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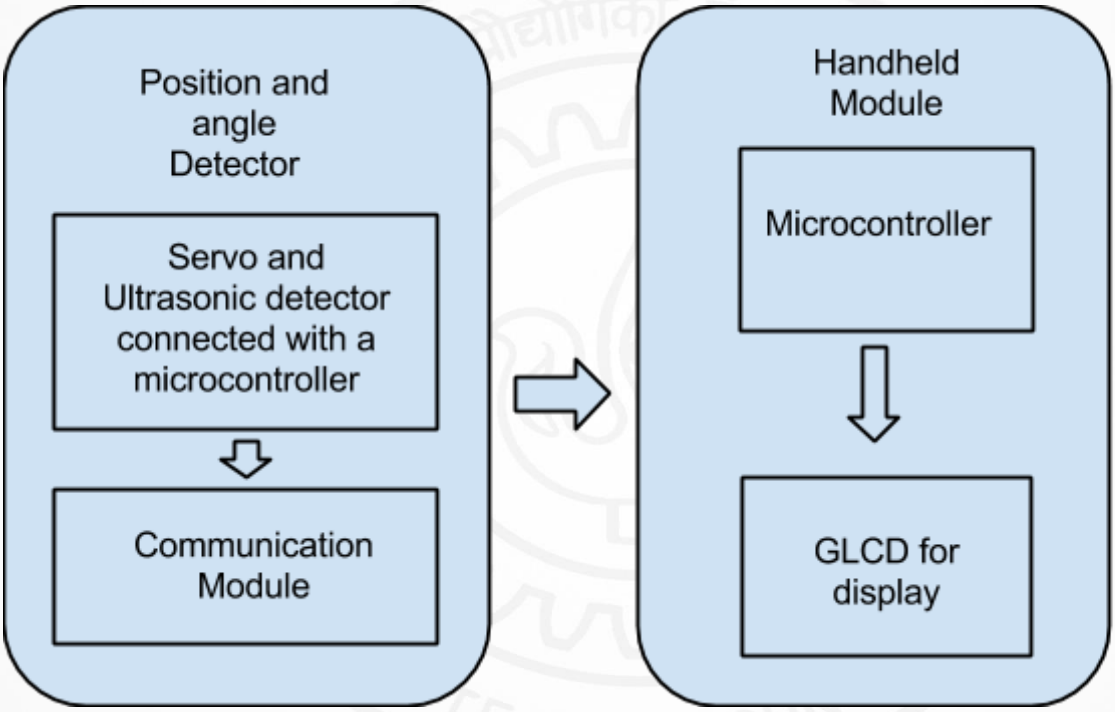
TUTORIAL FOR EMBEDDED 2015

Objective: The objective involves making an ultrasound echo based 180 degree rotating ranging device which scans an area and transmit signal wirelessly, to a handheld module which displays the results.



BLOCK DIAGRAM FOR THE CIRCUIT

Position and Angle Detector includes:

1) Ultrasonic Sensor for detecting the objects

2) Servos for rotating the sensor 180 degrees in a plane

3) Micro-controller

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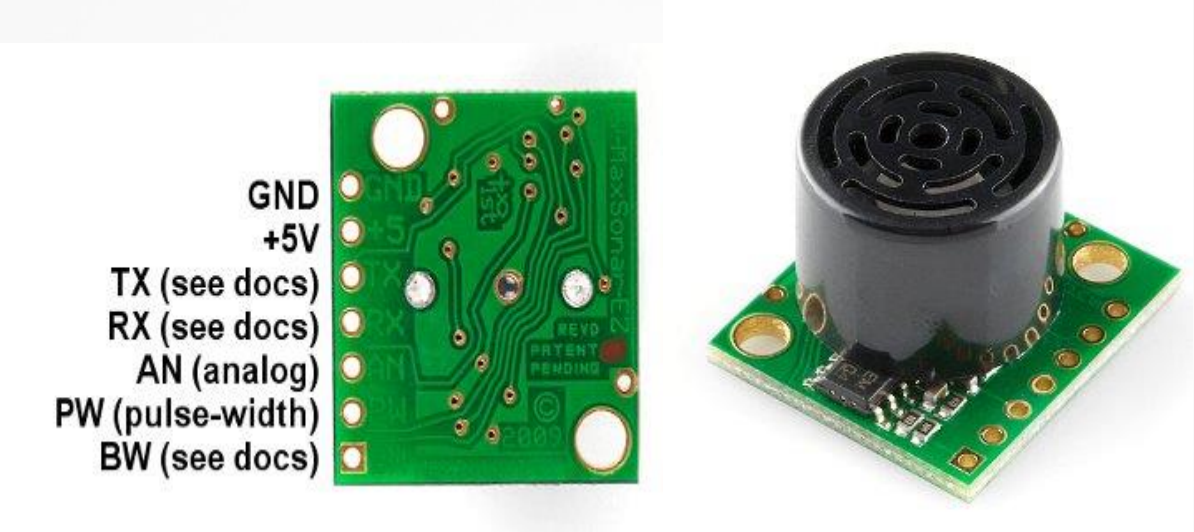
Ultrasonic Detector



The sensor sends out pulses of ultrasonic sound (at a frequency of 41 KHz) and listens for the reflection of the sound off nearby objects. It is subject to real-world acoustics and may not work well in noisy environments. It works best for detecting large, solid objects such as walls that provide a strong reflection.

The sensor has a range of 6" to 254" (6.45 meters) with 1" resolution. Objects closer than 6" will be reported as 6" away. If no object is detected within the sensor's range, the output will stay at the maximum range.

The sensor requires a power supply from 2.5V to 5.5V. The current requirement is only 3mA, which is easily supplied by an Arduino or other microcontroller with a built-in voltage regulator. Although the sensor will work at 3.3V, a 5V supply will provide the best output power for long-range operation.

For more details or **sample codes** visit:

http://maxbotix.com/documents/LV-MaxSonar-EZ_Datasheet.pdf

https://www.sparkfun.com/tutorials/263

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Servo Motor

Servo Motor is a device which uses error-sensing feedback signals to determine and control the position of a motor shaft.

A typical servo has three wires coming out. Two wires (red and black) are connected to power source (4.8V to 6V range) and the third wire is for signal input. Higher the voltage, higher the torque, but make sure not to exceed maximum voltage mentioned in the datasheet.

Servos are controlled by sending signals (pulses) via the signal wire connected to control circuit. The signal gives a position to servo to rotate to, and the motor (and the gear system) starts rotating.

Servo Control: Controlling a servo involves sending a modulated square-wave pulse which is known as pulse-Width-Modulation (PWM). If signal voltage from peak to peak is taken care as per the datasheet (which is generally 3V to 5V), then there two other main factors to be considered while sending a PWM signal to servo; “Frequency” and “Duty cycle”.

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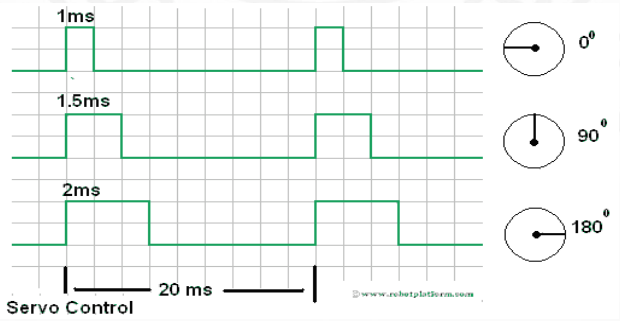
1) Frequency: Frequency is the number of times a positive pulse is fed to servo in a unit time .Frequency is generally 50 times a second (time period=20ms) for digital servos. If servo does not receive a pulse before the timeout period, then servo releases its hold and can move to any forced position.

2) Duty Cycle: "Duty cycle" is the width of positive pulse (square wave) and a deciding factor for servo's angular position. For example, if you have a servo with 180° turn, then 90° is the centre position of the servo with 0° being minimum, and 180°, being the maximum. Now, if a positive pulse of 1.5ms is sent, then the servo stays at 90° (servo centre) as long as it receives the same pulse. If another pulse of 1ms is sent, the circuit tries to move the shaft to 0°, and a pulse of 2ms tries to move the output shaft to 180°. This means, a pulse shorter than 1.5ms moves the servo in one direction and wider than 1.5ms moves it in another direction. Different servo models have different minimum and maximum pulse requirements.



For help regarding the code or further details about how servo functions visit:

http://arduino.cc/en/Tutorial/sweep

http://www.robotplatform.com/knowledge/servo/servo_tutorial.html

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Communication

There are several options available for wireless communication between the two microcontrollers. The choice can depend on speed, cost and range of the communication mode used. Some of them are described below:

1) **Xbee**-The Arduino Wireless Shield allows your Arduino board to communicate wirelessly using ZigBee. The Xbee 802.15.4 modules support point-to-point or multipoint communication without routing, so they are ready out of the box to establish peer communication between two radios without any configuration.

2) **Bluetooth**-The Bluetooth Shield integrates a Serial Bluetooth module. It has range of up to 10m without obstacle. Another advantage of Wi-Fi is that we can directly interface them with computer. It has a default baud rate of 38400 and has an on board PCB antenna.

3) **433MHz Transmitter/Receiver module-**It uses low costs RF transmitter and receiver from to establish radio link between two Arduino boards up to 500 ft. Communications is only one way. Bandwidth maxes out at 2400 bps, but there is a version with 4800 bps. The variable gain on the receiver causes it to pick up lots of background noise.