



Detection and Suction of Toxic Gases in Mines using Autonomous Ground Vehicle

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Abstract - In this paper we are going to focus and also to deal with the accidents which is happening in the mines due to the explosion and emitting of the toxic gases in the mines. Mines are one of the most important economic assets of our country, but every year there is numerous numbers of accidents happening in the mines due to the various problems in this one of the major problem is Gas Explosion. So in our project we are going to use the Autonomous ground vehicle to detect and suck the gas which is toxic for the humans and to the environment. With the help of this project we can reduce the Accidents which are happening on the mines and we can increase the reliability of working conditions in the Mines. This robot comprises of the various types of micro controllers, sensors for sensing, and 12v battery for power to drive the vehicle and relays for the automatic actuation of the vehicles. We are about to fixing the Ultrasonic and gas sensors for the detection of obstacles and the Toxic gas.

Key Words: sensors, micro controllers, radio frequency module.

I. INTRODUCTION

Safety is a prime intension of mine industry for proper functioning. It's not only for employees and workers but also for the environment and nation. Mines are the most critical challenge for safety, health and environment compared to other industry due to the complication in its operation and maintenance with wide range of hazardous. That's why maintaining of high standards of health, safety and environment in mines is of immense significance. There are several rescue robots still under progress and some of them have even been used in some emergence situations. The challenge facing to get Radio Frequency rescue robots working on the different field is to make them advanced or intelligent in software and reliable hardware to work in critical zone in the way that it can handle all possible obstacles. The significance of this paper is to get a valuable introduction of rescue robotics or unmanned machines, their challenges, how they are used today and what improvements could be in future of rescue robots for mines. To save the fatalities life of coal mines workers, due to unfortunate natural accident or unknowingly human made disaster, demands sophisticated and organized rescue planning from a government or rescue team. Accident comes with many obstacles for the rescue team that makes it hard for them to reach the victims, for example rainstorms, collapsed roof or side walls, obstructions, explosion and dangerous gases and different substances. Rescue robots, that are a type of field robots, can serve as appreciated tools for human teams under disaster

They can reach places between rubble and hazardous places that humans cannot, and effectively gather crucial information. The robots can also reach victims through narrow spaces and apply them with fluids and medication. To be useful tools the rescue robots must be smart and dynamic so they do not become obstacles for the rescue team.

II. REVIEW OF LITERATURE

In the hazardous environment, industrialized accident occurs. Due to which consequence may be very serious and it causes loss of environment, property and life. For moral, legal, & financial reasons hazardous environmental safety & security is more important wireless sensor network in industrial site, the deployment of distributed point source where the dangerous parameters used, produced and stored is described seven characteristics, fundamental aspects for estimating and emission method were identified. For measurement of temperature using Virtual Instrumentation is by Automatic Process Control in many industries.

This research shows survey study of need related with long term stewardship & environment monitoring. The aim of this paper is consideration of design for gas detection and save the workers of the detection of hazardous parameter using system on RF. In the wireless communication during emergencies is important for survival.

III. GASES EVOLVED DURING MINING

Natural gas is a fossil fuel. Like other fossil fuels such as coal and oil, natural gas forms from the plants, animals, and microorganisms that lived millions of years ago. When we begin to mines the place to utilize the minerals which has been deposited on the earth for the hundreds of centuries, the high compressed natural gases will be coming out in the rapid manner. In the combination of the natural gas which evolve during the mining the Methane plays the major role and gets the high concentration and more density. It is one of the toxic gases which is able to do harm for the humans. While mining other gases like carbon monoxide, hydrogen, nitrogen etc., will also evolve during the process.

IV. MOBILE ROBOTS

Mobile robot is an automatic machine that is capable of locomotion. Mobile robots have the capability to move around in their environment and are not fixed to one physical

autonomous mobile robot) which means they are capable of navigating an uncontrolled environment without the need for physical or electro-mechanical guidance devices. Alternatively, mobile robots can rely on guidance devices that allow them to travel a pre-defined navigation route in relatively controlled space (AGV - autonomous guided vehicle). By contrast, industrial robots are usually more-or-less stationary, consisting of a jointed arm (multi-linked manipulator) and gripper assembly (or end effector), attached to a fixed Radio Frequency. Christo Ananth et al. [4] discussed about a system, GSM based AMR has low infrastructure cost and it reduces man power. The system is fully automatic, hence the probability of error is reduced. Mobile robots have become more popular in industrial areas. Hospitals have been using autonomous mobile robots to move materials for many years. Warehouses have installed mobile robotic systems to efficiently move materials from stocking shelves to order fulfilment zones. Mobile robots are also a major focus of current research and almost every major university has one or more labs that focus on mobile robot research. Mobile robots are also found in industrial, military and security settings.

V. METHODOLOGY

In this project, we are going to propose the model of the mobile robot which is used to detect and suction the toxic gases and other natural gases which will be emitted in the mines frequently during the mining and in working. We are going to use the many transmitting devices for communicating with the robot and microcontrollers for the control and working of the robots inside the mines and to carry out the operation. We are going to use the unmanned Autonomous robot for the detection and suction of the gases in the mines. With the help of the microcontrollers, we are yet to in Radio Frequency the sensors, relays & driving mechanism of the vehicle. We are transferring the data's between the static sensor and movable sensor with the help of Arduino by using wireless transferring device (RADIO FREQUENCY). The transmission & receiver module are fixed at both sensors and will be interfaced with the Arduino for transmission.

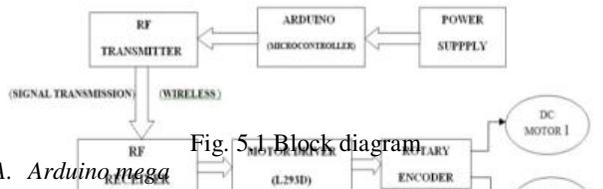


Fig. 5.1 Block diagram

A. Arduino mega

Arduino is an open-source project that created microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices.^[1] The project is based on microcontroller board designs, produced by several vendors, using various microcontrollers. These systems provide sets of digital and analog input/output (I/O) pins that can interface to various expansion boards (termed shields) and other circuits. The boards feature serial communication protocols, including Universal Serial Bus (USB) on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) based

on a programming language named Processing, which also supports the languages C and C++.

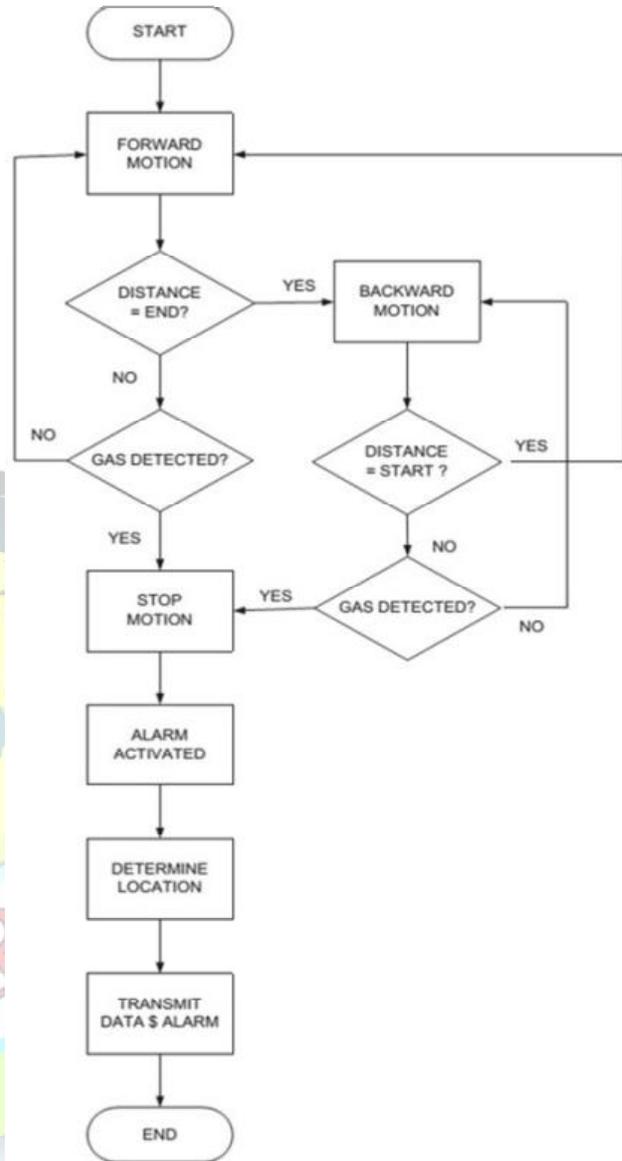


Fig. 5.2.1 Flow Chart

B. Radio frequency transmitter and receiver

The radio frequency module, as the name suggests, operates at Radio Frequency. The corresponding frequency range varies between 30 kHz & 300 GHz. In this radio frequency system, the digital data is represented as variations in the amplitude of carrier wave. This kind of modulation is known as Amplitude Shift Keying (ASK).

Transmission through radio frequency is better than IR (infrared) because of many reasons. Firstly, signals through radio frequency can travel through larger distances making it suitable for long range applications. Also, while IR mostly operates in line-of-sight mode, radio frequency signals can travel even when there is an obstruction between transmitter & receiver. Next, radio frequency transmission is more strong and reliable than IR transmission. Radio frequency communication

This radio frequency module comprises of an radio frequency Transmitter and an radio frequency Receiver. The transmitter/receiver (TX/Rx) pair operates at a frequency of 434 MHz. A radio frequency transmitter receives serial data and transmits it wirelessly through radio frequency through its antenna connected at pin4. The transmission occurs at the rate of 1Kbps - 10Kbps. The transmitted data is received by a radio frequency receiver operating at the same frequency as that of the transmitter.

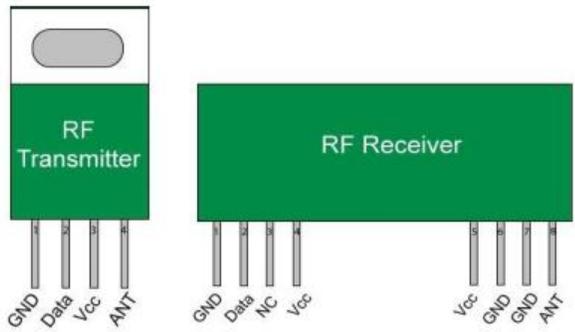


Fig. 5.3.2 Radio Frequency Module

VI. MQ6 GAS SENSOR

Gas sensors is one of the most important sensors which is used to detect the hazardous gases in the environment and in mines. In our project we are yet to use the MQ6 gas sensors which is used to detect the natural gases like methane and hazardous gases like CO, NO₂ etc., we are going to use the sensors because in mines the methane is the only natural compressed gas which is available in the plenty of the quantity. The specifications of the sensor are as follows.

- Type Semiconductor
- Detection Gas Natural gas/ Methane
- Concentration-300-10000ppm
- Standard test circuit -V_c:5.0V±0.1V ; V_H: 5.0V±0.1V

VII. DESIGN OF THE ROBOT

In our project we are going to use the multiple amounts of Transmitter and Receiver setup for the communication between the static and movable sensors which is fixed in the robots and in the walls of the mines. With the setup of the Arduino, mq6 sensors, radio frequency transmitter and buzzer will be fixed on the walls with the full setup. The receiver unit will comprise of the radio frequency receiver. With the help of the radio- frequency we are going to communicate with the signal to mobile robots which we created for the detection and suction of the gases. We are going to create the vacuum with the help of the suction pump. It will be automatically switched on with the help of the relay which is fixed to the Arduino. If the signal is received by the Arduino, it will begin to switch the relay on. Due to this reason the suction will be automatically carried out, if the methane or other natural gases are detected. If the gases exceeds its limits the buzzer will be switched on automatically with the help of the signal which is received from the Arduino will help to evacuate the humans from the hazardous zone.

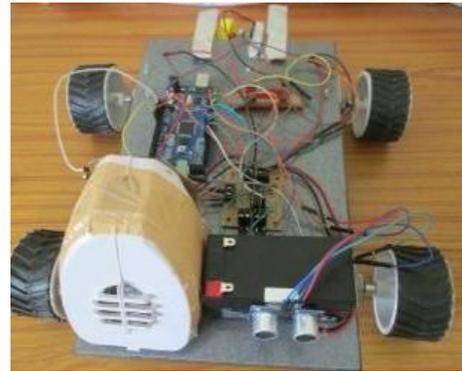


Fig. 7.1 Project Complete Setup



Fig. 7.2 Transmitter Setup

VIII. FUTURE SCOPE

In our Project we are going to add some special features on the movement of the vehicle and we are also decided to take our project to the level of pre-process sensing. The sensor and the pump are attached to the digging machine, it will reduce the life cause on digging process. The tank capacity is increased for the size of the mines or maximum capacity that what the Robot can carry.

IX. CONCLUSIONS

Thus we tend to believe that the robot we yet to introduce will be able to reduce the human losses in the mines due to the gas emission and explosion of gases. And thus we can be able to save the human life in the mines and the income of the nation will be increased. With the help of the robots we can also increase the reliability of working in the mines.

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