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Industrial Internet of Things (IIoT): An Overview

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Abstract: - **Internet of Things is an advancing technology which is transforming the living. IoT is a network of embedded objects, hardware components, software and internet. This network enables exchange and storage of data. This advancement has made many complex tasks seem simpler. Most of the areas today are subjugated by IoT and this automation is resulting in less human intervention. Automation helps in continuous monitoring and also can be used in critical conditions where it is hard for humans to stay. The review paper focuses on the overall advances and applications of IoT in various fields and later moves on to explain the automated surveillance system used in industries for monitoring purpose (IIoT).**

***Keywords*: Automation, Applications, IoT, IIoT, Industry.**

I. INTRODUCTION

In recent past, the IoT has taken the industry by storm. The major reason for this being the automation provided by the IoT devices. The IoT devices are planted in the necessary areas, they are connected to a network and are then deployed. These devices do their jobs effectively hence reducing human intervention. There is a difference between IoT and IIoT. IoT is defined as a connection of objects over internet. IoT can either be wired or wireless setups that monitor or perform a given task. These days almost all the fields have adapted to IoT driven systems. The agenda behind this revolution is to connect at any point of time irrespective of place and provide necessary provision. [1] The term IIoT was coined by a digital company GE [3]. The IIoT can be defined as a tool to get better control over the system and its operations by using various sensors, internet and storage facilities for data [2]. It is a smart and effective collaboration of machines, analytics and people. IoT is more concerned with consumer level wherein IIoT is concerned at manufacturing level and aims in enhancing the production. [3]

II. HISTORY

The industry revolution began in the 1700s. In the early 1700s the steam engine was invented by Thomas Newcomen. It marked the beginning of mechanics in the industry and new machines were invented to carry out the jobs. By the end of 1700s, there were machines invented to carry out the task of weaving and knitting. [4]

Figure II.1: First Industrial Revolution

The second industrial revolution began in the mid-1800s. Along with the machines, the electricity and mass production were involved. The materials like iron and steel became very popular and also major advances were seen in chemical industry too. [6]

Figure II.2: Second Industrial Revolution

The third industrial revolution started from 1960s. The introduction of software was seen during this period as internet became more and more popular. The major

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advances are 3D printing and robotics where internet is used for operations. [7]

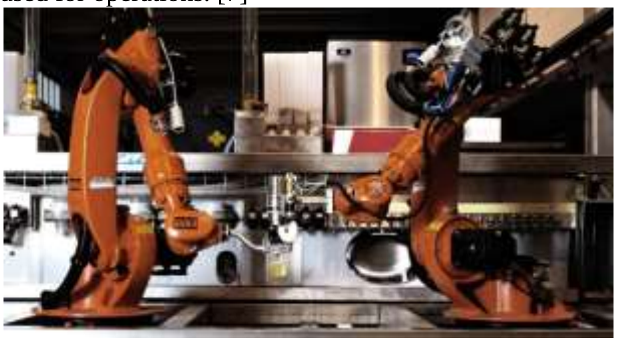

Figure II.2: Third Industrial Revolution

III. PRESENT

What we are witnessing now is the industrial revolution 4.0 through the use of cyber-physical systems. It means that physical systems such as machines and robotics will be controlled by automation systems equipped with machine learning algorithms. Minimal input from human operators will be needed. This revolution is happening through IIoT. [5]

Figure III.1: Industrial Revolution 4.0

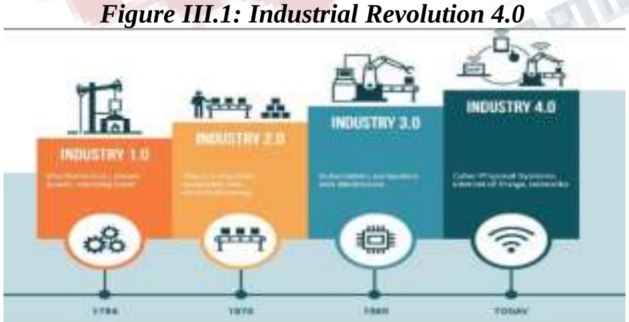

Figure III.2: Industry 4.0 via IIoT

The above figure shows the evolution of industry over the years. In the present eco-system, we are seeing many applications where automation is done on a large scale and human beings need not even bother about anything as the machines are doing the task efficiently. There are number of application of IoT in automation and most of them the same framework. [8]

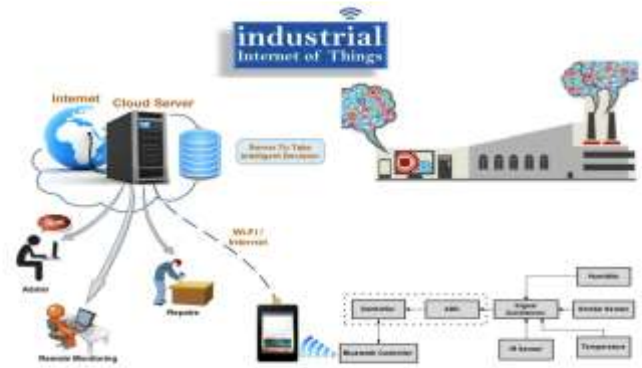

Figure III.3: Framework of IIoT

The above picture depicts the framework. The IoT devices are deployed in the industry, designed to carry out the specified operations. There are various parameters that can be monitored using IoT devices, some examples are humidity, temperature, smoke and so on. These devices are connected to servers or stations through internet. Before sending the signals are converted to compatible format and are forwarded to the controller. The controller then sends to the server through the internet connection. The server stores all the data and does the necessary analysis and prepares reports based on it. If any unusual activity is suspected then it alerts the management the same. This remote monitoring helps in taking accurate measures to solve the problem if any in the system. Some of the applications in automation are discussed. [8]

A. Home Automation:

Home automation includes smart lighting, smart appliances, intrusion detection, smoke/gas detection. The smart lighting helps in energy saving by automatically adjusting the light to the necessary conditions. This automation is enabled by using LEDs and IP-enabled lights. As they are connected to the network they can be monitored remotely through smart phones too. Smart appliances such as tv, refrigerators, air conditioners, music systems, automated blinds all these can be monitored using simple mobile applications or remotes. Intrusion detection system uses cameras and sensors to detect intrusions and send alerts. Alerts can either be through SMS or mails. Figure III.4 [11]

B. Smart City:

Smart city includes smart parking, smart lighting, smart roads, emergency response and so on. Parking is a major problem and to find a parking slot, it takes time and can create chaos. The solution to this is provided by using IoT devices to find available empty slots nearby and provide information about them to the drivers. Similarly, smart lighting too uses IoT devices that automatically

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turns on and off the street lights based on the sunrise and sunset timings. Figure III.5 [11]

Figure III.4: Home Automation

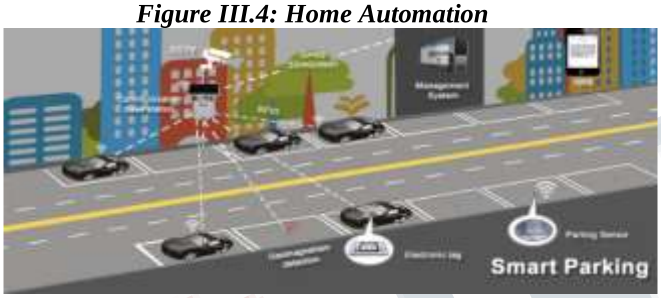

Figure III.5: Smart City

C. Environment:

In this conditions like weather, air quality, noise pollution, forest fire detection, river floods detection is monitored. IoT devices capable of monitoring parameters like humidity, temperature are used and the data is recorded and is stored in the cloud. Based on the analysis, a conclusion is derived and is transported through SMS or mail. One such example is AirPi, used to monitor air quality and weather. [11]

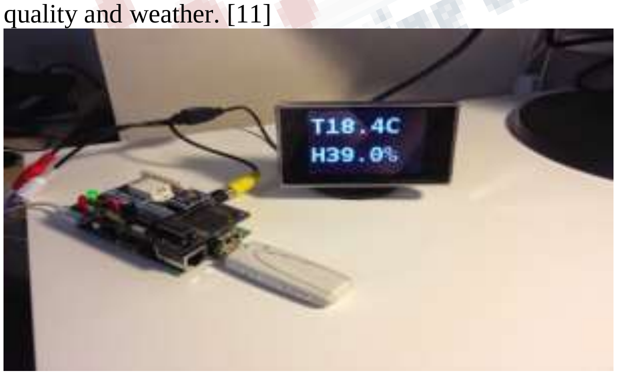

Figure III.6: Temperature Reading

D. Energy:

Energy comes at a price and is very important that we use it judiciously. Smart grid is one such IoT system wherein the electrical components are combined with the communication network. The data is collected in real time keeping in mind the nature of power transmission and usage and is analysed. This analysis gives the suggestions to manage needs and production and manage power. It is a high-speed, integrated, two-way communication model used for energy consumption and management. The major advantage is it reduces time delay and prevents unnecessary energy wastage. Prognosis is also involved in analysis process. [11]

Figure III.5: Smart Grid

E. Retail Management:

The innovation in this field has to be a boon to mankind. Be it payments or stocking of products or vending machine, this system has made shopping a lot easier. Using IoT devices correct amount of stocking can be done, which also reduces the cost. Similarly, these stockings can be tracked too using RFID tags. Smart payments are enabled by technologies like NFC and Bluetooth. In NFC communication happens when two devices tap each other. [11]

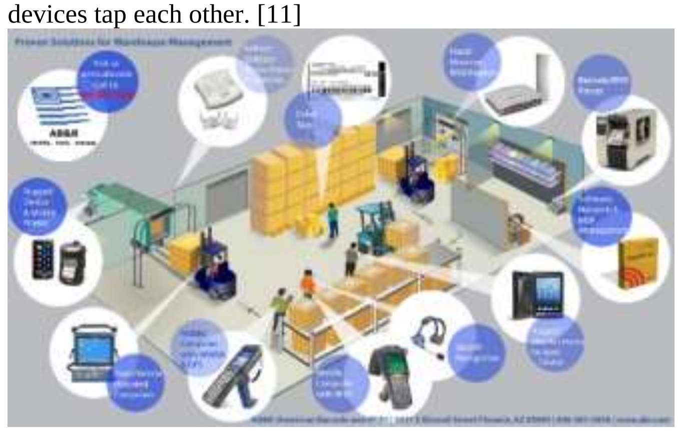

Figure III.6: Retail Management

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F. Health and monitoring:

The fitness trackers used today are smart fitness trackers ie they are connected to a network. The IoT devices track the vitals and send data on a regular basis. This data is sent to cloud for storage, the data is analysed and if any suspicious activity is recorded and sends an alert to the user. The network formed is called as Wireless Body Area Networks. Commonly used body sensors are temperature, heart rate, oxygen supply, blood pressure and so on. Fitbit is the most popular example of wearable IoT devices. [11]

Figure III.7: Smart Wearable Devices

G. Industry:

Machine diagnosis and prognosis refers to predicting the performance of a machine by analysing the data on the current operating conditions and how much deviations exist from the normal operating conditions. In diagnosis, we stress on determining the cause for faults. IoT plays a major role in both diagnosis and prognosis mechanisms. Case Based Reasoning(CBR) is a commonly used method that finds solutions to new problems based on past experience. The real time example for this is explained below; [11]

G.1. Thermal imaging cameras for flare monitoring

Flare stacks are used in many industries to burn off unwanted waste gas by-products, or flammable gasses released by pressure relief valves during unplanned over-pressuring of plant equipment. Applications include oil and gas well drilling operations, oil refineries, chemical process plants, gas distribution infrastructure, and landfills. In many cases, regulations require the monitoring of a stack's flame, or the pilot flame that ignites the gasses, to avoid having unburned hydrocarbons enter the atmosphere.

Thermal imaging cameras are an ideal monitoring tool, since they allow automated remote monitoring on a 24/7 basis in virtually any weather. In addition, thermal imaging cameras avoid many of the technical and cost-related problems associated with other technologies such as ultraviolet (UV) flame detectors, flame ionization spectrometers, thermocouples, and pyrometers [12].

Figure III.8: Thermal Imaging Camera

Flare systems are often a last line of defense that prevents dangerous hydrocarbon pollutants from entering the atmosphere.

Figure III.9: human eye

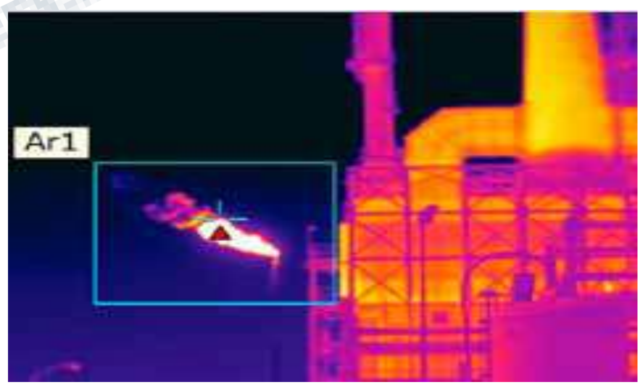

Figure III.10: Thermal Camera

Although invisible to the naked eye a thermal imaging camera can monitor whether a flare is burning or not. If the flare is not burning, harmful gasses can enter the atmosphere, an alarm can go off and immediate action can be taken.

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Working:
The FLIR A310 cameras provide several features that facilitate automatic control. As a starting point, the camera senses flame temperature and size, key elements in a control scheme. This calibrated data can be communicated through the A310 Ethernet port to a PLC or PC running the assist gas control program, using either a wireless access point, fibre-optic cable, or CAT6Ethernet cable. A plant manager needs to know immediately if flare stack combustion is lost, and get the flame reignited quickly to prevent a plant shutdown.

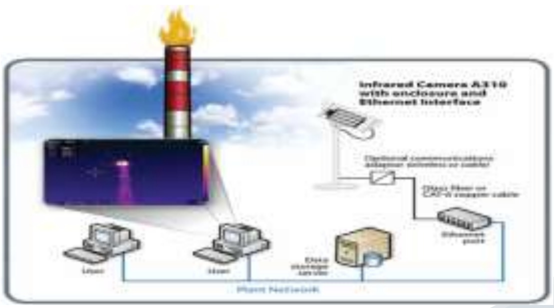

Figure III.11: Overview of Flare Gas Monitoring

FLIR thermal imaging cameras recognize the difference in the heat signature of a flare stack flame and the surrounding background (usually, the sky or clouds). In addition to detecting stack flame, these cameras can be positioned to monitor the igniter flame. Typically, cameras are mounted on a pedestal or other rigid structure in moisture resistant housings to protect them from harsh weather conditions. The camera's spectral response and calibration allows it to see through moisture in the air to obtain a good image and relative temperature reading of the flare stack or pilot flame. The images obtained with FLIR thermal imaging cameras even allow an observer to detect stack flame that might not be visible to the naked eye because of its composition or low gas flow volume. [12]

IV. FUTURE

The industrial Internet of Things is a driving force behind connectivity demands in a number of industries and its adoption will likely continue to increase. Over the decade or so, we can the revolution of industries for better. These are the inevitable changes in the future: [10] Over the next 12 months emerging technology will drive enhanced security rollouts. App development programs for Industrial Internet of Things (IIoT) will outgrow/outpace consumer IoT app development by 2020. IoT talent recruitment challenges will incentivize private enterprises to fund secondary education programs to nurture next-gen digital-workforce. Millions of smart IoT devices will be deployed into networks that use the 802.11 ah (HaLow) protocol by December 2017, driving it towards the standard for IIoT. The estimated growth in IIoT applications for utilities and energy industries will increase to more than 1.5 billion devices by 2020.

V. CONCLUSION

IoT has changed the outlook of almost everything. The major applications of IoT are path breaking and have added to the several advantages. The applications are very helpful and are reducing the human intervention by constant monitoring and analysis. In industries specially, the automation has made monitoring very easy. The various examples in this paper is testimony that IIoT is heading for major revolution and is soon going to be a trillion-dollar economy. Hence it is inevitable and is only going to create a lot more space for research and employment.

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