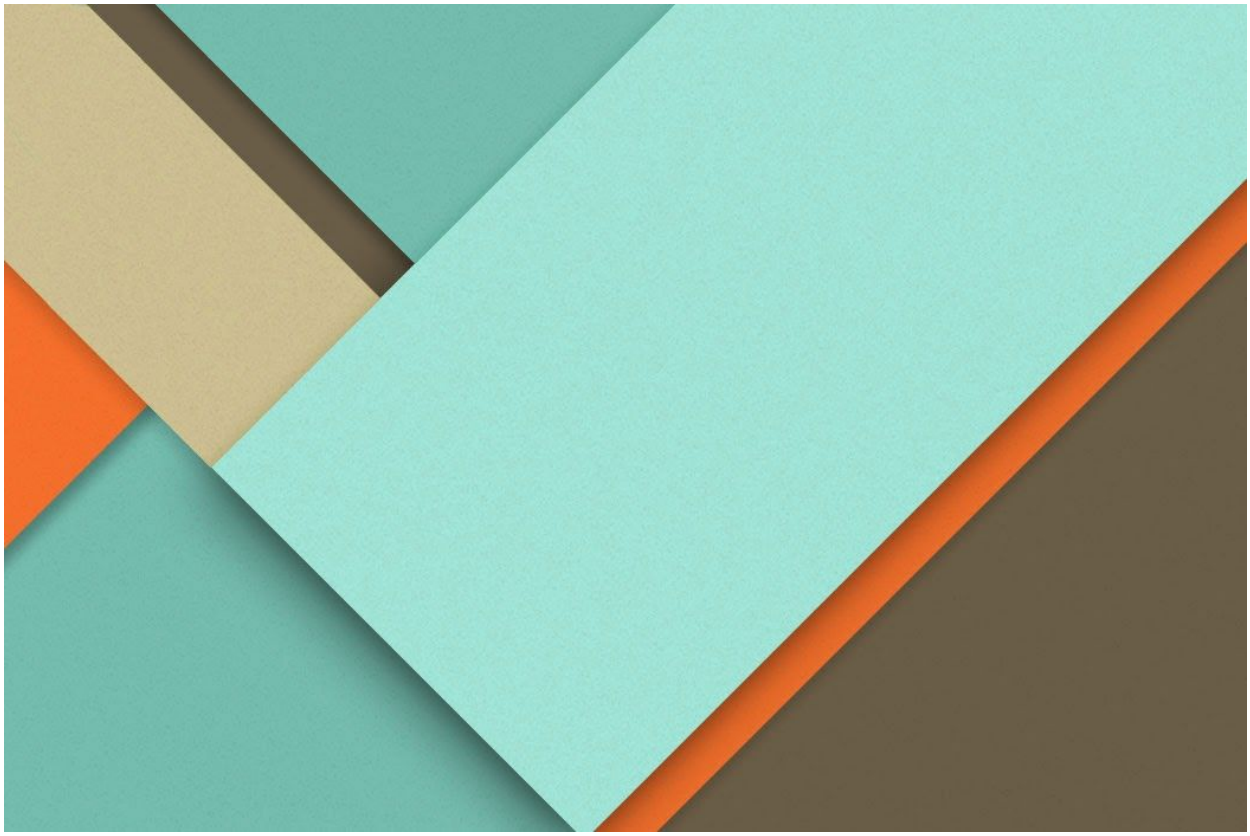


IoT4 Project

Setup Document V2

01.01.2021

Nauman Shakir
https://NaumanShakir.com
https://3STechLabs.com

Overview

This report is a walkthrough for setting up the required prerequisites for this project.

Document Parts

1. Components Used
2. Circuit Diagram
3. Firmware and Configurations

Updates

- Updated all the files to meet the requirements written in “Design Specifications” file.
-

Specifications

The system is divided into 4 different layers which should communicate with each other in real time.

Layers

- Hardware - Sensors' and Actuator Nodes
- Processing Layer - Server {Ubuntu Server 18.04 with Dashboard}
- Transport Layer - Gateway {Controller}

Components Used

- Controller NodeMCU ESP8266
- Entrance NodeMCU ESP8266
- Rider NodeMCU ESP8266
- PayBox NodeMCU ESP8266
- 2x Ultrasonic Sensors HC-SR04
- 2x MFRC522 RFID Readers
- Lithium Charger TP5000
- 2x Arduino Nano
- MPU6050 IMU
- 4x A4988
- 2x DC Driver MX1508
- Stepper Motors and Actuators
- RFID Cards and Stickers
- Micro-Switch
- Battery

Architecture

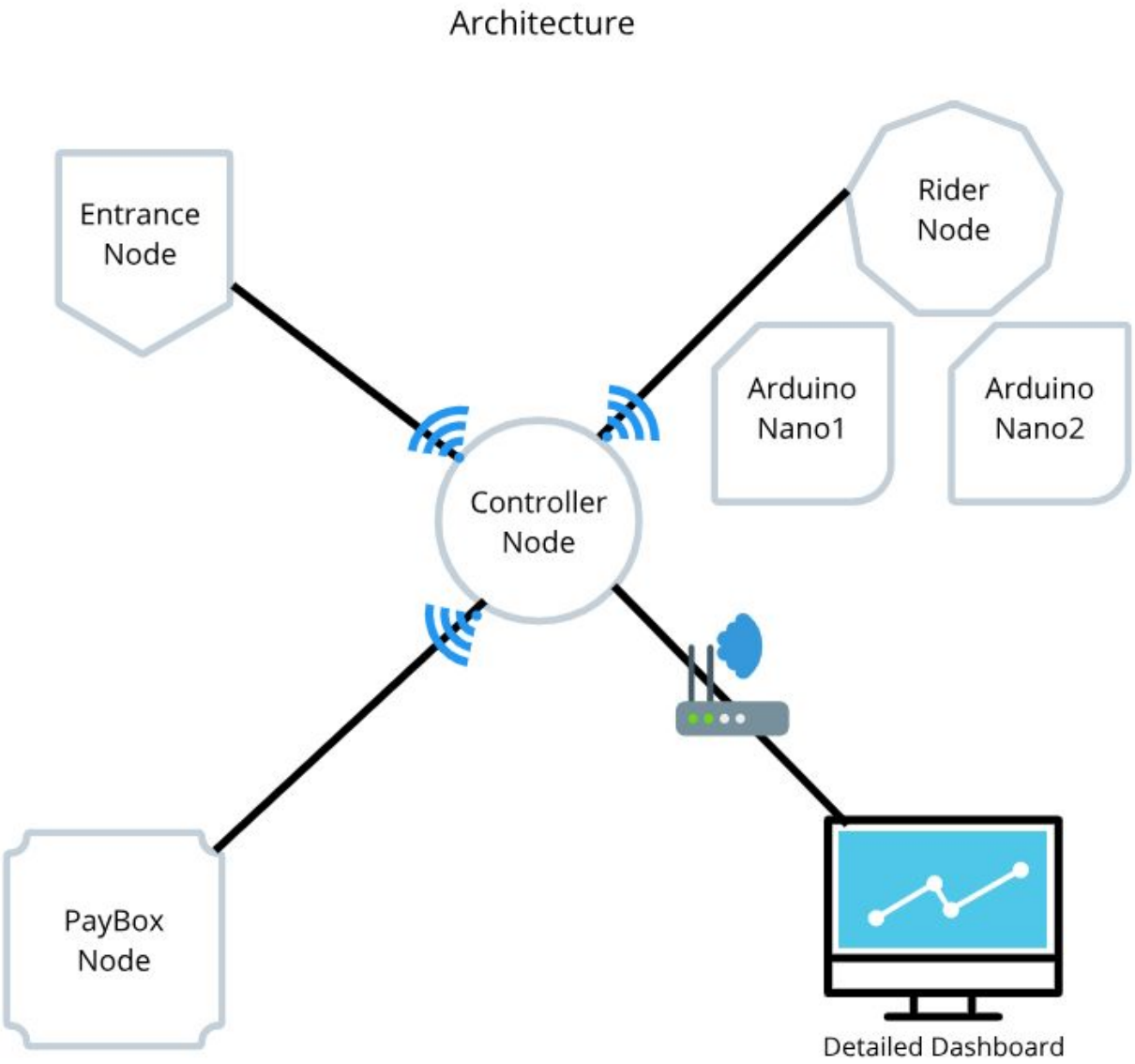
The complete project has multiple components

- Entrance Node
- Controller Node
- Rider Node
- PayBox Node

All nodes are connected wirelessly to a Controller Node. The Controller Node is connected to a WebApp based Dashboard running on a Ubuntu Server displaying the data of all nodes and allowing two-way communication within the system. The communication protocol used in this architecture is MQTT.

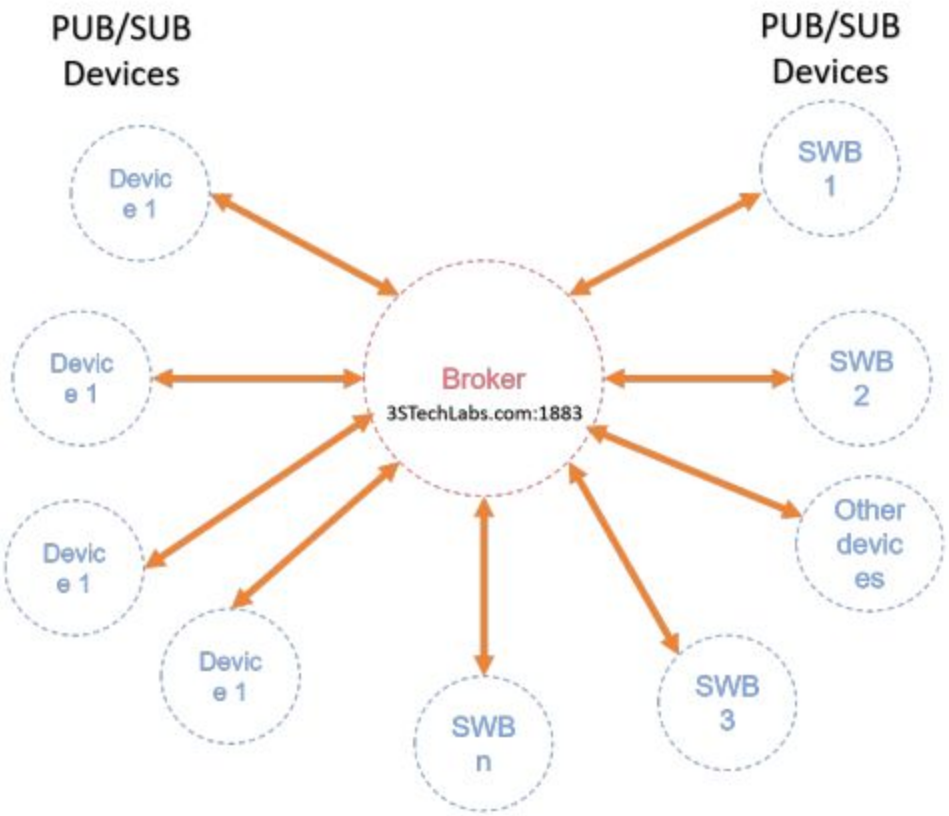
See the architectural diagram below.

Complete Architecture



Above is the Sensor Nodes architecture. Each box contains a single sensor along with Arduino Pro Mini. Each Sensor Node Can be connected to a single Master(ESP8266) on an I2C Bus. The sensor blocks work in a plug and play manner and can be added or removed as required.

What is MQTT?



Take an example of a system in which there are hundreds of people having smart bands that can display information of a person's surroundings. And then there are Android, iOS and Windows devices that can be used to monitor smart bands to define a set of parameters for bands.

So in a scenario where there are mixed types of devices including hardware platforms, the best communication protocol is MQTT.

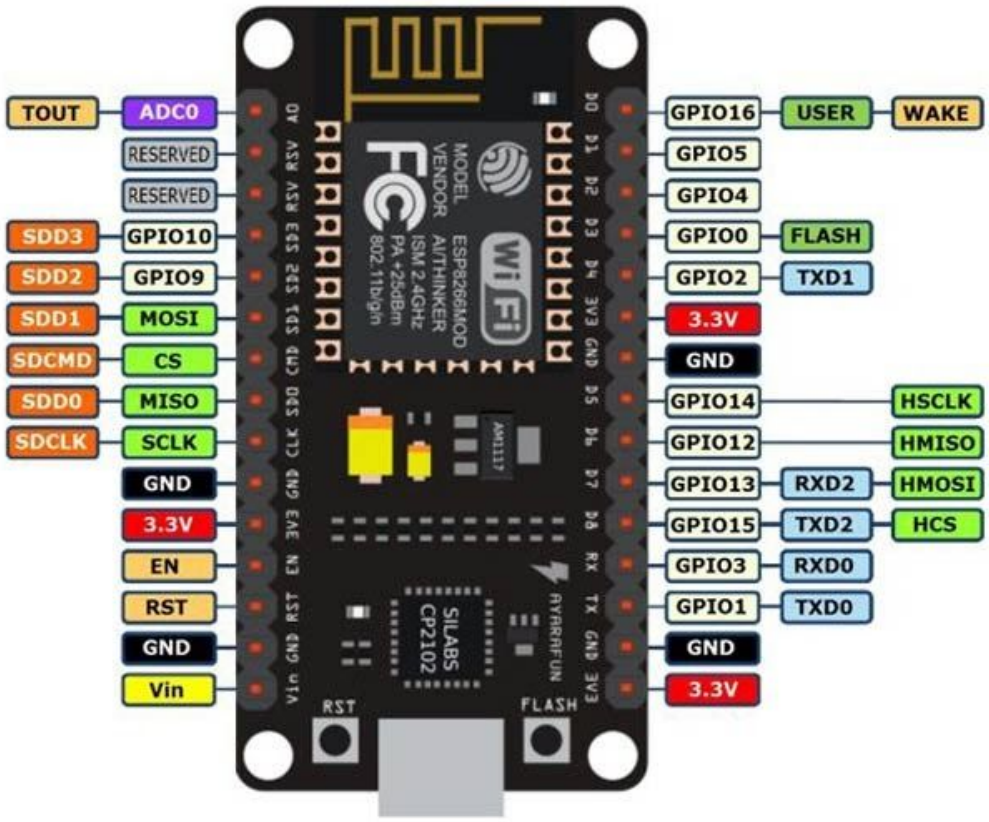
It can handle two-way and parallel communication and the number of devices that can be connected and communicate via MQTT are limitless, the only limit is server resources. MQTT is also known as pub/sub protocol.

Hence the protocol of choice here is MQTT.

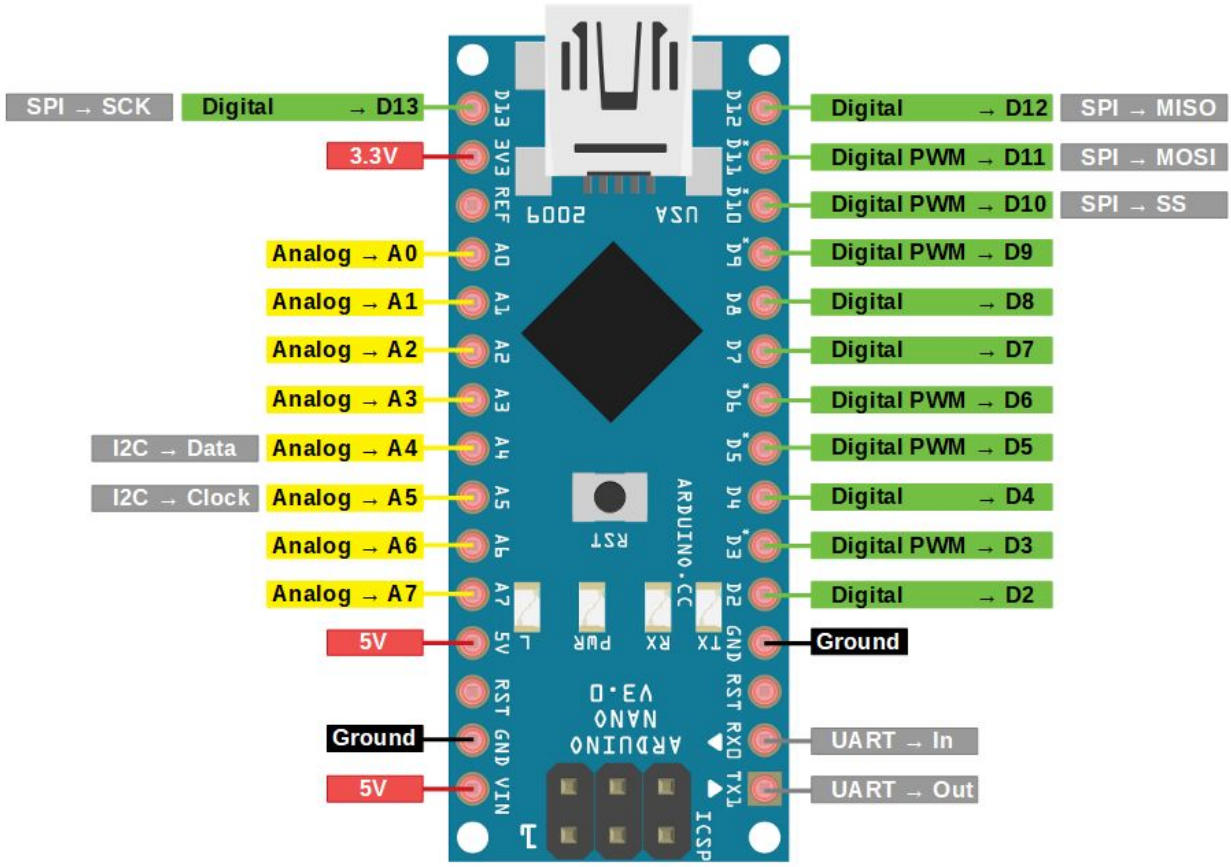
Circuit Diagram

For reference, the pinouts used for the boards are given below.

NodeMCU Pinout

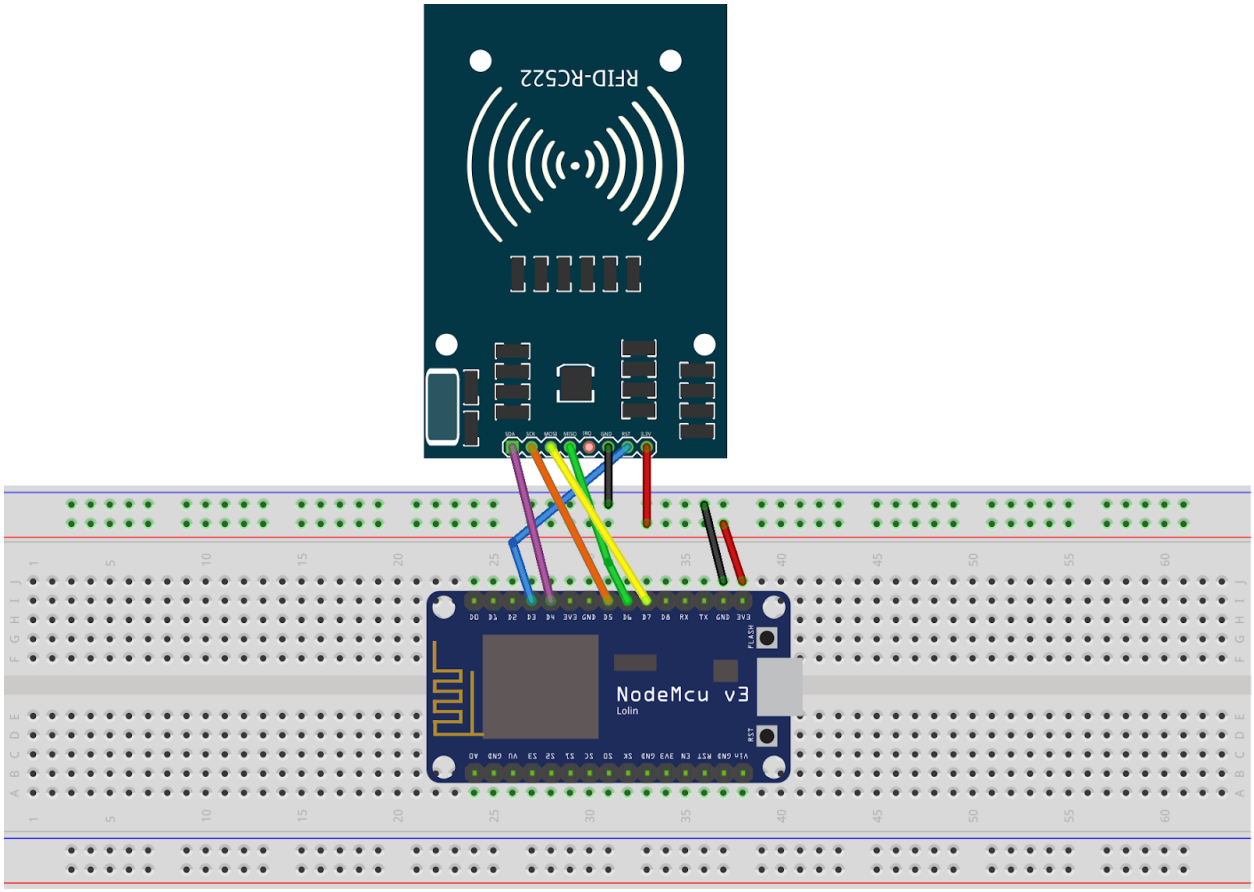


Arduino Nano Pinout

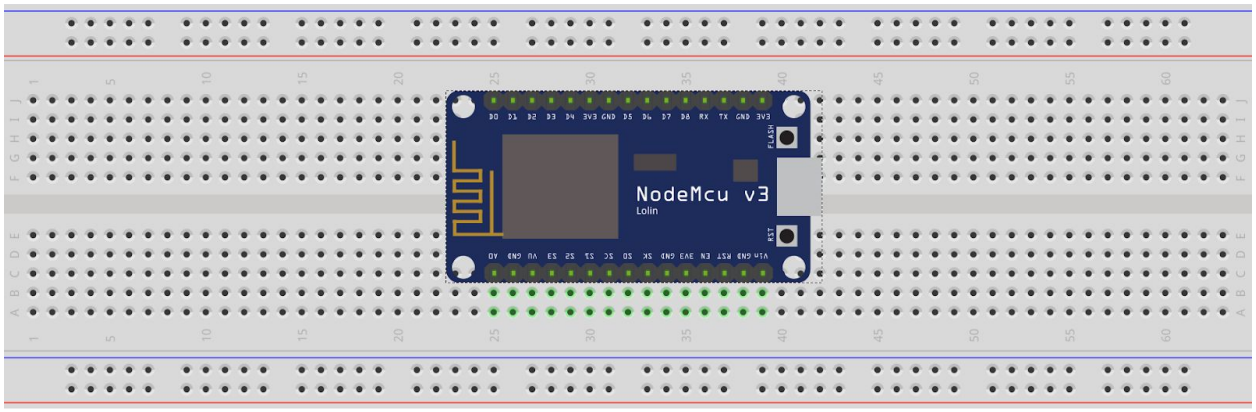


Source: Fritzing

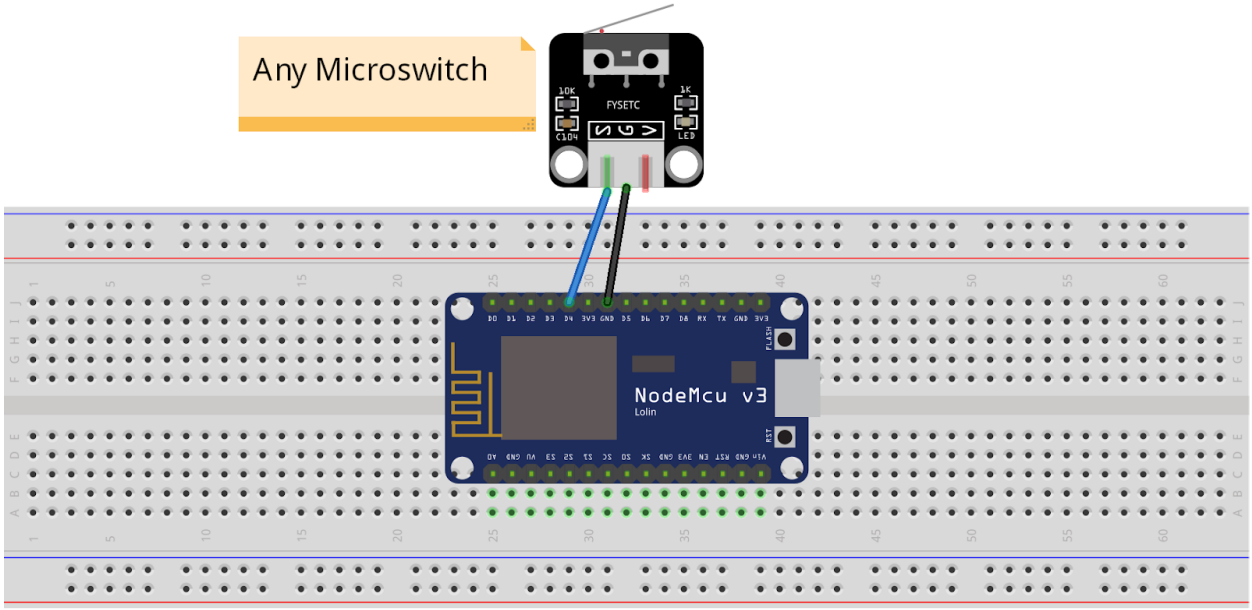
Entrance Node Circuit Diagram



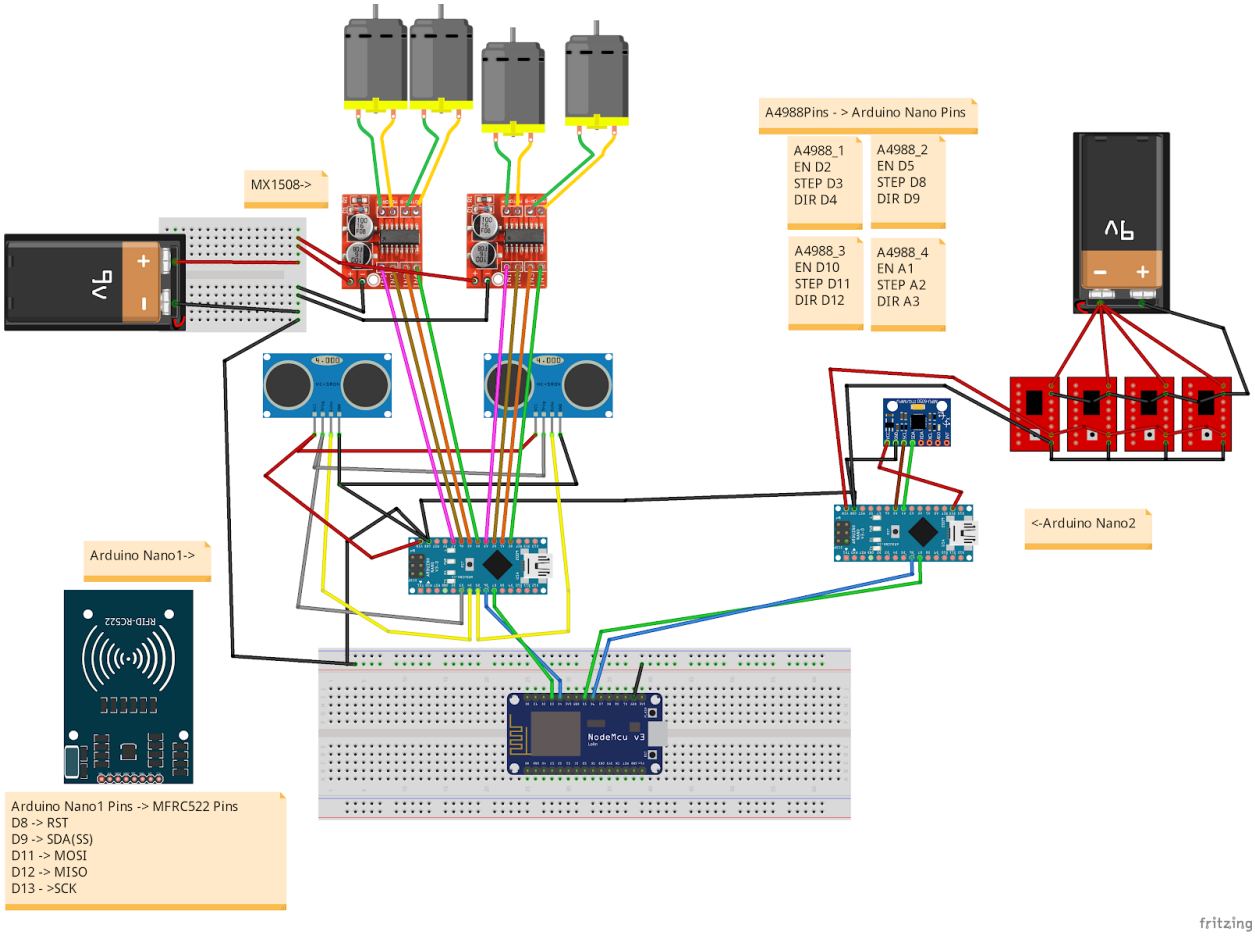
Controller Node Circuit Diagram



PayBox Node Circuit Diagram



Rider Node Circuit Diagram



[High resolution circuit diagrams are present in the CircuitDiagrams folder.]

Firmware and Configurations

Softwares and Frameworks Used

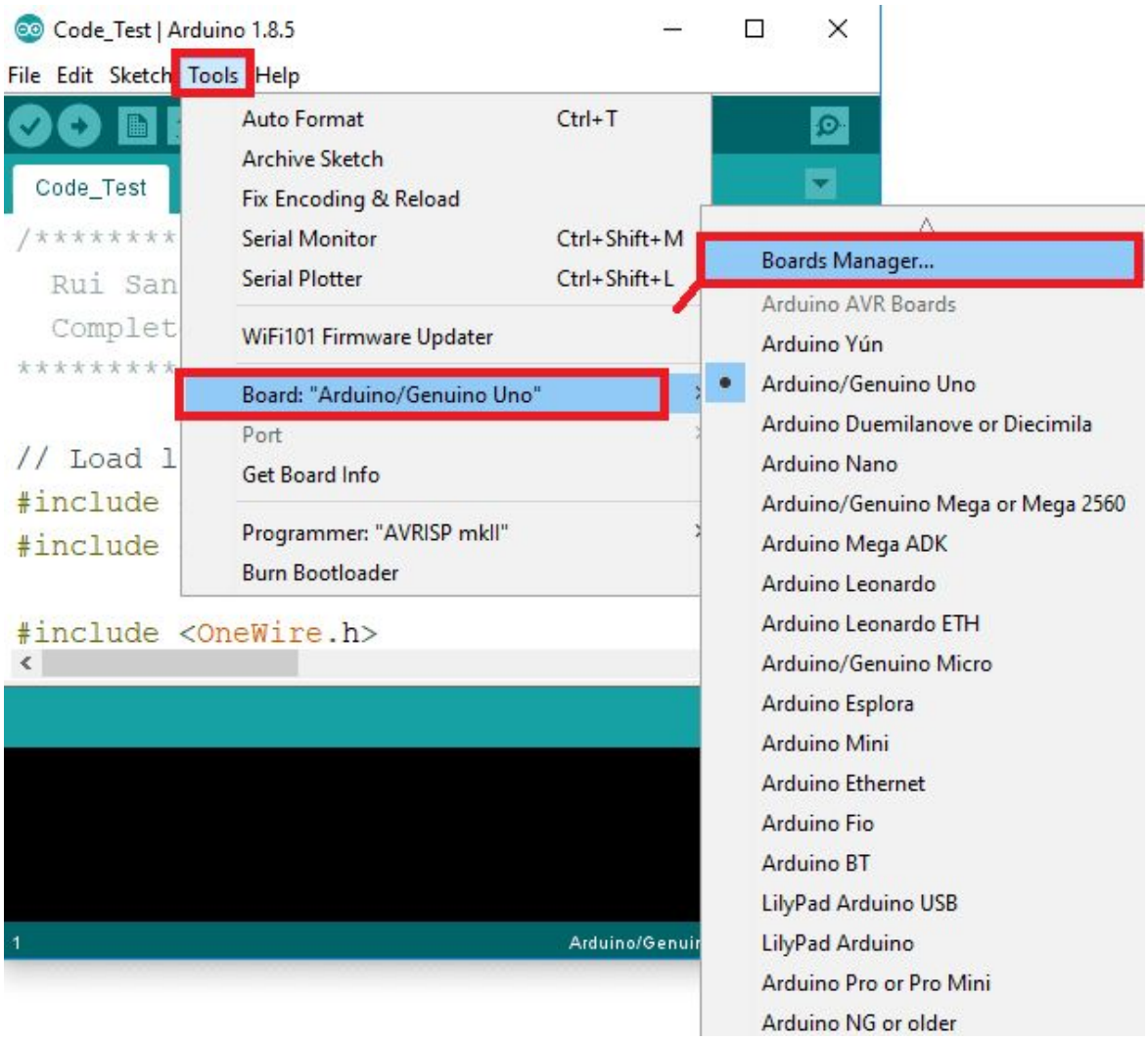
- Arduino IDE https://www.arduino.cc/en/Main/Software
    - For .ino files
- Fritzing https://fritzing.org/home/
    - For circuit design for .fzz and .fzpz files.
- NodeRED https://nodered.org/
    - As a test-bed along with MQTT Lens

Programming Arduino

- Download latest Arduino IDE from https://www.arduino.cc/en/Main/Software
- And open it.

Open the RiderAN1.ino file from the Rider->RiderAN1 Folder

3) Open boards manager. Go to **Tools** > **Board**



4) Select Arduino Nano

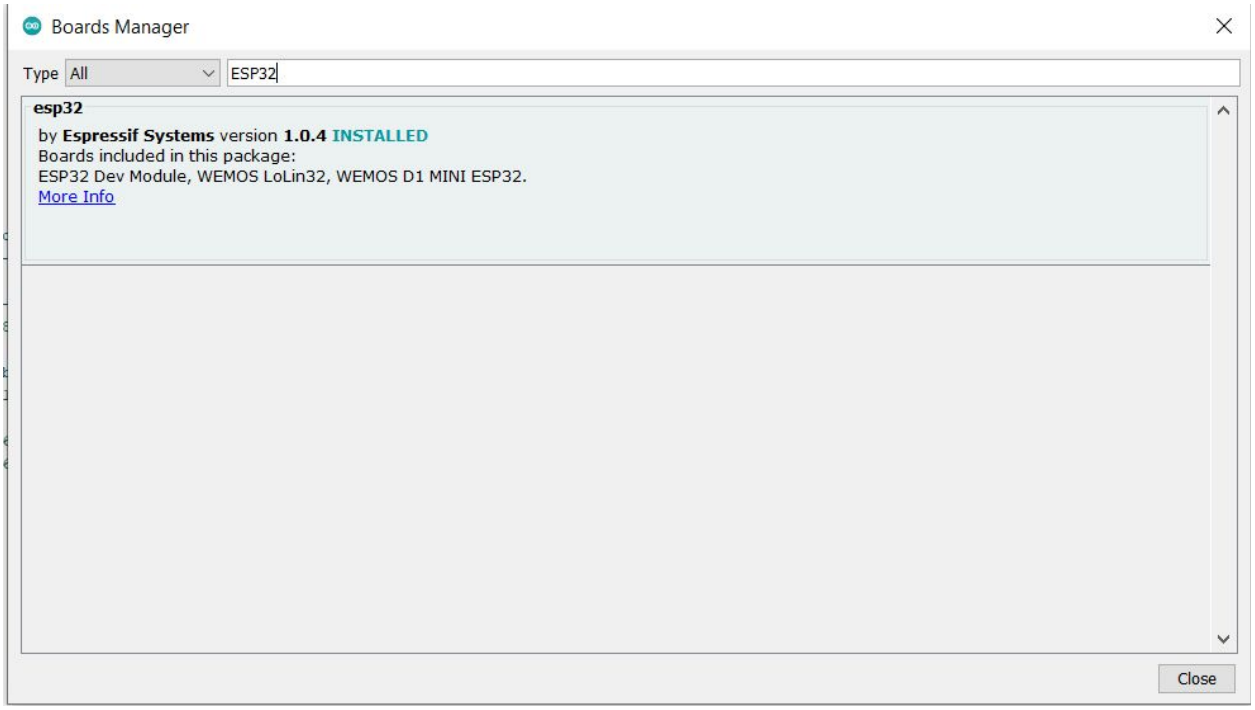
Make sure that you have selected Arduino Nano from Boards Menu.

5) You can now upload the code to Arduino Nano

6) Do the same with 2nd Arduino Nano and upload RiderAN2.ino code to it.

Programming NodeMCU

- Open Arduino IDE
- Click on File->Preferences
- In the additional Board Manager URLs put the following line
    - **http://arduino.esp8266.com/stable/package_esp8266com_index.json**
- Then click ok
- Now go to Board Manager from Tools->Boards menu
- Search for ESP8266 and click on install to install it



- Now from RiderFirmwareNodeMCU folder you can open RiderFirmwareNodeMCU.ino file
- Select NodeMCU v1.0 from Tools->Board
- Select correct COM port from Tools->Port
- Now you can upload the code to your NodeMCU.

Before Uploading to the NodeMCU

Open MQTTHandler.h of each node and change

- Change WiFiName to your WiFi router name
- Change WiFiPassword to your WiFi Router password.
- Note: you have to change all MQTTHandler.h files present in all folders.

Then save the changes and upload the code to the NodeMCU.

You can then upload FirmwareController, FirmwarePayBox, FirmwareEntrance similarly.

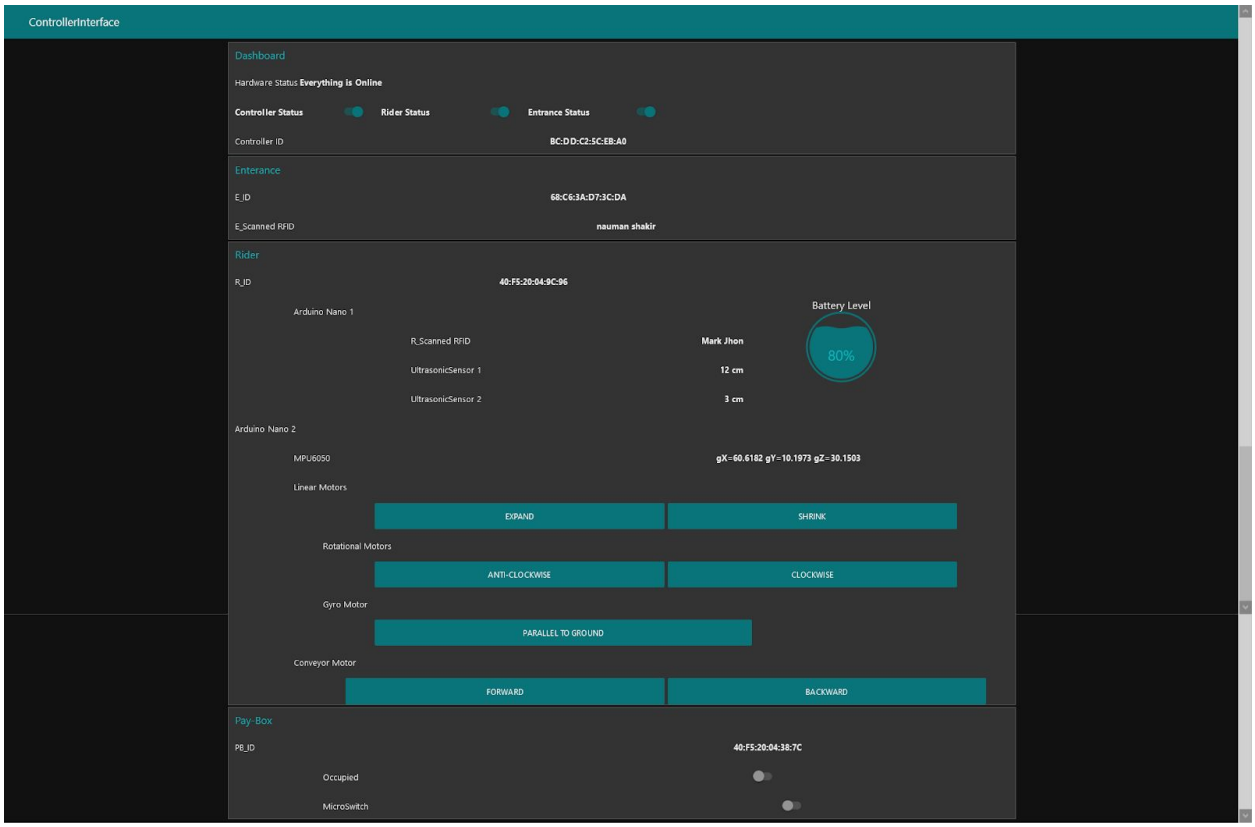
Testing the System

Power up all the nodes after assembling the circuit and then open the WebApp dashboard.

WebApp

The WebApp can be accessed from

http://nodered.production.wrapdrive.tech:1880/ui/#!/6



Issues

No issues as of now.

System Functionality

The working of the entire system is described below to remove any misunderstandings because the video demo is not very clear. The details below describe the functionality of the full program as it is programmed.

Entrance

- The entrance device waits for an RFID card scan, if it is scanned, it sends the data to the controller, assigns an ID which is also displayed in the WebApp in realtime and. Then it directs the controller to check the paybox and have its ID checked.

Controller

- It is the main and central component in the system. See page number 4 of this document for Architecture Diagram.
- It receives/sends the data from/to all components in the system including PayBox, Entrance Device, Rider Devices and the WebApp Dashboard(with database)
- Controller details are also displayed on the WebApp for the admin

Rider

- There is one NodeMCU and two Arduino Nanos attached to it.
- It waits for the RFID card scan, waits for a few seconds to process the data and then sends it to the main Dashboard. Gets the price and weight data from the database
    - Database is hosted here
    - https://phpmyadmin.production.wrapdrive.tech
    - use the details below to log in to the database
        - Hostname : pd-mysql-db-db.production.wrapdrive.tech:3306
        - Username: root
        - Password: pd-mysql-db
        -

Profile

Name: Nauman Shakir

Company: 3STechLabs

Designation: Founder and Program Manager

Email Address: NaumanShakir3S@gmail.com

Portfolio: https://NaumanShakir.com

I'm a Full-Stack IoT Developer and have done more than 150 hardware projects and running an IoT and Hardware Design House

https://3STechLabs.com

https://facebook.com/3STechLabs

https://Linkedin.com/company/3STechLabs

Freelancing Profiles

https://www.fiverr.com/naumanshakir

https://www.upwork.com/fl/naumanshakir3s