Study of IoT in Energy Industry

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Abstract – *As of now we are living in a era of digitization and automation, where the life of human being is getting simpler as almost everything is automatic, replacing the outdated manual systems. Today Internet has become an integral part of our day to day life, therefore, it is necessary to bring all the devices on a network. This is the main idea of Internet of Things(IOT). IOT is one of the promising technologies which can be used for connecting, controlling and managing smart objects which are connected to the internet using various protocols and means. This research paper focuses on study of IOT in energy industries , its applications, its merits, and demerits associated with it ,and solutions and new suggestions.*

Key Words: Internet of Things (IOT), process automation, grids, smart meters, sensors etc.

1. Introduction

The energy industry comprises of all of the industries involved in sales and production of energy, which includes fuel extraction, manufacturing, refining and distribution. Today's modern world consumes larger amounts of fuel, thus the energy industry is a crucial part of the infrastructure and maintenance in almost all countries. Therefore, a smart network is needed to save time and produce outcomes with greater efficiency. This advancement can be obtain using IOT.

IOT in energy sector can be used to track enormous system metrics, for instance - its overall health, performance, and efficiency or simply its maintenance. Connecting different devices and machines of a system on a single network through IOT can boost the growth of energy sector and will bring it to a new technology by transforming it from manual to automatic. It can also be used to control the large exploitation of fossil fuels which is the primary cause of greenhouse gases emission, harming the environment. IOT can be used to connect wind farms, solar farms, etc. to promote green energy.

Using IOT, organisations can reduce waste due to the improved control over energy consumption, which leads to cost savings and cutting of CO_2 emissions. They can cut maintenance and operating expenses through system modernisations and reduced human efforts, thus IOT helps in cost savings. These are some of the benefits of using IOT but there are some of the drawbacks which we will discuss in the later portion.

2. Applications of IOT in the Energy Industry

2.1 IOT in industrial energy management and production

1). Remote Asset Monitoring/Management

Sensors are being used to measure wear, tear, vibration, temperature, and other parameters to determine the overall health of assets from turbines to transmission lines. Adopting IOT in power generation can help to identify safety issues like gas leakage, which ensures safety of workers and equipment.

"General Electric", an American multinational company, is using IOT sensors to monitor the output and productivity of its equipment. Data collected from the sensors is used by the company to implement predictive maintenance models based on its prepared platform.

"The Pacific Gas and Electric Company (PG&E)", another American company has been using drones to find methane leaks during the Northern California wildfires. These drones remained in operation and communicated data to the unified control system which isolated leaks by the help of crew on-site. Thus, drones and smart sensors and more can be used as a part of safety hazard management for remote asset monitoring.

2). Process automation

As mentioned above, system's performance can be monitor using smart sensors in real time, and as a result, its efficiency can be adjusted using machine learning and AI. IOT - enabled drilling equipment can automatically

tailor the drill depth and external conditions can be adjusted using AI algorithms for fluent performance. Result of this is- it reduces manual work and maintenance cost.
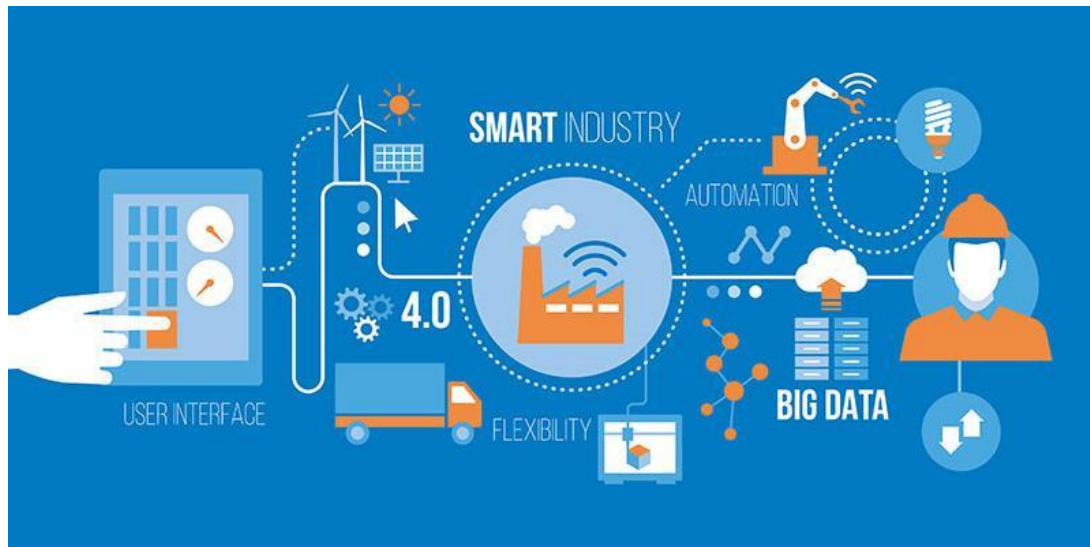
3). Integration and management of renewable energy sources

Using IOT, companies can switch alternatively for power generation from either fossil fuel or renewable energy (wind, solar, etc) depending on the peak demand periods. It even helps in storage of excess energy and use of it during this peak periods. They can also combine the energy generated from renewable means with the traditional coal or gas station. The output and uptime of renewable sources can also be easily maximised using IOT based solutions as it helps to ascertain the production values and overall health of renewable sources irrespective of their location.

4). Grid balancing and contribution

IOT with its key feature of providing "real-time information", the grid can prevent instability by ensuring that all the generation stations have met the connection requirements from frequency to voltage control.

In the future, electricity generated by the solar panels installed at the rooftops in several homes can be contributed/sold to the grid. The connection of renewable energy based generation plants with varying production levels to the grid will bring about variations in voltages at different nodes on the grid causing changes in power flow, but all these can be managed using real time data provided by IOT solutions, auto adjusting the grid to maintain stability.

2.2 Energy consumption with IOT

1). Smart decision making

IOT is helping consumers save cost and make smart decisions about their power usage.

Smart meters sent data to mobile app from which consumers can know about power consumed and maintain their budget. They can even turn off the supply of certain appliances and set conditions under which other appliances come on. This help to reduce waste and optimize their consumption.

These meters also send downtime information to utility agencies. Thus, utility agencies can act on this data and respond quickly to outages due to faults and other factors. Example –Duke Energy, a Florida-based company, has introduced a "self-healing grid system" which can automatically recalibrate itself after a power outage and as a result minimize downtime.

2). New power solutions

IOT based power solutions in upcoming future allow consumers to choose to buy power during periods when tariffs are low and use during peak periods when tariffs are high.

3). Smart Grids

IOT is enabling technologies that allow small homes to sell excess energy generated from sources like solar panels and wind farm to the grid. Initiatives in technologies like "vehicle to Grid", allow Electric cars to sell excess, unused energy to the grid.

For example: Chattanooga, Tennessee, one of the first cities to implement smart grid technology. This reduced shorter outages to 50% and helped community to save $1.4 million in operating costs. Moreover, smart grids have a positive impact on the environment.

4). Zero net energy buildings

Consumers driven concepts powered by IOT like Zero net energy buildings. It means all the energy needed by the house is generated by the house mostly via the use of renewable energy sources. Copenhagen, San Francisco and Vancouver are only some of the cities that have made significant efforts to become sustainable by reduction of energy consumption and improved energy efficiency.

3. Merits of IOT in energy industry

There are numerous advantages of IOT in energy Industry but some are as follows:

   i.   Reliability
   ii.   Cost effective
   iii.   Reduce labour work
   iv.   Eco-friendly measures
   v.   Improve infrastructure of cities
   vi.   Allows two way communication to consumers

4. Demerits of IOT in energy industry

Despite the number of undeniable advantages, smart energy solutions have some implications. These implications are as follows:

i. **Security**
Security is a common threat to all IOT solutions. The APIs that connect your devices into a unified network can be used as an entry point for targeted attacks.

ii. **Connectivity**
System needs to always be –on, with a minimum delay for data processing and feedback.

iii. **Integration**
Integration challenge arises when connecting a new IOT network to the existing legacy systems that often rely on outdated technologies.

iv. **Complexity**
IOT is a robust system of complex systems. This gives rise to a situation where a single issue in either the software or the hardware can create problems to an individual.

5. Solutions to the demerits of IOT in energy industry

i).Solutions to the security and connectivity can be solved using **edge computing**.

Edge computing - It refers to the computational of data that happens right where the data is produced, i.e. "at the edge" of the IOT network. So, instead of having a centralized, remote cloud to all the work, the data is handled and stored locally, that is at the nearest network node.

ii).Integration challenges can be solved by modernizing the current infrastructure. With the coming future, advancement in technology time to time can help to reduce complexity.

6. New suggestions to the IOT in energy industry

i). Devices like bulbs, fans, refrigerators, etc should be produced with wifi connection facility.

ii). Infrastructure models for sustainable cities should be made and then with proper plan and investment, connected with a common network, i.e. IOT.

iii). Speedy Internet should be made available all over the city or the country, so that data can be shared between different devices and users easily.

iv). Smart meters should be largely produced and installed.

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