Testing and Measurement Criteria for the Internet of Things (IoT)

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Abstract:- In order to survive in the digital world IoT become essential. Combining the new technology with developed software on created hardware where the performances are overlooked and makes testing of Internet of things (IoT) devices difficult. IoT is a huge concept which spans the connected home, smart cities, the manufacturing industry and the wearable electronics. However the advancement in the technologies are making industries more effective and enabling the machines to work smartly. As the IoT technology evolves there is a need for testing at different levels. IoT testing depends on the sensitivity of the devices, reliability of network and so on. In this paper we will discuss an overview of testing and measurement criteria for Internet of things IoT.

Keywords: Internet of Things (IoT), Testing.

1. INTRODUCTION

The internet of things (IoT) refers to the extension and use of the internet of things (IoT) in industrial sectors and applications. With a strong focus on machine-to-machine (M2M) communication, big data, and machine learning, the IoT enables industries and enterprises to have better efficiency and reliability in their operations [1]. The IIoT encompasses industrial applications, including robotics, medical devices, and software-defined production processes. The IoT goes beyond the normal consumer devices and internetworking of physical devices usually associated with the IoT [2]. What makes it distinct is the intersection of information technology (IT) and operational technology (OT). OT refers to the networking of operational processes and industrial control systems (ICSs), including human machine interfaces (HMIs), supervisory control and data acquisition (SCADA) systems, distributed control systems (DCSs), and programmable logic controllers (PLCs).

The convergence of IT and OT provides industries with greater system integration in terms of automation and optimization, as well as better visibility of the supply chain and logistics. The monitoring and control of physical infrastructures in industrial operations, such as in agriculture, healthcare, manufacturing, transportation, and utilities, are made easier through the use of smart sensors and actuators as well as remote access and control [4]. In the context of the fourth industrial revolution, dubbed Industry 4.0, the IoT is integral to how cyber-physical systems and production processes are set to transform with the help of big data and analytics. Real-time data from sensors and other information sources helps industrial devices and infrastructures in their "decision-making," in coming up with insights and specific actions. Machines are further enabled to take on and automate tasks that previous industrial revolutions could not handle. In a broader context, the IIoT is crucial to use cases related to connected ecosystems or environments, such as how cities become smart cities and factories become smart factories. The consistent capturing and transmitting of data among smart devices and machines provide industries and enterprises with many growth opportunities [7]. The data allows industries and enterprises to pick up on errors or inefficiencies in the supply chain, for example, and immediately address them, thus pushing for day-to-day efficiency in operations and finance. Proper integration of the IIoT can also optimize the use of assets, predict points of failure, and even trigger maintenance processes autonomously [10]. By adopting connected and smart devices, businesses are enabled to gather and analyze greater amounts of data at greater speeds. Not only will this enhance scalability and performance, but it can also bridge the gap between the production floors and general offices. Integration of the IIoT can give industrial entities a more accurate view of how their operations are moving along and help them make informed business decisions [12].

Fig.1 Fingerprint

2. NEED FOR IIOT TEST AND MEASUREMENT

It is based on totally system involved. The testers should concentrate as user approach and not like as testing based on requirements. It is important in order to certify protocols, operation systems, firmware and a complicated mesh of devices [3]. In order to test an end to end quality is needed to cover a set of web applications, set of embedded devices, test environment, tools and simulators. It incorporates the machine learning and big data to harness sensor data. It holds the potential in manufacturing for quality control and overall supply chain efficiency [14]. Manufacturing companies have more complex and dynamic processes; availability of real time data on critical parameters becomes more important. Looking at the

definition of IIoT, as well as some of the benefits and real-world use cases, it's critical to examine how sensors play a role in this equation. While software, machine-to-machine learning and other technologies work together to analyze data from physical objects the sensors are key to gathering the information [5]. If software is the brains of the IIoT, sensors are the nervous system collecting continuous streams of data to be processed. Industrial systems rely on sensors for reliable, consistent and accurate data in all aspects of automation. One could even argue the IIoT is nothing without sensors to measure parameters such as strain, temperature, position, and pressure. Sensors have been used in different industries for varied purposes for a long time now. However, IoT (Internet of Things) solutions created a need for the next generation sensors; loaded with features to solve the modern-day automation challenges [6]. The IoT sensors are smarter and have the capability to communicate with other sensors and remote computers as well. The paradigm of connected things has made sure that industries are able to work intelligently with an enormous amount of data being collected by the IoT sensors [15]. As data is at the crux of an industrial IoT setup, the role of sensors is imperative to making the entire ecosystem smarter. The industrial IoT solutions are being developed keeping the huge inflow of data in mind.

3. ROLE OF SENSORS IN IIOT

3.1 Smoke Sensors:

They have been in use for a long time but their integration with the IOT industrial automation solutions has created some interesting use-cases. These sensors find widespread use in applications like HVAC, construction site monitoring and the industrial units where a chance of fire and gas leakage is on a higher side [8]. When smoke sensors are integrated with an industrial IoT solution, even the slightest leakage of gas or minor occurrence of fire can be reported to the concerned team and major disaster can be averted. Companies like Heiman and Nest Protect manufacture smart IoT smoke sensors for both home and industry applications.

3.2 Proximity Sensors:

As the name suggests, these sensors measure the distance from itself and the nearest object. They are most commonly found on the car bumpers to alert the drivers in the case of an imminent collision. Proximity sensors also find application in the retail industry where the customer is informed about the discount as he or she walks near a product [11]. Other use cases are assembly lines of different industries like food, chemical, machine tools and many others.

3.3 Infrared Sensors:

Infrared sensors are essentially used to detect human presence. Infrared sensors have been deployed for Military applications extensively but over the few years, IR sensors integrated with the industrial IoT solution are finding applications in other industries as well. As these sensors can detect any infrared radiation including heat, they are deployed in electronics, chemical, and healthcare industries to name a few. Asahi Kasei Micro devices (AKM), Murata, Melexis MLX90614, Intersil ISL29021 are among the few IOT IR sensors used in Industries.

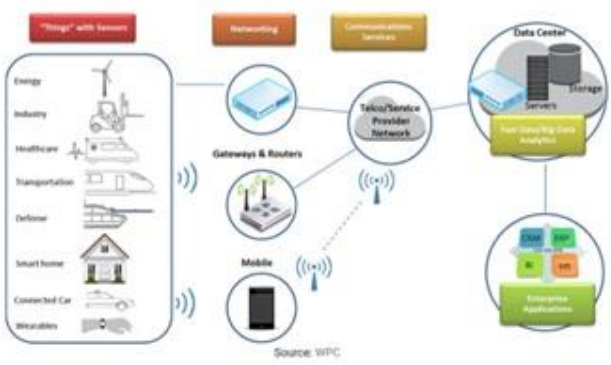

Fig.2 Role of Sensors in IIoT

3.4 Piezo Sensors:

The piezo sensors measure pressure and when integrated with an IoT solution can send data related to pressure changes in real time. Using these sensors, we can develop an industrial IoT system that is capable of monitoring pressure in pressure-critical equipments such as boilers, water systems, aerospace, oil drilling systems and more. Pressure Systems Series 960, 970, Paro-scientific Inc. Series 1000, 2000, 6000, Environ data BP10 Series are some of the most commonly used pressure sensors in industrial IoT applications [9].

3.5 Temperature Sensors:

Temperature sensors are among the most widely used sensors in industrial IoT applications. They find their use-cases in numerous industries that include FMCG, pharmaceuticals, biotechnology, and others where temperature-monitoring is crucial. Melexis MLX90614, Environ data TA40 Series, Geokon 4700 are the top picks for temperature sensors in industrial IoT applications.

3.6 Optical Sensors:

Optical sensors are one of those sensors that are capable of sensing more than just light. The underlying technology of these sensors lets it monitor any kind of electromagnetic radiation, i.e. light, electricity, and a magnetic field etc. Telecom, elevators, construction, healthcare, safety systems are some of the Industrial automation applications of Optical Sensors. Vishay's VCNL4020X01 and TCxT1600X01 are optical sensors designed specifically for the industrial IoT applications [16].

3.7 Image Sensors:

Image sensing has the power to revolutionize industrial automation in lot of industries like healthcare, transportation, and more. When integrated with the Internet of Things (IoT) enabled system, these sensors can help in monitoring of hospitals, factories, and more. These sensors can measure blood pressure with every beat, read the variation in pressure over the entire day and help in the prevention of cardiovascular diseases. In the transport sector, image sensors can help prevent train collision by alerting the driver of an approaching train on the same track. Omron and In-visage are two pioneers who are implementing the image sensing technologies in IoT with great outcomes. These are not all. Many other sensors are being popularly deployed in industrial IoT solutions and a

good number of them, capable of measuring other parameters, are in the process of development [17]. IoT is undoubtedly the future of industrial automation and its potential will largely depend on how effective, efficient and smart the sensors are. One can easily imagine the prowess of IoT when the sensors will be able to collect and analyze the data that is still untapped.

4. TEST APPROACHES

The complexity of the IoT systems architecture makes it necessary to have different types of tests across entire system components. Scalability, Performance, and Security are the key factors that need to be ensured while testing IoT applications. Some of the tests that we perform are mentioned below. Edge testing: Edge testing is important for any IoT application. It ensures coordination and real-time analysis at the edge of a network, which might get hindered by network bandwidth, capability, and reliability. Device interoperability testing: We access the capability of interoperate protocols and devices across different specifications and standards. Security and privacy testing: Our security and privacy testing ensures data protection, device authentication, and trust in cloud computing. Network impact testing [18]: This includes testing the performance of an IoT application in terms of quality and quantity in real network conditions with different network size, topology, and environment conditions. Performance testing: Application involving huge volume of data and accuracy is tested for performance under various aspects, like time, load, and real-time analysis. End user application testing: This involves usability testing based on functional and non-functional user experience of an IoT application.

5. CONCLUSION

In conclusion, having laid out the background including an overview IIoT .we provided a survey of existing definitions of IIoT. It explains about the IIoT in modern manufacturing field for the improvement in production. This gives the complete detailed study in the various techniques and methodology followed in the modern smart industries. Machine tools, as one of the key shared resources in manufacturing should be real-time monitored. By making full use of IIoT technology, various manufacturing resources are identified and their statuses could be then captured.

6. REFERENCES

[1] Albers, A., Gladysz, B., Pinner, T., Butenko, V., & Stürmlinger, T. (2016).
[2] Bartodziej, Christoph Jan (2017), The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics
[3] Batista, N. C., Melício, R., & Mendes, V. M. F. (2017). Services enabler architecture for smart grid and smart living services providers under industry 4.0. Energy and Buildings, 141, 16-27.
[4] Brettel, M., Friederichsen, N., Keller, M., & Rosenberg, M. (2014). How virtualization, decentralization and network building change the manufacturing landscape: An Industry 4.0 Perspective. International Journal of Mechanical, Industrial Science and Engineering, 8(1), 37-44.
[5] Devezas, T,. Leitao, J., Sarygulov, A. (2017). Industry 4.0: Entrepreneurship and Structural Change in the New Digital Landscape.
[6] Erol, S., Jäger, A., Hold, P., Ott, K., & Sihn, W. (2016). Tangible Industry 4.0: a scenario-based approach to learning for the future of production. Procedia CIRP, 54, 13-18.
[7] Faller, C., & Feldmüller, D. (2015). Industry 4.0 learning factory for regional SMEs. Procedia CIRP, 32, 88-91.
[8] Gilchrist, A.(2016). Industry 4.0: The Industrial Internet Of Things
[9] Givehchi, O., Trsek, H., & Jasperneite, J. (2013, September). Cloud computing for industrial automation systems A comprehensive overview. In Emerging Technologies & Factory Automation (ETFA), 2013 IEEE 18th Conference on (pp. 1-4). IEEE.
[10] Gölzer, P., Cato, P., & Amberg, M. (2015, May). Data Processing Requirements of Industry 4.0-Use Cases for Big Data Applications. InECIS.
[11] Gorecky, D., Schmitt, M., Loskyll, M., & Zühlke, D. (2014, July). Human-machine-interaction in the industry 4.0 era. In Industrial Informatics (INDIN), 2014 12th IEEE International Conference on (pp. 289-294). IEEE.
[12] Grangel-González, I., Halilaj, L., Coskun, G., Auer, S., Collarana, D., & Hoffmeister, M. (2016, February). Towards a semantic administrative shell for industry 4.0 components. In Semantic Computing (ICSC), 2016 IEEE Tenth International Conference on(pp. 230-237). IEEE.
[13] Greenwood, Jeremey (1997). The Third Industrial Revolution. American Enterprise Institute for Public Policy Research, 1997
[14] Hecklau, F., Galeitzke, M., Flachs, S., & Kohl, H. (2016). Holistic Approach for Human Resource Management in Industry 4.0. Procedia CIRP, 54, 1-6.
[15] Hermann, M., Pentek, T., & Otto, B. (2016, January). Design principles for industries 4.0 scenarios. In System Sciences (HICSS), 201649th Hawaii International Conference on (pp. 3928-3937). IEEE.
[16] Herter, J., & Ovtcharova, J. (2016). A Model based Visualization Framework for Cross Discipline Collaboration in Industry 4.0 Scenarios. Procedia CIRP, 57, 398-403.
[17] Procedure for Defining the System of Objectives in the Initial Phase of an Industry 4.0 Paper Focusing on Intelligent Quality Control Systems. Procedia CIRP, 52, 262-267.
[18] Velmurugan, S Ramesh, G P “Application of Information Science and Technology in Academic Libraries: An Overview”, Recent Trends and Advances in Artificial Intelligence and Internet of Things, Springer, Cham, Intelligent Systems Reference Library, Vol. 172, pp. 75-83, 2020.