The Analysis of Applications and Tools Used in Different IoT Technologies in Current and Future Worlds

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Abstract*: The instant evolution of the Internet of Things (IoT) has revolutionized various industries by interconnecting intelligent devices, enabling seamless data exchange, and driving innovation. This abstract delves into analyzing applications and tools employed within distinct IoT technologies in present and future contexts. The Internet of Things is the logical arrangement of physical objects surrounded by different software, sensors, and other technologies to link and exchange data or information with other systems over the Internet. The term IoT was 16 years old, but the idea of connected devices has been approximate since the past 70s. The idea was often called pervasive computing or embedded Internet. IoT was first time introduced by Kevin Ashton in 1999. Kevin Ashton is also considered the Inventor of IoT. Cisco Systems estimated that the IoT was invented between 2008-09. IoT applications use artificial intelligence and machine learning to add to the brightness of different devices. Most applications used in IoT are Self-driving cars, Smart Cities, Farming, Shops, Farming, Water Management, Wearable Technology, etc. Technological growth has helped develop efficient methods to solve many severe issues in real time. IoT has achieved a considerable focus due to its rapid processing and intelligence. In conclusion, this abstract underscores the pivotal role of IoT in modernizing industries and improving daily lives. By examining the current applications and tools and forecasting future trends, this analysis anticipates an IoT landscape empowered by advanced connectivity, intelligent algorithms, and decentralized processing architectures.*

Keywords: I*nformation and Communication Technology -ICT, ArtificialIntelligence -AI, Internet of Things-IoT, Machine Learning -ML*

I. SELF DRIVING CAR

II.

IoT technologies can improve the quality of the self-driving car in better understanding its environment, in addition to the sensors that are camera, radar, lidar, etc. Advanced AI algorithms process this data to make split-second driving decisions, enhancing road safety and efficiency. Cloud connectivity enables remote updates and data sharing, while edge computing accelerates decision-making. Despite progress, challenges such as regulatory hurdles and security concerns remain. As IoT evolves, self-driving cars are poised to reshape transportation, reducing accidents and congestion while presenting new possibilities for mobility-as-a-service and urban planning. These were the results of autopilot mode, a large-scale pilot project that breaks ground for a new generation self-driving car. Self-driving connected car is one of the most transformational technologies in the automotive industry. A self-driven vehicle can only be built with revolutionary digital technologies such as AI and ML. The addition of IoT ensures the car can drive safely under any road conditions and weather.

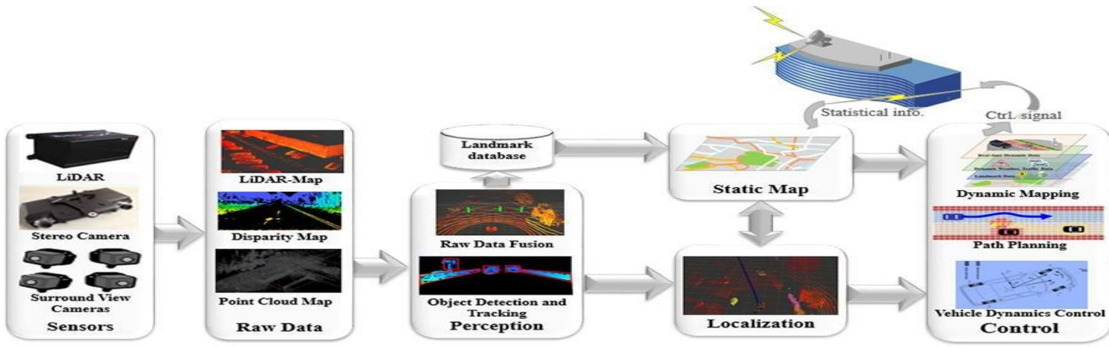

Figure 1.1 - Autonomous driving system application architecture

III. SMART CITY APPLICATIONS

IoT-enabled intelligent city use cases span multiple areas, such as contributing to a better environment and improving traffic to enhance public safety and optimization. The data from IoT sensors can help to make known patterns of how citizens use transport facilities in a particular city. Public transportation operators can use data to enhance the traveling experience and achieve safety and promptness. Public transport, whether car, buses, or trains, is at the heart of any smart city. This is primarily known in big cities with massive traffic jams. Intelligent public transport can streamline traffic and make commuters' lives much easier and safer. It is very suitable when the trains and buses are connected with a single IoT application, and you know exactly when the next service will arrive for better performance. IoT based smart cities allow citizens to save money on home security by giving them more control over their home security system. Smart-connected meters can send data directly to a public telecom network, providing reliable meter readings in different areas. Smart cities make maintenance and control of street lights more accessible and cost-effective. IoT & Machine Learning can be used to reduce city air pollution. This is possible by collecting data related to bright city pollution, like emissions from vehicles, pollution levels, weather, traffic levels, airflow, etc., using IoT applications in various sources and then calculating forecasts to see the trends so they can be controlled easily in intelligent cities. Innovative city solutions allow tracking different parameters for a healthy environment to maintain them optimally in town. For example, a municipality can arrange a network of sensors across the water grid to monitor the water quality index and connect them to a big data warehouse.

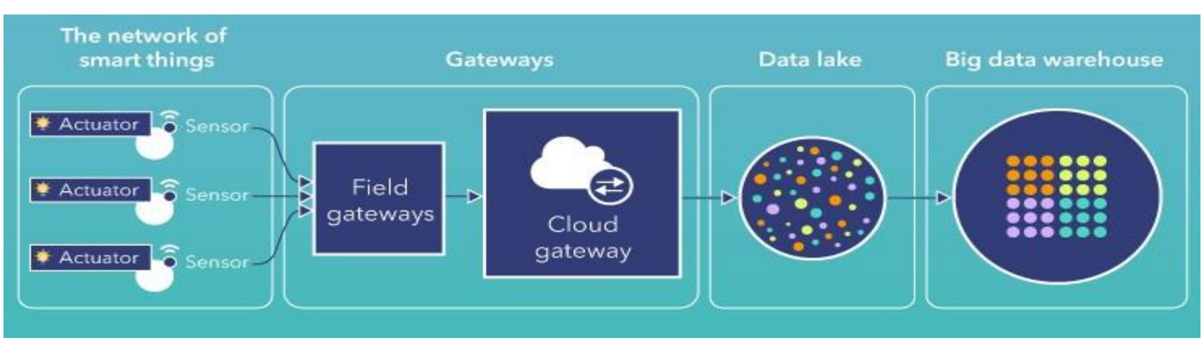

***Figure 2.1** – Smart City IoT-based Sensor Application*

IV. FARMING APPLICATIONS

Modern-day IoT sensors are now available for use in farming. These sensors are connected to the cloud through cellular or satellite networks. This system helps us to obtain live and accurate time system data analysis for making an effective decision in farming. The application of IoT has helped farmers in a lot of work, such as monitoring the different water levels in storage areas. This is done in real time, increasing the effectiveness of the whole farming process. One more thing made possible with the development of IoT technology is tracking seed growth in farming areas. Farmers can now track the utilization of resources and the time a seed takes to grow into a new plant. Smart farming is a capital-intensive and high technologyto increase food quality and progress. This is also called the application of ICT in Agriculture. Drone techniques are used daily in the agricultural sector to improve farming work. Ground-based and aerial-based drones are used in farming areas for crop health monitoring, pesticide spraying, irrigation, planting, and site analysis. The drones capture multispectral, thermal, and visual imagery during their flight at the above farming area. The significant benefits of using drones include crop health imaging, ease of use, saving time, and the potential to increase work. With strategy and planning based on real data collection and data processing, drone technology will give a high-technology revolution to the farming industry. Different kinds of sensors are used in an intelligent greenhouse that determines the environmental factors and assesses their suitability for plants in farming areas. Instant access is created by connecting the system to cloud computing with the help of different IoT tools and applications. This eliminates the need for constant manual searching of the farming work area. The cloud server manages the data processing and applies a control action inside the system; it's also used for future reference. Imaging plants and crop areas mainly involve using the sensor cameras placed in various corners of the farm to make images that go through digital image processing. Image processing combined with artificial intelligence and machine learning uses different photos from the database to compare with pictures of crops for concluding the crop size, the shape of the yield, the color of the crop, and growth, as a result, adjusting the quality factor of crop plants. Greenhouse farming is a tactic that helps enhance the yield of crops, fruits, plants, vegetables, etc. Greenhouses control the manual intervention or a proportional control process of farming, as manual intervention results in production energy loss and worker costs. An innovative greenhouse can be designed with the help of an IoT platform; this design smartly monitors and controls the environment, eliminating the need for manual involvement.

***Figure 3.1** – Use of IoT Devices in Farming*

V. WATER MANAGEMENT APPLICATIONS

Scientists know the water shortage will affect approximately 20% of the human population by 2025. United Nations reports indirectly control the rest of the planet's population, economies, and whole ecosystems. Innovative water systems based on the combination of IoT, Big Data, and Artificial Intelligence technologies can help prevent these predictions from happening and undo the damage of the irresponsible usage of water resources in different areas. Innovative water technology brings cleanness and improved control to the whole water supply system chain from start to end. It starts from a freshwater reservoir to wastewater collection and then recycling again for further use. This example inputs IoT devices for managing water systems and different software tools that help optimize water making, allocation, and utilization and enable intelligent water management practices. With the help of IoT sensors, contribute a substantially lower price point and with new sequence-powered networking solutions. Lower prices on technology solutions allow the utility to bestow more of its network. Therefore improving customer quality as well as falling costs in operations and maintenance.

Figure 4.1 *– Water Management*

VI. WEARABLE TECHNOLOGY

One of the most critical healthcare system applications today is wearable, based on IoT sensors and medical monitoring devices that patients can wear in particular human body areas. Smart wearable devices to be developed with the Internet of Things different sensor technologies. These healthcare wearables allow for remote monitoring of various health statistics.

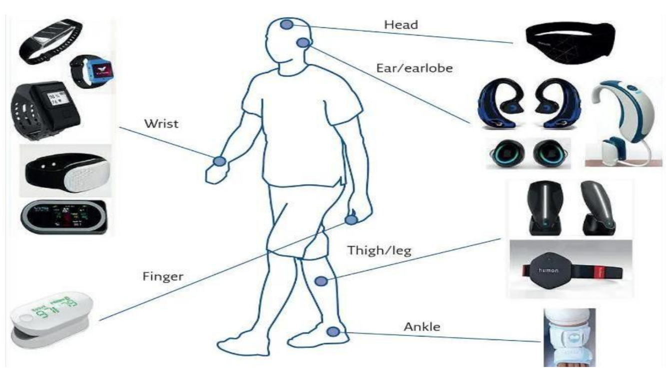

Figure 5.1 *–Wearable Devices*

The following are ongoing developments using IoT tools and applications:

a. **Blood Sensors -**Scientists and engineers from Brolis Sensor Technology are developing a noninvasive wearable sensor for testing blood elements such as glucose, ketones, lactate, urea, etc.
b. **Artificial Kidney -**With the advances in wearable technology, artificial kidneys have made it possible to transform patients' lives when kidney failures occur. The latest research from Arkansas University was one step nearer to artificial kidneys, a significant achievement of wearable technology.
c. **Sleeping Monitoring -** Wearable devices can measure and improve your sleeping style or duration. Wearable devicesmeasure sleep duration, heartbeat rate, breathing, humidity, and room temperature.
d. **Smart Contact Lenses -** One of the few success stories for wearable devices is about noninvasive intelligent contact lenses, whichautomatically record changes in your eye's dimensions.
e. **Asthma Monitoring -** Asthma Monitoring wearable technology can predict oncoming asthma attacks before thepatient wearing the device even notices the asthma symptoms in the human body.
f. **Wearable for Heart Attacks –** If someone suffers from irregular heartbeats, they can also opt to use implantable. The small battery devices are placed in the human body in the chest to monitor abnormal heartbeats. They also can regulate theheartbeat if the heart rate is slowed down; this is an excellent feature of this wearable device.
g. **Glucose Tracker -** The wearable devices for diabetes include unbroken glucose monitoring systems and automatedinsulin delivery systems in the human body.

Today, we live in a highly networked world where humans are connected to a vast reservoir of information and entertainment. About half of the global population now owns and uses a mobile device. In developed countries, most households areconnected to the Internet. Today, we use our smart devices for work, play, shopping, entertainment, knowledge exploration, and communication. It is predicted that by 2025, many systems will be connected to the Internet simultaneously.

YEAR	NUMBER OF CONNECTED DEVICES
1990	0.3 million
1999	90.0 million
2010	5.0 billion
2013	9.0 billion
2025	1.0 trillion

Figure 5.2 *– Connected Devices over the year*

The IoT, which implies connecting to all devices on a network via a wired or wireless connection, is changing the business world, creating opportunities for new proceed streams, more thoughtful relationships with customers, and greater efficiencies. Communication between mechanical and electronic devices is found in transportation companies, intelligent buildings, and instrumentation manufacturers.

Cloud Computing and Big Data are now somewhat developed and in a steady state of acceptance. They make it possible to analyze data from massive sensor arrays. They control the increasing demand for wireless sensors by developing new applications made willingly available for the IoT market. The combined rise of cloud, analytics, and social media creates fertile grounds for a thriving IoT background.

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