University of British Columbia Electrical and Computer Engineering
ELEC291/ELEC292
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Section 201

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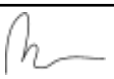
Nick Vo	11056892	100	

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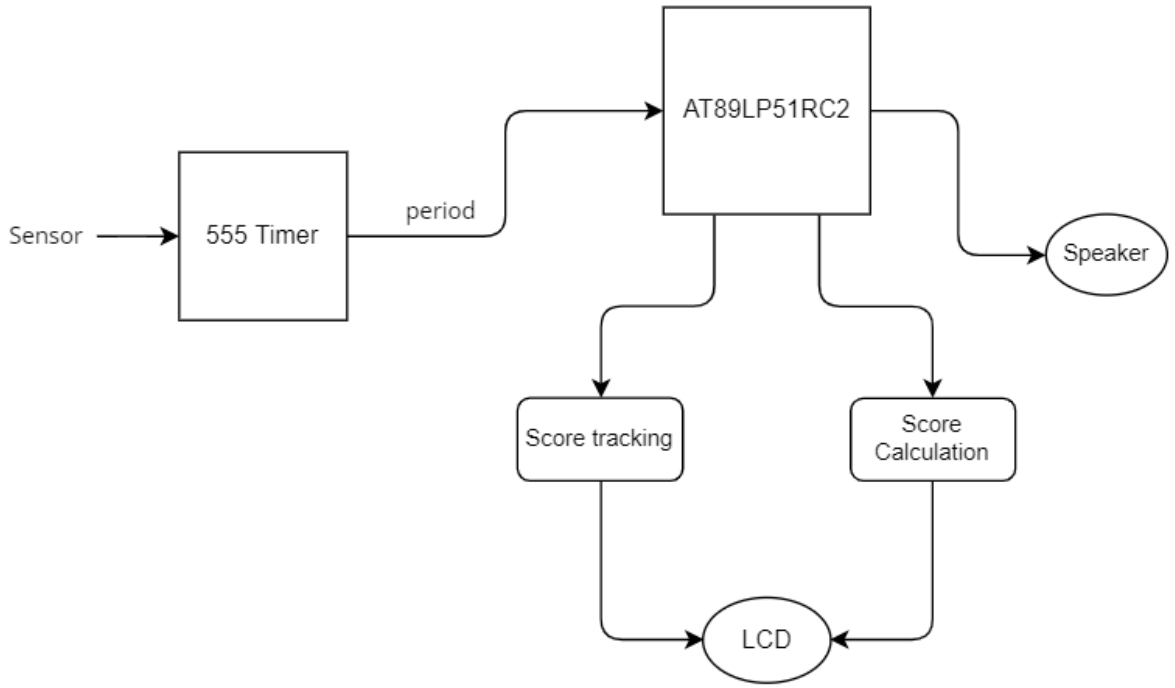
Table of Content

Introduction

In this project, we design, build, program, and test a microcontroller based capacitive sensors reaction game. This game will produce an audible signal using a speaker, wait for two or more players input from capacitive sensors, decide who wins the round, and keep a record of points for each player using the LCD, and whoever reaches 5 points first wins the game.

We have include the system block diagram below



Investigation

Idea Generation

We know we need to set up a simple capacitor in order to sense the presence of our hands for the game, so we decided we would use aluminium foil to make our capacitive sensor because it is a good conductor and cheap as well as easy to get. Next we just need to stabilise the foils by taping them to a piece of cardboard and attach wires to them that go to input pins on the 555 timer. Then we tested if our sensor could detect the capacitance changes for something like our hands. We can later combine the knowledge we have from Lab 2 and 3 to derive our assembly code for this project.

Investigation Design

We simply run our code from lab 3 again to test if our aluminium foil sensors can detect such small change in capacitance. Once we make sure it could, we proceed to write the game logic using push buttons first and implement the use of capacitors later.

Data Collection

We only collect 2 sets of data: the period measured from the capacitor and the correctness of players compared to the random sound tone. The tools we used include aluminium foil, 555 timer, AT89LP51RC2 microcontroller and LCD screen

Data Synthesis

If player 1 touches the sensor on the left when there's a high pitch sound played on the speaker then player 1 gains 1 point, 0 point if no action and -1 point if touches on low pitch sound. Similarly, player 2 gains 1 point for touching on low pitch sound, 0 point if no action and -1 point if touches on high pitch sound.

Analysis of Results

Since our hands have really low capacitance, the measurements are really accurate. We only care if there's a change in the capacitance measured so any errors can be negligible. One of the limitations we face is mostly the quality of our sensor due to its inexpensive nature, so sometimes it is hard for the foil to measure changes when we touch it with our hands.

Design

Use of Process

Due to lack of funding we had to settle with aluminium foil as sensor instead of a better sensor on the market and a simple cardboard to stabilise the foils.

Need and Constraint Identification

We just need this for the project. This could be a starting point for making touchscreen applications later on.

Problem Specification

We need to make the speaker to play the sound randomly, the sensor to sense even a small change in capacitance and implement score keeping for the gameplay

Solution Generation

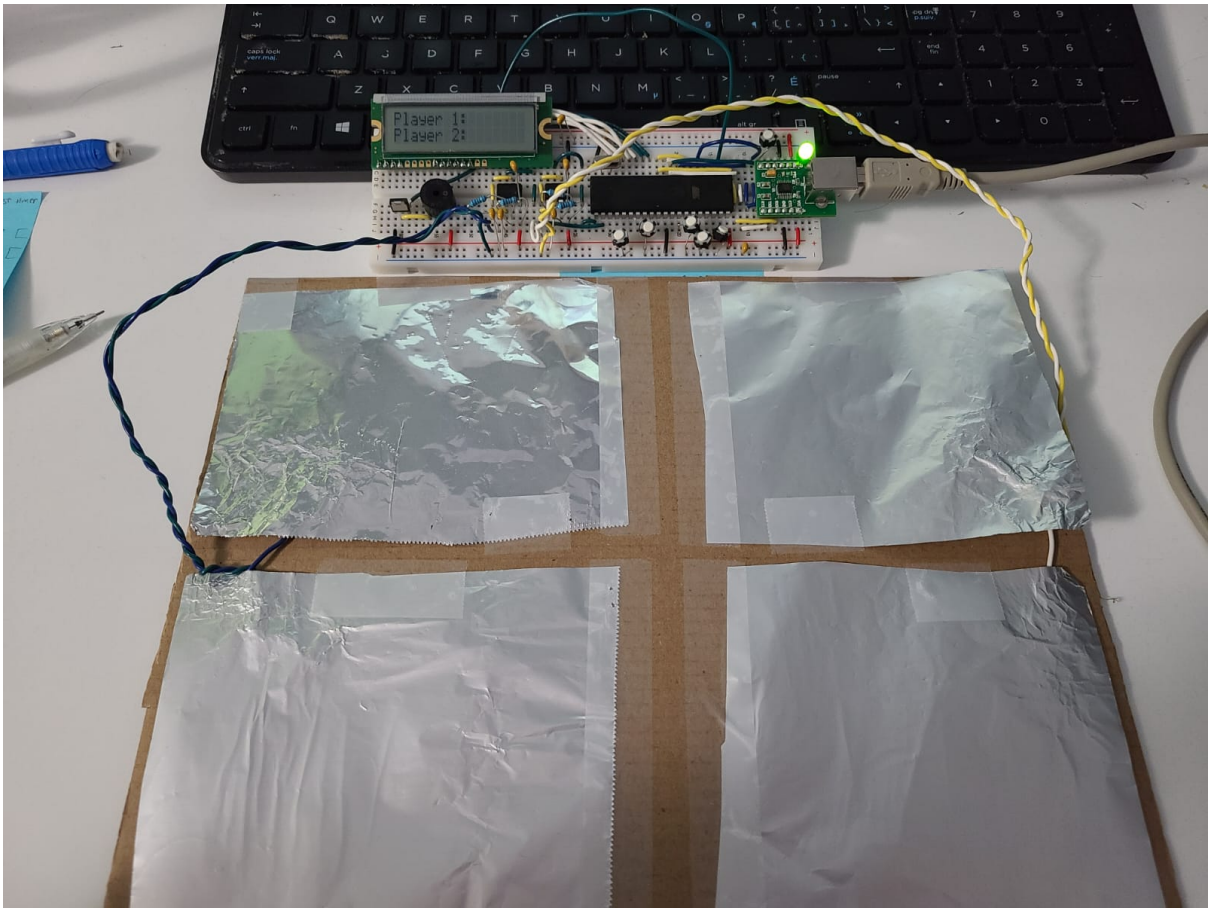
We attach the aluminium foil to a wire which is then connected to the 555 timer to detect any potential change in capacitance. Each time there's a match, we increment the score for the respective player and decrement if there's mismatch.

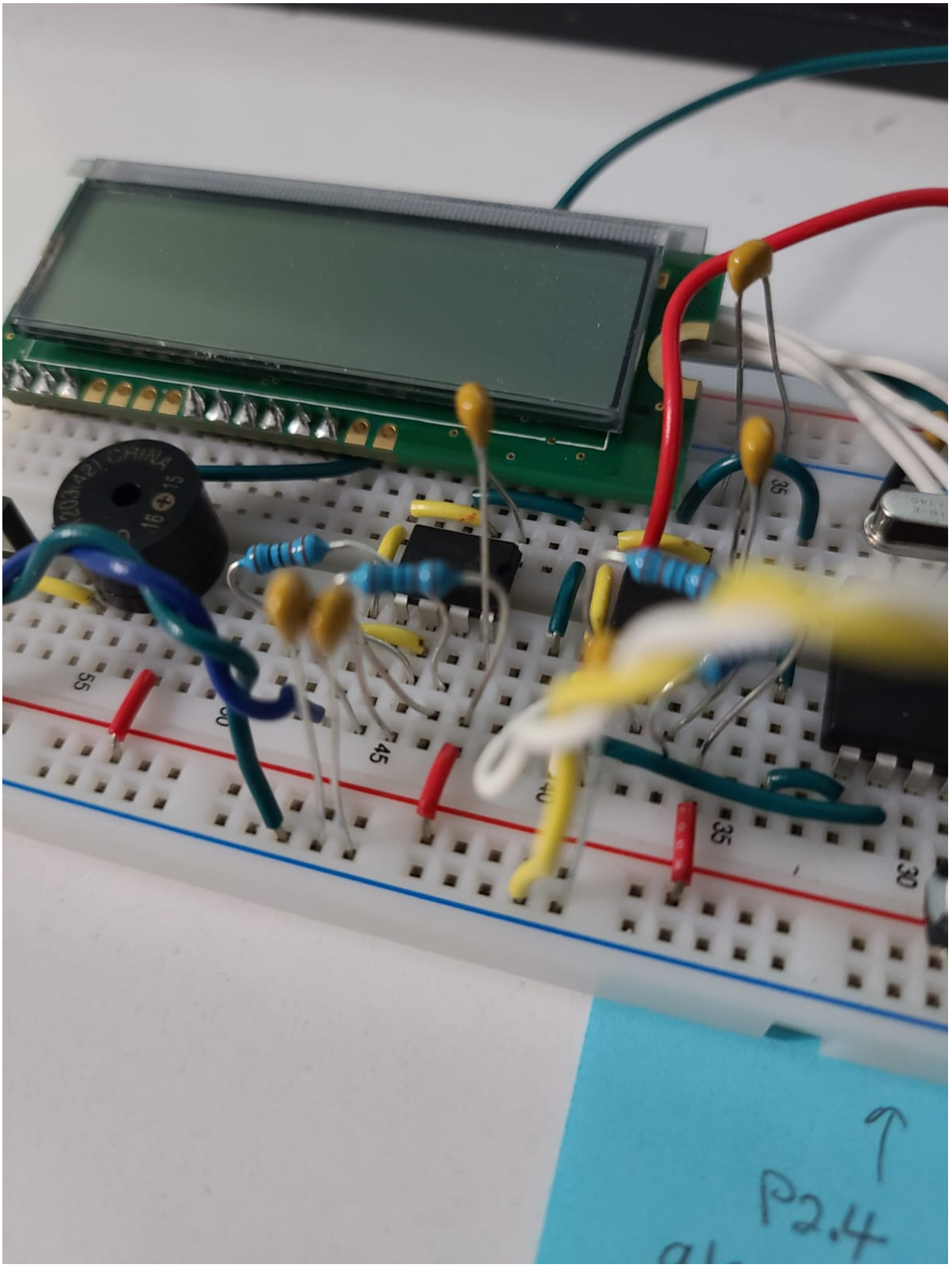
Solution Evaluation

Since our hand capacitance is small, the measurement will be very accurate. Any positive changes, however small it is, will be registered and evaluated according to the gameplay guideline above.

Detailed Design

We have attached the photos of our detail design below





Solution Assessment

The hardware design is easily replicable with the circuit shown in the above images. The software is simply the code we have submitted alongside this project on Feb 18.

The strength of our design is that the materials are cheap and easily accessible, which leads to its weakness that the quality of those materials are not really good and sometimes give unexpected data.

Live-Long Learning

With this Capacitive Sensor Reaction Game project, our team employed various technical concepts from prerequisites such as programming and hardware design skills. We found the courses ELEC 201 and CPEN 211 to be particularly useful in solving the circuit for designing the circuit as well as the assembly code to run it effectively.

From this we gained experience with embedded systems, circuit analysis, hardware design and construction which will provide valuable insight throughout our time as electrical engineering students as well as our future careers.

Conclusions

Despite delays with software, such as errors when combining different sections of source code, and delays with hardware, such as finding the cheap and reliable materials for the sensors, the capacitive sensor reaction game was a success.

References

J. Calvino-Fraga, Project 1 - Capacitive Sensors Reaction Game, University of British Columbia, 2022