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GPS and Radar Based Autonomous Mobile Robot for Emergency Application

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ABSTRACT:Robotics is the growing field in the branch of engineering , and act as the technological advances continue; researching, designing, and building new robots serve various practical purposes, whether domestically, commercially, or militarily. This project aims to develop an autonomous intelligent robot which could assist humans in rescue operations during times of fire hazards. It is a fully autonomous robot which does not need any human interventions. The model is basically a 4 wheeled robotic vehicle. The robot navigated by global positioning system (GPS) and an array of sensors for navigation. This robot can be implemented in industries or big institutions to automatically extinguish accidental fires.

KEYWORDs:GPS-Global Positioning System, UART-Universal Asynchronous Receiver Transmitter

I.INTRODUCTION

Natural disasters and conflicts continue to devastate communities around the world.Disaster areas are one of the most challenging environments faced by human beings. Some are too dangerous or too far away. For such situations,depending the technology like robotics. It is one of the most developed branches of engineering, and is now being implemented for different applications. Robotics deal with automated machines that can take the p lace of humans in dangerous environments or manufacturing processes, or resemble humans in appearance, behavior, and or cognition. Disaster management is one of such fields in which robotics is applied. Robotics is a rapidly growing field, as technological advances continue; researching, designing, and building new robots serve various practical purposes, whether domestically, commercially, or militarily.A robot is a machine designed to execute one or more tasks repeatedly, with speed and precision. There are as many different types of robots as there are tasks for them to perform. Mobile robots have the capability to move around in their environment and are not fixed to one physical location...A team of mobile robots can quickly set up a network of mobile sensors and actuators for rapid action. Many robots are built to do jobs that are hazardous to people such as defusing bombs, finding survivors in unstable ruins, and exploring mines and shipwrecks. , etc., show the potential of use of mobile robots functioning as a groupMobile robots have been used in search and rescue operation of World Trade Centre terrorist attack and Hanshin-Awaji earthquake etc. In such situations mobile robots can enter voids too small or deep for a person, and can begin surveying larger voids that people are not permitted to enter until a fire has been put out or the structure has been reinforced. Robots can carry cameras, thermal imagers, hazardous material detectors, and medical payloads and other sensing equipment's into the interior of a rubble pile and set up communication link with human operator using the ad-hoc network set-up by these robots. Each robot equipped with accelerometer, angular velocity sensor and magnetic compass as sensor devices, can plan its navigational path with reference to each other and can get the sensor network dynamically relocated. Team of mobile robots equipped with different sensors and distributed and cooperative planning algorithms can also automatically generate the maps for oil spill or radiation leaks.

II.SYSTEM MODEL AND ASSUMPTIONS

The model proposed here is an autonomous robotic vehicle that assists humans during fire hazards in industries or institutions. The robot automatically detects fire with the help of flame sensors located at different zones on the industry. Then with the help of a GPS the robot navigate to the location and extinguishes the fire with the help of a water tank and pump arrangement.

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This complete arrangement has 3 sections. First is a zone controller sections. Flame sensors are located at different locations. These locations are classified as zones. All flame sensors are connected to an AVR microcontroller. The location details (latitude and longitude) of the zones are preset in the controller. When one of the flame sensors is activated the controller sends the location details of that particular zone through an RF transmitter to the robot. This section is also equipped with ultra-sonic radar transmitters for local navigation purpose of robot.
The robot receives the data and tracks to that particular coordinate with the help of GPS. The robot has a central AVR microcontroller which controls and coordinates all the activities of the robot, and a dedicated 8051 micro controller for the GPS control. Once the robot reaches the zone, it uses the ultrasonic radar receivers to navigate to the fault location and then using the flame sensor provided in the robot, it detects the flame and using a dc pump it pumps a jet of water to the flame until it is completely extinguished. The radar technology helps in local navigation of the robot.

III.EFFICIENT COMMUNICATION

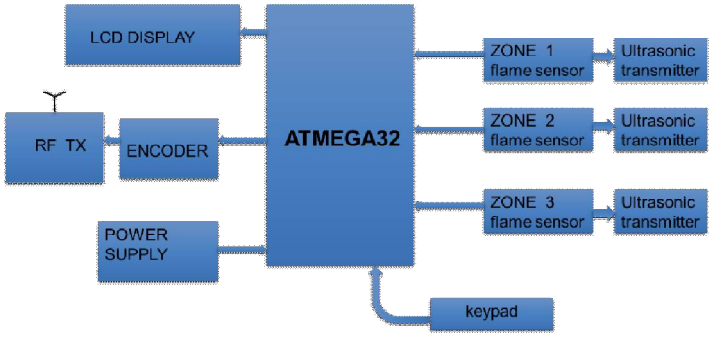

Fig 1 Zone control block

The sensors located at different zones are controlled by an AVR microcontroller. At the time on installing the sensors the latitude and longitude of the location is found out using a GPS and is feed to the AVR micro controller using a matrix key pad to address each zones. When any one of the sensors are activated the AVR controller sends its coordinates to the robot using an RF transmitter. This section is also equipped with ultra-sonic radar transmitters for local navigation purpose of robot.

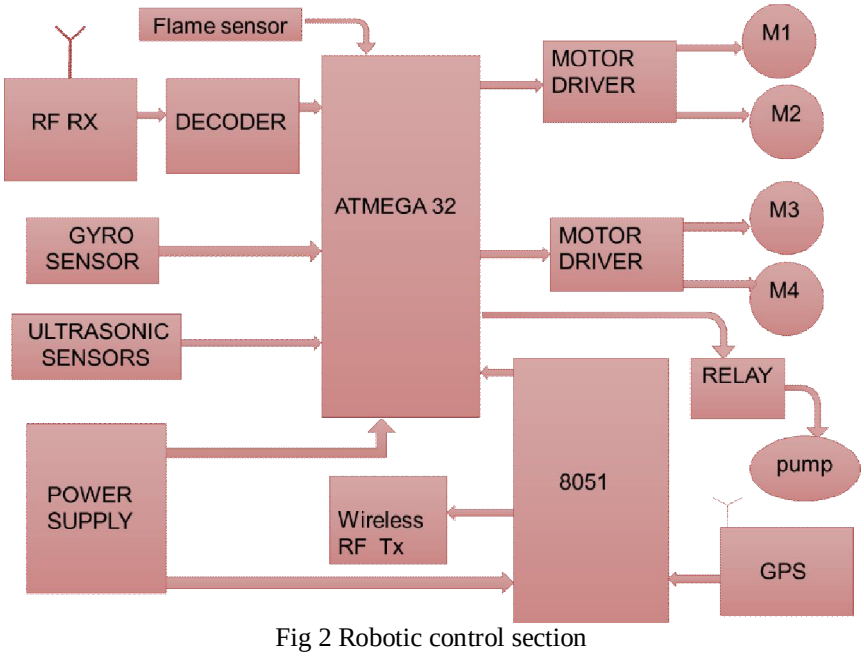

Fig 2 Robotic control section

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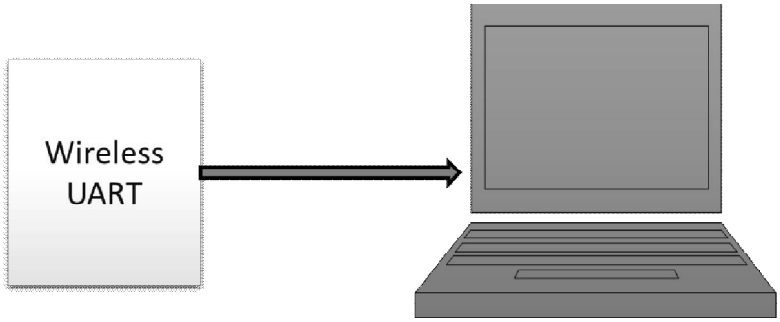

Fig 3.UART system connection

The robot is controlled by a central AVR microcontroller. There are ultrasonic sensors provided for obstacle sensing. A gyroscope sensor is used for sensing the direction of robot. Two motor drivers are provided for controlling the motors used for locomotion and the robotic arm. There is a relay used for operating the DC pump. A flame sensor is also provided in the robot for sensing the fire. All above components are controlled by the AVR micro controller. There is an RF receiver module provided for fetching the information from the zone controller. There is a dedicated 8051 microcontroller for receiving the GPS data. This secondary controller also sends the GPS information regarding the location to a system using a wireless UART module. The ultrasonic sensors provided helps in obstacle detection as well as local navigation.

IV.SECURITY

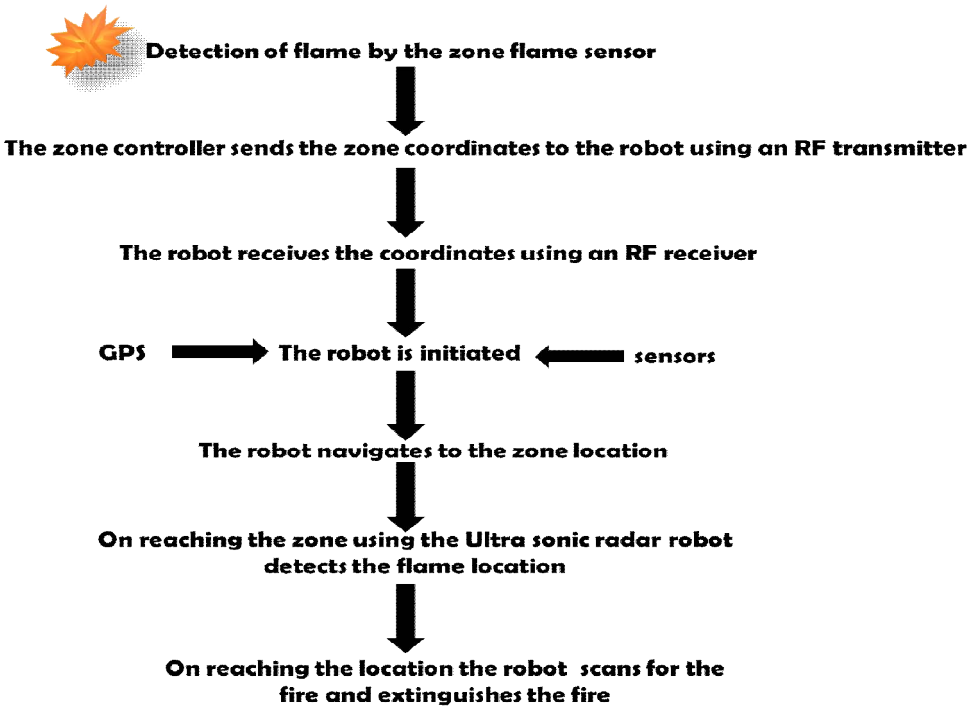

Fig 4. Overall working flowchart

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The flame sensors located at different zones are controlled by an AVR microcontroller (1). Each zone location is feed to the AVR controller at the time of sensor installation. So when one of the flame sensor detects a fire it gives a signal to the AVR (1). The AVR (1) sends the location information unique to that zone to the robot using an RF encoder and transmitter. The signal from the flame sensor also initiates the ultrasonic radar.
The information is received by the robot using an RF decoder and receiver. Then it is given to the main AVR controller 2. Now using the GPS data received from the GPS module and using the data from the gyro and ultrasonic obstacle sensors the robot tracks itself to the zone location. Once it reaches the zone, using the radar system it locates the fault location. The robot has an inbuilt flame sensor for locating the fire. Using this sensor the robot detects the fire and once the fire is conformed using a robotic arm arrangement the robot pumps water to extinguish it. The pump is operated using a relay which is triggered by the main controller.

VI. GPS SECTION

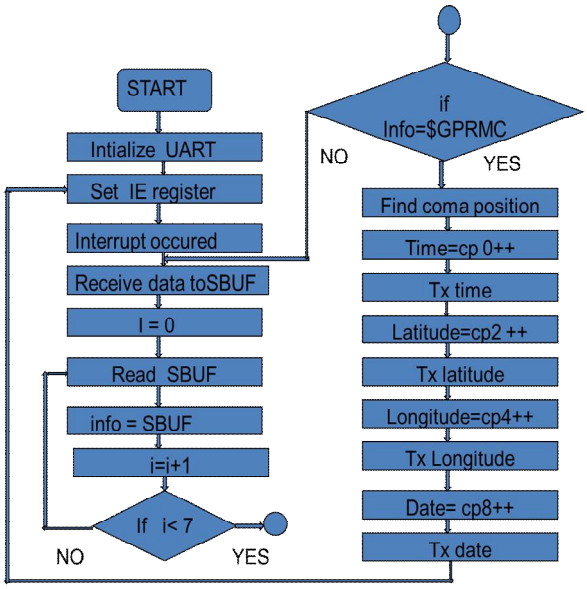

Fig 13.GPS working flowchart

This is the flow chart of GPS system used in robot. GPS means global positioning system, it is an ideal navigation system, used to collect information about the location from the satellite irrespective of weather conditions. It is used for various applications like construction, survey, environment, communication, intelligent vehicles, and agriculture and air planes. Here GPS system serves for obtaining the details of flame generated zone and provides an accurate navigation for locating the zone to the robot. GPS receivers receive almanac data from the satellite and also calculate their position by calculating its distance from then visible satellites and then by using triangulation method to calculate its position.GPS receivers also work on these NMEA Standards. After the data has been received and position has been calculated, the data is configured according to standards set up by NMEA (National Marine Electronics Association) and is serially transmitted at a baud rate of 9600 bps. The National Marine Electronics Association (NMEA) has developed standards that describe the interface between various marine electronic equipment's. The data given by the GPS receiver includes many information like position (latitude and longitude), altitude, speed, time etc. In its standards, NMEA has specified to send a series of data in a sentence. A particular sentence is totally self-reliant and is independent from other sentences. There are standard sentences for particular type of data and for various categories of devices. NMEA has also provided the functionality for individual companies to write their own sentences.

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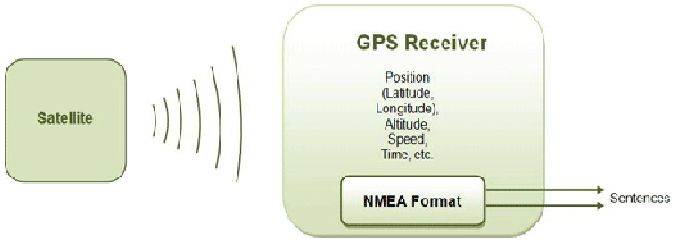

Fig 14.GPS section

All standard devices have a two letter prefix that defines the device for which it is being used, for GPS receivers the prefix is GP. The two letter prefix is then followed by three letters which represent the content of the sentence. The proprietor sentences allowed by the NMEA always start with P and are followed by a three letter sequence identifying manufacturer code and additional characters to define sentence type. For example a Garmin sentence would start with PGRM and Sony would begin with PSNY. Every sentence begins with a '$' sign, has about 80 characters and ends up with a carriage return/line feed sequence. Sentences are mostly framed in single lines (may run over to multiple lines sometimes) and the data items in each sentence are separated by commas. The data received is just ASCII text and varies in precision. A sentence ends with checksum which consists of a '*' and two hexadecimal digits. The checksum digits represent an 8 bit exclusive OR of all the characters between, but not including, the $ and *.

The GPS programming is carried out through a 8051 microcontroller unit .GPS is provided with serial communication. So first initiate the UART, .if any interrupt is occurring, the data receives starts. So enable the interrupt pin. The received data is stored in the sbuff register. The data is received in string form. GPS is inbuilt with different codes. The actual code needed is $GPRMC after which necessary latitude, longitude etc. are placed. So first of all check whether the code is $GPRMC .If it is true, then remaining data are collected step by step and comparing process is done. Here data is separated by commas. So storing the commas positions in a separate register is also activated. Finding the comma position, then reading the data required like time, date, longitude, latitude and that are transmitting to the base vehicle.

VII. CONCLUSION

The robot proposed in this project has very high importance in the present days. .It is a fire extinguishing robot, that extinguishes the fire at the time of fire hazards automatically and autonomously and help to protect the human beings and equipment's. Today, every people are busy and they do not get enough time to deal with safety. So the present situation, autonomous intelligent robot is very significant. The robot uses a new way of GPS and radar based navigation system

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