Food Waste Reduction

Inventory Notifier

CSE321 Fall 2021: Project 3

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Table of Contents

[01. Introduction 2](#_Toc89464879)

[02. Specifications and Features 2](#_Toc89464880)

[03. Integration of Required Features 2](#_Toc89464881)

[a) Watchdog Integration 3](#_Toc89464882)

[b) Synchronization Integration 3](#_Toc89464883)

[c) Bitwise Driver Control Integration 3](#_Toc89464884)

[d) Critical Section Protection 3](#_Toc89464885)

[e) Multithread Implementation 3](#_Toc89464886)

[f) Interrupt Implementation 3](#_Toc89464887)

[04. Design Process 3](#_Toc89464888)

[05. Block Diagram 3](#_Toc89464889)

[06. State Diagram 3](#_Toc89464890)

[07. Bill of Materials 3](#_Toc89464891)

[08. Instructions 4](#_Toc89464892)

[a) Schematic 4](#_Toc89464893)

[b) Construction Instructions 4](#_Toc89464894)

[c) Usage Instructions 4](#_Toc89464895)

[09. Test Plan Instructions 4](#_Toc89464896)

[10. Revision History Timeline 4](#_Toc89464897)

[Appendix A: References 5](#_Toc89464898)

# 01. Introduction

TODO

# 02. Specifications and Features

TODO

# 03. Integration of Required Features

TODO

## a) Watchdog Integration

TODO

## b) Synchronization Integration

TODO

## c) Bitwise Driver Control Integration

TODO

## d) Critical Section Protection

TODO

## e) Multithread Implementation

TODO

## f) Interrupt Implementation

TODO

# 04. Design Process

## a) Ask

### Purpose

In an effort to minimize food waste, foods that aren’t sold at the end of a work day can be taken home by the workers and consumed while the food is still in good condition. Design a system that will alert staff members at the end of a work day if there is still food in a container that can be taken home for consumption.

### Inputs

TODO

### Outputs

TODO

### Constraints

TODO

## b) Research/Imagine

TODO

In order to recognize if there is food remaining that can be taken home, a distance sensor can be used to approximate how much food is currently in a container. For this approximation to be accurate, the distance sensor’s data will also need reference distances for the maximum length away from the sensor when the container is empty and the minimum length away from the sensor as a reference for when the container is full. One button will be needed to allow a user to confirm these distances.

In order to recognize when workers should be alerted that there is remaining food, the system will need to be aware of the current time and the time after which it should notify workers of any remaining contents. Ten additional buttons will be needed to allow an easily accessible range of input numbers.

For both of these user inputs, an output indicator of what the system’s user has configured and is about to confirm would improve the ease of use of the system. An LCD can be used to display the current time, closing time, and distance between the sensor and the nearest object to it in the container.

The system should notify workers in such a way that they do not need to be actively monitoring the system in order to be alerted if it is past closing time and the container is not empty. A buzzer module would be able to accomplish this by creating a sound that will alert everyone in the immediate area. This produced sound should be carefully designed to not cause any hearing problems in the time frame that it would take for a worker to walk over and silence the buzzer before proceeding to collect any items left within the container.

# 05. Block Diagram

TODO

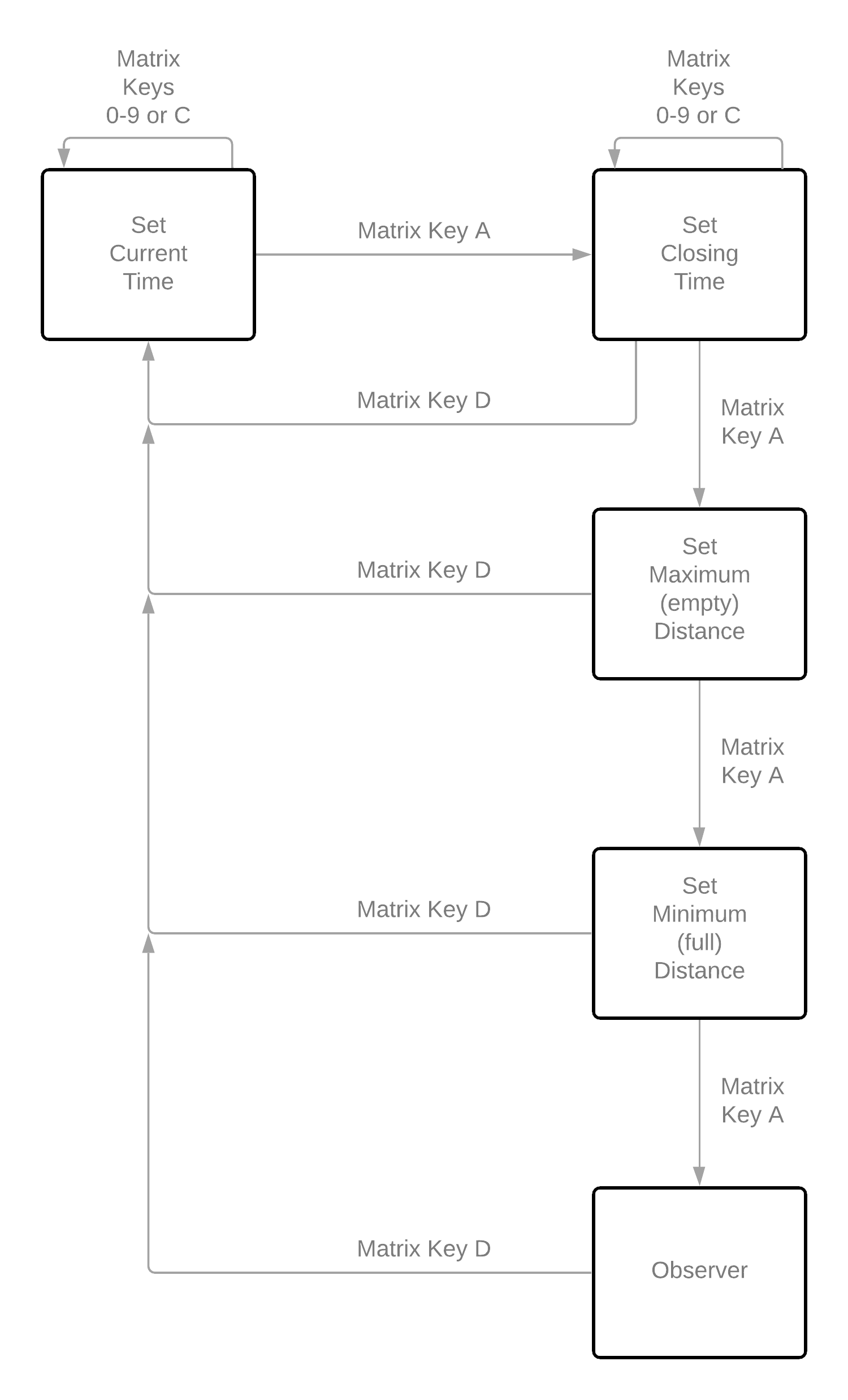
# 06. State Diagram

The following diagram covers the conditions necessary for the transitions between states.

The matrix key “A” is used as an option during all configuration stages to proceed to the next state.

The matrix key “C” is used in the time input stages to reset the input time to “hh:mm:ss” and reset the user data input cursor to the tens of hours position.

The matrix key “D” is used as a universal reset to the “Set Current Time” state in order to modify the system configuration.



# 07. Bill of Materials

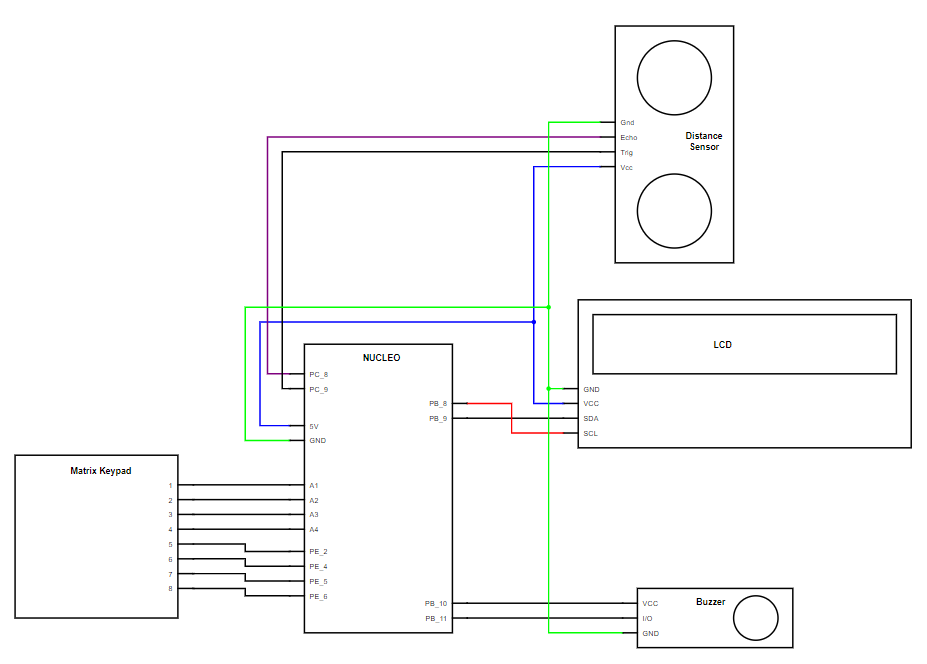
The following hardware will be required to create the system:

* NUCLEO L4R5ZI microcontroller
* 4x4 matrix keypad (8-pin)
* JHD1804 LCD
* 4-pin ribbon cable for connecting LCD to breadboard
* HC-SR04 Distance Sensor
* MH-FMD Buzzer Module (Low Level Trigger)
* Solderless breadboard
* USB 2.0 A to USB 2.0 Micro B cable
* Jumper wires (no less than 21)

# 08. Instructions

## a) Schematic

The following set of connections between the NUCLEO and peripherals need to be established (USB connection to a computer not pictured):



## b) Construction Instructions

In order to build the system, the following connections need to be established between the NUCLEO and peripherals using jumper wires. Use of a solderless breadboard and side rails for 5V (VCC) and GND is recommended.

Matrix Keypad:

* Matrix pin 1 must be connected to the NUCLEO Pin A1 (PC\_0)
* Matrix pin 2 must be connected to the NUCLEO Pin A2 (PC\_3)
* Matrix pin 3 must be connected to the NUCLEO Pin A3 (PC\_1)
* Matrix pin 4 must be connected to the NUCLEO Pin A4 (PC\_4)
* Matrix pin 5 must be connected to the NUCLEO Pin PE\_2
* Matrix pin 6 must be connected to the NUCLEO Pin PE\_4
* Matrix pin 7 must be connected to the NUCLEO Pin PE\_5
* Matrix pin 8 must be connected to the NUCLEO Pin PE\_6

LCD:

* The LCD pin labeled GND must be connected to the NUCLEO pin GND
* The LCD pin labeled VCC must be connected to the NUCLEO pin 5V
* The LCD pin labeled SDA must be connected to the NUCLEO pin PB\_9
* The LCD pin labeled SCL must be connected to the NUCLEO pin PB\_8

Distance Sensor

* The Distance Sensor pin labeled Gnd must be connected to the NUCLEO pin GND
* The Distance Sensor pin labeled Echo must be connected to the NUCLEO pin PC\_8
* The Distance Sensor pin labeled Trig must be connected to the NUCLEO pin PC\_9
* The Distance Sensor pin labeled Vcc must be connected to the NUCLEO pin 5V

Buzzer

* The Buzzer pin labeled VCC must be connected to the NUCLEO pin PB\_10
* The Buzzer pin labeled I/O must be connected to the NUCLEO pin PB\_11
* The Buzzer pin labeled GND must be connected to the NUCLEO pin GND

Once all connections between the NUCLEO and peripherals have been established, connect the NUCLEO USB-B port labeled “USB PWR” to the computer that will load the program onto the NUCLEO. This computer will need to have MBED Studio installed to compile the code and load it onto the NUCLEO.

After MBED Studio is installed, perform the following steps to load the necessary program onto the NUCLEO.

1. Download the GitHub repository containing the necessary program. If Git is installed on the system, this can be done with the following command:
   1. git clone https://github.com/CSE321-Fall2021/cse321-portfolio-MSNelyubov.git
2. In MBED Studio, click on File > Open Workspace.
3. Navigate to the path where the repository was downloaded.
4. Click on Project 3 and then click *Select Folder*.
5. Set the *Active program* to “Project 3”.
6. Set the *Target* to “NUCLEO-L4R5ZI …”.
7. Click on the play button to run the program.

## c) Usage Instructions

TODO

# 09. Test Plan Instructions

TODO

# 10. Revision History Timeline

2021 November 19: Project Statement and preliminary Bill of Materials generated.

2021 November 20: Implemented the range testing program to control the new distance sensor peripheral in an isolated environment.

2021 November 22: Implemented a multithreaded testing program to verify the effective utilization of Mutexes to control access to shared resources by multiple threads.

2021 November 24: The distance sensor and LCD were implemented as two independent threads of the main program with Mutex-protected access to shared resources.

2021 November 25: The Matrix keypad code from Project 2 was merged into the main program of Project 3 as a third thread to allow for User Input to control the state machine elements of the system.

2021 November 26: The state pattern and signal to the buzzer output were implemented into the main program.

TODO

# Appendix A: References

TODO

\* NUCLEO datasheet: https://www.st.com/resource/en/reference\_manual/dm00310109-stm32l4-series-advanced-armbased-32bit-mcus-stmicroelectronics.pdf

\* HC-SR04 distance sensor datasheet: https://www.digikey.com/htmldatasheets/production/1979760/0/0/1/hc-sr04.html

\* Buzzer datasheet: https://www.mouser.com/datasheet/2/400/ef532\_ps-13444.pdf

\* MBED OS API: timer https://os.mbed.com/docs/mbed-os/v6.15/apis/timer.html

\* MBED OS API: Watchdog https://os.mbed.com/docs/mbed-os/v6.15/apis/watchdog.html