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Gradient Based Routing Protocol For Modular Robotics

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Abstract: Advancements in microprocessor-based systems have revolutionized robotics, enabling single-robot and multi-robot systems (MRS) to excel in various applications such as search and rescue, forest fire detection, mining, and disaster management. MRS systems amplify robot capabilities, enabling complex tasks and distributed operations. Effective communication between robots is crucial for optimal performance. This paper explores MRS architectures, emphasizing networking issues and required services for enhanced efficiency. It compares MRS systems to mobile ad hoc networks (MANETs), analyzes robot-to-robot (R2R) and robot-to-infrastructure (R2I) communication links, and identifies protocols applicable at different levels of the MRS hierarchy.
Index Terms **– L923 Driver Module, Robosetup, HC05 Bluetooth, NODEMCU, UNO Arduino Board, 9V Battery, Andriod App**

1. INTRODUCTION

Robots that are built in modules have standardised docking interfaces for mechanical, electrical, and communication transfer. The image depicts a possible application. Parallel control and motion are possible because to lattice structures, which include regular three-dimensional patterns like hexagonal or cubic grids. Modules migrate to nearby positions via open-loop motions in lattice designs, simplifying reconfiguration. For systems with greater complexity, the computational representation can scale..

2. RESEARCH METHODOLOGY

The block diagram showcases the integration of various components, including a microcontroller, an L293 driver module, ROBOSETUP, and an HC05 Bluetooth module. The microcontroller, specifically the NODEMCU, assumes a central role by receiving inputs from the L293 driver module, ROBOSETUP, and the HC05 Bluetooth module. The desired output of the microcontroller is voice commands, which will control the system.

To establish this functionality, the NODEMCU must be connected to the board, enabling effective communication and data transfer. The remaining chapters of the document will delve into the hardware and software aspects, providing comprehensive insights and explanations.

These forthcoming sections will delve into the intricacies of the hardware components, detailing their roles, configurations, and interconnections. Likewise, the software elements will be explored, elucidating their significance in facilitating the desired functionalities of the system.

By delving into the hardware parts, readers will gain a comprehensive understanding of the microcontroller's role in processing inputs from the L293 driver module, ROBOSETUP, and the HC05 Bluetooth module. These inputs are crucial for generating appropriate voice commands as the system's output.

Furthermore, the software components will be dissected to illuminate the steps involved in programming the microcontroller and establishing seamless communication with the board. This will encompass exploring coding languages, libraries, and protocols necessary for successful system operation.

Through these chapters, a holistic understanding of the system's inner workings will be fostered, empowering readers to comprehend the interplay between hardware and software components.

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Additionally, potential challenges and troubleshooting techniques will be addressed, ensuring a comprehensive knowledge base for system implementation and maintenance.

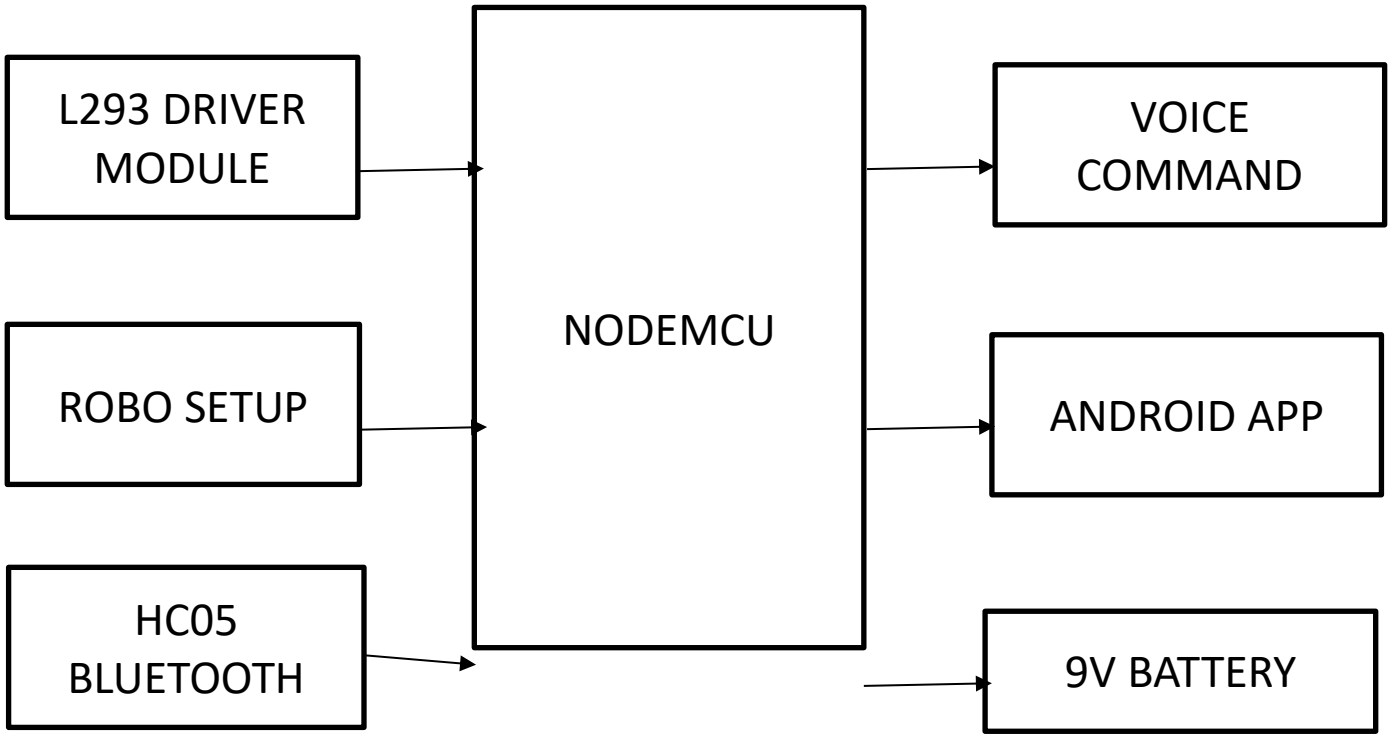

Figure 1: Block diagram of proposed system

2.1 COMPONENTS USED

L293 Driver Module – The L293 driver module is a popular integrated circuit used for controlling DC motors or stepper motors. It can drive two motors bidirectionally and handle up to 1A of current per motor. It operates by receiving control signals to determine the motor direction and speed.

NODEMCU - NodeMCU is an open-source firmware and development board based on the ESP8266 Wi-Fi module. It combines the capabilities of a microcontroller with built-in Wi-Fi, making it ideal for IoT projects. NodeMCU supports Lua scripting language and offers GPIO, PWM, I2C, and UART interfaces for easy connectivity and programming.

HC05 Bluetooth – The HC-05 Bluetooth module is a commonly used wireless communication module. It operates as a slave device and can be paired with a master device, such as a smartphone or computer, to establish a Bluetooth connection. It uses the Serial Port Profile (SPP) to transmit and receive data wirelessly between devices.

9V Battery– A 9V battery typically consists of six smaller 1.5V cells connected in series. When a circuit is connected to the battery, current flows from the positive terminal to the negative terminal, providing a stable voltage of 9V. The chemical reaction inside the battery converts chemical energy into electrical energy, powering devices such as smoke detectors, remote controls, and small electronic devices

Arduino ide– The Arduino IDE (Integrated Development Environment) is a software platform used to program Arduino boards. It provides a user-friendly interface for writing, compiling, and uploading code to the Arduino board. The IDE converts the code written in C or C++ into machine-readable instructions that can be executed by the Arduino microcontroller, enabling users to interact with sensors, actuators, and other peripherals.

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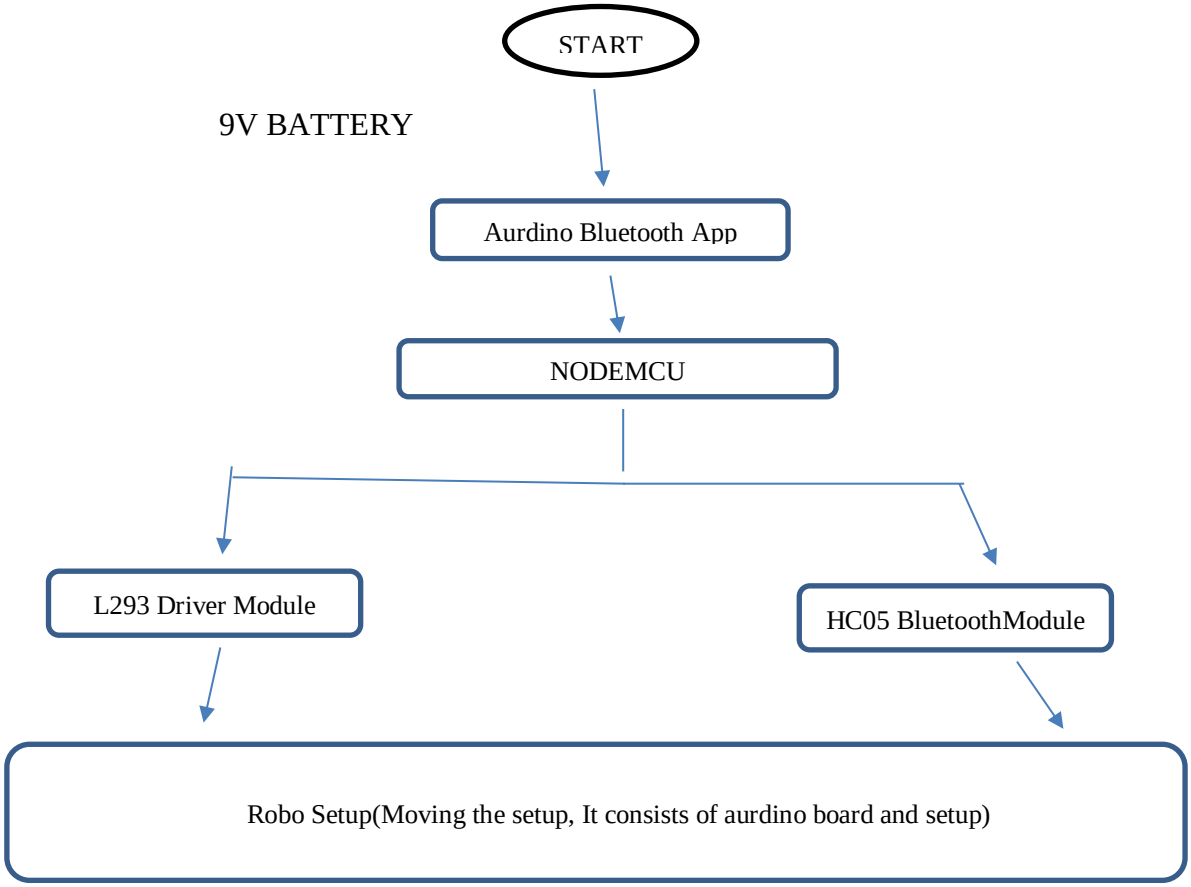
2.2 WORKING

The project aims to control a robotic setup using an Android app through a Bluetooth connection, employing a gradient-based routing protocol for efficient navigation. The system consists of several key components, including the L293 driver module and the NodeMCU board. The L293 driver module serves as an integrated circuit for controlling the robot's DC motors or stepper motors, enabling bidirectional movement and handling up to 1A of current per motor. The NodeMCU board, an open-source firmware and development board based on the ESP8266 Wi-Fi module, combines the functionalities of a microcontroller and built-in Wi-Fi capabilities, making it suitable for IoT applications. It supports the Lua scripting language and provides various interfaces like GPIO, PWM, I2C, and UART for seamless connectivity and programming.

The project also incorporates the HC-05 Bluetooth module, which operates as a slave device, facilitating wireless communication with a master device such as a smartphone or computer. It utilizes the Serial Port Profile (SPP) to establish a Bluetooth connection and transmit data between devices. By integrating the NodeMCU, L293 driver module, and HC-05 Bluetooth module, the system enables seamless communication and control between the Android app and the robot setup. The Android app, known as Arduino Bluetooth Controller, allows users to interact with the system by sending commands through voice or button inputs. These commands, such as moving the robot left, right, forward, or backward, trigger corresponding actions in the robot setup, resulting in responsive and intuitive control. The system's internal functionality lies in the code present on the NodeMCU, which is integrated with the HC-05 Bluetooth module, enabling it to execute commands received from the app and respond accordingly to user inputs.

2.3 FLOW CHART

Figure 2: Flowchart of proposed system



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3. RESULTS

A) Hardware

Figure 3.1: Before driver module is on

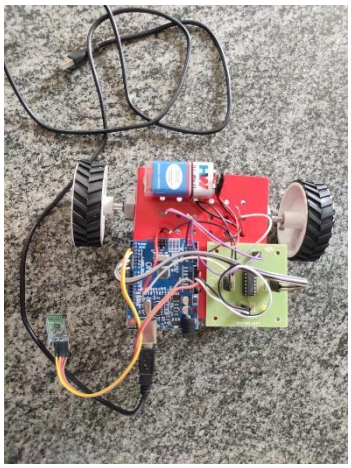

Figure 3.2: After driver module is on

B) Arduino IDE

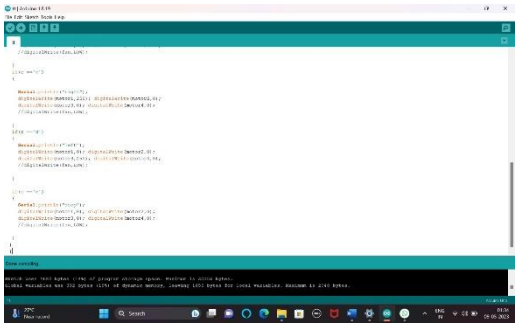

Figure 3.3: Arduino IDE

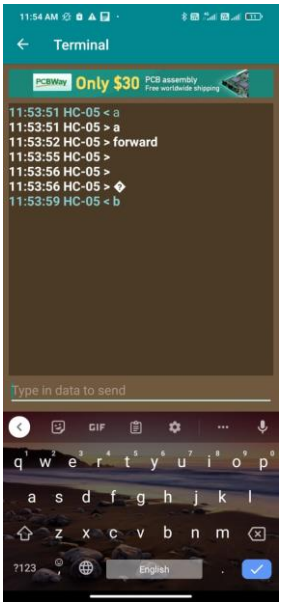

Figure 3.4: Mobile Telnet App Interface

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4. CONCLUSION

Modular self-reconfigurable systems hold tremendous potential for revolutionizing the field of robotics, offering versatility, value, and robustness. They present an opportunity for significant technological advancements and have the potential to bring about a transformative impact on automation. Researchers have been actively addressing numerous challenges associated with these systems.

Although progress has been made, it is evident that several significant challenges remain. This article highlights some of these outstanding issues, presenting them as grand challenges that have been collaboratively identified by a large number of researchers in the field. By doing so, it sheds light on the key directions that will shape the future of this rapidly growing domain.

The pursuit of modular self-reconfigurable systems involves tackling obstacles such as designing efficient reconfiguration mechanisms, addressing scalability concerns, enhancing system adaptability, and developing robust control strategies. Additionally, challenges related to power management, communication protocols, fault tolerance, and system coordination need to be overcome.

To unlock the full potential of modular self-reconfigurable systems, interdisciplinary collaborations, continued research, and technological breakthroughs are essential. By confronting these challenges head-on, researchers aim to pave the way for the widespread adoption of these systems, ushering in a new era of transformative automation and robotics.

5. FUTURE SCOPE

The future scope for this project includes further enhancing the capabilities and functionalities of the modular robotic setup. This can involve integrating advanced sensors and perception technologies to enable the robot to interact with its environment intelligently. By incorporating computer vision, machine learning, or sensor fusion techniques, the robot can navigate complex terrains, detect obstacles, and perform tasks with greater autonomy and efficiency.

Additionally, expanding the range of control options for the Android app can enhance user experience and provide more intuitive control over the robot. This can include implementing gesture recognition, voice commands, or augmented reality interfaces to enable more natural and immersive interactions.

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Maheshwaram Shiva,B.E.from Maturi Venkata Subba Rao Engineering College(MVSR),Osmania University In Electronics and Communication Engineering stream has worked on Fire Fighting Robot