BUS TRACKING SYSTEM

DESIGN DOCUMENT

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CONTENT

1.0 GENERAL INFORMATION

General Information section explains in general terms the system and the purpose for which it is intended.

1.1 System Overview

Bus tracking system is an application which allows people to know about the details of currently running buses. The application saves data in a database. Its operational status is under development. Bus tracking system operates on mobile devices with Android operating system.

1.2 Organization of the Manual

The user's manual consists of eight sections: General Information, System Summary, Getting Started, Hardware specifications, Network architecture, Using The System, Safety precautions and Reporting.

General Information section explains in general terms the system and the purpose for which it is intended.

System Summary section provides a general overview of the system. The summary outlines the uses of the system's hardware and software requirements, user access levels and system's behavior in case of any contingencies.

Getting Started section explains how to get Bus tracking system client application and install it on the device. The section presents briefly system menu.

Hardware specifications section provides a detailed description about the equipment / accessories.

Network architecture section explains how the system is connected in the ground level.

Using The System section provides a detailed description of system functions.

Safety precautions section consists of information to use the package safely for a long time.

Reporting section describes how to get help in case of an emergency and resolving issues.

2.0 SYSTEM SUMMARY

System Summary section provides a general overview of the system. The summary outlines the uses of the system's hardware and software requirements, system's configuration, user access levels and system's behavior in case of any contingencies.

2.1 System Configuration

Bus tracking system operates on mobile devices with Android operating system. Client application is compatible with Android 4.4 and higher versions. It requires connection to internet in order to access data in database. In the embedded system part, there are internal GPS receiver in order to obtain coordinates automatically as well as GPRS transmitter to send data to the database. Data saved in database can be seen using client side application. After installation on the device, Bus tracking system can be used immediately without any further configuration.

2.2 User Access Levels

Everyone can use client application, but only authorized users (Ministry of transportation / bus owners) are able to change data in the database. The database is automatically updated according to the data sent by each bus.

2.3 Contingencies

In case of power outage data are not sent to the database. In case there is no Internet connection, database will not be updated. Since the GPRS module takes some time to self-configure, reliability of data cannot be guaranteed at full level.

3.0 GETTING STARTED

Getting Started section explains how to get Bus tracking system suit with client application and install it on the bus. The section presents briefly system menu.

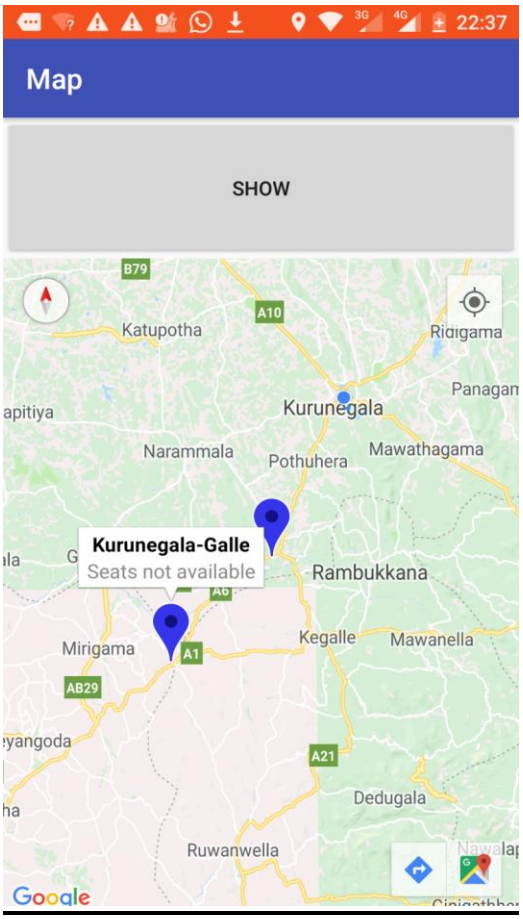
3.1 Installation

The embedded part should be placed in a side of a door in the bus. When settling it, the IR devices should be horizontal and the package should be 50cm above from ground. The newest installation version currently available can be downloaded if and request email is sent to delpierokavinda@gmail.com and is an ".apk" file, which should be installed on the smartphone.

3.2 System Menu

Client application is a single tabbed application. The app was designed simply for easiness of passengers. Once the app runs, it shows the details of buses near the user such as route number, destination, availability of seats.

3.3 Random scenario



4.0 HARDWARE SPECIFICATIONS

This section provides a detailed description of system functions.

4.1 IR sensors

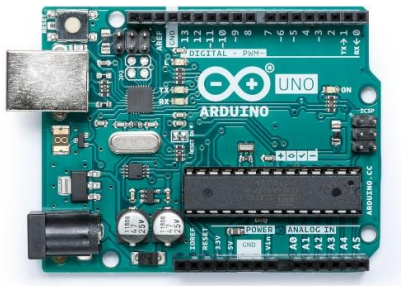
Infrared proximity sensor made by Sharp. “SHARP 2Y0A21 F 71” infrared sensors are used in the system. GP2Y0A21YK has an analog output that varies from 3.1V at 10cm to 0.4V at 80cm. The sensor has a Japanese Solderless Terminal (JST) Connector.

4.2 Ardiuno Uno

A simple Arduino board is used as the node of the system. Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller.

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)

Clock Speed	16 MHz
LED_BUILTIN	13
Length	68.6 mm
Width	53.4 mm
Weight	25 g



4.3 GSM / GPRS / GPS module

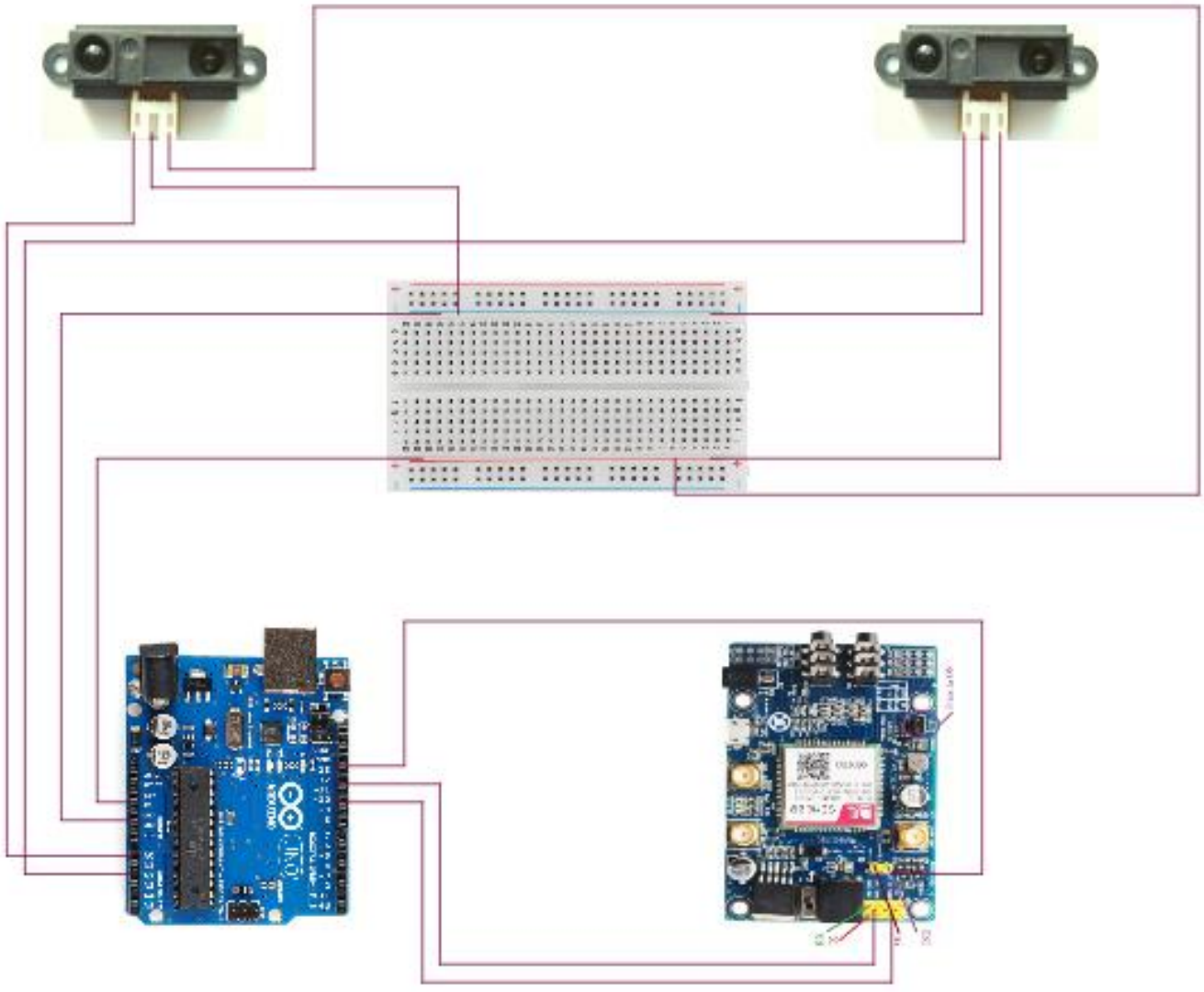
In order to have an internet connection for the bus and to know geographical location of the bus, a GSM/GPRS/GPS module is used in the system. SIM808 module is a GSM and GPS two-in-one function module. It is based on the latest GSM/GPS module SIM808 from SIMCOM, supports GSM/GPRS Quad-Band network and combines GPS technology for satellite navigation. It features ultra-low power consumption in sleep mode and integrated with charging circuit for Li-Ion batteries, that make it get a super long standby time and convenient for projects that use rechargeable Li-Ion battery. It has high GPS receive sensitivity with 22 tracking and 66 acquisition receiver channels. Besides, it also supports A-GPS that available for indoor localization.

PCB size	50mm X 30.5mm X 1.6mm
Voltage Input	3.4V ~ 4.4V
Interface	UART
Indicator	NET, STATUS
Button	POWER

Features

- Quad-band 850/900/1800/1900MHz
- GPRS multi-slot class12 connectivity: max. 85.6kbps(down-load/up-load)
- GPRS mobile station class B
- Controlled by AT Command (3GPP TS 27.007, 27.005 and SIMCOM enhanced AT Commands)
- Supports charging control for Li-Ion battery
- Supports Real Time Clock
- Supply voltage range 3.4V ~ 4.4V
- Integrated GPS/CNSS and supports A-GPS
- Supports 3.0V to 5.0V logic level
- Low power consumption, 1mA in sleep mode
- Supports GPS NMEA protocol
- Standard SIM Card

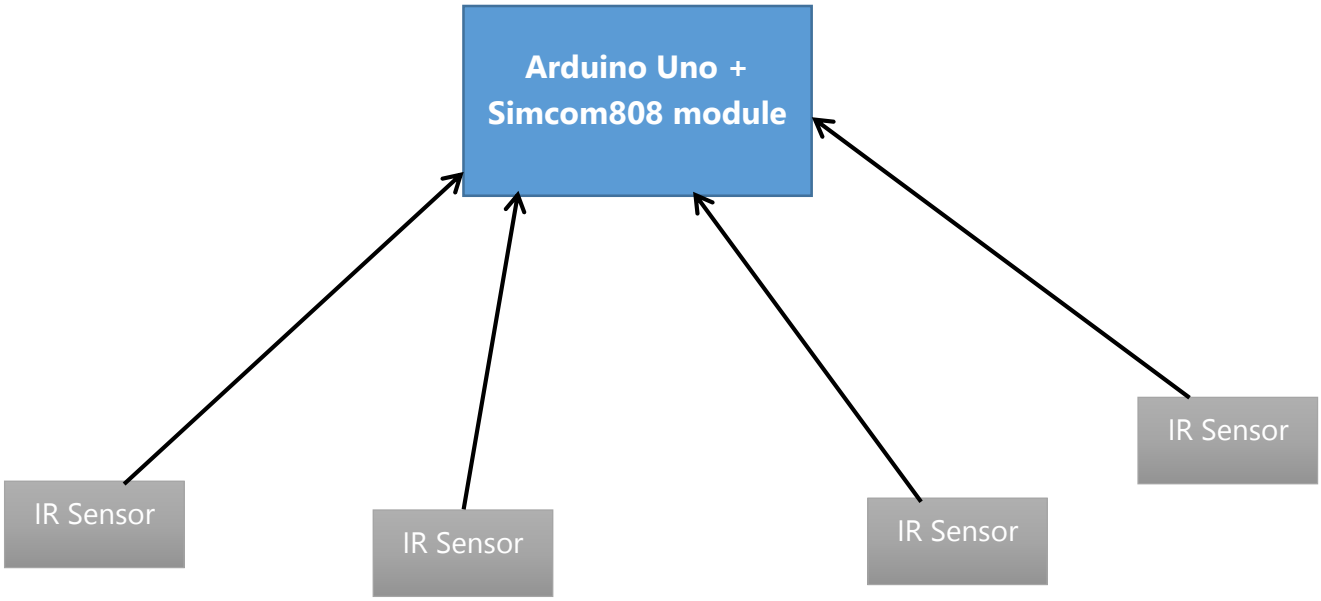
4.4 Hardware architecture

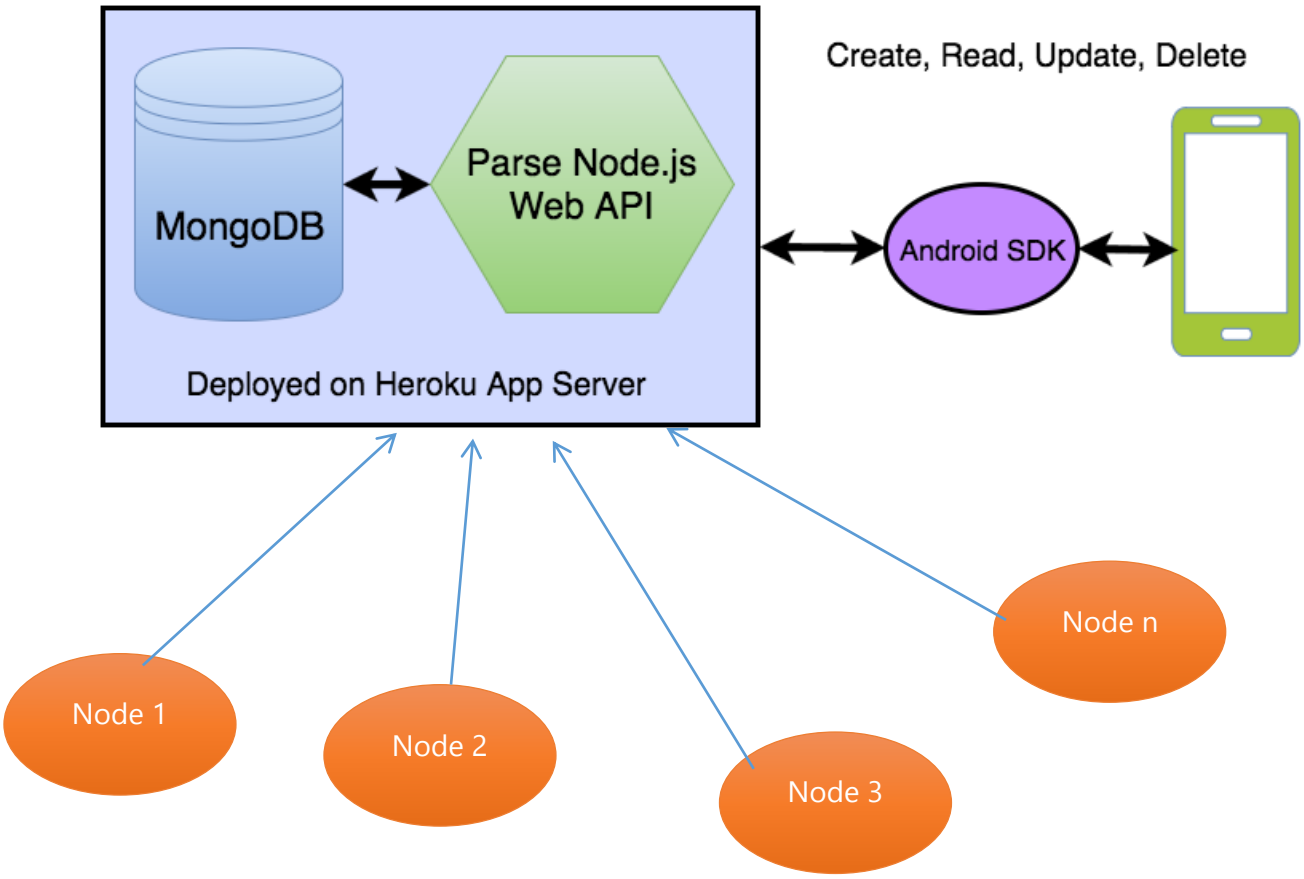


5.0 NETWORK ARCHITECTURE

This section provides a detailed description of network architecture of this system.

5.1 Hardware





5.2 Software

Following technologies are used to implement the software side of the whole network.

5.3 Database

A very brief structure of the database is shown below. It is just to understand the architecture.

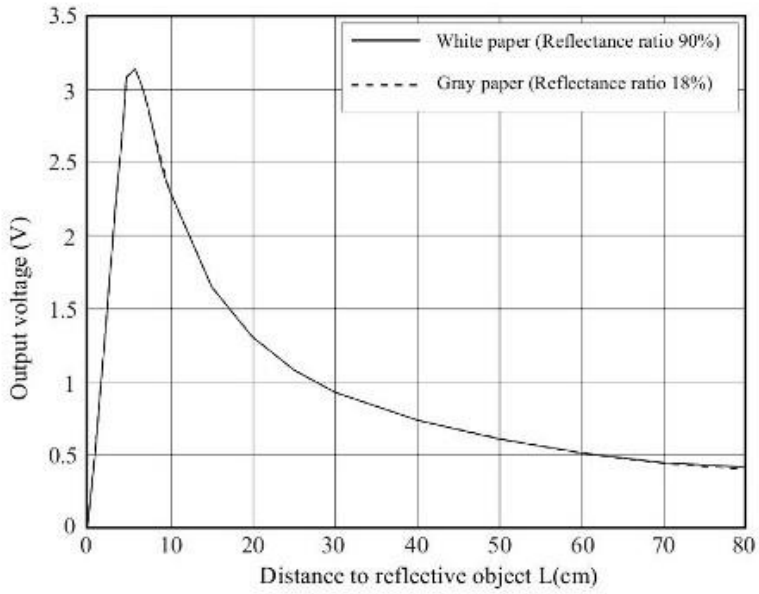
JSON format:

```
{
        "ID" : "__",
        "Latitude" : "__",
        "Longitude" : "__",
        "Count" : "__",
        "Seats" : "__",
        "Destination" : "__"
}
```

6.0 USING THE SYSTEM

This section provides a detailed description about how the system works in theoretically.

IR sensor



The variation of the output voltage of IR sensors against the distance to a reflective object can be modelled in the above graph. Even though the range of 0-10cm shows a gradual increase the range of 10-80cm gives us an exponential decrease.

Here we consider the range 10-80cm and assume it to be a gradual decrease in order to take the values easily.

By reading analogue values from output of the IR sensor and taking them as analogue inputs in Arduino (A0 & A1), all values are mapped between 0-1023 integers. Therefore, 10-80cm values are mapped to 0-1023 integers respectively.

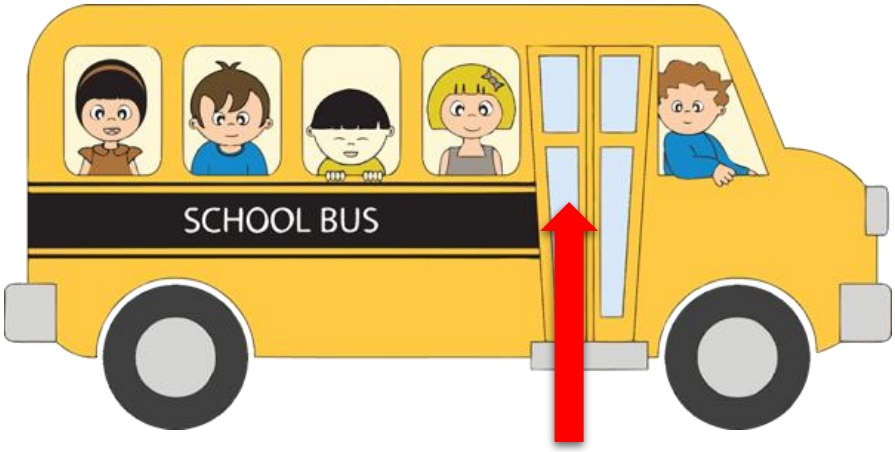
Passenger count system is designed to detect objects between 10-40cm but it can be adjustable according to size of the door of the bus.

For 10-40cm, let x be the maximum distance sensor can detect an object

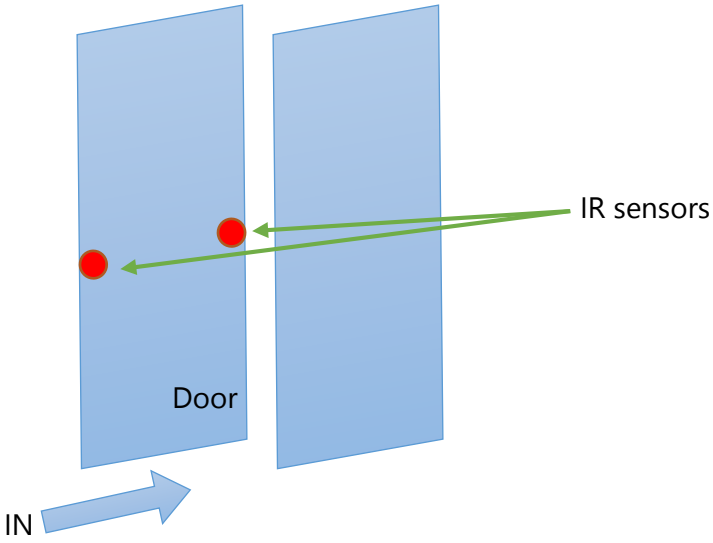
Therefore, $1023*10 = x * 40$

$x \sim= 256$

If object is detected between 10-40cm, analogue input value to Arduino is less than 256.



The full package will be placed in a side of the door.



7.0 SAFETY PRECAUTIONS

Before using the system, read the instruction manual very carefully since ignorance and negligence of anyone may cause damage both to property and himself.

∞ Use of electricity

This system uses power source of 12V-2A. But always use a voltage converter before connecting directly to any AC or DC power source in the bus.

∞ Transportation

Handle with care. The equipment are very sensible ones. Do not put load on the package or heavy pressure.

∞ Disassembling

Do not try to open the package. Always contact vendor to get support if there is an issue.

∞ Accessories

Contact the vendor to buy extra accessories and please get the system repaired by a technician.

8.0 REPORTING

If there is any issue that you cannot resolve, please contact us. We are happy to provide solutions in remotely or at your place whenever you want.

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