# UNIT-3 IOT

What is underground WSN?

Wireless underground sensor networks (WUSNs) are **networks of sensor nodes operating below the ground surface**, which are envisioned to provide real-time monitoring capabilities in the complex underground environments consisting of soil, water, oil, and other components.

In this paper, we investigate the possibilities and limitations of using WUSNs for increasing the efficiency of oil recovery processes. To realize this, millimeter scale sensor nodes with antennas at the same scale should be deployed in the confined oil reservoir fractures. This necessitates the sensor nodes to be operating in the terahertz (THz) range and the main challenge is establishing reliable underground communication despite the hostile environment which does not allow the direct use of most existing wireless solutions. The major problems are extremely high path loss, small communication range, and high dynamics of the electromagnetic (EM) waves when penetrating through soil, sand, and water and through the very specific crude oil medium. The objective of the paper is to address these issues in order to propose a novel communication channel model considering the propagation properties of terahertz EM waves in the complex underground environment of the oil reservoirs and

to investigate the feasible transmission distances between nodes for different water-crude-oil-soil-CO_2 compositions.

Underground wireless sensor

Underground sink sensor

Aboveground gateway
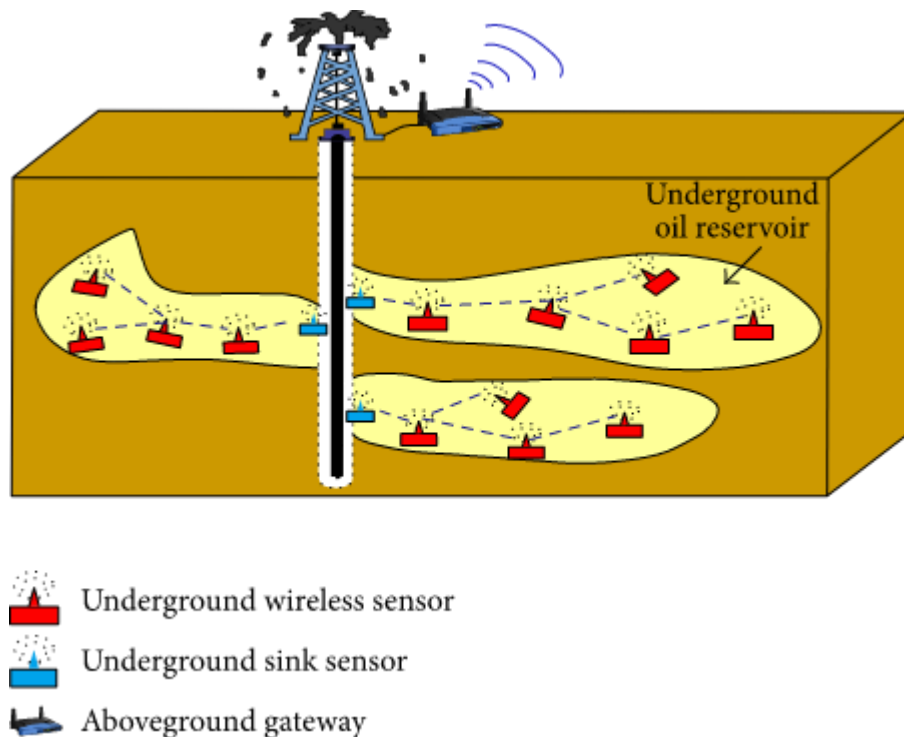
HABITAT MONITORING

Researchers in the Life Sciences are becoming increasingly concerned about the potential impacts of human presence in monitoring plants and animals in field conditions. At best it is possible that chronic human disturbance may distort results by changing behavioral patterns or distributions, while at worst anthropogenic disturbance can seriously reduce or even destroy sensitive populations by increasing stress, reducing breeding success, increasing predation, or causing a shift to unsuitable habitats. While the effects of disturbance are usually immediately obvious in animals, plant populations are sensitive to trampling by even well-intended researchers, introduction of exotic elements through frequent visitation, and changes in local drainage patterns through path formation. Disturbance effects are of particular concern in small island situations, where it may be physically impossible for researchers to avoid some impact on an entire population. In addition, islands often serve as refugia for species that cannot adapt to the presence of terrestrial mammals, or may hold fragments of once widespread populations that have been extirpated from much of their former range. Seabird colonies are

notorious for their sensitivity to human disturbance. Research in Maine [2] suggests that even a 15 minute visit to a cormorant colony can result in up to 20% mortality among eggs and chicks in a given breeding year. Repeated disturbance will lead to complete abandonment of the colony. On Kent Island, Nova Scotia, researchers found that Leach's Storm Petrels are likely to desert their nesting burrows if they are disturbed during the first 2 weeks of incubation. Sensor networks represent a significant advance over traditional invasive methods of monitoring. Sensors can be deployed prior to the onset of the breeding season or other sensitive period (in the case of animals) or while plants are dormant or the ground is frozen (in the case of botanical studies). Sensors can be deployed on small islets where it would be unsafe or unwise to repeatedly attempt field studies. The results of wireless sensor-based monitoring efforts can be compared with previous studies that have traditionally ignored or discounted disturbance effects. Finally, sensor network deployment may represent a substantially more economical method for conducting long-term studies than traditional personnel-rich methods. Presently, a substantial proportion of logistics and infrastructure must be devoted to the maintenance of field studies, often at some discomfort and occasionally at some real risk. A "deploy 'em and leave 'em" strategy of wireless sensor usage would limit logistical needs to initial placement and occasional servicing

What is a smart city?

Smart cities use IoT devices such as connected sensors, lights, and meters to collect and analyze data. The cities then use this data to improve infrastructure, public utilities and services, and more.

Below, we've outlined how smart cities provide a more efficient and higher quality lifestyle for their residents, and the methods they use to reach these goals.

Smart City Technologies

Smart city devices work to make everyday tasks easier and more efficient, while relieving pain points related to public safety, traffic, and environmental issues. Here are some of the most popular smart city technologies

Smart utility meters

A top IoT device among utility companies is the smart meter. These devices attach to buildings and connect to a smart energy grid, allowing the utility companies to manage energy flow more effectively.

Smart meters also allow users to track their energy consumption—leaving a significant financial impact. Insider Intelligence expects utility companies to save $157 billion by 2035 due to smart meter adoption and implementation.

Smart transportation

Connected vehicles have made their way to the forefront of public transit—and the efforts have already started to bear fruit. Insider Intelligence projects US connected cars will make up 97% of the total number of registered vehicles by 2035.

Specifically voice search and location data capabilities are attractive to drivers, and as smart applications continue to evolve and grow, so will the adoption of smart transit.

Smart grids

Arguably the greatest implementation of smart architecture and infrastructure is smart grids, which help tremendously with resource conservation. Amsterdam, for example, has been experimenting with offering home energy storage units and solar panels for households that are connected to the city's smart grid.

Smart waste management solutions

Waste management is both costly, inefficient, and can cause traffic buildup. Smart waste management solutions can alleviate some of these pain points by monitoring

how full trash cans are at a given point and send that data to waste management companies, providing the best waste pick-up routes.

Smart air quality monitors

There are constantly air particles, dust, dirt, cleaning chemicals, floating around in the air of one's office building or home. Smart air quality monitors can detect these particles and inform users of pollutants.

A **smart home system** can be something that makes our life quite easy. Starting from energy management where the power controls system in the AC appliances where we use the thermostat, all this is managed to cut down the power consumption that's taking place. A door management system, security management system, water management system are the part of this as well. Still, these are vital things that stand out in the smart home system. The limitation of IoT in smart home application stops where our imagination stops. Anything that we wish to automate or want to make our life easier can be a part of smart home, a smartphone system as well.

Smart Home

Now, a smart home usually is going to be a base of a **smart city**. The smart city is an evolution of a smart home. Here, it is not just the sensors of a single home that is connected, here its correlation or a network or a connection between various organizations, various domains as well as multiple segments of that city as a whole. In the smart city, the life of every single dependent becomes more comfortable and in tune really help to develop that city to greater extends as such. Now, the key factor for a smart city is government support as well, and if the governments are willing to take this step, then we hope we would see a smart city completely build on the Internet of Things.

Vehicular IoT

The IoT in vehicles will **deliver a faster, safer and richer experience for drivers**. It is now possible for drivers to access information about traffic, road conditions, fuel usage, vehicle

diagnostics, driving behavior and more. And vehicle IoT is increasing in importance.

A connected vehicle has embedded technology enabling it to connect to the internet, devices and even other vehicles or systems. The IoT in vehicles will deliver a faster, safer and richer experience for drivers. It is now possible for drivers to access information about traffic, road conditions, fuel usage, vehicle diagnostics, driving behavior and more.

The value of vehicle IoT for businesses is the ability to tap into data that will assist in making measured management decisions

And vehicle IoT is increasing in importance. In addition to the commuter car, other types of work and service vehicles are getting connected, including trains, buses and trucks. Companies are integrating vehicle IoT into their IT systems to automate business processes. Fleets of every size rely on connected solutions such as Geotab for monitoring and managing critical information related to productivity, driver safety, fuel consumption and compliance.

Smart Lighting System

Smart lighting uses IoT-enabled sensors, bulbs, or adapters to allow users to manage their home or office lighting with their smartphone or smart home management platform. Smart lighting solutions can be controlled through an external device like a smartphone or smart assistant, set to operate on a schedule, or triggered by sound or motion.

Smart lighting solutions can be built in a couple of ways. Smart bulbs are WiFi-enabled bulbs that can be controlled individually by a smart assistant or mobile

app. Most have the ability to change color or dimness. Light switches operate as an adapter for regular light bulbs and can control groups of lights.

Key Benefits of IoT-Enabled Smart Lighting

- Save money by switching to more energy-efficient LED bulbs.
- Set schedules to ensure that lights are off when they aren't needed – or control lighting schedules remotely as a security measure when you're away from home or out of town.
- Adjust the color or dimness of lights in different rooms or individual bulbs.

What is an IoT based weather monitoring system?

It is a system that involves in acquiring weather and environment data using advanced electronic sensors and sending them to a web server via internet for real time weather monitoring and storage of data for future analysis and study.

Why we need an IoT based weather monitoring system?

1. Ease of monitoring your local weather conditions in real time from anywhere in the world.

2. **For storing weather and environment data for short and long term for studying weather pattern changes and to understand how human induced climate change affected your local weather.**

3. **Easy deployment of the setup for monitoring local atmospheric conditions and microclimates for weather forecasting and prediction**

Types of sensors involved in weather monitoring:

We can find wide spectrum of electronic sensors involved in weather monitoring system depending on the kind of application.

For example:

Farmers need to know the temperature, relative humidity, soil moisture, rain fall etc. to enhance their crop production and the following type of sensors are utilized to obtain the data:

- **Temperature sensor.**
- **Humidity / hygrometer sensor.**
- **Soil moisture sensor.**
- **Rain sensor etc.**

Smart Agriculture

IoT Smart technology enables new digital agriculture. Today technology has become a necessity to meet current challenges and several sectors are using the latest technologies to automate their tasks. Smart agriculture, based on Internet of Things (IoT) technologies, is envisioned to enable producers and farmers to reduce waste and improve productivity by optimizing the usage of fertilizers to boost the efficiency of plants. IoT

based Smart Farming gives better control to the farmers for their livestock, growing crops, cutting costs, and resources

Smart Farming: The impact of IoT on Agriculture

- Automatic adjustment of farming equipment made possible by linking information like crops/weather and equipment to auto-adjust temperature, humidity, etc.
- In large farmland, IoT equipped drone helps to receive the current state of crops and send the live pictures of farmland.
- Analyzing farmland from the land using IoT based Smart Farming Solutions you will know the current situation of fields and crops in.

Healthcare System

Before Internet of Things, patients' interactions with doctors were limited to visits, and tele and text communications. There was no way doctors or hospitals could monitor patients' health continuously and make recommendations accordingly.

Internet of Things (IoT)-enabled devices have made remote monitoring in the healthcare sector possible, unleashing the potential to keep patients safe and healthy, and empowering physicians to deliver superlative care. It has also increased patient engagement and satisfaction as interactions with doctors have become easier and more efficient. Furthermore, remote monitoring of patient's health helps in reducing the length of hospital stay and prevents re-admissions. IoT also has a major impact on reducing healthcare costs significantly and improving treatment outcomes.

IoT is undoubtedly transforming the healthcare industry by redefining the space of devices and people interaction in delivering healthcare solutions. IoT has applications in healthcare that benefit patients, families, physicians, hospitals and insurance companies.

IoT for Patients - Devices in the form of wearables like fitness bands and other wirelessly connected devices like blood pressure and heart rate monitoring cuffs, glucometer etc. give patients access to personalized attention. These devices can be tuned to remind calorie count, exercise check, appointments, blood pressure variations and much more.

IoT has changed people's lives, especially elderly patients, by enabling constant tracking of health conditions. This has a major impact on people living alone and their families. On any disturbance or changes in the routine activities of a person, alert mechanism sends signals to family members and concerned health providers.

IoT for Physicians - By using wearables and other home monitoring equipment embedded with IoT, physicians can keep track of patients' health more effectively. They can track patients' adherence to treatment plans or any need for immediate medical attention. IoT enables healthcare professionals to be more watchful and connect with the patients proactively. Data collected from IoT devices can help physicians identify the best treatment process for

patients and reach the expected outcomes.

IoT for Hospitals - Apart from monitoring patients' health, there are many other areas where IoT devices are very useful in hospitals. IoT devices tagged with sensors are used for tracking real time location of medical equipment like wheelchairs, defibrillators, nebulizers, oxygen pumps and other monitoring equipment. Deployment of medical staff at different locations can also be analyzed real time.

The spread of infections is a major concern for patients in hospitals. IoT-enabled hygiene monitoring devices help in preventing patients from getting infected. IoT devices also help in asset management like pharmacy inventory control, and environmental monitoring, for instance, checking refrigerator temperature, and humidity and temperature control.

IoT for Health Insurance Companies – There are numerous opportunities for health insurers with IoT-connected intelligent devices. Insurance companies can leverage data captured through health monitoring devices for their

underwriting and claims operations. This data will enable them to detect fraud claims and identify prospects for underwriting. IoT devices bring transparency between insurers and customers in the underwriting, pricing, claims handling, and risk assessment processes. In the light of IoT-captured data-driven decisions in all operation processes, customers will have adequate visibility into underlying thought behind every decision made and process outcomes.

Insurers may offer incentives to their customers for using and sharing health data generated by IoT devices. They can reward customers for using IoT devices to keep track of their routine activities and adherence to treatment plans and precautionary health measures. This will help insurers to reduce claims significantly. IoT devices can also enable insurance companies to validate claims through the data captured by these devices.

Industry applications

Industrial IoT is defined as a **network of devices, machinery and sensors connected** to each other and to the Internet, with the purpose of collecting data and analyze it to apply this information in continuous process improvement. There are many Industrial IOT applications out there, and they have driven an increasing number of companies to engage in this new paradigm to improve their productivity and optimize their expenses and profits.

This is a market that is constantly expanding – one that major players have already adopted. Even though studies show different figures when it comes to accurate predictions of the market

value of IIoT in the upcoming years, the most important reports agree that investment will increase threefold at the very least.

To have access to this competitive advantage, one would be wise to know the main IIoT applications and how to implement the system.

The main Industrial IOT applications

Studies published by [Deloitte](#) show the importance given by the business world to generating IoT environments: in its 'Industry 4.0' report, 94% of the survey participants stated that digital transformation is an **essential strategic objective** for the organization.

While this is a **global trend**, in the case of the industrial sector, businesses need to be aware of the usefulness of Industrial IOT applications to generate processes that remain relevant in the upcoming years