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SECURITY SURVEILLANCE SYSTEM FOR INDUSTRIAL PROCESS MONITORING USING RASPBERRY PI

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Abstract: Cloud computing is thus a flourishing technology that has the potential to revolutionize the world. All items in the dimension have the ability to communicate with each other in the Internet of Things, which gives individuals with a comprehensive knowledge of everything. Many initiatives use IoT to assist individuals improve their daily lives by making them easier, quicker, and healthier. In this paper, we propose an IoT-controlled response efforts for care and traffic emergency response teams, which may be particularly valuable in the event of a catastrophic accident involving a car. To enhance the overall recovery technique and allow emergency responders to accurately estimate the resources required, a timely and accurate evaluation of the size of the disaster is vital. When an emergency situation is detected, the suggested equipment instantly goes to work. The application would contact the appropriate authorities and submit crucial and essential information, such as the location of the event, the monitored health state, and images taken with the camera when the accident occurred. The Raspberry Pi 3 was used to build the gadget, which necessitated the usage of particular sensors.

Now-a-days the accidents in the industries have increased. Even if any explosion occurs it can't be easily known to the laborers 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 transmittedto the mobile phone through Wi-Fi. A static ip address is configured in the microprocessor for the Wi-Fi. The robot has a camera that transmits live video signal to mobile phone 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. Oxygen is supplied is there is suffocation for the labourers. The robot is

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designed using a Raspberry Pi 2 board. The Wi-Fi dongle and sensors are attached to the robot and this robot is tethered with the mobile phone and can be controlled from a web browser using navigation buttons. By this the human intervention can be avoided inside the industry and the accidents can be prevented.

Keywords: wi-fi, raspberry pi 2, tethering, high end sensors, robots, static ip.

I. 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. A camera is also interfaced with the robot which will give a live video of the environment and this video is transmitted to the mobile phone to the user who is controlling the robot by means of Wi-Fi technology. 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. Some of the techniques like zigbee, bluetooth have a small range and the data rate is minimum when compared to Wi-Fi. So using Wi-Fi the data can be transmitted to a wide range with a high data rate of 54Mbps.

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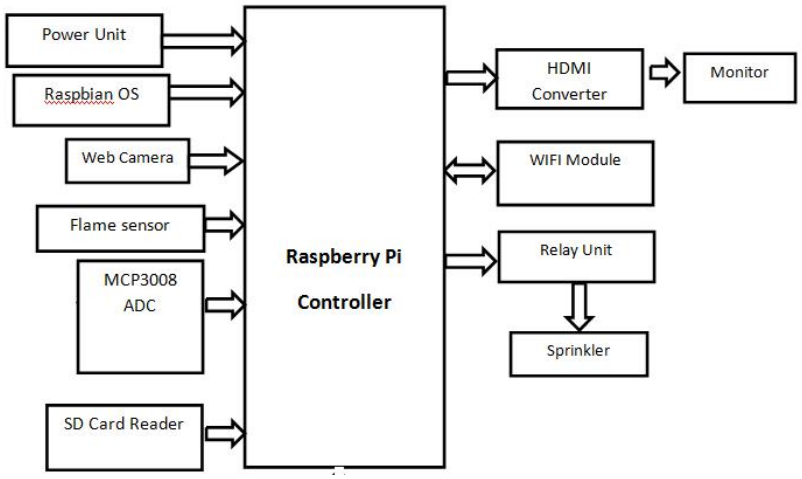

Figure-1. Block diagram of transmitter section.

The block diagram of the transmitter section for the coal mine monitoring is shown in the Figure-1 The Raspberry Pi 2 board is interfaced with the temperature sensor and gas sensors. A camera is connected to one of the USB port of the board. A buzzer is connected for giving alert to the labours and a cooling fan is interfaced inorder to reduce the ambient temperature in case if the temperature exceeds a threshold. A Wi-Fi dongle is connected to the USB port. Two DC motors are connected for the robot movement through the relay circuit. Another DC motor for supplying oxygen is connected to the board. This whole module is sealed and it is allowed to monitor the working environment. The power supply for the robot wheel is given by using a 12v battery.

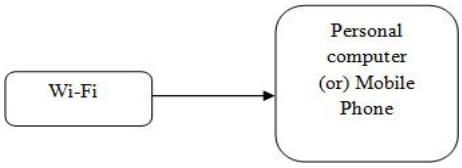

Figure 2. Block diagram of receiver section.

In the Figure-2 the block diagram of the transmitter section is given. In this section a mobile phone or a personal computer can be used. The robot is tethered with the mobile phone. The created web browser is openedin it and used.

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II. LITERATURE SURVEY

The IOT's associated work is discussed. The System may be developed in a variety of ways. Ahmed Imteaj et al. presented a fire alerting system for garment manufacturers that uses a Raspberry Pi and multiple temperature and relative humidity intensity sensors to generate the warning. Because the wildfire is not initially managed by some water spraying technique, it is inefficient. Wireless communication strategy for smoke detection and alarm was developed by Dong et al. To accomplish quick fire detection, a wireless automated fire alarm system with minimal power consumption has been designed. However, it fails to describe how to properly detect fires and how to use an authentication system to identify false alarms. Sun et al. highlighted large high-rise building fire instances in a particular location, which paints a clear image for fire engineers and architects of the fire danger level. In this, certain fire situations and actions were presented. The author suggested a Bayesian network for assessing fire alarm systems, which specifies the link between fire alarm as well as physical-chemical properties produced during the fire burning process. This approach is expensive and time intensive since it employs several sensor nodes. In, he proposed a smoke detectors based on video processing. By combining a pyro-electric Thermal imaging (PIR) module with a Raspberry Pi, the authors were able to detect an intruder or any odd occurrence in the home while minimising the delay. The author created a fire extinguisher system that was equipped with a variety of sensors, actuators, and was controlled by a microcontroller unit.

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. It has 26 GPIO pins, two 3.3V pins, two 5v pins and 8 ground pins. It has 4 USB ports also which allows us to connect the camera, Wi-Fi module etc.

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

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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.

A normal USB camera is connected to the board. The camera captures and sends the live video signal to the receiver. Also, a Wi-Fi dongle is used. It has a coverage area of 150 feet. The data transmission rate is about 54Mbps. So the live video can be transmitted without any delay. The robot wheel is connected to the two DC motors of 10rpm. Those motors are given 12V as the input voltage. The motors are not directly connected to the raspberry pi board. They are interfaced by means of a relay circuit. The cooling fan and the buzzer will work by means of the relay operation which acts as the switch here. A 4 channel relay board is used. The relay will also acts as a safety measure because the robot wheels are given a 12V and if any back emf occurs means it will short and damage the raspberry pi board directly. So in order to avoid this, an optocoupler is placed in the relay circuit board.

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 PocketPC etc. Also, it supports procedure-oriented programming as well as OOPS. The web browser is created by using HTML.

The static IP address should be configured in the raspberry pi for the Wi-Fi dongle. This assigned static ip address is for connecting with the Wi-Fi of the mobile phone for the live video

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transmission.

Since a normal usb camera is used it must be initially installed in the raspberry pi 2 board using the linux commands.

III. PROPOSED WORK

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 usb camera is fixed in the robot. The camera will capture the industrial environment and it will transmit the live video to the mobile phone and displayed in the created web browser. In the web browser three navigation buttons are formed for the up, left and right movement of the robot. An ALERT button is placed at the centre for giving alert to the workers in case of any emergency. The Wi-Fi dongle in the robot must be tethered with our mobile phone using the username and password. After tethering, a web browser should be opened and the static IP address must be given and the user name and the password of the raspberry pi are typed. After authenticating, the created web browser will be opened automatically and the robot is operated using the navigation buttons in the browser page. The robot wheels are given 12V from a separate rechargeable battery. The movement of the robot depends on the python coding inside the raspbion 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, the GPIO pin which is connected with the cooling fan through the relay is set to LOW which will operate the cooling fan. 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 CO2 is sensed, the oxygen supply cylinder will be opened by setting the GPIO pin of that particular relay to LOW.

The robot movement operations are given using the python coding and saved in the SD card in the microprocessor. These movement functions are called from the web browser navigation buttons using webiop macro function. When any navigation button is pressed it will call the particular function from the main program and the particular operation will takes place.

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For giving alert the audio file is saved inside and if any emergency situation occurs the ALERT button is pressed and thus thesound will be produced.

The sensed data will be displayed in the corner ofthe web browser.

ALGORITHM

Step 1: Give power supply to the raspberry pi board.

Step 2: Enable portable Wi-Fi hotspot in the mobilephone.

Step3: Connect the Wi-Fi dongle by giving the usernameand password.

Step 4: After tethering, open any web browser and thestatic IP address which is configured should be given.

Step 5: The created web browser will be opened.

Step 6: Give the following username and passwordusername: pi

password: raspberry

(The created web browser will be opened)

Step 7: Click on the navigation button for robotmovements.

Step 8: If any alert is to be given then press the ALERTbutton in the browser page.

IV. EXPERIMENTAL RESULTS

The following are the experimental results. The Figure-3 shows the designed robot. The cooling fan, the buzzer, Wi-Fi dongle and temperature sensor and the gas sensors are placed in the robot itself. The usb camera is fixed for the live video transmission. An oxygen cylinder will be fixed in the robot for supplying the oxygen during the suffocation for the workers.

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. By viewing the live video the robot is moved to the desired place. 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 will also be displayed in the browser page in our mobile phone or else pc with the help of the Wi-Fi connectivity.

The below Figure shows the gas sensor output. When there is any gas leakage inside the

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mining area, it will be sensed by MQ3 the gas sensor. If the gas leakage is sensed, the buzzer will become ON and alert the surrounding people. It not only senses the methane gas but also some other gases like oxygen, hydrogen and even smoke also. And so, if there is any suffocation inside the industry the oxygen supply will be given to the workers.

Figure-3. Gas sensor output.

In the above Figure, the sensation of gas is indicated by LED blinking. The Figure-6 shows the temperature sensor output. If the work environment is exceeds the normal room temperature, the cooling fan which is attached with the robot will automatically switched ON and thus the ambient temperature will be reduced. It will run until the surrounding temperature gets normal.

Figure-4. Temperature sensor output.

The temperature sensor output is indicated by the working of cooling fan. After cooling that particular place the robot is moved to another place.

V. CONCLUSION AND FUTURE WORK

The designed robot is reliable to use and can be used in any working environment. The

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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 work environment can be seen from the controller room itself. Since Wi-Fi is used, the data can be transmitted from any place. The suffocation of the labours 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. This project can be enhanced by placing a water sprayer in the robot. 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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