ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 11| Issue: 4| April 2025|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2025: 8.691 || ISI Value: 1.188

A NOVELPIPELINE GAS LEAKAGE DETECTION

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ABSTRACT

In cities, oil refineries, and other sectors, gas pipes are used to transfer gases. Any damage to these pipelines causes leaks to occur later, which might have disastrous effects on both industry and the safety of the people involved. Therefore, it is crucial that this pipeline infrastructure be kept safe and maintained. The project "Robot for Under Pipeline Gas Leakage Detection" is suggested in this regard. It is suggested that a novel mobile robot move through pipelines, inspecting them for any damage that might be causing leaks. The mobile robot has an inbuilt ultrasonic sensor. This sensor is designed to measure the separation between the mobile robot and the obstruction (in this case, the pipeline walls), control the robot's movement, and locate the pipeline leak. When damage is detected, the mobile robot will halt at that spot, the sensor will identify the damaged pipe's location, and a buzzer will notify the administrator that a leak has been found. Additionally, the admin receives data from the Mobile Robot that includes the leak's location. The concentration of the gas inside the pipe is measured by the Gas Sensors MQ2 and MQ6. If the concentration is lower than the nominal value for that specific pipeline, we will know that the pipe is leaking, and the Ultrasonic Sensor will inform us of its location. The Atmega 328p microcontroller, which is integrated with all of the sensors, manages and synchronizes their operations and sends data from the mobile robot to the user.

KEYWORDS-*Ultrasonic sensor,gas Leakage,MQ2 sensor*

I.INTRODUCTION

Explosions may result from leaks caused by corrosion or damage in industrial and subterranean gas pipes. This has led to the notion of creating a robot that uses a microprocessor to sense gases automatically. In hazardous and risky sectors like petrochemical companies and underground gas pipelines in cities, this robot takes the place of humans to perform pipeline inspection duties. This project makes use of an ultrasonic instrument and two types of sensors. The ultrasonic sensor will indicate the location of pipeline damage, and the sensors will identify any gas leaks.

II. THE EXISTING SYSTEM

Currently, the following tools and techniques are employed to detect pipeline damage:

1. Pressure/flow monitoring: Over time, a leak modifies the pipeline's hydraulics, which alters the pressure or flow values.Therefore, easy leak detection can be achieved by local monitoring of pressure or flow at a single spot. In theory, no telemetry is needed because it is done locally. However, its applicability to gas pipelines is restricted, and it is only helpful in steady-state situations.

2. Acoustic pressure waves: A high-velocity jet of fluid or gas escapes when the pipeline wall breaks. This results in negative pressure waves that are detectable and measurable as they travel through the pipeline in both directions. A sophisticated mathematical program that analyzes data from pressure sensors may pinpoint the leak's position in a matter of seconds. The amplitude of a pressure wave grows with the magnitude of the leak. Once the pipeline wall breaks down (or ruptures), the initial pressure waves stop and no more pressure waves are produced, so the approach cannot identify a leak that is still happening.

3. Digital oil leak detection cable: Digital sense cables are made up of a permeable insulating molded braid that encloses a braid of semi-permeable internal conductors. The microprocessor detects a change in the cable's electrical characteristics as escaping fluids move through the external permeable braid and come into touch with the inside semi-permeable conductors. The microprocessor can identify the fluid throughout its length with a resolution of less than one meter and provide the right signal to operators or monitoring systems. Because the sensing cables can be put in a pipe-in-pipe configuration, wrapped around pipes, or buried underground with pipelines, maintaining this system is both expensive and impractical.

4.Vapour sensing Tube: The installation of a tube along the pipeline's whole length is the fourth step in the vapour-sensing tube leak detection technique. When in cable form, this tube has a high permeability to the compounds that need to be detected in that specific application.

The materials to be measured come into contact with the tube as vapor, gas, or dissolved in water in the event of a leak. The interior of the tube eventually creates a precise image of the materials surrounding the tube.

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A pump moves the tube's air column past a detection device at a steady pace in order to analyze the concentration distribution inside the sensor tube. Gas sensors are installed in the detector unit at the end of the sensor tube. There is a noticeable "leak peak" with each rise in gas concentration.

III.IMPLEMENTATION OF PROPOSED SYSTEM

The concentration of the gas in the pipeline is measured by the Robot's MQ5 sensors.(MQ5 range: 100 ppm–3000 ppm)Under typical circumstances, a constant concentration of gas is maintained throughout the pipeline; any drop or variation in this concentration suggests a leak. The robot stops the leak's location and displays the data on the LCD screen when it detects such an abnormality. A buzzer is then activated.The HC-SR04 ultrasonic sensor directs the robot's movement.Fig.1.shows the block diagram.

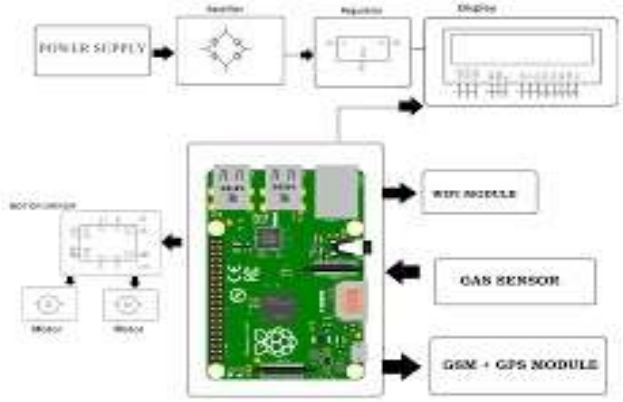


Fig.1.Block Diagram

Microcontroller ATMEGA328P: This Microchip controller is a high-performance, low-power device. Based on the AVR RISC architecture, the ATMEGA328P is an 8-bit microcontroller. Due to its use in Arduino boards, it is the most widely used AVR controller. The ATmega328 serves as the foundation for the Arduino Uno board, a microcontroller. It features a 16 MHz ceramic resonator, an ICSP header, a USB port, six analog inputs, a power jack, a reset button, and 14 digital input/output pins, six of which can be used as PWM outputs. This includes all of the necessary microcontroller support. To begin, they are only plugged into a computer via a USB connection, an AC-to-DC adapter, or a battery.

*WiFi Node MCU Model:*The Wi-Fi/NodeMCU module is an open-source Internet of Things platform. It comes with hardware based on the ESP-12 module and firmware that operates on Espressif Systems' ESP8266 Wi-Fi SoC.

Motor Driver: For your upcoming robotics project, this gear motor wheel is ideal. This gearbox is perfect for line-tracing robots or robotic cars. The bright yellow DC gear motor is made of plastic and is roughly 2.5 inches long, 0.85 inches broad, and 0.7 inches thick. The gear motor operates best between 4 and 7 volts (but 6 volts is advised), and the wheel can be put on either side. One can generate some excellent torque at 5 volts with a ratio of 1:48.

Gas sensors: LPG, alcohol, propane, hydrogen, CO, and even methane can all be detected or measured by the MQ-2 gas sensor. This sensor's module version has a digital pin that allows it to function without a microcontroller, which is useful if you're just looking to detect a single gas.This easy-to-use liquefied petroleum gas (LPG) sensor can detect the amounts of LPG (which is primarily made up of propane and butane) in the atmosphere. Gas concentrations between 200 and 10,000 parts per million can be detected using the MQ-6. This sensor responds quickly and has a high sensitivity.

LCD display: A 16x2 LCD display is a fairly basic module that is frequently seen in many different circuits and gadgets. There are two lines of 16 characters each, which is what a 16x2 LCD can display. Every character in this LCD is shown as a 5x7 pixel matrix. Command and Data are the two registers on this LCD.

Fig.2 shows data flow diagram of the system

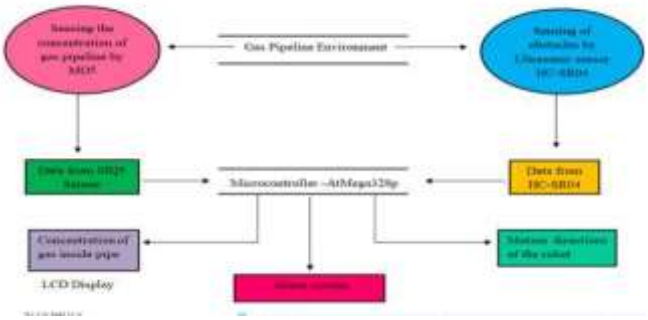


Fig.2.Data Flow Diagram

The suggested system's flow diagram. An HC-SR04 ultrasonic distance sensor is built into the mobile robot. This sensor is used to regulate the robot's movement. When a shift in the gas concentration is detected, the robot will come to a stop. As a result, the alarm is triggered, and an LCD will show the details of the leak and its position.The mobile robot will continue to move and continuously check the pipelines if no gas leak is found. The robot's MQ5 sensors are used to gauge the gas concentration inside the pipeline. (MQ5 range: 100 ppm–3000 ppm) Under normal circumstances, a constant concentration is maintained throughout the pipeline; any drop or variation in the gas concentration suggests a leakage point. The robot stops the leak's location and displays the data on the LCD screen when it detects such an abnormality. A buzzer is then activated. The HC-SR04 ultrasonic sensor directs the robot's movement.

IV RESULTS

The gas sensor's detection range is adjusted to raise and lower the detection's sensitivity level. The robot pauses when it detects damage, and the gas sensor's LED turns on and displays a message about the gas leak and the pipeline damage site.

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