MULTIPURPOSE ROBOTIC CAR USING ARDUINO BASED ON IoT

Arthi Udayakumar B.E(cse).,

Jayaram College of Engineering and Technology, Trichy.

E-mail:arthiudaya1996@gmail.com

ABSTRACT: The world of control is an exciting field that has exploded with new technologies where the Internet of Things (IoT) vision becomes reality. This paper proposes a multipurpose Robotic car that senses fire, harmful gases and detects human using fire sensor, thermister, gas sensor and PIR sensor which can be controlled by Arduino based on IoT.Each device is uniquely identifiable by the controlling software which is the core concept of IoT. The Internet of Things has been established using the concept of Global System for mobile Communication(GSM), Thus the user can control the car remotely and the sense information is transferred to the websites of the authorized user in remote. The application of such model can be used in Rescue operation in coal mine which is extremely dangerous due to several factors. It is particularly very harmful for the rescuers to get into the coal mine tunnel in disaster without the prior knowledge of environment because the subsequent explosions may likely to occur at any time it is therefore essential to detect the explosive environment details such as toxic gases, high temperatures and also detects humans trapped.

Keywords: Mobile Robot, Coal mine, Rescue, Self-Localization, Mobile Sensors.

1.INTRODUCTION:

1.1 Internet of Things (IoT)

The Internet of Things is the internetworking of physical devices, vehicles, buildings, and other items embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. The IoT allows objects to be sensed and/or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduce human investments.

1.2 Global System for Mobile Communications (GSM)

The Global System for Mobile Communications (GSM) is the most popular standard for in the world. GSM service is used by over 2 billion people across more than 212 countries and territories. The ubiquity of the GSM standard makes international roaming very common between mobile phone operators, enabling subscribers to use their phones in many parts of the world. GSM differs significantly from its predecessors in that both signaling and speech channels are Digital call quality, which means that it is considered a second generation (2G) mobile phone system. This fact has also meant that data communication was built into the system from the 3rd Generation Partnership Project (3GPP). The GSM logo is used to identify compatible handsets and equipment. But the drawback in this system is we must pay tariff and maintain signal strength high

1.3 Arduino

A microcontroller is a complete microprocessor system built on a single IC. Microcontrollers were developed to meet a need for microprocessors to be put into low cost products. Building a complete microprocessor system on a single chip substantially reduces the cost of building simple products, which use the microprocessor's power to implement their function, because the microprocessor is a natural way to implement many products. This means the idea of using a microprocessor for low cost products comes up often. Today microcontrollers are very commonly used in wide variety of intelligent products. For example, most personal computers keyboard and implemented with a microcontroller.

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board. The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – you can simply use a USB cable.

Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

2.LITERATURE REVIEW

This section provides a descriptive summary of some methods that have been implemented and tested for controlling system of robots and devices by IoT and Arduino.

Vladimir Vujovic et al. described a Raspberry Pi home automation system where Raspberry Pi works as a sensor web node for controlling appliances in home automation which makes it the perfect platform for interacting with many different devices. Here Raspberry Pi is not just a sensor node but a controller [1]. Yet the controlling mechanism only includes data collection and updating and works only in indoor environment.

Another device controlling mechanism of Raspberry Pi is described in a Raspberry Pi based home automation system through E-mail [2]. The contribution of this paper is, Raspberry Pi can read out the commands of users through E-mail and the devices to be controlled are interfaced with Raspberry Pi using relay driver [2]. However, clients can only control the switching state of the appliances, no other controlling system is included. Jaroslav Sobota et al. [3], proposes extremely inexpensive and flexible control platform using Raspberry Pi and Arduino running the REX control system which is an open system for embedded control [3].

On the other hand, REX platform is not standard enough and unable to control a large number of devices at a time. The collecting data from [4] reveals that large number of accidents occur in a coal mine or other places during and after a disaster. The main reasons being, gas accidents, explosives, flood, caving, etc. It requires the development of a system that can help minimize the human and material loss that happens during rescue operations in coal mines. [5] Thus sensors for detect the gas are mandatory in the robot to be deployed. The idea of a Mobile Robot is able to aid the rescue team entering into a coal mine [6] got picked up with the tremendous uplift in the technology. The Robot is used to get in to the disaster zone and rescue research operations. The robot can go in to mine and detect O2 levels, temperature, gas contents, etc. The data can be sent to controller in safe field.

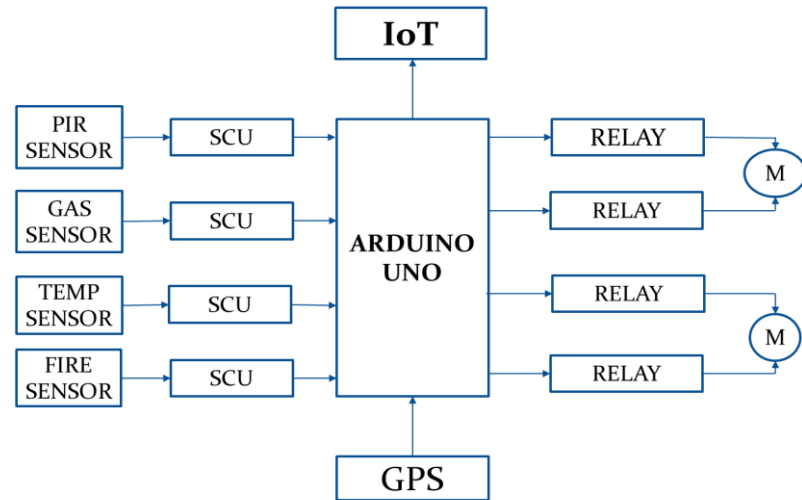## 3.PROPOSED SYSTEM

3.1 BLOCK DIAGRAM

Fig 3.1 Block Diagram

➢ SCU- Scan Control Unit

➢ PIR-Passive Infrared sensors

➢ GPS- Geographical Positioning System

➢ M – Motor

3.2 MODULES DESCRIPTIONS

3.2.1 PASSIVE INFRARED(PIR) SENSOR

Passive Infrared sensors (PIR sensors) are electronic devices which measure infrared light radiating from objects in the field of view. PIRs are often used in the construction of PIR-based motion detectors, see below. Apparent motion is detected when an infrared emitting source with one temperature, such as a human body, passes in front of a source with another temperature, such as a wall.
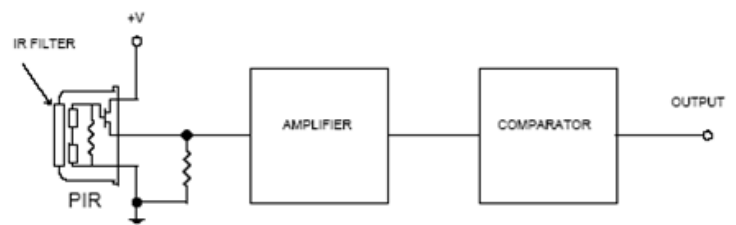
All objects emit infrared radiation; see black body radiation. This radiation (energy) is invisible to the human eye but can be detected by electronic devices designed for such a purpose. The term 'passive' in this instance means

the PIR does not emit any energy of any type but merely sits 'passive' accepting infrared energy through the front of the sensor, known as the sensor face. At the core of a PIR is a solid state sensor or set of sensors, with approximately 1/4-inch square area. The sensor areas are made from a pyroelectric material.

The actual sensor on the chip is made from natural or artificial pyroelectric materials, usually in the form of a thin film, out of gallium nitride (GaN), caesium nitrate (CsNO3), polyvinyl fluorides, derivatives of phenyl pyrazine, and cobalt phthalocyanine. (See pyroelectric crystals.) Lithium tantalite (LiTaO3) is a crystal exhibiting both piezoelectric and pyroelectric properties.

The sensor is often manufactured as part of an integrated circuit and may be comprised of one (1), two (2) or four (4) 'pixels' comprised of equal areas of the pyroelectric material. Pairs of the sensor pixels may be wired as opposite inputs to a differential amplifier. In such a configuration, the PIR measurements cancel each other so that the average temperature of the field of view is removed from the electrical signal; an increase of IR energy across the entire sensor is self-cancelling and will not trigger the device. This allows the device to resist false indications of change in the event of being exposed to flashes of light or field-wide illumination. (Continuous bright light could still saturate the sensor materials and render the sensor unable to register further information.)

At the same time, this differential arrangement minimizes common-mode interference; this allows the device to resist triggering due to nearby electric fields. However, a differential pair of sensors cannot measure temperature in that configuration and therefore this configuration is specialized for motion detectors.

3.2.2 THERMISTOR (TEMPERATURE SENSOR)

A thermistor is a type of resistor used to measure temperature changes, relying on the change in its resistance with changing temperature. Thermistor is a combination of the words thermal and resistor. The Thermistor was first invented by Samuel Ruben in 1930, and has U.S. Patent #2,021,491.

If we assume that the relationship between resistance and temperature is linear (i.e. we make a first-order approximation), then we can say that:

$\Delta R = k\Delta T$

Where, ΔR = change in resistance

ΔT = change in temperature

k = first-order temperature coefficient of resistance

Thermistors can be classified into two types depending on the sign of k. If k is positive, the resistance increases with increasing temperature, and the device is called a positive temperature coefficient (PTC) thermistor, Positron. If k is negative, the resistance decreases with increasing temperature, and the device is called a negative temperature coefficient (NTC) thermistor. Resistors that are not thermistors are designed to have the smallest possible k, so that their resistance remains almost constant over a wide temperature range.

3.2.3 FIRE DETECTING SENSOR

The flame sensor is used to detect the flame occurrence. When the sensor detects the fire then it became short-circuit. When there is no fire the sensor become open circuit. The flame sensor is connected with resistor. This connection formed the voltage divider network which is connected with inverting input terminal of the comparator. The reference voltage is given to non-inverting input terminal. The comparator is constructed with LM 741 operational amplifier.

When there is no fire, the flame sensor became open circuit. So the inverting input terminal voltage is greater than non-inverting input terminal (reference voltage). Now the comparator output is -12V which is given to the base of the switching transistor BC547. So the transistor is cutoff region. The 5v is given to 7404 IC. The 7404 is the hex inverter with buffer. Hence zero voltage is given to microcontroller.

When there is fire occurred, the flame sensor became short circuit. So the inverting input terminal voltage is less than non-inverting input terminal (reference voltage). Now the comparator output is +12V which is given to the base of the switching transistor BC547. So the transistor is turned ON. The zero voltage is given to 7404 IC. Hence +5v voltage is given to microcontroller. In the microcontroller we can detect the fire with the help of software.

3.2.4 GAS DETECTING SENSOR

Ideal sensor for use to detect the presence of a dangerous LPG leak in your car or in a service station, storage tank environment. This unit can be easily incorporated into an alarm unit, to sound an alarm or give a visual indication of the LPG concentration. The sensor has excellent sensitivity combined with a quick response time. The sensor can also sense iso-butane, propane, LNG and cigarette smoke.

Features:

• High Sensitivity

• Detection Range: 100 - 10,000 ppm iso-butane propane

• Fast Response Time: <10s

• Heater Voltage: 5.0V

• Dimensions: 18mm Diameter, 17mm High excluding pins, Pins - 6mm High

The gas sensor is the special sensor which designed for sense the gas leakage. In the gas sensor the supply voltage is given to input terminal. The gas sensor output terminals are connected to non-inverting input terminal of the comparator.

Here the comparator is constructed with operational amplifier LM 358. The reference voltage is given to inverting input terminal. The reference voltage is depending on the desired gas intensity. When there is no leakage the non-inverting input is grater then inverting input so the output of the comparator is positive voltage which is given to the base of the switching transistor BC 547. Hence the transistor is conducting. Here the transistor is act as switch so the collector and emitter will be closed. The output is taken from collector terminal. Now the output is zero which is given to hex inverter 40106.

When there is gas leakage the inverting input voltage is greater than non-inverting input. Now the comparator output is -12V so the transistor is cutoff region. The 5v is given to hex inverter 40106 IC. Then the final output data is directly given to microcontroller to determine the gas leakage.

3.2.5 GPS UPDATES

Whenever the Robotic Car is commanded to change its position, Arduino UNO polls the GPS sensor to get the updated GPS position and then when it is commanded to send the GPS position then this location is sent to the Data queue of the cloud service bus.

3.2.6 CONTROLLING UNIT

The microcontroller ATMEGA328-PU is used which is ATMEL microcontroller family. Arduino are popular due to their large user base, low cost, wide availability, and extensive collection of application notes, free development tools, and serial programming capability. The microcontroller is used to collect the parameter value from the sensor unit and compare it with the set point and transfer the corresponding data to the CPU. The microcontroller is the core of the surveillance robot.

3.2.7 Data Transceiver Unit

The transceiver unit is used both transmit and receive data. In this system we used IoT (GSM) technology for communication between robot and rescuer. One transceiver is mounted on the robot unit, which gets the data from the microcontroller and sensor is transmits to the control room where the other transceiver is placed. Likely, the transceiver placed in the control room will transmit commands to the transceiver mounted on the robot for the control. According to given programmed commends the robot can move in the mine tunnel.

3.2.8 Robot Driver Unit

The robot driver unit is primarily concerned about the movement of the robot in x-axis and y-axis. The robot is of conveyor belt type as it helps to manoeuvre over debris and rugged terrain. The wheels are run by four DC geared motors of 100rpm.
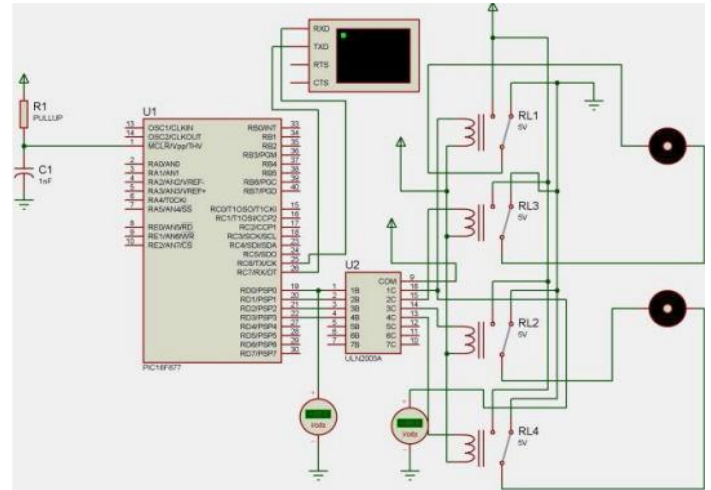

Fig 3.2.8.1 Robotic control unit

When both the wheels are given with positive pulse, the robot moves in forward direction, when the supply is negative pulse, it goes in backward direction and similarly by varying the negative and positive, left and right turn can be achieved. To choose the supply given to each motor, L293D IC is used. The robot movement circuit drives the robot to move in forward, reverse and turn left and right.

3.2.9 RS 232 COMMUNICATION

In telecommunications, RS-232 is a standard for serial binary data interconnection between a DTE (Data terminal equipment) and a DCE (Data Circuit-terminating Equipment). It is commonly used in computer serial ports. In this circuit the MAX 232 IC used as level logic converter. The MAX232 is a dual driver/receiver that includes a capacive voltage generator to supply EIA 232 voltage levels from a single 5v supply. Each receiver converts EIA-232 to 5v TTL/CMOS levels. Each driver converts TLL/CMOS input levels into EIA-232 levels.
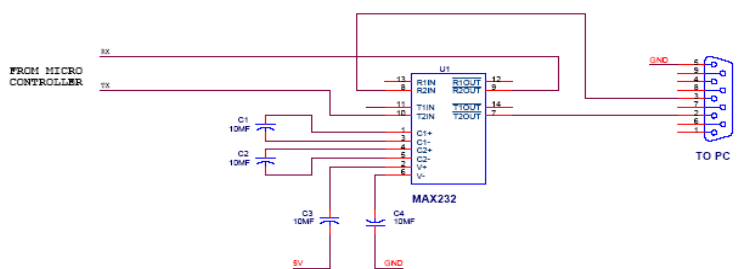

Fig 3.2.9.1 RS 232 Communication

In this circuit the microcontroller transmitter pin is connected in the MAX232 T2IN pin which converts input 5v TTL/CMOS level to RS232 level. Then T2OUT pin is connected to reviver pin of 9 pin D type serial connector which is directly connected to PC.

In PC the transmitting data is given to R2IN of MAX232 through transmitting pin of 9 pin D type connector which converts the RS232 level to 5v TTL/CMOS level. The R2OUT pin is connected to receiver pin of the microcontroller. Likewise, the data is transmitted and received between the microcontroller and PC or other device vice versa.

4. FEATURES

Unique identification of the target. Display of information and accurate location of the target defect or sensed thing in the website linked, Low power consumption, Faster processing ability at lower cost, In Coal mines for fire sensing and detecting harmful gas remotely where human can't reach, detecting human trapped in Coal mines or in Construction sites, Sensing Industrial environment through remote sensing.

5. CONCLUSION

In this paper an efficient approach of multiple control system is incorporated with IoT. Controlling multiple devices in multiple ways makes causes more convenience in handling a system. The sensed information is transferred to the authorized website of the user. The performance results prove that if the incorporation is efficient enough, multiple controlling methods have less effect on time and performance compared to single way of control system. The multipurpose robot for mine rescue, disaster surveillance is designed. A 12V/4A rechargeable battery is used to run the robot. The sensors are tested for their performance and to conduct the test, a wick or any other source of smoke is brought near to the MQ 7 sensor. This prototype robot has its safe values of $CO2$ set at 10 ppm and 70 ppm. The set point for temperature is 40 degrees Celsius. Once the measured value goes beyond these set points, a popup the monitor showing the parameters' level has exceeded.

In future this can be developed by flame proof materials, use of higher transmission it can travel for a greater distance and can be used in different environments based on the transmission range. A much improved image of the environment inside. Implantation of an arm on the robot can help the robot pick up samples or remove small debris from path inside the mine.

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