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Smart Vehicle with Voice-Activated Control and Home Automation

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ABSTRACT

The Internet of Things (IoT) connects devices, allowing them to share information and work together. This project uses IoT to create a semi-autonomous lawn mower that combines affordable smart home devices with flexible control options. The mower is a small, self-moving machine that can be operated using either a web application or voice commands. The web app works on Android smartphones, while voice control is enabled through Alexa and an Amazon Tap speaker for hands-free use.

The mower is built with simple hardware like a microcontroller, voice recognition tools, and low-cost sensors. It can move in four directions and has five speed settings, making it easy to adjust for different tasks. Sensors help it avoid obstacles, allowing smooth operation in indoor spaces. Tests showed the mower works reliably indoors, demonstrating how IoT can make everyday tasks easier.

While this version is designed for controlled environments, it opens the door to improvements like outdoor use and more advanced features. By combining home automation with robotics, this project shows how IoT can simplify tasks and improve convenience with technology.

INTRODUCTION

Recent advancements in speech recognition and smart home technology have made voice-activated systems more common and affordable. What was once advanced technology is now a part of everyday devices and homes. This progress has encouraged researchers to explore how voice technology can be used in practical projects, such as semi-autonomous vehicles, for both learning and practical purposes.

This project focuses on developing a voice-controlled vehicle to make learning about robotics easier and more accessible. It provides a simple, hands-on way for students and hobbyists to experiment with voice commands without needing expensive or complicated tools.

The vehicle is a low-cost prototype designed for basic navigation. It moves based on voice commands and uses ultrasonic sensors to detect obstacles, ensuring safety and ease of use. The project demonstrates how affordable, off-the-shelf components can be repurposed to create functional robotics.

To build the vehicle, easily available hardware such as smart speakers, ultrasonic sensors, motors, microcontrollers, and processors are used. These parts keep costs low and make the construction process straightforward, making it an ideal project for beginners and learners.

The finished vehicle shows how voice commands can control movement and how sensors can prevent collisions. This project highlights how everyday technology can be used to create low-cost, practical prototypes, opening the door to more research and innovation in robotics.

LITERATURE SURVEY

The concept of integrating voice commands into robotic and autonomous systems has seen significant advancements over the years. The paper *"Voice Activated Semi-Autonomous Vehicle Using Off the Shelf Home Automation Hardware"* (2018) by Solorio et al., explores the use of affordable, readily available smart home devices to create a partially voice-controlled vehicle. The study emphasizes practical and cost-effective approaches to enhance driving convenience and safety, leveraging common technologies like smart speakers to perform basic vehicle tasks through voice activation. Similarly, Dudeja and Kharabanda's *"Voice Controlled Robot"* (2014) focuses on speech recognition technology to enable intuitive human-robot interactions. This research highlights its potential applications in healthcare, manufacturing, and home automation, while also addressing challenges such as noise interference and accurate command interpretation.

Further extending these concepts, *"Autonomous Vehicle Navigation and Control Using Voice Commands and IoT Sensors"* (2021) investigates combining voice commands with IoT-enabled sensors for autonomous navigation. This integration allows vehicles to process real-time environmental data, improving adaptability and safety. Lastly, the report *"The Internet of Things: Mapping the Value Beyond the Hype"* (2015) by McKinsey Global Institute underscores the transformative impact of IoT across various sectors, emphasizing its ability to enhance efficiency, optimize resources, and enable predictive maintenance. Together, these studies illustrate the growing synergy between voice control, automation, and IoT technologies, paving the way for more accessible and interactive systems in robotics and autonomous vehicles.

METHODOLOGY

Platform Selection:

The Black & Decker CM1836 electric lawnmower was chosen for this project because it is well-suited for automation and electrical upgrades. This readily available model was ideal due to its electric power system, which made it easy to add new components with minimal changes.

The mower's electric system provided a convenient power source, allowing the team to focus on adding semi-autonomous features without major modifications. This made the development process simpler and more efficient.

One key advantage of the CM1836 is its dual electric motors, which power the mower's movement, along with a separate motor for the cutting blade. This made it a practical choice for building an automated system.

Its compact and lightweight design made it easier to adapt for semi-autonomous functions. The electric powertrain also reduces noise and emissions compared to gas-powered mowers, aligning with the project's goal of creating an eco-friendly and efficient solution. The simple electrical layout further streamlined the integration of sensors, microcontrollers, and actuators needed for automation.

Using this mower saved time and effort while showing how existing equipment can be upgraded for more advanced applications.

Power System Design:

The project's power system uses three 12V batteries connected in series to produce a total of 36V. This setup was chosen because it provides a reliable power source for the vehicle and ensures smooth operation. By connecting the batteries in series, the system could meet the voltage needs of key components like the blade motor and propulsion system.

The 36V power was mainly used to run the blade motor, which requires more energy for mowing. The propulsion motors, however, operated on 24V, which was also supplied by the same 36V battery system. This shared power setup made the design simpler and more efficient, reducing the need for extra parts.

This power system ensured enough energy for all components while optimizing performance by balancing power distribution. Using a single battery system for both high and low voltage needs made the design less complex and more reliable, minimizing the chance of failures.

The choice of 12V batteries, which are affordable and easy to find, also made the project cost-effective. These batteries are simple to replace or upgrade, ensuring the system remains usable over time. Overall, this carefully planned power setup created an efficient and practical way to power the semi-autonomous lawnmower.

Cloud-Based Command Processing:

The project used a cloud-based system to process voice commands sent from a smart speaker, turning them into clear instructions for the vehicle. This setup made it easy for users to control the vehicle using voice commands, which were quickly processed and sent back to the vehicle for execution.

The vehicle's controller was programmed to carry out these commands by converting them into movements and actions. An Amazon Tap speaker with Alexa acted as the voice interface, allowing users to operate the vehicle through any Alexa-enabled device. This made the system convenient and user-friendly.

The vehicle maintained constant communication with the cloud to ensure it could respond quickly and reliably to user commands. By frequently checking the cloud for new instructions, the vehicle was able to react in real time to voice inputs.

Using cloud-based processing made the system more flexible and powerful. Since commands were processed in the cloud, the vehicle's onboard hardware didn't need to handle complex tasks. This reduced the workload on the vehicle's systems, allowing for a simpler design while keeping performance fast and accurate.

The cloud-based approach also made it easy to update or improve the system. Any changes could be made in the cloud without modifying the vehicle's hardware. Additionally, this method lowered the vehicle's power and processing needs, as it only needed to focus on executing commands, not interpreting them. Overall, this design ensured an efficient, reliable, and easy-to-use voice-controlled vehicle.

Obstacle Avoidance:

Obstacle avoidance in a semi-autonomous vehicle uses different types of sensors, such as ultrasonic, infrared, or LIDAR, to detect objects nearby and measure how far they are from the vehicle.

The vehicle's control system processes this sensor information in real time to spot obstacles in its path. Based on this data, the system decides whether to adjust the vehicle's speed or change its direction to prevent a collision. The sensor data is fed into navigation algorithms that help the vehicle make decisions, like slowing down, turning, or stopping, to avoid obstacles. This improves the safety and efficiency of the vehicle's movement.

The obstacle avoidance system helps the vehicle navigate safely in various environments by continuously monitoring its surroundings. As the vehicle moves, the sensors detect any objects in its path, allowing the system to react instantly. This ensures that the vehicle can adjust its course on the fly, preventing accidents and allowing it to maneuver through tight or cluttered spaces.

By integrating these sensors with the vehicle's control system, the vehicle becomes more adaptable to different situations. Whether it encounters a small obstacle or needs to make a sudden stop, the obstacle avoidance system ensures it can handle the challenges, improving both its performance and safety in real-world conditions.

RESULTS

Vinyl Floor Tests:

The lawn mower performed well on the vinyl floor, which provided minimal friction for the omnidirectional wheels. Average speeds for a 5-meter distance were as follows:

- 1st speed: 21.5 m/min
- 2nd speed: 33.5 m/min
- 3rd speed: 36.9 m/min
- 4th speed: 42.2 m/min
- 5th speed: 44.8 m/min

4.2 Concrete Floor Tests:

On the concrete floor, the mower moved slower due to more friction. However, it was still able to move in all directions. Average speeds on concrete were:

- 1st speed: 10.0 m/min
- 2nd speed: 13.6 m/min
- 3rd speed: 17.4 m/min
- 4th speed: 28.1 m/min
- 5th speed: 35.0 m/min

4.3 Grass Soil Tests:

Tests on grass were the most challenging. The mower consumed more energy due to the activated blade and struggled to move smoothly. Average speeds on grass were:

- 1st speed: 7.1 m/min
- 2nd speed: 8.7 m/min
- 3rd speed: 13.6 m/min
- 4th speed: 25.1 m/min
- 5th speed: 27.0 m/min

4.4 Obstacle Detection Tests:

- The mower consistently stopped at an average distance of 7.3 cm from obstacles across all surfaces (vinyl, concrete, grass).
- The shortest stopping distance was 1.0 cm, and no collisions occurred during the tests.
- Speed did not affect the obstacle detection system, as results were consistent regardless of surface type.

In summary, the mower performed best on the vinyl floor, moved slower on concrete, and faced challenges on grass due to increased energy demands. The obstacle detection system worked reliably across all surfaces.

CONCLUSION

This project successfully created a voice-controlled, semi-autonomous utility vehicle using common home automation parts and open-source electronics. At its heart is a low-power, cost-effective 32-bit processor, perfect for real-time tasks, while the Particle Photon microcontroller allows smooth communication with other devices like Arduinos, PLCs, and FPGAs. The project also pushes forward the Internet of Things (IoT) by enabling cloud-based control, an area still being explored in semi-autonomous vehicles. The vehicle, controlled by Alexa voice commands, showed reliable performance on different surfaces like vinyl, concrete, and grass, and its ultrasonic sensors provided effective collision avoidance during tests.

Besides its functional abilities, the project demonstrates the potential of using home automation components in more advanced systems like semi-autonomous vehicles. By using open-source electronics and easily available hardware, the design is both affordable and accessible to hobbyists and engineers. The integration of Alexa voice control adds convenience, allowing users to operate the vehicle hands-free, which is useful in situations that require multitasking. The ultrasonic sensors for collision avoidance make the vehicle safer and more reliable, allowing it to move autonomously in various environments. This approach not only makes the technology more practical for everyday use but also opens up possibilities for future advancements in home automation and IoT-powered vehicles.

Additionally, the project shows how easily home automation technologies can be adapted for more complex and practical applications like autonomous vehicles. The combination of accessible components, such as smart speakers and sensors, with open-source electronics, makes it possible for anyone with basic knowledge of these technologies to experiment and build their own semi-autonomous systems. This accessibility encourages innovation and could inspire further exploration into integrating IoT with robotics in everyday life.

The use of cloud-based control and Alexa voice integration also highlights the growing potential of remote and hands-free operation in various settings. As more devices become connected through the IoT, systems like this project can offer practical solutions for automating tasks in environments such as homes, gardens, or even small businesses. The project not only demonstrates the feasibility of IoT-enabled vehicles but also sets the stage for future enhancements, such as improved navigation systems, better obstacle detection, and more advanced cloud capabilities.

REFERENCES

1. Dudeja, K., & Kharabanda, (2014), “A. Voice Controlled Robot”. Journal of The International Association of Advanced Technology and Science. Vol. 15, September 2014, ISSN-3347-4482.
2. J. Manyika, M. Chui, P. Bisson, J. Woetzel, R. Dobbs, and D. Aharon, "The Internet of Things: Mapping the Value Beyond the Hype," McKinsey & Company, Jun. 2015. [Online]. Accessed: Feb. 28, 2017.
3. J. Gubbi, R. Buyya, S. Marusic, and M. Palani swami, "Internet of things (IoT): A vision, architectural elements, and future directions," Future Generation Computer Systems, vol. 29, no.7, pp. 1645–1660, 2013.
4. F. Xia, L. T. Yang, L. Wang, and A. Vinel, "Internet of things," International Journal of Communication Systems, vol. 25, no. 9, pp. 1101–1102, 2012.