

Internet of Things in Scientific Research

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ABSTRACT:

The network of the physical devices which are connected to Internet for performing various actions like collection of data, analysis of the data, automation of the data is called Internet of Things (IOT). IOT mainly works based on the communications of the devices which are connected to the Internet. IOT plays a major role in the scientific research. There are various fields in which IOT is a mandatory tool for research. Some of them are Agriculture, Medicine, Weather forecast, Space Exploration and Smart Laboratories. Agriculture research takes the support of IOT for monitoring the soil behavior, weather patterns and atmospheric conditions using the devices like sensors. These data will be collected and further analyzed by the agricultural researchers for the betterment of the irrigation in that specific area. Medicine is also not an exception in using the IOT for the best results. In medical world, the human health conditions, blood pressure, glucose levels can be monitored using the IOT devices. These devices give the data very accurately. Space science is also taking the help of IOT in determining the complex solutions of the space exploration. Satellite communication is mainly based on the network which in turn is improvised by IOT devices. The health of astronauts can also be monitored using the IOT devices. The space weather can also be studied using this. Now a days, we have smart laboratories for betterment of the research. In these laboratories, the involvement of the humans will be very less. So, the IOT devices are playing a crucial role in managing these laboratories. The readings of the experiment, data of the results can be noted down very precisely using these IOT devices. Not only in the above fields, IOT is almost everywhere today. From Fashion to Technology, from tradition to literature, we can find the IOT involved. The future belongs entirely to IOT.

Keywords: network, physical devices, Space Exploration, Smart Laboratories, sensors, astronauts

1. INTRODUCTION:

IoT refers to internet of things, it is the interconnection of everyday objects to each other and connect them to the internet, enabling them to send, receive, and process thousands of bits of data and information. IoT is a connection of devices that contains sensors, software and other technologies which helps to connect and exchange information over internet. From smart homes which include smart technologies like automated lighting, climate control, art that changes on digital screens based on guest preferences etc. and wearable devices like smart watch, fitness trackers to industrial automation and smart cities, IoT is playing a crucial role in shaping the future of technology and society. There are many

complex chips and sensors are embedded around us. These devices range from household appliances and fitness trackers to cars and factory machines. The key components of an IoT system include sensors to collect data, connectivity using Bluetooth, cellular networks, data processing units, and interfaces for users to interact with the system. IoT plays a pivotal role in industries and infrastructure. In healthcare, IoT devices such as wearable health monitors and connected medical equipment enable real-time patient monitoring and remote care. Fields in which IoT is considered as mandatory are Agriculture, Medicine, Weather forecast, Space Exploration and Smart Laboratories etc. IoT is every where today. Rest of the sections in this paper discuss about use of IoT in different fields. Section II details the importance of IoT in scientific research. Section III deals with uses of IoT in Agriculture. Section IV explains how medicine is interconnected with IoT. Section V deals with Space science and its dependence on IoT. Section VI explains how smart laboratories use IoT for enhancements of experiments. Finally Section VII concludes the use and dependence of IoT in remaining fields.

2. SCIENTIFIC RESEARCH:

This section of paper explains how IoT is helpful in scientific research. Sensors helps in collecting real time data which can be used in performing experiments in fields like environmental science where continuous monitoring is mandatory. Researchers use IoT sensors to monitor temperature, humidity, air quality and soil conditions. Scientists track climate change, pollution and ecological changes more efficiently using these real time data than manual methods. Fields like molecular biology contain few experiments where accuracy is crucial element, precision instruments equipped with IoT technology are suitable in this field. IoT help in amplifying the research capabilities in fields like remote sensing, astronomy and space exploration by enabling data transmission over vast distances. With the help of IoT scientists can study and experiment the conditions in remote or hazardous areas without being physically present. IoT enabled devices like Buoys and underwater sensors are used by marine biologists to study ocean temperatures and marine life patterns. IoT based system monitor equipment on satellites and spacecrafts are used for providing feedback to researchers on earth. To reduce human errors and increase consistency, it is better to opt for automating experiments instead of performing it manually. Smart lab can be programmed to perform same task repeatedly and to maintain controlled environments. This helps scientists to focus on analysis and interpretation instead of performing same experiment multiple times. Using IoT devices helps in improving the accuracy, speed, and scale of data collection and analysis. As technology continues to evolve impact of IoT on research is expected to grow more significant.

3. AGRICULTURE:

Agriculture is considered to be India's one of the most important pillars. Climate change is considered as one of the most important boundaries that conventional farming faces. Consequences like reduced rainfalls, warm winds, overwhelming flooding, extreme hurricanes and other climatic shifts effect agriculture. IoT strategies are needed to increase productivity and reduce boundaries in agriculture sector. IoT helps farmers to access data and information regarding future trends and innovation.

Agriculture and food production practices which uses IoT, big data and advanced analytics is termed as Smart agriculture. IoT refers to integration s sensing, automation and analytics technology to the present agricultural processes. Following are few common IoT applications which are currently being used in smart agriculture.

1. Sensor-based systems for monitoring crops, soil, fields, animals, storage facilities, and just about anything else that has an impact on productivity.
2. Smart agricultural vehicles include drones, autonomous robots, and actuators.
3. Connected agricultural settings include smart greenhouses and hydroponics
4. Data analytics, visualization, and management systems.

To improve time efficiency, water conversation, crop monitoring, soil management, bug spray and pesticide safety IoT can be sued in this field. This helps in eliminating human labour, deconstructing agricultural methods and creating a difference in smart farming implementation. By using IoT in agriculture field farmers can increase yields and help control all cultivate operations.

4. MEDICINE:

There are many applications or services available now to provide patient satisfaction and better self-management. **An electrocardiogram** (ECG is a simple and effective test, which is used to record patient's heart's electrical activity. This is both efficient and cost-effective for long term care in cardiac patients. Through an android-based application, both doctors and patients can remotely access ECG information. **Blood pressure monitoring** can be used to measure blood pressure of patient. Hypertension is a serious health risk that can lead to heart attacks or strokes. Since blood pressure can fluctuate from moment to moment, continuous monitoring through medical sensors is essential for patients to stay informed about their health status. This apparatus contains sensing end, which includes wearable sensors that monitor blood pressure, along with an Inertial Measurement Unit (IMU) that correlates physical movements with the collected data. On the server end, the system handles network management, as well as processing and analysing the raw sensor data. To calibrate the blood pressure and IMU readings, features are extracted and organized into matric vectors, The system applies various regression algorithms such as K-Nearest Neighbours(KNN), Support Vector Machines (SVM), Bayesian methods, and Decision tress to predict future blood pressure values. The performance of these predictions is evaluated using Root Mean Square Error (RMSE).

5. SPACE SCIENCE:

IoT enhances the connectivity and performance of the Space equipment by establishing a proper communication in between the devices and creating a well maintained network among them. The Internet of Things (IoT) significantly contributes to space technology by improving automation and connectivity. **Continuous Monitoring:** IoT-integrated sensors in spacecraft and satellites transmit real-time data regarding their status, surrounding conditions, and mission updates. **Streamlined Communication:** IoT networks facilitate efficient interaction between space systems, ground stations, and global teams. **Efficient Data Handling:** IoT-driven platforms process and distribute extensive data

gathered from space assets, advancing research, enhancing disaster management efforts, and strengthening global connectivity.

6. SMART LABORATORIES:

Smart laboratories can be built using the IOT. This combines the automation and advanced technical equipment like sensors, robotics and data analysis. IOT connects the equipment, devices and system through a network which allows them to share the data and communicate among themselves. For example, sensors can monitor the environmental conditions like temperature, humidity etc. Smart devices will help to monitor the working conditions of the equipment and maintenance. Cloud based platforms will allow the devices to be properly maintained, data access and allow remote control. These environmental parameters are temperature and light intensity. By using this, system collects the necessary data, performs analysis and produces the appropriate results. Here what actually happens is the system uses the equipment only when it is necessary. In the remaining time, the equipment will be idle for reduction of power consumption and effective utilization of resources. This reference also depicts how a smart laboratory is developed using Raspberry Pi. In this laboratory they have used PIR sensor for motion detection, DHT11 for temperature detection and TSL2561 for luminosity detection. Here if the temperature of these sensors is crossing the threshold value, then the fans in the laboratory will be switched on automatically to reduce the temperature.

7. CONCLUSION:

IOT has wide range of advantages in many fields. As discussed above, IOT is a process which continuously strives for the enhancement and betterment of the existing technologies. As the main functionality behind the IOT is communication of devices, this helps reducing the time between functioning of one device and another device.

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