Design And Implementation of an IOT-Enabled Rover with Web Cam for Object Detection, Environmental Monitoring, And Web-based Control

Mrs Sk . Najma Sulthana[1], M. Pavan[2], V. Hemalatha[3], P. Rohith[4], N. Srija[5], M. Harish Kumar[6]

[12345]Department of Electronics and Communication Engineering,
PBR Visvodaya Institute of Technology & Science, Kavali (Autonomous),
SPSR Nellore (Dt.), Andhra Pradesh – 524201, India

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Abstract - The Design and Implementation of an IoT-Enabled Rover with WEB CAM presents a smart robotic platform capable of object detection, environmental monitoring, and web-based control. The system uses an usb web-CAM module for real-time video streaming and object detection, while a Raspberry Pi acts as the main controller to process data and manage rover operations. Environmental parameters such as temperature and humidity are monitored using **a** DHT11 sensor, and air quality is measured with an MQ-135 gas sensor. The rover is built on **a** DC motor–based robot chassis controlled through a motor driver, enabling smooth navigation. An LCD display shows real-time sensor values and system status. Using IoT and web-based interfaces, the rover can be remotely monitored and controlled, making it suitable for surveillance, environmental monitoring, and hazardous and exploration.

Key Words: IoT-Enabled Rover, usb web CAM, Object Detection, Environmental Monitoring.

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1. INTRODUCTION

The advancement of Internet of Things (IoT) technology has significantly influenced the development of intelligent robotic systems capable of remote monitoring and control. Robotic rovers integrated with sensors and vision modules provide efficient solutions for surveillance, environmental observation, and exploration tasks. In this project, an IoT-enabled rover prototype is designed using a Raspberry Pi as the main controller. The integration of a USB web camera allows visual monitoring and object detection, while environmental sensors such as DHT11 and MQ-135 enable atmospheric data collection. The system also incorporates a motor driver-controlled DC motor chassis for movement and an LCD module for displaying system information. By combining embedded systems, IoT communication, and sensor technologies, the rover prototype offers a compact and efficient platform suitable for research and practical applications in monitoring and inspection domains.

2. LITERATURE SURVEY

The Internet of Things (IoT) has emerged as a key enabler for various applications in automation, surveillance, and control. The rover uses an IoT network to stream data such as video, images, and environmental conditions to a remote server or user device. This system aims to enhance security in various areas, providing remote access and automated monitoring capabilities with real-time updates. This paper presents the design and implementation of an IoT-based surveillance rover that integrates an embedded system with wireless connectivity to enable remote monitoring and control. The rover is equipped with a camera module, motor driver, microcontroller, and wireless communication module. The system facilitates real- time video streaming and directional control via aweb-based interface.

3. EXISTING SYSTEM

The existing robotic monitoring systems primarily rely on standalone robotic platforms or manually operated surveillance devices with limited sensing capabilities. Traditional systems often lack integrated environmental monitoring and IoT-based remote access features. Many Block Diagram of Proposed System earlier rover models are controlled through short-range communication methods such as Bluetooth or RF modules, restricting operational flexibility. Additionally, separate monitoring devices are commonly required for environmental data collection, resulting in increased system complexity and cost. The absence of centralized processing and web-based control limits scalability and adaptability in hazardous or remote environments.

4. PROPOSED SYSTEM

The proposed system presents a prototype IoT-enabled rover integrating vision, sensing, and remote accessibility within a single platform. The Raspberry Pi serves as the core controller, handling image processing from the USB web camera and processing data from environmental sensors including DHT11 and MQ-135. A motor driver module controls the DC motors for rover navigation, while an LCD displays sensor readings and operational status. The system is connected to a web-based interface that enables remote monitoring and control through IoT technology. By combining object detection, environmental monitoring, and wireless control, the proposed rover offers a compact, efficient, and multifunctional robotic solution suitable for surveillance and exploratory applications. The proposed IoT-enabled rover addresses these gaps by offering a cost-effective, integrated, and flexible solution that combines real-time video surveillance, environmental sensing, and remote-controlled mobility in a single platform. By using a Raspberry Pi, the system supports multiple sensor integrations and efficient data processing..1

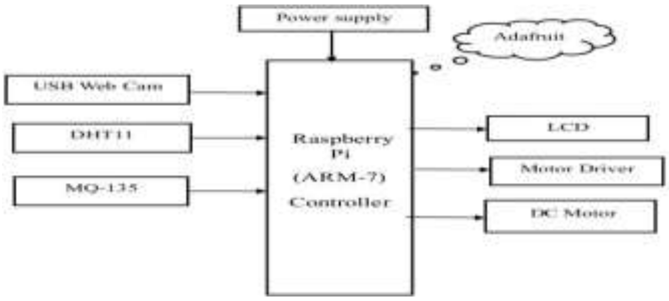

Fig.1: Block Diagram of Proposed System

5. IMPLEMENTATION AND RESULTS

The proposed system is implemented by integrating a microcontroller-based processing unit with sensing, display, and control modules to achieve real-time monitoring and operation. A central processing board (such as a Raspberry Pi) acts as the core of the system, interfacing with various peripherals through GPIO pins. Sensors, including a temperature and humidity sensor module, are connected to continuously collect environmental data. The acquired data is processed and displayed on an LCD screen for real-time visualization. A power supply unit, consisting of a rechargeable battery and a regulated circuit board, ensures a stable and continuous voltage supply to all the components of the system. The voltage regulators are used to maintain constant output levels, protecting sensitive components such as the Raspberry Pi, sensors, and display modules from voltage fluctuations. Additional modules, such as relay circuits and motor driver units, are incorporated to control external devices and actuators based on predefined conditions and commands from the controller.All components are interconnected using well-organized wiring to ensure reliable communication and to avoid short circuits or signal interference. The system operates by continuously collecting data from sensors such as the DHT11 and MQ-135, which monitor environmental conditions in real time. This data is then processed by the Raspberry Pi, which acts as the central control unit of the system.

Fig 1.1:Hard ware setup Of Proposed System

Fig 1.2: Software Setup Of Proposed System

Fig 1.3: Temperature and Humidity Sensor

Fig 1.4: Web Cam Setup

Fig 1.5: LCD Showing Results

6. DISCUSSION

The proposed system demonstrate its effective performance in realtime monitoring and control applications. The system successfully acquires data from the DHT11 Temperature and Humidity Sensor and processes it using the Raspberry Pi, ensuring accurate and continuous measurement of environmental parameters.The obtained values are displayed clearly on the LCD module, providing instant feedback to the user. During testing, the system responded promptly to changes in temperature and humidity, indicating reliable sensor integration and efficient data processing. In addition to sensing, the rover movement was successfully implemented using DC motors controlled through motor driver circuits. The motors enabled smooth The power supply unit maintained stable operation throughout the process, with no significant fluctuations effecting system performance.

7. CONCLUSION

The IoT-enabled rover with USB web camera prototype demonstrates the successful integration of embedded systems, environmental sensing, and web- based control into a unified robotic platform. By utilizing a Raspberry Pi as the main controller along with DHT11 and MQ-135 sensors, the system effectively monitors atmospheric conditions while enabling visual observation through the camera module. The motor driver-controlled chassis ensures reliable movement, and the LCD provides system feedback. The prototype highlights the potential of IoT-driven robotic systems for surveillance, monitoring, and exploratory purposes. The design offers flexibility, scalability, and practical applicability for future enhancements and advanced robotic research.

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