DESIGN AND FARICATION OFINDUSTRIAL PARAMETER MONITORING ANDCONTROL ROBOT

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Abstract

Now-a-days the accidents in the coal mine industries have increased. Even if any explosion occurs it can't be easily known to the worker and it may cause accidents. So in order to avoid this, a robot has been designed and this robot is allowed to monitor the ambient situations inside the coal mine industry. Some of the environmental parameters such as methane leakage, temperature, oxygen are sensed by using the high end sensors and the sensed data are transmitted   for monitoring the status of the coal mine and to control the robot movement.

If the temperature exceeds a threshold, the cooling fan is automatically set to ON and if any gas leakage is detected the workers are given alert through a buzzer. By this the human intervention can be avoided inside the industry and the accidents can be prevented.

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1. Introduction

In the hazardous working environment, human safety is an important concern. Coal mines is a place in which human lives are more dangerous and many workers are injured due to explosions and leakage of toxic gases. Fire accidents can also happen. At the same time if any person is absent in an important place for monitoring, it may also cause serious hazards. At present many systems are implemented in industrial areas but still those accidents are occurring. The new method is to design a robot and that robot is allowed to enter into the coal mine area. The robot will be equipped with some sensors like temperature and gas for detecting the toxic gases and the ambient temperature.

The robot used must be a flame-proof so that even if any disaster occurs it will transmit the information to the receiver without fail. Also, it must be designed to work in the high temperature situations. If any serious situation occurs means an alert given to the nearby workers. Wireless communication is also an important issue inside the industry

Usage of wired technologies are not worthy as the cables will get damaged after a certain period of time or due to some environmental factors. So the wireless transmission technology is preferred. The industrial monitoring protocol should be designed such that the system must have a reliable end to end data delivery. The data which is collected from the robot should be transmitted without any delay and loss of data.

2. Research Method

2.1 HARDWARE IMPLEMENTATION

The Raspberry pi 2 microprocessor is used since this is compact in size and the power consumption is too low. Broadcom chip BCM2836 SoC is placed in it and it has a memory of 1GB RAM with 900MHz frequency. Raspberry Pi 2 board is selected because it is fast when compared to the earlier versions. Many sensors or peripherals can be interfaced with it at the same time and can work very fast as the quad core processor is used in it. This processor allows us to interface many modules at a time.

The temperature sensor used here is DS18B20. As it is a digital sensor it is easy to interface with the raspberry pi board. It is used to sense the ambient temperature of the coal mine industry. This sensor is connected with the GPIO pins. The working of the cooling fan depends on the above sensed data. DS18B20 sensor has an operating range of about 55ºC to 125ºC. Inside the industrial area the temperature may exceed above 45ºC. So this sensor is used. MQ3 gas sensor is used in order to sense the gas leakage in the mining areas.

A gas sensor is for detecting the combustible, flammable and the toxic gases. The MQ3 sensor mainly detects the methane gas which is most emitted in coal mining areas. The voltage required is 5V which is provided from the GPIO pin. In the gas sensor, H-pins are allowed to heat for a while so that it can detect the gas. Once the gas is detected, an alert is given to the workers.

2.2 TECHNICAL DATA BUZZER:

A **buzzer** isan audio signalingdevice, whichmaybe Mechanical, Electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke. A buzzer is an electrical device that is used to make a buzzing sound, for example, to attract someone's attention.

Fig.1

DC MOTORS:

A direct current or DC motor convert's electrical energy into mechanical energy. It is one of two basic types of motors: the other type is the alternating current or AC motor. Among DC motors, there are shunt-wound series-wound, compound-wound and permanent magnet motors.

FUNCTION:

A DC motor consists of a stator, an armature, a rotor and a commutator with brushes. Opposite polarity between the two magnetic fields inside the motor cause it to turn. DC motors are the simplest type of motor and are used in household appliances, such as electric razors, and in electric windows in cars.

BASIC DC MOTOR OPERATION:

A DC motor is equipped with magnets, either permanent magnets or electromagnetic windings that produce a magnetic field. When current passes through the armature, also known as the coil or wire, placed between the north and south poles of the magnet, the field generated by the armature interacts with the field from the magnet and applies torque. In a DC motor, the magnet forms the stator, the armature is placed on the rotor and a commutator switches the current flow from one coil to the other. The commutator connects the stationary power source to the armature through the use of brushes or conductive rods. Furthermore, DC motors operate at a fixed speed for a fixed voltage and there is no slip.

Fig. 2

SENSORS:

In the broadest definition, a sensor is an electronic component, module, or subsystem whose purpose is to detect events or changes in its environment and send the information to other electronics, frequently a computer processor. A sensor is always used with other electronics, whether as simple as a light or as complex as a computer.

TYPES OF SENSORS FOR MAKING ROBOT

1. INFRARED SENSOR:

An Infrared sensor is an electronic sensor that measures Infrared (IR) light radiating from objects its field of view. They are most often used in IR-based motion detectors.

PRINCIPLE OF OPERATION:

We have already discussed how a light sensor works. IR Sensors work by using a specific light sensor to detect a select light wavelength in the Infra-Red (IR) spectrum. By using an LED which produces light at the same wavelength as what the sensor is looking for, you can look at the intensity of the received light. When an object is close to the sensor, the light from the LED bounces off the object and into the light sensor.
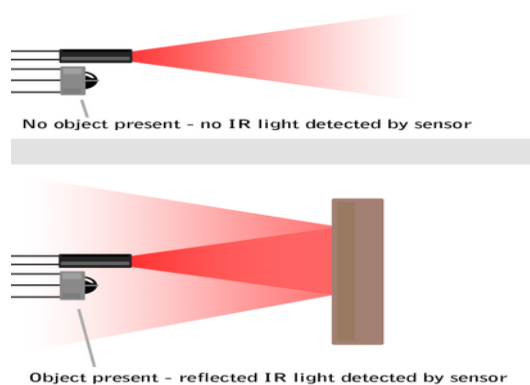
No object present – no IR light detected by sensor

Object present – reflected IR light detected by sensor

Fig.3

2. TEMPERATURE SENSOR:

Temperature is the most often-measured environmental quantity. This might be expected since most physical, electronic, chemical, mechanical, and biological systems are affected by temperature. Certain chemical reactions, biological processes, and even electronic circuits perform best within limited temperature ranges. Temperature is one of the most commonly measured variables and it is therefore not surprising that there are many ways of sensing it. Temperature sensing can be done either through direct contact with the heating source, or remotely, without direct contact with the source using radiated energy instead. There are a wide variety of temperature sensors on the market today, including Thermocouples, Resistance Temperature Detectors (RTDs), Thermostats, Infrared, and Semiconductor Sensors.

Fig. 4

3. GAS SENSOR:

In current technology scenario, monitoring of gases produced is very important. From home appliances such as air conditioners to electric chimneys and safety systems at industries monitoring of gases is very crucial. Gas sensors are very important part of such systems. Small like a nose, gas sensors spontaneously react to the gas present, thus keeping the system updated about any alterations that occur in the concentration of molecules at gaseous state.

Gas sensors are available in wide specifications depending on the sensitivity levels, type of gas to be sensed, physical dimensions and numerous other factors. This Insight covers a methane gas sensor that can sense gases such as ammonia which mightget produced from methane. When a gas interacts with this sensor, it is first ionized into its constituents and is then adsorbed by the sensing element.

Fig.5

- MQ3 gas sensor is used in order to sense the gas leakage in the mining areas.
- The voltage required is 5V
- If the gas leakage is sensed, the buzzer will become ON and alert the Surrounding people.

BATTERY:

An electric is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, smart phones, and electric cars. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode. The terminal marked negative is the source of electrons that when connected to an external circuit will flow and deliver energy to an external device.

2.3 IMPLEMENTED SOFTWARE

The raspbian os is used in the raspberry pi board. It is a free operating system that is based on Debian which is particularly optimized for the Raspberry Pi hardware. It comes with over 35,000 packages and pre-compiled software bundled in a simple format for easy installation in the Raspberry Pi. The coding for all the sensors and the robot movement are done using the python coding. Python is preferred since it is a simple and a minimalistic language. It is also free and open source software. This can be used in many platforms such as Linux, VxWorks, and Pocket PC etc. Also, it supports procedure-oriented programming as well as OOPS. The web browser is created by using HTML.

PROPOSED WORK:

A robot is designed using the raspberry pi board. The raspberry pi board is given a power supply of about 5V. The sensors which are connected are given power through the GPIO pins. An ALERT button is placed at the centre for giving alert to the workers in case of any emergency. The robot wheels are given 12V from a separate rechargeable battery. The movement of the robot depends on the python coding inside the raspbian os. The wheels are connected through a relay. The relay which here used is a 4-channel relay. When the robot is kept stationary, the GPIO pin which is connected to that particular relay is given high. During movement they are set to low. When the temperature sensor senses the temperature above 35ºC, Also, when any gas is sensed, the GPIO pin of the buzzer is kept low and thus the buzzer will be ON. If there is more suffocation inside the mining area, the carbon dioxide emission will be more. When this CO_2 is sensed, the oxygen supply cylinder will be opened by setting the GPIO pin of that particular relay to low. For

giving alert the audio and if any emergency situation occurs the ALERT button is pressed and thus the sound will be produced

Block Diagram
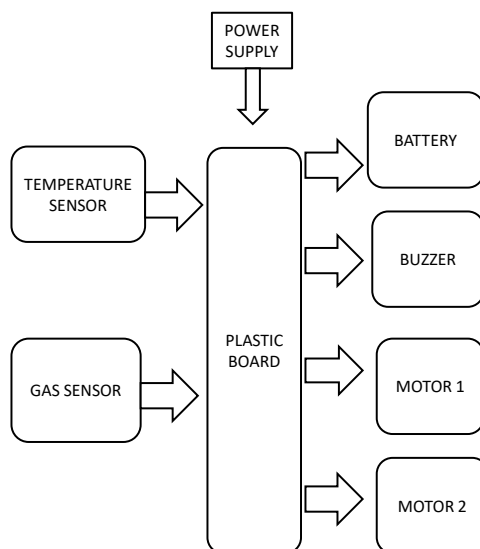
Block diagram of industrial parameter monitoring and control robot

3. Results and Analysis

The following are the experimental results. The Figure shows the designed robot..The ALERT button is for giving the emergency alert. The live video of the industrial area will be shown in that rectangular window in the centre. The time and date will be shown in the right most corner in the downside. In the emergency area, a person should be always present. If they are absent means, the alert is given through the speaker. The sensed data such as the temperature value, gas sensor value.
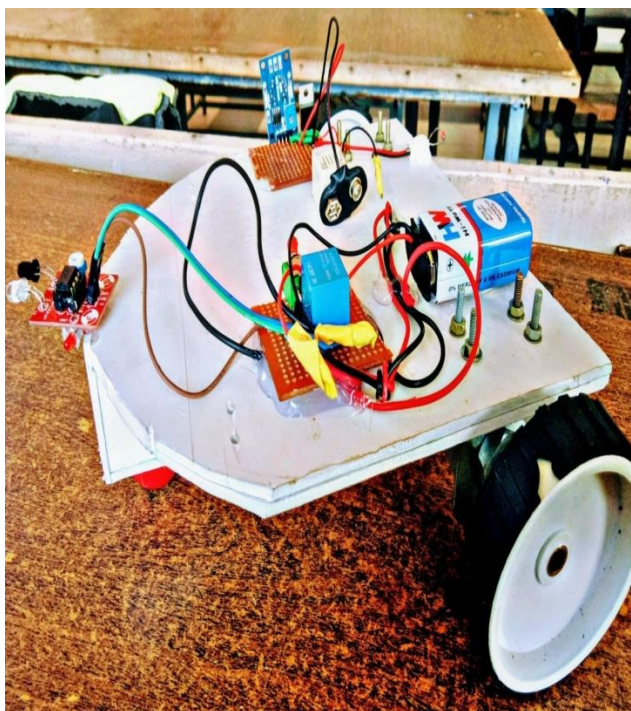
Final model of industrial parameter monitoring and control robot

ADVANTAGES & DISADVANTAGES

ADVANTAGES:

- Consistency Of Performance
- 24/7 Continuous Working
- Reduced Amount Of Operator Errors
- Improved Quality Of The Product
- It Can Move From One Location To Another Location
- Robotic Workers Never Get Tired
- Do Not Need To Be Paid
- Can Be Made To Perform Even The Most Dangerous Tasks Without Concern
- Wide Acceptance
- Identify Issues In Real Time, Before They Impact End Users
- Automate Responses To Speed Response Time And Maximized Availability
- Access Critical Data Quickly And Avoid A Lengthy Investigation Process

DISADVANTAGES:

- Initial Expensive Development Costs
- Unemployment Due To Many Assembly Line Jobs Now Being Done By Robots/Loss Of Human Jobs
- Possible Need For Extra Space/New Technology To Accommodate Robots
- Cost Of Maintenance /Running Cost Is More

APPLICATION AREAS:

- Exploration , monitoring and surveillance

    -Space exploration

    -underwater/surface exploration

-Wildlife observation

-Fire awareness monitoring

-Debris cleaning and human rescue

-spy robots

• Household and education

-Household appliances control

-Virtual stimulators and games

-Virtual distance laboratories

• Manipulations from distance ,indirect manipulations

-Bomb diffusion

- Tele surgery

-Nuclear decontamination and decommissioning

4. Conclusion

The designed robot is reliable to use and can be used in any working environment. The sensors which are used are so sensitive. The gas sensor will also detect other leakage such as hydrogen, smoke etc. This model can also be used for other purpose also. The suffocation of the working inside the mine is avoided. The accidents are prevented which are caused by ambient conditions.

This application can be used for all industrial area where human intervention for security can be avoided. In hospitals, shopping malls also this application can be used. In case of any fire accidents water has to be sprayed at the right place. Also, some other sensors such as dust sensor, humidity sensor can be interfaced for further convenience of the workers.

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