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A NOVEL ANALYSIS OF MACHINE LEARNING WITH HEALTHCARE TECHNOLOGIES USING IOT

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Abstract: The Internet of Things (IoT) is a modern-day technology that combines a variety of computing technologies, objects, animals, and humans. The items in the IoT framework communicate with one another and are given unique numbers to identify them. The identifying system establishes network connectivity and functions without the use of a centralized system. Sensor network advancements have enabled automation in a variety of fields, and the integration of soft computing technologies into the IoT system has enabled effective decision-making. The items in the IoT system act intelligently and carry out intelligent actions. Through connected devices, IoT-based technology improves people's daily lives and makes living things context-aware. The data collected from sensors will be processed using computational methods, resulting in accurate forecasts. Recent applications and soft computing algorithms are discussed in this article. Recent applications and soft computing algorithms are reviewed.

Keywords: Deep learning, Machine learning, IoT, Intelligent of object, healthcare, and automation, soft cyborg Techniques.

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1. Introduction

The essence of IoT is based on the perception of a large number of interconnected devices that exchange data within the framework of IoT [1]. It determines the functionality of networked devices, as well as their interaction with other devices and users, over the network's architecture. The Internet of Things (IoT) allows for seamless integration of objects all around the world. In today's society technological advancements have made IoT devices vital and integrated into the human daily experience[2,3].

Every device in the Internet of Things is connected to other devices in the network, which communicates, transmits, retrieves data, and intelligently triggers actions. IoT technology has lowered staff requirements in a variety of industries and has the potential to improve competency in manufacturing, transportation, smart education, and new technologies [4, 5]. Manufacturing, new industries, automation, cloud computing, cyber-security, artificial intelligence, and machine learning all benefit from the advancement of IoT. Adoption is one of the most difficult aspects of IoT integration. IoT has been described and portrayed in a variety of ways by many researchers, companies, and authors [5].

IoT obtains its full potential support by utilizing the central role of an intelligent device that employs a variety of sensors and actuators. The context of the atmospheric state can be perceived by objects that rely on the IoT system. The network's ability to process the service and interact with the rest of the world is improved as a result of the data collected. The IoT paradigm connects the entire world in order to achieve a pleasant and secure real-time scenario. The Internet of Things has had a significant impact on a variety of fields, including disaster management [6] and healthcare [7].

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Numerous IoT products, such as fitness shoe tracking systems, wearable bands for health monitoring, smart metres, RFID-enabled smart devices, real-time monitoring equipment, and other smart gadgets implanted with IoT technology. In addition, IoT applications combined with smartphone technology aid in the tracking of persons and the generation of essential warnings [8]. The biological sensor collects physiological data from humans and uses computational algorithms to process the information. The necessary actions are made based on the sensory information that has been processed [9].

The IoT's robustness has made it simple and quick to collect real-time sensor data from a variety of sources over a lengthy period of time. The physiological data, as well as atmospheric data, is gathered, and the data is processed by computational algorithms, which then provide the state of each individual user. There are a variety of sensors available for capturing physiological indications such as oxygen, pulse rate, heart rate, blood glucose level, and blood pressure [10, 11].

The sensors can precisely measure, store, analyze, and monitor each individual user's status. IoT techniques that are both reliable and inventive help to complete activities in less time and with more advantage. IoT has an ever-increasing and limitless potential, which has a major impact on society and influences daily life styles, corporate tactics, and industrial output. The effective application of IoT technology [15] is made possible by effective machine learning [12], deep learning [13], and optimization approaches [14].

The rest of the paper is laid out as follows: Section 2 discusses accessible bio sensors and their relevance in today's environment; Section 3 discusses applications and recent trends in IoT; Section 4 discusses machine learning-based data analysis; and Section 5 concludes the article.

2. Types of Biosensors and Applications

Biosensors are devices made up of physicochemical and biological elements that are used to observe biological scenarios. To identify the analyze and generate determined signals, a biosensor is used. One of the capable technologies established for analyzing and observing the state in a variety of industries is biosensor-based application. Several bio-sensing-related devices have been developed during the last decade to address the challenges faced by a variety of applications, and they will produce accurate findings.

The biological sensor collects biological signals, which are then converted into electronic signals. Due to the complexity of the electrical equipment that is directly associated with the biological framework, this transition is a difficult assignment. Biosensors have a wide range of applications in environmental monitoring, quality control in the food industry, marine industry, diagnostics in clinics, and other sectors where accurate and reliable studies are required.

The biosensors are used to detect glucose levels and identify pregnancies. When compared to traditional methodologies, biosensor-based applications provide increased stability and accuracy. Recent advancements in fluorescence spectroscopy, materials, nanotechnology, and biology have increased the potential for multi-marker, sensitive detection of a variety of diseases with a single device [16]. The following are some of the applications and how they are used:

Observing the context in the food processing business, evaluating the authenticity of food, safety and quality measurement, fermentation processes, and observing the context.

Bio-sensing technology for long-term food preservation.

In the medical field and in smart hospitals, biosensors are used.

Fluorescent biosensors for protein function prediction.

Bio defense applications for safety assurance, as well as biosensors in plant biology for crop monitoring.

3. IoT Innovation using Real Time World

Smart wearables collect data and analyse it, and in some cases, smart decisions are made based on the processed sensor data. The needed answer is sent to the user based on the decision made throughout the processing. Iot-enabled wearable devices are called smart gadgets, and they can be worn as external accessories that are embedded in garments, clothing, affixed to the skin, tattooed, or implanted into the body. These wearable devices link to the internet in order to collect, send, and receive data that can then be used to make smart decisions. Wearables make up a substantial part of the Internet of Things, and their applications are evolving from simple to specialist. Wear-sense technology is used in smart wearables, and it may interact with a wide range of devices, including computing technologies, smart gadgets, and communication paradigms. Since of the mobility of animals and humans, smart wearables have become increasingly important because they can acquire and send data via the internet, providing high support in making smart judgments. Wearables can help to speed up and improve the application's performance.

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Smart wearables have the potential to improve the quality of life, as well as safety and productivity. Wearable technology has become more popular as mobile networks have been more power efficient, electronic device sizes have shrunk, and sensors have become smaller. Wearable devices have made remarkable progress in recent years, and they have been used for a variety of applications. Wearables include wristbands, smart watches, headsets, eyewear, body straps, ear buds, smart accessories, and hand and foot worn gadgets, to name a few. This technology is also used in the gaming and robotics industries. However, the most significant life-changing use of wearable technology is found in medical use cases and continuous health monitoring. Table 1 explains the applications and the relevant inference.

Table1. Classification of Different IoT Sensors

Application Type	Sensor	Parameter Sensed	Node Process	Mobile App	Wearable	Connectivity	Reference
Rehabilitation	sEMG	Surface electromyography	Yes	No	Armband	BLE	[17]
	Ultra sound, IMU, RFID and Load Cell	Force, Orientation and Distance	No	Yes	Walker	Bluetooth and Wi-Fi	[18]
	Flex, Accelerometer and gyroscope	Orientation, Deflection and Acceleration	No	No	Hand and Leg	Wi-Fi	[19]
	Camera	Eye blinks and Face image	No	Yes	Face	Wi-Fi	[20]
Monitoring	Temperature and ECG	Heart rate	No	Yes	Wristband	Bluetooth	[21]
	SFH 7051	Heart rate	No	No	Wristband	Wi-Fi	[22]
	Passive breathing airflow temperature change	Respiratory	No	No	Headband	Back Scattering	[23]
	WHMIS inductive sensor and ECG	Heart rate	Yes	No	Chest, Leg and Hand	2G GPRS	[24]
	Capacitive	Respiratory	Yes	Yes	Chest	Bluetooth	[25]
	Piezoelectric or Vibration	Respiratory	Yes	No	Headband	Impulse radio and ultra wideband transmitter	[26]
	IC mounted on tablet shaped ingestible	Temperature	No	No	Finger	Coupling based on magnetic	[27]
	LM35	Temperature	No	No	Smart vest	Wi-Fi	[28]
	Pulseoximetry	Blood Oxygen	Yes	No	Bracelet	GSM or GPRS	[29]
	Piezoelectric	Blood Pressure	Yes	Yes	Cuff	Wi-Fi	[30]
	Gyroscope, audio and accelerometer	Mental Wellbeing	Yes	Yes	Wristband	Bluetooth	[31]
	Near infrared radiation	Blood Glucose	No	Yes	Finger	Wi-Fi	[32]

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4. Data Analytics process in Machine Learning and AI

In AI's perception, accumulated sensor data is kept in the system, and the data is used to complete the full task, which is to follow the precise instructions in the sensor data. Algorithms, on the other hand, are thought to be designed to do a certain purpose in the context of Machine Learning. In other words, a machine learning system will learn the state of a location and act accordingly.

In Machine Learning predicts new outcomes based on programming and a large amount of data. Straight decision-making commands are not permitted in this system, which allows the machine to understand the nature of the data before making any decisions. Figure 1 shows a diagram of machine learning with AI data.

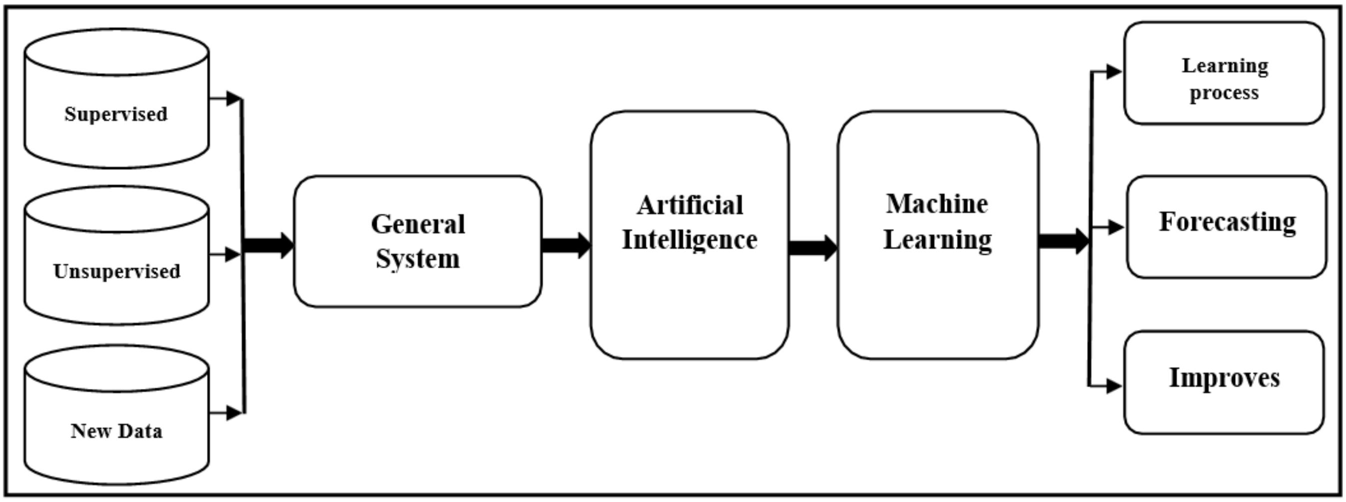

Figure 1. Performance Analysis of Machine Learning System with AI

The data is inspected by machine learning algorithms to find trends and construct a model, which is then merged into the system to estimate the required future values. Data analysis, the creation of an ML model, and the execution of a decision are the three processes in the machine learning process, as shown in Figure 2. The input data is used for learning in the first step, and the appropriate model is created. The generated ML model is used to make judgments in the following phase.

Several existing applications, such as alpha go, Google's Deep Mind, and self-driving cars, are built on machine learning algorithms. Machine learning and AI are interchangeable terms, albeit machine learning is a subset of AI. For example, AI identifies the evolution of future stock exchange with the use of patterns in previous stock data, and machine learning gathers previous data while forecasting is carried out based on the circumstance. AI has revealed the exponential progression and regeneration that is owing to significant breakthroughs in machine learning over the last decade. Machine learning is divided into three categories: supervised learning, unsupervised learning, and reinforcement learning.

Supervised learning

The basic goal of supervised learning is to figure out what function is required to link the data to the proper labels. A new model is created based on the findings, and it is applied to the same new data. Every photograph on Facebook is given a unique label value by Facebook. The algorithm is used to recognise the relevant people in the snapshot, and automatic identification for new data is started.

Unsupervised learning

Instead of labelling, AI offers data that is categorised in this unsupervised learning. The categorised data is reviewed in order to uncover the required hidden patterns. New clusters are created

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based on the data representation, and these clusters are then categorised. Google uses unsupervised learning to segment clients in order to serve them relevant advertisements based on their most recent searches.

Reinforcement learning

The nature of the data is used to generate models in both supervised and unsupervised learning. When the data is changed to a new configuration and the examination process is completed, a new model is created. Reinforcement learning used a continuous learning process to create a model depending on the feedback it received. The reinforcement-based model is iteratively developed and can be taught and progressed indefinitely. Table 2 summarises the application of machine learning techniques in IoT use cases.

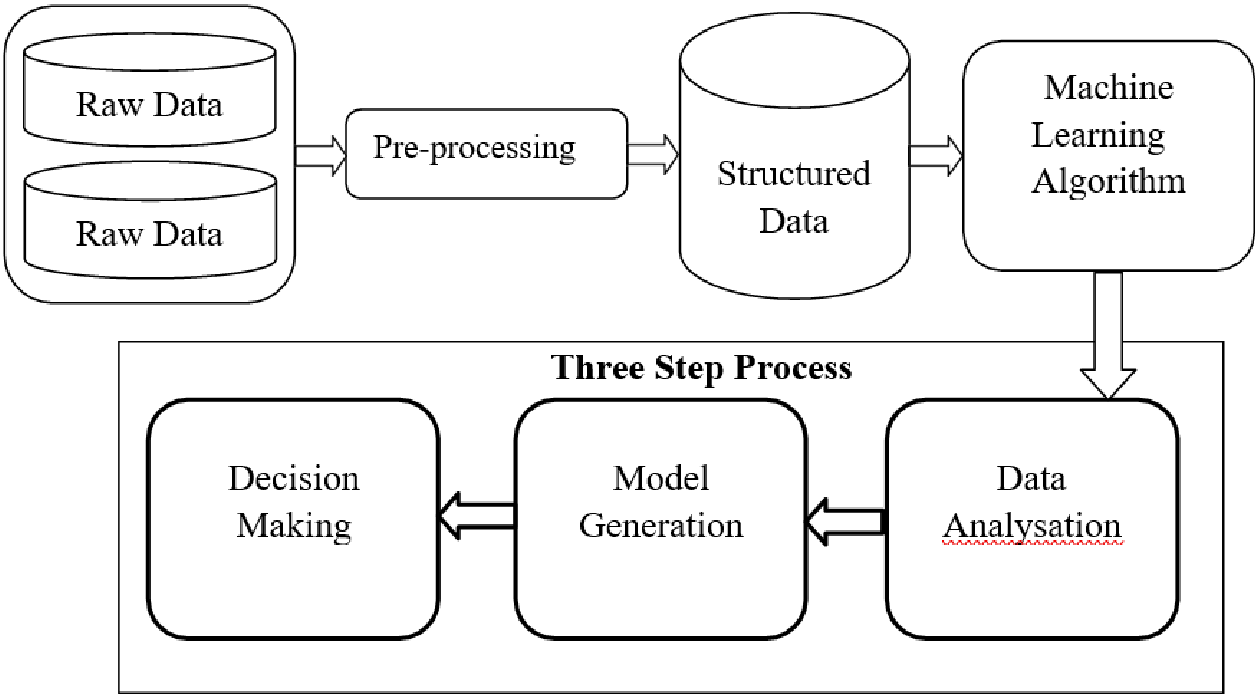

Figure 2. Major Three Step process of Machine Learning Algorithm

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Table 2. Summarization of Machine Learning techniques in the incorporation into the use case of Internet of Things

Machine Learning technique	Use Cases	Optimized Metrics	Reference
Classification	Smart Traffic	Forecasting of traffic and Data abbreviation is increased	[33, 34]
Identification of Anomaly	Smart Environment and Traffic	Identification of anomalies in power dataset, Forecasting of traffic and Data abbreviation is increased	[33, 34, 35]
Clustering	Smart Health and Traffic	Forecasting of traffic and Data abbreviation is increased	[33, 34, 36]
Linear Regression	Usage of Energy, analysis of market and economics	Forecasting by real-time and quantity of data is reduced	[37, 38]
Support Vector Regression	Smart Weather Forecasting	Forecasting	[39]
Support Vector Machine	All use cases	Data classification and forecasting by real-time	[40, 37]
Regression Tree and Classification	Smart Citizens	Forecasting by real-time and travel patter identification of passengers	[37, 41]
Naïve Bayes	Smart Citizens and Agriculture	Travel patter identification of passengers, food safety and calculating the count of the nodes	[42, 41, 43]
K-Nearest Neighbor	Smart Citizens	Travel patter identification of passengers and learned metric efficiency	[41, 44]
Density based Clustering	Smart Citizens	Travel patter identification of passengers, data labeling and detection of fraud	[40, 45, 41]
K-Means	Air Control, Smart Citizen, Smart City, Smart Traffic, and Smart Home	Travel patter identification of passengers, small dataset analysation, datastream analysation, predicting the consumption of energy, detection of fraud and outlier	[46, 45, 47, 48, 41, 49]
Principal Component Analysis	Public place monitoring	Detection of fault	[50]
Feed Forward Neural Network	Smart Health	Energy consumption minimization, element states are forecasted, redundancy of the data and information is rectified	[51, 43, 38]
One Class Support Vector Machines	Smart Human Activity Control	Detection of fraud and emerging anomalies in the data	[45, 54]
Canonical Correlation Analysis	Public place monitoring	Detection of fault	[50]

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5. Conclusion

The Internet of Things (IoT) is a rapidly evolving technology that combines a variety of computing technologies, objects, animals, and humans. The introduction of the Internet of Things (IoT) simplified and simplified the work. Inside the IoT system, devices function intelligently and make decisions based on the situation. IoT is widely used in a variety of applications, and it has yielded positive outcomes. The data collected from sensors will be processed using computational methods, resulting in accurate forecasts. Recent applications and soft computing algorithms are discussed in this article. Aside from that, there are numerous .In this article, IoT applications are also covered. The data collected from sensor applications is analyzed using an effective machine learning approach, with the sensor data making the important decisions.

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