Project Final Report – Week 15
CIS-033, Spring 2024

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Team Member

- Melissa Li

Project Objective

Build a small interactive game with color and position matching; using the skills and components we studied in this class.

Project Documentation

1. Milestones Achieved

All planned milestones for this project were achieved.

- **Build project:** acquire and assemble components on breadboard
- **Control components:** add code to read user inputs / write LED/Servo/Display outputs
- **Code Game-loop logic:** add code for game states, handling I/O at appropriate times, counting down time, adding score, etc.
- **Testing:** do tests to check for unexpected behavior, and address in Hardware / Software

2. Work Completed

(Please see "Project Metrics -> Timeline" section, for list of work items.)

3. Challenges

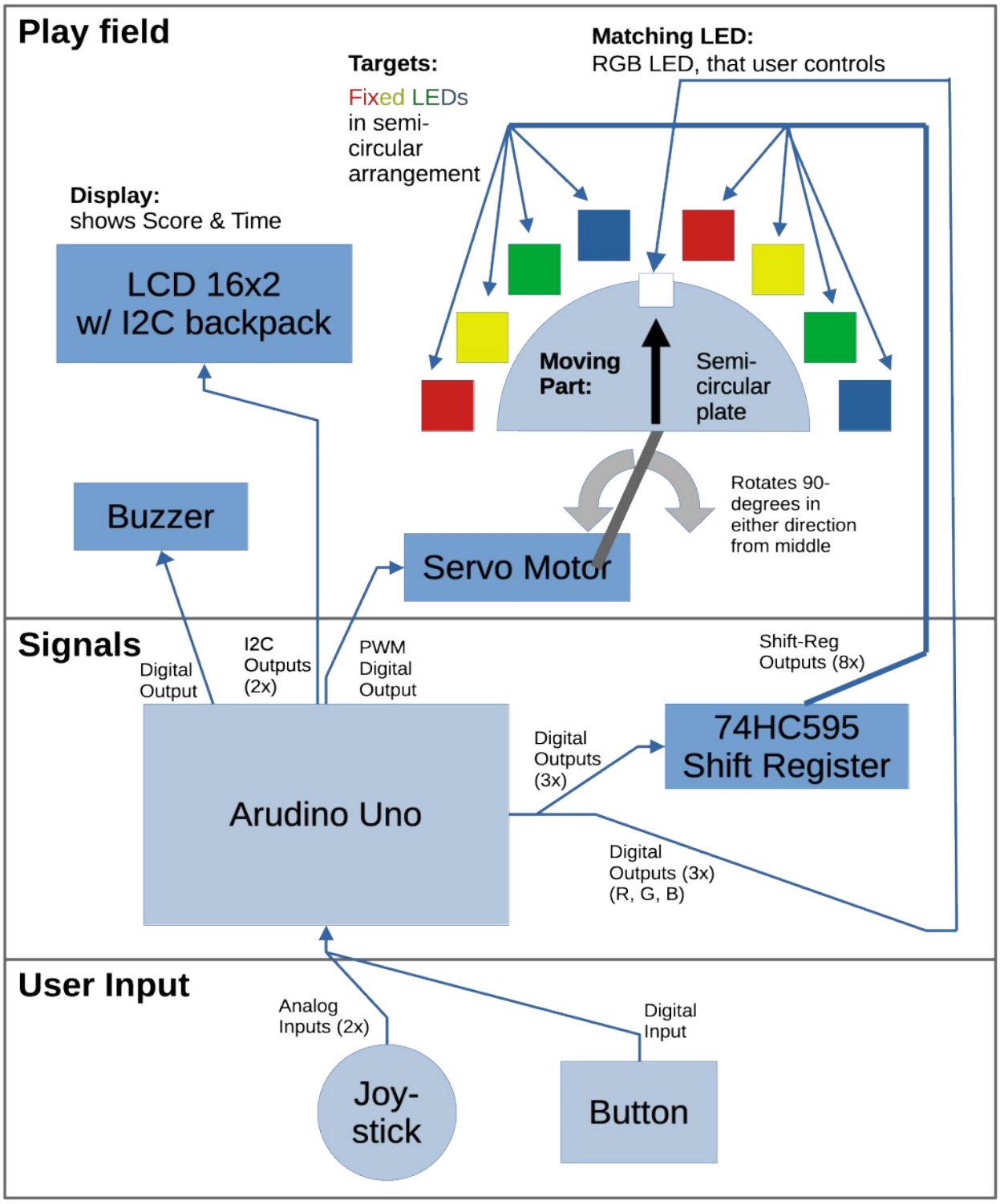
Hardware-side

- **Mount for Servo-motor + Fixed-LEDs:** so that their relative positioning makes sense for the game. This was accomplished by 3D-designing, and 3D-printing the necessary part.
- **Wiring the Fixed-LEDs:** with above mount, the Fixed-LEDs were in close quarters, but suspended above the breadboard, so they couldn't use the latter. Addressed by building my own connectors, by soldering wires to male & female jumpers, to connect Fixed-LEDs' power and ground in batches.

Software-side

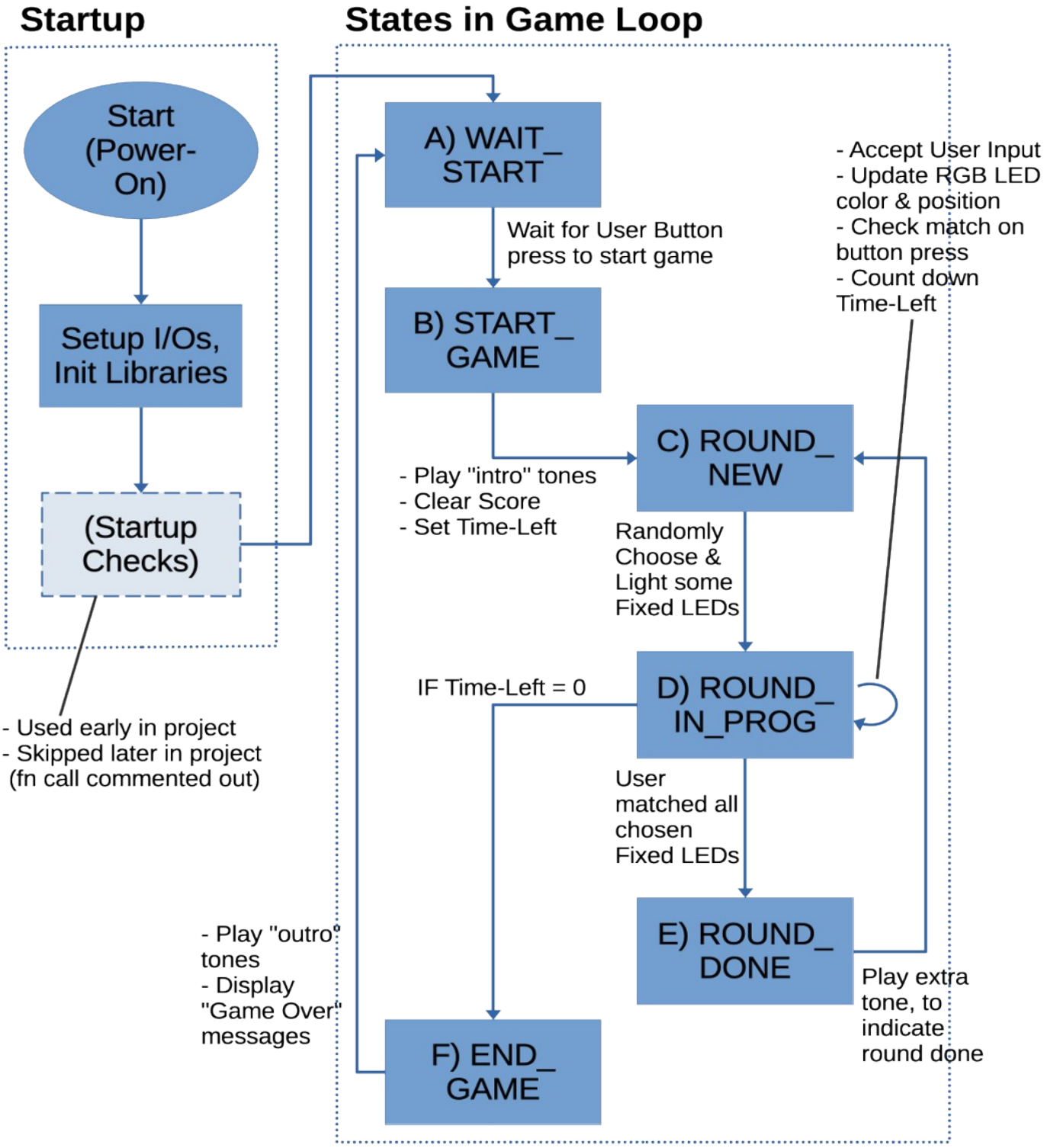
- **Handling inputs sensically:** with a limited number of user-controlled positions (15) & colors (4), could not update the former with every frame of user input. Otherwise the user would feel a lack of control, e.g. Servo-motor positions would go from one end to the other, with a brief joystick input. Solved this by adding delays, so that input was only passed to game logic once every several frames.

4. System Block Diagram

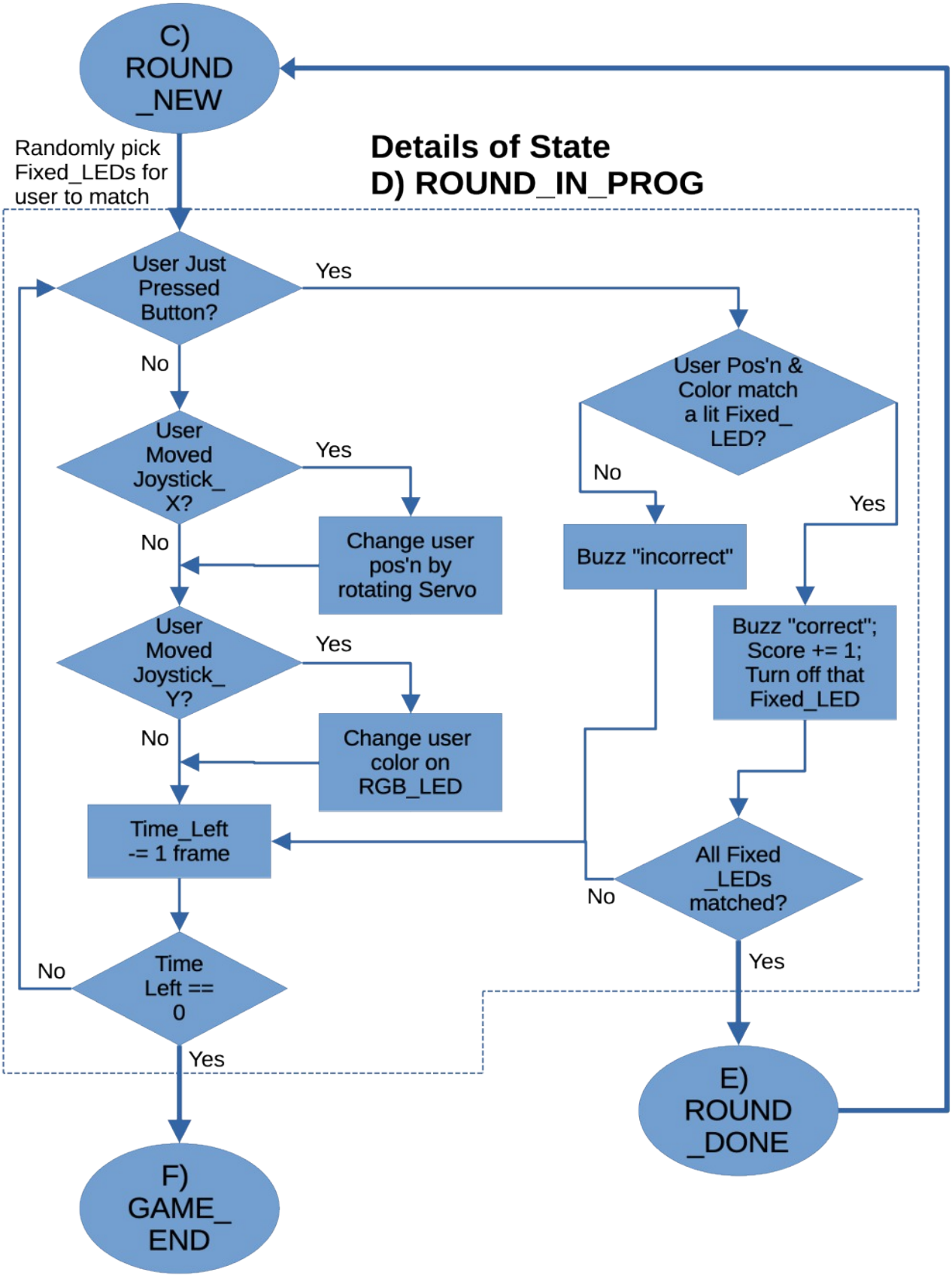


5. *Software Flowchart*

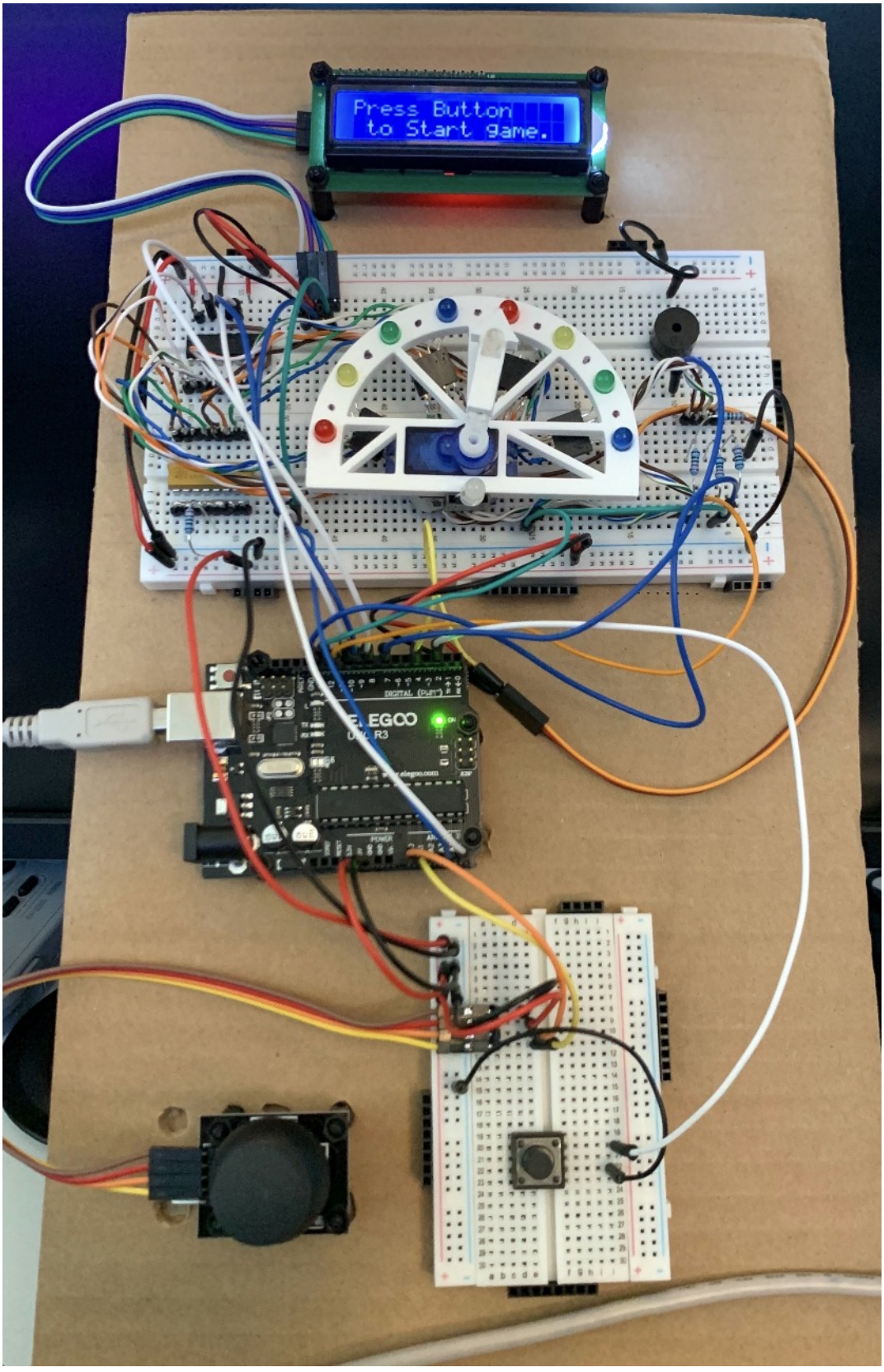
a) High-Level Flow



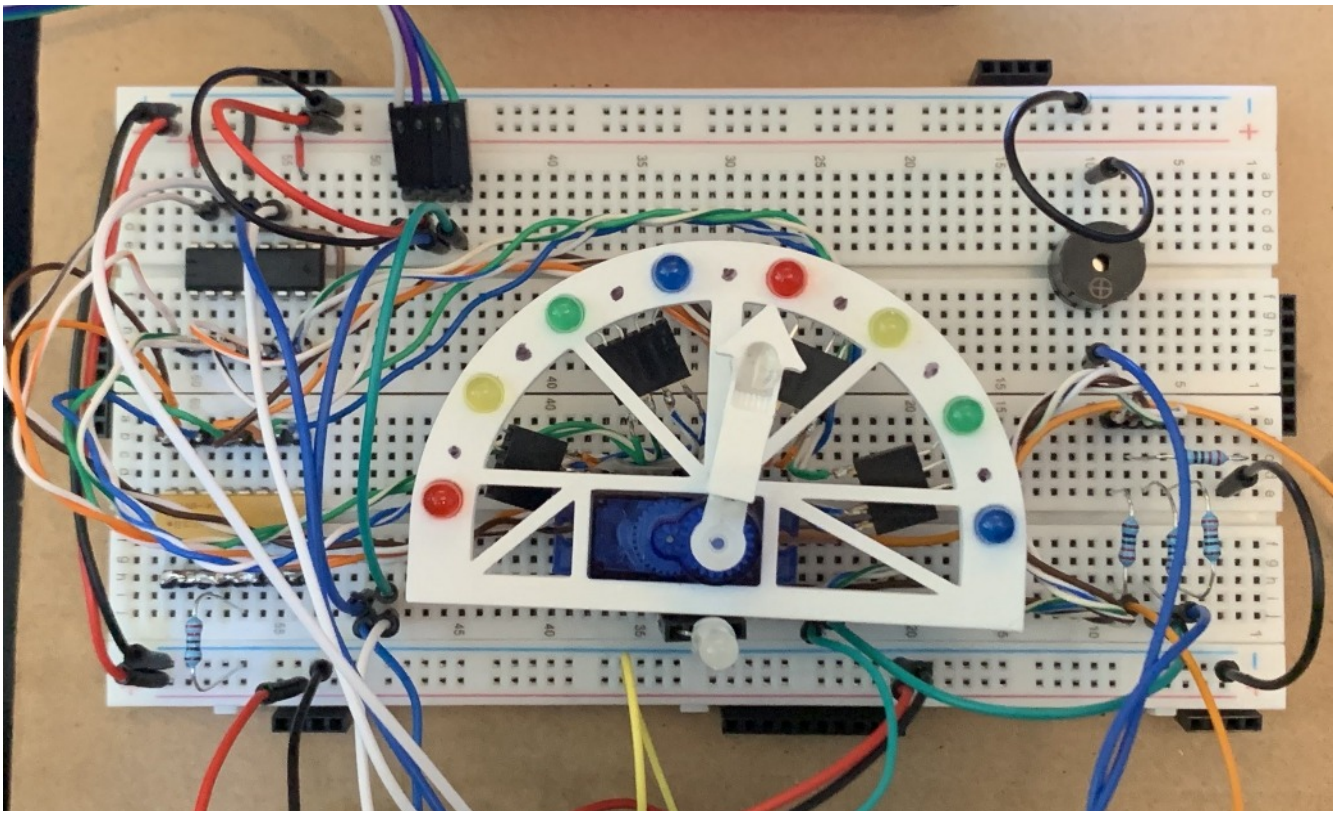
b) Detail of State D) ROUND_IN_PROG



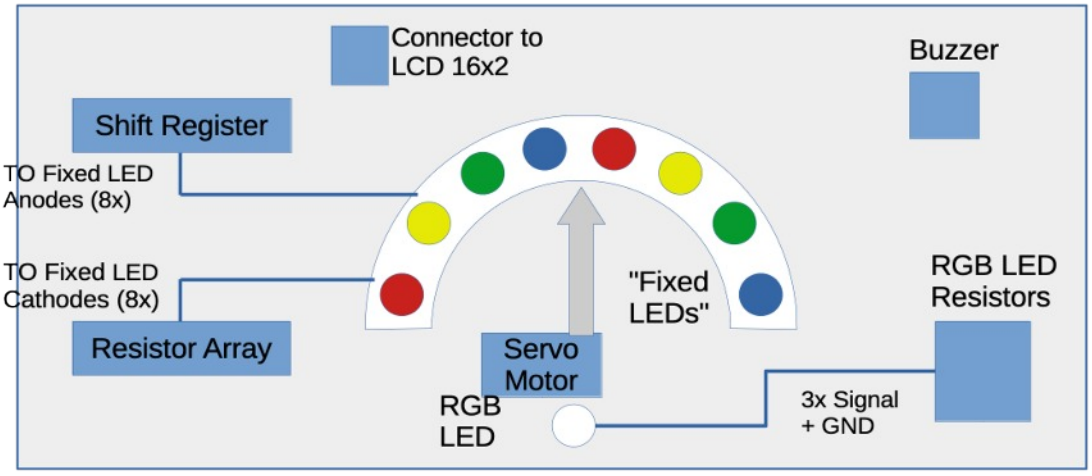
6. *Picture of Working Prototype*



Detail on large breadboard



Block Diagram of above, showing key components



Materials List

Item	Source	Cost
• Arduino UNO R3	Components from Elegoo Super Starter Kit, Purchased from Amazon	(Major part of) $ 49.2
• Servo-Motor		
• Joystick Module		
• Push-button Switch		
• 74HC595 Shift Register IC		
• "Fixed-LEDs": 2x Red, 2x Yellow, 2x Green, 2x Blue		
• RGB LED		
• Passive Buzzer		
• (multiple) 220 ohm Resistors		
• Breadboard Jumper Wires (various)		
• LCD Display Module 16x2, with I2C backpack	Purchased from Amazon	$ 6 (used 1 of 2-pack @ $12)
• Breadboards Kit		$ 9
• 2.54mm Header Assortment Kit		(Small part of) $ 10
• Nylon Hex Spacers and Standoffs Kit		(Small part of) $ 10
• Color-coded Wires (Brown, Orange, Green, Blue)	Taken from old Ethernet cable, with broken tabs	-- (already had)
• 4116R-001-221 8x Resistor Array IC	Purchased from Anchor Electronics (for previous project)	$ 1.8 (each; price when buying 10pcs)
• "Semi-circular Mount", and "Pointer Arrow" -- 3D Printed Parts	Self 3D Designed & Printed	-- (already had 3D Printer)
	Total Parts Cost:	$ ~86

Project Metrics

1. Timeline

Planned Week of	Done	Done On	Planned Actions
April 22, 2024	x	Apr 19	• Project Timeline Plan
	x	Apr 21	• Assemble components
	x	Apr 26	• Determine Arduino Pin Assignments for all components
	x	Apr 27	• Do Unit Tests, verify individual components / blocks
	x	Apr 27	• Prepare schematic with all connections
April 29, 2024	x	May 1	• Design & document Game Logic
	x	May 3	• Breadboard full circuit, with all components
	x	May 4	• Merge unit-test codes, verify components in single programs
	x	May 5	• Run startup tests, check all output components
May 6, 2024	x	May 10	• Mount RGB LED onto Servo-controlled part, and align fixed color LED in semi-circle around former
	x	May 11	• Code game logic
	x	May 13	• Test game mechanics
	x	May 14	• Add simple sounds for game
	x	May 17	• Build structure to assemble all components suitable for game
May 13, 2024	x	May 15	• Last minute code changes / fixes
	x	May 17	• Final polish

2. Budget

(Please see "Materials List" section. Cost is included there while tallying materials.)

Future Plans

1. Next Steps

Project intended scope was met within class time. Components and code are working as expected.

Next steps would be to build a better framing structure to hold the game components properly, with good angles for viewing and controls.

- Akin to a pinball cabinet: display at top, sloped play field, and controls close to user.

2. Challenges Anticipation

None at this Prototype stage.
However, if Project were to be brought to Production:

- More robust mount, to secure Servo Motor & Fixed LEDs
- Move circuits onto PCBs (Printed Circuit Boards), to solder down parts securely
- Better signal connections, probably using ribbons cables to bundle all signals between boards
- Secure frame to mount parts, instead of using a cardboard base.

3. Resource Requirements

Following above, if going to Production, then we need:

- a Circuit board design engineer, to design the above-mentioned PCBs
- a Mechanical / Industrial engineer, to design a cabinet to house the game

Team Collaboration

None. I worked by myself.

Conclusion

This final project has been a good capstone for the class, and allows students to demonstrates the skills they've learned, in a creative build.

Attachments

1. Video of Project running *(attached separately)*

2. Arduino Pinout Selection

Pin Special Fn ->					SDA	SCL	Serial Mon		Int0	Int 1; NO ~		~	~			NO ~	NO ~	NO ~		
Component \ Pin	**A0**	**A1**	**A2**	**A3**	**A4**	**A5**	**D0**	**D1**	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**	**D11**	**D12**	**D13**
(Serial Monitor)							(Serial)													
Joystick	IN	IN																		
LCD w/ I2C (*1)					I2C	I2C														
Servo (*2)											OUT									
Passive Buzzer (*3)														OUT						
Shift Register (*4)															OUT	OUT	OUT			
RGB LED (*5)																		OUT	OUT	OUT
Push Button (*6)									IN, Int											

3. Project Circuit Schematic