ECE 445

SENIOR DESIGN LABORATORY

PROPOSAL

RASPBERRY PET PAL

Team #445

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Abstract

This document provides an outline and LaTeX template for report formatting in Senior Design. This document does not teach you what to include, or how to use LaTeX. Assumes a workable level of LaTeX proficiency.

Contents

1 Introduction

In today's fast-paced and high-pressure world, young people are experiencing both loneliness and poverty. They long for social engagement and relationships, but most social activities are costly and pose a risk of infection during the pandemic. As a result, many young people turn to pets for companionship. However, owning a pet can financially burden those struggling to make ends meet. Furthermore, cute pets can sometimes create chaos in their owners' homes. Thus, an affordable and functional electronic pet seems like a necessary solution. Unfortunately, the current products on the market are either too expensive or fail to match a real pet's abilities, such as voice and behavior interaction. Therefore, lonely and financially strapped young people require an affordable and functional electronic pet.

1.1 Objective

The electronic pet should be able to perform all the desired functions reliably and accurately. It should be able to follow objects, display a range of emotions on its screen, recognize and respond to voice commands, carry and weigh objects, count steps, avoid obstacles, and interact with limbs using infrared detection. It will be equipped with cutting-edge technology and advanced features for an interactive and engaging experience. It can follow its owner's movements through target detection technology while displaying a range of expressions through a high-quality display screen. With its voice recognition and corresponding audio output, this pet can communicate with its owner and respond to commands. Additionally, it can assist in carrying objects through a built-in weighing system, track physical activity through its motion detection capabilities, and navigate its surroundings using obstacle avoidance technology. Furthermore, the pet's limbs are designed for interactive play and detection through infrared technology. With its advanced features, this electronic pet offers unparalleled interactivity and companionship for pet lovers of all ages.

1.2 Background

The new electronic pet is equipped with cutting-edge technology and advanced features for an interactive and engaging experience. This electronic pet is designed to follow its owner's movements through target detection technology while displaying a range of expressions through a high-quality display screen. With its voice recognition and corresponding audio output, this pet can communicate with its owner and respond to commands. Additionally, it can assist in carrying objects through a built-in weighing system, track physical activity through its motion detection capabilities, and navigate its surroundings using obstacle avoidance technology. Furthermore, the pet's limbs are designed for interactive play and detection through infrared technology. With its advanced features, this electronic pet offers unparalleled interactivity and companionship for pet lovers of all ages.

1.3 High-Level Requirements List

- Functionality: The electronic pet should be able to perform all the desired functions reliably and accurately. It should be able to follow objects, display a range of emotions on its screen, recognize and respond to voice commands, carry and weigh objects, count steps, avoid obstacles, and interact with limbs using infrared detection.

- User experience: The electronic pet should be easy to use and interact with. Users should be able to easily control and communicate with the pet through its display screen and voice recognition system. The pet should also respond to user interactions in a fun and engaging way.

- Durability and stability: The electronic pet should be built using durable and stable components to ensure that it can withstand regular use without breaking down. The car should be stable enough to navigate different terrains and avoid obstacles without getting stuck or tipping over.

- Battery life: The electronic pet should have a long-lasting battery life to ensure that it can be used for extended periods without needing to be recharged. This is particularly important if the pet is intended for use by children or in educational settings where it may be used for extended periods.

2 Design

2.1 Block Diagram

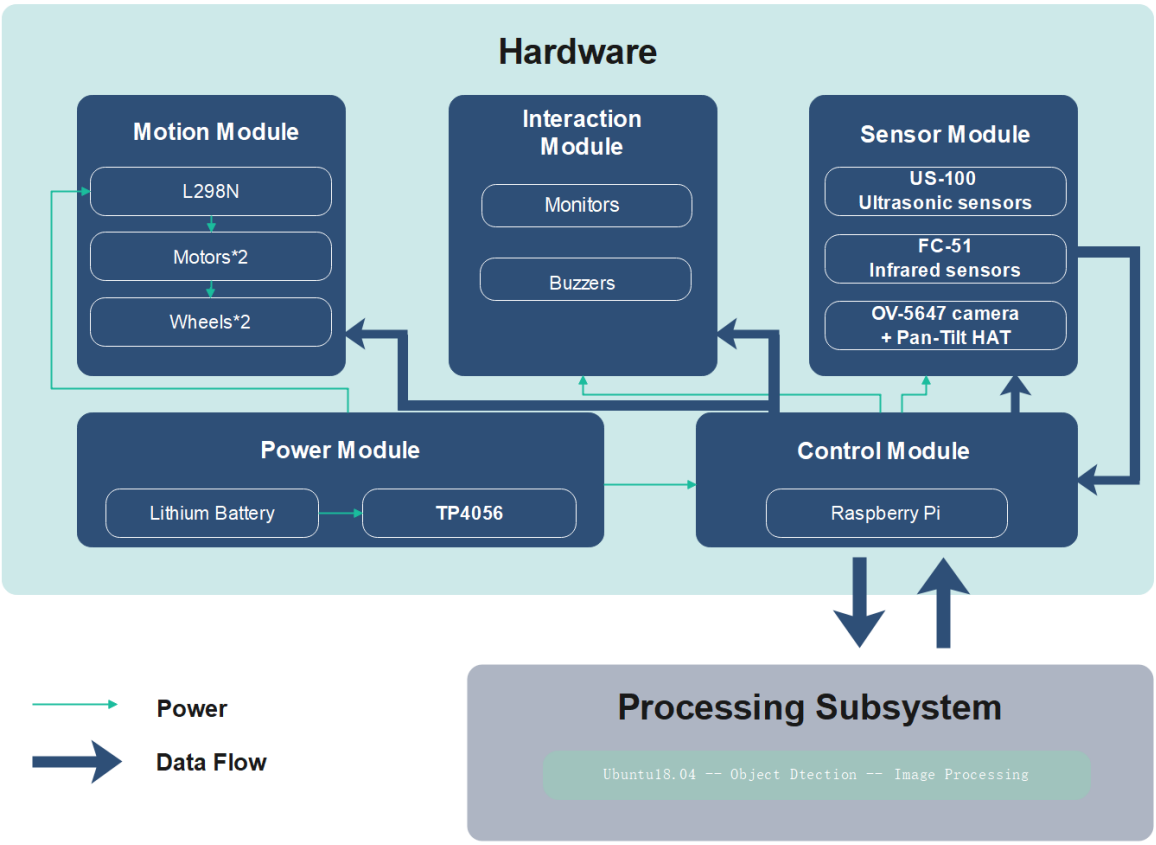

Figure 1: Block Diagram

2.2 Design Sketch

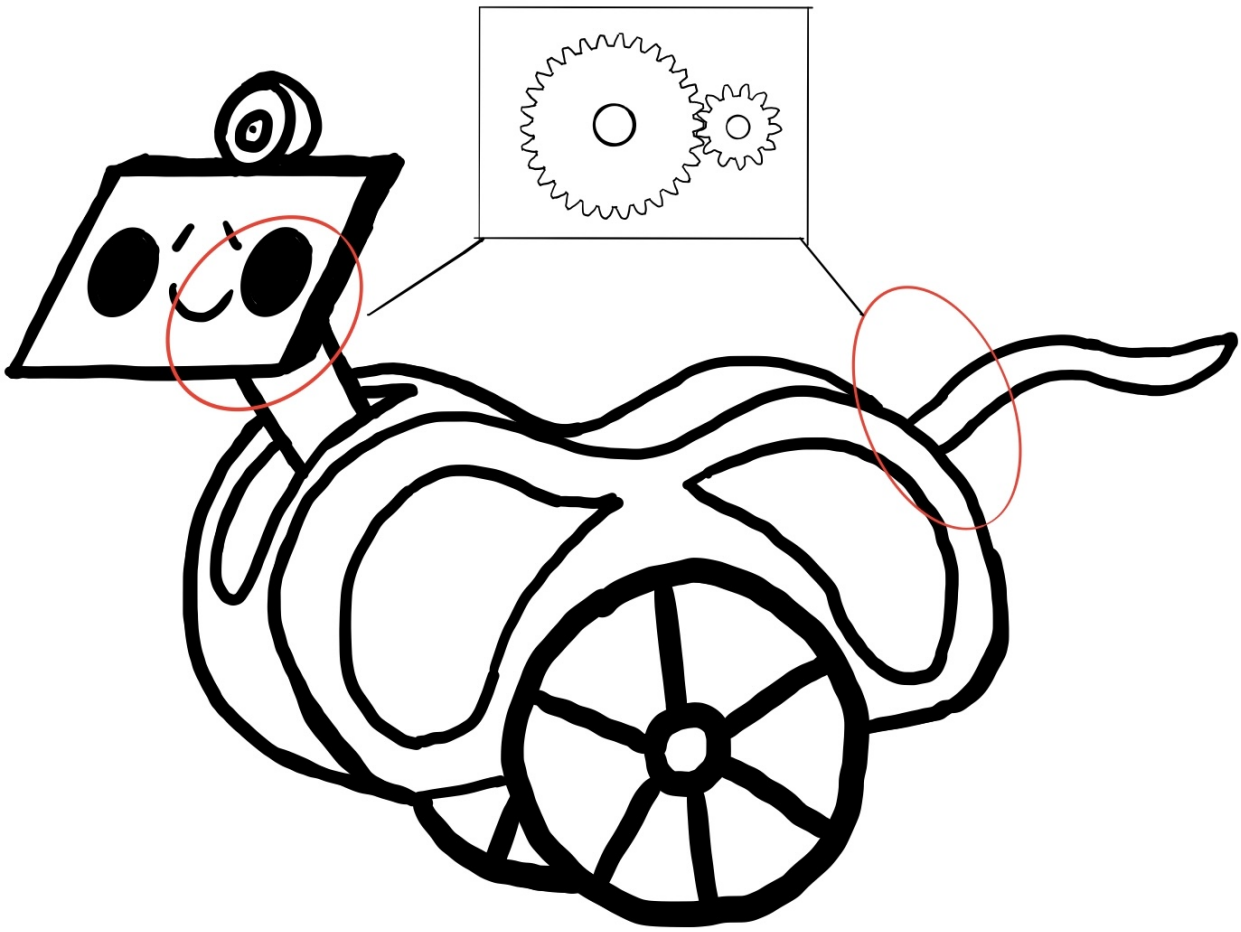

Figure 2: Design Sketch

2.3 Functional Overview and Block Requirements

The electronic pet module consists of four main components: the control module, the motion module, the sensor module, and the power module.

The **control module** includes the Raspberry Pi and a WiFi module, which allows the Raspberry Pi to connect to the eduroam network and be controlled remotely through SSH from a PC. The primary function of this module is to control the overall operation of the system and facilitate communication and data exchange with the other modules.

Requirements for the control module include:

- The Raspberry Pi must be able to connect to the eduroam WiFi network.
- An SSH client software must be installed on the PC for remote control.

The **motion module** consists of the motor driver board, motors, and wheels. The motor module is connected to the Raspberry Pi through GPIO pins, and the Python-written method is used to control the motor speed and achieve differential drive control of the two wheels. The primary function of this module is to move the pet robot.

Requirements for the motion module include:

- The GPIO pins of the Raspberry Pi must support PWM functionality.
- The motors must be connected to the driver board correctly.

The **sensor module** includes the OV-5647 camera module, a pan-tilt module, the US-100 ultrasonic sensor, and the FC-51 infrared sensor. The Raspberry Pi is used to control the GPIO pins and communicate with other hardware through the GPIO Zero library. This module is responsible for sensing the environment and detecting obstacles.

Requirements for the sensor module include:

- The camera module, pan-tilt module, ultrasonic sensor, and infrared sensor must be connected correctly.
- The GPIO pins of the Raspberry Pi must be connected to the respective sensors correctly.

The **power module** consists of a lithium battery and a protection circuit board. The lithium battery is connected to the protection circuit board, which in turn is connected to the Raspberry Pi and driver board to provide power to the entire system.

Requirements for the power module include:

- The voltage and capacity of the lithium battery must meet the requirements of the Raspberry Pi and driver board.
- The protection circuit board must be able to protect the battery during charging and discharging.

Overall, these four modules work together to create a functional electronic pet that can be controlled remotely and move around while sensing the environment.

2.4 Risk Analysis

Motor driver board compatibility issues: If the motor driver board is not compatible with the motors or the Raspberry Pi, it may not function properly or could potentially damage the components. This could be mitigated by carefully selecting a motor driver board that is rated for the appropriate voltage and current and has the necessary features to support the required number of motors.

Power supply issues: If the lithium battery voltage drops too low or the Raspberry Pi and motor driver board are not properly protected, it could result in damage to the components or loss of power. This could be mitigated by selecting a lithium battery

with the appropriate voltage and capacity for the project, using a charging and protection circuit to ensure safe operation, and monitoring the battery levels to prevent over-discharging.

AI model size: Considering the computational power of raspberry Pi, we should choose the lite weight AI model for inference.

3 Ethics and Safety

3.1 Ethics

Data privacy: The electronic pet module may collect and store personal data, such as images and audio recordings, as well as potentially sensitive data such as school network information. It is important to ensure that this data is collected and stored securely and that it is not used for any unauthorized purposes.

Accessibility: The electronic pet module should be designed to be accessible to a wide range of users, including those with disabilities. This may include features such as audio or haptic feedback, as well as support for assistive technologies.

Security: The electronic pet module should be designed to be secure against potential attacks, such as hacking or malware. This may include features such as encryption, firewalls, and user authentication.

3.2 Safety

Electrical Safety: The electronic pet may pose a risk of electric shock or overheating if not designed and constructed properly. Electrical safety features, such as grounding and insulation, must be incorporated into the design and manufacturing process to mitigate this risk.

Mechanical Safety: The electronic pet's moving components, such as its limbs, may pose a risk of injury if not designed and manufactured with safety in mind. It is important to ensure that the pet's moving parts are not sharp, can't pinch or crush, and are not likely to break off during use.

Teammember Safety: Working alone in the lab is strictly prohibited. A minimum of two individuals must be present in the lab at all times. Prior to being granted lab access, completion of mandatory online safety training is mandatory.

Appendix A Example Appendix

An appendix can go here! Make sure you use the `\label{appendix:a}` above so that you can reference this section in your document.