JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue

JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)

An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Patient Monitoring System based on MIoT

[1]Aayushya Gupta, [2]Rugved Alav, [3]Shital Kurwade, [4] Dr. K.T. Patil

[1-3]Students, [4] Professor

[1]Smt. Indira Gandhi College of Engineering, Ghansoli, Navi Mumbai, Maharashtra, India

Abstract: As the world focuses on tackling **corona virus** disease (COVID-19), monitoring patient becomes a very tough situation**,** where physical distancing and self-isolation plays a **very** critical role. In this paper, we have proposed a smart patient monitoring system based on IoT that can easily monitor vitals like Oxygen, Heartbeat, Temperature, Movement and Sleep of patient in a real-time and with no physical presence of a doctor. Our MIOT System is compact, portable and easy to handle and most importantly powered with battery. Device being compact and portable can be easily implemented in any hospitals, regardless of the infrastructure. As this system is based on IoT everything is managed by a centered communication architecture i.e. IoT Gateway. This gateway is able to manage all the devices in its communicable range as all the devices follow same protocol to communicate. This system can be linked to medical records database of patient for future reference globally. the real-time data parsed from the patient's device can also be relayed to the patient's concerned in real-time on a web application with help of the Unique Identification Number, the same can also be saved on Cloud for future reference and learning.

Index Terms **- COVID-19, Monitoring, Portable, Internet of Things, Gateway, Database, Real-time, Cloud.**

I. INTRODUCTION

The recent COVID-19 pandemic has shown us the importance of health monitoring devices for medical and personal use, but the biggest concern is the timely monitoring of patient's health in hospitals. Timely monitoring is very difficult in situations where the number of patients appear to be greater than the medical care available. Therefore, a wearable health monitoring device is essential to monitor and analyze patient's oxygen, heartbeat, temperature, sleep and provide real-time updates to Medicare Professional's.

Patient monitoring systems have been used for a long time as a part of treatment and monitoring. improvements in such systems will bring up a significant change in the current way of management. These improvements can be achieved by conversion of such systems to portable, battery powered with combination of wireless connectivity to the systems.

This paper not only engage in monitoring direct variables like oxygen, temp but also monitors patient's movement for analyzing sleep. Sleep is sort of brain activity which cannot be easily monitored by sensors. A basic sleep algorithm based on variables like acceleration and heartbeat can be achieved which is not up to the mark of monitoring exact sleep but is able to monitor enough useful dataset about the sleep and movement pattern of a patient. [1]

II. RELATED WORK

2.1 Wearable Sensor- Based System

According to authors Alexandros Pantelopoulos and Nikolaos G. Bourbakis [3]. They have given detailed information about WHMS (Wearable health monitoring systems). Wearable systems for vitals monitoring comprises of various miniature hardware and sensors capable of measuring parameters like pulse rate, spO2 (oxygen levels), body temperature. In WHMS, the obtained parameters or measurements are communicated either via wireless or a wired link to a central node for instance microcontroller. Due to this, the Security and privacy of collected patient vitals data are compromised.

They have also mentioned the design and wear ability criteria of hardware, i.e. the size of the system needed to be small and compact, system should not hinder any of the user's movements and actions, and also the radiation of hardware and possible aesthetic issues need to be accounted, wearable system should be ergonomic and comfortable.

2.2 Smart Sleep Quality Monitoring System

According to authors Khizra Saleem, Imran Sarwar Bajwa [2], They have conducted research on different techniques of sleep monitoring, the modern sleep monitoring techniques, currently under study are Monitoring sleep using Brain activity, Monitoring sleep using Autonomic signals, Monitoring sleep using Movement of patient and Bed based sleep monitoring.

As the quality sleep holds major role in patient recovery. They also mentioned the various factors categories affecting Sleep Are Mental/Physiological factors, Biological factors and environmental factors. Sleep illness caused through the mental/physiological factors are anxiety, insomnia and depression. The biological factors that interrupt sleep of a person are due to disturbance in body's nervous system, cardiac system and changed levels of metabolism. The environmental factor affects less compare to physiological and biological factor, as this factor includes brightness in the room, temperature, moisture, quietness in the room and bed comfort.

2.3 IOT Gateway

According to authors Gunjan Beniwalab and Anita Singhrovaa[4]. They have explained in detail about the importance of gateways in 'Internet of Things'. Gateways in Internet of things play an important role in routing the pre-processed filtered data to cloud platforms. An IoT gateway is a physical device or a virtual platform that connects sensors, hardware to cloud and serve as a wireless portal to give IoT device access to the internet.

The IoT gateway is an intermediate device that acts as a medium between various sensory networks and high-end IoT devices to the cloud platform over the Internet. Its main function is to manage heterogeneity due to the different types of data collected on different sensors and send the data to a higher control. The data collected by the gateway should be filtered and processed [5].

2.4 Lithium Battery

A lithium-ion battery is a type of rechargeable battery in which lithium ions move from the -ve electrode to the +ve electrode during discharge and vice versa when charging. Lithium-ion batteries are common in consumer electronics [6]. There are one of the most popular types of rechargeable battery for portable electronics, with best energy-to-weight ratios, low self-discharge rate, high open circuit voltage, no memory effect and a slow discharge when not in use.

The lifetime of a battery, and the energy delivered by a battery, for a given embedded system strongly depend on the current discharge profile. If a current of magnitude is greater than the rated current of the battery is discharged, then the efficiency of the battery (ratio of the delivered energy and the energy stored in the battery) decreases, in other words, the battery lifetime decreases [7]. This effect is known as Rate Capacity Effect. Additionally, if a battery is discharged for short time intervals followed by idle periods, significant improvements in the delivered energy seem possible. During the idle state of battery, the battery recovers charging capacity partially which is lost in previous discharges. We call this effect as the Recovery Effect [8].

III. Problem Statement

Building a portable chargeable body device for patient to track their attributes on screen with emergency calling feature. The patient device is used to send the information to healthcare professional in real-time and the guardian itself.

This system will provide information to the hospital system such as patient's Heartbeat, Temperature, Oxygen, Sleeping pattern. This system can also have alerts from patient, patients schedule can be transferred on the device to notify the patient also related information such as Medication used Test-reports data can be transferred on to the Cloud as a History service which can be used if-in-case of later admission of patient for an overview on previous history of patient.

IV. Proposed Work

4.1 Medical IOT System Design

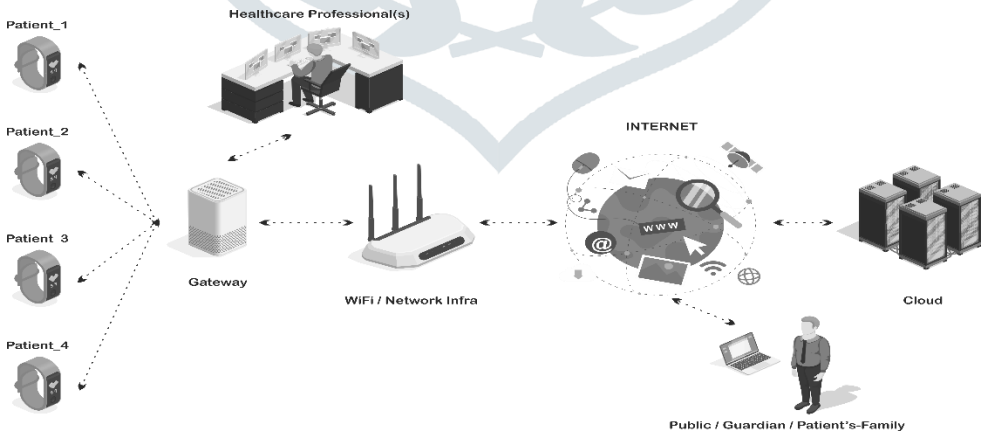


Figure 3.1 : Medical IOT System Design

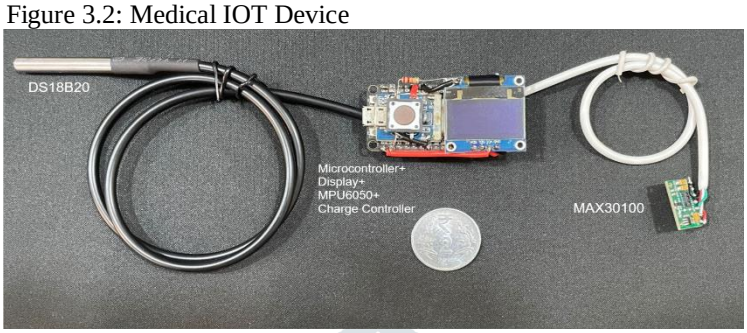
4.2 Extraction of Patient's Vitals using MIOT

The MIOT System design consists of Sensors, Microcontroller, Charge Controller, Battery and Gateway. These Sensors allow for comprehensive perception through Heartbeat recognition, SpO2 recognition and Temperature recognition and can convert this information to digital signals, which is more convenient for network transmission. Sensor technologies allows monitoring treatments in real time and facilitates the acquisition of various physiological parameters. about a patient. so, that diagnosis and high-quality treatments can be fast-tracked. Gateway used in this system, which is used for pairing, data collection, and host a web server. API (Application Programmable Interface) to serves real-time data and can be incorporated with any User interface.

Table 3.2: MIOT Sensors

Sensor name	Output	Protocol	Volt
MAX30100	BPM/SpO2	I2C	3.3
MPU6050	Accel/Gyro	I2C	3.3
DS18B20	Temp	1 Wire	3.3

Figure 3.2: Medical IOT Device



This device is powered by battery and is placed on either of hand of the patient. The temperature sensor is placed at underarm, MAX30100 which is a pulse based sensor is placed at the tip of the finger. OLED display is used to show the status of the device, the connection, sensors data, time, date, schedule. The display is also used to show QR code which can be directly accessed by the doctors, nurse to access the patient's profile on the go. Button on the display is used to interact with the device.

4.3 Extraction of Patient's Vitals algorithm

- Transaction of patient vitals data
- State about Sensors.
- Elaborate viewpoints on sensor
- The vitals of patient are examined by each of the sensors.
    - MAX30100 – Uses IR to detect the pulse or heart rate of patient. Two IR light is emitted from the device which is placed underneath of patient finger tip
    - Gateway is the centralised system which manages all the data captured by MIoT devices of patient.
    - It collects the data of all devices and pass it for further analysis process where the data is properly examined and the respective predictions are made.
    - On top o that for instance, as the sleep data is been captured, the further prediction is calculated based on the digital signals received by the MIoT device such as the person is in

4.4 Algorithm: Sleep monitoring and analysis

The average duration of the initial NREM-REM sleep cycle is about 70 to 100 minutes. Second cycle, and later, cycles last longer about 90 to 120 minutes.
NREM sleep makes up about 75 to 80 percent of the total sleep time spent, while REM sleep covers the remaining 20 to 25 percent.

(NREM) Stage 1: Stage lasts 1 to 7 minutes in the first cycle, which covers 2 to 5 percent of complete sleep, and is easily interrupted by disturbing sounds.

(NREM) Stage 2: Stage 2 sleep lasts 10 to 25 minutes in the first cycle and is extended with each successive cycle, covering between 45 and 55 percent of the total sleep episode. A person in stage 2 sleep needs more energy than the first stage to wake up.

(NREM) Phase 3: Sleeping Phases 3 and 4 are also called slow-wave sleep. Stage 3 lasts only a few minutes and makes up about 3 to 8 percent of sleep.

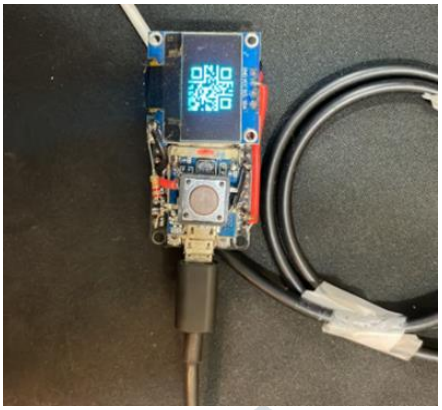
(NREM) Phase 4: Phase 4, which lasts approximately 20 to 40 minutes in the first cycle and forms approximately 10 to 15 percent of sleep.

(REM) Stage: REM sleep is defined by the presence of desynchronized (low-voltage, mixed-frequency) brain activity, muscle atonia, and rapid eye movement explosion. During the first cycle, the REM duration can take only 1 to 5 minutes; however, it becomes continuously longer as the sleep episode progresses.

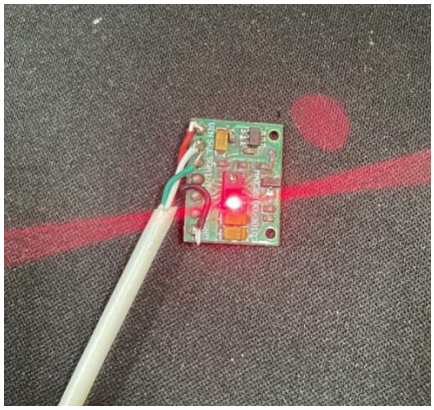
V. RESULTS AND DISCUSSION

5.1 Working of hardware

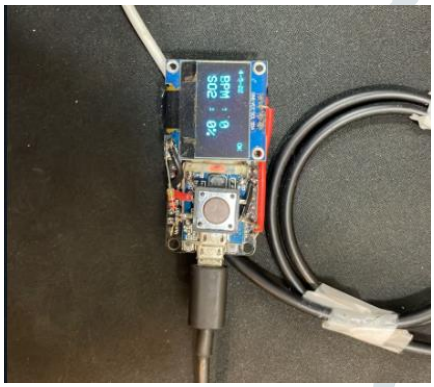
Initializing Gateway



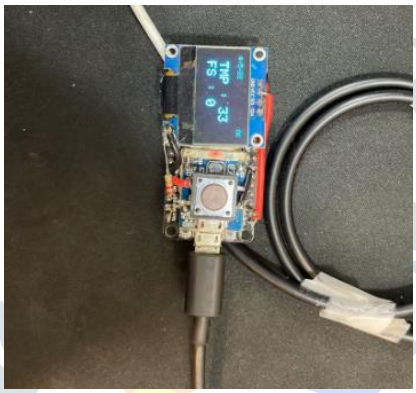
QR code for UI redirection



Pulse oximeter MAX30100

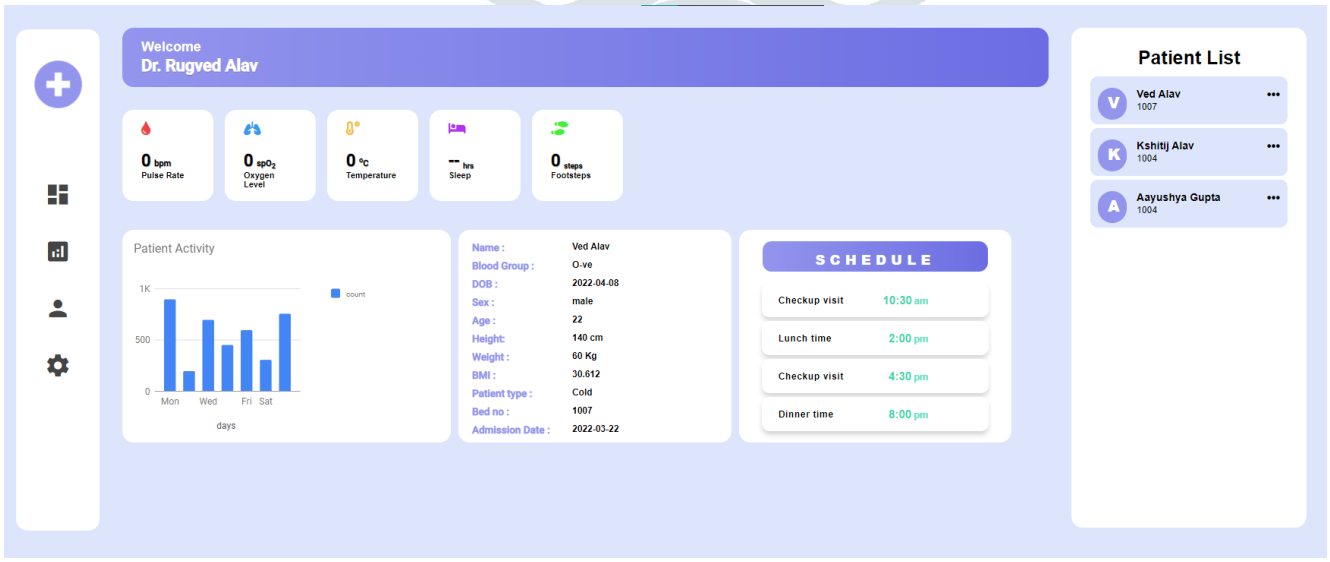


Patient vitals data 1

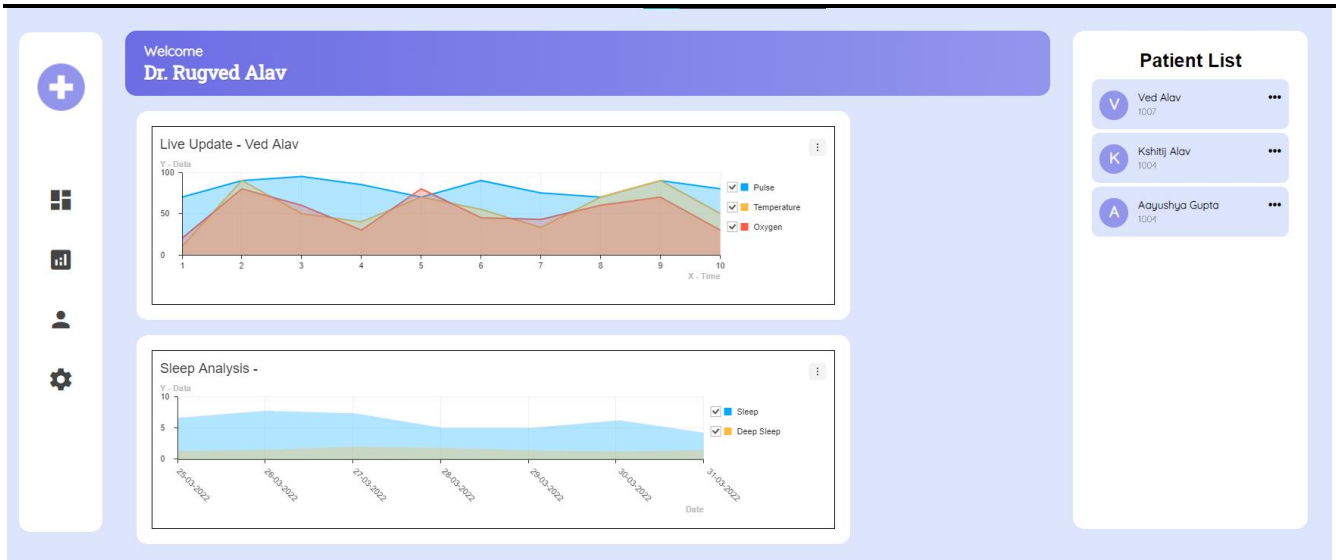


Patient vitals data 2

5.2 Working of Software (UI)



Medical IoT Dashboard



Graphical analysis

VI. ACKNOWLEDGMENT

We would like to thank all those people who helped us in successful completion of the research "Patient monitoring system using Medical IoT". I would like to thank Prof. Kishor T. Patil & Prof. Dipti V. Chandran of Smt. Indira Gandhi College of Engineering, for this guidance. Having learn so many things from this and they motivated me strengthened my confidence in doing the thesis. We express our deepest gratitude for his valuable suggestions and constant motivation that greatly helped the presentation work to successfully complete. Throughout the presentation work, his useful suggestion, constant encouragement has given me a right direction and shape to my learning. If we can say in words, we must at the outset of my intimacy for receipt of affectionate care to Smt. Indira Gandhi College of Engineering for providing such a simulating atmosphere and wonderful work environment.

REFERENCES

[1] vIOT based Patient Health Monitoring System: https://www.irjet.net/archives/V4/i3/IRJET-V4I3610.pdf

[2] vIoT Healthcare: "Design of Smart and Cost-Effective Sleep Quality Monitoring System" Khizra Saleem, 1 Imran Sarwar Bajwa, 1 Nadeem Sarwar , 2 Waheed Anwar , 1 and Amna Ashraf1

[3] Alexandros Pantelopoulos, Nikolaos G. Bourbakis," A Survey on Wearable Sensor-Based Systems for Health Monitoring and Prognosis",Publisher: IEEE DOI: 10.1109/TSMCC.2009.2032660.

[4] "A systematic literature review on IoT gateways"
Author links open overlay panel Gunjan Beniwalab, Anita Singhrovaa. https://doi.org/10.1016/j.jksuci.2021.11.007

[5] IoT Ecosystem: A Survey on Devices, Gateways, Operating Systems, Middleware and Communication Sharu Bansal, Dilip Kumar.

[6] Functional nanofibers in lithium-ion batteries H. QIAO and Q. WEI, Jiangnan University, China

[7] Analysis of capacity–rate data for lithium batteries using simplified models of the discharge process

[8] Utilization of the Battery Recovery Effect in Hybrid and Electric Vehicle Applications Andreas Baumgardt, Florian Bachheibl, Dieter Gerling University of Federal Defense Munich

[9] Sleep Disorders and Sleep Deprivation: An Unmet Public Health Problem. Institute of Medicine (US) Committee on Sleep Medicine and Research; Colten HR, Altevogt BM, editors. https://www.ncbi.nlm.nih.gov/books/NBK19956/