Kshitij 2014

EMBETRONIX

TUTORIAL

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In the present scenario, the natural resources provide a potential problem. If the rate of consumption remains intact then there are many odds in favour of exhaustion of the natural resources from our planet. We sincerely hope this does not happen, but the only solution to handle the crisis is by the use of natural resources from other planets. In that case as the humans cannot waltz in directly and search, we take the aid of machines. The use of embedded electronics is a promising way to do so.

Embedded Systems:

As the name itself suggests it is the embedded part of the mechanical or electrical system. An embedded system is computer system dedicated to handle a particular task within a larger mechanical or electrical system.

Embedded systems contain processing cores that are either microcontrollers, or digital signal processor, a processor is an important unit in the embedded system hardware. It is the heart of the embedded systems. Now a day's embedded systems are present in every step of our life.

Microcontroller:

Microcontroller is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of NOR flash or OTP ROM is often included on chip, as well as a typically small amount of RAM. Microcontrollers are mainly made for the embedded systems.

Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems.
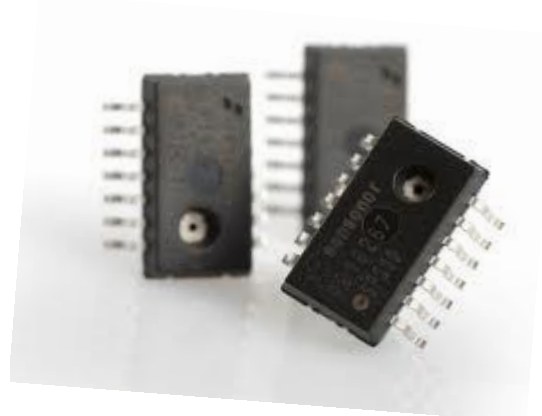
Types of microcontrollers

Intel MCS-51

It provides many functions (CPU, RAM, ROM, I/O, interrupt logic, timer, etc.) in a single package 8-bit ALU, Accumulator and 8-bit Registers; hence it is an 8-bit microcontroller 8-bit data bus ,16-bit address bus ,On-chip RAM – 128 bytes (data memory) , On-chip ROM – 4 Kbyte (program memory) , Four byte bi-directional input/output port , UART (serial port) ,Two 16-bit Counter/timers

Atmel AVR (8-bit)

The Atmel AVR is an 8-bit RISC single chip microcontroller. The AVR was one of the first microcontroller families to use on-chip flash memory for program storage, as opposed to One-Time Programmable ROM, EPROM, or EEPROM used by other microcontrollers at the time.

AVR32 (32-bit)

The AVR32 is a 32-bit RISC microprocessor in which most instructions are executed single-cycle. The MAC-unit is capable of performing a 32-bit * 16-bit + 48-bit arithmetic operation in two cycles (result latency), with an issue rate (bandwidth) of one cycle.

MIPS (32-bit PIC32)

MIPS (Originally an acronym for Microprocessor without interlocked Pipeline stages) is a reduced instruction set (RISC) Instruction set architecture (ISA). MIP32 defines a control set as well as instruction set.

PRINTED CIRCUIT BOARD:

A printed circuit board, or PCB, is used to mechanically support and electrically connect electronic components using conductive pathways, tracks or signal traces etched from copper sheets laminated onto a non- conductive substrate. Individual electronic components are placed on the surface of the substrate and soldered to the interconnecting circuits. Contact fingers along one or more edges of the substrate act as connectors to other PCBs or to external electrical devices such as on-off switches. There are three major types of printed circuit board construction: single-sided, double-sided, and multi-layered.

DIGITAL SIGNAL PROCESSOR:

A digital signal processor (DSP) is a specialized microprocessor with an architecture optimized for the operational needs of digital signal processing. A microprocessor incorporates the functions of a computer's central Processing Unit (CPU) on a single integrated circuit, or at most a few integrated circuits. Microprocessor is a multipurpose, programmable device that accepts digital data as input, processes it according to instructions stored in its memory, and provides results as output.
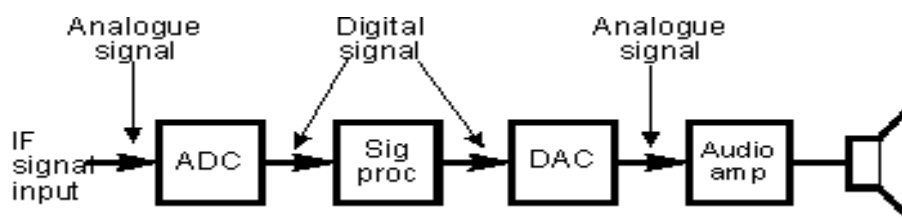
Block diagram of DSP.

SENSOR MODULE:

A sensor 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. It is a device, which responds to an input quantity by generating a functionally related output usually in the form of an electrical or optical signal. A sensor's sensitivity indicates how much the sensor's output changes when the measured quantity changes. Sensors need to be designed to have a small effect on what is measured; making the sensor smaller often improves this and may introduce other advantages.

There are different types of sensors as limit switches, proximity sensors, and photoelectric sensors.

Limit switch is an electromechanical device, proximity sensor uses electronic field to detect. Photo electric sensor uses light to detect the object. Radar and ultrasonic sensors also operate by detecting the reflected light from the object being detected. Inductive proximity sensor can be used to detect the metals whereas capacitive proximity sensor is used to detect both metals and non-metals.

LDR SENSOR
A Light Dependent Resistor (LDR) is a resistor whose resistance decreases with increasing incident light intensity, meanwhile when in the dark the resistance will increase. It can be said as simply variable resistors in many ways similar to potentiometers, except that the resistance changes in light level rather than by turning a knob.

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An LDR is made of a high-resistance semiconductor. If light falling on the device is of high enough frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electron (and its hole partner) conduct electricity, thereby lowering resistance.

A photoelectric device can be either intrinsic or extrinsic. In intrinsic devices, the only available electrons are in the valence band, and hence the photon must have enough energy to excite the electron across the entire band gap. Extrinsic devices have impurities added, which have a ground state energy closer to the conduction band - since the electrons don't have as far to jump, lower energy photons (i.e. longer wavelengths and lower frequencies) are sufficient to trigger the device.

DISPLAY MODULE:

LIQUID CRYSTAL DISPLAY:

A liquid-crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. In general, LCDs use much less power than their cathode-ray tube (CRT) counterparts. Many LCDs are reflective, meaning that they use only ambient light to illuminate the display. Even displays that do require an external light source (i.e. computer displays) consume much less power than CRT devices.

SEVEN SEGMENT DISPLAY:

A seven segment display is the most basic electronic display device that can display digits from 0-9. They find wide application in devices that display numeric information like digital clocks, radio, microwave ovens, electronic meters etc. The most common configuration has an array of eight LEDs arranged in a special pattern to display these digits. They are laid out as a squared-off figure '8' A seven segment is generally available in ten pin package. While eight pins correspond to the eight LEDs, the remaining two pins (at middle) are common and internally shorted. These segments come in two configurations, namely, Common cathode (CC) and Common anode (CA). In CC configuration, the negative terminals of all LEDs are connected to the common pins. The common is connected to ground and a particular LED glows when its corresponding pin is given high. In CA arrangement, the common pin is given a high logic and the LED pins are given low to display a number.

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Seven-Segment Display
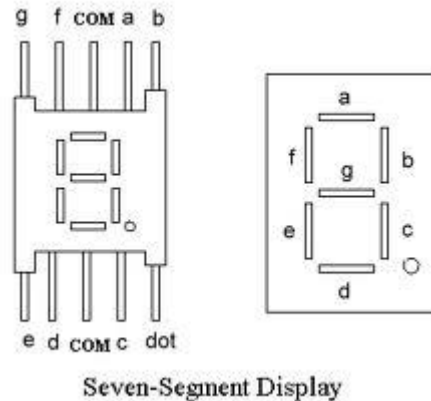
WIRELESS COMMUNICATION:

Wireless communication is the transfer of information between two or more points that are not connected by an electrical conductor.

The most common wireless technologies use electromagnetic wireless telecommunication, such as radio. There will be a transmitter on one end and a receiver on the other end as the actual information to be transferred is deciphered into waves to carry on with the job.

ZIGBEE

Zigbee is an RF (radio frequency) communication standard that makes it very simple to transmit digital information between devices. The simplest way to implement Zigbee in your device is by using Xbee modules. Xbee modules are inexpensive components which integrate an antenna, amplifier, transmitter/receiver, and circuitry that allows you to send and receive data between the Xbee and a microcontroller over a standard serial connection. Xbee modules are perfect for applications like building a remote control unit for your device, or allowing your device to wirelessly transmit data such between the sensor and the display module.

BLUETOOTH

Bluetooth operates in the range of 2400–2483.5 MHz (including guard bands). This is in the globally unlicensed Industrial, Scientific and Medical (ISM) 2.4 GHz short-range radio frequency band. Bluetooth uses a radio technology called frequency-hopping spread spectrum. The transmitted data is divided into packets and each packet is transmitted on one of the 79 designated Bluetooth channels. Each channel has a bandwidth of 1 MHz. The first channel starts at 2402 MHz and continues up to 2480 MHz in 1 MHz steps. It usually performs 1600 hops per second, with Adaptive Frequency-Hopping (AFH) enabled.

PROBLEM STATEMENT:

Aim:

As you stumble upon the new planet, you are to collect resources from it. You have two autonomous vehicles which will help you in gathering the resources.

Scout Vehicle:

The scout vehicle can walk over all types of sites and report if the site is a resource site or a danger zone. None of the dimensions of Scout Vehicle should exceed 15 cm.

Gatherer Vehicle:

This vehicle cannot go through the danger zones. This vehicle should collect resources from the resource site. The gatherer vehicle may cross the same point in the arena more than once. None of the dimensions of the Gatherer Vehicle should exceed 10 cm.

Thus the task will be to identify resource sites using a scout and collect resources from them using a gatherer avoiding the danger zones. Every team will get a maximum time of 12 minutes to complete a run.

Display Module:

A display module (LCD module/seven segment decoder) on the gatherer vehicle is to be used which shows if the site has useful resource or is a danger zone along with the coordinates, when the scout vehicle goes over it. However the display module should not show the site type or coordinates when the gatherer vehicle reaches a site.
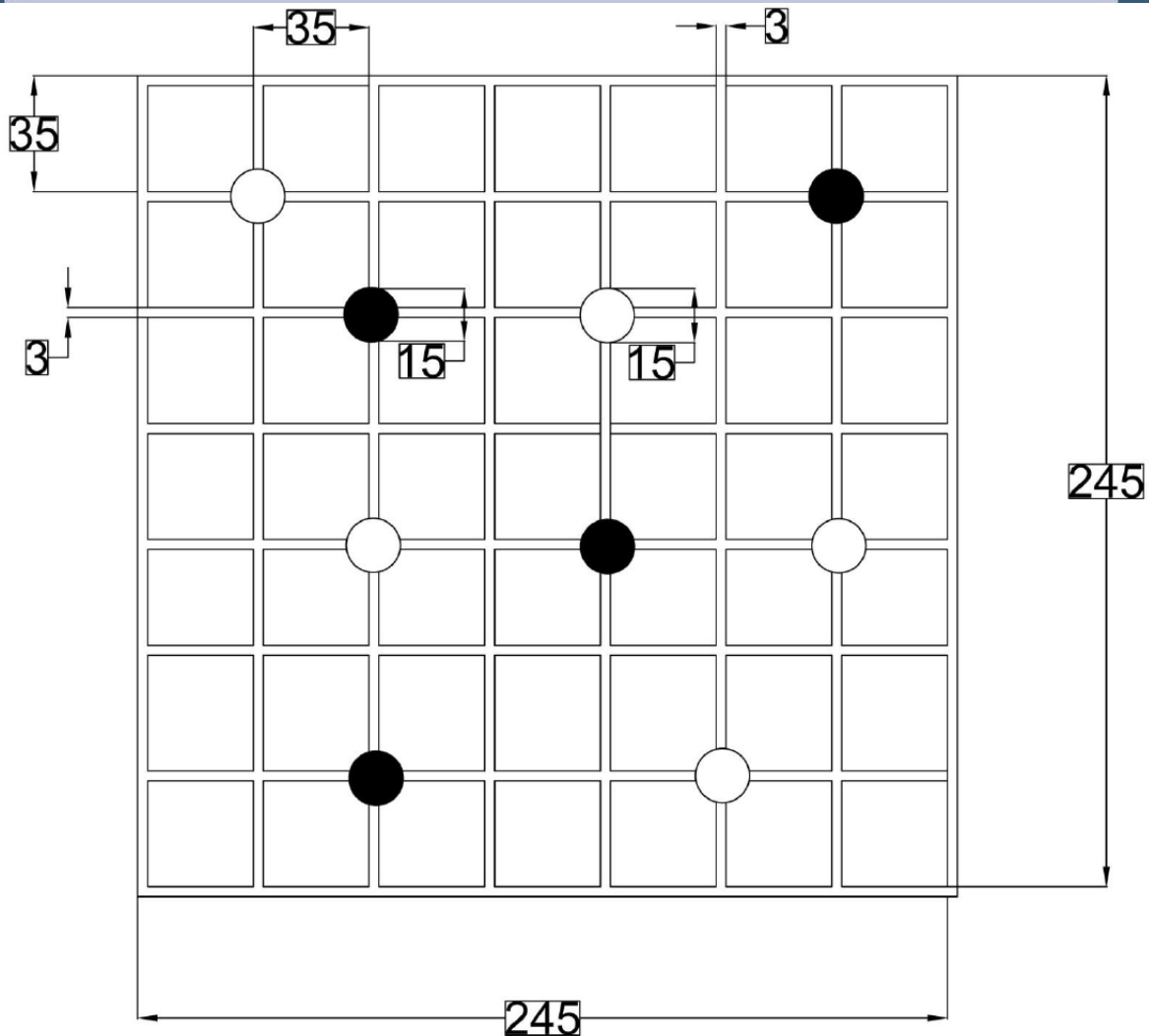
Communication Module:

There will be one communication module to be used for communicating from scout to display module which will be on the gatherer.

Sensor Module:

The sensor module is required to detect if a site is a resource site or danger zone or nothing. Sensor module can be present in both the gatherer and scout vehicle.

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Arena with its dimensions (in cm)

You may take help from the links provided below:

http://www.scribd.com/doc/35925045/Major-Project-Grid-Solving-Robot
http://playwithrobots.com/make-it-form-scratch/advance-line-follower-robot

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