RFIDice Tray

Project Description Draft

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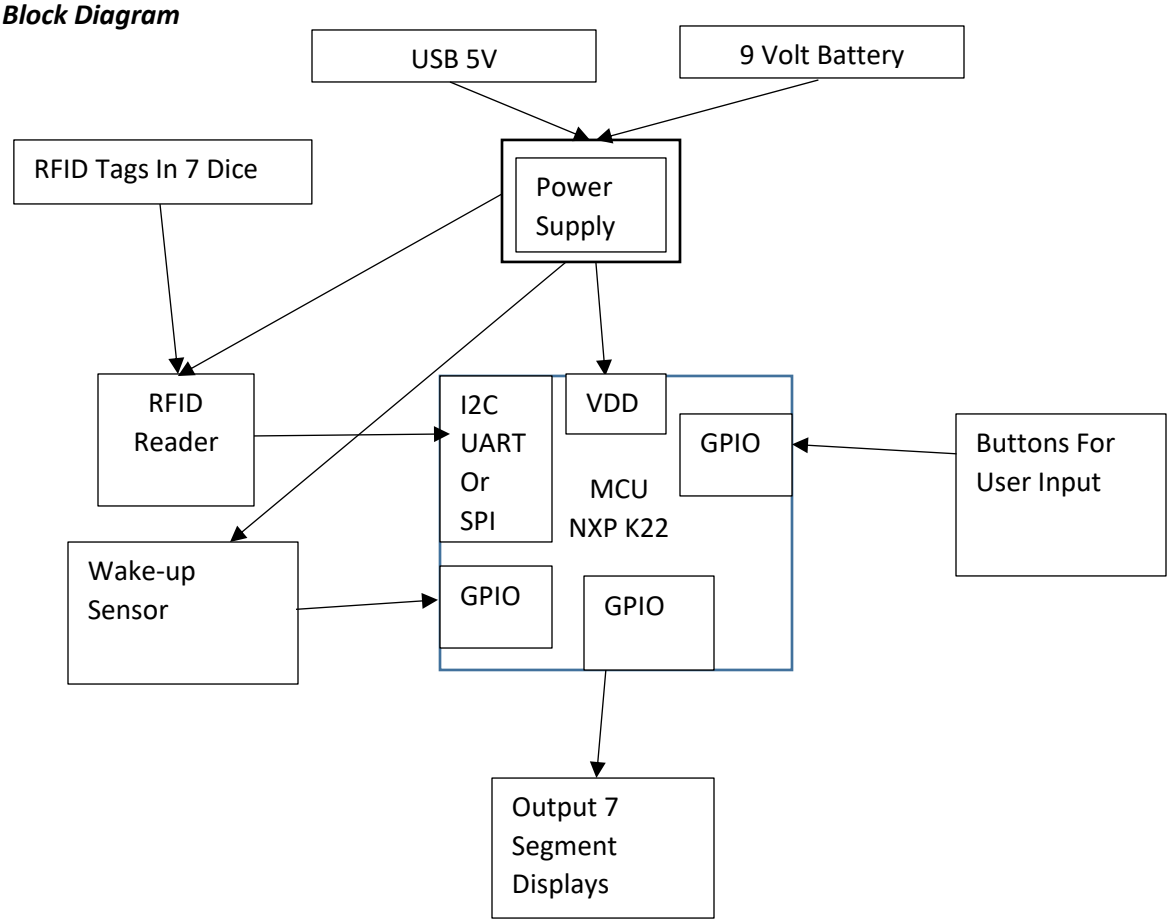
1. Summary

The RFIDice Tray is a tray that intakes dice that are RFID labeled. The dice tray corresponds the RFID of the dice to the number of sides on the die and displays a random number for that type of die. The RFIDice Tray is a neat desk toy and is useful for any game that requires multiple types of dice.

2. System Design

Block Diagram



Hardware Description

- **MCU**

  The MCU for this project needs to have a few communication options for communicating to the RFID chip, enough GPIO for listening to buttons and the wake-up sensor, and output to GPIO for the 7 Segment Displays.

  I decided on the MK22 because it is something I am familiar with, it comes in a non-BGA package, and has enough GPIO and I^2C Ports.

- **MCU Resources Required**
  - 3x GPIO Ports
  - 1x Inter-Integrated Circuit (I^2C)

- **Other Hardware Components**

  I have decided to use the PN532 NFC controller as my RFID reader. The device is a little overkill for what I'm doing but it does everything I need it to do.

  For the wake-up sensor all I need is a simple op-amp to let the MCU know to trigger an RFID read. A general purpose op amp LM 358 will work well enough.

3. Development Plan

Week 1: Order Development boards and parts

Week 2: Test RFID Sensor with Arduino

Week 3: Design initial dice detector circuit

Week 4: Test initial dice detector circuit

Week 5: Generate Schematic Design

Week 6: Review Schematic Design, Start final parts list

Week 7: Final Hardware Redesign

Week 8: Order PCBS

Week 9: Assemble and test boards

Week 10: Revise if needed, order new board if needed

Week 11: Assemble and test new boards if needed

Week 12: Spring Break

Week 13: Begin software Design (Setup environment)

Week 14: Design initial dice sensor software

Week 15: Design Communication with RFID chip

Week 16: Test RFID with RFID reader

Week 17: Combine initial dice sensor and RFID reader

Week 18: Finish combination

Week 19: Finish combination

Week 20: Finish Software design

Week 21: Software design reviews

Week 23: Revise code and test

Week 24: Demonstration

Development Tools

- K22 Development Board
- PN532 Breakout Board
- 4032 RFID Tags
- Arduino Board
- Digital Multimeter
- Altium
- MCUXpresso

Appendix A - Preliminary Parts List:

Part	Manufacturer P/N	Qty	Distrubuter	Bulk Lead Time	Single Lead Time
MCU	MK22FN512VLH12	1	Digikey	16 weeks	Immediate
RFID Reader	PN5321A3HN,C106,55	1	Digikey	8 weeks	Immediate
Gen. Op Amp	LM358BAIDR	1	Digikey	6 weeks	Immediate
RFID Tags	4032	7	Digikey	2 weeks	Immediate

Appendix B – Cost Breakdown

Part	Manufacturer P/N	Qty	Bulk Cost/Unit	Single Cost/Unit	Total Bulk Cost/Unit	Total Single Cost/Unit
MCU	MK22FN512VLH12	1	$5.56	$8.45	$5.56	$8.45
RFID Reader	PN5321A3HN,C106,55	1	$6.85	$10.96	$6.85	$10.96
Gen. Op Amp	LM358BAIDR	1	$0.36	$0.12	$0.36	$0.12
RFID Tags	4032	7	$2.95	$2.95	$2.95	$2.95
					$15.72	$22.48

Appendix C – Power Budget Calculations

Operation	Max Conditions		
Device Name	Current	Voltage	Power
Microcontroller	158 mA	3.8 V	0.6W
RFID Reader	30 Ma	5.5 V	0.165W

Bibliography

M. Murdock, *Digital Detection of Physical Dice Rolls Via Conductive Dice Tray - Disney Enterprises, Inc.*, 20-Aug-2015. [Online]. Available: https://www.freepatentsonline.com/y2015/0231486.html. [Accessed: 23-Oct-2020].

http://www.vs.inf.ethz.ch/publ/papers/hinske-pergames07.pdf