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GESTURE CONTROLLED BLUETOOTH SPEAKER USING ARDUINO

Nisha Munda*1, Soumi Dhali*2, Purnima Kumari Shaw*3, Shreya Dutta*4, Tanaya Kundu*5, Nabaneeta Banerjee*6

*1,2,3,4,5,6,7Department Of Electronics And Communication Engineering, Guru Nanak Institute Of Technology, Kolkata, India.

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ABSTRACT

A communication system has been proposed which converts sign language used by mute people into speech. It is done based on the novel hand gesture recognition technique. This solution approach consists of a hardware module and software application. In hardware module - The Gesture recognition is done with the help of sensor glove which are best positioned in fingers, based on the analysis of American Sign Language (ASL) signs. The design of glove and the concept of decoding gestures by considering the axis orientation with respect to gravity and their corresponding voltage levels are discussed. In Software part - an android application named Speaking gestures have been developed. It receives the data (alphabet/word) via Bluetooth, converts them into text and speaks it out. Bluetooth speakers are the most widely used speakers these days. Their compact size with portability and long battery life has made them a centre of attraction. Well we hereby take Bluetooth speakers to the next level by integrating touchless operation. The Bluetooth speaker allows user to change music by just swiping their hand over the Bluetooth speaker. Also the speaker allows user to adjust volume by just raising and lowering their hand over the speaker. The user can thus operate the complete speaker operation without even having to touch his/her phone or the speaker.

Keywords: Gesture Control, Bluetooth Speaker, Arduino HC-05, Bluetooth Module MPU6050 Gyroscope And Accelerometer, Gesture Recognition, Wireless Communication.

I. INTRODUCTION

The gesture-based speaker advances the state-of-the-art of Bluetooth speakers. The system includes an Arduino, battery charging board, Lidar sensor, LED, audio amplifier IC, Bluetooth module, and 6-watt speaker with subwoofer. To connect phones to the speaker for audio input, the system uses a Bluetooth module. A second charging input connector and an AUX connection for audio input are also supported by the speaker. The amplifier IC boosts the audio signal after it has been received without losing any data [1-4]. Now, the speaker module receives this signal and transforms it into high-quality audio. The Bluetooth speaker has a Lidar sensor installed on top of it. The Arduino processes the sensor's input before sending it to the controller, which can then change the song, adjust the level, or turn on the speaker. This makes contactless speaker operation possible. Power for the entire device is provided by the battery pack. The battery charger and protection circuitry regulates battery power and discharge. Additionally, this circuitry has an internal logic system that automatically turns off the system after more than five minutes of inactivity to conserve power.

In today's rapidly advancing technological landscape, the fusion of hardware and software innovations opens up a realm of possibilities for interactive and intuitive devices. One such innovation is the Gesture Controlled Bluetooth Speaker, a project that harnesses the power of Arduino microcontrollers to create a hands-free audio experience. This project aims to revolutionize how users interact with their audio devices by eliminating the need for physical buttons or remote controls. Instead, it leverages gesture recognition technology to interpret hand movements and translate them into commands for controlling playback, volume adjustment, and even playlist navigation. At its core, this project combines the versatility of Arduino boards with the convenience of Bluetooth connectivity. By integrating sensors capable of detecting gestures, such as accelerometers or infrared sensors, with Arduino microcontrollers, we can capture and process hand movements in real-time. The Bluetooth module facilitates seamless wireless communication between the gesture control unit and the speaker, allowing users to enjoy their favorite music or podcasts without being tethered to the device. Whether it's adjusting the volume with a flick of the wrist or skipping tracks with a simple hand gesture, the intuitive nature of gesture control enhances the user experience. Moreover, by utilizing open-source hardware and

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software components like Arduino and libraries such as Arduino Gesture Recognition, this project promotes accessibility and encourages experimentation and customization. Enthusiasts can modify the code, add new gestures, or integrate additional features to tailor the device to their preferences [5-7]. In addition to its practical applications, this project serves as an educational platform for aspiring makers and technologists interested in exploring the intersection of electronics, programming, and human-computer interaction. By providing detailed instructions, schematics, and code, this project empowers individuals to delve into the fascinating world of gesture-controlled technology.

II. REQUIRED COMPONENTS

a. **Watt speakers -** A 6 watt speaker is a transducer that converts electromagnetic energy into sound waves. The term "watts" refers to the amount of power that a speaker can handle.

b. **Subwoofer**- A subwoofer is a type of speaker that enhances the lowest frequencies in audio. These frequencies include-Bass guitars, Pipe organs, Deep voices, Kick, drums, Movie sound effects.

c. **Arduino** - The Arduino processes the sensor's input before sending it to the controller, which can then change the song, adjust the level, or turn on the speaker. This makes contactless speaker operation possible.

d. **Battery Charging Board**- converts AC power from external sources, such as residential outlets, to DC power to charge the vehicle's battery pack.

e. **Lidar Sensor**- Light Detection and Ranging is a ranging device that measures the distance to a target. It works by emitting rapid laser pulses and using sensors to measure the time it takes for those pulses to bounce back after hitting surfaces.

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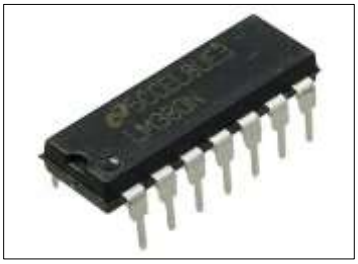
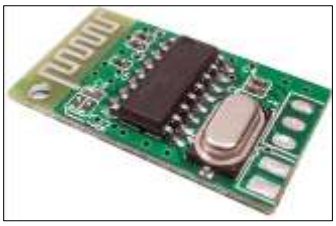
f. **Audio amplifier IC** - Audio amplifiers increase, control and amplify the strength or amplitude of the signals. They are used to increase the sound and quality of the audio signal.



g. **Bluetooth module** - Bluetooth modules use low-power radio communications to link devices over short distances. Wireless signals transmitted with Bluetooth typically cover distances up to 30 feet (10 meters).



h. **Battery set** - A battery set is a source of electric power consisting of one or more electrochemical cells with external connections for powering electrical devices.

i. **LED –** The LED perform a number of visual changes depending on the detected gestures. When the music is playing, the LED displays a randomized color change. When the music is paused, the LED displays no color. When the music is resumed from a paused state, the LED displays a static green color. The brightness of the LED also correlates linearly to the volume of the audio (increasing volume increases brightness, and vice versa).

III. WORKING PRINCIPLE

A gesture control Bluetooth speaker typically involves using sensors to detect specific hand movements or gestures. These sensors can include accelerometers, gyroscopes, or cameras. Here's a simplified explanation of how it might work:

a. **Gesture Detection**: Sensors capture hand movements or gestures, such as waving, tapping, or swiping.
b. **Data Processing**: The data from these sensors are processed to identify the specific gestures. This can be done using algorithms that analyze the sensor data patterns.
c. **Communication with Bluetooth**: Once a gesture is recognized, the system sends corresponding commands to the Bluetooth module. For example, a waving gesture might trigger the speaker to play the next track.

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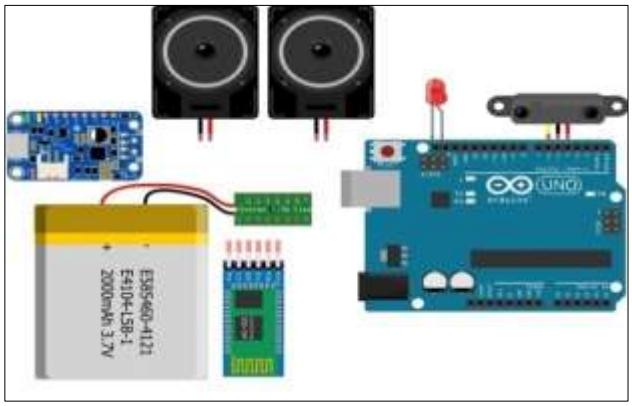
d. **Bluetooth Connection**: The Bluetooth module establishes a connection with a paired device, like a smartphone or tablet, to control audio playback.
e. **Speaker Control:** The Bluetooth speaker interprets the commands received via Bluetooth and adjusts its functions accordingly. This could involve actions like changing the volume, skipping tracks, or pausing playback.
f. **User Feedback**: The system might provide feedback to the user to confirm that the gesture was recognized successfully. This could be visual or auditory cues.

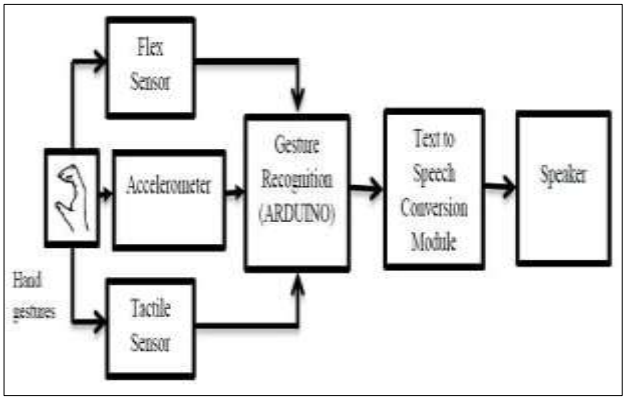
We have also described some additional considerations and features you might want to incorporate into a gesture control Bluetooth speaker project:

- **Custom Gestures:** Allow users to define and customize their own gestures for specific commands. This adds a personalized touch to the user experience.
- **Range Adjustment:** Implement a range adjustment feature to fine-tune the sensitivity of the gesture recognition. This ensures that the system responds appropriately to gestures without being overly sensitive or unresponsive.
- **Multi-Gesture Recognition**: Enable recognition of multiple gestures to perform a variety of functions. For instance, a swipe to the left could decrease volume, while a swipe to the right increases it.
- **Voice Commands Integration**: Combine gesture control with voice commands for a more versatile user interface. This expands the ways users can interact with the Bluetooth speaker.
- **Power Saving Mode:** Implement a power-saving mode that activates when the speaker is not in use. This helps conserve battery life or reduce power consumption.
- **Firmware Updates:** Design the system to support firmware updates. This allows for future improvements or the addition of new gestures and features without requiring hardware modifications.
- **Compatibility with Multiple Devices:** Ensure compatibility with a variety of Bluetooth-enabled devices, such as smart-phones, tablets, and laptops. This enhances the speaker's usability across different platforms.
- **User Calibration:** Provide an option for users to calibrate the gesture recognition system based on their preferences and environment, optimizing performance.
- **LED Indicators:** Use LED indicators to visually communicate the status of the speaker, such as Bluetooth connectivity, gesture recognition, and battery level.
- **Error Handling:** Implement robust error handling to gracefully manage situations where a gesture may be misinterpreted or not recognized correctly.

Remember to document your project well, considering both the hardware and software aspects, to help others understand and potentially replicate or build upon your gesture control Bluetooth speaker.

IV. CIRCUIT DIAGRAM & BLOCK DIAGRAM





V. ADVANTAGES

This Gesture Controlled Bluetooth Speaker provides the following advantages:-

a. Full Contactless Usage
b. Hand Swipe for changing to next song

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c. Raising or lowering hand to adjust volume
d. Swiping hand to turn On the speaker
e. Automatic turn Off when not in use
f. High Bass and efficient sound quality
g. Over 8 hours of Battery Life
h. Lightweight compact device for portability

Here are some advantages of a Gesture Controlled Bluetooth Speaker using Arduino:

Hands-Free Operation: One of the primary advantages of gesture control is its hands-free operation. Users can control playback, adjust volume, and navigate playlists without physically interacting with the device, enhancing convenience and accessibility, especially in situations where manual interaction is cumbersome or impractical.

Intuitive User Interface: Gesture control offers an intuitive and natural user interface. Interacting with the speaker through hand gestures mimics human communication patterns, making the experience more intuitive and user-friendly, particularly for individuals who may have difficulty operating traditional button-based interfaces.

Enhanced Mobility: With Bluetooth connectivity, users can enjoy wireless audio streaming from their smartphones, tablets, or other Bluetooth-enabled devices. The combination of gesture control and wireless connectivity enhances mobility, allowing users to move freely while controlling their audio playback from a distance.

Innovative Technology Integration: Integrating gesture recognition technology with Arduino microcontrollers demonstrates the innovative integration of hardware and software components. This project showcases how emerging technologies can be leveraged to create novel solutions that enhance everyday experiences.

Customization and Flexibility: Arduino-based projects offer a high degree of customization and flexibility. Users can modify the gesture recognition algorithms, add new gestures, or integrate additional features according to their preferences and requirements. This flexibility empowers users to tailor the device to suit their unique needs and preferences.

Engaging Learning Experience: Building and experimenting with a Gesture Controlled Bluetooth Speaker using Arduino provides an engaging learning experience for electronics enthusiasts, makers, and students. It offers hands-on experience with hardware programming, sensor integration, and wireless communication protocols, fostering curiosity, creativity, and problem-solving skills.

Accessibility Features: Gesture control can also serve as an accessibility feature, catering to individuals with mobility impairments or disabilities. By offering an alternative input method that does not rely on fine motor skills or physical buttons, gesture-controlled devices can promote inclusivity and improve access to technology for a wider range of users.

Conversation Starter and Novelty: A gesture-controlled Bluetooth speaker is not only a functional device but also a conversation starter and novelty item. Its innovative interface and futuristic appeal can spark curiosity and interest among friends, family, and colleagues, leading to engaging discussions about technology, design, and creativity.

VI. APPLICATIONS

The applications of a Gesture Controlled Bluetooth Speaker using Arduino are diverse and can be found in various contexts. Here are some potential applications:

Home Entertainment Systems: Gesture control can enhance the user experience of home entertainment systems by allowing users to control audio playback, volume, and other functions without needing to physically interact with remote controls or buttons. This hands-free operation is particularly convenient for users while they are engaged in other activities or from across the room.

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Smart Homes: In a smart home environment, a Gesture Controlled Bluetooth Speaker can serve as a central hub for controlling various connected devices. Users can use gestures to trigger actions such as adjusting smart lighting, setting thermostats, or even locking doors, creating a seamless and intuitive smart home experience.

Accessibility Devices: Gesture controlled technology can be applied to create accessibility devices for individuals with disabilities or mobility impairments. A gesture-controlled Bluetooth speaker can serve as a communication aid, allowing users to send pre-defined messages or control their environment using simple hand gestures, thus enhancing independence and accessibility.

Public Spaces and Events: Gesture-controlled Bluetooth speakers can be deployed in public spaces or events to provide interactive and engaging experiences for attendees. For example, at a concert or exhibition, attendees could use gestures to request songs, adjust volume levels, or interact with multimedia displays, adding an element of interactivity to the event.

Fitness and Wellness: In fitness and wellness settings, a gesture-controlled Bluetooth speaker can serve as a hands-free audio companion for users during workouts, yoga sessions, or meditation practices. Users can control their music playback or audio-guided workouts with simple gestures, eliminating the need to touch their devices with sweaty hands.

Education and Learning: Gesture-controlled Bluetooth speakers can be used in educational settings to facilitate interactive learning experiences. Teachers or presenters can use gestures to control audiovisual content during lectures or presentations, allowing for more dynamic and engaging classroom interactions.

Assistive Technology: In healthcare settings, gesture-controlled Bluetooth speakers can be integrated into assistive technology devices to support patients with limited mobility or dexterity. For example, patients recovering from surgery or living with conditions such as paralysis could use gestures to control their entertainment options or communicate with caregivers.

Interactive Exhibits and Museums: Museums, galleries, and interactive exhibits can integrate gesture-controlled Bluetooth speakers to enhance visitor engagement and interaction with exhibits. Visitors can use gestures to access additional audio commentary, interactive displays, or multimedia content, creating a more immersive and memorable visitor experience.

VII. CONCLUSION

In conclusion, the Gesture Controlled Bluetooth Speaker using Arduino represents a convergence of innovative technology, convenience, and creativity. Through the integration of gesture recognition capabilities with Arduino microcontrollers and Bluetooth connectivity, this project offers a myriad of benefits and opportunities across different domains. The hands-free operation and intuitive user interface provided by gesture control enhance the accessibility and usability of audio devices, revolutionizing how users interact with their audio experiences. Whether it's controlling playback, adjusting volume, or navigating playlists, users can seamlessly engage with their music or audio content using simple hand gestures, freeing them from the constraints of physical buttons or remote controls. From modifying gesture recognition algorithms to adding new features or integrating additional sensors, the possibilities for experimentation and innovation are virtually limitless, fostering a culture of exploration and discovery in the DIY electronics community. Furthermore, the applications of Gesture Controlled Bluetooth Speakers extend beyond personal entertainment devices to encompass a wide range of contexts, including smart homes, accessibility devices, public spaces, education, healthcare, and interactive exhibits. As technology continues to evolve and new advancements emerge, projects like the Gesture Controlled Bluetooth Speaker using Arduino serve as exemplars of the innovative integration of hardware, software, and human-computer interaction. By embracing the principles of creativity, accessibility, and collaboration, we can continue to push the boundaries of what's possible and create solutions that enrich lives and inspire generations to come. In essence, the Gesture Controlled Bluetooth Speaker using Arduino not only represents a functional audio device but also embodies the spirit of innovation, exploration, and empowerment, inviting individuals to embark on a journey of discovery and creativity in the realm of DIY electronics.

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