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Wheeled Autonomous Inspection Robot

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Abstract: ***In most industries today, inspection work is still done by people walking into risky places like chemical plants, mines, and factories. This puts workers in danger and takes up a lot of time and effort. To deal with this problem, we built a small wheeled robot that can move on its own and check for hazards like high temperature, gas leaks, and obstacles in its path. The robot uses a microcontroller to read data from a temperature sensor, a gas sensor, and an ultrasonic sensor. Based on what the sensors pick up, the robot decides where to go and sounds a buzzer if something is wrong. We tested it in a controlled setup and found that it works well, detects problems quickly, and does not need anyone to operate it manually. The whole setup is affordable and easy to build.***

Keywords: Industrial automation, Motor control, Embedded system, Robotic inspection, Sensor integration

I. INTRODUCTION

Over the past few years, robots and smart electronic systems have changed how inspection work is done in many industries. In places like chemical plants, oil refineries, and mining sites, regular checking of the environment is very important to keep workers safe. But right now, most of this checking is done by people who have to walk around and look for problems themselves. This is not just slow and tiring, but also quite dangerous when there are toxic gases or very high temperatures around.

The idea behind this project is to build a robot that can do this inspection work on its own. The robot moves around using wheels and carries sensors that can detect things like temperature changes, harmful gases, and objects blocking its way. A microcontroller acts as the brain of the robot and decides how it should move and when to raise an alarm.

We wanted to keep the design simple and low-cost so that even small workshops and colleges can use it. The robot also has features like automatic gas detection and obstacle avoidance, which make it practical and safe to use in real situations.

II. SYSTEM ARCHITECTURE

The robot is made up of three main parts that work together: the mechanical body, the electrical wiring, and the control system. The key components include DC motors, sensors, a microcontroller, a motor driver, and a power supply.

A. Motor Control Mechanism

Two DC gear motors are attached to the wheels to make the robot move. How fast or slow the robot goes depends on the signal sent from the microcontroller to the motor driver. We use a method called pulse width modulation, or PWM, to control the motor speed. The motor driver sits between the microcontroller and the motors, making sure the motors get enough power without damaging the controller board.

B. Sensor Integration

We added several sensors to make the robot smart enough to understand its surroundings. A temperature sensor keeps checking the heat in the area and flags if it gets too hot. A gas sensor sniffs for dangerous gases like LPG or methane and immediately sends a warning signal. On top of that, an ultrasonic sensor measures how far away objects are, so the robot can steer clear of walls and other things in its path.

C. Control Unit

The microcontroller is basically the brain of the whole system. It takes in readings from all the sensors, figures out what is going on, and then tells the motors and the buzzer what to do. Everything runs according to a program we wrote, which keeps looping and checking the sensor values continuously.

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III. WORKING PRINCIPLE

Once we switch on the power supply, the microcontroller boots up and gets all the sensors and motors ready. It sends a start signal to the motor driver, which then spins the DC motors and the robot starts moving forward. As it moves, the ultrasonic sensor keeps scanning the front area. If something comes too close, the microcontroller tells the motors to turn or stop so the robot does not crash into anything.

At the same time, the temperature sensor and gas sensor are always running in the background. If the temperature shoots up beyond a safe level or if any harmful gas is detected in the air, the buzzer goes off right away to warn people nearby. This way the robot keeps doing its job without anyone having to control it.

IV. HARDWARE COMPONENTS

Here are the main parts we used to build the robot:

• Microcontroller board for running the control logic • DC gear motors for driving the wheels • Motor driver module to handle motor power • Temperature and gas sensors for environment checking • Ultrasonic sensor for detecting obstacles • Wheeled chassis and a regulated power supply unit

We picked each part based on how well it works, how much it costs, and how easy it is to get hold of.

V. ADVANTAGES OF THE PROPOSED SYSTEM

There are quite a few good things about this robot:

• It spots obstacles and avoids them on its own • No need for someone to stand and operate it all the time • Speed can be changed depending on the area being inspected • The whole design is compact and does not cost much • Gives consistent results every single time • Sensors add an extra layer of safety

VI. APPLICATIONS

This robot can be put to use in several places, such as:

• Factories and chemical plants for regular safety checks • Colleges and universities for robotics study and research • Mines and other risky areas where people should not go often • Companies building automated monitoring tools

VII. RESULTS AND DISCUSSION

We tested the robot in a small indoor setup where we placed obstacles, heated areas, and a gas source at different spots. The motors ran smoothly and the robot moved without any issues. The ultrasonic sensor picked up every obstacle we placed in front of it. Whenever the temperature or gas level went above what we had set as the safe limit, the buzzer went off immediately. The whole thing worked reliably each time we ran it.

When we compared it with how a person would do the same inspection manually, the robot was clearly faster and more consistent. Nobody had to walk into any danger zone, and the results were the same every single time.

VIII. CONCLUSION

In this project, we designed and built a wheeled robot that can inspect industrial environments on its own using sensors and motor control. It successfully detects temperature changes, gas leaks, and obstacles without any human help. The whole build is simple, affordable, and works reliably. Going forward, we plan to add features like wireless data sending, a mobile app for remote monitoring, and maybe even some basic AI for smarter decision making.

IX. FUTURE SCOPE

There is a lot of room to make this robot even better in the future. For starters, we could add Bluetooth or Wi-Fi so that the sensor readings can be viewed on a phone from a safe distance. We could also use machine learning to help the robot learn from past data and figure out which areas are more likely to have problems, so it can focus its attention there instead of going everywhere equally.

On top of that, adding a small camera would let operators see a live video feed of what the robot is seeing. Using lighter materials and better batteries would also help the robot run longer and move around outdoors more easily. With all these upgrades, the robot could become a much smarter and more useful tool for keeping people safe in tough working conditions.

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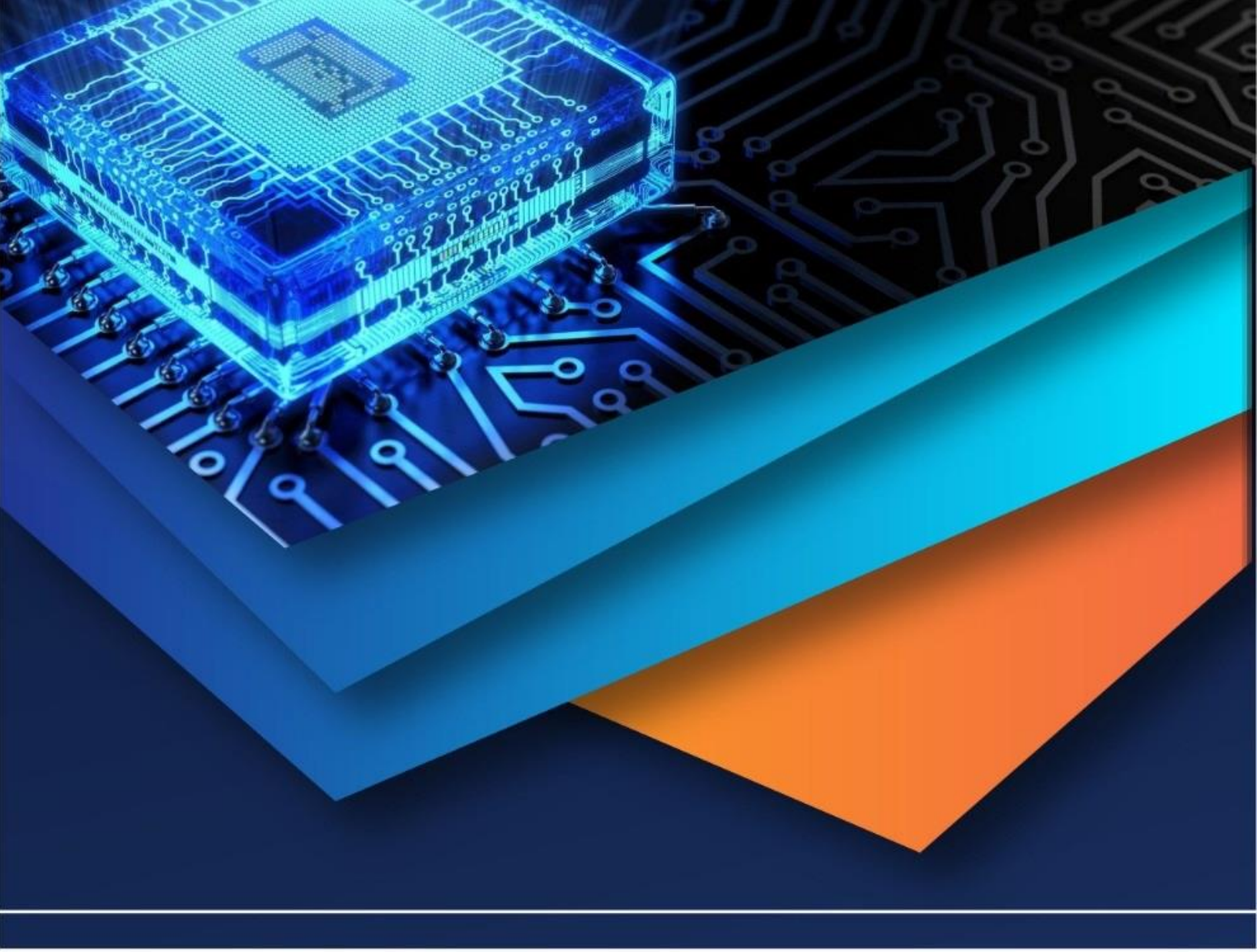

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