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Voice Controlled Humanoid Robot

Anitha S Aounti[1], Ankitha[2], Dhanushree A H[3], Hem Harshinee[4], Sushma D K[5]
[1, 2, 3, 4]*Student,* [5]*AssistantProfessor, Department of ECE, Vemana Institute of Technology*

Abstract—The rapid growth of robotics and embedded system technologies has increased the need for intelligent and user-friendly robotic systems. Conventional robot control methods such as remote controls, keyboards, and programmed instructions often make human-robot interaction difficult and less efficient. To overcome these limitations, this project proposes the design and development of a Voice Controlled Humanoid Robot that can understand human voice commands and perform corresponding actions.The proposed system uses speech recognition technology to convert voice commands into digital signals. These commands are transmitted through Bluetooth communication to a microcontroller such as Arduino or ESP32, which processes the commands and controls servo motors through a motor driver circuit. Based on the received instructions, the humanoid robot performs movements such as walking, turning, hand movements, and other predefined actions.The main objective of this project is to create a simple, low-cost, and efficient robotic system that improves natural communication between humans and robots. The system provides hands-free robot control, making it suitable for educational purposes, assistive technologies, automation systems, and future smart robotic applications. The project demonstrates the practical implementation of embedded systems, wireless communication, and voice recognition technologies in humanoid robotics.

I. INTRODUCTION

Robotics has become one of the most important fields in modern engineering due to its applications in industries, healthcare, education, defense, automation, and smart assistance systems. Among different types of robots, humanoid robots are gaining significant attention because they imitate human movements and provide better interaction with users. Traditional robotic systems are generally controlled using remote controls, switches, keyboards, or pre-programmed instructions. These methods require manual effort and reduce the flexibility and natural interaction between humans and robots.Voice recognition technology offers a modern solution for improving human-robot communication. By using speech as an input method, robots can understand user instructions and perform actions accordingly. Voice-controlled robotic systems provide hands-free operation, ease of accessibility, and efficient communication. Such systems are especially useful for elderly people, physically challenged individuals, and applications where manual control is difficult.The proposed project, Voice Controlled Humanoid Robot, focuses on designing a humanoid robotic system capable of responding to human voice commands. The system mainly consists of a speech recognition module or mobile application, Bluetooth communication module, microcontroller unit, motor driver circuit, and servo motors. The user provides commands through voice input, which are recognized and converted into digital signals. These signals are transmitted wirelessly to the microcontroller, which processes the commands and controls the servo motors to generate humanoid movements.

The project aims to develop a low-cost and efficient robotic system that enhances natural interaction between humans and machines. The humanoid robot can perform basic actions such as moving forward, backward, turning left or right, and hand gestures based on user commands. The integration of embedded systems and wireless communication technologies improves the flexibility and usability of the robot.This project also demonstrates the importance of speech recognition and automation in modern robotics. The proposed system can be further enhanced by integrating artificial intelligence, obstacle detection sensors, camera modules, and Internet of Things (IoT) technologies for advanced robotic applications. Therefore, the Voice Controlled Humanoid Robot provides a strong foundation for future intelligent robotic systems used in smart homes, healthcare assistance, industrial automation, surveillance, and educational research.

II. LITERATURE SURVEY

*[1] S. Kumar, R. Verma, Guptha P Sharma et al. (2019), "*VoiceControlledRoboticSystemUsingArduino*".*
Thispaperpresentsthedesignand implementationofaroboticsystemthatcanbecontrolledusingvoicecommandsthrougha smartphone application.Inthissystem,theusergivesvoicecommandssuchasforward,backward andrightusingamobileapplication. The application convertsthespeechintotextcommandsand sendsthemtotherobotusing Bluetoothcommunication. AnArduinomicro controllerisusedas themaincontrolleroftherobot.TheArduinoreceivesthecommandsviaaBluetoothmoduleand processesthemtocontrol themotor drivercircuit,whichinturncontrolstherobot'sDCmotors.

Basedonthereceivedcommand,therobotperformsthecorrespondingmovement.Theproposedsystemdemonstratesthatvoicerecognitioncansignificantlysimplifyhumanrobotinteraction,allowinguserstocontrolrobotswithoutmanualdeviceslikekeyboardsorremotecontrollers.

*[2] A. Sharma, K. Singh, R.Mehta et al. (2020), "*SpeechRecognitionBasedRobotControlSystem*".*
Thisresearchfocusesondevelopingaspeechrecognitionbasedrobotcontrolsystemthatenablesrobotstorespondtohumanvoicecommands. Thesystemusesaspeechrecognitionmodulethatconvertsspokencommandsintodigitalsignals. Whentheuserspeaksa command, he speechrecognitionmoduleanalyzesthevoicesignalandidentifiesthecommandusingspeechprocessingalgorithms.Therecognizedcommandisthentransmittedtotherobot'smicrocontroller.Themicrocontrollerinterpretsthecommandandsendscontrolsignalstotherobot'smotordriverandmotors,enablingtherobottoperformmovementssuchasmovingforward,backward,turningleft,orturningright.Thissystemimprovesthe efficiencyofhuman-robotcommunicationandprovidesahands-freemethodofcontrollingrobotic systems.

*[3] R. Guptha, S. Agarwal, M. Tiwari, et al. (2021), "*VoiceControlledHumanoidRobotUsingEmbeddedSystems*".*
Thispaperproposesthedevelopmentofahumanoidrobotcapableofunderstandingvoicecommandsandperformingpredefinedactions.Thesystemintegratesembeddedsystemstechnologywithvoice recognitionalgorithms.Therobot consistsofseveralservomotorsthat controldifferentpartsof therobotsuchasarms,legs,andheadtosimulatehuman-likemovements.Thevoicecommands givenbytheuserareprocessedusingspeechrecognitionsoftware.Afterthecommandisrecognized,theembeddedmicrocontrollerprocessesthecommandandsendsappropriatesignals totheservomotorstoexecutethedesiredaction.Theresearchhighlightstheimportanceof naturalcommunicationbetweenhumansandrobots,especiallyinareaslikeservicerobots, education,andassistiverobotics.

*[4] M. Patel, H. Shah, D. Tridevi N. Desai, Mark R Brinton, et al. (2018), "*SpeechRecognitionBasedIntelligentRobotfor HumanMachineCommunication*".*
Thisresearchintroducesanintelligentrobot systemthatcanbecontrolledusingspeechrecognitiontechnology.Thesystemusesspeech recognitionsoftwaretocaptureandinterpretvoicecommandsgivenbytheuser.Thespokencommandsarefirstconvertedintodigitalsignalsusingspeechrecognitionalgorithms.These signalsarethentransmittedtoaroboticcontroller,whichprocessesthecommandandperforms thecorrespondingaction.Therobotcancarryoutbasictaskssuchasmovementcontrolorobjecthandlingdependingonthecommandsreceived. Thestudyemphasizesthepotentialofspeech recognition systemsincreatingmoreinteractiveandintelligentroboticsystems.Thepaperalso highlightshowvoicerecognitioncanimproveaccessibilityforpeoplewhomayhavedifficulty usingtraditionalcontroldevices.

*[5] P. Singh, R. Kumar, A. Mishra S. Yadav, et al. (2020), "*BluetoothBasedVoiceControlledRobot*".*
ThispaperpresentsaBluetoothbasedvoice controlledrobotsystemwherevoicecommandsareprovidedthroughasmartphoneapplication. Thesmartphoneusesbuilt-inspeechrecognitionfeaturestoconvertspokenwordsintocommand signals. Thesecommandsaretransmittedtotherobotusinga Bluetoothcommunicationmodule.TheBluetoothmodulesendsthecommandstoamicrocontroller,whichprocessesthemand generatescontrolsignalsforthemotordriver.Themotordriverthencontrolstherobot's motorsto performactionssuchas movingforward,backward,left,orright.Thesystemdemonstratesthat smartphone-basedvoicerecognitioncombinedwithwireless communicationcancreatean efficientanduser-friendlyroboticcontrolsystem.

*[6] L. Wang, Y. Zhang, H. Chen Q. Liu, et al. (2022), "*VoiceRecognitionControlledHumanoidRobot*".*
Thisstudypresentsavoicerecognition basedhumanoidroboticsystemthatcanrecognizehumanspeechandperformvariousactions. Thesystemintegratesadvancedspeechrecognitionalgorithmswithmicrocontrollerbasedroboticcontrol.Thevoicerecognitionmoduleprocessesspokencommandsandconvertsthem intodigitalinstructions.Theseinstructionsarethensenttotherobot'smicrocontroller,which controlsmultipleservomotorsresponsibleforhumanoidmovements.Therobotcanperformtaskssuchaswalking,turning,orgesturing,dependingonthecommandsreceived.Theresearch demonstrateshowvoicerecognitiontechnologycanmakehumanoidrobotsmoreinteractiveand capableofrespondingnaturallytohumaninstructions.

III. CONCLUSION

The Voice Controlled Humanoid Robot project was successfully designed and implemented using Arduino, Bluetooth communication, and voice recognition technology. The robot is capable of responding to voice commands received from an Android application through the HC-05 Bluetooth module and performing movements such as forward, backward, left, right, and stop operations.

This project demonstrates the practical application of embedded systems, wireless communication, motor control, and automation in robotics. The use of voice commands makes the system user-friendly, efficient, and interactive.

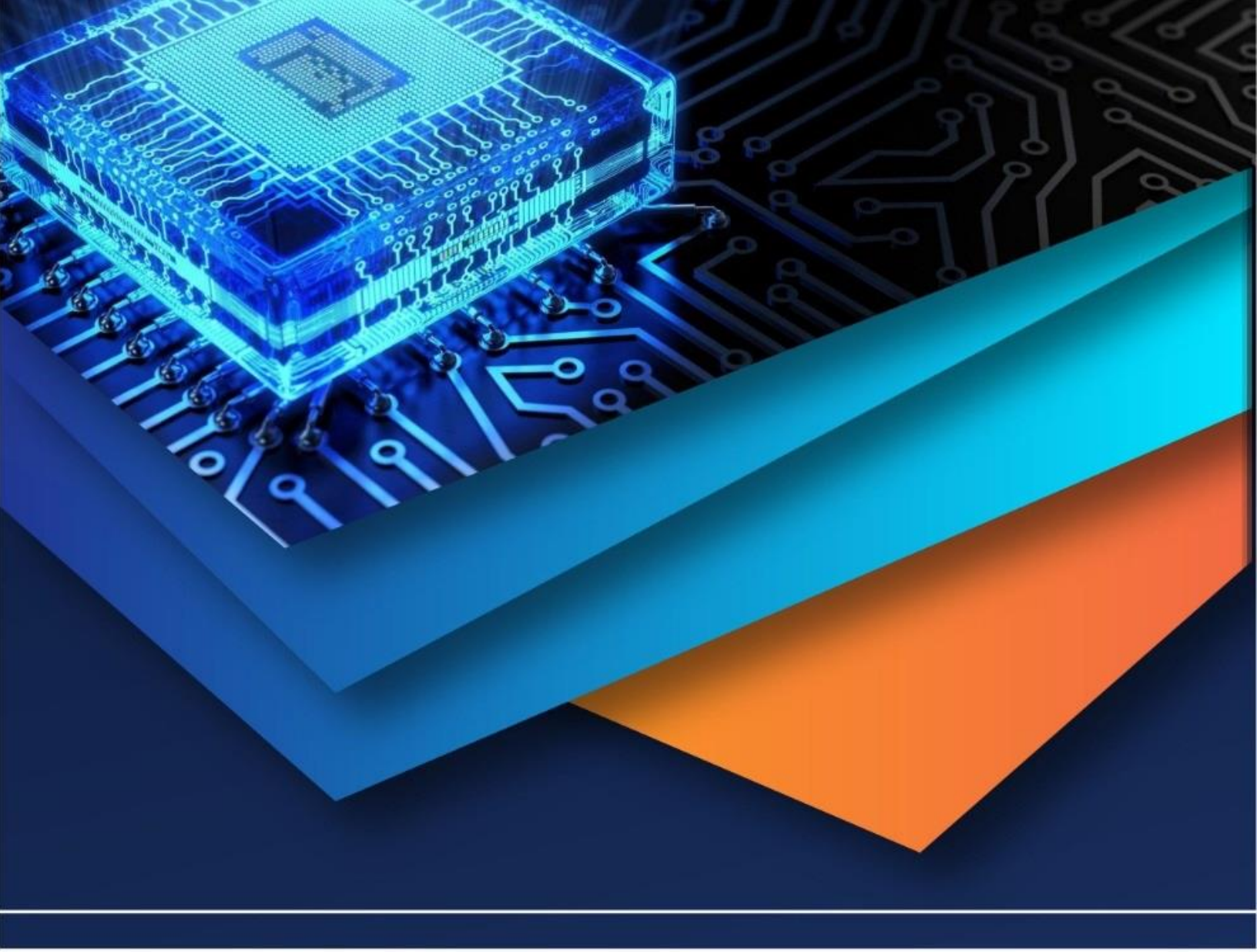
The project also helped in understanding the working of Arduino programming, Bluetooth interfacing, motor drivers, and real-time control systems.

The developed system can further be improved by adding artificial intelligence, obstacle detection, camera modules, gesture control, and IoT features for advanced robotic applications. Overall, the project provides a cost-effective and innovative solution for voice-based robotic control and serves as a strong foundation for future smart robotics systems.

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[3] R. Guptha, S. Agarwal, M. Tiwari P. Srivastava, "Voice Controlled Humanoid Robot Using Embedded Systems for Human-Robot Interaction", published on 22 August 2021.
[4] M. Patel, H, Shah, D. Trivedi N. Desai, “Speech Recognition Based Intelligent Robot for Human Machine Communication” published on 05 November 2018.
[5] Yicheng Yang, Ruijiao Li, Lifeng Wang, Shuai Zheng, Shunzheng Ma, Keyu Zhang, Tuoyu Sun, Chenyun Dai, Jie Ding, and Zhuo Zou, , “Scalable Dexterous Robot Learning with AR-based Remote Human-Robot Interactions”, pp.1-9, 2026.
[6] L.wang, Y. Zhang, H. Chen Q. Liu, "Voice Recognition Controlled Humanoid Robot Using Microcontroller and Servo Motors”, published in 12 September 2022..

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