Revival of the IoT Thermostat

ECE558 - Final Project
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Project Overview

- Revival of ECE-544 Final Project
  - Used Nexys 4 DDR board paired with PMOD modules (temperature sensor, OLED display and keypad)
  - Utilized a NodeMCU
  - DC motor to simulate thermostat fan
  - Python GUI for control interface
  - Website to pass information between Python GUI and NodeMCU/Nexys 4 DDR board
- Updated Project Components:
  - Android application that controls and monitors the thermostat
  - Raspberry Pi running Android Things "simulates" a thermostat
  - Google Firebase to hold thermostat information and to sync
  - DC motor to simulate thermostat fan
  - LEDs to indicate the current state of the thermostat (heating, cooling or stable)

Deliverables

ANDROID APPLICATION

Base Deliverables:
- **Ability to adjust temperature**
- **Ability to set fan mode (manual or automatic)**
- **Display current temperature from Raspberry Pi temperature sensor**
- **Multiple phone integration (when one person changes the settings other phones using the app will be notified)**
- **Implementation of sound**
- **Ability to read and write data to Firebase**

Stretch Deliverables:
- **Add speech recognition so the user can set the temperature with their voice**
- **Add a real time graph**
- What-if scenarios (example: if I have my system on for this long then it will cost X amount of money)
- The ability to schedule the thermostat to operate during a certain time block
- **Has the ability to access current weather conditions**
- Notifications to all phones when thermostat settings change

RASPBERRY PI APPLICATION

Base Deliverables:
- **Utilize Android Things**
- **Uses LED to indicate whether the system is heating, cooling or stable**
- **Motor direction indicates whether system is heating or cooling**
- **Ability to read and write data to Firebase**

Stretch Deliverables:
- Add a screen to Raspberry Pi
- Add text to speech to Pi app to verbally indicate that the temperature has been changed

DELIVERABLES HIGHLIGHTED IN GREEN AND BOLDED WERE COMPLETED

# Project Data Flow
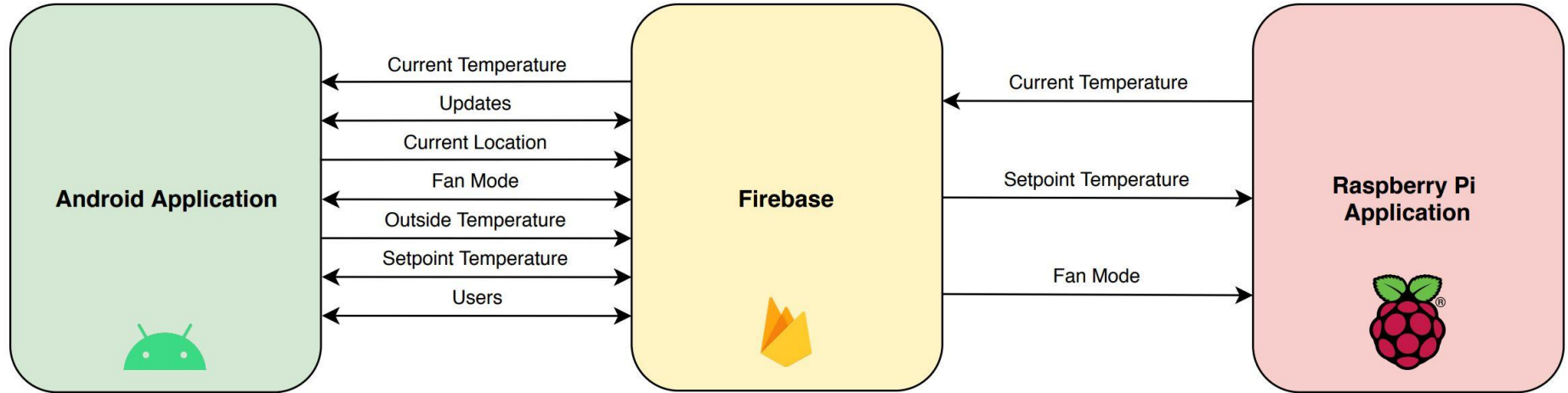
Android Application

- Composed of four main activities:
  - Main Activity
    - Allows user to set thermostat setpoint
    - Allows user to set thermostat fan mode
    - Dashboard indicating the current thermostat statistics (current temperature reading, current setpoint, current temperature outside and fan mode)
    - Provides buttons to launch other activities
  - Graph Activity
    - Displays a real time graph that updates every second
    - Ability to show/hide setpoint and temperature reading on graph
  - Updates Activity
    - Always the user to review previous changes to the thermostat system
    - Always user to sort updates from newest to oldest or vice versa
    - Always user to clear the updates history
  - Settings Activity
    - Allows user to turn on/off text-to-speech
    - Allows user to "change the location" of the thermostat
- All activities are able to handle configuration changes except the main activity, which is locked in portrait
- User must use back button to return to main activity from other activities
- Ability to read and write to Google Firebase
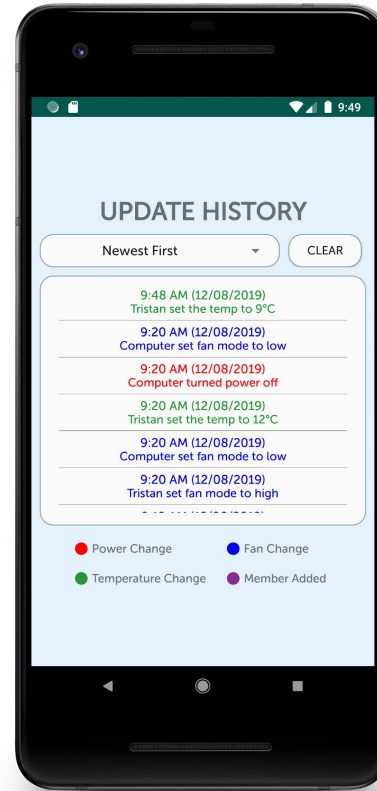- Ability to support multiple users

Android Application Screenshots
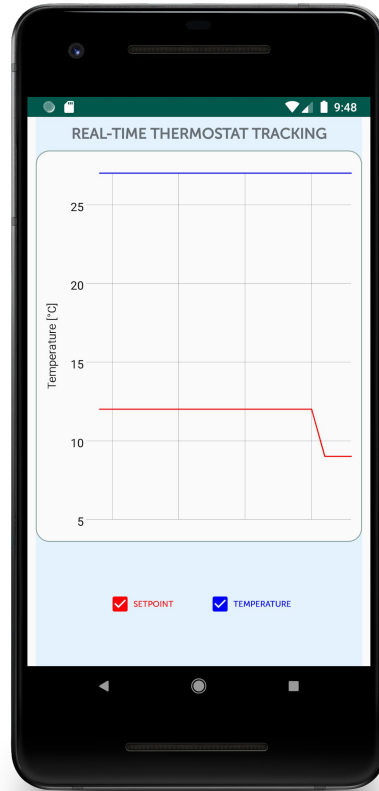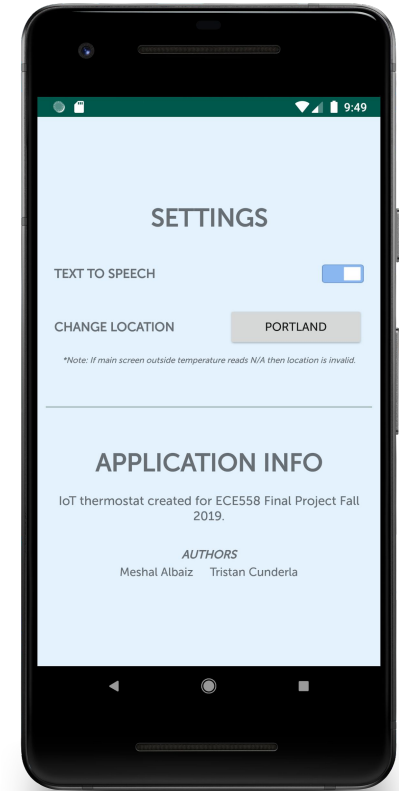

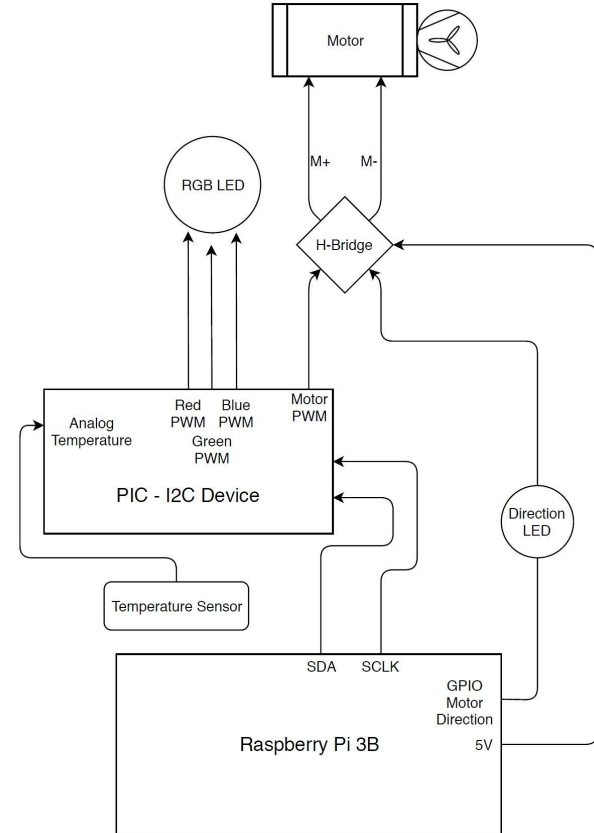Main Activity   Graph Activity   Updates Activity   Settings Activity

Raspberry Pi Application

- Pi application reads ambient temperature from the temperature sensor
- Application updates temperature value on Firebase every second using a thread
- RGB LED and motor speed & direction are updated if the temperature, setpoint, power status, or fanmode have changed

Google Firebase

- Both Android application and Raspberry Pi application read and write to Firebase
- Aids in synching thermostat settings between mobile devices
- Helps with communication between Android application and Raspberry Pi application

ece558-final-project-f2019
- **current_location:** "Portland
- **current_temp:** 26
- **fan_mode:** "high'
- **outside_temp:** -1
- **power_state:** false
- **set_temp:** 37
- **timer:** true
- **updates**
- **users**

Challenges

- Using the PMOD HB3 with Raspberry Pi
- Using custom seekbars and graph Java modules
- Data handling and syncing between multiple mobile devices

Demo

Questions?