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SMART MEDICAL MONITORING SYSTEM BASED ON ARDUINO AND MEDICAL SENSORS

Muntadhar Wahab Razzaq
E-mail: wwefor1999@gmail.com

Abstract

Background: According to trends in conversation and records technologies, artificial intelligence (AI) and the Internet of Things (IoT) have grown to be necessary in lots of facets of each day lifestyles. These technologies are critical to fashionable living, in particular as they quickly adapt to modifications in the global. Particularly, IoT is often utilized in industries such as production, agriculture, and healthcare. IoT makes it feasible for linked gadgets to reveal and examine patient facts within the healthcare enterprise, presenting greater insightful and knowledgeable know-how about human behavior. Methods: Applying the ESP8266 module for wireless verbal exchange, an Internet of Things-based fitness monitoring system become created for this look at. The MLX90614 temperature sensor, which measures body temperature, the MAX30100 pulse oximeter sensor, which measures blood oxygen tiers (SpO2), and the coronary heart price/pulse sensor (BPM), which measures blood stress, have been all integrated into the gadget. An Arduino microcontroller become in charge of the whole setup. Results: Despite the shortage of specific results within the abstract, the machine was able to measure crucial signs and symptoms together with blood pressure, frame temperature, and SpO2 in actual time through using the sensors and ESP8266 module. This allowed for non-stop affected person tracking. Conclusion: The examiner shows how IoT-based totally fitness tracking systems might beautify hospital treatment. The machine can supply precise and up to date health information in actual time through utilizing wi-fi connectivity and clever sensors, that can result in more urgent patient care.

Keywords: AI, IoT, BPM, SpO2.

بناء نظام مراقبة طبية ذكي يعتمد على ألاردوينو وأجهزة الاستشعار الطبية

منتظر وهاب رزاق

الملخص

الخلفية: وفقًا لاتجاهات تقنيات المحادثة والتسجيل، أصبح الذكاء الاصطناعي وإنترنت الأشياء ضروريين في العديد من جوانب الحياة اليومية. هذه التقنيات ضرورية للحياة العصرية، خاصة لأنها تتكيف بسرعة مع التغييرات في العالم. على وجه الخصوص، غالبًا ما يتم استخدام إنترنت الأشياء في صناعات مثل الإنتاج والزراعة والرعاية الصحية. يجعل إنترنت الأشياء من الممكن للأجهزة المتصلة الكشف عن بيانات المرضى وفحصها في مؤسسة الرعاية الصحية، مما يوفر معرفة أعمق وأكثر دراية بالسلوك البشري. **الأساليب:** باستخدام وحدة ESP8266 للاتصال اللاسلكي، تم إنشاء نظام مراقبة اللياقة البدنية القائم على إنترنت الأشياء لهذه الدراسة. تم دمج مستشعر درجة الحرارة MLX90614، الذي يقيس درجة حرارة الجسم، ومستشعر مقياس التأكسج النبضي

MAX30100، الذي يقيس مستويات الأكسجين في الدم (SpO2)، ومستشعر معدل ضربات القلب/النبض (BPM)، الذي يقيس ضغط الدم، في الجهاز. أصبح متحكم Arduino مسؤولاً عن الإعداد بالكامل. **النتائج:** على الرغم من نقص النتائج المحددة في الملخص، فقد تمكنت الآلة من قياس العلامات والأعراض الحاسمة بما في ذلك ضغط الدم ودرجة حرارة الجسم وتشبع الأكسجين في الدم في الوقت الفعلي من خلال استخدام المستشعرات ووحدة ESP8266. سمح هذا بتتبع المريض دون توقف. **الخلاصة:** يوضح الفاحص كيف يمكن لأنظمة تتبع اللياقة البدنية القائمة على إنترنت الأشياء أن تجمل العلاج في المستشفى. يمكن للآلة تقديم معلومات صحية دقيقة ومحدثة في الوقت الفعلي من خلال استخدام الاتصال اللاسلكي والمستشعرات الذكية، مما قد يؤدي إلى رعاية أكثر إلحاحًا للمرضى.

كلمات مفتاحية: انترنيت الاشياء، الذكاء الصناعي، مستشعر ضربات القلب، مستشعر نسبة الاوكسجين.

1. Introduction

Since monitoring human body capabilities has many uses, especially in sports technology, medical analysis, rehabilitation, and monitoring, it has received a lot of attention now. With the development of the Internet of Things, the scientific and technological field has recently developed a new step in wireless sensors and sensor networks, as shown in Figure (1). It is undeniable that the idea of sensor networks has been around for not long, but a whole new generation of specific applications of sensor networks has been made possible through the wireless field. Since wireless sensors and sensor networks are different from both wireless networks and computer networks, there are new issues arising from these systems, such as limited power and product life.

A wearable device needs to be able to record data in addition to displaying laboratory parameters in order to be monitored outside of it. The suggested method makes use of the idea of wireless sensor networks, in which every detector node has a WiFi connection. coordinated through a network protocol. By serving as a router, the coordinator enables internet-based communication between sensor nodes and end devices, which could be PCs or mobile phones. An accelerometer, temperature, heart rate, pulse oximeter (SpO2), and galvanic skin response sensors can be added to any sensor node. The sensor nodes are fully untethered and affixed to the human body. They are battery-operated. The lightweight and compact form of the sensor nodes makes it simple to attach them to the body.

The correct place or components must receive the collected data for an efficient health monitoring system in order for them to be processed and analyzed further to support decision-making and implementation. There are numerous methods for transferring information, including as Bluetooth, Wi-Fi, 3G, and 5G networks, internet-enabled cellphones, Short Message Services (SMS), and serial and parallel transmission. The aforementioned mechanisms significantly aided in the transmission of data necessary for the successful operation of health monitoring systems. Many studies made use of various media to transmit data efficiently when implementing and deploying systems

for people's general welfare and health monitoring.

In order to continuously monitor medical alerts, Juen et al, conducted an earlier study in which they used smartphones—such as the Motorola Droid Mini, ActiGraph GT3x, and Samsung Galaxy Ace—to transmit the extracted data and transfer it to the central database. The smartphones were connected via Bluetooth to a Nonin Onyx2 pulse oximeter, which measured heart rate and oxygen saturation. Additionally, in a related study, the extracted data were sent from the biosensors to the web server via GPRS/Wi-Fi/3G network, and from the smartphone to the web server via Bluetooth[1]. Furthermore, data was gathered and then sent to the data storage system via Bluetooth connected to the smartphone in a recent study by [2,3]. Also, Thaung et al. [4] used serial transmission in a related investigation to transfer the data acquired to the intended location. Every sensor, including the temperature, SPO2, and heartbeat sensors, has a one-minute time limit. The procedures include testing the first heartbeat sensor at a one-minute interval and then detecting the SPO2 sensor. Serial port transmissions were therefore used in every situation. In a similar vein, data from patients receiving care at home in Hong Kong was transferred to the central database system for telehealth monitoring assessment using a Sony Smart brand wellness tracker that had an integrated sensor [5].
This study makes use of WiFi technology to send data to a smartphone regarding temperature, heart rate, and oxygen availability. This enables people to be watched remotely and receive medical attention as soon as feasible.

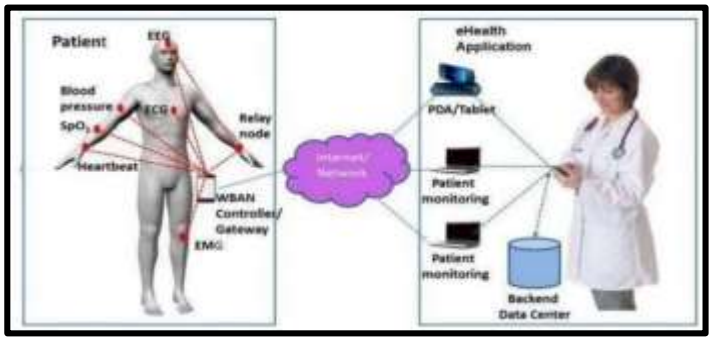

Fig. (1) IOT Health Monitoring System [6]

2. Methodology

An intelligent health monitoring system based on the Internet of Things allows for round-the-clock patient tracking. The current world's technical infrastructure is changing as a result of IoT. We can now implement a wide range of sophisticated systems in a relatively little area thanks to the Internet of Things, including intelligent climate management systems, smart environments, smart automobiles, smart traffic

control systems, and smart household products. This is due to the ease with which IoT modules can communicate with one another.

This project is one of many patterns and designs that have been utilized in the past to track a patient's health using the Internet of Things. The smart patient monitoring architecture module is composed of the following essential elements.

Monitoring Unit: A micro-sensor for oxygen, heart rate, and temperature.

Processing Unit: Arduino Uno linked to an ESP8266 Wi-Fi module for wireless communication.

Display unit: A smartphone that can receive data via a Wi-Fi connection and LCD to display reading.

The Monitoring health system (MHS) consisted of as shown in figure (2):

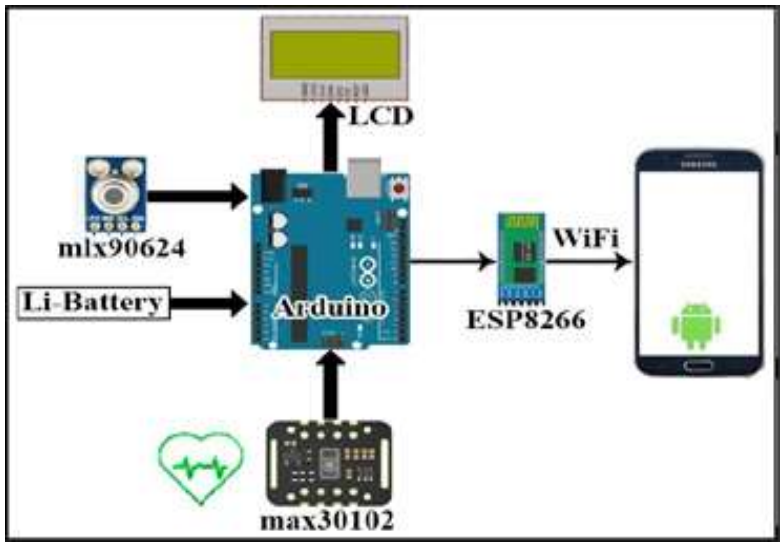

Figure (2) Smart Patient Monitoring Architecture

1) Arduino Uno.
2) Spo2 _ Heart-Rate Sensor (MAX30102).
3) Temperature Sensor (MLX90614).
5) ESP8622 Wi-Fi.
8) Phone application.
9) Li- battery
10)LCD display

❖ Arduino Uno Arduino is a versatile programmable hardware platform. This Arduino microcontroller, as seen in figure (3), is made by the Atmel corporation and has 16 MHz, an 8-bit core, 32 KB of storage, 2 KB of RAM, and 1 KB of EEPROM [7,8]. the Arduino UNO is based on ATmega328P microcontroller. It features a 16 MHz ceramic resonator, 6 analogy inputs, 14 digital input/output pins (six of which can be used as PWM outputs), a USB port, a power jack, an ICSP header, and a reset button. It comes with everything required to support the microcontroller. Arduino is power it with a battery or an AC-to-DC adapter or connect it to a computer via a USB cable to get going.

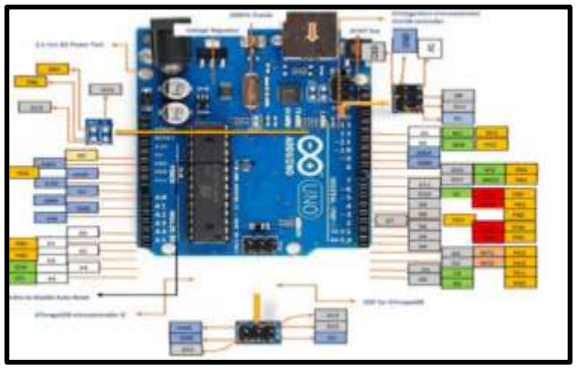

Fig. (3) Arduino Uno

❖ ESP8266 Wi-Fi Unit

Microcontrollers can create simple TCP/IP links, and interface to a Wi-Fi network with a Wi-Fi module ESP8266 as shown in figure (4). It has the compatibility with Arduino board which was making possibility of wireless data transfer. By integrating it with Arduino as a Shield, or by connecting it to the Arduino via UART, you may send data via the internet or receive them. Using the ESP8266 in client or server mode data could be transferred to web servers or cloud services. It is being highly used in various wireless communication IoT applications [9].

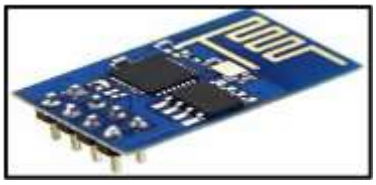

Fig. (4) ESP8266

❖ MAX30102 Sensor

Heart-rate sensor with pulse oximeter MAX30102, as depicted in figure (5). The MAX30102 Intelligent is used to gauge blood oxygen levels and heart rate levels. The

finger is struck to send and reflect infrared radiation, and the amplitude of the reflected wave is used to calculate the blood's oxygen content. Analysing this radiation's time series reaction also yields the heart rate [10].

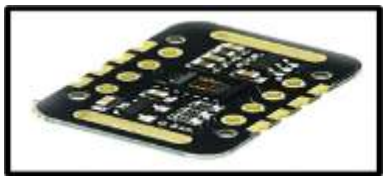

Fig. (5) MAX30102 Sensor

❖ MLX90614 Sensor

A high accuracy non-contact infrared temperature sensor, the MLX90614, is at the center of the module, as seen in figure (6). This sensor takes temperature without having to be touched, in contrast to most others. For example, this can be particularly helpful for keeping an eye on the temperature of items on a conveyor belt or a spinning motor shaft. By just pointing the sensor at the object you need to measure, it will absorb the infrared rays that are released and determine the temperature [10].

Fig. (6) MLX90614 Sensor

❖ LCD Display

One type of display that uses liquid crystals to function is the LCD (Liquid Crystal Display). Here, we will enable serial input from the computer and upload the sketch to the Arduino. The LCD is going to display the characters. Figure (7) of Liquid Crystal Display A display is an electronic device. A 16x2 LCD shows two of these strains and sixteen characters per line. This LCD has both data and command registers. The command registers hold the commands given to the LCD. The information registers shop the records that will be displayed on the LCD. It acts as a conduit for customers. [11,12].

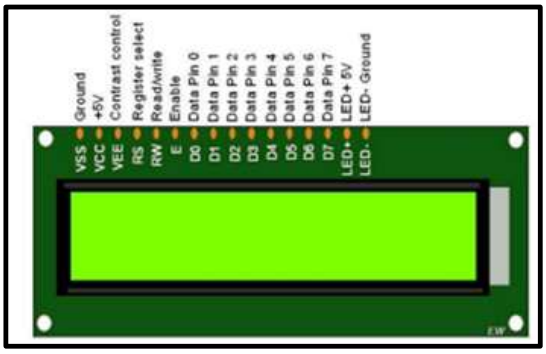

Fig. (7) LCD Display

❖ Remote XY Android Application

Programmers are not needed to design the user interfaces of Arduino project since they can use the free program called Remote XY. Remote XY is familiar with several Arduino boards and performing multiple communications such as Bluetooth, Ethernet, and Wi-Fi and has two parts. The first part is the web interface, where buttons and switches, among other controls, are created using an intuitive drag-and-drop design environment. The microcontroller needs to be updated with some code, which is the second need.

Actually, the coding is what creates the mobile application [13,14]. The design of the remote XY, as seen in figure (8), is as straightforward as feasible. It's really simple to set up, requiring only a few steps. The official website has a comprehensive tutorial, but here's a rundown of the essential actions needed to get going [15,16]:

1. Create a User Interface for the Website;
2. Set Up the Communication Channel
3. Create Source Code and Transfer It to the Arduino IDE
4. Connect to the Arduino with the Remote XY App that you downloaded.

Fig. (8) Remote XY application Main Screen

3. Proposed System

A smart health monitoring system was created so that the attending physician or those close to the patient may keep an ongoing eye on their health. The system's mechanism is depicted in the figure (9). The ESP8266 transmits the sensor data to the smartphone, and the LCD panel shows the data. According to the proposed system, the connected sensors can take patient's body temperature, pulse rate, and oxygen level at regular interval and continuously. This permits a constant assessment of the patient's condition and the decision of whether or not physical supervision is necessary. Figure (10) has outlined how the suggested system is linked.

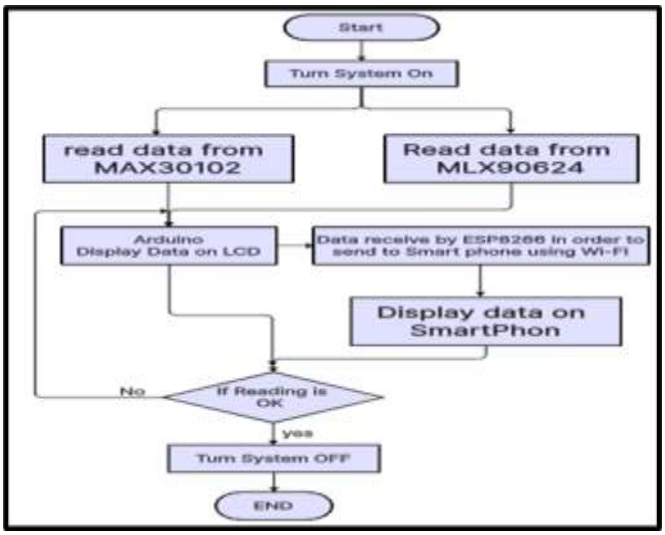

Fig. (9) Flow of Proposed System

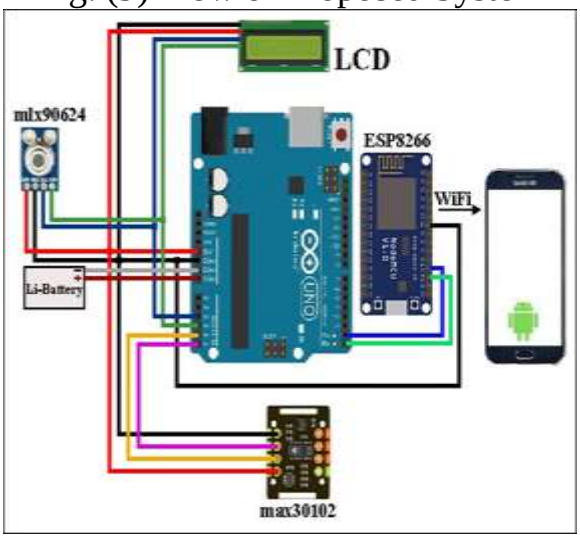

Fig. (10) Sensors Connection to Arduino Circuit

The external and internal appearance of the device is shown in figure (11). As seen in figure (9), this project utilizing an IoT system comprises two procedures, which are

as follows:

- Gather and present data on an LCD
- Gather information from the sensor and transmit it to a Wi-Fi gadget

Fig. (11) Internal & External Appearances for Health system

4. Results &Discussion

After the gadget was built, tests in the lab were carried out on it. The results showed that the device was successful in detecting blood oxygen levels, heart rate, and temperature. These results were displayed on the screen and sent concurrently to a mobile device, where they were displayed on the phone through the use of the Remote XY program, as illustrated in the figures below. The application of a temperature sensor to measure body temperature is shown in figure (12), where the corresponding reading is shown on a screen.

Fig. (12) Display Temperature on LCD

Figure (13) illustrates the integration of a heart rate sensor, and a “temperature sensor”, and a sensor for “oxygen saturation”, with their respective readings displayed on the screen. The accuracy of these measurements is indicated to be up to 98%.

Figure (14) represents the aggregation of sensor data and its display on a mobile screen using Wi-Fi connectivity. Figure (15) illustrates the display of sensor readings on both

the screen and mobile device. The results indicate that the readings of the heart rate sensor and oxygen percentage are identical, while there is a slight variance in the temperature sensor readings.

This difference can be considered within the acceptable margin of error for such devices

Fig (13) Display Reading of Both Sensor

Fig. (14) Display Reading of Both Sensors using Remote XY application

Fig. (15) Reading of Both Sensors on LCD and on Phone

5. Conclusion

In conclusion, our take a look at efficiently created and placed into use a smart monitoring system that allows caregivers and health workers to continuously test on sufferers' health from everywhere. The system uses an ESP8266 module to connect with a community and integrates an Arduino board with sensors to assess body temperature, heart price, and blood oxygen stages. The gadget was tested with superb outcomes, attaining an accuracy of as much as 98% in all cases. This machine helps physicians and nurses via giving them access to actual-time statistics, letting them comply with and reveal sufferers' conditions even when they're not in a health facility.

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