A FUTURISTIC APPROACH ON EFFECTIVE IMPLEMENTATION OF ENABLING TECHNOLOGIES IN THE INTERNET OF THINGS (IOT) FOR THE ESTABLISHMENT OF SMART HEALTH CARE MANAGEMENT SYSTEM

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ABSTRACT

With the ubiquitous influence of IoT, hospital management system incorporates its various accomplishments for establishing Smart Health care Management System (SHCMS). These kinds of implementation help the society with expeditious support in the phenomenon of health care. For digitizing the health care service IoT plays major role in connecting the medical resources with IoT services. This paper proposes the novel approach to equip the hospital with the enabling IoT technologies and transfigure its applications and also addresses the significance and possible implementation of smart health care management system using the approach of the Internet of Things (IoT), that can be furnished in the hospitals for rendering expeditious service for their patients.

Keywords: Internet of Things (IoT), Sensors, SHCMS Wearable devices Remote diagnosis, Smart healthcare

I. INTRODUCTION

The technology of the Internet of Things (IoT) coalesced and allows the hardware, software, and physical things to communicate with each other over the internet. IoT has created a remarkable influence on human life and contributes the vital exemplar for a wide range of smart applications. IoT plays an important role in the implementation of smart cities, Industry automation, smart home, etc by integrating things and user to communicate with each other. It also provide enormous applications in health care sector which is coined as Healthcare Internet of things(H-IoT). With the development of recent technologies health care system can provide service effectively in the absence of medical assistance

It provides various services in the healthcare applications as well. It is important to maintain various hazard indicators as a safety measures. The Internet of Things (IoT) make use of Body Sensor network (BSNs) for connecting the human with Technology. The revolution of IoT has changed the globe with its smart line of action. It facilitates things and humans connected through internet at any time. The smart devices connected at the human end collects the data and process it in real time.

The idea behind this technology is to embed sensors at various devices and access them through their handheld gadgets .It also helps in monitoring the status of the devices as well. For data acquisition, sensors are deployed which always consumes low power is the significant benefit of approaching the IoT. Ambient intelligence (AmI) use through IoT for the prediction of results .AmI is normally referred as an electronic environment which is responsive and sensitive by the presence of human beings.

This study primarily focuses of providing medical services to the victims by the synergistic application of IoT and Cloud computing and also analyzes and addresses various health care services which can be rendered with the help of emerging technologies in IoT.

In this perspective the organization the paper is as follows

- enabling technologies of IoT

- the IoT in healthcare applications

- IoT healthcare challenges.

II. LITERATURE SURVEY

In the conventional approach of providing medical service it is very difficult to handle massive patients. Smart health care system help the user to get a quick service by make them learn the recent technologies which are user friendly and easy to operate during emergency situations [1].Applications of IoT has been already stepped into all the areas includes smart city, smart home, smart grids and so on. Therefore the implementation of IoT based healthcare system would take the next level of medical infrastructure. [2] .In this approach how IoT can be effectively utilized and methodology suits for decision making system were deeply examined [3] .Applications of internet of medial things and its advantages and challenges were discussed also the potential of Internet of medical things has been emphasized and some of their applications were implanted in few health related organizations. [4] In this study authors emphasize on the applications of the IoT and big data have significant role in health care automation and digitalization. These technologies would upgrade the quality of medical services provided along with illustrious evolution of wearable medical devices to track the patient's health and they render medical support remotely. [5] .

The spurt of IoT in healthcare is a recent trend. There has been a stream in the use of fitness trackers or wearables in the last few years, and the market data is indicative of the same with the projected increase in the use of these in the future [6].The growth of IoT based health monitoring devices added with improved connectivity to the IoT communication framework has lead to the evolution of a healthcare-oriented system called IoThNet .With this methodology users health condition has been tracked and support them with good quality of medical services[7]. Because of being establishment of multiple standard architectures by various consortiums for different commercial purpose on implementation of IoT it is difficult to understand sometimes, so the standard architecture is necessary for the wide application of Healthcare IoT. [8].Applications of the IoT in the form of wearbles can be integrated with mobile application would be a great support for the users to track their health status and also help them to maintain their body fitness level. [9].

The assimilation of the IoT technology along with ubiquitous computing and Ambient Intelligence (AmI) provides variety of greater real world applications. It allows users to integrates their electronic gadgets with physical entities thereby attain their target ,since these devices are easily interconnect with each other over internet and supports in various applications such as health care, surveillance, smart parking ,agriculture ,etc. [10].Periodic observation of health condition along with cardiac assessment would highly helpful in earlier prediction of cardiac disease and thereby supportive in reducing the mortality rate [11].By the support of wearable medical devices vital signs of a human body can be tracked by smart phone and send to cloud environment for data processing and analysis ,thus provides timely supports to the user who is in emergency situation .The communication between the wearables and the smart phone commonly follows black tooth standard, It always provides efficient end to end communications and periodically track the physical condition of a patient and render timely service during urgency.[12]

III. METHODOLOGY

Existing health care system fails to provide service to all the victims who are in need of medical emergency because of crowded supplications .Even though a standard health care system with exemplar infrastructure has been established providing health care support to myriads of sufferers are impossible.

In the proposed methodology [fig 3.1]for the application of IoT technologies, three-tier architecture comprises of Sensor layer, communication layer and Processing layer has been used. Various sensors and wearable's can be used for monitoring the health status of an individual ,all the sensors are integrated with sensing unit[Fig 3.2] .They continuously collect and send the data to the cloud through IoT gateway. Data Processing and analyzing takes place and the predicted result from the cloud is transferred to the User interface system. End users involves in this phenomenon are doctors, medical assistants and hospital management team analyze the patient condition and provide necessary medical service to the user.
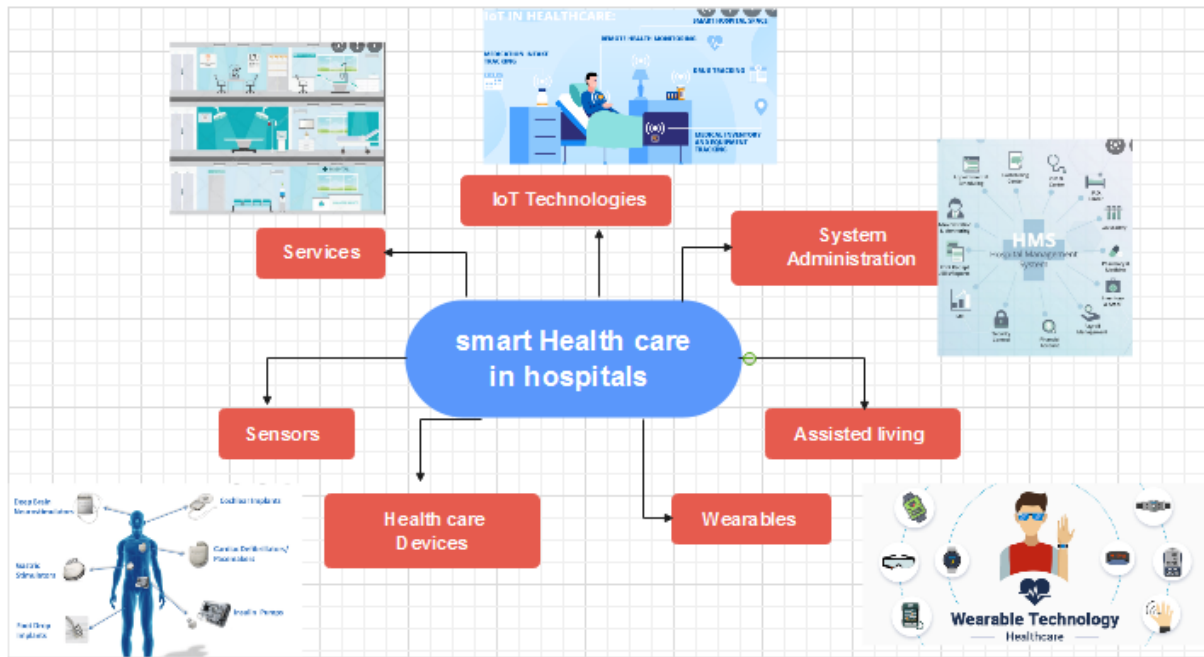
Figure 3.1 Architecture of Smart health care system

Sensors that can be deployed in health care are as follows:

I. Body temperature sensors

For all types of illness body temperature monitoring is widely used as preliminary diagnosis procedure and it can be achieved quickly with IoT enabled devices. Thermistor based sensors are being deployed now a day's which in turn calculates body temperature with high level of accuracy[13] .The accuracy level of sensor depends on how close the device is near to the human body. Several research is going on for developing such sensors which can be embedded in a fabric and act as a wearable [14].

II. Blood Pressure

Blood pressure need to frequently measured beyond certain age because hypertension is high prone for cardiac vascular disease that cause chronic illness. So many research[15]is going on for the effective implementation blood pressure monitoring within a period of pulse transit time(PTT) using IoT enabled devices. In this method the time taken by the pulse at the heart and pulse of other body location is measured and thus BP can measure. Recent research identified[16]two wearable PPG sensors, one on the wrist and other on the earlobe that measures the blood pressure shows high accuracy as compared with traditional sphygmomanometer.
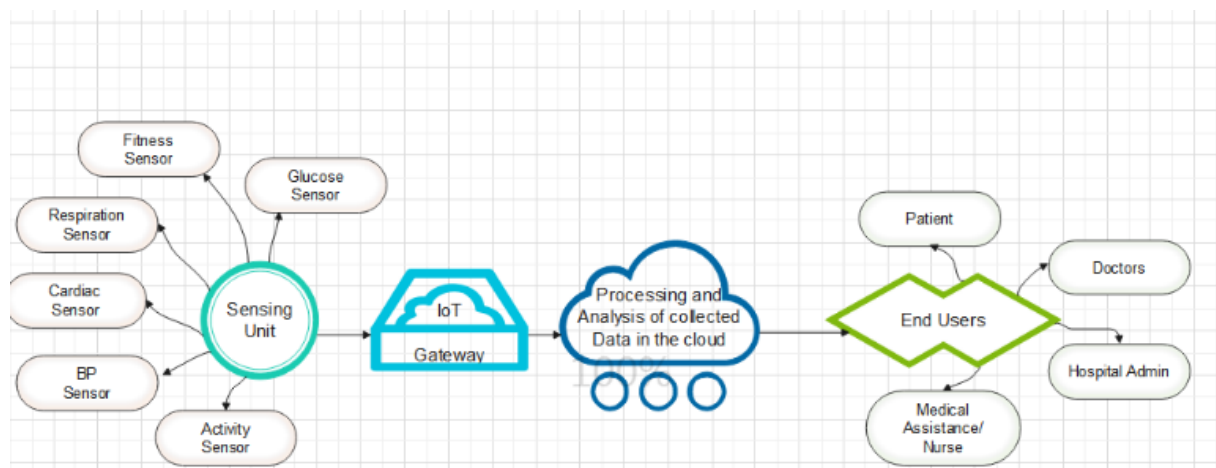

Figure 3.2 Implementation of IoT in Smart Health Care System

III. Heart Beat monitoring sensors

For monitoring the heart beat the commonly used techniques were electrocardiography (ECG), ballistocardiography (BCG), photoplethysmography (PPG) and phonocardiography (PCG).For all these methods cardiograph signals have been used in that case wearable sensors can be utilized to sense the signal. Accelerometer is the great choice and pulse oximeters are commonly used to monitor the heart rate [17].

IV. Blood Glucose Monitoring (BGM)

Glucose level in the blood can be monitor either by electrochemical based or by optical based, chemical level of interstitial fluid is observed by electrochemical based where spectroscopy techniques has been used in optical based glucose level monitoring.

Electro chemical sensors can be placed underneath the skin in the form of stretchable patches where sweat samples are collected and monitored the glucose level based on the correlation between the blood and sweat[18]. Optical based spectroscopy sensor is deployed for monitoring the blood glucose level where they uses Near infra red light source and photon counter.[19]

V. Oxygen saturation monitoring

The standard method followed to observe the oxygen saturation level is by pulse oximetry method. By the support of IoT based wearable pulse oximetry method [20] oxygen saturation level is observed with high accuracy. This method make use of blue tooth to transfer the observed data from the optimized low cost and low power consuming sensor to other end for continuous observation.

VI. Fitness tracking

IoT enabled health care system also focuses on tracking the fitness of a person by means of wearable where wrist band equipped with IoT is commonly being used. These kind of smart bands are used to monitor the fitness of person by tracking the heart rate, pulse and motion. It is highly recommended for sports person to track their fitness level all time [21].

IV. COMMUNICATION TECHNOLOGIES

For accomplishing the vision of implementing the enabling technologies of IoT smart gadgets play a vital role because of its high accuracy, low power consumption, smaller size and they are available at affordable price .These features are capitalized for their effective execution in smart healthcare support system.

Bluetooth-This wireless communication network is developed for the purpose data transmission over short distance. It works at a speed of 3mbps and connectivity range is up to 100m.It is mainly employed in IoT for tele-monitoring as it is having low power solution.

RFID is the Radio-Frequency Identification technology is mainly targeting to establish short range data communication .It comprises of a reader and a tag that are communicate with each other for transmission. Almost all applications of the IoT the data make use of RFID tags which has its own electronic product code(EPC) and available with low cost.

LR-WPAN is the Low Rate Wireless Personal Area Network mainly devised in IoT for its short range communication. It consumes low power and provides high reliability. Wi-Fi is being deployed for various applications such as home automation, wearable sensor devices, mobile devices, and smart grids.

Zigbee is a wireless technology drafted to furnish as a base for IoT, by allowing things to operate together. The configuration of this protocol is consist of a coordinator, end-nodes, routers and processing centre. The processing centre is responsible for data aggregation and data analyzing. It is often deployed for its significance such as low power consumption, low cost, interoperability, security and resilience.

Wireless sensor networks maintain heterogeneous sensors for the vast applications. It consists of nodes, routers and a gateway to collect and transfer the data that can be deployed as implantable or wearable based on the prevailing situation. These types of sensors are commonly used in healthcare to track the patient condition in home healthcare. It has its own pros such as broad coverage, low installation cost, and real-time data gathering, have been applied in

different fields such as emergency situations management, military operations, tracking the movement of animals, and healthcare monitoring systems. In health care support system it performs the patient's physiological parameters tracking, medical device monitoring, food allergy detection, pregnancy monitoring and cholesterol level monitoring. Generally, sensors that can be used in healthcare monitoring include inertial sensors (e.g., accelerometers, gyroscope, and pressure sensor), biosensors [e.g., Electrocardiography (ECG) monitoring, temperature and heart rate sensor], and wearable sensors (like fitness band and mobile phone).

V. CHALLENGES

Despite providing enormous application to the society, implementation of the IoT in health sector has its own challenges as well, so it necessary to address all the challenges while implementing in health care. This paper addresses few challenges in this section.

Security

One of the key issue to be address is data security ,There should given access only to limited users for maintaining single patient history. Since large amount of data has been transferred from sensors periodically it is possible for the intruders to modify or abuse. The system ensures the protection of data from unauthorized access. Sometimes hackers misguide the patients by using doctor's interface and also purchase drugs with fake prescription. These issues remain questionable in many of the applications because the architecture of IoT in healthcare is not well defined and it fails to provide the information about how to preserve the privacy and security of the data.

Scalability

As IoT provides many devices to interconnect with one another there should be imparted enough intelligence to adopt new changes as well resilience, since enormous sensors ,actuators and many devices are connected and working altogether IoT health care system leads to less scalable also doesn't provide quick response. The lack of uniformity among the connected medical devices reduces the scalability of devices, and these must be managed, maintained, operated and supported using appropriate addressing conventions, protocols, and power. Existing approaches to these challenges may be inadequate and fail to scale for the anticipated huge number and range of IoT objects. The main goal is to make the wearable device scalable to meet changing needs. The importance of scalability is that it helps the system to work gracefully without any delay and unproductive resource consumption and makes a good use of the available resources. Hence it is important to make a healthcare device with higher scalability to make it more efficient for the present and the future use.

Quality of Services

Nowadays, IoT is mainly used for real-time applications. QoS is directly related to the quality and the timeliness of the IoT data that can be used for decision support. It requires data generated from the health care sensors to be collected, transmitted, processed, analyzed, and used in a timely manner. But, in some cases the IoT devices fails to provide the necessary data on time. It can be considered as a challenge for the IoT healthcare sys- tem on regarding QoS. Also, the IoT devices generate large scale of real-time data in terms of volume, velocity, and variety and make a big data problem. It became a big challenge in combining and analyzing such data with historical patient data to obtain meaningful diagnoses suggestions within acceptable time frames (considering QoS). As the medical wearable systems deal with real- time and life-critical applications, they require a strict guarantee of QoS. This remains a significant gap in the areas of heterogeneous data collection, real-time patient monitoring, and automated decision support based on QoS. Thus, it is necessary to overcome these challenges based on QoS.

Continuous observation of Victims

Many patients includes elderly people requires continuous support and monitoring if they are suffering from chronic disease. For continuous monitoring, it is mandatory that smart devices and sensors send data to the required destination on time. However, it faces some limitations which can be a hurdle in continuous monitoring as if patient's devices start malfunctioning or its battery is about to die then remote data sharing cannot be achieved. Hence, continuous monitoring will be adversely affected.

VI. FUTURE SCOPE

With the emergence of 5G communication technology, the applications based on Tactile internet(TI) are being explored, especially in the areas of robotics, healthcare, and entertainment. In future TI can be effectively utilized

to perform Remote surgery where the surgeons operate the system remotely where it is highly reliable and provide ultra fast communication.

Ingestible Sensor provided as pills in the form of swallowable and the sensors will active once digested. The sensor is operated by fluids in the patient's body and battery or antenna is not required in the pill.After a pill swallowed, the liquid chemical in the stomach operates the sensor and available the power needed for the operation of the sensor. The sensor in the patient's stomach available real-time data about the patient's response to medications . Hence pills are useful to patients that take pills to chronic diseases . After activating the pill, the pill creates a unique number then sends it in a message. Besides the unique number, the consumable sensor transmits various parameters of the body to the user's mobile device. This data is sent from the mobile phone to a central portal where it is sent to a secure data server .Any person who monitors the patient's condition accessing the data sent to the server at any time through the mobile phone and from anywhere.

VII. CONCLUSION

This paper presented the different dimensions of the IoT based services in the sector of health care, and also discussed how the different sensors, wearable's, devices using IoT can be effectively deployed to get quick medical support and guidance. For deeper insight ,the possible devices that can be equipped with sensors for monitoring blood pressure, oxygen saturation level, blood glucose level and the method to track the health status is also discussed along with the component of the IoT communication technology. This study also examined the challenges and future scope of the IoT to provide the best medical service, thereby it has the ability to uplift the economy and growth of the country.

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