AUTONOMOUS RIVER DEPTH PLOTTING ROBOT TO PREVENT DROWNING ACCIDENTS IN TOURIST AREA

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Introduction:

Rivers and other water bodies often require frequent depth surveying to assess navigability, detect hazards, and monitor environmental changes. Traditional depth mapping and surveying methods are labour - intensive, time-consuming, and may present risks to survey personnel. The Autonomous GPS-Guided River Depth Plotting System is a project designed to address these challenges by automating the depth mapping process. Utilizing GPS-based navigation, compass orientation, and sonar technology, this system offers an efficient, autonomous solution for mapping river depths and identifying sudden depth variations, which are essential for safe navigation and effective waterway management. The system employs an autonomous boat equipped with a GPS module for location tracking and a compass module for accurate directional alignment. The boat follows user-defined waypoints provided through a one-time setup, where the coordinates are transmitted via Bluetooth from a mobile device. Once initialized, the boat navigates the river autonomously, continuously collecting depth measurements with an underwater sonar sensor.

Objectives:

- 1. Develop an autonomous boat capable of following pre-set GPS coordinates to navigate specific river areas for depth mapping.
- Enable seamless waypoint entry via Bluetooth from a mobile application, allowing users to input coordinates at the beginning of each operation.
- Use a GPS module and compass for accurate location tracking and directional control, ensuring the boat follows the designated path.
- Implement an anomaly detection system to identify sudden depth changes and potential underwater hazards during navigation.
- Enable the system to log the GPS coordinates of detected anomalies and transmit them instantly to the user's mobile app.
- Provide an efficient, low-cost, and user-friendly solution for safe, autonomous river surveying with minimal human intervention.

Methodology:

The *Autonomous GPS-Guided River Depth Plotting System* operates as an independent, unmanned survey boat designed to efficiently map river depths and detect underwater hazards. The system begins with a one-time setup where the user enters specific waypoint coordinates into a mobile application, which communicates with the boat via a Bluetooth module. Once the coordinates are set, the boat's navigation is fully autonomous. It uses a GPS module to determine its location and a compass module for directional control, enabling it to accurately follow the user-defined path**.**

When a significant depth anomaly is detected, the system logs the exact GPS coordinates of the dip and instantly sends this information to the mobile application, allowing users to take immediate action if necessary. This autonomous depth plotting system minimizes the need for human intervention, providing a reliable and efficient tool for hydrographic surveys, environmental monitoring, and navigation safety. The

integration of autonomous navigation and real-time depth anomaly alerts makes it an effective solution for managing and accessing river and waterway conditions.

Results and Conclusions:

The Autonomous GPS-Guided River Depth Plotting System represents a significant advancement in the methodology of underwater surveying and hazard detection. By leveraging modern technologies such as GPS, sonar sensors, and Bluetooth communication, this system provides an efficient, automated approach to mapping river depths while enhancing safety and reducing the reliance on manual labor. The ability to autonomously navigate predefined coordinates and detect sudden depth anomalies in real-time addresses critical challenges faced in traditional surveying methods, particularly in hazardous or inaccessible water environments.

As the project progresses, the potential for future enhancements—such as advanced obstacle detection, machine learning integration, and expanded environmental monitoring capabilities offers exciting opportunities for innovation. These developments could significantly broaden the applications of the system, positioning it as an essential tool for hydrographic surveying, environmental protection, and waterway management. Overall, the proposed system holds great promise for improving safety, efficiency, and data accuracy in underwater surveying practices, paving the way for smarter and more sustainable water resource management.

Project Outcome & Industry Relevance:

This project has wide-ranging applications across multiple industries and sectors:

Environmental Monitoring

- Helps government and environmental bodies monitor river ecosystems.
- Supports initiatives for water conservation and quality control.

Disaster Management & Early Warning Systems

- Plays a crucial role in flood risk assessment and mitigation strategies.

- Supports disaster preparedness agencies in issuing timely warnings and evacuation orders.

Agriculture and Irrigation

- Provides valuable data for planning irrigation schedules and water resource management.
- Helps mitigate the effects of drought or excessive rainfall on crops.

Urban Planning and Infrastructure

- Assists civil engineers and planners in designing infrastructure like bridges, dams, and drainage systems.
- Informs risk assessments for riverside developments.

Hydropower & Water Transport

- Aids hydropower plants in managing water flow and reservoir levels.
- Enhances navigation safety for boats and ferries operating in variable-depth rivers.

Working Model vs. Simulation/Study:

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Project Outcomes and Learnings:

- Hydrographic surveying for waterway navigation.
- Environmental monitoring of rivers, lakes, and reservoirs.

- Mapping riverbeds for erosion and sedimentation analysis.
- Detection of submerged hazards for maritime safety.
- Depth mapping in restricted or hazardous water regions.
- Flood risk assessment and modelling of riverbanks.
- Underwater structure inspection for infrastructure projects.
- Support for aquatic habitat studies in ecological research.
- Real-time monitoring for disaster response and mitigation.
- Mapping water channels for agricultural and irrigation planning.

Future Scope:

- **Advanced Obstacle Detection**: Integrating additional sensors (e.g., LiDAR, cameras) to enhance obstacle detection capabilities, improving navigation in complex environments.
- **Machine Learning Integration**: Utilizing machine learning algorithms to analyse depth data, predict underwater hazards, and optimize survey routes based on historical data.
- **Expanded Communication**: Implementing satellite communication systems for real-time data transmission in remote areas where cellular connectivity is weak.
- **Autonomous Docking and Charging**: Developing a self-docking mechanism for automatic charging, allowing extended operational time without manual intervention.
- **Multi-Boat Coordination**: Creating a fleet of autonomous boats that can communicate and collaborate to perform large-scale surveying tasks efficiently.
- **3D Mapping Capability**: Upgrading sonar systems to provide 3D mapping of underwater terrains, offering more detailed insights into riverbed structures and features.

- **Environmental Monitoring Enhancements**: Adding additional sensors for monitoring water quality (e.g., temperature, turbidity, dissolved oxygen) to provide comprehensive environmental data alongside depth measurements.

- **User-Friendly Interface Improvements**: Enhancing the mobile application with features such as live tracking, historical data visualization, and customizable alert settings for a better user experience.

- **Cloud Data Storage**: Implementing cloud-based data storage solutions for easier access, sharing, and analysis of collected data across multiple devices.

- **Regulatory Compliance and Safety Features**: Developing features that ensure compliance with maritime regulations and enhance safety measures, such as GPS geofencing to prevent the boat from straying into restricted areas.