



Vending Machine Simulation Development and Troubleshooting

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ENS101.2: Introduction to Engineering

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1. Abstract

This paper presents the design and implementation of a vending machine simulation using MATLAB/Octave. The simulation includes a graphical user interface (GUI) that replicates real-world vending machine functionalities such as product selection, payment processing, and product dispensing visualization. Key challenges encountered during development included image loading, GUI scaling, and error handling. The solutions implemented ensured a robust and user-friendly simulation. This paper discusses the methodology, results, and potential enhancements for future work.

2. Introduction

Vending machines have become an integral part of modern life, offering convenience and accessibility to a wide range of products. They eliminate the need for human interaction, providing automated solutions for quick purchases. This project simulates a vending machine using MATLAB/Octave to replicate these functionalities, emphasizing GUI design, interactive user experience, and dynamic visualization. The goal is to develop a practical understanding of simulation techniques and apply programming skills in a real-world context.

3. Thought Process and Work Activities

3.1. Work Process

3.1.1. Problem Definition and Planning

Project Topic: Vending Machine Simulation

Objective: To develop a vending machine simulation where users can select products, make payments, and calculate change.

3.1.2 Research and Idea Collection

YouTube Videos: Several tutorial videos on MATLAB GUI design and payment systems were watched.

- MATLAB GUI Design Tutorial:**

https://www.youtube.com/watch?v=NN_xxk7MHAw

The video provided information on adding GUI elements and assigning button functions. The different types of the uicontrol function were explained in detail.

Websites: Information was gathered from the official MATLAB documentation.

- MathWorks MATLAB GUI Documentation:**

<https://ch.mathworks.com/discovery/matlab-gui.html>

The documentation provided guidance on loading images using the axes element.

Code Example:

```
axes('Position', [0.1, 0.2, 0.8, 0.6]);  
imshow('VendingMachine.png');
```

- **Writing scripts and functions:**

https://youtu.be/NN_xxk7MHAw?si=KsRyM9QSgAcjT6T1

We learned Adding GUI Elements, uicontrol Function, Assigning Button Functions from this video.

AI-assisted debugging and research tools

- How to add a photo in Octave
- How to insert a PNG file
- How to create a button for adding money to the vending machine
- How to develop a money-loading simulation
- How to resize images added to the product screen
- How to include the image insertion code within the whole script
- How to add a button to the screen
- How to change the position of an added button
- How to create a 3D simulation with Octave

3.1.3 Coding Process

- In the **OCTAVE** environment, the desired commands were displayed using function structures on the main screen.
- A list containing product images and prices was created.
- The selected product list and total price were dynamically updated.
- The payment screen and a progress bar for the payment process were implemented.

3.1.4 Testing and Development

- User inputs were simulated to ensure the code functioned correctly under different scenarios.
- Potential error situations were analyzed, and appropriate error messages were added.

3.2. Resources Used

Resource Type	Resource Name/URL	Usage in Project
YouTube Video	MATLAB GUI Tutorial	Guide for using uicontrol and axes
YouTube Video	Writing scripts and functions	Guidance in GUI design
Website	MathWorks MATLAB GUI Docs	Detailed explanations of GUI elements
Image Source	pngwing.com	Obtaining product images
Image Source	pinterest.com	Obtaining product images

3.3. Problems Encountered and Solutions

Problem 1: Missing or Unloaded Product Images

- **Issue:** Product images were either unavailable or misplaced.
- **Solution:** Images were placed in the correct folder, and a try-catch block was implemented to check for missing images.

Problem 2: Selected Products Not Displaying in the List

- **Issue:** Selected products were not appearing in the selection or payment screens.
- **Solution:** A dynamic list box (listbox) was added for selected products.

Problem 3: Change Not Being Calculated on Payment Screen

- **Issue:** No change was calculated for overpayments.
- **Solution:** Change was calculated after payment, and the user was informed via a message box.

Problem 4: Payment Progress Bar Not Updating Dynamically

- **Issue:** The progress bar did not update correctly during payments.
- **Solution:** The progress bar was dynamically updated with each payment process.

4. Methodology

4.1 Initial Design

The project was initiated by defining the core functionalities of a vending machine:

1. Displaying available products along with their names and prices.
2. Allowing users to select products from a menu.
3. Processing payments, including change calculation.

The design process began with sketches and flowcharts to map the user journey, ensuring the interface was intuitive and easy to navigate

4.2 Implementation Steps

Step 1: Designed the welcome screen, which included a vending machine image and a navigation button to proceed to the product selection screen.

Step 2: Developed the product selection interface with a dropdown menu listing available products. Each product was displayed with its code and price.

Step 3: Implemented the payment interface, allowing users to input the selected product and confirm their purchase. Payment handling included dynamic change calculation.

Step 4: Incorporated errors handling mechanisms to address missing files and invalid user inputs, ensuring the program remained robust and user-friendly.

4.3 Error Handling

Error handling was a critical component of the project. Several measures were taken to ensure the simulation handled edge cases gracefully:

- File existence checks were implemented for required images to prevent runtime errors.
- A `try-catch` block was added to handle issues during image loading, displaying appropriate error messages instead of terminating abruptly.
- Input validation logic ensured users selected valid products and entered correct codes before proceeding.

5. Conclusion

This project successfully demonstrates the capabilities of Octave in creating interactive simulations. The vending machine simulation effectively replicates real-world functionalities, providing a robust and user-friendly interface. The challenges encountered during development offered valuable insights into GUI programming, error handling, and dynamic visualization. The final product meets the project objectives and lays the foundation for future enhancements.

6. References

1. MATLAB/Octave Documentation: [<https://octave.org/doc/>]
[<https://docs.octave.org/v9.2.0>Loading-and-Saving-Images.html>]
2. Tutorials on GUI Design in Octave:
[<https://www.youtube.com/watch?v=eUdXLsYhaok&t=101s>]
[<https://www.youtube.com/watch?v=UMcd2Xz4sBM>]
3. Peer Discussions and Debugging Sessions
4. ChatGpt: [<https://chatgpt.com/c/6783cacb-2600-8011-a776-1f80f3239864>]
5. Download image website:
[<https://www.pngwing.com/tr>]
[<https://tr.pinterest.com>]