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Intelligent Lifebuoy Based on Machine Vision Using Raspberry PI

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ABSTRACT: This composition introduces an innovative lifebuoy leveraging machine vision technology. Utilizing an OpenCV camera, the system detects individuals in distress. The camera then transmits the person's position data to a microcontroller unit (MCU). Subsequently, the MCU governs a motor drive module to adjust the lifebuoy's orientation towards the drowning individual, whether they are positioned to the left, right, or directly in front of it. Moreover, the MCU orchestrates the motor drive module to maneuver the lifebuoy closer to the drowning person, facilitating effective rescue operations. This advanced device ensures prompt and accurate identification and assistance for individuals in perilous aquatic situations. In scenarios where lifeguards are unable to intervene swiftly, this intelligent lifebuoy serves as a crucial intervention tool. By employing machine vision technology, it enhances the rescue process, offering a vital lifeline when traditional life-saving equipment may fall short.

KEYWORDS: Lifebuoy, Drowning, Arduino, Raspberry pi.

I. INTRODUCTION

Life-saving equipment such as lifebuoys, life jackets, and throwing devices have historically struggled to directly rescue drowning individuals. However, the advent of advanced life-saving gear is imminent. The intelligent lifebuoy presented in this text excels in identifying and rescuing drowning individuals efficiently. This smart device can be deployed along coastlines, beaches, or adjacent to water bodies, providing an additional layer of safety. In situations where lifeguards may not reach the scene in time, this intelligent lifebuoy becomes indispensable. Utilizing machine vision technology, it swiftly detects and sends crucial data to a central controller. This controller then orchestrates the motorized mechanism to navigate towards the drowning person, ensuring a timely rescue. This composition outlines the fundamental principles of the intelligent lifebuoy, which relies on machine vision for operation. Additionally, it conducts a water simulation test to validate its efficacy. Machine vision, a technology integral to this device, enables automated analysis and examination in various industrial and military applications. It encompasses a range of technologies, software, and methodologies aimed at enhancing automatic inspection, process control, and robotic guidance. Thus, the intelligent lifebuoy represents a significant advancement in water rescue technology, underpinned by sophisticated machine vision systems.

II. AIM

The primary objective of implementing an intelligent lifebuoy, utilizing machine vision and remote sensing, is to elevate the safety and efficacy of maritime endeavors. This innovative technology serves to identify and monitor various entities within water bodies, including individuals and vessels, enabling real-time alerts and aid provision when necessary. Additionally, it aids in the oversight and administration of maritime traffic, pinpointing potential risks and facilitating rescue missions. Ultimately, the overarching aim is to bolster safety measures and operational efficiency across maritime domains.

III. PROPOSED SYSTEM

The article highlights the development of a smart lifebuoy utilizing machine vision technology. It employs an OpenCV camera to detect individuals in distress, with the camera feeding positional data to a microcontroller unit (MCU). This positional data undergoes analysis using deep learning techniques stored in external memory. Subsequently, the MCU communicates relevant data to an Arduino Nano microcontroller, serving as an interface for controlling a motor drive

module. This module, in turn, manages the operation of DC motors, facilitating movement of the intelligent lifebuoy via low voltage control. Continuously monitoring camera feeds, the smart lifebuoy assesses images to identify drowning individuals. By calculating pixel density, the machine vision camera discerns faces, and positional data regarding recognized faces is derived through pre-trained 24x24 windows.

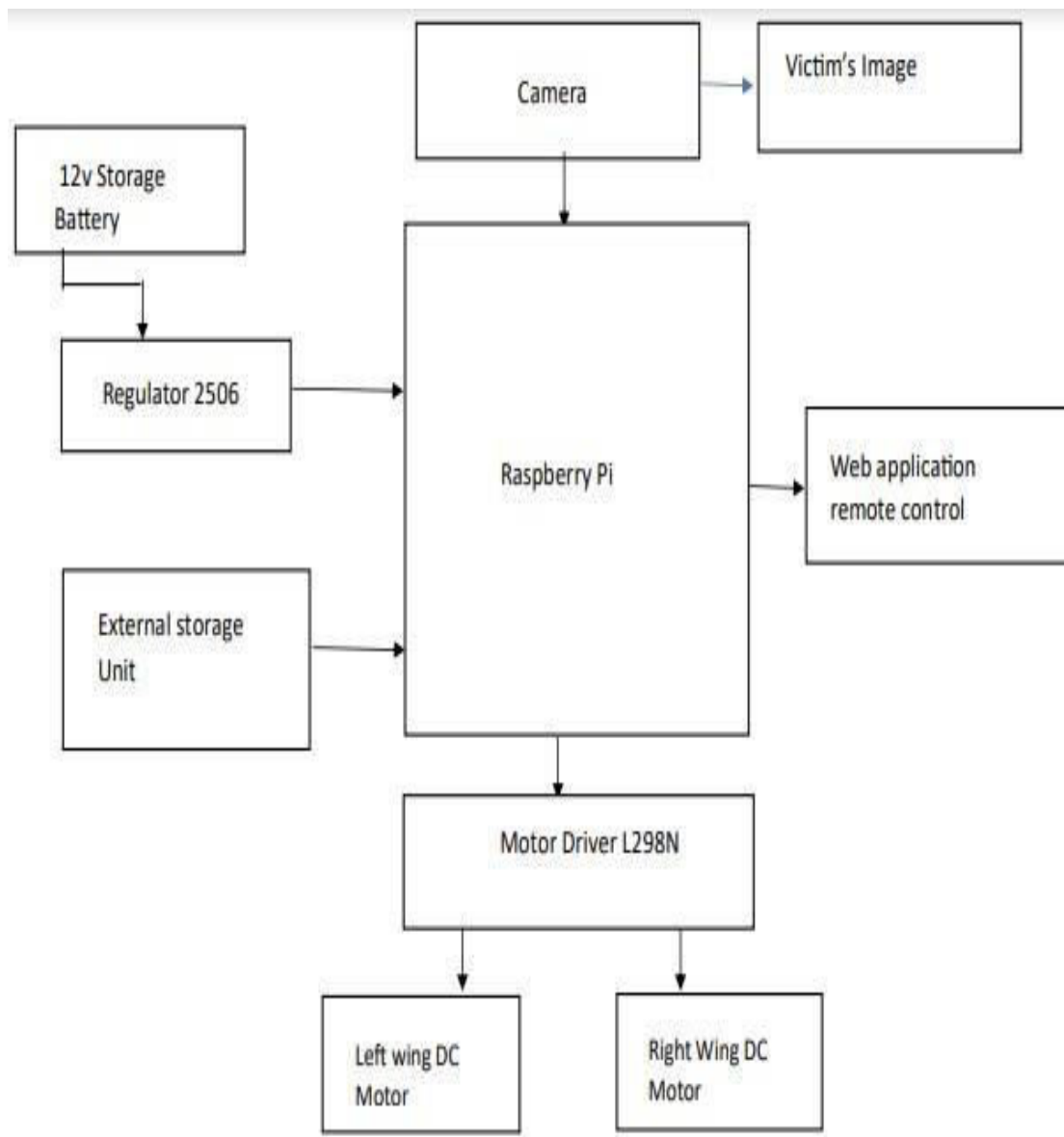


Fig.1 Block diagram of Intelligent lifebuoy based on machine vision using raspberry pi.

Functions of an intelligent controlled lifebuoy:

- Capture the image of victim image
- Identify the image of the person/victim
- Localize the object from various objects
- Tracking the image movement of the localized object
- Detect the object positional information
- Decides the direction of movement of the lifebuoy so as reach the victim.

IV. WORKING PRINCIPLE

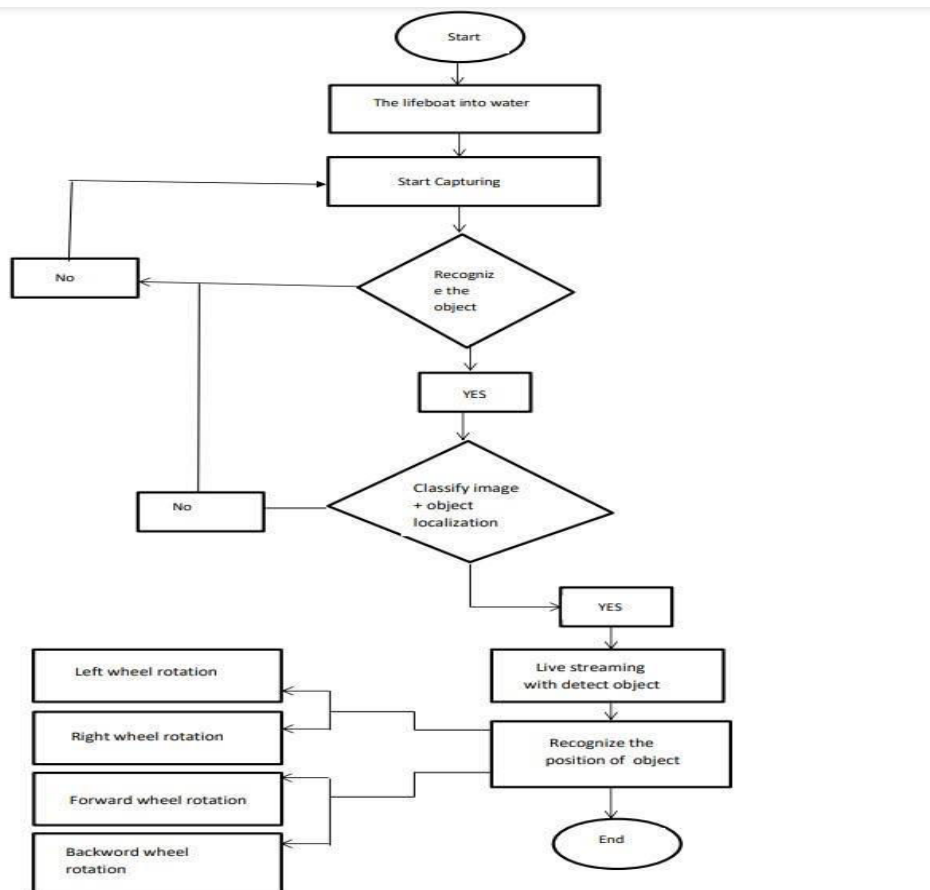


Fig.2 Flowchart of intelligent lifebuoy based on machine vision using raspberry pi

Object recognition encompasses various computer vision tasks related to identifying objects in digital images. Image classification involves predicting the category or class of an object depicted in an image. Object localization entails determining the position of one or more objects in an image and drawing bounding boxes around them to indicate their extent. Object detection combines these tasks by both locating and categorizing objects within an image. Therefore, we can delineate these three computer vision tasks: Image Classification, which involves predicting the class of an object in an image based on input image data and associated class labels. Object Detection, which identifies the presence of objects in an image and delineates their positions using bounding boxes.

V.METHODOLOGY

The intelligent lifebuoy, employing machine vision technology with Raspberry Pi, incorporates several essential hardware components.

Raspberry Pi 4: The Raspberry Pi 4, powered via a USB charger, serves as the central processing unit, capable of delivering power to connected peripherals.

Motor Driver: For motor control, the design utilizes an L298N Motor Driver module, enabling high-power operation for both DC and stepper motors.

DC motors: DC motors are employed for the buoy's movement, known for their widespread use in electronic applications.

MV Camera: The machine vision capabilities are facilitated by an MV Camera, functioning as an imaging device to support the lifebuoy's visual perception. This camera captures images crucial for machine vision tasks, often employing specialized optics for image acquisition. Powering the system is a 12V 1.3 Ah VRLA maintenance-free rechargeable battery, providing the necessary energy for sustained operation.

VI. RESULT & DISCUSSION

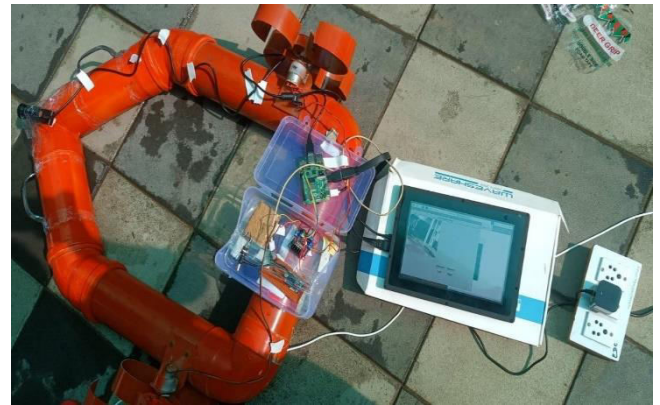
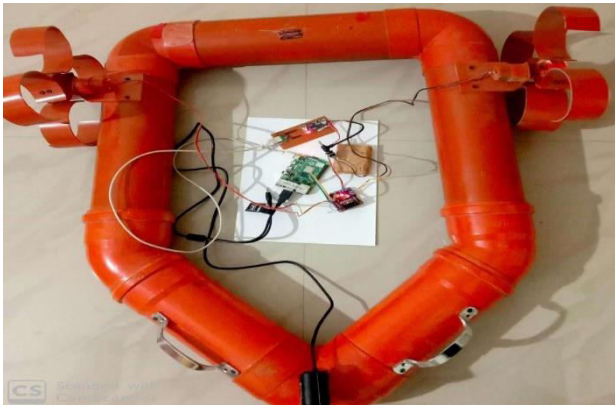


Fig1.Implementation of the project

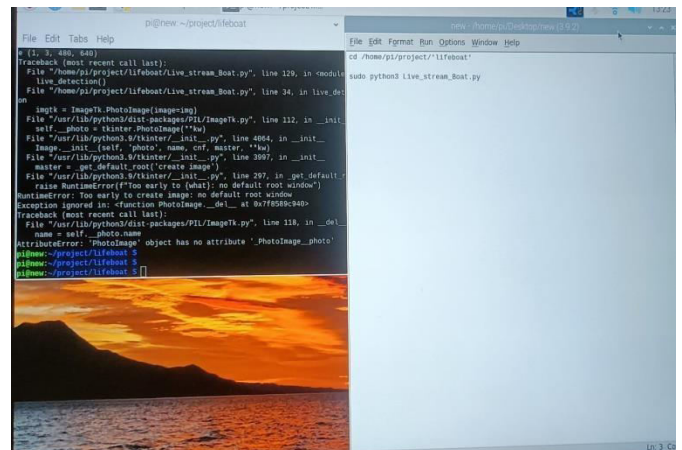
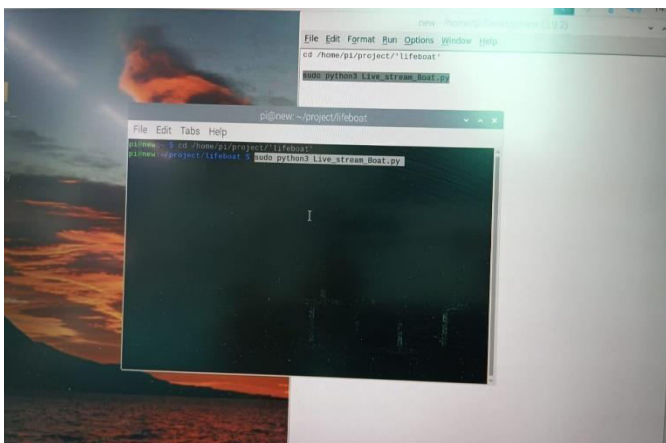


Fig2. Screenshots of command



Fig3. Outcomes of the project

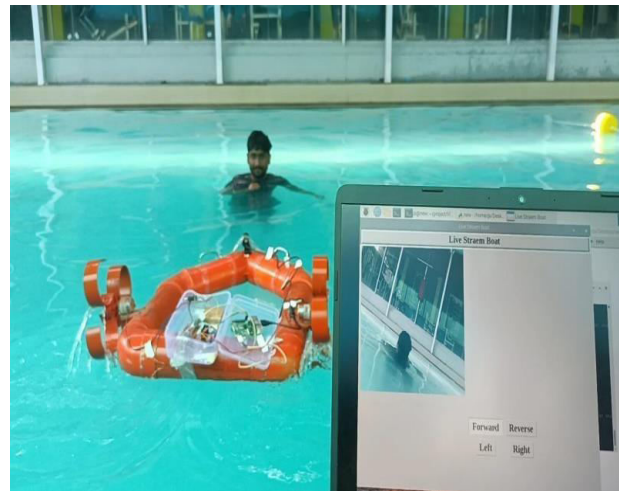
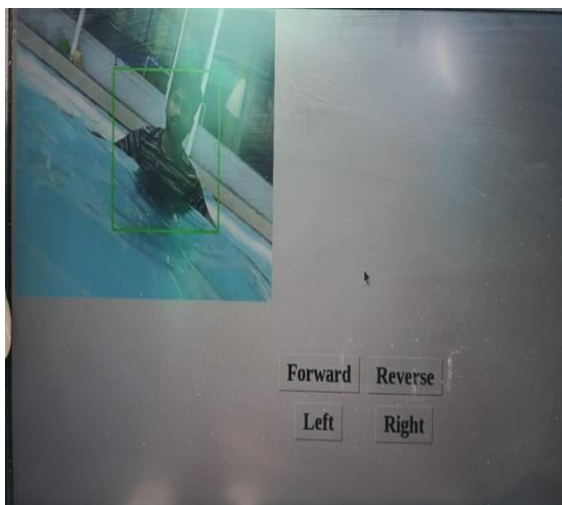


Fig4. Live Streaming with Object Detect

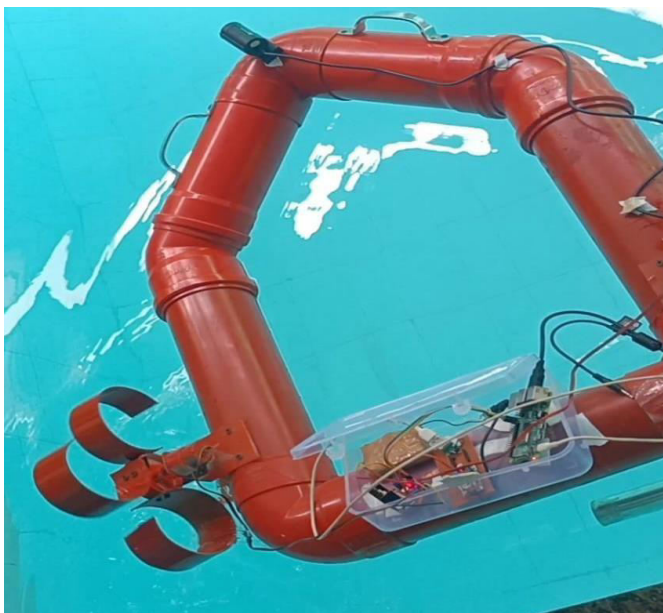


Fig5. Left Wheel Rotate

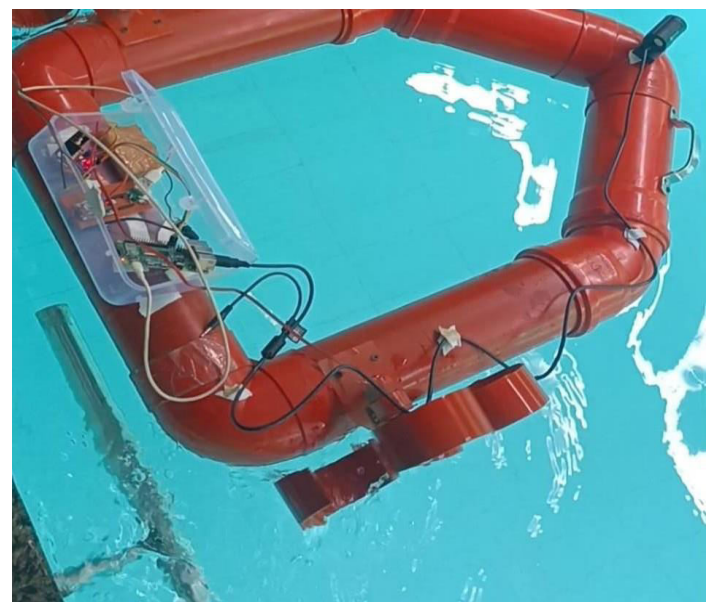


Fig6. Right Wheel Rotate

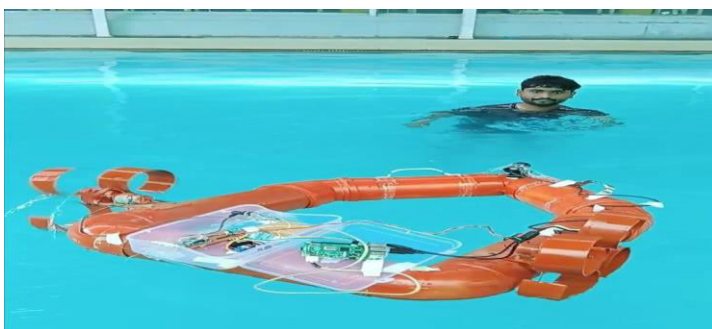


Fig7. Forward Move



Fig8. Reverse Move

VII. CONCLUSION

In summary, our system offers autonomous propulsion towards drowning victims, significantly reducing rescue time. It also enables nearby rescuers to swiftly deploy the intelligent lifebuoy upon spotting a distress incident. Upon receiving distress signals, the buoy autonomously tracks the incident's location using OpenCV camera surveillance in various water bodies. The chosen algorithm effectively identifies drowning individuals and communicates seamlessly with the motor controller board based on voltage polarity. In conclusion, this invention proves highly suitable for water-related accidents, offering efficient lifesaving equipment fabrication and operation.

ACKNOWLEDGEMENT

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