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Recognition of Daily Activities for People with Cognitive Challenges

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Abstract
This project introduces an innovative system for recognizing daily activities of intellectually disabled individuals using a multi-sensor approach. The proposed solution aims to enhance the quality of life and independence of people with intellectual disabilities by providing accurate and real-time activity recognition. By leveraging wearable technology, the system continuously monitors and analyzes various physiological and movement data. This comprehensive approach allows for a more nuanced understanding of daily activities, potentially improving care strategies and enabling more personalized support. The system's design focuses on user comfort, data privacy, and seamless integration into existing care frameworks, addressing key challenges in assistive technology for this vulnerable population.
Keywords: *Daily Activity Recognition, Intellectually Disabled Individuals, Multi-Sensor Approach, Wearable, Technology, Real-Time Monitoring, Physiological Data Analysis*

1. Introduction
Smart recognition of daily activities for cognitively challenged individuals is an innovative approach that leverages Internet of Things (IoT) technology and to enhance the quality of life for those experiencing cognitive decline. This project aims to develop a system that can automatically detect and analyze the daily activities of individuals with mild cognitive impairment (MCI) or early-stage dementia, providing valuable insights for both healthcare professionals and caregivers. The prevalence of cognitive impairment in the aging population has become a significant concern, with conditions such as MCI often going unnoticed until more severe cognitive damage occurs. Early detection and intervention are crucial in managing cognitive decline and potentially slowing its progression. Traditional assessment methods, such as questionnaires and laboratory-based simulations, often lack sensitivity and ecological validity. In contrast, smart home technologies offer a non-invasive and more accurate approach to monitoring daily functioning. This project utilizes a network of sensors strategically placed within a smart home environment to capture data on various instrumental activities of daily living (IADLs). These sensors can include motion detectors, contact sensors, and electric sensors to monitor activities such as meal preparation, medication management, and general mobility patterns. By analyzing this data techniques, the system can identify subtle changes in behavior that may indicate cognitive decline The primary objectives of this project are To develop a robust activity recognition model capable of accurately identifying and classifying daily activities performed by cognitively challenged individuals and To establish correlations between sensor-based observations and cognitive health status, enabling early detection of MCI or dementia and also To provide a user-friendly interface for caregivers and healthcare professionals to monitor and assess the functional status of individuals over it. [7]

1.1 Existing System
Existing systems for recognizing daily activities of cognitively challenged individuals typically employ a multi-sensor approach combined with advanced data processing techniques. These systems often

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include wearable sensors such as accelerometers and gyroscopes to capture movement and physiological data, as well as environmental sensors placed in living spaces to monitor ambient conditions and interactions with objects. Learning models, are used to recognize and classify activities based on the collected sensor data. Many systems are designed for real-time processing, allowing for immediate assistance when needed, while also prioritizing non-intrusive monitoring to respect user privacy and comfort. User interfaces, often in the form of displays or mobile applications, allow caregivers to view and interpret the collected data. Data storage and transmission systems, either local or cloud-based, are implemented for managing patient information. While these systems aim to enhance the independence and quality of life for cognitively challenged individuals, they face challenges in accurately distinguishing between similar activities and adapting to the unique needs of each user. Additionally, issues related to data privacy, battery life of wearable devices, and the need for personalized activity recognition models remain areas for improvement in current systems. [1]

2. Proposed System

The proposed system for recognizing daily activities of cognitively challenged people employs a comprehensive multi-sensor approach integrated with advanced IoT and data processing technologies. It utilizes wearable sensors such as accelerometers, gyroscopes, and biometric sensors, along with environmental sensors placed in living spaces, to capture a wide range of movement, physiological, and environmental data. The system incorporates NodeMCU and Arduino boards for efficient data processing and transmission, enabling real-time monitoring. A cloud-based platform like ThingSpeak is used for data storage, analysis, and visualization, allowing for scalable and accessible data management. Learning models, are implemented to accurately recognize and classify activities, with the ability to adapt to individual user patterns over time. The system features real-time monitoring with automated alerts for abnormal activities or vital signs, and a web-based interface for caregivers to access data and activity logs. Privacy and security measures including encryption and secure transmission protocols, are integral to the system design. This comprehensive approach aims to enhance the independence and safety of cognitively challenged individuals while providing caregivers with valuable insights into their daily activities and health status.

3. Related Work

Several studies have explored the use of technology for recognizing daily activities of cognitively challenged individuals: Rykov et al. demonstrated the potential of wearable sensors to predict cognitive function in patients with mild cognitive impairment (MCI). Their 10-week study used the Empatica E4 wrist-wearable device to collect physiological data during therapeutic interventions and daily activities. They found significant correlations between physiological markers and cognitive performance, particularly in processing speed and executive function. Robert et al. proposed a daily activity scenario (DAS) score to detect functional impairment in Alzheimer's disease (AD) and MCI patients using video monitoring. Their study involved 64 participants performing daily tasks in a "smart home" setting equipped with cameras. The DAS score, computed from video recordings, showed promise in quantifying instrumental activities of daily living (IADLs) impairment. Bonnechère et al. reported that cognitive mobile games (CMG) can be used to enhance cognitive performance in older adults. Oyama et al. developed a novel cognitive assessment tool using high-performance eye-tracking technology. Their system monitored gaze points while participants watched short movies and pictures, showing good correlation with traditional neuropsychological tests and accurate discrimination between dementia and MCI patients. Wearable inertial sensors have been used to detect cognitive impairment through gait analysis, with studies showing that reduced walking speed, stride length, and stability can be indicators of cognitive decline. Figure 1 shows Block diagram.

3.1 Hardware Requirements

- Arduino Uno
- Micro Phone Sound Sensor

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- Pulse Sensor
- Gyro Activity Sensor
- Relay Module

3.2 Software Requirements

- Embedded C
- Arduino software
- Proteus software 7.7

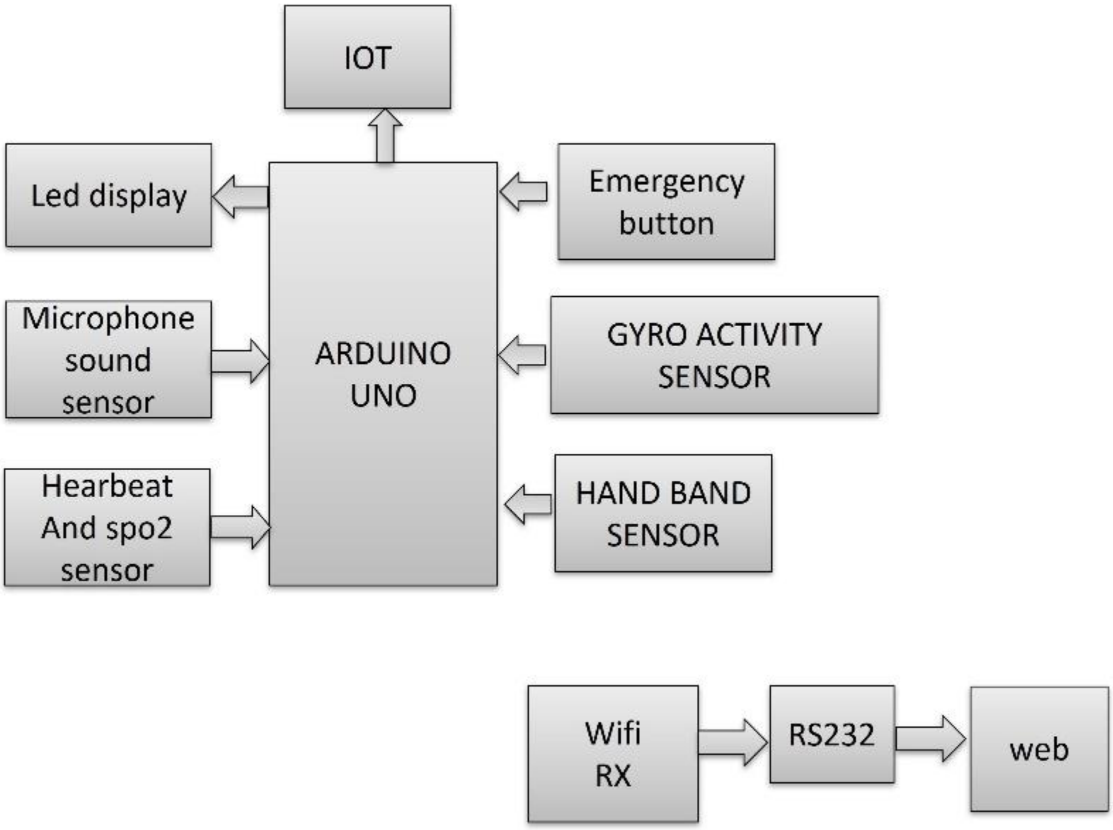

Figure 1 Block diagram

4. Arduino UNO

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. Simulation is done on Arduino IDE software. The ATmega 16U2 provides serial data to the main processor and has a built-in USB peripheral. Arduino Uno power cable Standard A-BUSB cable. It has 14 digital I/O pins. Figure 2 shows Arduino UNO. [6]

Figure 2 Arduino UNO

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5. Micro Phone Sound Sensor

A microphone sound sensor is a device that detects sound waves and converts them into electrical signals. It typically consists of a microphone, an amplifier, and signal processing components. The sensor works by capturing sound vibrations through its diaphragm, which then converts these mechanical vibrations into electrical signals. These signals are amplified and can be used for various applications such as audio recording, noise monitoring, and sound-activated systems, Figure 3 Microphone Sound Sensor [5]

Figure 3 Microphone Sound Sensor

6. Pulse sensor

The Pulse Sensor is a plug-and-play heart-rate sensor for Arduino. It can be used by students, artists, athletes, makers, and game & mobile developers who want to easily incorporate live heart-rate data into their projects. The essence is an integrated optical amplifying circuit and noise eliminating circuit sensor. Clip the Pulse Sensor to your earlobe or fingertip and plug it into your Arduino, you can ready to read heart rate. Also, it has an Arduino demo code that makes it easy to use The pulse sensor has three pins: VCC, GND & Analog Pin. Figure 4 shows Pulse Sensor [3]

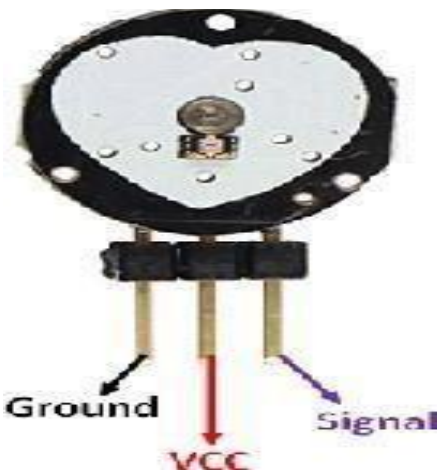

Figure 4 Pulse Sensor

7. Gyro Activity Sensor

A Gyroscope Sensor is a device that measures and maintains the orientation and angular velocity of an object. The term "gyroscope" is derived from the Greek words "gyro" (circle) and "skopein" (to see). The Gyroscope Sensor full form is simply Gyroscope Sensor. This sensor detects the rate of rotation around a particular axis and provide data that can be used to control or stabilize the orientation of an object. This technology is essential in applications requiring precise measurement and control of motion. Figure 5 shows Gyroscope [2]

Figure 5 Gyroscope

8. Relay Module

Relay modules are essential electronic components that function as controllable switches, enabling low-power digital circuits to manage high-power devices safely and efficiently. These modules typically consist of one or more relays mounted on a circuit board, along with additional components for isolation and protection. They offer versatile switching capabilities, electrical isolation between control and switched circuits, and compatibility with various microcontrollers like Arduino and Raspberry Pi.. Their ability to bridge the gap between low-voltage control signals and high-power electrical systems makes them invaluable in fields ranging from home automation and industrial control to automotive electronics and beyond, providing a reliable and flexible solution for power management and device control in numerous electronic projects and systems. Figure 6 shows Relay Module.

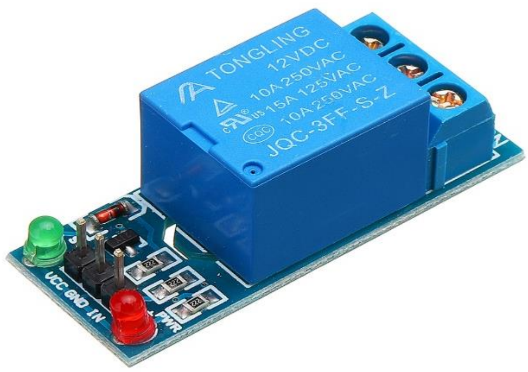

Figure 6 Relay Module

9. Simulation

This circuit diagram, created in Proteus ISIS Professional simulation software, shows a comprehensive microcontroller-based system with multiple integrated components. At its core is a microcontroller unit that serves as the main processing center, connected to an LCD display (LCD1) for visual output. The system incorporates three distinct sensors: a hand/band sensor, a sound sensor, and a position sensor, all of which feed data to the microcontroller through dedicated input pins.

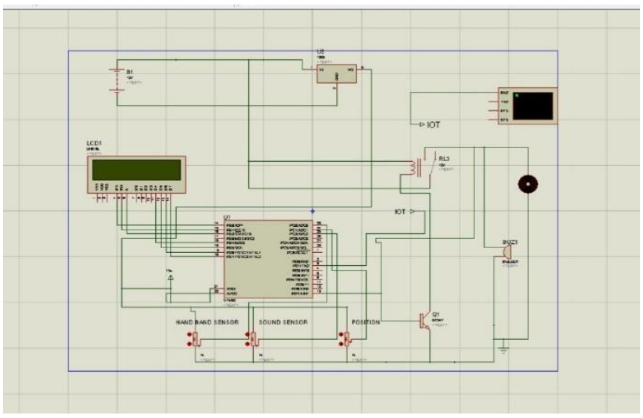

Figure 7 Simulation

A buzzer (BUZ1) is included in the circuit, driven by a transistor configuration for audio feedback or alerts. The circuit also features an IOT module, suggesting wireless connectivity capabilities for data transmission or remote monitoring. The components are interconnected through well-organized traces and include necessary supporting elements such as resistors (including R13) and other passive components. The layout demonstrates a clean, logical arrangement that facilitates easy understanding of signal flow and debugging. All connections appear to be properly routed with attention to proper grounding and power distribution, making it a well-designed electronic system suitable for prototyping and testing, Figure shows 7 Simulation, Figure 8 Steady State, Figure 9 shows Walk Detection, Figure 10 shows Run Detection, Figure 11 shows Voice Abnormal [4]

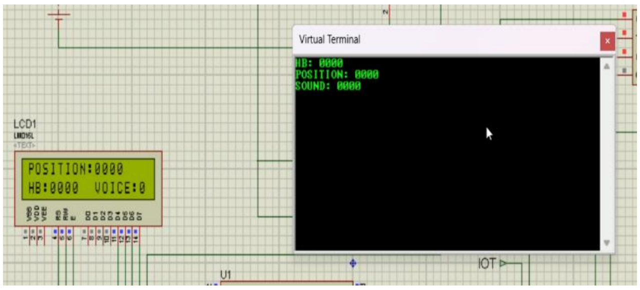

Figure 8 Steady State

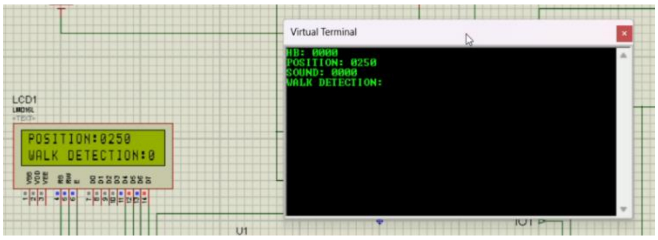

Figure 9 Walk Detection

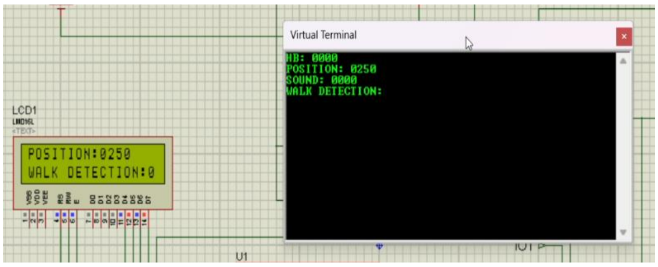

Figure 10 Run Detection

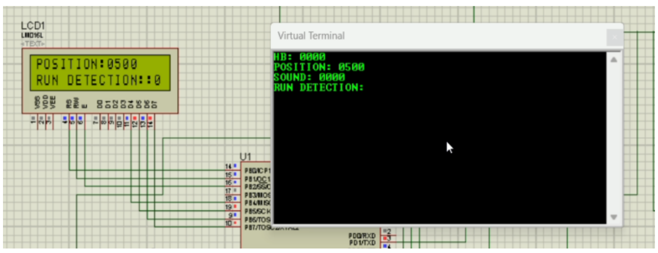

Figure 11 Voice Abnormal

Conclusion

In conclusion, the smart recognition of daily activities for cognitively challenged individuals represents a significant advancement in healthcare technology. By harnessing IoT sensors and using advanced algorithms. this approach offers a non-invasive, continuous method for monitoring cognitive health through daily activity patterns. The system's ability to detect subtle changes in behavior holds immense potential for early intervention and personalized care strategies. While challenges in data privacy and algorithm refinement persist, the benefits of this technology are clear: enhanced quality of life for individuals with cognitive impairments, improved support for caregivers, and valuable insights for healthcare professionals. As this technology evolves, it promises to revolutionize cognitive health management, offering a more comprehensive and nuanced understanding of cognitive decline in real-world settings. Ultimately, this innovative approach paves the way for more effective, timely, and personalized care for those facing cognitive challenges, marking a crucial step forward in our ability to support and improve the lives of an aging population.

Reference

[1]. Orlando Pereira, Joao M. L. P. Caldeira, Joel J.P.C Rodrigues "Body Sensor Network Mobile Solutions for Biofeedback Monitoring", Springer Science +Business Media, LLC ,2010.
[2]. Jesudoss A. and Subramaniam N.P., “EPBAS: Securing Cloud-Based Healthcare Information Systems using Enhanced Password-Based Authentication Scheme”, Asian Journal of Information Technology, Vol. 15, Issue 14, 2016, pp. 2457-2463.
[3]. Samuel Tanga, Vineetha Kalavally, Ng Kok Yew, Jussi Parkkinen "Development Of A Prototype Smart Home Intelligent Lighting Control Architecture Using Sensors Onboard A Mobile Computing System",
[4]. Samuel Tanga, Vineetha Kalavally, Ng Kok Yew, Jussi Parkkinen "Development Of A Prototype Smart Home Intelligent Lighting Control Architecture Using Sensors Onboard A Mobile Computing System", http://dx.doi.org/10.106/j.enbuild.2016.12.069, 2016, Enb 7248.
[5]. Jesudoss A. and Subramaniam N.P., “Enhanced Kerberos Authentication for Distributed Environment”, Journal of Theoretical and Applied Information Technology, 2014 Vol. 69, No. 2, pp. 368-374. (Scopus Indexed).
[6]. Gagnon-Roy, M., Bier, N., Couture, M., & Giroux, S. (2019). Smart Home Technology: A New Approach for Performance Measurements of Activities of Daily Living and Prediction of Mild Cognitive Impairment in Older Adults. Journal of Alzheimer's Disease, 68(1), 121-136.
[7]. Hussain, F., Hussain, F., Ehatisham-ul-Haq, M., & Azam, M. A. (2019). Activity Recognition System for Dementia Patients in Smart Homes using Learning Techniques. IEEE Access, 7, 29543-29555.