Project name:ultrasonic sensor

Introduction:

Snow depth is most often measured using an ultrasonic or radar sensor. The sensor is placed on an arm outstretched over the area to be monitored and the signal of the sensor is bounced off the snow surface. This type of system is used very frequently in reporting snow levels at ski resorts and high mountain areas that require this type of information. We have worked with cabin owners and winter resorts to provide systems that alert resort or homeowners to the presence of snow, and also for ski resorts to report on snow totals and snow status for maintenance and as a marketing tool to inform skiers of the snow depth and new snowfall.

Literature survey:

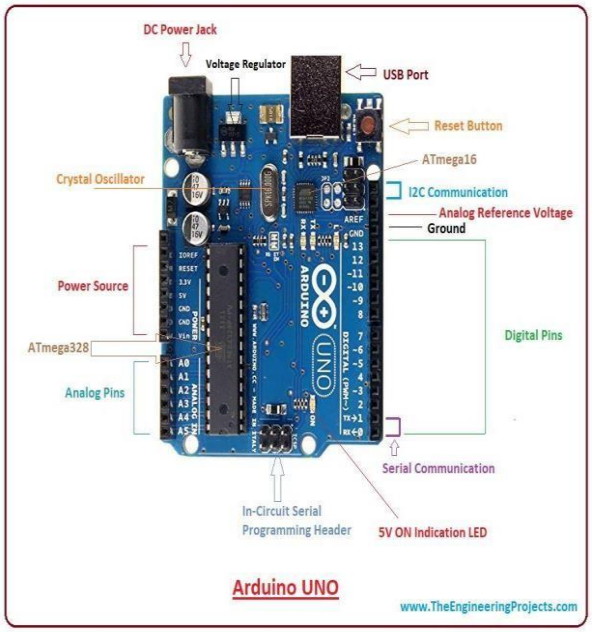
- This project is to measure the snow level in the countries where the winters are too cold with a heavy snow fall that helps the people to know about the snow level present outside and so that they can take the preventive measures.
- LOCUS-X is low cost ultrasonic sensor circuit designed forongoing hydrological studies in british coloumbia written by andres varhola
- This sensor is used to monitor snow dynamics and other complex dynamics.
- The basic locus model costs about 180$
- Research and application of ice thickness and snow depth automatic monitoring system,a research paper written by chao du,qi wang and xu liu and published by IEEE .
- Snow density retrieved from l-band radiometry a research paper written by mike schwank and reza naderpour.
- There are some resorts using the snow level monitoring system:alpine ski resort and dodge ridge ski resort and these systems are manufactured by a company named IEI.

Components required:

1. Arduino UNO
2. HC SR04
3. DHT-11
4. Connecting wires
5. Battery or Power supply
6. Ironbar for support.

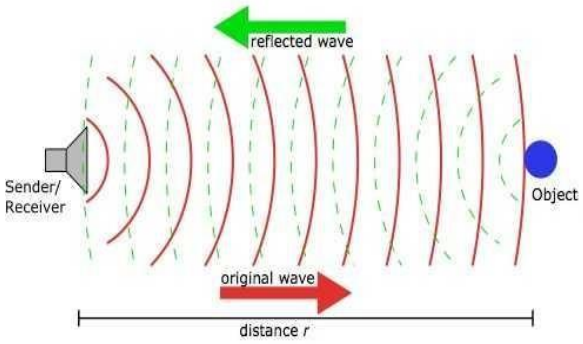
Description of components:

1. Arduino uno:
   - The **Arduino Uno** is an open source microcontroller board based on the microchip Atmega328p microcontroller
   - The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.
   - The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable.
   - It can be powered by the USB cable or by an external 9-volt battery though it accepts voltages between 7 and 20 volts.
   - Microcontroller: Atmega328p
   - Operating Voltage: 5 Volts
   - Input Voltage: 7 to 20 Volts
   - Digital I/O Pins: 14 (of which 6 provide PWM output)
   - Analog Input Pins: 6
   - Flash Memory: 32 KB
   - SRAM: 2 KB
   - EEPROM : 1 KB
   - Clock Speed: 16 MHz

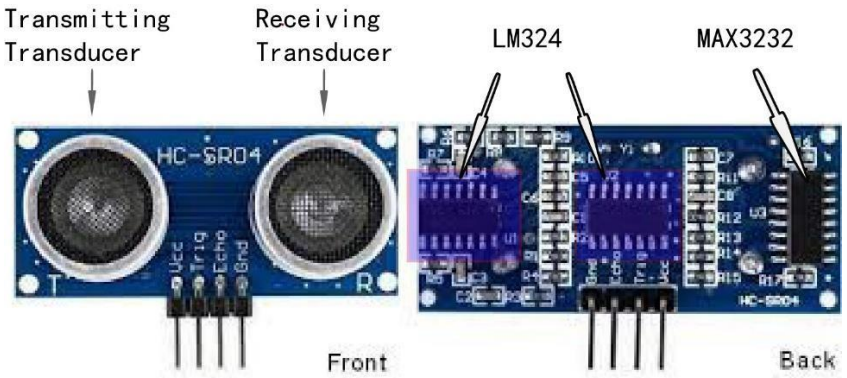


2. Ultrasonic sensor:

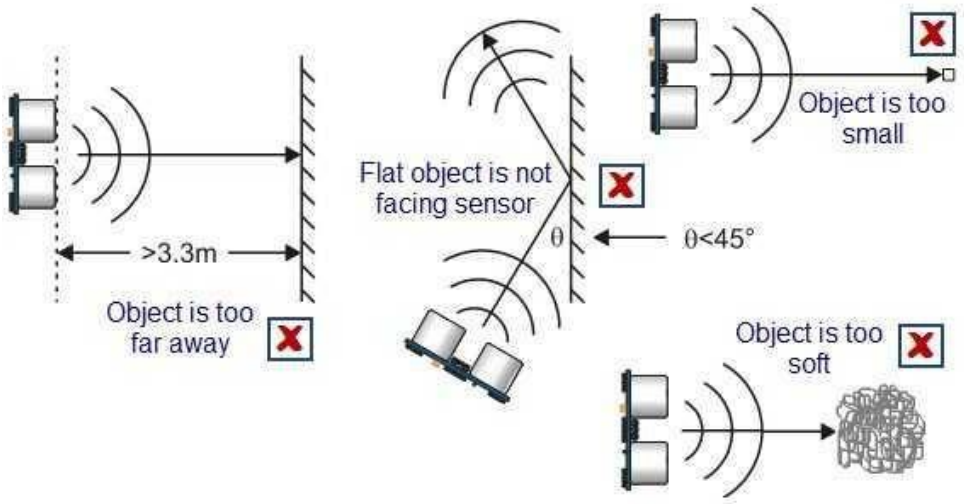
- The HC-SR04 ultrasonic sensor uses sonar to determine distance to an object.
- It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package. From 2cm to 400 cm or 1" to 13 feet.
- It operation is not affected by sunlight or black material like Sharp rangefinders are (although acoustically soft materials like cloth can be difficult to detect).
- To start measurement, Trig of SR04 must receive a pulse of high (5V) for at least 10us, this will initiate the sensor will transmit out 8 cycle of ultrasonic burst at 40kHz and wait for the reflected ultrasonic burst.
- When the sensor detected ultrasonic from receiver, it will set the Echo pin to high (5V) and delay for a period (width) which proportion to distance. To obtain the distance, measure the width of Echo pin.



- The transceiver sends a sound wave with the speed of sound (343.2 m/s) and the receiver waits for the signal to come back while counting the time. A basic sound echo phenomenon. Basic physics tells that if we know the speed and time we can easily calculate the distance by applying formula D = VT/2, where:D = distance, V = Sound speed, T = measured time for trigger signal to perform the round trip
- But working with ultrasonic sensors can be tricky sometimes if you don't know the entire picture. In a perfect setup, having a proper environment they should do a good job, but you can encounter problems if you do not respect the working conditions, especially the angle alignment, and also the ambient temperature.



HC-SR04



HC-SR04 Ultrasnoic sensor technical specifications

- Power supply: +5 DC
- Quiescent current: <2mA
- Working current: 15mA
- Effectual angle: <15°
- Distance range: 2cm – 400cm
- Resolution: 0.3cm
- Measuring angle: 30°
- Trigger input pulse width: 10us
- Ultrasonic frequency: 40kHz
- Dimensions: 45mm x 20mm x 15mm

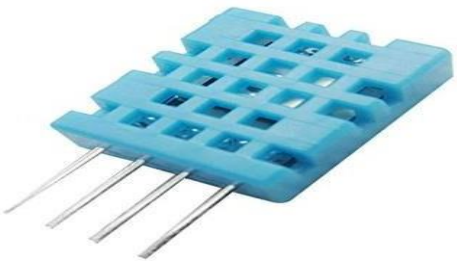
➢ **Ultrasonic Temperature compensation:**

- There are many factors that can influence the speed of sound but in this case the temperature and humidity is the most critical.
- To reduce the impact over the result we need to apply the practical formula for dry air. The approximate speed of sound in dry (0% humidity) air, in meters per second, at temperatures near 0 °C, can be calculated from C air = (331.3 + 0.606 * T) m/s where T is the temperature in degrees Celsius (°C). So at -13 °C we should have the speed of sound = (331.3 + 0.606 * (-13)) = 318.9 m/s.

- Therefore, because the temperature is not constant, a temperature sensor was needed, and we choosed to use a LM35 which is a 1-Wire Temperature sensor.

➢ Dht 11 temperature and humidity sensor:

- The **DHT11** is a commonly used **Temperature and humidity sensor.** The sensor comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data. The sensor is also factory calibrated and hence easy to interface with other microcontrollers.
- The sensor can measure temperature from 0°C to 50°C and humidity from 20% to 90% with an accuracy of ±1°C and ±1%. So if you are looking to measure in this range then this sensor might be the right choice for you.
- Specifications:
  - Operating Voltage: 3.5V to 5.5V
  - Operating current: 0.3mA (measuring) 60uA (standby)
  - Output: Serial data
  - Temperature Range: 0°C to 50°C
  - Humidity Range: 20% to 90%
  - Resolution: Temperature and Humidity both are 16-bit
  - Accuracy: ±1°C and ±1%



Applications of Ultrasonic Sensor:

Ultrasound can be used for measuring wind speed and direction, tank or channel fluid level, and speed through air or water. For measuring speed or direction, a device uses multiple detectors and calculates the speed from the relative distances to particulates in the air or water. To measure tank or channelliquid level, and also sea level, the sensor measures the distance to the surface of the fluid. Further applications include humidifiers, sonar, medical ultrasonography, burglar alarms and wireless charging.

Systems typically use a transducer which generates sound waves in the ultrasonic range, above 18 kHz, by turning electrical energy into sound, then upon receiving the echo turn the sound waves into electrical energy which can be measured and displayed.

This technology, as well, can detect approaching objects and track their positions.

Ultrasound can also be used to make point-to-point distance measurements by transmitting and receiving discrete bursts of ultrasound between transducers. This technique is known as sonomicrometry where the transit-time of the ultrasound signal is measured electronically (ie digitally) and converted mathematically to the distance between transducers assuming the speed of sound of the medium between the transducers is known. This method can be very precise in terms of temporal and spatial resolution because the time-of-flight measurement can be derived from tracking the same incident (received) waveform either by reference level or zero crossing. This enables the measurement resolution to far exceed the wavelength of the sound frequency generated by the transducers.

Applications of the project:

- This project is to measure the snow level in the countries where the winters are too cold with a heavy snow fall that helps the people to know about the snow level present outside and so that they can take the preventive measures and in some areas where the snow level must be continuously monitored to prevent any accidents live in some snow events like skiing and snow mobile racings.
- In this we have given a solution to know the snow level before starting those events and prevent any kind of loss related to it.

- This project uses an ultra sonic sensor to measure the level of snow and that is connected to an Arduino board and the readings are continuously taken from the sensor .
- This project is mainly useful in snow countries.