SAFETY HUB

TEAM 18
MDR PRESENTATION

University of Massachusetts Amherst
BE REVOLUTIONARY™

MEET THE TEAM

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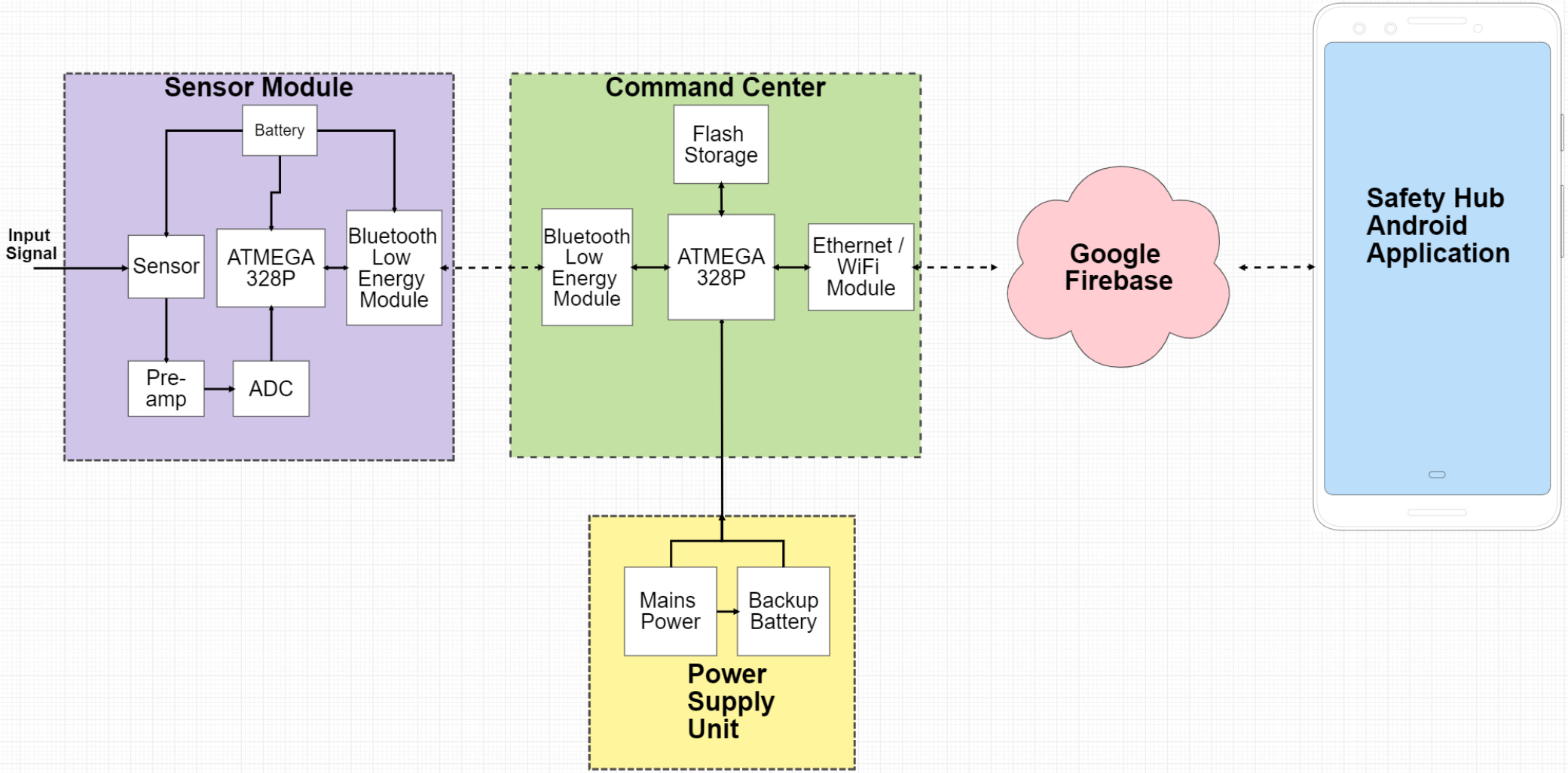
PROBLEM STATEMENT

In a laboratory environment, there are many safety and security issues which can arise on a day-to-day basis which can cause harm and damage to sensitive equipment. Many of these problems are caused due to human error and negligence and can have serious infrastructural and financial setbacks. For instance, if the temperature in the lab were to change drastically due to a window being left open, the change in temperature and humidity could have serious effects on delicate temperature sensitive equipment. Modern sensors today are not equipped with reprogrammable thresholds for temperature and humidity to alert lab owners of potential harm to their equipment. Moreover, lab equipment safety is of paramount importance, with many sensors unable to notify owners of who has entered the lab and at what time.

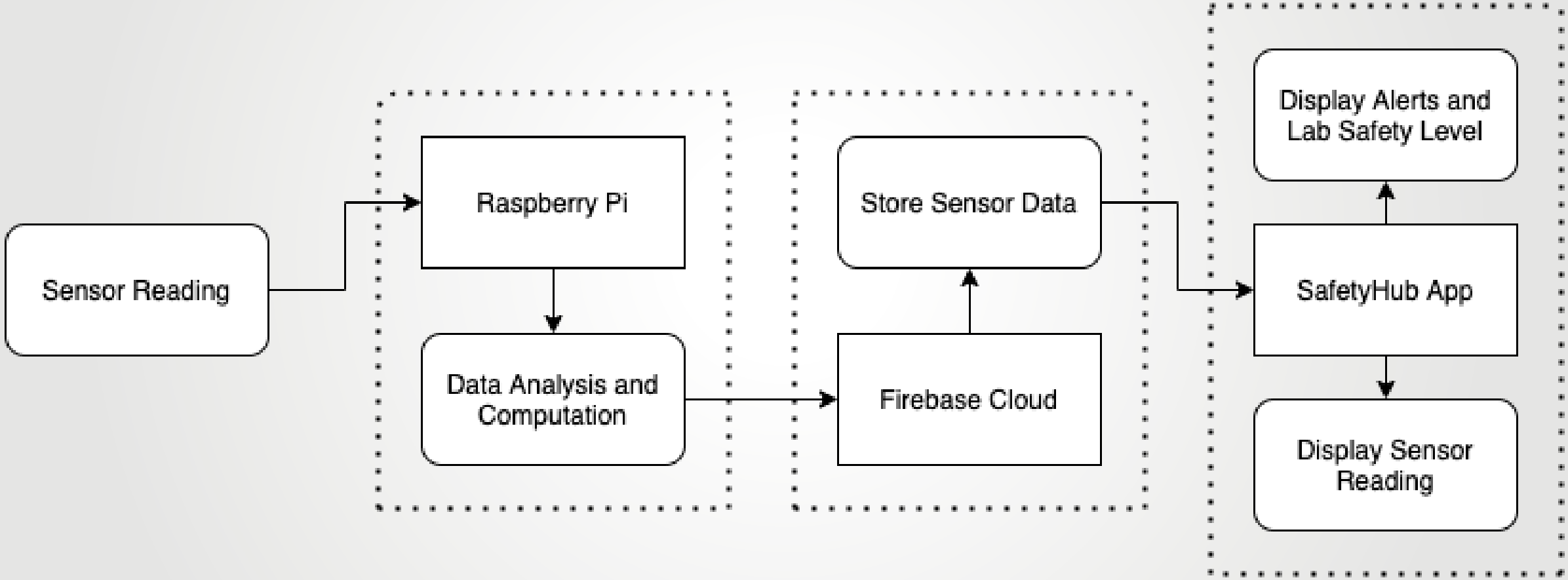
SYSTEM SPECIFICATIONS

- The device should be portable enough such that it can be mounted to the ceiling or top of fume hood – about 180mm x 60mm and less than 2.5kg (imagine two decks of cards side by side at their longest side)
- The device should be powered from a wall outlet and have a battery backup with enough energy to last one week in case the power goes out
- The device should have user friendly interface to receive notifications and calibrate the connected sensors and devices (app with touch controls)
- The device design should be modular and customizable to customer requirements (each component can be connected through a Bluetooth connection).

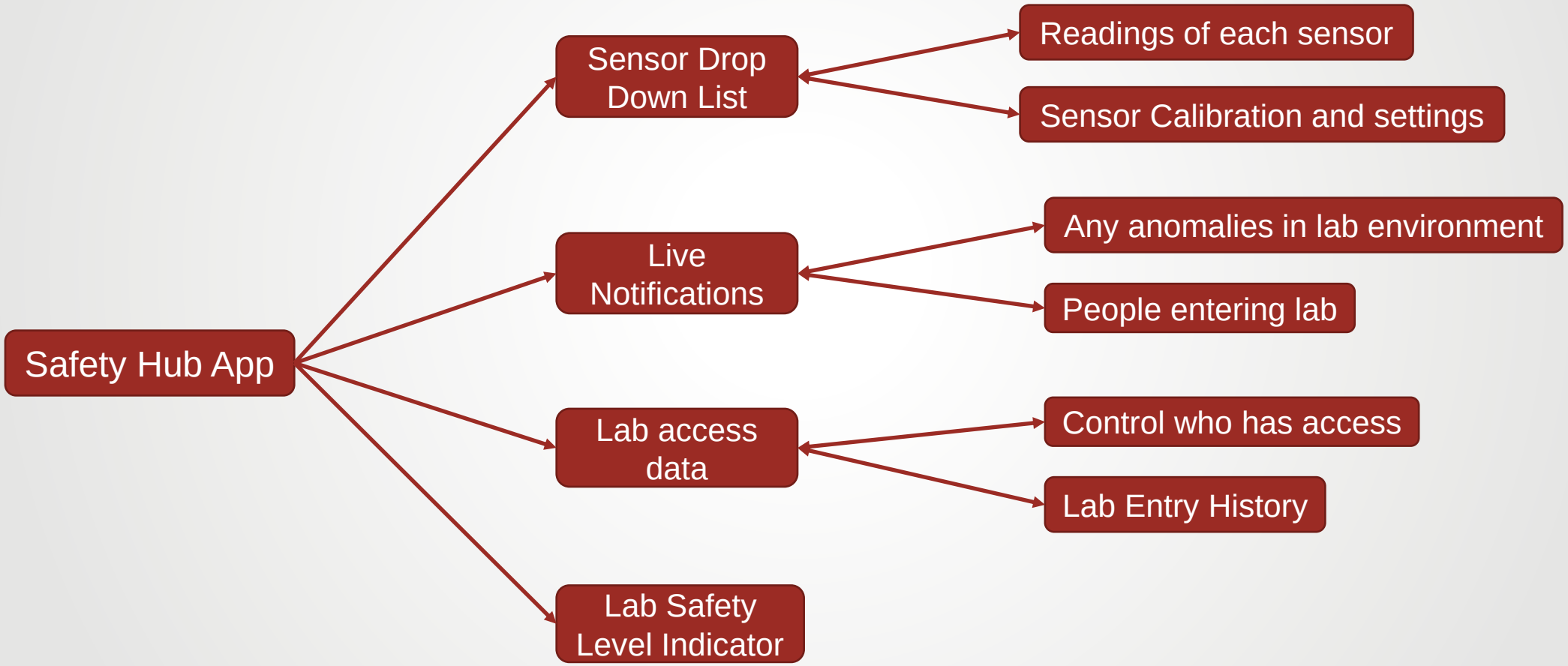
UPDATED SYSTEM DESIGN - HARDWARE



UPDATED SYSTEM DESIGN - SOFTWARE



SAFETY HUB APP DESIGN



LIST OF HARDWARE & SOFTWARE

Hardware

- Currently used:
  - Raspberry Pi 4.0
  - HC-SR501 PIR Sensor
  - MFRC522 RFID Reader
  - DHT-11 Temperature and humidity sensor
  - RFID tags
- Future Additions:
  - ATMEGA328P
  - ESP8266 WI-FI Module

Software

- Currently Used:
  - Firebase Cloud Server
  - PyCharm Python
  - Android Studio
- Future Additions:
  - Spice
  - Swagger API

MDR DELIVERABLES

Software Component

- App -
  - Rohit:
    - Home Page UI
      - Sensor Drop Down List
      - Lab Safety Indicator
  - Soumark:
    - Sign in Page
    - Relaying sensor data to cloud

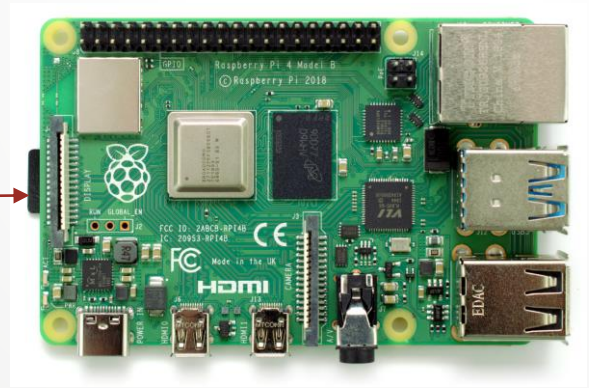
Hardware Component

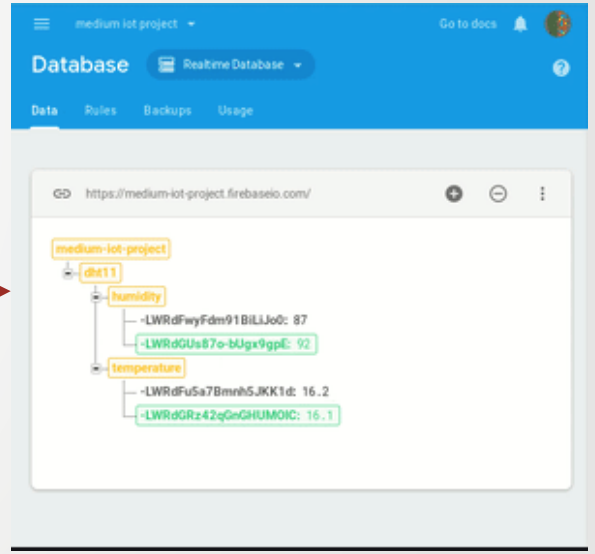
- Anthony:
  - Transmit and Receive Temperature and Humidity Data through a Bluetooth Low Energy (BLE) Connection
- Dhanush:
  - Setup connection between the PIR Sensor and RaspberryPi 4.0
  - Setup a Battery backup unit
- Rohit:
  - Scan and extract UID data from RFID tag

MDR ACCOMPLISHMENTS – SOUMARK RAY

- **Sending Sensor Data from Pi to Cloud**
  - **Raspberry Pi connected to Realtime Database**
  - **Sensor reading sent to Database and stored**

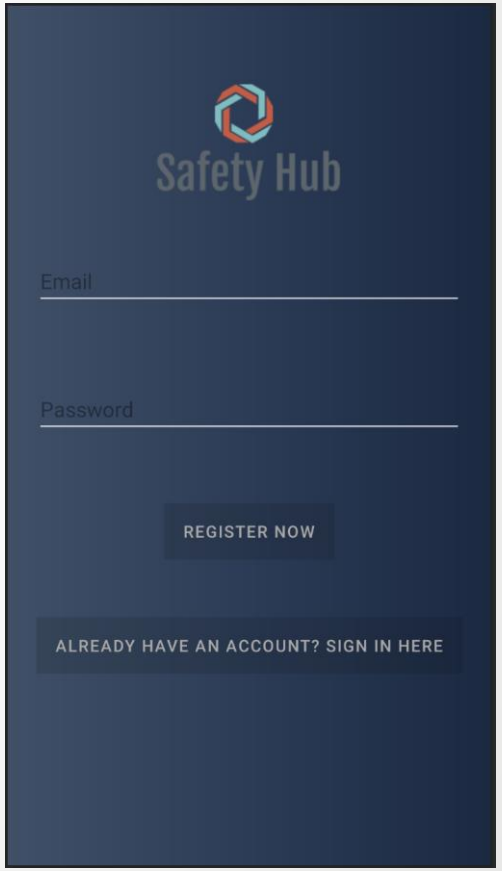
Sensor Readings

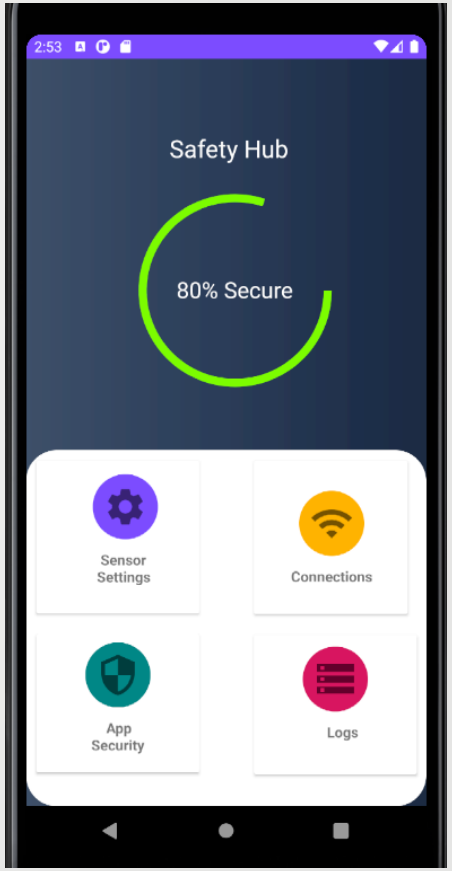




MDR ACCOMPLISHMENTS – SOUMARK AND ROHIT

- **Safety Hub App -**
  - **Soumark:**
    - **Functional Registration Screen**
    - **Functional Login Screen**
    - **User email and password authentication on Firebase**
    - **Home Page with Logout Button**
  - **Rohit:**
    - **Static Home Page with pseudo data**
    - **Sensor Drop Down List**
    - **Settings button to configure Thresholds.**
    - **App security Button**
    - **Logs button**



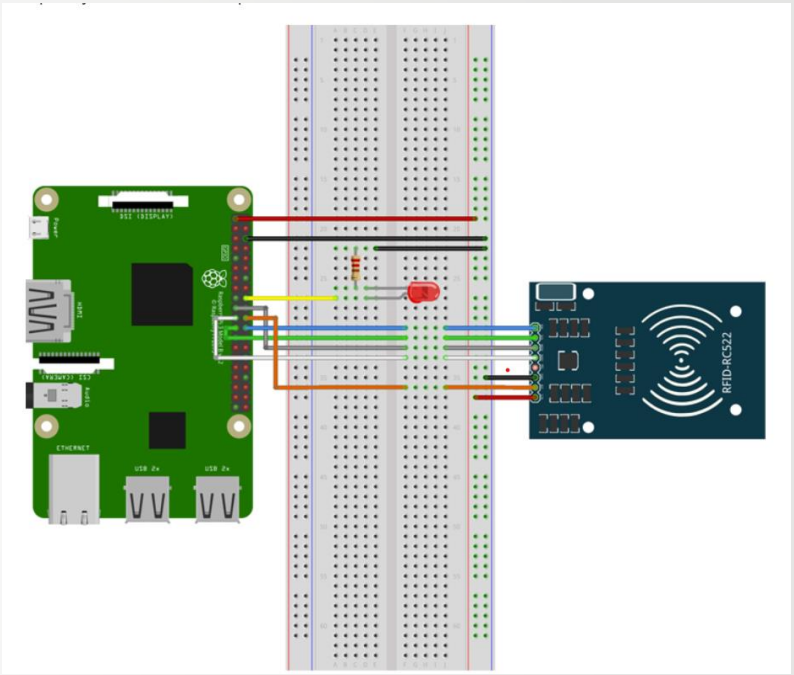


MDR ACCOMPLISHMENTS – ROHIT

- **RFID Scanner**
- **The RFID scanner used is the RC522, simple reader.**
- **From RFID tags, UID data is pulled.**

Simple python script developed which MFRC522() is used

- **Helps in pulling data from the RFID tag**
- **This UID data and text data is then parsed and sent to the firebase server**

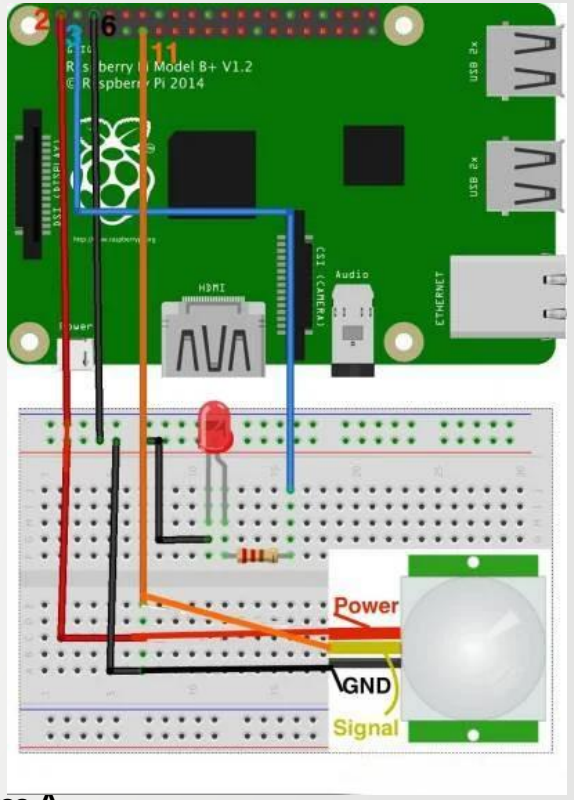


MDR ACCOMPLISHMENTS – ANTHONY

- **Temperature and Humidity Data Transmission to Raspbery Pi**
  - **Transmitted through Bluetooth Low Energy Module**
- **Android App UI with Temp. / Humidity Data displayed**
  - **Data transmitted to Raspberry Pi and Readouts and Time-Series plot displayed**

MDR ACCOMPLISHMENTS - DHANUSH

- **PIR Motion Detector**
  - PIR sensor model: HC-SR501
- **Battery Backup Unit**
  - Using a Power Bank with a 5V and 3A output.
  - Current Consumption of Raspberry Pi 4.0 while running PIR: 1020mA
  - Current Consumption of HC-SR501 (PIR): 0.5mA
  - Current Consumption of MFRC522 (RFID): 30mA
  - Current Consumption of HM-10 (BLE): 30mA
  - Current Consumption of DHT11: 0.3mA
  - Time the Battery Backup Unit will run the PIR Module: 10000mAh/1020.5mA
    =9.8 hours approx.



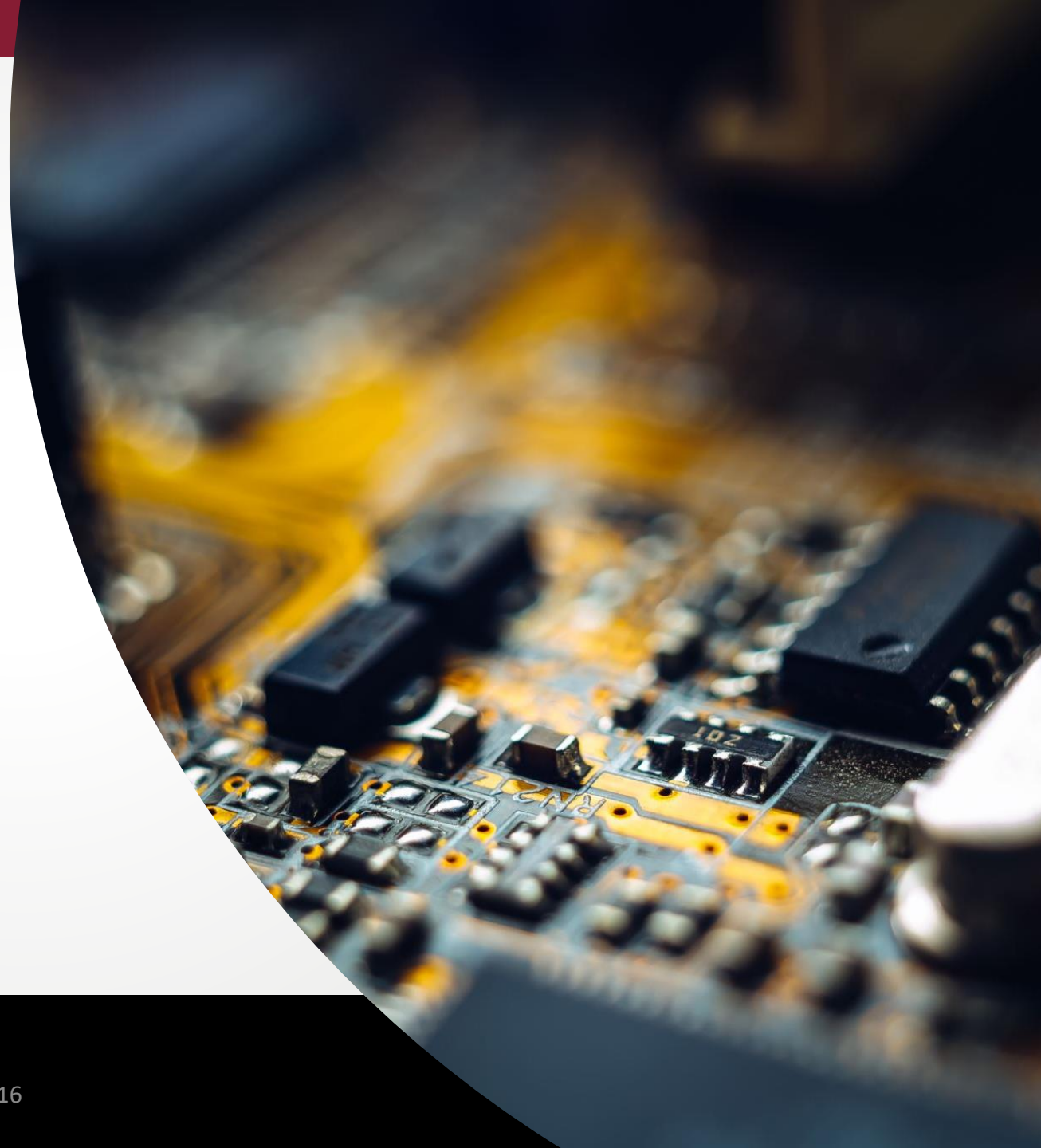
MDR HARDWARE PLAN FOR FPR

Custom Printed Circuit Board 1

- ATMEGA328 8-bit Microcontroller
- CC2541 Bluetooth Low Energy (BLE) Chip
- DHT22 Temp. And Humidity Sensor
- Lithium Coin Cell Battery Powered

Custom Printed Circuit Board 2

- MFRC522 RFID Reader
- CC2541 BLE Chip
- ESP Wi-Fi Chip
- HC-SR 501 PIR Sensor
- ATMEGA328 8-bit Microcontroller
- SD Card Reader
- Lithium Coin Cell Battery



PROJECT EXPENDITURES

Current Expenses

- Raspberry Pi 4 Board - $35 x 2 = $70
- RFID Readers – $6.76 x 3 = $20.28
- HC-SR501 PIR Sensors = $7.99
- HC-SR505 PIR Sensor = $11.99
- AM312 PIR Sensor = $8.49
- HM-10 Bluetooth 4.0 Module – $ 9.99 x 7 = $69.93
- Shipping and Taxes - $4.99

- Total Budget Spent = $193.67

Projected Expenses

- ATMEGA328P-PU - $2.08 x 4 = $8.32
- ESP8266EX WiFi Module - $1.06 x 3 = $3.18
- PCB costs - $30
- Shipping and taxes - $5

- Total projected budget = $46.5

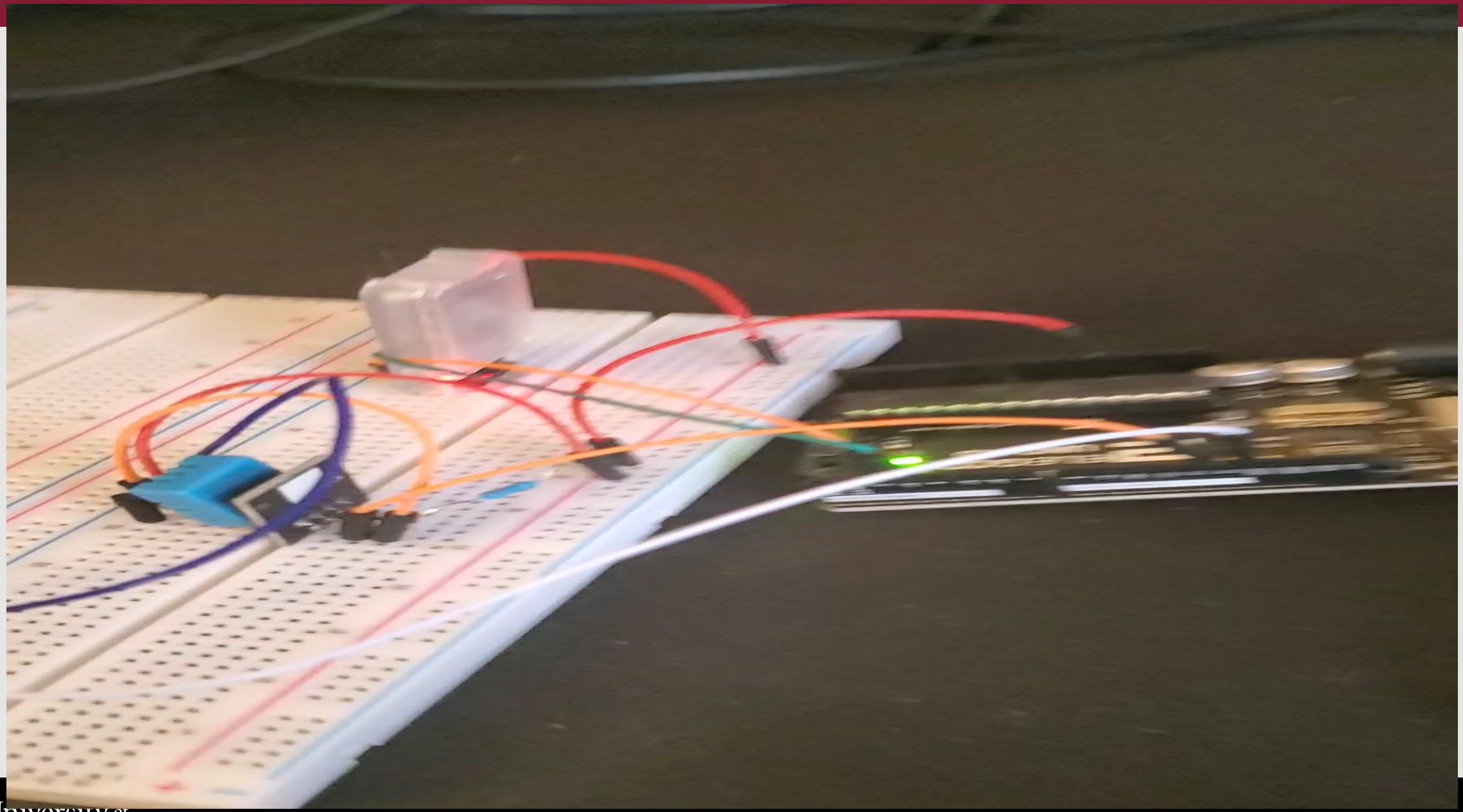
Projected total expenditure = $240.7

PROJECT MANAGEMENT

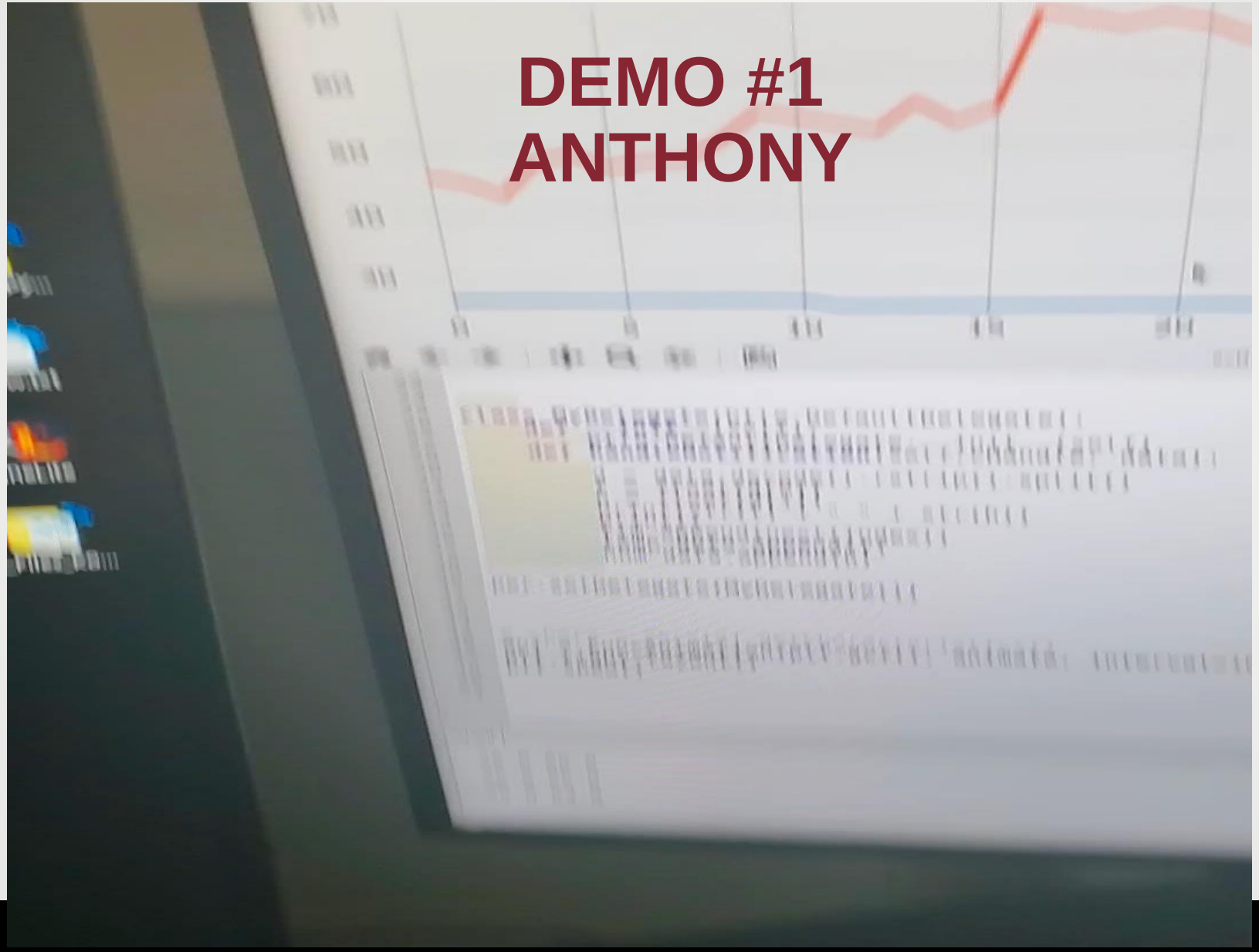
- **Rohit Draksha (Team Coordinator)**
  - SafetyHub App Backend (Swagger and Android Studio)
  - Wi-Fi Module connectivity
- **Soumark Ray (Budget Management Lead)**
  - Firebase Cloud Service
  - SafetyHub App Backend (Firebase and Android Studio)
- **Anthony Panarelli (Altium Lead)**
  - Custom PCB design
  - Sensor (Bluetooth) connections with board
- **Dhanush Chandra Palarapu**
  - Battery Backup unit
  - RFID and PIR Module connectivity.

GANTT CHART

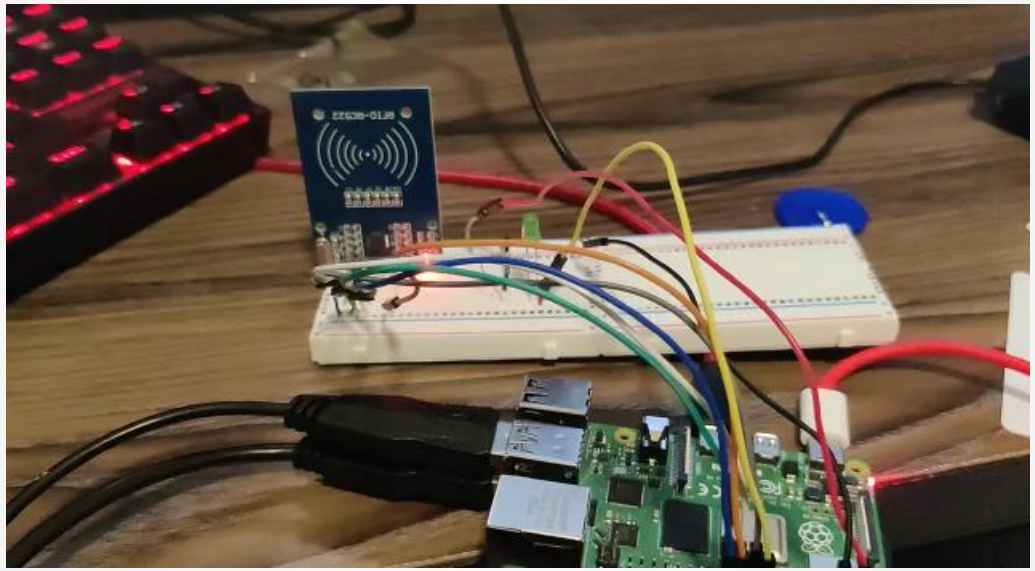
Hardware							
Team Member	Task	01-Feb	08-Feb	15-Feb	22-Feb	01-Mar	08-Mar
Rohit Draksha	Wifi Module Connectity						
Dhanush Palarapu	Battery Backup Design						
Anthony Panarelli	DHT 11 to ATMEGA 328P connection						
Software							
Team Member	Task	01-Feb	08-Feb	15-Feb	22-Feb	01-Mar	08-Mar
Soumark Ray	RFID Authentication Database						
Soumark Ray	Firebase connection with data from ATMEGA328P						
Dhanush Palarapu	RFID & PIR Module Integration						
Firmware							
Team Member	Task	01-Feb	08-Feb	15-Feb	22-Feb	01-Mar	08-Mar
Anthony Panarelli	Custom PCB Design						
Anthony Panarelli	Bluetooth Connectivity of Sensors with Board						
App Software							
Team Member	Task	01-Feb	08-Feb	15-Feb	22-Feb	01-Mar	08-Mar
Rohit Draksha	Customized thresholds for data						
Rohit Draksha	Configure push Notifications						
Soumark Ray	Relay Data from Cloud to App						



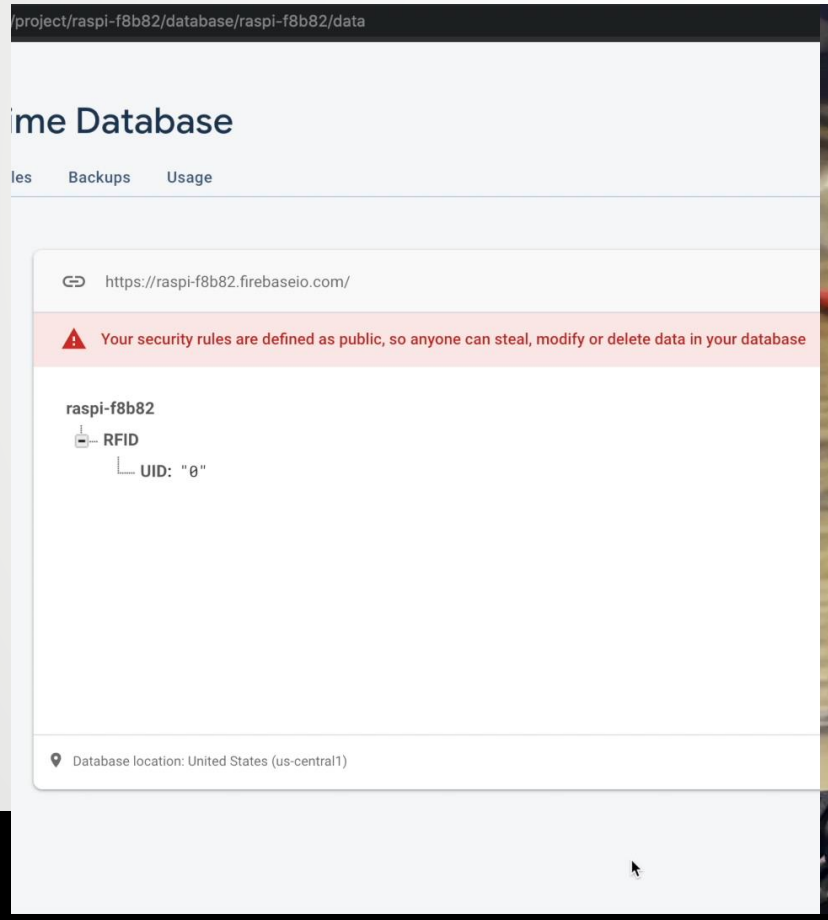
DEMO #1
ANTHONY

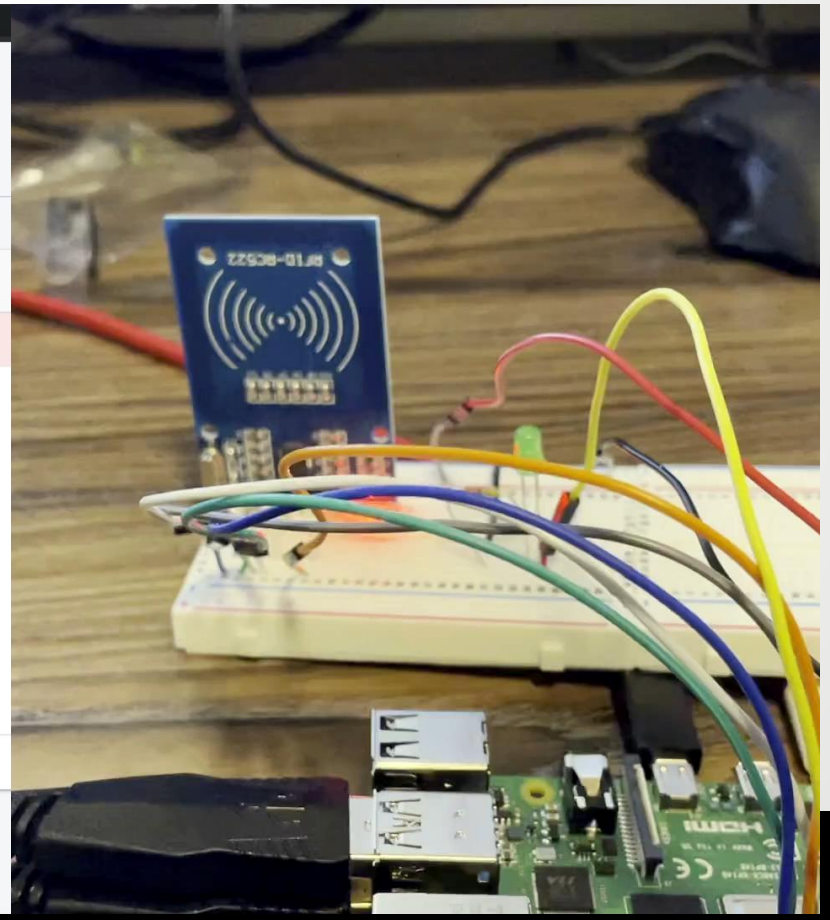


DEMO #2
RFID TAG SCAN AND UID EXTRACTION
ROHIT DRAKSHA

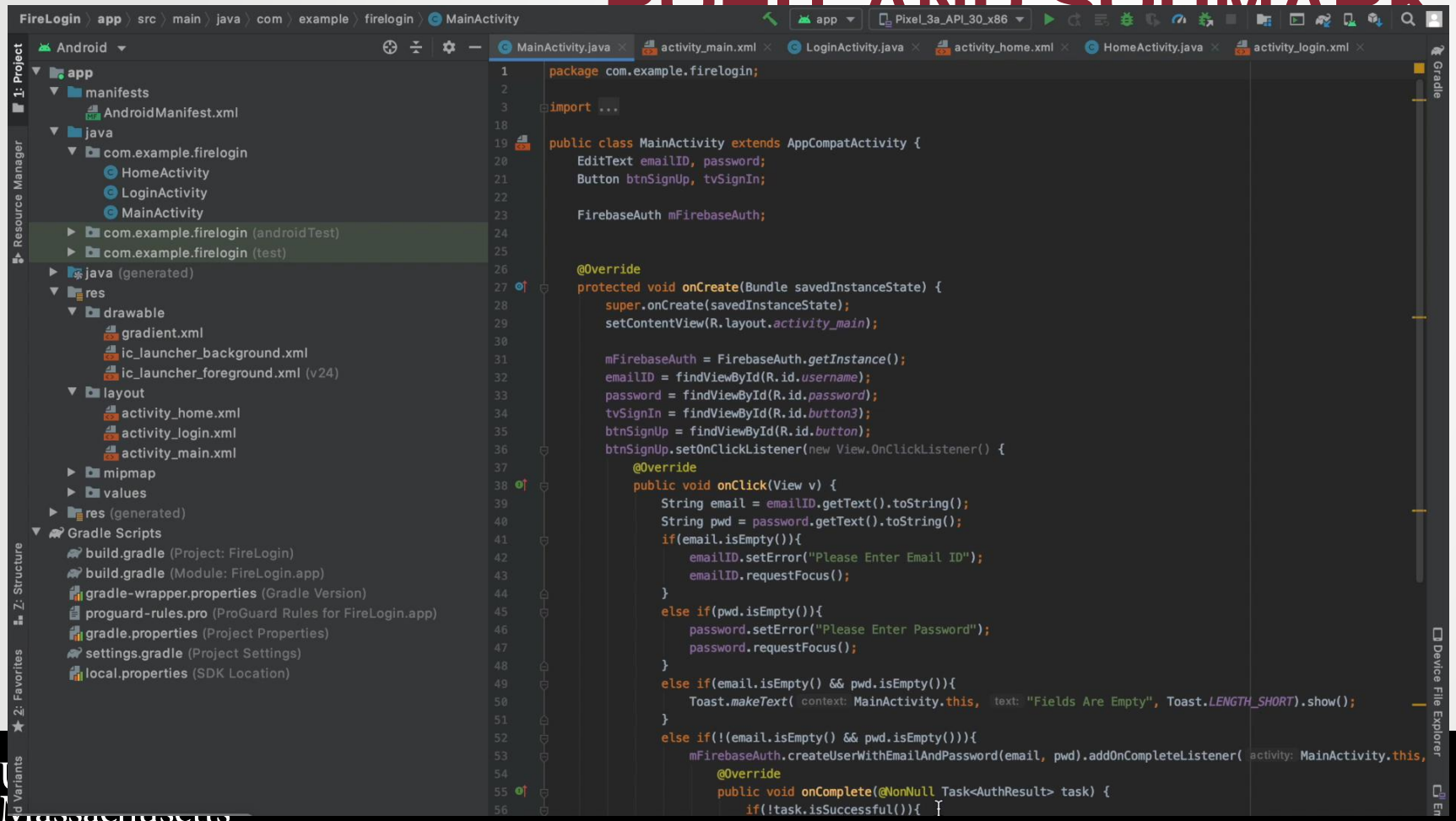


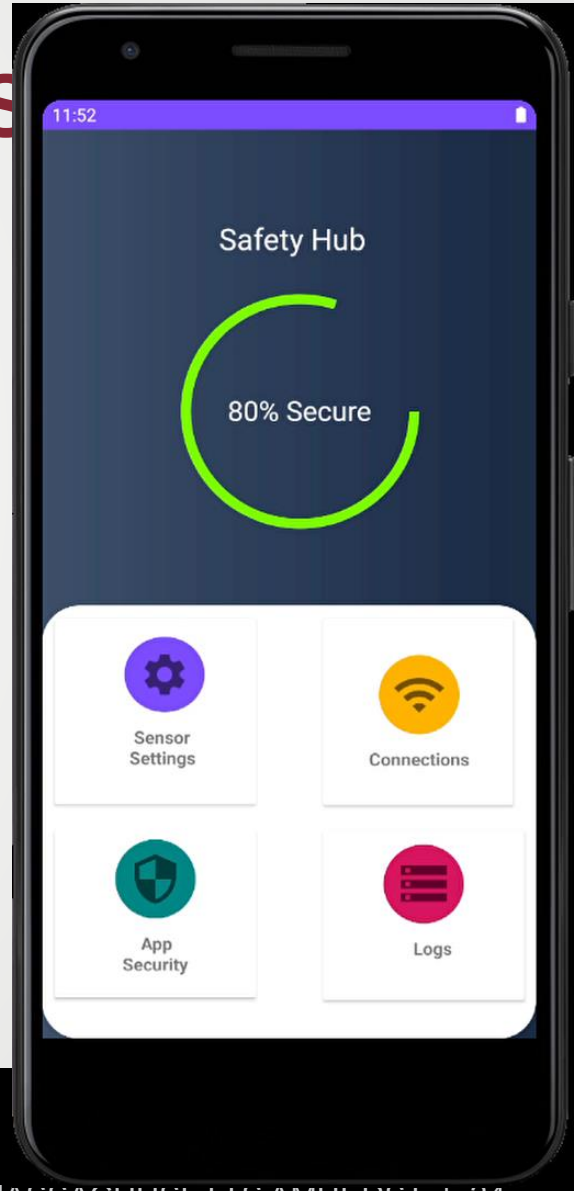
DEMO #3
CLOUD FUNCTIONALITY
SOUMARK RAY



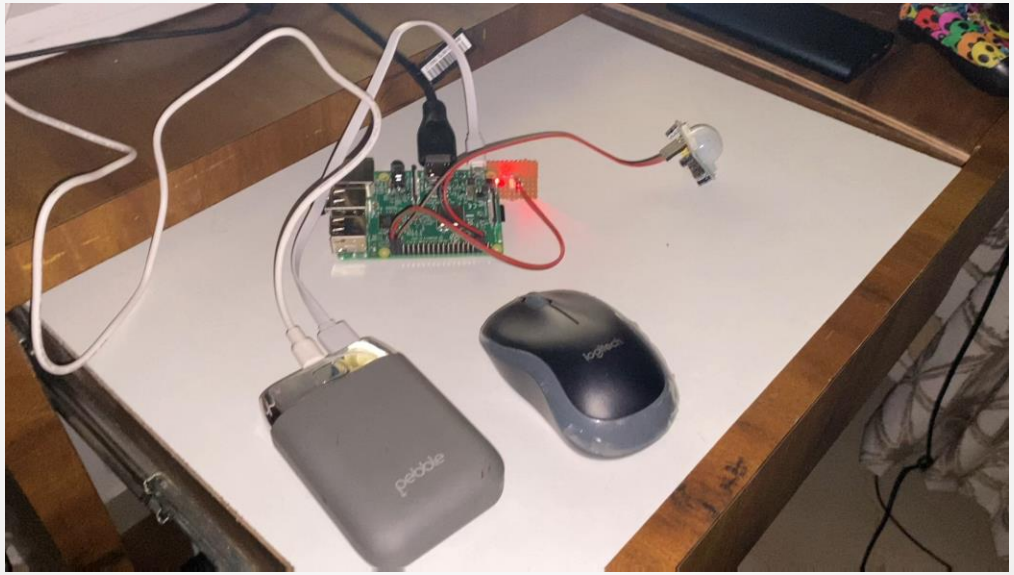


DEMO #4
SAFETYHUB APP AND FEATURES
ROHIT AND SOUMARK





DEMO #5
PIR SENSOR TRIPPED
DHANUSH PALARAPU



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QUESTIONS?

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