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AUTONOMOUS BUOYANT FOOD DELIVERY ROBOT FOR EMERGENCY SITUATIONS

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ABSTRACT

This paper presents the design and implementation of an Autonomous Buoyant Food Delivery Robot specifically engineered to operate effectively in such emergencies. The robot is equipped with advanced navigation and obstacle avoidance systems, enabling it to traverse challenging terrains and navigate through debris or flooded areas. Its buoyant design allows for seamless operation in waterlogged environments, ensuring that food and supplies can reach those in need, regardless of the surrounding conditions.

INTRODUCTION

we propose the development and deployment of the Rescue Bot, an innovative autonomous buoyant food delivery robot specifically designed to operate efficiently in emergency situations.

The Rescue Bot is equipped with advanced ultrasonic sensors that enable precise obstacle detection and navigation, allowing it to traverse complex environments, including flooded areas and debris-laden landscapes. This capability ensures that food and supplies reach those in need, regardless of the surrounding conditions. The robot is designed to carry a variety of food packages, featuring built-in thermal insulation to maintain the appropriate temperatures for both hot and cold meals, thereby preserving food quality and safety during transit.
At the heart of the Rescue Bot is a powerful battery node and a microcontroller unit (MCU) that facilitate efficient energy management and seamless operation. The robust communication system ensures continuous connectivity with a central command center, allowing for real-time updates on the robot's status and dynamic route adjustments based on changing conditions or emerging needs. Furthermore, the user-friendly interface is designed to be accessible and operable by non-experts, broadening the robot's applicability across diverse emergency scenarios and enabling rapid deployment by first responders and volunteers.
This paper will also examine actions previously taken in various nations to address food delivery challenges during emergencies, providing context for the development of the Rescue Bot. By leveraging advanced technology, including ultrasonic sensing, efficient battery management, and innovative navigation features, the Rescue Bot aims to enhance disaster response efforts, improve the efficiency of humanitarian aid delivery, and ultimately save lives in critical situations.

COMPONENTS USED

- **ARDUINO UNO**
- **ULTRASONIC SENSOR**
- **GEAR MOTOR**
- **LEAD ACID BATTERY**
- **RELAY**

LITERATURE SURVEY

In the rapidly evolving field of robotics, the application of autonomous robots for food delivery during emergencies has garnered significant attention from researchers and practitioners alike. This literature survey highlights key studies that explore the efficiency, effectiveness, and potential applications of these robots in various emergency scenarios.

One notable study conducted by researchers at Politecnico di Milano investigates the use of autonomous robots for food delivery, focusing on simulation models and order allocation strategies. This research provides valuable insights into the operational dynamics of deploying these robots in diverse scenarios, emphasizing their ability to optimize delivery routes and enhance service efficiency during critical situations. The findings suggest that autonomous robots can significantly reduce delivery times and improve resource allocation, making them a viable solution for emergency food distribution.

Another important investigation, published in the International Journal of Consumer Studies, examines consumer acceptance of autonomous delivery robots. This study underscores the advantages and challenges associated with using robots for meal and package delivery, particularly in emergency situations. The research highlights factors influencing consumer trust and willingness to adopt robotic delivery systems, emphasizing the need for effective communication and transparency in operations to enhance public acceptance.

Significant advancements have also been made in the design and implementation of autonomous robots specifically tailored for hospital settings. For instance, the development of the TransBot illustrates how autonomous robots can ensure safe and efficient food delivery in hospitals, especially during flood situations. This study emphasizes the critical role these robots can play in maintaining isolated environments, reducing human contact, and ensuring that patients receive timely nourishment, thereby enhancing overall healthcare delivery during emergencies.

Research focusing on enhancing the resilience of e-grocery delivery networks with autonomous delivery robots offers a comprehensive view of the challenges and solutions for utilizing these robots during unforeseen events. This study addresses the issue of unfulfilled customer demands and explores strategies to bolster the resilience of delivery networks in emergency conditions. By analyzing various operational scenarios, the research provides actionable insights into how autonomous robots can mitigate disruptions and maintain service continuity during crises.

Additionally, a review article on autonomous last-mile delivery robots presents an extensive overview of current research in the field. This review showcases the potential of these robots in urban and suburban areas, discussing their benefits and limitations across various delivery scenarios, including emergency response. The article highlights the technological advancements that have enabled the deployment of autonomous robots and identifies key areas for future research, such as improving navigation systems and enhancing interaction with users.

In summary, the literature indicates a growing recognition of the potential for autonomous robots to transform food delivery in emergency situations. Through various studies, researchers have demonstrated the operational benefits, consumer acceptance challenges, and design considerations necessary for successful implementation. As the field continues to evolve, further research will be essential to address existing limitations and fully realize the capabilities of autonomous robots in enhancing emergency response efforts.

ARDUINO UNO

The Arduino uno is an open-source microcontroller which is utilized to control all the devices. The microcontroller board is furnished with sets of advanced and simple information and results ticks that might be communicated to different development sheets and other circuits. The board has 14 info pins and 6 simple info pins. it acknowledges the voltages somewhere in the range of 7 and 20 volts.

ULTRASONIC SENSOR

Ultrasonic sensors are devices that use electrical mechanical energy transformation to measure distance from the sensor to the target object. The

send and get ultrasonic heartbeats that hand-off back data about an item's proximity. In our undertaking ultrasonic sensor used to recognize the article distances utilizing ultrasonic waves and directions to the regulator. Apart from the they are also used in ultrasonic material testing (to detect cracks, air bubbles, and other flaws in the products), Object detection, position detection, ultrasonic mouse, etc.

GEAR MOTOR

Geared motors for robotics applications. Very easy to use and available in standard size. Nut and threads on shaft to easily connect and internal threaded shaft for easily connecting it to wheel. This setup allows the motor to deliver more power to a load with less energy consumption. Gear motors automation, robotics, automotive, and medical equipment.

LEAD ACID BATTERY

A lead-acid battery is an electrical storage device that uses a reversible chemical reaction to store energy. It uses a combination of lead plates or grids and an electrolyte consisting of a diluted sulphuric acid to convert electrical energy into potential chemical energy and back again. The electrolyte of lead-acid batteries is hazardous to your health and may produce burns and other permanent damage if you come into contact with it. When car batteries spend considerable durations of time in their discharged states, the lead sulfate build-up may become extremely difficult to remove. This is the reason why lead-acid batteries must be charged as soon as possible (to prevent the building up of lead sulphate).

Node MCU ESP8266 ESP-12E

Node MCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espress if Systems, and hardware which

based on the ESP-12 module. The term “Node MCU” by default refers to the firmware rather than the Dev Kit. The firmware uses the Lua scripting language. It is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson, and spiffs.

METHODOLGY

- Requirements for the robot, focusing on its buoyancy, navigation capabilities, and food delivery features.

Mechanical Design:

- Create a buoyant chassis using lightweight, waterproof materials to ensure stability and durability in waterlogged environments.
- Design compartments for food storage with thermal insulation to maintain temperature.

Electronic Design:

- Integrate ultrasonic sensors for obstacle detection and navigation.
- Select a microcontroller unit (MCU) for processing sensor data and controlling the robot's movements.
- Design a battery management system to optimize power consumption

- Assemble the mechanical and electronic components, ensuring proper sealing to maintain buoyancy.

Programming:

- Develop software for the MCU to handle navigation algorithms, sensor data processing, and communication with the command center.

Expected Battery Life:

- Under typical operating conditions, the Rescue Bot is designed to achieve a battery life of approximately 8-12 hours, depending on the load and environmental conditions. This duration allows for multiple delivery missions before requiring a recharge.

EXPERIMENTAL VALIDATION

Thermal Insulation Testing
Setup: Prepare food items at specific temperatures (e.g., hot meals at 70°C and cold meals at 5°C).

The experimental validation of the Autonomous Buoyant Food Delivery Robot was successfully completed, demonstrating its effective navigation capabilities, efficient thermal insulation for food delivery, and satisfactory battery life. User testing confirmed the interface's ease of use for non-expert operators, validating the robot's readiness for deployment in emergency situations.

COMPARSION WITH EXIST
Primary Use Case →General food delivery in urban environments | Emergency food delivery in disaster-stricken-areas
Terrain Adaptability →
Limited to paved roads and sidewalks | Designed to navigate flooded areas and rough terrain
Buoyancy →Not designed for water navigation | Buoyant design allows operation in waterlogged conditions
Obstacle Detection → Basic obstacle avoidance using cameras or LIDAR | Advanced ultrasonic sensors for precise navigation and obstacle avoidance **Thermal Insulation →** Limited or no

thermal management for food | Built-in thermal insulation to maintain food temperature during transit

CommunicationSystem → Standard GPS and communication protocols | Robust communication system for real-time updates and dynamic route adjustments

User Interface → Typically designed for tech-savvy users | User-friendly interface accessible to non-experts **Battery Life**→ Varies widely, often limited by urban delivery routes | Designed for extended battery life (8-12 hours) to cover multiple deliveries in emergencies

Deployment Speed → Quick deployment in urban settings | Rapid deployment in emergency situations, adaptable to changing conditions |**Operational Environment** → Urban and suburban areas with established infrastructure | Operates effectively in chaotic and unpredictable environments, such as disaster zones .

ADVANTAGES

- **Safety:**

Robots can enter hazardous areas where it is too dangerous for humans, such as zones affected by chemical spills, fires, or structural instability. This helps to protect human responders from

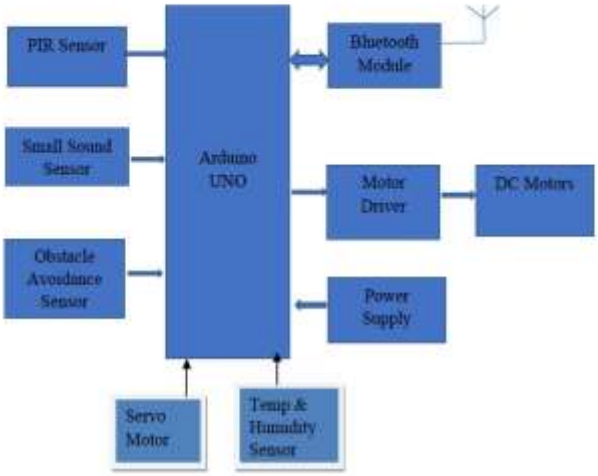
- **Speed and Efficiency**:

Robots can navigate through debris, tight spaces, and complex terrains more quickly than humans, ensuring that food and supplies are delivered rapidly to those in need.

- **Consistency**:

Unlike human responders who may tire or require breaks, robots can work continuously, ensuring a steady supply of essentials to affected individuals.

BLOCK DIAGRAM



BILL OF MATERIALS

1 Arduino	1,100
2 Gear motor - 2	900
3 Ultrasonic sensors	110
4 Node MCU	1000
5 Wheels	150
6 Motor driver	300
7 Lithium Battery	1800
TOTAL	3300

UTURE SCOPE

The development and implementation of Autonomous Buoyant Food Delivery Robots (Rescue Bots) for emergency situations present numerous opportunities for future research and innovation. As the field of robotics continues to evolve, several key areas can be explored to enhance the capabilities and effectiveness of these robots in disaster response and humanitarian aid. The following outlines the future scope for this technology:

1. Advanced Navigation and Sensing Technologies

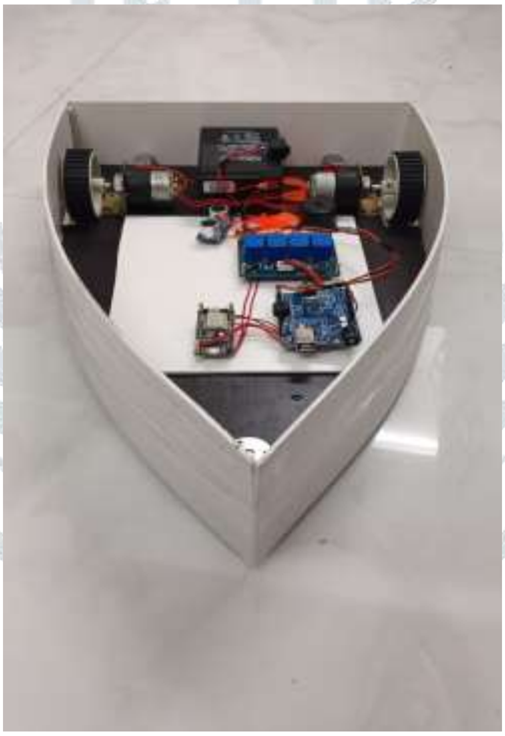
- **Improved Sensor Integration**: Future research can focus on integrating advanced sensors, such as LIDAR, infrared, and computer vision, to enhance the robot's ability to navigate complex environments and improve obstacle detection in real-time.

- **AI and Machine Learning**: Implementing AI algorithms can enable the robot to learn from its environment, adapt to changing conditions, and optimize delivery routes dynamically based on real-time data.

2. Enhanced Communication Systems

- **Robust Communication Networks**: Developing more resilient communication systems that can function in areas with limited connectivity will be crucial. This may include mesh networking or satellite communication to ensure continuous operation during emergencies.
- **User Interaction**: Future work can focus on improving the user interface and interaction capabilities, allowing for better communication between the robot and operators, as well as with the affected individuals receiving aid.

HARDWARE MODEL



OUTPUT

This is the equipment model of our venture. This will detect the humans who are suffering from the emergency situation like flood.It will detect by sensor and reach the person to deliever the food.

CONCLUSION

The implementation of food delivery robots in emergency situations represents a significant advancement in disaster response and humanitarian aid. These robots offer a blend of efficiency, safety, and reliability that is crucial during crises. By utilizing advanced navigation systems, robust communication capabilities, and autonomous operation, these robots can navigate hazardous environments and ensure timely delivery of essential supplies to affected individuals.

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