

Project Report

CS 6349, Fall 2016

AutoSense

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1. Introduction

“AutoSense” is an android application developed to measure the RSSI (Received Signal Strength Indicator) of the TI sensor tag in various indoor and outdoor environments. The app provides the user to select a beacon for testing and presents the measured data in the form of line charts for visual analysis. The app also assists in measuring the threshold speed up to which the beacon can be detected.

Using this app, the development team has performed the RSSI measurements of beacons (TI SensorTag) in various scenarios in the indoor and outdoor environment. The results of this testing are presented in the later part of this document.

1.1 Purpose

The purpose of this project is to benchmark the sensor tag based on the captured RSSI values captured from the sensor tag.

1.2 Scope

This application allows the user to detect nearby beacons, capture RSSI, generate graph based on the RSSI values.

1.3 Project Overview

AutoSense

- The “AutoSense” android application captures the RSSI (Received Signal Strength Indicator) of the BLE beacon.
- The captured data is then presented in the form of graphs for analysis.
- In addition to this, the threshold speed up to which a beacon can be detected is measured.

TI Sensor tag CC2650STK

Texas Instruments CC2650STK SimpleLink™ Bluetooth Smart SensorTag IoT Kit assists design engineers to realize cloud connected product ideas. The SensorTag includes 10 low power MEMS sensors in a tiny red package. The SensorTag is based on the CC2650 wireless

MCU, offering 75% lower power consumption than previous Bluetooth Smart products. This allows the SensorTag to be battery powered, and offer years of battery lifetime from a single coin cell battery.

The SensorTag has IoT connectivity support for the following sensors:

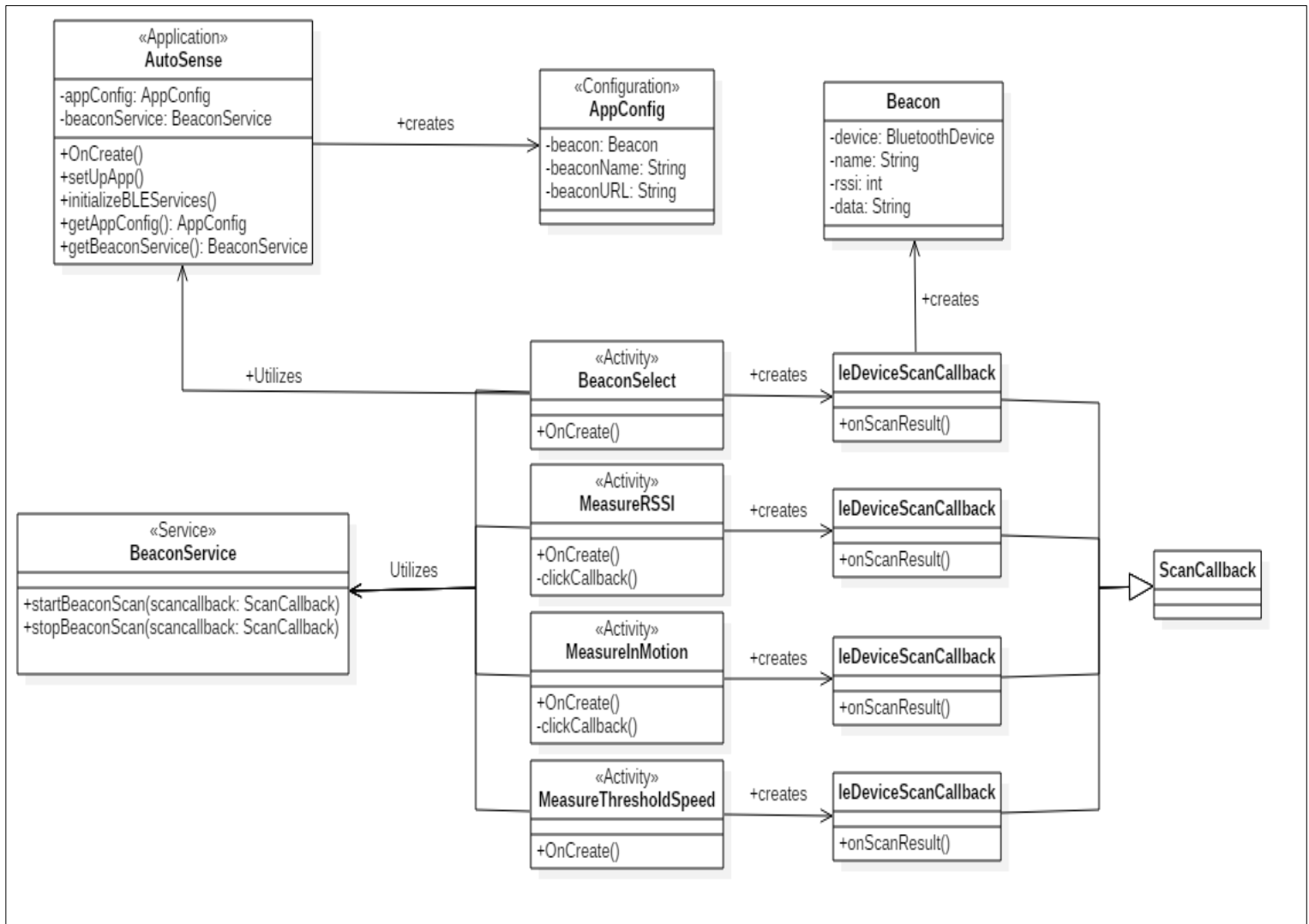
- IR Temperature, both object and ambient temperature
- Movement, 9 axis (accelerometer, gyroscope, magnetometer)
- Humidity, both relative humidity and temperature
- Barometer, both pressure and temperature
- Optical, light intensity

2. Requirements

- TI Sensor Tag CC2650STK
- Android phone with Bluetooth 4.0
- Minimum Android Version - 5.1

3. Design

Class Diagram



4. Test results

Test bed:

Phones: Moto G3 and Moto E1

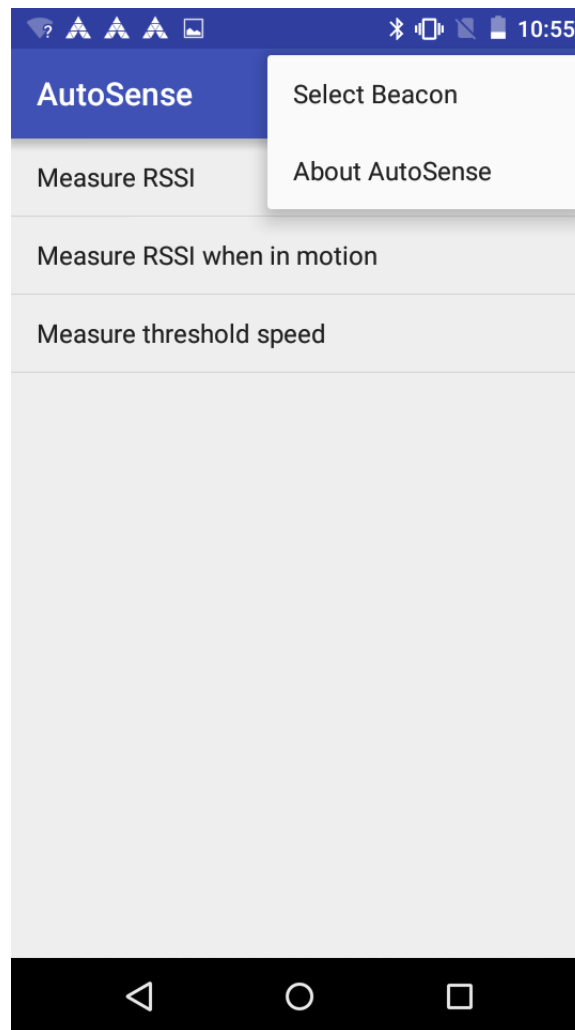
Android Versions: 6.0 and 5.1 respectively

Environment: ERB 5th ,6th floor and Parking Lot 50

BLE Device: TI Sensor tag CC2650STK

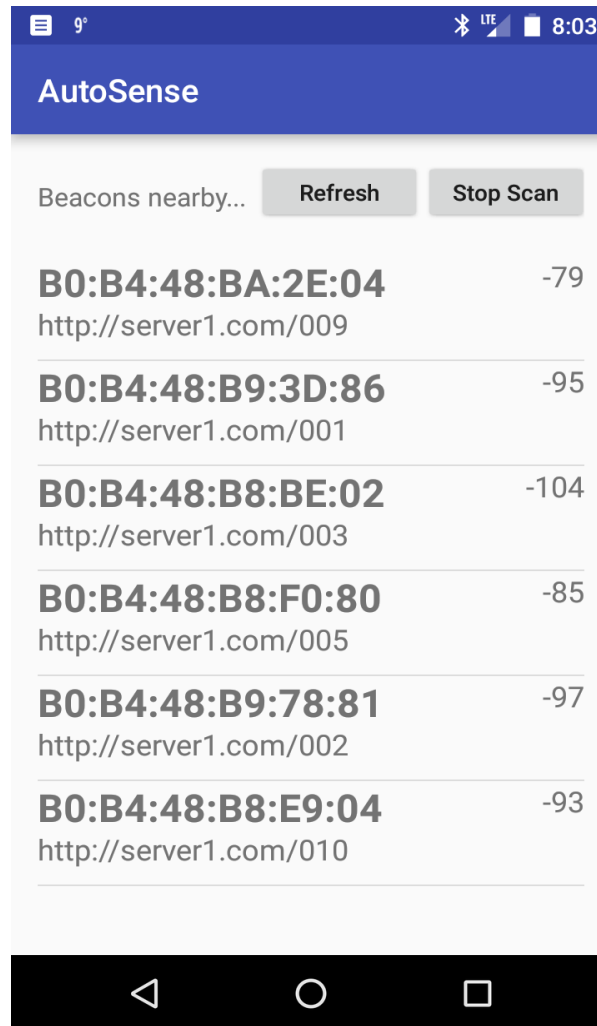
Bluetooth version: 4.0

4.1 Home screen of AutoSense



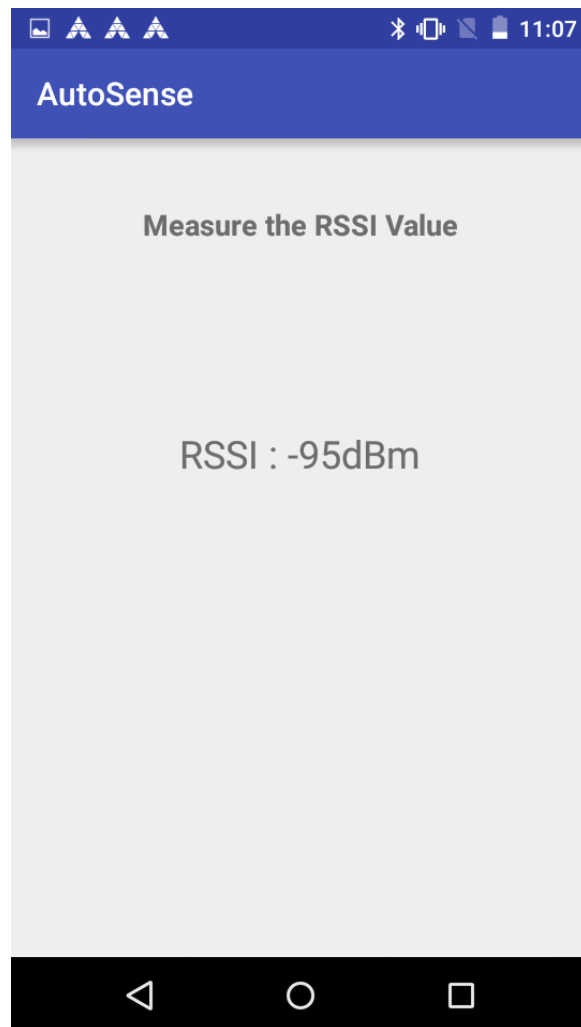
This is the home screen of the app. Here, the user is presented three main options of performing the tests on the beacon. Additionally, a menu is also provided to select the beacon. The user has to select the beacon first to start the test.

4.2 List of nearby beacons



In this screen, a list of all nearby beacons will appear with RSSI and the URL. The user can select the beacon for testing. The user can also refresh or stop the scan.

4.3 RSSI value of selected beacon

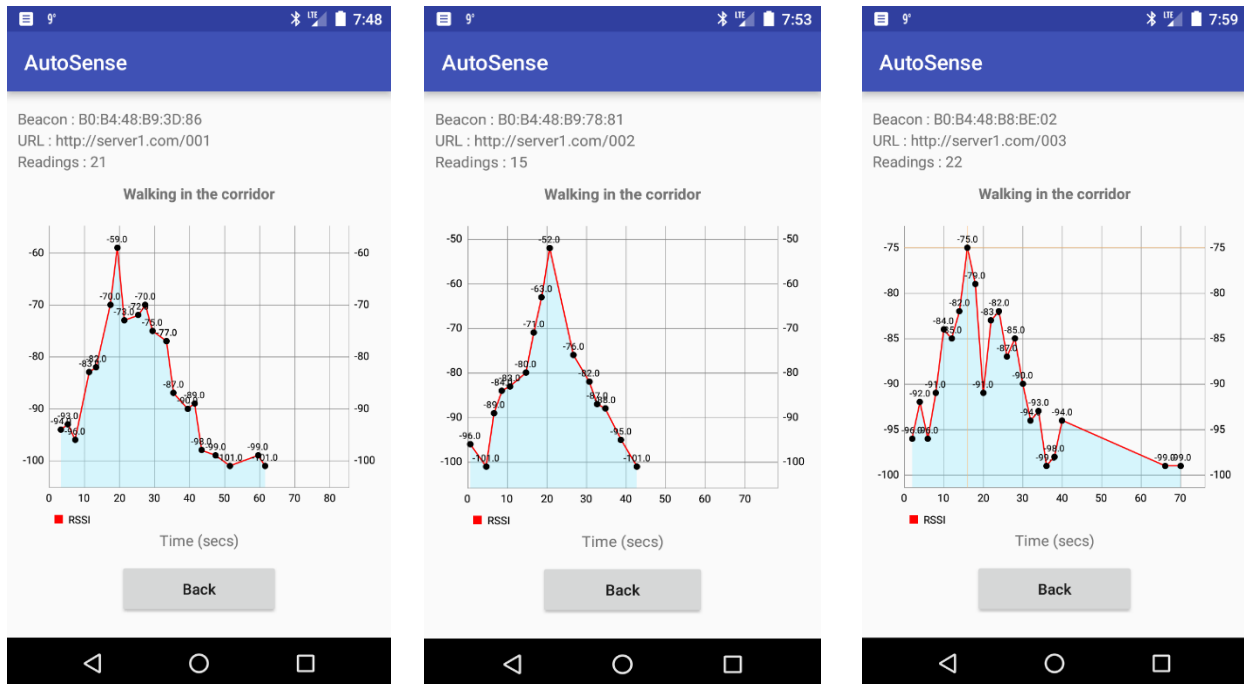


When the user selects the first option, the app navigates to the above screen. Here, the RSSI value of the selected beacon is displayed. The RSSI continuously updates as and when a scan record of the beacon is received by the mobile phone.

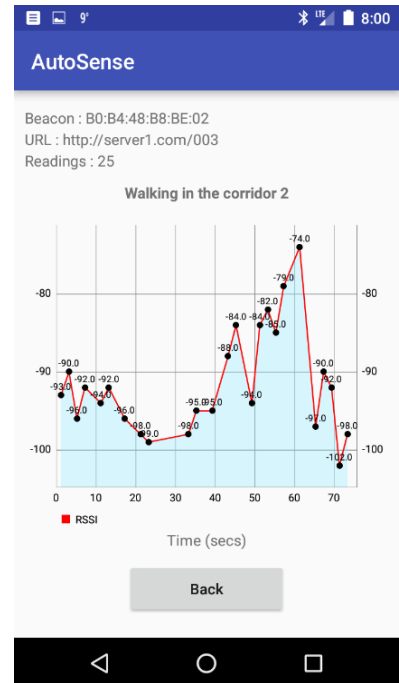
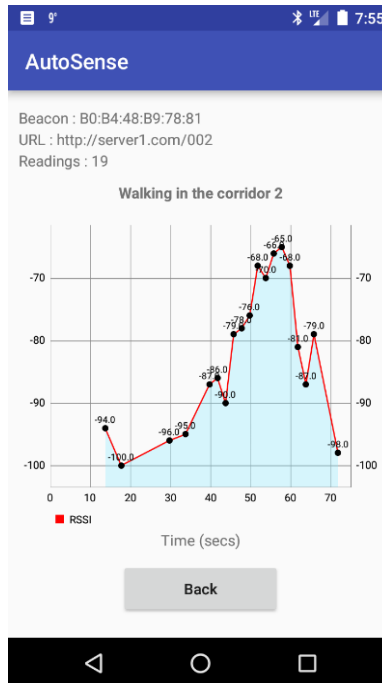
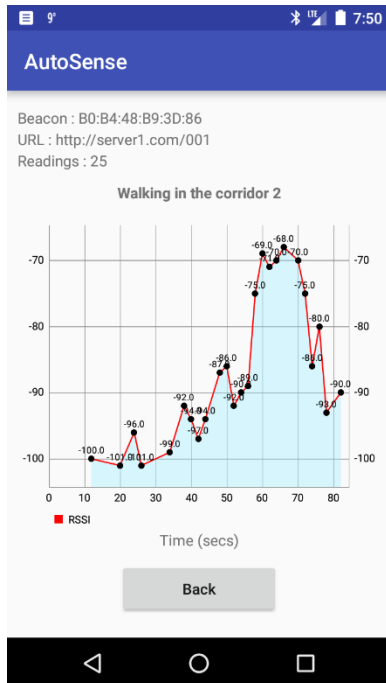
4.4 RSSI measurements in various indoor scenarios

We captured the RSSI of beacons in various scenarios using Moto G3 and Moto E1. Below are the various scenarios

4.4.1 Walking in the corridor with a Moto G3

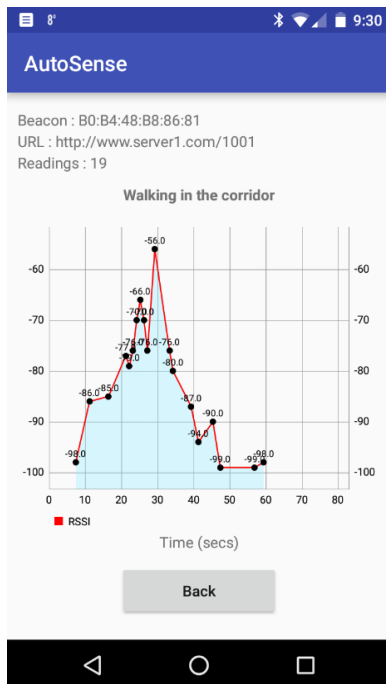


Measured RSSI of 3 beacons – Walking in the corridor

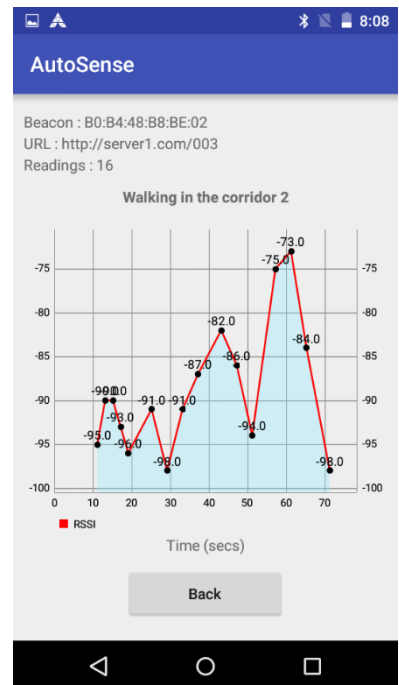
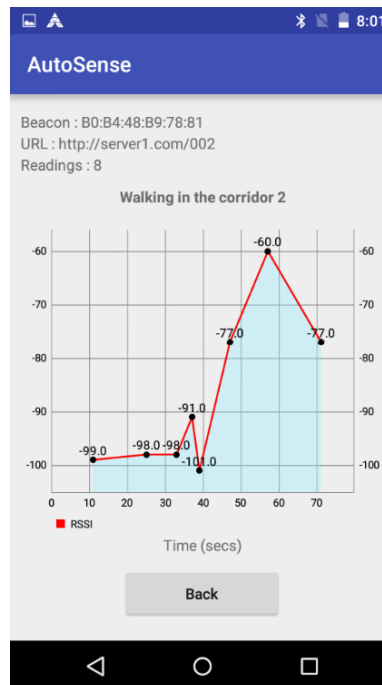
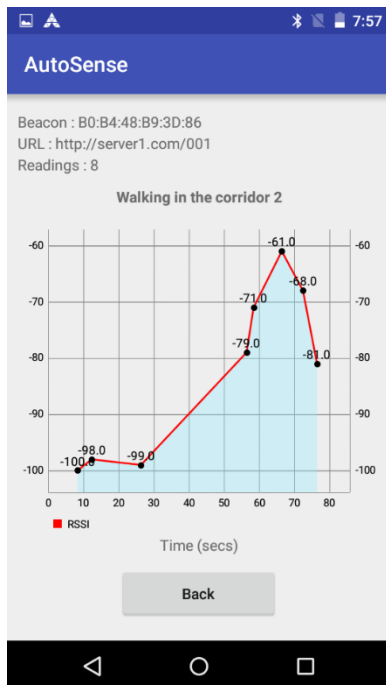
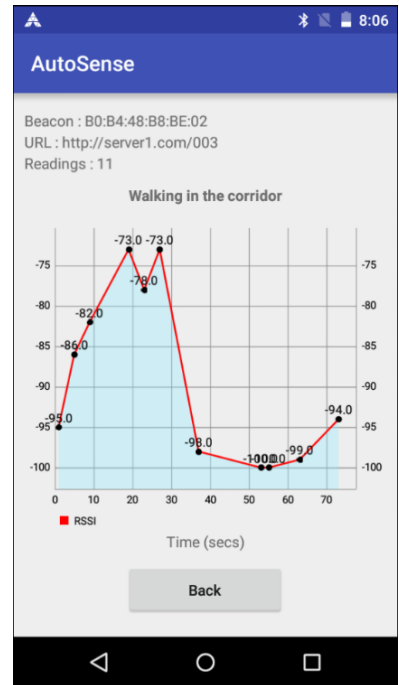
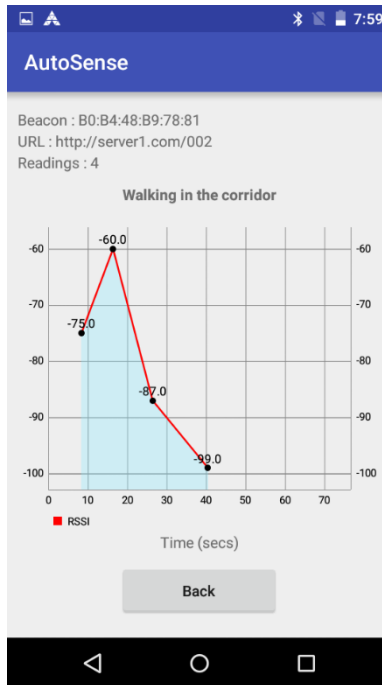
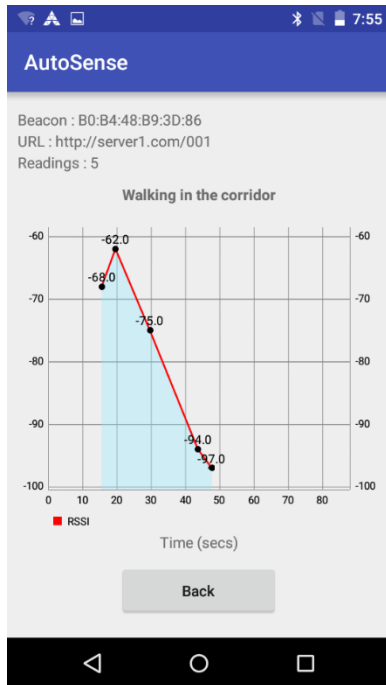


Measured RSSI of 3 beacons – Walking in the same corridor from the opposite direction

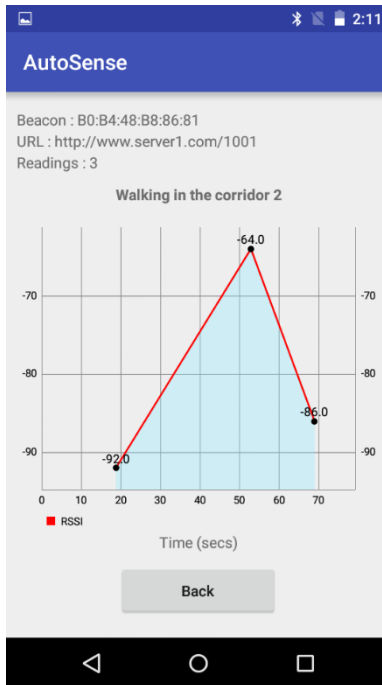
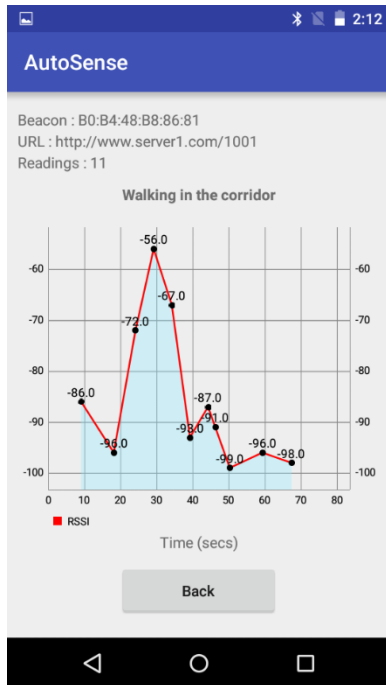
With calibrated beacon advertising at 10 Advertisements/sec



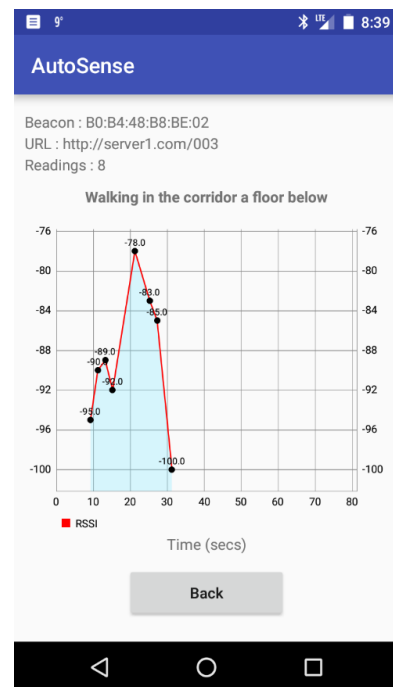
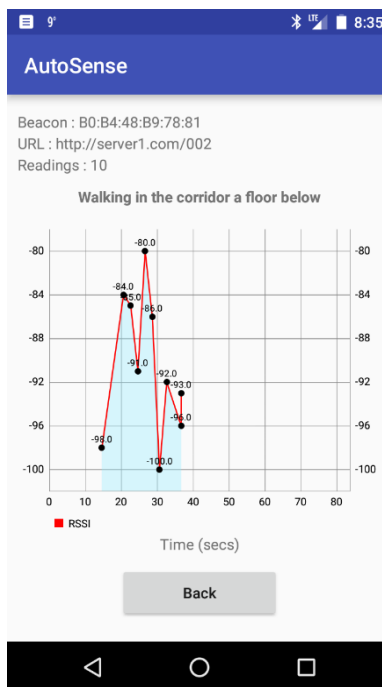
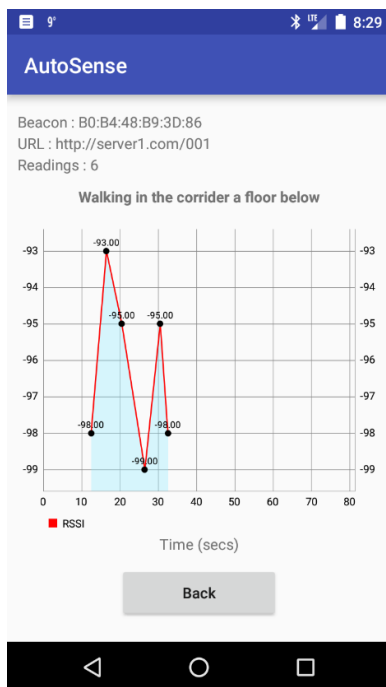
4.4.2 Walking in the corridor with a Moto E1

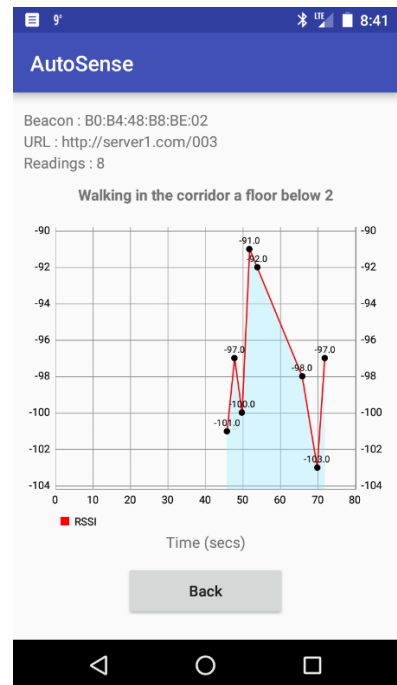
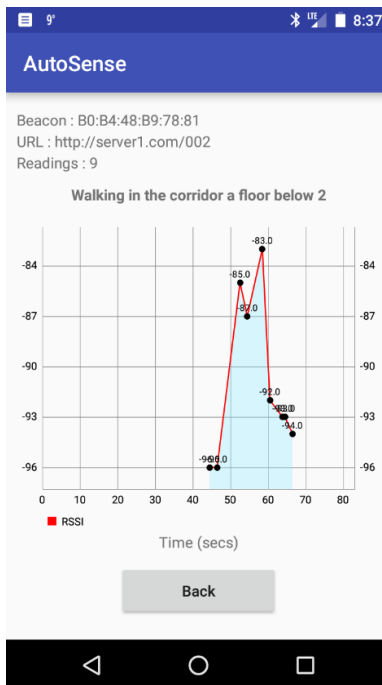
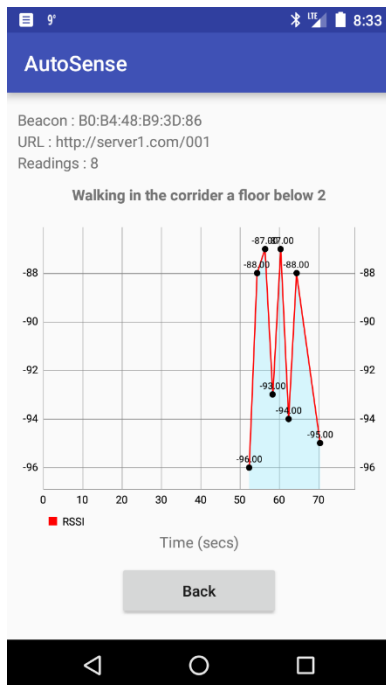


With calibrated beacon

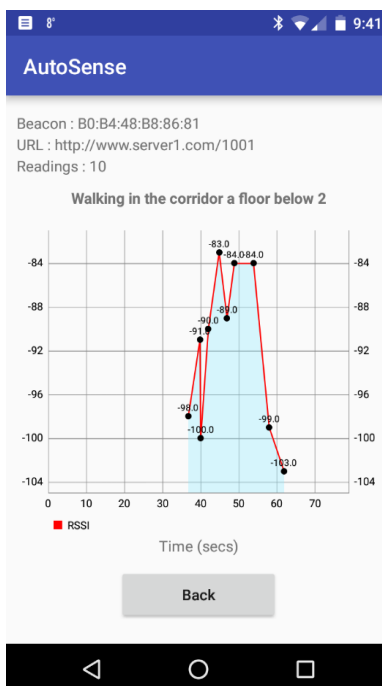
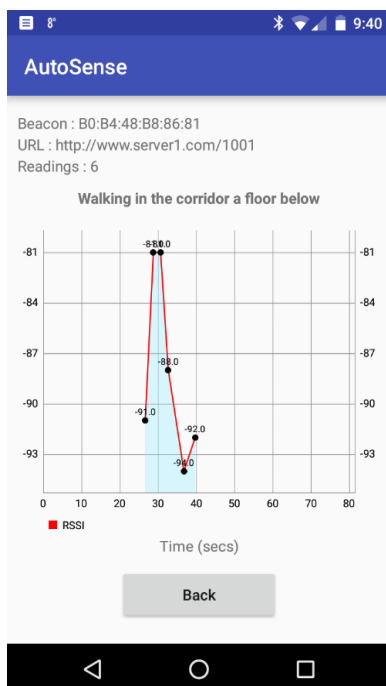


4.4.3 Walking in the corridor a floor below with a Moto G3

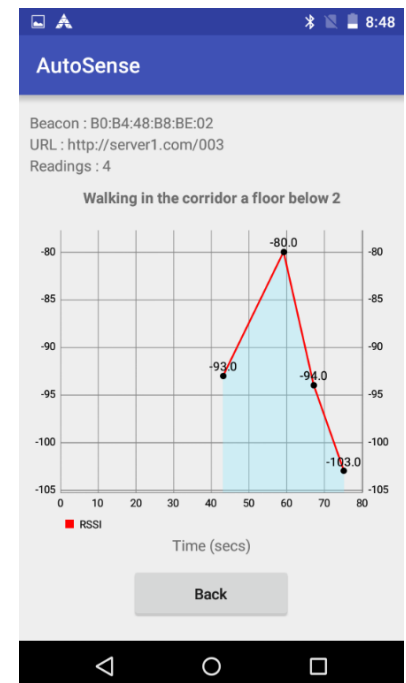
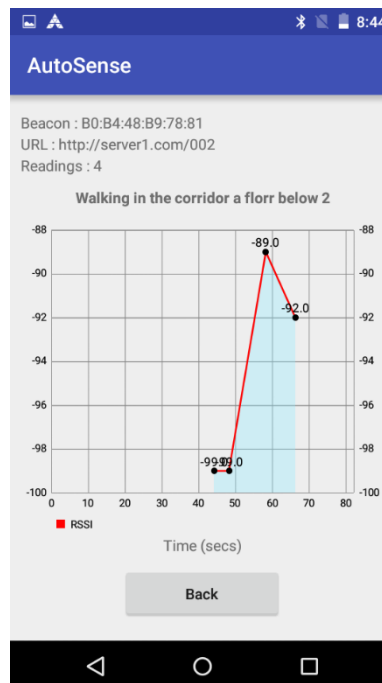
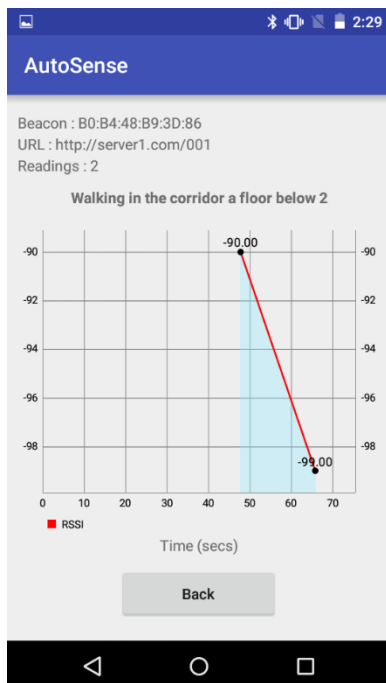
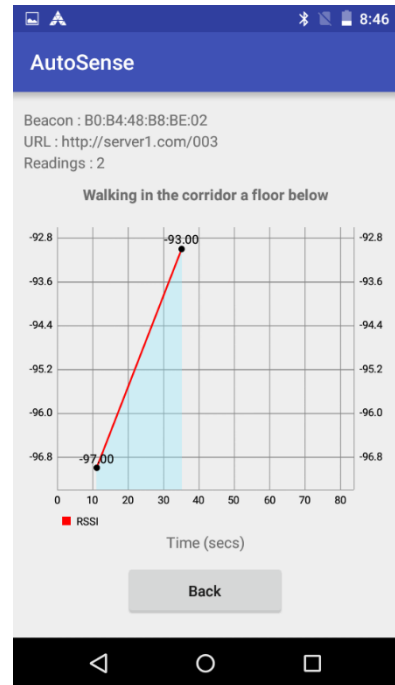
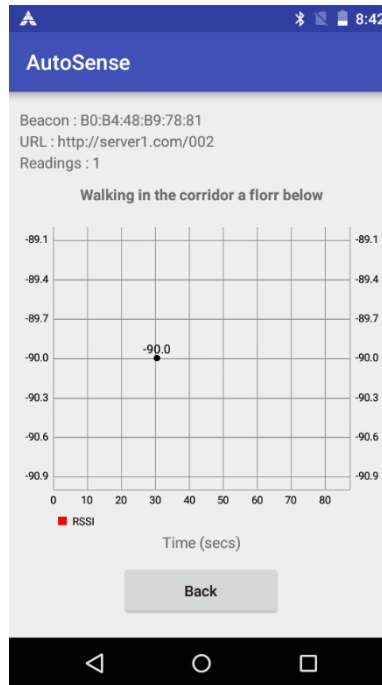
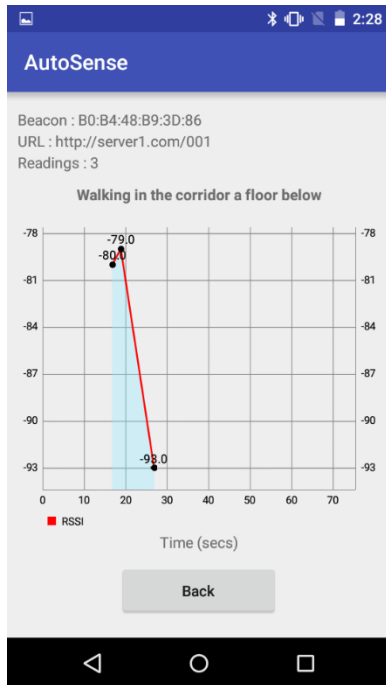




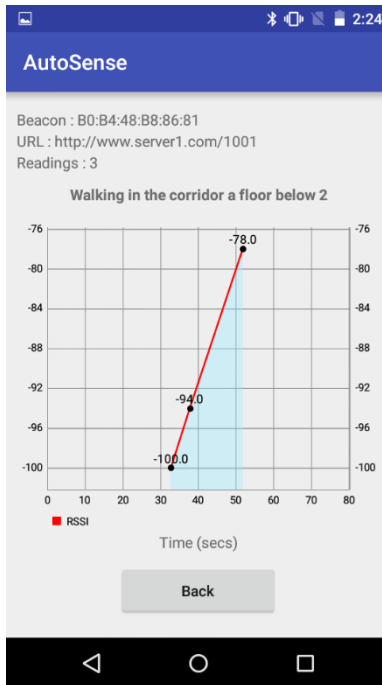
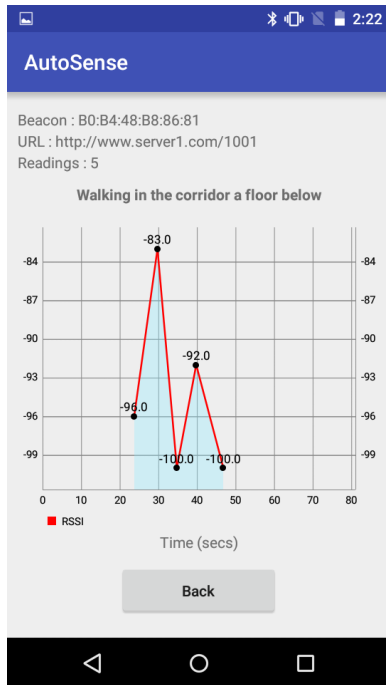
With calibrated beacon



4.4.4 Walking in the corridor a floor below with Moto E1



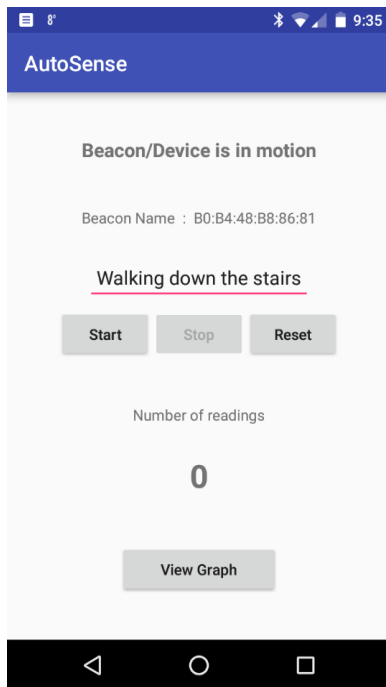
With calibrated beacon



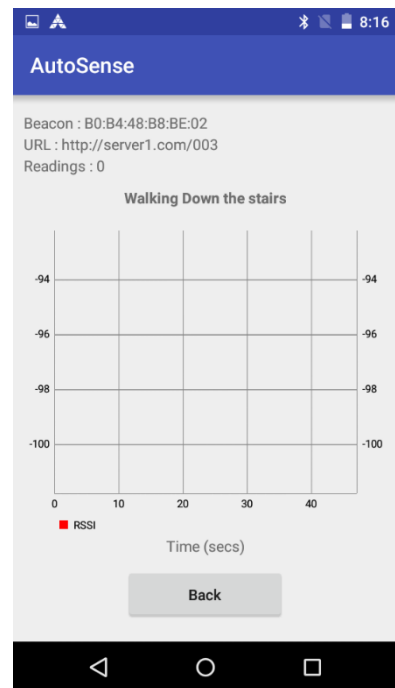
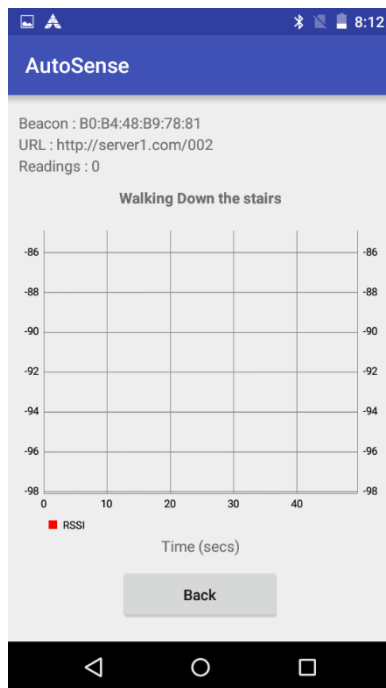
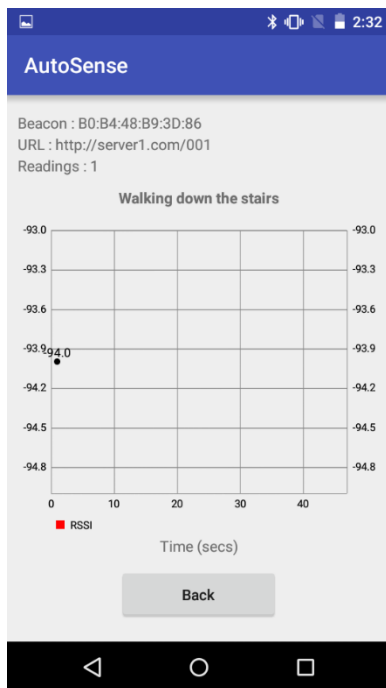
4.4.5 Walking down the stairs with Moto G3



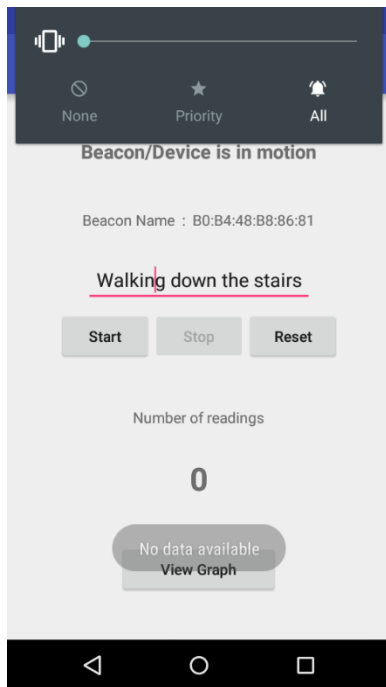
With calibrated beacon



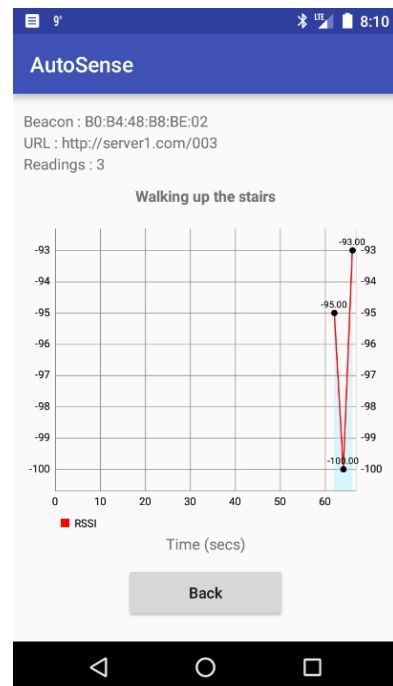
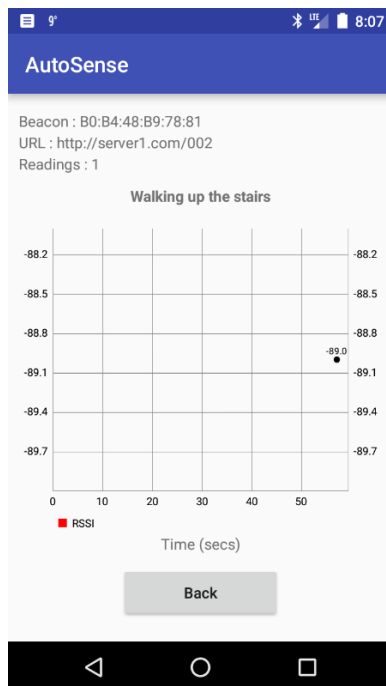
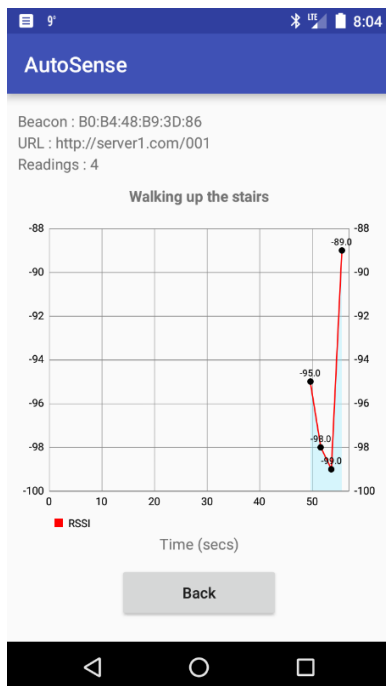
4.4.6 Walking down the stairs with Moto E1



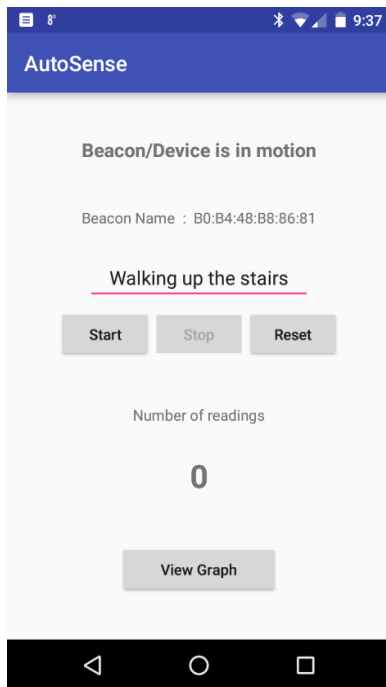
With calibrated beacon



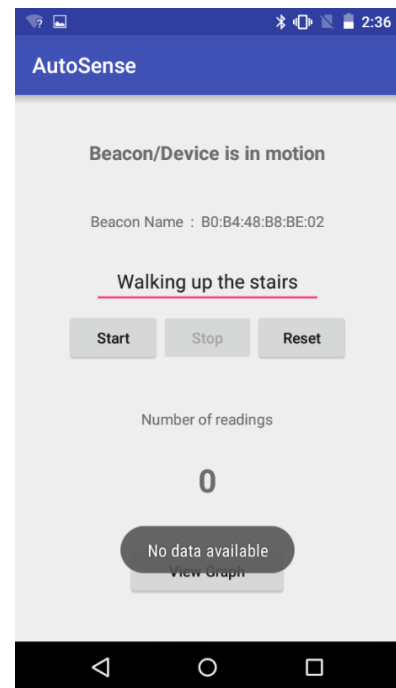
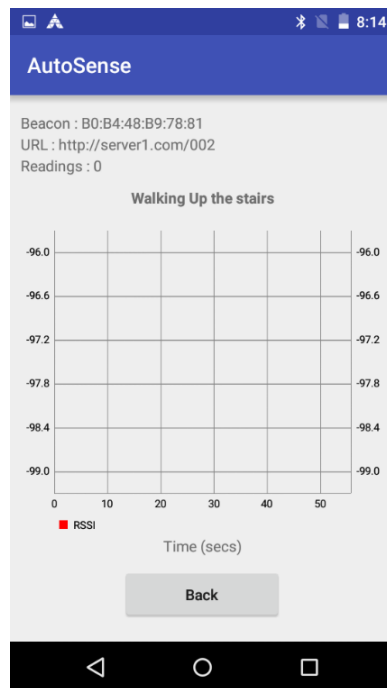
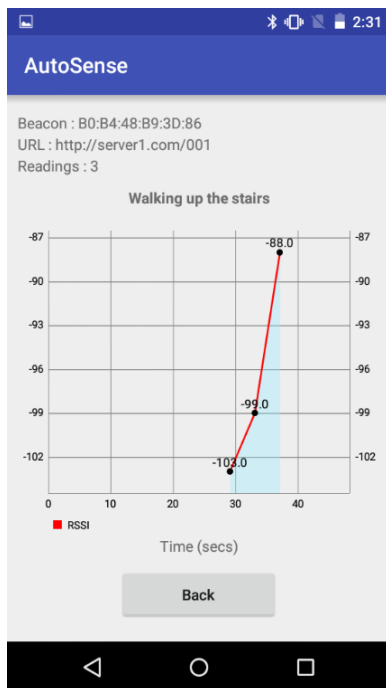
4.4.7 Walking up the stairs with Moto G3



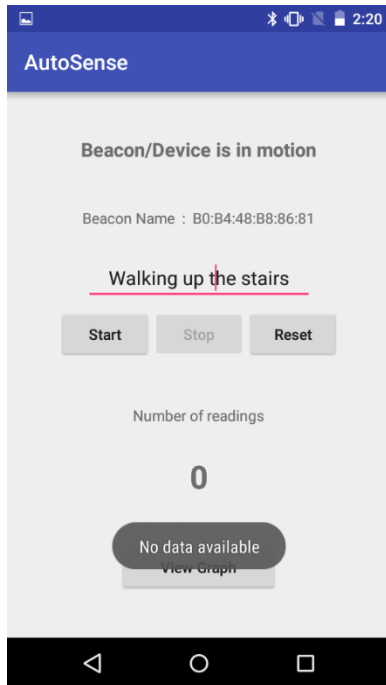
With calibrated beacon



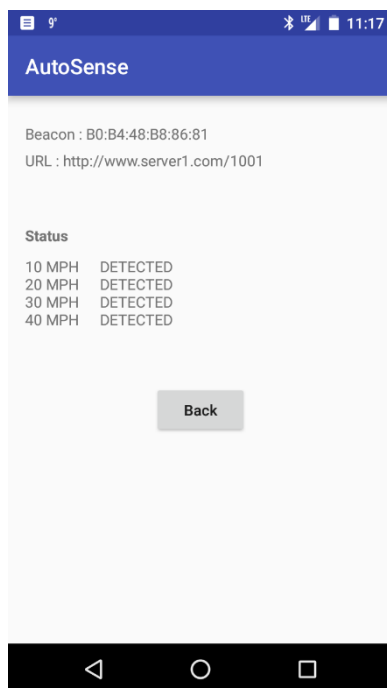
4.4.8 Walking up the stairs with Moto E1



With calibrated beacon



4.5 Measuring threshold speed in outdoor environment



5. Observations

- MotoG3 was able to pick up more advertisements than MotoE.
- More number of advertisements were detected when phone was closer to the beacon.
- In the outdoor, the beacon was detected when it was in motion at the speeds 10, 20, 30, 40mph.

6. References

- Android BLE SDK:
<https://developer.android.com/guide/topics/connectivity/bluetooth-le.html>
- Physical Web:
<https://github.com/google/physical-web>
- MP Android Chart:
<https://github.com/PhilJay/MPAndroidChart>