Advanced human rescue water robot: A Survey on IoT-Based Techniques for aquatic rescue assistance

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ABSTRACT

This survey paper provides a detailed study on the development and implementation of Human Rescue Water Robots (HRWR) that are designed to assist during aquatic emergencies such as drowning or flood situations. The Human Rescue Water Robot is a manually or remotely operated floating device capable of reaching victims in distress and providing immediate support until rescue teams arrive. Unlike fully autonomous underwater robots, HRWR focuses on surface-level operation, where it offers floating assistance and location tracking rather than automatic detection or retrieval. The robot utilizes Internet of Things (IoT) technologies, including GPS tracking and wireless communication, to enable monitoring and navigation. These systems allow rescue teams to locate the robot's position in real-time and coordinate rescue operations more efficiently. Through a comparative review of several existing IoT-based rescue systems, this paper discusses the design considerations, technological progress, and limitations of HRWR prototypes. The study also emphasizes the need for cost-effective, energy-efficient, and durable solutions that can enhance safety in aquatic environments.

Keywords: Human Rescue Robot, IoT, Water Rescue, GPS Tracking, Remote Control, Surface Robot, Robotics.

1. INTRODUCTION

The Human Rescue Water Robot is developed to support rescue operations during drowning or flood situations. It acts as a floating device that can be manually controlled to reach a person in need of help. The robot moves using servo motors connected to a fan or propeller, allowing it to move smoothly on the water surface. It is equipped with a GPS module to track its location in real time, helping rescuers monitor and guide it to the correct position. The robot does not detect humans automatically but can be directed by an operator to provide assistance until help arrives. This system aims to reduce the risk faced by human rescuers by operating remotely in hazardous or deep-water areas. It also ensures faster rescue response and better coordination through GPS-based tracking. The Human Rescue Water Robot provides a reliable and cost-effective solution for improving safety during water-related emergencies. The robot is lightweight, portable, and designed for stability, making it easy to deploy during urgent situations. It can operate efficiently in lakes, ponds, or flood-affected regions. With continuous improvements in control range and motor power, this system has strong potential for real-time rescue applications in the future

2. DATA ACQUISITION AND PREPROCESSING

In the Human Rescue Water Robot, data acquisition mainly involves collecting information about movement and location through the servo motor system and GPS module. The servo motors are responsible for driving the fan or propeller, which allows the robot to move across the water surface. The direction and speed of the robot are controlled through user input from a remote or microcontroller interface. The GPS module plays a vital role in tracking the real-time position of the robot. It continuously provides latitude and longitude coordinates, which are sent to a monitoring system or displayed on a mobile device. This helps the rescue operator know the robot's exact location during operation. Before the data is used, minor preprocessing is done to remove fluctuations or noise in the GPS readings. Techniques like averaging are used to provide smoother and more stable position updates. The microcontroller also processes control signals to generate accurate PWM outputs for the servo motors, ensuring precise movement.

3. LITERATURE SURVEY

The literature on IoT-based aquatic rescue systems reflects growing interest in using technology to enhance human safety in water environments. Several studies have focused on the development of remotely controlled or semi-automated robots that provide floating assistance, live location tracking, and stable control. [1] Kumar et al. proposed an IoT-Based Floating Rescue Device that uses an Arduino microcontroller and GPS module to provide live location updates to rescuers. The system was designed for easy deployment in lakes and reservoirs but was limited by short manual control range. [2] Reddy et al. designed a Remote-Controlled Water Robot operated using an RF transmitter and DC motor system. This model proved effective for small-scale rescue operations but lacked automatic control features. [3] Kaur et al. introduced an IoT-Based Rescue Boat using NodeMCU and Wi-Fi modules to continuously transmit the robot's position to an IoT cloud interface. Although it enabled real-time tracking, its performance depended heavily on network strength. [4] Verma et al. developed an Amphibious Rescue Robot that could operate both on land and water. It used servo motors and GPS for mobility but faced challenges in payload capacity and wave stability. [5] Das et al. created a GPS-Guided Floating Robot utilizing GSM-based communication to transmit coordinates to the base station. Despite reliable tracking performance, it suffered from delayed updates in low-signal areas. [6] Banerjee et al. presented a Smart Rescue Assistance Boat controlled via smartphone using Bluetooth communication. This system was simple and affordable but limited by its short-range connectivity. [7] Sinha et al. designed an IoT-Based Lifesaving Robot equipped with GPS and Wi-Fi modules to provide surface-level assistance and transmit location data. It proved effective in small water bodies but faced power limitations during long operations. [8] Mehta et al. proposed an Autonomous Floating Platform using jet motors and GPS trackers to offer floating support and continuous location updates, although it lacked sensing and detection capabilities. Overall, most of these studies focus on real-time monitoring, IoT integration, and reliable movement control, but none fully address challenges related to power management, long-range communication, and environmental durability.

Ref.	Author(s) & Year	Model / Technique	Dataset Used	Accuracy / Metric	Key Findings / Contribution
[1]	A. Kumar et al., 2023.	IoT-Based Floating Rescue Device Using Arduino	Custom IoT prototype tested in lake environment.	89%	Provides real-time GPS tracking and floating assistance; limited by short manual control range.
[2]	P. Reddy et al.,2022	Remote-Controlled Water Robot (RF transmitter & DC motors)	Controlled pond testing.	85%	Reliable for short-range manual operations; lacks autonomous navigation.
[3]	S. Kaur et al., 2023	IoT-Based Rescue Boat using NodeMCU and Wi-Fi	IoT cloud network simulation.	91%	Enables live tracking and control via cloud; performance affected by network strength.
[4]	N. Verma et al.,2024	Amphibious Rescue Robot (land–water dual mode)	Lab and outdoor field tests.	88%	Operates on both land and water; challenges in wave balance and payload.
[5]	R. Das et al., 2023	GPS-Guided Floating Robot (GSM communication)	GPS-based field test.	90%	Accurate coordinate transmission; delay in weak-signal regions.
[6]	A. Banerjee et al.,2022	Smart Rescue Assistance Boat (Bluetooth control)	Small-scale prototype testing.	83%	Cost-effective and simple to operate; limited Bluetooth range.
[7]	V. Sinha et al.,2024	IoT-Based Lifesaving Robot (GPS + Wi-Fi modules)	Controlled pool testing.	92%	Efficient real-time surface tracking; affected by power consumption during long use.
[8]	T. Mehta et al., 2023	Autonomous Floating Platform (Jet motors + GPS)	Simulated and field trials.	87%	Stable autonomous floating system; lacks obstacle and victim detection.

Table 1: Comparative Performance Analysis of IOT-Based Aquatic Rescue System

4. ADVANCEMENTS AND EVALUATION

Recent advancements in IoT and embedded systems have made water rescue robots more reliable and affordable. These robots are typically built using Arduino controllers and powered by DC or propeller motors for movement. They include GPS modules for location tracking and wireless interfaces such as Wi-Fi, GSM, or Bluetooth for remote operation. Compared to traditional rescue tools, IoT-based water robots enable faster deployment and continuous monitoring during rescue operations. Performance parameters such as battery life, control range, stability, and durability in harsh water conditions are crucial. Although current models provide effective support, challenges remain in maintaining balance during strong water currents and ensuring long-distance communication.

5. CONCLUSION

Human Rescue Water Robots provide an innovative approach to improving safety during aquatic accidents. Rather than relying on automatic detection, these robots function as assistive and trackable devices that can be controlled manually to reach victims quickly. By integrating IoT-based GPS tracking and remote operation, they enable rescuers to locate and respond faster. Future research should aim at improving stability, energy efficiency, and communication range to make these robots more dependable in real-world emergencies. Lightweight and modular designs could further enhance portability and affordability.

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REFERENCES

[1] A. Kumar et al., March 15, 2023 “IoT-Based Floating Rescue Device Using Arduino,” IJERA, 2023.

[2] P. Reddy et al., November 10, 2022 “Remote-Controlled Water Robot for Rescue Operations,” IJRET, 2022.

[3] S. Kaur et al., May 9, 2023 “IoT-Based Rescue Boat for Emergency Support,” IEEE Xplore, 2023.

[4] N. Verma et al., February 22, 2024 “Amphibious Rescue Robot for Flood Assistance,” JETIR, 2024.

[5] R. Das et al., August 18, 2023 “GPS-Guided Floating Robot for Water Rescue,” Sensors Journal, 2023.

[6] A. Banerjee et al., December 5, 2022 “Smart Rescue Assistance Boat Controlled via Smartphone,” IJIRSET, 2022.

[7] V. Sinha et al., April 7, 2024 “IoT-Based Lifesaving Robot with GPS Tracking,” IJEECS, 2024.

[8] T. Mehta et al., July 26, 2023 “Autonomous Floating Platform for Aquatic Rescue,” IJARCCE, 2023.