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A Multi Purpose Assistive Robotics System for Elderly and Disabled Support

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ABSTRACT- This paper is an account of the design and implementation of a versatile assistive robotic system, which is to be used to assist the elderly and the disabled in their daily activities. The most notable features are a mobility assistant and item transportation tracking mechanism based on Bluetooth, an emergency alert functionality activated by a panic button on the mobile device, and a medication reminder functionality that sends scheduled alerts and sends SMS notifications in case of abandonment. Due to its user-friendly and flexible interface, the robot will be able to address the needs of every user, promote independent living, enhance safety, and reduce the dependency of people on caregivers. The proposed solution improves the overall quality of life of the users and provides them with a respectable lifestyle.

KEYWORDS- Assistive Robot, Elderly Care, Medication Reminder, Emergency Alert, Bluetooth Tracking

I. INTRODUCTION

The necessity of the advanced assistive technologies has become urgent due to the growing number of individuals with disabilities and the tendency of the world population to become older. These communities are often unable to carry out even the most basic tasks such as taking medications, moving, and dealing with emergencies, and it can impact significantly on their autonomy and overall quality of life. Although effective, conventional methods of care giving might be resource intensive and may not necessarily provide credible support. Assistive robotics can offer an alternative because it is more promising due to its combination of automation, flexibility, and responsiveness in real-time. This paper introduces a multipurpose assistive robot [1] in order to assist the elderly and disabled persons in performing their daily chores.

The system has important features such as emergency alert system, which is activated by a mobile panic button, user tracking through Bluetooth to enhance mobility and a system with medication reminder, alert and SMS notifications features. The user-friendly and customizable interface of the robot aims to reduce the dependency of the caregiver and promote the user safety, independence, and dignity. [2],[3].

Recent developments: The new trends in embedded systems and robotics have now enabled the development of intelligent assistive devices which can be tailored according to the requirements of the individual user. These technologies have the potential of bridging the healthcare services versus the daily needs of the aged and disabled individuals especially in home-based care settings. Assistive robots may be reliable assistants, which enhance self-reliance by combining the functions of monitoring, alerting, and responding to the actions and crises of the user. Additionally, wireless communication technologies such as Bluetooth and GSM make real time interaction and alerts possible and ensure that assistance is availed in time as and when needed [4] as illustrated in Figure 1. With the help of these technologies, the proposed assistive robot provides a convenient and cost-effective solution that will not only remove the physical barriers but also improve the emotional well-being of the users making them feel secure and self-reliant.

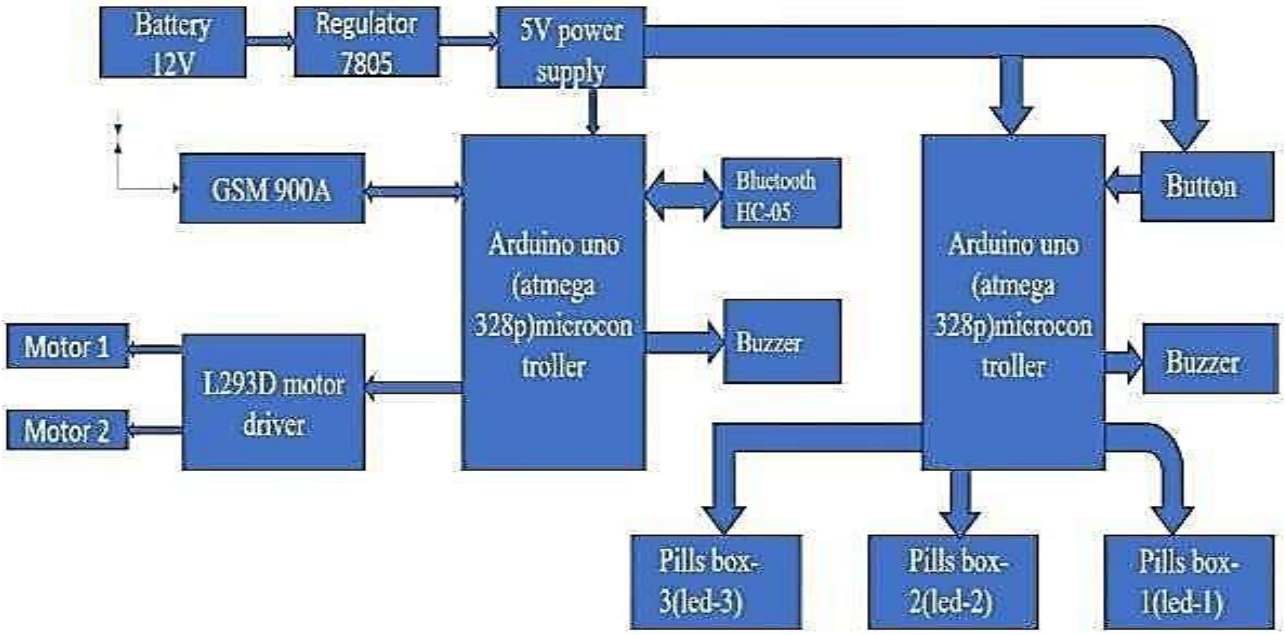

Figure 1: Block Diagram of Assistive Robotics for Elderly and Disabled Support

II. CLASSIFICATION OF ROBOTS

The most common types of assistive robots used to enhance the health and quality of life of older people are humanoid robots, non-humanoid (or animal-like) robots, and a third category of mechanical robots, which are not classified into either of the other two categories. These robots are designed in many forms such as fully autonomous to partially automated or completely under the control of the user [5].

A. Humanoid Robots

Humanoid robots typically have a head with faces on it, a neck, which is movable in various directions, a torso with built-in display or tablet to enable human interaction, and arms, some of which even have legs or wheels, allowing them to move around [6]. These robots have the ability to recognize obstacles, faces, read emotions, and communicate with each other using natural language processing through the help of a combination of sensors through built-in speakers. Humanoid robots are programmed to work remotely or perform autonomously, depending on their programming. Besides being part of IoT-enabled smart homes, they are often applied to support mobility, provide guidance, and promote physical and cognitive interaction in the form of games and memory tests.

B. Robots that are not Humanoids or Animals

Robots which are not of the anthropomorphic type belong under this category; they may take entirely abstract forms, or they may look like animals. The technologies that cause them to be commonly referred to as social robots include actuators, stereoscopic and infrared vision, touch and sound sensors, which are scattered throughout the robot.

The primary functions of these robots are to stimulate the mind, offer emotional support and companionship. Their existence will allow older users to feel less isolated, unwind, and overall enhance their emotional and psychological well-being.

C. Mechanical Robots

Mechanical robots are special machines that are designed to perform specific jobs; they do not appear like humans or animals. Such robots are typically implemented to support physical work, particularly in moving older adults around. The examples are mobility aids such as FriWalk and automated wheelchairs, as well as iGO intelligent robotic walkers.

These systems help users move freely and make them more independent since by using the set paths they can navigate indoors and outdoors with ease. Others, including FriWalk, allow user interfaces, such as tablets, to interact with it, offering additional features and user interaction, whereas others, such as iGO, are designed in a minimalistic fashion and are specifically designed to aid with movement.

III. COMPONENTS USED

A. Arduino Uno

Arduino Uno microcontroller is the brain of the robot, which receives the sensor inputs and can control all the command execution. It has many analog and digital input/output pins that make it easy to combine with various sensors and actuators. Arduino IDE made the process of programming and debugging easier, which leads to a more successful and friendly development.

B. GSM Module

The GSM module supports communication of data through the GPRS and operates on 2G cellular networks. In the case, when the user forgets about a scheduled drug taking, it will call caregivers or send SMS notifications. This will enhance the safety of the users and also ensure timely remote alerts.

C. L293D Motor Driver

The L293D motor driver allows the robot to move forward, backward and turn left or right due to its two DC motor controls. It offers perfect and smooth motor control and proper power control management in order to have reliable motion courtesy of H-Bridge technology.

D. Bluetooth HC-05

The Bluetooth HC-05 module enables the communication of the robot and a smartphone or any other device which has the Bluetooth capabilities. It is capable of operation either as a master or slave device and provides serial communication over a constant connection range of about 10 meters and this renders remote control and monitoring easier.

E. Lead Acid Battery

A lead acid battery is used to charge the entire robot system. This battery is highly reputed in terms of its long life and high current capability which provides a constant voltage supply at longer durations of use. Mobile robotic applications are a reasonable choice because it is reliable and not very expensive.

F. Buzzer

The buzzer is an audible alert system within the system. It activates sound alerts so that, upon activation of medication reminder alerts, users are notified in time and clearly of when they should take their medicine by making a loud sound.

IV. DIFFICULTIES AND USES OF ASSISTIVE ROBOTICS

A. Challenges

Among the main barriers to the use of assistive robotic systems, the high initial cost of their development and establishment should be mentioned. This might make its affordability hard to some users. Moreover, due to their lack of accustomation with new technology, some of the older population will be nervous or hesitant to adopt it. The power outage may lead to problems unless there is a source of electricity back up since the system will also need a constant power supply. Finally, the robot might be of little use to some houses since it cannot effectively work in a cluttered or dynamic environment. [7],[8].

B. Applications

The numerous applications of assistive robots in practical ways can enhance the quality of life of the people with disabilities and aged. They also ensure independence and safety of solo living elderly by helping them in their everyday activities and reminding them to take their medications. The disabled can also have these robots assist them in moving around or carrying things. The robots offer the much-needed cognitive assistance to people with memory issues including those with dementia, letting them remember about appointments and medications. They can also monitor surgery patients by reminding them to take their medicines and reporting to their care givers in case of an emergency. The latter features also enable long-term medical management of remote robots through the assistance of robots.

V. RESULTS AND DISCUSSION

The developed device is effective in enhancing the elderly care by integrating multiple supportive functions into one robotic system. The timely medication alert system ensured a reminder to users to take their medications in time with the help of buzzer and LED notifications. Remote monitoring of adherence is now possible as a result of the feedback provided by the "Pill Consumed" notification which confirmed an effective user interaction.

The emergency response device proved to be reliable during cases of emergencies since it immediately alerted guardians and rung audible bell to alert anyone within the vicinities. Moreover, the robot could follow the user with small items in its hands as it had the object transportation feature of bluetooth-based, which reduced physical effort and promoted independence among the users. In general, the system was found to be operationally helpful enhancing the safety, convenience, and the quality of life of senior users as demonstrated in Figure 2.

Model Of Proposed System

Remote Control Panel

Emergency Alert Notification

Dose Consumed Notification

Figure 2: Prototype Assistive Robotics for Elderly and Disabled Support

VI. CONCLUSION

Assistive robots also assist older people move around more easily in addition to assisting them with household tasks, encouraging them to take prescribed medications, and enhance cognitive and social interaction via games, music, and video calls. The entire care and autonomy are ensured by incorporating the IoT technology and smart home appliances and health monitoring sensors. Nonetheless, it is hard to create fully independent, relatively cheap, and reliable robots. Some of the issues that need to be addressed are data privacy, network security, user acceptance and quick emergency response. The older consumers might respond differently to other humanoid or animal-like interfaces hence it is also necessary to promote extended interaction with such robots. A blend of features of the two types can enhance effectiveness and customer satisfaction. A hybrid of the two groups would make users happier and more effective.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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