

## E marketing strategy in health care using IoT and Machine Learning

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### ABSTRACT

The Internet of Things (IoT) and Machine Learning (ML) have broad applications in a variety of fields, with healthcare system being one of them. The fast growth and enhancement of the web has resulted in the demise of traditional patient care methods and the replacement of them with electronic healthcare systems. The Internet of Things (IoT) technologies provides healthcare professionals and patients with the most up-to-date medical equipment ecosystem possible. Things connected to the Internet of Things (IoT) and machine learning are useful in a variety of categories, ranging from long-distance monitoring of the contemporary environment to mechanical automation. It is impossible to overstate the significance of digital marketing in the delivery of healthcare services. Doctors and medical experts now have the chance to promote their services to people all over the globe via digital marketing, rather than only in their immediate area. Digital marketing enables health professionals to demonstrate their competence to potential patients, to expand their professional area, and to improve the image of the healthcare industry. Furthermore, medical treatment applications have shown a strong desire in Internet of Items (IoT) things since they are less expensive, easier to comprehend, and enhance the personal happiness of patients. In the development of a wearable and implanted healthcare body network connection, a number of difficulties were encountered, which are detailed in this research. It is presented in this paper that an overall view of IoT and Machine Learning focused on healthcare is given in specifics, and then a list of applications that are used in health care that incorporate Machine Learning (ML) and the Internet of Things (IoT) is provided, along with all problems and difficulties that may arise by using this application or handset for healthcare system, as well as their significant application.

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### 1. Introduction

The Internet of Things (IoT) & Machine Learning (ML) have created additional worldwide perspective of information development in order to construct a strong worldwide framework by connecting a range of physical & digital 'things' with new interfaces and sensors. The Internet of Things (IoT) was originally proposed to utilize Radio-Frequency Identification (RFID) innovation techniques to integrate especially known items (things) and their

electronic representations in a web framework. Later, the phrase "Internet of Things" came into use in a variety of sensors, includes controllers, GPS applications, and smartphones, to encompass a wide range of things [1]. The continual merging of these sensors in a Web stage, as well as the supporting facilities, has generated a number of exploratory issues, ranging from frameworks engineering to deep learning and applications. Nowadays, IoT technology has made rapid strides in multi-disciplinary study in a wide range of scientific and mechanical controls, especially in medical services [2] (see Figs. 1 and 2).

As a result, the effect of IoT technologies and machine learning growth in healthcare currently is a movement from hospital to

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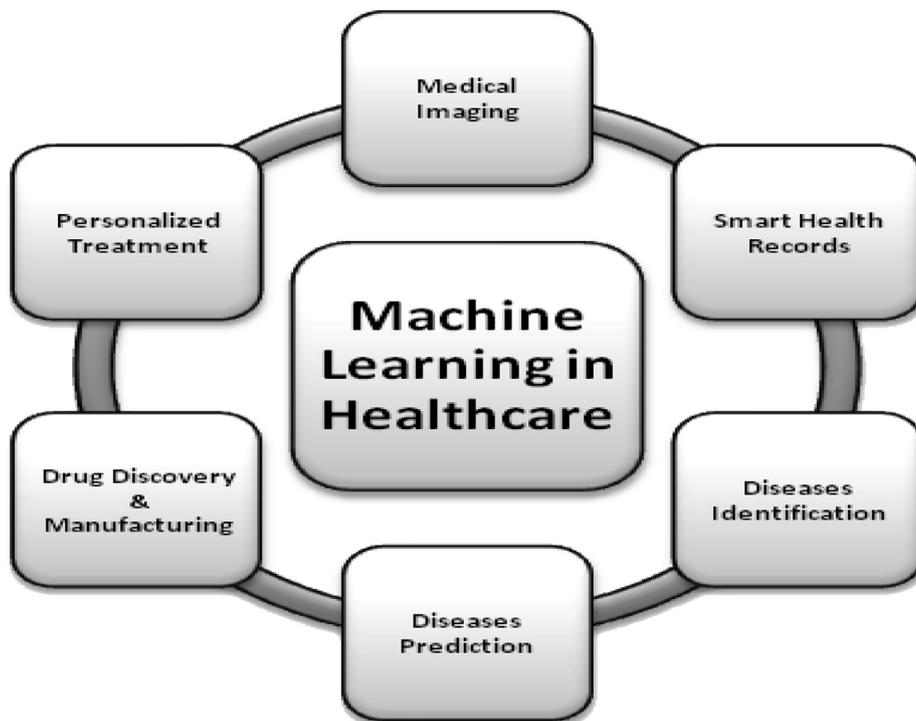


Fig 1. Machine Learning in Healthcare.

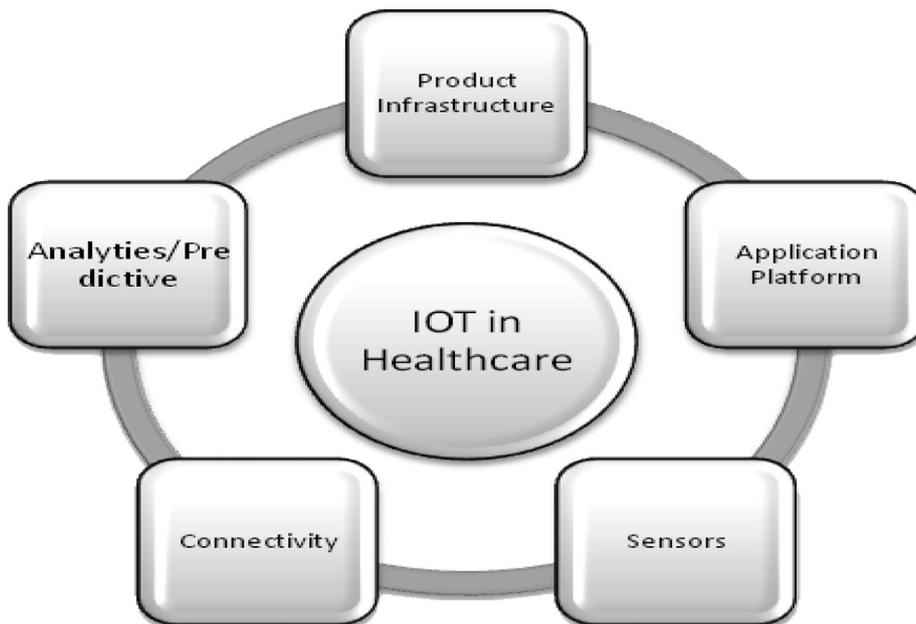


Fig 2. IOT in Healthcare.

home with frequent medical testing and other medical services, and the ease of use of medical equipment for physicians and patients. It would simplify health treatment for patients, especially in moments of emergency. Additionally, hospitals may decrease the load by shifting viable and fundamental tasks to home settings. One of the primary benefits is that patients may avoid hospital costs whenever they went to visit the doctor. Another barrier is the existing network structure’s inability to support real critical applications utilizing IoT, thus Software - defined Networking is

anticipated to be a viable network architecture for such applications [3].

As a result, in the near future, a trendy technology in the health sector must be launched in order to create sophisticated medical advances and utilize it to conveniently monitor patients from other locations. The physical conditions of the patient, as well as explanations of the patient’s medication, are all part of the patient’s surveillance. With the usage of IoT, the number of sensing devices, labeling, and so on has increased significantly. Handheld sensors may be used with IoT to get greater information. Using an android

application, a pharmaceutical container may be utilized to improve the device's usability [4]. At the appropriate time, the adoption of different technologies such as IoT will have a major impact in any sector, particularly the medical profession. People's living circumstances would improve as a result of IoT. The use of interactive tools would result in a number of beneficial advances in digital data management solutions, system operations, and controlled communications. There are many wearables' devices and applications that must be deployed in different areas of healthcare. This study will use IoT and machine learning to determine the most essential aspects of customized healthcare system. Furthermore, provide some past research on IoT and ML for customized healthcare system, as well as highlight associated problems and limitations [5].

## 2. Brief introduction to Machine learning in healthcare

Machine learning is also regarded to be a cutting-edge technology for change in our contemporary world. Machine learning is the development of systems which can understand from the information they are fed. The accessibility of huge amounts of information and low-cost computing resources motivates the advancement of machine learning [6]. Machine learning is derived from past findings made by the machine. Procedures are created and tested. Machine learning, to put it simply, is the process of deriving knowledge from outcomes. The goal of mastery learning is to identify trends in information and to utilize the structures that have been learnt to make meaningful conclusions. Machine learning may be seen as a wide interdisciplinary method that incorporates statistics, algebra, data gathering, and data analysis, among other disciplines. Machine learning (ML) is a basic technique in artificial intelligence that pulls knowledge from information via training. Due to the fact that it is located at the base of the tree and contains many branches and sub-branches [7].

## 3. Healthcare Machine learning applications

Machine learning technologies, when used in conjunction with algorithms procedures, have the ability to enhance the precision of treatment regimens and medical outcomes [8]. Deep learning, for instance, is a kind of sophisticated machine learning that replicates the way the human brain works and is rapidly being utilized in radiology & medical imaging applications. Deep learning applications can identify, characterize, and evaluate malignant tumors in pictures by using neural network models that can understand from information without the need for guidance [9]. Quicker response speeds & cloud infrastructures enable machine learning programmed to identify abnormalities in pictures that are beyond the human eye's ability to perceive, thus assisting in the diagnosis and treatment of illness. Future advances in machine learning in healthcare will continue to have a significant impact on the sector. Some instances of machine learning technology in the healthcare field are shown below.

### 3.1. Identification and diagnosis of a disease

By analysing millions of medical record & additional patient information, machine learning techniques may identify patterns linked with illnesses and health problems. Recent advances in machine learning have the potential to improve healthcare accessibility in poor nations while also innovating cancer detection and therapy. AI in healthcare applications can now detect skin cancer more effectively than a panel dermatologist. The paper mentions other advantages of machine learning, such as faster and

more efficient examinations and a smaller time period for training an algorithms vs a person [10].

### 3.2. Surgery using Robots

Machine learning may enhance the precision of surgical robotic instruments by using real-time data, knowledge from prior successful operations, and historical health records. Minimize manual mistake, assistance during the more complicated operations, and less intrusive operations are among the advantages. Robots, for instance, may accurately perform procedures to clear blood arteries and even assist in spine surgery. Surgical robots may also provide more than just automated support to surgeons by helping them design workloads and execute surgical operations [11].

### 3.3. Medicine that is customized to the individual

Health information from different sources, such as EHRs and genetic information, may aid in the advancement of customized treatment. A health practitioner does not have sufficient time in a day to examine all of the data required to offer patients with precision medicine [12]. But, machine learning's capacity to use large information and predictive analytics opens up possibilities for researchers to create customized therapies for illnesses such as cancer & anxiety.

### 3.4. Tasks for robotic patient support

Robots can immediately assist enhance patient skills. Examples include assisting paraplegic people with regaining walking capacity and completing duties such as checking blood pressure and reminding patients of medications. Robots may also be used to offer companion to ill or elderly people.

### 3.5. Diagnosis of medical imaging

CT scans, MRIs, or other imaging techniques provide such elevated details that even expert radiologists & pathologists struggle to sort through the megapixels and information.

Machine learning has shown to be useful in assisting healthcare practitioners in increasing their efficiency & accuracy. Machine learning in medical imaging is often used to diagnose cardiovascular problems, diagnose musculoskeletal injuries, as well as screening for cancer [13].

## 4. Brief introduction to IOT in the healthcare system

Intense fitness & wellbeing awareness are the primary elements that draw the attention of health care customers to Internet of Things gadgets. This alleviates the anxiety associated with frequent hospital visits and costly physicians. Healthcare insurance consumers in the medical industry are seeing a fast increase in total demand as a result of the industry's recent refurbishment and expansion. In order to meet the increasing impacts of numerous healthcare consumers, business practices must be changed [15]. According to the most current research, consumers will soon be ready to obtain use of the Internet of Things, which will represent a significant advance in the usage of IoT technologies, such as wearables and implanted devices. The primary strength was the ability to provide individualized patient care, which included information collection and judgement.

Doctors are able to play a major part in maintaining the health of their patients because of the diagnostics data gathered via electronic clinical record books, visualization tools, displays, and smartphones, all of which help them make better decisions.

Towards the end of the twentieth century, IoT-based personalized health assessment will become considerably more prevalent. People who work in the health field would be more acquainted with effective infection control methods, and intelligent technology would assist them. Additionally, keep them secure. Important choices were made quickly to enhance the condition of the individual based on the information collected by linked devices. The issue for the healthcare industry is not the development of new goods or technologies, although greater attention should be given to e-health customers, as has been suggested. Using linked equipment to improve human health and the related climate via the smart use of information, such equipment can monitor the quality of the air in the natural atmosphere and doctors may check patients remotely is becoming more common.

Apart from that, there are three important characteristics that confirm whether or not the sensor is functional in the IoT healthcare system.

- The technology must recognize and collect environmental information including such precipitation, temperatures, lighting, and so on. Blood oxygen rates/monitoring, blood glucose control, ECG surveillance, and so on are all aspects of the heartbeat.
- In the transfer of obtained information to the centralized controller, the system may operate independently. Portion of the sample, with another system, or if any conditions are fulfilled.
- Before the procedure is terminated, this must be in a dormant state. For instance, if the individuals' hypertension and blood glucose levels are critical, along with alert data, must be triggered for immediate response.

The patient's irregular pulse pattern sends a communication to the doctor, who encourages the individual to continue taking the prescribed medicine as soon as possible. Recompile of the implanted device or skin area for dosage sugar levels, temperature, and adrenaline surveillance. This kind of monitoring not only improves the patients' health but also enables the expert to offer advice until the situation gets critical. Sensors in individuals with cardiac issues aid in the regulation of the heart's rate [16]. Medical equipment such as CTs and MRIs may also be used to continuously analyse oxygen levels. Radio-Frequency Identification [RFID] technology, monitoring devices, and analysis phase for optimum process flow prevention and monitoring have all been used to effectively monitor patient activities. In today's society, behavioural and environmental factors such as smoking, noise, and so on have a significant impact on human well-being.

### 5. How could digital marketing assist and encourage the healthcare sector using ML and IOT

Table 1 shows how digital marketing strategies may encourage healthcare via ML and IOT in a variety of ways. Let us look at the main causes behind this [17].

### 6. What are the benefits of healthcare digital marketing in ML and IOT

Digital marketing is not just a profitable approach for gaining new patients, but it is also a cost-effective method of promoting healthcare services in ML and IoT [18].

Let's look at some of the main benefits in Table 2.

### 7. ML and IOT in healthcare issues and challenges

Customized electronic medical therapy is not subject to the same difficulties and limitations as traditional healthcare treat-

**Table 1**  
How digital marketing strategies may encourage healthcare via ML and IOT in a variety of ways.

<b>The popularity of smartphones has grown.</b>	Several individuals, especially youngsters, increasingly seek data through their mobile phones. Everything from the most recent sports result to the most recent supplements in city. Using this current trend may be a game changer for digital healthcare marketing.
<b>Email marketing is a better deal.</b>	For connecting out to individuals, healthcare facilities may take use of the many advantages of email marketing.
<b>The majority of potential patients place a premium on repute.</b>	Healthcare services may use digital technologies to demonstrate expertise, repute, and dependability. When giving a company a try, patients research its reputation.
<b>Revolution is inevitable, &amp; digital healthcare marketing is no exception.</b>	People are starting to become involved in the digital marketing healthcare sector in order to link with the appropriate hospital and healthcare professional. Digital marketing is perhaps the most adaptable, dependable, and simple-to-implement approach for healthcare marketing.
<b>Everything is tracked by digital measurements.</b>	Digital analytics are strong because they can monitor any information, trend, or event that will help you run a decent project in the lengthy period.

**Table 2**  
Main Benefits of Healthcare Digital Marketing in ML and IOT.

<b>Targeting by location</b>	Digital marketing allows healthcare facilities to focus a particular population, such as age, gender, region, and much more. It will be simpler to relate to patients this manner, and patients will have a much more personalized experience.
<b>Improved Search Engine Transparency</b>	One out of every twenty Google searches is for health services information, such as health and wellbeing recommendations, illness symptoms, nutrition advice, and so on. That's great news. You may improve your chances of appearing on Google's first site by using efficient machine learning, the internet of things, and search engine optimization.
<b>Patient visits have risen.</b>	With digital marketing, you have accessibility to a variety of professional tools and technologies that can help you grow your strategy for maximum effectiveness and generate high-quality prospects to your healthcare business.
<b>Decisions based on information</b>	Chasing down patient records may be tough with conventional marketing, but it is a snap with digital marketing in ml and IoT. Furthermore, digital marketing makes it simpler to make an educated, information choice.

ments. It takes into consideration the basic issues of IoT and machine learning. This illustrates how an older person may benefit from a Personalized Healthcare (PH) system that is based on a sensor. The sensor collects a variety of information, such as pulse rate, environmental supplement, blood glucose, and hypertension, among other things. [19] The information is analysed in order for the involved parties to make use of it. In addition, the database makes use of certain computer training algorithms to analyses the information collected in order to identify the potential risk for individuals, enhance their quality of life, and suggest possible solutions on the premise of this information. The most important issues and difficulties surrounding IoT and machine learning in PH treatments.

### 7.1. The sensors generate a tremendous amount of information

A difficult task is obtaining the right data from the information that has been collected. This project entails the development of an algorithms that can detect similarities in information gathered from wearable sensors and then extract those patterns. Machine learning & sampling techniques are two areas where there are significant research opportunities. Given the fact that computer-intensive operations are now being kept back, the effectiveness of Real Responsiveness is an area that has to be improved. Concern has been expressed about optimizing the volume of information transfer.

### 7.2. Privatisation of computing

Each computing would become more inefficient as the number of Internet of Things-enabled devices increased. Sharing technique development and parallel computing of the assignment stage are required to be completed successfully, respectively. This topic has a considerable amount of research significance in the fields of computing methods and resource requirements methods. The Internet of Things (IoT) and device security [14].

### 7.3. End point applications energy consumption

The battery utilized in Internet of Things gadgets is one of the most significant problems, and charging these devices may not be as easy as it might be. In most cases, this problem is resolved by discharging to a back-end processor and saving storage capacity that would normally have been adequate for internal processing.

## 8. Conclusion

Healthcare is among the quickest growing industries in current marketplace; increasing individuals need care, and it is getting more expensive. Government spending on health care has reached an all-time high, but the critical need for better patient-physician relationships has become clear. Cloud computing and artificial learning technologies, for example, have the potential to offer both patients and suppliers with better care and lower prices. In this topic we briefly discussed about the machine learning in healthcare and its application after that we examine the brief introduction to it in the healthcare system after that we discussing about the how could digitally marketing assist and encourage the healthcare sector using ml and it after that we discussing about the benefits of health - care digital marketing in ml and lot and last in this study we discuss about the ML and IoT in healthcare Issues and challenges.

### CRedit authorship contribution statement

**Tamal Mondal:** Investigation, Writing – original draft. **Sujay Mugaloremutt Jayadeva:** Conceptualization, Writing – review & editing, Supervision. **Rojalin Pani:** Formal analysis, Data curation. **Muthukumar Subramanian:** Conceptualization. **P. Ashokkumar:**

Writing – review & editing. **B.k. Sumana:** Formal analysis, Data curation.

### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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