Project Name: Monitoring and Leaking Detection System Using Raspberry-Pi

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Monitoring And Leaking Detection System Using Raspberry Pi.

"Innovative Solution for Hazard Detection and Prevention"

Project report By

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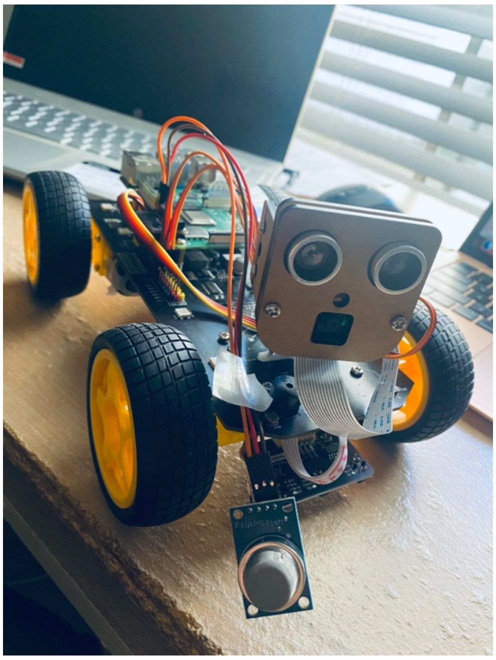
Abstract

Advances in high technology and industrial development lead to a rise in living standards. However, this has also increased in a variety of disasters or hazards such as the undesired release of various chemicals, flammable, and toxic gases, etc. The proposed Model can be used for detecting leakages of harmful gases and chemical petroleum products by monitoring containers or tanks using a Raspberry Pi-based robot. This robot will be used for capturing images and is also capable of providing the facility of live streaming whenever required. The Robot will also use a Gas sensor which will provide real-time data regarding the surroundings. The robot is connected to Wi-Fi so that it is not limited to short-range, instead can work on a much larger range. This robot can enter any place where humans cannot. And perform monitoring and capture images of the exact location of damage. This robot is used for monitoring tanks and containers or pipes in chemical or petroleum plants. These images and videos can be sent directly to the central data processing. After becoming aware of the leakages or unnecessary release of gases, necessary steps can be taken to avoid future problems and accidents.

Introduction

As technologies and chemical industries are evolving day by day, it has increased the living standards of humans incredibly. This breathtaking development has not come alone but also has been accompanied by a variety of serious problems such as an undesirable release of chemical pollutants, flammable, and toxic gases, etc. The environment has the most significant impact on Human health issues. Most dangerous gases such as Carbon monoxide (CO), refrigerant gas, and liquefied petroleum gas (LPG) are colorless and odorless compounds that are produced by incomplete combustion. Carbon monoxide (CO), often referred to as a "silent killer" is an injurious gas and its prolonged exposure to living beings can lead to brain damage and even death. Fires are the most common source of CO. A natural gas leak can be dangerous because it increases the risk of fire or explosion. Therefore, detecting gases is needed to ensure the safety of workers working in industry and people living in the surroundings.



We are all aware of the Bhopal gas tragedy. It is considered the greatest tragedy in chemical industry history, the Bhopal disaster was a gas leak incident in India at the Union Carbide India Limited

(UCIL) pesticide plant. A gas leak of methyl isocyanate gas and other chemicals from the plant caused as many as 25,000 deaths as well as 558,125 injuries. This incident would not have happened if proper monitoring of the tank or container had been done. Chemical Industries have many sections where humans cannot enter as the toxicity of chemical substances can affect human health. Also, there are some sections in petroleum companies where humans cannot enter to check leakages in plants due to small space. So, to deal with problems like this and ensure a safe environment there is a need for monitoring and leakage-detecting systems at chemical industries. The monitoring and leakage-detecting system is a Raspberry Pi robot that is controlled by a smartphone. Commands will be sent to the robot for movement. The robot is connected to Wi-Fi and hence can work for a larger range. The robot will capture images and process these images. We can switch from image-capturing mode to live-streaming mode from the phone.

Proposed Solution

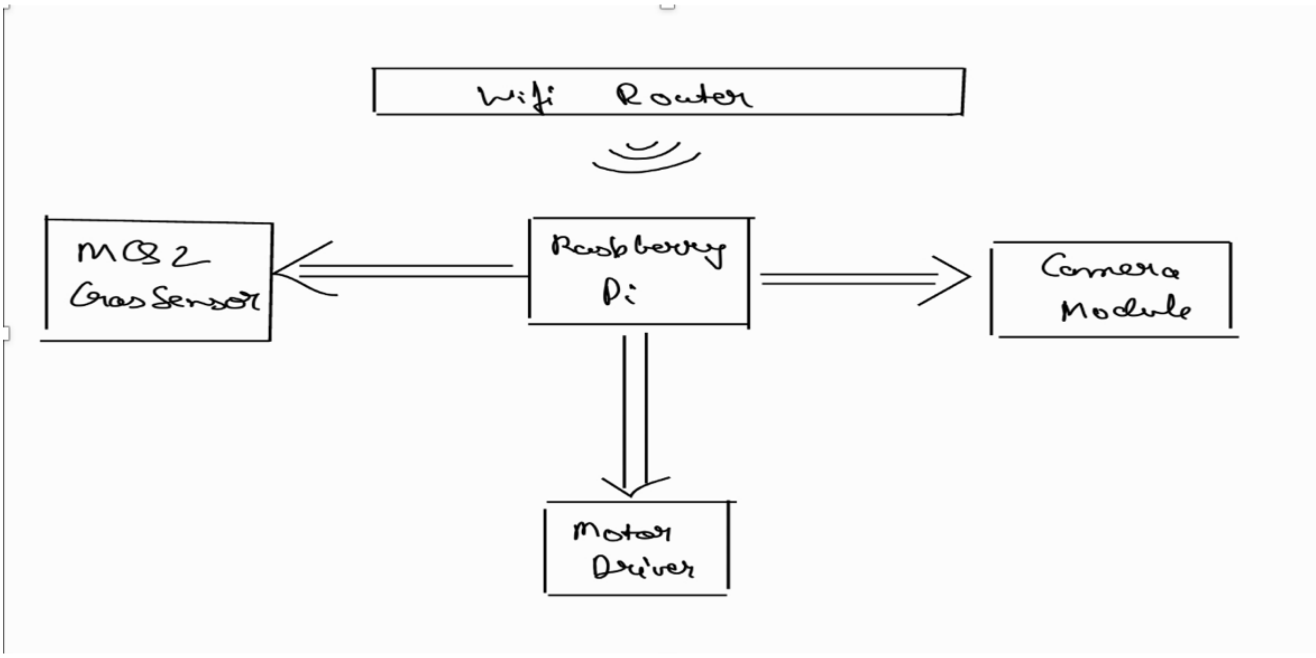
The proposed Solution acts as a Hazard Detection and Early Warning System.
The solution is as follows:

- The solution is a Raspberry Pi-based robot. This robot will be used for capturing images and processing them and can provide the facility of live streaming whenever required.
- The Robot will also have an MQ-2 Gas Sensor which will sense the surrounding toxic gas and will send it to the central data processing system via WIF1.
- The Robot will also have a camera installed on it which will capture the images of the monitoring site and process them. The image will enable the system to give more detailed information regarding the location of damage and more information related to damage such as depth and size of the hole.
- The System can provide Live Streaming of all the Real-time Data that is being captured by the camera on the robot.
- The Robot can move easily anywhere on the entire site and gives us Live data regarding the hazards.

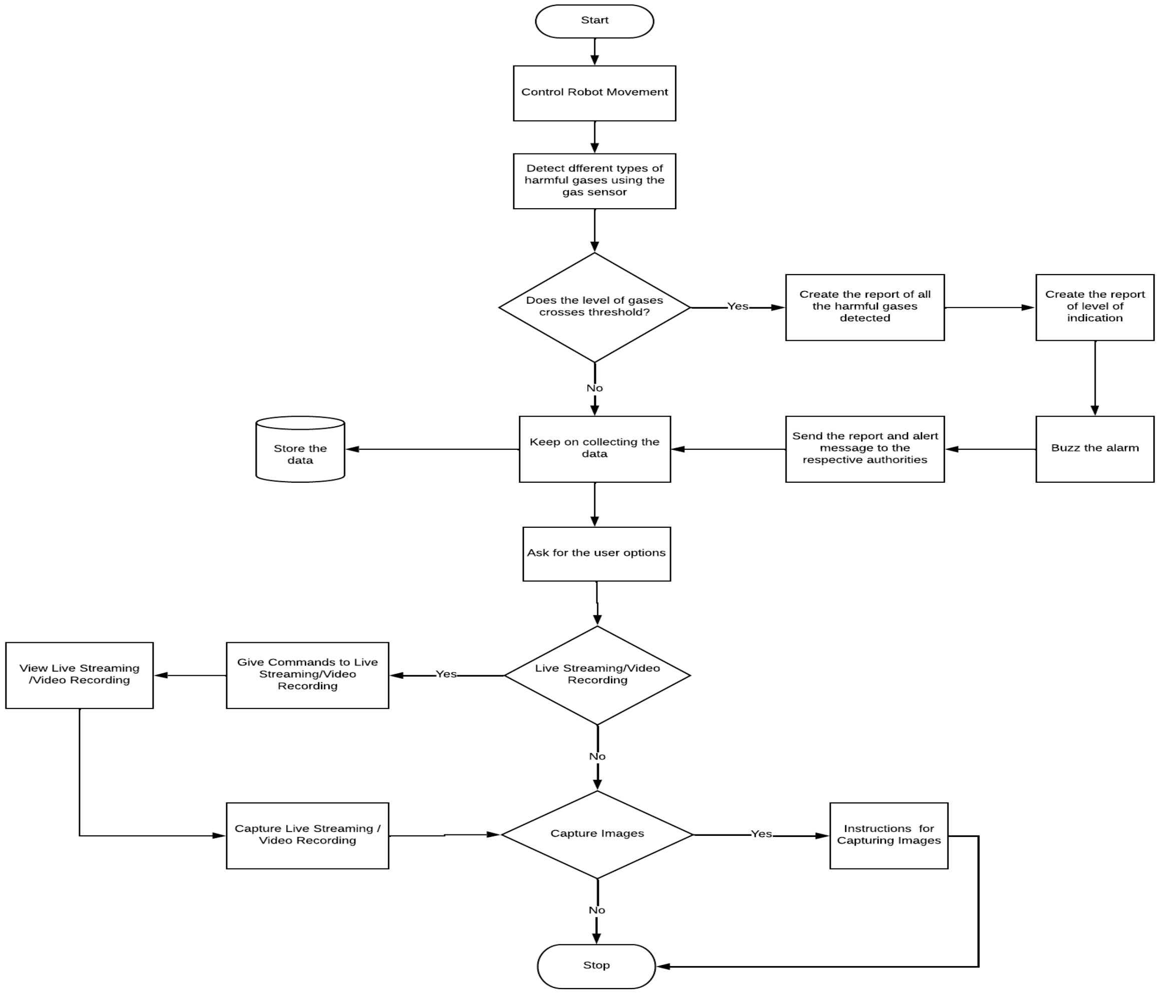
Creativity

- The entire system is built around a Raspberry Pi-based model.
- The system can capture the image that will give a detailed understanding regarding the Hazard like the location, depth, and size of holes, etc.
- The Robot can traverse all types of terrain.
- The Robot will have the gas and the pressure sensor installed on it which will enable it to give details to the ground stations regarding the leakage of toxic gases and temperature.
- In case the system detects leakage of any toxic gases or another parameter that can initialize the hazard it sends an alert to the ground stations thereby preventing the disaster from happening in the first place.
- The System or the robot uses WIFI to transfer the collected data to the ground station.

Block Diagram



Flowchart



Applicability in Disaster Management

- Due to the day-by-day emergence of technologies and development the risk of disaster increases which leads to loss of life and property. Recently on April 26, 2018, a fire broke out in a chemical factory in Navi Mumbai's Khairne MIDC area and spread rapidly to four other factories in the area. This incident injured several people very badly.
- One of the key motives of Disaster management is Disaster Prevention. Several incidents can be prevented if correct preventive measures are taken.

- The system will act as a hazard monitoring and early warning system. The System is based on the Raspberry Pi model which makes surveillance a rather more fun and convenient job to do. The system consists of the MQ-2 Gas Sensor to detect toxic gases. The system will consist of a camera that will capture real-time data, and live stream the data. The System can move freely in any direction and on all kinds of surfaces.
- If the system finds any leaks of harmful gases in the surroundings uneven increases in the temperature or any damage in the area it will send an alert to the controller machine. Thus, monitoring and reporting the system helps with Disaster prevention thereby helping us to achieve the key aspects of Disaster Management.

City Context

- The System is built using the Raspberry model and it is designed in such a manner that it can move seamlessly in any direction and on any kind of terrain. This makes the system work in all kinds of cities in any circumstances.
- The Raspberry Pi model can withstand high temperatures. Thereby the System will work in all the cities irrespective of their different geographical behavior.

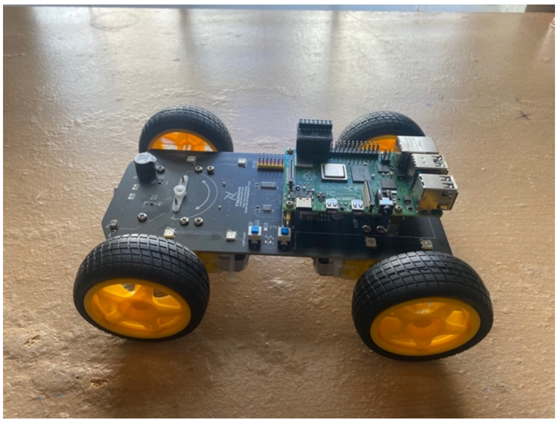
System Design and Assembly

Assemble the Circuit Board and Wires:

The initial step focuses on building the foundational structure of the robotic car. Motors are attached to the chassis using provided screws, and wheels are mounted onto the motor shafts. Additionally, the battery pack, a vital power source, is securely fastened to the chassis. This step establishes the physical framework necessary for the vehicle's movement and power supply.

Connect the Motors to the Motor Driver:

Moving to the electrical components, the next step involves connecting the motors to the motor driver board. This intermediary component is crucial for controlling the movement of the motors. Furthermore, the motor driver board is connected to the GPIO (General Purpose Input/Output) pins on the Raspberry Pi, establishina seamless communication link between the control unit and the motors.



Connect the Power Source:

Ensuring a stable power supply is paramount in the assembly process. Connecting the battery pack to the power input of the motor driver board is a key step. It is emphasized that the correct voltage is used for the motors, preventing potential damage, and ensuring optimal performance.

Connect Gas Sensor:
Expanding the functionality of the robotic car, this step introduces the integration of additional components, such as a gas sensor. These components are connected to the Raspberry Pi using GPIO pins, providing the vehicle with the capability to sense and respond to its environment beyond basic locomotion.

Mount the Raspberry Pi:
The control unit, represented by the Raspberry Pi, needs a secure attachment to the chassis. This step instructs users to affix the Raspberry Pi using screws or a mounting bracket. The stability of this attachment is crucial for the proper functioning of the robotic car.

Install Software:
Shifting the focus to the software aspect, this step involves installing the necessary software on the Raspberry Pi. This includes motor control libraries and any other dependencies required for the vehicle's programming and operation. Software installation lays the groundwork for effective control and coordination of the robotic car's movements.

Write Code:
Programming the robotic car is a pivotal step in its functionality. The recommended programming language is Python and libraries such as RPi.GPIO is suggested for GPIO control. This step empowers users to customize the behavior of the robotic car according to their preferences and project requirements.

Running the motor module

```
class Motor:
setMotorModel(self,duty1,duty2,duty3,duty4):
        duty1,duty2,duty3,duty4=self.duty_range(duty1,duty2,duty3,duty4)
           self.left_Upper_Wheel(duty1)
           self.left_Lower_Wheel(duty2)
           self.right_Upper_Wheel(duty3)
           self.right_Lower_Wheel(duty4)
PWM=Motor()
def loop():
        PWM.setMotorModel(2000,2000,2000,2000)       #Forward
          time.sleep(3)
        PWM.setMotorModel(-2000,-2000,-2000,-2000)   #Back
          time.sleep(3)
        PWM.setMotorModel(-500,-500,2000,2000)       #Left
          time.sleep(3)
```

```
        PWM.setMotorModel(2000,2000,-500,-500)     #Right
          time.sleep(3)
        PWM.setMotorModel(0,0,0,0)              #Stop
if __name__=='__main__':
loop()
```

Running the camera module

```
from picamera2 import Picamera2
picam2 = Picamera2()
picam2.start_and_capture_file("image.jpg")
```

Running the gas sensor

```
import RPi.GPIO as GPIO
import time
# Set up the GPIO mode
GPIO.setmode(GPIO.BCM)
# Set up the GPIO pin for reading the DO output
DO_PIN = 7  # Replace with the actual GPIO pin number
GPIO.setup(DO_PIN, GPIO.IN)
try:
    while True:
        # Read the state of the DO pin
        gas_present = GPIO.input(DO_PIN)
        # Determine if gas is present or not
        if gas_present == GPIO.LOW:
            gas_state = "Gas Present"
        else:
gas_state = "No Gas"
# Print the gas state
        print(f"Gas State: {gas_state}")
        time.sleep(0.5)  # Wait for a short period before reading again
except KeyboardInterrupt:
    print("Gas detection stopped by user")
finally:
    # Clean up GPIO settings
    GPIO.cleanup()
```

Test and Debug:

After the assembly, software installation, and coding stages, the robotic car is powered on to test its basic functionality. This step involves a thorough examination to identify and troubleshoot any issues with the hardware or software. Ensuring a smooth testing and debugging process is essential for the overall success of the project.

Working Demo:

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mVmZXJyYWxBcHBQbGF0Zm9ybSI6IldlYiIsInJlZmVycmFsTW9kZSI6InZpZXciLCJyZWZlcnJhbFZpZXciOiJNeUZpbGVzTGlua0NvcHkifX0&referrer=StreamWebApp%2EWeb&referrerScenario=AddressBarCopied%2Eview

Future Development

Expand Sensor Integration:

To propel the capabilities of the system, the first area of focus involves expanding sensor integration. The aim is to diversify the types of sensors incorporated, enabling the robotic system to cater to a broader range of applications. This expansion could involve exploring sensors that measure additional environmental parameters, delve into biometric data acquisition, or address specialized industry needs. By enhancing sensor integration, the system becomes more versatile, adaptable, and capable of handling a wider array of tasks and scenarios.

Enhanced Connectivity:

The second pillar of future development revolves around improving connectivity. This entails the integration of advanced communication modules to augment the system's ability to transmit and receive data. Exploring options such as 5G, Internet of Things (IoT) protocols, or mesh networking can significantly enhance connectivity, enabling faster and more reliable data exchange. This increased connectivity is crucial, especially in dynamic environments where real-time information is paramount, and it lays the groundwork for more sophisticated and responsive robotic systems.

Machine Learning Integration:

The third aspect of future development involves unlocking the potential of artificial intelligence (AI) through machine learning integration. This entails exploring opportunities to incorporate machine learning models into the system's framework. By leveraging machine learning, the system gains the ability to analyze data, recognize patterns, and make informed decisions. This evolution from rule-based programming to adaptive learning enables the robotic system to engage in predictive analysis, improving its decision-making capabilities over time and enhancing its overall efficiency.

Security Upgrades:

In response to the growing concerns surrounding cybersecurity, the fourth focus area is on prioritizing security measures. This involves a thorough investigation into advanced security protocols and features to fortify the system against cyber threats. As the system becomes more interconnected and data-intensive, robust cybersecurity measures are essential to protect sensitive information, maintain the integrity of operations, and instill confidence in users regarding the system's reliability and safety.

Education and Learning Platforms:

Lastly, a commitment to fostering educational initiatives forms the fifth avenue of future development. This involves the creation of learning resources, curriculum modules, and projects designed to support educational institutions and enthusiasts. By providing accessible and structured educational content, the aim is to empower individuals to understand, explore, and contribute to the field of robotics. This educational focus not only promotes knowledge dissemination but also contributes to the development of a skilled workforce capable of advancing the field further.

Conclusion

In conclusion, this project introduces a cutting-edge Raspberry Pi-based robot system meticulously crafted for industrial hazard detection, signifying a noteworthy stride towards bolstering disaster prevention objectives. The project's alignment with disaster prevention goals is underscored by its practical applicability, which is further enhanced by the inclusion of city-specific considerations and meticulous technical specifications. The thoughtful integration of these elements ensures the adaptability of the proposed solution across diverse terrains and challenging high-temperature environments. The detailed insights provided in the report elucidate the intricacies of the implementation process, elucidating the construction of the Raspberry Pi model on the robot and the integration of essential components crucial for robust hazard detection. Looking forward, the project holds promise as a forward-thinking solution, leaving room for potential future enhancements, such as the integration of GPS trackers and sound-capturing devices. Ultimately, the Raspberry Pi-based robot emerges as a compelling avenue for advancing disaster prevention and management within industrial settings, showcasing the potential for increased safety and efficiency in the face of potential hazards.

Acknowledgment

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Thank you