Smart Automated Health Check-up Robot

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ABSTRACT

Regular health checkups are essential for maintaining overall well-being; however, many individuals avoid hospital visits due to time constraints, accessibility issues, or lack of awareness. To address this problem, this project presents an Autonomous Health-Monitoring Robot designed to perform basic health assessments within defined areas such as apartments, gated communities, and local streets, thereby bringing healthcare services directly to people's doorsteps. The robot is developed using an Arduino microcontroller, L293D motor driver, and DC motors to enable autonomous movement, while safe navigation and obstacle avoidance are achieved using ultrasonic and IR sensors.

Once the robot reaches an individual, it performs essential health measurements using onboard sensors, including a DHT11 sensor for body temperature and humidity-based health estimation and a blood pressure measuring sensor, with real-time readings displayed on an LCD. The collected health data can be reviewed immediately and can be further extended for storage or remote monitoring. By automating routine health checkups and reducing the need for unnecessary hospital visits for basic diagnostics, the proposed system offers a practical, accessible, and preventive healthcare solution that enhances community well-being.

Keywords: Smart Healthcare, System Automated Health Monitoring, Medical Robotics, Intelligent Diagnostic System, Remote Patient Monitoring, Digital Health Technology.

INTRODUCTION

Healthcare systems are increasingly under pressure due to population growth, urbanization, and the rising prevalence of chronic diseases. Routine health monitoring plays a crucial role in early detection and prevention of serious medical

conditions, yet many individuals avoid regular checkups because of time constraints, long waiting hours, travel difficulties, and high healthcare costs. These issues are more pronounced in densely populated areas and rural regions where access to medical facilities is limited.

Advancements in robotics, embedded systems, and sensor technology have opened new possibilities for automating basic healthcare services.

The Smart Automated Health Check-up Robot is developed in this context to provide an accessible and preventive healthcare solution. The system combines autonomous mobility with sensor-based health monitoring to perform routine checkups within a predefined area. This approach helps bring healthcare services closer to people, enabling regular monitoring and early identification of potential health risks.

RELATED WORK

This project focuses on the design and development of a Smart Automated Health Check-up Robot capable of performing basic health monitoring tasks autonomously within a predefined area. The primary aim of the system is to reduce dependency on traditional hospital visits for routine health checkups by providing an accessible, mobile, and contactless health monitoring solution.

The system is built around an embedded controller such as Arduino or ESP32, which acts as the central processing unit for data acquisition, control, and decision-making. Various medical and environmental sensors are interfaced with the controller to measure essential health parameters including body temperature, heart rate, blood pressure, oxygen saturation, and ambient conditions. Autonomous mobility is achieved using DC motors controlled through a motor driver, along with ultrasonic and IR sensors for obstacle detection and safe navigation.

LITERATURE SURVEY

A innovative solution to automate the delivery of medicine to patients and monitor their vital parameters in healthcare facilities. Traditional methods often rely on human interventions for medicine delivery and patient monitoring, leading to inefficiencies and potential error.

The preliminary health tests of patients in the hospital are carried out by doctors. This requires them to be in contact with the patient which may unknowingly expose them to contagious diseases and it wastes their invaluable time for tests which are primitive in nature.

The entire world witnessed the covid-19pandemicinthe year 2020. The actual outbreak of this corona virus was first reported in Wuhan, China and later declared to be epidemic by (WHO) World Health Organization. The whole world was under tremendous pressure in monitoring health, managing, and maintaining hospitals and inventing new drugs.

In modern healthcare environments, especially during pandemics and critical health events, ensuring effective patient care while minimizing direct human contact has become paramount. Healthcare systems face immense challenges during pandemics and critical health events, often struggling to balance patient needs with staff availability and safety concerns.

The Internet of Things (IoT) is essential in innovative applications such as smart cities, smart homes, education, healthcare, transportation, and defense operations. IoT applications are particularly beneficial for providing healthcare because they enable secure and real-time remote patient monitoring to improve the quality of people's lives

EXISTING SYSTEM

The existing smart health monitoring systems using robotics are primarily designed to assist healthcare professionals by collecting basic physiological parameters from patients in controlled environments such as hospitals, clinics, and elderly care centers. These systems typically rely on stationary or semi-autonomous robotic platforms integrated with biomedical sensors to measure vital signs like body temperature, heart rate, blood pressure, and oxygen saturation. The collected data is either displayed locally or transmitted to a central monitoring unit for further analysis.

Overall, the existing systems aim to reduce the workload of healthcare professionals and minimize direct contact with patients, especially during infectious disease outbreaks. However, their functionality is often limited by rigid system architecture, lack of adaptability, and dependency on infrastructure such as continuous power supply and high-speed internet connectivity.

PROPOSED SYSTEM

Regular health checkups play a vital role in maintaining overall well-being; however, many people avoid visiting hospitals due to factors such as time constraints, limited accessibility, and lack of health awareness. To address this issue, the Smart Automated Health Check-Up Robot is designed as an autonomous system capable of performing basic health assessments within a

predefined environment such as apartments, gated communities, and nearby residential streets.

The collected health data can be reviewed on-site and has the potential to be extended for remote monitoring and data storage in future enhancements. By automating routine health checkups and reducing the need for hospital visits for basic diagnostics, the proposed system offers a practical, cost-effective, and accessible healthcare solution.

ARCHITECTURE

The power supply provides the required electrical energy to all components of the smart automated health check-up robot. It converts the available input power into a regulated DC voltage suitable for the Arduino UNO board, sensors, motor driver, and LCD. A stable power supply ensures reliable operation and accurate sensor readings.

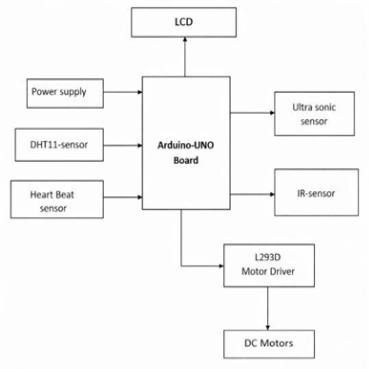

Fig 1: Block Diagram

MEDHOLOGY DISCRIPTION

Step 1: System Initialization When the system is powered ON, the Arduino microcontroller initializes all connected modules, including health monitoring sensors, navigation sensors, motor driver, and LCD display. The robot checks sensor readiness and sets initial threshold values required for movement and health measurement.

Step 2: Autonomous Movement Start The robot begins moving autonomously within the predefined area using DC motors controlled by the L293D motor driver. The Arduino sends control signals to the motor driver to regulate motor direction and speed.

Step 3: Obstacle Detection and Navigation During movement, the ultrasonic sensor continuously measures the distance to nearby objects, while IR sensors detect obstacles in close proximity. If an obstacle is detected within a predefined safe distance, the Arduino processes this data and commands the motors to stop, turn, or change direction, ensuring safe navigation.

Step 4: User Detection and Positioning When the robot reaches a user or a designated health check point, it stops at an appropriate distance. The system ensures stable positioning before initiating the

health check-up process to avoid measurement errors.

Step 5: Health Parameter Measurement The health monitoring sensors are activated to collect physiological data. The DHT11 sensor measures body temperature, and the Heart Beat Sensor records blood pressure values. These readings are sent to the Arduino for processing and validation.

Step 6: Data Processing and Display The Arduino processes the collected health data and compares it with normal reference values. The final readings are displayed in real time on the LCD screen, allowing the user to instantly view their health status.

Step 7: Completion and Resume Operation After completing the health check-up, the robot resumes its autonomous movement to serve other users within the area.

HARDWARE AND SOFTWARE REQUIREMENTS

Arduino Uno:-

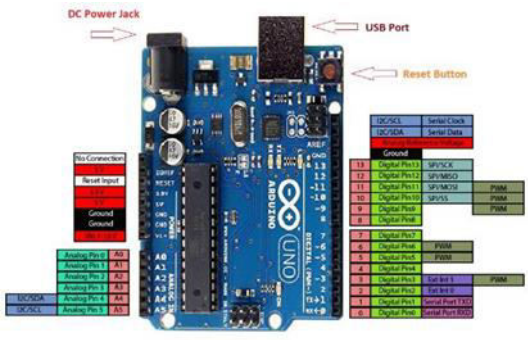

Fig: 2 Arduino Uno

The Arduino Uno is a microcontroller-based development board built around the ATmega328P and serves as the central processing unit in many embedded and robotics applications. It operates at 5V, has 14 digital input/output pins (including PWM) and 6 analog input pins, and can be easily programmed using a USB connection. In a smart automated health checkup robot.

L293D driver :-

Fig:3 L293D driver

The l293d can drive small and quiet big motors as well, check the Voltage Specification at the In a single L293D chip there are two h-Bridge circuit inside the IC which can rotate two dc motor independently. Due its size it is very much used in robotic application for controlling DC motors. Given below is the pin diagram of a L293D motor controller.

Dc motor:-

Fig:4 Dc motor

A machine that converts DC electrical power into mechanical power is known as a Direct Current motor. DC motor working is based on the principle that when a current carrying conductor is placed in a magnetic field, the conductor experiences a mechanical force.

Ultrasonic Sensor:-

Fig: 5 Ultrasonic Sensor

Ultrasonic Definition: The human ear can hear sound frequency around 20HZ ~ 20KHZ, and ultrasonic is the sound wave beyond the human ability of 20KHZ .

Long range detection: In industrial sensing, more and more applications require detection over distance. Ultrasonic sensors detect over long ranges up to forty feet, while limit switches and inductive sensors do not.

IR Sensor:-

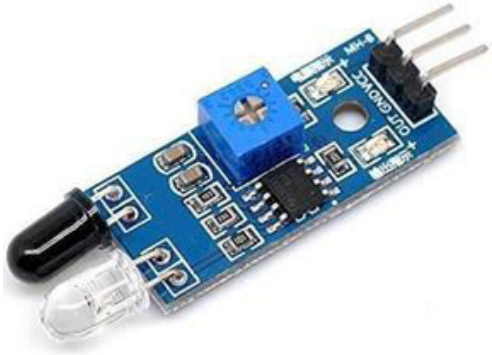

Fig:6 IR Sensor

An infrared sensor is an electronic device, that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called a passive IR sensor. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes, that can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode that is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and the

output voltages will change in proportion to the magnitude of the IR light received.

DHT 11 Sensor:-

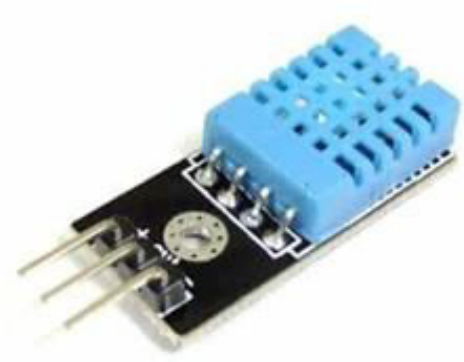

Fig: 7 Temperature Sensor

DHT11 humidity and temperature sensor is available as a sensor and as a module. The difference between this sensor and module is the pull-up resistor and a power-on LED. DHT11 is a relative humidity sensor. To measure the surrounding air this sensor uses a thermistor and a capacitive humidity sensor.

Heart Beat Sensor:-

Fig: 8 Heart Beat Sensor

The heartbeat sensor is based on the principle of photo phlethysmography. It measures the change in volume of blood through any organ of the body which causes a change in the light intensity through that organ (a vascular region).

LCD Display:-

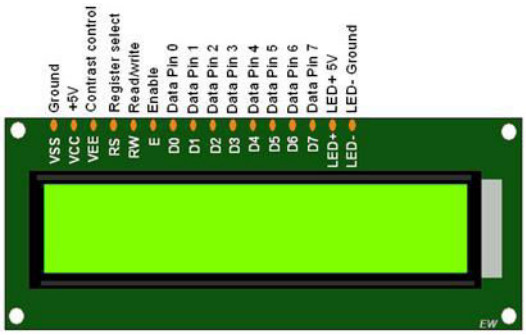

Fig:9 LCD Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16×2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A 16×2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5×7 pixel matrix. This LCD has two registers, namely, Command and Data.

SOFTWARE REQUIRMEENT:-

The software design of the automated health check-up robot controls how the system senses, processes, and responds to real-time data. It acts as the "brain" of the robot, coordinating all hardware components such as sensors, motors, and display units. The software ensures smooth operation, accurate measurements, and reliable decision-making.The entire system is programmed and monitored using the development environment provided by Arduino, and the control logic is written using Embedded C.

Arduino IDE

The Arduino Integrated Development Environment (Arduino IDE) is an open-source software platform used to write, edit, compile, and upload programs to Arduino microcontroller boards. It is developed and maintained by Arduino and is widely used for embedded systems, robotics, and automation projects.

It provides a simple and beginner-friendly interface that allows users to control hardware components through programming.

Programming Language Used

Arduino IDE uses a simplified version of Embedded C/C++. Programs mainly include: setup() → Runs once when the system starts loop() → Runs continuously to control system operations

Steps to Use Arduino IDE

Write program code in the editor

Verify (compile) the code to check errors Connect Arduino board to computer Select correct board and port

Upload program to the microcontroller Monitor output using serial monitor

RESULTS AND DISCUSSION

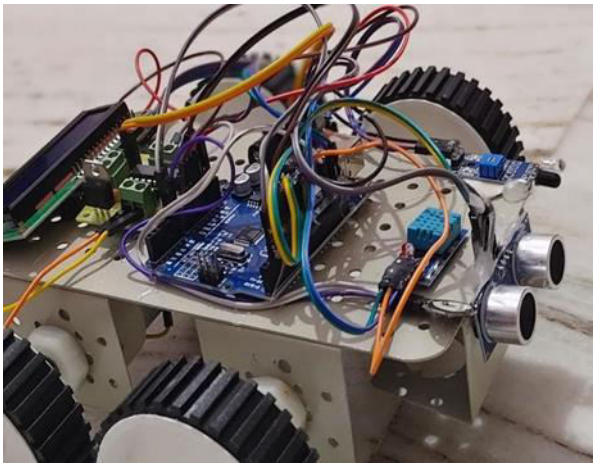

Fig:10 Designed System

The testing strategy for the Smart Automated Health Check-up Robot focuses on verifying the correct functioning of individual components as well as the complete integrated system. A modular testing approach is followed, where each hardware and software unit is tested independently before integrating it into the final system. This approach helps in

identifying errors at an early stage and simplifies debugging.

Finally, system-level testing ensures that the robot performs its intended function continuously without failure. The testing strategy confirms that the system meets project objectives such as accuracy, safety, and reliability.

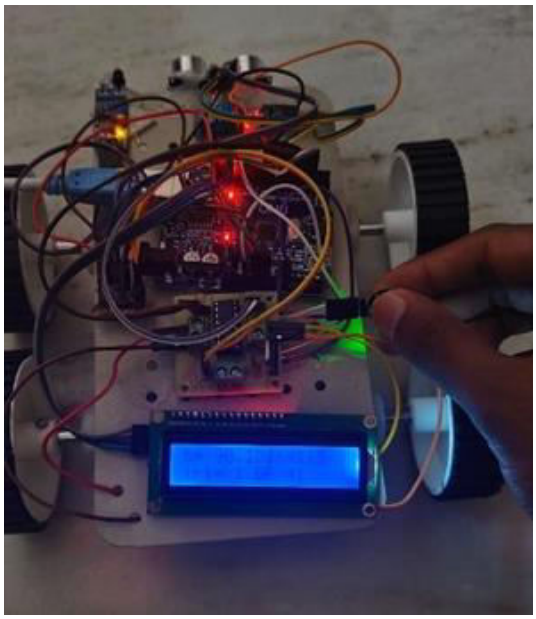

Fig: 11 Testing Sensors

System validation is performed to confirm that the Smart Automated Health Check-up Robot meets all functional and performance requirements. After integrating all hardware and software components, the robot is tested under real operating conditions.

CONCLUSION

The smart automated health check-up robot is a useful and innovative solution for modern healthcare systems. It helps in performing basic health monitoring quickly and efficiently while reducing the workload on medical staff. This project demonstrates how technology and automation can improve healthcare accessibility, especially in remote and crowded areas. Although the system has some limitations, such as dependency on sensors and technical.

FUTURE SCOPE

The Smart Automated Health Check-up robot has future advancement because rapid development in technology, systems are upgrading with advance AI technology in robotics, IOT integrated systems with AI and in medicine regeion also. This development can be advanced with Inegration of Artificial Intelligence, advanced sensor replacement , IoT & Cloud Data Storage of individuals, camera vision, Integration with Hospital Information Systems, Mobile App, Wearable Connectivity and Voice Interaction with Multilingual Support.

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