International Journal of Electrical Engineering.
ISSN 0974-2158 Volume 16, Number 1 (2023), pp. 1-8

https://dx.doi.org/10.37624/IJEE/16.1.2023.1-8

A Patient Health Monitoring System based on IOT

***Mrs. P. Mamta, G. Gayatri, A. Bhavana, P. Akhila, Mehanoor Tabassum and J. Meghana**

Electrical & Electronics Engineering,
Department G.Narayanamma Institute of Technology and Science Hyderabad, India
**Assistant Professor email: mamta.srinivasulu@gmail.com*

Abstract

In the past, medical facilities were the usual place to monitor physiological signs such as heart rate, SPO2, respiration rate, ECG, and temperature. However, with the advancements in technology, a wide variety of sensors have been developed that allow individuals to monitor their health. Combining the Internet of Things (IoT) and microcontrollers is a modern way to initiate patient monitoring systems. The Atmega328 microcontroller collects the data from sensors and wirelessly communicates using ESP8266 to an IoT website. The collected data is accessible for analysis and day-to-day readings are sent to physicians who can prescribe medication and recommend exercise practices to improve the quality of life of an individual and prevent diseases. The system includes sensors such as the LM35 temperature sensor, MAX30100 SPO2, and heartbeat sensor, AD8232 ECG sensor, and respiration rate sensor to track the individual health. All these sensors are connected to the Atmega328 microcontroller which is interfaced with an LCD display and Wi-Fi connection to send the data to Thingspeak. Therefore, this IoT-based patient health monitoring system effectively monitors the patient's health.

Key Words: IOT, ECG, MAX30100, THINGSPEAK, ATMEGA328

1. INTRODUCTION

The healthcare industry is shifting towards remote patient monitoring using IoT technology. In [**1**] it is presented a smart healthcare system connected with IOT. The presented system is able to monitor the condition of the individual remotely such as temperature, heart rate, ECG, etc. These systems collect and analyze patient health data remotely, allowing healthcare providers to monitor patients in real time from anywhere. This revolutionizes healthcare delivery, particularly for chronic disease management and continuous monitoring. IoT-based remote health monitoring systems have the potential to save lives for patients with critical health issues. The author describes the importance of a device that monitors a patient's health by measuring the heart rate continuously [2]. These values are stored in a cloud platform like Thing Speak. Ensuring data accuracy is crucial, avoiding incorrect information due to instrument failure or communication errors. In [3] have proposed a system for monitoring the oxygen level, heart rate, temperature parameters. The physician can track the patient's record as the data is stored. These systems utilize connected devices and sensors to remotely collect and monitor patient health data, transmitting it to healthcare providers for analysis and proactive care. Unlike the reactive approach of traditional healthcare, IoT-based monitoring enables proactive and personalized care, preventing complications, reducing hospitalizations, and lowering healthcare costs. In [4][5] authors discussed a system that could trace an individual ECG that will be sent to the concerned doctor. Thus, the system helps in identifying various cardiac problems. The project's main controlling device is an Atmega328 microcontroller. ATMEGA328 microcontroller interfaces with various sensors including AD8232, MAX30100, LM35, Respiration Sensor, and the esp8266 Wi-Fi module. It continuously reads sensor data and uploads it to the Thingspeak cloud, along with date and time information, to monitor ECG signals in the ATMEGA328. The rising prevalence of chronic diseases and aging populations has driven the demand for IOT-based patient health monitoring systems. These technologies can enhance patient health monitoring, Early detection and intervention and Personalized care. The paper is structured as follows: Sec.2 is Hardware Description and Working. Sec.3 presents result and analysis of the system. The Conclusion of the study is presented in Sec.4.

2. HARDWARE DESCIPTION AND WORKING

The fig 1 represents the block diagram of patient health monitoring system. It consists of a temperature sensor - LM35, an SPO2 sensor, a heartbeat sensorMAX30100, an ECG sensor- AD8232, and a respiration rate sensor for tracking the patient's health. All the sensors are connected to the Atmega328 micro controller, which is in turn interfaced to an LCD display and Thing speak through a WiFi module-ESP8266. The system sends the data to Thing speak wireless and works on a 5V power supply. A crystal oscillator of 11 MHz is connected to the micro controller to provide a stable output. An LED indicator indicates whether the system is ON or OFF.

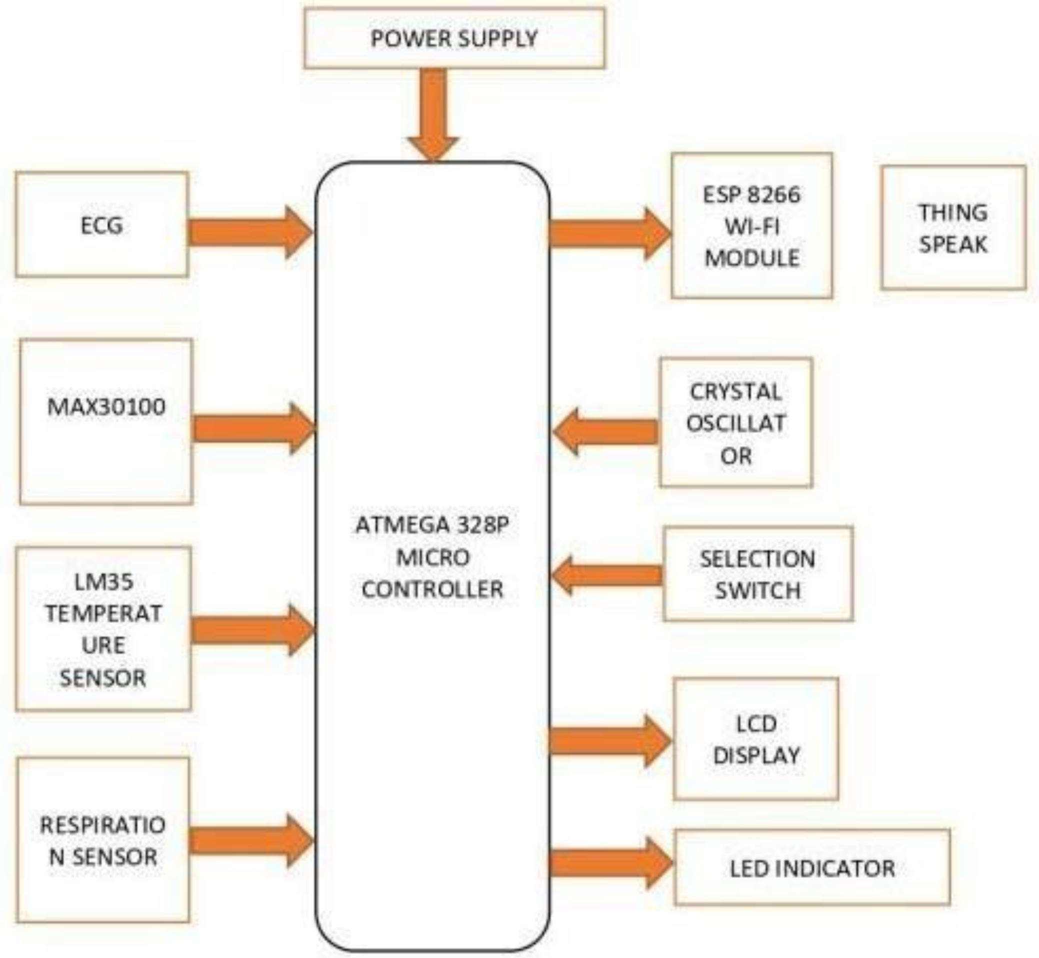

Fig 1: Block diagram of patient health monitoring system

ATMEGA328P

The ATMEGA328P-PN is widely used as a microcontroller and is particularly notable for being a key element in various Arduino board products. It serves as the central 8-bit RISC processor in the Arduino Uno and Nano models, capable of operating at a maximum clock frequency of 20MHz. It offers 32KB of program FLASH memory and 2KB of RAM.

LM35 Temperature sensor

The LM35 sensor series consists of highly accurate integrated-circuit temperature sensors that exhibit a linear relationship between voltage output and Celsius (Centigrade) temperature.

MAX30100 sensor- Heart rate and SPO2

The MAX30100 is a sensor specifically developed for wearable devices like smartwatches and fitness trackers. It serves as a pulse oximeter and heart rate monitor, utilizing both infrared and red LEDs along with a photo detector to measure the user's blood oxygen saturation level and heart rate.

RESPIRATORY SENSOR

Respiratory Inductance Plethysmography (RIP) sensors are commonly utilized to monitor respiratory movements by employing a flexible elastic belt wrapped around the chest and abdomen. These sensors detect changes in the circumference of the thoracic and abdominal walls during breathing. Alternatively, there are RIP sensors available in the form of a mouth mask, offering an alternative to the belt placement method.

AD8232 ECG SENSOR

The AD8232 sensor is employed for signal conditioning in ECG (electrocardiogram) and other bio-potential measurement applications. Its primary function is to amplify, extract, and filter bio-potential signals, which are typically small and prone to noise interference caused by electrode displacement and motion.

Esp8266 Wi-Fi module

The ESP8266 Wi-Fi Module is a self-contained system- on-a-chip (SOC) that includes an integrated TCP/IP protocol stack. It enables any microcontroller to connect to your Wi-Fi network. The ESP8266 can operate in two modes: it can either act as a standalone application or handle all Wi-Fi networking tasks for another application processor, relieving it of networking responsibilities.

THINGSPEAK

Thingspeak allows sensors, instruments, and websites to transmit data to the cloud, where it can be stored in private or public channels. Typically, it consists of an embedded operating system and the capability to communicate with the internet.

The whole system works on 5V DC. The heart of this device is the Atmega328 microcontroller, which allows us to measure temperature, SPO2, heart rate, respiration rate, and ECG. Initially, the Atmega328 microcontroller was programmed such that it calculates the values from the signals given by the sensors and displays them on an LCD screen. It also uploads the same values wireless to the Thing speak website through ESP8266. To do this, we need to program the ESP8266 module with a suitable WIFI name and password of our choice. Then, we need to go to the settings on our mobile device and select personal hotspot settings. We can then change the name of the hot spot and password to match those provided to the ESP8266 module. This will provide an internet connection, so we should turn on the hot spot and mobile data on

our phones. Now, we can log on to THINGSPEAK.COM using our login credentials to read and store the real-time measured values every 15 seconds.
As soon as the device is turned on, a pop-up message will appear indicating that it is connected. When we place our finger on the LM35 sensor and MAX30100 sensor, the heart rate, SPO2, and temperature appear on the THINGSPEAK website along with the date and time. Similarly, when we wear the respiratory sensor on our mouth, the real-time respiration rate appears on thingspeak. For ECG, we need to use three leads: red for the right arm, yellow for the left arm, and green for the right leg. This data is displayed on the LCD screen and saved on a PC for later analysis as shown in fig 1.

3. Result and analysis

Fig 2 shows a graphical representational ECG in mV and Respiration/min, fig 3 shows the Heart rate in BPM and temperature in degrees.

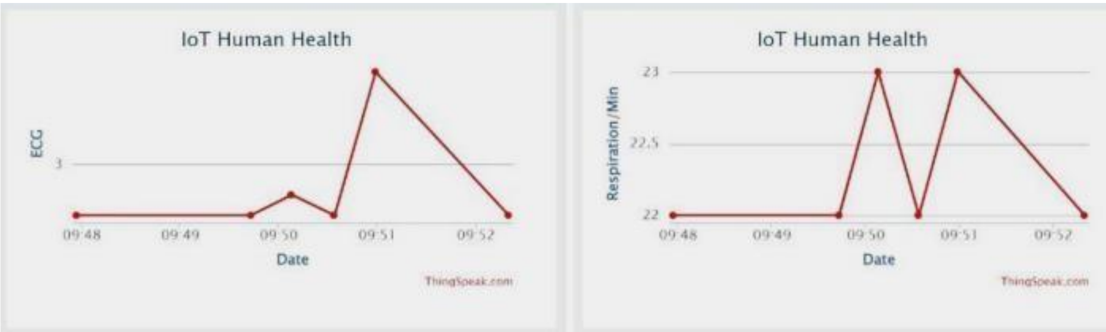

Fig: 2 Graphical Representation of ECG and respiration.

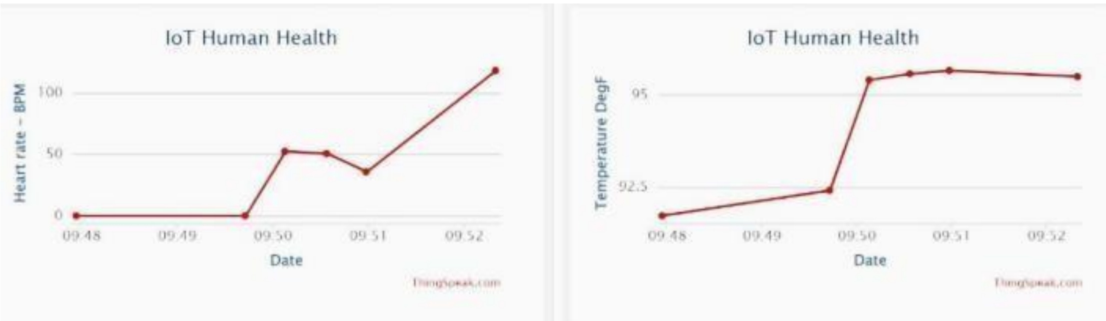

Fig:3 Graphical Representation of heart rate and temperature.

Sample survey (Test results)

Table 1: Sample survey test results

Person	Age	Temperature (°F)	ECG	SpO2%	Heart Rate(beats/min	Respiration(breaths/ min)
1	5	98	3.5	99	105	36
2	7	97.5	3.5	97	100	33
3	9	98	3.45	98	102	31
4	10	96	3.42	98	96	30
5	13	96.5	3.39	95	89	28
6	15	98	3.28	96	87	26
7	18	95	3.25	95	95	22
8	21	96	3.22	96	88	18
9	23	95.5	3.21	97	91	16
10	27	97.5	3.18	98	89	15
11	33	95	3	95	85	14
12	35	94	3	95	91	14
13	39	96	2.9	97	85	13
14	43	95	2.8	95	84	13
15	47	94	2.7	96	82	12
16	52	95	2.65	95	81	12
17	55	96	2.6	96	80	11
18	60	95	2.6	95	81	12
19	65	94	2.59	95	80	11
20	72	94.5	2.5	94	79	10

The above test results are the values obtained by conducting a survey on different age groups. The values are measured from the age of 5 years to 72 years.

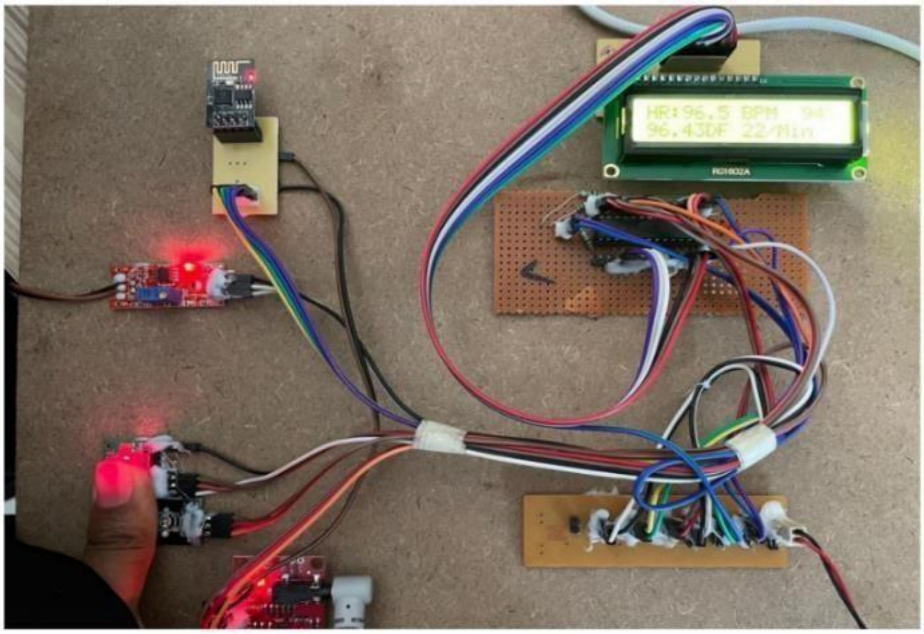

Fig: 4 Measured Values on LCD Display

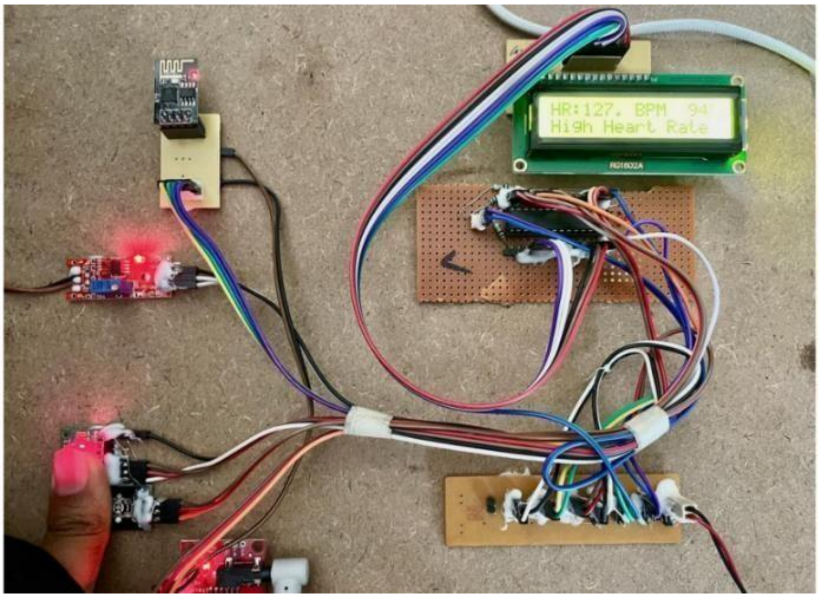

Fig :5 During Abnormal Conditions where the heart rate is above the normal value.

4. CONCLUSION

The system accurately monitors physiological signs such as heart rate, SPO2, respiration rate, ECG, and temperature. Combination of IoT and Arduino is a new way to introduce the Internet of Things to the patient monitoring system. The AT-mega 328 microcontroller collects data from sensors and transmits data wirelessly using ESP32 to the IoT- website. we can also identify some of the diseases existing in a person, the rise or decrease in any of the parameter may help us to detect abnormalities. Hence, wireless data transmission over internet, health related data can be sent to doctor's personal computer or on his mobile. So, no need to visit hospital every time and can get immediate remedy related to the health condition.

REFERENCES

[1] Rao K.R.R.M., Nath K.V.S., Krishna K.V.N.H., Kumar D.P., Manikanta V., Basha F.N. (2019), 'Iot based smart health monitoring device', International Journal of Innovative Technology and Exploring Engineering, 8(6), PP.157-160.

[2] Kishore K.H., Harsha S.P.S., Allu S.S.K., Teja P., Raghuveera E., Basha F.N. (2019), 'Iot based heart rate monitoring using iot', International Journal of Innovative Technology and Exploring Engineering, 8(6), PP.167-171.

[3] M. A. Kumar and Y. R. Sekhar, 'health care monitoring system', 2015 International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS), Coimbatore, 2015, pp. 1-5, doi: 10.1109/ICIIECS.2015.7192877.

[4] A. Bansal et al., ‘Remote health monitoring system for detecting cardiac disorders’, in IET Systems Biology, vol. 9, no. 6, pp. 309-314, 12 2015, doi: 10.1049/iet-syb.2015.0012.
[5] M. M. Masud, M. Adel Serhani and A. N. Navaz, ‘Resource-Aware Mobile-Based Health Monitoring’, in IEEE Journal of Biomedical and Health Informatics, vol. 21, no. 2, pp. 349-360, March 2017, doi: 10.1109/JBHI.2016.2525006.
[6] Azian Azamimi Abdullah, October 2012, ‘Design and development of an emotional stress indicator (ESI) kit’, Conference on Sustainable Utilization and Development in Engineering and Technology(STUDENT),2012, DOl:10.1109/STUDENT.2012.6408414
[7] H. Abdullah, T. Penzel, D. Cvetkovic, ‘Detection of Insomnia from EEG and ECG’, in IFMBE Proceedings. 15th International Conference on Biomedical Engineering, vol. 43, pp. 687–690 (2014)
[8] Juan Sztajzel, ‘Heart rate variability: a noninvasive electrocardiographic method to measure theautonomic nervous system’, September 2004.
[9] Jongyoon Choi and Ricardo Gutierrez-Osuna, Body Sensor Networks Using ‘Heart RateMonitors to Detect Mental Stress’, 2009.
[10] Julian F. Thavera, b.Fredrik Ahsc, Mats Fredriksonc, John J. Sollers Ill d, Tor D.Wagere ‘A meta- analysis of heart rate variability and neuro imaging studies: Implications for heart rate variability as a marker of stress and health ’,2012.