

Things That Think: Exploring IoT's Role Across Different Sectors

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Abstract- IoT stands for Internet of Things. It refers to the connection between physical devices, such as appliances and vehicles, that are embedded with software, sensors, and connectivity which enables these objects to connect and exchange data. This technology allows for the collection and sharing of data from a huge network of devices, creating opportunities for more efficient and automated systems.

Internet of Things (IoT) is the networking of physical objects that contain electronics embedded within their architecture in order to communicate with the external environment. Advancements in medicine, power, gene therapies, agriculture, smart cities, and smart homes are just a few of the categorical examples where IoT is strongly established. The Internet of Things (IoT) can be used in many different aspects of life, in both the private as well as public sectors. Thanks to IoT, people can do anything from anywhere by using IoT in their daily life. Consumers can use the IoT to help them monitor their lifestyle, agriculture in smart ways, industrial productions, track logistics & supply chain, make their homes automated by smart home technologies and cities smarter by using technologies like smart parking, smart street light etc.

Keywords- Internet of Things (IoT), Smart Environment, Smart Agriculture, Smart Cities, Smart Healthcare, Smart Retail, Smart Logistics, Artificial Intelligence (AI), Machine Learning (ML), Digital Twins, Big Data, Smart.

I. INTRODUCTION

The Internet of Things collects huge amount of data daily all around the world. It helps to create a huge and massive network by collaborating data, keeping it connected with an extensive network, and sorting out data precisely. It helps to solve various complicated issues simply and efficiently in a short time. Designing efficient devices is the primary work of IoT engineers. They design devices to remove laborious work and update the world with advanced technologies. These devices help in daily living and workplaces to keep updated with the latest technology and avoid manual work. With the rise of Internet of Things (IoT) technology, the seamless connection between the physical and digital worlds has been realized. The rise in usage of IoT has become a big challenge for the Engineers as it needs to handle a vast amount of data with

security. As loss of these important data may lead to a data discrepancy and cause critical damage to the system technology cybersecurity is also very important for the systems using IoT. Internet of Things (IoT) is a new paradigm that has changed the traditional way of living into a high-tech life style. Smart city, smart homes, pollution control, energy saving, smart transportation, smart industries are such transformations due to IoT. A lot of crucial research studies and investigations have been done in order to enhance the technology through IoT. However, there are still a lot of challenges and issues that need to be addressed to achieve the full potential of IoT. These challenges and issues must be considered from various aspects of IoT such as applications, challenges, enabling technologies, social and environmental impacts etc. The main goal of this review article is to provide a detailed discussion from both technological and social perspective.

II . APPLICATION OF IoT IN DIFFERENT SECTORS

The paper discusses different uses and applications of IoT in some of the important application domains. Also, the paper brings into real time uses and applications in different aspects of IoT. Moreover, the importance of big data and digital twins respect to IoT has been discussed. This paper would help the common people to understand the IoT and its applicability to the real world. With the Internet of Things (IoT) gradually evolving over the subsequent phase of the evolution of the Internet, it becomes very important to recognize the various potential domains for application of IoT, and the key challenges that are associated with these applications. Ranging from smart cities, to health care, smart agriculture, logistics and retail, to even smart living and smart environments IoT is expected to infiltrate into virtually all aspects of daily life. Even though the current IoT enabling technologies have greatly improved in the recent years, there are still numerous problems that require attention. Since the IoT concept ensues from different technologies, many challenges are bound to arise. The fact that IoT is so expansive and affects practically all areas of our lives so it makes it a significant research topic for studies in various related fields such as information technology and computer science. Thus, IoT is paving the way for new dimensions of research to be carried out in both Electronics as well as Computer Science fields. This paper presents some of the recent development of IoT technologies.

Smart Cities

Smart Cities are urban areas that use digital technology and data-driven solutions to enhance the quality of life for citizens, improve sustainability, and streamline urban services. They integrate Information and Communication Technologies (ICT) and the Internet of Things (IoT) to manage assets, resources, and services more efficiently. Important features of Smart Cities include Smart Infrastructure like Intelligent traffic systems, Automated lighting & energy systems and Smart grids and water management. It also includes Digital Governance like

E-governance platforms, Open data and transparent public services and Citizen feedback & engagement apps. It also consists of Sustainable Development like Renewable energy integration, green buildings & eco-friendly transportation and Waste management through sensors and analytics. It also helps in Efficient Transportation by providing Smart public transport (real-time tracking, route optimization), Electric vehicles & charging stations and Reduced congestion via AI-based traffic control. It also helps in Public Safety & Health by providing Surveillance with AI for crime prevention, Emergency response coordination and Smart healthcare & telemedicine services. It can also be used by citizens for connecting citizens through High-speed internet & Wi-Fi hotspots, Digital literacy & inclusion initiatives and Mobile apps for public services. Examples of Smart Cities are

- Singapore – Known for smart mobility, urban planning, and e-governance.
- Barcelona – Uses IoT for waste management, lighting, and water systems.
- Amsterdam – Focused on sustainability, open data, and citizen participation.
- Dubai – Incorporates blockchain in government and AI in public services.

Challenges faced can be like High initial investment costs, Data privacy & cybersecurity risks, Technological inequality and Integration of legacy systems. Future of Smart Cities can be thought of more AI-driven automation, Increased use of digital twins (virtual models of cities), Emphasis on climate resilience and Integration with 5G & edge computing.

The IoT plays a very important role in improving the smartness of cities and enhancing the infrastructure of the city. Some of IoT applications in creating smart cities are creating intelligent transportation systems, smart building, traffic congestion, waste management, smart lighting, smart parking, and urban maps. This may include different areas like smart manufacturing where robotics & automation is used for making industries smart, smart

governance where everything can be made easy using software, wi-fi everywhere for connecting everything to everyone, open data is the data which will be transparent for everyone for those needed, smart health is

providing healthcare for everyone in smarter way by identifying the health issues in advance & treating for the same, by practising smart agriculture by using updated technologies in



Figure : Smart City

agricultural fields, smart buildings have smart environment around them, smart energy management is the one where energy is not wasted & used accordingly and smart transportation is one where traffic can be monitored depending upon the congestion.

Smart city also consists of smart education where education can be given in a smarter way using wi-fi and other updated technologies like Virtual Reality & Augmented Reality which helps in making students understand the concept better.

Smart environment includes proper Waste Management in cities, checking water quality provided, Gas & Water leakage detection & prevention.



Figure : Smart City Components

Smart Healthcare

Smart Healthcare refers to the application of advanced digital technologies—such as Artificial Intelligence (AI), Internet of Things (IoT), Big Data, and cloud computing—to enhance the delivery, efficiency, and personalization of healthcare services. Important components of Smart Healthcare include providing IoT-enabled Medical Devices like Wearables (smartwatches, fitness bands) monitor heart rate, blood pressure, glucose levels, etc. and Remote patient monitoring devices transmit real-time data to doctors. It also includes recording Electronic Health Records (EHRs), Digital records of patient history, lab results, & treatments and accessible across different health providers for coordinated care. It also consists of technologies like Artificial Intelligence and Machine Learning for early disease detection (e.g., cancer, diabetes) through pattern recognition, AI chatbots for basic medical advice & appointment scheduling and predictive analytics for outbreak forecasting & resource planning. It is also useful for Telemedicine which provides virtual doctor consultations via video calls, reduces hospital visits, especially in rural or underserved areas and offers mental health support & chronic disease management remotely. It also uses Robotics and Automation for Robotic surgery with high precision and Automated dispensing of medications in pharmacies or hospitals. There are also apps like Mobile Health (mHealth) Apps for tracking symptoms, medication adherence & fitness goals and it also offers lifestyle

advice, mental wellness tools & health education. It also uses Blockchain technology for Health Data Security, secures patient records with transparency & tamper resistance and it enables safe sharing of medical data between providers. Benefits of Smart Healthcare includes early diagnosis & better outcomes from the medical problem, personalized treatment plans, reduced healthcare costs, improved access, especially in remote areas and greater patient engagement and self-care. Challenges are also there like data privacy and security concerns of patients, digital divide—limited access for elderly or rural populations, regulatory & legal hurdles and dependence on robust internet infrastructure. Real-World Examples are as follows

- Babylon Health (UK): AI-powered symptom checker and telemedicine app.
- Apollo Hospitals (India): Remote patient monitoring and AI in diagnostics.
- Ping An Good Doctor (China): Online health consultations via AI.
- Mayo Clinic (USA): Uses AI and big data for precision medicine and patient monitoring.

Most healthcare systems in many countries are not efficient, slow and are prone to error. This can easily be changed by using IoT technology in healthcare and devices can be automated and enhanced through technology. Open Data concept can facilitate various operations like report sharing to multiple individuals and locations, record keeping and dispensing medications would go a long way in changing the healthcare sector. IoT application offers most of the benefits in the healthcare sector by mostly categorizing it into tracking of patients, staff, and objects, identifying, as well as authenticating, individuals, and the automatic gathering of data and sensing. The medical workflow can be significantly improved once patients flow is tracked. After tracking the patient, the medical history will be tracked and the details will be provided to the concerned medical staff including the medical history, which makes the treatment easier. Smart healthcare can also be automated for

medical inventory management by placing automatic orders for the medicine which is over and supply of the same before the medicine ends to keep the continuity. Sensor devices are used by patients for diagnosing conditions and availing real-time information about patients' health indicators. Other elements of IoT also includes RFID, Bluetooth, and Wi-Fi among others. These will help in measuring and monitoring techniques of critical functions like blood pressure, temperature, heart rate, blood glucose, cholesterol levels, and many others. For elderly and physically disabled persons, this technology helps a lot as they cannot visit medicos frequently. Nano-sensors can also be used in order to screen and test the medical conditions of these people. Robot assistive surgeries are the new age surgeries which are used for surgeries where the human hand may not be able to reach or other unavoidable circumstances.

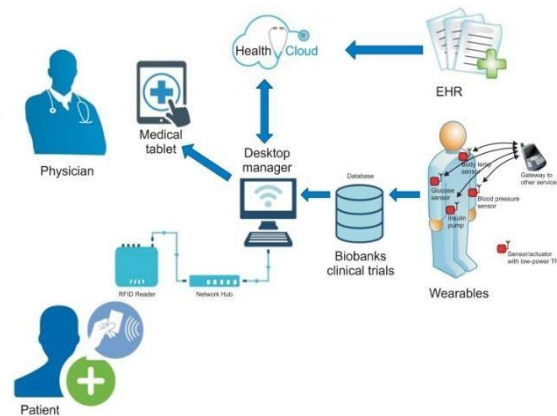


Figure : Working of Smart Healthcare

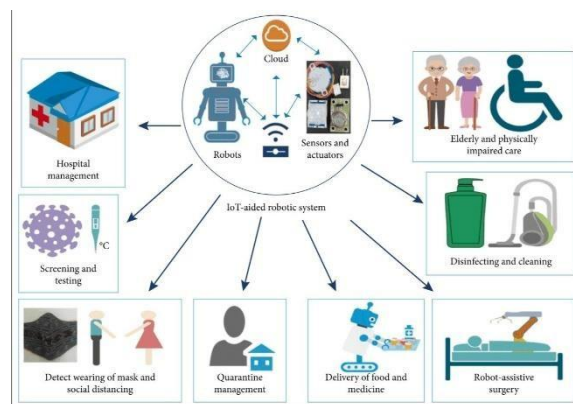


Figure : Smart Healthcare

Smart Agriculture and Water Management

Smart Agriculture (AgriTech) uses technologies like IoT, AI, drones, and data analytics to increase agricultural productivity, reduce waste, and make farming more sustainable. Important technologies in Smart Agriculture are IoT Sensors & Devices for Soil moisture, temperature & nutrient sensors and enable precision farming by only watering or fertilizing when needed. It also includes Drones & Satellite Imaging for monitor crop health & detect pests or diseases early and map large fields for better planning & irrigation. It also uses technologies like AI & ML for predicting optimal planting/harvesting times and analysing weather, yield forecasts & market trends. Automated Machinery & Robotics can also be used for autonomous tractors; seeders & harvesters and it can reduce labour costs and human error. Smart Greenhouses can also be used for controlled environments with automated lighting, heating & irrigation and real-time monitoring using mobile apps or cloud systems.

Blockchain can also be used in Agriculture for supply chain traceability & food safety and fair pricing & transparent transactions for farmers. Benefits of Smart Agriculture include higher yields with fewer resources, reduced environmental impact, real-time decision-making, less dependency on manual labour and enhanced food quality and traceability. Smart Water Management uses digital technologies to optimize water usage, improve quality, and reduce losses in supply networks and agriculture. The important features and technologies used are IoT-based Smart Meters for real-time water consumption tracking and detect leaks & unauthorized usage. It also includes technologies like AI & Predictive Analytics for forecast water demand and optimize water distribution & storage. Automated Irrigation Systems can also be used for delivering water based on soil moisture & weather conditions and reduce overwatering & conserve groundwater.

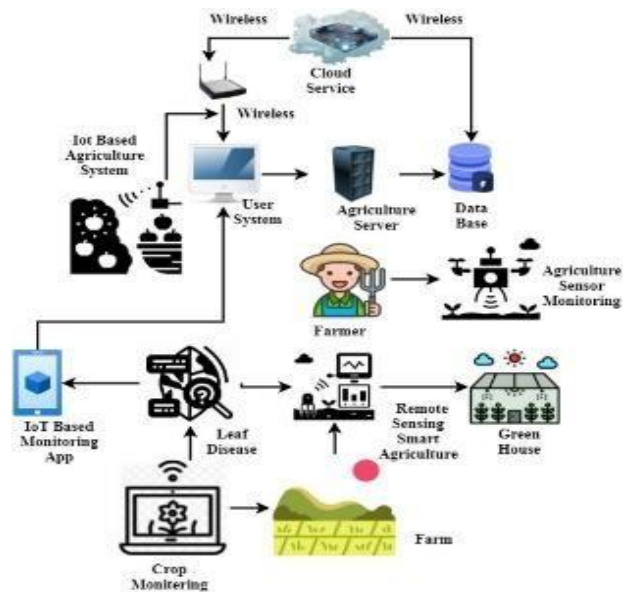


Figure : Working of Smart Agriculture

Water Quality Monitoring can also be done by using sensors detect contaminants like heavy metals or bacteria and ensure safe drinking water & agricultural use. Water can be saved by Rainwater Harvesting Systems which helps in integrated with sensors to measure collection & usage and it reduces dependency on groundwater. Sewage can also be made smarter by Smart Sewage and Wastewater Treatment which helps in real-time monitoring of treatment plants and efficient recycling and reuse of waste water.

Benefits of Smart Water Management are it helps in reducing water waste & leakage, better access to clean water, lower costs for utilities & consumers, enhanced resilience to droughts & climate change and finally for sustainable agriculture and urban water supply. The IoT has the capacity to strengthen and enhance the agriculture sector by using latest technologies in agricultural land. IoT can also help in controlling and preserving the quantity of vitamins found in agricultural products and regulate microclimate conditions in order to make the most of the production of vegetables and fruits and their quality. Furthermore, studying weather conditions allows forecasting of weather so that plants need to be watered or not thus controlling temperature and humidity levels to prevent fungus as well as other microbial contaminants. Different types of sensors

like Humidity sensor, Moisture sensor, Temperature sensor etc helps farmers to get the information about the humidity present in the soil, moisture of the soil and temperature of the environment. These sensors send data to the cloud through IoT technology which can be accessed by the farmers in order to get to know about these details. This also helps in monitoring the crop health and crop cycle. IoT also helps in providing the details of any plant disease by constant monitoring. Green house effect can also be maintained if required by use of all these technologies.

Livestock monitoring like tracking livestock, predicting health of the livestock etc can also be done using IoT technologies. By using GPS technology, livestock tracking can be done. Using temperature sensors helps in finding the

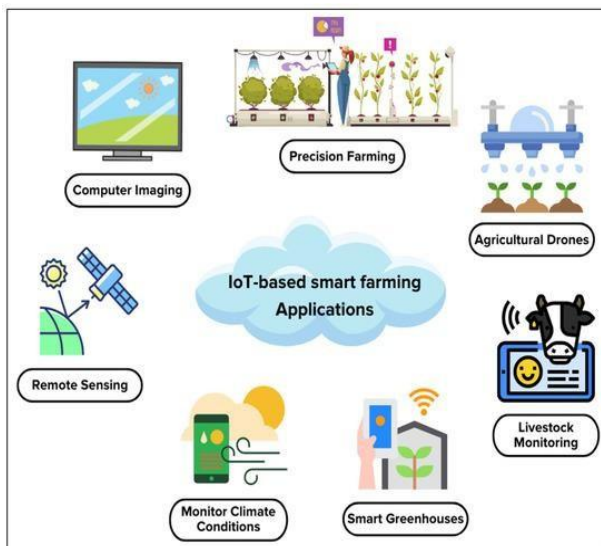


Figure : Uses of Smart Agriculture

temperature of livestock and if any discrepancy found, then medical help can be got. Precision farming is one where farming can be done based on several factors like environment, temperature, moisture etc. This helps in finding correct crop for the given environment and hence farmer can get maximum profit from the crops.

Retail and Logistics

Smart Retail uses digital technology to enhance the shopping experience, streamline operations, and

personalize marketing. Most important technologies used in Smart Retail are AI & ML for personalized recommendations (like Amazon, Netflix-style) and predictive analytics for customer behaviour & stock management. It also uses IoT & Smart Shelves for real-time inventory tracking and automated restocking alerts. AR/VR can also be used in shopping which helps in virtual fitting rooms and augmented reality for product visualization (e.g., IKEA Place app). Smart Retail can also be used in cashier-less stores by using RFID or camera-based tracking (e.g., Amazon Go) and walk-in, pick-up items, walk-out—automatic billing. This can also be used in chatbots & Virtual Assistants for 24/7 customer support and order tracking & FAQs of online shopping. It also uses mobile and contactless payments for QR code scanning, digital wallets (Apple Pay, Google Pay) and faster, safer checkout process. Smart Retail also uses Smart Mirrors & Digital Displays for showing the product details, colours, availability in real time and touchinteractive shopping experiences. Benefits of Smart Retail are it helps in enhanced customer experience & loyalty, reduced labour costs & human error, realtime inventory control and hyper-personalized marketing and promotions.

Smart Logistics applies digital tools to optimize supply chains, delivery routes, warehouse management, and fleet operations. Smart Logistics uses IoT and GPS Tracking for real-time shipment tracking and monitor conditions (temperature, humidity) for sensitive goods. It also uses AI & Predictive Analytics for forecast demand, optimize routes & delivery schedules and dynamic pricing based on traffic & fuel costs. Also, Robotics and Automation can be used for autonomous warehouse robots for picking, sorting, & packing (e.g., Amazon Robotics) and drones and autonomous delivery vehicles. It uses Blockchain for Supply Chain Transparency for immutable record of product origin, storage & delivery and prevents fraud & ensures authenticity (especially in pharma, luxury goods). Digital Twins of Warehouses helps in virtual models to simulate & optimize storage & logistics and test different layouts or delivery methods without disrupting operations. Smart Fleet Management helps in fuel efficiency monitoring and

predictive maintenance to reduce breakdowns. Benefits of Smart Logistics are faster & more reliable deliveries, lower operational costs, better supply chain visibility & control and enhanced sustainability (optimized routes = less fuel used). Executing the IoT in Smart Retail Management has many benefits like observing storage conditions throughout the supply chain, product tracking to enable trace ability purposes, payment processing depending on the location or activity period in public transport, theme parks, gyms, and others. IoT can be applied to various applications such as direction in the shop based on a preselected list, fast payment processes like automatically checking out with the aid of biometrics, detecting potential allergen products and controlling the rotation of products on shelves and warehouses in order to automate restocking procedures inside the retail house. The IoT elements mostly used in this setting consists of wireless sensor networks and radio frequency identification.

In retail, SAP (Systems Applications and Products) while in logistics it includes quality consignment conditions, item location, detecting storage incompatibility issues, fleet tracking among others. Other smart retail includes refrigerators fitted with LCD (Liquid Crystal Display) screens, enabling one to know what is available inside, what has over stayed and is almost expiring as well as what needs to be restocked. This information can also be linked to a system so that the product which is out of stock can be placed order automatically once it becomes out of stock or before it becomes out of stock.

CCTV can be used to monitor automatic robots which are used in Smart Retail House or Smart Warehouse. In Smart Retail each and everything can be automated so that human interference will be very less. Smart Retail will have automated robots which is used for fetching the products for which order has been placed. All the process from searching the product till delivering the product can be made automated by the help of robots.



Figure : Smart Retail

Smart Logistics helps in transferring one product from one point to another point. Smart logistics refers to the use of advanced technology and data analysis to optimize and streamline logistics operations. This includes the use of technologies such as artificial intelligence, blockchain, and the Internet of Things (IoT) to improve the efficiency and effectiveness of logistics systems. Smart logistics involves the integration of various technologies and systems to provide realtime visibility and control over logistics operations, enabling companies to make data-driven decisions and respond quickly to changing market conditions. The use of smart logistics can help companies to reduce costs, improve customer satisfaction, and increase their competitiveness in the market. Smart logistics involves the use of advanced data analytics and machine learning algorithms to analyse logistics data and identify patterns and trends. This enables companies to predict demand, optimize routes, and improve supply chain management. Smart logistics also involves the use of automation and robotics to improve the efficiency of logistics operations, such as warehouse management and order fulfilment. The use of smart logistics can help companies to improve their sustainability and reduce their environmental impact, by optimizing routes and reducing fuel consumption. Smart logistics is a key component of the digital transformation of logistics, and is expected to play a major role in shaping the future of the industry. The benefits of smart logistics include improved efficiency, reduced costs, and increased customer satisfaction.



Figure : Inside of Smart Retail House

Smart Environment

A Smart Environment uses advanced technologies like IoT, AI, big data, and remote sensing to monitor, manage, and improve the natural and urban ecosystem. The goal is to make cities and communities more sustainable, efficient, and resilient to environmental challenges like pollution, climate change, and resource depletion.

Smart Environment includes Air Quality Monitoring by using IoT sensors to track pollutants like CO₂, NO_x, PM2.5/PM10 in real time and data used to warn citizens, regulate traffic, or shut down polluting activities. Smart Environment includes Smart Waste Management for sensor-equipped bins detect when full & optimize collection routes and AI predicts waste generation trends. Smart Environment also includes concept called Energy Efficiency where smart grids for optimized electricity distribution, solar panels with IoT monitoring for performance & faults, smart meters track real-time usage to reduce waste and buildings use BMS (Building Management Systems) for lighting, heating, and cooling. It also includes Water Quality and Conservation by using IoT sensors detect contamination in lakes, rivers & pipes, leak detection systems minimize water loss in urban pipelines and smart irrigation in agriculture and parks based on soil moisture/weather. Smart Lighting Systems can also be part of Smart Environment by using streetlights with motion sensors dim or brighten based on traffic or pedestrians and reduce energy usage & light pollution. Climate Monitoring & Disaster Management can also be part of Smart Environment

by using AI + satellite data to predict natural disasters (floods, storms, wildfires), early warning systems integrated with city alerts and digital twins of cities used to simulate climate impact and mitigation strategies. It also consists of Green Mobility and Emissions Control by using smart traffic signals to reduce congestion and emissions, EV charging infrastructure tied to clean energy grids and bike-sharing & e-scooters linked to mobile apps.

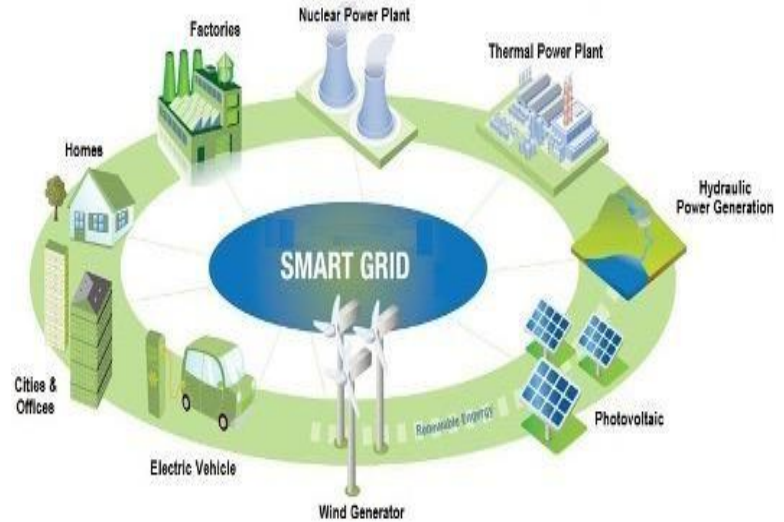


Figure : Smart Grid Technology

Benefits of Smart Environment Systems are improved public health through reduced pollution, better resource management & cost savings, realtime data for faster environmental decisions, enhanced disaster resilience & response and citizen engagement and transparency.

Technologies involved in creating Smart Environment are (i) IoT (Internet of Things) – Realtime environmental monitoring (ii) AI & Machine Learning – Pattern recognition and predictive analysis (iii) GIS & Remote Sensing – Environmental mapping and climate modelling (iv) Blockchain – Transparent carbon credit trading and recycling incentives.

A smart environment refers to the integration of technology into everyday settings to enhance functionality and user interaction. This includes smart homes, smart cities, and smart manufacturing, where systems are embedded in the physical

environment to create an interactive and responsive experience for users. Smart environments leverage technologies like artificial intelligence and the Internet of Things (IoT) to improve efficiency and data management, addressing challenges related to security and reliability.

The environment has a crucial role within all aspects of life from people to animals also birds and even plants are all affected by an unhealthy environment in one way or another. There have been numerous efforts to create a healthy environment by eliminating pollution and reducing wastage of resources but due to industries and

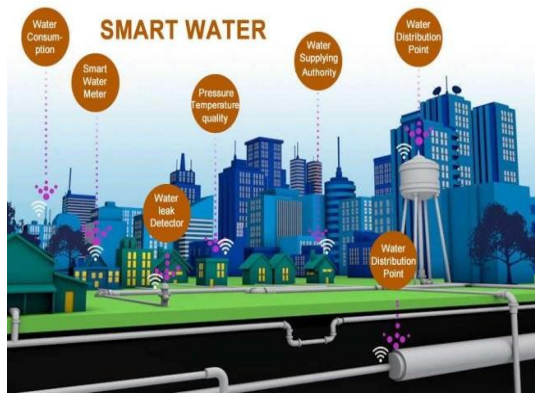


Figure : Smart Water Management

Ransportation we get lot of waste elements whichconsistently damage the environment. Hence, the environment requires smart and innovative ways to help in monitoring and managing waste in order to protect the environment. Smart environment strategies integration with IoT technology should be created for sensing, tracking and assessment of objects of the environment that offer potential benefits in achieving a sustainable life and a green world. The IoT technology allows observing and managing of air quality through data collection from remote sensors across cities and providing geographic coverage to accomplish better ways of managing traffic jams in major cities. Additionally, IoT technology can be applied in measuring water and energy usage.

In Smart Grid technology, efficient energy usage can be done. Here renewable sources of energy like

Wind energy, Solar energy etc can be used to generate energy. By using Smart Grid this energy can be distributed according to the usage of the people. In Smart Water Management, water consumption is calculated depending on the population of a particular area. Hence water is distributed accordingly to all the areas. In Smart Water Management, it is seen to that water is not wasted or there is no shortage of water to any area. In Smart Air Quality Management, the air quality is monitored in real-time so that pollution does not exceed the maximum limit. In this technology, several gases levels are tracked and monitored like Oxygen, Carbon Dioxide, Carbon Monoxide, Nitrogen etc. Gas sensors are used to track these gases from different air pollution sources like traffic, industries, residential areas, airports etc.



Figure : Smart Air Quality Management

III. CONCLUSION

The Internet of Things (IoT) is revolutionizing the way in which we interact with the world by enabling smarter homes, cities, industries, and healthcare systems. By connecting billions of devices & systems and generating real-time data, IoT enhances efficiency, reduces human intervention and supports more decision-making systems.

However, the rapid expansion of IoT also brings big challenges. Security and privacy concerns, data overload, lack of interoperability and high infrastructure costs remain major issues. Also, In Smart Air Quality Management, the air quality is monitored in real-time so that pollution does not exceed the maximum limit. In this technology,

several gases levels are tracked and monitored like Oxygen, Carbon Dioxide, Carbon Monoxide, Nitrogen etc. Gas sensors are used to track these gases from different air pollution sources like traffic, industries, residential areas, airports etc.

Regulatory frameworks often lag behind technological advancements hence creating uncertainty and risk. To fully realize the potential of IoT, it is essential to invest in robust cyber physical system, scalable and standardized platforms and good data governance. Collaboration between government, companies and communities will be critical to overcome these barriers and building a more connected, intelligent and secure digital future. Recent advancements in IoT have drawn the attention of researchers and developers worldwide. IoT developers and researchers are working together to extend the technology on large scale and to benefit the society to the maximum by also seeing into the security concerns. However, improvements are possible only if we consider the various issues and shortcomings in the present technical approaches. In this article, we presented several applications of IoT in different domains to develop an improved model. As IoT is not only providing services but also generating a huge amount of data. Hence, the importance of big data analytics should also be taken into consideration which can provide accurate decisions that could be utilized to develop an improved IoT system.

IV. FUTURE SCOPE

Current State of IoT includes the following

- Expanding Adoption.
- Enhanced Connectivity.
- Advanced Analytics and AI integration.
- Focus on Security & Privacy.
- Interoperability Challenges.
- Sustainability & Efficiency.

Technological Advancements in IoT includes

- 5G Connectivity.
- Edge Computing.
- Artificial Intelligence & Machine Learning.
- Advanced Sensors & Actuators.
- Blockchain Technology.

- Quantum Computing.
- Interoperability Standards.
- Low Power Wide Area Network (LPWAN).

Emerging Trends in IoT includes the following

- Expansion of Smart Cities.
- Increased Focus on Security & Privacy.
- Integration with AI & ML.
- Growth of Edge Computing.
- Increased Adoption of IoT in Healthcare.
- Advancements in Low Power & Long Range Networks.
- Quantum Computing and IoT.
- Development of Interoperability Standards.
- Sustainable and Green IoT Solutions.
- Enhanced User Experience through Voice and Gesture Control.

REFERENCES

1. Internet of Things (IoT): Definitions, Challenges and International Journal of Computer Applications (0975 – 8887), Volume 128 – No.1, October 2015.
2. Internet of things technology, research, and challenges: a survey by Amit Kumar Vishwakarma, Soni Chaurasia, Kamal Kumar, Yatindra Nath Singh & Renu Chaurasia, Springer Nature Link Volume 84, pages 8455–8490, (2025).
3. Internet of Things (IOT): Research Challenges and Future Applications by AbdelRahman H. Hussein, (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 10, No. 6, 2019.
4. Internet of Things (IoT) and Its Applications: A Survey Paper by Adarsh Kumar, Abhishek Guleria, Pankaj Verma, International Journal of Research in Engineering and Science (IJRES) ISSN (Online): 2320-9364, ISSN (Print): 2320-9356, Volume 10 Issue 11 || November 2022 || PP. 07-12.
5. Internet of Things (IoT) and its Applications: A Survey September 2020 International Journal of Computer Applications

- 175(21):975-8887 by Afrah Salman Dawood.
6. Applications of IoT: A Study in International Journal of Trend in Research & Development (IJTRD), ISSN : 2394-9333 by M Tirupathi Reddy & R Krishna Mohan.