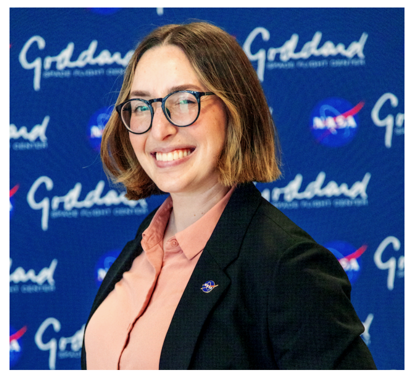
Project Title

(Try to choose a catchy title. Max 20 words).

Smarter Playtime: Developing a Motion-Based Motorized Cat Toy for Active Engagement

Student and Team Information

Team Name: Kitty Kinetics Team # on Canvas: 2	
Team member 1 (Team Lead): Newton, Morgan: 40885576: monewton@uci.edu	Newton, Morgan – 40885576 
Team member 2: Hermosilla, Carm: 76038461: cyhermos@uci.edu	Hermosilla, Carm – 76038461 

Updated Project Approach (10 points)

(Describe how you plan to articulate and design a solution, architecture you are finally using and communication protocol (Wi-Fi, BLE, ...). Include all project milestones as well. Max 300 words).

Our project uses a motion, sound and light approach to engage cats, with an architecture based on the LilyGo ESP32 microcontroller. We decided to use an accelerometer to detect movement along the x, y, or z axes, triggering the toy when a cat interacts with it. After experimenting with proximity sensing, we opted to omit it because it is impractical for a spherical design. The toy is housed in a modified hollow sphere, allowing embedded LEDs and attachments like feathers or bells. The .stl file was downloaded for free from Thingiverse and manually adjusted per our device specifications. Power will be supplied via an external USB power bank for simplicity and ease of replacement. We realized that a shutdown mode is unnecessary as the device powers off naturally when the battery depletes. We want the cats to enjoy playing with the device for as long as possible.

Updated Hardware Components (5 pts)

(The final list and quantity of the required components for the project)

Component	**Type**	**Quantity**	**Ordered?**
Microcontroller	LilyGo ESP32	1	☑
LEDs	LEDs	1	☑
Resistors	Resistors	1-4	☑
Accelerometer	Accelerometer	1	☑
Spherical housing	Thingiverse	1	☑
Motor	Motor Motor tutorial	1	☑
Motor driver	Motor Driver	1	☑
USB Power supply	*Need to find a small rechargeable power bank*	1	☐
Motor power supply	*Potentially going to use a Lipo battery*	1	☐
Buzzer	Buzzer/Speaker	1	☑
Attachments	Feathers, bells, wiggly worms	5	☑

Completed Project Tasks (15 pts)

(Describe the main tasks that have been assigned and already completed. Max 250 words)

Task Completed	Team Member
Designed and printed a hollow sphere prototype from Thingiverse and tested it with the cats. They seemed to like it!	Morgan
Adjusted the housing file to add perforations for the LED lights and an embedded hook for attachments.	Morgan
Implemented sensor logic for initializations, LED flashing, bird chirps, and motion detection using an accelerometer.	Morgan
Ordered the rest of our parts: LED, motor, motor driver, device attachments	Morgan

Challenges and Roadblocks (10 pts)

(Describe the challenges that you have faced or are facing so far and how you plan to solve them. Max 300 words)

Balancing the scope and timeline of the project has been a challenge, requiring us to simplify certain features, such as omitting battery life tracking, which was deemed unnecessary. I think we got a bit too ambitious! We also faced hardware compatibility issues, as initial microcontroller libraries caused delays, but these were resolved by switching to more suitable options. Fine-tuning the accelerometer's logic has been another focus, ensuring it responds accurately to motion while avoiding false triggers. To streamline power management, we are opting for an external USB power bank, eliminating the need for a shutdown mode, which significantly simplifies the design. Additionally, proximity sensing was excluded from the project due to the spherical housing design, which made it impractical to direct sensors effectively. For example, the sensor might be pointed down at the ground, which would pose issues with reading. Instead, we will rely on accelerometer-based motion detection to activate the toy. Additionally, programming each peripheral to run concurrently proved to be much more difficult than originally planned.

Pending Tasks (10 pts)

(Describe the main tasks that you still need to complete. Max 250 words)

Task	Team Member
Adding AWS data analytics tracking for play time	Morgan
Analyzing and summarizing data analytics	Carm
Select and test an external USB power solution	Morgan
Hardware Build	Carm
Testing the device	Morgan
Logic adjustments	Morgan
Demo Video	Carm + Morgan
Final Report	Carm + Morgan

Weak Points and Future Work (15 pts)

(Mention at least two points of your project that have room for improvement. These points can be additions to the existing project setup (components) or improvement of the current implementation. Max 200 words)

For future iterations, integrating a power source that allows battery tracking would enhance usability by providing real-time feedback on battery levels. This would be helpful in analyzing battery life to compare different, better options, if necessary. Additionally, modifying the spherical housing to include a weighted base could improve stability and create opportunities for incorporating proximity sensing functionality, which was not feasible in the current design. Another area for improvement could involve refining the accelerometer's sensitivity and responsiveness, enabling more precise motion detection. Adding customizable play patterns, such as programmed light and sound sequences, could further enhance the toy's engagement factor. Adjusting peripheral timing was also fairly difficult. Future implementations would hopefully focus on creating logic to allow parallel peripheral execution. Lastly, if we hypothetically were interested in bringing the device to market, exploring durable materials for the housing could extend the product's lifespan, as well as sourcing smaller hardware components.

Demo Video (15 pts)

Please include a link to a demo video showing the initial setup, the components and functionality of your IoT system (5 min max). If you cannot provide a video yet, please explain the reasons. Max 150 words).

Our demo video showcases Charlie (Morgan's cat) playing with the 3D-printed ball prototype, made of PLA. The second clip demonstrates the sleep state to play state transition. If the toy is moved, the play state is activated. The third video showcases the serial monitor output, displaying the toy's state, its position via x and y coordinates, and magnitude to elucidate how much the toy has moved. The play state will move each motor randomly, flash the led, and chirping noises. If the cat is not interested momentarily, the hunting state is activated which turns on the led and chirping noises. If the cat is completely uninterested, the device shifts to a sleep state to consume less battery. This output will be sent to the AWS database to monitor the current session's play duration and frequency between interactions. State timing changes have small delays for demonstration purposes, but will be readjusted after testing.

[Watch Demo Video Here]