BLOOD PRESSURE MONITORING SYSTEM

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Abstract— Health monitoring plays a critical role in preventive healthcare, enabling early detection and management of various health conditions. This report presents an IoT-based monitoring system that measures blood pressure and body temperature, with the addition of an SpO2 sensor for monitoring blood oxygen saturation levels. This system uses the MPX5100DP sensor for measuring blood pressure, the DS18B20 sensor for temperature, and the MAX30100 sensor for SpO2. Real-time data collected from these sensors is displayed on an LCD screen and transmitted to a cloud platform via Wi-Fi for remote access, enabling caregivers and healthcare professionals to monitor patients’ health remotely. The system achieves high accuracy, with an average error of 2.96% for systolic pressure, 3.29% for diastolic pressure, 0.63% for body temperature, and less than 2% for SpO2, making it a reliable solution for continuous health monitoring.

# INTRODUCTION

# Continuous monitoring of vital signs is essential for assessing human health and detecting abnormalities early on. Blood pressure, body temperature, and blood oxygen saturation (SpO2) are among the most critical health indicators. High blood pressure can be an early sign of cardiovascular disease, while body temperature reflects metabolic and immune system functions. Oxygen saturation levels, monitored through SpO2, are crucial for assessing respiratory health. With the rise of telemedicine and remote healthcare, there is a growing need for IoT-enabled systems that allow remote monitoring of these vital signs. This report focuses on the development and testing of an IoT-based system that uses Arduino to integrate multiple health sensors, providing an efficient, user-friendly, and real-time solution for health monitoring.

# METHOD

This research aims to develop an IoT-based blood pressure monitoring device. Blood pressure data is acquired using the MPX5100DP pressure sensor. The measurements are processed by a microcontroller, allowing the data to be displayed on an LCD screen. Accuracy is determined by comparing blood pressure readings from the developed device

with those from standard tools. Precision is evaluated by repeating measurements ten times under the same conditions.

The block diagram of the IoT-based blood pressure monitor includes an MPX5100DP sensor, push button, power supply, Arduino, ESP-01, relay, 16x2 LCD, air pump, and solenoid, as shown in Figure 1.

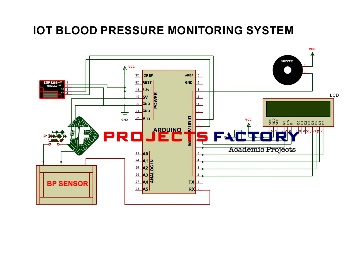


Fig 1. Block Diagram of Blood Pressure Monitoring Device

Once all components are connected, the circuit for the IoT-based blood pressure monitoring device is assembled as shown in Figure 2.

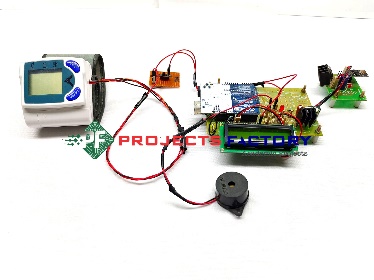


Fig 2. Circuit of IoT-based Blood Pressure Monitoring Device

Figure 2 presents the complete setup of the IoT-based blood pressure monitoring device, where the MPX5100DP sensor is the main component for measuring pressure. The device operates once the power supply is connected.

# COMPONENTS

List of components that are used in this project are:

1. MPX5100DP Pressure Sensor

Function: This is a precision sensor designed to measure air pressure, which is key for accurate blood pressure readings. It detects the pressure inside an inflatable cuff, converting the pressure into an analog electrical signal.

How It Works: When the air pump inflates the cuff, the MPX5100DP measures the pressure and sends an analog signal to the Arduino, which interprets it to calculate blood pressure. It has a high sensitivity to pressure changes, which is essential for detecting systolic and diastolic pressures.

1. Push Button

Function: The push button serves as a manual trigger to start and stop measurements. It allows the user to control when the blood pressure and temperature readings are taken.

How It Works: When the button is pressed, it sends a signal to the Arduino, which then begins the process of inflating the cuff and reading data from the sensors. This input helps ensure that the device only operates when desired by the user.

1. Power Supply

Function: This component powers the entire system, including the Arduino, sensors, LCD, and WiFi module, ensuring that each part operates smoothly.

How It Works: The power supply should provide a stable DC voltage, typically 5V or 9V, depending on the requirements of the components. The power supply needs to be stable and capable of delivering enough current, especially for components like the air pump and solenoid.

1. Arduino Microcontroller

Function: The Arduino serves as the central control unit of the device, managing data acquisition, processing, and communication between components.

How It Works: Arduino collects data from the MPX5100DP and DS18B20 sensors, processes it, and then displays it on the LCD. It also manages the relay module to control the air pump and solenoid valve and sends data to the ESP-01 WiFi module for IoT integration. Arduino's versatility makes it ideal for managing these diverse tasks.

1. ESP-01 WiFi Module

Function: The ESP-01 module provides wireless connectivity, enabling the device to upload data to the ThingSpeak IoT platform.

How It Works: It communicates with the Arduino using serial communication, receiving data to be transmitted over WiFi. When connected to a WiFi network, it sends blood pressure and temperature readings to ThingSpeak, allowing remote monitoring through a smartphone or computer. Its low power requirements and small size make it suitable for IoT applications.

1. Relay Module

Function: The relay module acts as a switch, controlling the air pump and solenoid valve by isolating the high-power devices from the low-power control circuit.

How It Works: The Arduino activates the relay to control the air pump during cuff inflation and then toggles it to operate the solenoid valve for releasing pressure. The relay’s ability to handle high current makes it essential for safely controlling these components within the circuit.

1. Air Pump

Function: Inflates the cuff to create pressure for measuring blood pressure.

How It Works: Controlled by the relay, the air pump inflates the cuff until the desired pressure is reached, enabling the MPX5100DP sensor to measure blood pressure accurately.

1. Solenoid Valve

Function: Releases air from the cuff to reduce pressure after measurements.

How It Works: The Arduino triggers the solenoid valve through the relay, allowing controlled deflation of the cuff, which is essential for accurate pressure readings.

# WORKING PRINCIPLE

The IoT-based blood pressure and temperature monitoring device begins with the user powering on the system and pressing a push button to initiate measurements. The Arduino microcontroller activates the air pump via a relay to inflate a cuff placed on the user's arm. As the cuff inflates, the MPX5100DP pressure sensor continuously monitors the pressure and sends readings to the Arduino, which processes the data to detect systolic and diastolic points indicative of blood pressure. At the same time, the DS18B20 sensor measures the user’s body temperature and sends digital readings directly to the Arduino, providing both pressure and temperature data. This information is displayed on a 16x2 LCD screen, offering immediate results. The ESP-01 WiFi module then transmits the collected data to the ThingSpeak IoT platform, allowing users or healthcare providers to access the readings remotely. After the measurements are completed, the Arduino triggers a solenoid valve to deflate the cuff in a controlled manner, ensuring both safety and accuracy. This system enables convenient and real-time health monitoring, with IoT integration for continuous tracking and remote access.

# V.CONCLUSIONS

# In conclusion, the IoT-based blood pressure monitoring system showcases a notable advancement in health monitoring technology. By integrating the MPX5100DP pressure sensor with an Arduino microcontroller and utilizing the ESP-01 WiFi module, the system enables real-time data collection and remote access through the ThingSpeak platform. The high accuracy rates achieved in measuring blood pressure demonstrate the reliability and effectiveness of this device for continuous health tracking. This project enhances accessibility to vital health data for users and healthcare providers, representing a cost-effective and efficient solution for improving patient care and promoting proactive health management. Overall, the IoT-based blood pressure monitoring system lays the groundwork for future innovations in remote health monitoring solutions.

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