SMARTWATCH PROJECT

For Internet of Things (IoT)

Date: 9th June 2021

Team Members:

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Alexandru MANDA
Walid NAOUSS
Joseph NIRMALRAJ
Martin LE GOFF

Protectline

isep
École d'ingénieurs du numérique

Organization and Teamwork

Aditya RANGANATH

- Battery Charging
- Database integration
- Web Interface

Alexandru MANDA

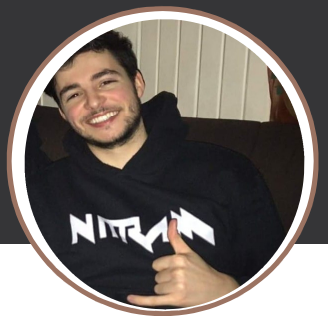
- Integration of the modules
- SIM module
- GPS location

Joseph NIRMALRAJ

- Sensor Integration
- Pedometer
- Accelerometer

Walid NAOUSS

- Fall Detection
- Accelerometer



Martin LE GOFF

- BLE Android Application

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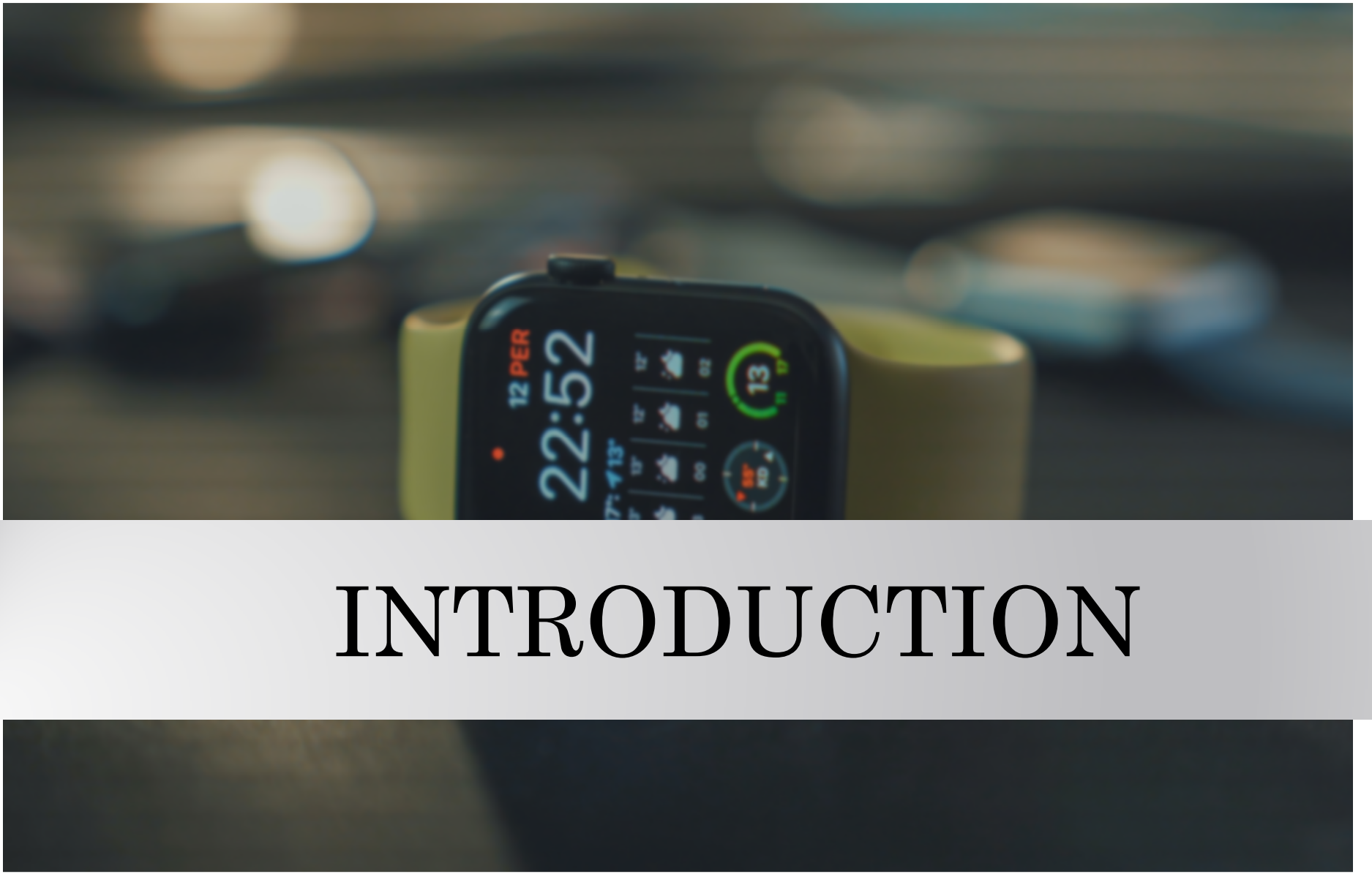


INTRODUCTION

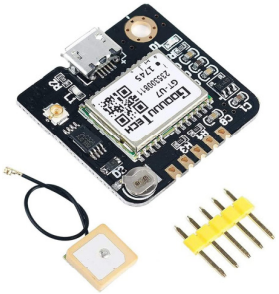
Introduction

The main objective of the project is to help seniors who are still considered as active to keep in track their activity. The idea is working also for the people far from their family and in case of an emergency they will be able to know if something will happen and they will be alerted. Also it has to be user friendly, permitting the seniors to have very easy interaction and also to have good battery life as well as portability.

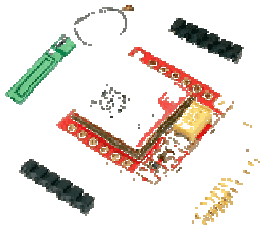
PROJECT FEATURES

Hardware Components

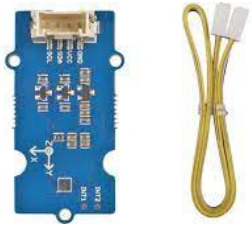
ADXL Accelerometer



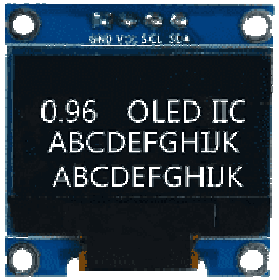
GPS Module



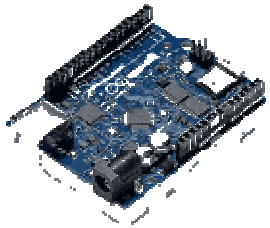
SIM 800LGSM/GPRS



BMA456 STEP COUNTER



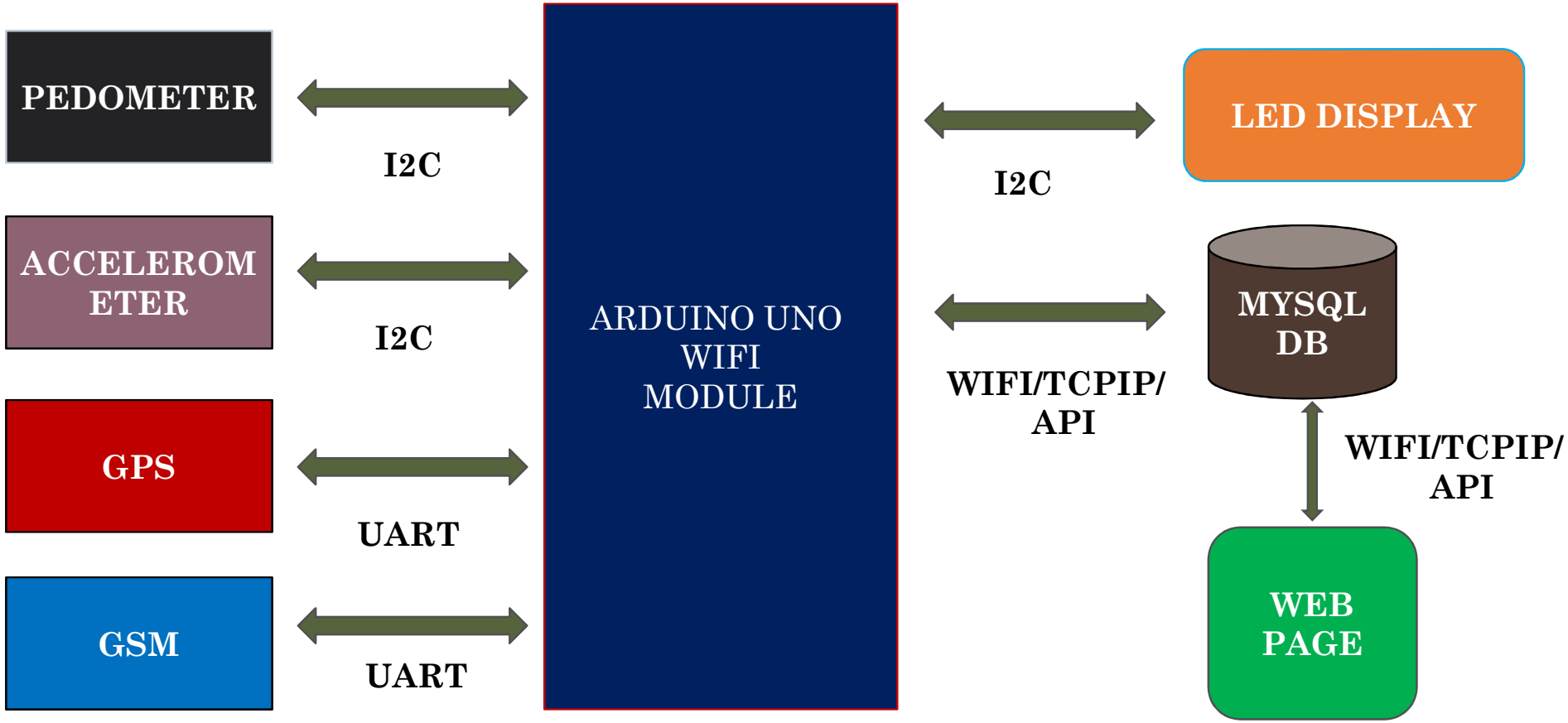
Adafruit OLED Module

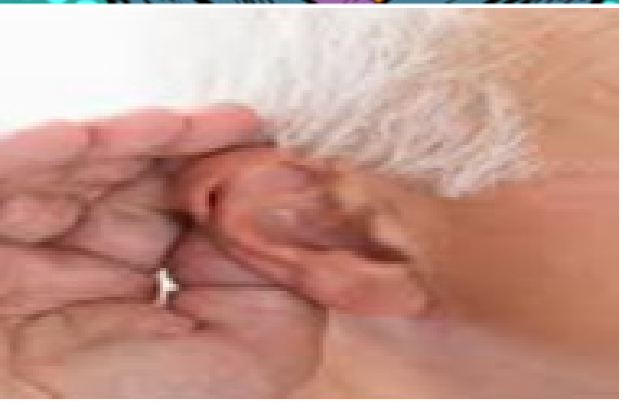


Arduino UNO WIFI REV Board

Lithium ion Battery

Hardware Architecture





Sensor Integration

Why is sensor needed to find Fall detection ?

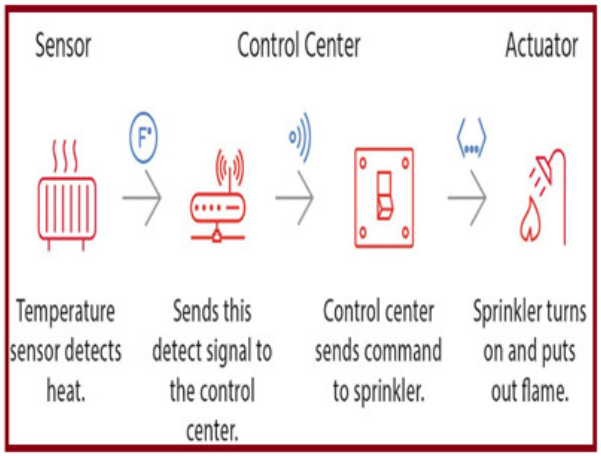
• If a person fall from one rest position to an another position, how do we detect ? Yeah, it's possible by,

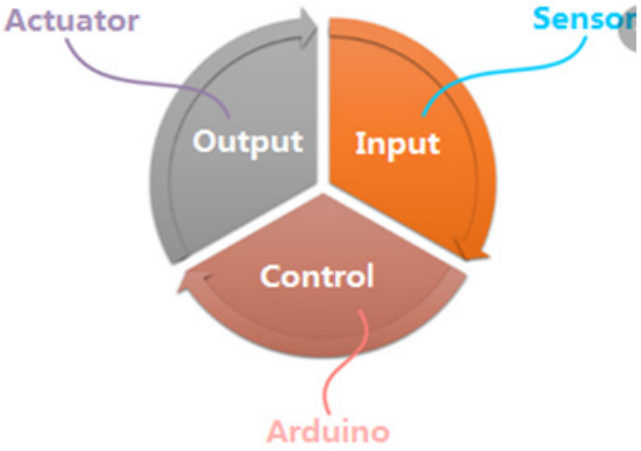
- Eye contact,
- Physical touch and
- Noise

• All these three points stated or descriptive In "Manual Measurement", it leads more Into slothful moments nowadays.

• Advantages of Utilization the technological aspects comes into the picture,

Role of Sensor and its Potential





- How do we do detect when there is no one is placed ?

- Role of sensor here is, In a control & automation system is to detect &measure some physical effect, providing this information to the control system.

- Information in terms of electrical signal or non-electrical signals (Mechanical movements)

- Further sensor information's are embedding with micro controllers and transmit to the required user for the appropriate decisions.

Portable Pedometer

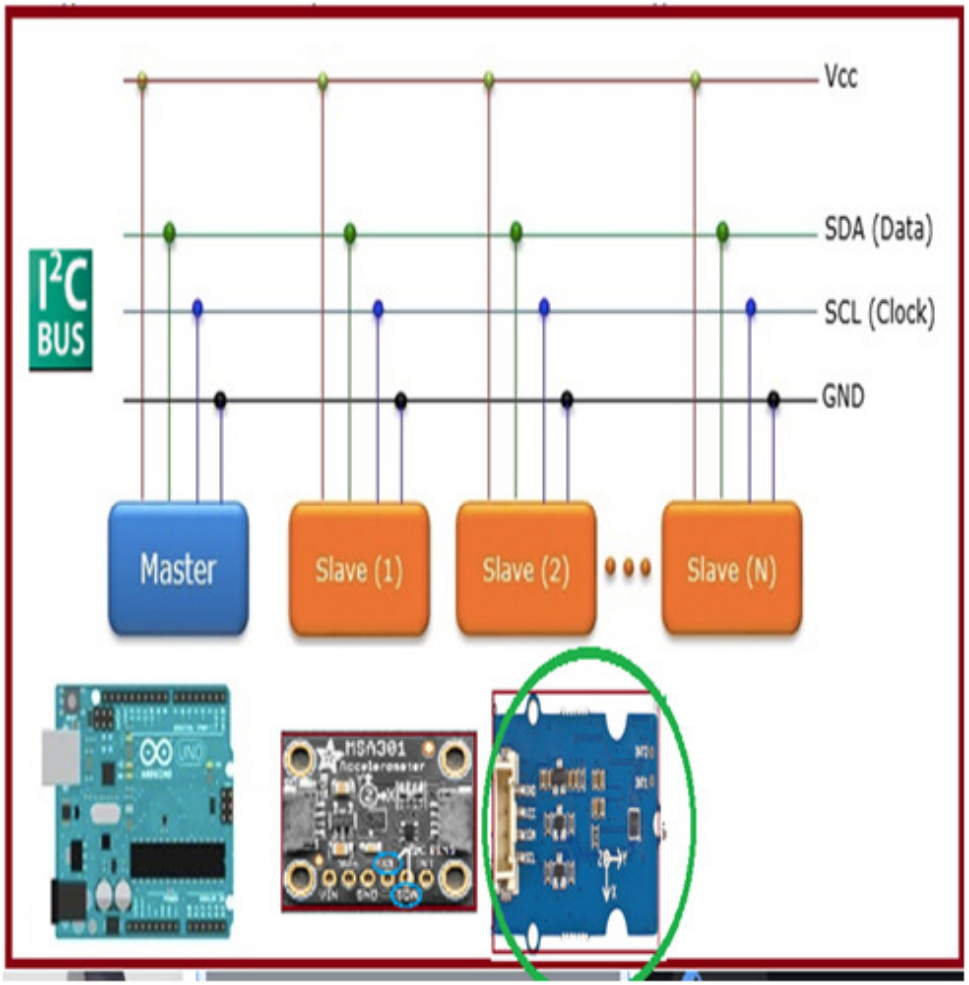
• We can demonstrate this product like wrist band,
Handy unit or Rolling belt unit. It has sensor in it
which works by battery.

• **Patients shall use this product and Output from this sensor make sure their safety.**

✓Step counting in wearable device based on
✓BMA456
✓Allows low-noise measurement of accelerations
✓in three perpendicular axes
✓Featuring 16-bit digital resolution and
✓embedded intelligence

Electrical/Interface Requirements:

• Operating voltage 3.3V/5V
• Supports I2C bus protocol
• Weight 3.2g
• Options in sensitivity
• Fancy (Display, colored product)



I2C Interface Details of Pedometer

- Inter integrated circuits widely used for attaching lower-speed peripheral chips to microcontrollers
- I2C uses only two bidirectional communication SDA and SCL.

✓Serial Data Line (SDA) and
✓Serial Clock Line (SCL)
✓Typical voltages used are
✓+5 V or +3.3 V

- SCL and SDA as signal lines.
- Both lines are connected to VDDIO externally via pull-up resistors.
- so that they are pulled high when the bus is free.

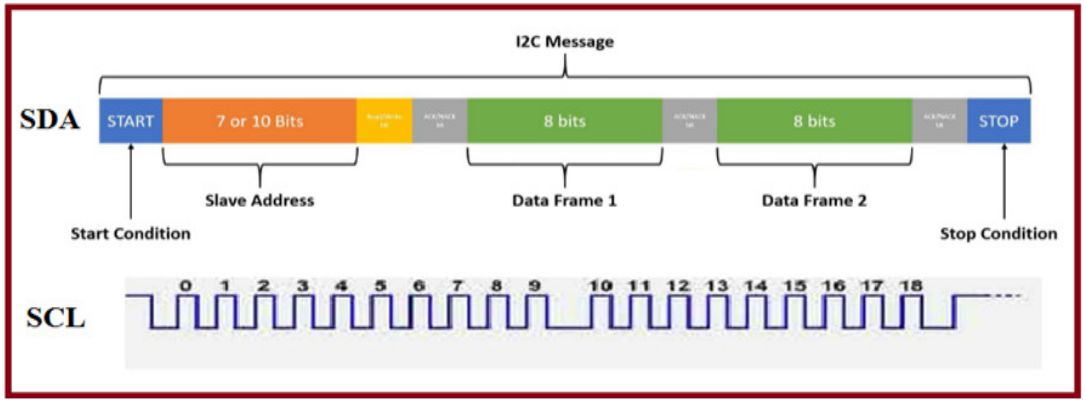
I2C Interface Details of Pedometer

• At start condition, SCL is high and SDA has a falling edge. Then the slave address is sent.

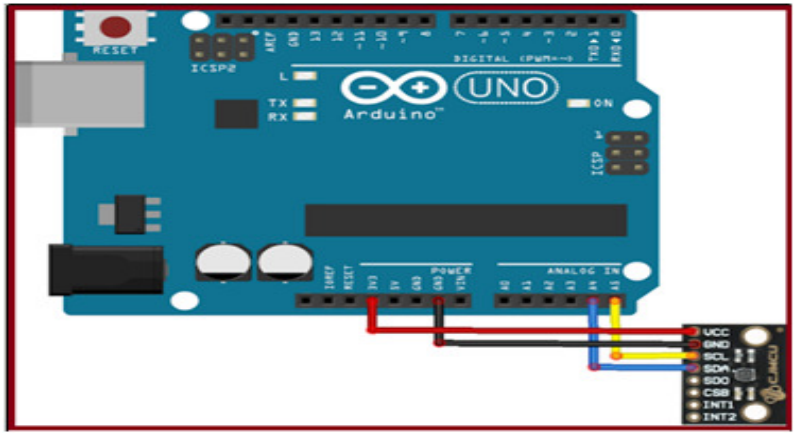
• After the 7 address bits, the direction control bit R/W selects
the read or write operation.

• When a slave device recognizes that it is being addressed, it should acknowledge by pulling SDA low in the ninth SCL (ACK) cycle.

• At stop condition, SCL is also high, but SDA has a rising edge. Data must be held stable at SDA when SCL is high. Data can change value at SDA only when SCL is low.



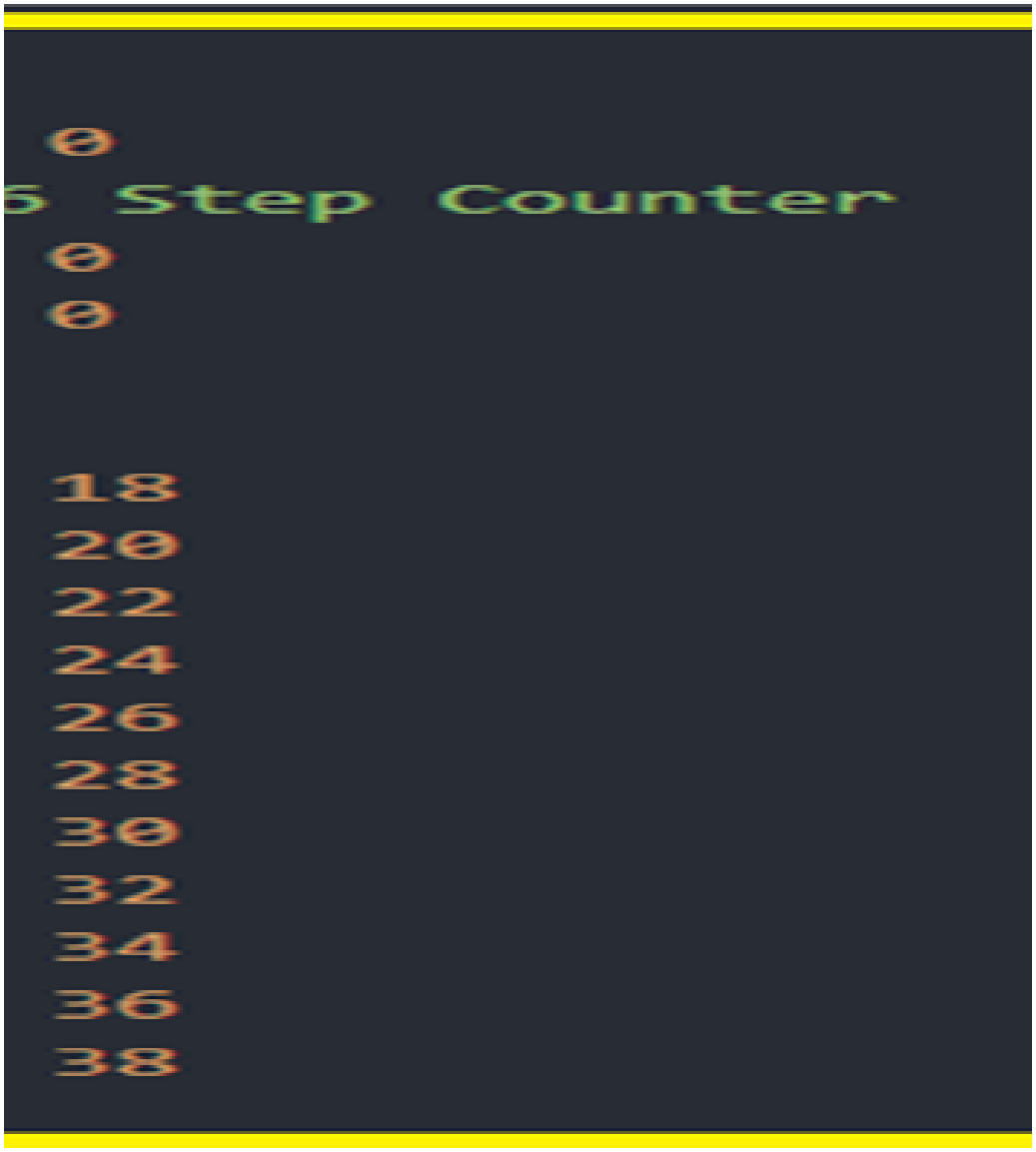
SENSOR PIN OUT		
GND	Black	GND
5V or 3.3V	Red	VCC
SDA	White	SDA
SCL	Yellow	SCL



Integration of Pedometer

• Terminate SDA, SCL, Vcc and GND pins of sensor
to controller as per the standard color code
•
• Download and integrate the BMA456 lib will enable
Communication between sensor and Arduino.

• Define the sensor (slave) device address
in the program,
✓ **0x19 device address**
• Initialize bma456 library
• Enable the step counter access
• Print the steps in loop with required delay



Result of Pedometer

- Access the step counter sensor by rotating or Movement by 45 deg,

- We shall be able to see the output in the serial Port monitor increment of counts.

Sensor Accelerometer

• An accelerometer is an electronic sensor that measures the acceleration forces acting on an object in order to determine the object's position in space and monitor the object's movement.

• An accelerometer at resting on a table would measure 1G (9.81 m/s2) straight upwards. In physical term, the rate of change of velocity of a body in its own instantaneous rest frame.

Why accelerometer MSA301

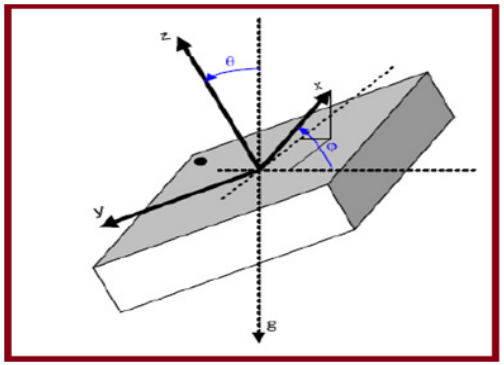
Why accelerometer and no other device like vibrating sensor or distance measurement sensor ?

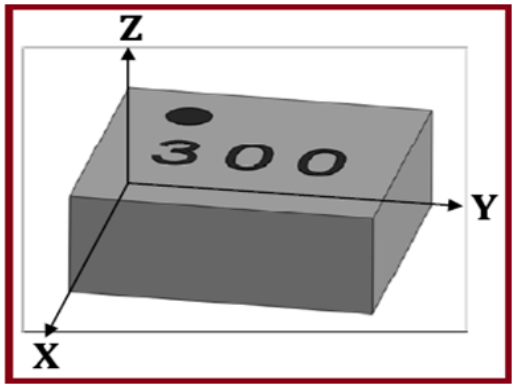
- Accelerometer include linearity over a wide frequency range and a large dynamic range and additionally it has capable of tri-axial measurement and I2C support

SLNO	MAIN FEATURE CONTENT OF MSA301
1	**Dynamical user selectable full scales range of ±2g/±4g/±8g/±16g**
2	**Allows acceleration measurements with output data rates from 1Hz to 500Hz.**
3	**Minimum supply voltage 1.62V to 3.6V and Maximum value -0.3 to 3.6V**
4	**Operating or maximum voltage of IO supply voltage is 1.2V to 3.6V**

Implementation of Sensor Accelerometer Into Project

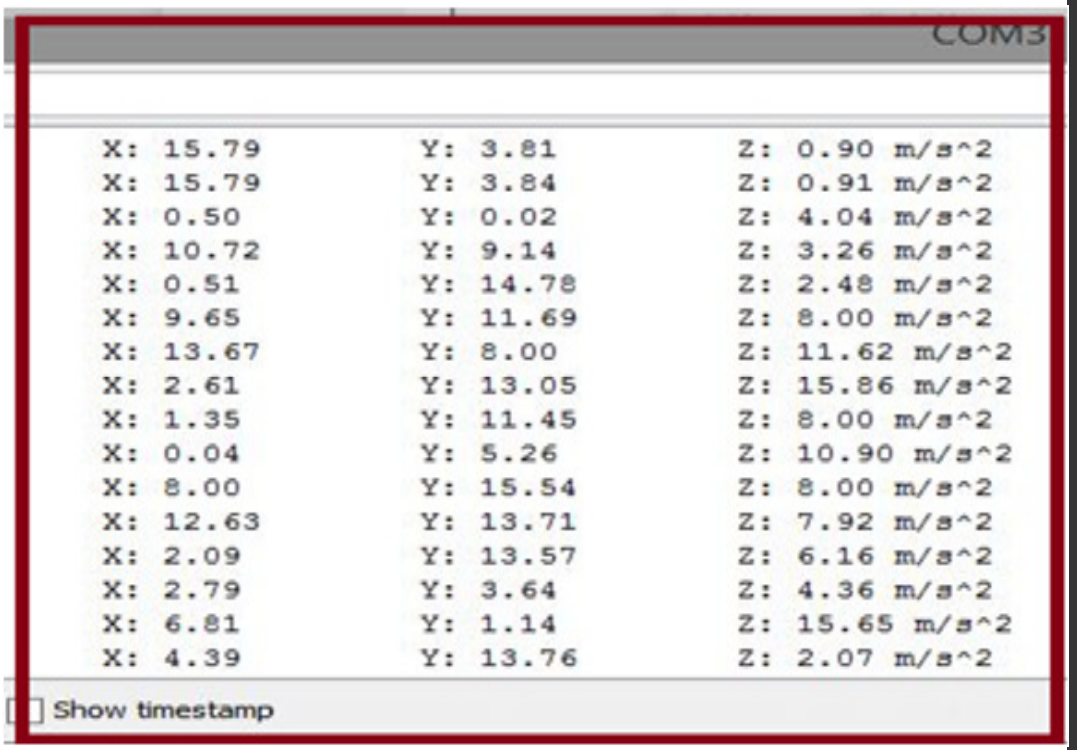
- The Orientation recognition feature informs on an orientation change of sensor with respect to the gravitation field vector ‘g’.
- The accelerometer scale of each depends on the sensitivity settings chosen which can be one of +/- 2, 4, 8, or 16g for the accelerometer. The accelerometer produces data in units of acceleration (distance over time2),
- The output scale for any setting is [-32768, +32767] for each of the six axes. Default of I2C is is +/- 2g for the acceleration. If the device is perfectly level and not moving, then:
- X/Y accel axes should read 0 or less constant value
- Z accel axis should read 1g, which is +16384 at a sensitivity of 2gwhich outputs the raw readings as mg/LSB.





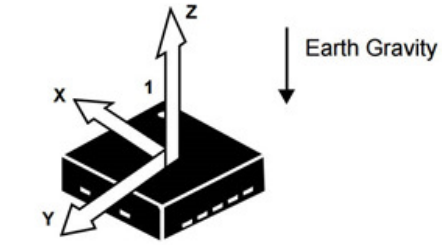
Implementation of Sensor Accelerometer Into Project

- **Output format**: mg = milli-G's, 1mG = 0.001 G's of acceleration, so 1000mG = 1G. And LSB = Least Significant bit, which is the last bit on the right. The raw values from the accelerometer are multiplied by the sensitive level to get the value in G.
- The acceleration output is 14-bits two's complement data. data for each axis is split into MSB part (one byte containing bits 13 to 6) and LSB lower part (one byte containing bits 5 to 0). To enable 'NEW_DATA_INT' function, (0x17) 'DATA_INT_EN' should be set.
- Changes in displacement (freefall with more than 30deg angle (Non Orientation))

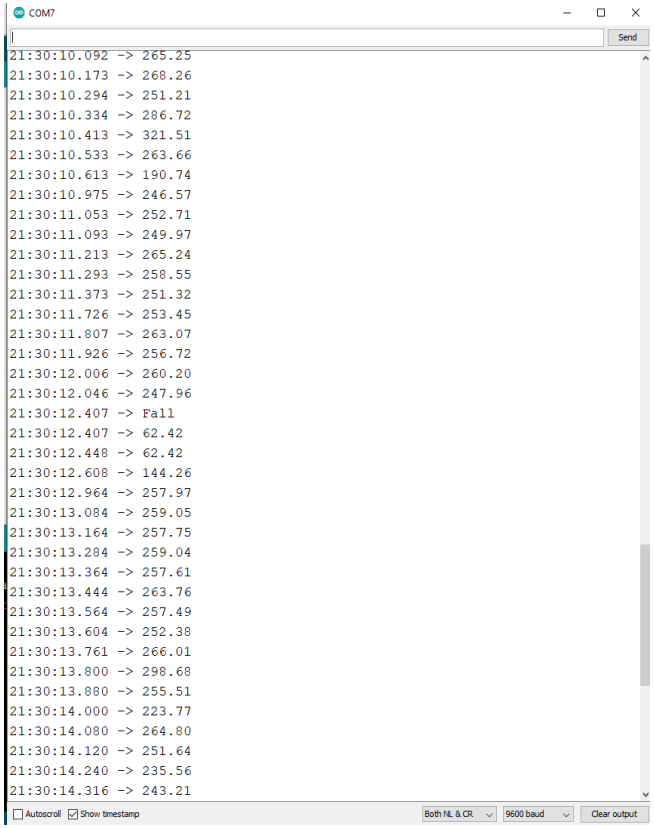


Fall Detection

- ✓ Fall detection devices automatically employ the technology to detect and get fast assistance for a senior that is prone to falls.
- ✓ Fall detection systems use accelerometers, a type of low power radio wave technology sensor, to monitor the movements of the user. State-of-the-art fall detection devices use three axis accelerometers.



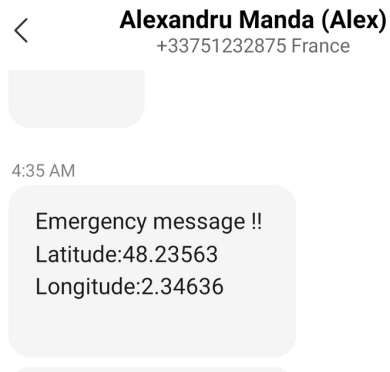
(TOP VIEW)
DIRECTION OF THE
DETECTABLE ACCELERATIONS



SOS Message

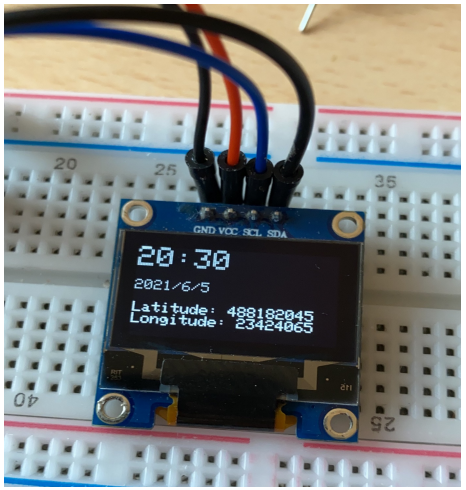
We get the values from the total acceleration and if it drops below 50 than it means that there has been detected the fall, so we will send an SMS so that the family will get notified with the location.
After we send the emergency message, we will send as well a call, so that the family can hear if the senior is having a serios incident or not

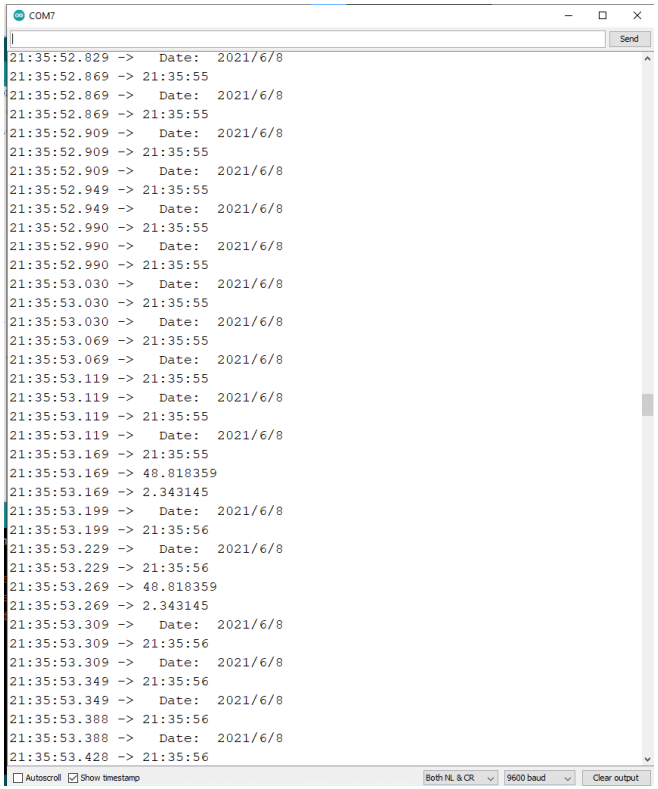
```
boolean Ok=FallDetection::detection();
if(Ok==true){
  SIM::SOSmessage(latitude,longitude);
}
```



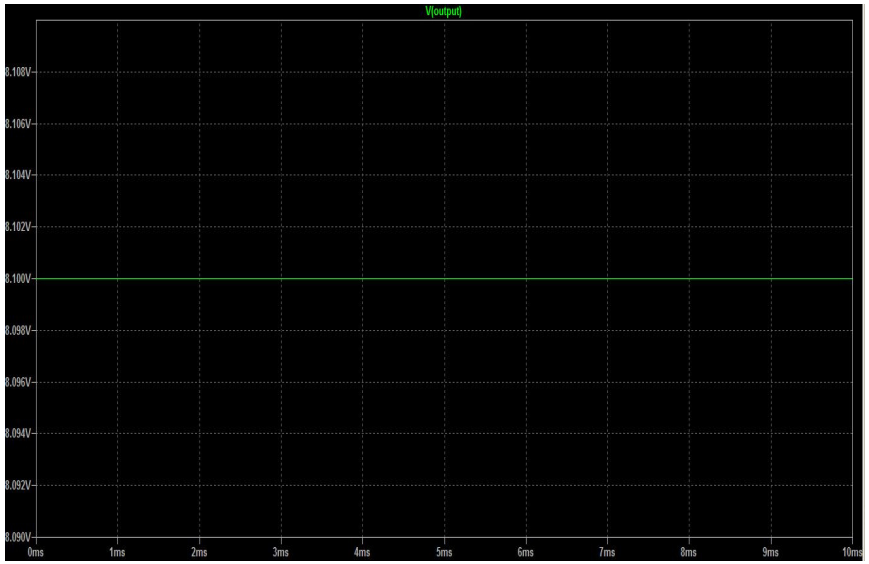
Geolocalization

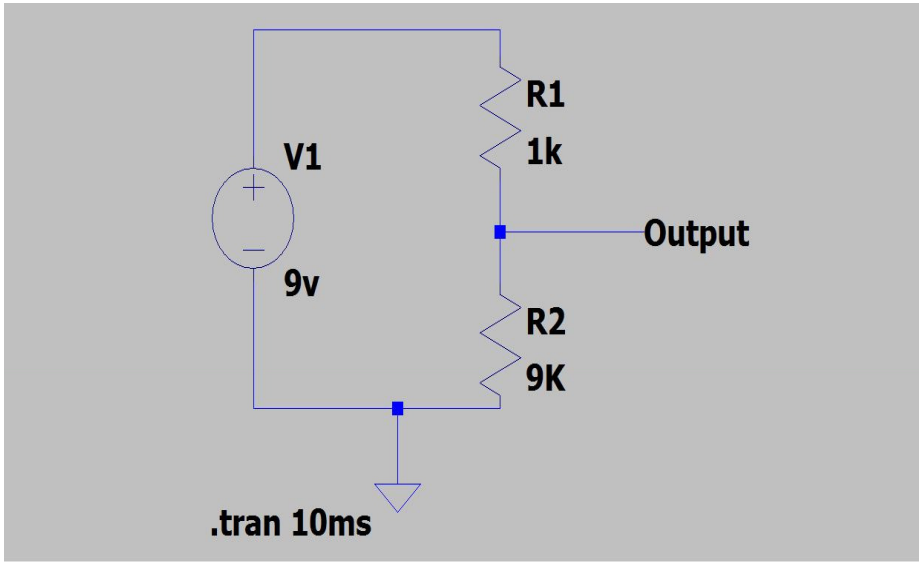
By the use of the GPS GT-U7 module we were able to take the information regarding the location (latitude and longitude), date and time and then display it on the screen





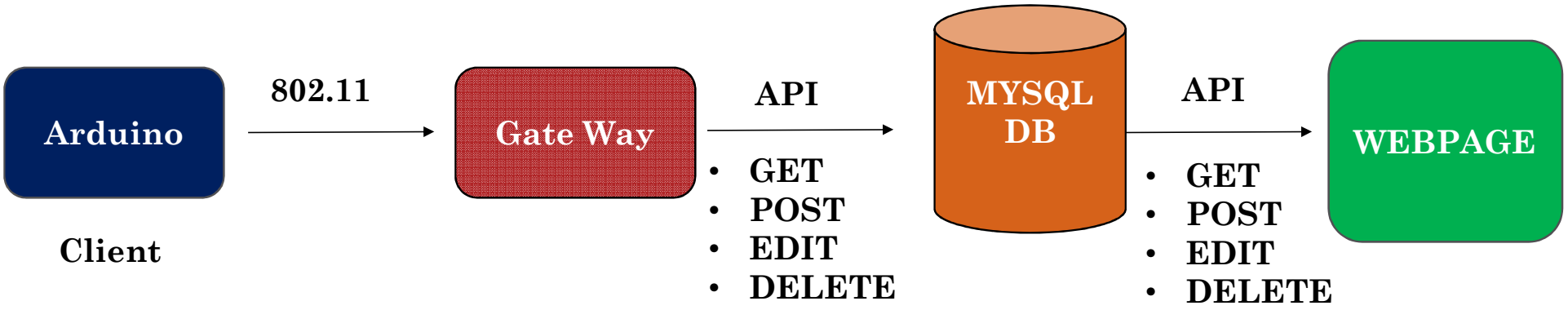
Charging Circuit





DC 9V → Charging Circuit → Lithium Ion Battery → LOAD

Database Message and Web Interface



Database Outputs

☐	Edit Copy Delete	9462	48.824753	2.280099	256.747	4	2021-06-07	11:36:11
☐	Edit Copy Delete	9461	48.824753	2.280099	256.747	4	2021-06-07	11:36:10
☐	Edit Copy Delete	9460	48.824753	2.280099	257.149	4	2021-06-07	11:36:09
☐	Edit Copy Delete	9459	48.824753	2.280099	257.149	4	2021-06-07	11:36:09
☐	Edit Copy Delete	9458	48.824753	2.280099	257.149	4	2021-06-07	11:36:07
☐	Edit Copy Delete	9457	48.824753	2.280099	257.149	4	2021-06-07	11:36:07
☐	Edit Copy Delete	9456	48.824753	2.280099	257.962	4	2021-06-07	11:36:06
☐	Edit Copy Delete	9455	48.824753	2.280099	257.962	4	2021-06-07	11:36:05
☐	Edit Copy Delete	9454	48.824753	2.280099	257.152	4	2021-06-07	11:36:04
☐	Edit Copy Delete	9453	48.824753	2.280099	257.152	4	2021-06-07	11:36:02
☐	Edit Copy Delete	9452	48.824753	2.280099	257.152	4	2021-06-07	11:36:02
☐	Edit Copy Delete	9451	48.824753	2.280099	257.152	4	2021-06-07	11:36:00
☐	Edit Copy Delete	9450	48.824753	2.280099	257.720	4	2021-06-07	11:35:59
☐	Edit Copy Delete	9449	48.824753	2.280099	257.720	4	2021-06-07	11:35:59
☐	Edit Copy Delete	9448	48.824753	2.280099	257.366	4	2021-06-07	11:35:58
☐	Edit Copy Delete	9447	48.824753	2.280099	257.023	4	2021-06-07	11:35:57
☐	Edit Copy Delete	9446	48.824753	2.280099	257.023	4	2021-06-07	11:35:56

Console

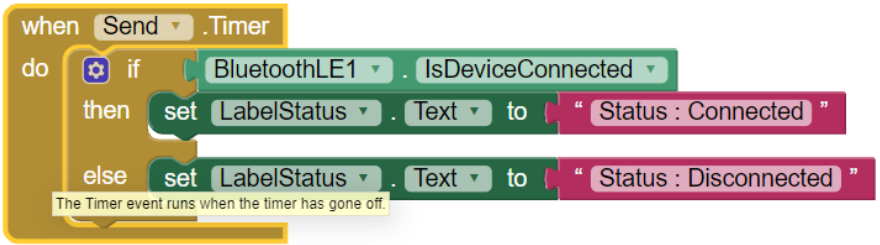
MYSQL DB Screenshot

VIEW DATA

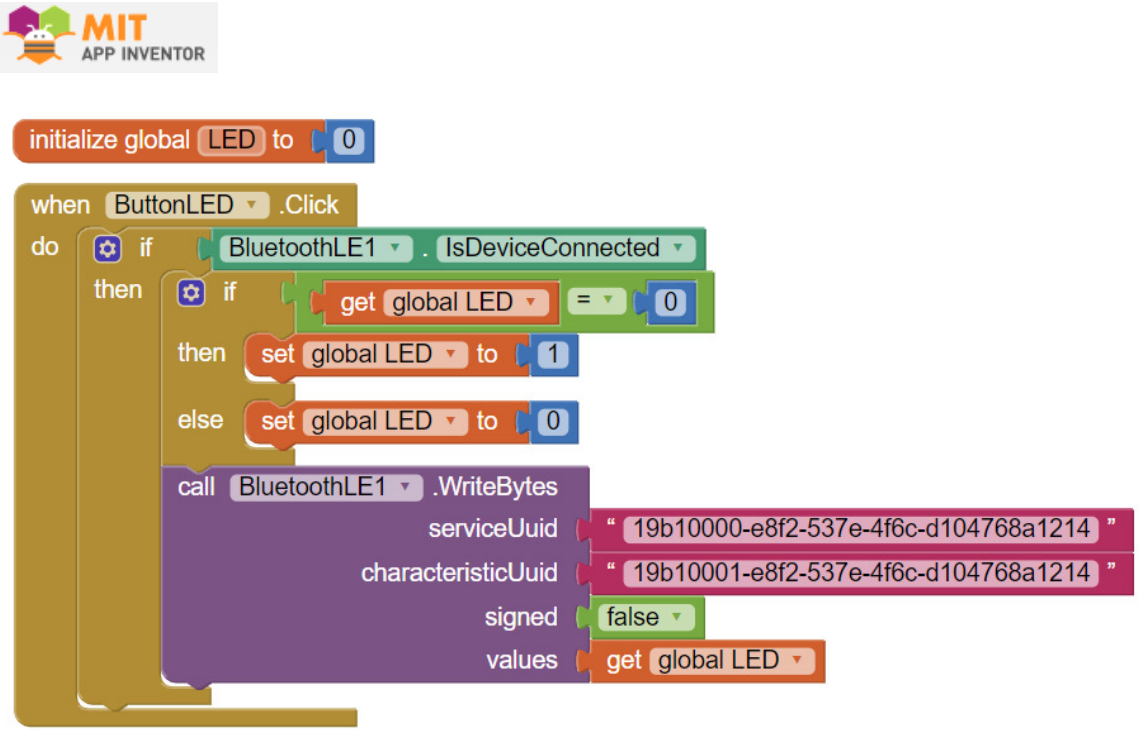
ID	LATITUDE	LONGITUDE	ACCLECRATION	STEPS	DATE	TIME
1	48.824753	2.280099	256.747 ms^2	4 Steps	2021-06-07	11:36:11
2	48.824753	2.280099	256.747 ms^2	4 Steps	2021-06-07	11:36:10
3	48.824753	2.280099	257.149 ms^2	4 Steps	2021-06-07	11:36:09
4	48.824753	2.280099	257.149 ms^2	4 Steps	2021-06-07	11:36:09
5	48.824753	2.280099	257.149 ms^2	4 Steps	2021-06-07	11:36:07
6	48.824753	2.280099	257.149 ms^2	4 Steps	2021-06-07	11:36:07
7	48.824753	2.280099	257.962 ms^2	4 Steps	2021-06-07	11:36:06
8	48.824753	2.280099	257.962 ms^2	4 Steps	2021-06-07	11:36:05
9	48.824753	2.280099	257.152 ms^2	4 Steps	2021-06-07	11:36:04
10	48.824753	2.280099	257.152 ms^2	4 Steps	2021-06-07	11:36:02
11	48.824753	2.280099	257.152 ms^2	4 Steps	2021-06-07	11:36:02
12	48.824753	2.280099	257.152 ms^2	4 Steps	2021-06-07	11:36:00
13	48.824753	2.280099	257.720 ms^2	4 Steps	2021-06-07	11:35:59
14	48.824753	2.280099	257.720 ms^2	4 Steps	2021-06-07	11:35:59
15	48.824753	2.280099	257.366 ms^2	4 Steps	2021-06-07	11:35:58

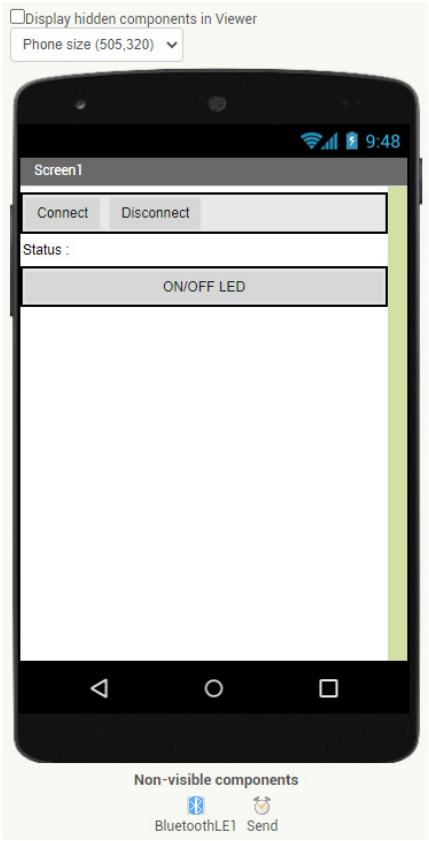
Webpage Screenshot

Bluetooth app Connection



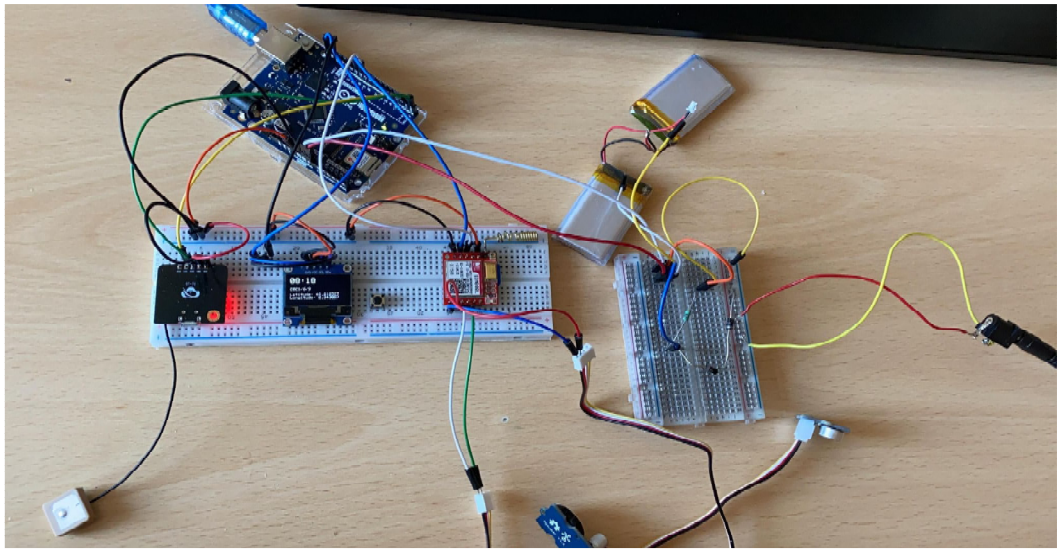
Bluetooth app Connection

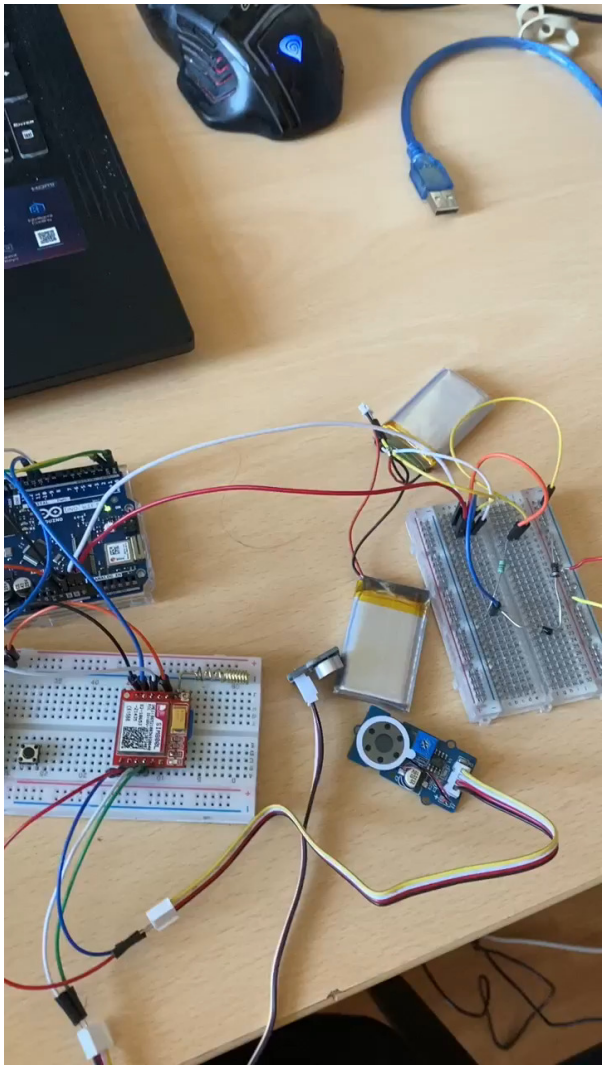




FINAL DEMO

Demo of the product





THANK YOU

Any questions...

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