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LOW COST AND HIGHLY EFFICIENT AUTOMATED PERSONAL ASSISTANT BOT USING IOT

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ABSTRACT

Personal Assistant bot comes in various designs and costs generally cost of these robots is high which make it luxurious item. Cost of bot is increased due to the different parts and modules used in development, to reduce cost a robot developed using ESP32 CAM with robotic arm which performs elementary functions of a personal assistant robot like moving around and picking up objects but also other functions like face recognition, training of bot were all done using the resources of smart phone/laptop which reduces the load on ESP32 CAM and in turns reducing the hardware cost. It operates in automatic and manual mode. IoT enables the utilization of TCP/IP web - app to control bot processes. Bot has 6 wheels, a robotic arm consists of 4 servo motors which can move 360 degree and a camera which help the bot in driving on any surface and climb small heights.

KEYWORDS: *Robot, ESP32, Face Recognition, IoT, TCP/IP*

1. INTRODUCTION

Generally, a personal assistant robot is a robot that helps you with day-to-day household tasks, making your life easier. These little bots serve many purposes from education to schedule tasks. Different bots are designed for different tasks to make our life easier. But the bots available in international market by various MNC's are very costly. Everyone cannot afford the personal assistants available in market. A cost-effective solution has to be developed to overcome the situation with basic features. Rapid advancements are taking place due to the latest technologies being used. IoT is an emerging technology which finds its use in real time applications. IoT can connect the farmer through the web application from anywhere. Wi-Fi module is used which connects to the TCP/UDP tool in smart phones, laptops, tablets etc.

In our designed system a multifunctional bot is developed which performs basic functions like moving around and picking up objects but other functions like face recognition, training of bot, reminders were all done using the resources of smart phone which reduces the load on ESP32 CAM and in turns reducing the hardware cost. As the technology is advanced so much nowadays that smartphone's resources can be utilized to perform operations which needs higher computation power than ESP32 CAM. Personal Assistant bot can be utilized in both automated and manual mode and assists in small household tasks. It's design with 6 wheels allows the bot to drive on any kind of surface and can climb small heights easily and live streaming using camera mounted on bot makes it easier to drive. Robotic arm is designed such way to move in 4 degrees of freedom with base movement of 360 degrees and gripper good enough to pick up basic objects.

2. LITERATURE REVIEW

Various literatures and research papers have been discussed about the design of Personal Assistant bot. A prototype of Personal Assistant is developed using Raspberry Pi and controlled using only 4 voice

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command over a certain distance. Bot detects humans or obstacles using ultrasonic sensor and for recognizing voice google speech recognition is used which can detect approximately 119 languages [1]. A bot is developed using ARM LPC2148 which can be Personal Assistants to farmers by performing basic farming tasks and controlled using GSM module (SIM) [2]. A Personal Assistant robot is developed using Arduino and android app, robot persons basic functions like moving around and speed control. Bluetooth is used to control robot using android app [3]. A voice command system for autonomous robots guidance is designed which can recognize limited number of patterns using a microcontroller such that it can distinguish between commands for each robot [4]. An on-line mobile robot is developed which can steer automatically by transmitting real time data using Bluetooth and using sensors to realize high motion and location precision [5]. A spy robot is developed using Arduino which receives command using Bluetooth to steer and a wireless camera is attached to spy [6]. Robot with sensing glove is designed in which a glove is used to give commands to steer the robot using Bluetooth [7]. A spy bot is developed for surveillance which can be controlled using Bluetooth from an android based smartphone which is mirrored using Internet [8]. An Arduino based firefighting robot was created which can run on manual mode using Bluetooth as well as on auto mode [9]. A mecanum-wheel robot is designed which can move in all possible directions on a plane and can be controlled using Bluetooth, controller or Wi-Fi [10]. Low power and highly power efficient is designed using Bluetooth for robots to communicate for commands [11]. A robot is designed using Arduino which consists ultrasonic sensor to avoid collision and can be controlled using Wi-Fi over a large area [12]. A water surface cleaning robot was developed using STC12C5A60S2 as a main controller, a cleaning module and Wi-Fi module to communicate and sends command [13]. Raspberry Pi has remained one of the favorite choices for development of robots as it offers great variety of features for robot, as machine learning can be easily used due to python support [14]. A personal assistant is designed and developed using both Arduino and Raspberry Pi to control motors and use Machine Learning algorithms to make personal assistant more efficiently voice recognition and making decisions [15].

3. COMPONENTS

3.1. Hardware

ESP32 Cam is the brain of Personal Assistant bot. Various functions are enabled using robotic arm which operates using 4 SG90 servo motors. A voltage regulator IC maintains the 5V/3.3V output voltage constantly. Personal Assistant bot is powered by 9V Lithium ion battery. 6 150 RPM Low noise dual shaft BO motor are fixed to the chassis of robot and 6 BO wider wheels to the motors are fixed for the movement. Motor drivers are used to drive motor in the desired direction. The motor driver used is L298N dual motor driver called dual H-Bridge. Using H-Bridge motors are derived in either directions. ESP32 Cam is Wi-Fi and Bluetooth enabled module. AI-THINKER modules are the first series of module made with ESP8266.

3.2. Software

Wi-Fi is used to communicate with bot, a webpage is hosted on localhost of the Wi-Fi connected with bot using ESP32 Cam which shows live video stream and other controls to control the bot. This bot can be accessed using a specific IP address on any device connected with the same network.

4. METHODOLOGY AND IMPLEMENTATION

Block diagram of Personal Assistant bot is shown in fig. 1. It consists of ESP32 Cam, Power Supply, Motor Driver, 4 Servo motors of robotic arm and camera. The microcontroller used is ESP32. It is integrated with Wi-Fi and Bluetooth. Personal Assistant is powered by Lithium-ion battery of 9V which is converted into 5/3.3V using voltage regulator and voltage is maintained constantly by regulator.

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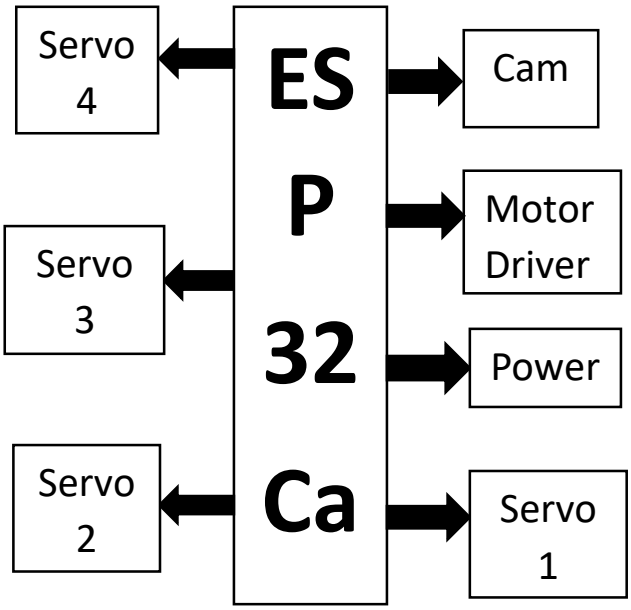

Fig. 1. Block Diagram of bot

Personal Assistant works in 2 modes automatic and manual. If user selects training mode through web-app and give some commands these commands are saved and can be used to run bot automatically on those command n number of times as shown in Fig 2 and 3.

Six 150 RPM Low noise dual shaft BO motors are placed on the wheels of bot fixed to chassis of acrylic board. Robot assembly's simultaneous movement is controlled by motor drivers. H Bridge is used for the movements of robot in forward, backward, right and left directions. With L298N, six motors can be run simultaneously.

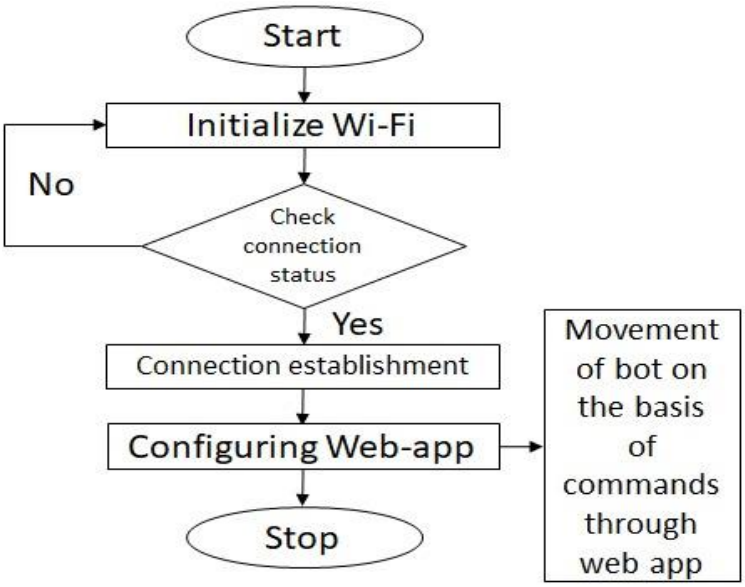

Fig. 2. Manual mode flow chart

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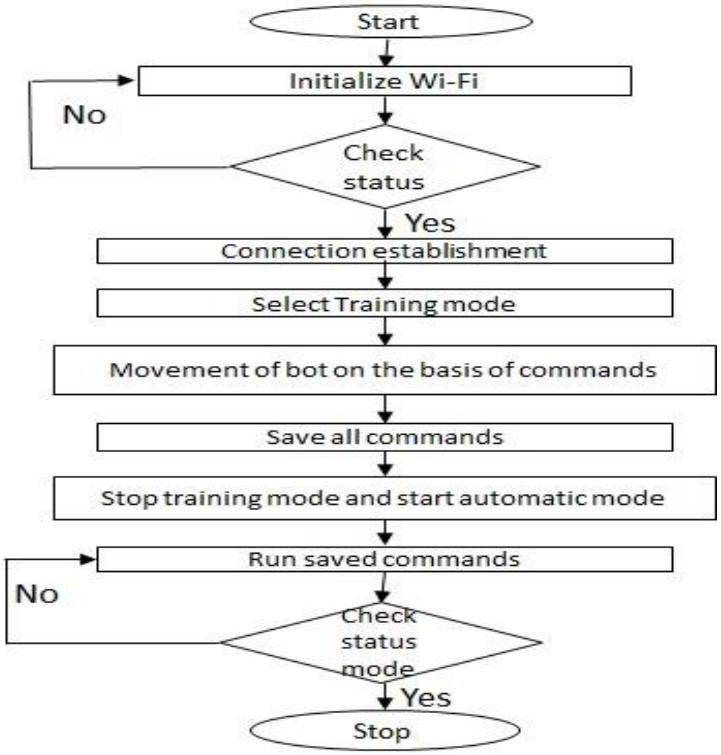

Fig. 3. Automatic mode flow chart

Six 150 RPM Low noise dual shaft BO motors are placed on the wheels of bot fixed to chassis of acrylic board. Robot assembly's simultaneous movement is controlled by motor drivers. H Bridge is used for the movements of robot in forward, backward, right and left directions. With L298N, six motors can be run simultaneously.

Bot consists of 6 wheels in which front 4 wheels are connected in the pair of 2 right wheels and 2 left wheels, remaining 2 wheels are independent as shown in fig. 4.

Fig. 4. Wheels

This design helped in making rocker-bogie suspension wheel mechanism which allows all six wheels to always be in contact with the ground while climbing over obstacles. Different pivot allows weight to be mechanically offloaded from one side to the other while climbing.

Robotic arm is also designed and made on acrylic board. 4 SG90 Servo motors are connected to the arm to make 4 degree of movement of robotic arm as shown in fig. 5.

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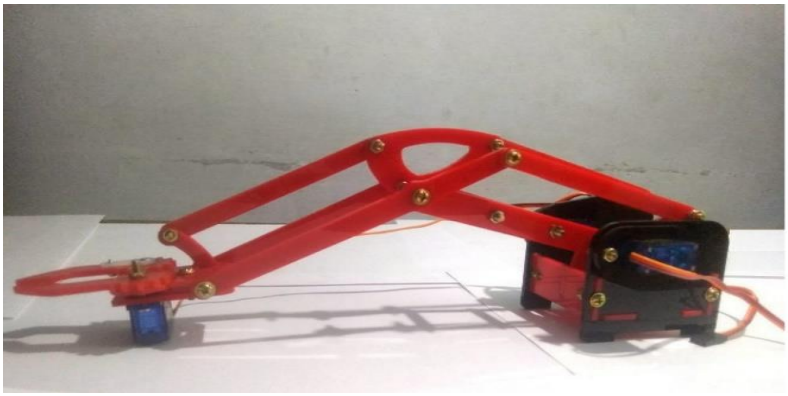

Fig. 5 Robotic Arm Mechanism

Once the bot is on, ESP32 Cam get connected to the Wi-Fi whose SSID and Password is entered while coding that is SSID: "Personal" Password: "autobots2021". After getting connected ESP32 will host a web page on local host of router generally 192.168.0.6(can vary router to router) were live stream of camera is displaying along with other options for camera like face identification, face recognition etc., and all other commands for bot is displayed as buttons divided in 2 sections one for bot and other for robotic arm. Commands will be sent to bot using Wi-Fi to ESP32 Cam which then process the commands and executes the desired function. Bot can move in 4 directions Forward, Backward, Right and Left. Robotic arm can rotate 360 degrees on base, arm and elbow can move up and down.

5. Results and Discussion

A Personal Assistance bot is developed which can perform multiple operations like picking up objects using robotic arm moving around and climbing small heights due to its design. TCP/IP web-app is used to give commands through Wi-Fi and guide the Personal Assistant bot to perform actions. Live footage of camera mounted on bot can be streamed using web-app. Below are the images of bot.

Fig. 6 Personal assistant bot

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Fig. 7. Side view of bot

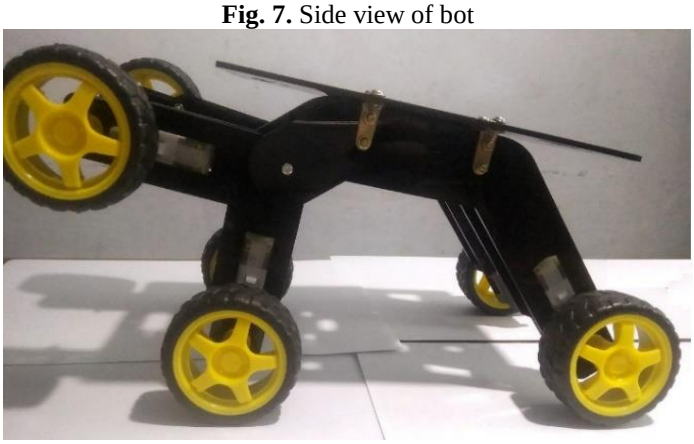

Fig. 8. Wheels in action

Fig. 9 Personal assistant bot

6. CONCLUSION

A multifunctional Personal Assistant bot is designed and developed which can perform multiple operations like picking up objects using robotic arm moving around and climbing small heights due to its design. TCP/IP web-app is used to give commands through Wi-Fi and guide the Personal Assistant bot to perform actions. Live footage of camera mounted on bot can be streamed using web-app. Although robots are made up of many things including some parts and components that can be replaced by one or removed by improved design and structure as this design use only one small micro controller

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on which camera can be mount and has inbuilt Wi-Fi this reduced the complexity of project and helped in achieving cross platform availability of control with face recognition and identification with a robotic arm mounted on base which can help to pick some basic objects. Acrylic sheets provide strength and finishing to the bot which can help it to become spy bot if situation demands so. The system is also cost effective many different modules are replaced with one. The designed prototype works successfully with high accuracy and can be incorporated for present and future practices.

7. FUTURE SCOPE

For future venture,

1. Voice assistant can be used that uses natural language processing (NLP) to interact with the user and take natural sentence commands.
2. Voice assistant can link into Google Assistant or Amazon Alexa so that it can do more than what the robot can do.
3. A custom PCB can be designed for bot which can makes connections handier and easier to use and can be scalable easily.
4. Gripper can be replaced with Flex Shape Gripper (Festo) – A gripper which has properties of chameleon tongue this gripper can take any shape according to the object.
5. Object detection can be used to identify different objects and pick them up.
6. Follow me command can be added by which bot can track user and follow the user everywhere.
7. Port forwarding can also be done to access port from any network.
8. Spy mode can be used in which bot will look like it's in sleep mode and record the live footage of camera. A mic can be attached with camera to hear things and will also be very helpful in spying as well.
9. A memory can be attached to memorize all trainings so that can be used any time.
10. GPS can be attached to automatically reach to the user form any location by finding path.

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