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**ASSIGNMENT-1: List 20 Use Cases of Internet of Things.**

- **Industrial process automation/optimization**

Organizations can keep a real-time record of the metrics of all the machines inside a plant using IoT and IP networks. Manufacturers can use this data to automate workflows and to optimize production systems. Automation and optimization support industrial companies to reduce costs and increase the quality and volume of output.

- **Energy Management**

Energy can be a costly input for industrial businesses. With fluctuating energy costs and strict government requirements of efficiency, managing energy distribution becomes important.

IoT devices can help manufacturers manage energy consumption based on real-time data collected from devices. Intelligent energy management systems reduce energy bills, operational expenditures and carbon footprint of the factory while increasing energy efficiency. WebNMS is an IoT platform that provides IoT applications including energy management to optimize the energy consumption of businesses.

- **Outdoor surveillance**

When IoT CCTV cameras combined with artificial intelligence and machine vision, governments can automate surveillance of streets through cameras. As IoT enables connectivity of machines, they are able to record and analyse video data in real time, and they can provide police officers with insights instead of single pieces of images.

However, outdoor surveillance processes personal information and there is potential for abuse in use of such technologies. Therefore appropriate checks and balances need to be implemented in such systems to ensure that personal information is not abused while risk of crime is minimized.

- **Smart lighting**

According to the 2018 Gartner IoT hype cycle report, smart lighting is the fourth-most mature IoT tech application. Smart lighting aims to optimize energy management.

Smart lighting is made up of street lighting with IoT sensors. Sensors collect data about the condition of traffic and pedestrians. With that data, street lights provide optimum lighting so that street lighting systems can save up to 80% of the energy.

Smart lighting can also be applied to factories or homes.

- **Electronic Road Toll Collection and Traffic Management**

Traffic engineers augmented by smart systems at a central traffic management center (TMC) can analyze data from IoT sensors then optimize timing of traffic lights throughout the day. This can help divide the traffic more evenly over roads as traffic volume fluctuates.

- **Smart parking**

In cities like San Francisco, parking is a big problem. With IoT sensors, parking problems in a city can be minimized.

Working principle of smart parking is:

- Sensors are attached to parking lots to detect parked cars
- Measurements are periodically sent to the cloud by microcontrollers
- Mobile Apps use cloud data to identify empty parking spaces,
- Drivers check mobile apps to identify vacant parking spaces close to the location they aim to go to.

- **Noise Monitoring**

In smart cities, sound monitoring systems can monitor noise levels and warn companies that violate limits and help manage noise levels.

- **Structural Health Monitoring**

IoT allows remote collection of architectural data to monitor events such as vibrations and changes in material conditions, predict structural damage, and prepare action plans for structures such as bridges, buildings, stadiums, ships, airplanes, etc.

- **Waste Management**

Traditional waste collections are complicated and costly since a fleet of trucks drives along busy streets using inefficient routes. Fill levels of garbage containers differ for each container: ranging from overflowing, partially filled and empty. IoT sensors can monitor fill levels for conventional bins and send the data to the relevant department of the city hall. With that information, the garbage truck routes can be optimized for trash collection.

Machine learning methods can also be implemented in IoT sensors (i.e. edge analytics) so that sensors can predict the fill levels of containers by learning from historical data.

- **Water conservation**

Sensors detect the water level in tanks and alerts when the water level is lower than the threshold. Well™, a smart home water conservation system developed by Mindtribe, uses IoT sensors to monitor water usage.

- **Smart Irrigation**

IoT sensors determine the weather condition and the soil moisture, which will help in getting the appropriate amount of water that soil needs. Bosch offers an IoT solution that measures how much water the tree needs and provides that amount of water.

- **Leakage Management**

IoT sensors can detect temperature changes, water leakage, chemical leakage, and pressure level in water tanks.

- **Water Quality Management**

IoT sensors determine what kind of chemicals are in the water. They also identify metrics such as total dissolved solids (TDS), bacteria, chlorine, electrical conductivity, etc.

## **Digital Health**

- **Ultraviolet Radiation Monitoring**

Sunlight consists of three major components:

- Visible light: Wavelengths between 0.4 and 0.8 micrometers,
- Ultraviolet light: Wavelengths shorter than 0.4 micrometers,
- Infrared light: Wavelengths longer than 0.8 micrometers.

Ultraviolet (UV) rays are electromagnetic waves that account for about 10% of solar light. When overexposed, UV rays have harmful effects such as skin cancer, premature aging, cataracts, and immune system suppression. IoT sensors measure UV sun rays to warn people not to be exposed in certain hours.

- **Fall Detection**

Falling into the ground and not being able to get up or request help can be a scary experience for senior citizens. IoT sensors can detect falls using geolocation data and summon help so that it reduces the time the elderly remain on the floor after a fall which could lead to lethal consequences.

- **Companion Robots**

A companion robot is a robot that is designed to create companionship mostly for elderly and single children. IoT sensors are essential for robotics and it is the same for companion robots as well. Sensors detect objects that surround the robot and enable the robot to move.

Researchers claim that people have become more receptive to companion robots during the pandemic. Since social isolation may lead people to loneliness, anxiety and frustration, especially for the elderly.

- **Medical Fridges**

Medical fridges monitor the temperature of vaccines, medicines and organic elements for clinics and health centers. Medical fridges provide an opportunity to follow all safety standards and national regulations of the pharmaceutical market using IoT sensors. They prevent medicines and vaccines from spoiling.

Efento is an IoT sensor and IoT platform vendor that has a variety of temperature measurement products along with wireless monitoring of temperature in medical refrigerators.

- **Patient Surveillance/Remote Patient Monitoring**

20% of patients who had surgery are readmitted to the hospital within just 30 days. Remote patient monitoring (RPM) systems use wearables to monitor the condition of patients who are resting at home after surgery. RPM enables real-time data collection about patients' body temperature which is the main indicator of infections. With RPM, doctors can observe patients' data and provide early diagnoses without requiring patients to be physically present at the hospital.

Telit is an IoT solution vendor and offers its customers a remote patient monitoring (RPM) solution that enhances patient monitoring capabilities and patient satisfaction. Telit's offering can reduce:

- patients hospital stay duration thanks to early diagnosis of complications
- hospital readmissions

## **Smart Retail**

- **Supply Chain Control**

IoT devices have transformed supply chain management. Sensors, which are attached to storage containers or to products themselves,

- show the location of goods using GPS,
- track the speed of movement providing an accurate estimated time of arrival (ETA) for goods,
- monitor warehouse conditions such as temperature, humidity, light intensity, and other environmental factors

- **Near Field Communication (NFC) Payment**

NFC enables contactless payments. POS vendors include NFC support in their systems, and customers are adopting contactless payments via their smartphones.

- **Layout Optimization**

Sensors in the store collect data like voice, image or video to better understand customer habits and preferences. Retailers can get insights to redesign the layout of their stores. The optimized layout can enhance sales.

