Embedded Systems: CMP-5045B
Automatic Drinks Dispenser
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Contents

1 Abstract

This Project Proposal will go over the Automatic Drinks Dispenser in depth about the motivation, target audience, market analysis, product expenses, UI design along with the peripherals needed for the project to function. The purpose of the Automatic Drinks Dispenser will be discussed with each peripheral's price being accounted for, along with its purpose within the project. The Gantt Chart created will be explained along with any problems that arose during the project's lifespan.

2 Introduction

The "Automatic Drinks Dispenser" is able to dispense two liquids into a glass with a push of a button from the Graphical Liquid Crystal Display (GLCD). Drinks are poured via air pumps connected to 4mm flexible PVC tubing. The liquids are stored in two separate plastic bottles acting as reservoirs, where a red 5mm LED is turned on when the liquid reaches a certain threshold. The LED indicates the liquid needs to replenished, to ensure users can receive the correct amount of liquid. Once the liquid has been successfully poured, the piezo buzzer is turned on for 1 second to signal this. To protect the electronics and stored liquids against the elements, the dispenser is enclosed in 12mm thick MDF with access to the back, hiding the wires and electronics from users.

The motivation behind the project was to integrate electronics into an already commonly used item in both offices and some households. The project has the ability to be expanded to hold more than 2 drinks, or a feature to implement the ability to combine drinks. Combining drinks could be useful at a bar where customers can select their drink of choice along with a mixer.

3 Market Analysis

The ability for drinks to be poured automatically could be useful for many types of environments. The main environment being a typical working office, where users are able to have their drinks poured to them automatically. The development of an application could allow users to pour their drinks remotely allowing users to focus more on their work. The drinks dispenser would be ideal in a bar where alcoholic drinks can be dispensed with payments being accepted. Customers could select a combination of drinks with a mixer which could then be poured into their glass.

Characteristics and requirements for use in Bars:

- Scale the product up to be able to pour multiple customers drinks at the same time.
- Have the ability for customers to have a combination of drinks.
- Enable payments to be made allowing customers to purchase drinks via the machine.
- Have 10+ choice of drinks to choose from.
- Increase overall product size to be 5ft.

Characteristics and requirements for use in Offices:

- Scale the product up to be able to produce hot drinks, such as teas and coffees.
- More choices of drinks to choose from.
- Increase overall product size to be 5ft and connect water the mains.

Although there are already products similar in the market, there are few products that are able to automatically dispense drinks. The use of the touchscreen allows all users to use the product with a simple tap on the screen. Other products in the market require users to press and hold a button to dispense each liquid. This automatic drinks dispenser has the ability to pour multiple liquids at the same time with the use of the Graphical Liquid Crystal Display (GLCD).

The product could be seen as an investment from businesses in an office setting, as they could generate cash from selling the drinks. Energy drinks could be one option where customers have to pay via coins, or by their credit card. Similar to a vending machines, the drinks machine would be a small addition in an attempt to generate more money.

4 Product Expenses

The Product Expenses section of the report goes over the rough costs for each of the products used within the project. Each product shows the model number, the quantity needed, the price per item along with a link on where the product was purchased.

4.1 Budget Table

Product Name	Model	Quantity	Price/Item (£)	Link
Discovery Board	STM32F746NG	1	56.26	Click here
Air Pump	PYP370-12Z	2	8.19	Click here
Piezo Buzzer	HYDZ	1	N/A	N/A
Liquid Level Sensor	XKC-Y25-V	2	10.39	Click here
5V Relay	SRD-05VDC-SL-C	2	4.64	Click here
Red LED 5mm	L4RR5000H1D1	2	0.20	Click here

Table 1: Budget table to show names and prices of products used within the project.

The quantity of each item would increase depending on the environment it was placed in. If the drinks dispenser was used in a bar, there would be an increase in the amount of air pumps due to the wider range of drinks available. This would also be applicable to the total number of 5V Relays however the one Piezo Buzzer could be kept no matter the size of the product. The use of multiple Discovery Boards could be utilised to allowing 2 or more customers use the drinks dispenser at the same time. This would increase efficiency and ultimately generate more income.

Full links to products used within the project:

- 1 Discovery Board: "https://uk.farnell.com/stmicroelectronics/stm32f746g-disco/dev-board-cortex-m7-discovery/dp/2480961"
- 2 Air Pumps: "https://rb.gy/3s7iw"
- 2 Non Contact Liquid Level Sensors: "https://rb.gy/d218y"
- 2 5V Relays: "https://rb.gy/x3zsz"
- 2 Red LED 5mm: "https://uk.rs-online.com/web/p/leds/2285039"

5 System Architecture

"The architecture of a system reflects how the system is used and how it interacts with other systems and the outside world." [1] System Architecture Diagrams are used to depict the system's component architecture. It's used to depict the connections between components and peripherals and usually gives clarity as to what function each component performs.

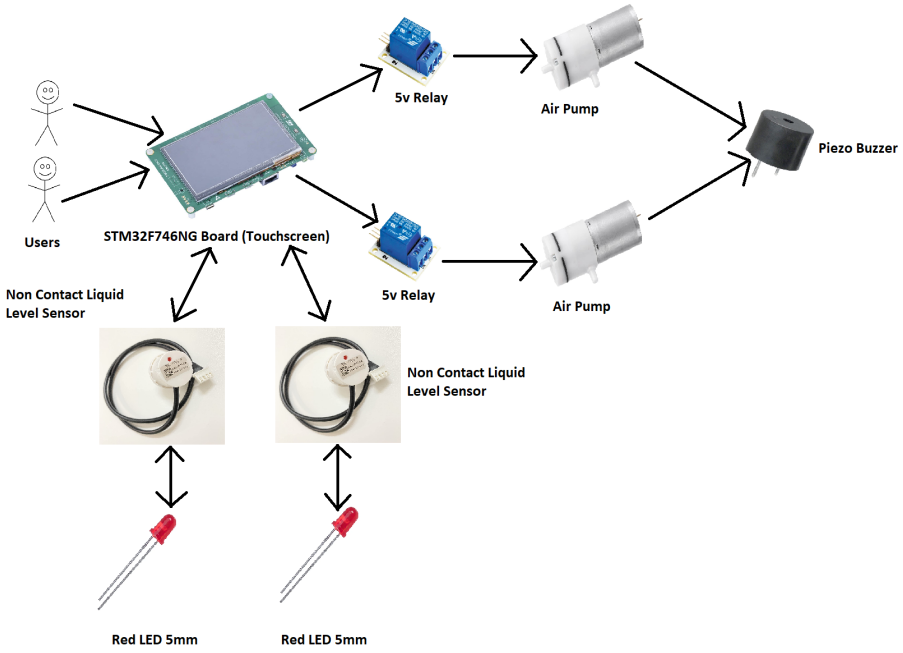

Figure 1: System Architecture model to define the structure and behaviors of the project.

The System Architecture diagram 1 depicts the various different components that are required for users to be able to have their own drink dispensed to them. The diagram begins with input being detected from a user once they have interacted with the touchscreen on the Discovery Board. The code for the menu screen constantly checks for user input and when detected, checks against the coordinates of the buttons to see if they user has selected one. Depending on which button has been chosen, a small amount of electrical current will be sent to one of the 5v relays to turn it on. This will activate the air pump, pumping the liquid up through the PVC tube, straight into the users glass. Once successfully poured, the buzzer will be activated to inform users of this. The non contact liquid level sensors are constantly detecting the current amount of liquid in each reservoir. When no liquid is detected, the Red LED will be activated to signal this.

6 UI Design and Flowchart

The Flowchart2 depicts the flow of the program that a user would experience when dispensing the drink of their choice. Data validation is in place to ensure the user is poured the correct amount of drink each time along with the chance of them encountering an error almost never.

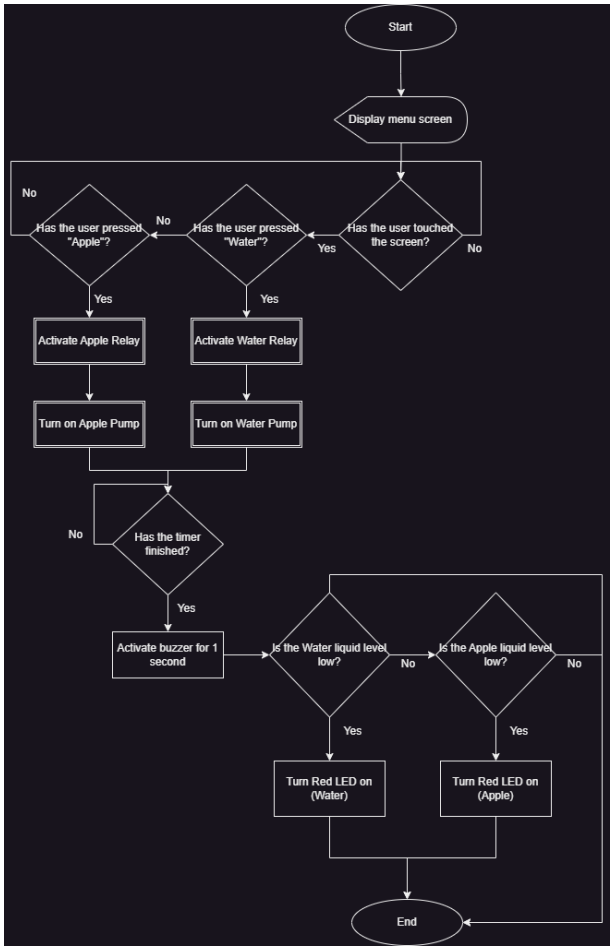

Figure 2: Diagrammatic representation (Flowchart) to show the flow of the program and the processes involved.

The actual design of the Graphical User Interface (GUI) is one which is simplistic, where the user is only able to select a drink between two options (water or apple). By limiting the number of buttons users are able to press, should increase the usability of the drinks dispenser, allowing all age groups to use the device without any issues being encountered.

7 Peripheral Integration

In order for the Automatic Drinks Dispenser to function correctly, a number of different peripherals were needed to be implemented. These peripherals fall into one of two categories, 'Known Peripherals' and 'Unknown Peripherals'.

7.1 Known Peripherals

The main known peripheral was the STM32F746NG Discovery Board, which was needed for all other peripherals to function. The board was able to signal all peripherals when they were needed. The board allows development with the STM32F7 Series micro controllers based on ARM Cortex-M7 Core. With the use of the responsive touchscreen built into the discovery board, users were able to tap the screen, starting the code to pour the drink of their choice. Users were able to view the screen clearly due to the 4.3-inch display with color LCD-TFT.

- 1 GLCD Touchscreen - STM32F746NG Discovery Board

7.2 Unknown Peripherals

Unknown Peripherals were key in enabling users to have their own drink poured before them. Each pump was designated to a drink, delivering the user their liquid of choice through the use of 4mm PVC piping straight into the glass. Once successfully poured, the Piezo Buzzer would be activated for 1 second, informing the user their drink had been poured. A prompt on the screen would be displayed also informing the user to take their drink. The use of the non contact liquid level sensors would toggle a red LED when no liquid was detected. This helped to inform owners of the product that the liquid needs to be refilled to ensure no customer or user encounters a problem with the amount of their drink they're dispensed.

- 2 Air Pumps (PYP370-12Z)
  - Data sheet: "https://cdn.bodanius.com/media/1/1fb1998_mini-pump-pc002104-datasheet.pdf"
- 1 Piezo Buzzer (HYDZ)
  - Data sheet: "https://www.farnell.com/datasheets/2171929.pdf"
- 2 Non Contact Liquid Level Sensors (XKC-Y25-V)
  - Data sheet: "https://www.hadex.cz/spec/m530e.pdf"
- 2 5V Relays (SRD-05VDC-SL-C)
  - Data sheet: "https://www.circuitbasics.com/wp-content/uploads/2015/11/SRD-05VDC-SL-C-Datasheet.pdf"
- 2 Red LED 5mm (L4RR5000H1D1)
  - Data sheet: "https://www.farnell.com/datasheets/1498852.pdf"

8 Project Management

"Project management involves the planning and organization of a company's resources to move a specific task, event, or duty towards completion." [2] The use of a Gantt Chart, created during the planning phase was essential in achieving this. Task deadlines were created as shown in 3 which were followed during the project's lifespan.

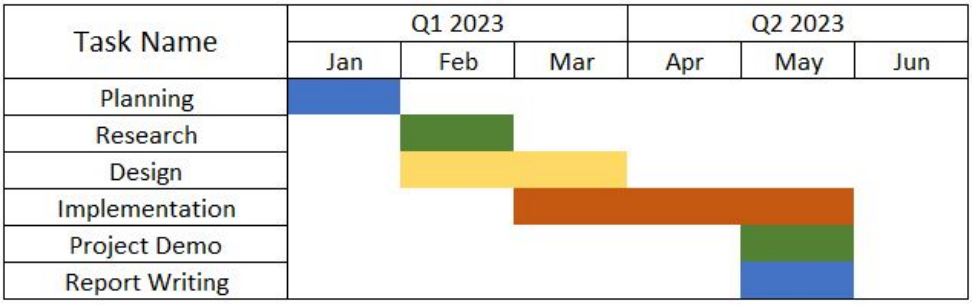

Figure 3: Gantt Chart used to ensure the project was completed on time and all tasks were achieved.

The project began with the Planning phase which evaluated different ideas that the project could've been. After careful consideration of the ideal project to make, the 'Automatic Drinks Dispenser' was chosen. February then involved the research into the chosen project including current drinks dispensers created in a similar manner and around the same price range. These were compared and ideas/features were taken in the hopes to implement them into my drinks dispenser. The design phase also begun in February along side researching. The design phase was the second most important phase of the project as the implementation phase would be based on the designs created. Designs were created and altered after evaluating them to create a final design that would be used as the guidelines for the final creation.

References

[1] June 2022. URL: https://www.interviewbit.com/blog/system-architecture/ (visited on 05/29/2023).

[2] The Investopedia Team. *Project management: What it is, 3 types, and examples*. May 2023. URL: https://www.investopedia.com/terms/p/project-management.asp#:~:text=What%5C%20Is%5C%20Project%5C%20Management%5C%3F,%5C%2C%5C%20technology%5C%2C%5C%20and%5C%20intellectual%5C%20property. (visited on 05/29/2023).