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Care Guard: Holistic Health Monitoring and Autonomous Care System

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***Abstract*—Care Guard: Holistic Health Monitoring and Autonomous Care System outlines a comprehensive system integrating various sensors, microcontrollers, and communication technologies to monitor health parameters and provide assistance. The system employs a 12V battery for energy supply and incorporates components for instance, a temperature sensor, pulse oximeter, RFID, touch sensor, Arduino MCU, air quality sensor, LCD (16x2 lines), motor drivers M1 and M2, WiFi, and IoT. The project aims to enhance healthcare by leveraging IoT and robotics technologies to create an intelligent health monitoring and assistance system. The system continuously monitors vital health parameters such as temperature and pulse oximetry, providing real-time data comment addressed for users via the LCD. Additionally, it utilizes RFID technology for patient identification and touch sensors for user interaction. Furthermore, the method incorporates an automatic nurse assistant robot, which utilizes motor drivers for locomotion and navigation. The robot assists users by providing reminders for medication intake, scheduling appointments, and offering guidance on health-related queries. The incorporation of WiFi and IoT enables remote monitoring and control of the system, allowing healthcare professionals to access patient data and provide timely assistance from anywhere. Overall, this project presents a comprehensive solution for health tracking and assistance, leveraging IoT, robotics, and sensor technologies to improve healthcare accessibility and quality.**

Keywords*— Health Monitor, Nurse Assistant Robot, Temperature sensor, Pulse Oximeter, Radio Frequency Identification Technology, Internet Of Things etc.,

I. INTRODUCTION

In today's fast-paced world, ensuring effective healthcare monitoring and assistance is becoming increasingly crucial. With the advancements in technology, particularly in the realms of IoT and robotics, innovative solutions are emerging to address these needs. The project "Care Guard: Holistic Health Monitoring and Autonomous Care System " presents a comprehensive approach to revolutionize healthcare monitoring and assistance. This method aims to integrate various cutting-edge technologies to create a cultured system which not only monitors vital health parameters but also delivers timely assistance to users. The core components of this system include a diverse array of sensors, microcontrollers, communication modules, and a robotic assistant, all orchestrated to work seamlessly altogether. At its heart, the arrangement is powered by a 12V battery, providing the necessary energy for its operations. The utilization of battery power ensures portability and flexibility, enabling users to access healthcare monitoring and assistance regardless of their location.

Key sensors integrated into the system include temperature sensors for continuous monitor of body temperature and pulse oximeters for tracking blood oxygen levels. These sensors provide vital health data in real-time, which is crucial for identifying health problems in their early stages and timely intervention. RFID technology is employed for patient identification, streamlining the procedure for accessing individual health records, and ensuring personalized assistance. Touch sensors offer an intuitive interface for user interaction, enabling users to input data and navigate through the system effortlessly. The Arduino Microcontroller Unit (MCU) serves as the brain of the system, orchestrating the operations of various components and processing the collected data. It acts as the central hub for data aggregation, analysis, and decision-making. Additionally, an air quality sensor is integrated into the system to measure environmental conditions, ensuring a healthy and safe living environment for users.

The method also features a nurse assistant robot, equipped with motor drivers for locomotion and navigation. This robotic assistant provides personalized assistance to users, including reminders for medication intake, scheduling appointments, and offering guidance on health-related queries. Furthermore, the integration of WiFi connectivity and IoT enables remote monitoring and control of the system. Healthcare professionals can access real-time patient data, analyze trends, and provide timely assistance, irrespective of geographical constraints.

II. Literature Survey

Hossain et al. [1] have presented an assistant robot named ADIO, which helps to reduce person-to-person contact and see towards cleanliness. Further, the robot can provide medication, automatic sanitization, and check basic metrics like thermal level, pulse frequency, and oxygen saturation level through an Android app to maintain the database.

Hossain et al. [2] have presented an assistant robot named ADIO, which helps to reduce person-to-person contact and see towards cleanliness. Further, the robot can provide medication, automatic sanitization, and check basic parameters such as pulse rate, temperature and oxygen saturation level through an Android app to maintain the database.

Kuo et al. [3] have presented the robot, which is mainly used to monitor vital signs. It can detect illness and alert if there is some emergency and long-term monitoring via data and event logging. The main aim was to prepare a robot that could operate in human presence and serve the people with vital sign monitoring facilities in the hospitals.

Tasaki et al. [4] have developed the latest type of robot that accompanies healthcare experts making therapeutic rounds in patients' rooms at hospitals. This robot mainly executes two assignments: carrying out all the methods and techniques required as a practitioner and storing all the healthcare-related data on the rounds.

Datta et al. [5] have presented a portable healthcare robot for a medication management framework. It is based on an investigation of the medication management prepared in an elderly care facility. The main objective of this project was to make a robot that can interact easily and the software tools to decrease the death rate and side effects caused by the treatment.

Ahn et al. [6]. This proposed model has the potential to be divided into three systems: a receptionist robot (Reception Bot), a caretaker assistant robot (Care Bot), and a medical server (Robo Gen). The function of this robot is to help the human receptionist and the nurse perform the required task.

Sharkey et al. [7] have presented the development of the Paro seal robot, which is a baby harp seal-shaped robot. It is used for people who have the disorder to lose memory. This robot has different emotions and features as it cries and responds to people by stroking. So, the objective is to prevent close contact.

Hirose et al. [8] have presented the development of a robot that provides a hair-washing facility for patients with the help of scrubbing fingers. This robot helps wash hair in clinics and facilitates the burden of healthcare experts and care workers. It highlights the mechanical and control innovations required for touching somebody tenderly on the head. This incorporates the self-aligning instrument, which is a hollow rack component of the robot's end-effector.

Mukai et al. [9] have presented the development of the nursing robot RIBA, which can lift the patient from the bed to the wheelchair and vice versa. To perform this operation smoothly in the environment, coordination between the caretaker and the robot is necessary.

Punetha et al. [10] have presented the layout and manufacturing of a line-following robot that can carry medicine to patients whenever required. It uses an electronic system capable of detecting and tracking a line which is drawn on the floor. The sensors used in this robot are a light-dependent resistor, IR sensor, and proximity sensor.

Dharani et al. [11] have presented the MEMS sensor detects an accident, The GSM module sends an SMS alert with the vehicle's location and condition to a registered mobile number. Instead of airbags, LED illuminate to indicate deployment.

III. Existing System

An internal clock or timer chip on the Arduino module keeps track of the current time [16]. This allows unmanned system to schedule tasks, set reminders, and track activity duration. An RFID reader module committed to the MC scans RFID tags. These tags, often worn like keycards, store unique identifiers. By reading the tag, the robot can identify the user and potentially access personalized information or instructions. A Bluetooth module enables unmanned system to communicate wirelessly with other Bluetooth-enabled devices. This allows data exchange, like sending sensor readings or receiving control commands from another device (e.g., a smartphone app). A pulse sensor (e.g., fingertip sensor) measures the user's heart rate. A temperature sensor (e.g., thermistor) measures the user's body temperature. The Arduino acts as the brain of unmanned system. It receives sensor data, processes it based on programmed instructions, and controls the robot's movements and actions. A motor driver module controls the speed and pathway of robot's motors. The Arduino sends signals to the motor driver, dictating how the motors move, allowing the unmanned system to navigate and perform actions. An SMS module (e.g., GSM module) connected to the MC board enables sending text messages. This allows the unmanned system to send alerts or notifications in specific situations (e.g., high temperature detected). The robot likely uses two DC motors and wheels for movement. By controlling the pathway and speed of each motor individually, the robot's movements as follows:

Forward: F

Backward: B

Turn left: L

Turn right: R

The block diagram of existing work is shown in figure 1 with different components integrated at one place.

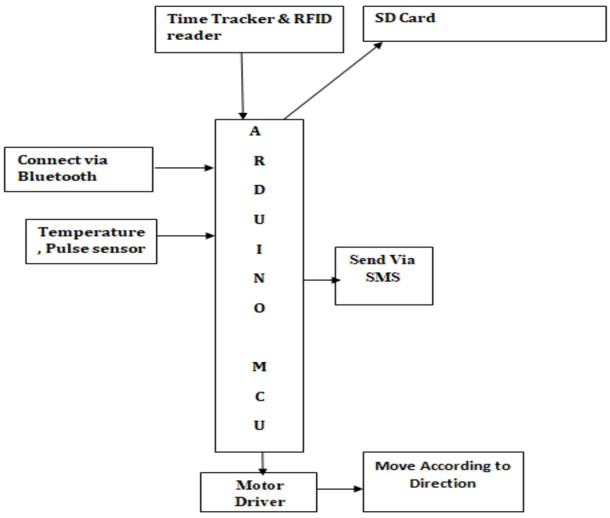

Fig. 1. System Architecture

IV. PROBLEM STATEMENT

With a population that is growing older, heightening healthcare expenses, and limited access to healthcare professionals in remote or underserved areas, there is a pressing demand for technology-driven approaches to enhance healthcare accessibility, efficiency, and effectiveness [12]. Traditional healthcare monitoring methods often rely on periodic clinic visits or manual tracking of health parameters, leading to delays in detecting health issues and providing timely interventions. Additionally, the privation of personalized assistance and guidance can result in suboptimal healthcare outcomes, particularly for individuals with chronic conditions or limited mobility. In light of these challenges, the project aims to develop a comprehensive IoT-enabled healthcare monitoring platform technology integrated with an automatic nurse assistant robot. This system will enable continuous monitoring of vital health parameters, such as temperature, pulse, and blood oxygen levels, in real-time.

V. PROPOSED METHOD

This article proposed that patients will be issued with an RFID card that stores all the information required to regulate the patient's health status, along with a unique patient identity. This Automatic Nurse Assistant Robot will be updated with the new user ID if any new patients are admitted to the ward. To track a patient's health characteristics, ANAR will contact each patient in that particular ward and ask that they place their RFID tag in forward-facing of the RFID reader so that the reader may access that user's exclusive database. Following a successful patient ID verification, patients are instructed to place their fingertips on sensors that track their health. Sensors installed on the ANAR will read patient bodily data, upload it, and store it on a cloud platform such as UBI DOTS. After successfully storing the data on the cloud, family members and medical professionals will find it simple to keep tabs on the patient's present condition.

A. Block Diagram

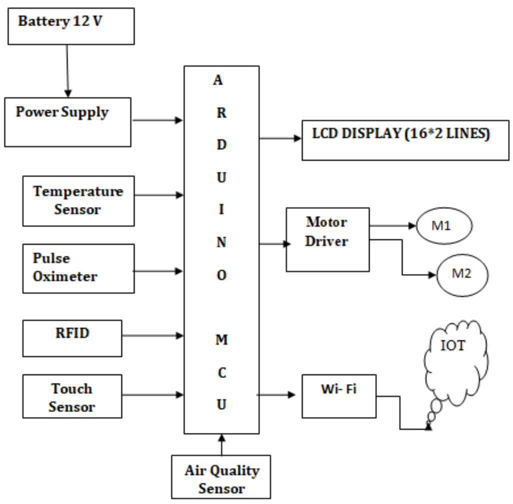

Fig. 2. System Architecture

The "Care Guard: Holistic Health Monitoring and Autonomous Care System" is a sophisticated system [13] designed to monitor health parameters and provide personalized assistance to users is shown above in figure 2.

1) Battery 12V and Power Supply:

The 12V battery serves as the primary power source for the system, providing the necessary energy to operate all components. A power supply unit ensures proper voltage regulation and distribution to each component within the system.

2) Temperature Sensor:

The figure 3 shows the temperature sensor measures the ambient temperature of the user's surroundings. This data is crucial for monitoring ecological features that may impact the user's health, such as fever or extreme temperatures.

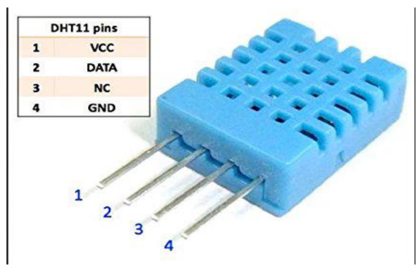

Fig. 3. Temperature sensor

3) Pulse Oximeter:

The pulse oximeter shown in figure 4 measures the user's heart rate and blood oxygen saturation levels. This vital information helps assess cardiovascular health and respiratory function, allowing for early detection of potential health issues.

Fig. 4. Pulse oximeter

4) RFID (Radio-Frequency Identification):

The RFID system enables efficient patient identification and data access is shown in figure 5. Each user is assigned a unique RFID tag or card, which is read by the RFID reader to retrieve their medical records, preferences, and other relevant information. RFID allows a reader or scanner to read a tag without needing to see the tag itself, unlike barcodes. Through a tiny antenna, the tag receives electromagnetic waves that are sent out by the scanner. The tag reflects its waves back. These waves arrive at the scanner, which transforms them into digital data.

Fig. 5. RFID tag key

5) Touch sensor:

The touch sensor shown in figure 6 provides an intuitive interface for user interaction. Users can input data, navigate menus, or trigger actions through simple touch commands, enhancing the usability and accessibility of the system.

Fig. 6. Touch Sensor

6) Arduino MCU:

The Arduino MCU shown in figure 7 serves as the system processor, orchestrating the operations of all components. It collects data from sensors, processes it according to predefined algorithms, and controls external appliance such as motors and displays. The open-source electronics platform Arduino offers a versatile and approachable way to construct complex robotic systems. Because Arduino fosters creativity and problem-solving skills, it is significant. It may be programmed with simple commands to control the device's operation by plugging it into a computer.

Fig. 7. Arduino Microcontroller

7) Air Quality Sensor:

The air quality sensor monitors the quality of the air in the user's environment, detecting pollutants, allergens, and other harmful substances [15]. The component is shown in figure 8. This information is essential for maintaining a healthy indoor environment, particularly for individuals with respiratory conditions.

Fig. 8. MQ-135 Sensor

8) LCD Display:

The LCD provides visual feedback to the user, displaying health parameters, notifications, and other relevant knowledge in a clear and easy-to-read format as shown in figure 9.

Fig. 9. 16*2 LCD

9) Motor Driver:

The motor drivers M1 and M2 regulates the motion of the automatic nurse assistant robot. They receive commands from the Arduino MC and regulate the speed and pathway of the motors, enabling the robot to navigate and perform tasks autonomously. The figure 10 displays the components of motor drivers that is used in this project.

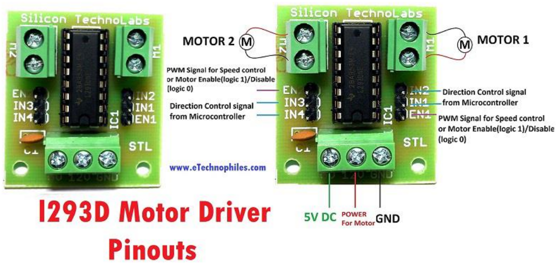

Fig. 10. Motor Driver

10) WiFi and IoT Connectivity:

The WiFi module enables wireless connectivity to the internet, allowing the system to transmit data to remote servers or cloud platforms [17]. This connectivity enables remote monitoring, data analysis, and communication with healthcare professionals or caregivers.

B. Flow Chart

The flow chart of the proposed work is shown in figure 11 which can understand easily.

- Start: The system initiates.
- Display "Welcome to ANAR" message: A welcome message is displayed on the system interface.
- Scan RFID card: The system scans for an RFID card input from the user.
- If an RFID card is detected: The system proceeds if an RFID card is detected.
- Check if patient ID is matched in the database: The system checks if the patient ID from the RFID card matches any records in the datastore.
- If patient ID is matched: If it matches in the database, the system proceeds with displaying personalized information.
- Display "Welcome [Patient ID]" message: A personalized welcome message is displayed on the interface.
- Retrieve and display: The system retrieves and displays relevant health information for the identified patient, including Air Quality Index (AQI), Pulse Rate, Oxygen Level, and Body Temperature.
- End: The system concludes after displaying the information.
- If patient ID is not matched: If it is not matched in the database for the scanned RFID card, the system proceeds with displaying an error message.
- Display "Patient not registered" message: An error message indicating that the patient is not registered is displayed on the interface.
- Stop: The system stops processing further

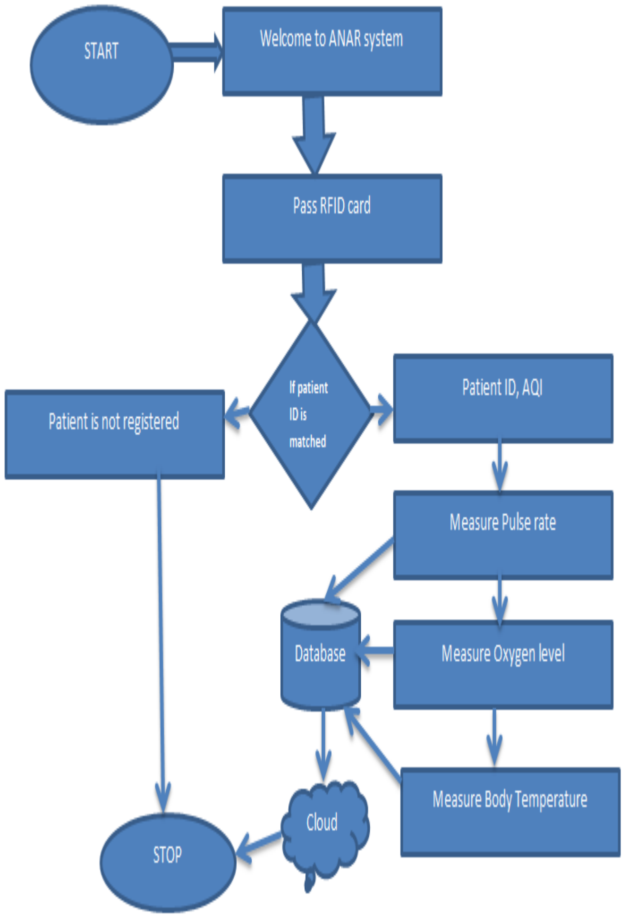

Fig. 11. Flow graph of proposed work

C. SOFTWARE REQUIREMENTS

1) ARDUINO IDE

The Arduino IDE is an open-source software that simplifies the process of developing code and facilitates its uploading to the Arduino board. The uploaded code includes a programme that explains how the process operates. The primary benefit is that any Arduino board may be utilised with the software. Many different types of sensors, including temperature, accelerometer, and heartbeat sensor, may be controlled and communicated with by the Arduino.

2) UBI DOTS

The basic components of any IoT [14] application powered by Ubi dots are: Devices, Variables, Synthetic Variables Engine, Dashboards, and Events. Within this article we will address each of these concepts as they relate to Ubi dots IoT Development and Deployment Platform and how you can superior your Ubi dots Apps to best connect with the users.

VI. SIMULATION RESULTS

The simulation results for Health Tracker Using Iot with Automatic Nurse Assistant Robot provides the information of the patient's health and displays patient ID, pulse rate, body temperature, and oxygen level and gives the air quality data that the patient is getting. The hardware configuration and the parameters are represented in figure 12 to figure 22 respectively.

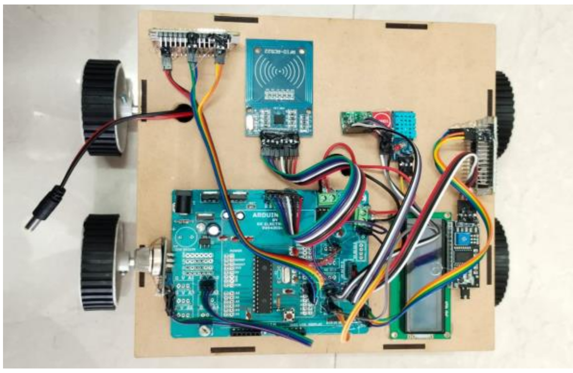

Fig. 12. Hardware setup

Fig. 13. RFID reading

Fig. 14. LCD Health Monitoring

Fig. 15. LCD Air quality index

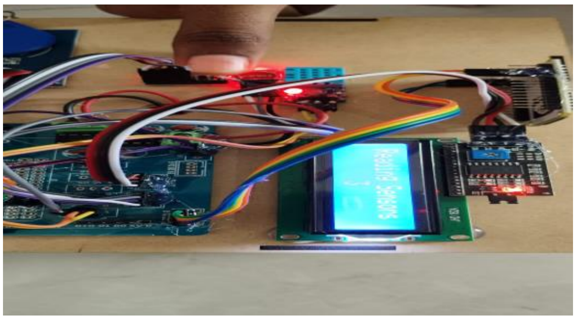

Fig. 16. LCD Reading data from sensors

Fig. 17. LCD Pulse Rate

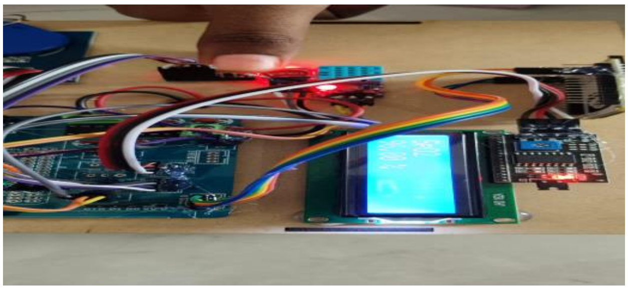

Fig. 18. LCD SPO2 level

Fig. 19. LCD Temperature

Fig. 20. LCD sends data from the internet

Fig. 21. Display of all parameters from the bigot's panel

Fig. 22. Mail Notification

VII. CONCLUSION

The system enables continuous monitoring of vital health parameters such as temperature, pulse rate, oxygen level, and air quality, providing real-time data feedback to users and healthcare professionals. This ongoing surveillance allows for initial stage detection of health problems and timely interventions, ultimately improving healthcare outcomes and patient well-being. The automatic nurse assistant robot enhances the system's capabilities by providing personalized assistance and guidance to users. Through intuitive interfaces and autonomous navigation, robots are capable of task execution of this kind medication reminders, appointment scheduling, and responding to health-related queries, relieving the burden on healthcare professionals and enhancing user independence and autonomy.

Future Scope

Integrating the system with telemedicine platforms can enable remote consultations and telehealth services. Users can communicate with healthcare professionals in real time, receive medical advice, and even undergo virtual examinations or assessments, expanding access to healthcare services. Further development of the automatic nurse assistant robot can include advanced capabilities similar to this voice authentication, natural language processing, and emotion detection. This can enable more natural and interactive communication between users and the robot, enhancing the user experience and effectiveness of assistance.

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