Input Device: Scanner (2D)

CSE 315

Peripherals & Interfacing

Abdullah Al Omar

Lecturer, CSE, UAP

Input Device : Scanner

An input device, that digitizing an image

It has a light source and a set of optical sensors

Reflected light is sensed by the sensors & converted into digital signal

Scanners : Classification

On Scan Technology

- Flatbed Scanners
- Sheet-fed Scanners
- Handheld Scanners
- Drum Scanners

On Dimension

- 2D Scanners
- 3D Scanners

Scanner : Flatbed

- Also known as desktop scanner
- The most commonly used scanner
- Document is stationary
- Head is movable

Scanner : Sheet-fed

Desktop scanner

Document is movable

Head is stationary

Scanner : Handheld

Movable scanner	Can be hold by hand	Can be used for quick scan	Scan quality is not much better	E.g. Barcode reader

Scanner : Drum

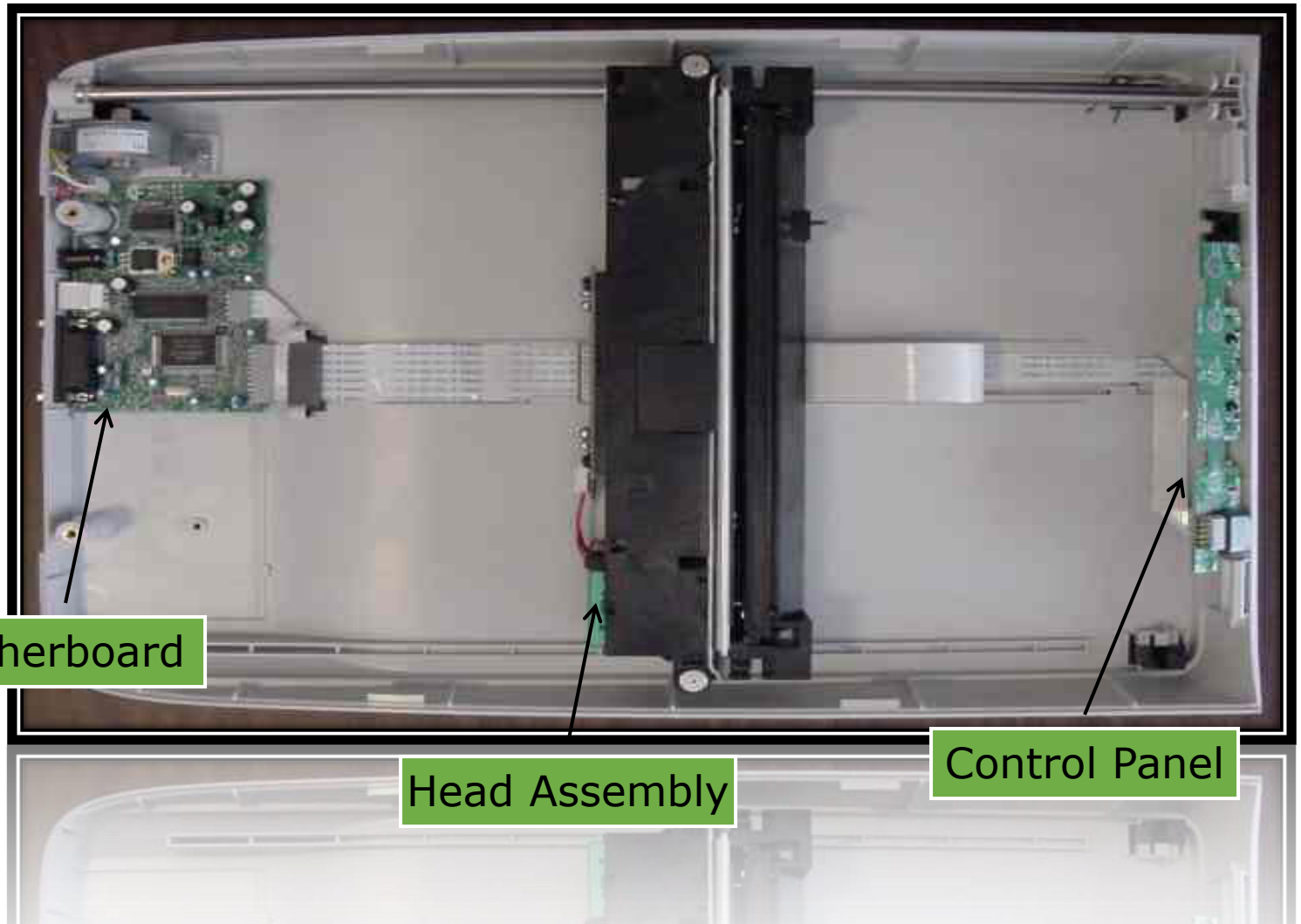
Used in graphics production houses

Used for scanning a large size of image

Anatomy : Flatbed Scanner

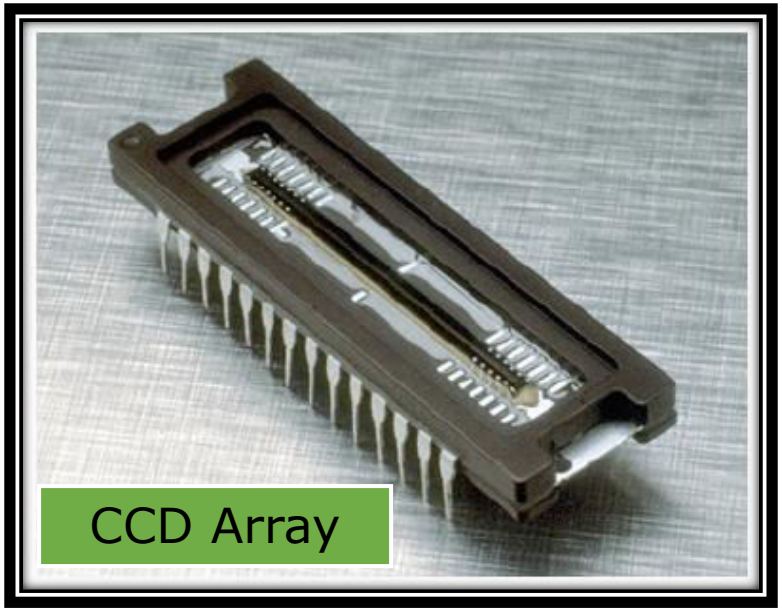
- Basic components of a flatbed scanner are:
  - **C**harged **C**oupled **D**evice (**CCD**) Array
  - Mirrors
  - Lamp
  - Lens
  - Filter
  - Scan Head assembly
  - Mother board
  - Control Panel
  - Frame

Anatomy : Flatbed Scanner



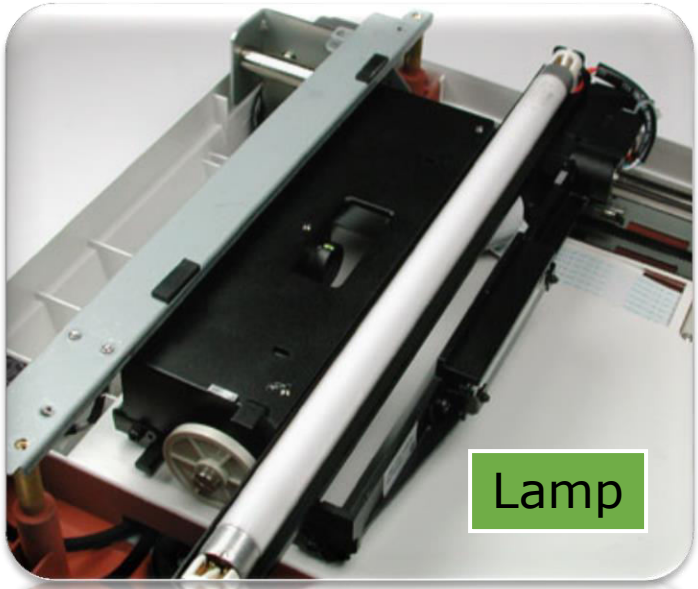
Anatomy : Flatbed Scanner

- CCD Array (image sensor) is the main component of a scanner
- CCD is a set of light sensitive diode known as photosites
- CCD converts photons into electrons



Anatomy : Flatbed Scanner

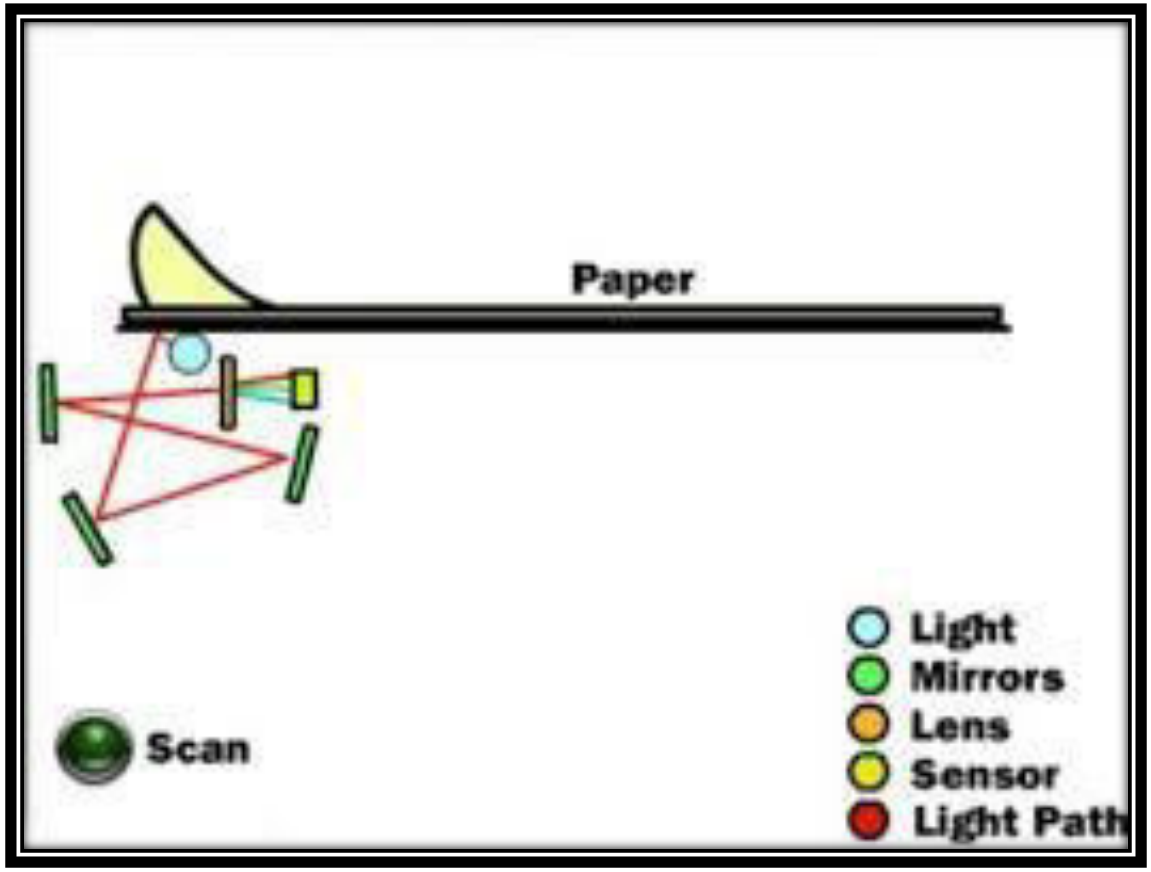
- The document is placed and cover is closed
- A lamp is used to illuminate the document
- The scan head is moved slowly across the document



Anatomy : Flatbed Scanner

- The image of the document is reflected by a mirror (1st one)
- That reflected image, is reflected by two other mirrors
- The last mirror reflects the image onto a lens
- The lens focuses the image through a filter on the CCD Array
- The purpose of three mirrors in a scanner to reduce extra light intensity

Anatomy : Flatbed Scanner



Thank You

Input Device: Scanner (3D)

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Scanner : 3D

- A 2D scanner with **Z** dimension
- It is able to analyze a real world object in all the (X, Y, Z) dimensions
- This type of scanner is specially used in entertaining industries (movie & gaming)

3D Scanner : Functionality

- To create a **point cloud** of geometry samples
- These points are then used to redraw the object
- As like as camera, a 3D scanner can only collect information of an object that is obscured

3D Scanner : Classification

- Depending on the technology
  - Contact 3D Scanner
  - Non-contact 3D Scanner
    - Non-contact Active
    - Non-contact Passive

3D Scanner : Contact

- Scan through physical touch
- This is basically a scanner with **CNC** (**C**omputer **N**umerical **C**ontrol)
- There is a mechanical system available that holds the scan unit
- This system can move in any direction
- E.g. **C**o-ordinate **M**easuring **M**achine (**CMM**)

3D Scanner : Contact

- Contact 3D Scanner is used in manufacturing industries
- Cons: Need physical contact

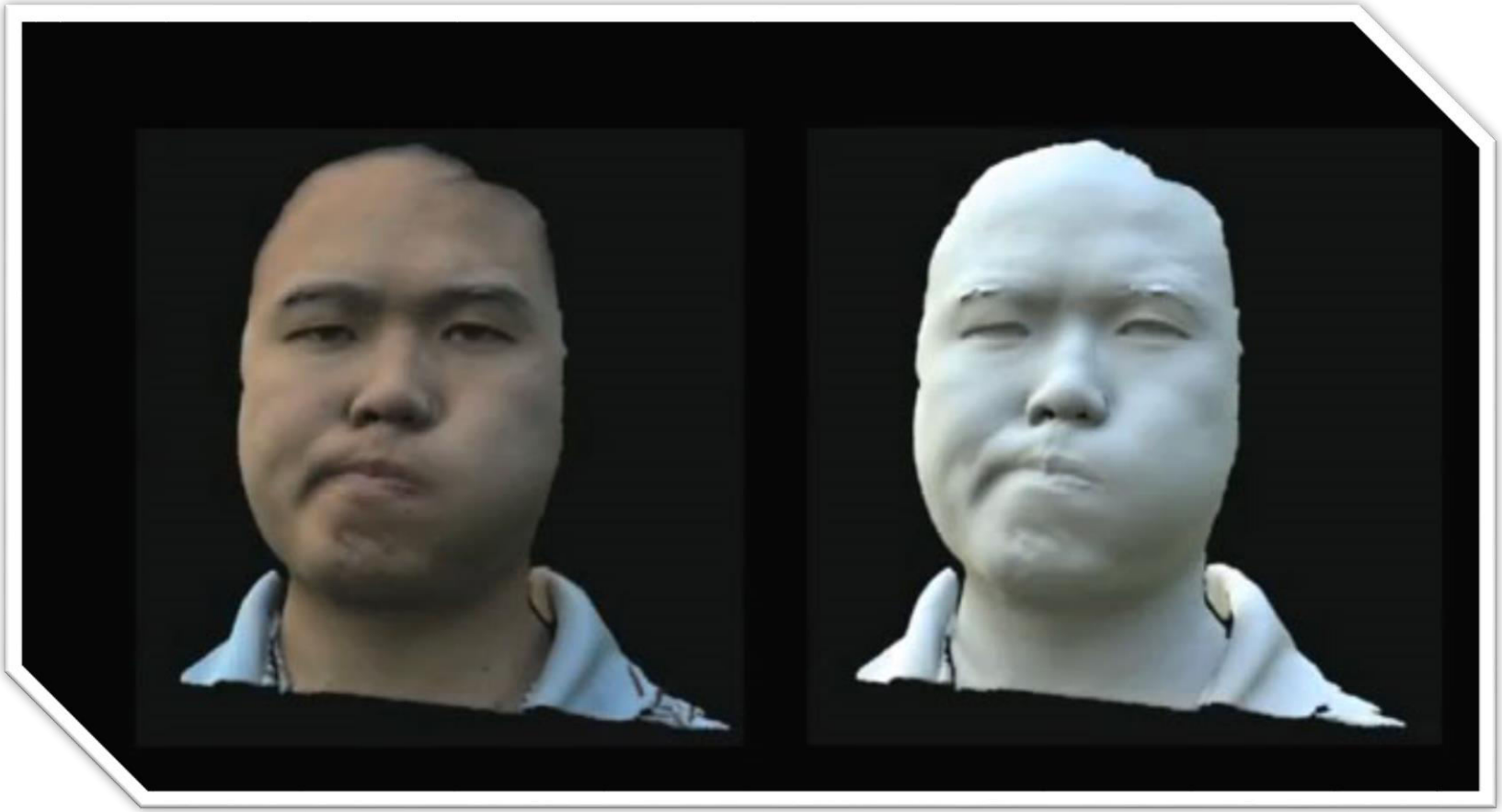
3D Scanner : Non Contact

- This type of scanner do not need any contact with the target object
- Instead of Physical contact, radiation is used
- Radiation could be LASER, IR or VR
- Depending on the radiation these are
  - Active (NCA): Uses external light resource
  - Passive (NCP): Uses the reflected light

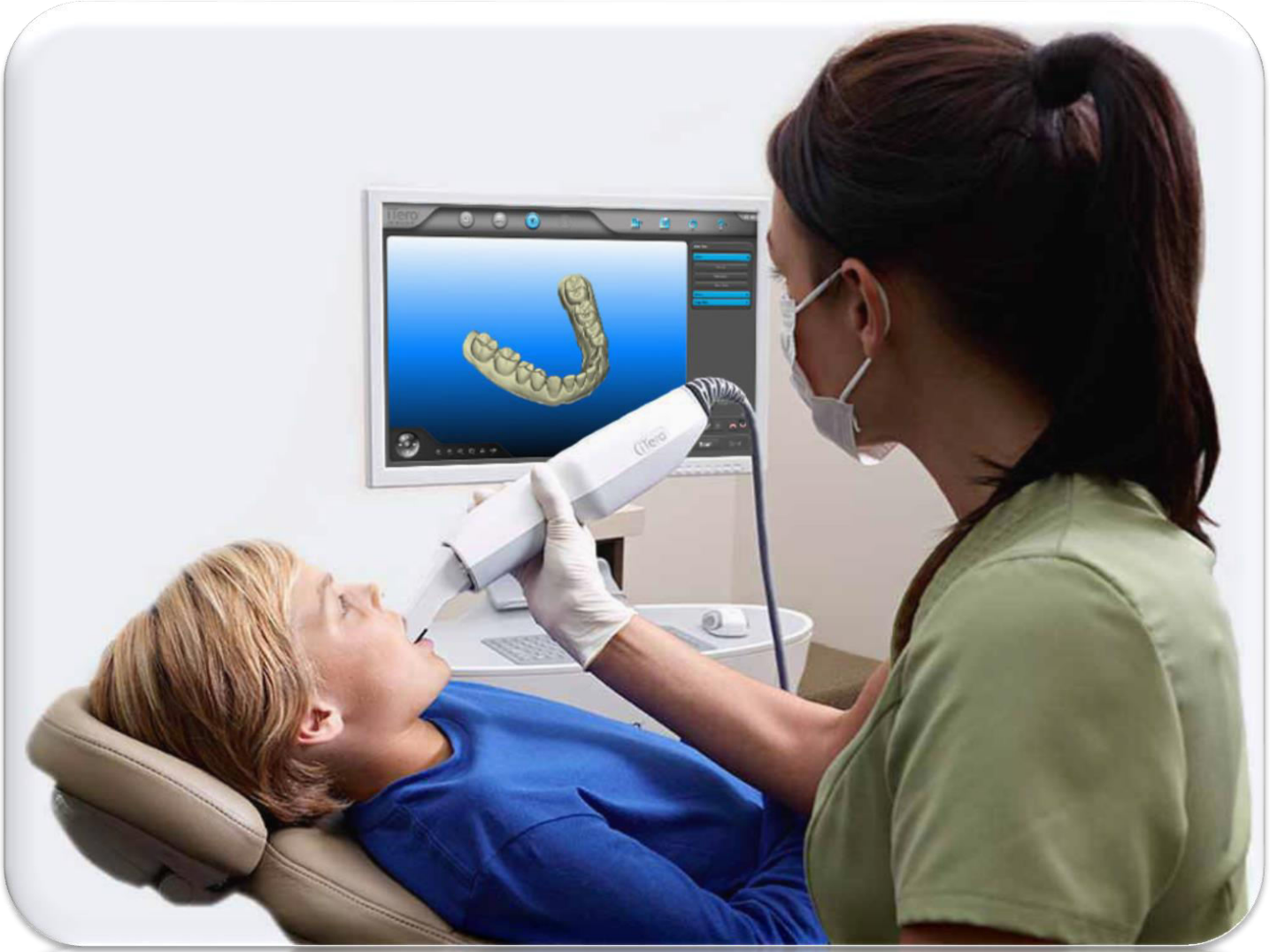
3D Scanner : NCA & NCP

- Name of some NCA
  - Time-of-flight: Uses LASER
  - Triangulation: Uses LASER
  - Conoscopic Holography: Uses LASER
  - Hand held: Uses LASER
  - Structured light: Uses VL
  - Modulated light: Uses VL
  - Volumetric: Uses X-Ray
- NCP uses reflected light from the target object

3D Scanner : Screenshot



3D Scanner : Screenshot



3D Scanner : Screenshot

3D Scanner : Applications

- Creating **CAD** (**C**omputer **A**ided **D**esign) models of real object
- Building (house) modeling
- Product quality assurance
- In dentistry
- In cancer
- In gaming

Camera Vs Scanner

Key Point	**Camera**	**Scanner**
Dimension	Creates an image from 3D to 2D	Creates an image from 2D to 2D or 3D to 3D
Portability	Portable	Non-portable
Resolution	Higher	Lower
3rd Party software	Not Necessary	Necessary
On system monitor	Available	Not Available

Thank You

Sonar Sensor with the Implementation

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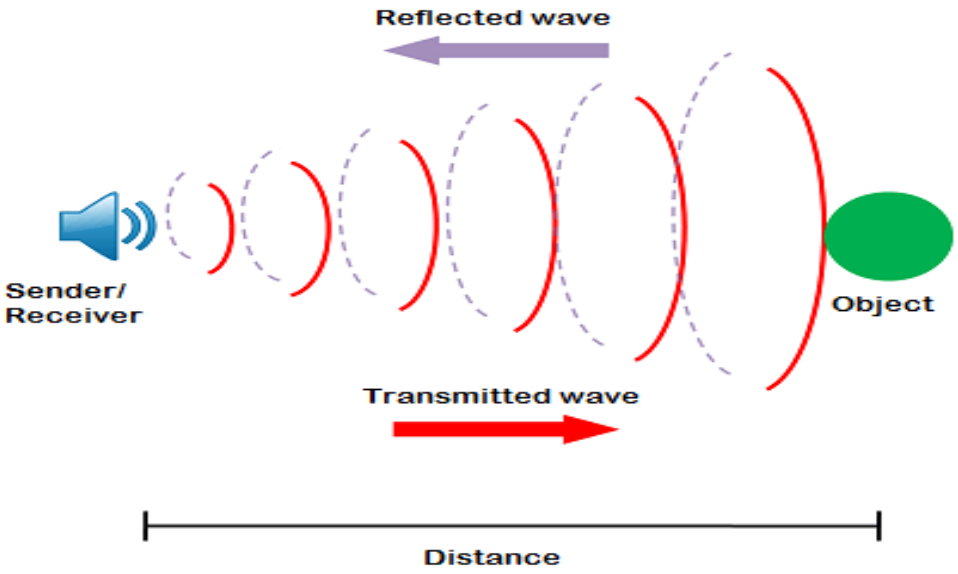
What is Sonar?

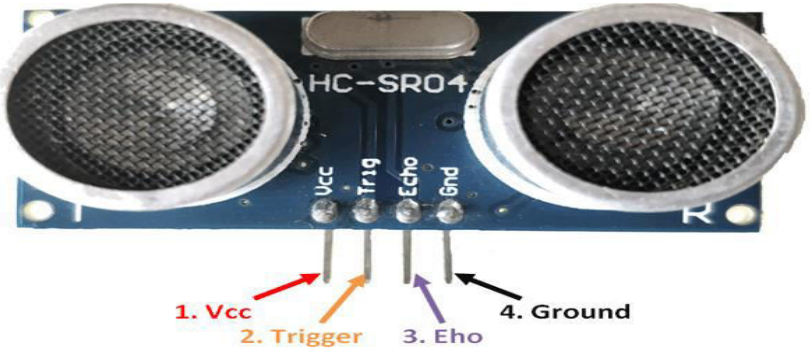
Sonar is a technique that uses sound propagation to navigate, communicate with or detect objects on or under the surface of the water.



Ultrasonic Sensor

An **Ultrasonic sensor** is a device that can measure the distance to an object by using sound waves.

Pin Configuration



VCC

- The Vcc pin powers the sensor, typically with +5V

Trig

- Trigger pin is an Input pin. This pin has to be kept high for 10us to initialize measurement by sending US wave.

Echo

- Echo pin is an Output pin. This pin goes high for a period of time which will be equal to the time taken for the US wave to return back to the sensor.

GND

- This pin is connected to the Ground of the system.

Features:

- Operating voltage: +5V
- Theoretical Measuring Distance: 2cm to 450cm
- Practical Measuring Distance: 2cm to 80cm
- Accuracy: 3mm
- Measuring angle covered: <15°
- Operating Current: <15mA
- Operating Frequency: 40Hz
- Trigger Input Pulse width: 10uS

Working principle

1

The transmitter (trig pin) sends a signal: a high-frequency sound.

2

When the signal finds an object, it is reflected and back toward the sensor

3

And the receiver(echo pin) receives/observed it.

Applications

Obstacles finding robots

biped robot, obstacle avoider robot, path finding robot etc.

Easy Control of Trash Collection Vehicles

Liquid Level Sensing

Water Depth Sensing with Ultrasonic and Wastewater Management

Vehicle Detection

Car Washes, Automotive Assembly, and Parking Garage Applications

Product for Blind people

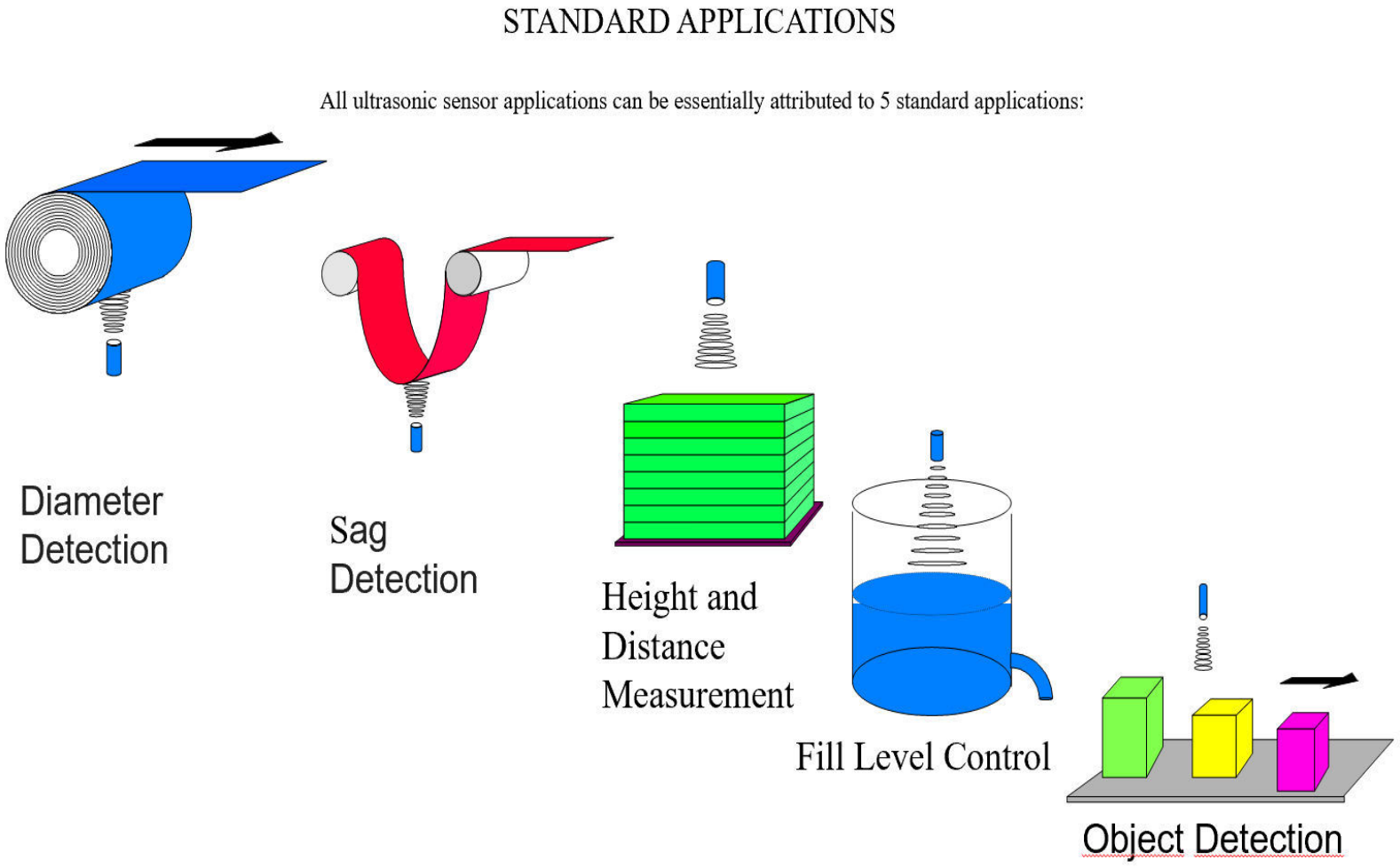
Smart (gloves, white cane, shoe, hat) etc.

Mapping

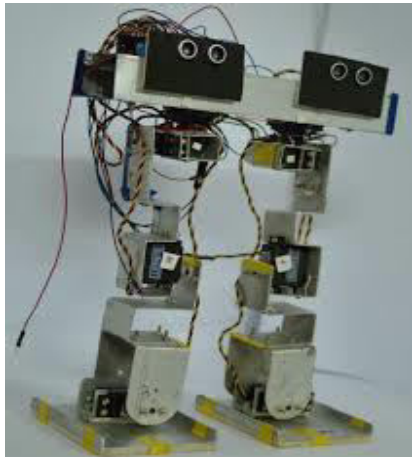
150 ultrasonic projects

https://www.hackster.io/projects/tags/ultrasonic

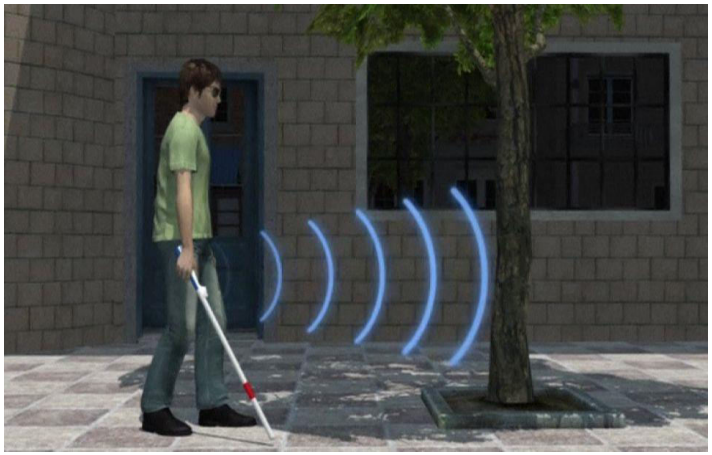
Contd…


STANDARD APPLICATIONS
All ultrasonic sensor applications can be essentially attributed to 5 standard applications:
Diameter Detection
Sag Detection
Height and Distance Measurement
Fill Level Control
Object Detection

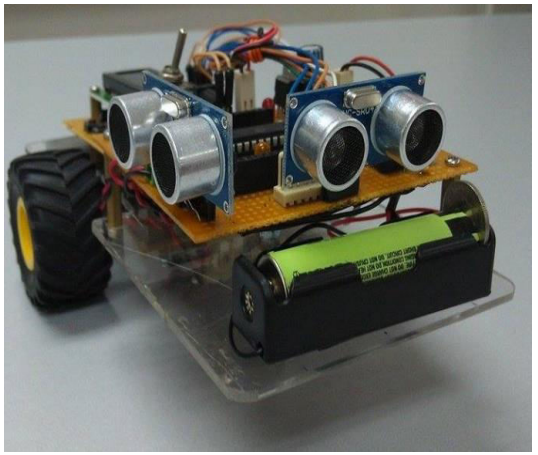
Contd....



Intelligent self balance robot

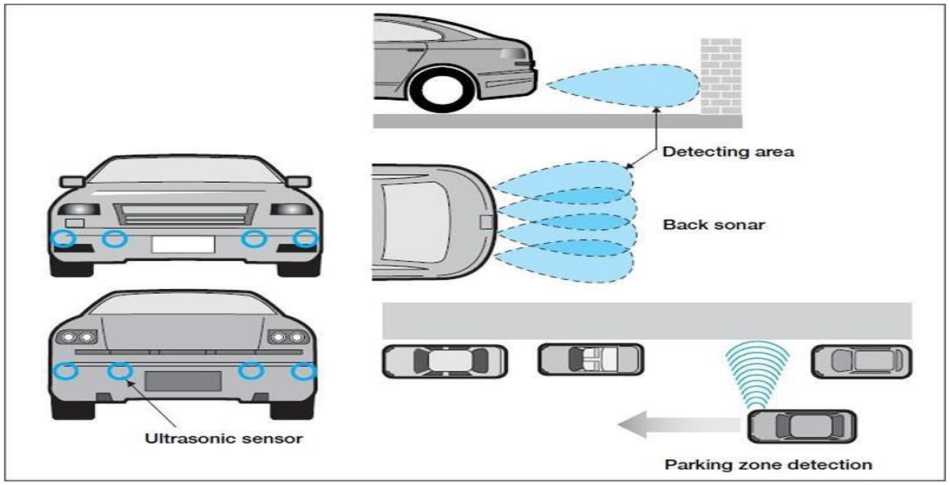


Smart White Cane



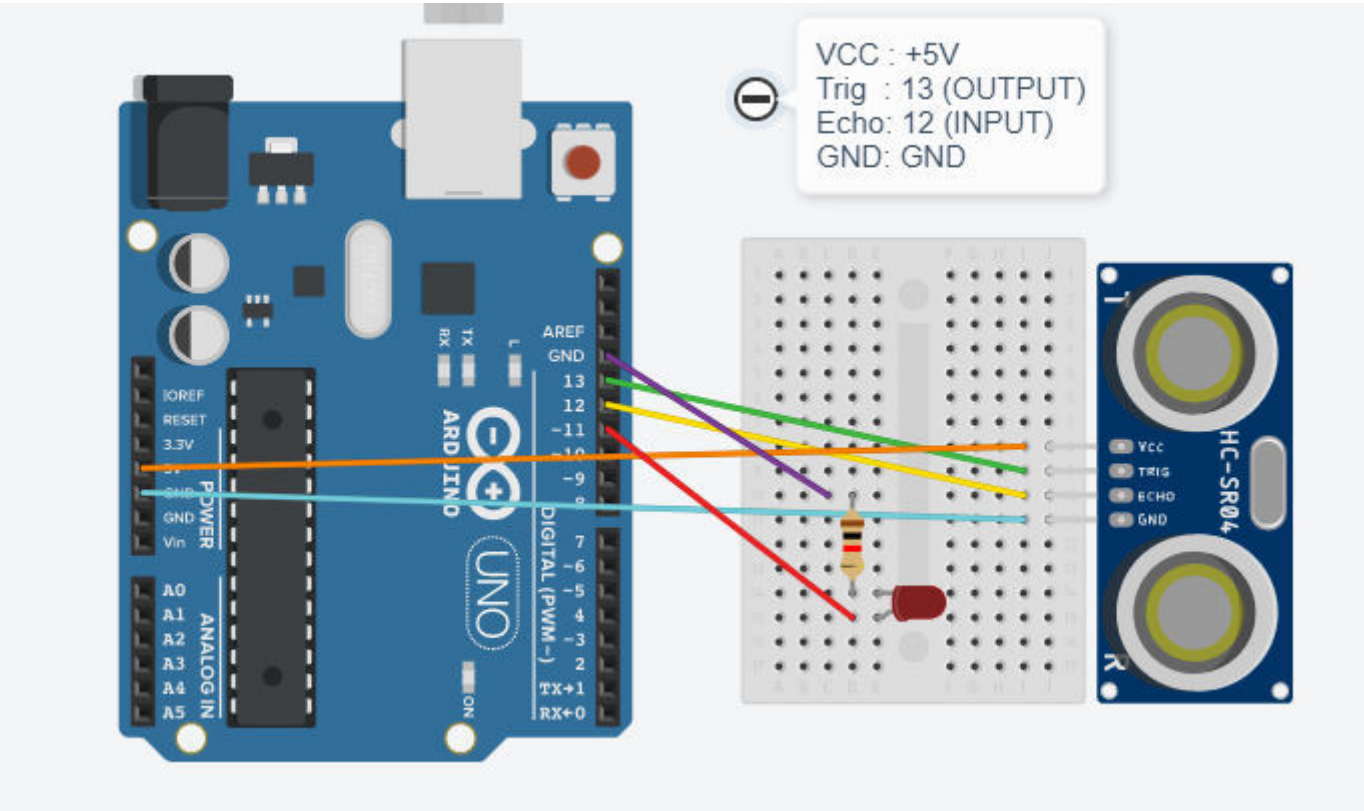
Wall follower robot

Trash level detection



Car parking

Diagram :


VCC : +5V
Trig : 13 (OUTPUT)
Echo: 12 (INPUT)
GND: GND
HC-SR04
Vcc
TRIG
ECHO
GND
UNO
ARDUINO
POWER
ANALOG IN
DIGITAL (PWM~)

Code:

```
const int trigPin = 13;
const int echoPin  = 12;
const int led = 11;
void setup()
{ Serial.begin (9600);
pinMode(trigPin, OUTPUT);
pinMode(echoPin, INPUT);
pinMode(led, OUTPUT);
}
void loop()
{
long duration, distance;
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
duration = pulseIn(echoPin, HIGH);
distance = (duration/2) * 0.034;
if (distance < 10)
{
digitalWrite(led,HIGH);
}
else {
digitalWrite(led,LOW);
}
}
```

Distance= velocity * time

s= 343 m/s * (duration/2) [As the duration of time has been calculated for two ways]

s= 34300 cm/s * (duration/2)

s= 34300/1000000 cm/micro-sec * (duration/2)

s= 0.0343 cm/us * (duration/2)

Hardware Requirements (Proteus)

- Arduino
- LED
- Pot & Pot HG
- Ultrasonic V2.0 B

Library for Proteus

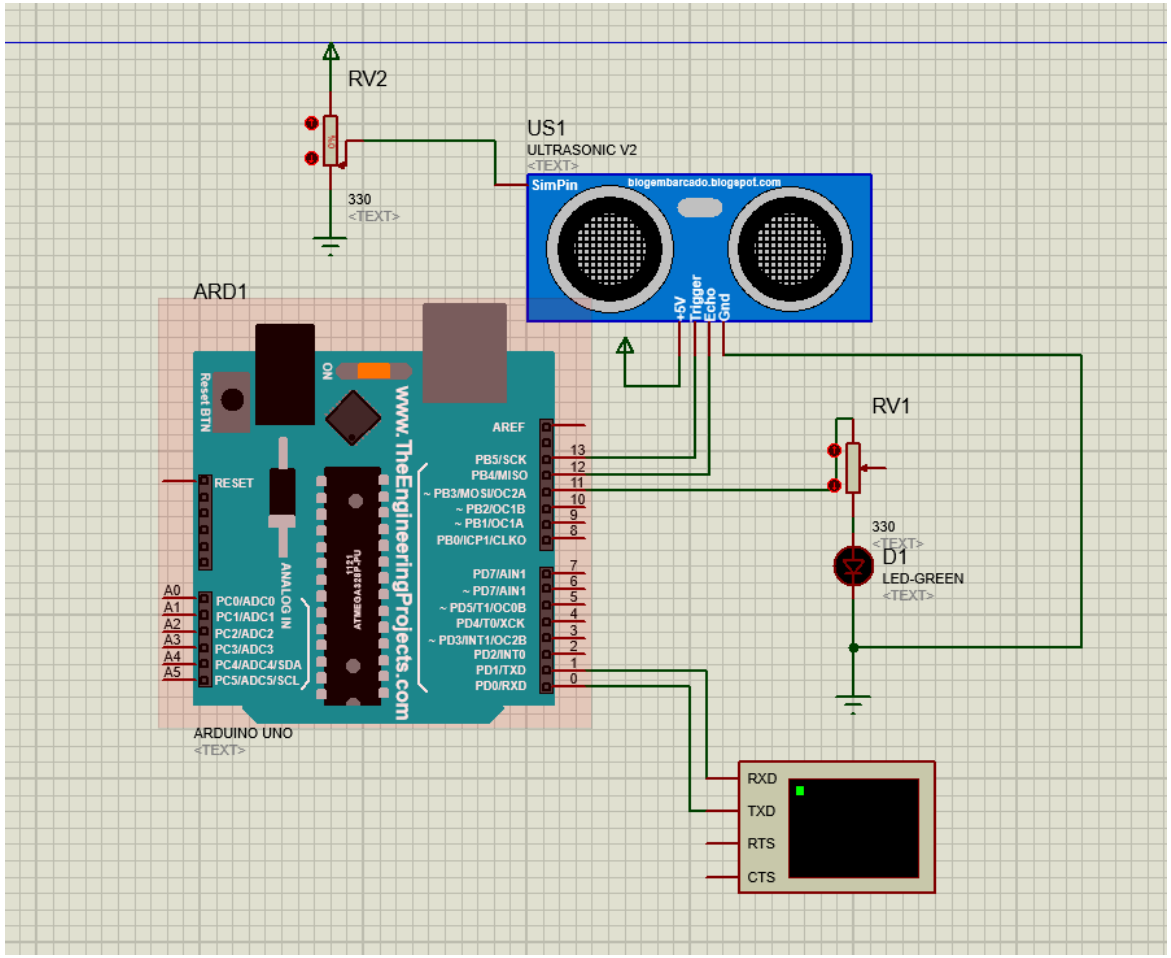
- Put the following in the path:

C>Program data>Labcenterelectronics>Proteus8Professional>Library

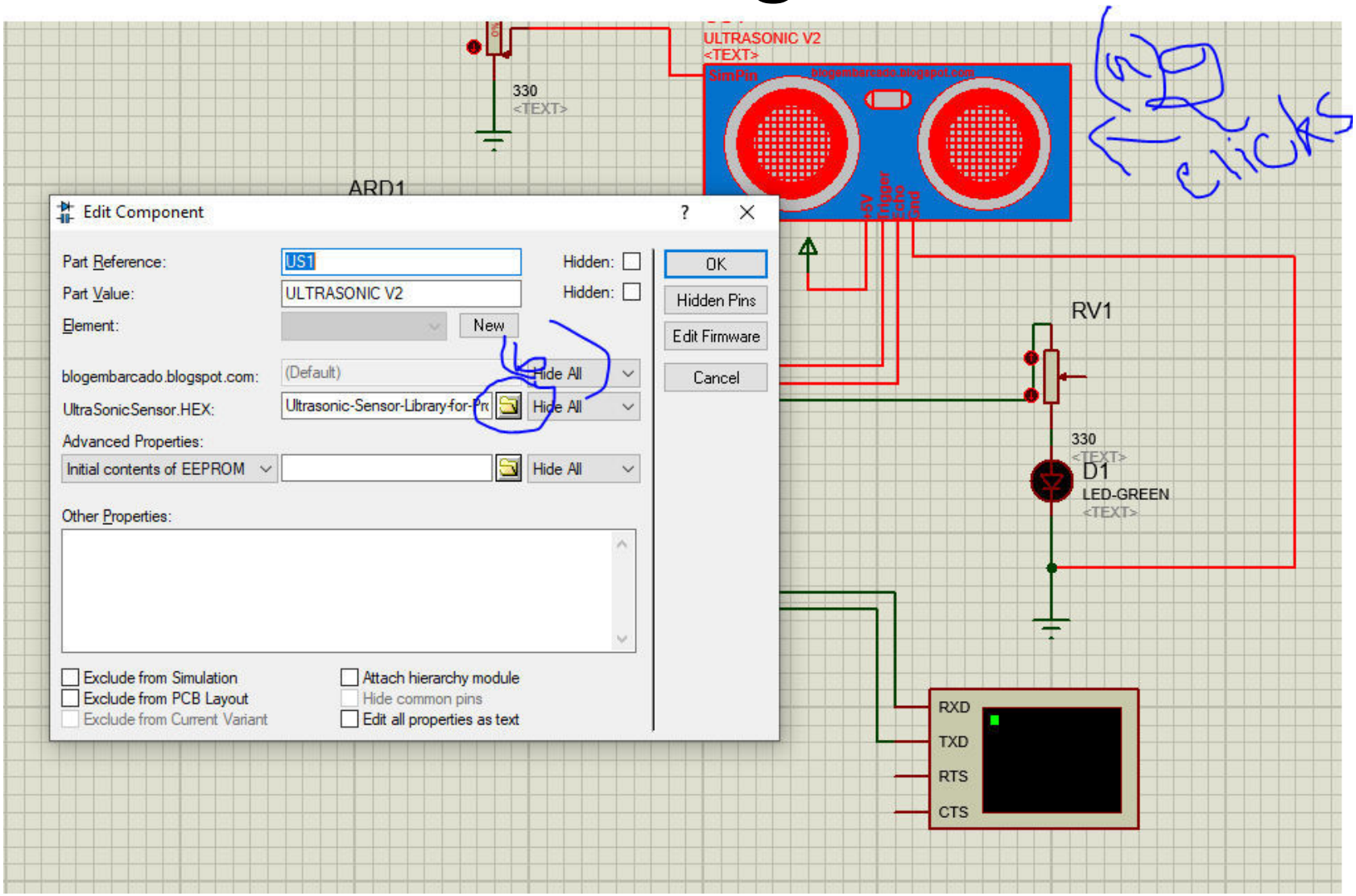
Files name:

1. UltrasonicTEP.HEX
2. UltrasonicTEP
3. UltrasonicTEP.LIB

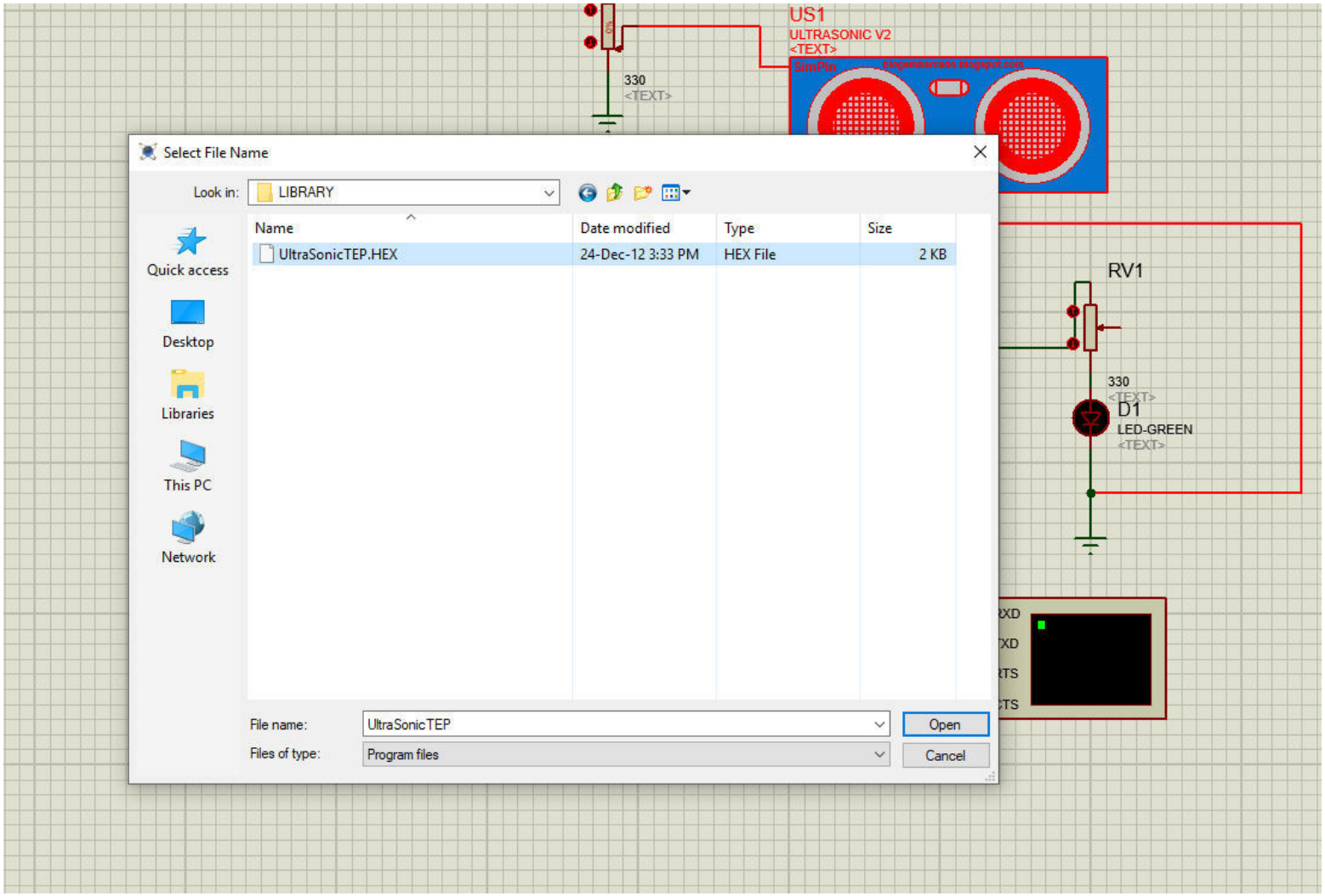
Proteus integration



Proteus integration

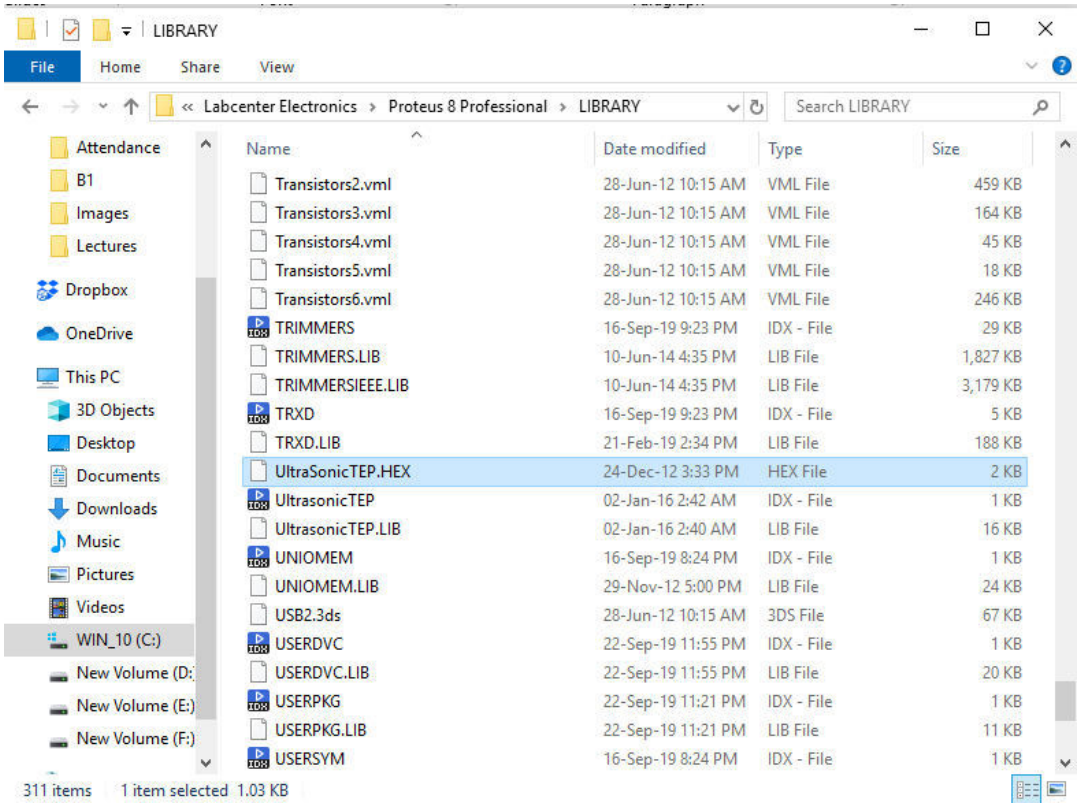


Proteus integration

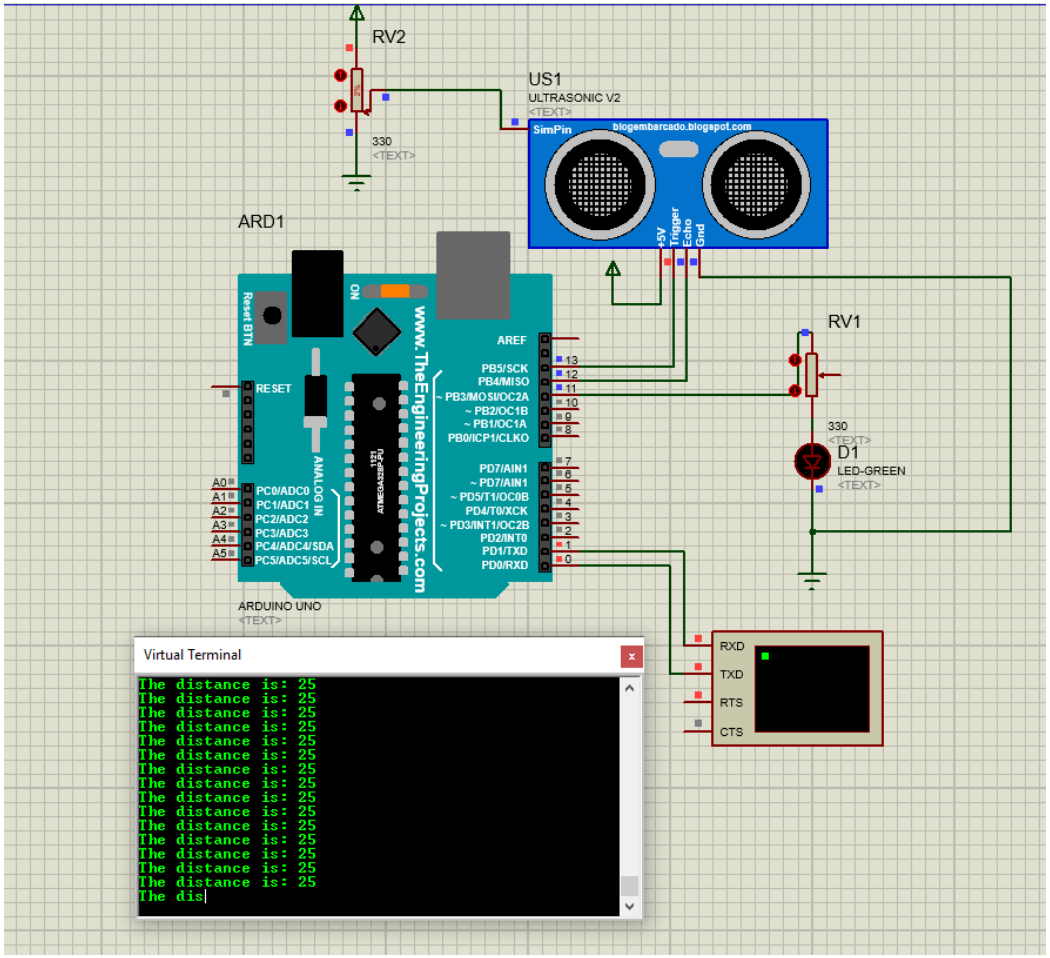


Library Path

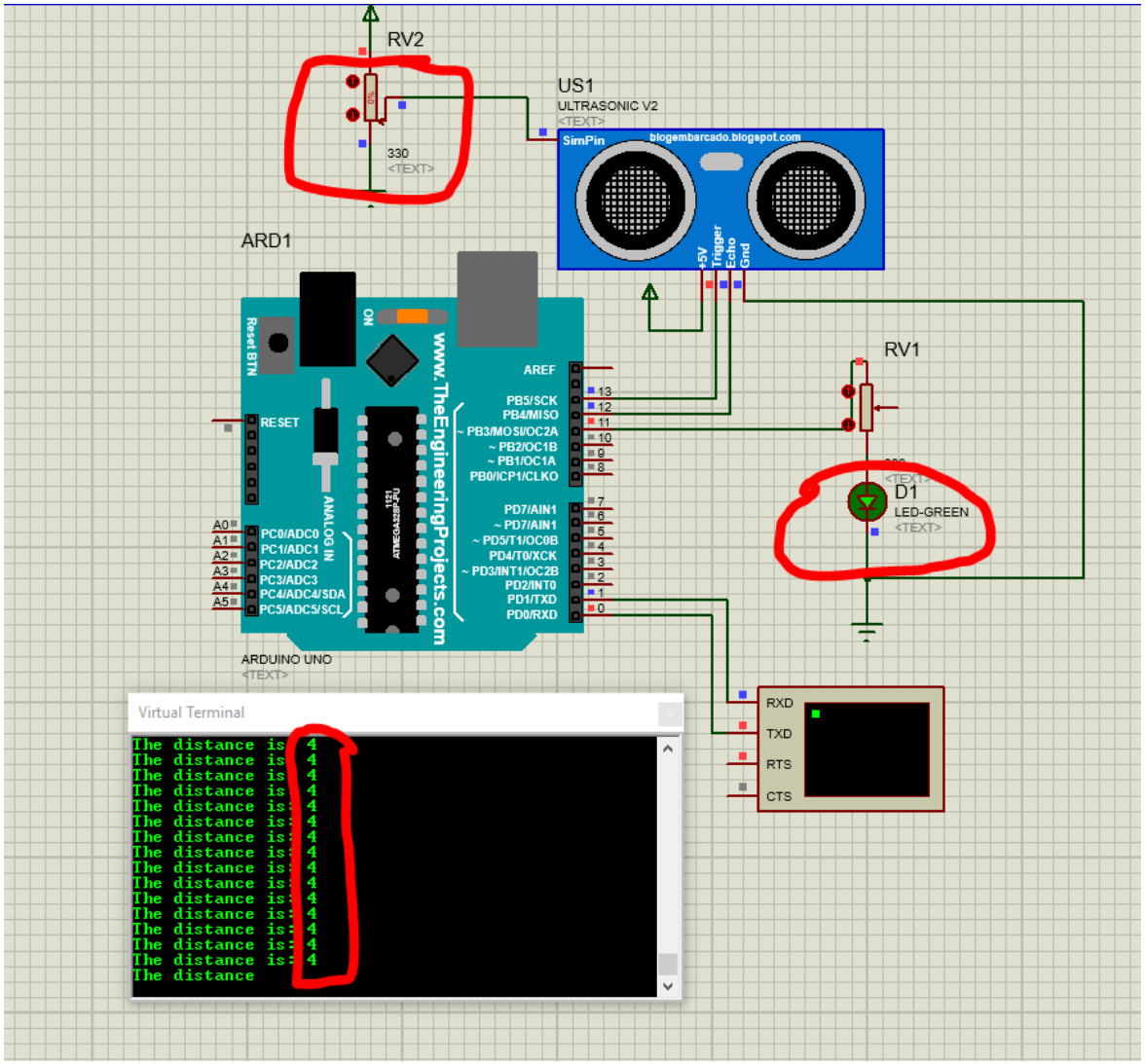
- C:\ProgramData\Labcenter Electronics\Proteus 8 Professional\LIBRARY\UltrasonicTEP.HEX



Proteus integration (working)



Proteus integration (working)-value less than 10



pulseIn(): Reads the echoPin, returns the sound wave travel time in microseconds. if value is HIGH, **pulseIn**() waits for the pin to go HIGH, starts timing

Distance = Speed × Time ; here universal speed of US wave at room conditions is 340m/s. convert to 0.034 cm/us.

Duration: divide the duration by 2 because the wave was sent, hit the object, and then returned back to the sensor.

THANK YOU

Liquid-Crystal Display (LCD 16X2)

CSE 315

Peripherals & Interfacing

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What is LCD?

- A Liquid Crystal Display (LCD) is a thin , flat panel display device used for electronically displaying information such as text ,images and moving picture.
- LCD is used in Computer monitors, Televisions , Instrument panels, Gaming devices etc.
- Polarization of lights is used here to display objects.
- The LCDs have a parallel interface, meaning that the microcontroller has to manipulate several interface pins at once to control the display.

16*2 LCD

- **16×2 LCD** is named so because; it has 16 Columns and 2 Rows. There are a lot of combinations available like, 8×1, 8×2, 10×2, 16×1, etc. but the most used one is the 16×2 LCD. So, it will have (16×2=32) 32 characters in total and each character will be made of 5×8 Pixel Dots

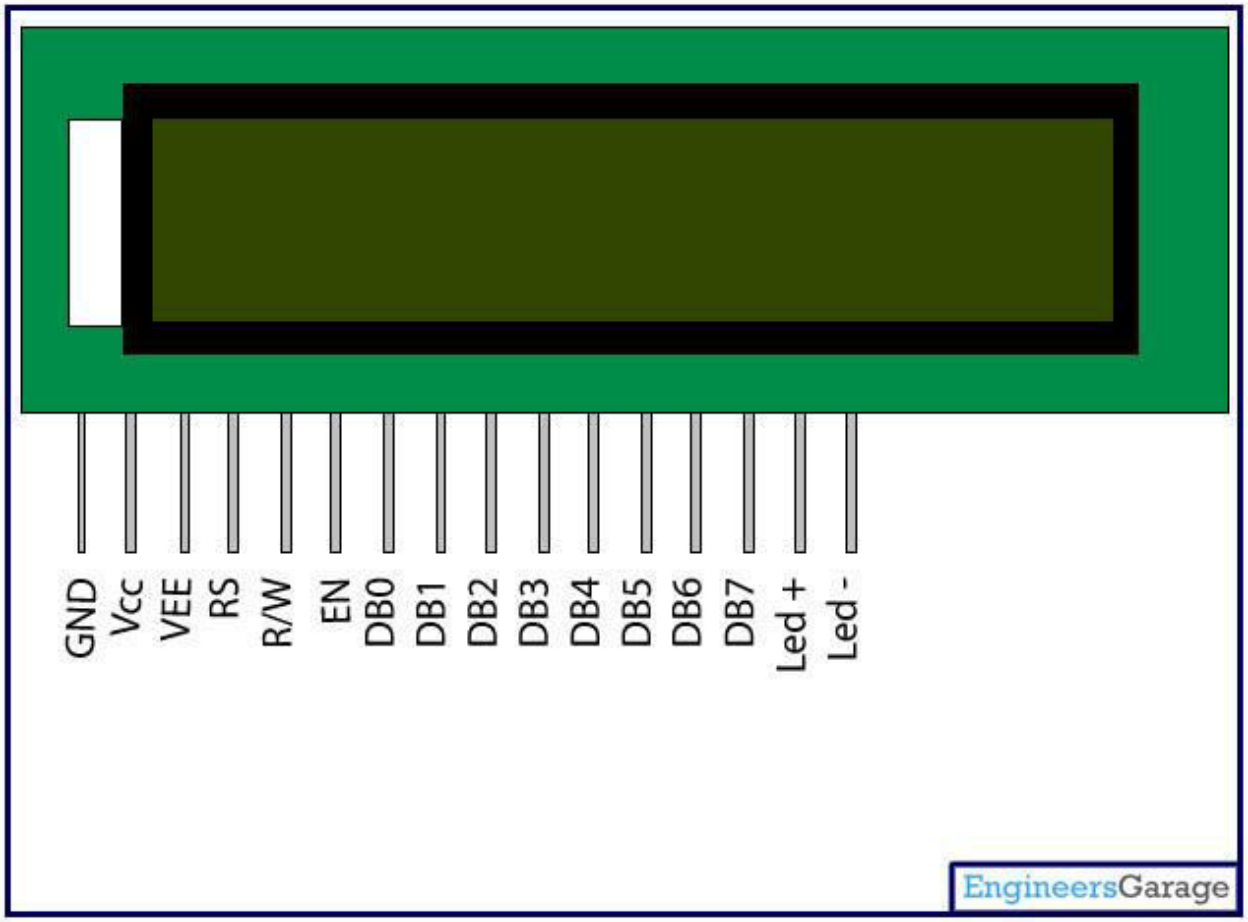
Why LCD?

- Smaller size —LCDs occupy approximately 60 percent less space than CRT displays an important feature when office space is limited.
- Lower power consumption—LCDs typically consume about half the power and emit much less heat than CRT displays.
- Lighter weight —LCDs weight approximately 70 percent less than CRT displays of comparable size.
- No electromagnetic fields —LCDs do not emit electromagnetic fields and are not susceptible to them. Thus, they are suitable for use in areas where CRTs cannot be used.
- Longer life —LCDs have a longer useful life than CRTs

Features of 16×2 LCD

- Operating Voltage is 4.7V to 5.3V
- Current consumption is 1mA without backlight
- Alphanumeric LCD display module, meaning can display alphabets and numbers
- Consists of two rows and each row can print 16 characters.
- Each character is build by a 5×8 pixel box
- Can work on both 8-bit and 4-bit mode
- It can also display any custom generated characters
- Available in Green and Blue Backlight

Pin Configuration:



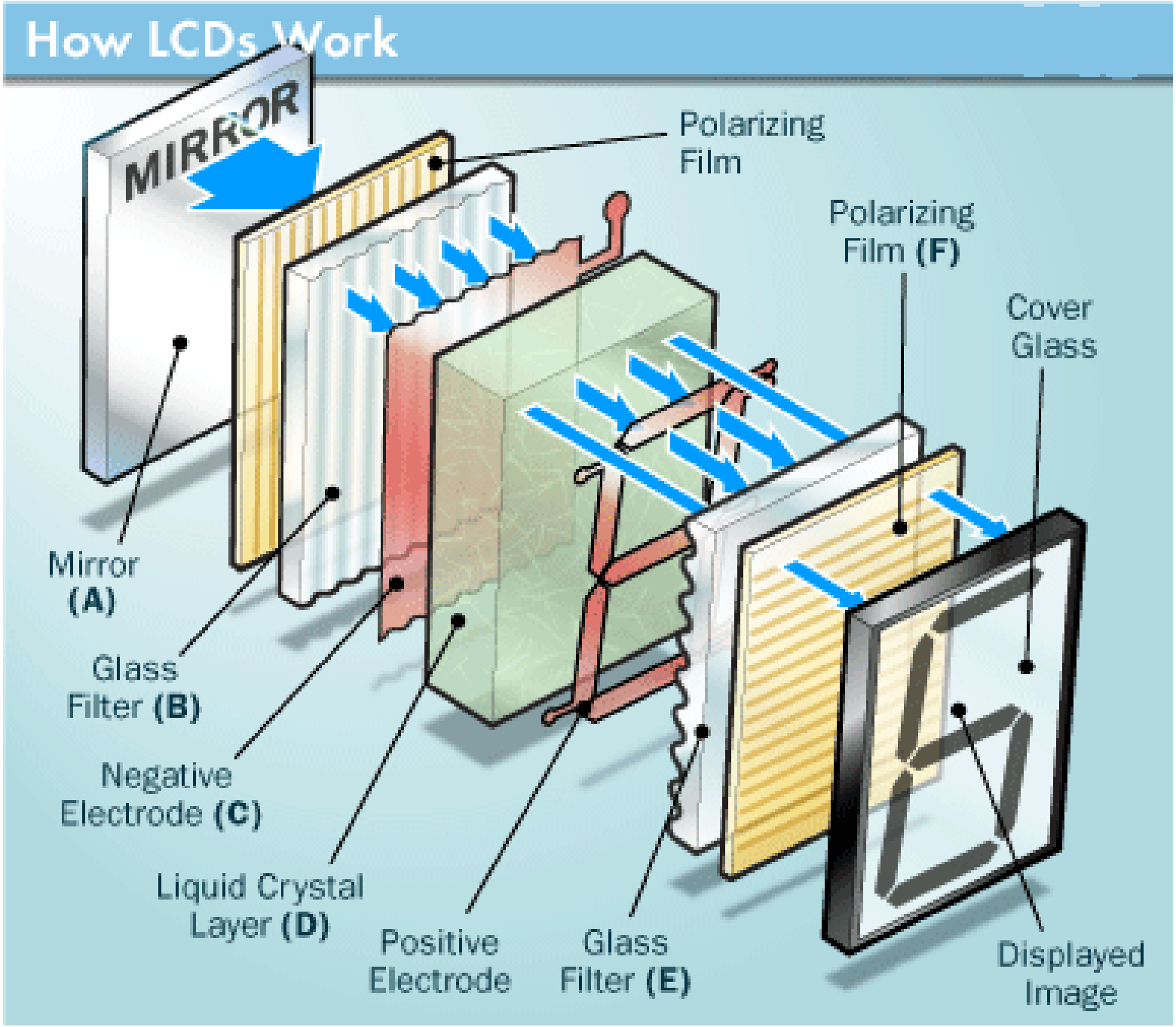
Pin Description:

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	V_{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight V_{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

Working:

- Liquid crystal display screen works on the principle of blocking light rather than emitting light. LCD's requires backlight as they do not emits light by them. We always use devices which are made up of LCD's displays which are replacing the use of cathode ray tube.

How LCDs Work



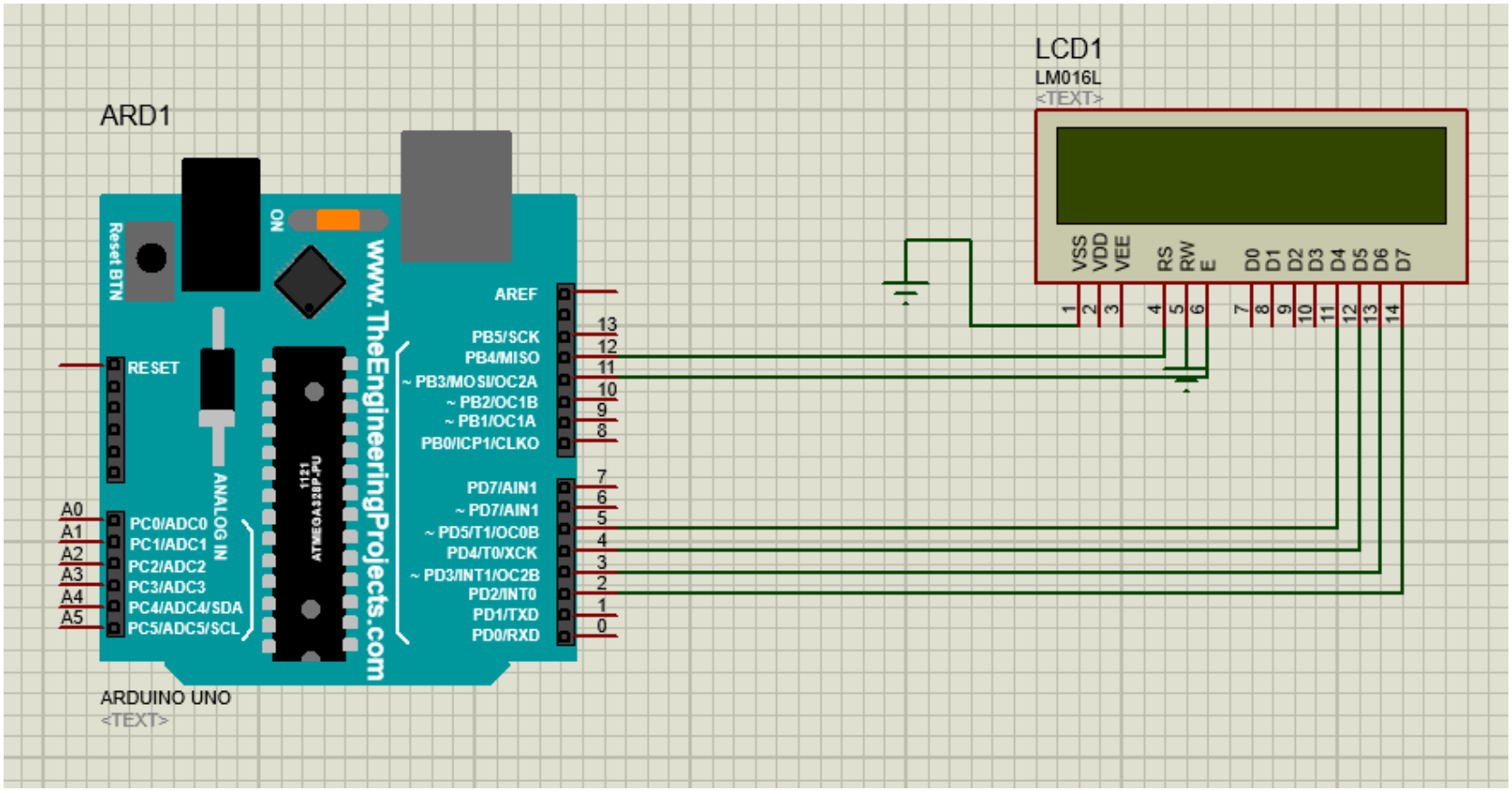
Coding:

```
#include <LiquidCrystal.h>

LiquidCrystal lcd(12, 11, 5, 4, 3, 2);

void setup() {

  lcd.begin(16, 2);

  lcd.print("hello world!");

}

void loop() { }
```

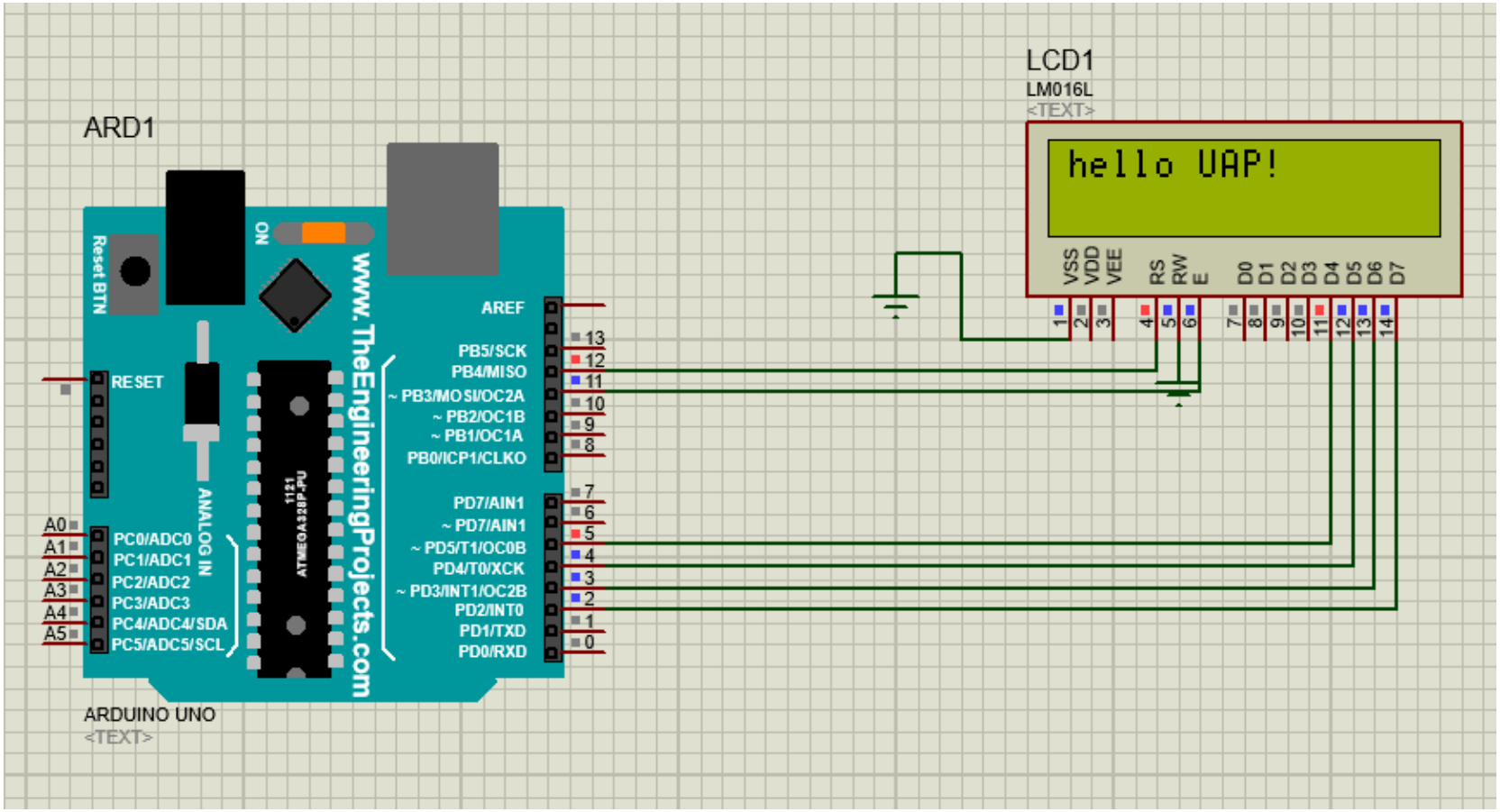
Required Components

- Arduino
- LM016L

Proteus Integration:



Proteus Integration:



Projects:

- Temperature Controlled AC Home Appliances
- Car Speed Detector Using Arduino.
- Home Energy Monitor
- Arduino Calculator.
- Arduino Clock and so on.
- Normal Game (Car and obstacle)


Thank
you!