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Gas Inspection Robot with Alert and Leakage Control System

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Abstract - This paper presents the development of an Arduino based gas inspection robot and control system.The purpose of the robot is to automatically detect the gas leakage along a transporting pipe line and sends the information about the leakage and location to the control room trough GSM and GPS Modules and the automatic control system shut off the gas and power supply to prevent accidents.Pipeline gas leakage detection is very difficult as it is odourless but very flammable and the pipeline may be very large.The combustible property of the gas leads to mass destruction of both industrial and residential premisis along with human casualties.The developed gas inspection robot and has shown it's capability to detect the gas upon leakage using the gas sensor and the control system helps to shut-off the gas and power supply to prevent the accidents.The experiment has shown that the gas inspection robot and control system can acts as the precautionary measure to prevent accidents upon gasleakage.

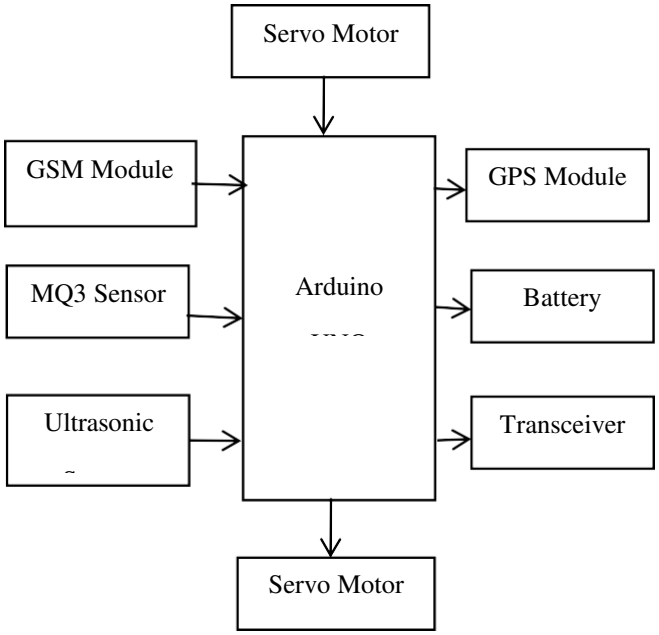
Key Words : Robot , Sensor , GSM , Arduino , shut-off

1.INTRODUCTION

Over the years, technology is fast paced and different security devices were innovated. Robotics is one of the quickest rising engineering researches of today. Robots are intended to avoid human factor from difficult job or unsafe work and for remote location applications. Robotic solutions are available in the form Pipe Inspection Robots. It can detect leaks in a pipe system through the use of electronic sensors. It has the ability in detecting single or multiple leaks in pipeline . In fact, there are robotic technologies widely used in offshore oil and gas industry nowadays.The main device used in this paper is the integration of a microcontroller.Microcontroller can be programmed to detect gas leakage. This can be applied to detect gas with a mobile communication for security measures. This automated hazardous gas detecting robot using wireless sensor networks with GSM alert and GPS modules to identify the precise leakage locations during the of the leakage as it is very important for maintenance purpose and control system for industries designed and built to prevent accidents. With this kind of robot, human and property can be saved in a much higher percentage.In our study to develop mobile gas inspection robot, two kinds of sensor will be used for the gas detection and obstacle avoidance.As pipeline leakagecannot be anticipated, therefore, our robot will continously monitor and inspect the pipeline.

2. METHODOLOGY

3.Figure : System Architecture of the Robot



Hardware Requirements : Arduino UNO ,MQ3 Gas Sensor , LCD display , GPS Module , GSM Module , Servo Motor , Relay, Transceiver, Ultrasonic Sensor , Battery & Solenoid valve

Software Requirements : Arduino IDE Software

System Architecture of the Robot :

The system architecture of the mobile gas inspection robot is shown in the above figure.It consists of two servo motors to drive the robot along the pipeline.The gas leakage is sensed by using the MQ3 gas sensor provided to the robot.Ultrasonic sensor is used to avoid any obstacles during the motion of the robot along the pipeline.The GSM Module installed to the robot sends the information of the gas leakage to the registered mobile number and the location coordinates of the leakage are known by the GPS module and are included in the SMS alert send to the registered mobile number.The power for driving the robot is provided by a battery.The transceiver can acts as both transmitter and receiver but here it is used as a transmitter to send information about theleakage,

Architecture of the Alert & Control System :

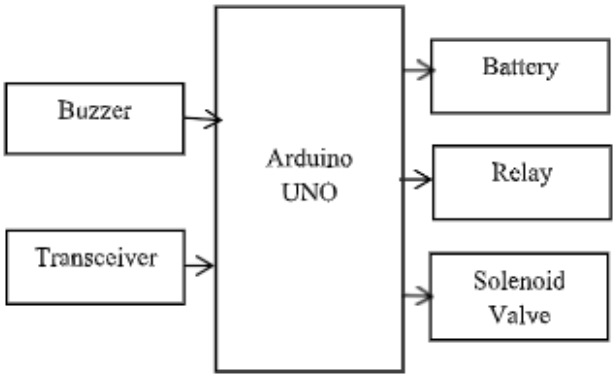


Figure : Architecture of the Alert & Control System

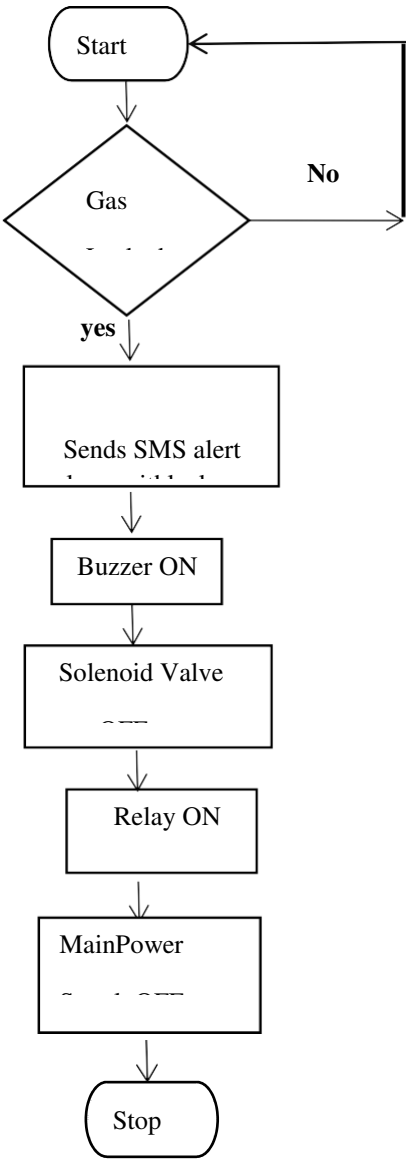
The architecture of the alert & control system is shown in the above figure.The buzzer alerts the control room by making sound and the solenoid valve and relay are used to shut down the gas flow and main power supply.The transceiver is used as a receiver to receive the leakage status.

Working Mechanism :

The robot starts moving along the pipeline driven by the servo motors and starts detecting for any gas leakage.If the any leakage occurs the output of the sensor pin goes high and sends it to the arduino microcontroller.Then the arduino starts sending an alert message “Gas Leak Occured” to the registered mobile number along with the location coordinates of the leakage from the GPS Module through the GSM module.The transceiver gets ON and acts as a transmitter to send the leakage status to the alert and control systems.The Tx includes “address” in the message to get identified by the receiver.The location coordinates of the leakage is send to the control system through the GPSmodule.

Both the transceivers works on same channel.The tranceiver at the control system acts as a receiver and checks for the address of the transmitter in the message and ignores the message if not present.As soon the receiver receives the message then the arduino microcontroller start taking action.The buzzer will be ON to alert.The arduino sends a low logic to the solenoid valve to turn off the valve and contol the gas flow.Finally the arduino sends logic high to the relay and the relay will be ON which cuts the main power supply to prevent fireaccident.

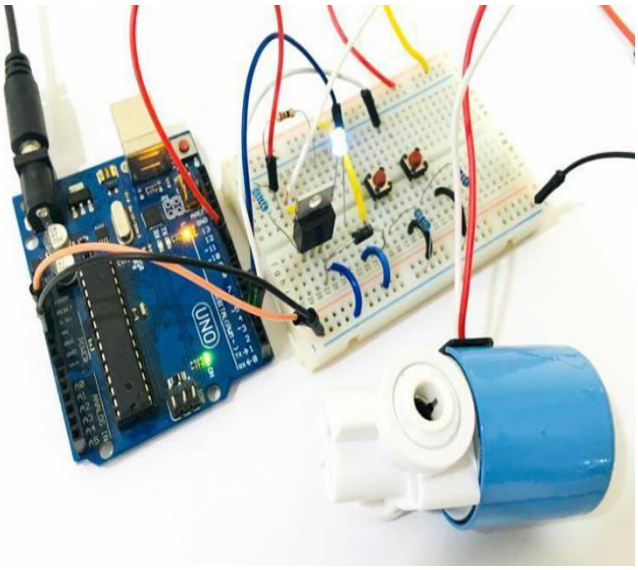
Working Flowchart :



4.TESTING & RESULT

The testing of the prototype is divided into movement of the robot and functionality of alert and control systems.The movement of the robot is tested for forward , backward , rotate , turn to left , turn to right and obstacle avoidance.The robot has moved forward and upon reaching the end of the rail,it reversed to the start point.The functionality test is done by spraying a gas towards the sensor.As the robot detected the gas it sends an SMS alert to the registered mobile along with the leakage coordinates.The buzzer is on.The relay module is tested by using a bulb to turn off automatically when the relay is on and the solenoid valve is also tested to turn off.It proved that the sensor , alert and control systems are functioning as per thedesign.

Figure : Gas Inpection Robot



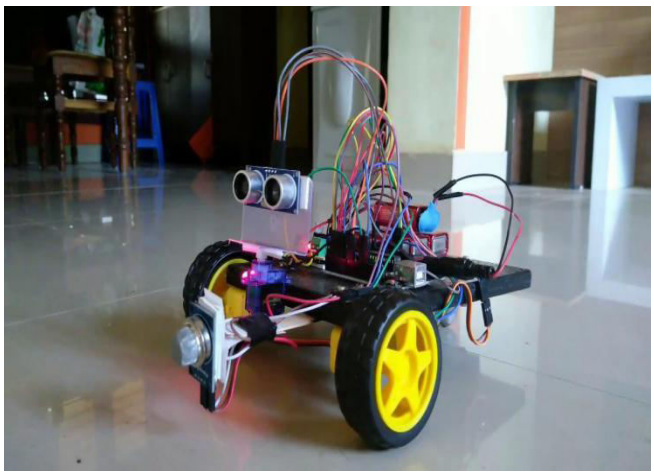


Figure : Relay Module with Arduino

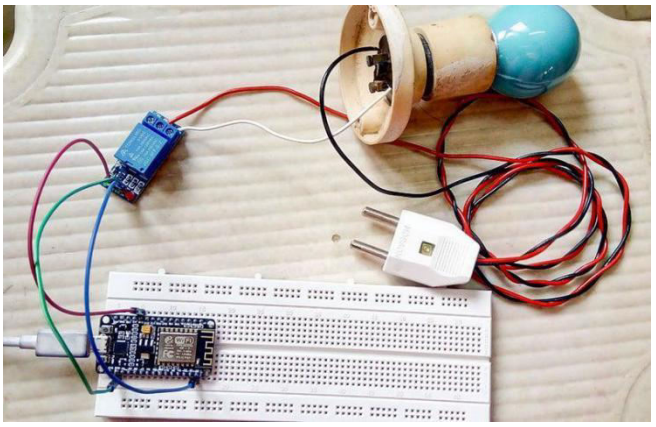


Figure : Solenoid Valve with Arduino

3.CONCLUSION

Overall, the developed microprocessor based gas sensing mobile robot has been successfully implemented.The movement of the robot is achieved by controlling the servo motor .The gas sensing function is achieved by the gas sensor. The notification is implemented using the GSM module. The functionality of the mobile gas inspection robot has been tested and successfully verified. The robot is capable of detecting gas presence and calculates therobot location as it transverse on the rail. The robot can automatically return to it the start point and stops as it detects an obstruction in front of it. In the presence of gas,the control system provided shuts off the gas and main power supply to prevent accidents.The mobile gas inspection robot is useful to monitor gas pipeline from any gas leakage that may lead tocatastrophe.

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