ERTOS Mini Project Report

Maharashtra Institute of Technology, Pune

Department of Computer Engineering

Smart Traffic Light System

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1. Purpose and Requirement Specification

System Purpose

Smart traffic light system is an IoT based project which primarily aims to control the traffic lights on the roads in accordance with the varying traffic density on these roads and analyze the commuter traffic.

Behavior

In its normal operation, the system operates the traffic lights in a predetermined order for a fixed amount of time. On detection of more cars on a particular road, that road is given more priority over the others and will break the predetermined order, to let that traffic go first. It also sends all this data to the cloud to enable analysis about the busiest road and traffic density on each road.

Requirements

1. **Hardware Requirements:** Raspberry Pi 3.0, 8 LEDs, 2 breadboards, wires, connectors, HDMI cable
2. **Software Requirements:** Raspbian O.S., in-built Python, Google's Firebase platform, Firebase cloud database.

● **System management requirements:**
   Functioning of the traffic lights according to the dynamic traffic flow.

● **Data analysis requirements:**
   System analyses the traffic density along with the optimal route for traffic diversion.

● **Application Deployment Requirement:**
   The system does not incorporate any application. The data storage and analysis can be done on the Firebase platform.

● **Security Requirement:**
   Access to the database on Firebase will require the correct login credentials so the traffic data of all roads can be viewed only by the authenticated person.

2. Process Specification Model

The system mainly consists of 4 traffic signals at a crossroad. Thus, the devices involved are LED's whose ordering is controlled through the program on Raspbian. The flow of the Smart Traffic Light System is defined below as follows:
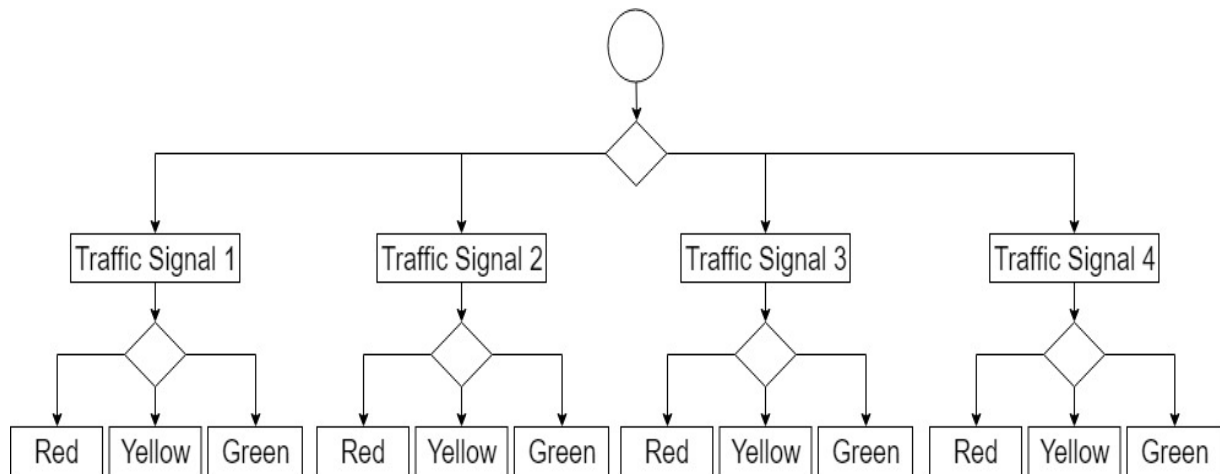

Fig 1. Process Model Specification

3. Domain Model Specification

The Domain Model Specification defines the entities, objects and concepts involved in the Smart Traffic Light System. These are given as follows:

- **Physical Entity**
    It includes any entity/object which can be clearly identified in the physical environment of the system.
1. Lights
2. Cars
3. Roads

- **Virtual Entity Attribute**
    Virtual entity is defined as the representation of physical entity in the digital world.
1. LEDs
2. Detectable toy cars
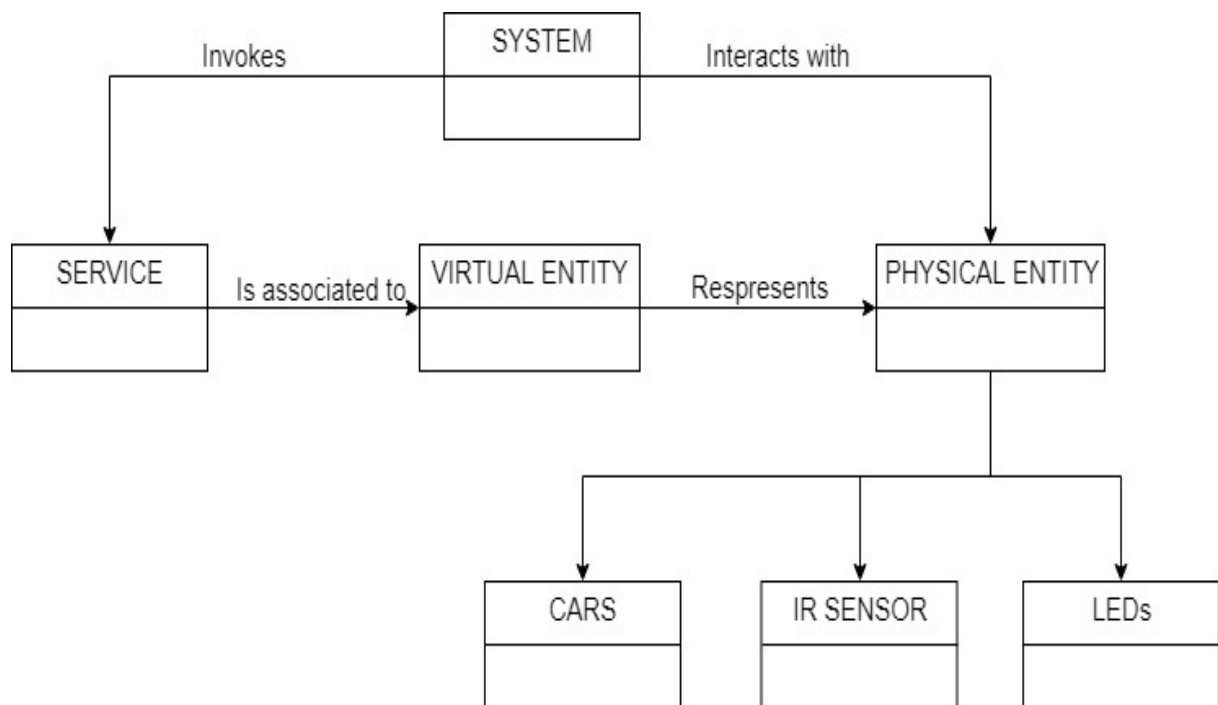3. Raspberry Pi application

Fig 2. Domain Model Specification
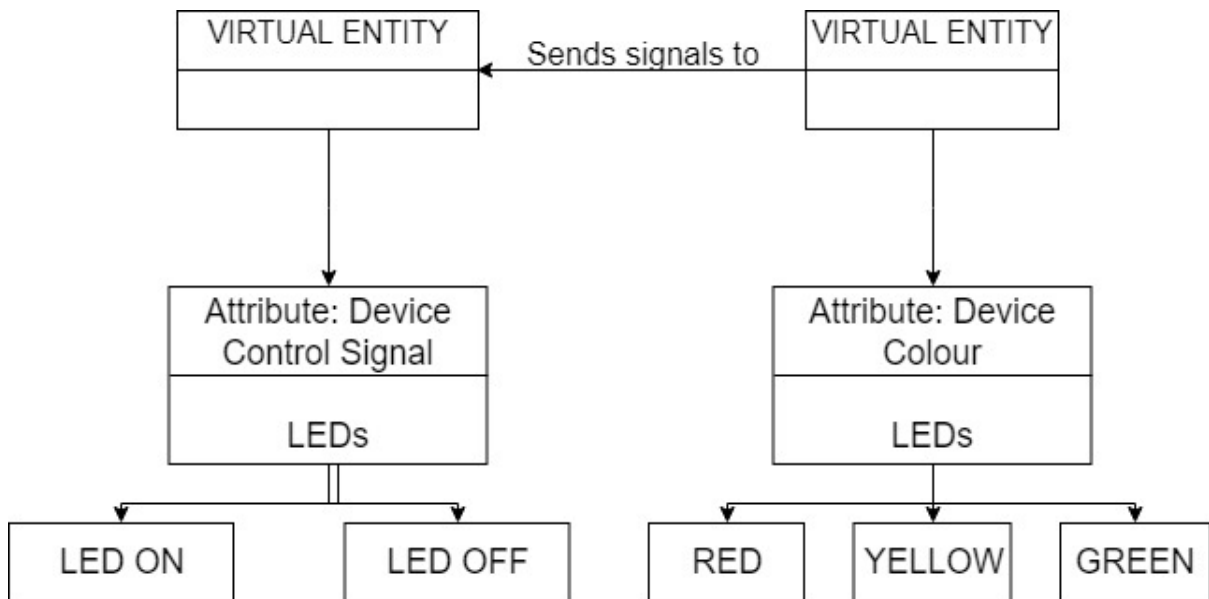
4. Information Model Specification

Fig 3. Information Model Specification
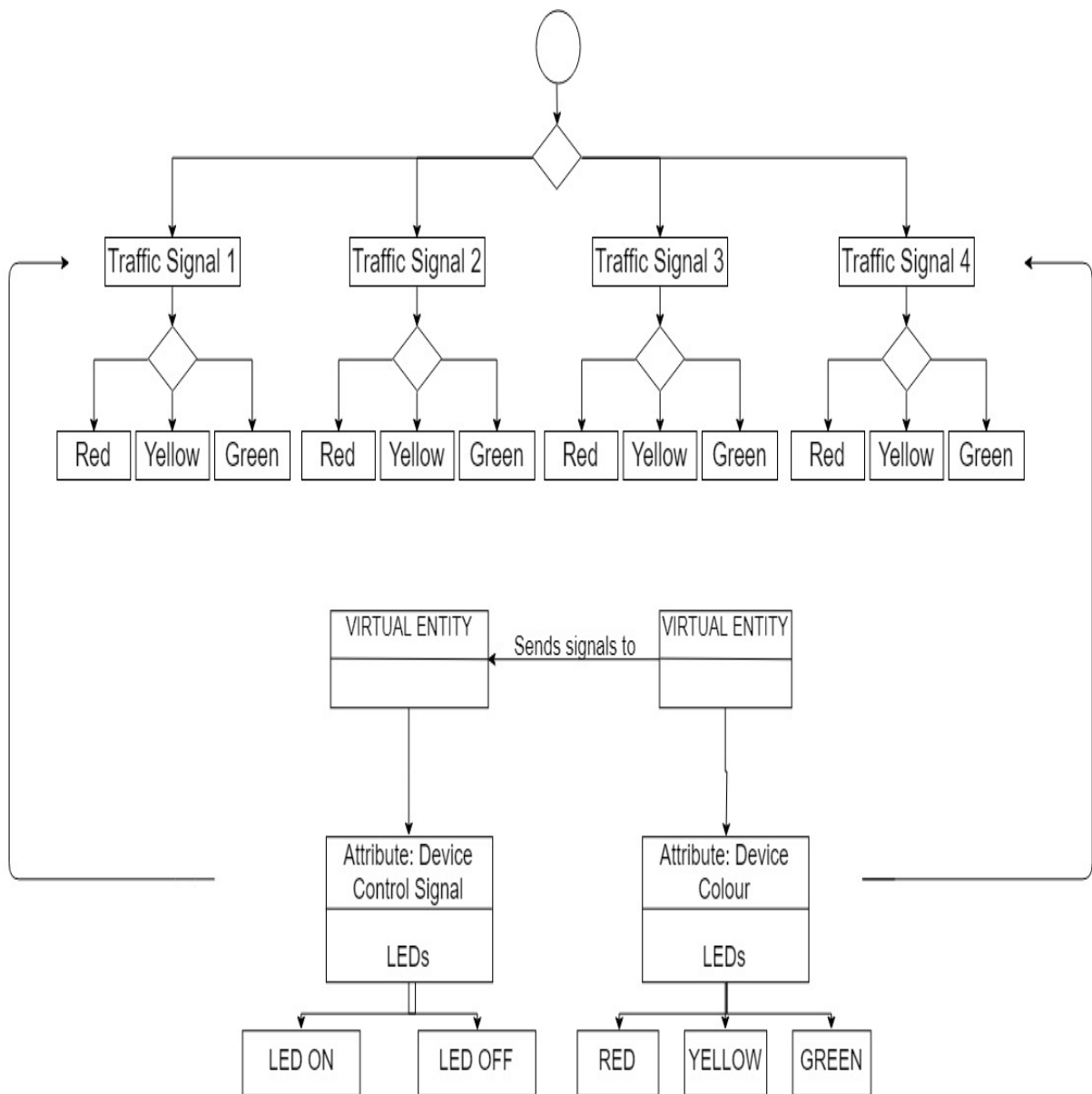
5. Service Model Specification

Fig 4. Service specification

6. IoT Level Specification

In Smart Traffic Light system, IoT Level-3 is implemented. We are storing the data related to status of all the traffic on the roads on the cloud. The Raspberry Pi is connected to Firebase cloud database wherein this data can be viewed. The analysis is done locally on the microcontroller. The data is retrieved and stored on the Cloud real time.
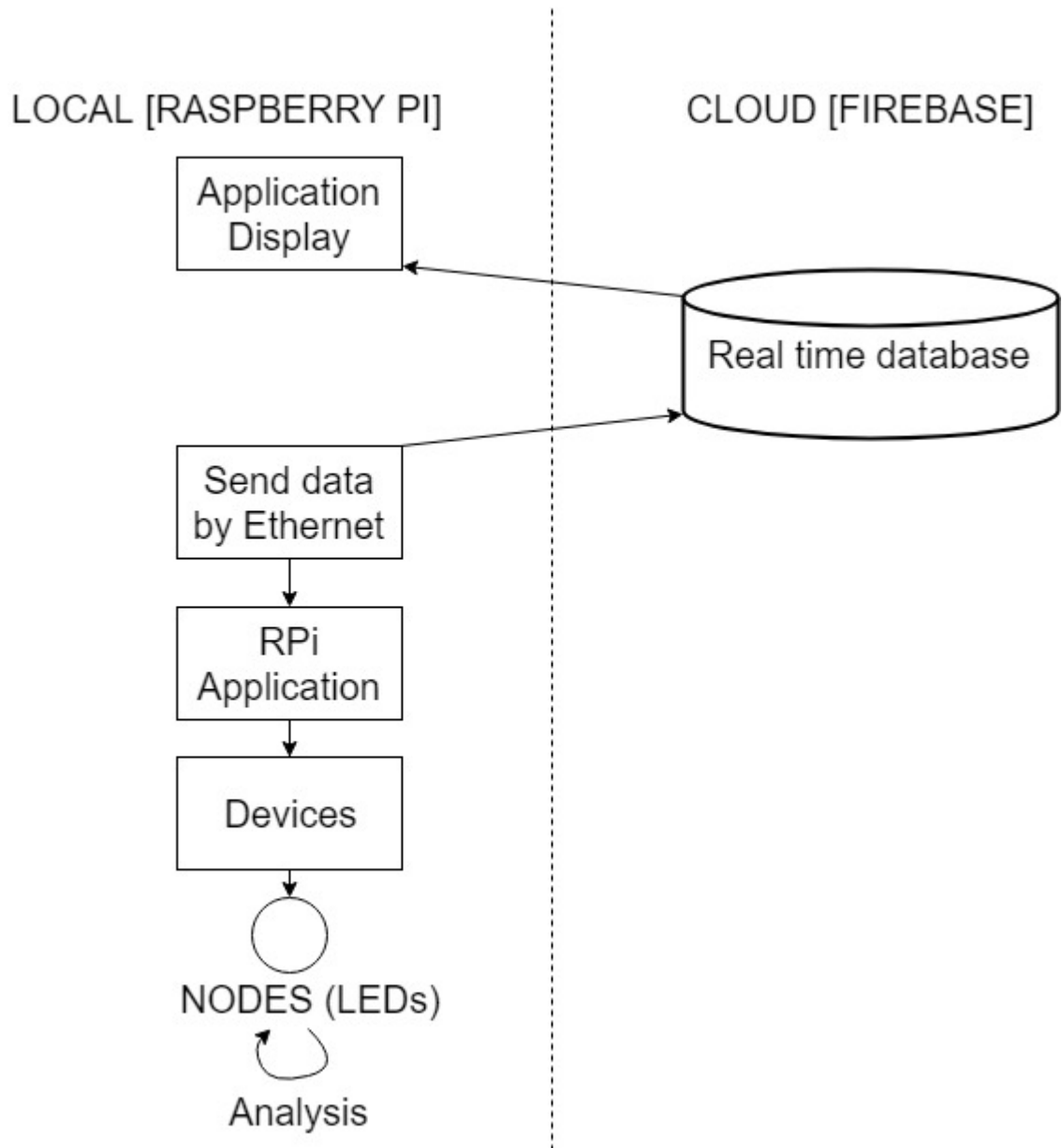

Fig 5. Iot Level Specification
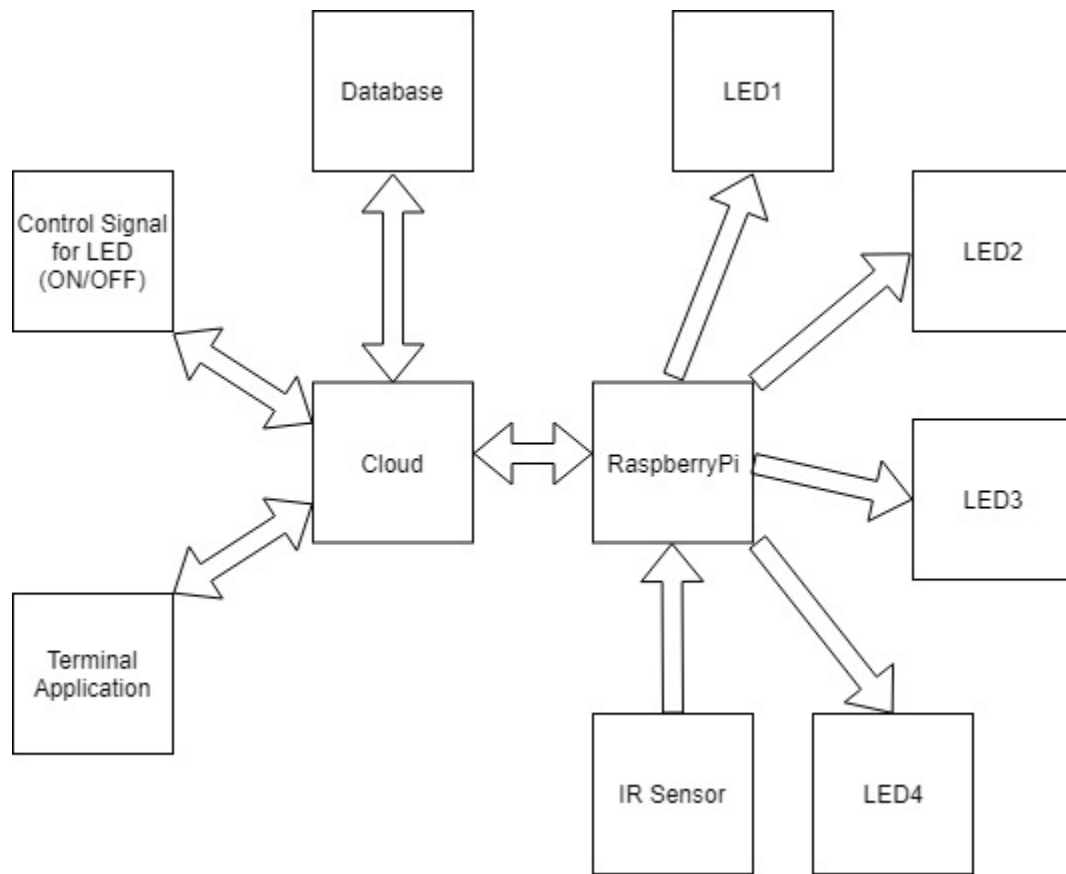
7. Function View Specification

Fig 6. Function View Specification

8. Operational View Specification

Operational View specifications for the smart traffic light sytem are as follows:

Services:
Controller Service - Hosted on Web Application.
Mode service – Google's Firebase Platform. A real time database which is hosted on cloud. The data is posted on the database through the Python script using the post() function in a JSON data format.
State service – Hosted on the local device, implemented with Python.

Application:
Cloud Application - Firebase cloud, Application Real time Server, Database Server - JSON format.
Terminal Application – Analysis is displayed on the terminal of the Raspbian OS.

Devices:
Sensors: IR sensor
Actuator: Traffic Light
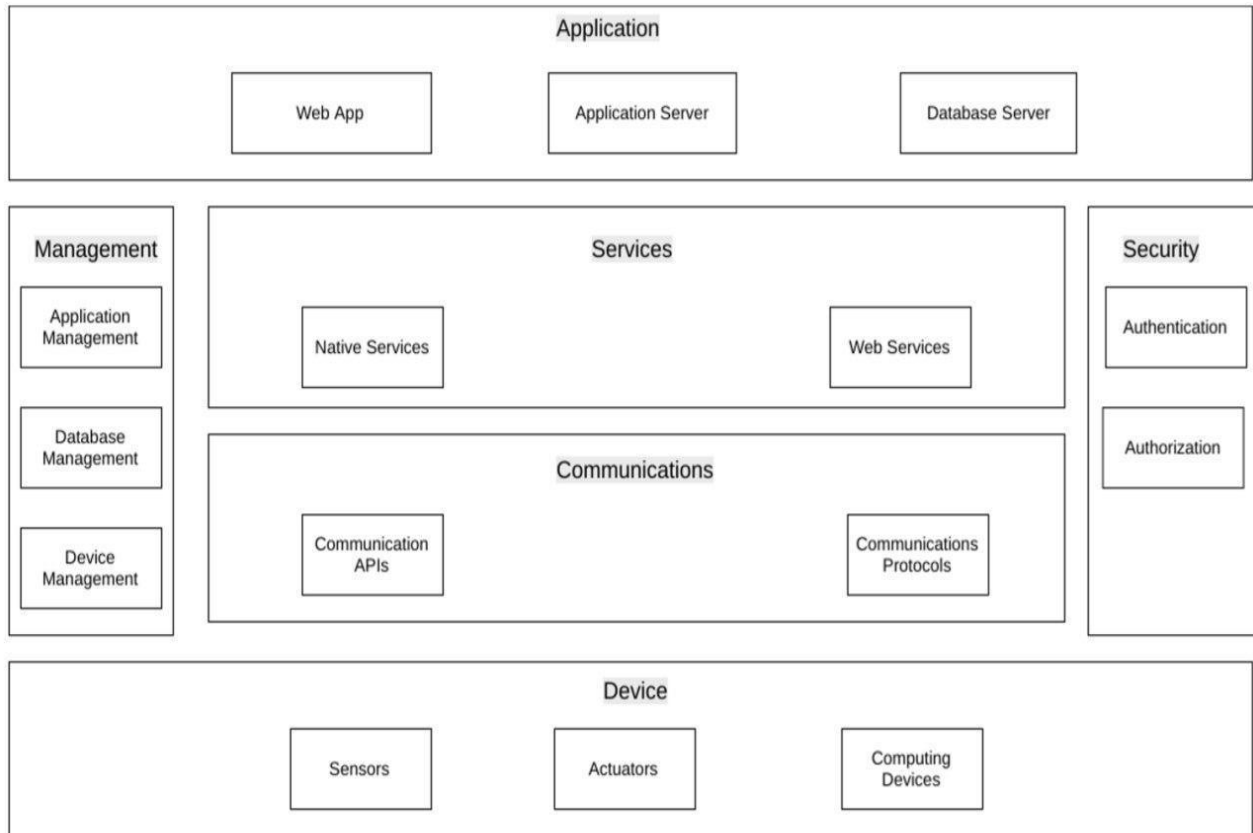**Computing Devices:** Raspberry Pi

Fig 7. Operational View Specification

9. Device and Component Integration

The devices used for the implementation of this system are as follows:
- Raspberry Pi 3.0
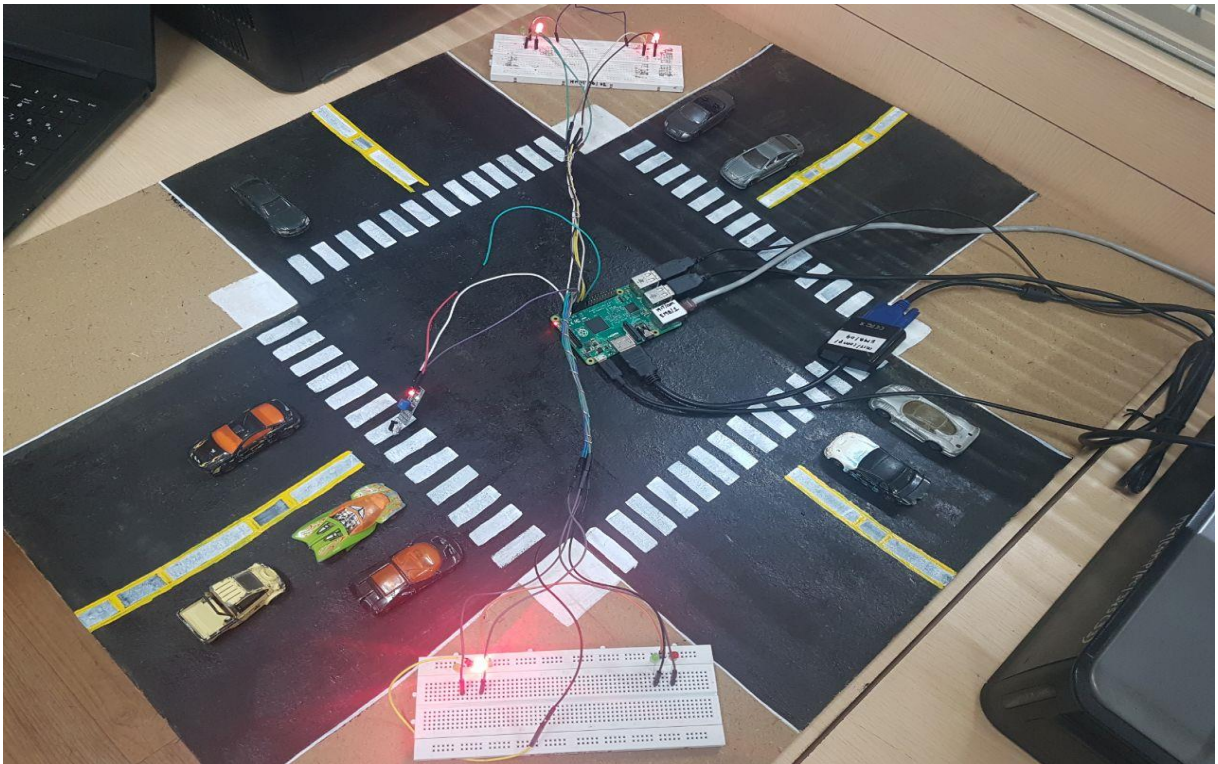- Raspbian O.S.
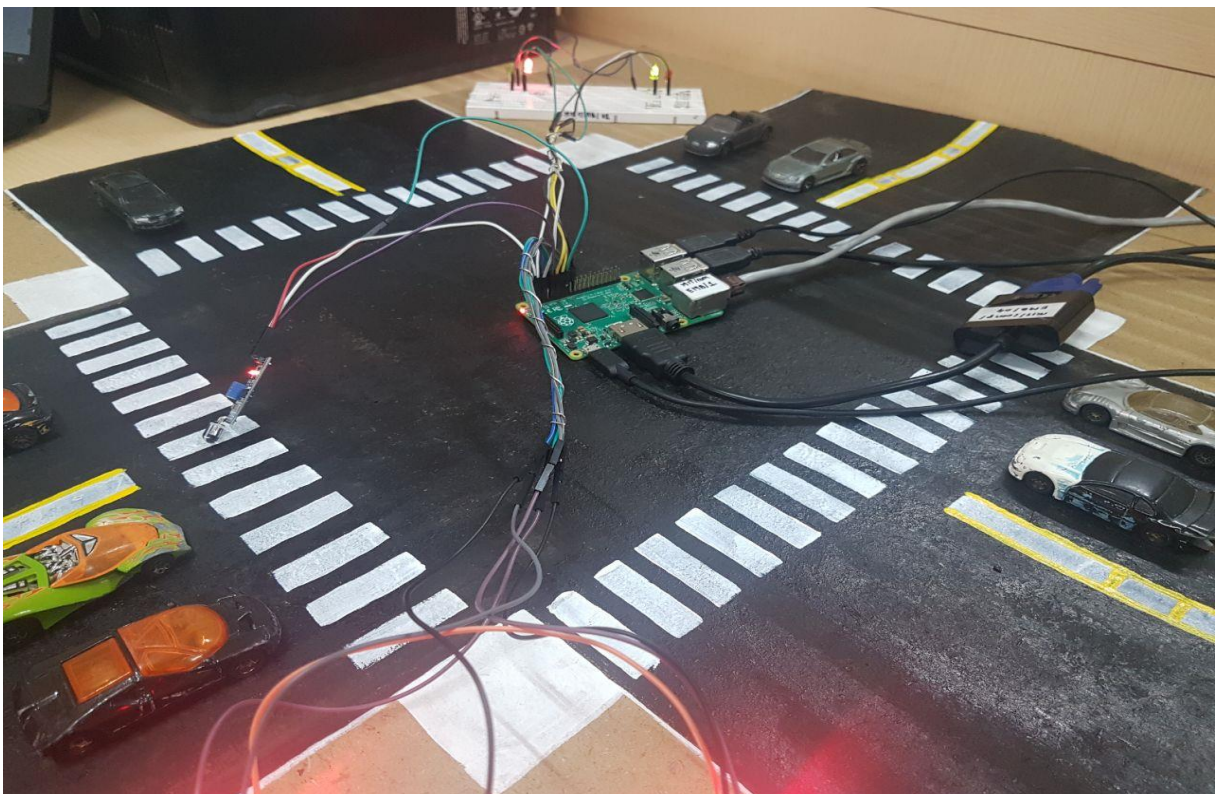- LEDs
- Infrared Detector

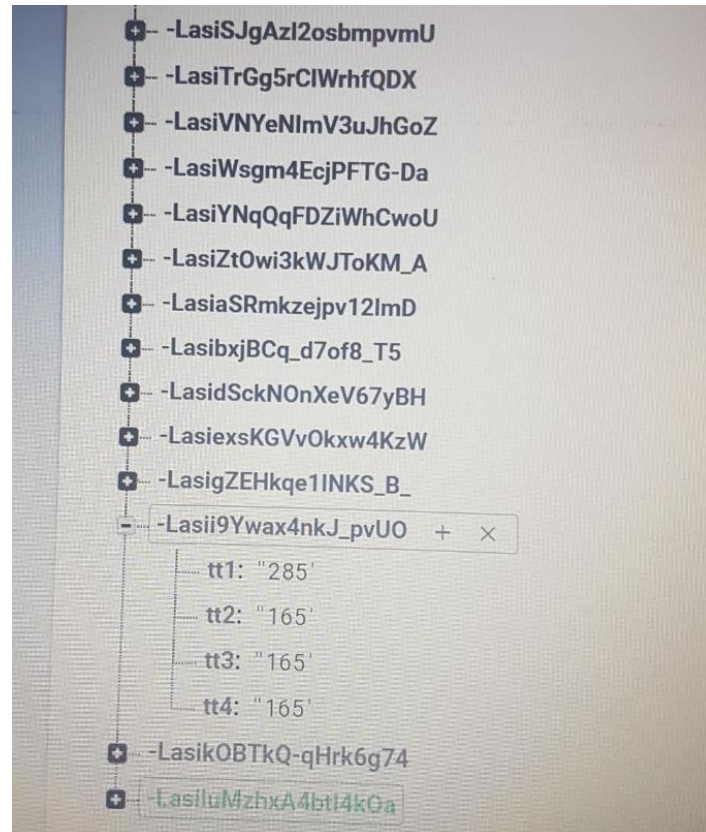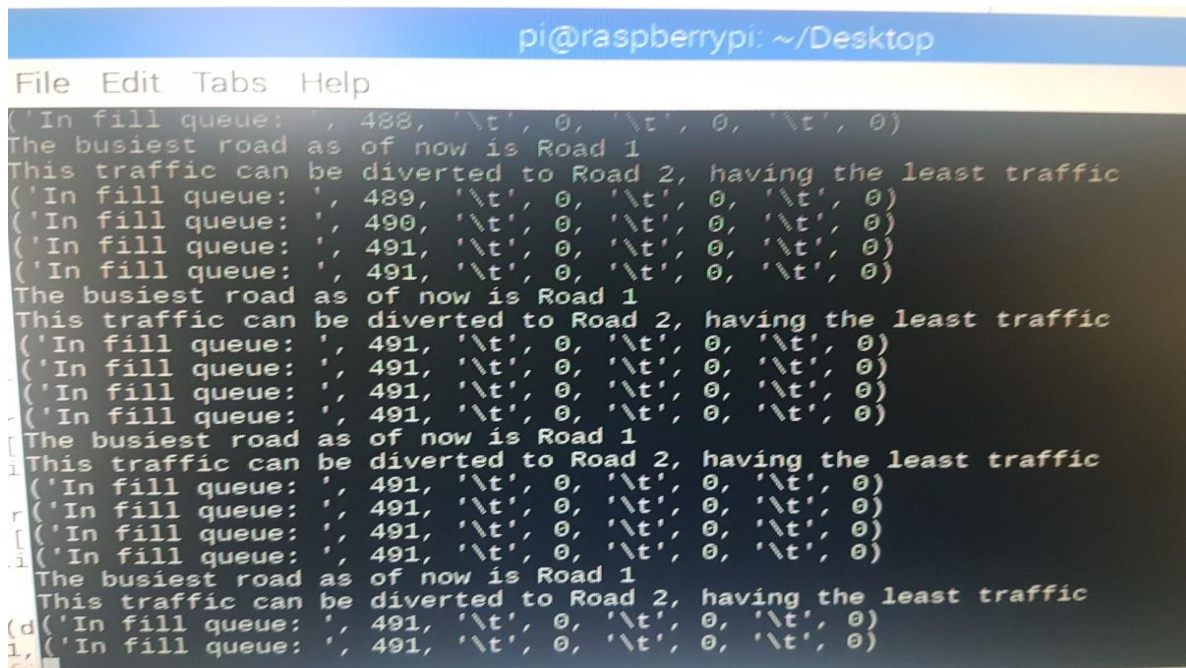*Fig 8. LED Circuit*

Fig 9. IR Circuit

10. Application Deployment

Fig 10. Data on Firebase

Fig 11. Android UI Interface