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Review and Design of Hybrid Surveillance Robot using Rocker Bogie Mechanism

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***Abstract*— This paper describes a review of surveillance robots and proposes a new hybrid control robot that incorporates a rocker bogie mechanism for better and more accurate movement. Six DC motors allow the robot to deftly navigate surfaces, including stairs. Notable features include real-time video capture, people detection and live video monitoring with ESP32 cam, GPS-based location monitoring, environmental monitoring with DHT sensor, and Lidar-assisted obstacle detection. Control is facilitated by a app, which gives users intuitive commands on the articulate arm with 360 degree working. Navigation relies on a custom motor driver and rotary encoder for accurate distance measurement. The implemented human detection algorithm ensures real-time safety alerts. Communication between robot and user is done through GSM and a Android app. We provide a detailed overview of the block diagram, hardware components, supported by detailed survey. This hybrid robotic surveillance system, combines the rocker bogie mechanism with an augmented arm controlled via a app, representing a major advance in robotics, and commands a solution that is more work promises real-world diversity.**

***Index Terms*— Surveillance, Arm, Rocker bogie mechanism, Human detection algorithm, Rotary encoder, Monitoring**

I. INTRODUCTION

Enhancement of the mobility, accuracy and maneuverability of robotic systems, we introduces a novel hybrid robotic control system that integrates a variable rocker bogie mechanism This device a are added to provide unparalleled movement precision, allowing the robot's capacity to deftly navigate a Assortment of landscapes including stairs and other difficult terrain. A formidable mechanical devices act as the driving force for the robot, it allows for a unique application.

The primary features of this new robotic system are real-time video recording, people recognition and live video monitoring facilitated by the ESP32 cam. Enhancing its sensing capabilities, the robot offers a combination of GPS-based location tracking, environmental detection via a DHT sensor, and Lidar-assisted obstacle detection These functions The robot is capable of operate smoothly in dynamic and unpredictable environments.

The system's user interface is optimized through a dedicated app, allowing users to easily control the articulate arm through a full 360-degree scope of motion through a custom motor driver and rotary encoder so get the navigation accurately to ensure accurate telemetry during flight. Further enhancing the benefits of robotics is human recognition technology, which provides real-time security alerts to enable immediate response to potential threats

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Communication between robot and operator is established through GSM technology, with additional sensitive Android or web app connectivity. This paper details the system design, hardware components, and software algorithms supported by in-depth analysis. Combining the versatility of a rocker bogie mechanism with flexible hand control through easy-to-use operations, this hybrid robotic monitoring system represents a major breakthrough a results in robotics, providing ready-made solutions to a numerous real-world application challenges

II. Literature Survey

Salado et al [1] proposed the designing and development of a Land Wheeled Autonomous Mini-Robot (LWAMR) tailored for indoor surveillance applications. The LWAMR achieves autonomy through a combination of position, speed, and distance sensors. It's also furnished with a spycam capable of real-time image and video transmission, controlled by a servomechanism.Their work provides extensive insight into the LWAMR's design specifics, control algorithms. In addition, in healthcare settings, such a robot could help care for patients by sensing sensations such as pain or relief, allowing doctors to respond quickly in healthcare settings, such a robot could help care for patients by sensing sensations such as pain or relief. The feature of capturing images with the Pi-camera further enhances its ability to provide a visual record of observed activity.

Harshitha et al [2] proposed the Surveillance robot using raspberry pi and iot introduces a surveillance robot designed for integration into household environments. The central controller of this robot is the Raspberry Pi 3 Model B, known for its robust capabilities. The setup includes a webcam connected to the Pi, monitoring the designated area and generating notifications upon detecting any trespassing or intrusion. Notably, the camera incorporates a face recognition algorithm, enabling the identification of the individual responsible for triggering motion. If the identified person is authorized, an on-board voice assistant engages in conversation. However, in the case of unauthorized personnel, the system sends out notifications containing images captured by the camera and activates live streaming of the webcam feed. This live streaming capability, facilitated by the Pi, allows remote analysis of the camera feed From any internet-connected locations.

Ashish et al[3] design the Automated Hybrid Surveillance Robot concept centered around a Raspberry Pi-based automated surveillance robot. This robot is designed for autonomous movement within a designated facility and possesses obstacle avoidance capabilities.Key features of this robot include the ability to detect various human emotions within the facility. When it senses any such emotions, it promptly alerts registered users via SMS notifications. Additionally, the robot captures images of the detected activity using a Pi camera, providing visual records of the disturbance.The addition of emotion recognition adds a unique dimension to its operation, enabling it to sense and respond to human emotions within the controlled environment Detection of these emotions alerts subscribers by SMS notifications to help ensure a response to any disturbances or stressful situations

Saravanakumar et al[4] focuses on developing a virtual environment to detect suspicious and targeted locations without endangering human lives. The primary objective involves the creation of a robot vehicle specifically designed for observing and monitoring suspicious objects or areas. This robot is equipped with versatile movement capabilities, enabling it to navigate in various directions—left, right, forward, and backward. It serves the purpose of video surveillance and remote control of targeted areas via Wi-Fi communication. The webcam installed on the robotic unit captures live video, transmitting it in real-time to a remote, Robotic vehicles dedicated to inspecting and monitoring dangerous objects or environments provide a valuable solution. Its versatile maneuverability, allows for steering in a wide range of directions, adapting to different environments and conditions, ensuring that target areas are well covered. Adding a webcam to a robotic device to capture live video is a smart move. This real-time video feed improves the monitoring of transmissions to a remote location via a Wi-Fi connection.

Luo et al[5] developed a new outstanding six-wheeled mobile robot with reconstructed body and adaptive obstacle climbing. The robot can adapt to three modes by adapting terrain, crossing obstacles and moving. The paper begins with the design and mechanical design of the proposed mobile robot. The geometry of the robot is then modeled, and geometric constraints, steady states, and conditions for crossing the obstacle are derived and fabricated and configured followed by mathematical simulations to establish geometric external force , external forces, and motion stability are emphasized, where for obstacle crossing, feasible design parameters are determined Moving from simulation to physical realization, the proposed mobile robot is modeled and integrated into the mechatronic system and remote control The model is subjected to field evaluation to ensure that the proposed design is the theory from the result is well. The results show that the mobile robot is rated in accordance with all specified criteria and is considered to be applicable in dangerous rescue situations.

Kim et al[6] presents the comprehensive design, optimization, and performance assessment of a alterable wheel-leg hybrid robot. This robot features a unique transformable wheel that combines the effective benefits of both

circular and legged wheels. Notably, the transformation process of the wheels is passive, eliminating the need for additional actuators, which simplifies the overall design. Additionally, a new triggering mechanism is implemented to enhance the success rate of the transformation process.To optimize climbing ability in legged-wheel mode, the design parameters for both the transformable wheel and the robot are fine-tuned based on behavioral analyses. The performance evaluation encompasses considerations of stability, energy efficiency, and the maximum obstacle height the project can overcome.Key findings include the robot's capability to climb over an obstacle 3.25 times as tall as its wheel radius, maintaining a speed of 2.4 body length per second with specific resistance of 0.7 on a flat surface. This achievement underscores the effectiveness of the new transformable wheel in enhancing the robot's climbing capabilities without compromising its driving performance

NAnandravisekar et al[7] proposed the IOT based Surveillance Robot and reflects the burgeoning intersection of Internet of Things (IoT) technology and robotics for enhanced surveillance capabilities. This emerging field addresses the demand for enhanced monitoring systems in diverse applications, such as security and disaster response. Prior research has explored the fusion of IoT components, like sensors and communication modules, into robotic platforms to enable real-time data transmission and remote monitoring. Its likely contributes to ongoing discourse on leveraging IoT in surveillance robots, potentially offering advancements in connectivity, autonomy, and overall system efficiency. Understanding this literature is vital for researchers and practitioners aiming to navigate the evolving landscape of IoT-driven innovations in the realm of surveillance robotics..

Denker et al[8] focuses on the Design and Implementation of a Semi-Autonomous Mobile Search and Rescue Robot: Salvor and contributes to the extensive literature on search and rescue robotics. In recent years, research in this field has emphasized the development of semi-autonomous robotic systems to enhance enhancing both the effectiveness and security of search and rescue operations. Past research has investigated various aspects, including sensor integration, navigation algorithms, and human-robot interaction, to design robots capable of navigating complex environments and assisting in rescue missions. The paper likely aligns with these trends, providing insights into The development and execution of Salvor as a semi-autonomous mobile "search and recovery missions robot. Understanding existing literature in "search and recovery missions is critical for researchers and practitioners seeking to advance the capabilities of robotic systems for disaster response scenarios, thereby contributing to the broader field of autonomous and semi-autonomous robotics..

Tarunpreet et al[9] design the Wireless multipurpose Robot for Military Applications and adds to literature on the development of multifunctional robots for military purposes. Military robotics has been a significant area of research, addressing to the versatile and adaptable robotic systems to assist in various military operations. Previous studies have explored wireless technologies, sensor integration, and multiple functionalities in military robots to enhance their capabilities in reconnaissance, surveillance, and potentially hazardous tasks. The paper likely delves into the development and execution of a wireless multifunctional robot, providing insights into its applications in military contexts. Understanding the existing literature in military robotics is crucial for researchers and practitioners aiming to develop advanced robotic systems tailored for military applications.

Pandey et al[10] proposed the critical aspects of kinematic and dynamic robustness of the rocker-bogie system system when navigating irregular landscape. The designed rocker-bogie robot introduces an innovative approach to achieving optimal stability conditions and self-adaptability during high-speed operations. It features a two-mode operations system equipped with six wheels, with the wheels strategically aligned with a bar link mechanism.The simulation of the two-mode operation system mechanism provides insights into its functionality. Subsequently, a physical prototype of rocker bogie is meticulously designed and fabricated, guided by the optimal fittest data obtained from the simulation. The performance evaluation of the developed prototype is systematically compared with simulation results, aiming to fortify the robustness of vehicle.

III. WORKING PRINCIPLE

A. Block diagram

Breakdown of Block diagram-

Control Systems

- *Arduino Mega*: The central microcontroller responsible for processing sensor data, controlling motors, and managing overall robot behavior.
- *ESP32 CAM:* A Wi-Fi-enabled microcontroller with a camera module, likely used for video surveillance and wireless communication.

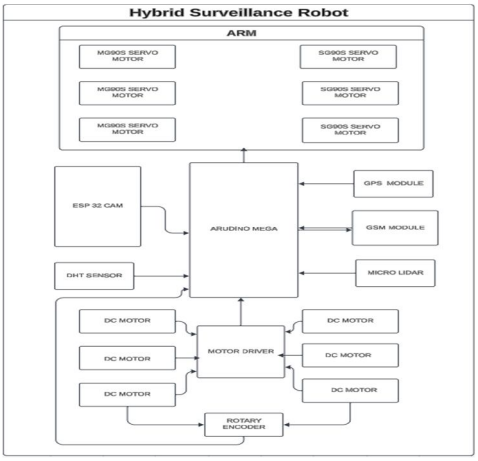

Figure 1. Block diagram of Hybrid Surveillance Robot using Rocker Bogie Mechanism with ARM

Sensors:

- *DHT Sensor:* Measures temperature and humidity, potentially for environmental monitoring or robot self-diagnostics.
- *Micro LIDAR:* A compact LIDAR sensor for accurate distance measurement and object detection, crucial for navigation and obstacle avoidance.
- *GPS Module:* Provides location data for mapping, tracking, and autonomous navigation.
- *Rotary Encoder:* Tracks wheel rotation to estimate speed and position, aiding in navigation and motion control.

Actuators

- *MG90S Servos (x6):* Small servo motors, likely utilized for regulating robot's arm joints and provide precise movement.
- *DC Motors (x6):* Drive the robot's wheels for locomotion.

Motor Control

- *Motor Driver*: Controls The velocity and orientation of the DC motors, ensuring smooth and efficient movement.

Communication

- *GSM Module*: Enables cellular communication for remote control, data transmission, and alerts.

Additional Points

- *ARM*: While labeled, its specific components and functions aren't detailed in the diagram. It likely refers to a robotic arm assembly with multiple joints for manipulation tasks.
- *Power Supply*: Not explicitly shown, but essential for powering all components.

Overall Functionality

- *Surveillance*: Capturing video and environmental data using the ESP32 CAM and sensors.
- *Navigation*: Obstacle avoidance and autonomous movement using LIDAR, GPS, and rotary encoder.
- *Manipulation*: Potential object interaction using the robotic arm.
- *Remote Communication*: Data transmission and control via Wi-Fi (ESP32) and cellular network

IV. CONCLUSIONS

In conclusion, by assistance from literature survey it is found that the hybrid robotic monitoring system presented carries importance milestone in the field of robotics. The addition of the rocker bogie mechanism has proven to aid precision and flexibility, allowing the robot to carefully navigate tight spaces including ladder interactions.
Features include real-time video capture via ESP32 cam, live people recognition and video surveillance, with GPS based location tracking, environmental awareness from DHT sensors inside, and Lidar-assisted detection of

obstacles together contribute to better and more efficient surveillance prama. The rhythmic arm, which is controlled through an intuitive app interface, extends the robot's capabilities, allowing for 360 degrees of movement

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