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AN IOMT-BASED FRAMEWORK FOR HOME HOSPITALIZATION

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Abstract: Health is a basic necessity, and access to high-quality health care is a human right. Cloud computing groups the many more computing and Networking Technologies and makes an idea that provides a base for better reliable and cost-efficient business applications for corporate purposes. Cloud computing provides a good structure and a good cost for the organization with reduced administration. Recent advances in sensor communication, sensors, and microelectronics are focused on monitoring and managing chronic diseases and search potential emergencies. Health monitoring can be managed by one or both: the cost of main challenges and citizen-centered care. This likewise permits a specialist to make electronic visits, including no transportation with full correspondence from the specialist to the patient. They can see each other, which permits the specialist to see the diseases just as mention to the patient what it should have been finished. In this paper we discussed about home hospitalization framework dependency on the IoT, and cloud based health care monitoring system.

Keywords: Cloud Computing, Chronic Diseases, Microelectronics.

1. Introduction

Many primary health care clinics located in the rural areas do not have any electronic systems at all & continue to operate paper- based systems, resulting in patient records being kept by patients themselves. The impact of the use of multiple systems is that it is difficult and costly to develop a national overview of patient statistics. On a more basic level, it is extremely difficult for individual institutions within the healthcare sector to share information between each other. With options available to government to improve the efficiency & effectiveness of its delivery process of primary health care, mobile & wireless technologies offer some exciting opportunities for a low cost, high reach service. There is strong evidence that mobile technologies could be instrumental in addressing slow response rates of existing system for rural areas. The paper proposes an approach where the health status of a patient is retrieved and delivers health-promoting messages in a non-interruptive fashion through a wireless body-area network; they can communicate with medical services. However, a multidisciplinary endeavor such as cloud

is required to achieve their potentials for healthcare system that lead to the emergence of a new type of advanced service for healthcare. The proposed approach makes cloud based healthcare system more realistic and feasible in terms of providing expert-based medical care.

In medical areas, utilizing pervasive medical gadgets furthermore, their availability with the advanced networks or/and the Internet brought new dreams for human medical diagnoses, treatments and monitoring, wireless body area network (WBAN), and remote observing of patients' health. The pervasive gadgets or clinical sensors are associated with the particular parts of patients' bodies, to quantify the obtained clinical data, for example, blood pressure, sugar level, pulses, and other medical signs, and the noticed medical data will be transmitted to the medical help or medical counsel, through the availability of remote media including cellular networks, where they got medical data will be inspected for additional determination. Robotized medical logical instruments, for example, electrocardiogram analyzers are additionally accessible for medical data investigations progressively habits and are accounted as a part of the telemonitoring framework [1] (A. Neloy, 2019). As telemonitoring frameworks are not the new innovative arrangements in the observing of patients' health, a few medical healthcare services frameworks have been conveyed to monitor the indoor or on the other hand/and remotely found patients' health status to survive the emergency cases and to battle against and analyze the critical diseases before they become worst. To be more improved, the innovations called cloud computing frameworks are proficient and adaptable solution for existing network furthermore, have been assuming tremendous parts in medical services frameworks as far as data monitoring, procurement, and capacity. Through utilizing and conveying public cloud registering innovation for medical services, the general preparing of medical services frameworks is much proficient and simple to manage. It implies that the hospitals can simply utilize the administrations of public cloud to support the continuum of medical services and furthermore can deal with the administration and other required IT requirements that can possibly recover the continuous data of patients immediately, really synchronized what's more, safely divided between the frameworks (and clients), and adaptable in instances of responsibility, and the data is consistently be available when required. In consideration, through utilizing of cloud computing framework, a health association is ready to deal with its overall organizational structure, as an solution arises with the intelligible ideal medical care framework.

Further, in cloud computing, the public cloud is productive in the observing of data and managing of services, for pervasive medical care frameworks and be considered suitable for the issue of versatility and security. As the recovering of medical data has extraordinary worth and needs to be secured during transmission over the Internet, subsequently a few medical associations have not been achieving upon the public cloud stages, because of the security issues and to acquire the high-security level during data trades. In short, public cloud services are effective and solid; however they still include potential weaknesses since they are called freely open for all. To determine the issues of safety, private cloud computing is a critical and confided in arrangement for medical data

trades, with the fulfillments of data privacy and approved admittance; additionally, medical associations can likewise use their other significant resources.

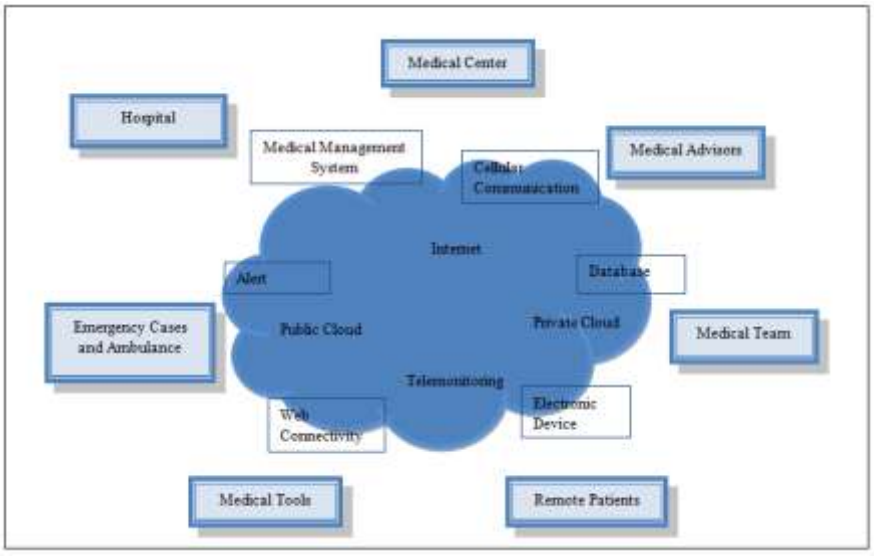

Fig. 1. Typical cloud computing structure for healthcare systems.

2. Noteworthy contribution in the field of proposed work

This paper proposes a home hospitalization framework where patient fundamental signs and ecological components of hospitalization rooms are observed utilizing the IoT, and Cloud computing. This section presents the main works dependent on these innovations, which offer frameworks and solution for monitoring of patient health and natural components. In recent years, the IoT, and Cloud computing have been used to monitor patient health as depicted in many exploration works, because of the capacity of these innovations to give speedy, safe, and minimal expense solution [21–23] (Maryam Shabbir, 2019) (N. Axak, 2020). At [24] (Omar Alshorman, 2014) for example, an IoT-based smart medical services framework is planned that gathers patient data from various sensors and permits a specialist to monitor patient physiological parameters remotely, and analyze diseases rapidly, and gives cautions to both the guardian and the doctor by conveniently sending SMS or messages. In Ref. [25] (Oviinc Kocabas, 2019) an e-health framework for elderly's health monitoring dependent on IoT was proposed, where this framework periodically collect physiological and general health parameters of the elderly utilizing the My signals stage and an Android application that assumes the part of Cloud server and empowers the elderly and their families to monitoring their health and communicate with medical services providers. An IoT-based application has been suggested that clarifies the advantages of the idea. [26] (Patel, 2017). This application aims to provide reliable, accurate, and immediate heart rate monitoring to utilize embedded wearable gadgets, mobile edge gadgets, and Cloud services.

In recent years, the utilization of smart phones and tablets has expanded in health monitoring applications, where they are utilized as mobile computing devices and as Cloud, servers that process the information and send it to the Cloud [27–30] (Pelu, 2019) (Shakeel, 2017). A mobile application was utilized at [31] (Surakratanasakul, 2017) to monitoring the patient's heart progressively as an application through the beat rate sensor, which estimates the patient's heartbeat and then sends it to storage in a remote database. This application also sends notifications to the doctors if an issue is found in the heartbeat. A mobile application was also used to develop a framework for observing fundamental signs at work [32] (Suresh, 2021). With respect to checking natural components, it has been talked about in many examinations. At [33] (V. Patil, 2018) for example, the direction was given on the most proficient method to utilize innovation for ecological monitoring. At [34] (V. Tamilselvi, 2020) a complex event preparing engine was acquainted with monitor the environment based on IoT that recognizes oddities continuously. In Ref. [35] (Y. Xiong, 2019) is offered a smart framework for monitoring and internal ecological management dependent on environmental sensors and Cloud computing, where this framework collect information identified with inward gases and then it stores and process ecological information in the Cloud, and this framework empowers users to monitor the environment and get warnings if air quality surpasses as far as possible, through an web based monitoring platform. At a natural monitoring framework for inside warm comfort has been proposed to investigate the warm comfort of people in indoor environments, depending upon the IoT.

3. Proposed methodology

3.1 Work Flow Diagram

The flow chart below depicts our proposed system's workflow and indicates how we address the primary issue of active health monitoring. The flow chart of with us proposed model is showed sequential manner in this diagram. It all begins with a single quick tap, which turns on our device and system. Our equipment is designed to read the user's vital signs and send the data to our cloud. These input readings are processed in our cloud and given to the patient and doctor panels according to their preferences. After reviewing the prediction, doctors can offer medical advice to patients using our web-based interfaces, and patients can ask their doctors questions via our website. Patients can access their historical records and doctors' advice in an organized manner, and designated doctors can provide replies and feedback to the patient's panel. Finally, you can log out to bring all of the processes to a stop.

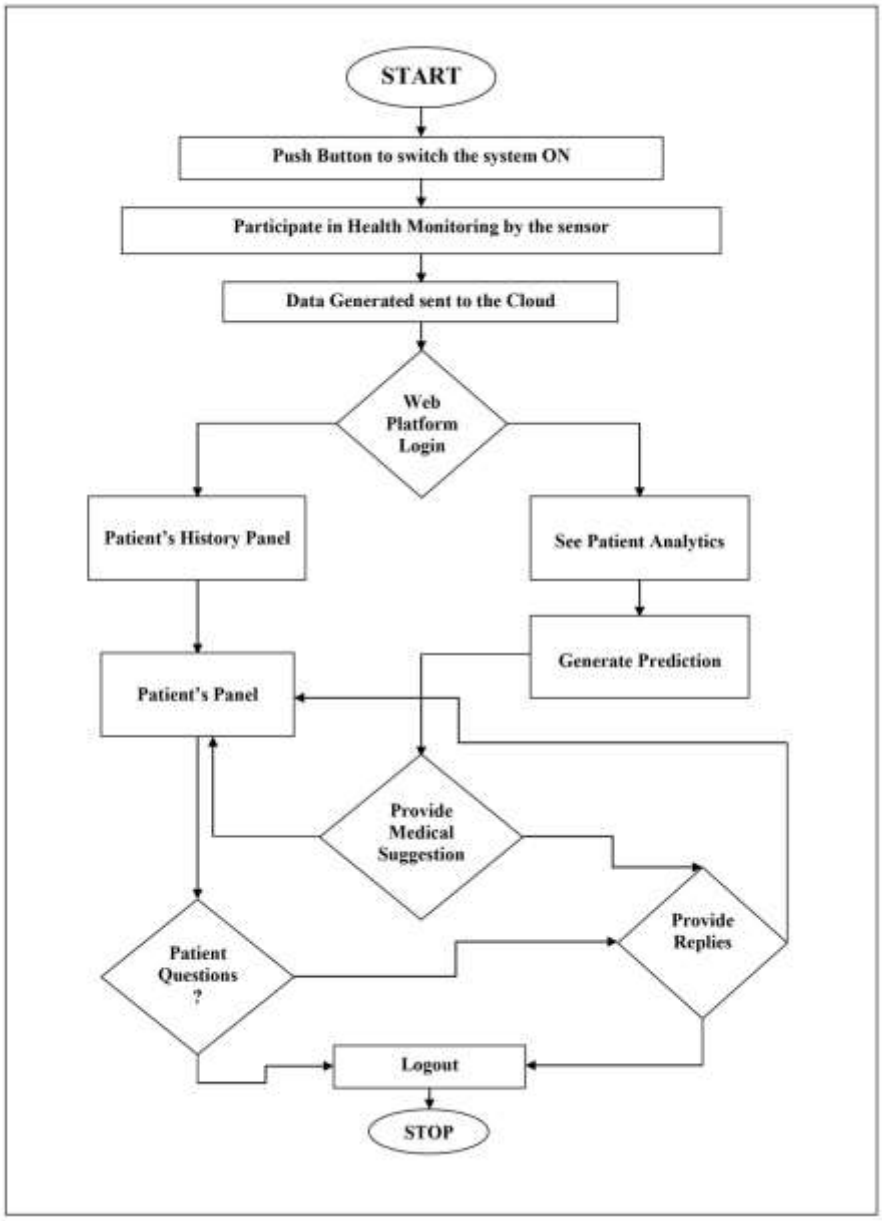

Fig. 2. Flowchart of Proposed Methodology

This system has three phases:

1. Data Accession
2. Data Analysis and Symptoms detection
3. Cloud Application and Notifications

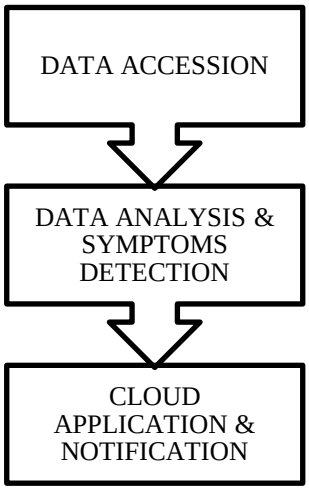

Fig.3. System Phases

3.2 Device Description

Arduino: It is a Microcontroller board contained CPU, RAM, ROM, High Power Supply (7V-12V), Programming and I/O Connectivity. It is cost less, simple and easy to use and coding also easy in it. It provides interface with analog sensors and electronic components.

ESP8266 Wi-Fi Module: ESP8266 (NodeMCU) is a Wi-Fi module self contained SoC (System on a Chip). It has 32 Bit RISC Processor and clock speed Max 160 MHz. 2.5V-12V Power Supply and TCP/IP Protocol Stack. It is mainly used for the Arduino applications.

Pulse Measure Sensor AD-8232: It is a simple sensor which is used in many places. The basic sensor has three pins namely, Ground, VCC and the Input Signal (A0 signal). The pulse sensor represents that the order to find the heartbeat rate. Thus the sensor is in heart shape in its nature.

Oxygen Measure Sensor MAX-30102: The MAX30102 Oximeter heart is an Arduino compatible and inexpensive sensor that permits calculation oxygen rates.

Temperature with Humidity Measure Sensor DHT-11 : The DH11 is a basic, ultra low cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin.

Sensing Pads ECG : An electrode is a conductive pad that is attracted to the skin and enables recording of electrical current, No electricity is sent into the body. An ECG leads is a graphical description of the electrical activity of the heart and it is created by analyzing several electrodes.

3.3 Methodology

Real-time data sensing in home hospitalization: data collected from the patient's house would be used to determine the patient's health status. The deployment of appropriate sensors is suggested to assist the control unit in mapping the conditions around patients using the k-means algorithm. Data transmission: data is communicated from the

system to the leading device through Wi-Fi module, where the device manager gathers data and moves it over to the control device, where the data is received and the machine learning algorithms are separated. The K-means clustering technique is developed by employing simple conditional statements. These are unrestricted learning algorithms that are used to view and aggregate data of a similar sort.

K-means Cluster Algorithm

The K-means clustering algorithm divides items into clusters based on how "similar" they are to one another and how "dissimilar" they are to objects in other groups.

1. The K-means clustering approach begins by defining the K-means cluster collection.

2. Then, without restoring the centroids, load them first by sliding the data set and selecting K- means data points at random for each centroids.

3. Continue iterating until there is no variation between centroids, i.e. the position of the data point's clusters remains constant.

The primary function is the

$$P= \sum_{i=1}^{m} \sum_{k=1}^{K} \omega_{ik} \left\| x^i - \mu_k \right\|^2$$

------ (1)

Where ω_{ik} =1 for the data point x^iif it is belonging to the cluster K; then otherwise when the w is the ω_{ik}= 0 also μ_k is centroid of the $x^i$of clusters.

It is the minimization problem of the two parts. First minimize the P with respect to the μ_k .

$$\frac{\partial P}{\partial \omega_{ik}} = \sum_{i-1}^{m} \sum_{k=1}^{K} \left\| x^i - \mu_k \right\|^2$$

$$\Rightarrow \omega_{ik} = \begin{cases} 1 \\ 0 \end{cases} \left\| x^i - \mu_k \right\|^2$$

----- (2)

In the other words the assign of the data points x^i to the closest of the cluster. It is the sum of the squared distance from clusters centroid.

$$\frac{\partial P}{\partial \mu_k} = 2 \sum_{i=1}^{m} \omega_{ik} \left(x^i - \mu_k \right) = 0$$

$$\Rightarrow \mu^k = \frac{\sum_{i=1}^{m} \omega_{ik} x^i}{\sum_{i=0}^{n} \omega_{ik}}$$

----- (3)

The k-means iterative way and irregular initialize of the centroids start of the method, for the various initializations may contribute to the various clusters

$$\frac{1}{m^k}\sum_{i=1}^{m_k}\left\|x^i - \mu_{c^k}\right\|^2$$

----- (4)

Table 1- K-means Clustering Method

Properties	K-means Clustering Method
Definition	A particular number of disjointed, flat clusters is generated by k-means clustering method.
Clustering criteria	The K-means clustering method is well suited to generating globular cluster.
Category data	The K-means clustering algorithm used in the data category shall be first numerically transformed by assigning the category data rank.
Sensitive to noise of the system	The data collection is more vulnerable to noise.
Execution time	K implies that the algorithm clustering improves run-time.
Quality	It shows less quality of the system
Data set	It is good for the large data set.

4. Expected outcome of the research

This section describe the method involved with implementing the proposed home hospitalization framework, where a top to bottom look is given to the implementation of the hospitalization room's ecological monitoring process and the implementation of the patient's health monitoring process, and the presentation of the mobile applications for various actors in this framework, as well as talking about the attributes and benefits of this proposed framework and its evaluation utilizing the System Usability Scale (SUS).

In this paper, a home hospitalization framework dependent on the IoT, and cloud computing have been proposed. This framework permits patients to recover and get treatment in their homes and among their families, where the patients' health and the natural elements of the hospitalization, rooms are monitoring intermittently, through a vital signs sensing unit and ecological sensing units that are introduced in the hospitalization rooms and mobile applications produced for this reason. This framework additionally enables doctors, patients, and their family members to manage and monitor hospitalization activities through their mobile applications. The home hospitalization framework proposed in this paper is recognized by its minimal expense, reliability, and security in expansion to its capacity to tackle the issues presently saw emergency in hospitals, as it can significantly reduce the burden on them. This framework has received excellent acknowledgment by patients and doctors the same concurring to the results of the usability evaluation.

As future work, changes will be made to this framework to make it more appropriate to the isolate activities of Covid patients, as we will develop for the patients' mobile application to empower them to measure vital signs without help from anyone else, and we will add video correspondence between the patients and their managing doctors utilizing this application. We will develop also a smart band that the Covid patients will wear. This wristband estimates the patient's temperature and heartbeat in real time and sends them to the Cloud for storage and analysis, to save the patient rapidly if their health condition is not well. This wristband also sends the directions of the patient's area utilizing GPS to the Cloud progressively to interfere if the patient violates the isolate.

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