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E-Mail :
editor.ijasem@gmail.com
editor@ijasem.org

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Smart Healthcare Emergency App with Fingerprint Sensor: Better Ambulance Navigation with Highlighted Emergency Routes

[1] N. Chandra Sekhar, [2] Katuri Nandini, [3]Anumala Devi Priya, [4]Jayanthi Rajeswari Sravya, [5] Nagireddy Veera Sai Devi Kumari,

[1]Assistant Professor, Department of ECE, Rajamahendri Institute of Engineering & Technology.

[2,3, 4,5] Student, Department of ECE, Rajamahendri Institute of Engineering & Technology.

ABSTRACT:

The ability to track patients in real time and guide ambulances efficiently is life-saving in medical emergencies. There are significant delays in treatment due to the absence of computerized health monitoring and optimum route selection in traditional emergency response systems. An Internet of Things (IoT) smart healthcare emergency system is shown in this project. It incorporates the MAX30100 pulse oximeter, an infrared (IR) sensor, and IoT connection to improve patient monitoring and ambulance management. Early warning of life-threatening situations is possible thanks to the MAX30100 sensor's continuous measurement of heart rate and oxygen saturation (SpO2) levels. Assisting with obstacle recognition, the IR sensor allows the ambulance to navigate through crowded locations with ease. Thanks to the Internet of Things (IoT), hospitals may get real-time data on patients' vitals and the whereabouts of ambulances, letting medical staff plan ahead. Improved emergency response times and patient survival rates are achieved by the automation of patient monitoring, hospital warnings, and route selection.

EMBEDDED SYSTEMS

A computer system that is purpose-built to carry out a single or limited set of tasks, often under the restrictions of real-time computing, is known as an embedded system. As with other physical and mechanical components, it is often integrated into a whole device. A personal computer or other general-purpose computer, on the other hand, may be programmed to do a wide variety of functions. These days, many of the everyday items we use rely on embedded systems to function. Design engineers may improve the embedded system to decrease product size and cost while boosting reliability and performance since it is devoted to certain functions. Because of their mass production, certain embedded systems are able to take advantage of cost savings. From small, handheld gadgets like digital watches and MP3 players to massive, permanently installed systems like those managing nuclear power plants, traffic lights, and industrial controls are all examples of physically embedded systems. From simple systems using a single microcontroller chip to complex systems housing several modules, peripherals, and networks in a massive chassis or enclosure, complexity may range greatly. The phrase "embedded system" lacks a precise definition because the majority of systems have programmability in some form. While they share some components with embedded systems, such operating systems and microprocessors, handheld computers are not technically embedded systems as they enable the loading of multiple programs and the connection of peripherals. Computer hardware and software, either fixed in capability or programmable, particularly intended for a certain sort of application device—this is what's called an embedded system. Embedded systems may be found in a wide variety of objects, including but not limited to: vehicles, medical devices, cameras, home appliances, aircraft, vending machines, toys, and, of course, cellular phones and personal digital assistants. A programming interface is given to programmable embedded devices, and programming for embedded systems is a niche field in and of itself. Embedded Java and Windows XP Embedded are two examples of embedded-specific operating systems and language platforms. On the other hand, certain budget consumer goods include integrated application and operating system components, employ very cheap microprocessors, and have limited storage space. Instead of being loaded into RAM (random access memory), as applications on personal computers are, in this situation the program is written permanently into the system's memory.

CHARACTERISTIC OF EMBEDDED SYSTEM

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- Speed (bytes/sec): Should be high speed
- Power (watts): Low power dissipation
- Size and weight: As far as possible small in size and low weight
- Accuracy (%error): Must be very accurate
- Adaptability: High adaptability and accessibility
- Reliability: Must be reliable over a long period of time

APPLICATIONS OF EMBEDDED SYSTEMS

Here, in the Embedded World, we are living. The smooth operation of the various embedded goods that surround you is crucial to your day-to-day existence. In your living room, you have a TV, radio, and CD player; in your kitchen, you have a washing machine or microwave oven; and at your office, you have card readers, access controllers, and palm devices that let you do a lot. In addition to all of this, your automobile has a plethora of built-in controls that handle functions between the bumpers, most of which you probably don't give a second thought to.

- **Robotics:** industrial robots, machine tools, Robocop soccer robots
- **Automotive:** cars, trucks, trains
- **Aviation:** airplanes, helicopters
- Home and Building Automation
- **Aerospace:** rockets, satellites
- **Energy systems:** windmills, nuclear plants
- **Medical systems:** prostheses, revalidation machine.

MICROCONTROLLER VERSUS MICROPROCESSOR

When comparing microprocessors and microcontrollers, what are the key differences? Any general-purpose microprocessor, such an 8086, 80286, 80386, 80486, or a Pentium from Intel, or a 680X0 from Motorola, etc., is considered a microprocessor. In addition to lacking on-chip I/O ports, these microprocessors also lack random-access memory (RAM). Because of this, they are often called general-purpose microprocessors. Designing a working system around a general-purpose CPU like the 68040 or Pentium requires the addition of extra components like as RAM, ROM, I/O ports, and timers. Though these systems are more costly and cumbersome due to the inclusion of external RAM, ROM, and I/O ports, they provide the benefit of being versatile in that the designer may choose the quantity of RAM, ROM, and I/O ports required for the work at hand. Microcontrollers are an exception to this rule. On a single chip, you'll find a microprocessor, random access memory (RAM), read/write (ROM), input/output (I/O) ports, and a timer in a microcontroller. So, since the CPU, random access memory (RAM), read/write memory (ROM), input/output (I/O) ports, and timer are all integrated into a single chip, the designer is unable to include any more memory, I/O ports, or timer into the product. Because of its set quantity of on-chip ROM, RAM, and number of I/O ports, microcontrollers are perfect for many applications where space and cost are important considerations. It is not necessary to have a 486 or even an 8086 CPU for many applications; for instance, a TV remote control. Typically, these programs will need some kind of input/output function in order to read signals and toggle bits.

INTRODUCTION

Integrating the IoT with emergency medical services is really beneficial. Patients in these circumstances need quick treatment, and the Internet of Things (IoT) makes patient care more efficient by making sure ambulances get to hospitals on time. The ambulance's paramedics have access to hospital records, so they may choose the closest hospital that has the patient's specific needs met. The death toll is drastically cut because to this simplified system's efficiency boost. When hospitals and patients need a solution quickly, the Internet of Things (IoT) in healthcare plays a crucial role. One way in which the Internet of Things (IoT) can improve the efficiency of emergency medical services is by reducing the amount of time it takes to transfer patients to hospitals.

The goal of integrating IoT-based emergency medical services is to provide patient data and, depending on the patient's state and needs, choose the closest hospital. In emergency scenarios, such as car accidents, the ambulance's embedded system should be able to find the closest hospital and get information regarding doctors' availability and patient requirements. By using the embedded technology in the ambulance, the nearest hospital can be found and the specialist and hospital may be notified in advance to make the appropriate arrangements.

LITERATURE SURVEY

With the use of GPS and the Internet of Things (IoT), people in dire circumstances may find the nearest hospital much more rapidly.

• Prior to a patient's arrival, hospitals may get alerts

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and patient information, and paramedics can obtain critical hospital data, such as the availability of specialists, during crises.

• The Internet of Things (IoT) and global positioning systems (GPS) may improve the efficiency of emergency medical services by reducing the time it takes to transfer patients to hospitals.

EXISTING SYSTEM

The delays in treatment caused by traditional emergency response systems are a direct result of the reliance on manual communication between hospitals and ambulances. Because most ambulances do not have the technology to monitor patients in real-time, paramedics have a hard time gauging their status prior to arrival at the hospital. Suboptimal route selection and extra travel time are further outcomes of ineffective or nonexistent GPS-based navigation. There is a lack of capability for continuous SpO2 tracking and obstacle detection in current systems, however basic heart rate monitoring may be included. In addition, hospitals aren't kept informed of arriving patients in real-time, which causes them to be unprepared and slows down emergency response times. These shortcomings draw attention to the need for a state-of-the-art, fully automated healthcare emergency system that combines patient tracking, automated communication, and real-time location monitoring.

PROPOSED MODEL

With the use of the MAX30100 sensor, an infrared sensor, and Internet of Things connection, the suggested emergency healthcare system may improve patient monitoring and ambulance navigation. The MAX30100 sensor keeps tabs on your heart rate and SpO2 levels all the time, so you can catch oxygen shortages and cardiac problems early on. Even in heavily populated regions, the IR sensor can identify roadblocks, allowing the ambulance to navigate more efficiently. With the use of Internet of Things (IoT) technology, medical staff may be ready for a patient's arrival by receiving real-time data on the patient's vitals and where they are located on a hospital dashboard. Hospitals are promptly notified of emergency situations via automated notifications, allowing for prompt medical action. By combining intelligent route planning, real-time health monitoring, and smooth communication between hospitals and ambulances, this technology improves the efficiency of emergency response.

BLOCK DIAGRAM

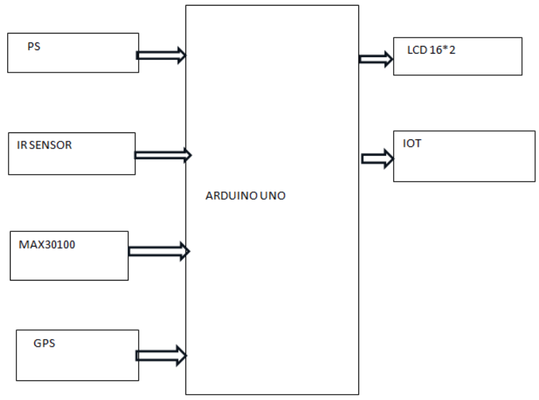

Figure 1: Block Diagram

Microcontroller:

A tiny controller, or microcontroller, as the name implies. Often used as a processing or controlling unit, they are similar to single-chip computers. For instance, microcontrollers that do decoding and other regulating operations are likely integrated into the control you are using. They find further use in vehicles, home appliances, microwaves, toys, and any other area requiring automation.

Arduino Uno Microcontroller:

One such microcontroller board is the Arduino Uno, which uses the Atmega328 (datasheet). It has a 16 MHz crystal oscillator, 6 analogue inputs, 14 digital input/output pins (6 of which may be used as PWM outputs), a power connector, an ICSP header, a reset button, and a USB connection. All you need is a USB cable, an AC-to-DC converter, or a battery to get it going; it comes with everything you need to support the microcontroller.

A key difference between the Uno and all previous boards is the absence of the FTDI USB-to-serial driver chip. Rather of that, it has an Atmega8U2 that has been configured to convert USB to serial. To celebrate the impending release of Arduino 1.0, the name "Uno"—which means "One" in Italian—has been chosen. The Uno and Arduino version 1.0 will serve as the foundational versions for future Arduino releases. For a comparison with prior generations, see the index of Arduino boards. The Uno is the newest in a series of USB Arduino boards and the standard model for the Arduino platform.

ARDUINO UNO BOARD:

One board that uses the Atmega328 microprocessor is the Arduino Uno. A 16 MHz ceramic resonator, 6 analog inputs, 14 digital I/O pins (including 6 PWM outputs), 1 USB port, 1

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power connector, 1 ICSP header, and 1 reset button are all part of it. All you need is a USB cable, an AC-to-DC converter, or a battery to get it going; it comes with everything you need to support the microcontroller.

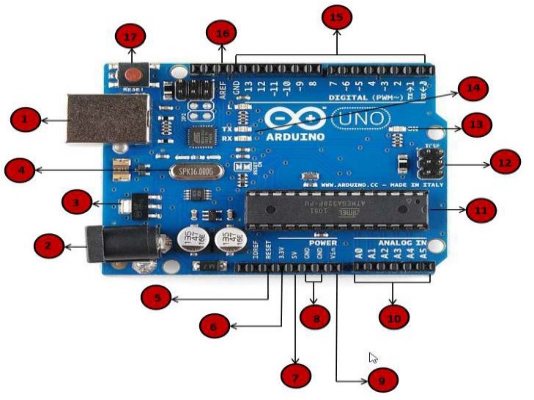

Figure 2: Arduino uno board

In contrast to all of its predecessors, the Uno does not have the FTDI USB-to-serial driver chip. As an alternative, it makes use of USB-to-serial converters coded into the Atmega16U2 (Atmega8U2 up to version R2).

HARDWARE COMPONENTS

POWER SUPPLY UNIT

The power supply for this system is shown below.

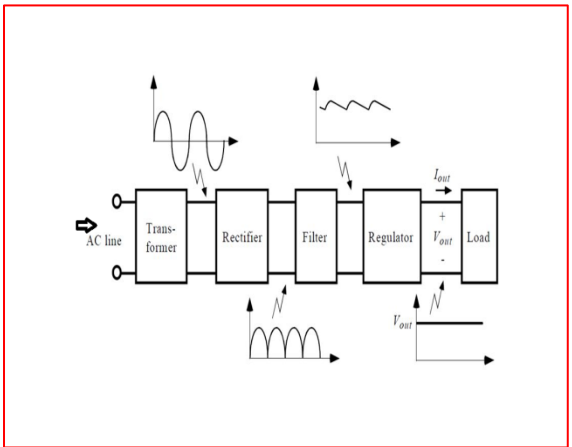

Figure 3: power supply

Diodes:

Only one path of electrical current may pass through a diode. Current may flow in either direction, as shown by the arrow in the circuit symbol. Originally termed valves, diodes are essentially an electrically enhanced version of the mechanical component.

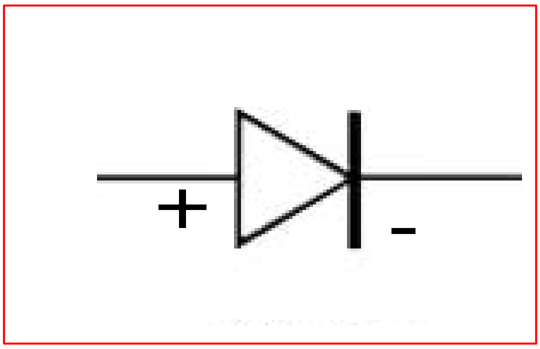

Figure 4: Diode Symbol

One kind of electrical component that restricts current flow is the diode. A voltage loss of around 0.7V will be the sole influence on the signal when the diode is "forward-biased" in this way. No current will flow through a diode that is "reverse-biased" when the current is applied in the other direction.

Rectifier

A rectifier's job is to change the phase of an alternating current (AC) waveform so that it appears as a direct current (DC) waveform. Both "half-wave" and "full-wave" rectifiers are used for rectification. Diodes are used in both devices to convert AC current into DC current.
The Half-Wave Resettable
The graphic shows that the half-wave rectifier is the simplest rectifier type since it only employs one diode.

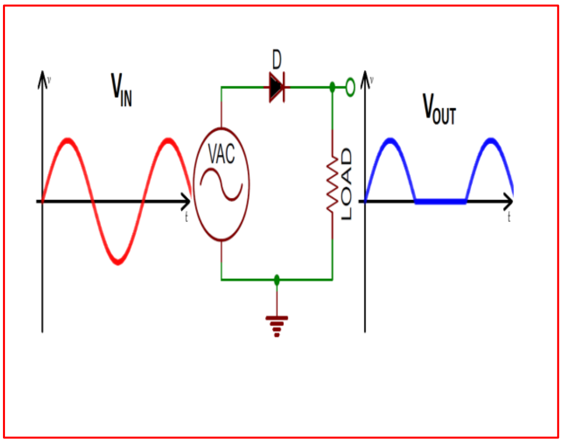

Figure 5: Half Wave Rectifier

LIQUID CRYSTAL DISPLAY

An array of color or monochrome pixels arranged in front of a light source or reflector makes up a liquid crystal display (LCD), a thin, flat display device. Two polarizing filters, with their polarity axes perpendicular to one other, and a column of liquid crystal molecules hanging between two transparent electrodes make up each pixel. Light would not be able to travel through them if

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the liquid crystals weren't interposed. To make light flow through two filters, the liquid crystal changes the polarization of the light entering the first filter.
A program's ability to communicate with the outside world depends on its input and output devices, which in turn rely on human communication. An LCD display is a typical accessory for controllers. 16X1, 16x2, and 20x2 LCDs are among the most popular types of displays that are often linked to the controllers. Which works out to sixteen characters on a single line. The first set has 16 characters on each line while the second set has 20 characters on each line. The use of "smart LCD" displays allows for the visual output of information by many microcontroller devices. Affordable, user-friendly, and capable of producing a readout utilizing the display's 5X7 dots plus cursor, LCD displays built on the LCD NT-C1611 module are a great choice. They use mathematical symbols and the usual ASCII set of characters. The display needs a +5V power and 10 I/O lines (RS, RW, D7, D6, D5, D4, D3, D2, D1, D0) for an 8-bit data bus. The only additional lines needed for a 4-bit data bus are the supply lines and six more (RS, RW, D7, D6, D5, D4). The data lines are tri-state and do not affect the microcontroller's function when the LCD display is disabled.

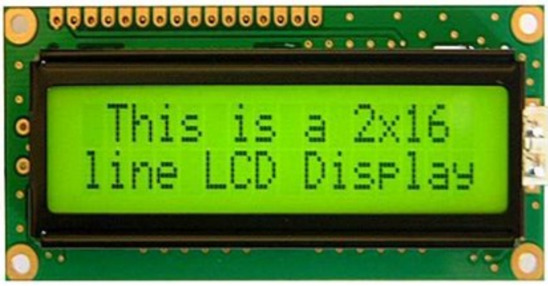
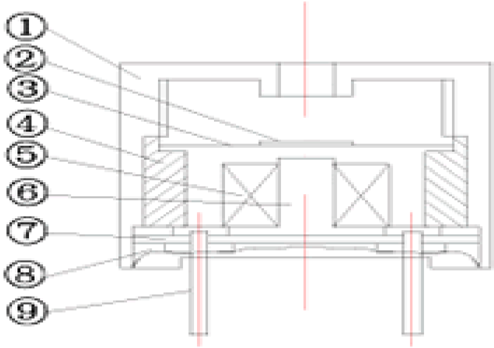


Figure 6: 2x16 LCD Display

BUZZER

In a magnetic transducer, the circuitry includes an iron core, a yoke plate, a wound coil, a permanent magnet, and a vibrating diaphragm that can be moved. The magnet's field gently draws the diaphragm up nearer the core's surface. A positive alternating current (AC) signal causes the diaphragm to move up and down, which in turn vibrates the air. This is achieved by the current passing through the excitation coil, which forms a fluctuating magnetic field. A resonator, which is composed of a cavity and one or more sound holes, may amplify vibrations in order to generate a loud sound.



ESP8266 Wi-Fi Module

This project revolves on this. Because the project relies on WIFI control of appliances, the module is a crucial part of it.
One remarkable feature of this tiny board is the integrated MCU (Micro Controller Unit), which allows for the control of I/O digital pins via a simple programming language that is almost pseudo-code like. Another benefit is that the ESP8266 Arduino compatible module is a low-cost Wi-Fi chip with full TCP/IP capability. The Chinese company Es press if Systems is situated in Shanghai and makes this gadget.
In August 2014, this chip made its debut in the ESP-01 version module manufactured by the third-party company AIThinker. The MCU can establish basic TCP/IP connections and connect to WiFi networks with the help of this little module. He was His tiny size and cheap pricing (1.7–3.5$) enticed a lot of hackers and geeks to look into it and utilize it for all sorts of projects. Because of its enormous success, Espressif now offers a wide variety of models with varying size and technological specs. Its replacement includes ESP32.

RELAYS:

Industrial controls, automotive systems, and home appliances all make extensive use of electrically controlled switches called relays.
By using a relay, two independent voltage sources may be isolated from one another; in other words, a little quantity of voltage or current on one side can manage a big amount of current or voltage on the other side, and vice versa.

Inductor

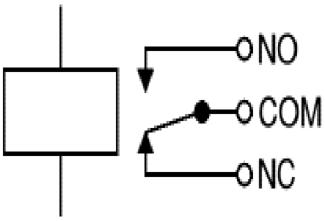


Fig7 : Circuit symbol of a relay

DRIVING A RELAY:

Two of the SPDT relay's five pins are used by the magnetic coil, one serves as the common terminal, and the other two are typically closed and normally connected. The coil is activated when a current passes across it. At the beginning, when the coil is deenergized, the usually closed pin and common terminal will be connected. A new connection will be formed between the common terminal and usually open pin when the coil is activated, breaking this connection. Therefore, the relay will be activated whenever the microcontroller sends an input signal to it. You may drive the loads connected between the common terminal and typically open pin while the relay is on. Consequently, the high-current loads are driven by the relay, which receives 5V from the microcontroller. This means the relay may be used as a means of isolation. The microcontroller and digital systems do not have enough current to operate the relay. In contrast to the 10 milliamps required to activate the relay's coil, the microcontroller's pin can only provide 1 or 2 milliamps. This is why the microcontroller and the relay are separated by a driver, like ULN2003, or a power transistor. By connecting ULN2003 to the relay and microcontroller, it is possible to activate many relays simultaneously.

SOFTWARES

The Arduino platform is an open-source, user-friendly hardware and software environment for prototyping. It is comprised of a programmable circuit board (also called a microcontroller) and an Integrated Development Environment (IDE) called Arduino that is pre-made for writing and uploading code to the physical board. The main characteristics are: • Many sensors can send signals in digital or analog formats to Arduino boards, which may then be used to activate motors, control LEDs, establish connections to the cloud, and much more. • The Arduino IDE (also called "uploading software") allows you to command your board's operations by communicating with the microcontroller on the board. • A separate device, known as a programmer, is not required to load fresh code into an Arduino board, in contrast to most prior programmable circuit boards. The usage of a USB connection is all that is required. • The Arduino IDE employs a streamlined version of C++, which facilitates programming learning. Last but not least, Arduino offers a standardized form factor that simplifies the microcontroller's tasks. Now that we know what the Arduino UNO board is and how it works, we can go on to setting up the Arduino IDE. As soon as we figure this out, we can upload our software to the Arduino board.

CONCLUSION

When used to emergency healthcare, MAX30100, infrared sensors, and internet of things connection provide a novel approach to enhancing patient monitoring and ambulance navigation. This method allows for the early diagnosis of critical circumstances by continuously measuring heart rate and oxygen levels, unlike traditional methods. Internet of Things (IoT) data transfer allows hospitals to provide real-time updates, which improves patient care by decreasing treatment delays. Ambulance navigation is enhanced with the inclusion of infrared-based obstacle detection, allowing for seamless movement even in crowded places. Improved Internet of Things (IoT) security standards, route optimization using machine learning, and AI-powered health condition prediction are all possible future additions. With this approach, emergency healthcare has come a long way, allowing for faster response times, better hospital readiness, and more lives saved.

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