Implementation of Remote Nursing of COVID-19 Patient Based USB Camera and Wi-Fi Module

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Abstract. The medical care field is a very complicated one, because it associates with people as how far they suffer from different types of diseases, where often, an inadequate or uncomfortable environment which leads to an inconvenience results. This work will provide the technology that to make the patient environment more suitable, more comfortable, and consequential to satisfy the most patient requirements, adaptability, this system manage the number of visitors inside the patient's room so as to reduce the spreading of infections and disturbances causing by them by using IR sensor. This system uses Atmega32 as system controller with web camera attached to PC for remote monitoring of patient room, and GSM for remote communication with doctors and nurse. The web camera is controlled via stepper motor which direct the camera according to the specific position on demand. The communication between user and web camera is via software package (AnyDesk).it has ability to check up and intercommunicate between nurse staff and patient. The system is flexible and efficient with fast response during emergency conditions. Also the system introduced a health monitoring system with BLYNK mobile application to fetch patient parameters from ESP32 WIFI module like spo_2, heart rate and body temperature which will really be helpful to doctors for reviewing real-time patient data. COVID-19 is forcing telemedicine to the forefront of national attention especially remote surveillance systems, a long-overdue exposure, but it comes during a complicated crisis. Providing care beyond the traditional face-to-face model, remote systems are critical components in the ever-changing environment of a spreading epidemic.

Key words: medical care, COVID-19, USB camera, Wi-Fi module, remote nursing.

Introduction

As the result of development in information technology (telemedicine) take place by using communication technology (internet-mobiles e-mail) to exchange medical information and providing a good consulting, health care and treatment for patients. This happens remotely between patient and the service provider and no need for them to be in the same place.

The previous studies have shown that remote health care system through telephones and the detection of medical case in real time, tracking the case, making analysis and the exchange of data with the medical team, and discover a new diagnoses method is possible.

In December 2019 the world health organization declared the virus in china it is mutant form SARS –co-2, the virus Symptoms varies from someone to another it appears as continues Worsening dry cough, shortness and difficult of breathing temperature over

38dgree, muscle aches, loss of taste or smell and also loss of appetite. Kidneys, lungs, are the first organs that have direct affect. There other symptoms like vomiting diarrhoea, headache, and all the symptoms take duration about 14 days.

The virus can spread from carries and these symptoms may not appear on them beside contact to infected people and crowded places is good environment to spread the virus so the system have to avoid crowdedness, quarantine and isolation is the effective way to keep selves safe, isolation may be at home in case there no places in medical facilities (WHO, 2021).

In 2017 an investigation was executed to look for a Real Time Telehealth system using Lpc2148 to be implemented and developed to monitor and measure two physiological factors in human body these values stored in cloud technique using Wi-Fi unit, the stored data will be analysed by (Tableau) Android application and Internet of things platform (Thing Speak). If a normal value is detected, instantly the value will be sent to the doctor as well the patient family who are using GSM unit. Data will update continually (Nilay and Sawyer, 2017: 375; Mahgoub et a., 2015).

In 2018, a Real-time Heart Pulse Monitoring Technique using wireless Sensor Network and Mobile Application was suggested, the system which monitor heart beats in real time and display the results on smart phone and computer. Sensors technology is used to monitor the beats by finger print through (Arduino) controller with (Ethernet shield), so the results can be received through internet anywhere (Ali et al., 2018: 5118; Paul et al., 2016).

Problem Statement

Today many hospital uses conventional bed side patient monitoring system, these currently available systems suffer from tedious technical limitation specifically in case of COVID-19 pandemic, and those systems are expensive also require more staff to be operated.

The lack to communications with doctors in case of emergency conditions in COVID-19 emergency centre that require quick response, make it difficult for patient to get quick treatment services with high accuracy. Also the Lack of the medical experts in clinic and difficulties especially during the current pandemic and obtaining information about a supervised and control critical patient cases.

Research Objectives

The aims of this study is to develop monitoring for COVID-19 of patient health care system to works from a distance by using high efficiency and accuracy sensors and local communication networks for fast medical services in case of utilize the available critical conditions to achieve better quality patient care and to avoid crowds.

The specific objectives:

To design a prototype that implements:

1. A Heart Rate, Temperature and Spo2 Monitor System using Sensors based Wi-Fi module.
2. A monitoring system using mobile phone with android system and USB camera to make real time communications between patients and doctor.
3. Control visitors number to avoid rush by using photo-sensor.

Material and Methods

Research Plan

To provide the required communication for monitoring the location of patient and direction of imaging must be collected and selecting a suitable microcontroller, GSM

modem, USB camera and opens (Any desk) with the high accuracy to satisfy the input/output requirement.

In addition, a set of sensors or input switches can be used to provide the communication between the real world and the microcontroller for that a suitable programming language is essential for linking the selected hardware together to provide the required function.

A suitable software is essential to achieve the requirements with response to the inputs using Proteus package for Simulation, then the system will be Implemented and study the output results to test and approve them.

Block diagram of the proposed system

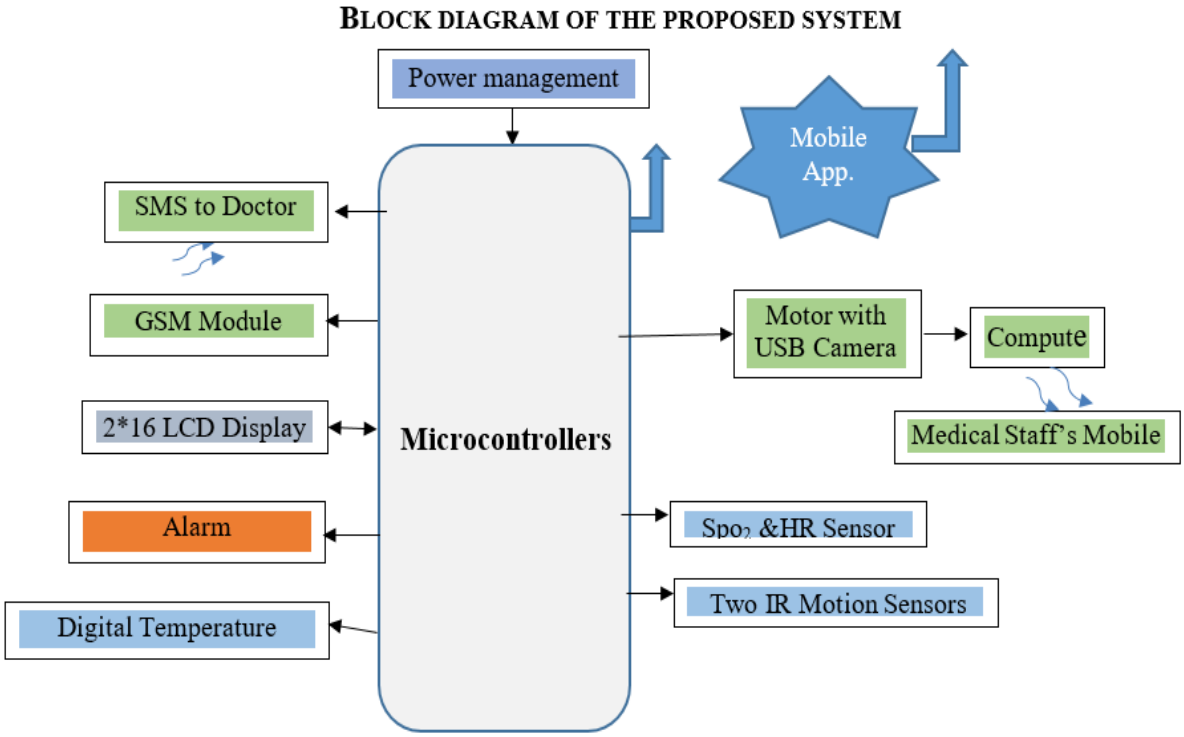

Fig. 1. Block diagram of the system (Surveillance& Remote)

In this project there are two IR sensors. IR1 detect the number of individuals entering the hospital. IR2 detect the number of individuals leaving the hospital. The system also measures heartbeat, SPO_2 and a body temperature by using (MAX 30100 IC) and Digital temperature sensor (DS18B20), data are received by ESP8266. The system receives signals from sensors and processes the data and checks the condition of the patient. if the conditions is normal then the system will repeat the same process of receiving data whenever the condition steps out the normal range. These data transmit wirelessly with help of the ESP8266 controller and it received immediately at mobile device through application and for quick response. It also uses Atmega32 for controlling drug intake.

Software of Designed System

The flowing diagram represent the flow chart that describes the procedure are sequences used in software design:

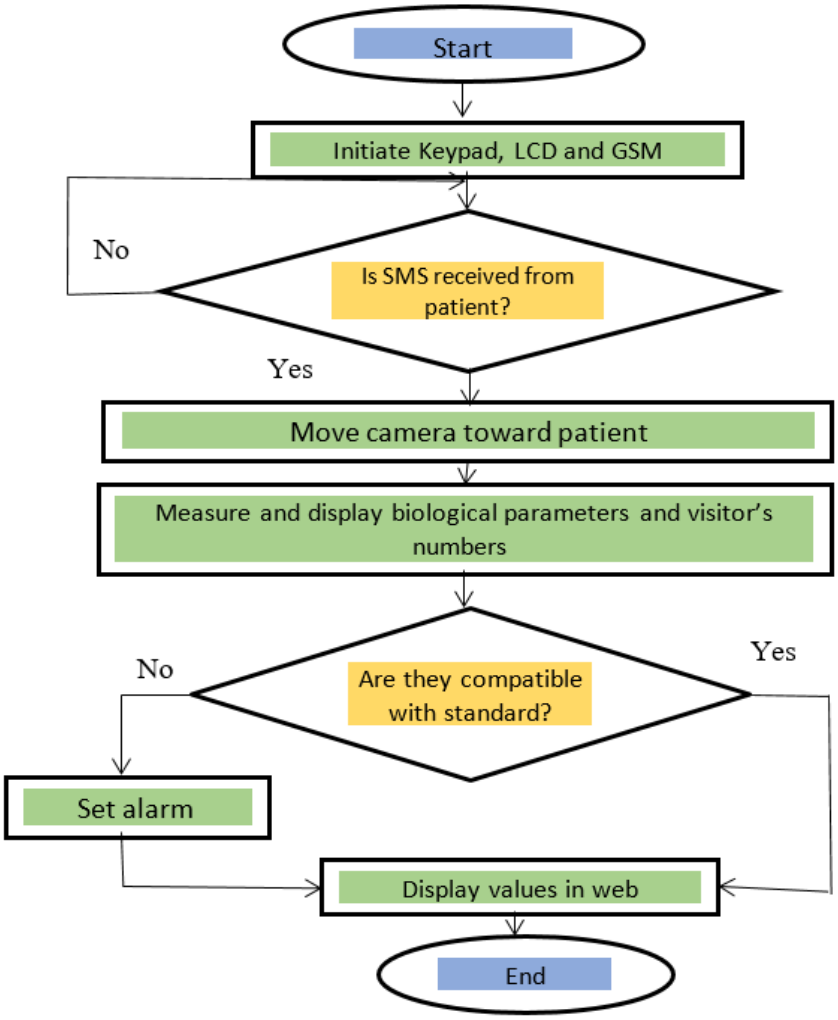

Fig. 2. Flow chart

Results

Results Analysis

To make sure that results are adequate the system compared them to a reference reading that the system get from medical patient monitor. And the system acquired the temperature, humidity and spo2 values and to be sure that system delivers proper outputs.

Table 1. Comparing Temperature Outputs with Actual Output

Age	Actual Readings	System Readings	Actual Readings
24	100	99	99.1
25	89	90	98.2
32	81	81	97
41	126	128	94.5

The system realize the results are similar to medical device reading which shows that device reading is in close range with standard medical temperature devices.

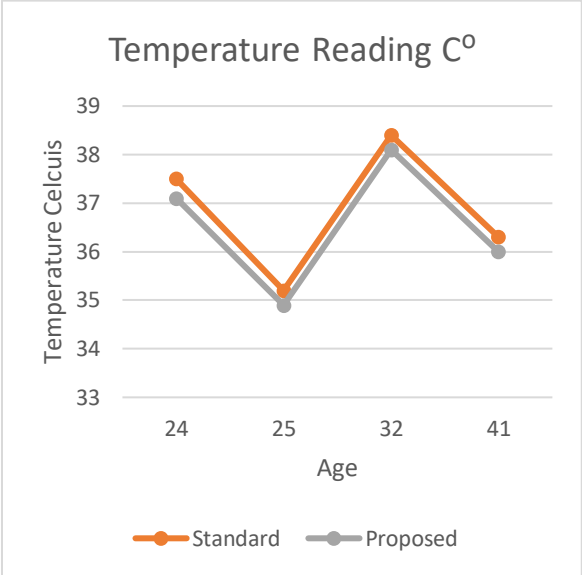

Fig. 3. Comparing temperature outputs with actual outputs

Table 2. Comparing SPO2 outputs with actual outputs

Age	SPO_2 readings from patient monitor in %	SPO_2 readings using device in %
24	99.1	98.8
25	98.2	97.8
32	97	96.9
41	94.5	94.9

From the above table the actual oxygen concentration reading from the medical device are in close proximity to own which shows that device reading is in precise and accurate and within range to the standard SPO2 devices.

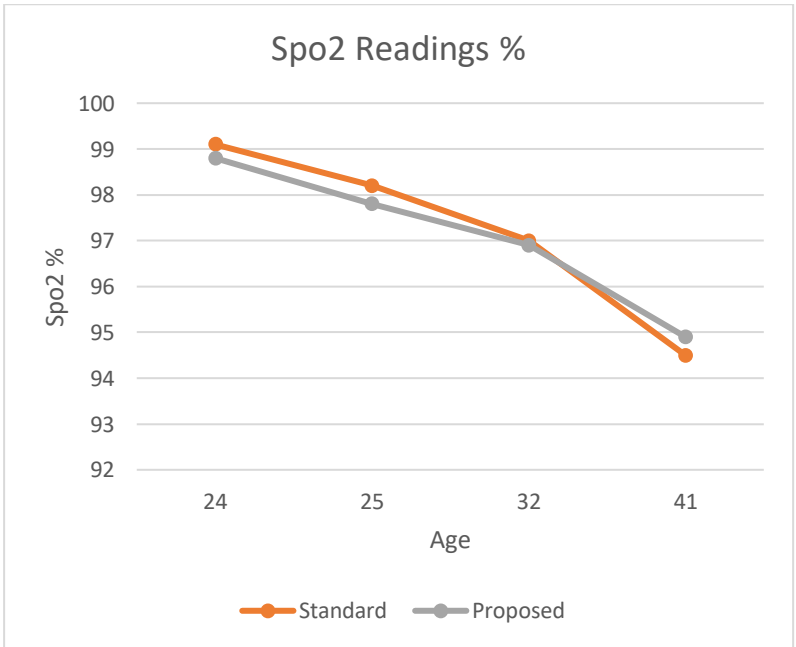

Fig. 4. Comparing SPO2 outputs with actual outputs

Table 3. Communication system with doctor and patients

Patient(Switch)	SMS	Stepper motor angle
1	Patient 1 require help	15^0
2	Patient 2 require help	30^0
3	Patient 3 require help	45^0
NO switched pressed	No message	0^0

Results Display

From the start the system activates and also tries to initiate the GSM module. This takes 5-10 seconds to establish a good connection. And it starts to blink and when it blinks slowly, the connection is a success. The output can be displayed on the LCD screen whether the connection was a Success or failure. Finally, upon drug intake time occurred the system sends an SMS message to the doctor's phone informing him that patient specific drug intake time was due. The doctor can also activate the camera which is connected to monitor the patient with "activate Camera" SMS message and also activate the real-time monitoring system to measure patient SPO2, temperature and heart rate, and send patient's results via WIFI to BLINK application for viewing results on smart phones.

Patient results received and view with BLYNK from system which indicate elevated heart rate, the number of visitors and real-time temperature readings. BLYNK also keep records of all readings in case the doctor wants to review patient history

Fig. 5. BLYNK Display for abnormal readings

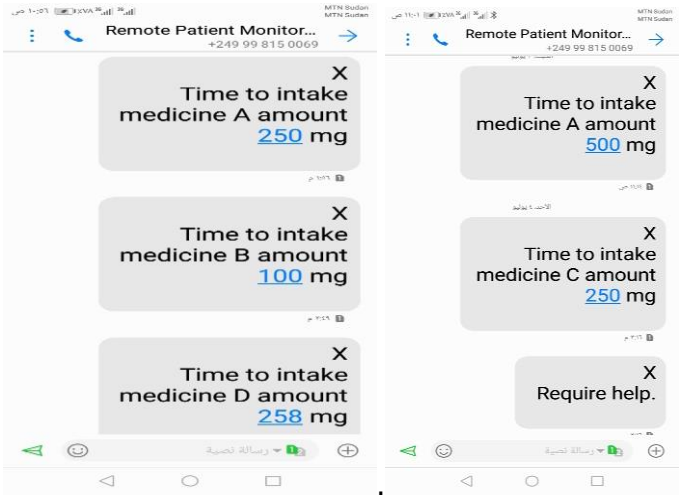

Fig. 6. Communication between system and the doctor

The above screens show the communication history between the doctor and patient circuit, which informs the doctor of patient's drug dosage and if he requires help he can monitor patient responses via installed remote camera.

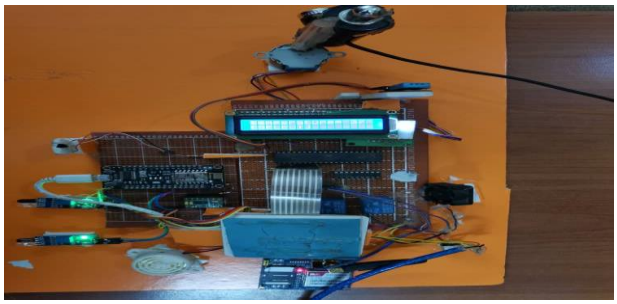

Fig. 7. Circuit Implementation

The above figures show simulated prototype of system and the next figure shows the actual implementation of the circuit which shows all different components used in designing the system.

Discussion

This prototype was the proposed system. The main objective is to concentrate system operation to used wireless and GSM communication methods. And the system was successfully and was implemented as a prototype and generated a proper result analysis. Basically real-time wireless communication is a very broad. incorporating today's technology like SMS messages to control system for easier monitoring patient's health and drug intake activities save time and manage drug intake properly, and presenting a health monitoring system with BLYNK mobile application will really assist doctors on reviewing real-time patient data. The most important objective of project was to compile a real time communication pathway between doctors and patients. With this the system have implemented and tested out prototype and in order to introduce system fully in real life more improvements, development is needed. And the main objective of system will be completed when the system uses the health monitoring system and application in real life to assist with COVID-19 pandemic.

Conclusion

The system browse the design and implementation of Remote Patient Monitoring

system based on wireless technology using a cellular phone and USB camera, therefore this system is flexible and efficient with fast response during emergency situations specially in case of COVID-19 pandemic because of its ability to operate in social distancing and relaying spo2 readings directly to the medical staff, this will really be helpful to doctors for reviewing real-time patient data.

The system can be extended and developed to measure patient necessary parameters: ECG, and Blood Pressure and send these parameters to the doctor on demand.

The system can be modified to give advices to certain patient for unsafe movement or action done by him.

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