



# REAL TIME VIDEO CONTROLLED TRACTION FOR SURVEILLANCE ROBOTS IN COAL MINE

Sarath Chandran.C<sup>1</sup> and Anjaly K<sup>2</sup>

Assistant professor, St. Joseph's College of Engineering & Technology, Palai, Kerala ,India<sup>1</sup>

PG Scholar, St. Joseph's College of Engineering & Technology, Palai, Kerala , India<sup>2</sup>

**Abstract:** This paper represents the efforts undertaken for the developments of a video based coal mine rescue robot. That may be used for various complex environments. The gas, temperature, motion, distance and fire are detected and transmitted to the ground control center through the wireless network module by using the camera and different sensors. It helps the rescue team for better planning and execution of their operation. It also zenith a flame detection system, which provides more accurate and faster information on the fire scene.

**Keywords:** Sensors, Zigbee, Camera, flame detection, Serial communication.

## 1. INTRODUCTION

A coal mine enterprise is a high risk profession and technique. In recent years, the situation about which safety production is serious in the coal mine field, hazard accidents are occurring[2]. So they cause huge losses for the miner's and property losses. It has been observed that most of the accidents occur mainly due to lack of systematic monitoring and maintenance operations. To minimize the chance of accidents and thereby increasing the productivity of the mining operations using autonomous robots[1]. Every mining operation needs a special attention in order to deflate the chances of any kind of accidents. It has been initiated to carry out this task without human intervention using the field of robotics.

In this paper presents a novel video based coal mine rescue robot. After the coal mine disaster occurs the situation is unknown and very dangerous to go to the mine without any environment Situation. So the first mission of the rescuers is to detect the mine situations.

In this situation coal mine robot is an ideal tool.

The coal mine robot is a peculiar kind of robot, which operates without human control, comes under embedded system. The robot was controlled by software. It is used to detect the current situation of the tunnel. It sends the information throughout its path i.e., detected gas, flame and temperature signals through the zigbee transmitter, and a receiver is used to receiving the signals and it displayed on the monitor. It consists of a microcontroller based embedded system connected to various sensors that monitoring different situations and conditions of the mine. This system also transfers live videos from mine to the ground station using zigbee. This data determines the position and current situations inside the mine and

provides the rescuers a chance of making an immediate action if necessary.

The main objectives of using robot are,

a) Where human entrance is not possible.:

Robots have been put to use in complex environments that are too hazardous for man.

b) To rescue operations

Robots also work under dangerous conditions, for search and rescue operations. Robots are put to work in underground mines. A lot of research today is focused on improving rescue functions of robots.

## 2. PROPOSED SYSTEM

Here, in this project using zigbee technology the details get communicated and so we can identify the situation happening under the ground. This robot can go into explosion environment and detect all the under ground conditions.

Video based robot functions mainly include: 1) Fire Detection. It can detect the fire on both sides of fixed route, but also detect the fire automatically in the area without fixed route. When a fire is detected the robot move back. 2) Gas Detection. 3) Temperature Detection. 4) Obstacle Avoidance. The Ultrasonic sensors are used for obstacle avoidance and distance detection. 5) Record Distance Travelled. 6) Remote Wireless Transmission. It can send fire information wirelessly to remote terminal in real time. Remote terminal's functions mainly include: 1) Receiving the fire data sent from robot in real time 2) Displaying fire information, and saving record in real time.

There is a task selection key pad in order to give commands for doing certain task. We have two sections in this project, one is a transmitter section which is kept with base station and the receiver section act as the robot, these two sections are connected with a wireless module namely Zigbee module. Robot using PIC16F877A as control centre, obstacle avoidance sensor, gas sensor, temperature sensor, PIR sensor and wireless transmission module and so on. The general structure block diagram is shown in Figure 1.

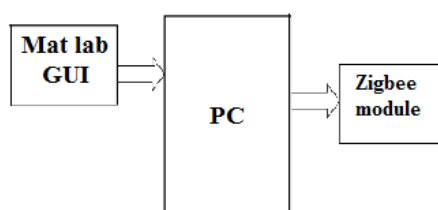


Fig1: Transmitter section

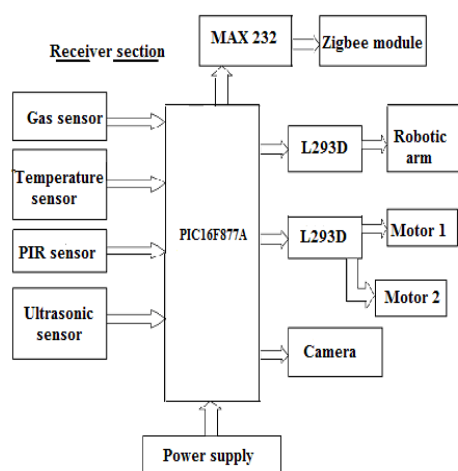


Fig2: Receiver Section

The block diagram shows the working mechanism of the robot. In the first step sensors processing the data and gives the digital output (Figures 2a). In the second step the micro controller receives the data from the corresponding sensors and monitors the value of each sensor (Figures 2b). If there is any unusual change occurs such as variation in gas sensor value, sudden increase in temperature value from the temperature sensor, and life detection sensor, it will inform to the base station. This is possible by exchanging the data from transmitter section to the receiver section through zigbee. In a similar fashion the mining people can give direction to the robot to do some specific task by proper task selection key pressing. The navigation can be controlled by giving the instructions

## 2.1 Brief Description Of The System

This paper integrates a real time video controlled robot that can work efficiently to help coal miners and also act as a life saver for miners. To use the real time monitoring

system and video images in the coal mine were susceptible to dust, light and miner's safety. Robot sends information of fire scene to remote terminal in real time, remote terminal receives fire information. A temperature sensor and gas sensor are also provided along with this, to check the current situation of the mine, if any critical temperature or unwanted gas occurs it will immediately inform the control station and take necessary actions.

### 2.1.1 Gas & Temperature Detection

A sensor (also called detector) is a converter that measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument. Gas and temperature sensor for which MQ-6 and LM35 sensors are used respectively. The MQ-6 gas sensor is highly sensitive to combustible gas such as LPG, propane, butane etc. The MQ-6 can detect gas concentrations anywhere from 200 to 10000ppm. The LM 35 has a range of 0-110 degree Celsius. In which gas sensor sense the unwanted gases and give instruction wirelessly to the control station. The temperature sensor also give the temperature rates and compare the current reading to the previous reading.

#### 1) Motion & Distance Detection

Motion and distance detection sensors for which PIR and Ultrasonic sensors are used. Ultrasonic sensors are based on measuring the properties of sound waves with frequency above the human audible range. The motion sensor is an infrared human detection sensor. As this sensor detects temperature differences, it is well suited to detecting the motion of people by their body temperature.

### 2.1.2 Flame Detection

Robot, finding fire automatically in the area without fixed route, need to ensure whether there is a fire around the environment or not at first. If the answer is yes, the robot will determine the direction, and drives fast towards it according to the information detected. The robot stops moving and move backward, then detects information and sends it to the base station.

The camera module consists of a wireless camera and an AV receiver and an AV tuner card. The wireless camera is mounted on the robot and the video signal is transmitted to the AV receiver and it is tuned to get the original signal. The video is then transmitted to the PC by interfacing an AV tuner card

Several methods exist for the detection of fire through live video capture. Fire detection is capable of detecting all types of fire and smoke well and consistently. They are highly sensitive to bright light. The fire is detected using the brightness of light. The maximum brightness indicates the fire detection. The detectors were very accurate in detecting light. When the flame detector "see" a flame, robot starts to signal that it had found the fire. The behavior was going to help robot be able to find the fire faster.

## 2.2. Hardware Implementation

The objective is to design and develop a prototype that can increase miner's safety, efficiency and confidence[8]. To achieve this goal we have to design a system that has the following functional components:

- PIC microcontroller
- Sensors
- DC Motors
- Zigbee
- Camera

PIC is a family of modified Harvard architecture microcontrollers made by Microchip Technology. PICs are popular with both industrial developers and hobbyists alike due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, and serial programming capability. PIC architecture is RISC type.

A sensor or detector is a converter that analyse a physical property and converts it into a signal which can be read by an observer or by equipment. Four sensors are used. They are gas and temperature sensors for which MQ-6 and LM 35 sensors are used respectively. Gas sensors will be used to detect harmful gases such as methane, butane, propane etc and check the level of such gases in the surrounding atmosphere. The MQ-6 can detect gas concentrations any where from 200 to 10000ppm. The LM 35 has a range of 0-110 degree Celsius.

Motion and distance detection sensors for which PIR and Ultrasonic sensors are used. Ultrasonic sensors are based on measuring the properties of sound waves with frequency above the human audible range. The passive infrared sensor module is used for motion detection. It can be used as motion detector for security systems.

The robot driver module is concerned about the movement of the robot. The wheels are run by two DC motors of 200rpm and one DC motor is used for arm. The DC motors are drive the robot to move in forward, reverse and turn left and right. The complete motion endorses up on these DC motors. The robotic arm is used for pick and move operations. To each motor L293D IC supply is used. DC motors are widely used in robotics.

Wireless Small size camera for Surveillance and robotics. The tiny and low power operation makes it useful for mounting on wireless robots to transmit the videos to receiver. That signal can be directly seen into TV or in pc through TV Tuner or Video Capture Card. The camera module consists of a wireless camera and an AV receiver and an AV tuner card. The wireless camera is mounted on the robot and the video signal is transmitted to the AV receiver and it is tuned to get the original signal. The video is then transmitted to the PC by interfacing an AV tuner card. The camera module will transmit the video coverage of the paths and thus helping in easier mapping of the path to be taken by the rescue team. For real time detection, wireless camera of high range is to be used to get good

clarity and good coverage. The camera will also help the robot from getting stuck in a pit as the obstacles lying in path is foreseen and required action can be taken, thus improving the life of robot inside the tunnel. ZigBee is a specification for a suite of high level communication protocols used to create personal area networks built from small, low-power digital radios. ZigBee is based on an IEEE 802.15.4 standard. Though low-powered, ZigBee devices always transmit data over longer distances by passing data through intermediate devices to reach more distant ones, creating a mesh network; i.e., a network with no centralized control or high-power transmitter/receiver able to reach all of the network devices

### 2.3. Software Implementation

The program was written and simulated using MATLAB, MikroC, which is a complete IDE. It consists of a text editor, C compiler and a simulator to simulate our code. It can directly burn the program to the system since a SOC has been used here. Circuit implementation and layouts is done by OrCad 6.5. VR Bot module is programed by EASY VR Commander version 3.4.10.

## 3. RESULT AND DISCUSSION

The video coal mine robot is designed and it is shown in fig3. Camera and other equipments are integrated into it. A 12v rechargeable battery is used to run the robot.



Fig3: Video coal mine robot

### 3.1 Sensor Unit

A sensor or detector is a converter that analyse a physical property and converts it into a signal which can be read by an observer or by equipment. The figure shows that sensors are detect the temperature, distance, life, etc are measured.

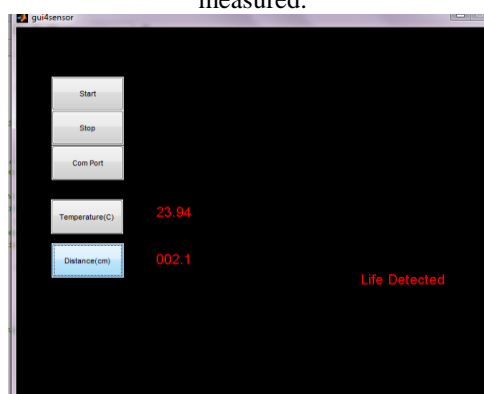


Fig4: Sensor unit

### 3.2 Video Flame Detection

Several methods exist for the detection of fire through live video capture. Fire detection is capable of detecting all types of fire and smoke well and consistently. They are highly sensitive to bright light. The fire is detected using the brightness of light. The maximum brightness indicates the fire detection. The detectors were very accurate in detecting light. When the flame detector “see” a flame, the robot begins to indicate that it had found the fire. The behavior was going to help robot be able to find the fire faster.

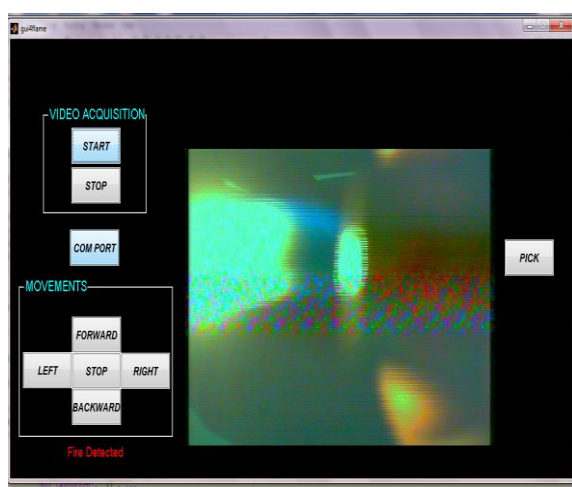


Fig5: Video Flame Detection

## 4. CONCLUSION

The project is aimed at providing human safety for the rescue team in dangerous environments. It can be implemented in real time by using components with better range and efficiency. This robot enters into complex environments. It provides data like various gases after the explosion has occurred and also the temperature based on which the rescue team will be sent with necessary precautionary measures in order to make sure that the rescue team does not come to any harm.

In the future this can be acquired by the exercise of higher transmission range so that it can travel for a greater distance and can be utilized in different environments based on the transmission range. Development can also be made in the number of sensors incorporated in the robot. Various other sensors like liquid, O<sub>2</sub> sensor can be added and thus helping to get a much improved image of the environment inside.

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