LED20 PDS

Team 1

Version 1.1

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ECE 411

Industry Design Processes

Executive Summary

Our product is a 3D-printed, illuminated D20 die designed to enhance the tabletop gaming experience with both visual and audio effects. When rolled, the die lights up with a predetermined pattern corresponding to the number it lands on, adding an exciting visual element to gameplay. Additionally, when a 20 or a 1 is rolled, the die plays a tune to either congratulate the player's critical success or revel in their critical failure, making key moments even more memorable.

Specifically crafted for Dungeons & Dragons (D&D) enthusiasts, tabletop RPG players, and fans of electronics, this device blends traditional dice-rolling with modern interactive technology. It operates just like a standard D20: players roll it during gameplay, and the built-in electronics automatically detect the number rolled, triggering the corresponding light pattern.

By combining classic game mechanics with engaging visual and audio feedback, this product appeals to a wide audience of gaming and electronics enthusiasts, making every roll more gratifying and lively.

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1 Market Analysis

The primary target customers for this product are Dungeons & Dragons (D&D) players, tabletop RPG enthusiasts, and fans of electronics or novelty gaming accessories. This audience is generally comprised of tech-savvy individuals who enjoy enhancing their gaming experience with unique and interactive tools.

In terms of competition, there are existing illuminated dice and smart dice on the market, but most lack the combination of both customized light patterns and audio feedback for critical rolls. Some competitors offer dice that light up, but they are typically either generic or limited in terms of features.

Our product stands out by offering not only illuminated feedback but also the added feature of audio cues for critical successes (rolling a 20) or failures (rolling a 1), which adds extra excitement and immersion to the game. This differentiation makes it more appealing to customers looking for a more engaging and fun gameplay experience.

We estimate a selling price of around $30 to $40 per die. This is based on the cost of materials (3D printing, electronics) and similar specialty gaming accessories in the market, while remaining affordable for most gamers who are willing to pay a premium for enhanced gameplay features.

2 Requirements

Must:

- Illuminate the user's rolled number on the upright face of the die.
- Have a battery life that lasts the length of a typical D&D session (4-6 hours)
- Be able to withstand the impact of a 3 foot drop.
- Play a congratulatory or disheartening noise depending on if a "20" or "1" is rolled, respectively.

Should:

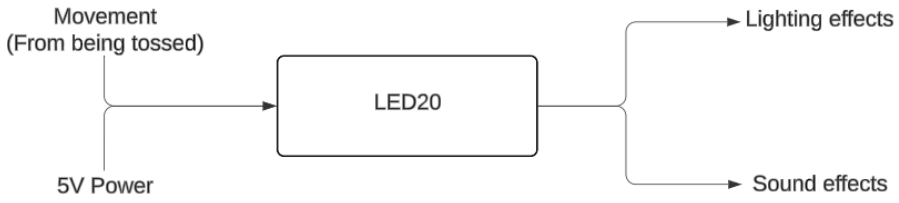
- Look aesthetically pleasing
- Be no larger than the palm of a hand (3" x 3" x 3")

May:

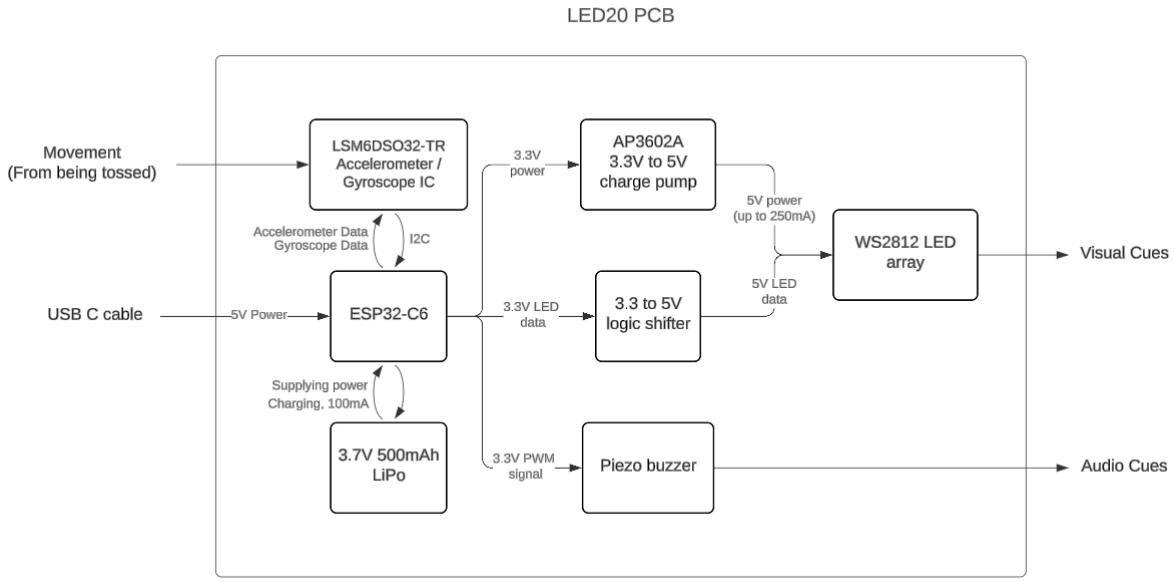
- Have different selectable lighting modes
- Have wireless charging capabilities

3 System Architecture

L0 Block Diagram



L1 Block Diagram



4 Design Specification

The design specifications for the LED20 come from a few major goals. The first goal is to package everything inside a die no larger than the average palm (3" x 3"). The second goal is that it should be designed with power efficiency in mind. Another goal is that the die must withstand the repeated impact of tabletop rolls. Lastly, it must be chargeable.

Technical Specifications

- Processor - ESP32-C6
- Sensor - LSM6DSO32-TR Gyroscope
- Actuator - WS2812 LED Array
- Power Source - One 3.7V 500mAh LiPo Battery
- Mechanical Design - Impact-resistant 3D printed half shells that thread into each other to form a twenty-sided die (D20). The shell will house the PCB, LED's, speaker, and battery.
- Programming Environment - Arduino or C
- Dimensions - Less than 3" x 3" x 3" (W x L x H)
- Battery Life - Should be more than 6 hours (consume less than 300 $\frac{mW}{hr}$)
- Audio - Piezo buzzer

A Appendix: Bill of Materials

Item	Link	Price Per Each	Quantity	Total Cost
Neopixels	NeoPixel Mini	0.1995	100	19.95
ESP32	Tiny Matter-Native Board	5.2	4	20.8
Accelerometer Breakout	Adafruit LSM6DSO32 6-DoF Accelerometer and Gyroscope	12.5	2	25
Accelerometer (Chip Only)	Accelerometer Chip Only (Digikey)	4.26	6	25.56
Boost IC	TPS61030PWPR Texas Instruments	3.25	6	19.5
100mAh LiPo Battery	Lithium Ion Polymer Battery - 3.7v 500mAh	7.95	4	31.8
Combined Total				142.61

(Note: This Bill of Materials is a work in progress and does not reflect the total cost of the project. An updated version will be included in later reports.)