Railway Maintence and advancement using Internet of Things

Apoorv Saxena
UG Student
Department of information Technology
SRM University – Kattankulathur

Abstract: - Demand for connected things is emerging very fast from a report of IBM connected device will yield insights driving the potential economic value of 11 trillion USD. However there many complex System like Railway which is working on old mechanical and electrical system which is expensive to maintain as well as they are not perfect. This paper Discuss how can railway switch its system to more affordable and fast, by using technological advancements in IoT and Analytics problems like ineffective periodic check of locomotive wagons and coaches will be avoided, it will be helpful for broad benefit to the rail industry like reducing congestion, improving mobility, reducing the environmental impact of transportation providing economic benefits for riders and operator, crowd management and asset management. This system will work on diverse types of sensor which will gather a large amount of data like motor temperature, door health wheel health all this data will be transferred to Shed were they know which locomotive to call or not. There are 11,122 Locomotive in Indian railway every locomotive undergoes periodic check thus this system will make things go faster. It also Discusses how mqtt which is client server architecture attached with eclipse paho and eclipse mosquitto make this system are convinent as mqtt which is very light weight, small code print, it's real time, work in the low network.

Index Terms – mqtt , Railway maintanence , IoT

I. INTRODUCTION

Indian Railways is following "Periodic Maintenance" for locomotive/coaches/wagons and other equipment. In" periodic Maintence" machines are advised to come for regular service after certain time or distance covered or in case of emergency failure they are checked and maintained due to limited resource and vast system this system is ineffective as the healthy machinery is also checked while it provide no data how could damage be reduced thus it's expensive also cause economic damage as system does not work on it 'so full potential.

Internet of things provide a better alternative there are now billions of devices connected and many open source software and stable and safe system present. With the help of different types of sensor we could gather information about Motor temperature, Speed , Breaking effort and power consumption.

This all sensor combined to mqtt server which collects data and when there is enough network at any station or manually in natural calamity causes transfer it to the shed where they could monitor the health of every component and change it if necessary this will reduced the cost and increase the productivity also with all this data a good study could be done for better future projects. Customer service will also be affected as doors, AC could be checked at a real time. This real time technique will be implemented by using mqtt(message query telemetry transport) integrated with Eclipse Mosquitto and Eclipse Paho mqtt is a client server architecture. Here is a broker and a client. Broker act like a serve and it take query from thousands of client(sensor in our case and process it) it is highly efficient because of it's real time property and less code foot print with low battery usage and it even support In low network with eclipse paho and Mosquitto it will be a subscriber-publisher relation. Where Eclipse paho at an end will subscribe the data while at the other end eclipse Mosquitto while publishing the data.

II. BENEFIT OF IOT APPROACH

The Indian Railways lacks new technologies; therefore chances of human error are more Though nothing can be fool proof with technology it certainly reduces the chances of accidents. It has been found out by CNN-IBN after assessing the internal safety report of the Railways. 18 out of every 21 accidents occur because of human error. It has also been found out that most of the time organizations compromise on the safety measures. Reasons, why safety measures are compromised, are a low investment, delay in installing anti-collision devices and shortage in manpower.

This Human Error could be avoided if we have all the data of every equipment and at any point of breakage it could be sorted out more easily.

Avoidance of periodic maintenance will help to increase safety measure as the entire system will work fast they ever before.

IoT maintence system will be easy to install as all software are open source and it it's integration to the system is affordable.

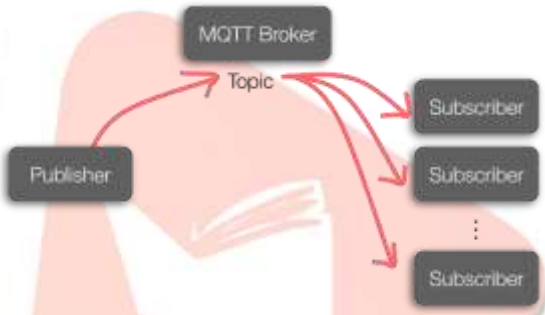
Next Benefit will be of Crowd Management where the doors and escalator and other equipment connected to each other could be very helpful in peak season to avoid any kind of misshaping.

III. How will this System Integrate and Work

IoT maintenance system will be integrated in the existing system with no change in the ongoing system but by integrating sensor and server node in the train here diverse sensor relate to each other using different IoT protocol as per the terrain and the workload for ensuring that the whole connected system is isolated in it's self for this different closed IP and high-end security architecture could be implemented. After the connected sensor ranging from various parts of locomotives and other part of the train they will collect real time data that will ensure everything is working as planned in the case of any error the entire system will connect data and send it to a node in the train or nearest station it can be easily done as mqtt works on low network usage. After that data is sent to the maintenance shed where they could judge which machine to call and what to repair over all it will help to evolve better technology for future as well.

Next is the asset management system railway has over 119,000km of total track and has vast amount of resource which are currently not in used by applying sensor equipped with RFID Technology (Radio Frequency Identification) all the information from this resource can be kept easily cost of RFID tag is 5 cents in mass production but the usage is very high as there are large amount of unused resource that can be used in near future. This system is quite old but not in use in the current system here every asset in marked with RFID tags which give all the information of that product. And as it passed from RFID machine the information gets updated and at the time of the big project, these material can be used which will help in reduction of the wastage and money the whole system does not need any constant connection or software and can be easily upgraded in future causing this system to really reliable. Also, this system will provide a better backup program at the time of serious situation s it could be easily switched. In future with the help of the same ultra-sonic sensor, the parking system for 8,000 systems could be developed as this sensor could know if there is a car standing in the parking or not and will update the real time data to the user making the whole travelling experience more simpler.

Other major component of the system include mqtt and Eclipse paho, Eclipse Mosquitto, Java API XML Pages etc.



Mqtt and sensor integration is going to be the most important part of the whole maintenance. Here mqtt gather information from the sensor ad transfer it to the nearby system mqtt are able to manage thousands of clients an thus are reliable Eclipse Paho and Eclipse Mosquitto are going to sustain the Subscriber and Publisher respectively which are responsible for inflow and outflow is the data the system are compactible with many devices like raspberry. JSP pages are used so that code print is fired on the server side so our application wok more faster and could accommodate more user and sensor with mqtt some of the other benefits are:-
Publish Subscribe model provides one-to-many message delivery

• Uses TCP/IP for network connectivity
• Can work with SSL/TLS for
• MQTT offers three message delivery QoS:
at most once
at least once and
exactly once
• These QoS are met even in case of network, publisher or client failures
• Very simple specification and APIs, making it easier for developers to work with MQTT based products
• Most important APIs are CONNECT, PUBLISH, SUBSCRIBE, UNSUBSCRIBE, and DISCONNECT
• As MQTT is specifically designed for constrained device, it provides only the bare minimum features to support them.
• The message header is short in MQTT and smallest packet size in 2 bytes, making it ideal for small and constrained devices
• As MQTT is a publisher/subscribe model, sender, and receivers are decoupled from each other
• Doesn't restrict the format of data to be in any format, thus allowing flexibility
• 'Last Will' feature, which allows abnormal client/sensor termination to be notified to all interested parties
• Both commercial and open sources MQTT based broker products are available. These include IBM WebSphere MQ v 7.1 onwards, EclipseIoT Mosquitto, ActiveMQ and HiveMQ.

Because of this technology mqtt is used.

Eclipse Mosqutio

Eclipse Mosquitto is an open source MQTT broker/server. Based on the lightweight MQTT protocol, Mosquitto is very favorable for diverse kind of devices, sensors and other 'Internet of Things' devices. MQTT clients can connect to a given Mosquitto broker and publish/ subscribe the messages from a topic. Eclipse Mosquitto's main responsibility is to provide a communication channel

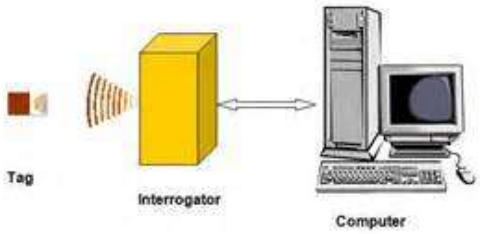
between publishers/senders and subscribers/ receivers. Any publisher, using the Eclipse Paho MQTT Client API can publish the messages to an MQTT Broker. These MQTT clients should specify the topic, on which they want to publish the message. These topics are configured on MQTT broker. Any subscriber or receiver, that want to receive the message, subscribe to that particular topic.

Eclipse Paho

Eclipse Paho provides MQTT client libraries in multiple languages including Java/C++, C#,NET, and Python. Eclipse Paho also has utilities for MQTT-SN (sensor networks). Both publishers and subscribers can use API's provided by Eclipse Paho MQTT Client library, and send/receive messages to/ from MQTT broker.

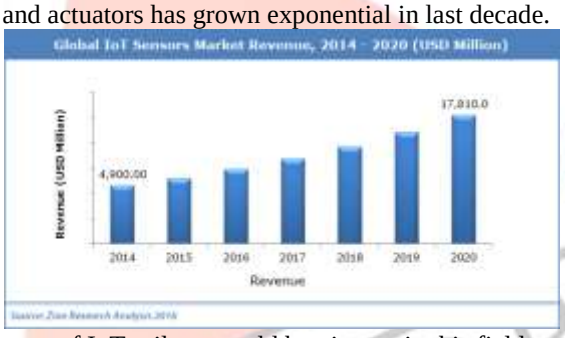
RFID Technology

A technology that employs a microchip with an antenna that broadcasts its unique identifier and to the location to receivers. Employs a microchip called a smart tag. Broadcasts unique 96-bit identifier to receiver relay the data to a computer. As given in the figure RFID Tag contain all the information like from where the product is coming where going providing valuable information.



IoT Sensor

A small number and basic IoT sensor when combined can make thousands type of combination which could help to do diverse types of work the market of the sensor and actuators has grown exponential in last decade.

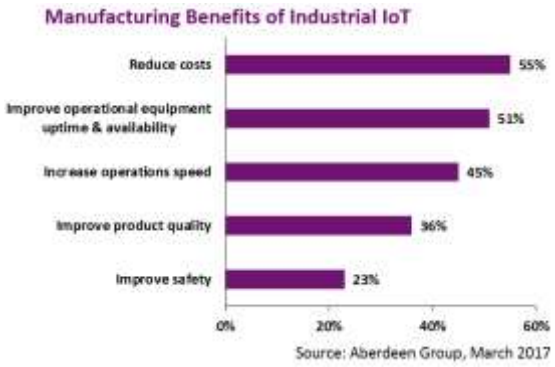


The above graph totally indicates the future of IoT railway could be pioneer in this field as there are thousands of ways these sensors could be used ranging from track health to cleanliness in station. Different types of sensor that could be combined are :- Temperature Sensor , Proximity Sensor, Pressure Sensor , Water Quality Sensor , IR sensor could be combined to form combination for the whole system.

other Equipment include Java API and hardware devices like RFID Tag Detection machine which are easily available in the open market.

Cost Benefit

It will help to address the issue of periodic maintenance and other safety feature as well there are few places where like these kinds of system of maintenance been used like by car company and estimated reduction of 30-40% maintenance cost has been seen also customer benefit will add the revenue sources overall it will help railway to come out from a trapped system to a profitable system. The initial cost would be high because of the vastness of Indian Railway but once established t will make things go faster from over all stats it's preferred that a huge economic benefit will be seen soon other way to generate income will be from taking Ads from Monetization , Real time output will help to increase customer sentiment which will result in market gain RFID will help to increase goods transportation.



Above stats tell the benefit of integrating Internet of things to the current System.

Challenge

Integrating this system at first glance seems quite painful as implementation seems quite messy and will require a large amount of human skilled force. Security concerns related to location and other sensitive data being shared and transmitted Lack of industry standards. Right now, most of the work done is vendor specific/proprietary Need to have a proper IT Analytics system in place. Can involve huge costs upfront. There needs to be a great will of change in the system and official for this change but it's the need of the hour.

IV. Conclusion

This paper present how diverse types of technology could combine with each other to provide a solution. MQTT is also discussed which is a very famous protocol of IoT also other prospects are given there. The paper concludes by stating the current problem and it's solution.

V. References

1.Details about MQTT protocol http://mqtt.org/
2. Eclipse IoT - http://iot.eclipse.org/
3.Eclipse Paho - http://www.eclipse.org/paho/
4. What is Internet of things - http://whatis.techtarget.com/definition/ Internet-of-Things
5. Eclipse Mosquitto - http://projects.eclipse.org/projects/technology. mosquitto
6.Eclipse Paho MQTT Client API – http://www.eclipse.org/paho/files/ javadoc/index.html
7.www.indianrailway.gov.in
8. Joel Levitt,Complete Guide to Predictive and Preventive Maintenance ,Industrial Press, Inc.; 2 edition (June 15, 2011)
9. IoT and Predictive Maintenance- http://blog.bosch-si.com/categories/ manufacturing/2013/02/iot-and-predictive-maintenance/
10. An IoT Based Predictive Connected Car Maintenance Approach Rohit Dhall, Vijender Solanki