IoT Coffee & Tea Maker

Project Proposal

The Brew Crew

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1. Introduction

In such a fast pace society, caffeine is highly regarded and is an important staple in many peoples' diets all around the world. It provides people with energy to help them be more alert, focused, and refreshed as they take on their day-to-day activities and work. One of the most common ways people meet their caffeine needs every day is by drinking a beautiful cup of coffee.

People spend up to hundreds of dollars of their hard-earned money to purchase machinery just to make this valued drink. Other times, because of our world's face-paced lifestyles, people either run out of time to make their coffee or people simply skip the machinery altogether and end up spending profuse amounts of money to purchase this drink from vendors such as fast-food restaurants or quick-service places just to get an overpriced form of their beloved caffeinated beverage. Sometimes people even miss out on their daily caffeine intake because they might wake up late for work so they don't have time to make their morning cup of joe. Our product seeks to alleviate the daily struggle for people to get their favorite caffeinated beverage in an efficient and cheap manner by providing them with our newly innovated IoT smart coffee maker using the Raspberry Pi 4.

Our machine will come with a lot of functionality to help give customers the most efficient coffee-making experience they could ever hope to have. The machine will use a mobile application that allows customers to choose exactly when they want to have their favorite cup of coffee. The mobile application will allow customers to schedule their coffee whenever they want, whether that be as soon as possible, if they are in need of immediate caffeine intake, in twenty minutes, if they want to have their cup after they go about their morning routine, or even every Monday at 7:30 am. The mobile application will give users the ability to do just that, and it let them be able to find time to incorporate their favorite cup of coffee into their busy routines. In addition, a

touchscreen display on the machine will provide customers with the same functionality as the mobile application for times when they don’t want to use their phones and would like to interact with the machine manually. The IoT smart coffee maker will ensure that users have an easy and pleasant experience making their favorite cup of coffee so they can spend less time worrying about getting their caffeine intake and focus more on the important day or night ahead of them.

2. Definitions, Acronyms, and Abbreviations

Internet of Things (IoT)	The Internet of Things describes physical objects or technologies that are embedded with a combination of sensors, processing ability, software, or other technologies, and they are able to connect to and exchange data with other devices and systems over the Internet or a communication network.
IoT	*abbr.* Internet of Things
Raspberry Pi 4	An inexpensive computer that is a platform for the fundamental basics of computer organization. The Raspberry Pi 4 will serve as the main functioning computer for the IoT coffee maker.
RPi 4	*abbr.* Raspberry Pi 4
Flask	A web framework in Python that allows the formatting of web pages.
Dynamic app	The construction of a web page so across all user devices the web page looks the same.
Responsive design	The formatting of a webpage that adapts the formatting based on the device accessed from.
Cron job	A Linux command that allows for job scheduling to run commands periodically at fixed times.
MySQL	A database management system.

3. Project Detail

3.1. General System Design Overview

The use of motors in this design is critical to the functionality of this coffee maker. The motors will not only initiate the beginning of the brewing process, but they will also activate to dispense the proper amount of coffee grounds into the reusable coffee filter so that the coffee can be efficiently brewed. The actual circuitry containing the motors will be established when we can analyze the components of the coffee machine used for the prototype project.

Our prototype mobile Flask application will serve as one of the primary ways to interact with the IoT coffee maker. It will provide the user with the ability to brew their coffee at the press of a button. If a user wants to go about their morning routine before they want their coffee, they will have the option to set a time which will range from the time it takes the water to heat up in the coffee machine and the time to brew to any time after that the user wants their coffee to be ready. For example, if it takes a user twenty minutes to go about their morning routine, they can set the time to have the brew ready to be 20 minutes from when they want. In addition to this functionality, the app will also provide the user the ability to make regularly scheduled times to have their coffee ready. For example, if a user wants their coffee every Wednesday at 6:30 am before they leave for work, they will be able to use the scheduling feature on the app to make this happen.

In addition, the IoT coffee maker's touchscreen interface will be the portal that allows the user to manually interact with the machine. The customer can use the touchscreen when they do not want to interact with the machine via mobile phone or simply when it is more convenient to manually interact with the machine. The touchscreen will be mounted to the front of the machine's custom-built housing and connected to the RPi 4. The touchscreen interface will display the same Flask application used for their mobile

device (responsive design will make the app display well on the touchscreen device) to allow the user to manually interact with the coffee machine. The touchscreen interface will improve customer satisfaction due to the increased ease of use of the machine since they can interact with the machine both manually and from afar using their phone.

3.2. Flask Application

The prototype Flask application will be one of the most crucial parts of the project. This will allow the user to directly interact with the machine via mobile device or touchscreen interface. To achieve synergy with the consumers and to ensure the coffee maker does not get overloaded with requests which could cause many problems for the machine and the user, it will be a dynamic webpage application. The dynamic app will ensure that across each of the user's devices (their mobile device and the touchscreen), the Flask app will update in real-time, ensuring the coffee maker is not overloaded with requests such as a user making multiple unwanted cups of coffee by accident. We will use MySQL to store scheduled brew times so the Flask app can retrieve them at any point when needed to keep the app dynamic. In addition to MySQL, we will use cron jobs to have the Raspberry Pi 4 carry out the necessary functions to brew the customer’s cups of coffee at their desired times. In addition to making the Flask app dynamic, it will also need to follow responsive design guidelines. This will allow the formatting of the Flask app displayed and formatted properly and beautifully across their devices. Having a responsive design will ensure the consumer’s satisfaction is higher due to a friendlier interface to interact with.

The general intended design for the Flask application can be seen below in *Figure #1* which shows a diagrammatic flow chart representation of our intended mock prototype application.

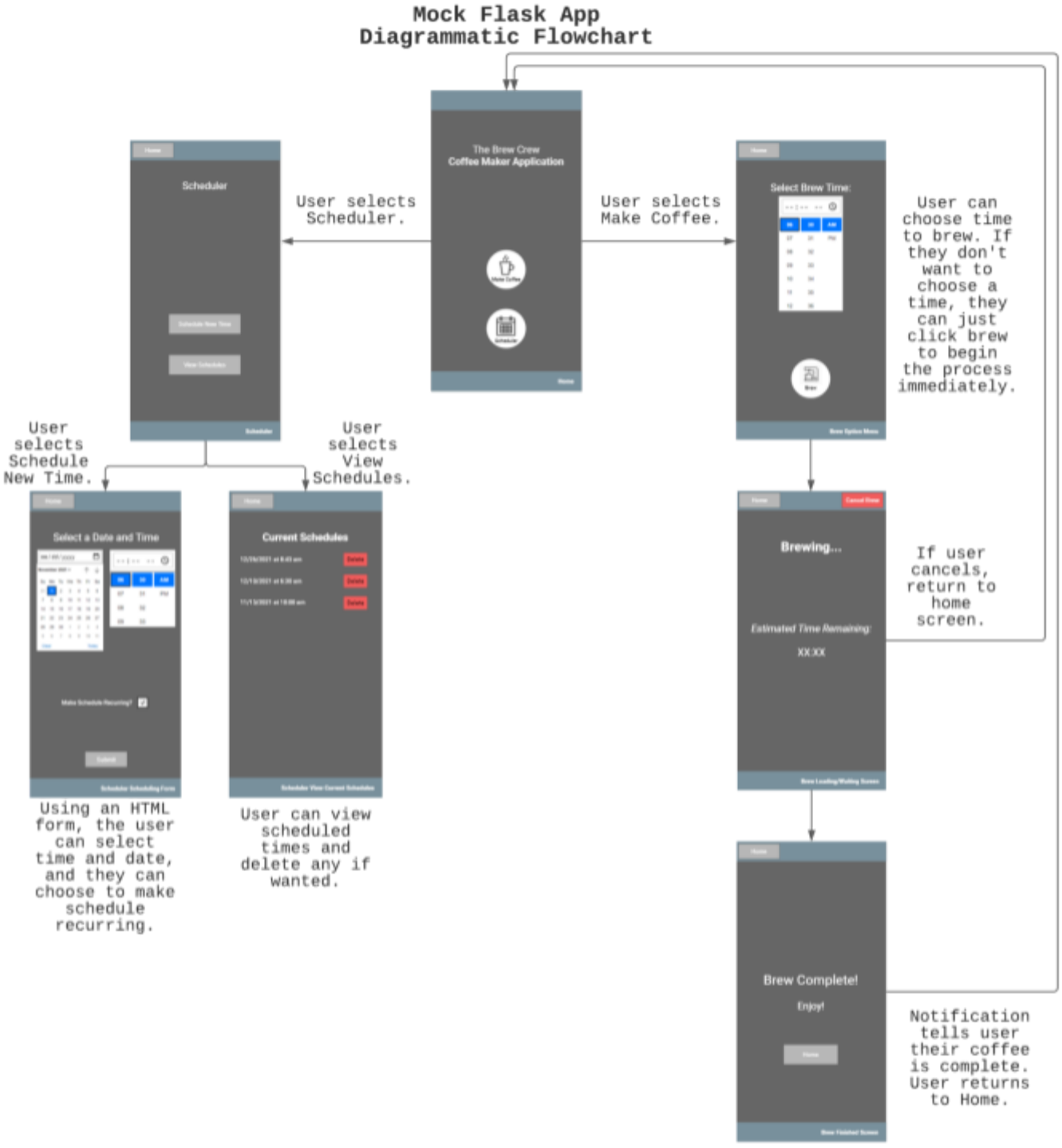

Figure #1: Diagrammatic flow chart of mock/prototype application.

3.3. Mobile Application to Completed Brew Process

The mobile application to the completed brew process is outlined in the flow chart in *Figure #2* below. First, the user will open up the mobile application from their device and navigate to the home screen. Next, the user will make the decision to choose either to make coffee or use the scheduler. If the user chooses to make coffee, the user will be prompted to see if they want their coffee at a later time or right now. Depending on the choice decided by the user, the coffee will either begin brewing immediately or postpone to a later scheduled time of the day. When the coffee begins brewing, the screen will load a screen indicating to the user that the coffee is brewing and the estimated time that remains. During this screen, there will be a cancel feature, allowing the user to cancel the brewing process at any time up until the coffee is being poured out. Once their coffee is brewed, the screen will switch to a completed screen with the option to go back to the home screen.

Figure #2: A flow chart depicting the functionality of the application when accessed from an external device not directly connected to the RPi 4 (e.g. mobile phone).

3.4. Manual Touchscreen Interface to Completed Brew Process

The manual touchscreen interface to the completed brew process is outlined in the flow chart in *Figure #3* below. Similar to the mobile application, the touchscreen will present the Flask application to allow the user to control the coffee maker directly. First, the user will press the touchscreen and decide whether to brew a cup of coffee now or schedule a cup for later. Depending on whether the user wants coffee now or later will change what the application does. If the user presses the coffee button, the program will prompt a user to select a time later or now for a coffee. While the coffee is brewing, the brewing screen will show with the estimated time remaining. While this screen is showing, the user will have an option to cancel the coffee for a specific amount of time. After the coffee is finished, the brewing complete screen will show, with an option to travel back to the home screen.

Figure #3: A flow chart depicting the functionality of the application when accessed from the touchscreen interface.

4. Budget

The current estimated budget for this project is divided up into two parts: materials cost and labor cost. The overall budget as well as the budget for each section is as follows:

Materials Cost:

The current expected cost for the materials that will be used in the project is broken down as follows:

- Raspberry Pi 4 - $75
- Coffee Machine w/ Reusable Filter - $25
- Raspberry Pi Solid State Relay Board - $20
- EUDAX Mini Generator Motors 3V-12V - $10
- Smraza Raspberry Pi 4 Touchscreen - $42
- Netac Micro SD Card 32GB - $12

Total Materials Cost: $184.00

Labor Cost:

The itemized cost for labor for each role in the project is as follows:

- Network Engineer - $43.55/hour for 25 hours - $1088.75
- Lead Developer - $47.88/hour for 25 hours - $1197.00
- Project Manager - $53.46/hour for 25 hours - $1336.50
- Hardware Guru - $42.89/hour for 25 hours - $1072.25
- Testing & Quality Assurance - $17.33/hour for 25 hours - $433.25

Total Labor Cost: $5127.75

Overall Estimated Budget: $5311.75

5. Project Plan

5.1. Group Project Roles & Role Assignments

For this project, there are five primary roles that have been assigned to all three members of the group. These five roles for this project are defined as follows:

Project Manager: The leader of the project. The Project Manager is tasked with organizing the project meetings, submitting the project files, and monitoring the progress of the group to assure the group is not falling behind.

Network Engineer: The Network Engineer is tasked with setting up the wireless connection of the Raspberry Pi and connecting the device to the Raspberry Pi via Bluetooth.

Hardware Guru: The Hardware Guru is responsible for the assembly of the project. This will include the attaching of the Raspberry Pi, motors, and anything else that is needed to achieve the project goal. The Hardware Guru will also need to work closely with the Lead Developer to make sure there is synergy with the hardware and the software.

Lead Developer: The Lead Developer is responsible for the programming of the Raspberry Pi. This will include working with the Hardware Guru to make sure that there is a connection between hardware and software.

Testing & Quality and Assurance: The Testing & Quality and Assurance will be in charge of assuring that the product is a high-quality product and works as intended.

The currently assigned roles for each member of the group are listed below:

Anthony:

Lead Developer, Network Engineer, and Testing & Quality and Assurance.

Matt:

Project Manager, Network Engineer, and Testing & Quality and Assurance,

Simon:

Hardware Guru, and Testing & Quality and Assurance.

5.2. Major Goals

For the goals of this project, our next goals are to learn the functionality of the coffee maker. This will be accomplished by taking apart the coffee maker and examining the various wiring and mechanisms and reviewing the documentation. Doing this will allow us to construct a circuit diagram and establish any further hardware components needed for our design.

In addition to learning how the coffee maker works, we must begin the programming of the Flask app so we can ensure the app functions properly.

Lastly, we must design the custom housing of the coffee maker to ensure we have a set design for when the construction process begins. The housing is a very important aspect of the product because it is the physical design that customers and people will see.

5.3. Gantt Chart

The timeline of our project is depicted in the Gantt chart shown in *Figure #4* below:

THE BREW CREW PROJECT TIMELINE	10/29-11/4	11/5-11/11	11/12-11/18	11/19-11/25	11/26-12/2	12/3-12/5
Order and receive neccasary components	Matt					
Disassemble coffee maker and learn the various components and parts of the pre-purchased coffee maker	Simon					
Develop a circuit diagram for the product	Simon					
Begin coding the Flask application.	Anthony and Matt					
Continue coding and finish app design		Anthony and Matt				
Begin constructing the desired circuit for the hardware aspect of the IoT coffee maker		Simon				
Finalize IoT coffee maker inerds/circuit construction			Simon			
Build coffee maker housing				Matt		
Assemble the complete physical/hardware (including housing) of the IoT coffee maker				ALL		
Finalize coding and Flask app				ALL		
Run tests and finalize the project					ALL	

Figure #4: Gantt chart showing the timeline of each expected project step.

6. Target Market

The target market for this product is the people who have busy lifestyles want to streamline their morning routine and get their cup of coffee in an efficient and timely manner. These consumers include college students and your everyday workers who rely on caffeine to stay focused and energized throughout the day.

In the morning nobody wants to wait minutes for their coffee maker to warm up and wait while it slowly brews their coffee. Our device allows the user to start the coffee maker in the comfort of their bed so that when they get up, they can directly walk over and pick up a hot, freshly brewed cup of coffee. For the users who do not drink coffee directly after waking up, this device is also a great match for them. The timer or scheduler features of the app that allows the user to select an amount of time for the coffee maker to wait before it dispenses the coffee. For example, if the user likes to drink their coffee after they shower and get dressed, they could set a timer for 1 hour, go about their routine, and then pick up their freshly brewed coffee when they're finished.

The web app also offers the versatility of scheduling when to brew coffee. This gives the end-user the ability to set a time every day for the coffee to be brewed, further streamlining their morning routine, reducing preparation time. These features make the product excellent for those living busy lives and who need caffeine to ensure they are ready for the busy day or night ahead of them.

7. References

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