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# Exploring Machine Learning Techniques for IoT Applications in Smart Healthcare Systems

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**ABSTRACT:** The use of digital technology, often known as digitalization, is highly prevalent in modern applications. Internet of Things (IoT) needs to be the necessity for the future deployments to embrace predictive analysis, remote sensing and automation. IoT devices are combined embedded technology with the sensor devices and actuators with the internet. To make the modern healthcare system “Smart” the medical devices need to have the integration of pervasive computing and IoT along with. Thus it can be possible to make the Smart Health Care System (SHS) to provide improved and affective medical treatment with timely, automatic and smart clinical services [2]. Now-a-days the healthcare system service is not restricted to patient only, rather the SHS is able to detect and prevent critical medical conditions automatically by monitoring different signs of the patients. By its method, artificial intelligence (AI) creates a path for the IoT to become efficient and intelligent. IoT has shown itself as performing an important part in the healthcare system for the quick automation process. Mostly due to the involvement of cloud in the scenario huge volume of data is generated related to healthcare, and this values in accurate predictions of the disease and necessities by implementing the technology of machine learning (ML) and Deep Learning (DL) models that helps in enhancing the functionality in complex applications[1]. Apart from all these also some risk factors lies in using these technologies which we have discussed throughout the chapter.

**KEYWORDS:** Machine Learning, Deep Learning, Internet of Things, Convolution neural network, Recurrent Neural Network

## I. INTRODUCTION

Over the past few years, the healthcare technology community has shown tremendous excitement and interest in the Internet of Things (IoT). With its vast potential, IoT opens up numerous opportunities to enhance the practical importance of the healthcare domain. Modern medical technology includes several sensors and gadgets that can link through a variety of networks, giving access to vital data regarding patients' illnesses. When we understand the symptoms, we may use this knowledge to predict illness and recovery keep track of patients from a distance, and generally improve the diagnosis and treatment process by adding automation and portability. Analysis utilising ML algorithms has shown to be crucial for IoT because of the enormous amount of data that these devices create in real-time and their complicated nature. These algorithms enable us to derive meaningful inferences and extract important information from the collected data. ML models can achieve high levels of accuracy when trained in the right environment, but this is typically easier said than done.

## II. MACHINE LEARNING (ML)

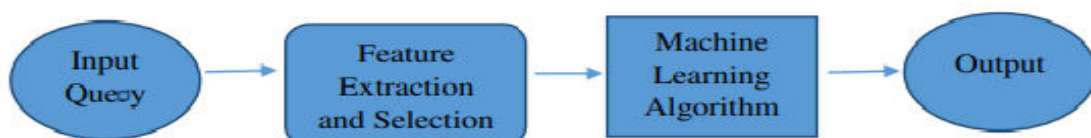


Figure 1:Flow of ML

Both supervised learning and unsupervised learning are key components of machine learning (ML). Data monitoring is part of it. The query which is given like as a input to the feature extraction, which extracts all the features of the machine learning algorithms, including association, clustering, and classification to predict and diagnose. After making a forecast, output is produced in the form of a prediction based on the model's preferences. The use of ML-based systems has many benefits. Large amounts of data, often known as training data, can be used to train them. When compared to manual efforts, these systems are more efficient since they can execute repetitive tasks, in which human errors are removed. Physicians can be assisted by the technology. The technology can learn information about medical science from the textbooks, journals, and clinical practices, because it utilizes these to consult and provide adequate patient care. This is very difficult for humans. Existing ML methods still lack the inferences that a human mind is capable of making. The integration of ML with IoT devices makes it simpler to monitor, manage, and analyse medical records. Furthermore, ML algorithms have the ability to process huge amounts of biological data. This also identifies specific patterns and mutations linked to a variety of diseases, which can speed up the development of innovative therapies.

### III. DEEP LEARNING

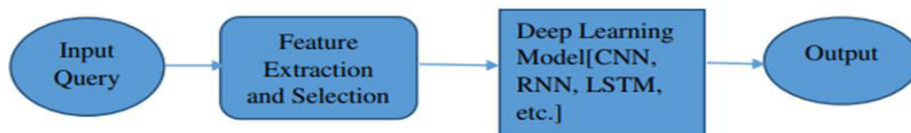


Figure 2:Flow of DL

During the model's training phase, when computing resources are powerful, training takes more time. It is a significant difficulty in DL. It became possible to evaluate and handle complex problems and data without utilising conventional ways thanks to the rapid development of extremely powerful hardware resources (like GPUs) and efficient training models. Therefore, the introduction of DL is necessary in the field of AI to process the data and approach. Like regular ML, DL can be divided into two categories: i) Unsupervised Learning (model is trained using unlabeled data); ii) Supervised Learning (model is trained using labelled data)[4]. It is primarily designed to recognise and detect text, handwriting, pictures, sound signals network etc. Various DL model is deployed in the process of recognition and detection [i.e., MNN(multilayer neural network), LSTM(Long Short-Term Memory), CNN(Convolution Neural Network) and RNN(Recurrent Neural Network) etc.

### IV. ROLL OF DL,ML,AI IN IOT

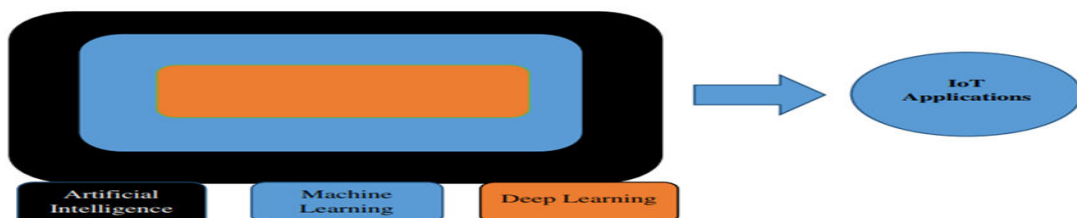


Figure 3: Role of AI, ML, DL in IOT application

Applications for AI, ML, and DL in IoT are rapidly developing and expanding. IoT is a new trend that is employed in practically all applications, including healthcare (monitoring, disease analysis)[3], education, home applications[6], industries, and prediction (traffic, driving), as shown in Figure 3. Therefore, in this study, we concentrate on providing a thorough overview of how AI, ML, and DL are utilised in IoT applications in terms of processing and functioning to handle all real-time, day-to-day applications.



V. SMART HEALTHCARE

Technology and equipment (sensors, actuators) used in "smart healthcare" are those that give patients as a whole better diagnostic tools and better treatments and also it may gather data from installed sensors, store and process it automatically, and then transfer it via the Internet to distant medical servers.

VI. INFLUENCE OF ML IN IOT

IoT framework may be made even too much effective and efficient for society by using the traditional machine learning and meta-heuristics combination (as illustrated in Fig. 4). For example, it is possible to reduce traffic with smart traffic management

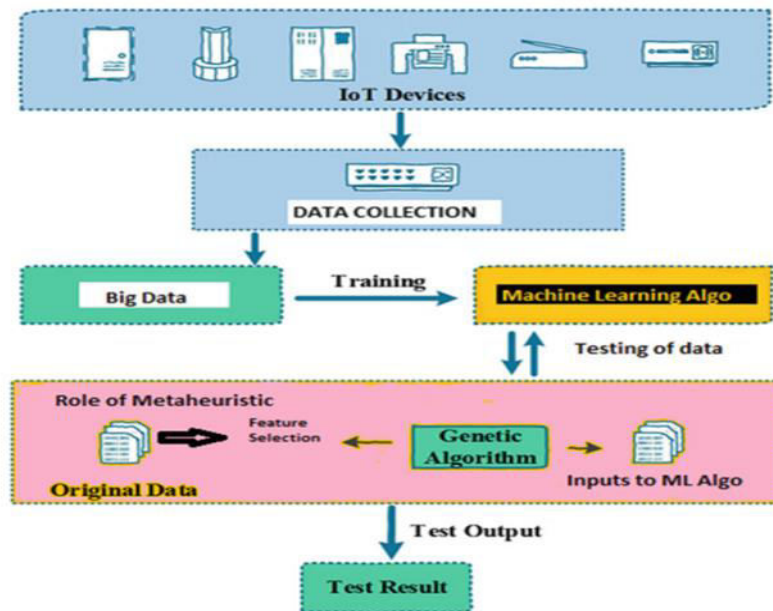


Figure 4: Influence of ML on IoT

VII. LITERATURE REVIEW

Outline of the papers		
References	Modality	Findings
Bharadwaj, Hemantha Krishna, et al. "A Review on the Role of Machine Learning in Enabling IoT Based Healthcare Applications." <i>IEEE Access</i> 9 (2021): 38859-38890.	Linear Regression, Logistic Regression, SVM	An extremely accurate technique is produced by the efficient feature selection and parameter optimisation.
Rajan Jeyaraj, Pandia, and Edward Rajan Samuel Nadar. "Smart-monitor: patient monitoring system for IoT-based healthcare system using deep learning." <i>IETE Journal of Research</i> (2019): 1-8.	Deep Learning algorithms	Increase classification data accuracy
Subasi, Abdulhamit, et al. "Human activity recognition using machine learning methods in a smart healthcare environment." <i>Innovation in Health Informatics</i> . Academic Press, 2020. 123-144.	SVM	F accuracy rate is 90%

<p>Newaz, AKM Iqtidar, et al. "Healthguard: A machine learning-based security framework for smart healthcare systems." <i>2019 Sixth International Conference on Social Networks Analysis, Management and Security (SNAMS)</i>. IEEE, 2019.</p>	<p>KNN, RF</p>	<p>Security aspect in using IoT in ML can achieve 91% .</p>
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### VIII. CONCLUSION

Although smart healthcare systems improve patient diagnosis and care, they also create a number of security issues. The main applications and platforms that AI and IoT are advised for a more dependable, precise, and predictive healthcare system. In the discussed architectures, there is a general trend towards moving information processing to the edge. This may be a result of the resources for edge and fog devices being more widely available. Even yet, the cloud is still mostly used for the primary inferencing. IoT-based healthcare applications made possible by machine learning require specialised hardware, including Tensor processing units. Although there are so many unique approaches are being put forth, certain systems cannot realistically be deployed since the current healthcare industry[9] cannot grant false negatives and requires great accuracy. Additionally, patients' privacy and security issues affect their faith in such applications and desire to participate. However, with suggestions and implementation of applications that ensure high data privacy and security, it is anticipated that in the near future, patient awareness and trust for these applications will grow.

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