

John Danison

ECET 32900 – Lab 4

2/20/2025

## **Goal**

The goal of this laboratory assignment is to design an embedded system for a microwave oven. This involves identifying system requirements, defining the functional and hardware architecture, and developing a software model. The project follows an embedded system design approach, ensuring that the microwave meets essential safety, usability, and performance requirements. By the end of the lab, I will have completed a full conceptual design of a microwave embedded system including both hardware and software elements.

## **Activities Description**

To achieve the goal of designing a microwave oven embedded system, I followed a structured process.

1. Research and Requirement Gathering
  - a. I reviewed different microwave oven models to identify key oven functionalities.
  - b. I studied the provided Microwave Oven General Requirements document.
  - c. I followed the oven control example found in the Embedded Systems Design handout to help gather a structured approach to the design specifications.
2. Defining System Requirements
  - a. I listed the core requirements such as a power source, human interface display, a keypad, sensor, and door mechanisms.
  - b. I considered other optional features such as pre-programmed cooking modes and safety mechanisms.
3. Redefining the Problem
  - a. I studied additional user needs beyond the basic system requirements and identified usability and safety enhancements such as a child lock and overheating protection.
4. Developing the Functional Model
  - a. I created a breakdown of what the microwave system should be doing, including heating, timing, altering, and safety features.
5. Designing the Hardware and Software Models
  - a. I mapped the hardware components to functionalities such as the microcontroller needed, keypad, sensors, and motor for the rotating plate.
  - b. I designed a software activity diagram to define system behavior.
6. Documentation and Reviewing the Design
  - a. After researching the different available microwaves on the market, I compiled all my findings into a single list to base my design from.

## **Problem Definition**

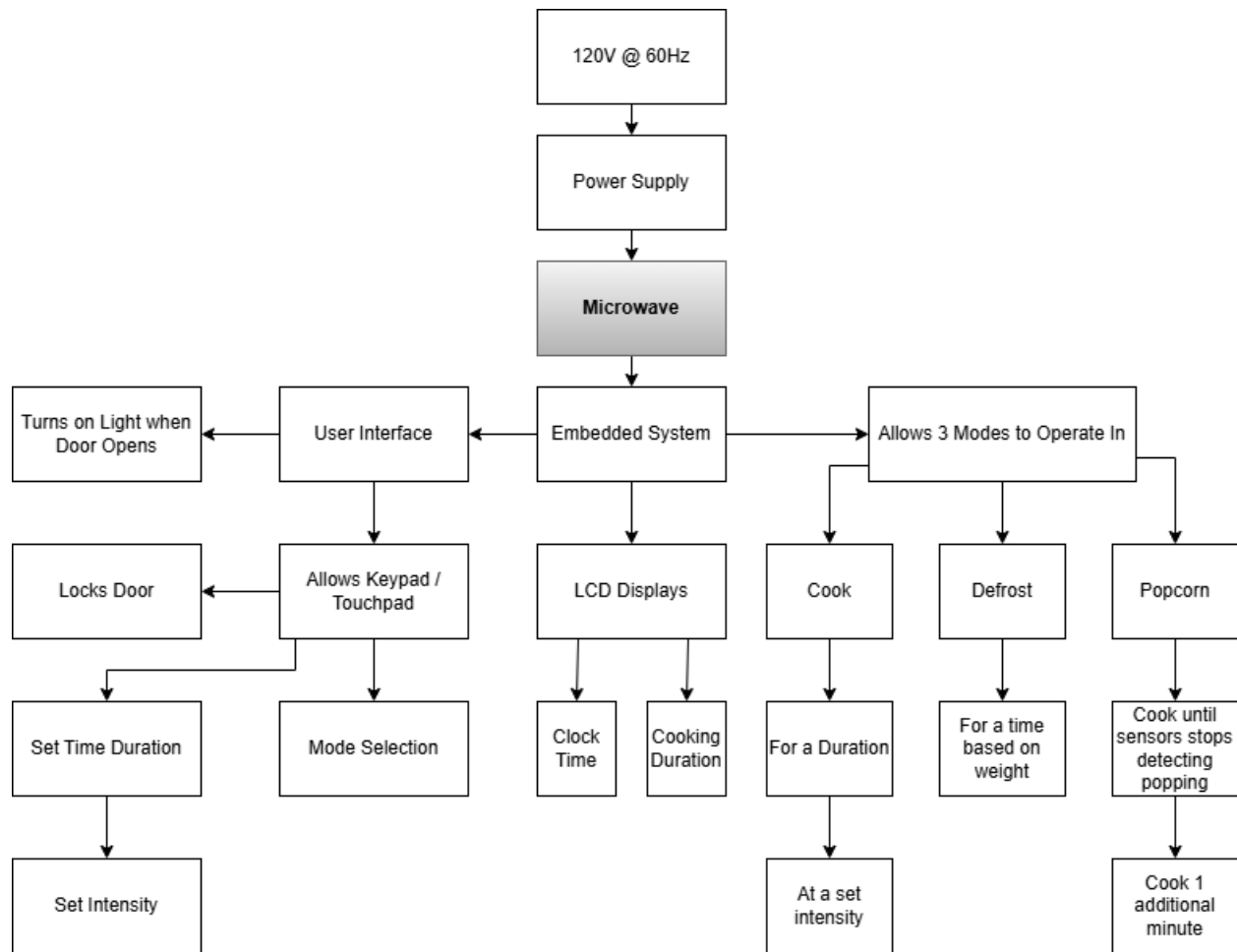
Per the lab 4 lab instructions, we must design a microwave oven using different functionalities of current options on the market. The general requirements are:

- Power Source
- Enclosure
- Rotating Base
- Internal Light becomes on when door is open
- Alert Sound when programmed timing is over
- Manually operated door to open and close
- Open button – to be pressed to open
- Door handle with a handlebar to open the door
- Start switch
- Stop switch
- Door lock – when in operation the door is locked
- Punch keypad – to program the clock and timer
- Display unit – shared by clock and timer unit
- Mode selection button

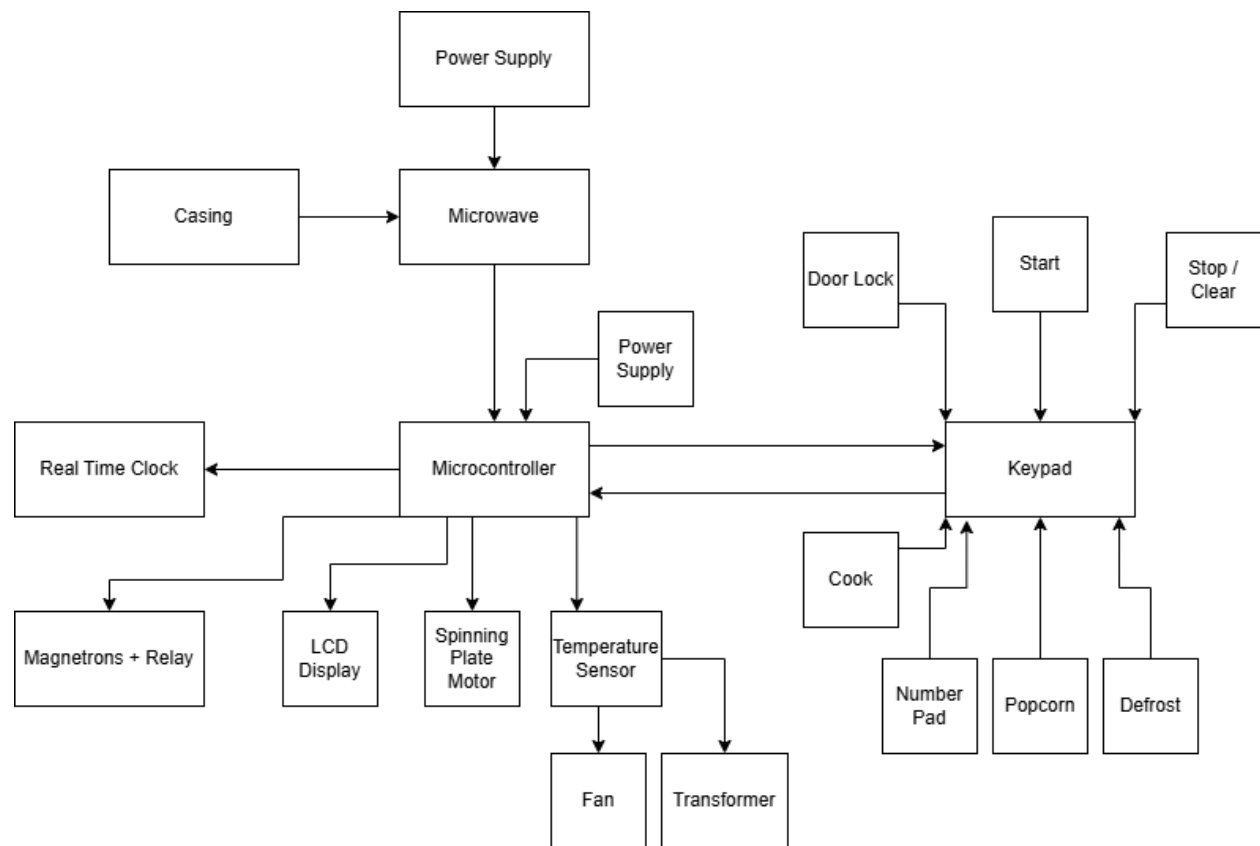
## Redefining The Problem



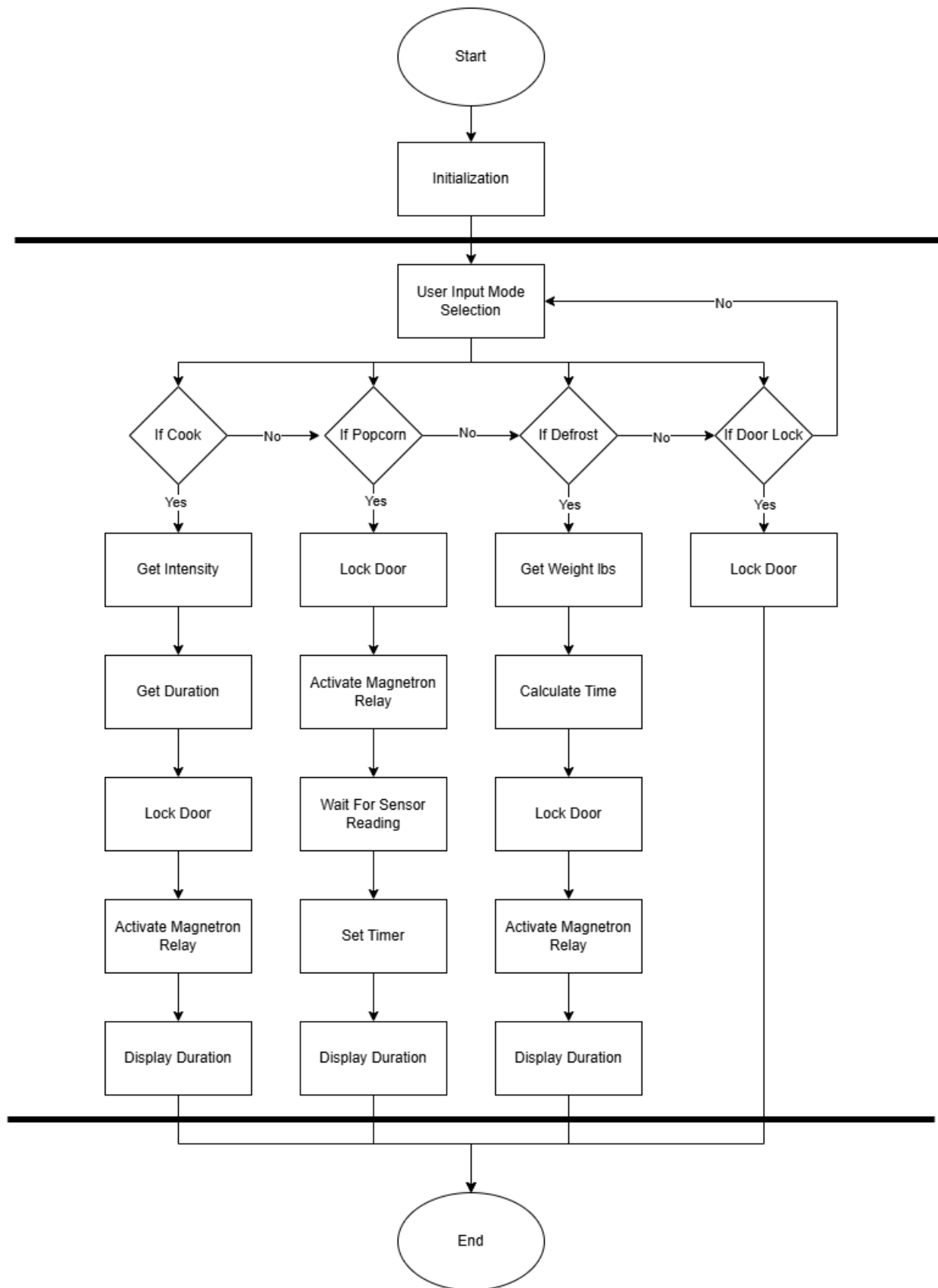
## Functional Model



## Hardware Architecture / Model



## **Software Architecture / Model**





## **Other Plans**

Beyond the core functionality of the microwave oven, additional considerations must be incorporated into to enhance safety, usability, and energy efficiency. A child lock feature can be added to prevent accidental activation, ensuring that young children cannot operate the microwave without adult supervision.

To further improve safety, an overheat protection system will automatically shut down the appliance if internal temperatures exceed safe limits.

Additionally, a smart sensor system can be integrated to detect food moisture levels and adjust cooking time accordingly preventing overheating or undercooking. This can help to ensure user satisfaction when using this product.

To enhance energy efficiency, the microwave can include an eco-mode that reduces power consumption when idle and an auto shut-off feature that turns off the display and internal components after a period of inactivity. By implementing these enhancements, the microwave will not only meet basic operating requirements but also provide a safer, smarter and more efficient usage experience.

## **What Did I Learn?**

I learned about how designing a product takes much more work than just coming up with an idea. There is a whole process of researching, planning, and making sure all the parts work together before actually building anything. It helped me see how important it is to really understand the requirements and think about what the users need. This connects with what we talked about in lecture, where we learned about breaking down a design step by step to make sure everything is covered. In the future, I can use this insight to plan and develop better projects by focusing on research and organization before jumping headfirst into the technical design.

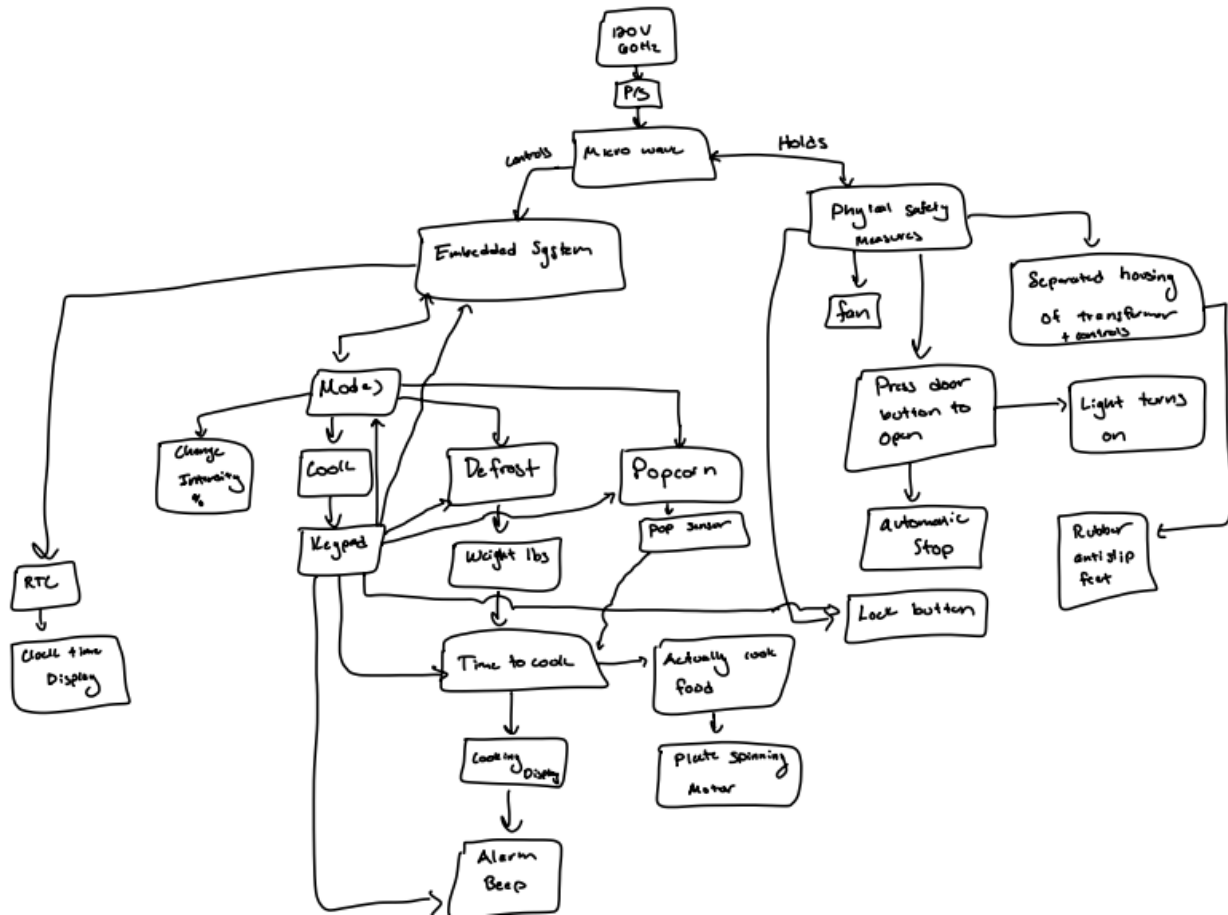
## References

- Helling, A. (n.d.). *10 parts of a microwave: Explained in detail*. Rethority. Retrieved February 20, 2025, from <https://rethority.com/parts-of-a-microwave/>
- Leathers, J., Cox, J., & Shea, P. (2025). *Class discussion on microwave oven embedded system design*. [Unpublished class notes].
- ECET 329. (2025). *Lecture and lab material on embedded system design*. [Course materials]. Purdue University.

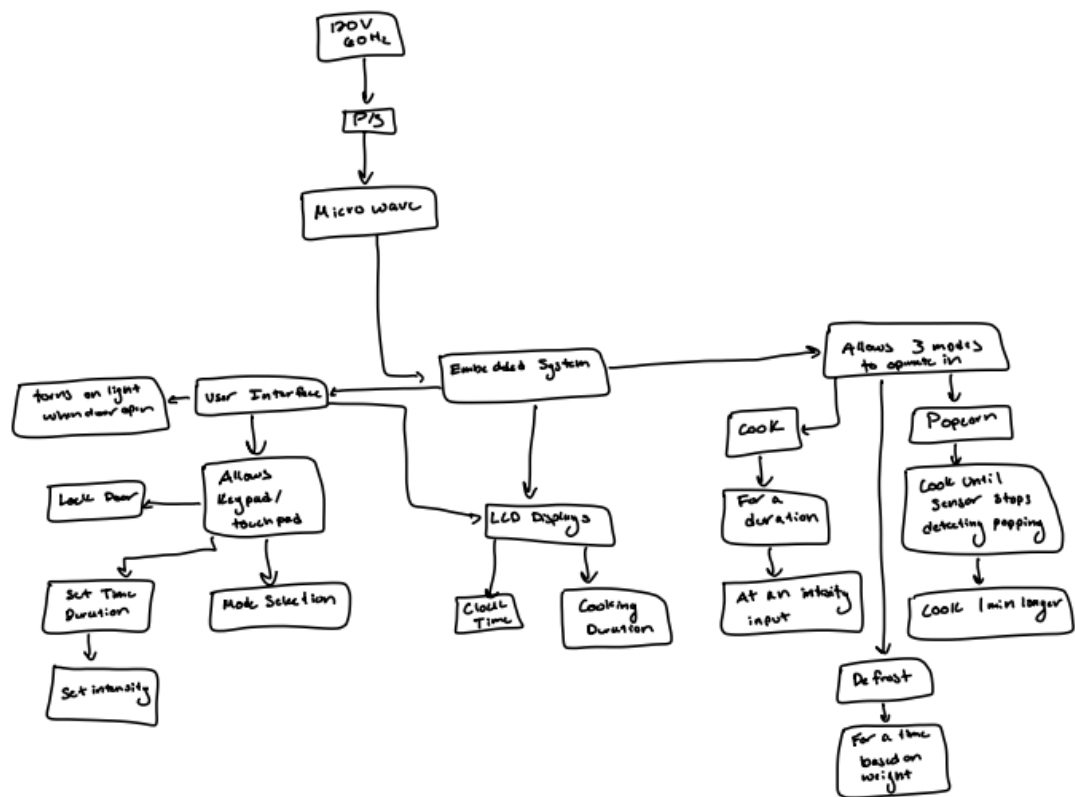
## Appendix

Below is the copy of my handwritten charts along with the TA signature of completion.

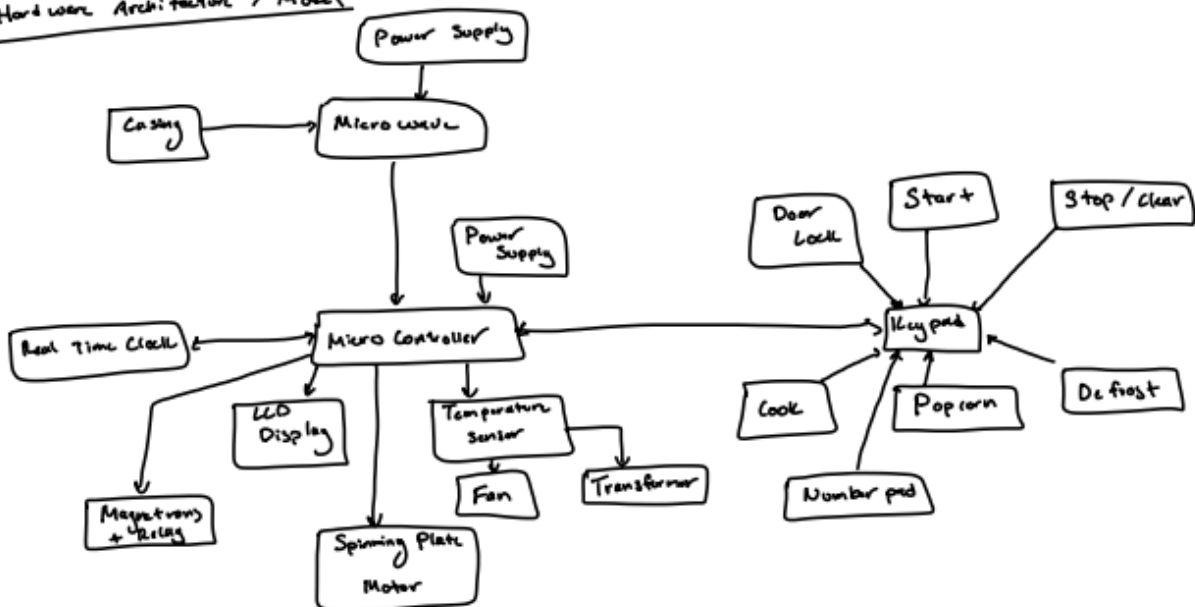
Re defining Problem



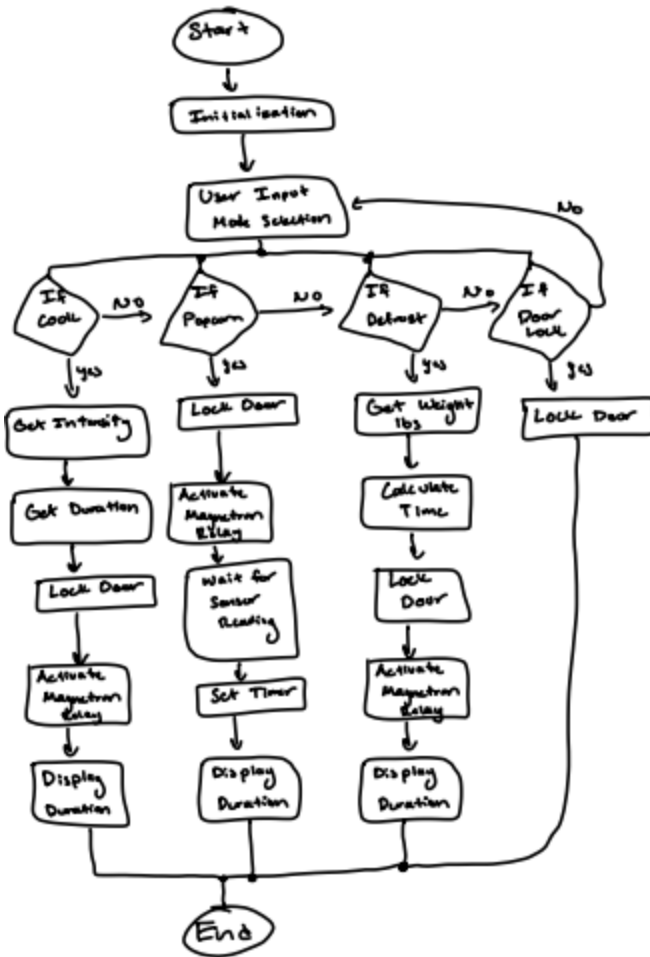
## Functional Architectural Model



## Hardware Architecture / Model



## Software Architecture / Model



SW  
LAB9