Multi-entertainment Tic Tac Toe Game

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1 Introduction

1.1 Objective

Game is always a significant activity throughout the history of human being. Although it seems like it is sometimes purely for entertainment, games offer elements that are crucial for human development, both physically and mentally. The use of games includes self-improvement, encouraging positive lifestyle changes, and increasing motivation to complete work objectives.

An arcade game or coin-op is a coin-operated entertainment machine typically installed in public businesses such as restaurants, bars, and amusement arcades.This new style of game is emerging after the early 1970s because of the rapid development electronic hardware components. Graphic display, sensors and peripheral devices make this possible.

Nowadays, arcade games are not only games; they are becoming part of people's life. For example, when people are waiting for lunch, waiting for the bus, or waiting for a doctor, they need to have a fun time-killer device. And for most people, their time killer is their phone. However, an arcade game can be more interactive, educational, and more involved. The purpose of the arcade game is that it makes people more focused while playing the game. You cannot be bothered by text message or email while playing an arcade game. For example, you might not want to play Fruit Ninja on your phone anymore because it's so old-school; However, if the dean put an arcade game on the first floor, I believe a lot of students would stop by and take a glimpse of the game device.

Therefore, we want to make a tic tac toe game that is fun to play together. For instance, when customers in the restaurant are waiting for dining, rather than checking their phones, a small game box can help customers get in the mood. Also, such a device can help people get to know each other without too much awkwardness. Moreover, it is portable and low-cost. For many popular restaurant, the waiting-to-be-served time can be very long. The customer can grow boredness during this time, which would affect their appetite, so it would be a very good idea for the boss of the restaurant to provide a few game devices to their customers to play. It would make customer willing to wait for a long-time other than leave for another restaurant. Another situation with long boring waiting time would be when people are waiting for the bus; the government could implant several game devices on the bus station for people to play, which could give them a good time while waiting.

1.2 Background

The history of the arcade game can be traced back to 1950s which are made by the electro-mechanical device. Different from video games nowadays, arcade games owns more hardware components. Make an arcade device is a very great way to get an idea how common hardware devices work and cooperate with each other. Moreover, the realization of arcade game also needs software codes to control and schedule the hardware. Usually, the software

part is in much lower level comparing to modern video game running on a mature gaming engining. Build an arcade game device could be an appropriate project for ECE 445.

[1]Tic-tac-toe could be traced back to ancient Egypt. An early variation of tic-tac-toe was played in the Roman Empire, around the first century BC. It was called *Terni lapilli* (*three pebbles at a time*), and instead of having any number of pieces, each player only had three. Thus they had to move them around to empty spaces to keep playing. The game's grid markings have been found chalked all over Rome.

We are three Computer Engineering Students, and we hope through this project, we could learn how to make a portable game device. We would like to make the tic tac toe game box a high completeness, good-looking, and captivating product. After this class, we might donate some sample product to NGO, MTD bus, and primary school.

1.3 High-Level Requirements

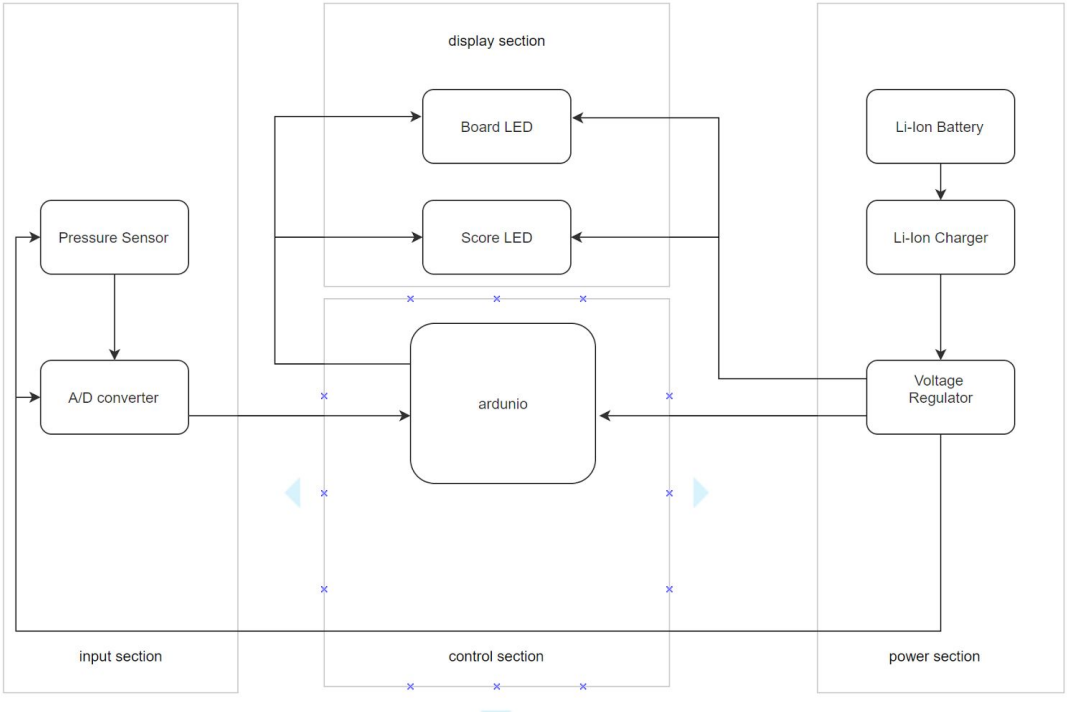
software：when AI vs. human, AI must give the best ruse for the game。

hardware：LED blocks must support animation pattern according to the different degree of force put on the pressure sensor.

2 Design

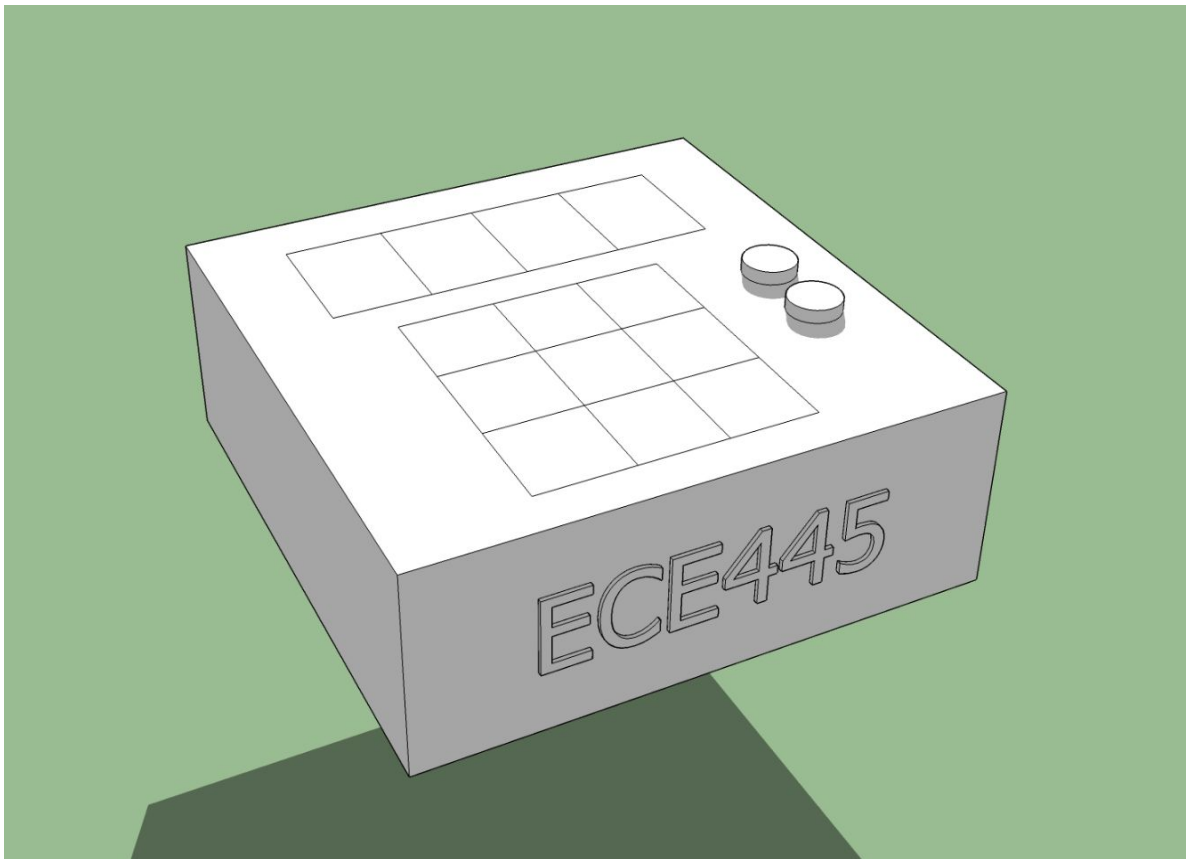
2.1 block diagram

The project is majorly composed of four sections: input, display, control, and power.The power section will deliver the corresponding voltage to every electronic element.
Display section ‘s light will be determined by the control section, which will continuously receive the input from the input section that receiving pressure input.



2.2 physical diagram

We want to make a delicate, hand-friendly box, which might make of wood. There is text screen which will display the score, player, etc. under the text screen, there will be a led screen that has 9*8*8 led pixels. The final project would be similar to the above picture. The 3*3 LED tic-tac-toe board, 1*4 LED display on the top and two buttons on the right. The cube box would be made from wood or plastic and the hardware design is concealed inside. Underneath the 3*3 LED board lies 9 pressure sensors. The power supply is a battery that is plugged on the bottom of the cube box.

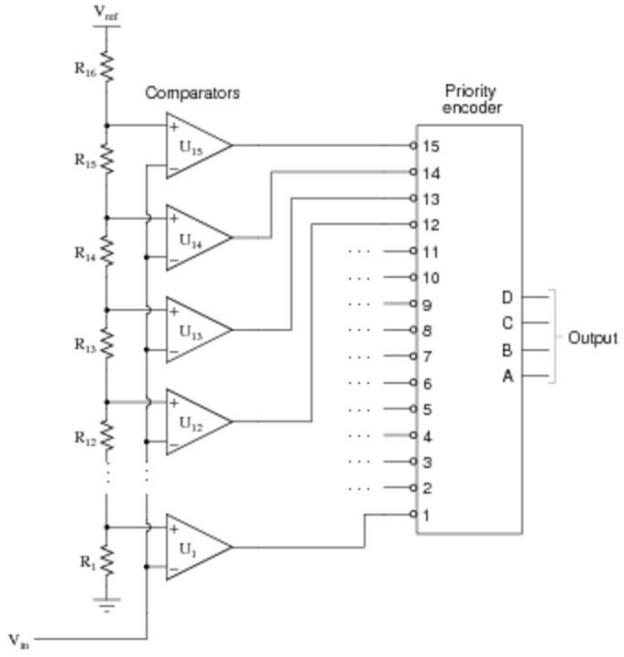


2.3 Overall Functionality

2.3.1 Power Supply:

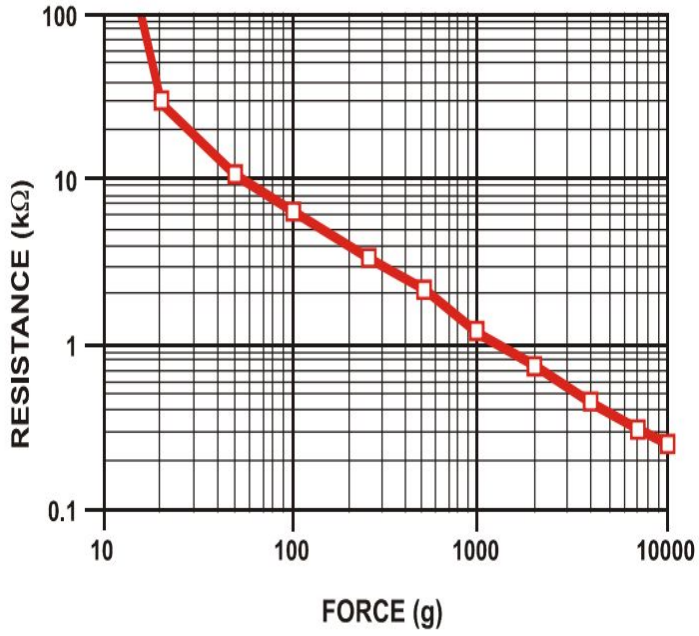
A power supply is required to keep the whole system up continually. Power from 6 Alkaline cells (1.5 V each) would power the Arduino, and it would be regulated to the correct voltage for the rest of the system.

2.3.2 A/D converter



Input: 9 analog signal from sensors
Output: 4 bit unsigned long
The analog to digital converter circuit is need to transfer the signal from 9 pressure sensors to the microcontroller.
As it is descripted on the above 2.3.2 description. They are essentially 9 resistors. A analog to digital circuit is needed to convert the analog signal from pressure sensor to microcontroller. The circuit is like the left picture which requires 9 comparators and a mux(in the picture it is priority encoder). Therefore nine inputs from the sensors and a 4 bit output from the mux telling the position of the sensor being pushed.

2.3.3 Pressure Sensor

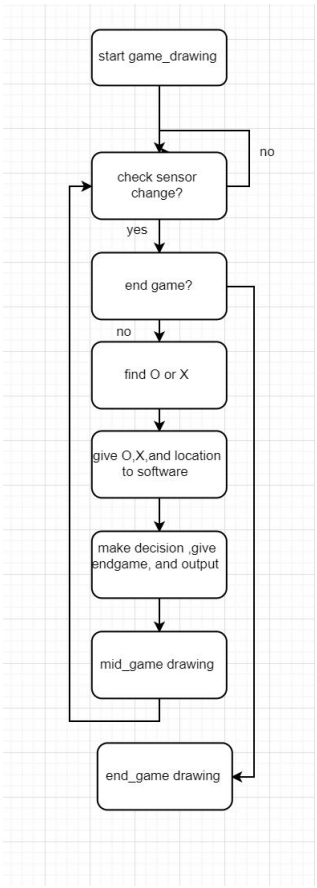


Input: pressure force by human finger
Output: the current went through Force Sensing Resistors (FSR), is a polymer thick film (PTF) device which exhibits a decrease in resistance with an increase in the force applied to the active surface. We want to make A/D converter directly connect to the sensor, as the force increase, resistance will increase, and since the according current will decrease, the digital signal will be decreased from 1 to 0.

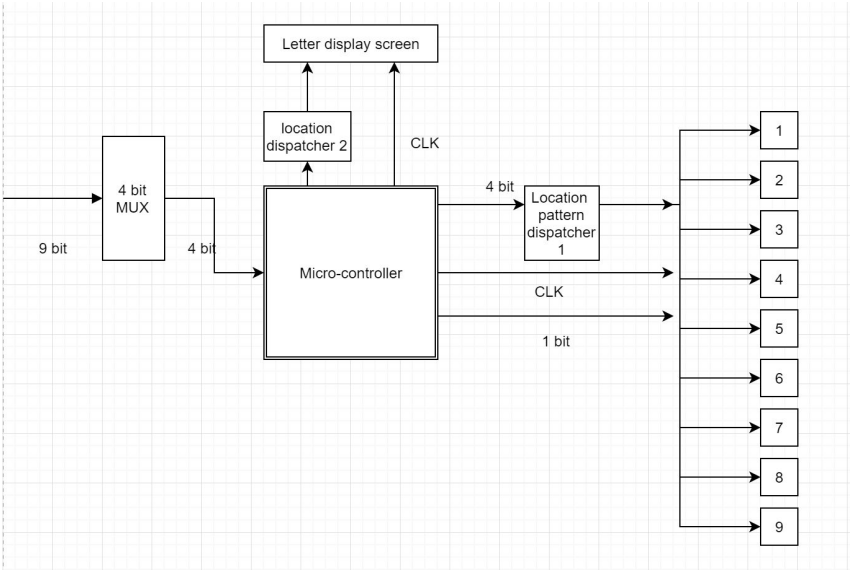
2.3.4 Microcontroller

Input: 4-bit input digital signal, 5.5v power

Output: 2 bit CLK + 2 bit data translate + 6 bit location dispatch



The microcontroller will be the decision maker for the 9*8*8 LEDs on the board since the 8*8 LED need clock and input, the microcontroller will generate a 4 -bit chip select signal, an overall input for all the LED light, and a CLK to ensure the data-transfer. Also, it will receive the input from the 4-bit mux, which is from the pressure sensor. Following on the left are the control flow on the controller



2.3.5 Location Dispatcher

Input: 4 bit(No.1), 2 bit(No.2)

Output: 9bit (No.1).4 bit(No.2)

There are two separate dispatchers both are made of decoder, both will account for the chip select signal of the 8*8 LED, the first is 4 bit - 9-bit decoder, and will decide which board should receive the signal and display the tic tac toe. However on in some conditions, we need to light up several sections of the board, for instance during the start the end games' graphics. In this case, since the led will remain its current lighting condition if the Vcc is not cut off, we will light each section one by one using the controller command. For the second location dispatcher, there is 2-bit input, and the decoder will select the according to LED screen to display text

2.3.6 Letter Display Screen

Input : Vcc, GND, CLK, Din, CS

Output :LED light

We plan to use four 8*8 screens ask the letter display on the top; also it receives chip-select input from location dispatcher, and 1-bit clock and data input from the controller

2.3.7 Pressure Sensor Location Encoder

Input : 9 bit

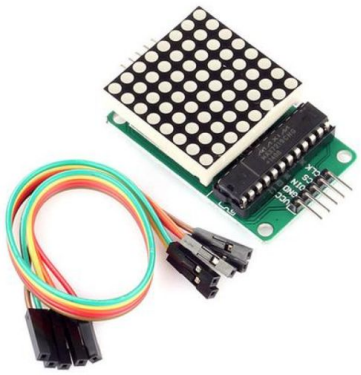
Output :4 bit

This is a 9 -4-bit MUX, which will receive the input from pressure sensor and send the encoded signal to controller

2.3.8 9*8*8 LED Module

Input: 1 bit serialized

Output: 1 bit serialized



The 8*8 LED matrix we choose is SainSmart MAX7219 Red LED Dot Matrix Display Module, which is compatible with Arduino. The material is FR4 + electronic components; a single module can drive one 8*8 common cathode dot matrix, the working voltage of the MAX7219 chip is 5v.

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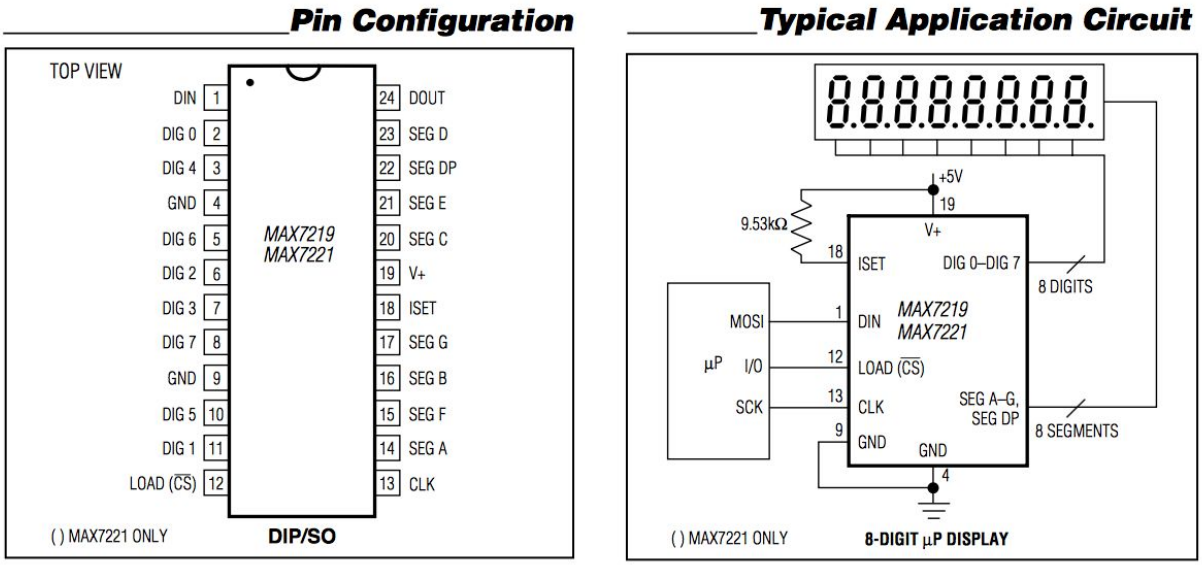
MAX7219/MAX7221

Serially Interfaced, 8-Digit LED Display Drivers



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The control chip is shown above and as long as the CS(chip select) is low, and the V+ is connected to the power, and CLK is connected to our Arduino CLK, our chip is ready to take input, DIN is for Serial-Data Input, Data is loaded into the internal 16-bit shift register on CLK's rising edge.

2.3.9 Buttons

The two buttons we are going to use are big dome Pushbutton(Red), which can be purchase at Sparkfun.
COM-09181

3 Safety and Ethics

According to IEEE code of Ethics #1[2], we have to aware of the potential safety hazards with our project. Since our tic-tac-toe game box is a portable device, a lithium-ion battery is applied for power supply. We need to avoid the battery overheated which would result in a fire. The combustible fire can be handled by a foam extinguisher which is installed in the senior project lab. All of the members of our team have completed the lab safety training, and we have understood the position and usage of the fire extinguisher. Moreover, we will constantly check the surrounding temperature of our circuit board to make sure it does not have a thermal runaway (between 32°F to 113°F)[3].

Another risk we need to take into concern is the use for Children. In 2012, the U.S. Consumer Product Safety Commission (CPSC) reported 11 toy-related deaths and an estimated 265,000 toy-related injuries treated in emergency rooms[4]. Our tic-tac-toe game box is an electronic device that could be dangerous for small children. We must have prominent warning labels so that kids will not access the dangerous circuit hardware of our game box. The cords and strings would be hidden inside the game box so that it would not pose a strangulation hazard for infants. We would set the age limit for our tic-tac-toe game for people older than eight years old according to the U.S. Consumer Product Safety Act[2].

Regarding environmental protection, since our game box is a box, we would need a cube box to encapsulate the whole inner circuit and leads. The panting and material for the cub box should be degradable and environment-friendly. The pigment for the box painting should be non-volatile and non-toxic[4].

We would finally make our detailed instruction book for this tic-tac-toe game box so that the customer would have enough knowledge to avoid the potential dangers.

According to Student Rights and Responsibilities part 4 Academic Integrity Infractions 1-402 Academic Integrity Infractions[6], we will not use or attempt to use any code, data, circuit design or idea without authorization and citation. We highly appreciate all professors, TAs, and any other people who give us helps during the project. According to IEEE code of ethics # 7[2], all sources of help and reference would be acknowledged and included in the reference section. We might seek inspiration from GitHub, sparkfun.com, arduino.com. Even if we figured that we might be able to reuse some open source code from the websites, I stated above or some other websites, but we will develop a good portion of our code and circuit by ourselves and keep our project a very original one. For devices and components, we purchased from amazon or Sparkfun or any other website, we would state the price, where we got them, and how are they implanted into our circuit and design.

The customer can only use our game box to play games. The input voltage of our game box would be only 5 V, which is very safe for play even if the coat of the wire is worn out, and the player touches the broken part. We would help each other during the whole process and make sure that everyone in the team is on the same page.

References

[1] Schaefer, Steve (2002). "MathRec Solutions (Tic-Tac-Toe)". Retrieved 2015-09-18.

[2] Ieee.org, "IEEE IEEE Code of Ethics", 2016. [Online]. Available: http://www.ieee.org/about/corporate/governance/p7-8.html. [Accessed: 29- Feb- 2016].

[3] United States Consumer Product Safety Commission, “Regulations, Mandatory Standards & Bans”, 2014, https://www.cpsc.gov/Regulations-Laws--Standards/Regulations-Mandatory-Standards-Bans

[4] Natura Veda Innovations from nature, “The Dangers of FD&C Color Pigments”, 2017 https://www.naturaveda.com/pages/the-dangers-of-fd-c-color-pigments

[5]BU-410: Charging at High and Low Temperatures:http://batteryuniversity.com/learn/article/charging_at_high_and_low_temperatures

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