LITERATURE SURVEY

Date	9 September 2022
Team ID	PNT2022TMID00231
Project Name	Project - Smart Solutions For Railways
Maximum Marks	2 Marks

Taxonomy of the Literature Survey:

S.No.	Title	Published by	Applications
1	On Track to the Future with Smart Railways	INTEL	Smart Ticketing ➤ Automated Fare collection ➤ Access Control Passenger Infromation ➤ Digital Signage and Connected kiosks
2	Smart Ticketing System for Railways in Smart Cities using Software as a Service Architecture	IEEE	Smart Ticketing using ☆ AWS ☆ Lambda ☆ IoT ☆ Raspberry Pi ☆ Dynamo DB Simple Notification Service
3	Application of Smart Computing in INDIAN RAILWAY Systems	International Journal of Scientific Research and Management Studies (IJSRMS)	☆ Passenger reservation system ☆ Unique identification ☆ Inter-database query processing ☆ Automatic ticket vending machine ☆ Ubiquitous computing

4	Passenger Railway Industry: The Mobility Revolution shows the way ahead	TATA Consultancy Services(TCS)	◊ Mobility as a sevice(MaaS)enables the real time personalized mobility. ◊ Contactless travel and minimized human touchpoints. ◊ Use of IoT in better planning and optimization of transport networks and services.
5	How IOT smart sensors can address operational challenges introduced by increasing automation in railways.	Rail systems Australia	◊ This paper will explore the concept of using IoT alongside automation. ◊ Automatic Train Supervision (ATS) system that supervises and regulates trains on the network automatically. ◊ Automated maintenance and condition monitoring systems.
6	Smart Transport and Logistics: a Node-RED implementation	ResearchGate	☑ Background on smart transport and logistics. ☑ Node-red and developement
7	Evaluating Website Quality: A case of Indian Railway Website	International Journal of Entrepreneurial Knowledge	☑ Measuring Website Quality ☑ Data collection ☑ Data analysis and results. ☑ ANOVA

ON TRACK TO THE FUTURE WITH SMART RAILWAYS

Authors: Ricky Branner, Global Director Business Development, Cities & Transportation , Intel Corporation
Catalina Varela, IOTG Retail Market Solutions, Intel Corporation

Station solutions:

"Acer Intelligent Transportation E-Ticketing System"

In this, Passengers, who use stored value cards,, can be quickly charged through the gates at stations and the eGate Validator will deduct fare from the contactless card automatically. This Complete e - ticketing supports multiple methods of payment and multi-issuers' transaction in one device. This provides multi group transfer discount based on parameter settings , multiple fare deduction modes, group ticketing and periodical ticket application. This e - ticketing system can greatly improve the quality of intelligent traffic and transport efficiency by automating the entire ticketing management process for a railway station.
Solution: Acer Intelligent transportation e-Ticketing System

"22 Miles Interactive Wayfinding Kiosk"

Powered by Intel NUCs, the 22Miles Interactive Wayfinding Kiosk is a powerful digital signage solution that improves the wayfinding experince by helping end-users navigate busy, complex transportation hubs abd buildings. The solution features interactive, near real-time navigtion, mapping and information, all easily managed from the 22Miles Publisher Pro CMS.22 Miles is flexible, multi-function cross-platform software solution providing railway sations with 3D Wayfinding, 4K Video Walls, mobile indoor positioning, dynamic signage and more, powered by Intel NUCs. The interactive wayfinding and digital signage software can be embedded into a variety of devices like kiosks and video walls. This provides wayfinding with near real-time, turn-by-turn mobile wayfinding experience and enables dynamic map pop ups. This also delivers quick infromation access combined with boarding pass scanners and offer travelers a self-service kiosk. The wayfinding experience is improved by using smart pathway algorithms with automatic destination routing, unique construction pathway re-routing and ADA compliance.

Case studies: Case Study | Digital Signage & Wayfinding Software (22miles.com)
Solution: Solution Offering - Intel® Solutions Marketplace
Website: Digital Signage & Wayfinding Software (22miles.com)

SMART TICKETING SYSTEM FOR RAILWAYS IN SMART CITIES USING SOFTWARE AS A SERVICE ARCHITECTURE

Proposed by: Mr. Godson Michael D'silva, Mr. Anoop Kunjumon, Mr. Lukose Roy, Ms. Jessica John

This paper proposes a smart ticketing system architecture for railways which completely scraps the idea of paper tickets and completely harness the amount of money commuters has invested for their travelling. If the commuter intends to travel from a source to destination with no intention to return on the very same day, then only half ticket costing will be taken into consideration. The commuters will be benefited with the provision of using the seasonal tickets as per there requirements depending on the number of days they has subscribed. This model also enables the authorities to detect those commuters who never pay and buy or fail to carry their tickets or pass while travelling. The proposed system will also have features like crowd analysis and suggesting cost effective offers to the railway commuters.

In this proposed architecture the railway ticketing system is implemented on AWS public cloud using services, such as AWS IoT, Lambda and Dynamo DB. Even supervised machine learning is done in lambda to get some useful insights. Taking into consideration the huge amount of event data generated, auto scalability and performances is taken care by AWS public cloud.

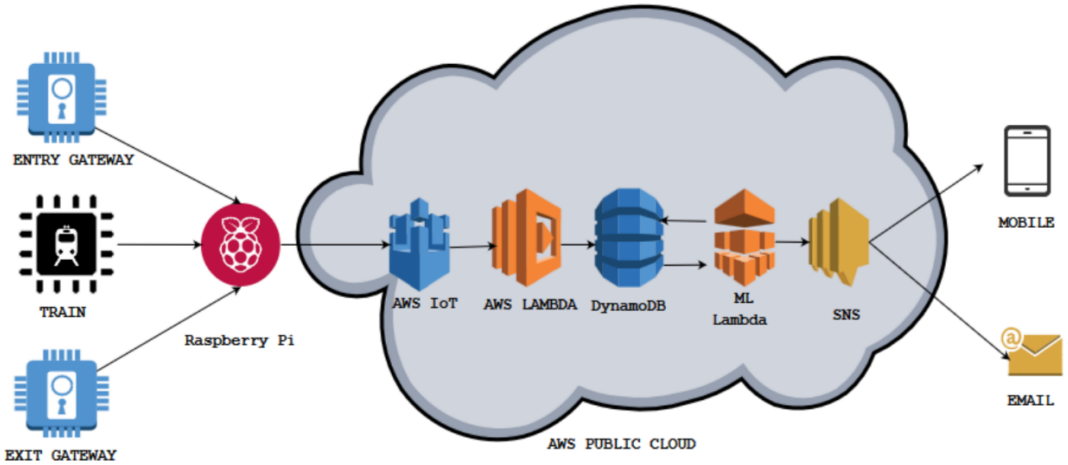


Figure 1: Generalized Smart Ticketing Architecture

This smart ticketing proposed architecture is divided into three main section first is capturing the RFID Sensors data through a raspberry pi device, second is publishing the event data from raspberry pi to AWS IoT and last one is performing processing on the IoT Events. The processing of the IoT events consists of various operations such as capturing and persisting the IoT Events, performing costing operations for seasonal and regular ticketing and performing some machine learning operations to predicts useful parameters.

REFERENCE:

- ✓ Md. Foisal Mahedi Hasan, Golam Tangim, Md. Kafiul Islam, Md. Rezwanul Haque Khandokar, Arif Ul Alam “RFID-based ticketing for public transport system: Perspective megacity Dhaka”, Computer Science and Information Technology (ICCSIT), 2010 3rd IEEE International Conference, 07 September 2010.

- ✓ Prasun Chowdhury, Poulami Bala, Diptadeep Addy “RFID and Android based smart ticketing and destination announcement system”, Advances in Computing, Communications and Informatics (ICACCI), 03 November 2016.

APPLICATION OF SMART COMPUTING IN INDIAN RAILWAY SYSTEMS

Proposed by: Parag Chatterjee , Asoke Nath

Smart Computing is a comparatively infant sector of technology which can be efficiently implemented in Railway systems for up gradation to a more efficient and smart model. Most of the railway services serving as public transport have to consider passenger data as an important key factor. To provide fast and efficient passenger services, a major role lies on handling this passenger data in an efficient manner besides processing and storing it fast and seamlessly.

Smart Passenger Reservation system backed by unique ID:
The Unique Identity (E.g. Aadhaar Number in India) would serve as the chief pillar for this entire smart Passenger Reservation System model. The Unique Identity (UID) would be considered as the key for primary identification in the services offered by the Passenger Reservation System. Countries having UID registration in a comprehensive status can easily implement this UID-based reservation model to get a very efficient and smart approach in ticketing system. As in case of India, since the UID registration is not fully completed country-wide, the model would be initially implemented on selected domain, parallel to the existing one, which in turn would gradually eat up the existing Passenger Reservation System with incremental coverage.

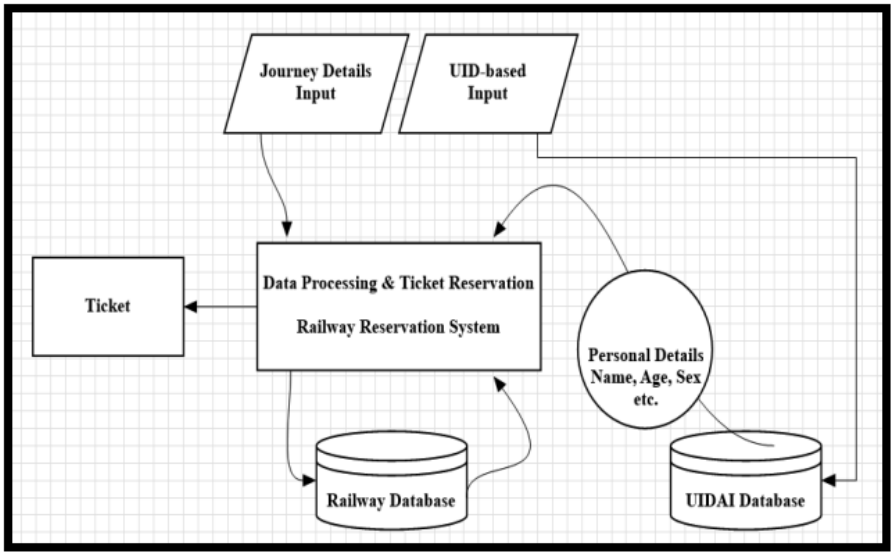


Fig. 1. Working of the UID-based Reservation System in Indian Railways

PROPOSED SMART MODEL FOR PASSENGER RESERVATION SYSTEM

The preliminary implementation of smart Passenger Reservation System model is proposed in terms of two separate areas, one for the railway reservation counters, and another for the online reservation system (E-tickets).

A. Railway Reservation Counters

To illustrate the working of Smart Passenger Reservation System model in terms of ticketing, a schematic algorithm is discussed.

- Passenger seeking a journey ticket approaches to a Reservation counter
- He produces Identity Card (E.g. Aadhaar Card) to the railway personnel, bearing the UID Number (or simply quotes the UID Number)
- The passenger inputs Finger-print in the Finger-print Reader installed in the counter (or some other biometric information or face detection).
- The system matches the finger-print and the UID Number and retrieves the details like “Name, Age, Sex, Phone Number, Address” from the UIDAI (Unique Identification Authority of India) database.
- The railway personnel enter the required Train Number, Journey details (like date, source, destination etc.), Class of travel, Concession etc.
- The ticket comes out and the booking clerk hands over the ticket to the passenger on receipt of requisite fare.
- Also an auto-generated SMS reaches to the registered mobile numbers of all the passengers along with the ticket information (PNR NO., Journey details etc.)

B. Online Reservation System

Now this new model is to be discussed with respect to E-ticketing system. In this model, the passenger seeking reservation will enter the portal of Indian Railways. In the user interface, the passenger needs only to enter the UID. As soon as the UID is entered, the UID itself feeds the railway database with all personal information obtained from the UIDAI database by virtue of inter-database query services. Then a One Time Password (OTP) is generated and is sent to the mobile number registered against the UID. That OTP is to be entered into the system within a stipulated time, after which the OTP expires. With this OTP from the registered mobile number, the identity of the passenger is verified. After this verification, the passenger can enter the journey details and proceed for payment and receipt of ticket.

Also, once a passenger books a ticket using E-ticketing system, the corresponding UID and registered mobile number information is saved in the portal. Next time the user needs to book a ticket, he can simply send SMS from his registered mobile number. In reply, the portal sends the necessary connected information already saved in the system (name, UID etc.) which can be verified by the user. If satisfied, the user can proceed further with interactive SMS and the ticket gets booked. Provisions would be there where the ticket charges are directly debited from a Bank Account connected to the particular UID.

REFERENCE:

- ✓ Indian Railways Vision 2020 (Para 6.1 Reinventing Passenger Services with Change for a better tomorrow as the motto, Page 8-9)
- ✓ Resource Center, Unique Identification Authority of India (http://uidai.gov.in/library/references.html)

PASSENGER RAILWAY INDUSTRY : THE MOBILITY REVOLUTION SHOWS THE WAY AHEAD

Proposed by: Dr. Kandukuri Raju, Romil Shah ,Mayukh Das

There is a need for enhancing passenger experience and ensuring profitability for railway operators worldwide. The need is to invest in next generation rail travel where a passenger is informed at every stage of his journey in real time to enable personalized mobility. Mobility as a service (MaaS) is also gaining increasing traction today as the COVID-19 pandemic makes a strong case for contactless travel and minimized human touchpoints. Emerging IoT based data sources will see greater uptake as they help travelers make better informed choices about their journeys. The use of IoT will also aid in better planning and optimization of transport networks and services. It will result in a resilient and connected rail travel experience that is safe, seamless and has the traveler at the front and center of the whole transportation business.

Mobility as a Service(MaaS):

Mobility as a Service (MaaS) is emerging as the key driver that facilitates the shift from physically connected to digitally connected services. Implementing a digital ticketing or a frictionless check out system that supports account-based, cashless and biometric ticketing in collaboration with other partners in the travel ecosystem could prove to be the starting point for better, safer customer experience. It will also reduce the cost of travel for rail operators and passengers alike. MaaS also facilitates reduction in environmental emissions, paving the way for cleaner travel.

Intelligent rail travel: Focusing on passenger experience and safety

The future of passenger rail travel will witness ecosystem play where multiple vendors will be part of the travel management system supported by aspects like customer engagement, planning and routing, booking and ticketing, reporting, partner management and payment gateways, all integrated on a single unified customer centric platform. The benefits will come by way of reduction in delays caused due to long queues at ticketing windows, commuting services and travel enquiries; enabling frictionless automated payments and refunds, and ensuring seamless travel with real time updates for passengers. Coupled with prescriptive analytics to assist passengers across their journey; ecosystems will drive mass personalization, while simultaneously reducing the cost of operations and risks for rail operators.

Passenger safety - the engine for seamless travel experience:

Some of the key customer safety trends that are currently in high demand in the passenger railways segment include deriving real-time information on rail movements and leveraging predictive maintenance and driver assistance systems. As part of predictive maintenance strategies, some of the leading rail operators use artificial intelligence (AI) to identify defects in their locomotives and cars thereby preventing any untoward incidents. AI helps in predicting when assets need maintenance with real-time asset health monitoring sensors. The advanced driver assistance systems help in preventing accidents and prescribes solutions to avoid any mishaps in real time.

Cyber security is also becoming a priority for rail operators as the cyber threat landscape expands; putting passenger data privacy at risk. Physical safety, an erstwhile challenge for rail transport, is also witnessing increasing emphasis with rail operators leveraging systems with On board Biometric or QR code ticketing App based AC adjustments App adjusted recliners Query solving on-the-go by using phygital assistants or Voice enabled chatbots, local maps Language translator alerts on events at destination Frictionless Payments Digital payments and currency exchange Fraud management Onboard Entertainment Music and entertainment Personalized movies Wifi connectivity Retail Merchandize Personalized retail products Parcel delivery onboard One-Stop solution for end-to-end travel support Service on Wheels 3D cameras, biometrics and sensors to track the behavior of passengers moving through subway stations and eventually report any suspicious activities. Biometric ticketing inspection would help in identifying passengers thereby reducing frauds. Machine vision based automatic inspections, leveraging high resolution video cameras and drone-based surveillance at the stations and depots is becoming a surging trend now, enabling safety of people and railway assets.

Leveraging a connected ecosystem will help railway companies deliver mass personalization, thereby providing best-in-class travel experience to the customers; driven by better safety and simplified processes. This in turn will help the passenger railway companies to track their customer's preferences and analyze the patterns of travel.

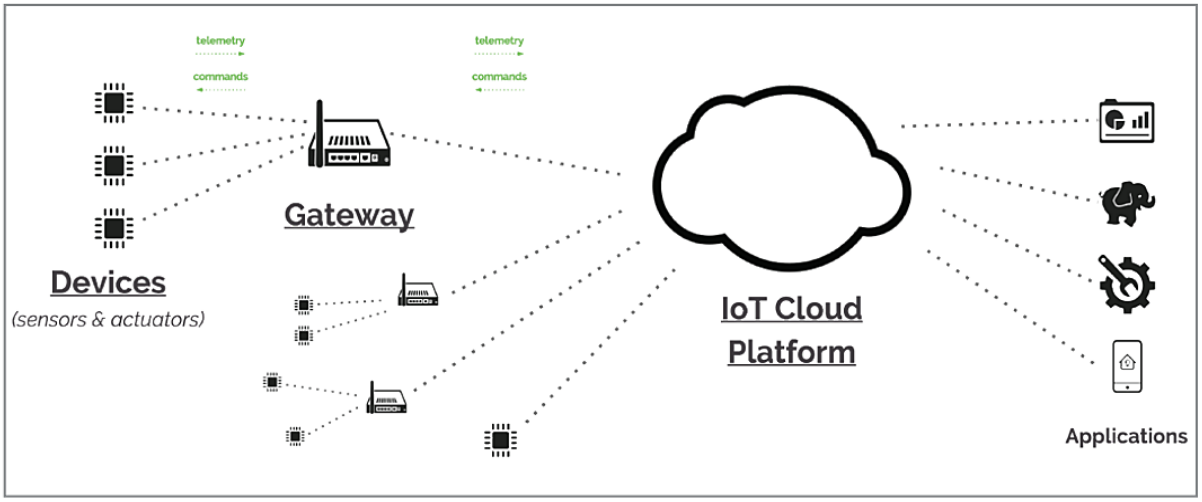
Reference:

Travel, Transportation & Hospitality page on www.tcs.com

HOW IoT SMART SENSORS CAN ADDRESS OPERATIONAL CHALLENGES INTRODUCED BY INCREASING AUTOMATION IN RAILWAYS

Proposed by: Mr Fersy Ramon Philip Castillo

The Internet Of Things:
As defined by the International Telecommunications Union (ITU), IoT is an infrastructure that enables advanced services by connecting physical and virtual objects using existing and interoperable information and communication technologies . A large assembly of technologies and devices can be classified as IoT – with the main caveat being that they must be interconnected through a network, usually the Internet.

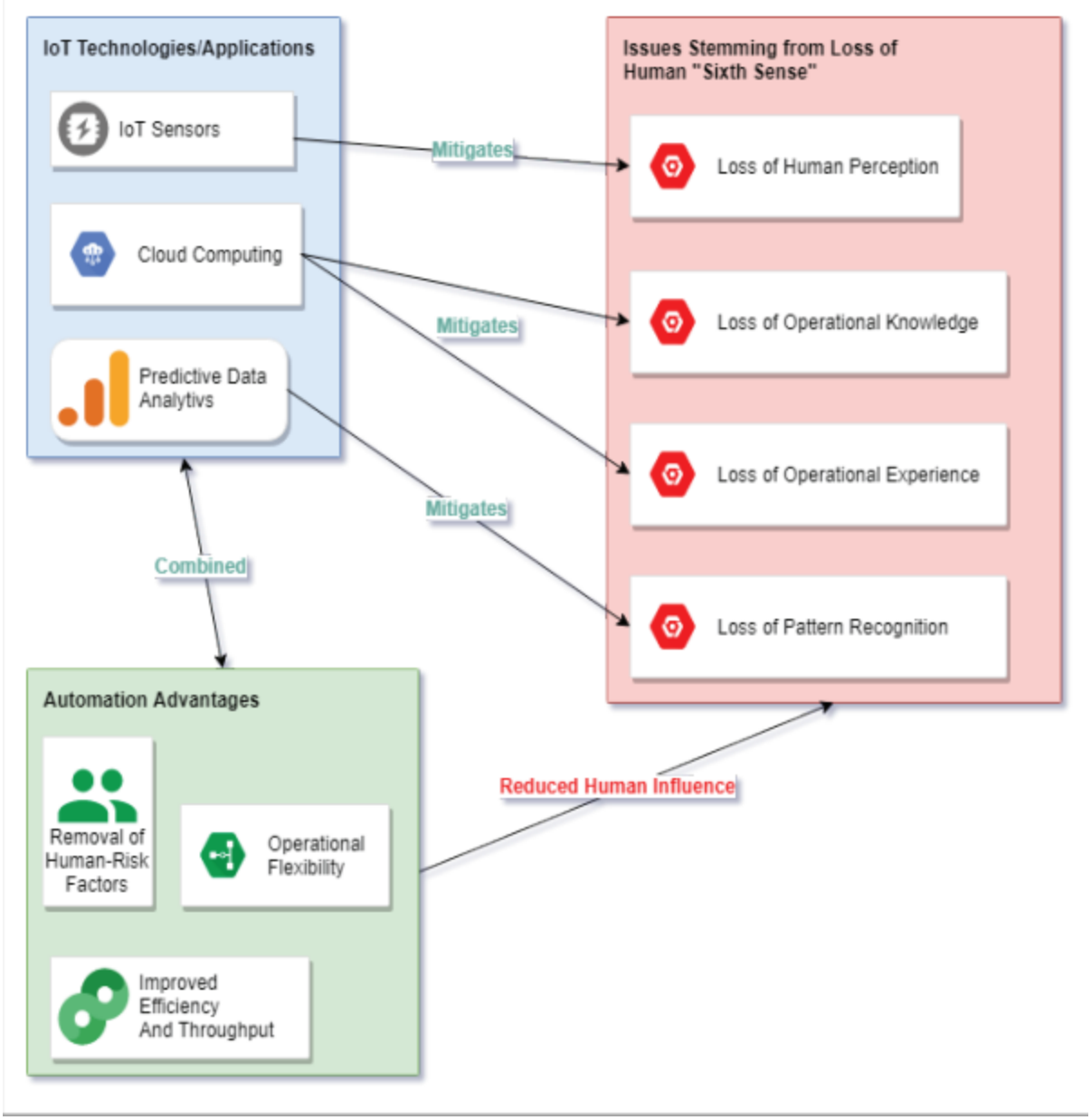


Sensors :
The devices that monitor changes in the environment or events as allowed by their design and programming. Sensors can detect practically any parameter, and with the advent of micro-electro-mechanical sensors (MEMS), the precision and accuracy of sensors are more than capable of industrial use, including for the purposes of rail safety.

Cloud Computing :
The capability of accessing computer resources on-demand, such as data storage and computing power. Cloud computing enables IoT devices to perform tasks as necessary and provides access to data storage as needed, given no limitations on connectivity or bandwidth.

Predictive Data Analytics :
Utilising statistical techniques such as data mining, predictive modelling, and machine learning in order to analyse current and historical facts to make predictions on future events. Data analytics allows for patterns in collections of data to be identified, and then utilised in order to create scenarios for both failure modes, and possible scenarios to solve said failures.
Because of IoT's overall flexibility, it is an attractive technology to utilise with regards to the railways in general.

Automation and IoT covergence:
IoT-capable sensors can aid in moderating the loss of perceptional capability . With enough sensors spread out across a train and/or track infrastructure, an appropriate sensor package that covers multiple variables can aid in detecting deviations from normal operations. The data gathered by these sensors can then be sent to the cloud for post-processing.
IoT technology is inherently susceptible to cyber based attacks because of its interconnectivity without proper encryptions in place, a small opening in the network can result multiple avenues of attack.
IoT also makes use of edge computing, where processing the data can be performed not only in the cloud, but on the sensor and/or gateway, as needed. Edge computing allows for more efficient data transfer in regard to bandwidth and power, as less data is needed to be sent to the cloud for further processing and analytics. This is due to more processing occurring "closer to the edge" of the cloud architecture, where devices and sensors are located



By using predictive analytics on the processed data in the cloud, the system can generate possible scenarios for any given a fault (imminent or otherwise). Using this predictive data, possible consequences alongside optimal solutions are generated with the aim of minimising safety related impacts. The probability that these scenarios could be detected through the use of historical data and machine learning, allowing for a system that (over time) can more accurately identify whenever a fault is either imminent

or currently in the system, and the most appropriate solution to resolve or mitigate the failure risk (operational or safety related).
Using IoT technologies, environmental data can be detected through sensors and sent to the cloud for processing, whereby a system diagnosis would detect and report the fault. Automated systems can then be re-directed to the fault for maintenance as needed.
The combination of IoT and automation has the potential to propel the rail industry forward, not only in safety but in other aspects yet to be discovered, due to the latent potential for improvement when both technologies are used in tandem.
IoT technology is already being used in several fields and is in a similar position to automation in terms of growth and possible applications. It is a growing industry that has clear potential for growth and expansion.

Reference:

- International Railway Safety Council - International Railway Safety Council 2019
- International Association of Public Transport. METRO AUTOMATION FACTS, FIGURES AND TRENDS 2016.

Reference link:

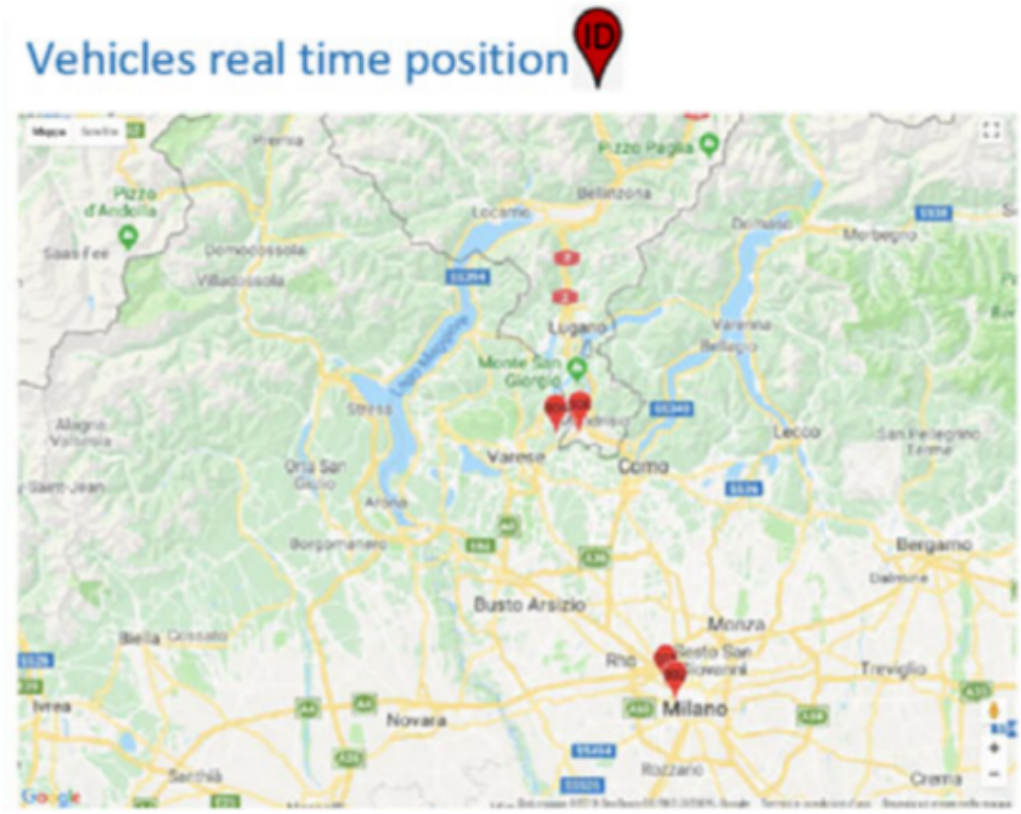
- https://international-railway-safety-council.com/about-us
- http://sts. hitachirail.com/en/products-services/glossary.

SMART AND LOGISTICS: A-NODE RED IMPLEMENTATION

Proposed by: Sabrina Sicari , Alberto Coen-Porisini

BACKGROUND ON SMART TRANSPORT AND LOGISTICS AND MOTIVATION

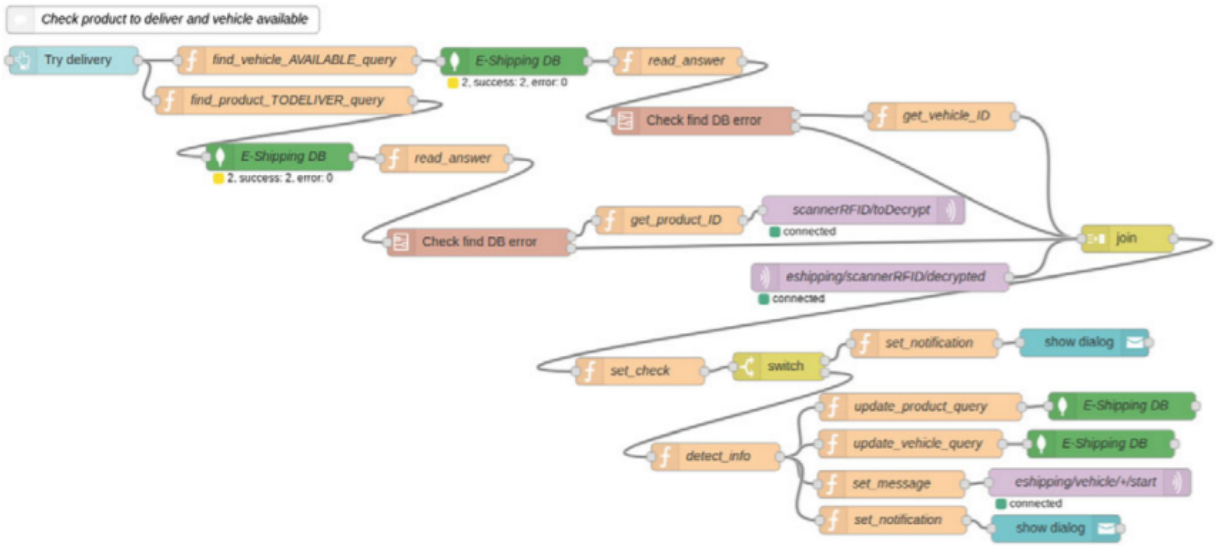
Transports and logistics play an important role among the IoT applications. A case study that details the behavior of an IoT-based DNS infrastructure, which adopts a three-tier hierarchy of domain name servers and a three-level caching strategy, is simulated. Preliminary results indicate that such an approach may be feasible for object tracking in the IoT domain. A logistics cloud-based framework, presented in, mainly makes use of radio-frequency identification (RFID) technology in order to monitor the goods and pallets in a warehouse. The main drawback is that the experimental evaluation is limited to the simulations of RFID, without considering the whole conceived architecture, consisting of private and public cloud, and other service provider modules.



Unfortunately, no performance evaluation is carried out, where possible software and hardware technologies are proposed to implement a smart public transport system. Limits to envision a future era of “Internet of Vehicles,” where advances in the IoT principles’ application will foster intelligent transport and vehicles will be increasingly autonomous and able to take decisions without the human intervention.

NODE-RED DESIGN AND DEVELOPMENT

Node-RED∗ comes from an open project, developed by IBM, proposing a flow-based and event-driven programming tool. The application’s behavior is thus represented as a network of black-boxes, which may communicate with each other and regulate the flow of the information within the designed system. A visual browser-based representation supports designers and developers in better understanding the happening interactions within the whole IoT network. In fact, many entities may be involved, both hardware (eg, sensors) and software (eg, services) ones. Node-RED also enables the real connection of hardware devices and application programming interfaces (APIs). Since Node-RED allows the integration of different technologies, thanks to proper libraries, the following ones have been adopted in the presented solution: (a) MongoDB†, as database engine, instead of a relational database, due to its greater efficiency in responding to a large number of queries in a short time; (b) Java as programming language, due to its widely adoption in actual real implementations; (c) Message queue telemetry transport (MQTT)‡, as lightweight publish and subscribe method, for information sharing and system’s notifications. Note that Node-RED is responsible for controlling the data flow and for providing the logic of the whole IoT application. MongoDB has the active role of identifying the current status of the products (ie, TO SELL, IN DELIVERY, DELIVERED) and the status of the smart vehicles (ie, AVAILABLE, IN DELIVERING).



A Java program simulates the communications, via proper TCP connections, with sensors and RFID tags toward the Node-RED control application. Instead, communications among the involved components only take place via MQTT protocol, exploiting a well-defined topic hierarchy, sketched in Figure 1. As revealed by Figure 1 and by the flows presented in the rest of the paper, the adopted publish and subscribe system manages both messages useful for the management of the logistics and anomalies, which are reported as alarms to the warehouse.

REFERENCES:

1. Miorandi D, Sicari S, De Pellegrini F, Chlamtac I. Internet of things: vision, applications and research challenges. Ad hoc Netw. 2012;10(7):1497-1516.
2. Sicari S, Rizzardi A, Grieco LA, Coen-Porisini A. Security, privacy and trust in internet of things: the road ahead. Comp Netw. 2015;76:146-164.
3. Jazdi N. Cyber physical systems in the context of industry 4.0. Paper presented at: IEEE International Conference on Automation, Quality and Testing, Robotics; 1–4; Cluj-Napoca, Romania; 2014.

EVALUATING WEBSITE QUALITY: A CASE OF INDIAN RAILWAY WEBSITE

Proposed by: Rajesh Kumar Jain, Santhosh Rangnekar

Quality can be defined in many ways depending on what product or service it is related with or who i.e. customer, or producer is defining it. The American Society for Quality defines quality as a subjective term for which each person has his or her own definition. In technical usage, quality can have two meanings: the characteristics of a product or service that bear on its ability to satisfy stated or implied needs, and a product or service free of deficiencies. Indian Railways, a premier public sector enterprise of the country is the largest rail network in Asia and the worlds' second largest network of employees under the one management. Indian Railways is a multi-gauge, multi-traction system covering a total of 108,706 km of track. This track includes 86,526 KM route of broad gauge (1676 mm) line of which 16,001 km has been electrified. It has 18,529 km of meter gauge (1000 mm) line, and 3,651 km of narrow gauge (762/610 mm) line.

Data Collection:

The Indian Railways Website quality was compared with a perceived ideal Website. Respondent's expectations were captured with regard to their perceptions of an ideal Website quality and their actual experiences of accessing the Indian Railways Website. The attributes for assessing the Website quality of Indian Railways were developed on the basis of pertaining literature review, interview with Website users and with personal observations. A framework was developed for understanding customer satisfaction with users of Websites. A total of 62 respondents, users of Websites were selected randomly. Respondents included were drawn from various organizations, industries, age groups, and occupations.

Data Analysis and Results:

Responses obtained were statistically tested for their significance. One-way ANOVA was applied to analyze the data.

Table 1 **Single Factor ANOVA**

SUMMARY

Groups	Count	Sum	Average	Variance
Ideal Website	62	2794	45.06452	28.32364
Indian Railways	49	1778	36.28571	54.79167

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	2109.285	1	2109.285	52.75945	5.94E-11	3.928193
Within Groups	4357.742	109	39.97928			
Total	6467.027	110				

The ANOVA test above shows the significance of the differences in the two groups. At a very small 'p' value (of 5.94E-11), the null hypothesis that there is no significant difference between the Ideal and Railways Website quality is rejected. In other words as is clear by the observed 'F' value of 52.75, which is bigger than the critical 'F' value (of 3.92), there lies a statistically significant difference in the Indian Railways and Ideal Websites.

Discussion:

The items in the questionnaire included were Continuous Connectivity, Quick Response and Help Whenever Needed, Ease of Access, Options to Pay, Buy, & Search, Content Usefulness, Ease of Navigation, Simple to Use and Properly Structured, Confidence & Clarity of Data Generated, Privacy & Security of User, Aesthetics, and Customization/Personalization. Out of the 11 dimensions of Website quality reported by Zeithmal et al. (2001) the dimensions which are common are Quick Response and Help whenever Needed, Ease of Access, Options to Pay, Buy, and Search, Ease of Navigation, Privacy and Security of User, Aesthetics, and Customization/Personalization. We additionally found Continuous Connectivity, Content Usefulness, Simple to Use and Properly Structured, Confidence and Clarity of Data Generated as important attributes of Website quality. Russell and Taylor III (2003), additionally reported Server Reliability, Speed of Page Loading, Transaction Time, and Domain Name as important determinants of Website quality. The employee-related dimension of service quality, which is important for excellent service quality, does not exist on the Internet; this becomes an advantage of the Internet, because consistency of service is almost

ensured. However, it also requires that the potential for problems be eliminated because there is no helpful, well-trained employee immediately available to correct the situation.

Limitations:

Although these results provide some important insights about the customer satisfaction and contents, continual monitoring of the development and functionality of Websites will be needed. The data presented should be enlarged both cross-sectional and longitudinally for having a better picture of dynamics of Web-enabled ticketing. The sample frame used for this study may not necessarily be representative of all the Website users. Also there may be some quality attributes other than those included in this study that vary in importance, which may be associated with distinct motivations and experiences in Website usage. Therefore the needs of different user groups in terms of their extent of desired involvement with Websites need to be identified. Hence future research need to explore these aspects. Also the electronic marketplace on the Web in India is not yet much popular and hence there is a limited knowledge for consumers as to how to pursue electronic ticketing activities on the Web.

References:

1. Avery Jim, (2000), Business 2.0, March, 2000 downloaded from http://www.baldrigeplus.com/Newsletter_Supplement_2.html.

2.Barnes, S. and Vidgen, R. (2000), “WebQual: an exploratory study of Web site quality”, paper presented at the European Conference on Information Systems, Vienna, 3-5 July