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Design and Fabrication of Talking Robot

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ABSTRACT

This project presents the design and fabrication of a talking robot using Raspberry Pi, a low-cost and highly capable single-board computer. The robot is controlled through Wi-Fi, enabling remote communication and interaction. Equipped with object detection capabilities, the robot can navigate and interact with its environment. Motor control is also implemented, allowing the robot to move and perform tasks. The robot's speech recognition and synthesis capabilities enable natural language interaction with humans. Robots talk in two ways one is Speech Synthesis & another is Pre-recorded audio. Robots work with better accuracy too. Many companies want to use talking robots. So, I am trying to create this robot with lower manufacturing costs and include many advanced features. With technology growing fast in recent years, we need to make some improvements. Nowadays, speech technologies on mobile devices are improving in terms of understanding language and being reliable.

Keywords: Raspberry Pi, Wi-Fi, and obstacle detection using Python

I. Introduction

Currently, the work on the development of robots, which humans must be able to interact with in a natural and intuitive manner, is gaining rapid momentum. The design of a talking robot utilizing cheap single-board computers is introduced in this project. In this case, the Raspberry Pi is selected due to its high level of capability in relation to its price. The robot should be designed with Wi-Fi-controllable capability because it helps in the development of a remotely communicating and interacting robot and its natural object detection capability. This enables it to interact and navigate. Motor control can also be done for moving the robot and doing some work. By combining Raspberry Pi, Wi-Fi connectivity, object detection, and motor control, this project seeks to contribute to the advancement of robotics and AI, while also exploring the possibilities of human-robot interaction and collaboration. These robots can learn to speak many languages. They have a lot of uses, for example, they help in customer service, teach languages, or even entertain us. Sometimes, humans control them, or they run on computer programs. They typically use some advanced technology, like natural language processing, to recognize and answer what people speak. talking robot can convert written words into spoken ones. This makes it easier for the robot to talk to people in a very natural manner. After all, talking robots do appear in many different places. This includes customer service, education, & entertainment. They are also made for areas like healthcare, where it is really important that communication should be done just like a human. In fact, talking robots really understand the human language so well. They can be programmed similarly to follow the commands and answer some of the questions too. The project is the development of a talking robot that will assist people in homes, offices, hospitals, and other healthcare facilities. The robot will be designed to be user-friendly, adaptive, and scalable for possible future component features and functionalities.

II. RELATED WORK

[1] The development of talking robots using Raspberry Pi has been explored in various studies. Kumar et al. (2020) designed a low-cost talking robot using Raspberry Pi for elderly assistance. The robot is equipped with speech synthesis and recognition capabilities, allowing it to interact with elderly individuals and provide assistance with daily tasks. The authors highlight the potential of the robot to improve the quality of life for the elderly and reduce healthcare costs.

[2] Ali et al. (2018) implemented a talking robot using Raspberry Pi and Python for machine learning applications. This study presents the implementation of a talking robot using Raspberry Pi and Python, focusing on machine learning applications. The robot is trained to recognize and respond to voice commands and can learn from user interactions. The authors demonstrate the potential of the robot for various applications, including home automation and customer service.

[3] Cho et al. (2016) implemented a talking Robot using Raspberry Pi and Arduino for Hybrid Robotic Systems. This study presents the development of a talking robot using a hybrid approach, combining Raspberry Pi and Arduino. The robot integrates speech synthesis and recognition capabilities with robotic movements, demonstrating the potential for hybrid robotic systems. The authors highlight the benefits of combining the strengths of both platforms.

III. METHODOLOGY

The talking robot is one that would be able to yield or electrically produce sound, more specifically spoken words, as a means of communication. To do so, it must have a text-to-speech process, pre-recorded speech, or a hybrid of both. Talking robots find applicability in many areas, such as customer service, language learning, and entertainment. In addition, a Speak robot is a machine capable of voicing utterances or utterance-like noises.

This may pursue through various means such as text to speech synthesis or prerecorded speech. Mechanical robots can apply to perform many kinds of works, such as customer care, entertainment, or education. Talking robot in cheap and efficient way to build. You can connect it to a Raspberry Pi, a small, cheap computer functioning as the robot's brain. By adding a microphone and speaker to the Raspberry Pi and loading open-source software, like the Python programming language and the Open Speech Platform, you can begin to build a very simple voice-controlled robot. A role of the Raspberry Pi is to be the central processing of the system, sort of like the 'brain' of the robot. It makes use of the main control software running on it. The Raspberry Pi majorly deals with input from other sensors, such as the camera and ultrasonic sensors, and processes that data to send commands to the motor driver and other output devices, such as the speaker. It also oversees wireless communications in relation to the remote control of the robot, through which the user can operate the robot by Wi-Fi. It is directly connected to the Raspberry Pi and made to capture and obtain images for live video streaming. It allows the user to perceive what the robot is viewing in real time at a remote location. Visual feedback of this kind is crucial when manually controlling robots, especially when the robots are traversing complex environments. It uses an ultrasonic sensor to detect such obstacles

It gives out an ultrasonic pulse that eventually reflects back when it meets an obstacle. The distance of the obstacle then is calculated by the use of time taken for the reflected waves to reach the source. These data are then fed into the raspberry pi, and from the reflected waves distance information is calculated. This information is, in turn, used to navigate. A fair distance from the obstacles will keep the robot from colliding and hence it can navigate easily without any fear of mishap

IV. Hardware Requirement

- Raspberry pi-4
- Pi camera
- Motor
- Motor Driver
- Ultrasonic Sensor
- Microphone
- Li-ion Battery
- Wheels
- Speaker
- Amplifier
- BMS
- Power bank
- Jumping wires

V. SOFTWARE REQUIREMENT

- Coding language: PYTHON
- Multithreading
- IDE: TONNY

VI. LIBRARIES

- Open CV
- GTTS
- Pygame
- Pyaudio
- Pyrobot

VII. BLOCK DIAGRAM

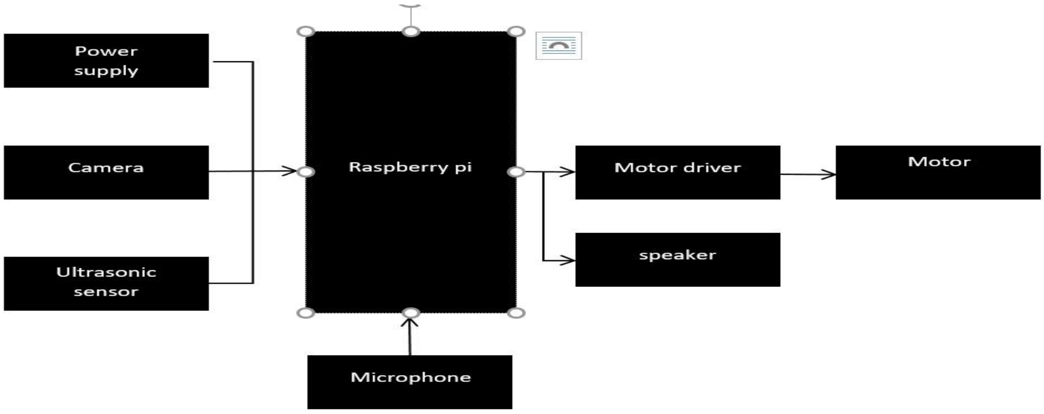

Fig 1: Block Diagram of Talking Robot

Working

The power supply delivers all electric power that can possibly be consumed by the system. The power supply unit ensures stable and sufficient voltage and current to Raspberry Pi and all peripherals connected to it. In many cases, it is feasible to supply a Raspberry Pi with an AC adapter that down-converts household electricity into much lower voltage. The power supply must last long, to supply sufficient power to the Raspberry Pi, various motors, sensors, and other accessories, all operational simultaneously without the slightest lag in performance. The Raspberry Pi serves as the central processing unit for the entire robot. It is basically the brain for the whole robot. It runs the main control software that supervises all the activities of the robot. It processes input captured from different sensors, like the camera and ultrasonic sensor, and then sends commands to the motor driver and other output devices, like the speaker. The camera is mounted onto the Raspberry Pi to capture and stream images in real time, allowing for surroundings of the robot to be visible to the user. It is very critical for the manual control of a robot, especially in a highly sensitive environment. The ultrasonic sensor used in this section is used to detect obstacles. It works by throwing out ultrasonic waves, and after hitting a barrier, it measures the time the wave takes to bounce back. The Raspberry Pi processes this data in order to know the distance of the obstacle. It is very important for navigation, helping the robot to avoid hitting against objects in its environment and to drift safely. The microphone is required in order to pick up audio input from the environment that would facilitate the robot to respond to voice commands. Audio data can be sent to the Raspberry Pi, where it can be manipulated through speech recognition. The robot acts as a voice assistant that does something or answers one's request according to the user's spoken command. The Raspberry Pi plays back the audio responses. These are responses from the voice assistant or for the PA system. The integration of the speaker enhances the interaction of the robot, whereby there can be an audible response to the user. The motor driver acts to interface between the Raspberry Pi and the motors. The Raspberry Pi sends control signals to the motor driver, which interprets the signals into the appropriate levels needed by the motors. It is, therefore, enabled with the Raspberry Pi to enable the control of motor speed and direction for the robot to move forward, backward by making turns. The motors do the physical movement of the robot. They are attached to the wheels and are controlled by the motor driver. The power given to them controls the direction and speed at which the robot is to be driven in specific directions. The motors form the very lifeblood of motion in the robot, providing mobility for it to move around its environment.

VIII. IMPLEMENTATION

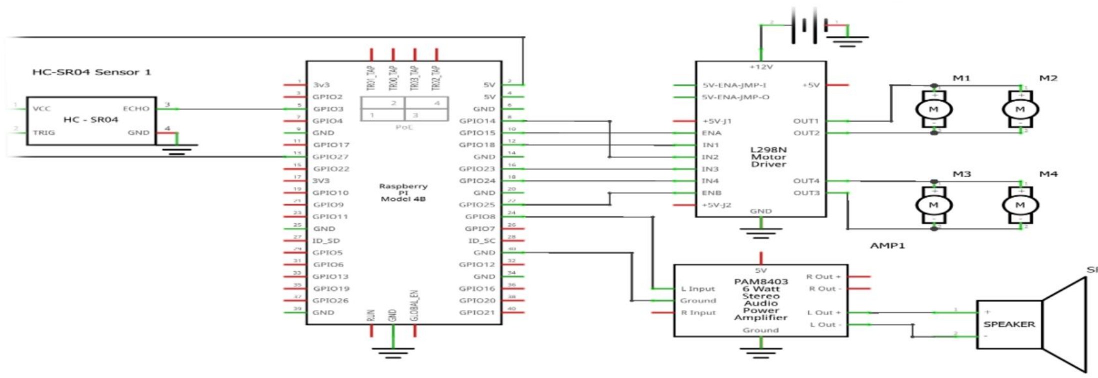

Fig 2: Circuit Diagram

The Raspberry Pi-based Smart Robot is an advanced robotics project that leverages the computational power of the Raspberry Pi 4 and integrates various sensors and components to create a versatile and intelligent robotic system. The key components involved in this project include the Raspberry

Pi 4, motor driver, DC motors, wheels, ultrasonic sensor, Pi camera, microphone, and speaker. The robot is designed to be controlled remotely via Wi-Fi, offering a range of functionalities such as obstacle detection, live video streaming, and voice interaction at the heart of the robot is the Raspberry Pi 4, a powerful single-board computer that serves as the main controller.

The Raspberry Pi 4 is connected to a motor driver, which in turn is connected to the DC motors and wheels. The motor driver acts as an interface between the Raspberry Pi and the motors, allowing the Raspberry Pi to control the movement of the robot. By sending appropriate signals to the motor driver, the Raspberry Pi can move the robot forward, backward, and turn in different directions. For obstacle detection, the robot is equipped with an ultrasonic sensor. The ultrasonic sensor emits sound waves and measures the time it takes for the echoes to return, allowing the robot to detect objects in its path. When an obstacle is detected within a certain range, the Raspberry Pi processes this information and adjusts the movement of the robot to avoid collisions. This functionality is crucial for autonomous navigation and ensures that the robot can move around safely in its environment. The Pi camera is another essential component of the robot, enabling live video streaming. The camera captures real-time video footage, which is transmitted to a remote device over Wi-Fi. This allows a user to remotely monitor the surroundings of the robot and control its movement based on the visual feedback. The live video stream is particularly useful for applications where the robot needs to navigate through complex environments or perform tasks that require visual inspection. The microphone and speaker add a layer of interactivity to the robot by enabling voice assistant capabilities. The microphone captures voice commands from the user, which are processed by the Raspberry Pi using voice recognition. The robot can respond to these commands and perform actions accordingly. The speaker is used to play back the responses of the voice assistant, providing audible feedback to the user. This feature allows the robot to interact with users in a natural and intuitive manner, enhancing the overall user experience.

IX. RESULT AND DISCUSSION

The output of the proposed system is shown in the figures. The proposed system is executed successfully by using technologies like Raspberry PI, Ultrasonic Sensor, Motor Driver, DC Motor, Servo Motor, and Speaker Mic. Finally, our wish has been fulfilled as an identity of our project and our robot working. The results of this project contribute to the development of talking robots that can interact with users in a more human-like way. Future work can focus on improving the robot's speech synthesis and recognition capabilities, as well as exploring applications in areas such as education, healthcare, and customer service. The project's findings on the cost-effective and rapid development of talking robots can inform future research and development in this area

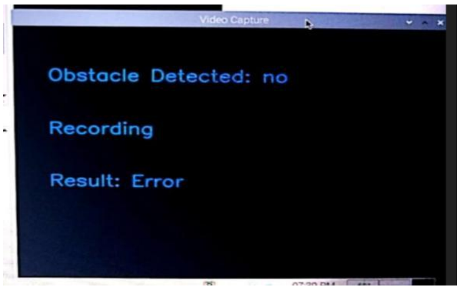

Fig: 3 Design and fabrication of talking output.

X. CONCLUSION

The purpose of this research was to identify effective strategies for dealing with repetitive motions identified in individuals with autism spectrum disorder. To make a robot talk we can go through two methods Speech Synthesis and Pre-recorded audio. Among them, the option doesn't perform understandably well with Raspberry Pi. So, we are going for the method of Pre-recorded audio. Finally, our wish has been fulfilled as an identity of our project and our robot working. We would like to thank everyone who believes in me and supports our project.

XII. Future scope

Improve speech synthesis and recognition accuracy to achieve more human-like interaction. Integrate additional sensors and actuators to enhance the robot's perception and interaction capabilities.

Explore applications in various domains, such as:

- Education: interactive learning companion
- Healthcare: assistive technology for patients
- Customer Service: interactive Chabot
- Entertainment: interactive storytelling

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