PROJECT REPORT
ON
SMART HEATER

SUSHRUTH RADHAKRISHNA (W1386450)

SURYA TAMIRISA (W1418681)

SHUBHAM PATEL (W1429265)

TANAY DESAI (W1282876)

PROF. FAROKH ESKAFI

COEN 210, COMPUTER ARCHITECTURE, FALL'17

COMPUTER ENGINEERING DEPARTMENT

SANTA CLARA UNIVERSITY

Abstract

After a long day people usually prefer not to have much work at home. This led to the invention of many smart home automation devices which improved convenience, and enhanced ease of living. And, still there is scope for much easier living. As many prefer a hot cup of coffee waiting for them when they get back home, we derived the problem statement from the former, and worked to ease this process.

Instead of heating the coffee manually, after the user is home, the Smart Heater can keep the coffee hot by the time we get back home. This is done using an Android application to control your heater, through an active internet connection. The middleware includes raspberry pi and the output has a heating unit.

Contents

1.Introduction

1.1. Purpose

This project is developed to save the users time by making the process of heating a drink, automated. This is done by controlling the unit from an android application, which is connected to the internet. While the heating unit is connected to a raspberry pi, which receives the signals from the phone through the database.

1.2. Scope

The primary purpose of the project is to automate the system of heating coffee, though a mobile application. This purpose can be extended to various implementations depending on use of different combinations of hardware set. The purpose of the problem statement stated in the Abstract is solved, i.e. the user's time and effort are minimized by this automation project.

2. System Analysis

2.1. Existing System

People usually have a hot cup of coffee, once they are back home after a long day. They heat up the coffee once they are back home. It requires some time and effort to do so.

2.2. Proposed System

We propose that the above-mentioned system can be changed using smart automation technology. The heater which is used to heat up the coffee, can be connected and operated from a mobile application (android for now).

3. Technology Used

3.1. Hardware

- Raspberry pi: 64-bit ARMv8 Quad-Core Processor at 1.2 GHz.
- Pressure and Altitude sensor - I2C Protocol (Inter-Integrated Circuit); is a multi-master, multi-salve, packet switched, single ended, serial computer bus.
- Temperature and Humidity sensor- UART; A universal asynchronous receiver-transmitter (UART) is a computer hardware device for asynchronous serial communication in which the data format and transmission speeds are configurable.
- Cypress board: Analogue to Digital converter.
- Relay: to allow low power electronic or computer type circuits to switch relatively high currents or voltages both "ON" or "OFF", some form of relay switch circuit is required to control it.
- Heating element
- Socket board, connect to electricity

3.2. Software

- Database: Google's Firebase v4.; run by MongoDB, which is a NoSQL database program.
- Mobile Application Development Platform: Android Studio 3.0
- Mobile Platform for Testing: Android Operating System Emulator

4. Architecture Overview and Implementation

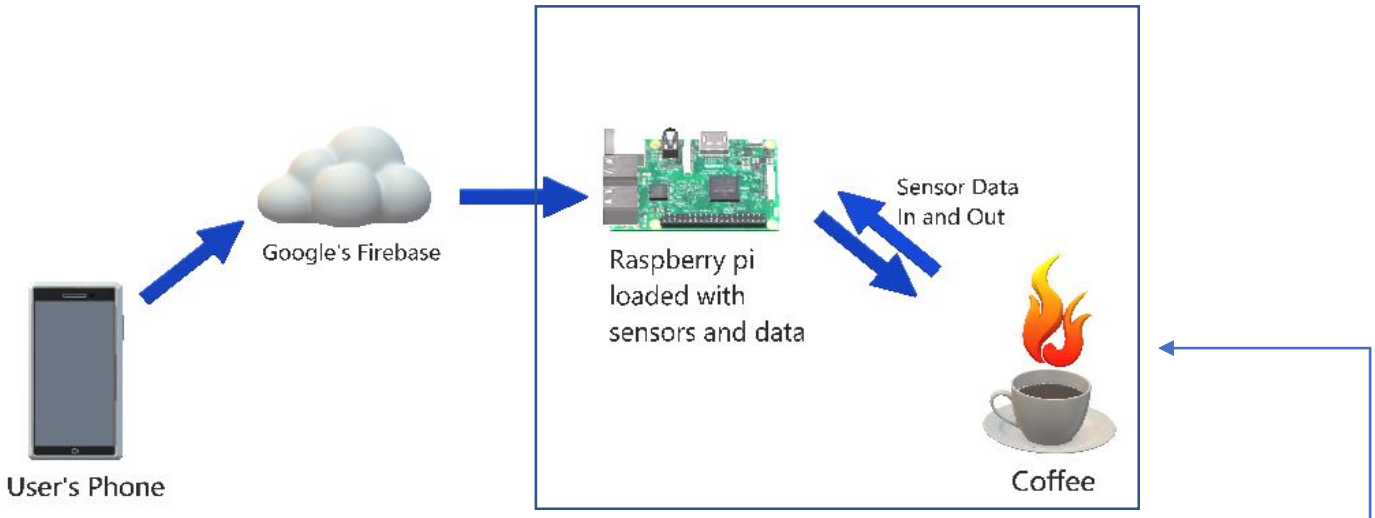

Fig 4.1. (Architecture)

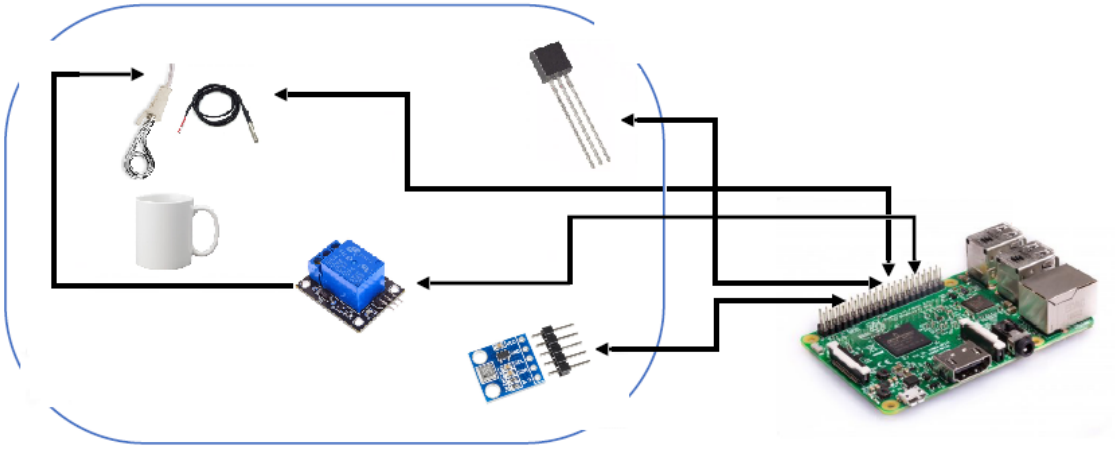

Fig 4.2. Connections to the Raspberry pi

Three modules:

i) Mobile Application to Firebase

ii) Firebase to Raspberry pi

iii) Raspberry pi to heating unit

The mobile application is coded in java using Android Studio. The user's mobile application is connected to the real-time database, Firebase, which has a high refresh rate, at 30 milli seconds. Even the firebase to Raspberry pi has a pretty low refresh rate, but is implemented with a delay of 30 seconds, to reduce the load. Firebase is integrated with Raspberry pi using python script. The third module is pretty simple, which constitutes of a relay, to switch on and off the voltage.

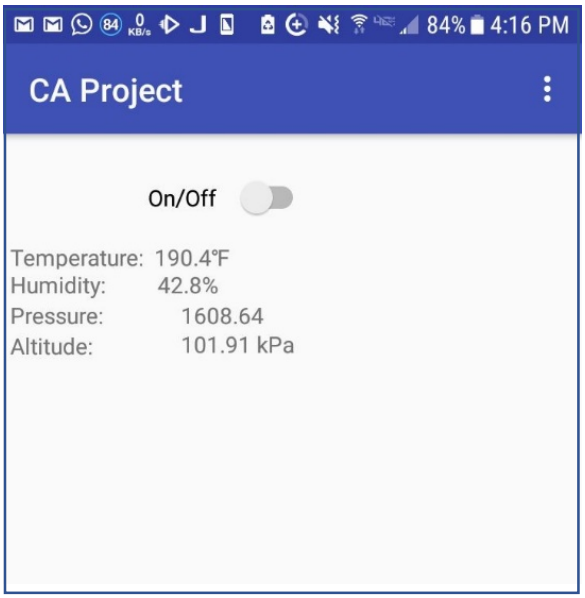

Fig 4.3. Mobile Application

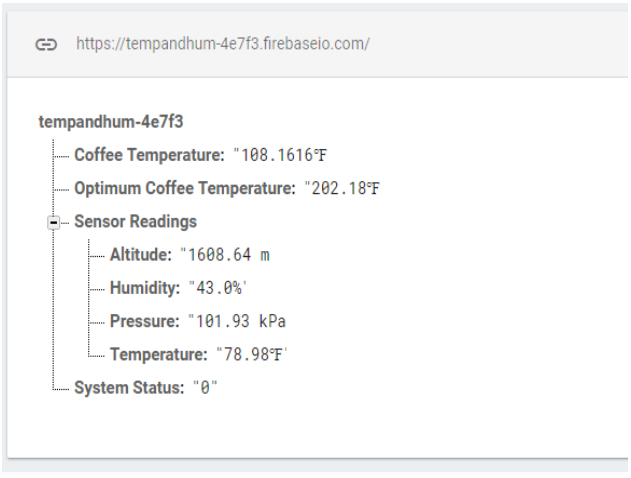

Fig 4.4. Database Structure in Firebase (NoSQL)

Pressure is calculated based on the altitude, and through which the ideal temperature for the product (coffee, in this case), is calculated. This is what is used to derive various parameters from altitude, from which the unit can be provided with the right temperature, pressure and humidity from the unit's altitude.

$$p = p_0 \cdot \left(1 - \frac{L \cdot h}{T_0}\right)^{\frac{g \cdot M}{R_0 \cdot L}}$$

Formula 4.1. Calculating Atmospheric Pressure at different altitude

$$\ln\left(\frac{P_1}{P_2}\right) = \frac{\Delta H_{vap}}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

Formula 4.2. Calculating Temperature at different pressure.

5. Conclusion

Of the four parameters considered above, this project implements a single parameter, an automated coffee heater (Smart Heater). This home automation device aims to improve the ease of living, while saving the user's time invested on a task.

5.1. Future Enhancements

The project can be equipped with pressure and humidity control units, with which you can actually control all three parameters, temperature, pressure and humidity, depending on altitude, through a mobile application.

5.2. Enhanced Project Scope

With added pressure and humidity control units, this application can be implemented in:

- Medical equipment's while transporting organs.
- Chemical laboratory for maintain unstable compounds.

- Home automation.
- Flight simulators.

5.3. References

- **GIT HUB LINK** - Smart Heater GitHub: https://github.com/sushruth91/SMART-HEATER--RASPBERRY-PI.git
- Raspberry pi Documentation: https://www.raspberrypi.org/documentation/
- Firebase Documentation: https://firebase.google.com/docs/