CHAPTER 1

INTRODUCTION

Internet of Things (IoT) refers to interconnection orcommunication between two or more devices without human-to-human and human-to-computer interaction. Connected devices are equipped with sensors oractuators perceive their surroundings. IOT has four major components which include sensing the device, accessing the device, processing the information of the device, and provides application and services. In addition to this it also provides security and privacy of data. Automation has affected every aspect of our daily lives. More improvements are being introduced in almost all fields to reduce human effort and save time. Thinking of the same is trying to introduce automation in the field of track testing. Railroad track is an integral part of any company's asset base, since it provides them with the necessary business functionality. Problems that occur due to problems in railroads need to be overcome. The latest method used by the Indian railroad is the tracking of the train track which requires a lot of manpower and is time-consuming.

During July 2014, it was envisaged that the Indian Railways will opt for an enterprise resource planning (ERP) solution, which will integrate freight, passenger, human resources and administrative operations across the country. Features like real-time IoT and IR Page 2 of 7 monitoring of trains, mobile-based wake up call for passengers and destination arrival alerts, and station navigation information system would be taken forward. Thus the potential for the IT industry to leverage existing strengths in cloud, mobility and IoT (Internet of Things) for the Railways. In the Proposed Investment Plan (2015-2019), Information Technology/Research has been assigned Rs 5,000 crore. There will be an integration of train control and asset management applications. According to Gartner, by the 2020, there will be 26 billion devices connected to the internet. Gartner further estimates that IoT products and services will generate revenue exceeding $300 billion in 2020. IDC on the other hand has forecast that the worldwide market for IoT solutions will grow to $7.1 trillion in 2020. In a 2012 study by Beecham Research for Oracle, several verticals were identified that would benefit from machine to machine (M2M) device connectivity and create the IoT ecosystem. These were connected smartphones to cars to homes, commercial buildings, retail, industrial, IT facilities, etc.

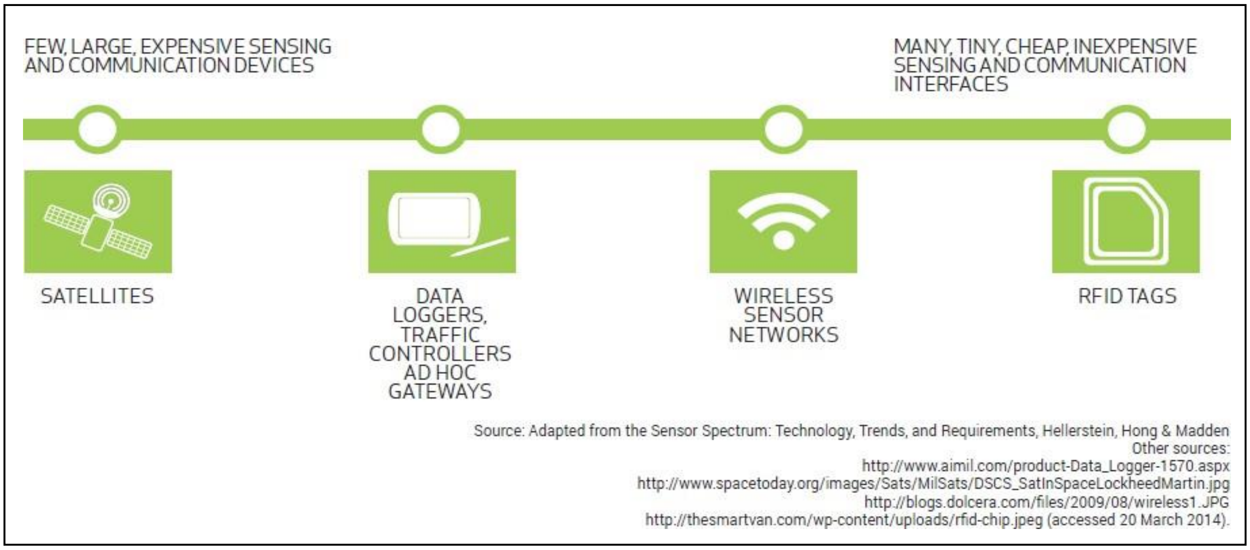


Figure 1.1 A Spectrum of Sensing Devices

This scheme has great potential for the Internet of Things (IoT). The Internet of Things (IoT) has been defined by International Telecommunication Union in Recommendation ITU-T Y.2060 (06/2012) as a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies. The IoT is a “network” of ‘things’ that can broadcast data and connect to the internet or to a network. Objects, animals or people are given unique identifiers and the capability to transfer data over a network. All this is achieved without human intervention. The convergence of wireless technologies, micro-electromechanical systems (MEMS) and the Internet leads to IoT.The regulations and standards for IoT are in the process of being set around the world.However, companies working in this area are not waiting for formal bodies to set therules. They are banding together to work on informal standards until formal IoT standards are enshrined, probably in 2017. The challenge is that not only do devices.

1.1 DESCRIPTION:

IoT technologies help railways successfully manage passenger safety, operational efficiency, and the passenger experience. **Smart sensors can be used to track important assets, manage passenger flow, and enable predictive maintenance**.

1.2 SOLUTION ARCHITECTURE:

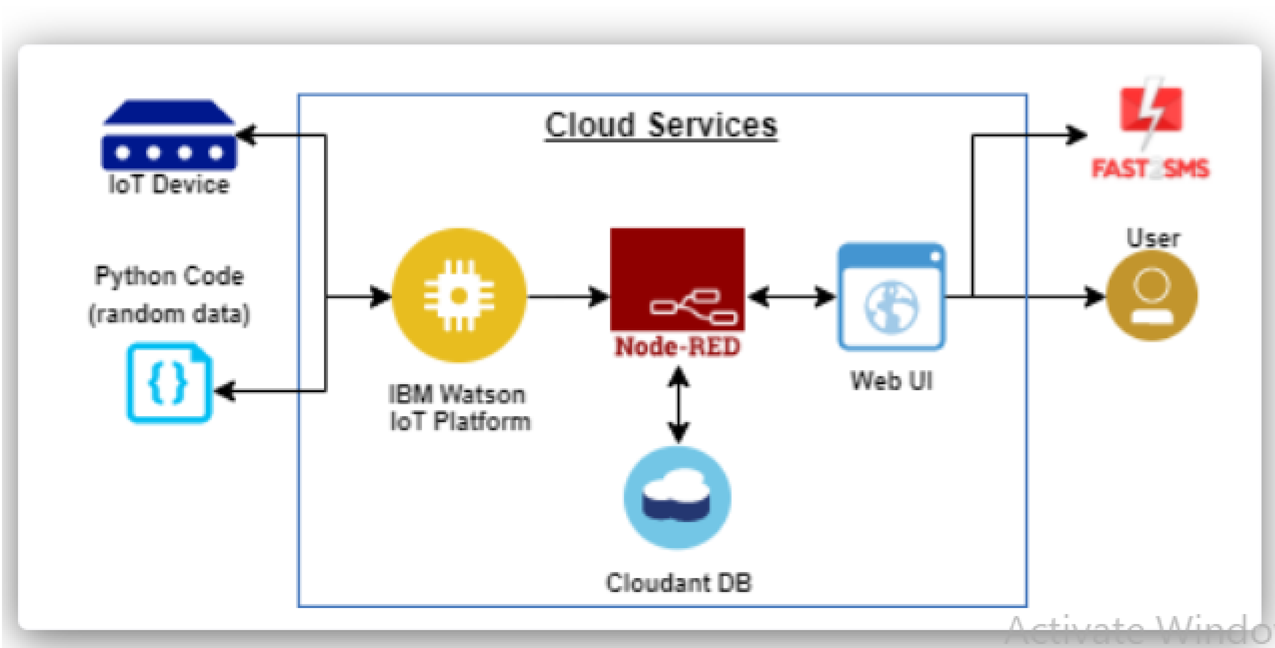


Figure 1.2 Solution Architecture

1.3 FUTURE SCOPE:

In future CCTV systems with IP based camera can be used for monitoring the visual videos captured from the track. It will also increase security for both passengers and railways. GPS can also be used to detect exact location of track fault area, IP cameras can also be used to show fault with the help of video. Locations on Google maps with the help of sensors can be used to detect in which area track is broken.

CHAPTER 2

LITERATURE SURVEY

2.1 Barry Jesia G and Harrison James E (2008), he entitled "**Arrangement of Injury in light of Transport Accidents Including Railway Train**", he analyzed and looked at the train mishaps, hospitalization keep, and so on. It gets in to extra portrayal of insights. The peril of huge injury, in light of separation cosmopolitan, is multiple times greater for travelers travel via car contrasted and travelers going by rail. The mean length of keep in clinic for a transport mishap including a railroad train was four days that were longer than the mean length of save for all External reasons for injury.

2.2 Zuhairi Mahdi Al-Ahmed Salih (2013), the examination paper is about "**Programmed Railway Gate and intersection control based sensors and microcontroller**", he gives a few answers for limit rail auto collisions and examines that this is risky than other transportation mishaps in wording of seriousness and passing rate and so forth. Hence more endeavors are important for improving security. There are numerous Railways crossing which are unmanned because of absence of labor expected to satisfy the interest. Henceforth numerous mishaps happen at such intersection since there is nobody to deal with the working of the railroad entryway when a train approaches the crossing. The principle targets of this Paper is to deal with the control arrangement of railroad door utilizing microcontroller.

2.3 Anil M.D.et al (2014), he talked about "**Cutting edge Railroad mishap counteraction System Using Sensor Network"** in that he talked about expanded rail traffic thickness over the world and in such conditions how to control. This framework makes employments of IR sensors, fire sensor, Zigbee and installed frameworks which forestall mishap. At the point when the train landing in a particular side then transmitter IR sensors make their appropriate clue and afterward at the equivalent time the collector IR sensor gets their sign and makes railroad into halting position.

2.4 Keil Micro vision Integrated Development Environment: Keil Software advancement instruments for the 8051 miniaturized scale controller family bolster each degree of designer from the expert applications architect to the understudy simply finding out about installed programming improvement. The business standard Keil C Compilers, Macro Assemblers, Debuggers, Real-time Kernels, and Single-load up Computers bolster ALL 8051-good subsidiaries and assist you with getting your ventures finished on time. The source code is written in low level computing construct. It is spared as ASM record with an augmentation. A51.the ASM document is changed over into hex record utilizing keil programming. Hex document is dumped into miniaturized scale controller utilizing LABTOOL programming. Without a moment's delay the record is dumped and the ROM is scorched then it turns into an implanted one.

2.5 "**SMART RAILWAY SYSTEM FOR SAFE TRANSPORTATION**" by Devyani Bonde, Priyanka Pawar, Sneha Patekar, Ruchita Mane, Supriya Pawar : It is the need of great importance to defend the individuals from railroad mishaps and guaranteeing the wellbeing all through the excursion. There are numerous individuals are utilizing trains as their method of transportation and train can convey numerous travelers one after another. The developing populace needs more trains for the transportation where in which security is the principle standards. The created correspondence framework can pass solid data to the train well ahead of time. The motor driver can control the train dependent on the data passed by the correspondence framework. The Digitalization of railroads and guaranteeing wellbeing highlights utilizing quick and solid correspondence framework makes rail route a superior method of transport than the others. 52 A multi-sensor impediment discovery framework for the utilization on railroad track was determined, actualized and tried. The applied look-ahead sensors are: Video cameras (optical detached) and LIDAR (optical dynamic). The items conveyed by the sensors were melded, grouped and their depiction is sent to the focal vehicle unit. It has been demonstrated that the combination of dynamic and detached optical sensors and a railroad track information base lead to vigorous framework execution. The general location execution has demonstrated to be practically identical to that of a human driver. This is a practical yet fiery answer for the issue of railroad track geometry study using a technique that is one of a kind as in while it is straightforward, the thought is totally novel and up till now untested.

The task examines the specialized and plan perspectives in detail and furthermore gives the proposed multi sensor railroad track geometry reviewing framework. This venture additionally presents the subtleties of the usage consequences of using basic parts comprehensive of a GPS module, GSM Modem and MEMS based track identifier get together. The proposed railroad framework is completely mechanized utilizing RFID, Bluetooth, GPS, Wi-Fi and Live Video Streaming. 53 Autonomously driving trains are being worked on for future frameworks to upgrade open traveler traffic. In any case, the security level for this application must be equivalent to in regular frameworks. In this way, entirely fit sensor frameworks are viewed as which ought to distinguish all hindrances before the train. Therefore, a multi sensor framework containing radar and video innovation is under scrutiny for this difficult application.

2.6 According to **Gartner, by the 2020**, there will be 26 billion devices connected to the internet. Gartner further estimates that IoT products and services will generate revenue exceeding $300 billion in 2020. IDC on the other hand has forecast that the worldwide market for IoT solutions will grow to $7.1 trillion in 2020. In a 2012 study by Beecham Research for Oracle, several verticals were identified that would benefit from machine to machine (M2M) device connectivity and create the IoT ecosystem. These were connected smartphones to cars to homes, commercial buildings, retail, industrial, IT facilities, etc. This scheme has great potential for the The Internet of Things (IoT). The Internet of Things (IoT) has been defined by International Telecommunication Union in Recommendation ITU-T Y.2060 (06/2012) as a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies. The IoT is a “network” of ‘things’ that can broadcast data and connect to the internet or to a network.

The applications of IoT range from building and home automation and monitoring, environmental monitoring, infrastructure management, industry, energy management, transport systems, urban area management, medical and healthcare systems, etc. New ideas and new companies are creating innovative products and protocols while established companies like Cisco, IBM and Microsoft are investing heavily in IoT technology.

In India, the first set of IoT-enabled products and services are already being seen. In Bangalore, Electronic City is poised to work 'smart' with smart systems deployed for water, parking, security, etc. In Chennai, a start-up called MaxMyTv, connects devices in the home to the T.V. to enable information flow, control and monitoring. A technical and legal framework is also being readied. One of the top most initiatives in the form of Digital India Program of the Government which aims at 'transforming India into digital empowered society and knowledge economy', is expected to provide the required impetus for development of the applications of IoT range from building and home automation and monitoring, environmental monitoring, infrastructure management, industry, energy management, transport systems, urban area management, medical and healthcare systems, etc. Railways have been an essential mode of transportation to people all over the world for centuries. They were critical to the industrial revolution and played a major role in creating thriving, innovative societies. Today, railways are more important than ever as country and city governments are being asked to find innovative ways to safely get back to business post-COVID, meet the changing needs of their citizens, address urban population increases, and reduce their environmental impact. To meet these challenges and position themselves for future success, many forward-thinking governments and railway operators are looking for smart, intelligent IoT technologies to modernize their railways. **Technologies for Connected Railways.**

There are many types of smart devices that enable IoT in railways, such as vibration and temperature sensors, vehicle and station cameras, digital signage, machine learning libraries, security systems, and more. When these intelligent devices work together in one end-to-end solution, railway operators can by leveraging IoT technologies, railway operators can aim to provide a more intelligent, connected, efficient, safe, and convenient railway experience for everyone while also realizing these benefits: Congestion and overcrowding create operational inefficiencies. Using deep learning and AI through computer vision, operators can monitor passenger flow and gather data for advanced analytics to help enable more-informed decision-making around staffing and security. Sensors, cameras, and in-vehicle computers empower rail operators to monitor their fleet's diagnostic data to minimize breakdowns, predict maintenance repairs, and optimize servicing schedules to keep trains in working order and movies Computer vision and AI-enabled smart cameras help automate safety alerts when there are potential water spills, fire and smoke, or accidents. They can also be used to help locate missing children in crowds or detect if someone climbs onto conveyor belts, falls on escalators or onto trackways, or enters restricted areas.

IoT technologies provide operators myriad possibilities for creating new solutions and services to meet passenger expectations. Operators can personalize travel for individual passengers with near-real-time data collection and analysis or provide strong and reliable onboard Wi-Fi so passengers can stay connected throughout their journey. In this area are the maintenance centre and the depot, to maintain and store trams during the night in particular. A power substation is also located in this centre. This substation converts 20 kV 3-phase public grid to 750 VDC tram network. This is one of the 7 substations feeding Reims' tram network. This substation is named SST7 as it is the last one, providing electricity to this end-of-line area. The main objective of this use case is to study the energy monitoring options for individual infrastructure assets as well as for the complete traction power network. Monitoring options will be identified, in order to provide continuous monitoring of electrical infrastructure, optimization of the infrastructure performance and the implementation of preventive maintenance. The smart metering use case for electrical infrastructure monitoring through the detection of electrical anomalies (IN-OP) will be realized on four substations that are part of the traction power supply system on a 45km section of the West Coast Mainline (WCML) which emanates from London Euston Station to Scotland.

Data needs will depend on the monitoring application and will comprise of current and voltage including harmonics, temperature, etc. A higher frequency sampling is likely to be be required, but by using a defined trigger point data acquisition the volume of transmitted data can be minimized. Information and Communication Technology (ICT) platforms for future railway systems are expected to support a wide range of applications with highly variable performance attributes covering both operational and end-user service requirements. These platforms are expected to offer services ranging from delay sensitive video to infotainment services, and from best effort applications to ultra-reliable ones such as M2M (Machine-to-Machine) communications. An important consideration in the design of these platform is the very high mobility of train transportation systems beyond 2020 that in many cases may exceed 500 km/h. In addition to high mobility scenarios, connectivity for zero to low mobility cases (interconnecting devices at stations and substations) must be also supported.

Other applications, such as remote maintenance of rolling stock and remote processing will have central role in future railway platforms [1]]. In response to these challenges, IN2DREAMS relies on an advanced communication platform enabling connectivity between a variety of monitoring devices and computational resources through a heterogeneous network infrastructure. The connectivity, coordination and collaboration required is provided, on an on-demand basis in accordance to the cloud computing paradigm.

2.7 IJRET: International Journal of Research in Engineering and Technology eISSN: Banuchandar, V.kaliraj, P.Balasubramanian, N.Thamilarsi The paper composed by these creators fundamentally put a spot light on two things; one is the decrease of time for which the entryway is being kept shut. What's more, besides, give a security to the street clients to lessen the mishaps by utilizing unmanned method of opening the railroad door.

2.8 Hnin Ngwe Yee Pwint, Zaw Myo Tun, Hla Myo Tun: The paper describes automatic railway gate systems by using PIC 16F877A Microcontroller for saving precious Haman lives. Here Inductive and IR sensors used as input 51 components while buzzer, light indicator, DC motor and LCD display are the output components. The paper manages control the railroad track by utilizing an anticollision method, the whole framework is displayed and constrained by 8952 microcontroller to keep away from the rail line accidents.Some of the past frameworks identified with the railroad door robotization are found in .The mechanization of entryway was first attempted in Korea. This System was proficient in decrease of setback level close to intersection. Attractive sensors assumed a significant job in the Korea's computerizations of intersection entryways. Sensors which were sent under the ground were unaffected by the progressions caused in condition and they help in perceiving vehicular heading. In current Railway's Technology is attempted to present here and examined about the disservices of manual framework. The train's identifiers here sensors play a noticeable part in mechanizing the framework and furthermore practical.

2.9 IOT BASED SMART RAILWAY CROSSING SYSTEM by GOLLA TEJASWI, Dr.G.S .SARMA: Computerization of the railroad door control framework is actualized so as to decrease connection oflifting andshutting the intersection door which permits and stays away from vehicles and individuals from passing the intersection. Rail crossing has been the underlying driver for of incident and numerous lethal issues. Computerization of the intersection entryways makes simple and secure to control the doors. People may make wrong or incidents which might be extremely perilous, robotization of entire thing will abbreviate potential outcomes of the accidents and mistake. Robotization of the 54 lifting and closing of the railroad crossing door with the use of Arduino utilizing sensor and utilizing engines will help in controlling the entryways. This can be executed in the remote territory where it is hard for people to work in like in the spots of extraordinary climate.

As everything in this world has a constraint our set forth framework represents a few confinements which utilizations of InfraRed sensors are. Independent of train or some other article in its inclusion zone it will identify as an item is identified which is wrong. Second impediment happens to be while lifting and Vol 08 Issue08, Aug 2019 ISSN 2456 – 5083 Page 150 closing of intersection door however this flops in dodging the developments of the vehicles intruding. We just control crossing entryway here. So as to determine this issue, we take help of weight that goes about as extra to the set forth work. Alongside Infra-Red sensors it is acceptable to utilize load sensors. Here the heap sensor utilization is constrained as it isn't monetarily doable for little region however when actualized in a bigger degree this will give a tremendous effect.

2.10 Pillai Binu B and Singh G.D (2015), his article is on “Scenario of Road Accidents in Kerala and its ILL effects”. He analyses detailed study on Road accidents and it’s after effects lead to a major economic, social and health problem. It highlights the costs experienced during and after the accidents include hospital expenses, administrative and court expenses, wastage of time and also the cost of intangible consequences like pain, grief and sufferings. This can be compared with Rail accidents where in the cost involved and pain undergone by the victims. In Rail systems several measures has been planned and implemented in our country to control the impact of injuries during Rail accidents but the actual implementation is lacking.

CHAPTER 3
SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

Existing train tracks are manually researched. LED (Light Emitting Diode) and LDR (Light Dependent Resister) sensors cannot be implemented on the block of the tracks]. The input image processing is a clamorous system with high cost and does not give the exact result. The Automated Visual Test Method is a complicated method as the video color inspection is implemented to examine thecracks in rail track which does not give accurate result in bad weather. This traditional system delays transfer of information. Srivastava et al., (2017) proposed a moving gadget to detect the cracks with the help of an array of IR sensors to identify the actual position of the cracks as well as notify to nearest railway station. Mishra et al., (2019) developed a system to track the cracks with the help of Arduino mega power using solar energy and laser. A GSM along with aGPS module was implemented to get the actual location of the faulty tracks to inform the authorities using SMS via a link to find actual location on Google Maps.Rizvi Aliza Raza presented a prototype in that is capable of capturing photos of the track and compare it with the old database and sends a message to the authorities regarding the crack detected. The detailed analysis of traditional railway track fault detection techniques is explained in table.

In the fast developing country, people are facing many accidents; it would be undesirable for any nation to losing their life for unwanted cause. Railways are one of the important transports in India. There is a need for manual checking to detect the crack on railway track and always railway personnel takes care of this issue, even though the inspection is made regularly. Sometimes the crack may unnoticed . Because of this the train accident or derailment may occur. In order to avoid this situation and automate the railway crack detection has been proposed. Here ultrasonic sensor is used to detect the crack in the railway track by measuring distance from track to sensor, if the distance is greater than the assigned value the microcontroller identifies there is a crack, also it tells the exact location of the crack by the formula “DISTANCE=SPEED*TIME”.

This paper suggests a conceptual framework and architecture to capture free riders (fare dodgers) in an early stage by using a RFID distance scan combined with people counting techniques as a tool to locate and monitor passengers. As a case study this paper uses the ticketing system in The Netherlands. It is a RFID-based ticketing system which uses a smartcard called OV-Chip card. It explains the current setup in The Netherlands, systems and architectures used and shows where possible problems and improvements could be achieved. An experiment is done to measure certain basic distance read ranges in different situations and locations. The results show that by making use of a different system architecture (RFID technology and People Counting Techniques) an improvement in catching free rides (faredodgers) in a much earlier stage is inspectors.

In this paper, numerical investigations are carried out to assess the possible use of vibration measurements to identify the presence of a fatigue crack in railway axles. A non-linear finite element model of a cracked axle, reproducing the crack breathing mechanism, is introduced. The solid model of the axle is built in the ABAQUS FEM software and a crack is introduced in it. Numerical simulations are presented for two different types of axle: hollow ones, as in passenger trains, and solid ones, as in freight trains. Simulation are carried out for different possible locations of the crack and different measuring points for the monitoring equipment. Results indicate that the presence of a crack in the shaft affects not only the vertical vibration signal, but also the horizontal (perpendicular to the axle axis) one, generating harmonic components of bending vibration at frequencies that are multiple integers of the frequency of revolution of the axle. Results revealed also that the horizontal vibration provides promising indicators of axle fault development because the effect of various sources of disturbance, namely wheel out-of roundness, can be more easily dealt with.

Adaptive noise for railway crack detection using EMD [15] rail crack is one of the most important reasons for track degradation and it can lead to serious traffic accident. In order to detect cracks in rail, various methods are employed. Recently AE technology can passively receive signals from crack. It is an effective nondestructive detecting method for real-time and dynamic detection [3]. With the increase of traffic speed and density on modern INTERNATIONAL JOURNAL OF CURRENT ENGINEERING AND SCIENTIFIC RESEARCH (IJCESR) ISSN (PRINT): 2393-8374, (ONLINE): 2394-0697, VOLUME-5, ISSUE-4, 2018 47 railways, the detection method at low speed will occupy the railway and affect the operation of trains.

The filtering method which is based on the fixed frequency bands is difficult to determine the bands of noise signals in various speed conditions. By selecting appropriate wavelet basis, the wavelet method has a good performance in signal detection. However, the selection of wavelet basis has an important influence on the results. A rail crack detection method based on the adaptive noise cancellation method of EMD is proposed for the high speed application. The rest of this paper is organized as follows. Section II presents the rail crack detection method based on the adaptive noise cancellation method of EMD. Section III introduces test rig and test procedure. In Section IV, the proposed method is investigated by the signals at different speeds and the noise influence is also analyzed. Section V gives the concluding remarks. The acquired signal is decomposed into a number of IMFs by the EMD method, and the correlation analysis is used to determine which IMF contains the useful information. Then, the IMFs which contain the useful information are reserved, and the IMFs which primarily contain the noise signals are removed.

At last, the denoising signal is reconstructed based on the useful IMFs and it is utilized to detect the crack signal by wavelet transform. In practice, the detection based on the entire length of signal will lead to great amount of calculation and poor real-time performance. Therefore, the acquired signal is divided in to a number of small segments, then the segments of signal are processed one by one in real-time. The rail crack detection method based on the adaptive noise cancellation method of EMD. Section III introduces test rig and test procedure. In Section IV, the proposed method is investigated by the signals at different speeds and the noise influence is also analyzed. Section V gives the concluding remarks.to achieve the aim of adaptive noise cancellation. The acquired signal is decomposed into a number of IMFs by the EMD method, and the correlation analysis is used to determine which IMF contains the useful information.

At last, the denoising signal is reconstructed based on the useful IMFs and it is utilized to detect the crack signal by wavelet transform. In practice, the detection based on the entire length of signal will lead to great amount of calculation and poor real-time performance. Level crossing controller and rail track using IR sensor and internet of things the most commonly used transportation mode in India. It is also one of those modes of transport that faces a lot of challenges due to human errors such as level cross accidents, collisions due to broken track etc. A level cross, an intersection of a road and a railway line, requires human coordination, the lack of which leads to accidents, also the main problem about railway analysis is detection of the crack in the location .If this problem are not controlled at early stages they might lead to a number of derailment resulting in heavy loss of life and property.

In traditiznal system level crossings are managed by the gatekeeper and the gatekeeper is instructed by the means of telephone at most of the level cross from the control room. But the rate of manual error that could occur at these level crosses are high because they are unsafe to perform without actual knowledge about the train time table. Delay in the opening and closing of the gate could lead to railway accidents. It is a 64 pin High Performance ARM microcontroller. It is also tiny size and low power consumption microcontroller. Due to their tiny size and low power consumption, LPC2148 are ideal for application where miniaturization is a key requirement, such as access control system. Video analysis for rail inspection at a large scale has become a possibility.

Safety in railways is one of the key issues for public transportation companies and a fast and efficient inspection system is important to ensure the safety of railways. Traditional rail inspection methods include destructive techniques, such as coring, and non-destructive techniques, such as hammer sounding. But these methods can just “cover limited area and have limited effectiveness in identifying possible sites of deterioration” (Delatte et al., 2003. A video logging project in most countries recently where the recorded video is viewed by a human expert manually to make decisions. Here objective is to automatically find clips in video sequences and thereafter recognise whether they are broken and if they are new or old as indicated by their colour.

Metal clips hold the rail track to the sleepers on the ground. We need to find the clips and locate their position. All the boundaries between two dissimilar regions in an image are represented as a one-pixel width line after Canny edge detection. As we are only concerned with track and clips, so we do not need to analysis all the edges. As a result, some edges that is shorter than a threshold in the edge detected image should be considered as unimportant features and be removed. Help of wifi in the railway system “Probe” means an exploratory device for investigating and obtaining information on a remote or unknown region. In the field of road traffic, research is proceeding to acquire detailed traffic flow information and reflect it in traffic control by using probe cars that are regarded as “probes” with an information-obtaining function and having them transmit real time traffic information such as traffic jams and travel times.

3.2 PROPOSED FRAMEWORK:

The proposed work consists of ARM processor based CC3200 microcontroller, sensor unit and a control unit. In CC3200 has an inbuilt UART setup, GSM modem and 32bit I/O ports. The 32 bit register bits are directly connected to ALU allowing two independent registers to be accessed for one single instruction executed during one clock cycle. A JTAG interface is available for Boundary-scan, On-chip Debugging support for programming.in our paper automatic track changing features added its will reduce man power. This paper also include automatic ticket booking using RFID technicque. It will save the time. It has another feature that is people counting it will allows only required number of people to inside the train when required number of people enter into the train it will automatically close the door.

ADVANTAGES OF PROPOSED SYSTEM:

- Information concerning categorization of faults can be analyzed across multiple assets, even multiple operators, to spot trends and identify areas for preventative maintenance.
- Predictive and preventive maintenance can dramatically increase the percentage of times a train is in use rather than sitting in a maintenance or repair shop, and also improve the passenger experience and safety.
- Cost effective for Railway Department
- Many lives can be saved

CHAPTER 4
REQUIREMENTS SPECIFICATIONS

HARDWARE SPECIFICATION

SOFTWARE SPECIFICATION

CHAPTER 5

PREREQUISITES – SOFTWARE

5.1 Connect Device to IBM Watson IoT Platform

IBM Watson IoT Platform is a complete end-to-end solution for IoT needs. It integrates a bundled set of services to connect, capture, register, analyze, and archive your IoT devices anddata.

For more information and documentation on IBM Watson IoT Platform please see the following - https://www.ibm.com/support/knowledgecenter/en/SSQP8H/iot/kc_welcome.htm

This is part two of a two-part series. This document is a simple, easy to follow process toconnect a device to IBM Watson IoT Platform. It will go through connecting via an MQTT connection.

In part one, see part 1 - Configure IBM Watson IoT Platform to Connect a Device, IBM Watson IoT Platform account was created and configured, a device type was created, and a device was added

I. Connect Device to IBM Watson IoT Platform using MQTT

The main means to connect devices to IBM Watson IoT Platform is via MQTT. Thedevice will need a MQTT client software to connect and publish events. To add MQTT capability to devices, IBM provides reference implementations

Please see the following. https://github.com/mqtt/mqtt.github.io/wiki/libraries

The device must satisfy the requirements for the connection to be able to publish anevent. On the device add a username, and password/authentication token and connect. Use the registration information to connect the device and start receiving device data. Set up the device for MQTT messaging and authenticate by using the organization ID, device type, device ID, and authentication token that was created inpart one of this series. How to setup a specific device will vary by device.

The following information is required when connecting your device

URL

<orgid>.messaging.internetofthings.ibmcloud.com

where orgid is the ID of the IBM Watson IoT Platform organizationcreated in part one.

Port

8883

This is a secure encrypted connection

Device ID

d: <orgid>:<device type>:<device id>

where:

orgid in the ID of the IBM Watson IoT Platform organizationcreated in part one device type is the device type created in IBM Watson IoTPlatform in part one device id is the device created in IBM Watson IoT Platform inpart one.

Username

use-token-auth

Username is the same value for all devices - use-token-auth.

This tells IBM Watson IoT Platform to use the devices authentication token

which is the password.

Password

Authentication token

Password is the device’s unique authentication token that was generatedwhen the device was created in part one.

Event topic format

iot-2/evt/<eventid>/fmt/<formatstring>

where:

eventid specifies the event name that is shown in IBM Watson IoT

Platform format string is the format of the event, such as JSON.

5.2 Message format

JSON

Certificate (optional)

when you use secure MQTT messaging, newer client libraries automatically trust the default certificate that is presented by IBM Watson IoT Platform service. If this is not the case for your client environment, you will needa full certificate chain and specify that in the connection.

Once connected you will see the device connected in IBM Watson IoT Platform andthe device can send data.

II. Login to IBM Watson IoT Platform to Verify Connection

Go to URL - https://internetofthings.ibmcloud.com/

Click Sign in

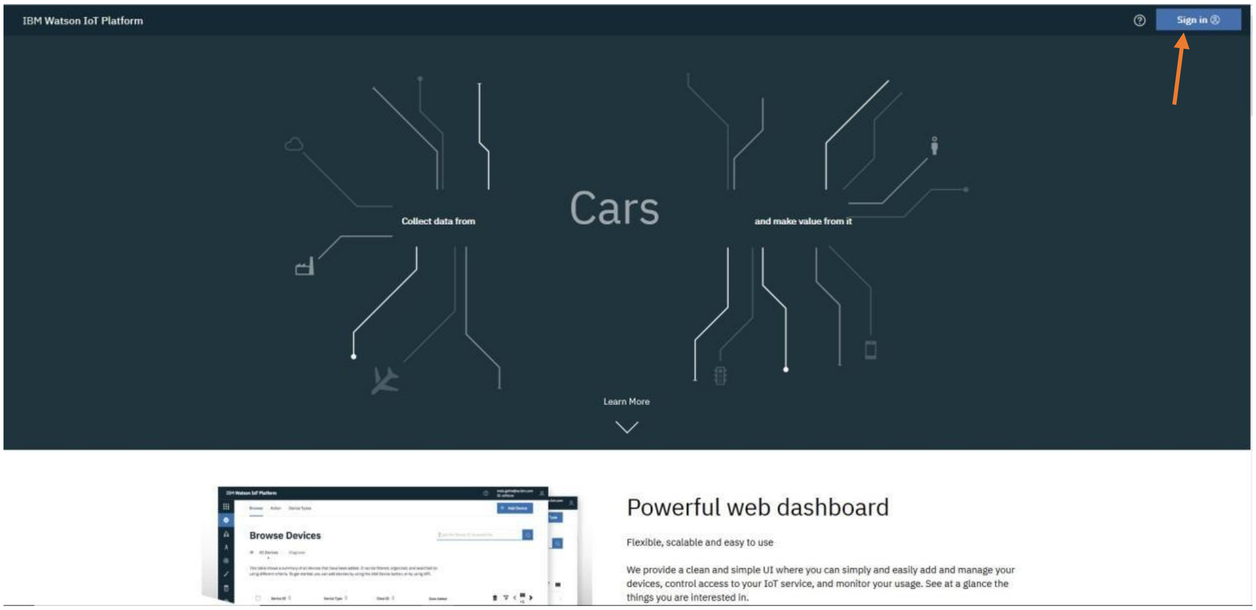


Figure 1.3 Sign in page

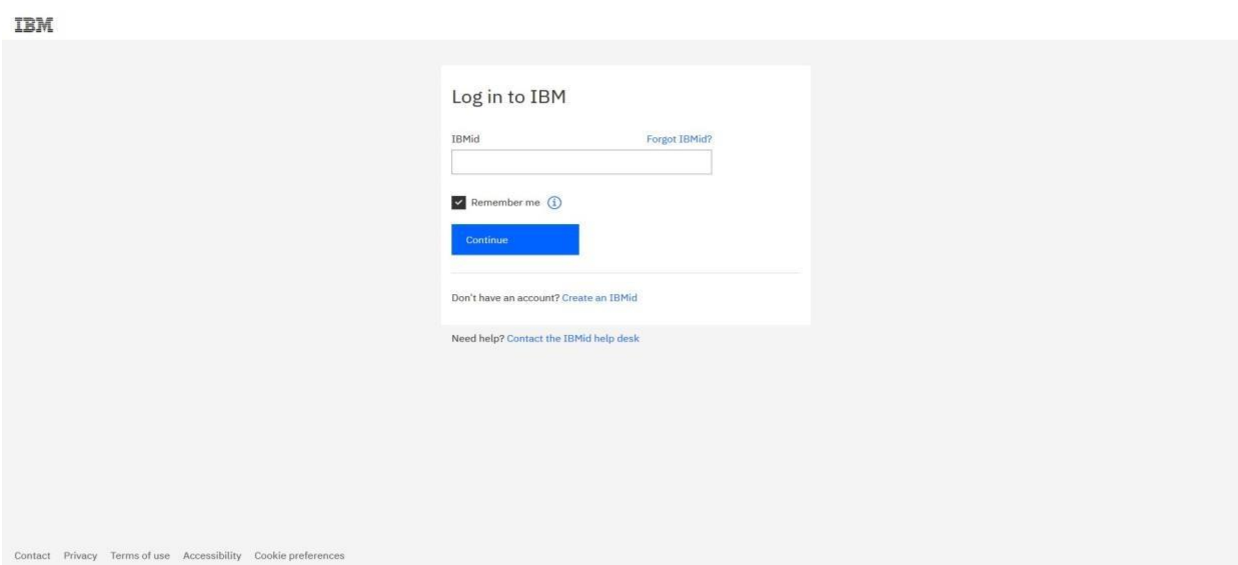


Figure 1.4 Login Slide

Enter the Password and click Login(Click Remember Me if you want)

You are now logged into IBM Watson IoT Platform

Click select org

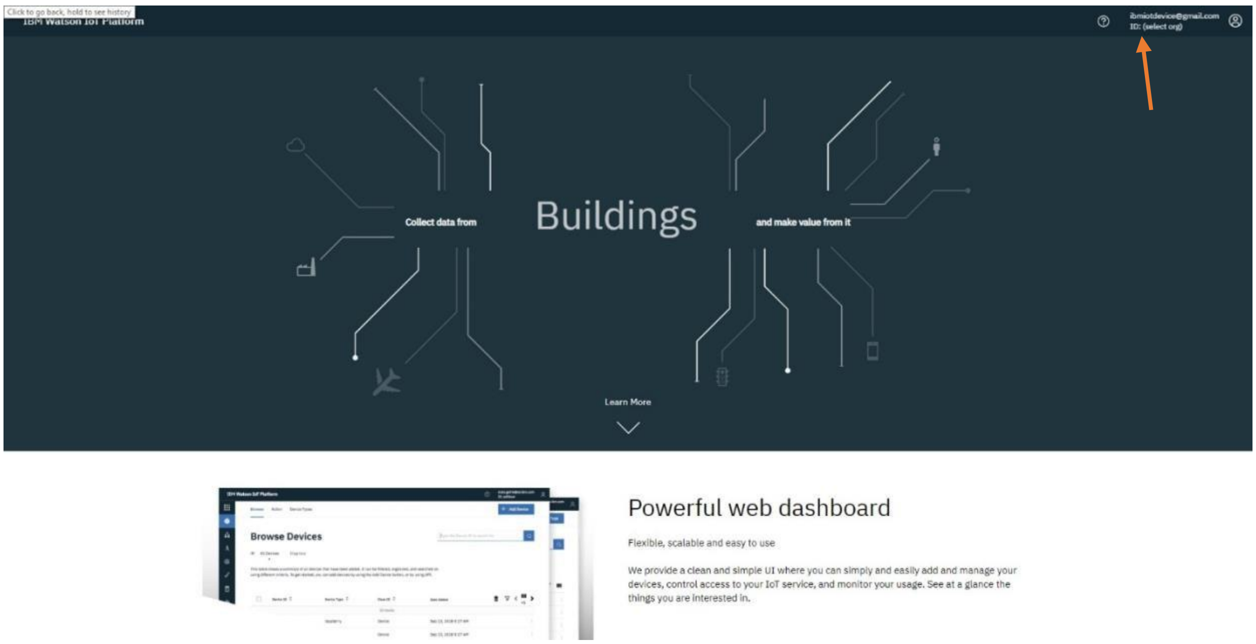


Figure1.5

Select the org

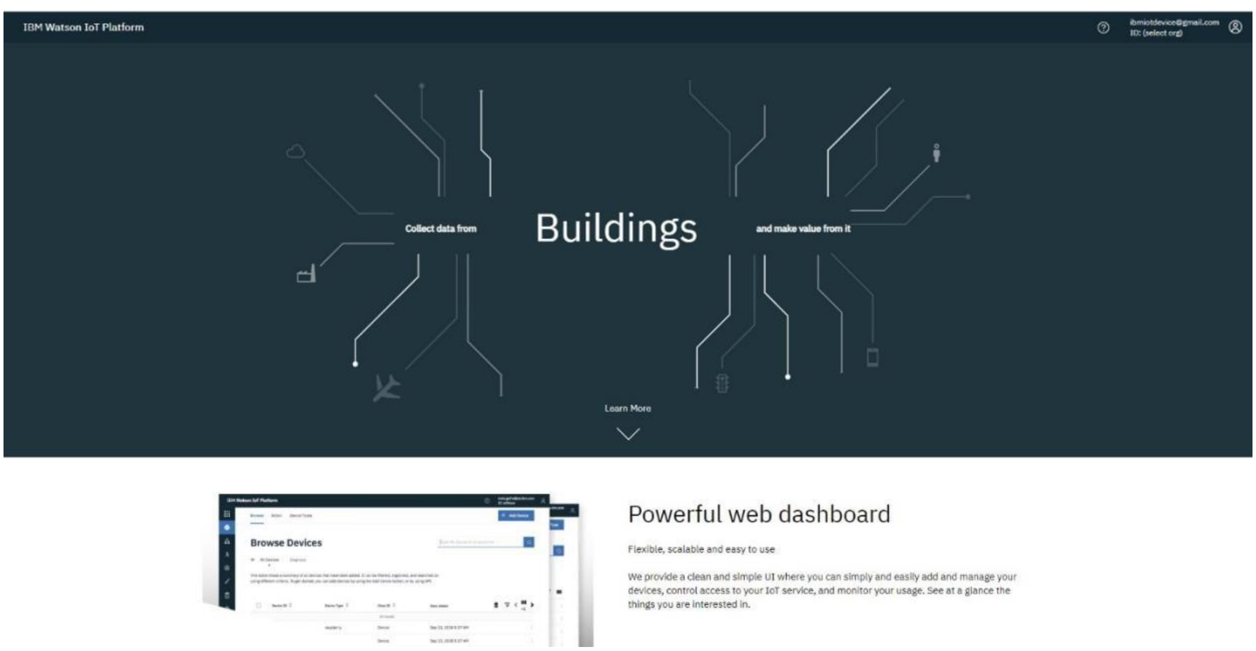


Figure 1.6 Dashboard

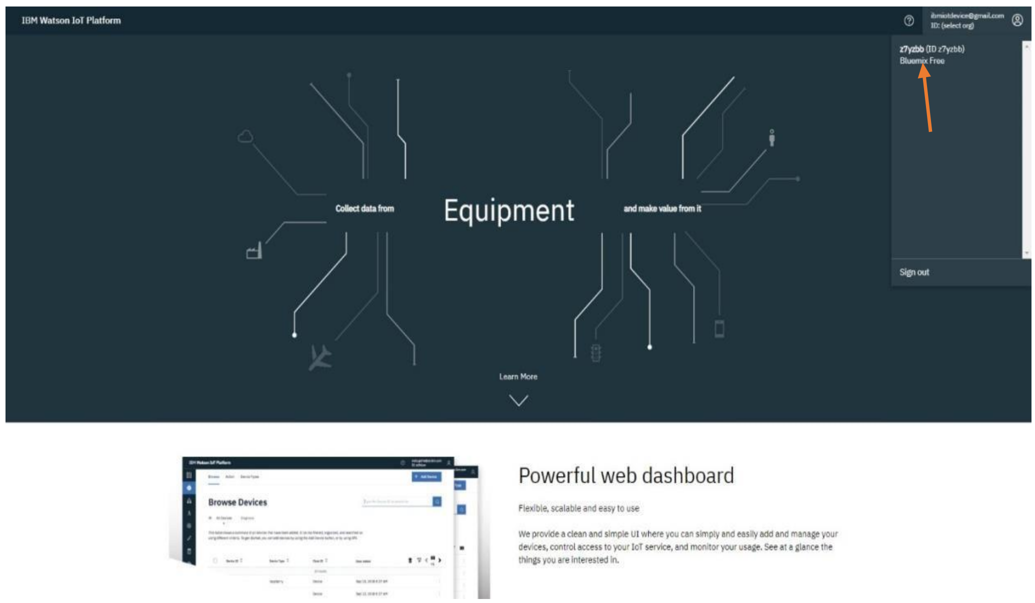


Figure 1.7 Equipment

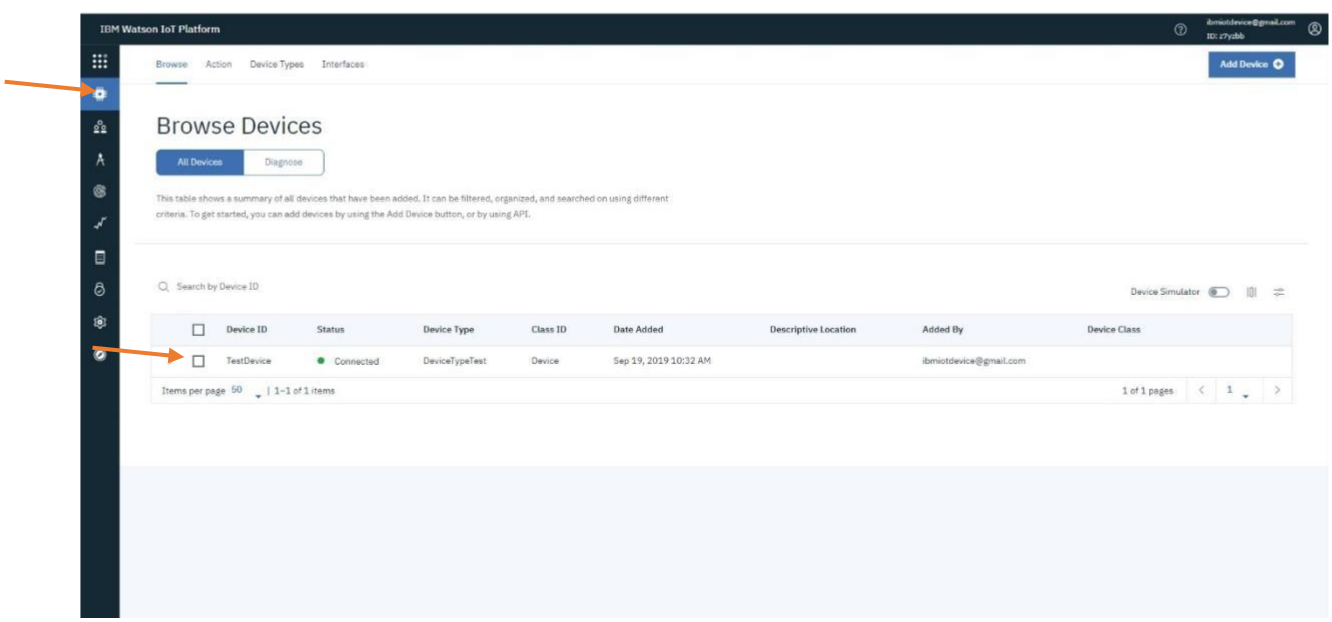


Figure 1.8 Browse Devices

Click the device and Logs and see that the connection was made

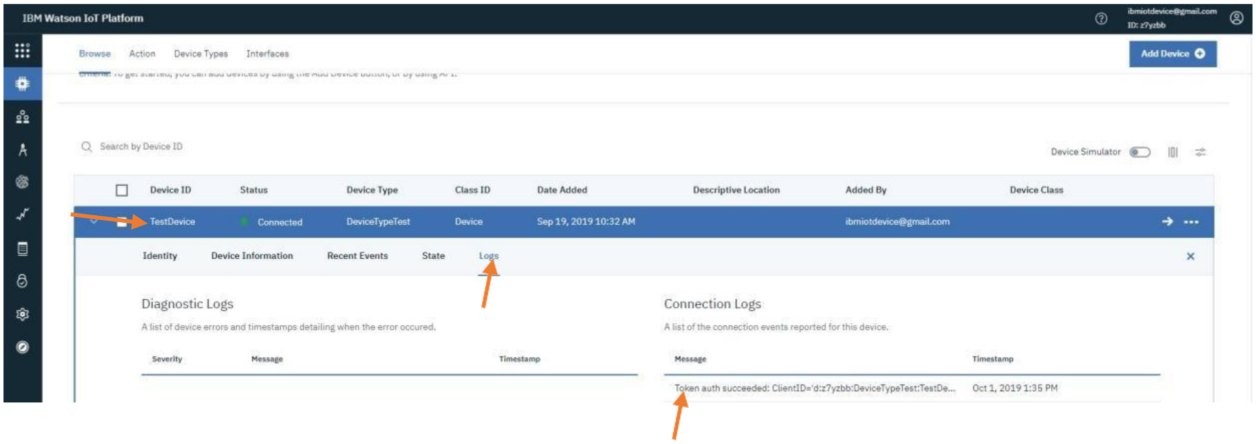


Figure 1.9

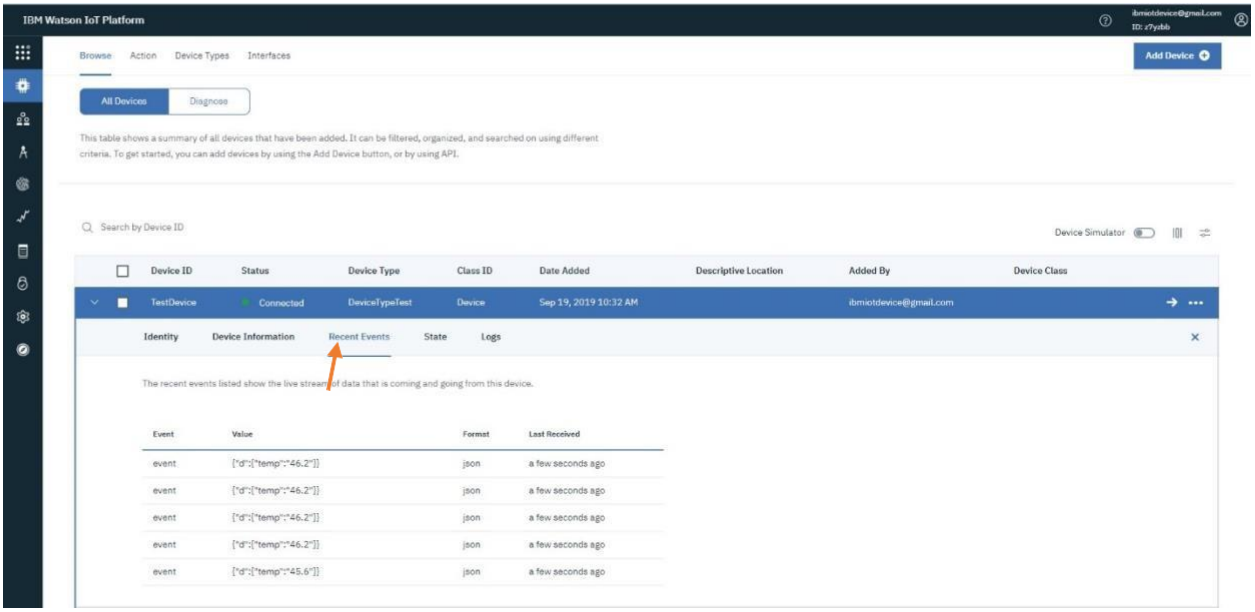


Figure 1.10

5.3 Example Device Configuration and Python Connection (Optional)

Test done with a Raspberry PI with Python

Install Python

sudo apt-get install python-dev python-pip

Install the wiotp-sdk and psutil python modules sudo pip install wiotp-sdk psutil

Define environmental variables for the org, device type, device id, and authentication token. These values are the ones created and/or generated in IBM Watson IoT Platform in part one.

These variables correspond to the device parameters for the registered deviceWIOTP_IDENTITY_ORGID

WIOTP_IDENTITY_TYPEID
WIOTP_IDENTITY_DEVICEID
WIOTP_AUTH_TOKEN

Commands

export WIOTP_IDENTITY_ORGID=<orgid>
export WIOTP_IDENTITY_TYPEID=<devicetype>
export WIOTP_IDENTITY_DEVICEID=<deviceid>
export WIOTP_AUTH_TOKEN=<authtoken>

Run python

python iotpsutil.py

III. Connecting to Quickstart (Optional)

If you have issues connecting the device, you can use Quickstart to troubleshoot witha ‘simple’ connection. To make a quick connection of the device to IBM Watson IoT Platform you can use Quickstart. Connecting to Quickstart allows you to quickly verify your installation and connectivity to IBM Watson IoT Platform. It is not requiredto test via Quickstart. When you connect to the Quickstart service, authentication or registration is not required, and the orgId must be set to quickstart.

Quickstart does not require any IBM Watson IoT Platform configuration. It is a quick way to test connectivity from a device to IBM Watson IoT Platform in a unsecure connection.

Go to URL - https://internetofthings.ibmcloud.com/

Scroll down and click Launch Quickstart

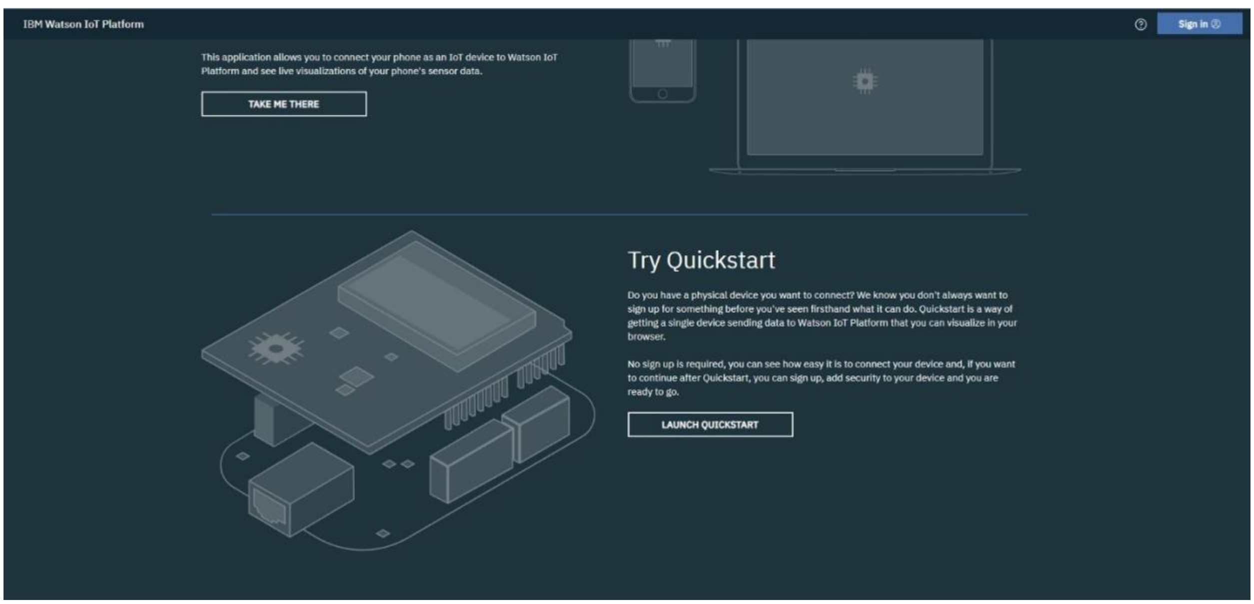


Figure 1.11 Quickstart Page

Click the box to accept the terms and enter the device id. Click Go
Device id will be a value from the device. See example below of a Raspberry Pi test.

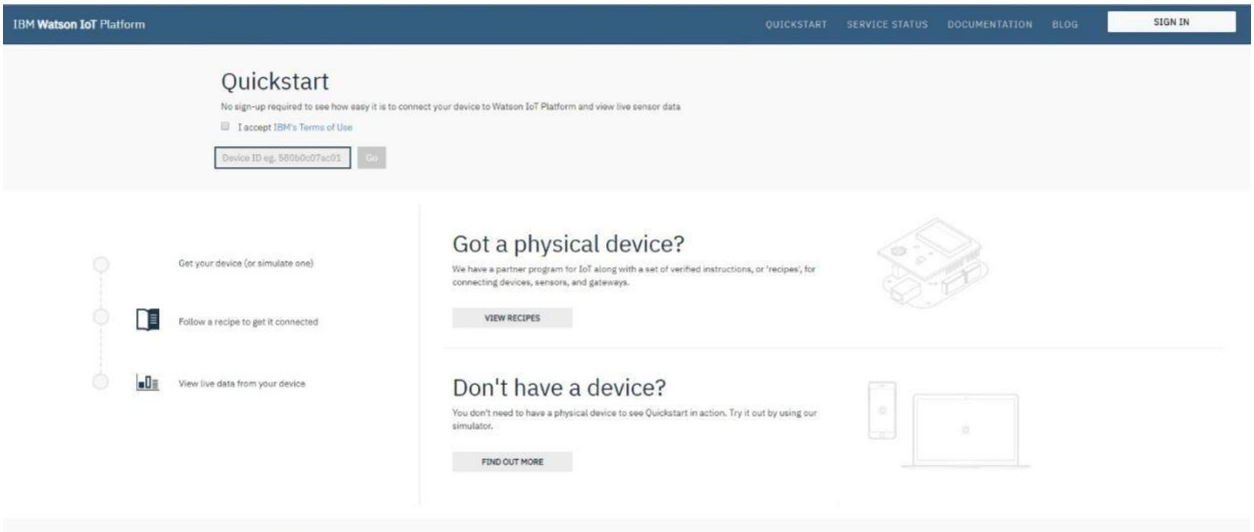
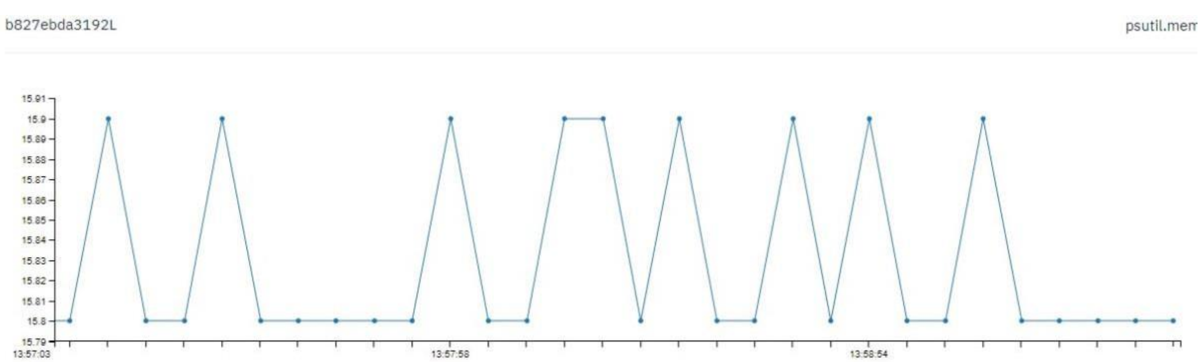


Figure 1.12 Pathway

Data will start appearing for the device



Event	Datapoint	Value	Time Received
psutil	mem	15.8	Sep 24, 2019 1:59:34 PM
psutil	network.down	0.22	Sep 24, 2019 1:59:34 PM
psutil	network.up	0.07	Sep 24, 2019 1:59:34 PM
psutil	disk.read	0	Sep 24, 2019 1:59:34 PM
psutil	disk.write	0.8	Sep 24, 2019 1:59:34 PM
psutil	name	raspberrypi	Sep 24, 2019 1:59:34 PM
psutil	cpu	1	Sep 24, 2019 1:59:34 PM

Figure 1.13 Graph page

Example Device Configuration and Quickstart Connection (Optional)

Test done with a Raspberry PI with Python

Install Python

sudo apt-get install python-dev python-pip

Install the wiotp-sdk and psutil python
Modules sudo pip install wiotp-sdk psutil

Download the sample code from GitHub

sudo apt-get update
sudo apt-get install python-dev python-pip
sudo pip install wiotp-sdk psutil
wget https://github.com/ibm-watson-iot/iot-python/archive/master.zipunzip master.zip
cd iot-python-master/samples/psutil/src

Connect to quickstart

python iotpsutil.py --quickstart

The –quickstart command line argument will configure the device client to connect to quickstart using a generated deviceId based on the Pi's MAC address.

Output

<DateTime Stamp> wiotp.sdk.device. client.DeviceClient INFO Connected successfully: d:quickstart:sample-iotpsutil:b827ebda3192L Welcome to IBM Watson IoT Platform Quickstart, view a vizualization of live data from this device at the URL below:

https://urldefense.proofpoint.com/v2/url?u=https-XXXX

(Press Ctrl+C to disconnect)

Where XXXX is the rest of the specific URL

IV. Additional Information

- For more information and documentation on MQTT please see the following – https://www.ibm.com/support/knowledgecenter/SSQP8H/iot/platform/reference/mqtt/index.html
- https://developer.ibm.com/blogs/open-source-ibm-mqtt-the-messaging-protocol-for-iot/

- For more information and documentation on MQTT connectivity please see the following - https://www.ibm.com/support/knowledgecenter/en/SSQP8H/iot/platform/devic es/mqtt.html

- If you're not using MQTT, there are other ways to get data from devices to the Watson IoT Platform. Please see the IBM Watson IoT Platform Knowledge Center for information - https://www.ibm.com/support/knowledgecenter/en/SSQP8H/iot/platform/iotpla tform_task.html#iotplatform_task

- IBM Watson IoT Github repositories - https://github.com/ibm-watson-iot/

5.4 IDEATION

TOP THREE IDEAS

1) **TOPIC NAME**: Smart Ticketing Automated Fare Collection

DESCRIPTION: By implementing sensor beacons, edge computing, AI, and cloud-based technologies, operators can eliminate queue lines at ticket machines. Using sensors on station platforms or trains, the system is designed to detect a specific smartphone app as passengers enter the station or train and automatically charges correct fair. This not only streamlines the process for both passengers andoperators but can also simplify back-end billing and revenue management and collect usage behavior for long-term planning.

2) **TOPIC NAME**: An android application for the passengers

DESCRIPTION: The passengers should enter their travelling details to connect with the officials in case of emergency and the main thing is they should enter the particular station they want to inform and they can contact emergency services like ambulance.

3) **TOPIC NAME**: Smart Coaches

DESCRIPTION: A few innovative improvements are the State of the Art SMART Coaches having special diagnostic systems and sensors connected to integrated computer systems for increased passenger comfort, SMART Locomotives having new features as Asset Performance Monitor (APM), Locotrol, LocoVision, Rail Integrity Monitor (RIM) etc,

CHAPTER 6
BRAINSTORMING:

1) Augmented Reality and Holographic Projection for Rail:

The idea behind this was to enable office-based workers to offer advice withoutneeding to travel to the site, which can help save both time and money for the company and reduce delays for passengers.

In the next few years, this will go even further. High Speed 1 is partnering with NRHS to introduce AR headsets that can holographically project digital assets into the real world. These Microsoft HoloLens headsets will turn any space into a training environment for maintenance workers so they no longer need to spend large amountsof time on tracks. This can help improve safety, quality of training and reduce service disruptions for passengers.

2) Smart Ticketing Automated Fare Collection:

By implementing sensor beacons, edge computing, AI, and cloud-based technologies, operators can eliminate queue lines at ticket machines. Using sensorson station platforms or trains, the system is designed to detect a specific smartphone app as passengers enter the station or train and automatically chargescorrect fair. This not only streamlines the process for both passengers and operators but can also simplify back-end billing and revenue management and collect usage behavior for long-term planning.

3) Security Risks:

All this additional connected technology comes at a risk to security, because these devices and connections could be hacked into and used by anarchists or terrorists tocontrol trains, spy on their passengers and more. However, if the devices and connections are built securely, for example with the use of flat shielded twisted paircables (available from In2tec), the risk of external interference will be minimized.

1) **3D Laser Scanners**

3D laser scanners are quickly being adopted in multiple industries and rail is no exception for 2019. The German rail system is using 3D scanners to accurately measure tracks and effectively plan routes.

This technology has the ability to collect millions of measurable data points, from dimensions to spatial relationships of objects, accurately within seconds. This dramatically reduces the time that would have been spent otherwise, eliminates the chances of inaccurate data being collected and in particular, helps with complex projects.

2) **Smart Coaches**

A few innovative improvements are the State of the Art SMART Coaches having special diagnostic systems and sensors connected to integrated computer systems for increased passenger comfort, SMART Locomotives having new features as AssetPerformance Monitor (APM), Locotrol, LocoVision, RailIntegrity Monitor (RIM) etc.

3) **Transforming Rail Carriages**

Companies such as Eurotech are providing next generation CCTV systems specifically for use on the rails, to meet global demand for increased railway security. The Indian government stated in 2018 that it would be implement CCTV in all 11,000 trains (currently 50 with CCTV) and 8,500 stations (currently 395) by 2020. Meanwhile, the Canadian government has outlined a plan to put recording devices in all trains by2030.

1) **Thermal and Visual Imaging Equipment**

Network Rail displayed their revamped survey helicopters at Rail Live 2019. Survey Helicopters feature high-tech thermal and visual equipment which allows maintenance teams to quickly cover large areas and identify the smallest of faults in assets or the surrounding environment.

Equipment like this can help to significantly cut down on the time and money spent checking rail equipment for faults and allow teams to quickly react to problems before they occur.

2) **An android application for the passengers:**

The passengers should enter their travelling details to connect with the officials in case ofemergency and the main thing is they should enter the particular station they want to inform and they can contact emergency services like ambulance.

3) **Internet Of Things:**

One of the key trends of the rail industry in 2018 was connected mobility, to “be able to smoothly continue their digital lives while riding trains”, this usually means providing Wi- Fi, mains and USB charging points. However, this can also mean providing devices to passengers, such as In2tec’s Smart Office technology, a fully-flush secret until lit keyboardthat is easily implementable into the tray tables or full tables of seating areas, and can be connected to an accompanying display or passenger’s device. The connected mobility trend is part of a bigger trend towards connected trains full of devices that track and exchange information such as the number of passengers, or perform functions such as displaying seat reservations.

1) **Interactive Train Windows**

In 2016, it was announced that German railway provider Deutsche Bahn and American research company Hyper loop Transportation Technologies (HTT) were to create the “Innovation Train”.

Although there has been some delays to the project, the trains are set to reach speeds of up to 760mph. This train’s most notable feature is the touch-screen interactive windows which would allow passengers to access information like the destination and high profile events, time and date, temperature, train speed and more.

2) **Better Product Development in the Industry**

Rail OEMs and operators can leverage IoT not only for better operations with the given infrastructure but also in the manufacturing processes of locomotives, wagons and train coaches. The actual feedback on product quality comes only later through sales and
Buyers’ complaints.

Feedback on manufacturing processes is an inherent part of product development with the Internet of Things concept. Engineers can use analytics with operations and performance data to derive valuable, actionable insights. This helps them understand the manufacturing procedures more dynamically and enhance final product’s quality sooner than in traditional methods. Continuous engineering and IoT can help to quicken the delivery of more sophisticated and connected products in the rail industry.

Digital Twin Models

London’s Cross rail, which will be known as the Elizabeth Line when it opens sometime in 2021, uses a digital twin model of the entire network. Digitally twinning all of the physical assets, from facilities and systems to environments, makes it much easier for engineers and data scientists to gain a deeper understanding of the complete network.

USE CASES FOR IoT ENABLED RAILWAYS:

Railway operators around the globe are implementing IoT-enabled solutions to create intelligent, connected railways today. From advanced analytics applications to digital signage and predictive maintenance, IoT technologies are being used in innovative ways in both existing and newly constructed railways. Here are some of the most common IoT use cases today:

Predictive Maintenance

Predictive maintenance is a cost-effective, important safety and efficiency tool for railway operators. Transitioning away from reactive maintenance to predictive maintenance helps allow operators to intervene before downtime occurs and create a foundation for continuous improvement. It automates real-time monitoring of equipment by using smart sensors and machine vision cameras and controls to gather data from tracks, locomotives, trains, and equipment. With edge computing, data is analyzed close to where it is collected in near-real time, and alerts can be triggered if issues are detected. Machine learning can be used at the edge or in the cloud to analyze collected data to better understand past equipment failures and help predict the likelihood of future downtime and maintenance requirements. These models can be continuously trained to help improve the accuracy of maintenance predictions. The use of predictive maintenance ultimately aims at empowering operators to:

- Plan and schedule maintenance cycles.
- Optimize servicing schedules.
- Minimize breakdowns and failures.

With more predictable servicing and maintenance schedules and fewer resulting breakdowns, railway operators benefit from lower maintenance costs and extended life cycles of tracks, trains, and equipment. Passengers benefit from improved reliability of railway operations and a better overall experience.

Safety Sensors

Keeping passengers and railway staff safe is the top priority for operators. Implementing safety sensors across all parts of a railway is one way operators can provide a safer rail experience for everyone during their transportation journey.

Safety sensors can be added to critical components of the train, such as breaks and wheels, to help alert operators of any issues. Computer vision solutions can help enable automated and safe platform and train screen door systems or help detect when passengers slip and fall.

Asset Tracking

Railways deal with an almost unmanageable number of assets on a daily basis, including tracks, equipment, stations, and passenger assets, such as luggage. Knowing where all assets are at all times is imperative to helping keep everyone safe and operations efficient. Using computer vision to track assets in near-real time can help reduce dwell time of stationary locomotives and increase operational efficiency.

Passenger Flow

One of the biggest challenges operators face is getting passengers from one place to another. Congestion, overcrowding, and the potential for crime result in inefficient operations, lost revenue, and, ultimately, passenger dissatisfaction. Using cameras in the station and onboard the train and deep learning and AI through computer vision, operators can measure and analyze passenger flow to help improve operations decision-making and station planning.

CONCLUSION:

Accidents occurring in Railway transportation system cost a large number of lives. So this system helps us to prevent accidents and giving information about faults or cracks in advance to railway authorities. So that they can fix them and accidents cases becomes less. This project is cost effective. By using more techniques they can be modified and developed according to their applications. By this system many lives can be saved by avoiding accidents. The idea can be implemented in large scale in the long run to facilitate better safety standards forrail tracks and provide effective testing infrastructure for achieving better results in the future.

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