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Robotic Dog

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ABSTRACT
Mesh networking is the concept of connecting different microcontroller boards. In mesh networking, if there are ten microcontroller boards then we can control all with any one of them. The data is processed through all the nodes so that if a node is not working there will be no issues. For example, consider a temperature humidity sensor connected with fan and AC using mesh networking. We can control both fan and AC with the data given by Temperature humidity sensor.

This paper describes how to build a robotic dog. This Robotic dog uses the functionality of mesh networking for connecting all nodes which is used to control the robot. The input taken by the CAMERA or MIC with the help of an ESP32, (a microcontroller board) is transferred to another ESP for processing. After processing, the data is transferred through Wi-Fi, Bluetooth or by using Tensorflow to convert data to audio and then send it to speaker module. So the circuit will not be complicated and the project will be scalable. And if a module faces any issues or errors, the work will be done by another module. We can integrate AI in this ESP module, so it acts like a personalized AI robot.

1. INTRODUCTION

Sparko, the first robotic pet, was built by the American company Westinghouse in 1940. It was a mechanical dog that could bark, wag its tail, and move its head. However, it never got sold due to poor public interest. The first robotic pets to be put on the market were Hasbro's Furby in 1998 and Sony's AIBO in 1999. Furby was a furry creature that could interact with its owner and learn new words. AIBO was a robotic dog that could respond to voice commands and perform tricks. Since then, robotic pets have grown increasingly advanced. They can now learn and remember information, respond to emotions, and even form relationships with their owners.

Now we are introducing the robotic dog which itself is a home assistant. The new AI integrated robotic dog that can identify its owner and understand actions! This amazing new product is perfect for anyone who loves dogs but doesn't have the time or space for a real one. The AI robotic dog is equipped with state-of-the-art technology that allows it to recognize its owner's face and voice, as well as understand simple commands. It can also walk, run, and play fetch, just like a real dog. The AI robotic dog is the perfect pet for anyone who wants the companionship of a dog without the hassle of owning one. It's also great for people who live in apartments or other small spaces, as it doesn't require any exercise or grooming. All the good features of a dog can be added to this robot.
Features:

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- Identifies its owner's face and voice
- Number of owners can be increased.
- Understands simple commands
- Walks, runs, and plays fetch
- Perfect for apartments and small spaces
- No exercise or grooming required
- Self-charging mechanism
- Wireless charging
-

2.WORKING

The working of a Robo dog is as follows:

1. When a person comes in front of the dog and looks into it, the dog will recognize them and give them a warm welcome with a simple motion of its body.
2. If the person asks the Robo dog a question, the integrated AI will answer it through the speaker.
3. The dog can move in all directions, depending on the commands given to it.
4. It can detect hand movements and move accordingly, based on the program written in the ESP32 module.
5. As the dog is integrated with AI, it can answer almost any question that is asked of it.
6. The ESP CAM in the dog's eyes recognizes the owner's face, and the voice recognition module recognizes their voice, so there is no risk of a false command from a stranger.
7. The ESP32 in the dog's head is connected to the ESP CAM in its eyes, the voice recognition module in its ears, and the openCV software for visual object recognition.
8. The voice recognition module is integrated with Tensorflow, which converts speech to text and text to speech.
9. The dog's body moves according to the input from the Cam and Mic, and it creates a motion according to the input by moving the servos fixed to its legs, tail, and head.
10. The ESP32 sends signals to the corresponding servos for the motions.
11. If the Robo dog's battery level drops to 25%, it will automatically go to the charging station and charge itself.

3. Components used:

- ESP32:
  A microcontroller that is used to control the other components
- Servo:
  A motor that is used to move .
- Voice recognition module:
  A module that is used to recognize spoken commands.
- ESP CAM:
  A camera that is used to capture images and videos.
- Battery:
  A battery that is used to power the components.
- Connector:
  A connector that is used to connect the components.
- A pair of wireless charging modules:
  Two modules that are used to charge the battery wirelessly.
- Lipo battery:
  A type of battery that is used in this project.
- Lipo charging board:
  A board that is used to charge the Lipo battery.
- A power source to run the charger:
  A power source that is used to run the charger.

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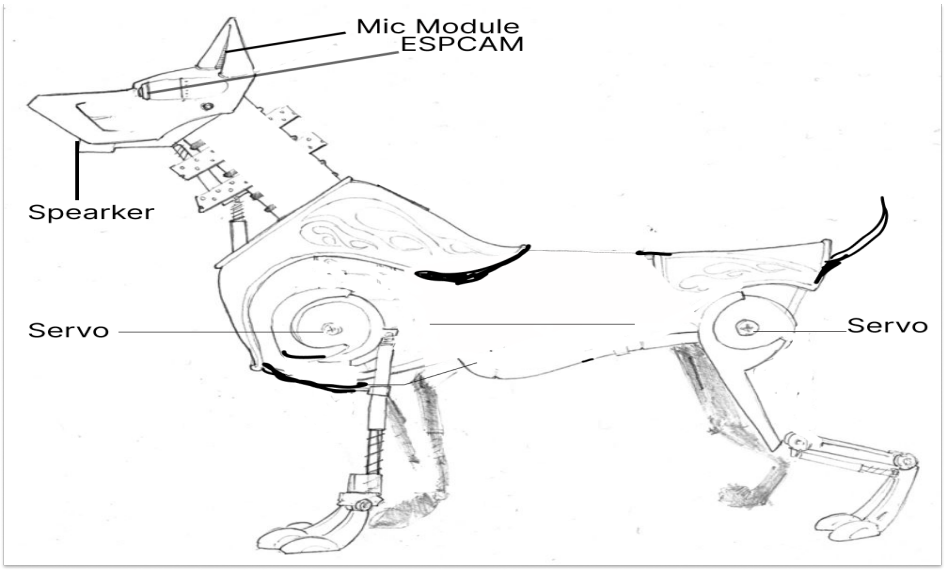

Figure 1: Basic components placed in the Robot.

4. MAKING:

4.1 Head:

Components: 4 ESP 32 , ESPcam, Mic module, Speaker

The ESPcam is integrated with OpenCV, enabling it to process visual data and recognize hand gestures and faces. The Mic module captures audio data through voice commands. The Speaker plays audio data, including AI-generated responses or feedback. Hand gestures captured by the ESPcam are converted into instructions to control a robot arm or perform other actions. Face recognition allows the system to identify individuals in the room and trigger specific interactions. The system interacts with a physical body, such as a robot arm, to carry out tasks based on recognized gestures and faces. Overall, this setup showcases the integration of computer vision and machine learning with microcontrollers to create an interactive and responsive system controlled by hand gestures and face recognition.

For example, you could use hand gestures to control a robot arm. You could also use face recognition to identify people in a room and then control the robot arm to interact with them.

The possibilities are endless!

The other 3 ESPs are for other purposes.

The setup consists of three ESP32 devices. The first ESP32 is connected to a microphone to capture voice commands. The second ESP32 is integrated with AI models like ChatGPT and Bard using APIs. It receives the voice commands, determines if they are meant for AI or for actions, and interacts with the AI models to obtain responses. If the command is intended for AI, the second ESP32 sends the audio data to the AI models, which generate textual responses. The third ESP32 has TensorFlow Lite and converts the AI-generated text responses into audio format. The audio data is then sent to a speaker and played out loud for the user to hear.

On the other hand, if the voice command is for an action (e.g.,"Turn on the lights"), the second ESP32 processes the command and sends the appropriate action command to the body (a physical system). The body performs the action and sends a response back to the second ESP32. The second ESP32 treats this response as if it were an AI-generated response for that particular action command.

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In summary, this system enables users to interact with AI models using voice commands. The AI models process the commands and respond accordingly, and action commands are executed by the body, with its responses being treated as AI responses. The third ESP32 converts AI-generated text responses into audio format and plays them on a connected speaker, making the interaction audible to the user.

This is how the head works.

5.Body

The ESP in the body receives all the responses and data from the head ESPs. The servomotors then act according to the instructions from the ESP. This allows the robot to move and react to its environment. For example, if the head ESP detects that something is in front of it, it will send a signal to the servomotors to move the robot's head out of the way. The servomotors are controlled by the ESP, which uses the data from the head ESPs to determine how to move the robot. This allows the robot to move smoothly and accurately.

The same ESP32, which is integrated with other components of the system, takes on the responsibility of monitoring the robot's battery level. At regular intervals or upon specific events, the ESP32 reads the battery level from the connected battery sensor. Based on the reading, it makes a decision whether the battery is low or not by comparing it against a predefined threshold value. If the ESP32 detects that the battery level is low, it initiates the self-recharge process for the robot. To achieve this, the ESP32 communicates with the robot's control system and triggers the navigation process to guide the robot to its designated charging station or docking point. Once the robot reaches the charging station, the charging process begins, and the robot's battery is recharged. During the charging period, the ESP32 continuously monitors the battery's charging progress by observing the voltage or utilizing charging status signals. Once the ESP32 determines that the battery is fully charged, it stops the charging process and instructs the robot to disconnect from the charging station and resume its normal operations or return to its last assigned task. With this autonomous self-recharge capability, the robot can maintain its operational efficiency and functionality without requiring manual intervention when the battery is low, ensuring seamless and efficient operation in the long run.

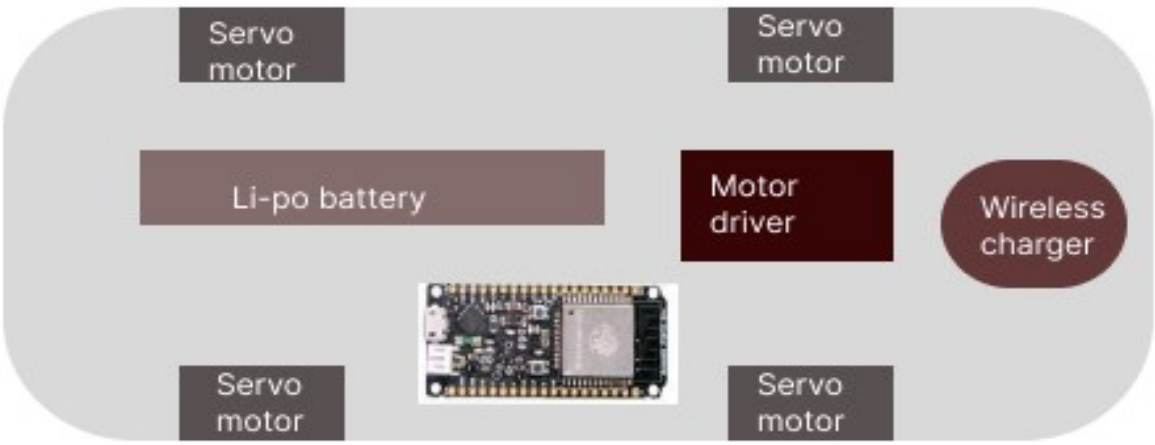

Figure 2: Structure of the body (Top view)

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6.Conclusion

In conclusion, the robotic dog, equipped with various advanced technologies, represents a significant advancement in the field of robotics and artificial intelligence. Through the integration of components such as ESP32 microcontrollers, the ESPcam, a Mic module, and a Speaker, along with the powerful capabilities of OpenCV for computer vision and machine learning, the robotic dog demonstrates remarkable interactivity and responsiveness.

The use of OpenCV enables the robotic dog to recognize and interpret hand gestures and facial features, allowing for intuitive control and personalized interactions with users. Additionally, the integration of a Mic module allows the robotic dog to receive voice commands, enhancing its usability and providing an alternative means of interaction.

Moreover, the ESP32's ability to monitor the robot's battery level and initiate self-recharge when necessary showcases the autonomous and self-sustaining nature of the robotic dog. This feature ensures that the robot can maintain its operational efficiency without human intervention, making it a practical and reliable companion.

Overall, the robotic dog embodies the seamless fusion of cutting-edge technology, computer vision, and AI integration, resulting in a highly interactive, intelligent, and independent robotic companion. With its wide range of functionalities and capabilities, the robotic dog holds promise in various applications, from assisting individuals with everyday tasks to providing entertainment and companionship to users of all ages. As technology continues to evolve, the potential for further advancements in robotic companionship is both exciting and promising, making the robotic dog a remarkable glimpse into the future of robotics.