

ECE 445

Auto cat snack dispenser

Team #39

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Introduction

1.1 Problem

When people are not at home, pet cats may get bored and hungry. Although there are various independent feeders and toys on the market, there isn't a device that can cheer cats up, feed them remotely, and ensure enough exercise for cats all at the same time.

Most of the feeders on the market are designed to dispense food-based either on the remote command of the owners or the request of cats themselves. Feeders, based solely on cats' demands, may cause cats to overeat and gain unhealthy diet habits. Other feeders, which require owners to manually feed their cats on remote control, can be inconvenient when owners are not able to stay active.

Therefore, an auto feeder, which can keep track of the amount of cats' exercise and play with cats, is needed.

1.2 Solution

To solve the problem, we plan to design an auto cat snack dispenser and exercise machine. This cat feeder toy project involves three crucial parts: a special collar placed on cats, a dispenser put on the ground, and a laser pointer attached to a mechanical arm connected to the base of the dispenser. Our snack dispenser can

attract cats' attention and lead them to do exercise, and it can also detect cats' movements and record how much exercise cats have done.

We will connect an infrared sensor (IR) right under the dispenser. Once cats are hungry and approach their bowl, the IR sensor will detect it and send the data to the microcontroller unit (MCU).

The laser pointer attached on the mechanical arm will then start to work, and at the same time, the inertial measurement unit (IMU) in the special collar will also begin to record cats' movements. Once enough exercise is done, the IMU will send the data back to the microcontroller unit and tell the dispenser to drop some amount of snacks.

The whole device will halt for a period of time until the next activation.

1.3 High-level requirement list

- The IMU stays at a low power consumption mode and does not start to record data until the infrared sensor detects cats approaching the sensor on the dispenser.
- When activated, the laser pointer starts to move and leads the cats to do exercise, while the collar starts to send wireless data to the base unit.
- Once the dispenser drops snacks, the whole system does not restart immediately. It halts for at least five minutes to start the next activation.

1.4 Visual Aid

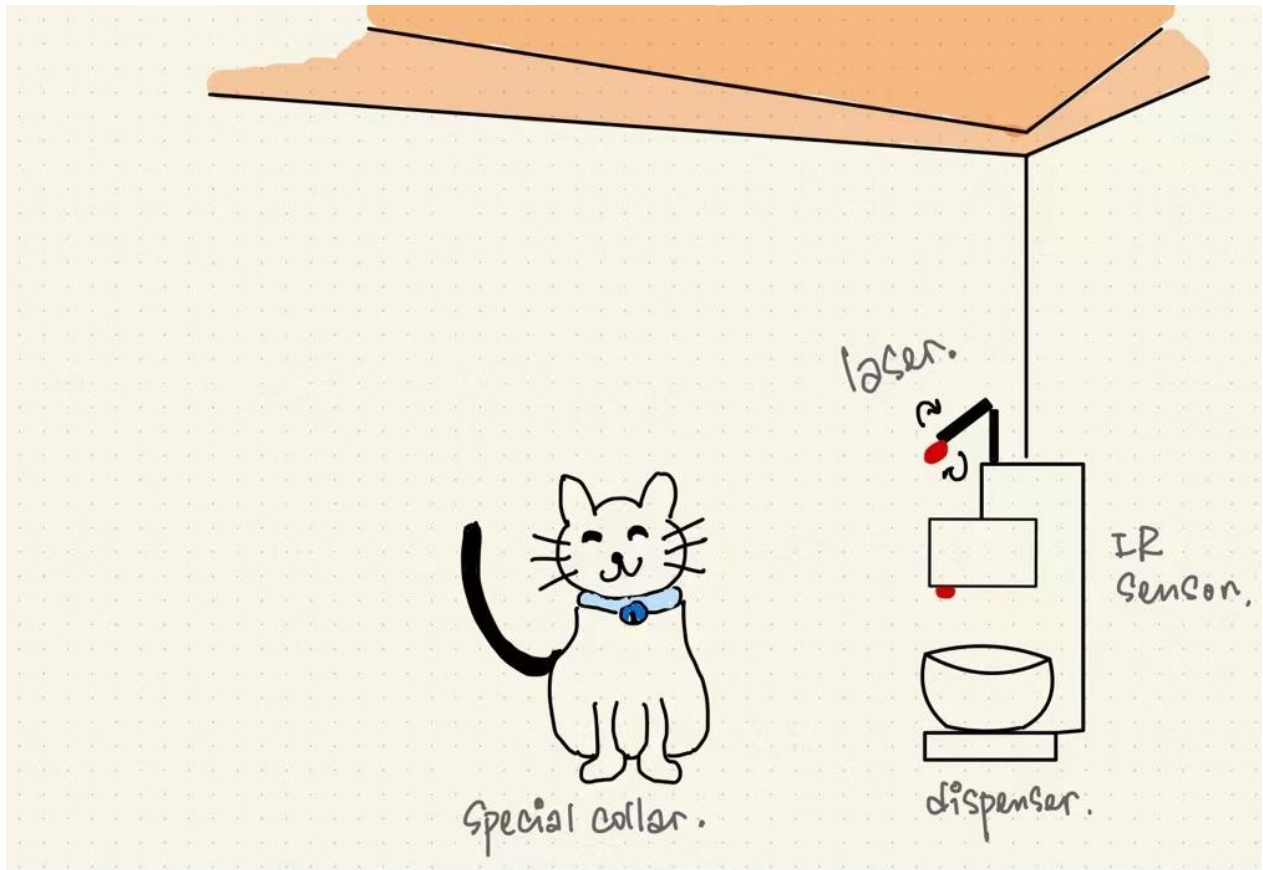


Figure 1. Physical Design of Auto Cat Snack Dispenser

Design

2.1 Block Diagram

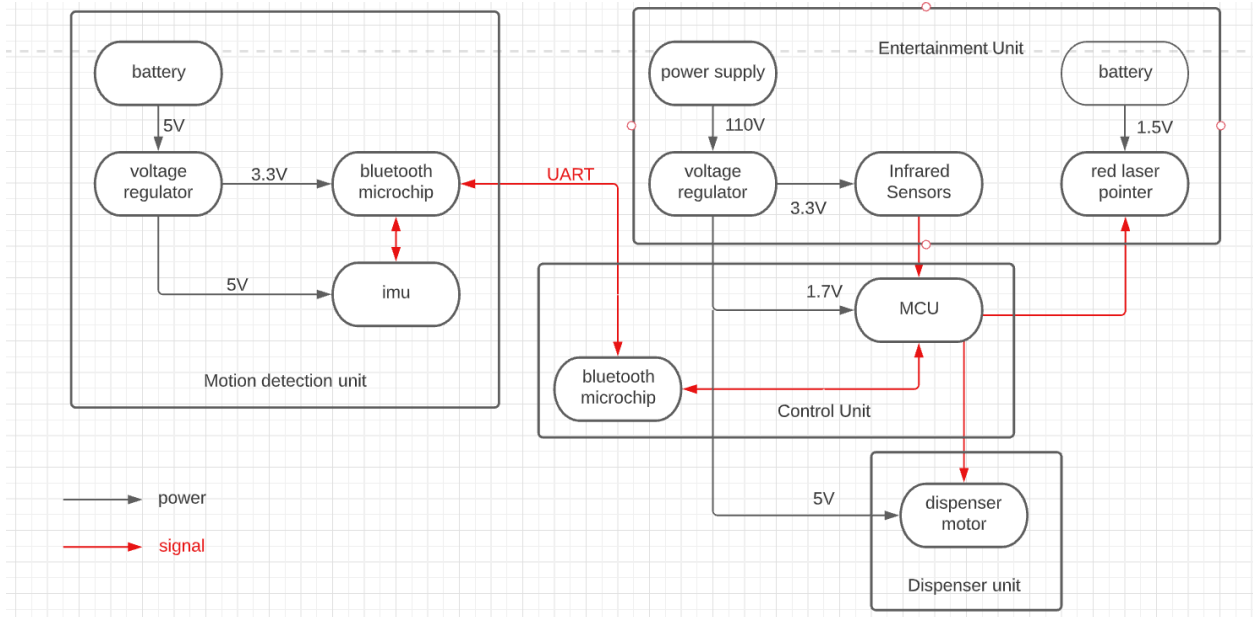


Figure 2. Block Diagram of Auto Cat Snack Dispenser

2.2 Block Diagram Description

To successfully operate our device, our auto cat snack dispenser is composed of four units. The four units are the motion detection unit (the special collar on cats), the entertainment unit (the laser pointer attached to the mechanical arm), the dispenser unit (the dispenser on the ground), and the control unit. The control unit is composed of an MCU and bluetooth chip.

2.3 Subsystem Requirements

2.3.1 ## Subsystem 1: The entertainment unit

Description:

The entertainment unit uses an infrared sensor and a red laser pointer to attract cats' attention. The red laser pointer is attached to the mechanical arm on the dispenser. Once the IR sensor detects cats approaching, it will send the signal to MCU, which then sends a signal to turn on the red laser pointer and start the motion detection unit.

Subsystem requirement:

- The infrared sensor and the red laser pointer are both powered with their corresponding appropriate voltages(3.3V and 1.5V respectively). The power of the red laser pointer should be less than 5mW following the regulation of laser usage. The battery should power the laser for at least a 24 hour working span.

Components in this subsystem:

Infrared sensor: This sensor is used to detect if cats approach the machine. It turns on the machine when the cat is seeking snacks under it.

Laser pointer: The laser pointer is to attract cats' attention. It is turned on once the IR sensor detects cats approaching.

2.3.2 ## **Subsystem 2:** The movement detection unit

Description:

The movement detection unit contains an IMU and a Bluetooth microchip. This system is powered by a battery through a voltage regulator. Once the Bluetooth microchip receives signals from the other Bluetooth microchip in the control unit, IMU starts to detect cats' motion. After enough exercise is recorded, IMU sends data back to the Bluetooth microchip.

Components in the subsystem:

IMU: It includes all the sensors for detecting cats' movements. It also sends the wireless signal to the control unit. IMU stands for inertial measurement unit, and it contains a gyroscope and an accelerometer, which are both used to detect cats' motion.

Bluetooth microchip: It is used to send and receive wireless signals.

Subsystem Requirement:

- This subsystem maintains a low power consumption when it is at rest. Only Bluetooth will be powered by a 3.3V or 5V battery at rest.

2.3.3 ## **Subsystem 3:** The snacks dispenser

Description:

After enough exercises are recorded, snacks will be dispensed. This subsystem ensures a fixed amount of snacks is dispensed each time. The system then halts for a period of time until the next activation becomes available.

Components in the subsystem:

Dispenser motor: It is used to control the amount of snacks dropped by turning a fixed angle at every activation.

Subsystem requirement:

- It can dispense a fixed amount of snacks at every activation.
- It halts for at least 5 minutes before the next activation.

2.3.4 ## **Subsystem 4:** The control unit

Description:

This subsystem contains an MCU and a Bluetooth microchip. It receives signals from the other three subsystems, and it sends corresponding signals back to the three subsystems.

The MCU receives signals from the infrared sensors first, and then it sends data to start the red laser pointer and start the movement detector. Once enough exercise is recorded, the Bluetooth microchip from the motion detection subsystem will transmit data to the Bluetooth microchip in this subsystem. After the MCU processes the signals, it tells the dispenser to drop snacks.

Components in this subsystem:

MCU: It stands for the microcontroller unit. It should process the data from IMU and calculate whether the cat has consumed enough energy.

Bluetooth subsystem: It is used to send and receive wireless signals between MCU and IMU.

Subsystem requirement:

- The project ensures an efficient wireless signal data path.

2.4 Tolerance Analysis

One potential risk of our project is the inaccuracy of the IMU detecting and recording cats' movement . The IMU is composed of a gyroscope and an accelerometer, which are not exactly accurate most of the time. However, since we are only using the IMU to detect if cats have done exercise, they don't need to provide precise data and angles for every move of our cats.

3 Ethics and Safety

Our project is to build a safe and convenient snack dispenser for cats. We will uphold the highest standards of integrity and responsible behaviors while we are working on the this project, and we will make sure our final project is ethical. Any resources we will be using for this project will be correctly cited, and any time we need to seek for help, we will always talk to our TA first.

One potential ethical problem of our product is that if there is any component so small in our final product that cats may miseat them. Based on our design, cats are only able to reach the dispenser (the bowl) and the special collar, and both these two parts should be big enough so that cats cannot swallow them. One other concern people may have is that if the laser pointer is harmful for cats. However, since the laser pointer is constantly moving, cats are not supposed to have direct eye contact with it. If the owner chooses to directly use the laser to hurt his cat, it is really beyond the control, but we will include a safety instruction clearly stating the potential danger of misusing the laser pointer.

We will regulate our behaviors to avoid safety issues in the lab. We will not work alone in the lab, will not bring any food or drink to the lab room, will use both hands when connecting circuits, will notify our TA if anything is broken, and will clean up our work station after we finish our work.

4. Reference

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