Using an Embedded System for a Quality Cup of Coffee

Evan Powers
Eastern Washington University

Joshua Stermer
Eastern Washington University

Tsion Yohannes
Eastern Washington University

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Supervisor: Dr Meyer

Powers, Evan, Joshua Stermer, and Tsion Yohannes
Electrical Engineering

1. Abstract

Many coffee lovers spend up to $5 on a cup of coffee everyday. To save money one could make them at home, but a quality machine with PIDs start at $1000. Using an embedded system one could spend less than $50 and a few hours implement PIDs into an existing $400 machine that will last a lifetime. microcontroller. Learning C language combined with hardware implementation applied to cheap and simple everyday objects can improve everyday quality of life and save money.

This is challenging because we have to incorporate the additional circuitry into a pre established circuit with limited space, and tie in new code. In addition to the PID controls that are commonly found on high-end espresso machines, Our team decided to implement a touch screen interface, which required programming using a proprietary IDE and language. The resulting product is able to match temperature and pressure consistency levels that are found in competing machines. When we added in programmability of pre-infusion we start to compete with machines in the $5000 range, like the La Marzocco GS3, but we go even further with a touch screen interface, and the ability to plot temperature and pressure over time on the included LCD screen.

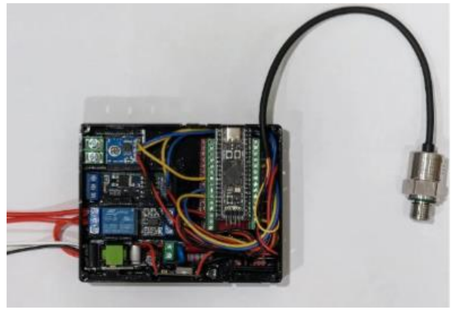

Figure 1A&B Additional internal components required for the project to work

2. Methods

The only key to improving a coffee machine is to increase its consistency. We measured, plotted and controlled a few key variables:

- Water Temperature at the brewhead
- Water Pressure
- Flow Rate
- Steam Temperature
- Steam Pressure

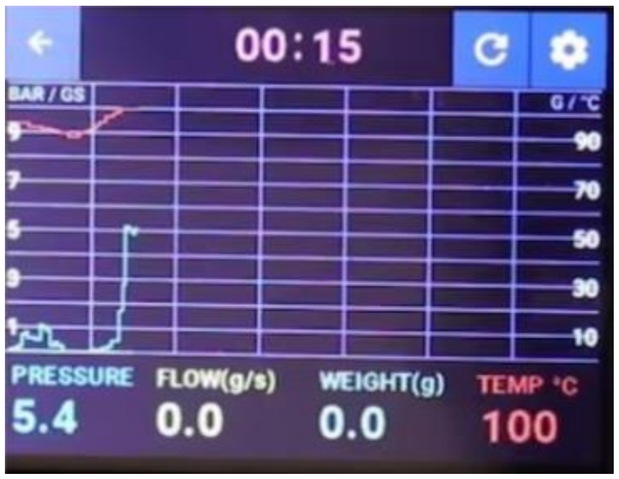

Figure 2: Live Plotting of Pressure, Temp and Flow)

We implemented these by adding a variety of sensors and actuators for each of the systems we wanted to control.

We then implements PID systems for each of them, which had goal values set by our touchscreen interface.

A proportional–integral–derivative controller (PID controller or three-term controller) is a control loop mechanism employing feedback that is widely used in industrial control systems and a variety of other applications requiring continuously modulated control

3. Discussion

With the other variables remaining consistent and easily controllable through adjustments on the touch screen, only a few variables remain in the brewing process:

- Coffee beans being used
- Grind size

Both of these would normally affect flow rate, but because of the PID controller in the flow rate control of the machine, we can adjust those two variables to only affect the taste

Figure 3: A latte brewed from our machine

4. Conclusions

- We successfully increased the consistency of brew methods
- A pre-infusion routine was added
- Touch screen allows for fine adjustments in the temperature and pressure in an easy-to use manner
- A smart grinder would be the next step in consistency