WWW.IJRPR.COM

**International Journal of Research Publication and Reviews**

Journal homepage: www.ijrpr.com

# Smart Industries Using the Internet of Things

***G.Padmanabha Sivakumar[a], Mannava Vivek[b]****

*EIE Department, SCSVMV Deemed to be University, Kanchipuram, Tamilnadu-631561, India.*

A B S T R A C T

In the present industrial conditions, automation has been limited to individual processes and machinery. It means that each machine has a separate controller that controls the operation of that particular machine. This kind of operation requires an operator or many operators to continuously monitor each machine at fixed intervals. While this method of operating might be suitable for small scale industries that have a small number of machines, in medium to large scale industries, this results in an increased requirement of the workforce. This, in turn, increases the production cost, and also with humans, there is a greater chance of error.Also, with this kind of system in place, there is little or no chance of monitoring these machines from a distance. Also, it is a tedious process to gather the operation's log data from each machine, organize them, and make a report to the higher management authorities.With the above-mentioned shortcomings, the operation of the individual machines becomes a hassle. Also, in times of an emergency or an accident, it becomes difficult to detect the particular machine responsible for the alert. To help overcome these shortcomings, this project, to automate the industry/factory floor is being proposed. This project is a system designed to monitor the sensor data and other parameters from different individual systems and display it on a single monitor used by a single operator. This allows to greatly reduce the workforce that is generally employed for this purpose on a factory floor. Also, this allows one user to monitor all the parameters of all the machinery from one location, and this helps in better decision making in case of an emergency.With this system in use, in addition to the efficiency of the control network, the managerial staff and other top-level executives can always keep an eye on the proceedings on the factory floor.

Keywords: IOT, Industrial Internet of things, Smart Industry, Industry 4.0, Cognitive systems, Smart manufacturing

## 1. Introduction

Industrial automation, in its simplest form, is the use of control systems, such as computers or robots, in addition to information technologies to control and handle different operations and components in an industry, to reduce the human workforce. In the flow of industrialization, it can be defined as the step after the mechanization of the industry. Earlier, the purpose of automation was to increase the overall productivity of the industry by working more hours than a human being and at a fraction of the cost required to hire a person. With the advancement of industrialization, and with the increase in the demand for various goods, the main focus of automation has shifted to increasing the quantity and quality of the manufactured goods**.**

### *1.1. Industry 4.0*

Industry 4.0 is the subset of the fourth industrial revolution that concerns the industry. The fourth industrial revolution encompasses areas that are not normally classified as an industry, such as smart cities, for instance.Although the terms "industry 4.0" and "fourth industrial revolution" are often used interchangeably, "industry 4.0" factories have machines which are augmented with wireless connectivity and sensors, connected to a system that can visualize the entire production line and make decisions on its own.

* *Corresponding author.* Tel.: +91 95380 44840.
E-mail address: vivekmannava@gmail.com

The Internet of Things, or IoT, refers to the billions of physical devices around the world that are now connected to the internet, all collecting and sharing data. Thanks to the arrival of super-cheap computer chips and the ubiquity of wireless networks, it's possible to turn anything, from something as small as a pill to something as big as an airplane, into a part of the IoT. Connecting up all these different objects and adding sensors to them adds a level of digital intelligence to devices that would be otherwise dumb, enabling them to communicate real-time data without involving a human being. The Internet of Things is making the fabric of the world around us smarter and more responsive, merging the digital and physical universes.IoT is a subset of Industry 4.0, one of the core technologies that support digital transformation. Industry 4.0 IoT refers to machinery and equipment with attached sensors. These sensors monitor production processes and dispatch information for analysis and reporting. IoT is simply a subset of Industry 4.0.

### *1.2 Indsutrial Iot*

There are three areas of value for the Internet of Things in the manufacturing sector:

**1. Intelligent assets and equipment -** Internet of Things (IoT) makes the assets and equipment used in manufacturing processes more intelligent, improving reliability and reducing downtime. It connects data from equipment and other sensors and integrates it with other important information (like weather and historical data from ERP and production systems). Operating both at the edge of the network and centrally in the cloud, it applies predictive analytics and prebuilt industry models to detect anomalies and failure patterns. Then, it can also recommend corrective actions and manage their execution.

**2. Cognitive processes and operations-** IoT uses cognitive analytics to deliver data-driven process improvements that enhance quality and productivity. With connectivity to different IoT platforms, we can use analytics to correlate the many variables that contribute to process failure or quality issues. We can also predict failure earlier than statistical process control and apply new forms of analytics (like image and audio) to determine issues from non-traditional types of data.

**3. Smarter resources and optimization-** IoT optimizes the resources engaged around production, whether that's keeping production line workers safe, improving the expertise of the workforce, or optimizing energy consumption. For example, by connecting sensors outfitted on workers, we can detect if they're in hazardous conditions and help provide a safer work environment. It can be used to combine a worker's expertise with the effectiveness of their tools to determine if the right worker/tool combo is in place to get work done. And it can also monitor environmental conditions and energy consumption in the factory to reduce energy usage.

## 2. IBM – IOT platform

IBM IoT platform is one of the services provided by the IBM blue-mix portal. It is built from the IoT platform – starter kit available in resources.Watson IoT Platform provides powerful application access to IoT devices and data to help you rapidly create analytics applications, visualization dashboards, and mobile IoT apps. You can use Watson IoT Platform to perform powerful device management operations, store and access device data, and connect a wide variety of devices and gateway devices. Watson IoT Platform provides secure communication to and from your devices by using MQTT and TLS.In order to create a IoT platform it is essential to assign a space name, a name for the application and the host name.

The next step is to add a device to the IoT platform. In this project, the device is a Node MCU with Wi-Fi capabilities and can communicate with the IoT platform using the MQTT protocol. Add the device name and device type and additional build details as required and generate the Authentication token. This auth. Token is used to confirm the communication between the correct device and platform.Once the device has been added to the platform, the IoT platform dashboard can be used to define the device types, register more devices, monitor incoming data and see live data visualizations using charts.

### *2.1. Ibm Bluemix Services:*

Platform as a service (PaaS) is a service model where providers deliver not only infrastructure but also middleware (databases, messaging engines and so on) and solution stacks for application build, development and deploy. Bluemix is a PaaS offering from IBM based on open standards and cloud to build, deploy, manage and run omnichannel applications like web and mobile, big data and other smart services. There are currently 50 services available on Bluemix to help developers rapidly create and deploy innovative solutions.

**Benefits of IBM Bluemix:**

Now, let's look at some of the features of Bluemix:

- Bluemix is the new development environment built on Cloud Foundry for the cloud era to build applications rapidly and incrementally composed of services.
- Open standards allow developers to avoid vendor lock-in, leveraging the open and flexible cloud environment using a variety of tools from IBM, third party or open technologies.
- Bluemix offers more than 200 software and middleware patterns available from IBM and IBM Business Partners to help enterprise and born-on-the-cloud developers develop portable and compatible applications for hybrid cloud. Pre-built services make application assembly very easy.
- It provides an integrated experience for the developers with DevOps in the cloud and thus helps them build enterprise and mobile applications quickly and more efficiently.

**Bluemix DevOps provides:**

- A facility to store and manage code by means of the Git repository.
- A built-in web-based integrated development environment (IDE).
- Easy integrations with popular development tools like Eclipse and Visual Studio.
- Agile planning, tracking, and team collaboration
- Services for automatic application development
- It allows developers to transform an idea into an application faster.
- It hides the complexities associated with hosting and managing cloud-based applications, allowing developers to focus on just development.
- Bluemix can automatically scale a deployed application up or down based on application usage.

### *2.2. Node-Red application:*

The Node-Red starter kit allows you to create an application using the Node-Red tool. Node-Red is a flow-based programming tool for visual programming, originally developed by IBM for wiring together hardware devices, APIs and online services as a part of internet of things. Node-Red provides a web browser-based flow editor which can be used to create JavaScript functions.The Node-Red starter kit available in IBM Watson blue-mix services come pre-configured, allowing you to create your own Node-Red based application that can be quickly deployed to IBM cloud. It also allows you to add services, generate and download the code, and also use the IBM cloud developer tools CLI to run debug the app locally. The web-browser based editor comes with many configurable nodes, that can be used to represent the various devices connected to the IoT platform. It also allows you to deploy the app to Kubernetes, Cloud Foundry, or a DevOps Pipeline.

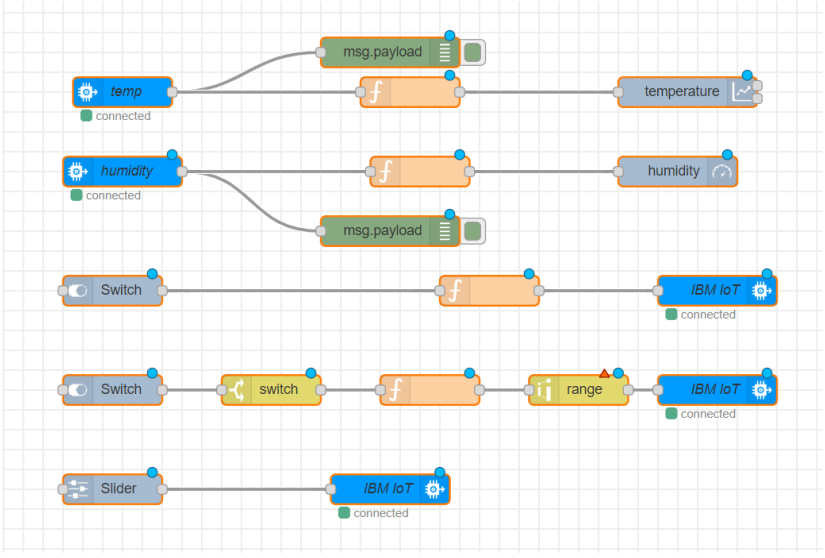


**Fig. 1** - Sample Node-Red programming window

### *2.3. Cloudant service:*

Cloudant is an IBM software product, which is primarily delivered as a cloud-based service. Cloudant is a non-relational, distributed database service of the same name. Cloudant is based on the Apache-backed CouchDB project and the open source BigCouch project.
Cloudant's service provides integrated data management, search, and analytics engine designed for web applications. Cloudant scales databases on the CouchDB framework and provides hosting, administrative tools, analytics and commercial support for CouchDB and BigCouch. Cloudant's distributed CouchDB service is used the same way as standalone CouchDB, with the added advantage of data being redundantly distributed over multiple machines.In this project, it is used to create databases to store logistics and operational data and also to be able to query the data using MySQL structures Query language.

### *2.4. MQTT communication protocol:*

MQTT is a machine-to-machine (M2M)/"Internet of Things" connectivity protocol. It was designed as an extremely lightweight publish/subscribe messaging transport. It is useful for connections with remote locations where a small code footprint is required and/or network bandwidth is at a premium. It is also ideal for mobile applications because of its small size, low power usage, minimised data packets, and efficient distribution of information to one or many receivers


**Fig. 2 -** MQTT Client to Broker Protocol

**Shared Subscriptions** – If the message rate on a subscription is high, shared subscriptions can be used to load balance the messages across a number of receiving clients.
**Message Properties** – Metadata in the header of a message. These are used to implement the other features in this list but also allow user defined properties e.g. to assist in message encryption by telling the receiver which key to use to decrypt the message contents
**Message Expiry** – An option to discard messages if they cannot be delivered within a user-defined period of time.
**Session Expiry** – If a client does not connect within a user defined period of time, state (e.g. subscriptions and buffered messages) can be discarded without needing to be cleaned up.
**Topic Alias** – Allows topic strings in messages to be replaced with a single number, reducing the number of bytes that need to be transmitted if a publisher repeatedly uses the same topics.

## 3. Working

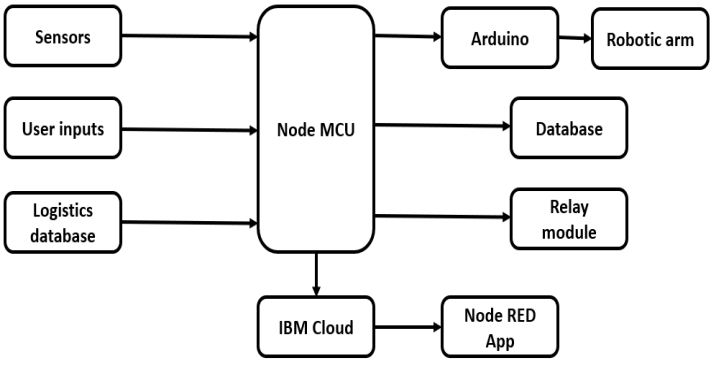


**Fig. 3 –** Block wise representation

The data from the various sensors and transducers employed in a machine is collected from the respective individual controllers and is sent to a central controller, which is, in this case, a Node MCU. The Node MCU gathers all this data, converts into a suitable format for data transmission and uploads the data to the cloud service on the IBM IoT platform. Multiple such devices can be added to the IoT platform to de-centralize the IoT network. Also, the data from the logistics division also gets uploaded to the cloud in a similar manner. All this data is then accessed by the Node Red application.
The Node Red application contains different nodes, which are UI elements, to represent the data flow from the various sensors and other devices. These nodes output the data in a graphical form, which includes charts and graphs etc., for review by the operator. Although each individual machine has a

controller module of its own, there might be situations when sudden, immediate actions might be needed, like in the case of an emergency, or in case of a maintenance run etc. In situations like these, the central operator will have the facility to activate particular controls that alters the running of the industry. There are two modes of communication being done in this project. One form is using the MQTT protocol, which occurs during data transmission between the Node MCU and the cloud service. MQTT protocol is suitable for light-weight transmission between devices that are connected over a network.Another form of communication, is serial communication that is happening between the sensors and Node MCU, as well as between the Node MCU and the Arduino when the commands from the user is being sent to the Arduino controller.

## REFERENCES


- S. Bera, S. Misra and A. V. Vasilakos, "Software-Defined Networking for Internet of Things: A Survey," in IEEE Internet of Things Journal, vol. 4, no. 6, pp. 1994-2008, Dec. 2017, doi: 10.1109/JIOT.2017.2746186.
- Zanella, N. Bui, A. Castellani, L. Vangelista and M. Zorzi, "Internet of Things for Smart Cities," in IEEE Internet of Things Journal, vol. 1, no. 1, pp. 22-32, Feb. 2014, doi: 10.1109/JIOT.2014.2306328.
- W. Shi, J. Cao, Q. Zhang, Y. Li and L. Xu, "Edge Computing: Vision and Challenges," in IEEE Internet of Things Journal, vol. 3, no. 5, pp. 637-646, Oct. 2016, doi: 10.1109/JIOT.2016.2579198.
- L. Chettri and R. Bera, "A Comprehensive Survey on Internet of Things (IoT) Toward 5G Wireless Systems," in IEEE Internet of Things Journal, vol. 7, no. 1, pp. 16-32, Jan. 2020, doi: 10.1109/JIOT.2019.2948888.
- H. Wu et al., "Dynamic Edge Access System in IoT Environment," in IEEE Internet of Things Journal, vol. 7, no. 4, pp. 2509-2520, April 2020, doi: 10.1109/JIOT.2019.2943696.
- D. Minoli, K. Sohraby and B. Occhiogrosso, "IoT Considerations, Requirements, and Architectures for Smart Buildings—Energy Optimization and Next-Generation Building Management Systems," in IEEE Internet of Things Journal, vol. 4, no. 1, pp. 269-283, Feb. 2017, doi: 10.1109/JIOT.2017.2647881.
- F. Ganz, D. Puschmann, P. Barnaghi and F. Carrez, "A Practical Evaluation of Information Processing and Abstraction Techniques for the Internet of Things," in IEEE Internet of Things Journal, vol. 2, no. 4, pp. 340-354, Aug. 2015, doi: 10.1109/JIOT.2015.2411227.
- Q. Wu et al., "Cognitive Internet of Things: A New Paradigm Beyond Connection," in IEEE Internet of Things Journal, vol. 1, no. 2, pp. 129-143, April 2014, doi: 10.1109/JIOT.2014.2311513.
- G. Bedi, G. K. Venayagamoorthy, R. Singh, R. R. Brooks and K. Wang, "Review of Internet of Things (IoT) in Electric Power and Energy Systems," in IEEE Internet of Things Journal, vol. 5, no. 2, pp. 847-870, April 2018, doi: 10.1109/JIOT.2018.2802704.