

# **Project Concept Document (PCD)**

## **Autonomous Coffee Machine**

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# **Project Concept Document**

## **1. Executive Summary**

This goal of this project is to design an autonomous coffee machine that can be controlled remotely. This machine will rid users of the hassle of setting up their brews in the morning, and waiting for their coffee to be done.

## **2. Product Users**

Home Owners and Small Businesses are my primary market but I could see a scaled version of this machine targeting large corporate offices and other places such as gas stations and coffee shops.

## **3. External Impacts on/of Project**

### **3.1 Economic**

There should be no economic impacts with this project, and if I were to have this manufactured I would have it built in the U.S.A so this would actually contribute to our countries economy and workforce.

### **3.2 Social**

This might contribute to the American obesity problem because it allows people to be increasingly lazy and if I do a good job it might increase the amount of coffee consumed by certain people, which will also contribute to America's obesity.

### **3.3 Environmental**

The coffee machine will only work with reusable coffee filters, which should reduce the waste of coffee filters and save some trees. If the

mechanical design is done with the proper materials there will be no negative environmental impact due to this project.

### **3.4 Political**

A coffee machine should have no political impact though I am sure CNN could find a way to make this coffee machine make president Trump look bad.

### **3.5 Health & Safety**

If the machine is manufactured properly, with the correct materials to withstand heat and the material doesn't affect people with health problems or allergies there should be minimal health risks. For pricing purposes we will most likely prototype with ABS plastic because it can withstand heat, but could cause health problems because it is known to release toxins that can cause cancer. With the machine being powered by a 120V residential outlet there is a risk of a user being electrocuted.

## **4. Project Assumptions, Dependencies, and Constraints**

### **4.1 Project Development**

My primary concern is getting the mechanical "body" of the machine designed. If I can successfully do that I should be able to finish the project without too many roadblocks. I am also assuming that I am going to be able to connect to my Raspberry Pi from anywhere via Wi-Fi, and this might introduce security issues that I can't resolve within the time I have to develop the product.

### **4.2 Project Usage / User / Operational**

The user will have to access my webpage, which is where the user interface is going to be. The user will then have to select brewing parameters in the HTML form and then press submit. If the machine is capable of performing the brew a countdown will start on the webpage until the coffee is ready. If for any reason the machine cannot complete the brew the user will get an error message on the website.

#### **4.3 Manufacturability**

I am going to need certain components if not all of the machine's components to be manufactured, and the material has to be able to withstand heat and not cause health issues if consumed. This could be an issue, but I am hoping I can get a local shop to help me with this.

#### **4.4 Supportability**

As of right now my only plan is to develop a well-written manual on how to setup and operate the machine. However, if I were to turn this product idea into a company and start selling to the public I would need some sort of customer support line.

#### **4.5 Sustainability**

Sustainability is going to be a problem because the installation and setup is going to be hard to make easy for the non-technical consumer. This product would absolutely require a customer support helpline, as well as a well-written instruction manual. Since I am only prototyping this design I am not going to stress about this, but if I wanted to try and market this product I would have to address all these issues.

#### **4.6 Reliability**

All of the hardware needs to easily be able to last a couple of years under normal operation. The software should be robust and operate properly under all conditions. The only part that doesn't have to be as sturdy are the filters, because a lot of people replace filters every year or so anyways.

#### **4.7 Regulatory Compliance**

Since the coffee machine is making a beverage it would probably have to pass food safety regulations set out by the food and drug administration.

### **5. User Accessible Features**

- Wi-Fi Enabled for remote control
- Multi-Cup Brewing as a user option
- Brew Strength as a user option
- Database to store use information
- Manual override to brew without Wi-Fi connection

## 6. Estimate Project Costs

Purchase Invoice		
Component	Description	Cost
Raspberry Pi 3	Microcontroller that controls coffee machine and hosts website with the user interface	\$34.72
Micro SD Card	Hard Drive for the controller	\$10.00
Mainstays 12-Cup Coffee Maker	Base Machine with functional components	\$10.84
E-flite 5mm Prop Adapter	Prop Adapter to Connect the stepper motors shaft to something threaded	\$3.21
Nema 17 Bipolar Stepper Motor (84 oz.in)	Stepper motor to precisely spin the carousel	\$13.99
(2) Reusable Coffee Filters	Reusable coffee filters to hold the grounds and sit in the carousel	\$8.00
6MM x 130MM all thread rod	My way of extending the motor shaft to connect to the carousel.	\$2.19
(2) 6MM Coupling nut	How I am connecting the all thread rod to the prop adaptor on the motor	\$1.98
6MM Wing nut	The wing nut is acting as the lower nut holding the carousel to the all thread shaft.	\$1.73
6MM Acorn cap nut	The upper nut holding securing the carousel to the all thread	\$1.67
	<b>Total Price</b>	> \$60

## 7. Glossary

Polylactic Acid – PLA is a biodegradable thermoplastic derived from renewable resources such as cornstarch or sugarcane. It is one of the most popular bioplastics.

Acrylonitrile Butadiene Styrene – ABS is a common thermoplastic well known in the injection molding industry.

## 8. Appendixes