IoT Remote Monitoring Application

For Washing Machines and Dryers

Team 17

SDDEC18-17

Team Members & Contributions

John Fleiner & Ben Young

- Android & iOS

Thomas Stackhouse & Casey Gehling

- Spring Boot Web Server
- AWS IoT

Hongyi Bian & Yuanbo Zheng

- Hardware Implementation

Advisor:
Goce Trajcevski

Client:
Greiner Jennings Holdings

Outline

1. Overview
2. Requirements
3. Considerations
4. System Design
5. System Implementation
6. Testing
7. Prototype

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OVERVIEW

Project Overview

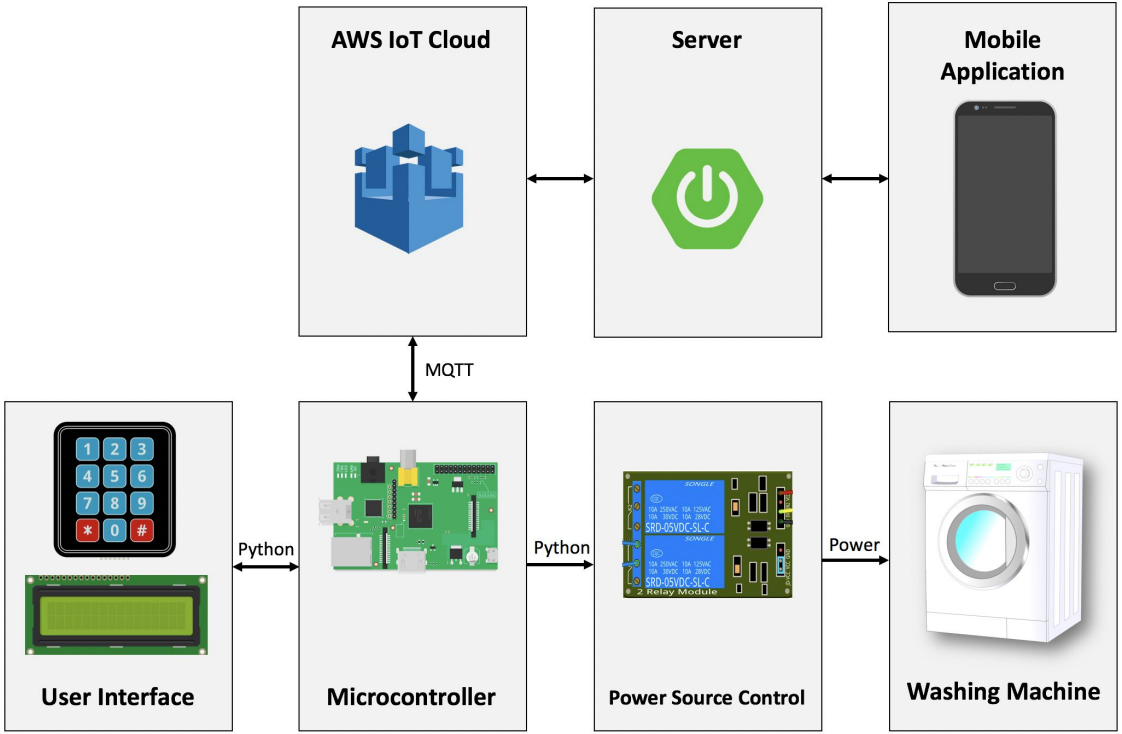
Problem Description

- Laundromats:
  - Managing Multiple Locations
  - Effective Scheduling

Project Goals

- Mobile Reservation Application
- Appliance Assignment Mechanism

Concept Diagram



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REQUIREMENTS

Requirements Specification

Functional Requirements

- Create & Pay for Reservation
- Reservation Code ⟶ Unlock Appliance
- Reservation Ends ⟶ Lock Appliance

Full List of Requirements on pages 16 - 20

Requirements Specification

Non-Functional Requirements

- Secure Personal Data
- Authorized API Access
- Commercially Scalable

Full List of Requirements on pages 21 - 22

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Considerations

Market Survey

IoT Pay-per-wash Industry

- Subscription based services

Microsoft Azure Berendsen IoT Hotel Laundry Service

- IoT tracking on linen ID tags

Samsung Electronic Laundry Innovation

- IoT compatible with SmartThing ecosystem

Resource Requirements

Items	Price
Amazon Web Service IoT	$73.67
Portable Washing Machine	$109.97
Raspberry Pi 3 Model B	$35.00
16x2 LCD Display	$9.95
3x4 Matrix Keypad	$7.50
4-Channel Relay Module	$6.97
Basic Electronic Kit	$15.00
Total:	$258.06

Risks → Mitigations

- **Privacy**
  - HTTPS, Spring Security Auth
- **Storing Credit Cards**
  - Database/Transfer Encryption
- **Accidental Soldering Errors**
  - Backup Hardware

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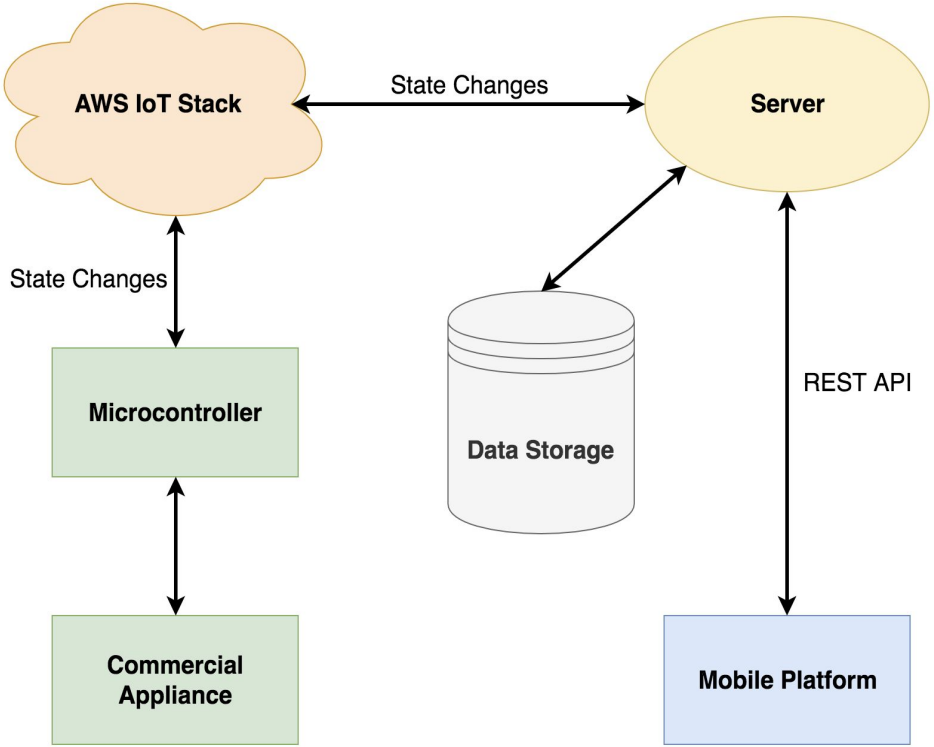
System Design

System Architecture & Analysis



Mobile

- Android/iOS Native Apps

Backend

- Spring Boot Web Server
- AWS IoT
- MYSQL DB

Hardware

- Raspberry Pi 3
- Washing Machine
- Keypad & LCD

Design Trade Offs

- **Spring Server vs Calling DB Directly**
  - Centralized & Scalable
  - Prior Experience
  - Separating Visualization and Computation
- **Native Applications vs Cross Platform**
  - Implementation-Specific Functionality
  - Added Maintenance
- **Cloud Provider - AWS IoT**
  - Clients' Request
  - Prior Experience

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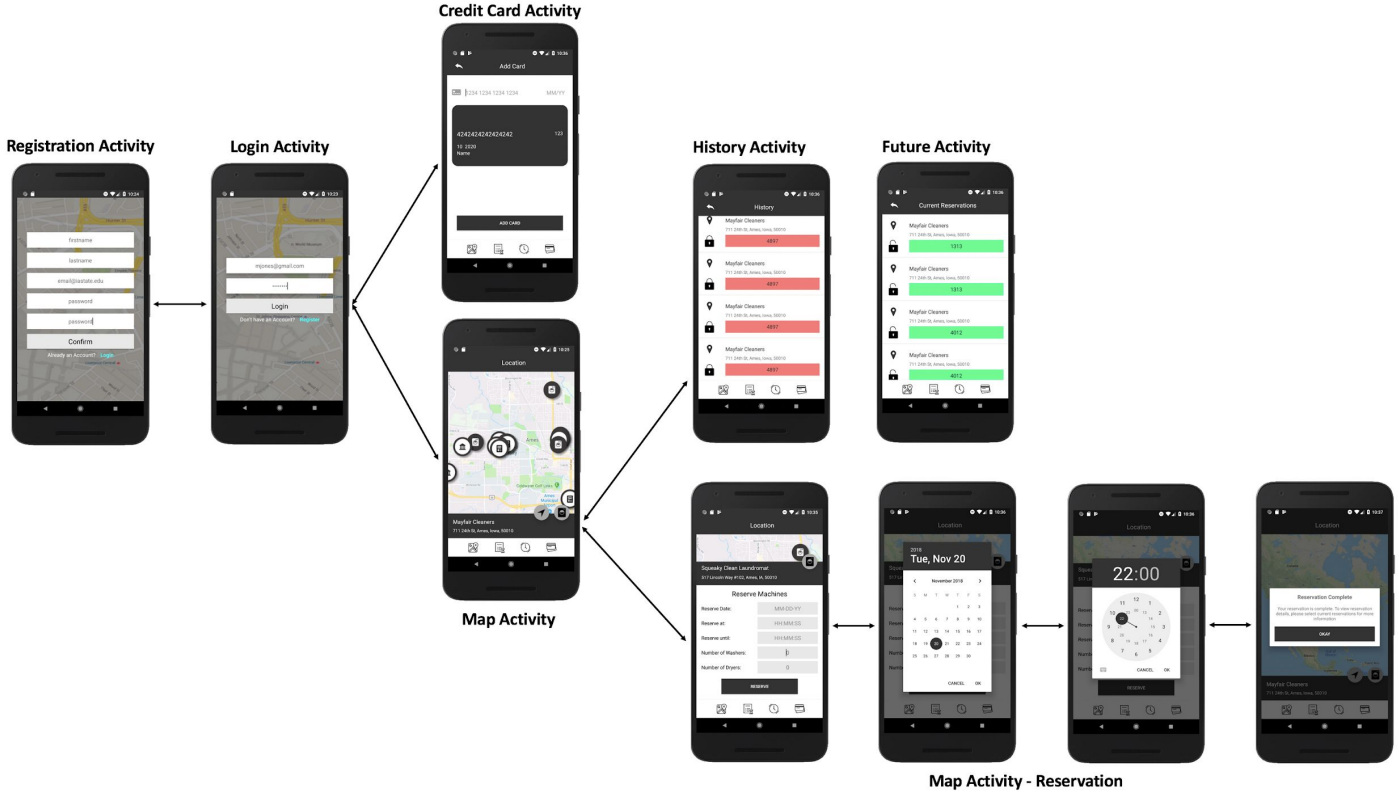
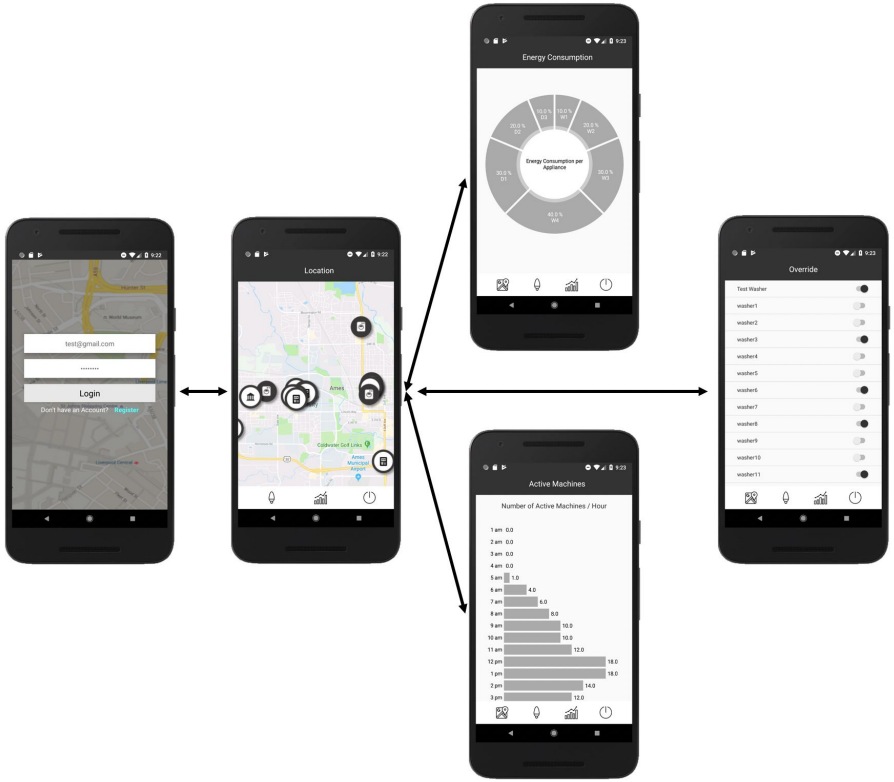
System Implementation

Customer Interface



Admin Interface



Mobile Implementation

SDKS

- Stripe SDK (Payment Transaction Service)
- Google Maps SDK

Libraries

- MPAndroidCharts
- Charts

Backend Design

Web Server

- Spring Boot Web Server (SBWS)

Cloud Service

- Cloud Hosting (AWS)

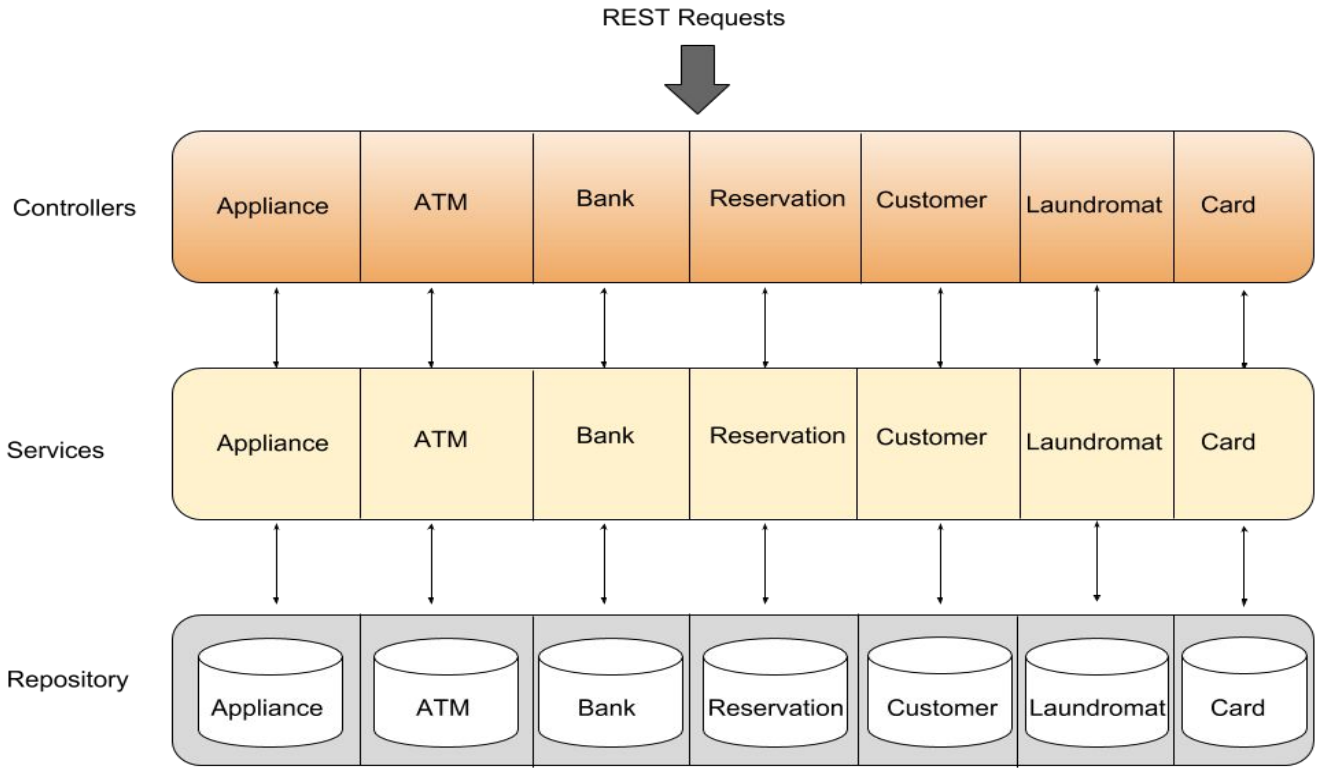
Database

- MySQL External Database

Communication

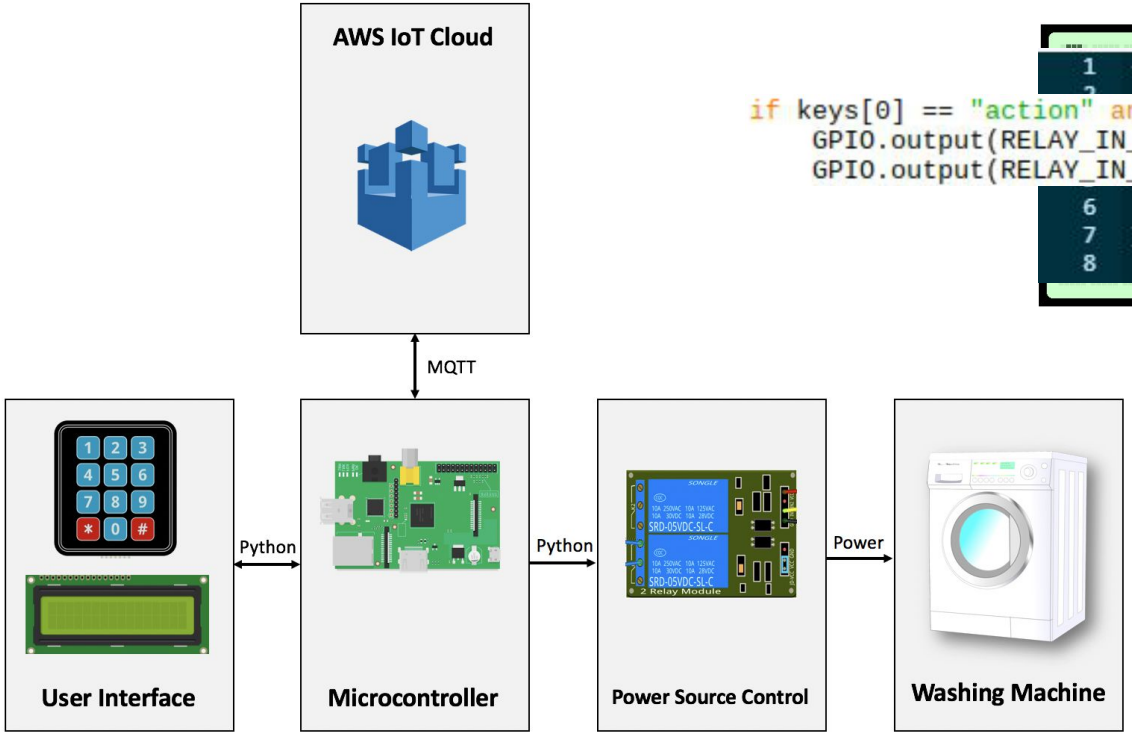
- MQTT Integration

Backend Diagram



- SBWS
- AWS
- MySQL
- MQTT

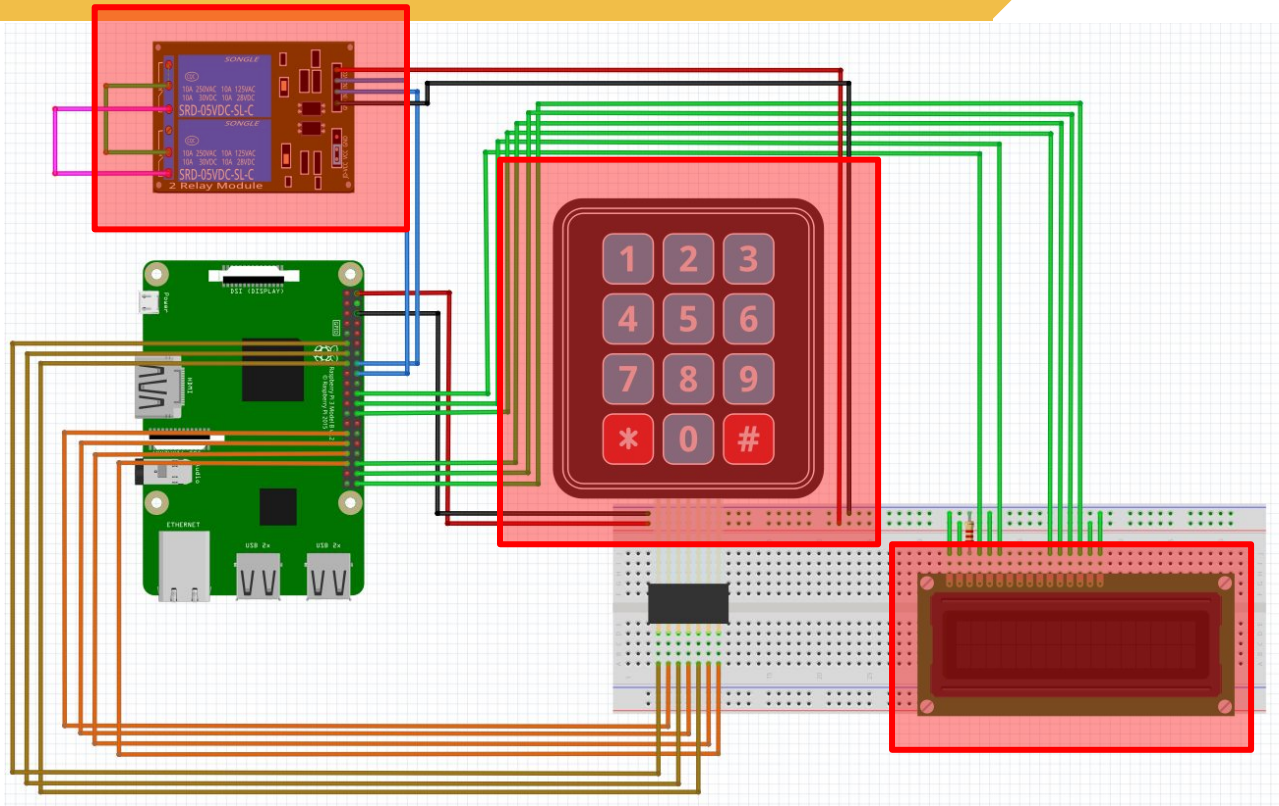
Hardware Concept Diagram




```
if keys[0] == "action" and data['action'] == "on":   #Power on
    GPIO.output(RELAY_IN_1, GPIO.LOW)
    GPIO.output(RELAY_IN_2, GPIO.LOW)
```

```
1  {
6    "action": "on", "time": "3600"
7  }
8
```

Electronic Diagram



RPi 17/40 pins

- 6 → LCD
- 7 → Keypad
- 2 → Relay
- 2 → 5V Power

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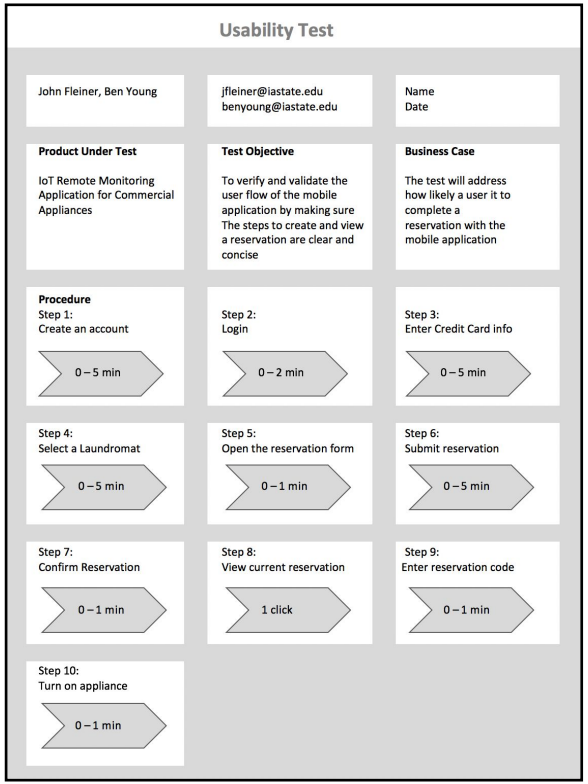
Testing

Mobile Usability Testing



Summary

- On Average 7/9 Tests Originally Passed

Detailed Results

- Please refer to pages 64 - 67 for more detail

Mobile Unit Testing

is_reservation_num_appliances_valid()	Given a request for 1000 machines, verify that the applications displays a warning and prevents a reservation from being created	False	False
is_reservation_valid_card()	Given a valid reservation, but an invalid credit card, verify that the applications displays a warning and prevents a reservation from being created	False	False

Summary

- 21/28 Tests Originally Passed
- 75% Success Rate

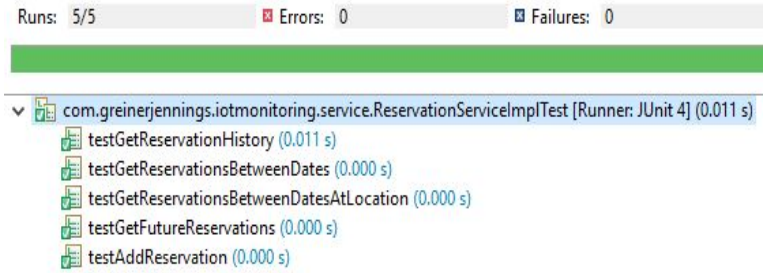
Detailed Results

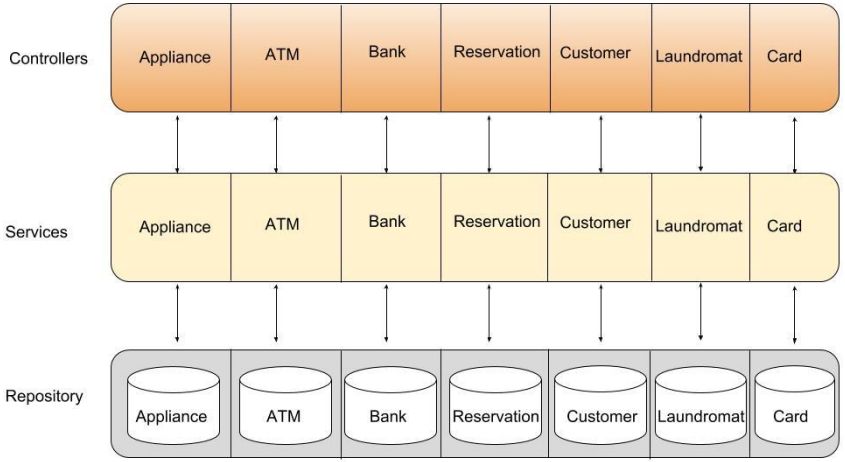
- Please refer to pages 67 - 71 for more detail

Backend Testing & Results

Completed JUnit Testing

- Service Layer
- Repository Layer





Hardware Testing

Onboard Scripts Testing

- Python Scripts
- Shell Scripts

Circuit Functionality Testing

- Relay Module
- LCD Screen
- Keypad

Lessons Learned & Client Feedback

Lessons Learned

- Soldering: Delicate Work
- Many UI Iterations

Client Feedback

- Pleased with Prototype
- Un-concerned of Scalability

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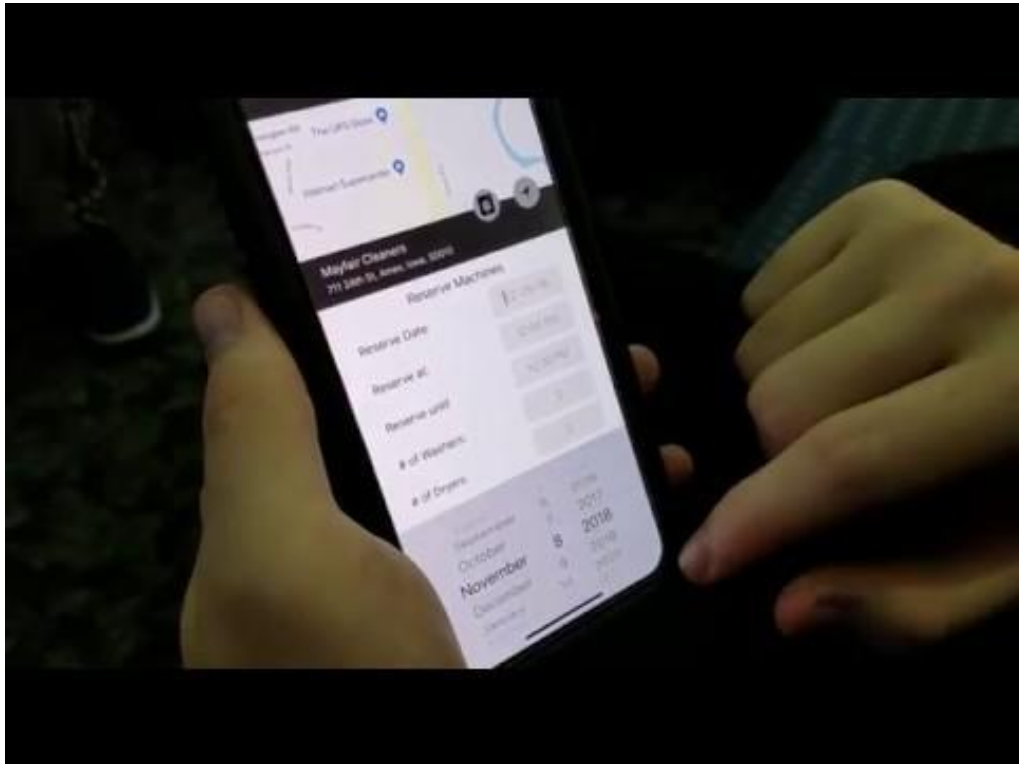
Prototype

Prototype Demo



Future Work - Commercialization

Commercialization

- Data Privacy Enhancements
- AWS Scalability

Future Work

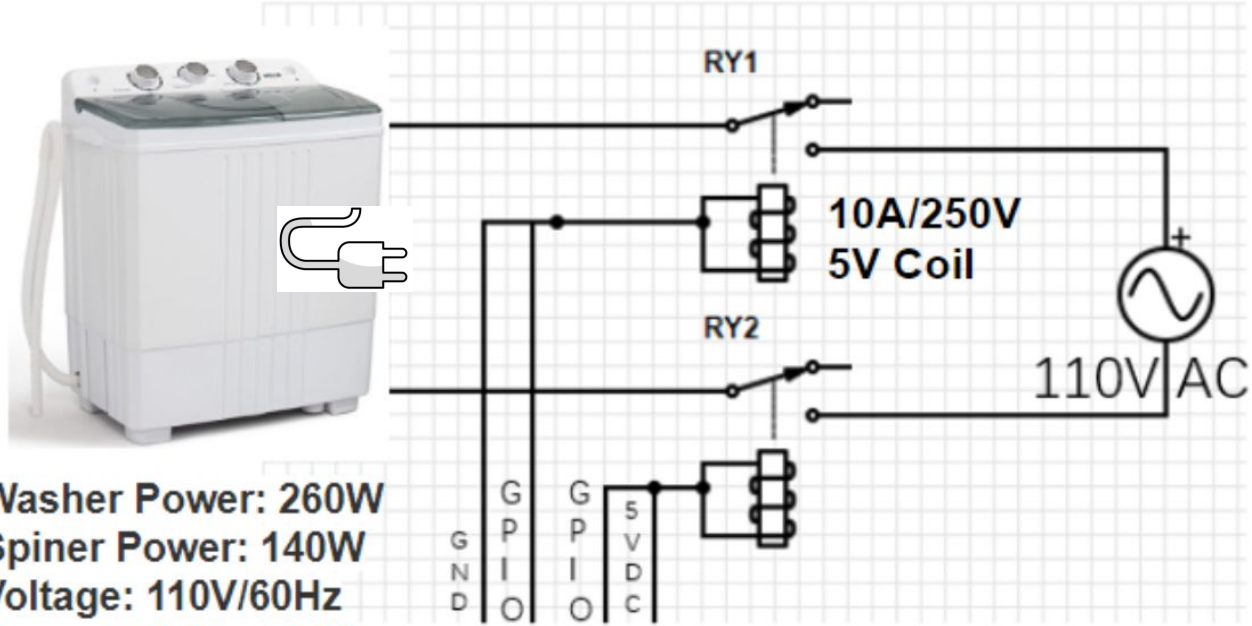
- Surge Pricing
- Hardware Usage Analytics
- Multi-Location Analytics

THANKS!

Any questions?

sddec18-17@iastate.edu

Circuit Diagram



Washer Power: 260W
Spiner Power: 140W
Voltage: 110V/60Hz
Current: 1.2A ~ 2.2A