**Electronic Tracking Collar**

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Humber College School of Applied Technology

# Declaration of Joint Authorship

We, Gurpreet Singh and Simarjeet Brar, confirm that this work submitted for assessment is the joint work of ourselves, and is expressed in our own words. Any uses made within of other works of any other author, in any form (ideas, equations, figures, previous technologies, tables, programs, texts) are properly acknowledged at the point of use. A list of the references used is included. Simarjeet handled web interface and database and Gurpreet handled android application and hardware.

Approved Proposal

## Executive Summary

As a student in the Computer Engineering Technology program, I will be integrating the knowledge and skills I have learned from our program into this Internet of Things themed capstone project. This proposal requests the approval to build a device that is used to track animals for safty and research purposes. The internet connected hardware will include a custom PCB with sensors and actuators for the measuring of light, distance travelled per day, and geological locaition (latitiude and longitude using Gps). We will be using Firebase to store all the data and readings from sensor on the interenet. The android application will be used to get all that data from the database and display it in user freiendly manner. In the winter semester I work on light sensor to use it as an automatic switch to save energy. The hardware was set up in CENG 317 Hardware Production Techniques independently and the application was designed in CENG 319 Software Project. These will be integrated together in the subsequent term in CENG 355 Computer Systems Project as a member of a 2 student group.

## Background

ET-Collar is a device that ensures the safety of your pet or animals at zoo. As we all know life these days is extremely busy so if have pets its not only a great responsibility but also their safety is the biggest concern. Our device there help your pets to ensure they are safe and sound at home when you’re not around. Our Product is small lightweight enough to not affect your pet anyway. It uses GPS chip track down exact location of the animal. So if you’re pet accidentky got lost you can always check their location on your phone.

## Concluding remarks

This proposal presents a plan for providing a solution for the green house at Humber College. This is an opportunity to integrate the knowledge and skills developed in our program to create a collaborative capstone project demonstrating my ability to learn how to support projects. I request approval of this project

# Abstract

There are is a high demand of people that studies animal and wants to track them down and learn about the environment they live in. To solve this issue, a system that monitors the movement of animals and the environment they are in is being created.

The mentioned system should determine the location where the animal is and the level of lighting around the animal/pet wearing the device. Moreover, the system should allow to track the distance cover by them.

This technical report discusses the Et-Collar, a system designed fulfill all the requirements mentioned above.

The device will calculate the location, the level of lighting and the distance travelled by the one wearing the device.  Once the data is calculated by the device, the information will be sent to a database.

The database, will hold all the real time information and goes in parallel with an android application.

Moreover, the android application will display the most recent data (real time data).

 Devices as the one being designed already exists in the market, however we are designing a device that can be reproduced by anyone with no specific knowledge in programming or microcontroller as all the necessary instruction and code are going to be made available.

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Introduction

Project Description

The aim of the project is to design and implement a device that can track and monitor animals activity.

The final product will be different than others already on the market as the device can be reproduced by anyone without any specific knowledge.

The approach adopted to walk through this project is using all the skills learned throughout the program, the hardware used is: TSL2561 (Light sensor), LIS3DH (accelerometer), GP-20U7 (GPS).

The main issue is to integrate this three sensors, make them work together while pushing data on the DB.

The database adopted to work along the three sensor is Firebase, which will store the readings of the three sensors, additionally some more information about the user will be stored on the DB.

To overcome the issue of integrating the three sensors at once is to work on the single sensors first and then integrate each other. The first step on getting the DB up and running is being able to get the connection working from the device to Firebase.

The purpose of this project is to, let animal lover, keep track of animals and help them study and monitor them with the best accuracy.

Furthermore, other aspects such as size and portability are very important and considered in the development of the final product. This problem is overcome by designing and cutting a case to protect and make the product look more professional.

Requirement Specifications

1. Software Requirements
2. Mobile Application

Mobile Application will be used to display sensor data on screen from firebase database it requires a multiple screens for user that will not only display the readings but also the guidelines of the project and how to use the device. It uses google maps to display location of the animal.

1. Database

Database is used to store sensor data on the internet for easy access through application. Gurpreet will be handling all the sensor data that is to retrieve readings and upload them on cloud using python code.

1. Hardware Requirements
2. Development Platform

The platform chosen to work on the sensors is the raspberry pi 3, as it has built in Wi-Fi, which makes it easier on to work on.

Moreover, Gurpreet Singh will work on the platform and integrate the different sensors accordingly. Simarjeet Brar will assist in troubleshooting any problem and take care of any portability issue.

1. Interface Boards and Sensors

Sensor that are used in the project are Light/Lux Sensor (TSL2561), accelerometer (LIS3DH) and GPS (GP20u7). These sensors will be used to get readings about lux and distanced by the animal GPS will be used to get location. All the sensors are first tested separately and then put together on single Printed Circuit Board (PCB) designed by both of us.

1. Other Hardware and enclosure

We will designing a case to protect our sensors from physical damage so for that we need acrylic sheets to create a perfect case. It should a compact and low weight product that will make animals feel comfortable wearing around their neck.

References

# Technology Report Guidelines Computer Project under blackboard.

# Example of Technical Report Computer Project under blackboard.

Build Instructions

Project Report

# Billing materials

Below is a listing of the materials used for the project with a link to the place that they have been bough.

* [Raspberry pi ……………………… $ 99.00](https://www.canakit.com/raspberry-pi-3-model-b-plus-ultimate-kit.html)
* [TSL2561………………………………$ 09.99](https://www.adafruit.com/product/439)
* [LIS3DH ……………………………..$ 14.95](https://www.adafruit.com/product/2809)
* [GP-20U7……………….…………..$ 56.08](https://www.sparkfun.com/products/13740)
* [Sd card (8gb) .……………………..$ 9.](https://www.amazon.ca/Sandisk-Ultra-Micro-UHS-I-Adapter/dp/B073K14CVB/ref=sr_1_4?s=electronics&ie=UTF8&qid=1537837988&sr=1-4&keywords=micro%2Bsd%2Bcard%2B16gb&th=1)39
* [Male to female Headers……..$ 9.](https://www.amazon.ca/Haobase-120pcs-Multicolored-Female-Breadboard/dp/B01DLKLL6C/ref=sr_1_1?ie=UTF8&qid=1537837802&sr=8-1&keywords=jumper+wires+male+to+female)99 (optional)
* 7 pin header……………….…………n/a
* 8 pin header………………………….n/a
* 40 pin header……………………….n/a
* PCB………………………………………..n/a

Total………………………………………………….189.41

Prices may change based on location, shipping, currency,etc..

# Time commitment

The overall time taken to complete the hardware part was 15 hours, to complete the android application it took around 30 hours spanned in 4 months

However, if anyone wants to replicate the project it should take no longer than seven hours to complete, of course all the required materials should be by hand.

Moreover, the estimated completion time consider that the source code, PCB design, instruction for DB set up and android application are provided and working. If changes are made, more time needs to be added for the completion of the project.

# Hardware

## Raspberry pi setup

Once you have got your raspberry pi. Start working on its functionality, download required operating System and allow all the permissions required.

If it is the first-time installing OS on raspberry pi and do not know how to do it follow these steps:

#### Step 1: Download Raspbian

It can easily take more than half an hour to download the software.Download Noobs from <https://www.raspberrypi.org/downloads/>

#### Step 2: Unzip the file

The Raspbian disc image is compressed, so you’ll need to unzip it. The file uses the ZIP64 format, so depending on how current your built-in utilities are, you need to use certain programs to unzip it.

#### Step 3: Write the disc image to your microSD card

Select the drive of your SD card in the ‘Device’ dropdown.

#### Step 4: Put the microSD card in your Pi and boot up

Select ‘Write’ and wait for the process to finish which may take around 20 minutes to complete.

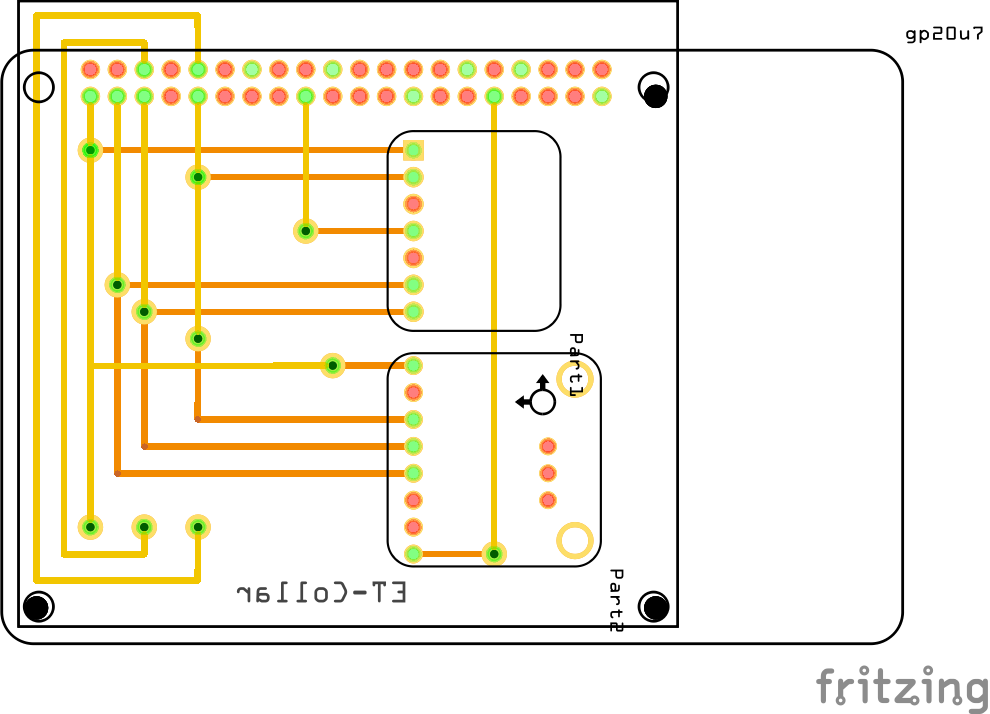
## Hardware setup

At this point you should have your pi ready and working. First we need to do is to check address and functionality of the sensors used in the project. So first connect your sensor through wires to the PI in order to check the correct address. After you have confirmed the I2C address for sensors you can design Printed circuit board and connect all the sensors together together through PCB.

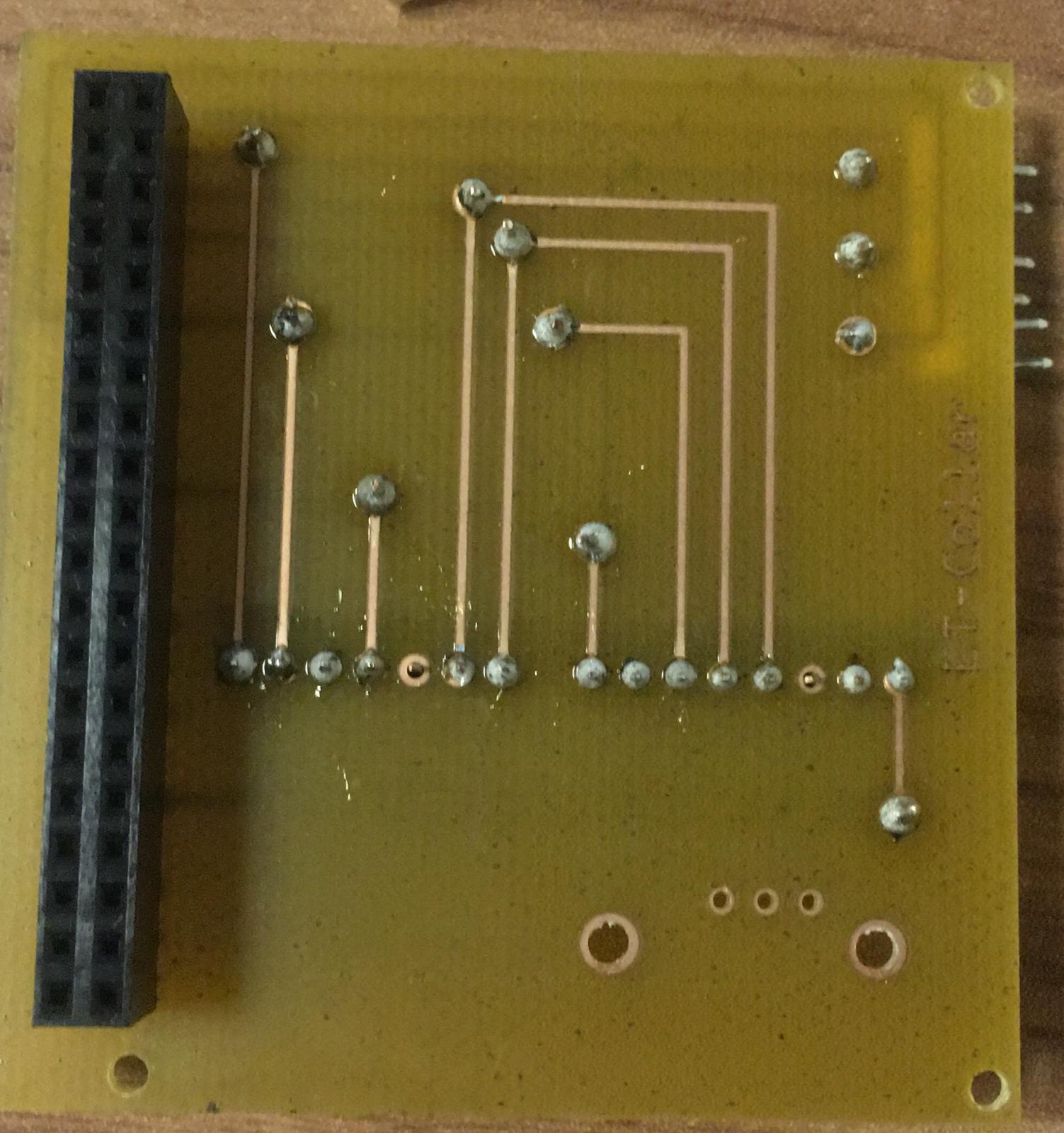
## PCB and Soldering

You can use fritizing to design your PCB. If you don't know how to use fritizing you can follow the guidelines on this website: <http://fritzing.org/learning/>

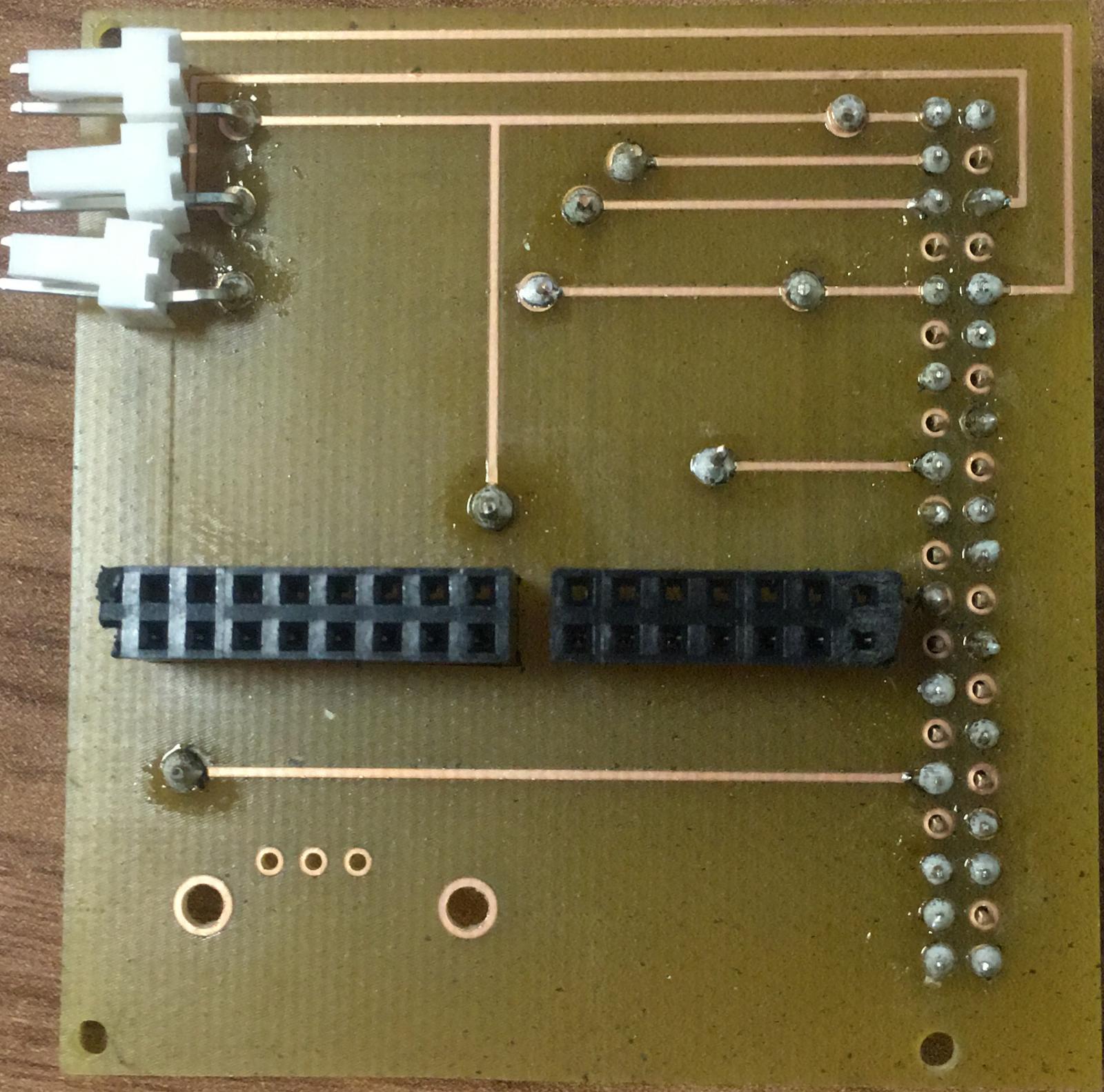
The wires that are yellow are on the top side of the board and orange ones are at the bottom. It is important not to cross two wires on the same side of board or in other words are in same colour. Note both sensor and RPI should be soldered on each side of the board. Also, make sure all the wires that are touching the PI pins are to be soldered on top side hence: should be same in colour same(yellow) and for sensor pins are going to be at bottom.



Next step, once the PCB is board is available, is to carefully solder socket headers to the PCB you have to be very carefull. Safety is the first priority so it is important to know what are you working with. If you haven't done soldering before you should get help from someone with experience or from youtube videos. For above design PCB should look like this. Bottom Side

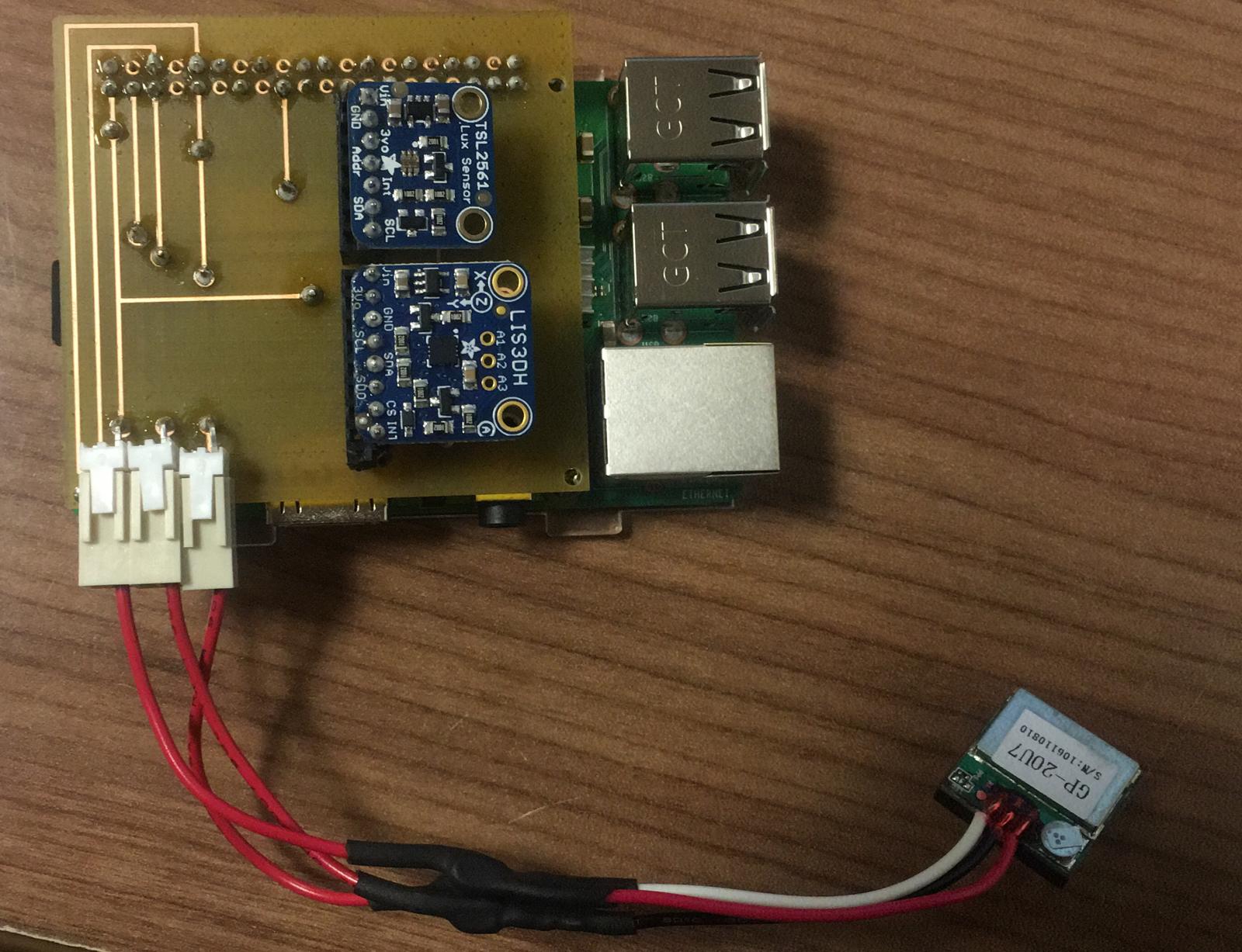


Top Side



After that you can just attached your sensor and raspberry pi to PCB. Make sure all the wires are connected and your sensor is at the correct address.

Connect sensors to PCB and to RPI as well.



## Get Data/Sensor Readings

So at this point you should have your raspberry pi and sensor ready to use to read data. To get data from sensor and display it in human readable form we have to run a script you can program that in java/c/python. Here, I am running this python code over here.

# Software Setup

The overall time taken to complete the hardware part was 15 hours, to complete the android application it took around 30 hours spanned in 4 months However, if anyone wants to replicate the project it should take no longer than seven hours to complete, of course all the required materials should be by hand. Moreover, the estimated completion time consider that the source code, PCB design, instruction for DB set up and android application are provided and working. If changes are made, more time needs to be added for the completion of the project.

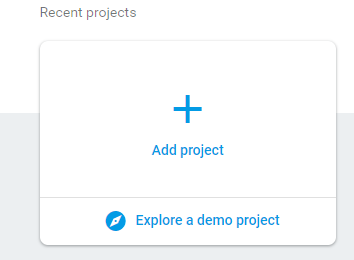
# Firebase

## Firebase structure

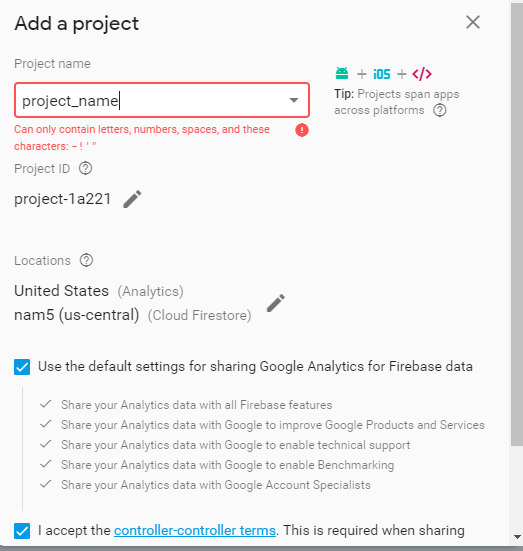
|  |
| --- |
| { |
|  | "AnimalData" : { |
|  | "202481592591255" : { |
|  | "Light" : "Dark", |
|  | "Location" : "43.811657, 79.735212", |
|  | "Lux" : "647", |
|  | "Status" : "Idling", |
|  | "Time" : "2019-03-01 15:11:35" |
|  | } |
|  | } |
|  | } |

## Create DB structure

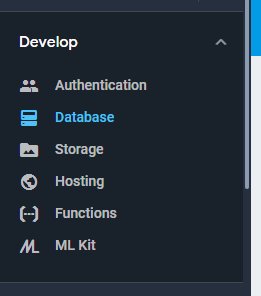
Once registered to firebase click on add project.

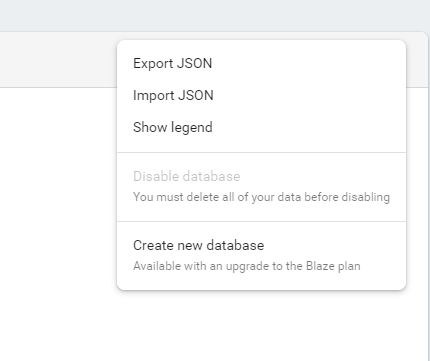
[](https://user-images.githubusercontent.com/47256700/54047180-69624280-41a4-11e9-89e8-a317544acf44.png)

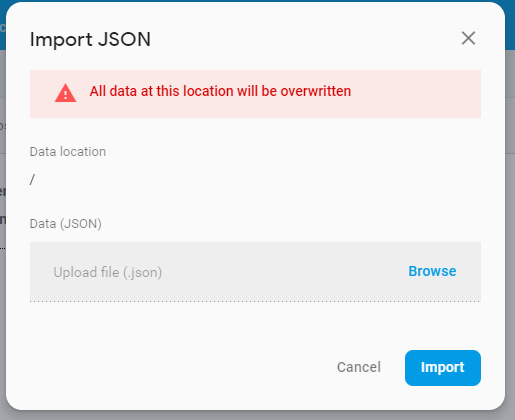
Then name and add the project to you android application

[](https://user-images.githubusercontent.com/47256700/54047193-6d8e6000-41a4-11e9-9a4b-d3b7296a5a9c.png)

Once the project has been created select database from the left menu and then import- creta the json structure provided an the top of the file.

[](https://user-images.githubusercontent.com/47256700/54047231-8139c680-41a4-11e9-916f-9833e56e531d.png)

[](https://user-images.githubusercontent.com/47256700/54047236-86971100-41a4-11e9-93ec-b805e4388f9d.png)

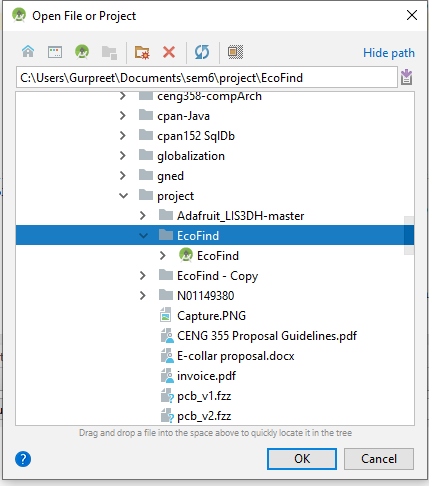
[](https://user-images.githubusercontent.com/47256700/54047244-8e56b580-41a4-11e9-908e-12082a1f2cad.png)

# Software

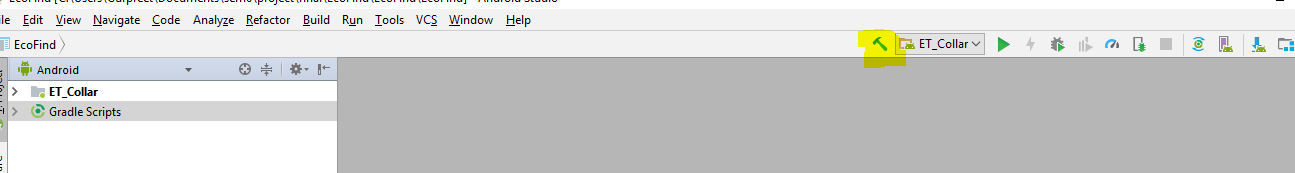
As software, an android application was developed to retrieve data from the DB (firebase), of which the code is available (----add link----). Download the android application or the APK and install it on the device (add link here).

Quick instruction to build and compile the code on android studio.

Open the project:



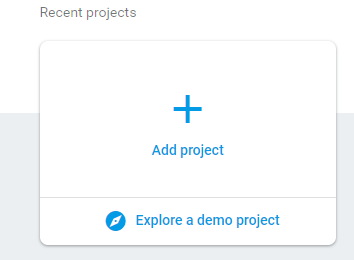
Once opened, click on the compile button of the application.

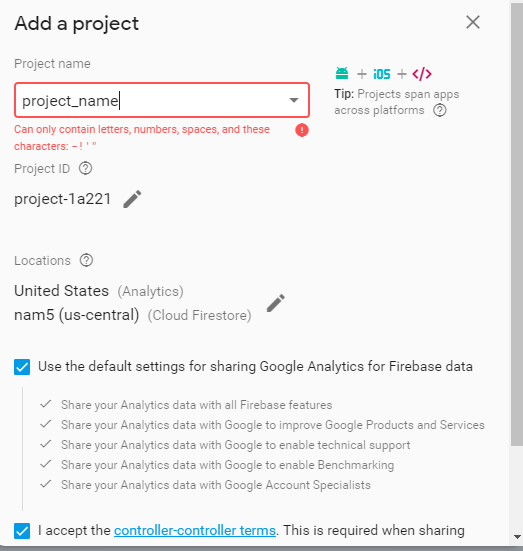


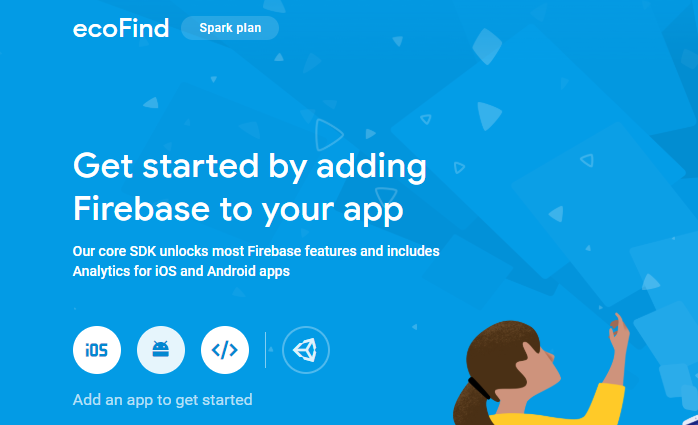
Once opened the json file can be added and the path to the database can be modified if using own DB (not recommended).

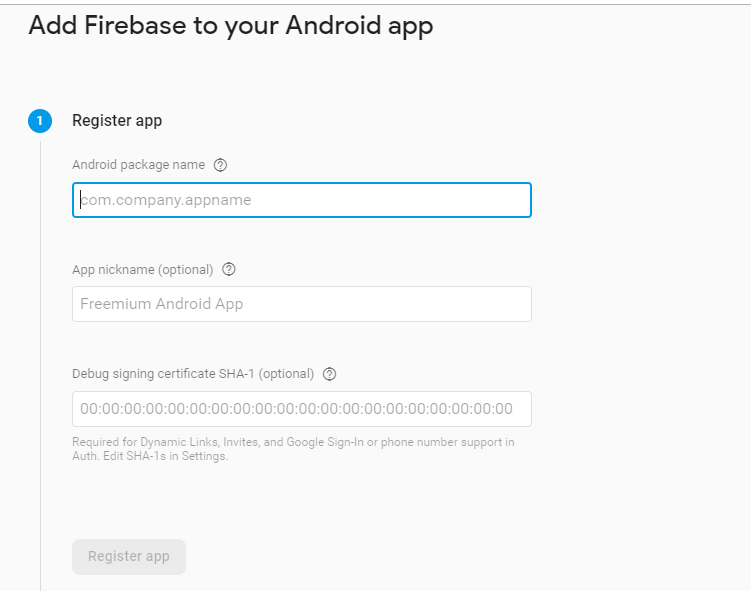
However, if someone wishes to add their own JSON file, they can download and modify the android application and the path to the database, refer to this link: <https://developers.google.com/android/guides/google-services-plugin>.

Database:



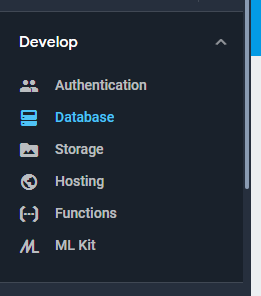


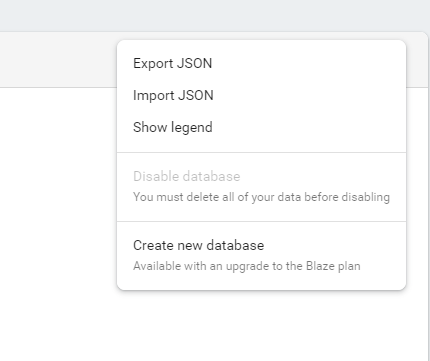




Follow the instructions

Once the project has been created and added to the android application select database and import the json structure of the file.





The Database will be filled with data when both hardware and software are running.

Python Code:

*from pyrebase import pyrebase*

*import smbus*

*import time*

*import math*

*from datetime import datetime*

*from pytz import timezone*

*from uuid import getnode as get\_mac*

*# defination of firebase connection*

*config = {*

*"apiKey": "AIzaSyCC1VCy28n6ztDLauYS1SPN0suiBPNpnDQ",*

*"authDomain": "ecofinder-29360.firebaseapp.com",*

*"databaseURL": "https://ecofinder-29360.firebaseio.com",*

*"projectId": "ecofinder-29360",*

*"storageBucket": "ecofinder-29360.appspot.com",*

*"messagingSenderId": "1021640576680"*

*}*

*firebase = pyrebase.initialize\_app(config)*

*dp = firebase.database()*

*# Get I2C bus*

*bus = smbus.SMBus(1)*

*# LIS3DHTR address, 0x18(24)*

*# Select control register1, 0x20(32)*

*# 0x27(39) Power ON mode, Data rate selection = 10 Hz*

*# X, Y, Z-Axis enabled*

*bus.write\_byte\_data(0x18, 0x20, 0x27)*

*# LIS3DHTR address, 0x18(24)*

*# Select control register4, 0x23(35)*

*# 0x00(00) Continuous update, Full-scale selection = +/-2G*

*bus.write\_byte\_data(0x18, 0x23, 0x00)*

*time.sleep(0.5)*

*t=0;*

*u=0;*

*sTot=0;*

*# LIS3DHTR address, 0x18(24)*

*# Read data back from 0x28(40), 2 bytes*

*while 1:*

*# X-Axis LSB, X-Axis MSB*

*data0 = bus.read\_byte\_data(0x18, 0x28)*

*data1 = bus.read\_byte\_data(0x18, 0x29)*

*bus = smbus.SMBus(1)*

*# Convert the data*

*bus.write\_byte\_data(0x49, 0x00 | 0x80, 0x03) #initilize light sensor readings*

*data3 = bus.read\_i2c\_block\_data(0x49, 0x0C | 0x80, 2) #read Light Sensor data*

*data4 = bus.read\_i2c\_block\_data(0x49, 0x0E | 0x80, 2)*

*xAccl = data1 \* 256 + data0*

*if xAccl > 32767 :*

*xAccl -= 65536*

*# LIS3DHTR address, 0x18(24)*

*# Read data back from 0x2A(42), 2 bytes*

*# Y-Axis LSB, Y-Axis MSB*

*data0 = bus.read\_byte\_data(0x18, 0x2A)*

*data1 = bus.read\_byte\_data(0x18, 0x2B)*

*# Convert the data*

*yAccl = data1 \* 256 + data0*

*if yAccl > 32767 :*

*yAccl -= 65536*

*# LIS3DHTR address, 0x18(24)*

*# Read data back from 0x2C(44), 2 bytes*

*# Z-Axis LSB, Z-Axis MSB*

*data0 = bus.read\_byte\_data(0x18, 0x2C)*

*data1 = bus.read\_byte\_data(0x18, 0x2D)*

*# Convert the data*

*zAccl = data1 \* 256 + data0*

*if zAccl > 32767 :*

*zAccl -= 65536*

*xAccl2=(xAccl/4)/4096;*

*yAccl2=(yAccl/4)/4096;*

*zAccl2=(zAccl/4)/4096;*

*tAccl=math.sqrt(xAccl\*xAccl+yAccl\*yAccl+zAccl\*zAccl)*

*v=u+tAccl\*t;*

*s=((v\*v)-(u\*u))/(2\*tAccl);*

*u=v;*

*t=5;*

*sTot+=s;*

*tAccl=math.sqrt(xAccl2\*xAccl2+yAccl2\*yAccl2+zAccl2\*zAccl2)*

*print("----------Animal Data-----------")*

*print("Total accelaration is: %d" %tAccl)*

*if tAccl>=1:*

*status = "Moving"*

*else:*

*status = "Idling"*

*print("Status: "+status)*

*ch0 = data3[1] \* 256 + data3[0]*

*ch1 = data4[1] \* 256 + data4[0]*

*lReading = ch0 - ch1*

*lux = str(lReading)*

*print ("Lux Value :%d lux" %lReading)#light print data*

*if lReading >= 1000:*

*light = "Sunlight"*

*elif (lReading > 100 and lReading < 500):*

*light = "Indoor"*

*else:*

*light = "Dark"*

*print("Light: "+light)*

*nt=datetime.now(timezone('US/Eastern'))*

*UpdateTime = nt.strftime("%Y-%m-%d %H:%M:%S")*

*location = "43.811657, 79.735212"*

*mac = get\_mac()*

*path = "AnimalData/"+str(mac)*

*print("Mac: %d"%mac)*

*dp.child(path).update({"Time":UpdateTime, "Status":status, "Lux":lux, "Light":light, "Location":location})*

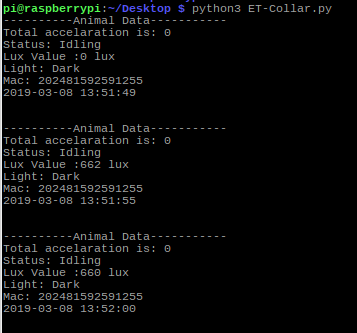
*print(UpdateTime)*

*print("\n")*

*time.sleep(5)*

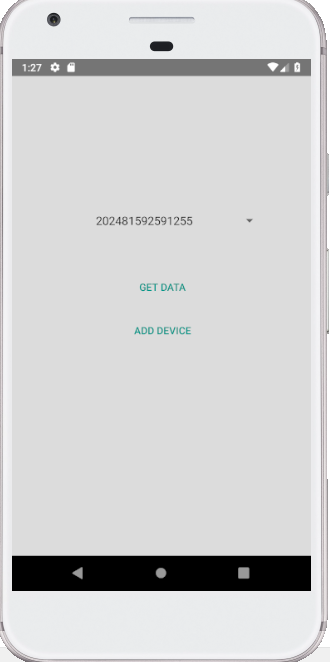
Display Data

When you will run the above python code you will get the following output:

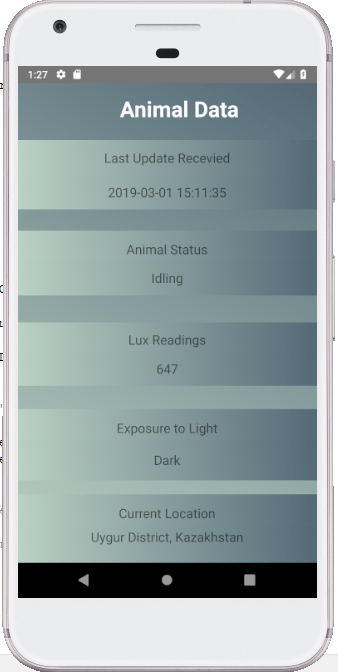


Android App Data

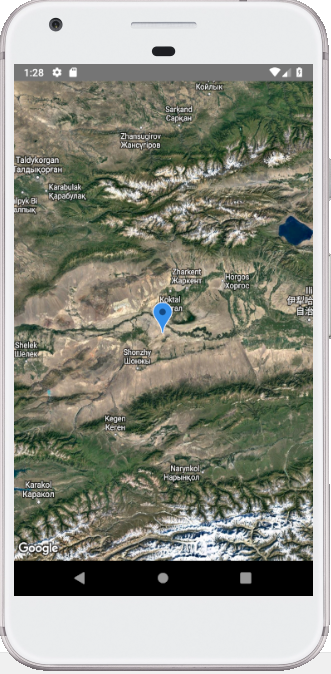
If everything is working fine you should get following screen on APP Select Status it will ask you to choose devices that are added to your account.

[](https://user-images.githubusercontent.com/47256700/54047821-18534e00-41a6-11e9-88f9-05385f572abb.png)

After you have selected you device's MAC address press get data to display data.

[](https://user-images.githubusercontent.com/47256700/54047820-18534e00-41a6-11e9-979c-5903e3b3794e.PNG)

Press map button to show animal's position on map

[](https://user-images.githubusercontent.com/47256700/54047819-18534e00-41a6-11e9-9592-5b36784b9a2b.png)