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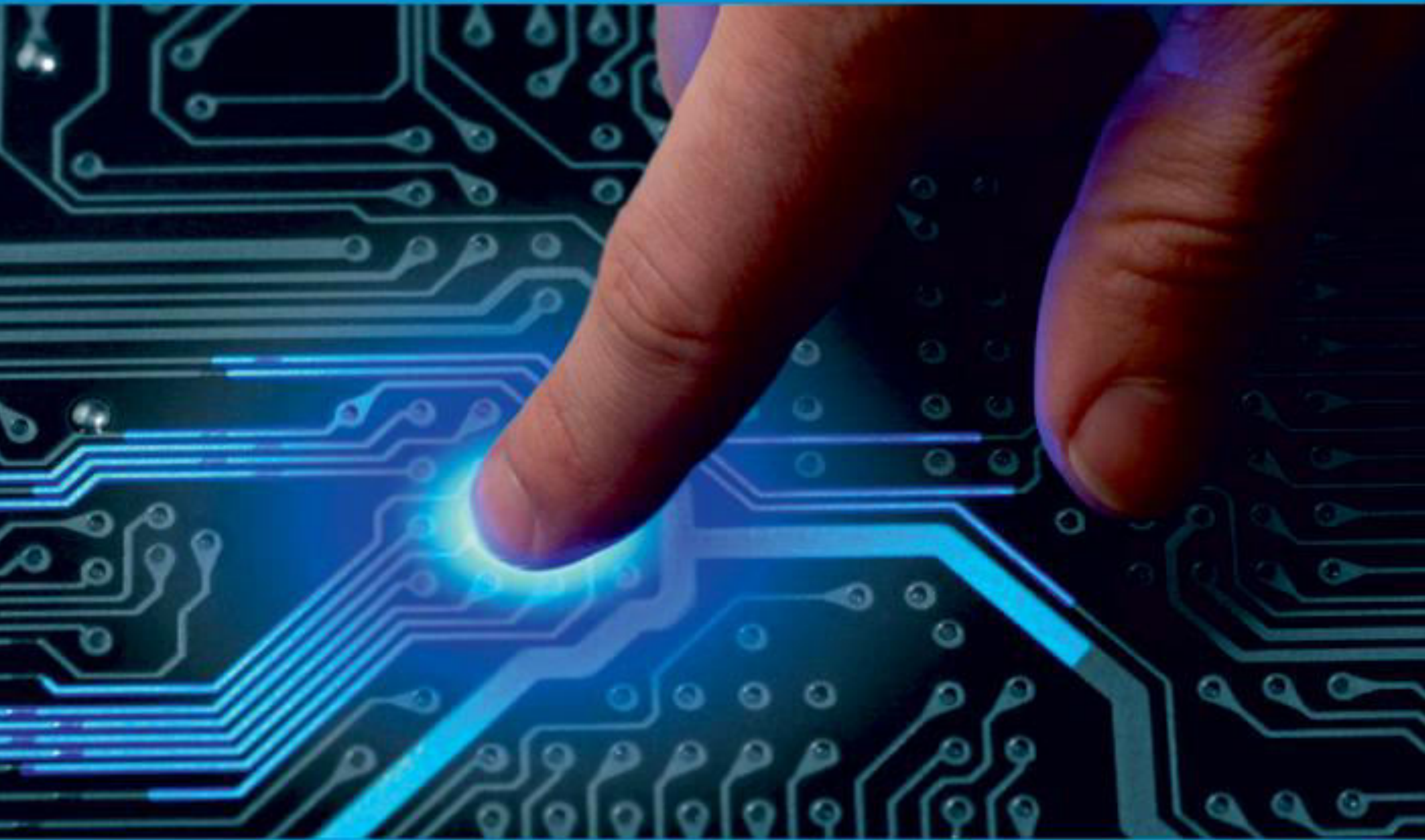

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Floor Cleaning Robot Using Android App

Dharam Chaitanya[1], Dudhade Mahesh[2], Shaikh Minaj[3], Prof. N. S. Sapike [4]

Department of Computer Engineering, Vishwabharati Academy's College of Engineering, Ahmednagar, India[1,2,3,4]

Professor, Department of Computer Engineering, Vishwabharati Academy's College of Engineering, Ahmednagar, India[5]

ABSTRACT: The contemporary household landscape is witnessing a paradigm shift towards enhanced intelligence and automation. The integration of home automation systems not only provides increased convenience but also affords individuals more time for other pursuits. This project endeavors to conceptualize and actualize a Vacuum Robot that operates autonomously and manually through a designated mobile application. The Vacuum Cleaner Robot, utilizing components such as Arduino Mega, Arduino Shield, LDR Sensor, Real-Time Clock, Motor Shield L293D, Ultrasonic Sensor, and IR Sensor, aims to streamline the cleaning process, replacing manual vacuuming with an efficient automated solution. The primary objective of this initiative is to successfully design and implement a prototype Vacuum Robot that adheres to user-friendly criteria outlined in the aforementioned context.

KEYWORDS: Home Automation, Robotic Vacuum Cleaner, LDR Sensor, L293D, Android Phone, Arduino UNO, Floor Cleaning, ESP8266.

I. INTRODUCTION

The modern era has witnessed the pervasive integration of smart machines, commonly known as robots, across diverse domains such as manufacturing, industry, production lines, and healthcare. These intelligent machines are adept at undertaking arduous, hazardous, and precision-demanding tasks, thereby enhancing efficiency and productivity. Unlike their human counterparts, robots operate tirelessly, contributing to 24/7

workflow and achieving unparalleled precision in a significantly reduced timeframe. One prominent application of robots is found in the realm of assistive mobile robotics, where these machines perform a myriad of functions across various sectors, including industry, manufacturing, and healthcare, ultimately aiming to improve human life.

This research seeks to extend the utility of robotics into the domain of household chores, where the potential impact on daily life is significant. Leveraging the capabilities of smartphones, advanced mobile devices equipped with powerful computing platforms, this project integrates hardware and software components to create a collaborative system. The combination includes a microcontroller, motor shield, sensors, an Android application, and a Bluetooth module, establishing a seamless connection between the physical robot and its software control. The design rationale is rooted in the idea of making household tasks, specifically the cleaning process, more accessible through a human-machine collaborative effort, ultimately driven by the efficiency and affordability of smartphone technology.

The transformative power of smartphones in redefining traditional human-machine interactions cannot be overstated. As compact yet potent devices, smartphones have evolved beyond their conventional roles and are becoming instrumental in supporting collaborative activities within communities. The advent of the Android platform has revolutionized mobile application development, opening avenues for technical exploration and innovation. In the context of this project, the Android smartphone serves as a dynamic interface, providing real-time, three-dimensional signal data derived from its built-in 3-axis acceleration sensor. This data, transmitted via a Bluetooth module, facilitates communication with the robotic system, wherein a microcontroller processes the information to execute specific motions. The intersection of robotics and smartphone technology exemplifies a paradigm shift in how we interact with machines, showcasing the potential for enhanced human-machine collaboration in various domains.

II. RELATED WORK

The existing systems in the domain of floor cleaning robots have witnessed significant advancements, yet they are not without their drawbacks. One notable limitation lies in the relatively narrow scope of functionalities offered by many robotic floor cleaners. While there are several options available on the market, a common drawback is the lack of comprehensive features, with only a limited number incorporating wet floor cleaning capabilities. This restricts the versatility of these robots, especially in scenarios where thorough cleaning involving wet surfaces is necessary.

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Another drawback of certain existing floor cleaning robots pertains to their autonomy and adaptability. Some models may lack the sophistication required to navigate complex environments effectively. Issues such as difficulty in avoiding obstacles, inadequate sensing capabilities, or suboptimal mapping mechanisms can hinder the overall efficiency of these systems. As a result, there is a room for improvement in enhancing the autonomy and adaptability of floor cleaning robots to ensure seamless operation in diverse household environments.

Additionally, the existing systems may face challenges related to user interaction and control. The interfaces provided for manual control or adjustments might be less intuitive or user-friendly, impeding the overall user experience. This aspect becomes crucial as user acceptance and ease of interaction play pivotal roles in the successful integration of such robotic systems into everyday household routines.

Moreover, the power efficiency of existing floor cleaning robots is an area that demands attention. While these robots are designed to operate for extended periods, optimizing power consumption remains a concern. Enhancements in energy-efficient components, intelligent power management systems, and advanced battery technologies could contribute to addressing this drawback, ensuring prolonged operational periods without frequent recharging.

In the realm of related work, researchers and developers have explored various sensor technologies, such as infrared sensors and ultrasonic sensors, to enhance navigation and obstacle avoidance capabilities in floor cleaning robots. Some systems integrate machine learning algorithms for improved mapping and decision-making, contributing to more intelligent and adaptable robotic behavior. Collaborative efforts with mobile applications have also been observed, allowing users to control and monitor the robot remotely.

The problem at hand revolves around the inefficiencies and challenges associated with traditional floor cleaning methods, prompting the need for a dedicated solution in the form of a Floor Cleaning Robot. Conventional manual cleaning processes are time-consuming, labor-intensive, and often fall short in achieving optimal cleanliness, especially in hard-to-reach areas. The lack of an automated and intelligent system results in reduced overall cleaning effectiveness, as well as a considerable expenditure of human effort. Additionally, the absence of real-time adaptability to varying floor surfaces and the inability to address diverse types of dirt and debris further exacerbate the limitations of existing cleaning approaches. The aim of this project is to address these issues by developing a sophisticated and autonomous Floor Cleaning Robot that leverages technology, such as sensors and smart navigation algorithms, to optimize cleaning efficiency, coverage, and adaptability to different floor conditions. This innovative solution seeks to streamline the floor cleaning process, enhance user convenience, and ultimately redefine the standards of cleanliness in both residential and commercial settings.

III. PROPOSED METHODOLOGY

The proposed system is centered around a transmitter app running on an Android mobile phone, serving as the user interface for commanding the floor cleaning robot. This app enables users to transmit specific commands based on their input preferences, initiating movement instructions for the robot. The transmitter app functions as a remote control, facilitating seamless communication between the user and the cleaning robot. The utilization of an Android mobile phone as the transmitter not only provides a user-friendly interface but also capitalizes on the device's computing power and connectivity features.

The floor cleaning robot itself is equipped with two cleaning pads and a water sprayer designed for efficient cleaning. Comprising two motorized rotating cleaning scrubs, the robot is adept at tackling various types of dirt and debris. The cleaning mechanism is further enhanced with the inclusion of a water sprayer, contributing to the overall effectiveness of the cleaning process. The robot's design ensures thorough coverage and optimal cleaning performance. The integration of the cleaning pads, rotating scrubs, and water sprayer attests to the versatility of the robot in addressing different cleaning requirements.

The communication between the Android mobile phone and the robot is facilitated through a Bluetooth receiver. Upon receiving movement commands from the transmitter app, the microcontroller within the robot decodes and processes these commands. Subsequently, the microcontroller operates the motors, enabling the robot to execute the desired motion as instructed by the user. The responsiveness of the system allows for real-time control and adjustments, ensuring that the robot adapts swiftly to the user's cleaning preferences.

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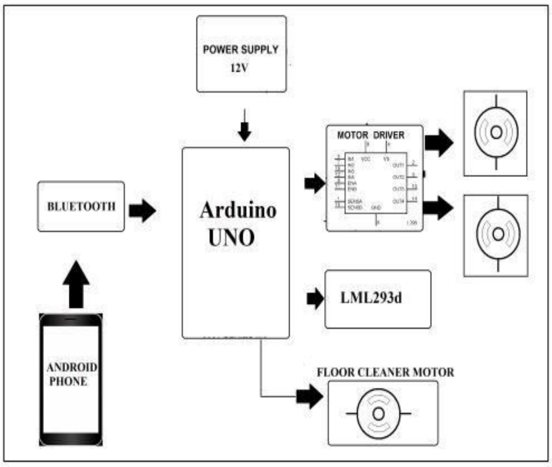

Fig 1. Proposed System Architecture

Notably, the proposed working of the system extends beyond basic movement control. The Android app provides users with the capability to control the sprayer and cleaning mechanism, offering a comprehensive and customizable cleaning solution. This integration of user-controlled functionalities enhances the efficiency and versatility of the floor cleaning robot, making the entire floor cleaning process remarkably easy, fast, and virtually effortless for the end user.

The proposed system involves the design and implementation of an RC car equipped with a vacuum cleaner, integrating advanced features to ensure autonomous and obstacle-avoidant operation. The foundation of the system lies in the installation of four DC motors on the RC car, each connected to wheels to facilitate movement. The motors are meticulously soldered with positive and negative wires, creating a robust and reliable connection. The control of motor speed and direction is achieved through Arduino IDE code, leveraging a motor shield to realize the desired performance. This configuration allows the RC car to navigate with precision and agility based on the instructions embedded in the Arduino code, offering a dynamic and customizable driving experience.

A key innovation in the proposed system is the incorporation of an ultrasonic sensor, strategically placed on the RC car to detect obstacles in its path. This sensor plays a crucial role in preventing collisions with walls, tables, chairs, or any sizable obstacles that may pose a threat to the RC car or its attached vacuum cleaner. When an obstacle is detected, the Arduino code triggers a change in the RC car's direction, ensuring a swift and effective avoidance maneuver. This obstacle avoidance mechanism is vital for preserving the integrity of the RC car and preventing potential damage, especially when navigating through confined spaces or cluttered environments.

The continuous execution of the Arduino code ensures that the RC car operates seamlessly, constantly monitoring its surroundings with the ultrasonic sensor. The cycle repeats at regular intervals, allowing the system to respond promptly to obstacles and navigate through the environment with adaptability. By integrating a vacuum cleaner with obstacle avoidance capabilities, this proposed system offers an innovative solution for automated floor cleaning in varied settings, promising efficiency and safety in its operation.

IV. WORKING MODULE

The proposed methodology involves the integration of various hardware components and technologies to create an innovative floor cleaning robot and an obstacle-avoiding RC car, both controlled by an Android mobile application. The core components include the Arduino Uno board, Bluetooth module, L293D motor driver, four-wheeler robot chassis, and a servo motor for precise control. Additionally, the floor cleaning robot incorporates cleaning pads, water sprayer, and motorized rotating cleaning scrubs, while the RC car integrates ultrasonic sensors for obstacle detection.

The first step in the methodology is to assemble the hardware components for both the floor cleaning robot and the obstacle-avoiding RC car. This includes connecting motors to the Arduino Uno board using the L293D motor driver for controlled movement. The Bluetooth module is integrated to establish wireless communication between the Android mobile application and the robotic systems. The four-wheeler robot chassis provides a stable platform for the cleaning robot, allowing it to move in various directions, while the servo motor ensures precise control for specific tasks.

Next, the Android mobile application is developed to serve as the transmitter for both the floor cleaning robot and the RC car. This application enables users to transmit commands based on their input preferences, activating movement commands and controlling additional functionalities such as the water sprayer and cleaning mechanism. The Bluetooth module facilitates communication between the Android app and the Arduino Uno board, providing a seamless interface for users to interact with the robotic systems.

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For the floor cleaning robot, the Android app transmits movement commands to the Arduino Uno board, which then decodes these commands. The microcontroller on the robot processes the instructions and operates the motors, allowing the robot to achieve the desired motion. Simultaneously, the cleaning pads, water sprayer, and rotating cleaning scrubs are controlled based on user input through the Android app, streamlining the floor cleaning process.

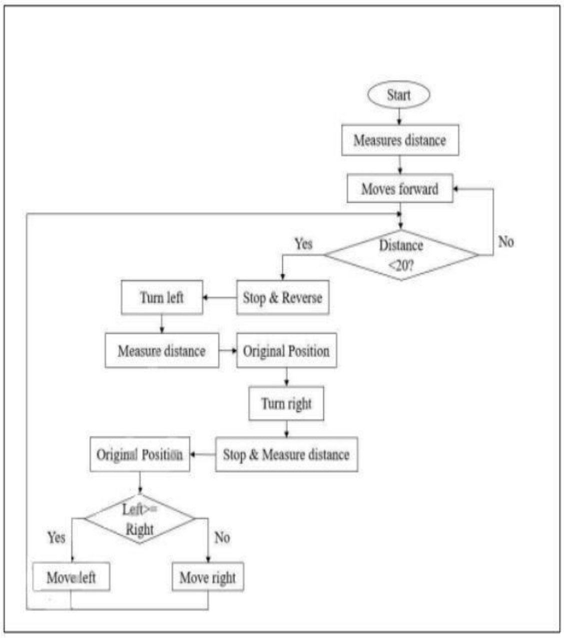

Fig 2. System Flow Diagram

In the case of the obstacle-avoiding RC car, the ultrasonic sensor detects obstacles in the car's path. Upon detecting an obstacle, the Arduino Uno board receives signals from the sensor and triggers a change in the RC car's direction using the motor driver. This continuous cycle of obstacle detection and direction adjustment ensures that the RC car with the attached vacuum cleaner can navigate through the environment without collisions, optimizing safety and efficiency.
In summary, the proposed methodology involves the systematic integration of hardware components, development of an Android mobile application, and utilization of sensors to create versatile and efficient robotic systems. The combination of Arduino-based control, Bluetooth communication, and obstacle detection technologies aims to deliver user-friendly, autonomous, and effective floor cleaning and obstacle-avoidance capabilities.

V. CONCLUSION

In conclusion, the implementation of the Smart Vacuum Cleaner and the obstacle-avoiding RC car showcases an innovative and cost-effective approach to automated floor cleaning. The pre-defined code executed on the Arduino Uno enables the RC car to intelligently navigate and avoid obstacles, while the vacuum cleaner efficiently collects dust without human intervention. The incorporation of a transmitter app for user control, along with features like cleaning pads, water sprayer, and motorized scrubs, enhances the system's versatility. While the vacuum cleaner's simplicity and affordability are highlighted, there is room for improvement, such as incorporating a detachable dust bag for easier dust disposal. Overall, this project demonstrates the potential for automated cleaning solutions to reduce human health hazards and streamline household chores effortlessly.

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