A ROADMAP TO SMART HEALTHCARE AUTOMATION SENSORS AND TECHNOLOGIES

Abstract

Life is pleasant simpler and easier in practically every way as automation technology advances. A wireless automation system that uses the internet to monitor health, functionality and features from anywhere in the world is known as a smart health automation. With the use of sophisticated data retrieval and classification models, disease may potentially be studied or even unusual health problems could be predicted. Employing Internet of Things (IoT) technology to observe human daily life, which includes activities, physiological characteristics, stress, and vital signs. There are numerous uses for the Internet of Things (IoT), including in manufacturing, healthcare, agriculture, and other industries. Wearable technology has become widely used in the health monitoring system in recent years, which has encouraged the development of the Internet of Medical Things (IoMT). The IoMT can significantly lower the mortality rate by aiding in early disease detection. Because of their various applications to users, smart healthcare systems have gained importance. It can be monitored and controlled remotely. This chapter includes a roadmap on IoT, automation technology and various recommendations into smart healthcare automation system sensors.

Keywords: Internet of Things (IoT), Smart health montoring, Smart Technologies, Smart Applications, Sensors, healthcare, machine learning (ML), deep learning (DL).

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I. INTRODUCTION

The Internet of Things (IoT) is receiving attention due to the anticipated improvements in medical services [6], disease prediction and prevention, and cost reduction it can bring about, while the rise in patients with chronic diseases is being attributed to bad eating habits. Such chronic diseases demand a continual monitoring procedure and management through healthcare and disease management services. In order to assist life care based on living pattern analysis, patients need progress monitoring information connected to their health status. The quality of life can be improved by using IoT-based healthcare services, which include an infinite stream of data generation. One of the top paradigms is deep learning (DL), which offers precise pattern prediction and categorization services [10].

In recent years, remote monitoring systems have improved in effectiveness [3]. Analyze the disease indications, cross-check patient records to registered patterns, and track and synthesis patient records [7]. IoT offers quick and efficient patient monitoring technologies that are crucial for remote patient monitoring when there is no medical staff present. Today, combining non-intrusive equipment and computer vision and deep learning algorithms, it offers a supporting monitoring system (IoT-based sensors or cameras). Monitoring is more effective when problems of patients are identified based on visual signals, such as body posture, movements, and facial expressions. Researchers have recently deployed expensive specialist hardware, pressure mattresses, and sensors for patient monitoring systems. The survey indicates that ML techniques have been used to analyses patient data that is increasingly complex. These techniques allow for data classification, patient anomaly detection, and prediction-making. The process of determining a disease or identifying a specific disease is classification. On many levels, the Internet of Things is being regulated to play a crucial role in the transformation of digital health care. The primary challenge facing the healthcare sector is offering high-quality care at a reasonable price. Results are insufficient when a poor clinical diagnosis and treatment are used [3]. Numerous patient records, multiple disease diagnoses, resource management, etc. are all part of the healthcare industry. Several patient records, multiple disease diagnoses, resource management, etc. are all part of the healthcare industry. The importance of remote health monitoring systems has increased as a result of the Internet of Things' (IoT) pervasive development and medical industry application. IoT refers to the network of numerous physical things that continuously monitors physical events. As technology advances and consumer demand for comfort and accessibility rises, funding initiatives are being developed at a faster rate. In order to fulfil specific medical requirements, patients must look for care in other cities or go to hospitals in other countries.

The Internet-of-Things (IoT) in the healthcare sector has recently gained popularity and has been identified as a promising feature to advance the more affordable existing technology.
The sub-categories of IoT include computers with sensors, microcontrollers, and transceivers that are linked together to transmit data and give users access to precise information. IoT can be used in the healthcare sector in a variety of ways, including disease detection as a preventative measure, disease monitoring as a self-healing strategy, and disease treatment as a cure. Wearable technology has been created to assist patients in receiving the most appropriate care. Smart gadgets that can be worn with external are IoT-based wearable.

II. ADVANTAGES AND DISADVANTAGES OF DIFFERENT WEARABLE BIOSENSORS

Sl. No.	Wearable biosensors	Advantages	Challenges
1	Epidermal-based sensors	• Eliminate the use of pointless needles • Reasonable Price. • Noninvasive bodily fluids are resistant.	• Skin-related issues are caused. • Don't offer lasting firmness. • Requires a new sample • Young-adult studies on accuracy and dependability.
2	Tear-based sensors	• Less intrusive • frequently monitors biomarkers • Simple to use, and portable	According to the enzymatic reaction: • Lacks replication Requires frequent sanitation, and is uncomfortable for the user.
3	Exercise-based sensors	• Real-time sensor analysis. • Non-intrusive evaluations	• Sample volume restrictions • Incapability to monitor blood sugar levels in regular life without activity
4	Saliva-based sensors	• Very Handy. • Sensitive. • Compatible. • Simple to manage.	• The results are affected by fluid viscosity. • Demands appropriate washing and is difficult to keep clean.
5	Iontophoresis-based sensors	They are flexible, gentle on the skin, and simple to use.	• Cannot be made smaller. • User-independent • Uunable to offer long-term stability.
6	Microfluidic-based sensors	• Miniaturized. • detection of limit is low • Easy development.	• Possibilities of receiving misleading results • Inability to correctly identify target molecules at lower concentrations, such as ng/mL.

In the case of Wireless systems, it can be used for automation systems. Due to the advancement in technologies such as Wi-Fi, cloud networks in nowadays, everywhere we use wireless systems than before. The wireless network has more advantageous and easily accessible compared to the wired network. To allow automation as well as local and remote control, these devices such as Sensors, displays, connectors, appliances, and devices connected together. Smart automation technology must mature, and can be accomplished by defining, evaluating, and enforcing a broad variety of factors, both technical and non-technological. For example, the outline of wireless smart health systems is shown in Figure 1
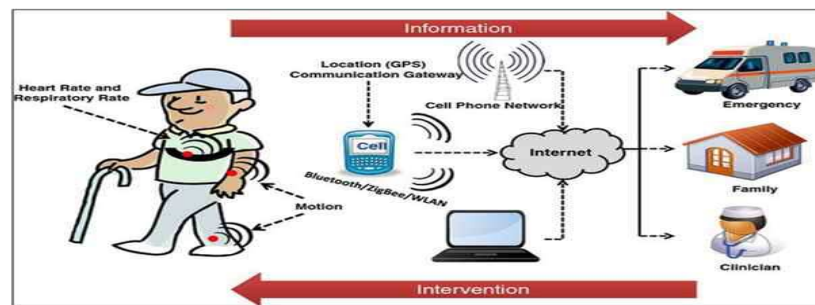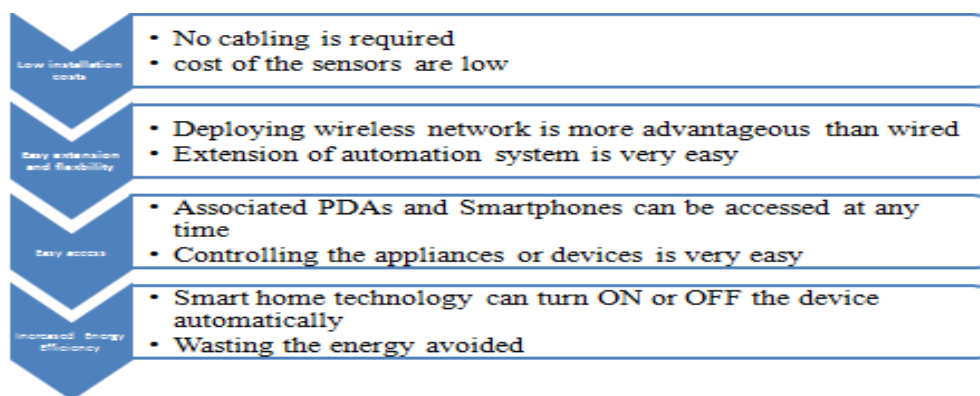
Figure 1: Wireless Smart Monitoring system

III. PROS OF WIRELESS SMART AUTOMATION SYSTEM

1. **Related works:** The authors of [6] provided an overview of a heart disease monitoring system, which can capture and transmit the patient's physical parameters to a remote healthcare facility center in real time through IoT technology. In human body, the heart is the most essential organ. Thus, heart disease is a major health problem .In the clinical industry, heart disease prediction is a most important and challenging issue and is depended on the observation of several symptoms which includes chest pain, chest congestion, blood pressure, shortness of breath, and cold sweats etc. To assist diagnosis and to predict heart disease, IoT sensor values are taken as input. Ten years ago, after a thorough physical and clinical examination, diseases could only be diagnosed. Now, using a smart-watch we can identify the health abnormalities.

2. **Part of IoT and AI in health care industry:** IoT applications must be used to treat a variety of illnesses in diverse medical settings, according to a compelling consideration model [10]. Incorporating IoT into healthcare organizations provides health care providers with crucial information that helps them identify the causes and symptoms of infections while also approving therapy. Devices as wearable's, such as wellness bands, and other remotely connected technologies, such as pulse and pulse checking sleeves, glucometers, etc., are utilized as IoT for patients, allowing for individualized care.

   These devices are particularly adjusted to remember carbohydrate content, practice checks, configurations, different types of pulses, and more. IoT has changed individuals, especially elderly patients, by enabling the ongoing monitoring of medical problems and difficulties. One drawback of this is that it mostly affects persons who live

alone and those who live with their family. When an individual's daily tasks are disturbed or alter, a ready system notifies worried family members and healthcare providers. IoT for Doctors - By using wearables and other IoT-enabled home monitoring equipment, doctors may monitor their patients' wellness even more efficiently. With this the doctors can follow patients' observance to therapy plans or any necessity for guaranteed clinical consideration. Medical care experts are empowered by the IoT to be more focused with the patients more precisely. Information gathered from IoT gadgets can contribute doctors with differentiating the best treatment measure for patients recover at the normal results. IoT for Hospitals – other than patients' health, there are number of different categories where IoT devices are useful in medical industry. Clinical gear like wheelchairs, defibrillators, nebulizers, oxygen siphons and other observing hardware are made with the utilization of the named sensors of IoT gadgets.

An algorithm should provide helpful insights, accurately predict future occurrences, and efficiently manage the network and resources under all constraints. To do value prediction, category prediction, feature extraction, or structured discovery, we must optimize our procedures.

Sensors, screening and mechanism are requisite to make health-care cities smarter [9]. These sensors' feedback values help healthcare suppliers conduct observing and control through automation. Healthcare suppliers can make quick choices that yields positive results.

The face of healthcare has been changed by the IoTs, AI and computing technology (Sharma, 2019). In devices like smartwatches, sensors have been implanted in the body or worn on the body's surface.

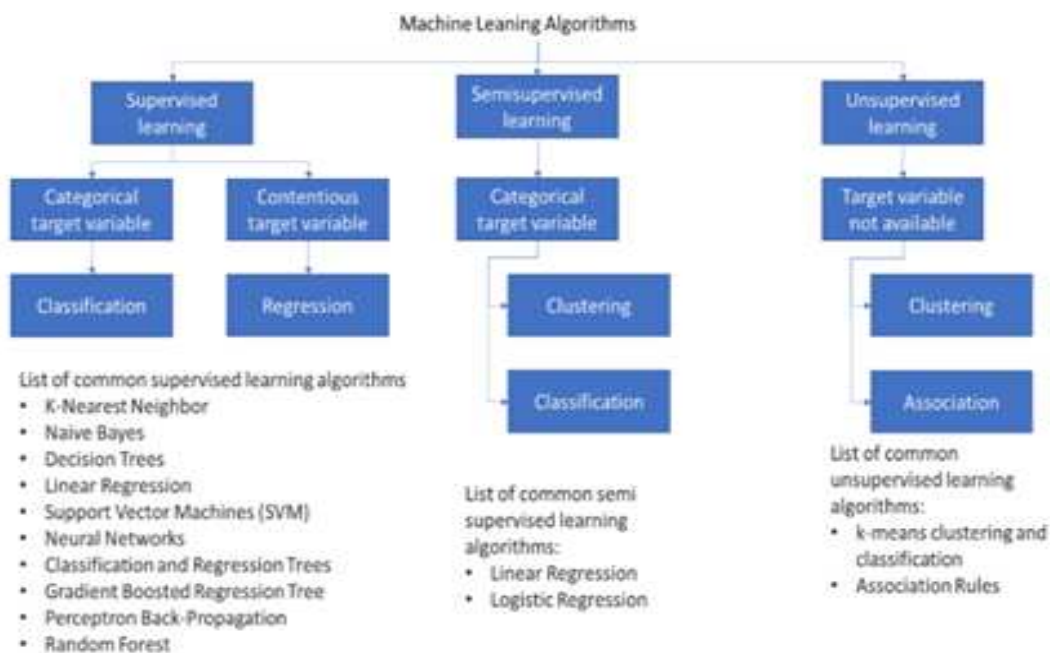## 3. Machine learning algorithms

Figure 2: Machine Learning Algorithm and Classification [11]

To do a modest data analysis, it is crucial to specify the job at hand [11]. Selecting or synthesizing the best data mining algorithm is a challenging component of any IoT-driven smart world.

Improving patient health and the quality of life for residents of smart cities is the primary goal of these IoT-based healthcare solutions. Over the past 10 years, there has been fantastic input into new ideas and designs for remote healthcare checks.

Table 1: Machine learning algorithms and use cases used in healthcare [9].

Machine Learning Algorithm	Function	Application and use cases for smart city healthcare
K-means	The structure of unlabeled data is exposed which uses the clustering algorithm to handle a lot of data	Healthcare in smart cities and at home
Dbscan	Make known the structure of unlabeled data. Handles a wide range of data types. Clustering management of human data.	Human Sensor Data Management, e.g., communication feedback provided by body level temperature using MIoT
Support Vector Machines	Organize massive amounts of data into groups according to their kinds. handles a variety of data kinds and big quantities. extremely effective for intelligent data processing techniques data that has high-speed characteristics is processed and trained.	Human health pattern, health behavior, and Lifestyle pattern, E.g., Real-time sensing of blood sugar level Forecasting Healthcare Solutions
Clinical Correlation Analysis	Two common algorithms for obtaining data attributes are shown. The relationship between the two categories of data is displayed and matched by CCA. An input that compares many data sources to find abnormalities.	Through the interaction and integration of numerous tools, equipment, and cases, application is made in generating healthcare solutions.
Neural Networks	Offers a useful learning paradigm for problems with function approximation.	Learning methodologies are used to enhance the functionality of healthcare tools, software, and equipment. Examples of use cases in management of rehabilitation.
Anomaly Detection Algorithms	Standard and anomalous dataset. Comparative analysis of unusual data sets. Classifier in binary form and construction deduction.	Applications specific to monitoring, such ECG and blood pressure monitoring. Automated to assist in finding errors in the information gathered.

4. **Sensors for smart automation system:** IoT Sensors are playing vital role in Smart health technology. Based on their sensing capabilities the following sensors are very useful to build smart health automation systems.

IoT Sensors	Applications
IR sensor	Predict the temperature of an object and an identify the motion.
IR thermometer	Measurements of a subject's temperature are made at a distance.
Smart devices	Detection of Heart rate
IR camera	For observation, and note and change in thermal reading
Optical sensor	Used for observation, contact-less detection, counting or positioning of parts.
Optical camera	For virtual conference/meeting/news broadcasting
Motion sensors	To capture the footage of intrusion
Infrared sensors	To detect body heat, Home security.

IV. BENEFITS AND RISKS

A lot of amazing (and undeniable) advantages come with the shift to personalized and digitalized smart healthcare [1]. Health systems are an investment in wealth and health, i.e., the wellbeing of the population and the expansion of the economy, rather than a drain on properties [1]. Digital technology has the potential to significantly change medicine and the healthcare sector. Digital technology would also level the relationship between patients and medical personnel [2]. The integration of digital and genomic technologies with health, healthcare, lifestyle, and society is intended to increase the effectiveness of healthcare delivery and make treatment more individualized and accurate [3]. The survey's results will help the doctor become more effective at diagnosis, increase the accuracy of his or her predictions, and assist information technology researchers in creating the right algorithms and medical instruments.

Additionally, Smart-healthcare systems are prone to a number of security holes [9] that, if not fixed, could jeopardize your information or services.

1. The algorithms used by artificial intelligence (AI) systems lack clean and trained data. distorted dataset
2. Noisy, unclean, and insufficient data
3. Decreased repute, quality of services, confidentiality, packet forwarding ratio, reputation, and reviews
4. Machine learning programs, devices, and bandwidth are heavily powered by energy and heavily rely on electrical resources in order to transfer information.

V. CONCLUSION

People are living longer in practically all of the world's nations thanks to rising living standards, better lifestyles, better education, and increased access to world-class healthcare. Despite greater lifespan, pressure on healthcare delivery companies is rapidly growing. People are not just living longer lives, but they are also suffering from chronic ailments. Chronic illnesses, also known as non-communicable diseases (NCDs), such as cardiovascular disease, cancer, asthma, diabetes, and chronic respiratory diseases, are often long-term ailments with sluggish progression that result in early mortality [8]. The spread of chronic illnesses will have a domino effect on health-care systems. Through IoT, the status of patients can be observed instantly and continuously in real time, [4]. Researchers can focus on a) remote health and monitoring services, b) assisted living and elderly care, c) chronic disease identification and management, d) personalized medication, and reduction of emergency waiting times and e) Monitoring of medical staff, equipment, and safety measures, as well as the creation of new sensors for more recent applications that make use of secure protocols.

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