# Development of Robotic Assistant for Health Care Sector with A Special Focus to Aid the Geriatric Patients

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**Abstract**

Human manual efforts in their day-to-day tasks are reduced by robotic helpers. This paper analyzes the robot created to assist the aged people. The created robot can be controlled by voice commands with its own inbuilt microphone to pick up human speech orders. This robot can do a variety of movements, turns, grab operations, move an object from one location to another. Personal assistant robot is built using Microcontrollers. The results reveal that the developed robot will be one of the best companions for the geriatric patients and will be an alternate solution will make a new mark in the health care sector.

*Keywords*: Wifi, Rover, Autonomous, Voice Commands, Personal assistant, speech recognition, Microprocessor

## 1. Introduction

Humans have progressed over time in their ability to design new technologies that reduce human work and save human life. People are frequently harmed while handling hazardous substances in the chemical and explosives manufacturing industries due to a lack of proper care or precaution. Physically challenged and elderly people have difficulty handling objects and require assistance in doing so. As a result, if a robotic assistant that can be controlled with vocal instructions is developed, it will be extremely useful. Assistant robots can be employed for a variety of tasks, such as handling dangerous chemicals and products in the chemical industry or in the household. These robotic helpers can be utilized for shaping, manufacturing, and tooling in a variety of industries, including industrial, defense, and aerospace. Humans' primary mode of communication is speech signals. Voice signals are used in almost every discussion to interact. A microphone can be used to transfer sounds and various speech signals into electrical form. A computer-based system that transforms vocal signals is known as voice recognition. Using a remote server, this voice recognition technology can be utilized to control and generate speech acknowledgement. A robot voice can recognize hundreds of spoken commands and carry out the required activity because everyone has a different accent, voice identification is a difficult undertaking. Robot voice accomplishes this by utilizing the Bit Voicer Server, which supports 17 languages from 26 nations and regions.

These robotic helpers can be employed in a variety of industries, such as manufacturing and defense, for shaping, manufacturing, and tooling. The robot helper reacts to verbal commands. The contribution of the paper has introduction, study of literature, components used for research method, results and discussions, conclusion and references.

## 2. Study of Literature

Investment in industrial robots climbed up globally and orders for robots increased enormously reaching the highest level ever recorded. Global growth is expected to be over 7% each year on average. There are currently over 600,000 home robots in use, with millions more predicted in the coming years. In general, there are three modes of communication such as isolated word or phrase mode, continuous speech mode and small vocabulary systems. The Isolated word (or phrase) mode deals with the user who speaks single words (or phrases) from a vocabulary list in this mode Connected word mode: the user speaks in this mode. The Continuous speech mode demonstrates the user to use a broad (sometimes limitless) vocabulary to talk fluently that would specify the way of recognizing Robot's voice. The Small vocabulary systems recognizes up to 100 words. The medium vocabulary systems can recognize up to 1000 words. The Broad vocabulary systems can recognize over 1000 words. It has been proposed that a speech recognition module is not required to govern a robot. In this system, an android application is used to recognize and process human voice, which is then transformed into text using text recognition software. This study explores the issues raised by the significant increase in life expectancy, which has resulted in a demographic shift toward an older population in modern developed societies. The article highlights the limitations of present home technologies in fulfilling the changing demands of the elderly, who are expected to spend more time at home as they age. By 2050, the number of senior people worldwide is expected to triple. The problem is exacerbated because wider adoption of these automated, smarter, and more recent technologies is hindered by people's lack of familiarity with them. The study proposes the integration of assisted living technologies into a Mobile Robotic Platform (MRP) as a solution to these difficulties. It also presents the concept of ASPiDA, an all-encompassing system intended to assist the elderly in their homes. [1]

The study highlights the benefits of using Series Elastic Actuators (SEAs) in rehabilitation robotics, including their high compliance, shock tolerance, and backdrivability. In uncertain human-robot interactions, it tackles the problem of creating an Assist-as-Needed (AAN) technique for multijoint SEA-driven rehabilitation robots. The suggested approach uses an iterative learning algorithm for robot-level dynamics and a fast time-scale controller for SEA-level dynamics, modifying assistance in response to the assessment of human-robot interaction. Experiments with healthy participants verify the strategy, which is used to a two-degree-of-freedom SEA-driven robot, encouraging proper motions with minimal help and adapting to the subject's purpose [2].

The research investigates a robot-mediated therapy approach for post-stroke rehabilitation that utilizes performance-based help control. Three modes are available to accommodate different stages of rehabilitation: Restriction Interaction Region (RIR), Assist-as-Needed (AAN), and Zero Interaction Force (ZIF). AAN offers varying aid depending on motor ability, RIR maintains safety with a significant assisting force, and ZIF permits free motion referencing. The strategy's success is validated by experimental results with able-bodied participants, which indicate correct functionality and the ability to modify modes and support based on subjects' motor performance. With increasing tracking error, the method adjusts by offering more support and promoting active effort by adjusting the adaptive stiffness coefficient. Crucially, the dimensions of the strategy can be tailored to suit various topics and needs [3].

With an emphasis on agent embodiment, the study investigates the creation of intelligent agents to facilitate group discussions among senior citizens. User responses to two types of agents—voice assistants and humanoid robots—were compared. Two phases of the study were conducted with older persons and a human facilitator: a preliminary study and an experimental study. Notwithstanding their artificiality, both agent forms were useful for the socially awkward duty of facilitating discourse. Talkative personalities, on the other hand, found the "bodied" robot version to be less satisfying. The results emphasize how crucial it is to take user attributes into account when designing agents. Additional observations and design implications are also presented, with a focus on agent voice in particular [4].

Social robots are autonomous systems that interact with people in natural settings. They are used in healthcare to provide support in private homes, hospitals, and nursing homes. This assessment emphasizes technological features and focuses on the condition of social robots today. The three main categories of robots that are covered are telepresence, companion, and humanoid robots. Commercial applications, scientific literature (Scopus Elsevier), patent analysis (Espacenet), and supplementary sources (Google search) are all included in the analysis. The article offers a succinct summary of social robots in healthcare by classifying different devices and arranging their specifications [5].

Social robots are essential to the healthcare industry because they can engage with people on their own in real-world settings, including nursing homes, hospitals, and private homes. This assessment emphasizes technological features while highlighting the current status of social robots. There is discussion of three categories: telepresence robots, companion robots, and humanoid robots [6].

The use of robotics and soft actuators in rehabilitation is growing, with a focus on safe human-machine interaction. They have benefits including robustness to a variety of settings, easy construction, complicated motions, and safe contact. This review examines the state of soft actuators in rehabilitation today, encompassing soft materials and a range of powering techniques [7].

In order to improve healthcare decision-making, this study presents a cognitive system for assistive robots that uses artificial intelligence (AI). The technology dynamically modifies robot actions to match the demands of individual patients, proving its viability in an actual setting [8].

Robots can help those who look after the elderly population. Prior studies concentrated on developing capacities rather than incorporating robots into the provision of professional care. Design possibilities were found in a field study conducted in a senior living facility. These opportunities included improving caregiver workflows, accommodating resident abilities, and giving feedback to all stakeholders [9].

Recent developments in haptic guiding pose problems to robot-assisted training. As an alternative, Model Predictive Controllers (MPCs) were investigated in this study with 40 participants. The ball MPC increased performance but limited variability, whereas the end-effector MPC encouraged movement variability and improved learning. MPCs offer significant advantages for neurological patient training since they demonstrate promise in enhancing motor learning in tasks with complicated dynamics [10].

By encouraging independence, CHARMIE, a flexible healthcare and household assistance robot, tackles issues faced by aging populations. It carries out activities like fall detection and room tidying with capabilities like map development, safe navigation, and human-robot interaction. In addition, CHARMIE helps with public health situations like as COVID-19 by offering safe healthcare support [11].

Persons with low eyesight can navigate more easily thanks to the Augmented Cane's sensors and clear feedback. When used in place of a typical white cane, it improved walking speeds by 18% for the visually impaired and 35% for the sighted in tests. Around 250 million people worldwide will benefit from the open-source, affordable design's sophisticated navigation features, which increase mobility and quality of life [12].

This paper offers a unique Force Exertion Ability Enhancement (FEAE) and admittance control based Robotic Assistive System (RAS) for senior mobility in a wheeled mobile manipulator. The RAS offers user-controlled, compliant behavior together with limited horizontal guidance and vertical assistance. An expensive force/torque sensor is not necessary when using a nonlinear disturbance observer. By increasing Cartesian force exertion within joint torque limitations, the FEAE boosts system performance. An experimental validation using a 4-wheel omnidirectional mobile manipulator shows that the suggested method works well [13]. In order to build gadgets that support aging in various settings, such as residences, assisted living facilities, nursing homes, and family housing, this article examines the limitations of present technology. It lists typical problems including financial hardship and loneliness and highlights how technology is necessary to overcome obstacles unique to a given locality and promote successful aging in place [14]. **A**lthough the concept of the "Elderly Care Giver" influenced care robotics, R&D obstacles have limited the practical role of robots in care. The development of care robots frequently depends on speculative scenarios and their focus on simple activities. Activities that address social, emotional, practical, political, economic, and ecological aspects of care ecosystems should be taken into account if they are to be successful. To understand care organization with limited resources, candid conversations about the motivations driving care robot projects are necessary [15].

## 3. Components for Research Method

Raspberry Pi B+, Lidar, Body, Motors, Motor Driver, Display, Mic, Camera and GPS.

### 3.1. Raspberry Pi B+

The Raspberry Pi Foundation, in collaboration with Broadcom, developed a series of miniature single-board computers (SBCs) in the United Kingdom. It has a level 1 (L1) cache of 16 KB and a level 2 (L2) cache of 128 KB. The GPU is the primary user of the level 2 cache. Raspberry pi model B+ is used for this project which has Bluetooth. Fig. 1 shows the Raspberry Pi used for this work.

Fig 1: Raspberry Pi

### 3.2 Compatibility and Ethernet Compatibility Over 300mbps with 40 Gpio Pins.

Fig. 2 shows the flowgraph of RAM, IO, GPU, USB Hub.

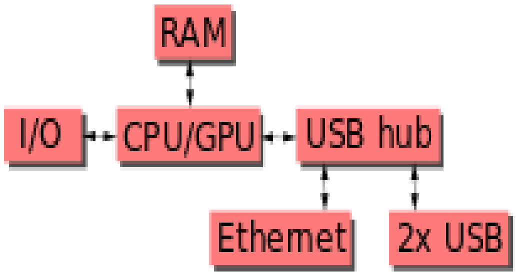


Fig. 2 Flowgraph of RAM, IO, GPU, USB Hub

### 3.3 The Lidar

The TF-Luna Light Sensing and Ranging (LiDAR) module (shown in Fig. 3) was presented as a time-of-flight sensor for quick distance detection. GPIO pins 14/15 were used to connect the module to the RPi through the UART serial interface. A plotter tool was developed as a means of testing the module's operation and viewing its behavior.

Fig. 3: LIDAR

### 3.4 The Body

The most important aspect of a robot is its flexible body, which shields and surrounds the overall CPU and fragile boards. A body also aids in the structure of the robot's shape, and provides support to the whole system while doing any task. The body of the robot is shown in Fig. 4.


Fig 4: The Body

### 3.5 Electric Motors

A DC motor is an electronic device that runs upon direct current which converts electrical energy into mechanical rotational force. DC motors may be powered directly from rechargeable batteries, which is how the earliest electric cars got their start. DC motors are still used today in a variety of applications, from toys to disc drives to steel rolling mills and paper presses. The DC motor used for this work is shown in Fig. 5.

Fig. 5: Electric Motors

### 3.6 Motor Drivers

Using a Raspberry Pi Model B+ and this motor driver kit (as shown in Fig. 6) and Python library, a pair of bidirectional brushed DC motors can be operated. The DRV8835 dual H-bridge motor driver IC from Texas Instruments is used on the expansion board, allowing it to function from a wide range of voltages. It consumes 1.5 V to 11 Vs of power which is the best suitable range to work with micro controllers. The board can deliver 1.2 A per channel continuously. The board comes fully created with SMD components, including a reverse battery protection FET and the DRV8835 driver.

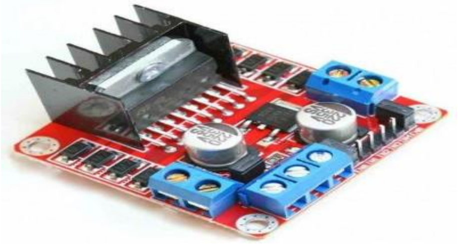

Fig. 6: Motor Drivers

### 3.7 The Display

A liquid crystal display (LCD) (as shown in Fig. 7) is used as the user interface between human and robot. This operates on the principle of light modulating properties of liquid crystals. Computer monitors, televisions, instrument panels, and aeroplane cockpit displays are just a few of the applications.

Fig.7 The Display

### 3.8 Mic

A little microphone (as shown in Fig. 8) which can be operated within the range of 1.5 to 2.5 volts is used to detect the random sounds and human voice sounds and convert them into AC or DC signals which will be passed on the microcontroller.

Fig. 8 Mic

### 3.9 Camera

This camera module as shown in Fig. 9 is small and serving best performance and good for streaming in live.

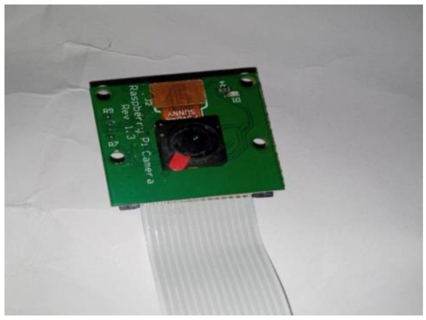

Fig. 9: Camera

#### *3.9.1 Features of Raspberry Pi 5MP Camera Module*

- Fully Compatible for Model B+ Raspberry Pi
- 5MP Omni vision 5647 Camera Module
- Still Picture Resolution: 2592 x 1944
- Video: Supports 1080p @ 25fps, 720x360p 60/90
- 15-pin Serial Interface with MIPI Camera
- Size: 20 x 25 x 9mm
- Weight 3g

### 3.10 GPS Module

The NEO-6M GPS Module (shown in Fig. 10) is a complete GPS module that is based on the NEO-6M. This is an upgraded GPS module that can be used with Raspberry Pi.

Fig. 10: GPS Module

#### *3.10.1 Features NEO-6M GPS Module:*

- 5Hz position update rate
- EEPROM to save configuration settings
- Rechargeable battery for Backup

- Supply voltage: 3.3 V
- Configurable from 4800 Baud to 115200 Baud rates. (default 9600)
- Support SBAS (WAAS, EGNOS, MSAS, GAGAN)
- Separated 18X18mm GPS antenna

## 4 Results and Discussions

The robot's movement is controlled by speech commands. The robot recognizes the voice commands with mic and the internal op amp cuts off the noises and passes on the clear voice sound. The vocal stream is subsequently translated to text in real time via an internet cloud server. The hardware platform is made up of a moveable robotic arm incorporated within the robot's body. Two robotic hands make up the robotic arm. The arm is utilized to place the hands in their proper positions, and the hands are used to pick, hold and drop objects. It works similarly to human hands, with the robotic arm acting similarly to our arm and the robotic hands acting similarly to our hands. Two DC motors control the robot's body movements.

### 4.1 Modules used

#### *4.1.1 Speech Recognition*

The ability of a machine to listen to and recognise spoken speech is referred to as voice recognition. The uttered words can then be converted to text, a query can be made, and a response can be given using Python's speech recognition. With the help of computer programs that take in information from the microphone, process it, and convert it into a proper form, you may accomplish voice recognition in Python.

Speech recognition may appear futuristic, but it is already in use. You can shout out your query on automated phone calls, and virtual assistants like Siri and Alexa use speech recognition as well.

### 4.2 Process of speech recognition

Speech recognition starts by converting the sound energy into electrical signals using the microphone and we also use some noise cancellation techniques to acquire clear audio. After that, the electrical energy is transferred from analogue to digital, and then to text. It takes the audio data and breaks it down into sounds, then uses algorithms to analyse the sounds to identify the most likely word that fits the audio. All of this is accomplished using Natural Language Processing and Neural Networks. By recognizing temporal patterns in speech, hidden Markov models can improve accuracy. The working model is shown in Fig. 11.

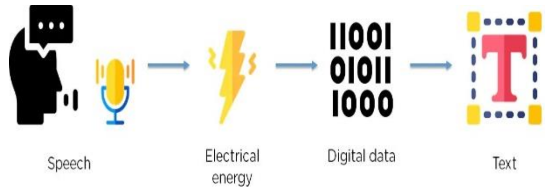


Fig. 11 Working Model

### 4.3 Procedure of Working

The working procedures of the robot are as follows:

- Build the robot's body first
- Connect the motors, chipsets, and limbs.
- Use WIFI to establish a reliable internet connection and local Network connection. Speak any of the pre-programmed commands to direct the robot's actions.

#### *4.3.1 Voice Controls*

Forward - The body moves forward.
Backward - The body moves backward.
Left - The robot moves to the left.
Right - The robot moves to the right.
Up – The robotic arm moves upward.
Down - The robotic arm glides downward.
Open - Robotic hands that are open
Close - Robotic hands are quite close together.
Bring Water - Brings a Water to you.

When a user speaks a command, the mic listens to it first, and the voice input is processed by the speech recognition module, The Google API is used to convert the speech to text format. The matching driver code of the code is executed if the text matches the commands list. When a user commands the robot to bring a given object, the object's coordinates should already be initialized, and the robot uses the GPS module interface to reach the coordinate and bring the object. The robot's arm picks the thing, and the Lidar sensor is used to detect and avoid obstacles along the way. The workflow is shown in Fig. 12.

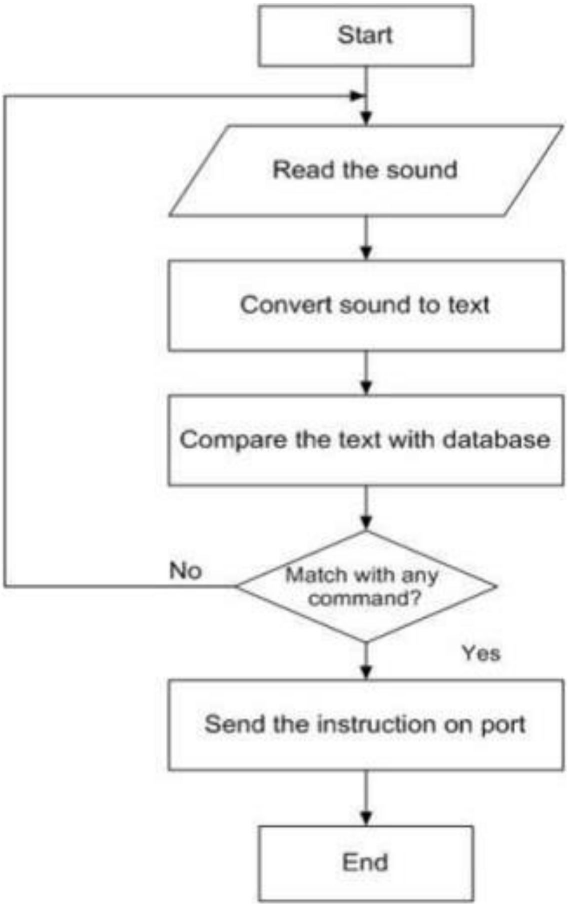


Fig. 12 Workflow

## 5 Conclusions

The personal assistant robot is built on a microcontroller platform and has the ability to track its present location. Improvements are also considered in terms of prospective uses in the home, hospitals that could aid the geriatric patients. Some of the areas that can be further investigated are the robot's mouth and microphone, its performance, and the effect of noise on voice to text conversion. The robot's functioning is unaffected by the speaker's accent since voice commands are handled by a cloud server that works regardless of the speaker's accent. Using renewable energy sources to power the robot would not only reduce the cost of the robot, but it would also be environmentally good. Another form of energy source is solar energy. The robotic assistant developed has a wide range of potential uses, from the chemical industry to a relaxing environment within a home wherein the elderly people can live happily and at ease.

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## Authors Introduction

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