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AI-Based Elderly Health Monitoring and Emergency Assistance Robot

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Abstract: *The increasing demand for elderly healthcare has encouraged the development of smart assistive technologies that support independent living and improve patient safety. This review paper examines existing research on intelligent healthcare solutions, focusing on vital sign monitoring, fall detection, medication management, and robotic assistance. It evaluates the techniques used in these systems, highlighting their major benefits, technical limitations, and areas requiring further investigation.*

The review identifies the need for a unified solution capable of combining multiple healthcare functions rather than relying on separate devices or applications. To address this gap, an AI-based elderly health monitoring and emergency assistance robot is proposed, integrating health sensors, intelligent event detection, and IoT-enabled communication. The proposed approach aims to facilitate timely emergency notifications, improve caregiver accessibility, and provide a more reliable support system for elderly individuals.

Keywords: Artificial Intelligence, IoT Communication, Elderly Healthcare, Assistive Robot, Fall Detection, Emergency Alert System, Smart Healthcare.

I. INTRODUCTION

The rapid growth of the elderly population has increased the need for efficient healthcare systems capable of providing continuous monitoring and timely emergency assistance. Many elderly individuals suffer from chronic illnesses, reduced mobility, and age-related health complications that require regular supervision. Traditional healthcare methods mainly depend on hospital visits and manual caregiving, which may not always provide immediate medical support during emergencies.

Recent advancements in Artificial Intelligence (AI), the Internet of Things (IoT), embedded systems, and smart sensors have enabled the development of intelligent healthcare solutions. Wearable devices, health monitoring sensors, cloud platforms, and mobile applications allow continuous monitoring of vital parameters such as heart rate, body temperature, blood oxygen level, and movement while enabling caregivers to access patient information remotely.

Several researchers have developed assistive robots, fall detection systems, medicine reminder applications, and IoT-based healthcare platforms. Although these systems successfully perform individual healthcare functions, most lack a unified approach that integrates health monitoring, emergency alerts, medicine management, and caregiver communication into a single platform.

Based on the reviewed studies, it identifies the need for a more integrated and accessible approach to elderly healthcare that addresses health monitoring, medication management, emergency assistance, and caregiver communication. The findings of this review provide a foundation for developing reliable, user-friendly, and cost-effective healthcare solutions that can improve elderly safety, support independent living, and enhance the overall quality of life.

II. LITERATURE REVIEW

1. The work “MediBOT – Smart Medicine Reminder Robot” presents a robotic approach for medicine reminder and medication-management assistance. The system is designed around the idea of using a robotic platform to support users with scheduled medication. The work demonstrates the application of robotics in medication assistance and provides a basis for developing automated medicine reminder systems for elderly and dependent users [1].

2. Abdollahi et al. (2023) presented “Artificial Emotional Intelligence in Socially Assistive Robots for Older Adults: A Pilot Study,” which investigated the integration of artificial emotional intelligence into the socially assistive robot Ryan. The robot was designed to provide companionship to older adults through conversation and used multimodal emotion recognition based on facial expressions and speech sentiment. The study compared empathic and non-empathic versions of the robot with 10 older adults living in a senior care facility, examining the robot’s ability to engage users and support human-robot interaction [2].

3. Liang et al. (2023) proposed “Medication Adherence Management for In-home Geriatric Care with a Companion Robot and a Wearable Device.” The proposed Medication Adherence Management System (MAMS) combines a companion robot and wearable device to support medication reminders, medication confirmation, and medication history recording. The system was evaluated with 35 human subjects, obtaining average scores of 8.17 for convenience, 8.49 for usefulness, and 8.23 for adoptability. The reported System Usability Scale scores were 75.29 for MAMS, 78.60 for the robot, and 76.40 for the wearable device [3].
4. Garg et al. (2024) presented “A Review Paper on Smart Medicine Reminder Robot.” The paper discusses a Smart Medicine Reminder Robot incorporating an automatic alarm system for medication scheduling. The system allows patients to configure medication dosage timing and set alarms for different dates and times. The work examines robotic and automated approaches for reducing dependence on manual medication scheduling and improving medication reminder assistance [4].
5. Zafrani et al. (2024) presented “Assimilation of Socially Assistive Robots by Older Adults: An Interplay of Uses, Constraints and Outcomes.” The study investigated the long-term interaction of older adults with a socially assistive robot by examining uses, constraints, and outcomes simultaneously. Nineteen community-dwelling older adults aged 75–97 used a socially assistive robot for physical training for six weeks. Their experiences were collected through interviews, weekly telephone surveys, and robot-generated reports. The analysis identified two groups of users, termed “Fans” and “Skeptics,” demonstrating that the assimilation of socially assistive robots can vary among older adults depending on their experiences, expectations, and constraints [5]. □
6. “Smart AI Driven System for Elderly Health and Safety Surveillance” presents an AI-driven approach for monitoring elderly health and safety. The work addresses the use of intelligent systems for elderly surveillance and safety-related monitoring. The study provides a basis for combining sensing, health observation, and safety-related alert mechanisms within an elderly assistance system [6].
7. “SOS Smart Reminder and Emergency Detection Device Using ESP8266 and MPU6050” presents a smart system combining reminder and emergency-detection functions using ESP8266 and MPU6050. The use of a wireless ESP8266-based controller supports communication, while the MPU6050 provides motion-related sensing for emergency detection. The combination demonstrates an approach in which reminder functions and emergency detection can be incorporated into a connected electronic system [7].

III. METHODOLOGY

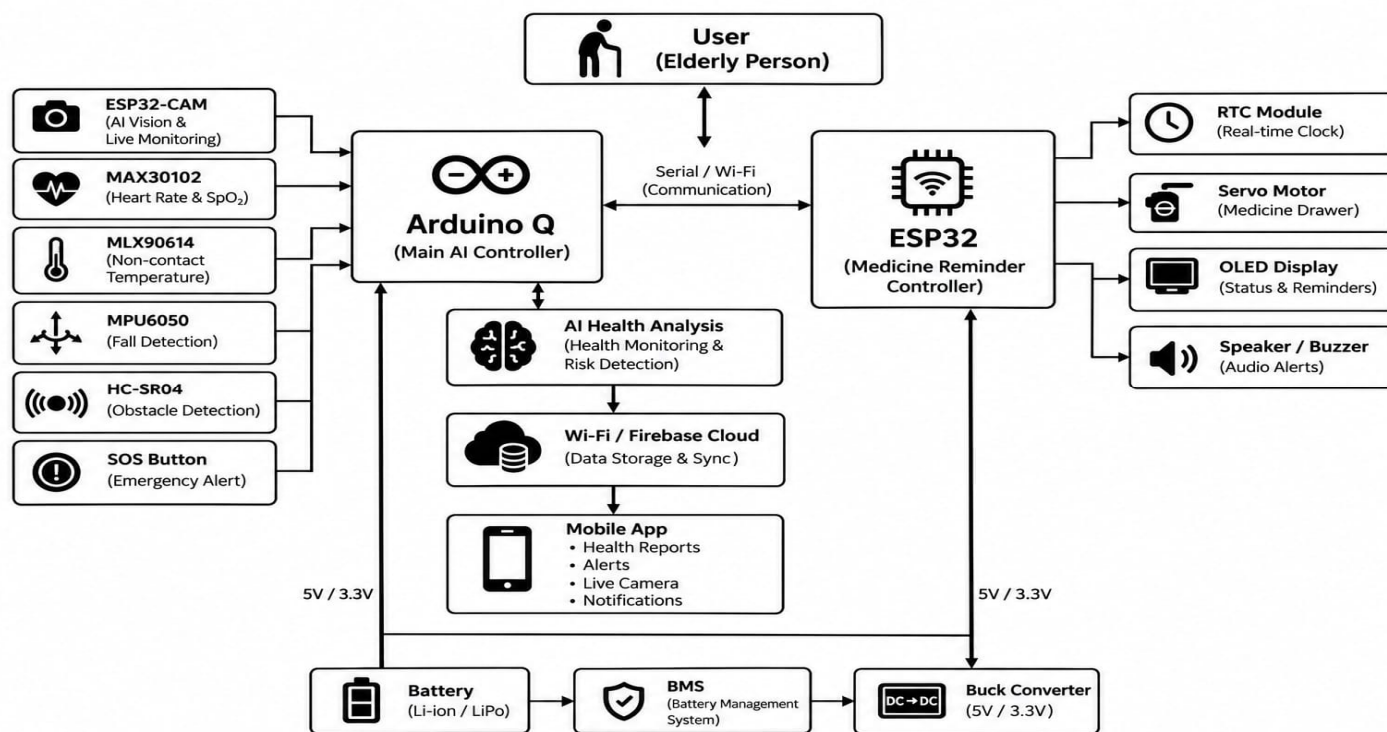


Fig 1. BlockDiagramofMethodology:

The proposed methodology is organized into sensing, processing, decision-making, actuation, and communication stages. A suitable microcontroller acts as the main control unit and interfaces with the required sensors and modules.

1) *Medicine Reminder Module*

Medicine schedules are predefined according to the user's requirements. A timing or real-time clock module can maintain the schedule. At the specified time, the controller activates an audible or visual reminder and provides an indication to the user.

2) *Health Monitoring Module*

Selected health parameters are measured using suitable sensors. The controller receives sensor readings, processes them, and displays or records the relevant information. The exact sensors can be selected according to the final prototype requirements.

3) *Obstacle Detection and Movement*

Ultrasonic or other suitable proximity sensors detect obstacles around the robot. The controller processes the sensor information and controls the motor driver and DC motors to support movement while reducing the possibility of collision.

4) *Emergency Alert Module*

When a predefined emergency condition is detected or an SOS input is activated, the system generates an alert. The alert mechanism can provide a local indication and, when connected to an IoT service, transmit relevant information to a caregiver.

5) *IoT Monitoring*

The controller communicates selected status information through a wireless network and IoT platform. Caregivers can receive information such as medicine reminder status, selected health readings, or emergency notifications when the communication system is available.

6) *System Integration and Testing*

All modules are integrated into the mobile robotic platform. Individual modules are first tested separately and then tested together. The system is evaluated for reminder timing, sensor response, obstacle detection, motor operation, alert generation, communication, and overall usability.

Complete flow:

Sensors & Schedule → Controller → Data Processing → Decision → Movement / Reminder / Monitoring → IoT Communication & Emergency Alert

IV. DISCUSSION

Various research studies have explored AI, IoT, wearable sensors, and assistive technologies to improve elderly healthcare through continuous monitoring and emergency support. Existing systems successfully perform functions such as vital sign monitoring, fall detection, medicine reminders, and remote patient supervision. However, most of these solutions focus on individual healthcare tasks and lack a unified platform that combines all essential features for comprehensive elderly care. As a result, caregivers often need to rely on multiple independent systems for effective patient monitoring.

The proposed AI-Based Elderly Health Monitoring and Emergency Assistance Robot addresses these limitations by integrating Arduino Q, ESP32, MAX30102, MLX90614, MPU6050, ESP32-CAM, Firebase, and a Flutter mobile application into a single healthcare platform. The system continuously monitors heart rate, SpO₂, and body temperature, detects falls, reminds users about medication schedules, and immediately notifies caregivers during emergencies. Camera-based monitoring and IoT connectivity further improve remote supervision and enable timely medical assistance.

Compared with conventional elderly healthcare systems, the proposed solution provides a more comprehensive and intelligent approach by combining health monitoring, emergency response, medicine management, and caregiver communication. This integrated design enhances elderly safety, supports independent living, and reduces the workload of caregivers. Although issues such as network availability, implementation cost, and data security still require further research, the proposed system demonstrates significant potential for developing reliable, affordable, and user-friendly smart healthcare solutions for elderly individuals.

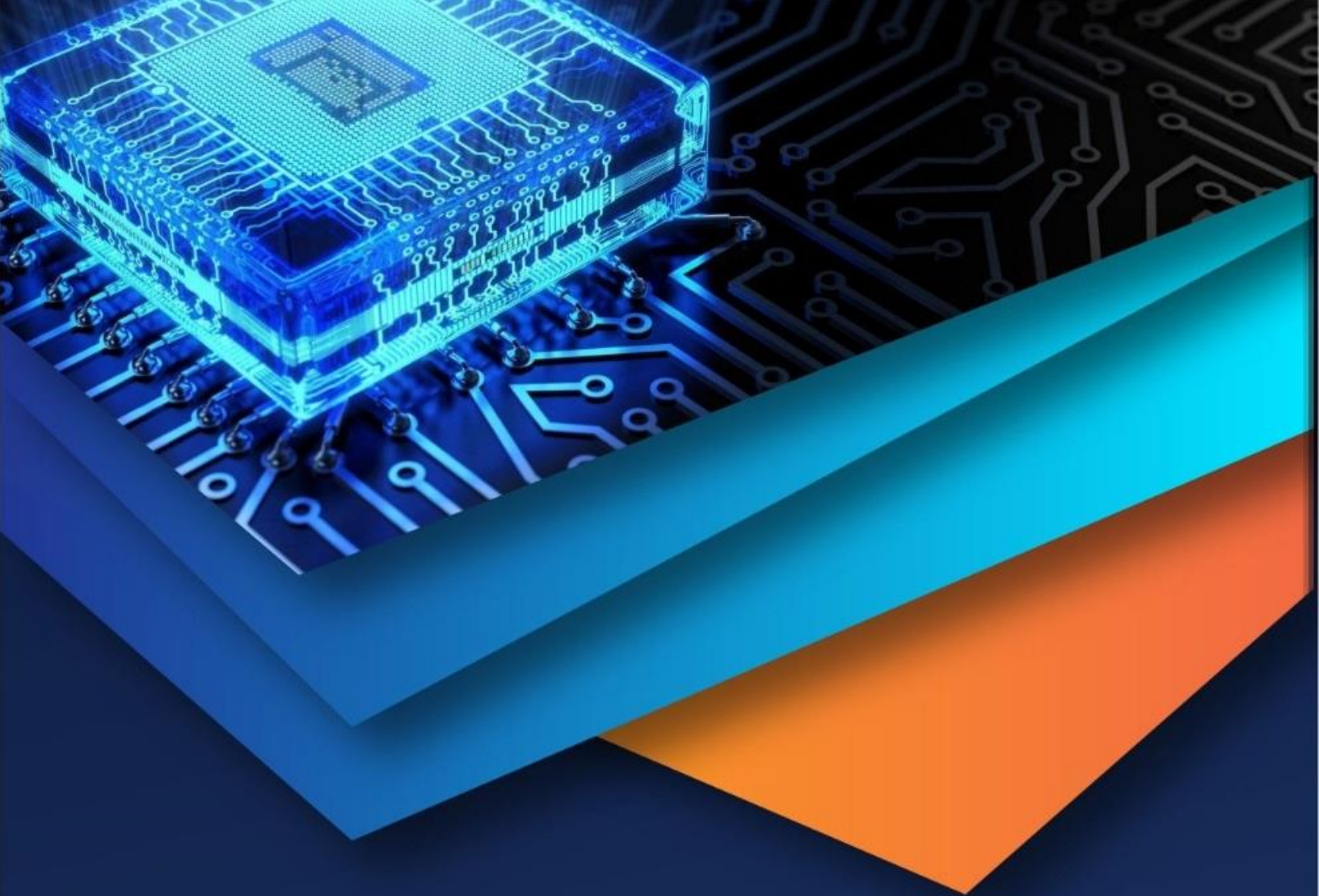
V. CONCLUSIONS

This review paper presented an overview of recent developments in AI-based elderly healthcare systems, IoT-enabled monitoring technologies, assistive robotics, and emergency assistance solutions. The reviewed studies demonstrate considerable progress in health monitoring, fall detection, medicine reminder systems, and remote patient care. Nevertheless, most existing solutions are designed to perform limited functions and do not provide an integrated healthcare platform for elderly users.

Based on the identified research gap, an AI-Based Elderly Health Monitoring and Emergency Assistance Robot is proposed to combine continuous health monitoring, emergency alert generation, medicine reminders, caregiver communication, and IoT-based remote monitoring into a single intelligent system. The integration of smart sensors, embedded controllers, cloud connectivity, and mobile applications can improve elderly safety, healthcare accessibility, and independent living. Future research may focus on advanced AI-based health prediction, voice interaction, enhanced cybersecurity, and energy-efficient system..

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