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Localization of an Autonomous Mobile Robot for Refinery Inspection Using IOT

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Abstract:

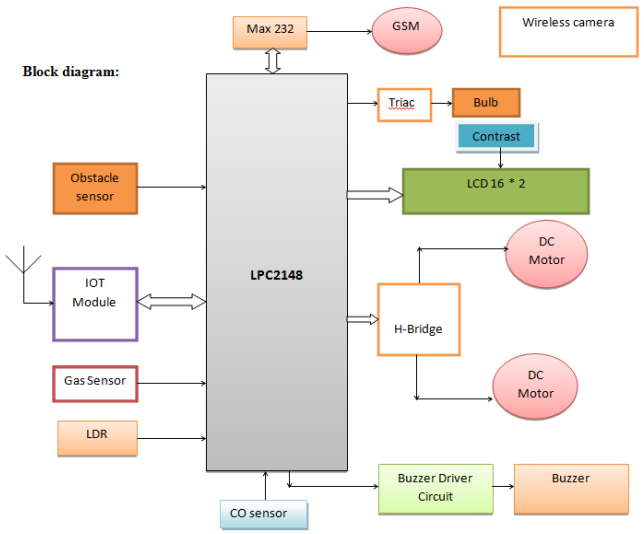
Oil and gas refineries can be a dangerous environment for numerous reasons, including heat, toxic gasses, and unexpected catastrophic failures. In order to augment how human operators interact with this environment, a mobile robotic platform is developed. This paper focuses on the use of WiFi for communicating with and localizing the robot. More specifically, algorithms are developed and tested to minimize the total number of WiFi access points (APs) and their locations in any given environment while taking into consideration the throughput requirements and the need to ensure every location in the region can reach at least APs. When multiple WiFi APs are close together, there is a potential for interference.

A graph-coloring heuristic is used to determine AP channel allocation. In this project, the robot is controlled autonomously and will be monitoring the industry as in the application. The robot is designed with the high end controller and featured with the Gas Sensor, if this sensor is activated by means any leakage in the industry , will detect and gives a alert buzzer sound. The LCD is also interfaced to the controller such that the data is displayed on it for the visual enhancement.

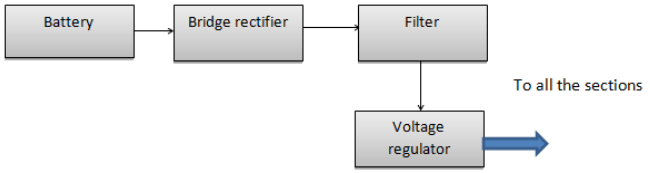
An IR sensor is interfaced to detect the obstacle and it moves accordingly. A LDR sensor is interfaced to the controller to sense day/night mode and bulb will get on accordingly. A CO sensor is interfaced to detect harmful gas. A GSM modem connected to the controller to send SMS in case of abnormal condition. A wireless camera is also given to the robot for surveillance.

An IoT module is also interfaced to know the status of the robot with the gas leakage detection. This whole project is powered with the battery of 12 V, 1.3 Ah.

Block Diagram



Power supply design:



Existing system

This robot is controlled by a RF remote. This can be moved forward and reverse direction using geared motors of 60RPM. Also this robot can take sharp turnings towards left and right directions. This project uses AT89S52 MCU as its controller. The RF modules used here are STT-433 MHz Transmitter, STR-433 MHz Receiver, HT12E RF Encoder and HT12D RF Decoder. The four switches are interfaced to the RF

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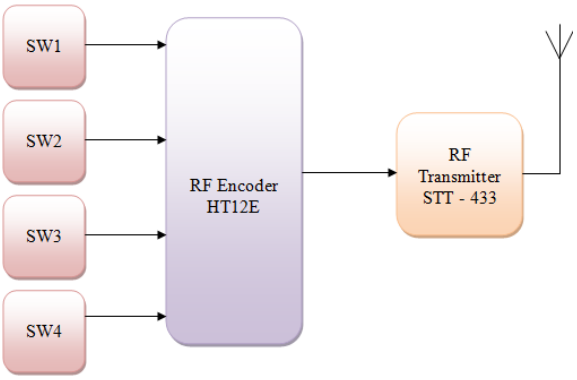
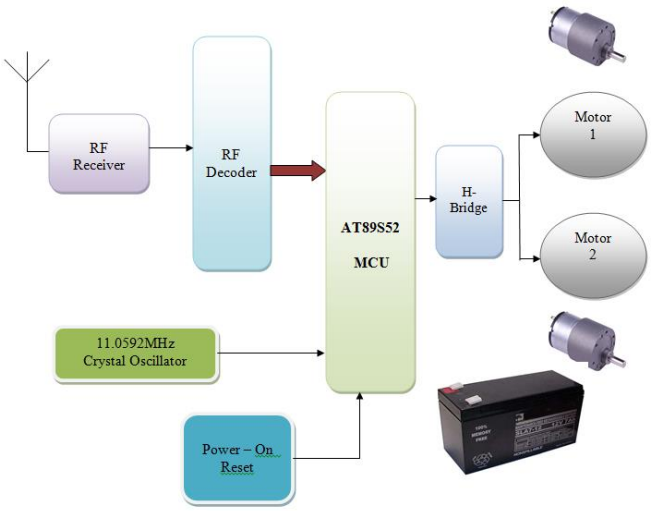
transmitter through RF Encoder. The encoder continuously reads the status of the switches, passes the data to the RF transmitter and the transmitter transmits the data. RF receiver takes the data and gives input to the controller so that the robot moves accordingly. This project uses 9V battery.

Block Diagram: Transmitter

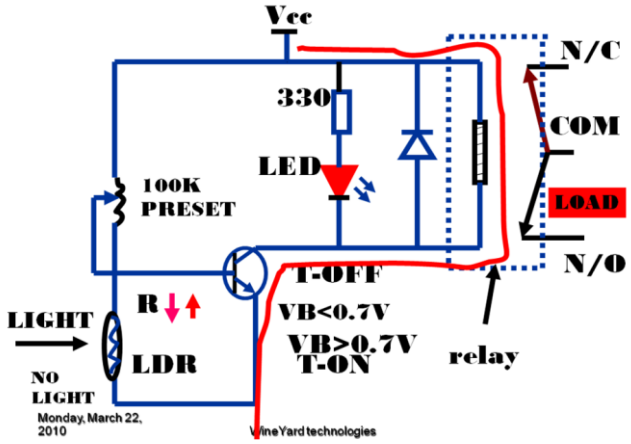




Drawback: This robot is controlling using RF technology which can be operated with smaller distance and they are no sensors

Modules used are explained below

An LDR is an input transducer (sensor) which converts brightness (light) to resistance. It is made from cadmium sulphide (CdS) and the resistance decreases as the brightness of light falling on the LDR increases.



Carbon monoxide sensor

A carbon monoxide detector or CO detector is a device that detects the presence of the carbon monoxide (CO) gas in order to prevent carbon monoxide poisoning. In the late 1990s Underwriters Laboratories (UL) changed their definition of a single station CO detector with a sound device in it to a carbon monoxide (CO) alarm. This applies to all CO safety alarms that meet UL 2034; however for passive indicators and system devices that meet UL 2075, UL refers to these as carbon monoxide detectors.

MQ-2 Semiconductor Sensor for Combustible Gas

Sensitive material of MQ-2 gas sensor is SnO2, which with lower conductivity in clean air. When the target combustible gas exist, The sensor's conductivity is more higher along with the gas concentration rising. Please use simple electro circuit, Convert change of

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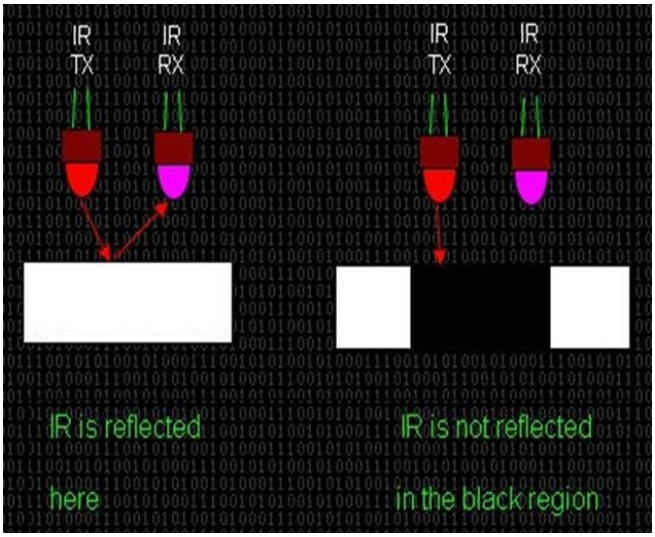
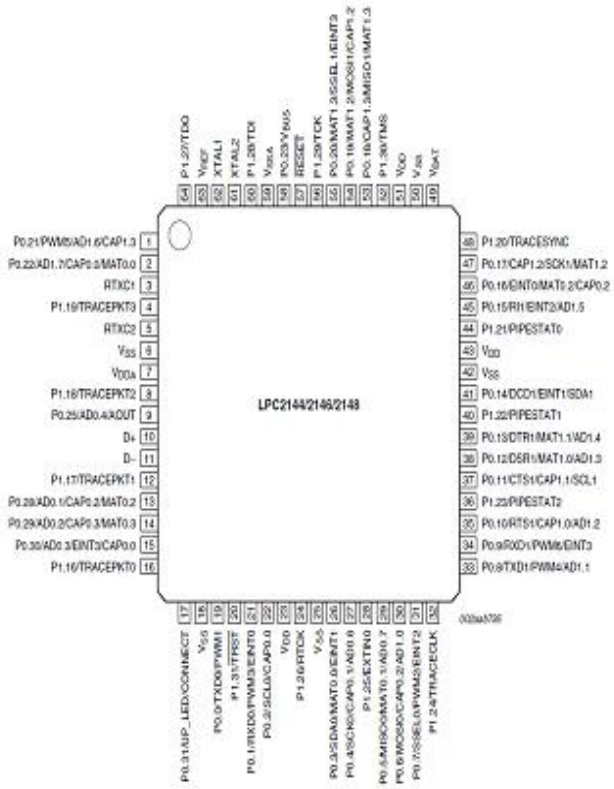
conductivity to correspond output signal of gas concentration.

IR sensor

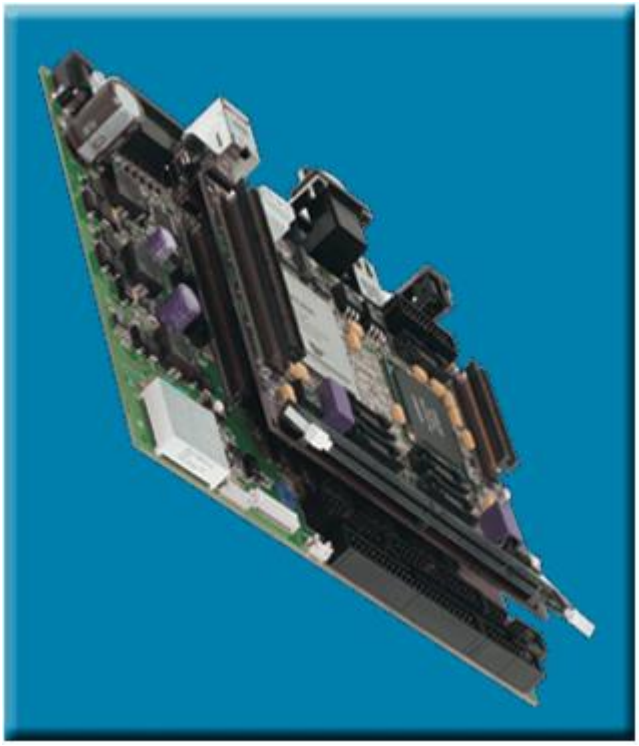
IR reflectance sensors contain a matched infrared transmitter and infrared receiver pair. These devices work by measuring the amount of light that is reflected into the receiver. Because the receiver also responds to ambient light, the device works best when well shielded from abient light, and when the distance between the sensor and the reflective surface is small(less than 5mm).



LPC2148



Pin diagram



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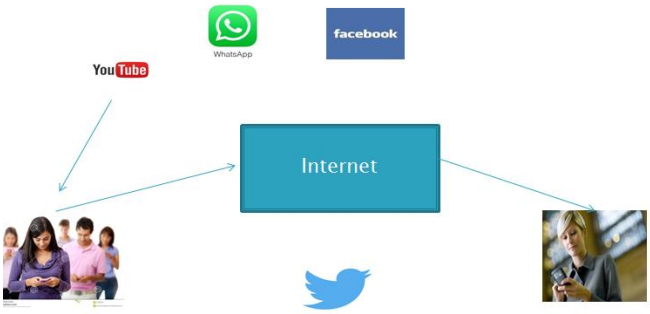
ARM7TDMI Processor Core

- Current low-end ARM core for applications like digital mobile phones
- TDMI
  - T: Thumb, 16-bit compressed instruction set
  - D: on-chip Debug support, enabling the processor to halt in response to a debug request
  - M: enhanced Multiplier, yield a full 64-bit result, high performance
  - I: Embedded ICE hardware
- Von Neumann architecture

INTERNET OF THINGS

Internet is helping people to communicate each other using different applications



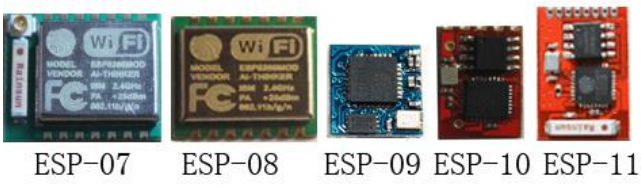
Internet of things helps the things to communicate each other using IoT module

ESP8266EX

- The Internet of Things (IoT) is the network of physical objects or "things" embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data.

Different Modules

- ESP8266(ESPRESSIF)
- ESP8089
- ESP6203



Wi-Fi module

ESP8266EX offers a complete and self-contained WiFi networking solution; it can be used to host the application or to offload WiFi networking functions from another application processor. When ESP8266EX hosts the application, it boots up directly from an external flash. In has integrated cache to improve the performance of the system in such applications. Alternately, serving as a WiFi adapter, wireless internet access can be added to any micro controller-based design with simple connectivity (SPI/SDIO or I2C/UART interface). ESP8266EX is among the most integrated WiFi chip in the industry; it integrates the antenna switches, RF balun, power amplifier, low noise receive amplifier, filters, power management modules, it requires minimal external

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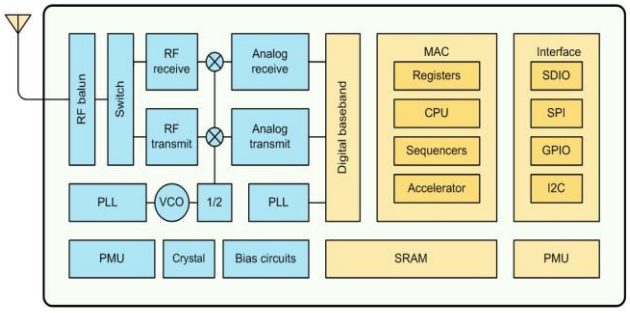
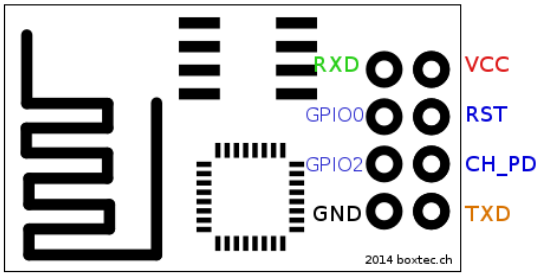
circuitry, and the entire solution, including front-end module, is designed to occupy minimal PCB area.





ESP8266EX also integrates an enhanced version of Tensilica's L106 Diamond series 32-bit processor, with on-chip SRAM, besides the WiFi functionalities. ESP8266EX is often integrated with external sensors and other application specific devices through its GPIOs; sample codes for such applications are provided in the software development kit (SDK).

Applications:

Monitoring the industries
Perfect checking of pipe refineries
Leakage detections

Advantages

Highly reliable
Continuous monitoring

Conclusion

IOT based communication and localization of an autonomous mobile robot for refinery inspection has been implemented for the purpose of safety using LPC2148.

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