Version	Date
V 1	**10/23/24**
V 2	**10/31/24**
V3	**11/20/24**
V4	**12/5/24**
V5	**12/10/24**

Product Design Specification

Team 9: FLOPS

Authors:
Tim Hoke
Mohammad Alshaiji
Luis Hilbert Rivas
Stuart Packard

Course:
ECE 411
Introduction to Industry Design
Fall 2024
PDS sheet

Product Name

The name of the product is “The FLOPS”! Which stands for the FeLine Obesity Prevention System.

Executive Summary with Concept of Operations

The device helps cat owners achieve their cat’s target weight by automatically recording weight measurements. Each time the cat enters its bed, the device records a weight measurement and stores the result. Users can log the amount of food they give their cat, and based on their target weight, adjust the feeding amounts to see how it affects the cat’s weight. The software’s user interface displays these weight trends in easy-to-read plots, allowing users to observe and track trends over time. They can use the trends to make an informed decision on how to adjust their cat's diet.

This approach is valuable for managing a cat’s weight, whether the goal is to address overweight, underweight, or maintain optimal health. Unlike relying solely on observation, the device offers a precise, data-driven method for weight management. It automates data collection, minimizing the need for manual effort from the owner.

Although regular vet visits remain essential, this device provides insight into weight changes between those visits, which typically occur only once or twice a year.

Brief Market Analysis

Cat owners who need to manage their cat’s weight will benefit from this product, especially those who struggle to weigh their cat. Some cats, being timid, won’t let their owners pick them up and place them on a scale. In some cases, owners have physical impairments that make it difficult or impossible to lift their pet. Our product provides a solution by automatically weighing the cat in its bed. It also appeals to gadget lovers who enjoy the convenience of automated tools. Although designed for cats, small dog owners can also use this scale, and we plan to expand to larger pets in the future.

Our main competitors include brands that sell at pet supply retailers like Petco, PetSmart, and of course, Amazon. Companies such as IBE Supply and Unipaws focus on offering scales with digital readouts and comfortable seating for pets. Some of these companies, like Unipaws, also let users track measurements through a Bluetooth connection to a smartphone.

Our design stands out from other pet scales. We’ve created a form factor that integrates with a cat bed, using curved or beveled edges to hold it securely in place. Unlike competitors’ steel-plate scales, our product offers a more attractive, cat-bed-like aesthetic. More importantly, the scale provides automatic and continuous weight measurements, so users don’t need to forcibly weigh their pets. This allows owners to monitor weight fluctuations more frequently.

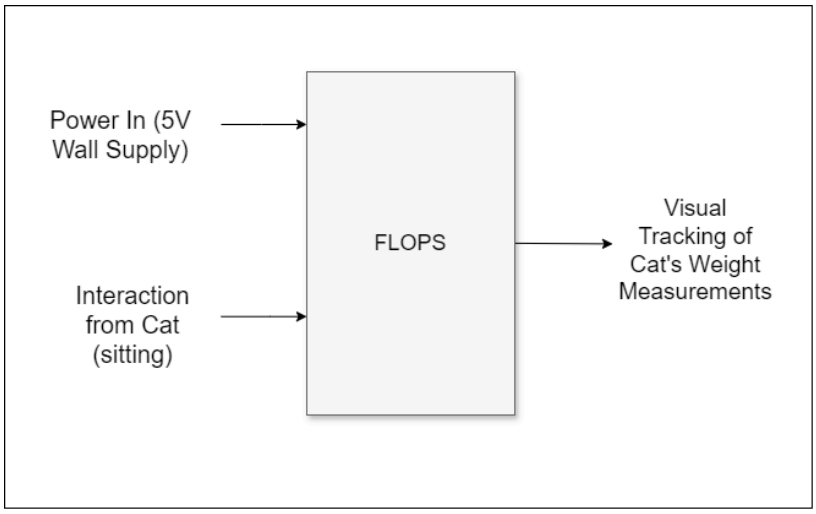
Competitor products range from $60 for basic designs to $125-$150 for those with digital readouts and Bluetooth features. Our components cost around $50, so we can sell this product for $99.99, offering more features at a lower price than the competition, while still maintaining a healthy profit margin.

Requirements

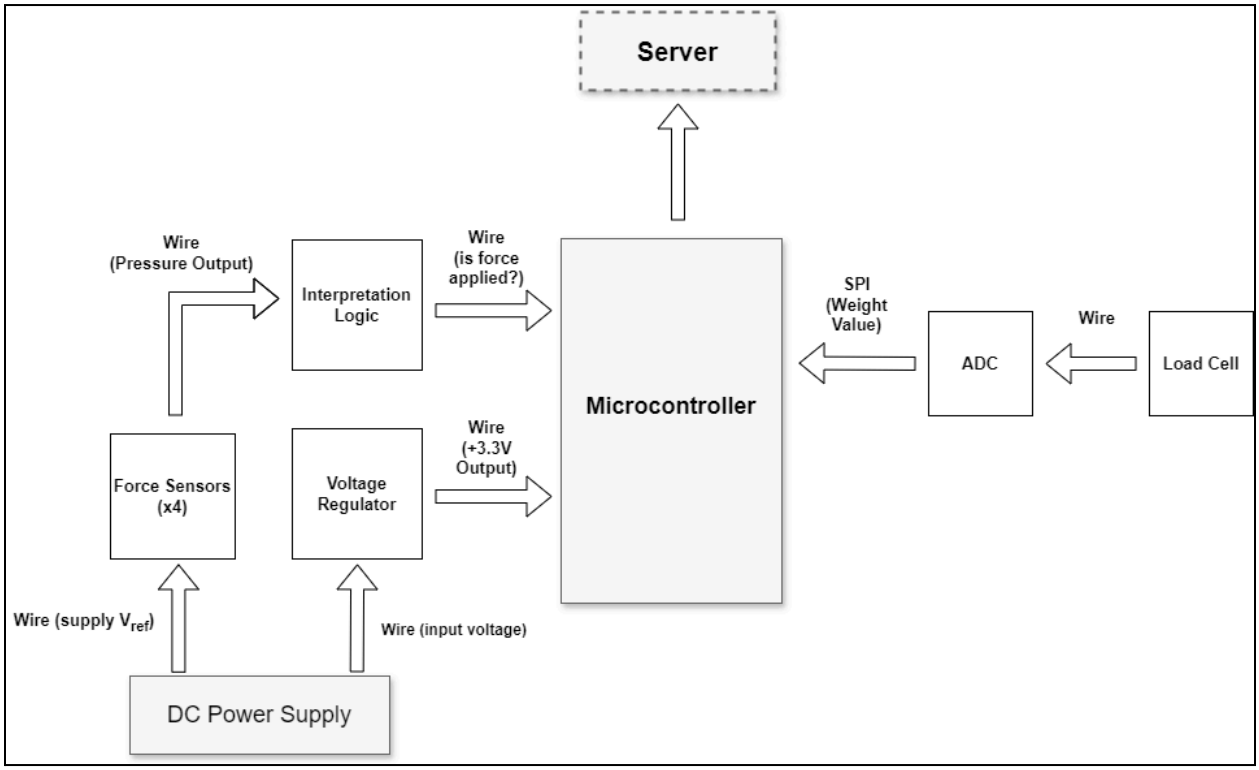
- Must have continuous power; the system needs to be online and ready to take a measurement whenever a cat lays on its bed.
- Must be able to collect data points of weight over time and display a plot of data to the user.
- Must collect data automatically.
- Must not have to manually put the cat onto the scale in order to get weight measurements.
- Must be able to handle the weight of a cat for an extended period of time.
- Must be able to accurately measure within the normal weight range of a cat.
- Must indicate the power is on.
- Must be sensitive enough for the force sensors to output greater than 2 Volts for the input High of the AND gate.
- Should have an indication that power is on for the user.
- Should have something interesting like a toy for the cat to interact with.
- Should be able to display force as a function of time graph to users quickly.
- Should display graphs and tables of previous values from a website or other application.
- May have an interface for the user to input internet access credentials.

System Architecture

- Level 0:



- Level 1:



Design Specification

- 5V wall plug for power supply:
  - Plugged into the barrel jack on the housing.
  - Voltage regulator IC's for powered components that aren't 5V tolerant.

- Strain Gauges:
  - Metallic foil strain gauge for weight measurement.
  - Mounted to stiff lower platforms.
  - **Adafruit Strain Gauge Load Cell** - 20kg max

- ADC :
  - High Precision reading output for strain gauge communication.
  - SPI output.
  - **Avia Semiconductor HX711** - 24 bit ADC IC

- ESP32:
  - Signal and data processing controller.
  - **Espressif ESP32 S3-WROOM S3-1-N16R8** - rx/tx Bluetooth & WiFi module

- Mechanical Aspects:
  - Square surface of cat bed, pressure sensors on underside of surface
  - Enclosure for Load Cell and PCBA.

- Flexible Piezoresistive Pressure Sensors.
  - For detecting pressure from a cat sitting in bed.
  - 4 sensors feed into 4 input AND gate.
  - Output of AND gate to gate to power MOSFET to allow power on for ESP32, ADC/strain gauge.
  - **Uneo Tech GHF10** - 0-500N max

- Data Display
  - Web server to offload data from the ESP32 over WiFi for storage and user interaction.
  - Touch screen for user to enter WiFi credentials
  - Expressif IDF and Platform.io have VSCode extensions popular for ESP32 programming, as does the Arduino IDE.