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7-Segment Based Health Monitoring System

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Abstract: The project introduces a health monitoring system that uses Arduino technology and leverages the Internet of Things (IoT). This system aims to measure key health parameters like heart rate, blood oxygen level, and body temperature. IoT enables smart devices to connect to the internet seamlessly. In health monitoring, IoT encourages the development of systems using sensors worn either inside or outside the body. These sensors collect physical and logical data, as well as patient movements, offering comprehensive insights into health conditions. The system integrates sensors such as LM35 and Pulse Oximeter & Heart Rate Sensor, connected to an Arduino UNO board and ESP8266 for wireless data transmission to Thing Speak. This setup allows continuous monitoring and recording of health parameters, promoting proactive health management. Additionally, the system employs a 7-segment display to indicate the number of drug tablets and the type of vitamin in a tablet-bottling assembly line. Logic expressions, circuitry, and VHDL code are used to display the tablet count (0 – 9) and the corresponding vitamin type (Vitamin A, B, C, D, E) via a BBC micro bit microcontroller. This feature provides visual cues for the production stage/phase, with potential applications in various industrial settings. Overall, the proposed health monitoring system offers a promising solution for personalized and real-time health monitoring, promoting proactive healthcare management while enhancing industrial monitoring capabilities.

Keywords: IOT, Health Monitoring, Heart Rate, Body Temperature, ARDUINO, Thing Speak

1. Introduction

IoT-based patient health monitoring systems encompass medical devices with internet connectivity capable of measuring various health parameters, including heartbeat, body temperature, blood pressure, ECG, and activity levels. These devices record, transmit, and can alert healthcare providers in the event of sudden changes in a patient's health.

One common method involves directly connecting the device's digital output to a microcontroller to measure the Beats per Minute (BPM) rate. This measurement relies on the principle of light modulation caused by blood flow through the finger with each pulse. Patient pulse rate and temperature data can then be monitored and recorded using platforms like Thing Speak, enabling remote access to the patient's medical history from anywhere in the world via the internet.

The 7-segment display stands as a quintessential component in electronic display devices, serving to showcase decimal numbers from 0 to 9 and occasionally basic characters. Initially illuminated by light-emitting diodes (LEDs), the 7-segment display gained widespread popularity. However, more recently, liquid crystal displays (LCD) have also emerged as a viable alternative.

Its versatility finds application in a myriad of electronic devices, including microwave ovens, calculators, washing machines, radios, and digital clocks, where it proficiently communicates numeric information. To gain a deeper comprehension, let's delve into the pinout configuration of the seven-segment display.

2. Literature Review

2.1 7-Segment Display Pinout:

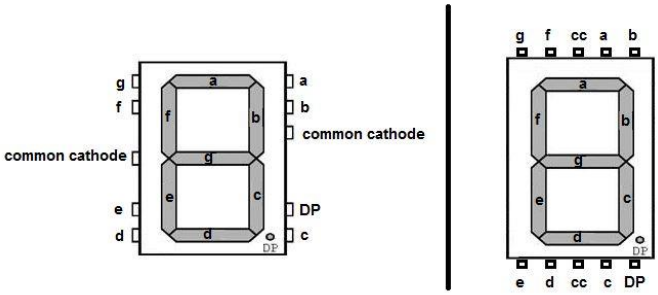


Fig 2.1.1 7-Segment Display Pinout

A seven-segment display is made of seven different illuminating segments. These are arranged in a way to form numbers and characters by displaying different combinations of segments.

The binary information is displayed using these seven segments. LED is a P-N junction diode that emits energy in the form of light, different from a standard P-N junction diode which emits in the form of heat.

Whereas LCD uses liquid crystal properties for displaying and does not emit light directly. These LEDs or LCDs are used to display the required numeral or alphabet.

2.2 7-Segment Display Types:

There are basically 2 types of seven-segment LED displays:

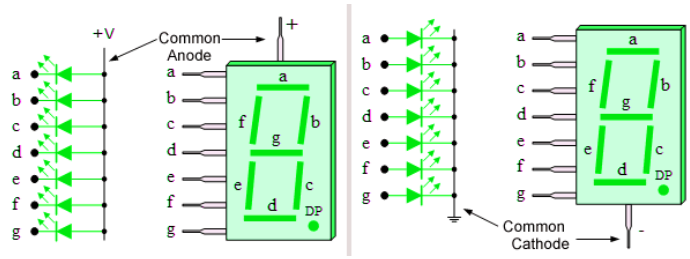


Fig 2.2.1 Common Anode and Common Cathode 7 Segment LED Display

2.2.1 Common Anode 7 Segment Display:

All the Negative terminals (Anode) of all the 8 LEDs are connected together. All the positive terminals are left alone.

2.2.2 Common Cathode 7 Segment Display:

All the positive terminals (Cathode) of all the 8 LEDs are connected together. All the negative thermals are left alone.

2.3 Seven-Segment Display Working:

Seven-segment devices are generally made up of LEDs. These LEDs will glow when they are forward-biased. The intensity of the LEDs depends on the forward current. So, a sufficient forward current has to be provided to these LEDs to glow with full intensity. This is provided by the driver and is applied to the seven segments.

2.3.1 7-Segment Display Codes:

The below table shows the 0-9 codes for the seven-segment LED display.

Table 2.3.1: Display numbers on a 7-segment display in common anode configuration

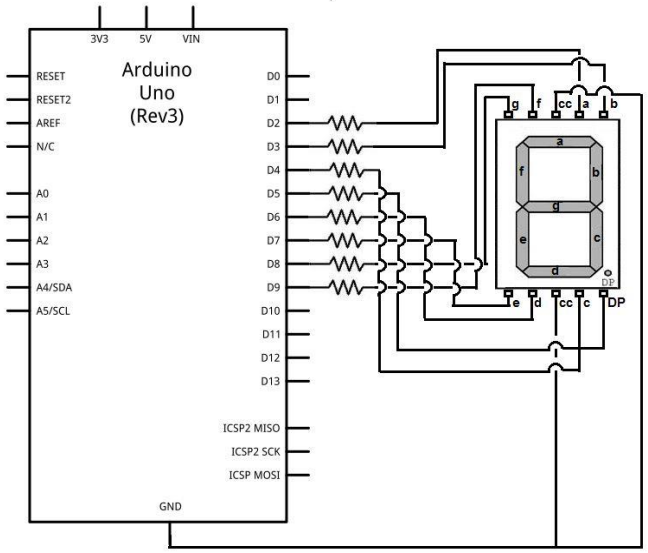
Number	g f e d c b a	Hex code
0	1000000	C0
1	1111001	F9
2	0100100	A4
3	0110000	B0
4	0011001	99
5	0010010	92
6	0000010	82
7	1111000	F8
8	0000000	80
9	0010000	90

Table 2.3.2: Display numbers on a 7-segment display in common cathode configuration

Number	g f e d c b a	Hex Code
0	0111111	3F
1	0000110	06
2	1011011	5B
3	1001111	4F
4	1100110	66
5	1101101	6D
6	1111101	7D
7	0000111	07
8	1111111	7F
9	1001111	4F

Below we are interfacing a 7-segment display to Arduino UNO for reference.

2.4 Seven-Segment Display Circuit with Arduino:



2.5 Seven-Segment Display-based Projects:

Seven segment displays are made up of LEDs combined such that they can be used to display numbers and letters. As their name implies, they are made of seven LEDs plus an additional LED for a dot. Led dot matrix displays, on the other hand, are made up of LEDs in a square matrix form to give an indication of a letter, number or symbol. Seven segment displays can be in form of common anode or common cathode.

They can also be in form of single digit or multi digit seven segment displays. Seven-segment displays are used in many types of everyday products, for example, in a tablet-bottling system, to give an indication of measurement types such as temperature or a reading on calculator or meters. The 7-segment display for the bottling system is controlled by logic circuits which encodes a decimal number in binary form consequently activating suitable LEDs of the display. 7-segment displays cannot only indicate numbers (0 to 9), they can also display some alphabets.

The application of 7-segment display in this paper is to give a visual indication of the number of tablets in a drug bottling assembly line as well as give a visual indication of the Vitamin type being assembled. The digital drug tablet-bottling assembly line works by grouping and assembling a particular Vitamin tablet in a bottle along a production line after these tablets have been manufactured. In this paper, we design a digital system to indicate the alphabets (A, b, C, d, and E) which is used to categorise the kind of vitamin tablet that is assembled in a drug bottling production line. The design of numbers 0 – 9 using a single digit 7-segment display is also developed to give an indication of the number of tablets in the bottle. In this paper, the decoding logic for indicating A, B, C, D, and E letters is presented in detail.

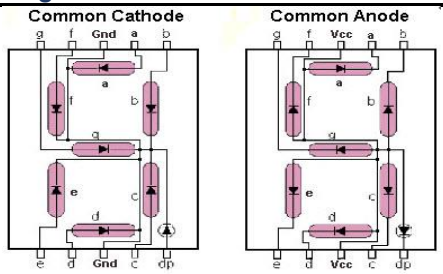


Fig 2.5.1

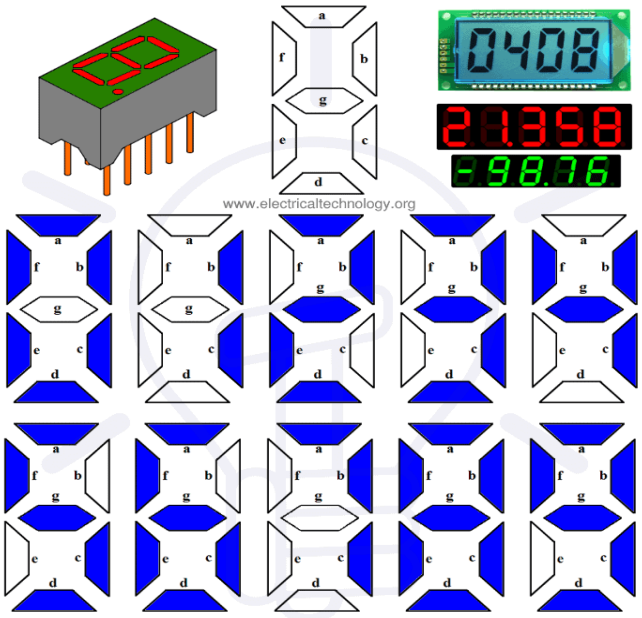


Fig 2.5.2

2.6 IOT based health monitoring system capable of monitoring blood pressure, heart rate, oxygen level, and temperature of a person:

2.6.1 Main components used:

Oximeter, LCD Display, Arduino UNO

16x2 Character LCD – This device that can show 16 characters in each of its two rows, hence giving a total of 32 characters of information. LCD stands for Liquid Crystal Display. It is used to display alphanumeric values like status information, sensor readings, and more in various devices.

Pulse oximeter - The MAX30100 is an integrated pulse oximetry and heartrate monitor sensor module. It combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse rate and heart-rate signals.

2.6.2 Result:

- IoT makes health monitoring systems more flexible and more updatable in future.

3. References

- Vaneeta Bhardwaj et.al. monitored a person's blood pressure, heart rate, oxygen level and temperature for diagnosis and treatment - *IoT-Based Smart Health Monitoring System for COVID-19, SN Computer Science (2022) 3:137 https://doi.org/10.1007/s42979-022-01015-1*
- Hamizah Anuar et.al. discussed the development of wearable Core Body Temperature sensor device. Conducted experiments with the sensor on the different parts of the body. When the sensor was placed on the forehead, a difference of approximately 0.05 °C was found between CBT sensor's recorded temperature and clinical thermometer's recorded temperature. Hence, the forehead region was found to be the most optimum place to measure the core body temperature using the sensor - *Anuar, H. and P.L. Leow. Non-invasive core body temperature sensor for continuous monitoring. in 2019 IEEE International Conference on Sensors and Nanotechnology. 2019.*
- IOT may be potentially life changing for patients whose health data such as heartbeat, body temperature, blood pressure, ECG requires attention in regular intervals of time. Their data can be constantly monitored using IoT-driven, noninvasive sensor. It is an efficient and time saving solution that may also provide real-time records as well as previous health records to healthcare service providers using cloud technology. - *IoT for Healthcare by B. Sobhan Babu, K. Srikanth, T. Ramanjaneyulu, I. Lakshmi Narayana (ResearchGate)*
- An IoT enabled pulse rate monitoring system is formed to help improve healthcare. The device is controlled by a Raspberry Pi and employs a simple pulse sensor. The device mainly consists of MCP 3008 Analog-Digital Converter (ADC), a simple pulse sensor, Raspberry Pi Zero W Case. The processing layer contains Thing Speak and a mobile device may be used as the application layer for displaying results. It is then compared with the fingertip pulse oximeters that are commercially available. Tests were conducted on fifty healthy individuals, ages 25 to 40, to see how well the device would function. With a 93% overall accuracy guarantee, it produced an error rate of about 5 BPM. - *NEUROQUANTOLOGY | MAY 2022 | VOLUME 20 | ISSUE 5 | PAGE 5056-5066| DOI: 10.14704/NQ.2022.20.5. NQ22781 DR. NOOKALA VENU/ INTERNET OF THINGS BASED PULSE OXIMETER FOR HEALTH MONITORING SYSTEM.*
- A remote health monitoring system using IoT is proposed where sensors are placed on the human body to sense the body temperature and heartbeat. To monitor the environmental temperature and humidity in the patient's room at home, two additional sensors are installed. A control unit then evaluates the values of these sensors. The patient's health records are stored in servers utilizing Wi-Fi Module based remote correspondence. Authorized personnel can access these records and based on the values received, the patient may be diagnosed by the doctors from a distance. This health monitoring system uses IOT to become a remote yet reliable solutions in the medical field. - *IOT BASED HEALTH MONITORING SYSTEM DOI:10.31838/jcr.07.04.137 by* ***Prajoona Valsalan****.*
- In conclusion, the potential of IoT-based health monitoring systems is bound to revolutionize healthcare. By providing remote monitoring capabilities, efficient detections and prevention of health-related problems, these systems improve and enhance the quality of healthcare.