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# Self Operable E-Health Diagnosis and Monitoring System with Gesture Control and Voice Assistance

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**ABSTRACT**

In the present timeline, technology has advanced significantly, and the healthcare sector is constantly expanding. People in rural areas who cannot access corporate hospitals postpone their health check-ups due to the difficulty of traveling long distances. The readily available and expensive nature of diagnostic technologies have prevented many rural residents from seeking clinical examinations, even in cases when they have health issues. Corporate hospitals often make people to wait for long periods of time for health reports and causing delays. These issues highlighted the need for a device which aimed at developing an Arduino based health diagnosis system

To resolve this issue, we have introduced a device that offers a comprehensive health diagnosis and monitoring system that uses Arduino technology to store and display vital health information. The system is designed to analyze electrocardiograms (ECG), photoplethysmograms (PPG), body temperature, heart rate and stress levels in real time and then process this information to create meaningful health status assessments and store them in the database for further health assessments. Furthermore, these data could be displayed through web server or an application. Additionally, this system provides voice assistance for the condition of patient when it is critical which helps in early detection of health conditions.

Hand gestures are incorporated into this device, which makes it distinctive. Users can control the display of health parameters and easily move through the system's features with simple hand gestures. Users can switch between different types of modes in the system (such as on/off and different operation) by moving their hand in specified patterns.

**Keywords:** rural healthcare access, real-time health monitoring, electrocardiogram analysis, photoplethysmogram monitoring, body temperature measurement, heart rate detection, stress level assessment, health status assessment, health data storage, web-based health data display, health monitoring application, voice-assisted health alerts

## 1. Introduction

These days, technology has advanced significantly, and the health-care sector is constantly expanding; there is a great deal of study being conducted on human health. Even in this day and age of artificial intelligence and machine learning, diagnostic systems are out of reach for the majority of the globe due

to their high cost and lack of knowledge. One person dies every 33 seconds due to heart attack , and over 18 million people die each year from heart disease and other cardiovascular disorders throughout the world. One-third of all fatalities worldwide are caused by heart problems. Heart failure is the cause of 27% of all recorded fatalities in a report titled "Deaths and Suicides in India." An estimated 8 million people die each year as a result of inadequate medical treatment and supplies. Every 10,000 Indians, about 122 of them die as a result of not routinely monitoring their conditions .

For better health, people should have regular medical checkups each year but that is not happening . The readily available and expensive nature of diagnostic technologies have prevented many rural residents from seeking clinical examinations, even in cases when they may have issues. More than one lakh rupees was spent on an ecg machine. and 85,000 rupees for technologies that track health. And this Amount of money is not possible for rural people to affort to avail them self. And even in government hospitals there is no proper diagnostic systems to check patients , Many rural people unwill to go to hospital for regular checkups due to the cost of health .

Our work contributes to the advancement of healthcare . and it also cost-effective and accessible for everyone .With the help of current technologies like ai and ml , Our machine aims to help in medical field of diagnostics, ultimately leading to improved patient Outcomes and healthcare delivery.

## 2. Literature Survey

Comparative analysis of the system with the existing projects

| S.NO | EXISTING WORKS | PROPOSED SYSTEM |
|---|---|---|
| [1] | Wearable sensors for hand gesture recognition in the context of healthcare applications. The Method of Hand gesture detection describe by author in [1]. Use wearable sensors to track hand gestures for various applications, including healthcare. | The proposed system project aims to detect hand gestures without wearable sensors, making it more convenient for users. The device detects gestures and displays ECG and PPG results on its screen, providing a user-friendly interface. |
| [2] | This paper in [2] proposes a model that uses hand gestures made by the speech impaired with the help of fingers for different sequence of words are captured by the flex sensors and produces a voice output with the help of a speaker. | This system is proposed in such a way that this predefined hand gestures helps to control the display of health parameters of the patients without touching them physically to maintain the delicacy of the system. |
| [3] | The author of [3] proposed a design that uses two sensors one is temperature sensor (LM35) another one is the pulse rate sensor (AD 8232) which gives body temperature and heart rate. That record of data can be stored and accessed through ThingSpeak(cloud services). | Additional sensors have been incorporated in this system, such as ECG (REES52) and PPG (HRM311E) sensors, temperature sensor (LM35), heart rate (HW-827) sensor, stress level sensor. These record of health parameters of the patients can be stored and accessed through firebase. |
| [4] | The author in the [6] have brief about the barriers to implementation of ICT in the rural hospitals are lack of computer equipment. | We have Overcame the barriers as mention by author in[6].The gesture detection the sensors of ECG PPG temperature are integrated in one device and the data is |

| | | |
|---|---|---|
| | | updated on Firebase database. |
| [5] | Screens are a standard feature of systems, and values are found and shown there following the findings. | The system includes voice alerts in case of abnormal readings of parameters, which helps in early detection of health problems. Notifying users immediately of deviations from normal values, it enables timely intervention and management of potential diseases, improving overall health monitoring and preventive treatment. |
| [6] | Values from diagnostic systems are recorded on a report which is subsequently checked by physicians following appointments. and requires a long time to produce results. | After the test, all of the system's values are stored in a database, and a report is instantly and automatically posted to a website and an app. |
| [7] | The authors of [7] introduced a robot which detects and extinguishes the fire depending on its class by using deep learning (DL) techniques. Accuracy was mentioned up to 98.25% in detecting the fire and 92% in detecting the fire type. Alerting the fire agents through sending the image of fire and buzzer sounds are not introduced in this robot. | Fire accident personnels would receive the **images** of the fire-detected area immediately after the robot detects it and the robot makes a buzz sound to alert nearby people. No DL mechanisms were used and made it simple by using sensors. |

## 3. Problem Statement

These days, technology has advanced significantly, and the health-care sector is constantly expanding; there is a great deal of study being conducted on human health. Even in this day and age of artificial intelligence and machine learning, diagnostic systems are out of reach for the majority of the globe due to their high cost and lack of knowledge. One person dies every 33 seconds due to heart attack , and over 18 million people die each year from heart disease and other cardiovascular disorders throughout the world. One-third of all fatalities worldwide are caused by heart problems. Heart failure is the cause of 27% of all recorded fatalities in a report titled "Deaths and Suicides in India." An estimated 8 million people die each year as a result of inadequate medical treatment and supplies. Every 10,000 Indians, about 122 of them die as a result of not routinely monitoring their conditions .

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## 4. Objectives For Proposed Work

Using Arduino technology, the "MANAGED ELECTRONIC HEALTH DIAGNOSIS AND MONITORING SYSTEM WITH GESTURE CONTROL AND SOUND PUMP" project aims to create a novel and all-encompassing health monitoring system. The following are the project's primary goals:

1. Multiparameter Monitoring of Health: Create a small gadget that seamlessly combines a number of medical data, including temperature, pulse, ECG (electrocardiogram), PPG (photolethysmogram), and stress level assessment. An integrated perspective of an individual's health is made possible by this.
2. Real-time data analysis: Utilizing cutting-edge algorithms, process gathered data in real-time to deliver prompt and precise health evaluations. The device can identify abnormal cardiac rhythms, stress patterns, and potential temperature anomalies by monitoring ECG and PPG inputs.
3. Health Analysis and Interpretation: Present and analyze combined health data to determine the general state of health. Provide unambiguous signals that specify whether a user's health is normal or requires care.
4. Gesture control: This feature consists of hand gesture control, which enables users to effortlessly move between different functions using simple gestures. A user-friendly experience is ensured by this function, especially for those who have mobility challenges.
5. Remote Access: By connecting the device to the Internet, you can enable remote access to health data. Healthcare providers may monitor patients remotely and encourage proactive health management by having safe access to real-time health data from any location.
6. Advanced Data Visualization: Utilize interactive, comprehensible graphs to present health data, highlighting changes and patterns in the EKG, PPG, temperature, heart rate, and Over time, stress levels can increase over time. This improves users' perception of their health status.
7. In addition to visual information, audio feedback is provided. The device is more comprehensive and versatile, as voice prompts help users understand their health results.
   A modern health monitoring system is created using Arduino technology. The project meets the need for proactive and easily accessible health management by integrating various health parameters and offering gesture control. Through these goals, the project aims to improve users' understanding of their health status and encourage timely intervention when necessary..

## 5. Procedure

The development procedure for the "Vital Sense" project, which utilizes Arduino and sensors, and is programmed in both Arduino and Python, is outlined below:

**Step 1: Hardware Setup:**

Assembling of required hardware components, including Arduino board, ECG and PPG sensors, temperature sensor, heart rate sensor, stress level sensor, and Wi-Fi module.

Connect the sensors to the appropriate pins on the Arduino board, ensuring proper wiring and compatibility.

**Step 2: Sensor Data Acquisition:**

Programming the Arduino to read data from each sensor using its libraries and interfaces. For example, using the appropriate libraries like LiquidCrystal.h, heartRate.h, and MAX30105.h to collect ECG, PPG, temperature, heart rate, and stress level data.

**Step 3: Data Processing and Analysis:**

Implementing algorithms in Arduino and Python to process the collected sensor data. Using signal processing techniques to filter noise and extract meaningful health metrics.

Combining the sensor data to assess the user's health condition. Algorithm is t be designed to identify irregular heartbeats, stress patterns, temperature anomalies, etc.

**Step 4: Gesture Control Integration:**

Using a pre-trained deep learning model MediaPipe for real-time hand detection and landmark localization by implementing the simple rule-based logic to recognize specific hand gestures.

Preprocessing:

The input video frame is converted to RGB format as the MediaPipe model expects RGB images. (imgrgb = cv2.cvtColor(img, cv2.COLOR_BGR2RGB))

Hand Detection and Landmark Detection:

The hands.process(imgrgb) function processes the RGB image to detect hands and their landmarks. This involves running a deep learning model that identifies the hand(s) and computes the precise location of each landmark. (res = hands.process(imgrgb))

**Step 5: Internet Connectivity**

Integrating the Wi-Fi module to establish an internet connection. Programming the Arduino to send processed sensor data to a cloud server using HTTP protocols.

**Step 6: Cloud Server Setup**

Set up a cloud server to receive and store the transmitted data. Using firebase to store historical health metrics and user profiles securely.

**Step 7: Remote Data Viewing:**

Developing a web-based and mobile application using Python and JavaScript. This application will retrieve data from the cloud server and present it to the user in a user-friendly interface.

**Step 8: Step1: Data Visualization:**

Utilizing Python libraries to generate graphs and visual representations of the health data. Creating a clear and understandable graphs that illustrate the trends and variations in ECG, PPG, temperature, heart rate, and stress levels.

**Step 9: Auditory Feedback Integration**

Programming the system to generate auditory feedback using sound modules. Using Python to convert health metrics into spoken cues that provide users with audio information about their health status.

**Step 10: User Interaction Testing**

Thoroughly testing the system's hand gesture recognition and ensure its responsiveness and accuracy.

Validating the data accuracy by comparing the results with established medical instruments and techniques.

The "Vital Sense" project involves hardware setup, sensor data acquisition, data processing, internet connectivity, remote data viewing, gesture control, and auditory feedback integration. By following these steps, the project achieves its objective of providing comprehensive health monitoring with the ability to interpret data, be controlled by hand gestures, and offer remote access through the internet, while also generating understandable graphs and audio feedback for users.

## 5. Results And Discussion

Displaying the different health parameters readings is facilitated through the use of hand gestures. We

could seamlessly control the device through different hand gestures. This model incorporates three distinct gestures, each triggering the commencement of specific operations corresponding to the indicated gesture.

For every gesture we use our system detects it wirelessly and a new health parameter will be incremented as integrated. By default we have temperature as parameter of study.

Gesture 1: Temperature and PPG


Corresponding Graph:


Gesture 2: TMP PPG BPM


Corresponding Graph:


AS shown in the above this gesture adds BPM feature additionally for our system.

Gesture 3: TMP PPG BPM ECG


Corresponding Graph:


AS shown in the above this gesture adds ECG feature additionally for our system.

## 7. Future Scope

In the future, expanding the device's functionalities to include AI-powered predictive analytics might enhance the ability to identify illnesses early and provide personalized health recommendations. Accessibility will be further increased by including telemedicine components that enable remote consultations with medical professionals. Developments in sensor technology could improve diagnosis and vital sign monitoring. Enabling secure health data management and seamless integration with current healthcare systems with blockchain technology would safeguard patient privacy and provide seamless integration into wider healthcare networks. Lastly, to optimize the device's impact on rural healthcare access, partnerships with governments and non-profits would be sought after for the device's deployment and assistance in underprivileged areas worldwide.

## 8. Conclusion

Our project offers an innovative solution to the challenges of traditional health monitoring systems. Using Arduino technology, the project seamlessly integrates vital health indicators, including ECG, PPG, temperature, heart rate and stress levels, into a single platform. The inclusion of hand gesture control improves the user experience and makes health monitoring intuitive and natural. In addition, the remote use of the system allows you to check your well-being from anywhere, which promotes preventive health management and facilitates remote consultations. With graphical and audible presentation of data and actionable insights, Vital Sense transforms raw data into meaningful information. This project envisions a future where people can participate in their health in a holistic, accessible and individual way and move towards a healthier life. of.

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