**EE 354** **Assigned: October 24, 2016**
**Project 2** **Due: December 5, 2016**
***On the level***

***Description and specifications***

Figure 1 is a screen shot of the ball in a maze game on Android apps. The objective is to move the ball through the maze to the green square as quickly as possible. For this project you will design and implement a hardware version of this game using LEDs to simulate the ball. Your playing field (board) must be 6 LEDs wide by 5 LEDs high where a LED which is on represents the ball. A microcontroller will determine which LED is lit. The board can tilt left-right or top-bottom. It will have two potentiometers which can be read by the A/D converter to determine the amount of tilt and its direction. Your software will move the ball in the direction of the tilt until it comes to a wall.


**Figure 1**
**Ball in maze game from Android apps**

The walls for your board will be painted onto a clear sheet and placed over the LEDs. Figure 2 shows a typical configuration.

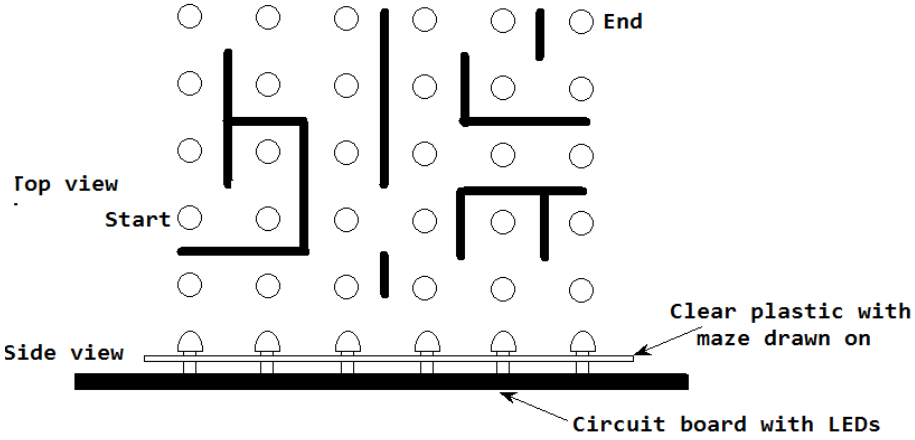


**Figure 2**
**5 x 6 matrix of LEDs with maze.**

Your software must be aware of the walls so that a ball does not pass through. It should also know where the start and end positions are as well as the edges of the board. You will also need some means whereby the user can reset the game as well as turn it off and on.

*Configuration variations*
You will be determine the tilt by reading the value of two potentiometers. There are three ways in which these potentiometers can be mounted to sense the tilt.
*Tilt Method 1:*
You use two low-friction potentiometers with one placed on each axis of tilt along the side of the board. The potentiometers can have a small weight attached to the turning arm so that the weight always points down. Tilting the board will cause the potentiometers to turn.

*Tilt Method 2:*
You use a two-axis thumb joystick. These typically have a flat surface on the top which can be attached to the bottom of your board. As the board tilts the two potentiometers in the joy stick will change and this change can be read with the A/D converter.

*Tilt Method 3:*
You use a joystick that is separate from the board. The user guides the ball through the maze with the joystick. This could be a small thumb joystick or a full sized joystick.

All three methods require that you read two potentiometers using an A/D converter. Other variations may be possible but you should get permission from your instructor before doing something other than one of these three methods.

The game which you build should meet the following specifications:

1. The game which you build must fit within a container that is no larger than 6" x 8" x 2". If you are using tilt method 3, the joystick may be separately connected to the container but it should have a plug-in jack for this purpose.
2. The game must be completely self-contained and battery operated.
3. The game must be sturdy enough to survive a four foot drop onto a concrete floor.
4. You must use the ARM STM32F407VG processor to drive your game.
5. You must have an on/off switch and a reset switch.
6. Your container must be relatively water resistant. For testing purposes 8 ounces of water will be poured over each game while it is running. This water must not impede the game in any way.
7. Your container must be secure and should not rattle when shaken.
8. You must provide a mechanism for changing the batteries that does not require disassembly. Removing one or two screws is acceptable.
9. Your software must contain at least one subprogram in C and at least one subprogram in ARM assembler.
10. Your project must consider the following factors in the design: safety, manufacturability, economic, environmental, and reliability.

Variations on the original game are encouraged.

***Grading:***
This project will be done individually and a single grade will be given for each project. A total of 100 points is available for the project and will be awarded on the following basis:

| Points | Item |
|---|---|
| 25 points | Does your project work and meet specifications |
| 15 points | Creativity and novel added features |
| 15 points | Finished product quality |
| 15 points | Documentation of software |
| 15 points | Documentation of hardware |
| 15 points | Other documentation |

The project report should consist of:

- A cover sheet with your name, the project number and title, and the date turned in.
- A list of novel features. Creativity may consist of novel hardware or software implemented features or a novel packaging technique.
- A list of those items you were able to demonstrate as working to the instructor.
- A discussion of how you considered safety, reliability, economic, manufacturability, and environmental factors.
- An estimate based on theoretical and empirical data as to the power requirements.
- Hardware documentation.
- Software documentation.

At a minimum your hardware documentation must consist of a system diagram, a complete circuit diagram (with pin numbers), and a mechanical sketch or photo of your project done to a level of detail such that another person in the class could build your project from your diagram. At a minimum your software documentation should consist of fully commented source code for all of the modules in your program and a pseudocode design with enough detail that another person in the class could duplicate the function of your software.

The grade for this project will be based on what is complete and handed in as of ***11:00am on December 5, 2016. No late grades will be given.***