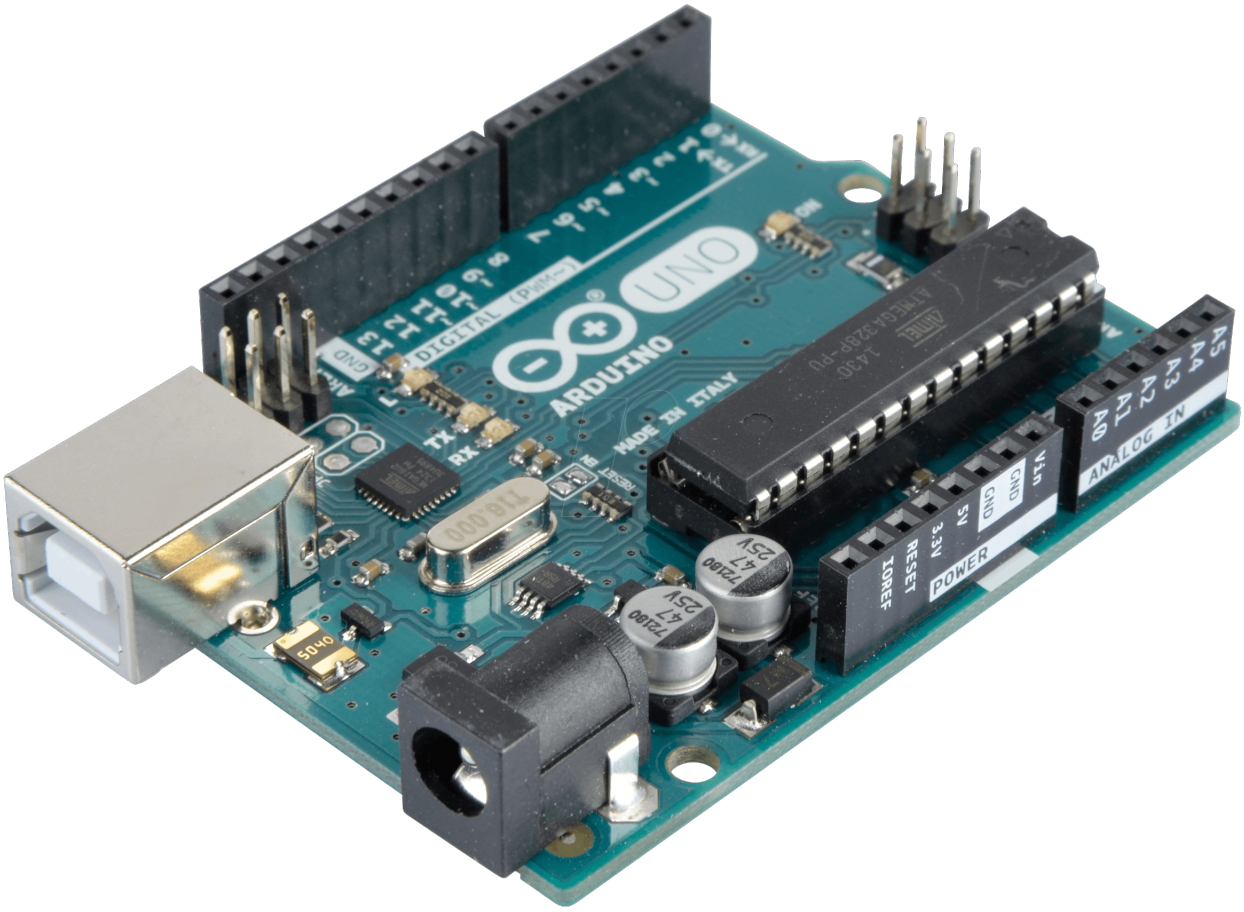
SAN FRANCISCO STATE UNIVERSITY

ENGR 294 - Introduction to micro controllers

Arduino Uno speed radar project



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1 Abstract

In this document you will see how I made my project for the ENGR-294 class. This project is a speed radar using an Arduino uno microcontroller, an LCD screen and an ultra sonic sensor.

2 Introduction

The project is a speed radar so it's application is measuring speed. At this scale the system is too small to measure precise speeds and to work with long distances. However it can be used to give a velocity feedback on small devices such as robot vacuum. Using bigger and better sensors, it could be used to measure car speed's on the highway.

3 Background

I choose to do this project because it was a challenging project using basic physics laws and coding. I also wanted to discover how to use sensors with Arduino and the LCD screen.

4 How does it works?

4.1 The physics behind the project

For this project I used the Arduino uno microcontroller, an ultrasonic sensor and an LCD screen.
In order to calculate the speed of the moving object we use the ultrasonic sensor to measure the distance between the sensor and the object. As we want to measure velocity, we need to calculate the distance from the sensor at two different moments.
At a time t_1 an ultrasound will be produced by the ultrasonic sensor. The sensor will give us the travel time of the sound (τ) so we can calculate the distance d_1 using the sound's velocity in the air (c)

$$d_1 = c.\tau$$

Then we do the same thing a time t_2, as the object is moving, we can calculate the distance d_2 using the same relation.
The last step is to calculate the traveled distance to deduce the velocity. The traveled distance is defined by $D = |d_2 - d_1|$ and the time it took to travel is defined by $T = |t_2 - t_1|$. Now we just have to calculate the velocity:

$$V = \frac{D}{T} \tag{1}$$

Then we will be displaying the value of the velocity on the LCD screen.

4.2 Schematics

First let's describe the two components we are using on this project:

4.2.1 The components

The ultrasonic sensor: The ultrasonic sensor we are going to use is the HC-SR04 that can generate ultrasounds with a 40kHz frequency. As shown, the sensor must be connected to 4 pins of our Arduino and out of these 4 pins one of them will be an output to the system (TRIG) and another one an input (ECHO).

Figure 1: Ultrasonic sensor

The LCD screen: The LCD display is made can use up to 16 pins on our Arduino. Some of them are just there to change the brightness of the screen etc. But the most important ones are the Data pins. For now, as we don't know what we are going to display on the screen, we still don't know how many data pins are going to be used.

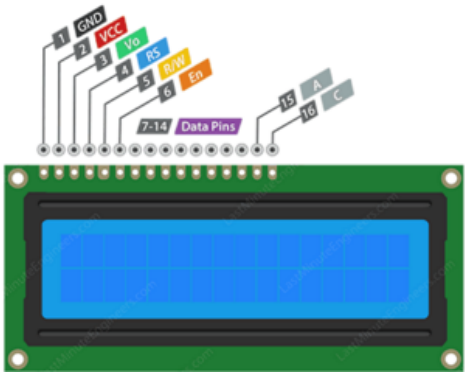

Figure 2: LCD screen

4.2.2 The circuit

Now that we know the components of the system we can wire it in way that it works:

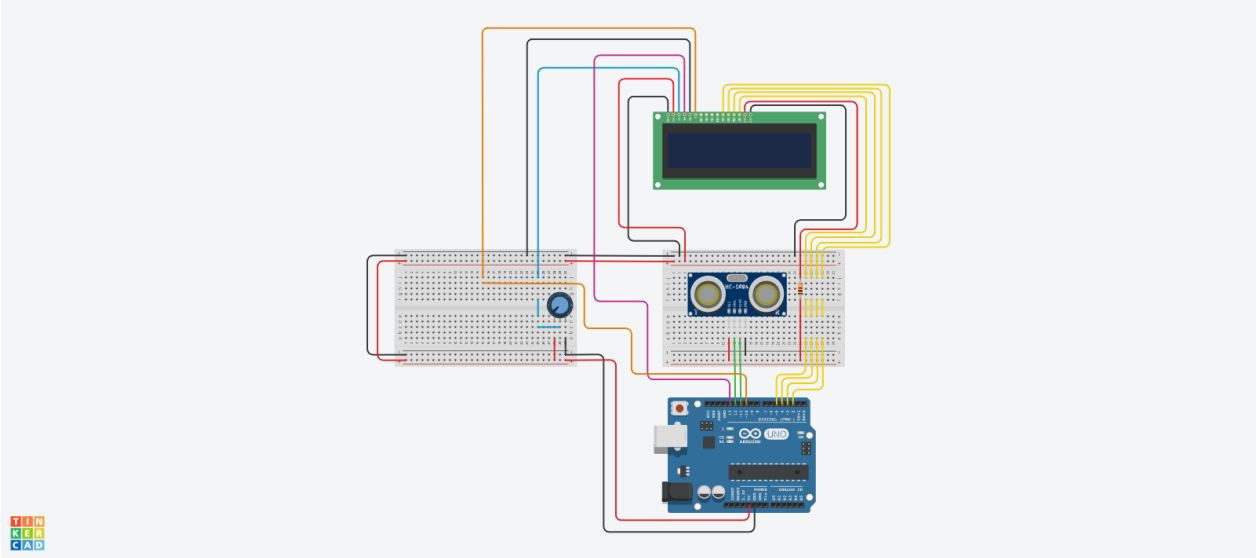

Figure 3: Final schematic

4.3 Testing phase

4.3.1 Simulation

To test the system I simulated it on a software called Tinkercad which allowed me to use my system and test different settings without breaking the actual components. Once the simulation seemed working at its best I could upload the code on my arduiino board and test it in real life.

4.3.2 testing in real life

In order to test in real life I recorded a slow motion video where I would move an object in front of the sensor from a certain point to another. To see the distance the object has moved I would also place a ruler. Then I just had to see the video and calculate the speed by hand and then compare it to the speed displayed by the LCD screen. Then I would change parameters again to have the more accurate result on the LCD screen.

5 Conculsion

To improve the project I would have worked with IR sensor instead of an ultrasonic sensor as there are less chances to get noise from the environment and it's more precise.

During this project I learned how to manage different components with an Arduino board, how to simulate systems and learning on how the components work is very interesting as we can understand how small object of our daily life could work.

6 Bill of materials

- Elegoo uno R3
- Ultrasonic sensor: HC-SR04
- 16 pin LCD display
- potentiometer