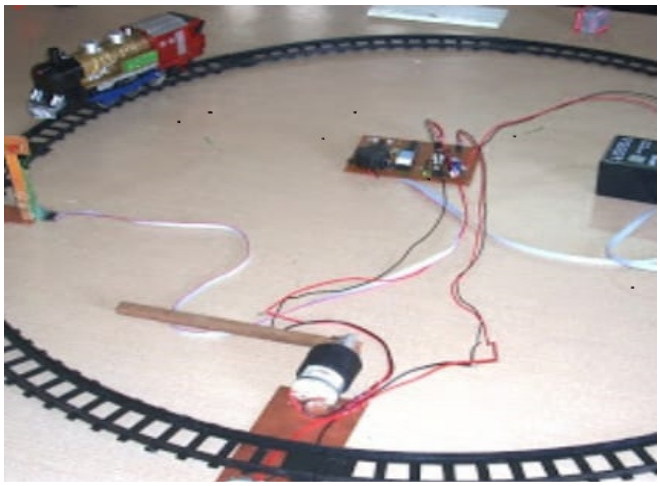
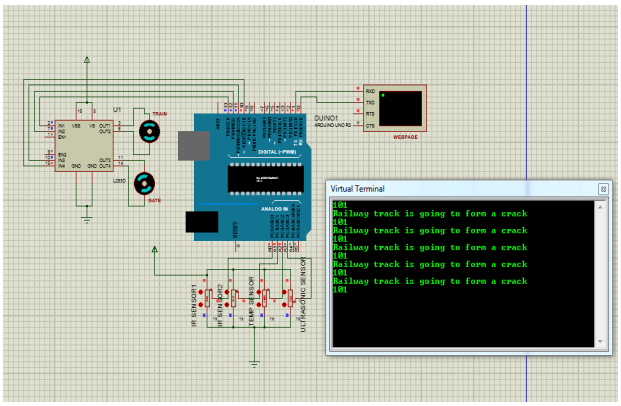


Fig.10.Railway Monitoring and Alert Generating System Kit Output

In figure 10 shows, the analysis reveals that the IOT is an essential enabler of the CBM to enhance the efficiency of maintenance. IOT can bring the effect of cutting cost which can be more than hundreds of million dollars, the railway maintenance can be a great business model of the IOT application. IOT will be realized in many smart city applications as well as railway for enhancing the productivity.In a technical aspect, each element of the IOT solution is ready to be applied to the field. To achieve low power consumption and high reliability device platform needs to adopt various communications schemes and a circuit design schemes.the condition information collects from the terminals requires to be properly processed and accessed so that each data consumer can get the data in his own favor.To enhance the reliability of data transfer in multipath and interference-coexistence environments,LoRa as an IOT network is needed also the LoRa needs to have a capability to recognize and deal QoS of vital informations for guaranteeing railway safety.Due to

the notable advancements of IOT technologies, the information and communications community is at the midst of an ongoing major evolution. Wide scale enhancements ranging from sensing, accessing, and processing are inevitable to continuously sustain the ever increasing demands of smart IoT applications in the industry.



In this figure shows, the enhancements ranging from sensing, accessing, and processing are inevitable to continuously sustain the ever increasing demands of smart IOT applications. The evolution of IOT technologies will continue creating new and innovative applications [22].

CONCLUSION

Thus, the railway monitoring system is the device platform needs to adopt various communications schemes and a circuit design scheme to achieve low power consumption and high reliability.The smart railway infrastructure have been produced by IOT based process which is to bemonitored and controlled by an authorized person.

REFERENCES

[1] A.K.S. Jardine, D. Lin and D. Banjevic, "A Review on Machinery Di-agnostics and Prognostics Implementing Condition-Based Maintenance," Elsevier Mechanical Systems and Signal Processing, vol. 20, no. 7, pp. 1483-1510, Oct. 2006.

[2] A. Grall, C. Berenguer and L. Dieulle, "A Condition-Based Maintenance Policy for Stochastically Deteriorating Systems," Elsevier Reliability Engineering and System Safety, vol. 76, no. 2, pp. 167-180, May 2002.

[3] F. P. Garci, A. Marquez, F. Schmid and J. C. Collado, "A Reliability Centered Approach to Remote Condition Monitoring. A Railway Points Case Study," Elsevier Reliability Engineering and System Safety, vol. 80, no. 1, pp. 33-40, Apr. 2003.

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[4] P. Li, R. Goodall, P. Weston, C. S. Ling, C. Goodman and C. Roberts, "Estimation of Railway Vehicle Suspension Parameters for Condition Monitoring," Elsevier Control Engineering Practice, vol.15, no.1, pp. 43-55, Jan. 2007.

[5] M. Bocciolone, A. Caprioli, A. Cigada and A. Collina, "A Measurement System for Quick Rail Inspection and Effective Track Maintenance Strategy," Elsevier Mechanical Systems and Signal Processing, vol. 21, no. 3, pp. 1242-1254, Apr. 2007.

[6] S.-S. Kim, C. Park, Y.-G. Kim and C. Park, "Parameter Characteristics of Rail Inspection Measurement System of HSR-350X," Springer Journal of Mechanical Science and Technology, vol.23, no. 4, pp. 1019-1022, May 2009.

[7] UIC FU-7100 v2.0, Future Railway Mobile Communication System User Requirements Specification, Mar. 2016.

[8] Y.-S. Song, J. Kim, S.W. Choi, and Y.-K. Kim, "Long term evolution for wireless railway communications: Test-bed deployment and performance evaluation", IEEE Communications Magazine, vol. 54, no. 2, pp. 138– 145, Feb. 2016.

[9] J. Kim, J. Lee, J. Kim and J. Yun, "M2M Service Platforms: Survey, Issues, and Enabling Technologies," IEEE Communications Surveys and Tutorials, vol. 16, no. 1, First Quarter 2014.

[10] A.Gluhak, S.Krco, M. Nati, D. Pfisterer, N. Mitton and T. Razafind-ralambo, "A Survey on Facilities for Experimental Internet of Things Research," IEEE Communications Magazine, vol. 49, no. 11, pp.58-67, Nov. 2011.

[11] Korea Railway Authority Network, A Regulation of track maintenance, pp. 45-84, Mar. 2015.

[12] J. Kim, J. Lee, J. Kim and J. Yun, "M2M Service Platforms: Survey, Issues, and Enabling Technologies," IEEE Communications Surveys and Tutorials, vol. 16, no. 1, First Quarter 2014.

[13] A.Gluhak, S.Krco, M. Nati, D. Pfisterer, N. Mitton and T. Razafind-ralambo, "A Survey on Facilities for Experimental Internet of Things Research," IEEE Communications Magazine, vol. 49, no. 11, pp.58-67, Nov. 2011.

[14] SemTech Application Note ANI200.22, LoRa, Modulation Basics, pp.1-26, My 2015.(http://www.semtech.com/images/datasheet/an1200.22.pdf)

[15] G. Y. Li, Z. Xu, C. Xiong, C. Yang, S. Zhang, Y. Chen and S. Xu, "Energy-Efficient Wireless Communications: Tutorial, Survey, and Open Issues," IEEE Wireless Communications, vol. 18, no. 6, pp.28-35, Dec. 2011.

[16] 3GPP TR 45.820 v.13.1.0, Tech. Spec. Group GSM/EDGE Radio Access Network; Cellular System Support for Ultra-low Complexity and Low Throughput Internet of Things (CIoT), 2015.

[17] T. Baker, B. Al-Dawsari, H. Tawfik, D. Reid, and Y. Ngoko, "GreeDi: An energy efficient routing algorithm for big data on cloud," Elsevier Ad Hoc Networks, vol. 35, pp. 83-96, 2015.

[18] S. D. T. Kelly, N. K. Suryadevara, and S. C. Mukhopadhyay, "Towards the implementation of IOT for environmental condition monitoring in homes," IEEE Sensors Journal, vol. 13, pp. 3846-3853, 2013.

[19] B. Martinez, M. Montn, I. Vilajosana, and J. D. Prades, "The power of models: Modeling power consumption for IoT devices," IEEE Sensors Journal, vol. 15, pp. 5777-5789, 2015.

[20] T. Baker, Y. Ngoko, R. Tolosana-Calasanz, O. F. Rana, and M. Randles, "Energy Efficient Cloud Computing Environment via Autonomic Meta-director Framework," IEEE International Conference on Developments in eSystems Engineering (DeSE), pp. 198-203, 2013.

[21] P. Kuila, and P. K. Jana, "Energy efficient clustering and routing algorithms for wireless sensor networks: Particle swarm optimization approach," Elsevier Engineering Applications of Artificial Intelligence, vol. 33, pp. 127-140, 2014.

[22] S. Chen, H. Xu, D. Liu, B. Hu, and H. Wang, "A vision of IOT: Applications, challenges, and opportunities with china perspective," IEEE Internet of Things journal, vol. 1, pp. 349-359, 2014.