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Development Of Smart Medidoc System For Monitoring Healthcare In Iot Environment

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Abstract

This paper focuses on the design and development of a system to monitor health parameters of the patients using IoT Technology. This system helps to measure patient's health parameters such as body temperature, pulse rate, oxygen saturation level, weight and height. The design of MEDIDOC system is performed using SOLIDWORKS software. The static structural analysis is performed on the base structure of MEDIDOC system using ANSYS software to evaluate the total deformation, equivalent stress and factor of safety. The results suggested that the structural effect on the base structure due to load is under permissible range. Then, the electronic integration with the system is carried out. The non-contact type sensors are used for all kind of measurements and controlling of various sensors are performed through NodeMCU. The collected data of human health parameters such as height, weight, body temperature, pulse rate and oxygen saturation level are displayed in the LCD screen. Hand dispenser is also incorporated in the system to avoid any kind of cross infection. The measurement data of human can be transmitted to Google sheet with the help of IoT. Hence, physician can access and validate the measurement data at any point of time. The proposed system offers efficient way of examining human health parameters and facilitates the physician to minimize the checkup time compared to conventional approach.

Keywords: MEDIDOC; Health parameters; IoT; Static structural analysis; SOLIDWORKS

1. Introduction

Modern healthcare services are one of the emerging technology which uses wearable devices or cloud of things to manage patient's data and other remote services. Majumder *et al* [2] has developed a health check-up system which used various sensors for measuring health parameters such as blood pressure, heart rate and temperature. The main components of the developed system are IR transmitter, receiver, LM-35, MPXV5050GP, data collecting unit, arduino board and bluetooth module. In general, it is known that ZigBee is considered to be very less uploading rate than bluetooth, due to which bluetooth is selected for better functionality and also it is affordable than GSM. Hasibur *et al* [3] worked an automated smart health band to measure blood pressure, body temperature and pulse rate of the human body simultaneously. They designed appropriate signal processing circuits to avoid the error incurred during random arm movements and also to minimize the noise level. Hasmah *et al* [4] established portable heart rate monitoring system which focuses on Home-smart clinic. This system is introduced to establish a network between medical assistance and patients in remotely manner. The functional role is to measure the heart rate where real time information can be collected from the patients and can be sent to doctor via internet and also acquire the previous data of patient at any point of time. Rajalakhshmi *et al* [5] investigated on development of a prototype model for the health monitoring system to measure body temperature, heart beat rate, and oxygen level of human body.

This system enables to check patient health continuously without wired communication technology. The abnormality of data can be analyzed through embedded processor support. Mohan Lal Sahu *et*

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al [6] implemented the continuous monitoring system to measure heart rate and human body temperature. GSM module is used to send the collected data via SMS. LABVIEW software with File Transfer Protocol (FTP) is used to validate the collected data in the graphical form. Neel Kamal *et al* [7] proposed the model to monitor the thermal measurements of human body and observe the human body position continuously by using real-time tracking and computer-assisted machines. They concluded that the developed system is able to report precise data at 200 samples and also helps to detect hypothermia, heatstroke, bradycardia of patient by analyzing the precise data. Gupta *et al* [8] integrated machine learning system with healthcare device to predict the future disease in the human body. Senthamilarasi *et al* [9] developed IoT based health checkup system to measure human body health parameters such as heartbeat, temperature, EEG data. Kim *et al* [10] used compact and intelligent medical sensors to measure physiological parameters of human body. They employed an adaptive load control algorithm for weakening the delay induced by ZigBee sensors. Bansal *et al* [11] designed a monitoring system for cardiac care using ECG signal analysis. Trust based decision making protocol is implemented for healthcare systems [12]. Islam *et al* [13] explored the comprehensive survey on IoT based healthcare systems. Jung *et al* [14] investigated on flexible health monitoring system attained through wearable sensors to measure bio medical signals. Thwe *et al* [15] approached wireless technology to monitor the physiological parameters such as body temperature and heart rate through RF network. They experienced that the system able to collect the history of patients easily and quickly. Hasim *et al* [16] carried out experiments to monitor the temperature and humidity at both indoor and outdoor environment by IoT application. In this study, design and development of a system to monitor healthcare of the patients using IoT Technology. This system helps to measure patient's health parameters such as body temperature, pulse rate, oxygen saturation level, weight and height.

2. Methodology

The methodology employed in this study is shown in Fig. 1. Initially, MEDIDOC system is designed by considering the electronic components integration. Then the base of system is designed with wood material and analyzed using ANSYS software. Then interface between software and hardware is achieved via Arduino software. Finally, the sensors are used to collect the data and stored in the Google sheet.

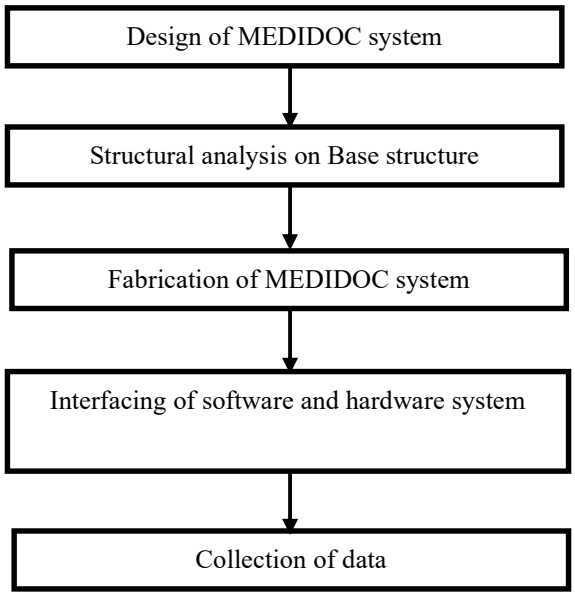

Fig. 1. Methodology

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3. Design of MEDIDOC system

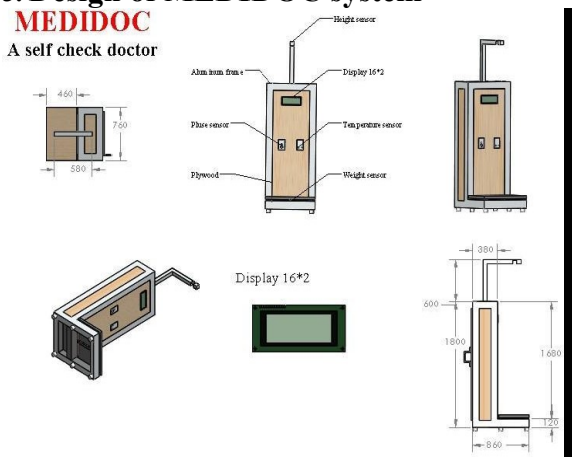

Fig. 2. Design of MEDIDOC system

Fig. 3. Developed MEDIDOC system

The base structure of system is designed with the dimensions of 860 mm x 760 mm x 120 mm. The vertical column of MEDIDOC system is maintained with the length of 1680 mm, which is made up of aluminum frame and plywood. It consists load cell, pulse sensor, temperature sensor, height sensor and LCD display. The design of MEDIDOC system is performed using SOLIDWORKS software which can be seen from Fig. 2. The developed MEDIDOC system is shown in Fig. 3.

4. Static structural analysis of MEDIDOC system

The static structural analysis is performed on the base structure of MEDIDOC system using ANSYS software to evaluate the total deformation, equivalent stress and factor of safety. The boundary conditions of base structure are shown in Fig. 4. The bottom edges are fixed and the load of 800 N is applied at the top surface of base structure. Fig 5-7 shows the static structural analysis results which express that the maximum total deformation is obtained at the center portion of base structure. The equivalent stress of 0.21 MPa is attained at base structure which is less than permissible value. It is also identified that higher factor of safety is achieved at the entire portion of base structure.

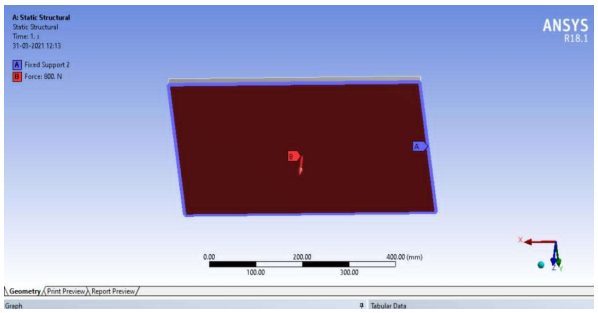

Fig. 4. Boundary condition of base structure

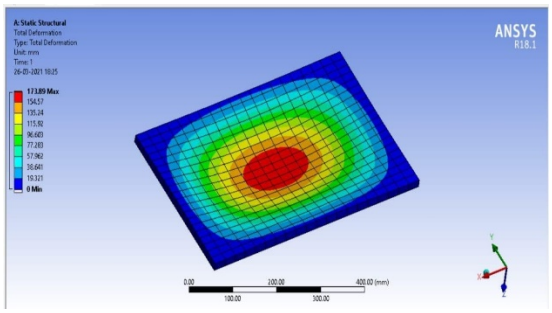

Fig. 5. Total deformation of base structure

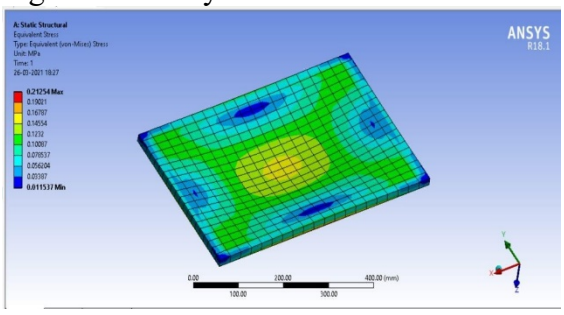

Fig. 6. Equivalent stress of base structure

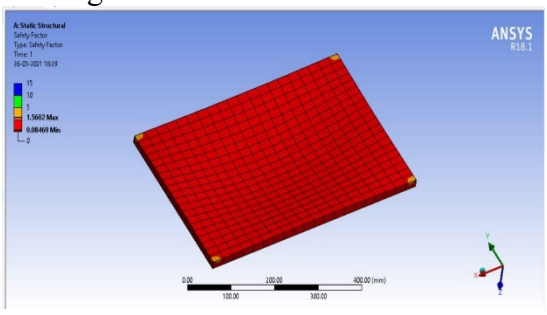

Fig. 7. Factor of safety of base structure

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5. Integration of Electronics system

Fig. 8. Display of Height

Fig. 9. Display of Temperature

Fig. 10. Display of Heartbeat

Fig. 11. Display of Weight

DATA

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	A	B	C	D	E	F	G
1	DATE	TIME	WEIGHT(Kg)	HEIGHT (cm)	PULSE RATE	TEMP (Celcius)	
2	23/3/2021	3:47:15 PM	65	163	66	36	
3	23/3/2021	4:12:05 PM	53	160	60	37	
4	24/3/2021	7:05 AM	62	157	62	40	
5	24/3/2021	8:10:06 AM	57	162	60	38	
6							

Fig. 11. Collected human health parameters in Google sheet

The load cell is fixed the bottom of base structure to measure human body weight. Ultrasonic sensor (HC-SR04) is used to identify height of the person. The digital non-contact infrared thermometer of MLX90614 is used to detect the body temperature when the wrist position getting close to temperature sensor. The pulse rate of patient can be measured when the patient places his thumb finger on the pulse sensor for few seconds. When the patient places his index finger on the pulse oximeter, the saturation level of oxygen can be measured. Then the mentioned sensors are connected with NodeMCU and Arduino IDE programming is simulated. The collected data of human health parameters such as height, weight, body temperature, pulse rate and oxygen saturation level are displayed in the LCD screen as shown in the Fig. 8-11. Finally, NodeMCU will transmit all the collected data of the patients to Google sheets in a wireless manner as shown in Fig. 12.

6. Conclusion

MEDIDOC is a self-check doctor that is used to find the health parameters like weight, height, pulse rate, body temperature, oxygen saturation level of the patients. This monitoring system is more easily accessible, run for a long period of time so that the patient can be given medical assistance more rapidly. The information regarding the patient's health is uploaded to Google sheet with the help of IoT (Internet of Things) technology, where doctors get accessibility to view the data and give prescription to the patients. This system helps in reducing the amount of time spent by the patients in checking up their health parameters and also reduces the manpower, since they have to move from one place to another for each different check-up and have to look for the medical representative to assist the patients. MEDIDOC system is designed in such a way that every patient finds it easy to operate and get their health check-up done in a short span of time.

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