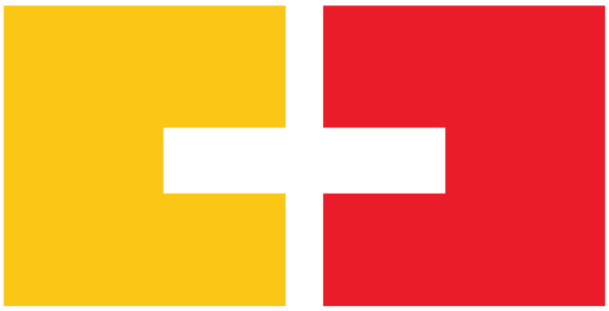

HOCHSCHULE
HAMM-LIPPSTADT

Bicyclists' Safety Solutions- Relative Positioning and Warning of Impending Vehicles Using Atmega 128a

LAB REPORT

Group Members:

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Responsibilities:

Kashif & Ammar:
(Accelerometer & LCD Interfacing with Atmega 128A/Tilt sensing)

Raihan:
(Warning Alert using Piezo Buzzer & Ultrasonic sensor with Atmega 128)

LAB:

Microcontroller

Instructor:

Abstract

According to Statistics, 36% of people in Germany use their own bicycles for transportation twice a week or more [1]. It saw a 16.8% increase in bicycle fatalities in 2019 compared to 2010- according to Statistisches Bundesamt [2]. It was also the highest number of fatalities with a staggering figure of 445 among all the EU member states [3]. According to [4], the most common fatal bicyclist-motorist crash is likely by a vehicle approaching from behind the bicycle.

Keeping these facts in consideration, the goal of this project is to design a sensor-assisted tracking device for bicyclists that will track any vehicle and will visualize the coordinates of the vehicle (if any) in the LCD display and the piezo buzzer will generate a warning when the vehicle is in certain proximity.

Introduction

The device will help to create cycling easier and safer. Using this module on the bikes will help them get accurate data on the coordinates they are heading towards. And the ultrasonic sensor will help the bicyclist to determine if someone is coming from behind and how near he is to the bicycle if the vehicle comes really near to the bicycle, then the buzzer will beep which will alert the bicyclist to maintain a safe distance. To get the coordinates in X, Y, and Z axis we used the accelerometer sensor, and to display the result we used the LCD of 16×2.

Project:

The main components which we have used to make the project are as follows:

1. Microcontroller: The project design will be based on the lab-provided PCB board with an embedded Atmega128A chip.
2. Sensors: Accelerometer, Ultrasonic sensor- HC- SR04(Generic)
3. Actuator: Piezo buzzer, LCD
4. Inputs: The analog data from sensors
5. Outputs: Digital signal visualized in LCD and sound by the Piezo buzzer

Description of components:

An accelerometer is a piece of electromechanical equipment that measures the force of gravity-induced acceleration in g units. Applications that require tilt sensing can benefit from it, such as gaming apps, mobile phones, and GPS Mapping). The X, Y, and Z axes of acceleration are measured by the ADXL335.

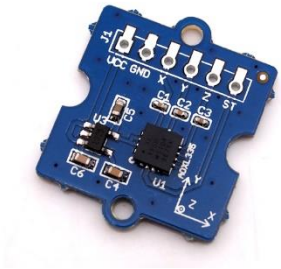


Figure 1 Adxl335 [5]

ADC, these voltages can be converted into a digital signal that the microcontroller processes to determine the tilt.

In the sensors and modules section, look up the topic ADXL335 Accelerometer Module to learn more about the accelerometer and how to use it. The objective of the project will be to interface a 3-axis accelerometer (ADXL335) and an LCD. The microcontroller will sense the different Analog values of the accelerometer convert them into digital and then display them on the LCD.

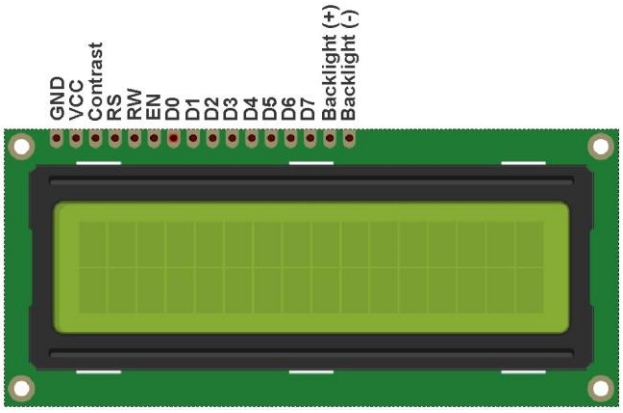


Figure 2 LCD [6]

The SONAR and RADAR systems underpin the operation of the Ultrasonic Module HC-SR04.
The ATmega128A is connected the ultrasonic transmitter, receiver, and control circuit for the HC-SR-04 module. There are only four pins on the module: Vcc, Gnd, Trig, and Echo.
Eight pulses of 40 kHz are produced whenever the Trig pin receives a pulse that lasts at least 10 seconds. After this, the module's control circuit raises the Echo pin.

Figure 3 Ultrasonic sensor [7]

Until it receives a return echo signal for the transmitted pulses, the echo pin remains high.
The time it takes for the generated ultrasonic sound to travel toward the object and return is determined by the length of time the echo pin stays high, or its width.
Using this time and the speed of sound in the air, we can use a straightforward formula to determine the object's distance and when the object comes near to the sensor the buzzer will beep to alert.

Figure 4 Piezo Buzzer [8]

Connection Interfaces:

For the accelerometer we have linked ADC0-ADC2 to the X, Y, and Z pins with the PF0-PF2 pins of Atmega 128A. This will offer distinct analog values that are independent of one another. And the values will appear on the Lcd in the X, Y, and Z. I showed the LCD the matching digital result. Since it operates in 4-bit mode, the DATA pins are attached to PD0–PD3, while the RS, RW, and E pins are connected to PD4, PD5 and PD6 respectively. You will note when viewing the video portion that the X, Y, and Z values only range from 300 to 500.

The resolution is 10 bits. We can state it simply as the accuracy or precision with which an ADC operates. The resolution for a 10-bit ADC operating at 5V Vref is 4.88mV. This means that the digital output will rise or fall by one unit for every 4.88mV change in the analog input. The output data will range from 0- 1023(2^10=1024), with 1024 possible values, because it is a 10-bit ADC.

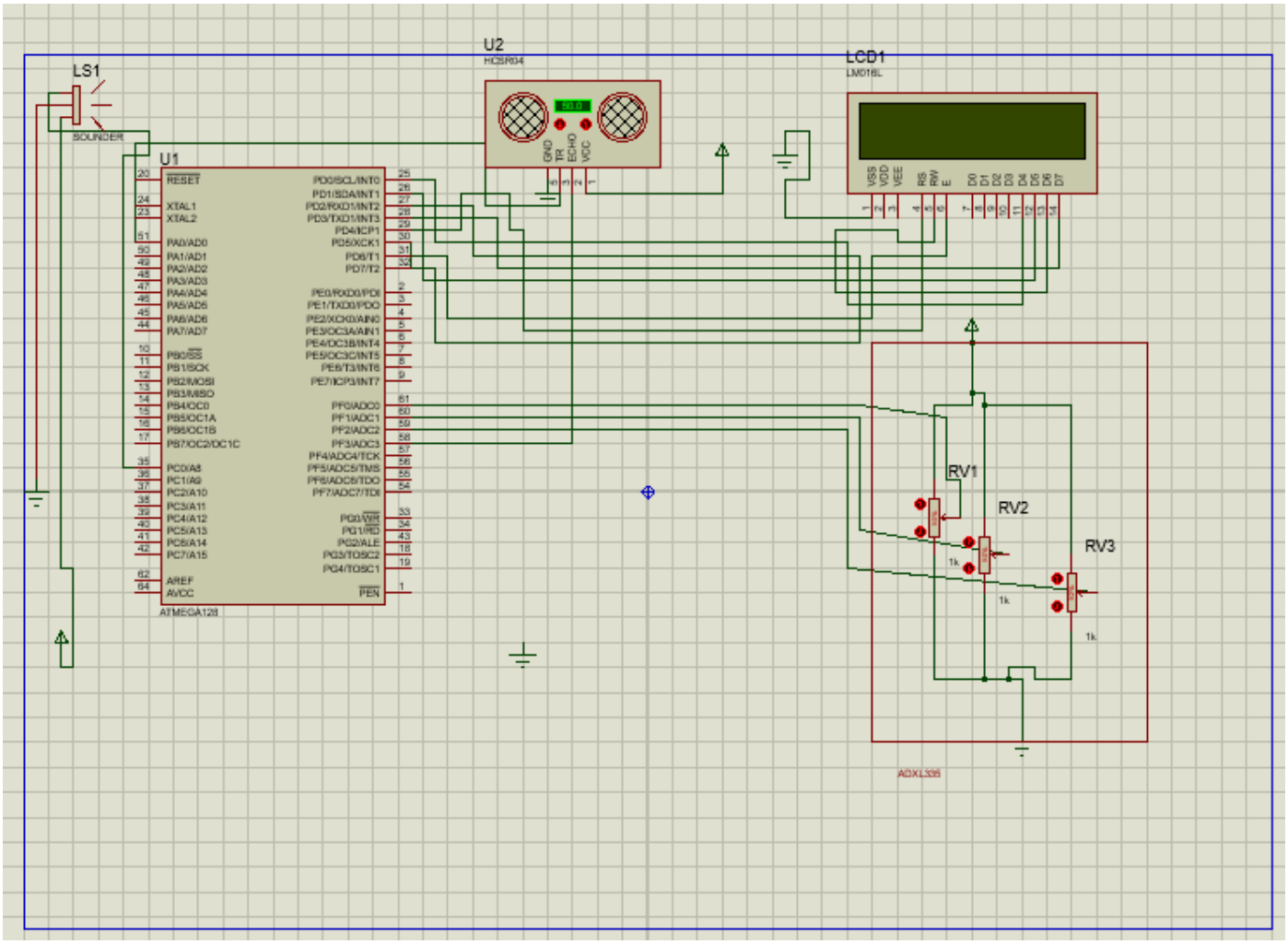
For the ultrasonic sensor, we have used the analog-to-digital converter with ADC3 for the echo and trigger pin with AD0 of the Ultrasonic sensor which are linked with PF3 and PA0 respectively. To get the beep of the sensor we connected one pin of the buzzer with the PC0

The microcontroller needs to transmit at least 10 us trigger pulse to the HC-SR04 Trig Pin After getting a trigger pulse, HC-SR04 automatically sends eight 40 kHz sound waves and the microcontroller waits for rising edge output at the Echo pin.

When the rising edge capture occurs at the Echo pin which is connected to an input of ATmega128A, start Timer of ATmega128A and again wait for a falling edge on the Echo pin.

As soon as the falling edge is captured at the Echo pin, the microcontroller reads the count of the Timer. This time count is used to calculate the distance are using the Atmega 128A.

Circuit Diagram:



Conclusion:

In a nutshell, this tilt sensing project will help us to get the GPS coordinates in X,Y and Z directions which can help us in the various applications in real life. Which can be used in the smartphones to locate where are you located exactly and also in modern vehicles. The warning alert project will provide the ty for every vehicle against collision and dangerous accidents. It will also ease the driver during driving.
But our main target is to make bicycle riding easier and safe for the rider. While riding the bicycle the rider will have proper control over his bike and his bike will alert him if the vehicle will come into the danger zone so he can maintain a safe distance.
For the programming of the project, we used the C language to interface it with the Atmega 128A microcontroller. Subsequently, we used the Microchip studio to program each module.

References

[1] K. Buchholz and F. Richter, “Infographic: Where cyclists are going places,” statista.com. https://www.statista.com/chart/25156/share-using-bike-for-transportation-regularly/. (Accessed Nov 16, 2022).

[2] “One in seven people killed in road traffic in 2019 was a cyclist,” Federal Statistical Office, https://www.destatis.de/EN/Press/2020/08/PE20_N049_46241.html. (Accessed Nov 16, 2022).

[3] F.Slootmans, “European Commission (2021) Facts and Figures Cyclists,” European Road Safety Observatory, Brussels, European Commission, Directorate General for Transport, Version 1.0, October 2021, Nov. 16, 2022. [Online]. Available: https://roadsafety.transport.ec.europa.eu/system/files/2022-03/FF_cyclists_20220209.pdf

[4] W. Jeon and R. Rajamani, “Rear vehicle tracking on a bicycle using active sensor orientation control,” *IEEE Transactions on Intelligent Transportation Systems*, vol. 19, no. 8, pp. 2638–2649, Aug. 2018, doi: 10.1109/TITS.2017.2764006

[5] Accelerometer_ADXL335 “Seeed-Studio” Available Online: https://github.com/Seeed-Studio/Accelerometer_ADXL335. (Accessed Jan 02, 2023).

[6] A. Joseph “Interface 16x2 LCD (parallel interface) with Arduino Uno” (2 May, 2020), Available Online: https://www.hackster.io/akshayjoseph666/interface-16x2-lcd-parallel-interface-with-arduino-uno-2e87e2 (Accessed Jan 02, 2023).

[7] csw1“Ultrasonic sensor with Arduino uno”(28 April, 2020) Available Online: https://www.hackster.io/csw1/ultrasonic-sensor-with-arduino-uno-f33ca1. (Accessed Jan 02, 2023).

[8] RND 430-00027 - Piezo Buzzer 82dB 3.2kHz 18V Available Online: https://www.distrelec.de/en/piezo-buzzer-82db-2khz-18v-rnd-components-rnd-430-00027/p/30225582.(Accessed Jan 02, 2023).