

2022 Low-Cost Flow Velocity Sensor

User Manual V1.0

Budapest, 2022

This sensor can measure flow velocity and flow rate of segmented flow.

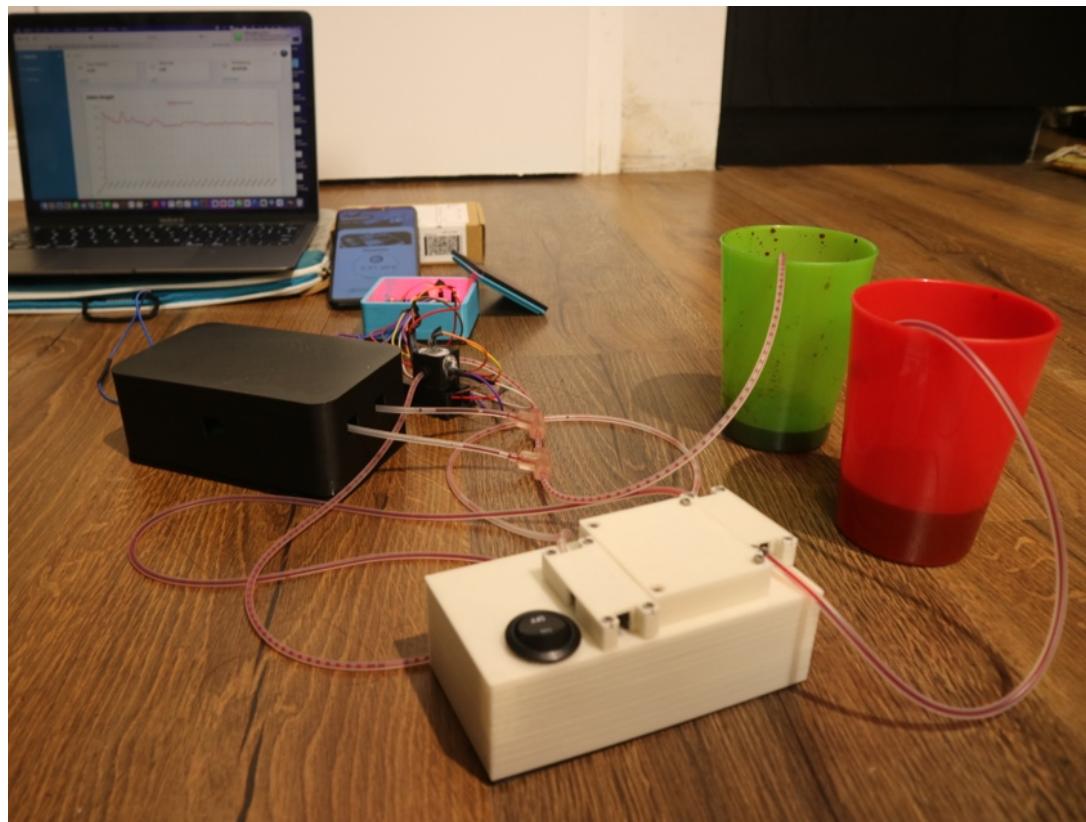
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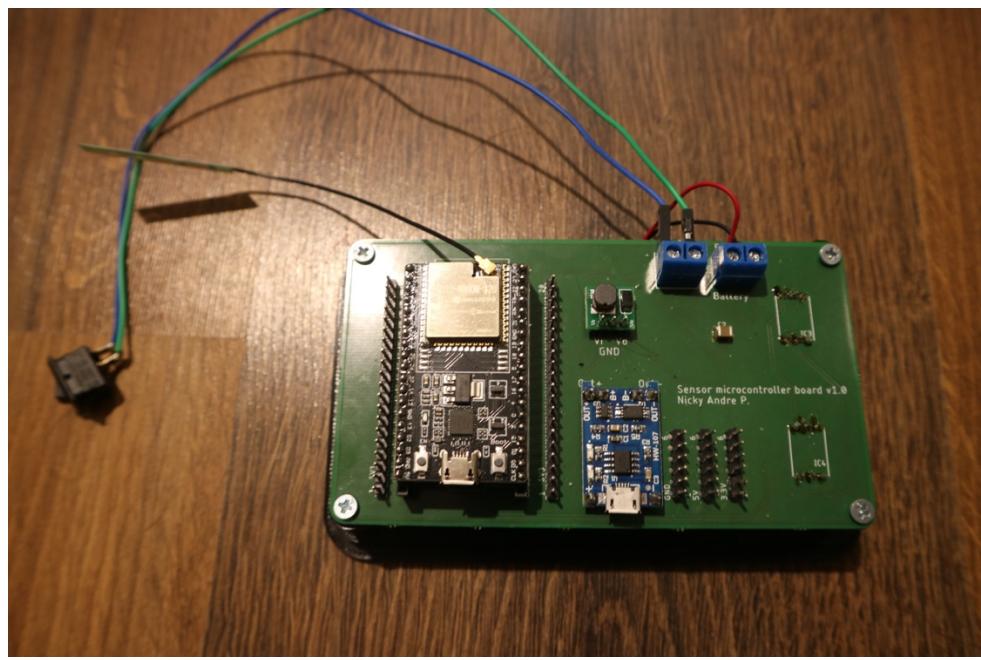
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1. Package Content

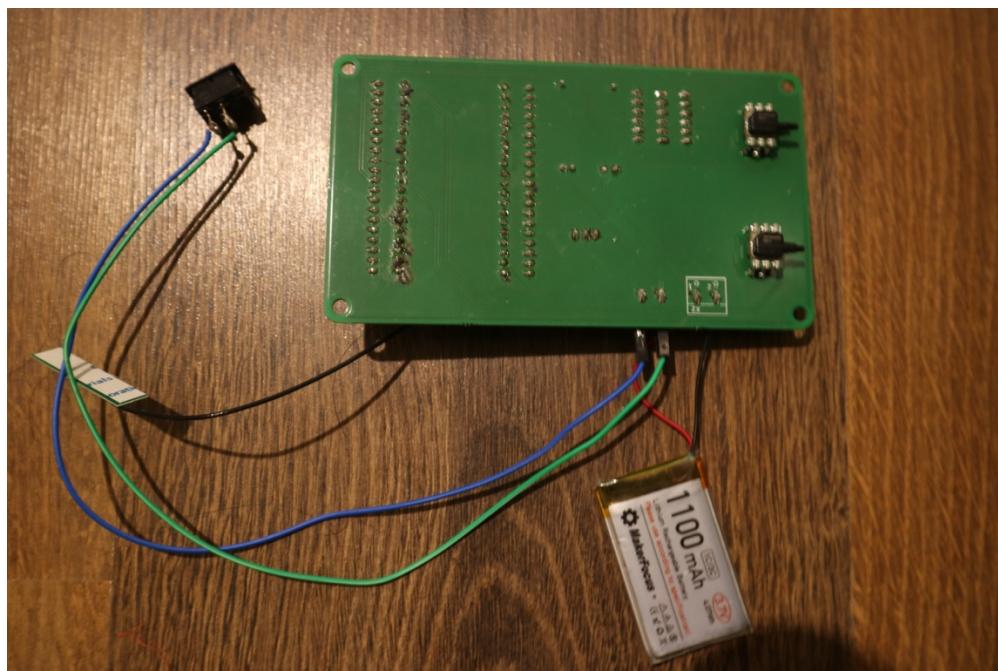
One Package of the flow velocity sensor is consist of :

- 3D printed sensor setup (sensor box, sensor stand, and enclosure)
- 3D printed controller enclosure (PCB stand, and enclosure)
- 3D printed sensor driver enclosure (box, and closure)
- 1100 mAh Lithium-ion battery
- PCB headers and pins
- Smd resistor and trimpot (List in BOM)
- ESP32 WROOM 32U
- DCDC step up 2108A driver
- TP4056 charging circuit
- ON-OFF switch
- Screw terminals
- Pin Header
- 2 IR emitter
- 2 Phototransistor

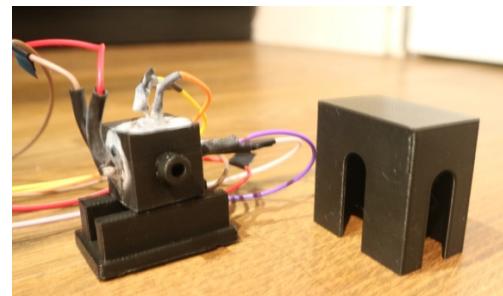




Top side



Back side



2. Safety Precautions

Before operating the sensor please make sure the following safety is considered :

- Solder the PCB components according to schematic and photo.
- Do all wiring thus the PCB will not get into short circuit
- Do power the board only from USB cable into the ESP32 or from the battery choose one option
- The Battery is fully charged when the LED in TP4056 module light is blue please disconnect the charger if the blue LED on the charging module is on.

3. Features

- Android studio and website user interface
- Connection into firebase realtime database
- ESPNOW connection with Taltech Piezopump module
- Detecting flow velocity from 0 up to 1.6 mm/s

- Detecting flow rate from 0 up to 5 ul/s
- Data acquisition can be done through the website developed, where flowrate vs time graph can be downloaded into .png file, and all the data can be downloaded as .csv file.
- The hardware, Android Application, and Website is connected into the same firebase realtime database.
- The PCB is occupied with Pressure sensor as well, you can use pressure sensor as a measurement option. You can either use the pressure sensor or the flow sensor at once. Both sensor cannot be operated at the same time.

4. Technical Description

- Flow velocity : 0 up to 1.6 mm/s
- Flow rate : 0 up to 5 ul/s
- Tubing ID : 1mm
- Power ON/OFF
- 1100mAh Lithium Battery Makerfocus

5. Connection and Operation

Please follow step by step guide carefully to be succesfull operating the pump.

1. Set up the ESPNOW protocol with Taltech Piezopump, please beware that the UI will not work if there is no proper ESPNOW connection between Taltech Piezopump system and the flow sensor!.
2. To set up the ESPNOW protocol, first obtain MAC address of the Taltech Piezopump. Upload the available ObtainMACaddress.ino file into the Taltech Piezopump ESP32 board.
3. You will obtain the MAC address as given in the picture below in the serial monitor write down the MAC address.

```

rst:0x1 (POWERON_RESET),boot:0x13 (SPI_FAST_FLASH_BOOT)
configsip: 0, SPIWP:0xee
clk_drv:0x00,q_drv:0x00,d_drv:0x00,cs0_drv:0x00,hd_drv:0x00,wp_
mode:DIO, clock div:1
load:0x3fff0018,len:4
load:0x3fff001c,len:1216
ho 0 tail 12 room 4
load:0x40078000,len:9720
ho 0 tail 12 room 4
load:0x40080400,len:6352
entry 0x400806b8
30:AE:A4:07:0D:64

```

The MAC address '30:AE:A4:07:0D:64' is highlighted with a red box in the scrollable list of boot parameters.

4. Set up WiFi connection of the Taltech Piezopump

```
// Replace with your network credentials (STATION)
const char* ssid = "TendaRozsa"; // Set your WiFi name here
const char* password = "Rozsa2020"; // Set your WiFi password here
```

5. Assembly all the sensor packaging properly, glue the photodetector setup into the box.
6. Assembly the sensor PCB.
7. Assembly sensor driver PCB.
8. Connect Dout1 Dout2 into ESP32 pin.
9. Test the sensor driver PCB with power up the PCB using 5Volt.
10. Test the setup insert the tubing into the inlet and outlet.
11. Generate Segmented flow and test the PCB sensor driver.
12. Calibrate the sensor driver on the trimpot using screwdriver.
13. if both LED turn on when air is in the optical path and LED is off when water in the optical path then the setup is ready.
14. Modify the firmware of the sensor with the following step.

```
// REPLACE WITH YOUR RECEIVER MAC Address
uint8_t broadcastAddress[] = {0xA4, 0xE5, 0x7C, 0xE0, 0xF6, 0x84};

extern volatile unsigned long timer0_millis;

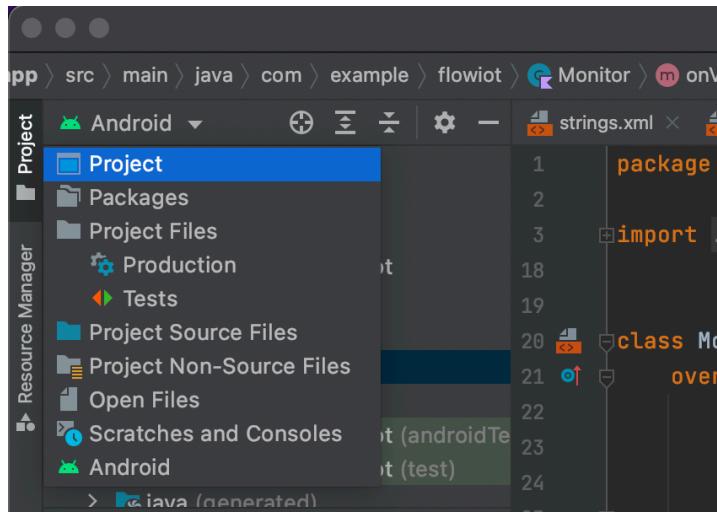
// Insert your SSID
constexpr char WIFI_SSID[] = "TendaRozsa";
```

15. Upload both the pump Arduino code and sensor Arduino code into each board.
16. Create New Firebase Realtime Database in your google account follow video in the link below for the step by step.
<https://www.youtube.com/watch?v=qKxisFLQRpQ>
17. Replace new firebase realtime database parameter in the Taltech piezopump firmware. You can get obtain the host with going to the realtime database “ <https://.....firebaseio.com/>. For the auth go to settings tabs>project settings>service accounts>Database secrets> There will be secret with black dot that will be the Auth. You can see this video to be more clear where to find firebase host and auth :
<https://www.youtube.com/watch?v=lUkNbpVK2vA&t=453s>

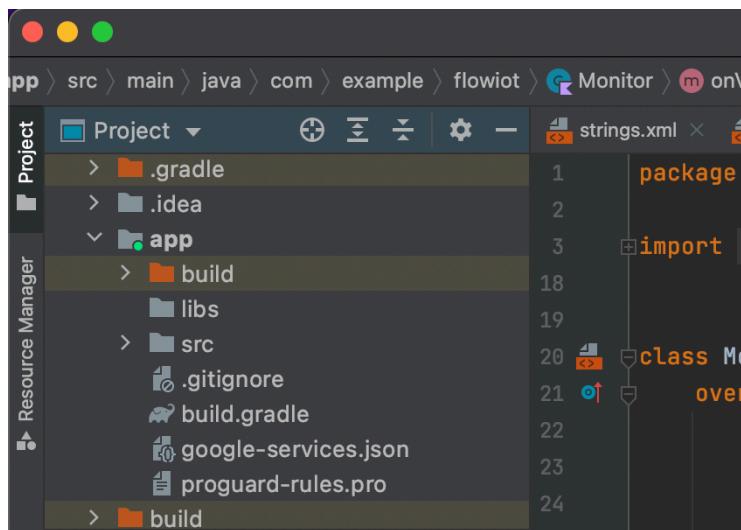
```
// Set your firebase parameters here !
#define FIREBASE_HOST "
#define FIREBASE_AUTH "
```

18. Install Android Studio and Open the open-source android studio firmware given in the Android studio.
19. Restart the connection of the App with Firebase Realtime Database with the following step. The App should be connected into your own Firebase Realtime Database.
20. Delete google-service.json file from the project follow instruction below

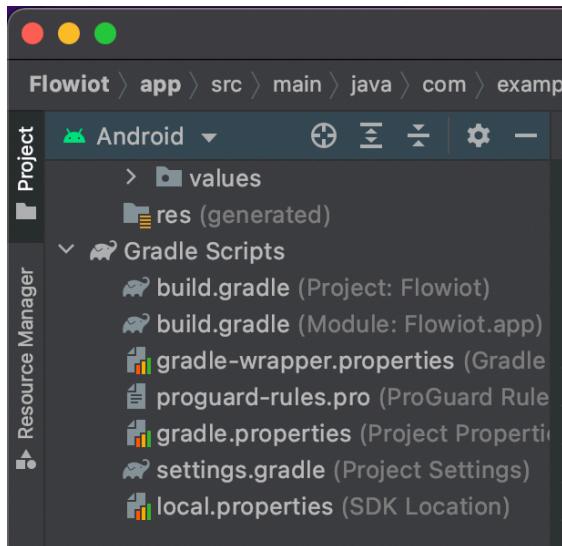
21. Click android on the top left of android studio window> Choose project instead of android like picture shown below



22. After choosing Project, there will be list of folder, expand the app folder you will find google-service.json file there, right click and delet those file.



23. Remove dependencies from build.gradle, go back to android instead of project with clicking the same step as number 20, scroll down and you will find this two file with build.gradle name.



24. From the project one delete the classpath ‘com.google.gms:google-service:4.3.10’ line

```
dependencies {
    classpath "com.android.tools.build:gradle:7.0.3"
    classpath "org.jetbrains.kotlin:kotlin-gradle-plugin:1.6.0"
    classpath 'com.google.gms:google-services:4.3.10' //delete
    this line

    // NOTE: Do not place your application dependencies here; they
    belong
    // in the individual module build.gradle files
}
```

25. From the module build.gradle, search and delete the following two lines in the file.
Beware only delete the following two lines only!

```
implementation 'com.google.firebaseio:firebase-database-ktx:20.0.4'
id 'com.google.gms.google-services'
```

26. Restart the Android studio (close and reopen the Android Studio) and the folder again.
27. Reconnect the App into your new Firebase Realtime Database follow video below for more clear step.

<https://www.youtube.com/watch?v=LJpn81pG06Y>

or below link.

<https://www.youtube.com/watch?v=rFTJTLdoGDY>

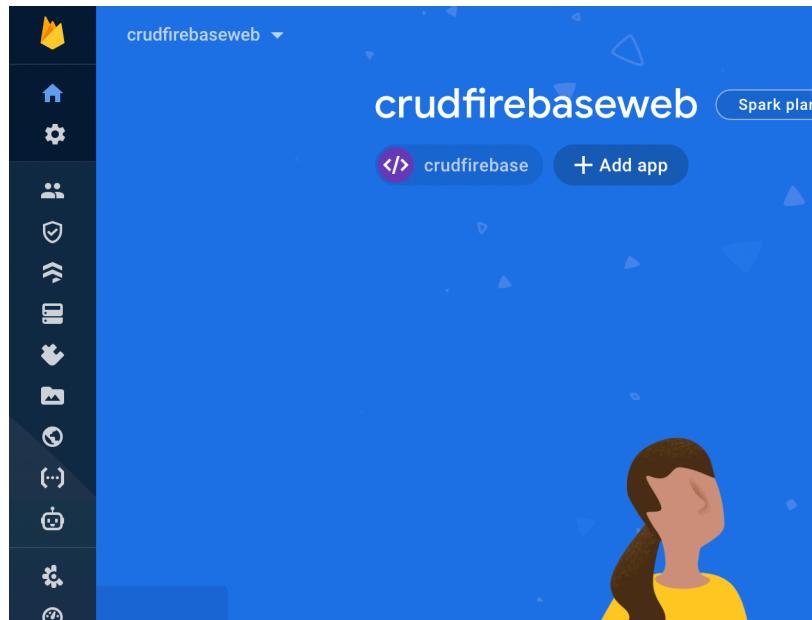
Follow only one video choose one!.

28. After the Firebase Realtime database connection is finished. Then the App is already connected into the Firebase Realtime Database. If the connection did not happen restart the step from step 20.
29. Try to run the App either on the Android simulator on android studio, or build your apk file and install it on your own phone. You can follow video below for more clear step.
Install and run App on emulator : <https://www.youtube.com/watch?v=hfQWXvSPtrI>

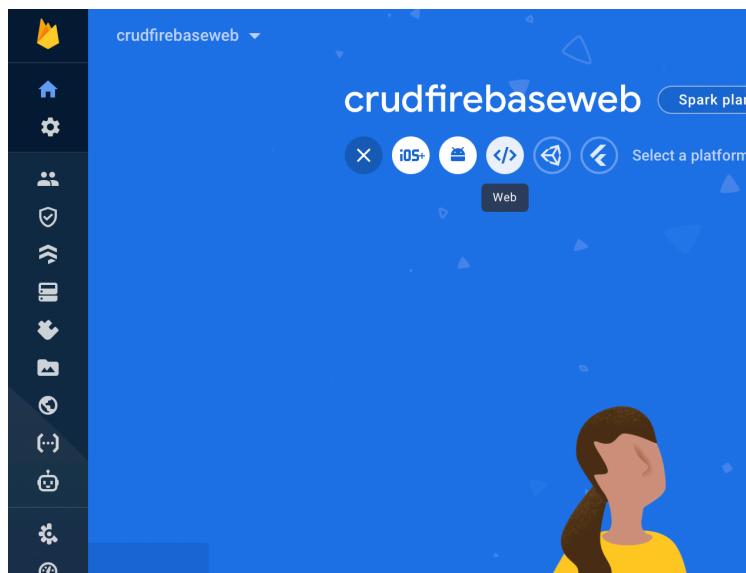
Generate Apk : <https://www.youtube.com/watch?v=OpuoZrKUVmo>

30. Test the app with changing the pump control value, open your firebase realtime database console.
31. Observe if the value in the realtime database is changing then the App is connected and you are good to go.

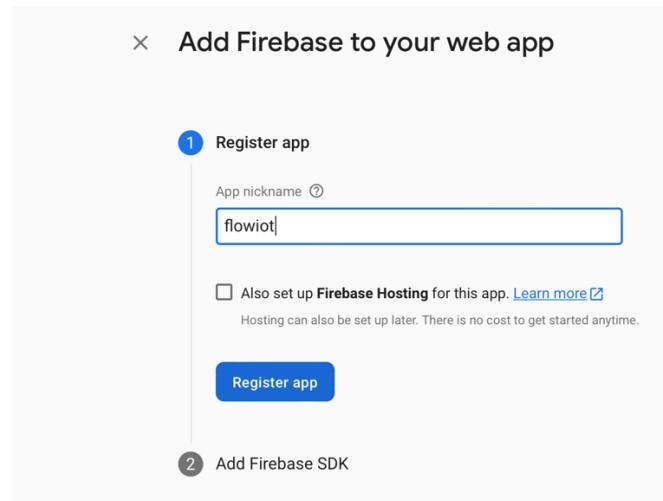
32. Connect the website into firebase realtime database follow the step below
33. Go to the home of your firebase database console like depicted in figure below, click Add app below.



34. After clicking Add App, choose web like picture below.



35. Then name your App and click register app.



36. After register App it's time to Add Firebase SDK into your website code. The code will looks like given below choose the <script> tag.

```

<script type="module">
  // Import the functions you need from the SDKs you need
  import { initializeApp } from "https://www.gstatic.com/firebasejs/9.8.1.firebaseio.js"
  import { getAnalytics } from "https://www.gstatic.com/firebasejs/9.8.1/firebase-analytics.js"
  // TODO: Add SDKs for Firebase products that you want to use
  // https://firebase.google.com/docs/web/setup#available-libraries

  // Your web app's Firebase configuration
  // For Firebase JS SDK v7.20.0 and later, measurementId is optional
  const firebaseConfig = {
    apiKey: "AIzaSyB4PU5kgPD1jvTyMi9_SKJDEs_ZID4i00I",
    authDomain: "crudfirebaseweb.firebaseioapp.com",
    databaseURL: "https://crudfirebaseweb-default-rtbd.firebaseio.com",
    projectId: "crudfirebaseweb",
    storageBucket: "crudfirebaseweb.appspot.com",
    messagingSenderId: "890240974033",
    appId: "1:890240974033:web:7e0ec47cf2a82207d719f0",
    measurementId: "G-KH0KB0MJ2P"
  };

  // Initialize Firebase
  const app = initializeApp(firebaseConfig);
  const analytics = getAnalytics(app);
</script>

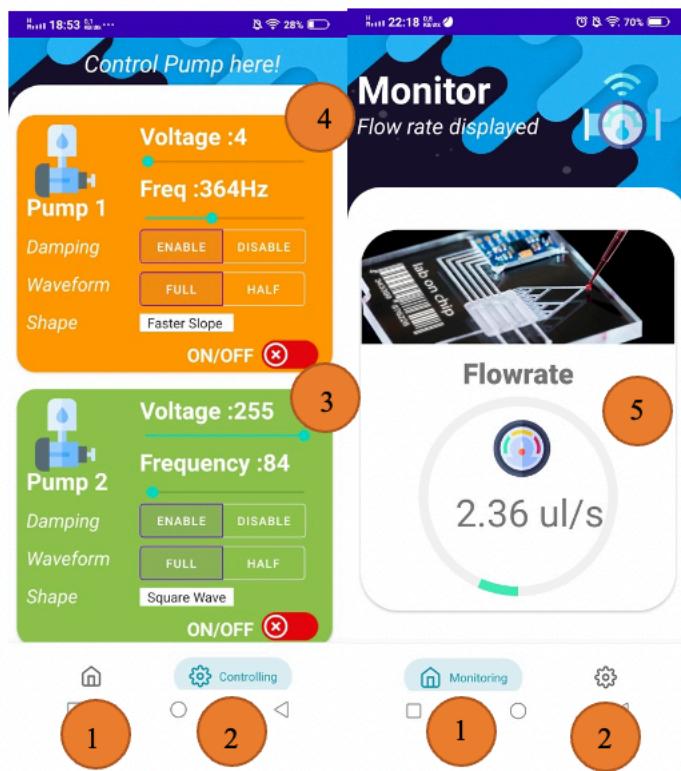
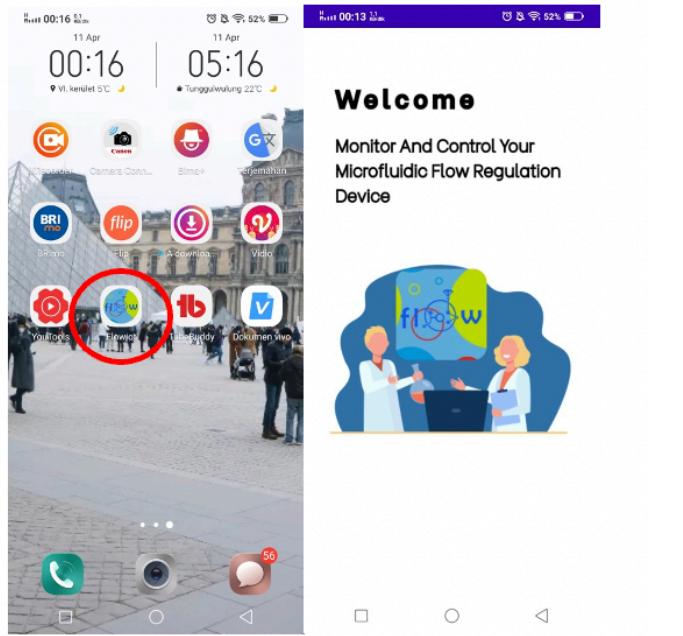
```

Are you using npm and a bundler like webpack or Rollup? Check out the [modular SDK](#).

Learn more about Firebase for web: [Get Started](#), [Web SDK API Reference](#), [Samples](#)

37. Copy all of this code find the similar code in the dashboard.html file, and datalog.html file replace those code in the file with this new code.
 38. Test the sensor with flowing the segmented flow into the flow sensor
 39. The setup finished and you can use the Sensor, website, and Application all together.

6. Android Application User Interface



1. Monitoring menu

By clicking the monitoring menu, monitoring UI will be displayed. It is a UI where the flowrate value will be displayed, and moving gauge will move according to the flowrate value.

2. Controlling menu

With clicking the controlling menu, controlling UI will be displayed. It is a UI where all parameters of two pump can be change and controlled.

3. Pump 1 parameter

All of the pump 1 parameters can be changed in this part, which are driving voltage, frequency, damping, waveform, waveform shape, and pump on off.

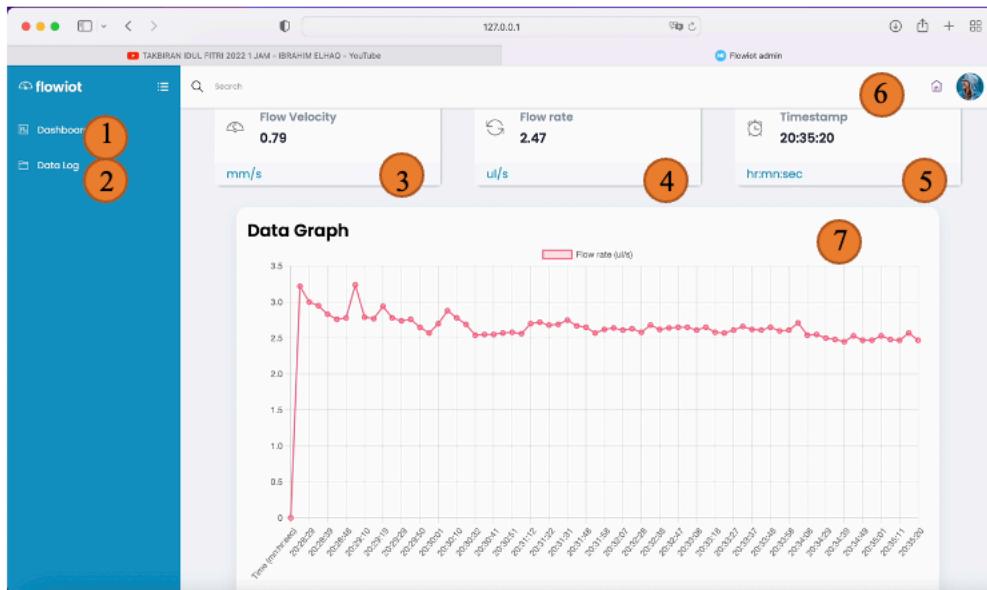
4. Pump 2 parameter

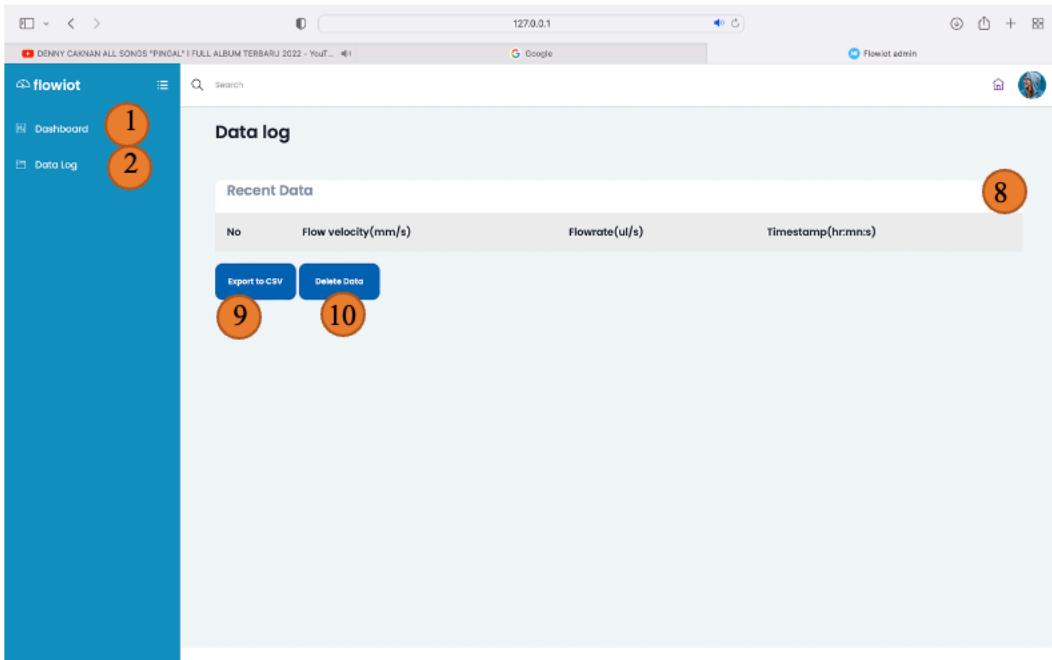
All of the pump 2 parameters can be changed in this part, which are driving voltage, frequency, damping, waveform, waveform shape, and pump on off.

5. Flowrate value displayed

Flowrate value obtained from the database will be displayed, and moving gauge will move according to the flowrate value

7. Website User Interface





1. Dashboard menu

With clicking this dashboard menu dashboard window of the website will be displayed. Which mainly used to display all the value obtained from the sensor and plotting a graph of flowrate vs time.

2. Data Log menu

With clicking this data log menu datalog window of the website will be displayed. Which used to put the data into a table format then this table can then be downloaded as .csv file.

3. Flow velocity value

Flow velocity value obtained from the sensor will be displayed here. Those number will change in real time if there is new velocity value from sensor.

4. Flowrate value

Flowrate value obtained from the sensor will be displayed here. Those number will change in real time if there is new flowrate value from sensor.

5. Timestamp value

Time value obtained from the pump ESP32 will be displayed here those number will change in realtime if there is new timestamp value from sensor.

6. Logout button

This house logo is logout button if this logo is pressed then the user will be logged out from the platform and back into the sign in window.

7. Graph displayed

Graph which used to plot the flowrate vs time value. This graph is using chartJS which is an open source HTML5 charts for website. This chart will move in realtime if there is any new flowrate and timestamp value obtained.

8. Table

All the flow velocity, flowrate, and timestamp will be displayed in this table. If there is new value obtained then new row will be added in this table.

9. Export to csv button

When this export to csv button is clicked then whatever displayed in the table section will be downloaded as .csv file to the computer.

10. Delete button

This delete button is used to delete all the data in the table, and also all data of the table in the database will be deleted as well. It will be very useful to start another data acquisition process again.