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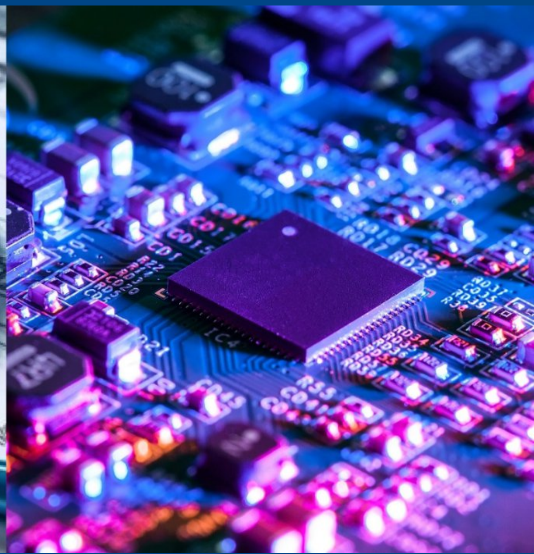

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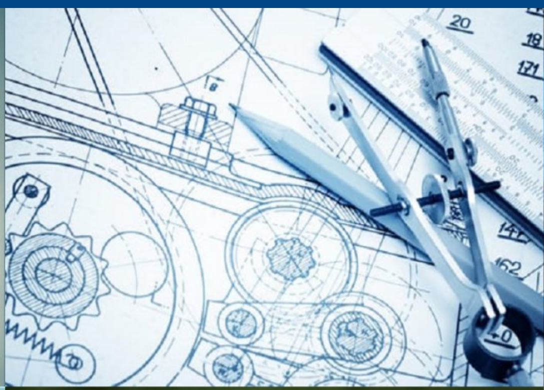

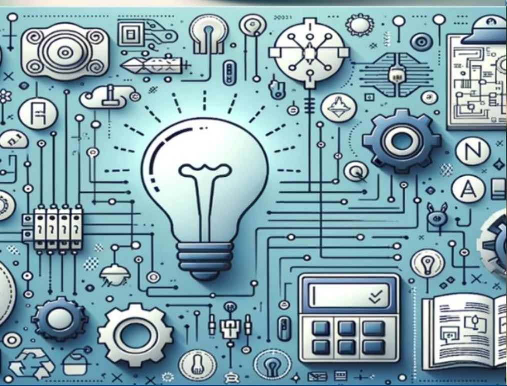

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Wearable IoT Based Dehydration Monitoring System for Elderly Patients

Naresh Kumar K, Kowshik Prabhu R, Giridharan V, Ilayavan M, Sidharthan

Assistant Professor, Department of BME, GRT-IET, Tiruttani, Tamil Nadu, India

BME IV-Year Student, Department of BME, GRT-IET, Tiruttani, Tamil Nadu, India

BME IV-Year Student, Department of BME, GRT-IET, Tiruttani, Tamil Nadu, India

BME IV-Year Student, Department of BME, GRT-IET, Tiruttani, Tamil Nadu, India

BME IV-Year Student, Department of BME, GRT-IET, Tiruttani, Tamil Nadu, India

ABSTRACT: AI-driven Dehydration is a common and serious health issue among elderly individuals, often leading to complications such as fatigue, kidney problems, and hospitalization. This project proposes a wearable IoT-based dehydration monitoring system designed specifically for elderly patients to enable continuous and real-time health tracking. The system integrates wearable sensors that measure physiological parameters such as body temperature, heart rate, and skin moisture levels to estimate hydration status. The collected data is processed using a microcontroller and transmitted via IoT connectivity to a cloud platform for analysis and monitoring. Machine learning algorithms analyze patterns in the collected data to detect early signs of dehydration and generate timely alerts for caregivers and medical professionals. The system also includes a mobile application that provides real-time notifications, hydration reminders, and health reports, ensuring proactive care and prevention. By combining wearable technology, IoT communication, and intelligent data analysis, the system shifts dehydration monitoring from periodic manual observation to continuous automated supervision. This approach reduces the risk of unnoticed dehydration and enhances patient safety. Additionally, the system is cost-effective, portable, and user-friendly, making it suitable for home-based and hospital environments. Overall, the proposed solution aims to improve elderly healthcare management, reduce medical emergencies, and promote better quality of life through smart and preventive monitoring systems.

KEYWORDS: ESP32 WROOM, heart rate sensor, temperature sensor, skin moisture sensor, IoT, machine learning, mobile application, cloud platform.

I. INTRODUCTION

Dehydration is a critical health concern, especially among elderly patients, due to reduced thirst sensation, chronic illnesses, and medication effects. It can lead to serious complications such as dizziness, confusion, urinary infections, and even life-threatening conditions if not detected early. Traditional methods of monitoring hydration rely on manual observation, periodic medical checkups, and patient self-reporting, which are often unreliable and delayed. These limitations highlight the need for an efficient and continuous monitoring system that can detect dehydration at an early stage. With advancements in wearable technology and the Internet of Things (IoT), it has become possible to monitor health parameters in real time. Wearable devices equipped with sensors can continuously track physiological signals such as heart rate, body temperature, and skin moisture, which are closely related to hydration levels. IoT enables seamless data transmission from these devices to healthcare providers, allowing remote monitoring and timely intervention. This project focuses on developing a wearable IoT-based dehydration monitoring system specifically designed for elderly patients. The system integrates sensors, microcontrollers, and cloud-based platforms to provide real-time analysis and alerts. By using intelligent algorithms, the system can identify patterns indicating dehydration risk and notify caregivers instantly. The proposed solution aims to reduce dependency on manual monitoring, improve early detection, and enhance patient safety. It also supports preventive healthcare by ensuring timely hydration, ultimately improving the overall quality of life for elderly individuals.

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II. METHODOLOGY

The proposed system is a wearable IoT-based dehydration monitoring solution designed for elderly patients. It consists of sensors that continuously measure physiological parameters such as heart rate, body temperature, and skin moisture levels. These sensors are connected to a microcontroller, which processes the collected data and transmits it to a cloud platform using IoT technology.Machine learning algorithms analyze the data to identify dehydration patterns and predict potential risks. When abnormal conditions are detected, the system sends real-time alerts and hydration reminders to caregivers through a mobile application. The application also provides daily health reports and hydration status updates.

The system ensures continuous monitoring, reduces manual effort, and enables early detection of dehydration. Its wearable design makes it comfortable and suitable for daily use, improving patient safety and supporting preventive healthcare for elderly individuals. The system also incorporates personalized hydration recommendations based on user health data and environmental conditions. It adapts to individual needs by analysing patterns over time. This intelligent approach improves accuracy in dehydration detection and ensures timely preventive actions, reducing health risks among elderly patients**.**

III. LITERATURE REVIEW

Smart Wearable for Detecting Dehydration, **:** N. Maragatham, B. Manoj Kumar, 2025. This study focuses on the development of a smart wearable system designed to detect dehydration in individuals using advanced sensing technologies. The system integrates multiple physiological sensors to monitor parameters such as body temperature, heart rate, and skin moisture, which are closely associated with hydration levels. The wearable device continuously collects real-time data and processes it using embedded systems to identify variations that may indicate dehydration. The research emphasizes the importance of early detection, especially for elderly individuals and patients with limited mobility. By using IoT connectivity, the collected data is transmitted to a cloud-based platform where it can be accessed by healthcare providers and caregivers. The system also includes a mobile application that displays health status and sends alerts when abnormal conditions are detected. One of the key features highlighted in the study is the use of data analysis techniques to improve accuracy in dehydration detection. The system can differentiate between normal fluctuations and critical conditions, reducing false alerts. Additionally, the wearable design ensures comfort and ease of use, making it suitable for continuous monitoring. The study concludes that such smart wearable systems can significantly improve healthcare management by providing real-time monitoring and early warning signals. It reduces dependency on manual observation and enhances patient safety. Overall, the integration of wearable technology and IoT offers an efficient and reliable solution for dehydration monitoring.

Towards On-Device Dehydration Monitoring Using Machine Learning from Wearable Device's Data, Farida Sabry, Tamer Eltaras,2022 .

This research presents an advanced approach to dehydration monitoring using machine learning techniques applied to data collected from wearable devices. The system focuses on processing physiological signals such as heart rate, temperature, and activity levels to identify patterns related to hydration status. Unlike traditional methods, this approach emphasizes on-device processing, allowing faster analysis and response without relying heavily on cloud systems. The study highlights the role of machine learning algorithms in improving the accuracy of dehydration detection. By training models on collected data, the system can recognize subtle changes in body conditions that indicate dehydration risks. This enables early intervention and reduces the chances of severe health complications. Another important aspect discussed is the efficiency of wearable devices in continuous health monitoring. The system ensures low power consumption while maintaining reliable performance, making it suitable for long-term use. Alerts and notifications are generated when abnormal patterns are detected, allowing timely action by caregivers. The research concludes that combining wearable technology with machine learning provides a smart and efficient solution for dehydration monitoring, improving healthcare outcomes and supporting preventive medical care.

IV. ENVIRONMENT REQUIREMENTS

Hardware Requirements:

1.ESP32-WROOM-32DevBoard: Main controller of the system that processes data and controls all components. Supports Wi-Fi and Bluetooth for communication. Used for automation and smart control of the robot.

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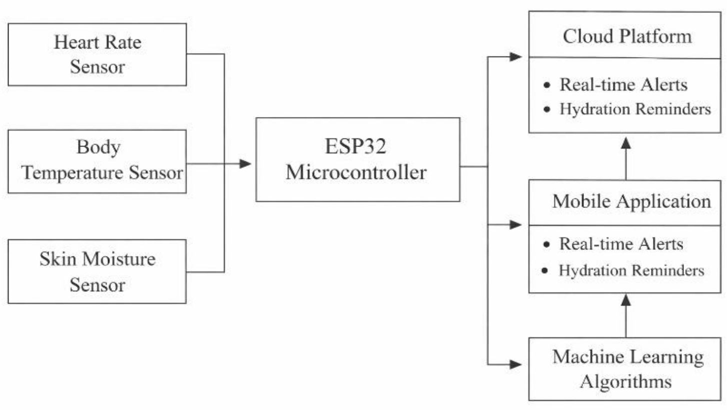
2.UV-CLamp: Emits ultraviolet light to kill bacteria and viruses. Used for surface and air sterilization. Provides chemical-free disinfection.
3.WaterLevelSensor: Monitors the liquid level in the disinfectant tank. Prevents dry running of the mist maker. Ensures proper operation and safety.
4.Motordriver: Responsible for movement of the robot. Motor driver controls speed and direction. Enables smooth navigation of the system.
5.4WDRoverChassis: Mechanical base of the robot with four-wheel drive. Provides stability and mobility on different surfaces. Supports mounting of all hardware components.
6.MistMaker Generates fine mist of disinfectant (e.g., chlorine dioxide). Ensures uniform spraying in the environment. Improves disinfection coverage
7.UltrasonicSensor: Detects obstacles using distance measurement. Helps in safe navigation and collision avoidance. Improves automation and safety.
8.ServoMotor: Controls directional movement or spraying angle. Allows precise positioning of components. Enhances flexibility of operation.
9.12VLi-ionBatteryPack: Provides power supply to the entire system. Ensures portable and cordless operation. Supports long working duration of the robot.

Software Requirements:
1.Operating System: Provides a platform to develop and run the system software. Used for programming, data processing, and system monitoring. Examples include Windows or Linux for development environments.
2.Arduino IDE: Software used to write, compile, and upload code to microcontrollers like ESP32. Supports Embedded C/C++ programming. Useful for interfacing sensors and managing real-time data collection.
3.Blynk / IoT Platform: Used for connecting the wearable device to cloud services. Enables real-time data monitoring through mobile applications. Provides alerts, notifications, and remote access to health data.
4.Python: Programming language used for data processing and analysis. Supports machine learning model development. Helps in analyzing sensor data and detecting dehydration patterns.
5.TensorFlow: Machine learning framework used to build predictive models. Enables intelligent dehydration detection and decision-making. Improves accuracy of health monitoring system.
6.Simulation Tools: Used to design and test the system virtually before implementation. Helps in analyzing sensor behavior and system performance. Examples include Proteus or MATLAB.

V. SYSTEM ARCHITECTURE



VI. MODULE DESCRIPTION

ESP32 Microcontroller: Acts as the core unit of the system. Collects data from sensors and processes it efficiently. Supports Wi-Fi and Bluetooth for real-time data transmission and smart monitoring.
Heart Rate Sensor: Measures the pulse rate of the patient continuously. Helps in detecting abnormal heart rate patterns related to dehydration. Provides accurate real-time physiological data.

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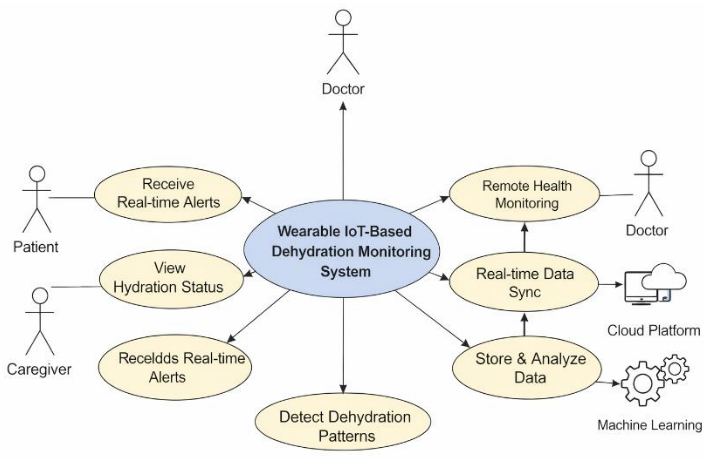
Body Temperature Sensor: Monitors the body temperature of the user. Helps identify temperature variations that may indicate dehydration or health issues. Ensures continuous health tracking.
Skin Moisture Sensor: Detects the moisture level on the skin surface. Helps in estimating hydration levels of the body. Plays a key role in dehydration detection.
IoT Communication Module: Transfers collected data to cloud platforms using Wi-Fi. Enables remote monitoring by caregivers and healthcare professionals. Ensures real-time connectivity and updates.
Mobile Application: Displays real-time health data and hydration status. Sends alerts and reminders to drink water. Provides an easy interface for users and caregivers.
Machine Learning Module: Analyses sensor data to detect dehydration patterns. Improves prediction accuracy using trained models. Enables early warning and smart decision-making.
Alert System (Buzzer/Notification): Provides instant alerts when dehydration is detected. Notifies users through sound or mobile notifications. Ensures timely preventive action.
Battery (Power Supply): Supplies power to the wearable device. Ensures portable and continuous operation. Supports long-term usage without frequent charging.

VII. REHABILITATION SUPPORT

The wearable IoT-based dehydration monitoring system supports rehabilitation by ensuring continuous monitoring of hydration levels, which is essential for elderly patients recovering from illnesses or surgeries. Proper hydration plays a vital role in faster recovery, improved metabolism, and overall physical stability. By providing real-time alerts and reminders, the system helps patients maintain adequate fluid intake and prevents complications related to dehydration.
It also assists healthcare providers and caregivers by reducing the need for constant manual supervision. This allows them to focus more on critical care activities rather than routine monitoring tasks, improving efficiency and quality of care.

Additionally, the system ensures consistent health tracking through IoT-based monitoring and data analysis. This creates a safer environment for recovery and supports long-term rehabilitation in homes, hospitals, and care centers.

VIII. CASE DIAGRAM



IX. CONCLUSION

The wearable IoT-based dehydration monitoring system for elderly patients was developed as an effective solution to continuously monitor hydration levels and prevent dehydration-related health complications. The system utilizes sensors such as heart rate, body temperature, and skin moisture sensors to collect real-time physiological data. With the integration of the ESP32 microcontroller and IoT technology, the collected data is transmitted to cloud platforms for analysis and remote monitoring. This project reduces the dependency on manual observation and ensures early detection of dehydration, which is critical for elderly individuals. By providing real-time alerts and hydration reminders through a mobile application, the system helps patients maintain proper fluid intake and avoid serious health risks. It also supports caregivers and healthcare professionals by minimizing constant supervision and improving overall efficiency in patient care. The inclusion of machine learning techniques enhances the system's ability to analyze patterns and predict dehydration risks with better accuracy. The wearable design ensures comfort, portability, and ease of use, making it suitable for both home and hospital environments. Overall, the proposed system offers a cost-effective, reliable, and intelligent solution for dehydration monitoring. It improves patient safety, supports preventive healthcare, and contributes to better quality of life for elderly individuals.

X. FUTURE WORK

Future work for this system can focus on improving accuracy, intelligence, and usability by integrating advanced technologies such as AI, wearable enhancements, and personalized healthcare features. Future systems can use deep learning algorithms for better prediction. AI can analyse complex health patterns in real-time. Improves accuracy in dehydration detection and decision-making.Use additional sensors like sweat analysis and blood oxygen sensors. Provides more accurate hydration assessment. Enhances overall health monitoring capabilities.

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