IoT based Patient Health Care for COVID 19 Centre

Shreerang J. More, Pranav S. Patil, Jitendra M. More, Prayag S. Patil, Satish S. Marathe

Abstract: ***In this paper, COVID 19 centre monitoring and management system has been proposed and integration of different sensor network with Internet of Things (IoT). The sensors implemented can communicate with data collection and processing unit. The data collection done by that unit can directly transferred to cloud using internet connectivity at COVID 19 centre. Therefore work aimed to propose COVID 19 centre management with IoT based approach to handle medical services and patient monitoring and treatment work flow. In the experimented model, Node MCU ESP8266 controller and temperature sensor (DHT11) are integrated. A system has capability to monitor and control COVID 19 centre services and patient monitoring via remote connection. It is evaluated with three temperature sensors connected to measure temperature of patients. Mobile based blynk has been utilized for the cloud based IoT implementation. Sensor sends data over blynk server and then can be seen anywhere using smart phone application. In addition, when patient get fever more than regular value, an alert was sent to authority in a quick time. After results, it is indicated that the developed system has effective potential to work in pandemic situation and has technological feasibility. The benefits of implemented research methods are useful in digital health management in pandemic scenario. Even hospitals, COVID centers, intensive care unit (ICU) can be operated effectively and patient diagnosis application based on online database has wide scope in the area of internet of things and patient health management.***

Keywords: Blynk, COVID 19, Health Care, IoT, Node MCU, Sensor Network.

I. INTRODUCTION

The corona virus disease or COVID 19, has influenced the world with serious pandemic situation. This situation is associated with health issues and infection is raising all over the world. Due to which lot of infected patients need medical facilities and services with adequate resources and management. Internet serves different operations and processes than can be employed in such pandemic situations. Internet of Things (IoT) based system has strong technology area where medical diagnostics and patient database can be handled effectively. With real time integration of IoT based services, COVID 19 pandemic can be handled with significant challenges. Large number of devices are able to connect with complex networks for exchanging data with higher flexibility [1]. Proper health management has significant digital applications with monitoring and control options. It also has alert, display and control capability to serve during pandemic situations and emergency medical services. COVID 19 pandemic situation has affected all countries and problems are arising large number of people infected with novel virus. COVID 19 centre is a critical area where proper monitoring and management is needed with communication facilities. Remote monitoring and screening of patient's health. Doctors and medical support staff may have direct access to patient's health data and diagnosis record based on real time data [1].

II. LITERATURE REVIEW

Homera Durani and Mitul Sheth proposes that node ESP8266 unit used for various home applications with server based system. Home application handled/controlled by mobile user internet [2]. In this paper monitoring for system works on the wireless communication and observation of running data shown in app blynk.Various objects are wireless connected with network such as Internet of Things (IoT). Wi-Fi communication layer links for home application are used. Raspberry pi store the data and send to the application user on request [2]. D.Shiva Rama Krishnan and Subhash Chand Gupta investigated that orientation of wireless-sensing node system. This project explains about unexpected death rate through patient health monitoring system to communicate the problems. Temperature and heartbeat sensor are used to collect the patient health data and arduino-uno are used to the sensors [3]. In case of sudden changes data are sent to the Internet of Things (IoT). The given system was utilized for home use through patient which is not in serious conditions but depends on timely detected through doctor or family. Within a much minimum time the results for ECG, blood pressure and temperature are monitored by health monitoring system [3]. Peerasak Serikul, Nuttapun Nakpong and Nitigan Nakjuatong proposed that the controlling and monitoring the things with network via internet. The modern technology used for farming which gives better performance in productivity and quality. Node MCU ESP8266 and SHT21 humidity sensor was used to send data to blynk [4]. While code generated with the help of Arduino IDE. Peoples are connected through the technology such as Internet of Things (IoT) which allows communication and data exchange. The author conclude that IoT technology should use for humidity monitoring of paddy bags which are stored inside the warehouse using smart capsules.The result shown that blynk application server could store the data from humidity sensor present inside the paddy bags [4].

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III. METHODOLOGY

Large number of interconnected devices can be connected to form a network for COVID-19 quarantine centre. Even alert and tracking system is possible to integrate with this system in order to capture the data related to the patient health status, health conditions and medical emergencies. The system may also include the set of sensors arranged in COVID quarantine facilities to maintain record and entry exit logs for tracking patients or infected people. Decision making based on data collected via the smart system may help in more convenient and faster way. Analysis of patient quarantined in COVID-19 centre is based on the set of devices and sensors like temperature probes, Electrocardiogram sensor (ECG), blood pressure sensor, SPO2 pulsioxi meter, etc. Proposed system includes IoT framework for complete quarantine centre management through cloud based platform.

The medical sensors allotted to gather the data and real time information related to health status of the patients e.g. body temperature, heart beats and activity, blood pressure, oxygen level in blood etc. These sensors can be connected such that they can work together with communication standards. Quarantine centre with central processing unit can handle the complexity of computations and information handling. In this paper, ESP 8266 embedded device is utilized to share data with the central information management system via cloud based platform. Sensor data transferred blynk platform with IoT implementation.

IV. COVID-19 CENTRE MANAGEMENT

A. Building Network Deployment

As centre building needs to be connected to the cloud, it should have network related devices and communication services. Even communication networks like Wi-Fi, RS232, ETHERNET, and RS 485 can work together for connecting to devices and communication equipment.

B. System Installation

The system requirement includes connectivity based on IoT solution and architecture. Even it should be easy to access, deploy in server and other data storage. All application interface based on web service method needs to be developed for continuous monitoring and decision taking. Doctors, medical research centres and government organizations should be connected in parallel reporting structure. Mobile based applications and web services also found to be useful for faster and time saving solution for immediate assistance and monitoring in COVID 19 situation.

Real time monitoring of patient health status under the COVID 19 treatment with IoT platform development. The health reports and status are followed with the set of procedures:

1. The patient body condition is monitored with the network of sensors. Doctors can investigate and visualize data for the COVID 19 patients and their health status in accordance with condition of severity.

2. The treatments and historic health records of patients can be accessed through database. The information is possible to download and store in local devices. Thus doctors and other medical persons also able to check and monitor patient records and recovery rate.

3. Team of people monitoring COVID 19 centre supplies and resources must be assigned with digital devices and smart wearable. Intercommunication of security and other agencies makes efficient way of handling all the operations related to management of pandemic conditions.4. Entry - Exit of assets and people i.e either patient, belongings, equipment, vehicles etc. needs to be checked for attendance and timely service. Data related to visited people, time period, vehicles entry - exit provides information to sense operations and safety rules.

5. Within COVID 19 centre, challenges occur in integrating IoT system and database management. Critical data related to patients and health status needs to be gathered. Such data is really valuable for evaluating reports of patients. Even real time status of condition of severity and diagnosis is monitored as well as stored in database for the use of doctors and medical research purpose.

V. PROPOSED ARCHITECTURE

An implementation of an internet of things for a COVID 19 centre requires certain strategies. It also includes deployment of cloud based connected devices. Different devices having capability of fetching data over internet are arranged inside COVID 19 environment. Afterwards patient wards and emergency rooms are equipped with digital sensor network and connectivity so that health data can be collected. Sensor network by means of sensors like temperature probes, blood pressure sensor, etc. are connected to internet via data collection and processing unit. These sensors are able to perform screening and measurement of patient's health related factors such as blood pressure, body temperature, etc. Real time working and monitoring is possible with these deployed sensor network. Each patient within COVID 19 centres should be kept under observation and health check-up status time to time. Sensing slight abnormalities within the patient's health can lead to cause critical situations and COVID 19 treatment protocols.

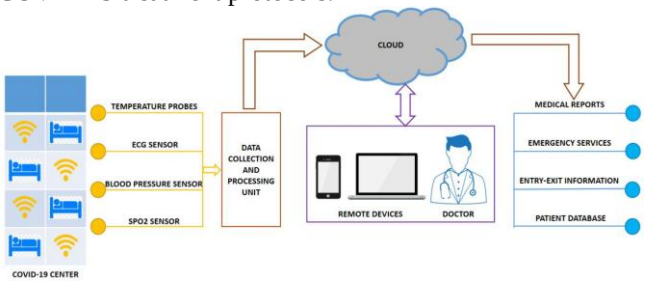

Fig.1 Proposed architecture for COVID - 19 centre management

COVID 19 centre management is based on the internet connectivity having IoT based solutions to assess patients and records in pandemic situations. Proposed system enabled with real-time health status monitoring for patients under COVID 19 centre as shown in Fig.1. The set of medical devices including sensors and diagnostic equipment are arranged and connected such that they will provide necessary data to the data centre and cloud. Also end users may include government agencies or doctors who are able to take decisions based on the situation and database sources. In our model, sensors are deployed in the dedicated COVID - 19 observation wards with connected network for exchanging information. These sensors are able to gather patient's data and health status into the data collection and processing system.

The system unit then transforms this data into usable format with the help of software and tools for data processing and storage. Afterwards distributed network is arranged to exchange the data across the cloud based service. This data is authenticated for the use of doctors and government health care units dedicated for COVID 19 emergency services.

VI. SYSTEM DESIGN AND IMPLEMENTATION

Patient heath status was assessed with the help of data received from sensors. Electronic equipment like diagnosis machines, lab test devices can also collaboratively work with this data to predict more accurate case reports. Here sampling test has been carried out with the measurement of temperature with DHT 11 module. As DHT 11 can specify the readings with more precise way in order to collect and produce results. Computer system with temperature measurement setup has been shown. It has connectivity to cloud service via use of internet enabled Node MCU.

A. Iot Architecture

The first layer of IoT architecture is physical layer. This layer is supposed to connect all the necessary sensors which are required for patient health monitoring system for COVID-19 second layer of architecture is data link layer which consist of Node MCU which handles the various protocols required for reliable communication throughout the network. This layer mainly uses Wi-Fi for the communication and network routing. The data sensed by the sensor connected at the physical layer, is send to the cloud based system (Blynk for this system) to access the data at the remote location by the doctors and health organizations. This data can be monitored on smart phones, tablet etc. Doctors and medical officers are controlling the rights to decide management of COVID-19 centre. System is powered and connects to user's device e.g. for users such as doctors, medical researchers, government organization and enabling servers to manage all database for the required scale.

B. Node MCU

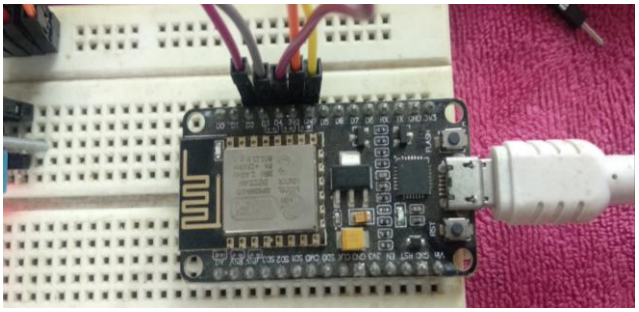

Fig.2 Node MCU

Node MCU is a Small in size micro controller which has inbuilt Wi-Fi connectivity chip called ESP8266 and have compatibility with many sensors. We are using this chip for collecting the data related to patient health and ESP 8266 is used for transferring the data to cloud.

Doctors are able to access that cloud stored data in real time and if any critical and emergency situation occur then they can take action on it.

C. ECG Sensor

The ECG sensors are place on skin surface in the form of electrodes which are able to detect changes in heart activities. The activity of heartbeat comprises of muscles selector physiologic pattern and reflects as a result of depolarizing and re-polarizing action. Most preferably 12 lead electrocardiograms are used for ECG tracing of COVID-19 patients. The ECG sensor collects the signals from the body of patient and these signals are first amplified to improve the signal strength. The ECG generated data is transferred to the cloud using specific protocol like TCP/IP via internet connectivity

D. DHT 11

The most common factor in COVID 19 positive patients is fever. So as per treatment perspective, measurement of temperature of patient's body is highly essential during hospitalization state. The sensor features a temperature & humidity sensor complex with a calibrated digital signal output.

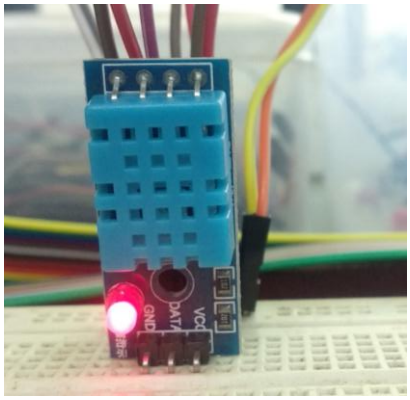

Fig.3 Temperature sensor

As the value of temperature and humidity data output as a serial data. The electrodes are on the surface of the component which is a moisture holding substrate. As the substrate absorbs water, ions that increase the conductivity between the two electrodes are released. This change in resistance is proportional to the relative humidity. The resistance between electrodes will decrease with higher relative humidity and increase with lower relative humidity. Temperature and humidity both data are in serial form.The sensor data pin gives :-

- 8-bit humidity integer data
- 8-bit the humidity decimal data
- 8-bit temperature integer data
- 8-bit fractional temperature data
- 8-bit parity bit.

E. Blynk

For our system, we specially need fast operating, user friendly and compatible software solution which satisfied by Blynk app. This is an open source IoT platform which is user friendly and as well as compatible with most of the android and IOS systems. Blynk platform provides a user friendly dashboard where user can add different components such as Gauge, graphs, GPS location and much more. In our system, we are going to use gauge and graphs to monitor the different parameters from the patient's body. Blynk app provides notification alerts facility, which can be used as an alert for doctors and paramedics in case of a medical emergency.

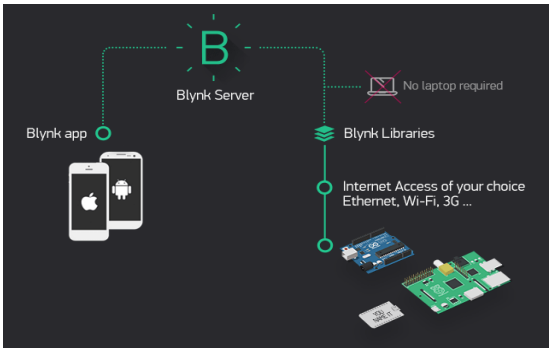

Fig.4 Blynk architecture [9]

The important things for this system are Node MCU, blynk library and smart phone application. Application creates an interface between user and upcoming data. Blynk library enables Node MCU to send the data to blynk server.

VII. SYSTEM FLOWCHART

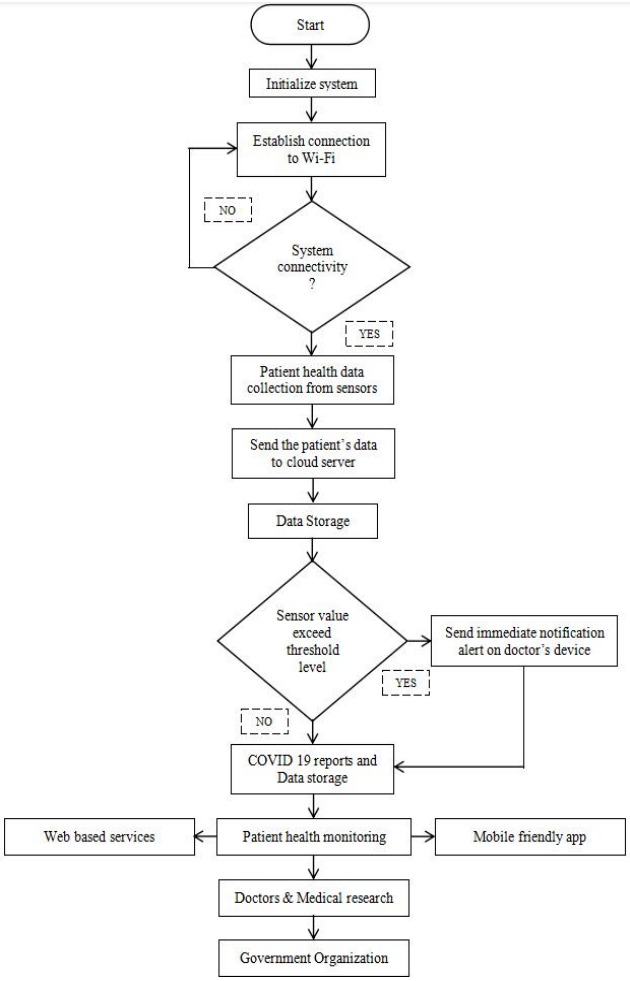

Fig.5 Flowchart representation

VIII. EXPERIMENTATION AND WORKING

IoT based network for sensors and patients within building are integral part of operational strategy. Use of micro-controller within experimentation phase was more desirable rather than setting up a large network. So temperature monitoring and record was achieved with hardware components like Node MCU and interfacing DHT 11 with the mentioned framework. A sampling was carried out for the patient's body temperature changes and recorded results along with the IoT based environment. We have justified the system level performance and temperature data. The plot shows the descriptive visualization based on the time based temperature quantity and variation within sampling period. ESP 8266 offers the connectivity and association of the resulted data with IoT.

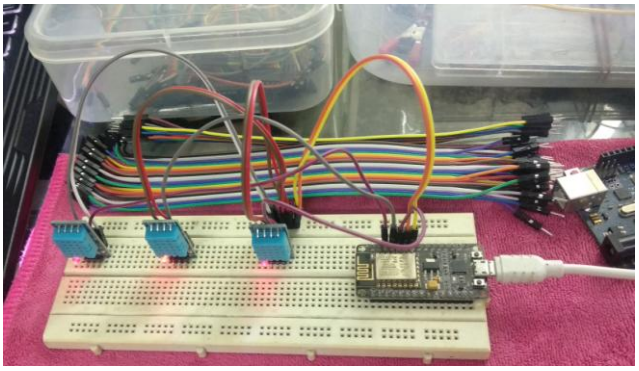

Fig.6 Experimental setup

Afterwards the data needed to be send to web server i.e. blynk platform based on the connectivity. Data in the form of reading information is stored in database and can be seen by user at any condition and place. Stored information can be utilized for future analysis of database.

A sampling was carried out for the patient's body temperature changes and recorded results along with the IoT based environment. We have justified the system level performance and temperature data. The plot shows the descriptive visualization based on the time based temperature quantity and variation within sampling period. ESP 8266 offers the connectivity and association of the resulted data with IoT.

The sensor data can be fetched to user device via private server with ESP 8266. The overall monitoring and control system has provision for IoT based platform i.e Blynk app installed in user device. It helps to get status of patient via blynk based on android OS is installed within smart phone system.

A. Blynk Dashboard

Blynk application will consist of multiple types of widgets. Initially every blynk user receives 2000 energy after launching the application. The various widgets in blynk application needs various energy. So initially user can use only specific number of widgets in the dashboard. If user needs more widgets, then user can parches the energy.

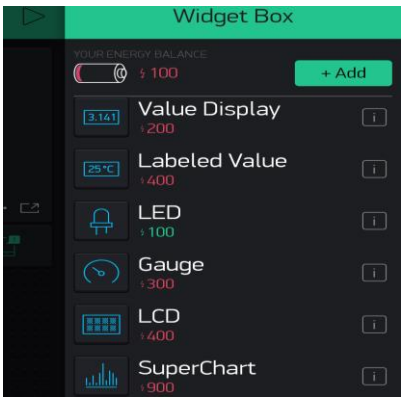

Fig.7 Blynk dashboard and widget box

Widgets used here are:-

- Value display:- This widget shows the incoming sensor data in digital. If user wants information with labeled value, then user can use 'Labeled Value' widget, which shows information with specified label.
- Super chart: - This widget shows the incoming sensor data in graphical format. User can modify the interface of widget according to preference. Here user can also add multiple inputs and can display it on same graph.

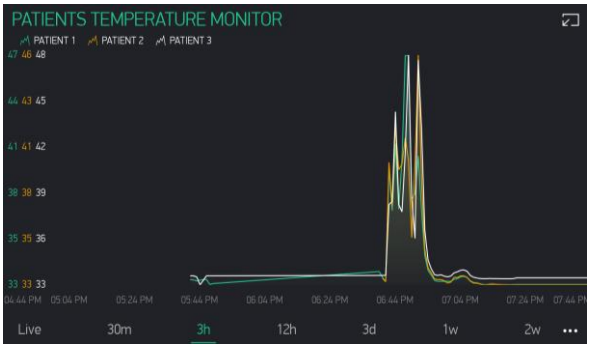

Fig.8 Patient data monitor on super chart widget

- Notification:- This widget is mainly used for sending notification on the user's smart-phone. User can set the threshold value in the program, so if threshold value exceeds the limit, then application will automatically send notifications on the user's device.

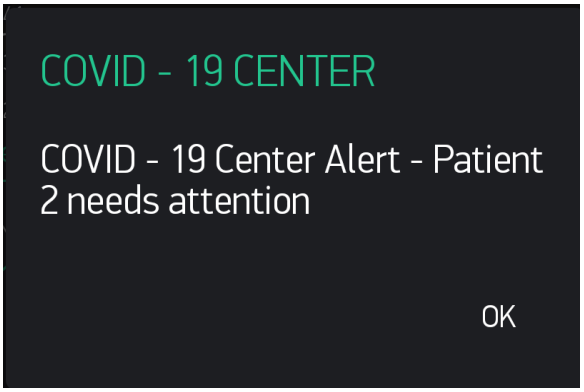

Fig.9 Blynk notification

Also blynk app consist of shared access facility, so that multiple users can access the data of single project. In our case, shared access will help to monitor the patient health data and it will show to multiple doctors as well as medical researchers and government organization.

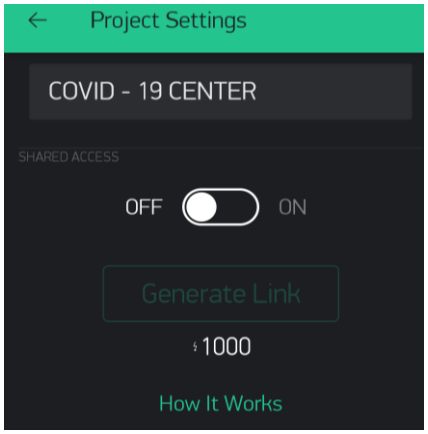

Fig.10 Blynk shared access facility

B. Widget Based data visualization

Fig.8 shows the data based on time as well as patient under COVID 19 centre. Here information related to the health status including the temperature is shown for two patients. The data was displayed on the multiple line graphs as shown in Fig. 8 and Fig. 11. Patient temperature monitoring on real time basis for days. For more convenience, there is facility for viewing historical data on the dashboard. Even database storage done over the patient data is exported to file formats i.e. CSV. With that examination and analysis activity was done.

C. Database Management

The information collected as form of database i.e. health status data received from COVID 19 centre. Then report is made according the basis of time, date and the patient's information. The report i.e. CSV files ready to share among emails of related people and management of central observation & control. It's been shown that temperature readings obtained from sensors is visible with values. It is convenient to check out significant changes in health of patients using tools such as Microsoft Excel. All the sensor data is stored via blynk IOT server with the help of internet based connectivity.

D. COVID 19 Centre Emergency Gateway

The system developed has notification capability in case of certain alerts related to health status and danger levels. Monitoring system was able to convey messages as well as able to detect happened during the working within COVID 19 centre facility. As shown in Fig.9 notification format has been displayed as per required rate of emergency. Even specific email can be transferred across medical persons and professionals. Real time alerts are able to minimize time required for treating emergencies and severe conditions of patients.

IX. RESULTS

All connected devices and medical equipment are controlled and linked with networks using hardware supported by ESP8266 board. In case of interface for doctors and medical team, the COVID - 19 patient data visualization shown in Fig.11 the system interface for one node of DHT 11.

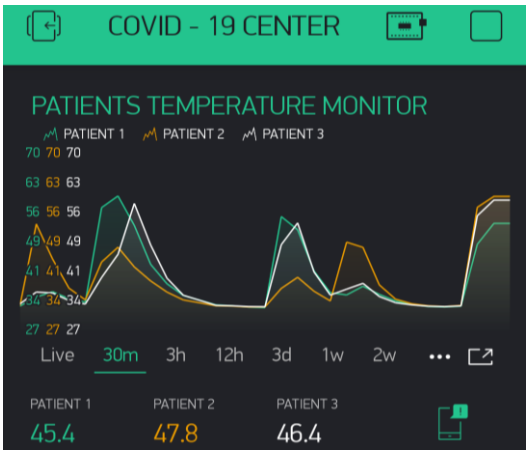

Fig.11 COVID - 19 patient data visualization

Customized blynk app gives extensive functions to monitor and control the data received from COVID 19 centre via remote connection. The blynk platform even allows user to share data or reports with other users. As soon as app starts running on device, real time as well as historical data measurements related to patient health e.g body temperature, Blood pressure, Oxygen level, Electrocardiogram, etc. can be seen at any place via remote connectivity. The described paper with COVID 19 management based on IoT system has potential to manage effective operations at hospitals, test laboratories, medicinal distributors and government offices.

X. CONCLUSION

The proposed research and methodology was done related to COVID 19 centre management with internet of things (IoT) based architecture for monitoring patient health status. According to research, it is found that blynk based application has more advantages if widgets are appropriate for mobile devices. Multiple user access with login credential is possible to work with integrated environment. Remote management has potential to minimize direct physical contact with the COVID 19 centre staff and patients. Health care services are integrated with digital technologies and connected environment. Patients with infected conditions can be handled and supervised in remote and smart way with internet based cloud services. Doctors, medicinal suppliers, researchers and government agencies can manage the database as well as making decisions in pandemic situations. Even activities like interval check-ups, patient inspection based on data reports, ringing alarms for emergency, interaction with patient via talkback chat etc. are done remotely. Doctors can also be remotely notified for certain changes, alerts or medical emergencies. Status of each patient and each COVID 19 centre among regions can be monitored on real-time basis. Similarly some alerts to security, management workforce related to fire safety, accidents, intruders detection related to violation of security can be given through digital messages or alert sounds. As internet of things (IoT) provides large level to bring up physical and virtual world together.

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