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Artificial Intelligence of IoT in Health Care System

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Abstract:

Hospitals and many other health facilities now have extensive healthcare monitoring systems. The growth of Internet of Things (IoT) technologies makes it possible for healthcare to advance from in-person session to telemedicine. This paper suggests a smart healthcare system for the IoT that can constantly follow a patient's imperative signs. The Internet of Things (IoT) is reshaping the healthcare sector with promising improvements in testing and monitoring procedures. Two of the technologies with the best ever worldwide are the Internet of Things (IoT) and artificial intelligence (AI). The AI and machine learning components of the IoT-based RHM system are primarily used.

KEYWORDS: *Healthcare monitoring system, Internet of things, Sensors, ESP32*

1. Introduction

People's craving for a healthier life is vitally based on their state of healthiness. Unfortunately, the issue of global health has led to a challenge because of an amount of circumstances, including inadequate health services, the existence of significant differences between rural and urban areas, and the lack of availability of doctors and nurses during the most difficult times. IoT is nothing more than the process of using sensors and networks to connect computers to the internet [9, 10]. These interconnected parts can be employed in health monitoring devices [11]. The two most important indices of human health are heart rate and body temperature. In the medical field, there are numerous fatal disorders like heart disease , breast cancer , diabetes ,liver condition etc. This study suggests a personalised healthcare system that uses sensors to measure patient vital signs, body temperatures, and room humidity, then communicates the information via Wi-Fi so that medical personnel can access data stored on a server. In addition to the customisation of important health-related criteria, the proposed system offers a solution for the issue of keeping a single database of patients in hospitals utilising a web server [8]. With regard to device connectivity, the IoT idea has improved the world's accessibility, integrity, availability, scalability, confidentiality, and interoperability. [4].

1.1 Healthcare Services, Applications, and Remote Sensing

A smart healthcare system is actually a piece of technology that makes it possible to treat patients and raise their quality of life [7]. The advancement of artificial intelligence has had a positive impact on health along with other areas of life. There are some issues with the store-and-forward architecture currently used in conventional telemedicine:

(i)The insist for a neighborhoods hospice with a enthusiastic staff.

(ii) Medical equipment is required to create patient reports

(iii) A main hospital's medical expert must provide diagnosis and medication information within 24-48 hours.

(iv) The cost of nearby medical facilities required Wi-Fi connection.

The data of a patient can be sensed and processed by this system using a medical decision support system. The elements of IoT-based Smart Healthcare are shown in Fig. 1. The fundamental components of an IoT-enabled smart city healthcare system are shown in Fig. 2.

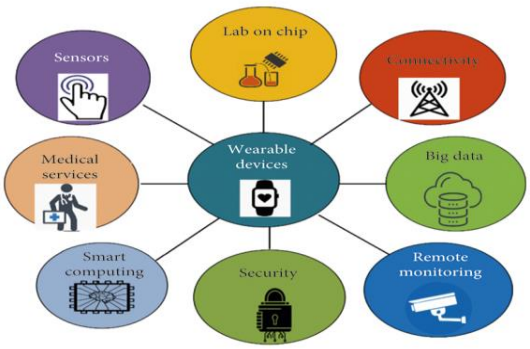

Figure 1: IoT-based Smart Healthcare component

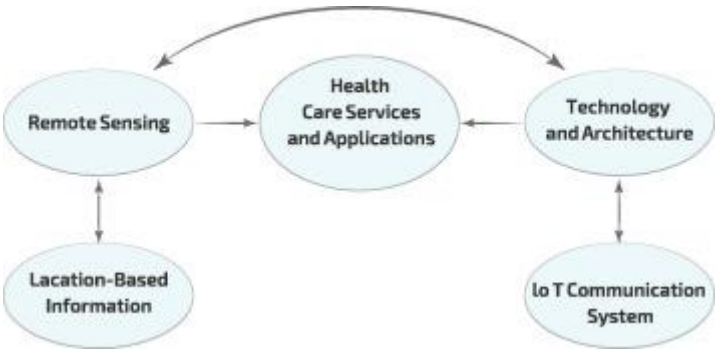

Figure 2: Components of a healthcare system for smart cities facilitated by IoT [2]

Data centres with Application Server and Database Servers make up the architecture for smart healthcare services shown in Fig. 3. The Health Monitoring Service consists of the Health Monitoring Server and the Health Monitoring Application. The Health Monitoring Service uses the Internet to connect to the data centre.

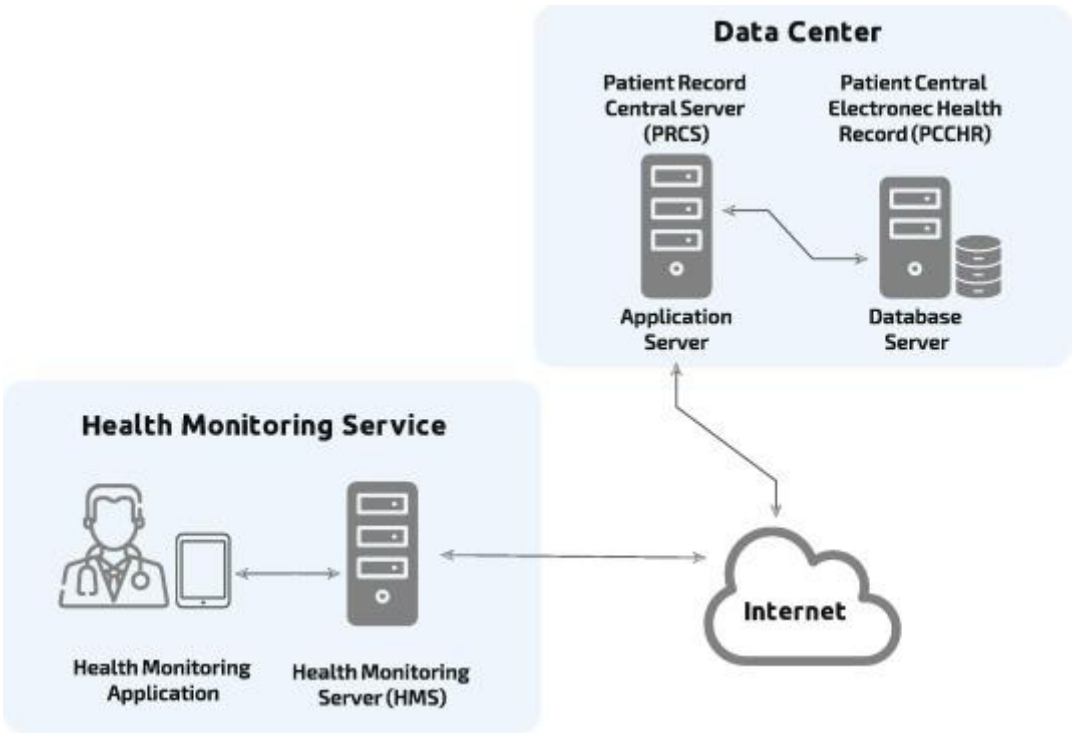

Figure 3 : Technological Architecture for intelligent healthcare services.

Fig 4 represent the classification of smart healthcare system . It consists of Applications, End Users, Management, Services, Medical Devices and Technologies of Connectivity.

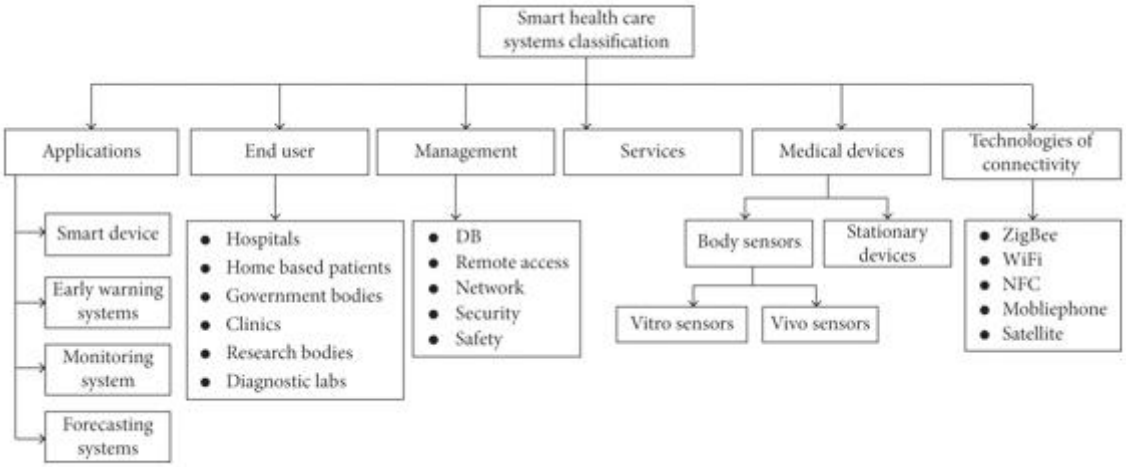

Fig 4: Categorization of Smart Healthcare System [1]

2. Related Work

IoT has been used to follow patient health in certain major medical science studies. An innovative and smart healthcare system based on forward-looking technologies like the Internet of things (IoT) and machine learning is presented by Kashif Hameed et al. in 2020. The data of a patient can be sensed and processed by this system using a medical decision support system. By comprehending the most significant monitoring applications based on a variety of models with various associated IoT-based sensors, Mazin Alshamrani (2022) examines interrelated technologies and systems for RHM services. Finally, by exposing the topic's primary shortcomings and suggesting potential research opportunities, this study adds to our understanding of science. A machine learning-based healthcare model is suggested by Amit Kishoret al. (2021) to accurately and early predict the various diseases. An Internet of Things (IoT) enabled Smart Healthcare System will be made available in India so that anyone can receive healthcare whenever they need it, anywhere. The Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPGIMS) telemedicine network has implemented health systems. Additionally highlights some important facets of artificial intelligence and the internet of things along with some of their possible applications. A model called the EO-LWAMCNet, developed by Areej A. Malibari in 2023, is suggested to accurately forecast a patient's chronic health status (such as kidney or heart problems).

3. Architecture of Smart Healthcare System

The proposed technique deals through the difficulty of remote patient monitoring and gives them the appropriate care throughout hospital professionals. The IoT server, cloud storage, communication channels, and a gateway make up the smart healthcare monitoring and patient managing system that is suggested in this study. Figure 5 displays the suggested system's architecture.

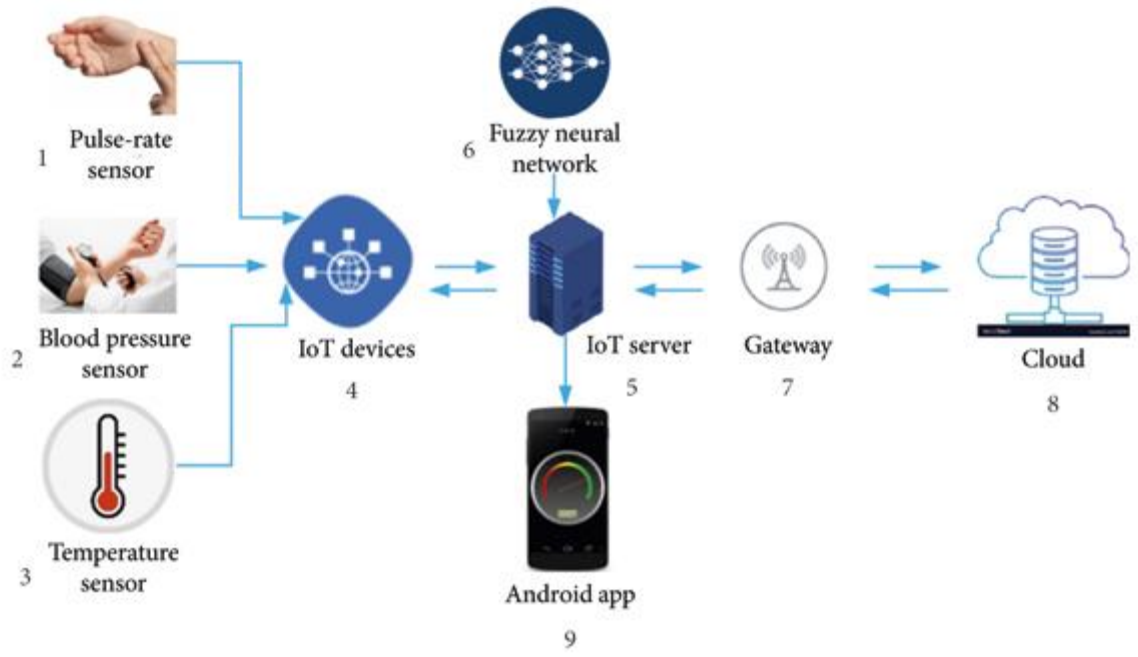

Fig 5: Architecture of Smart healthcare system

Figure 6's architecture displays a physical view of the proposed system's required parts. The Arduino board connects these three sensors in order to g ather and categorise medical data. Devices for networking and communication control the data transport. The fuzzy logic system is employed in this ar rangement to enable decision-making, and data analytics gives the decision-making capabilities. The doctor view gives medical staff the ability to keep an eye on and engage with the patient from a distance.

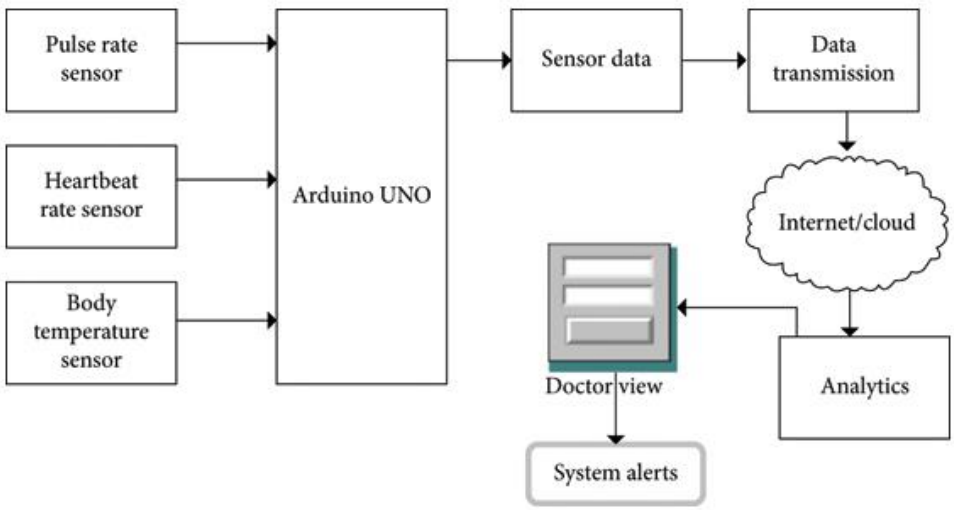

Figure 6: Patient monitoring in distant region clinics

3.1 Fuzzy Logic-Based Smart Healthcare Monitoring and Management

Neural networks place more emphasis on identifying patterns than on the reasoning behind a choice [9]. The fuzzy logic systems are superior at elucidation the decision-making process, but applying the inference rules is challenging because it requires prior knowledge [5]. The fuzzy neural network is the result of these restrictions. Fuzzy systems learn their rules from neural network patterns [4]. The neural inputs and neural outputs for the neural network are shown in Figure 7.

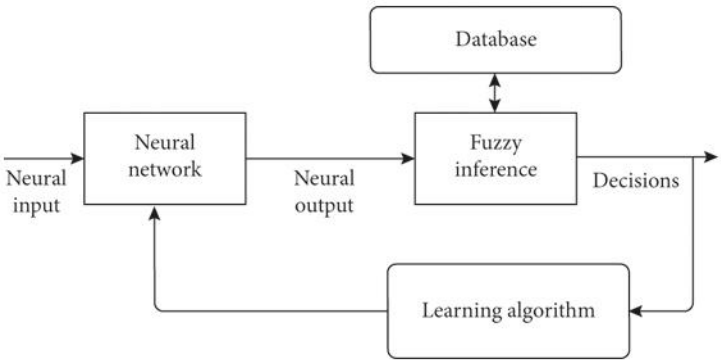

Figure 7: fuzzy neural network model.

Here are a few defined fuzzy rule instances. If the temperature is high, the pulse rate is low down, and the blood pressure is very elevated, the decision should be high. If the temperature is short, the pulse rate is elevated, and the blood pressure is average, the decision should be little. If the temperature is usual, the pulse rate is regular, and the blood pressure is low, the decision should be elevated.

4. Experimental Results

Under the supervision of medical experts, the system is tested. Samples are gathered from various locations. The server received the data that had been gathered by the sensors. The Arduino programme and web browser display the results.

Table 1: Sensor information for the tests.

Sr. no.	Temperature (°F)	Pulse rate (%)	Blood pressure (BP-low)	Blood pressure (BP-high)
1	103	64	99	170
2	102	62	88	137
3	101	101	92	142
4	101	105	82	133
5	99	103	84	128

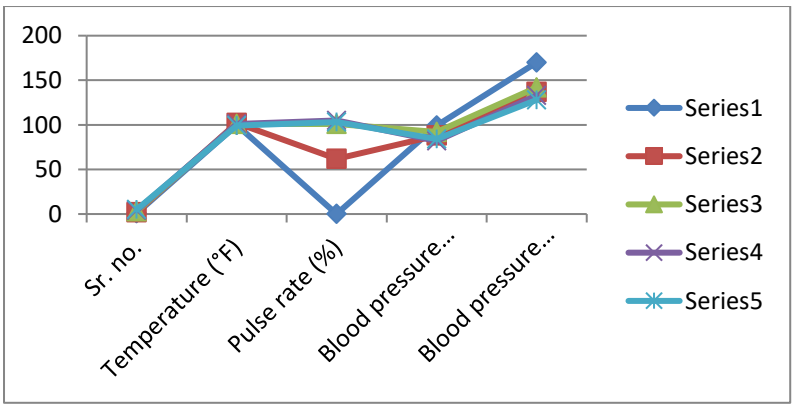

Figure 8: Sensor data

Table 2 : Heart rate data collected by analog machine (actual) and developed system (observed)

Subjects	Actual data (b.p.m)	Observed data (b.p.m)	Error %
S1	68	69	1.44
S2	71	73	3.1
S3	73	78	3.06
S4	76	75	3.5
S5	74	73	2.24
S6	81	84	2.42

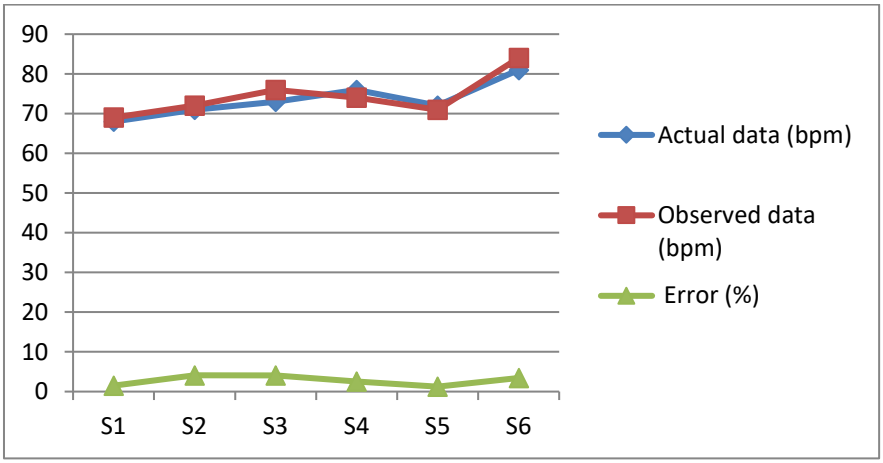

Figure 9: Heart Rate

Table 3:Body temperature data collected by analog machine (actual) and developed system (observed)

Subjects	Actual data (°F)	Observed data (°F)	Error (%)
S1	98.2	99.8	0.53
S2	98.3	96.8	0.76
S3	94.2	98.4	0.52
S4	99.4	95.6	0.52
S5	98.5	95.4	0.44
S6	93.4	95	0.83

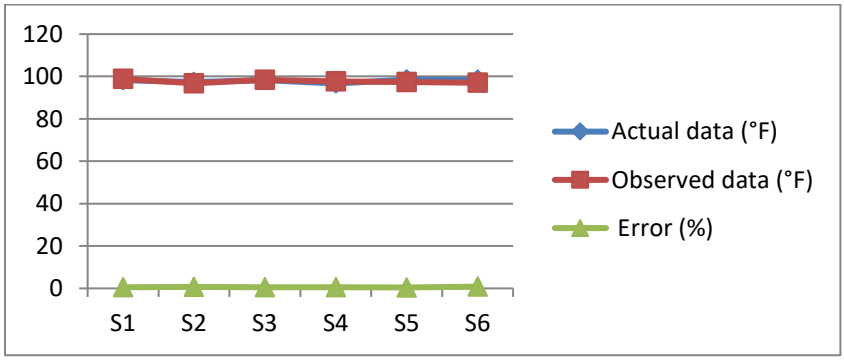

Figure 10: Body temperature

5. Conclusion

The proposed system benefited from fuzzy logic, an approach to decision-making that is simple to use and put into practice. The technology introduced "smart healthcare" to track patients' vital signs like body temperature and heart rate. For all instances of the created healthcare system, the success percentage between observed data and actual data is around more than 96%. The created architecture is very trouble-free to utilize and design. Upcoming research can wrap several supplementary metrics that are vital for decisive a patient's state.

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