



Smart Shovel

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a device developed during Metropolia IoT course

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Functions of the Arduino

When gyroscope is in its normal position, the Arduino has a boolean state of 0(false). If gyroscope is twisted from its normal position it changes state to 1(true). At this state Arduino pre-processes the data and outputs all the measured values in serial. State changes to 0 only when the shovel is returned to its normal position.

Load Cell is calibrated with tare default value when the Arduino is first powered on. Therefore the shovel has to be empty and placed on the floor when powered on.

Weight is measured every 100ms in an array that has a maximum length of 100. This gives us 10 second window to look back, when the shovel state changes to 1. Measured weight is the average weight of the values in the array.

Temperature is measured every time the state changes to 1.

Functions of the Android App

In a background thread Android post-processes the inputstream, parsing all the values between the characters and strings ending to #-symbols. Android counts the amount shovelled, total weight, average weight, average temperature and time consumed.

Android analyzes the data and compliments the user on the user interface if s/he performs well.

When user presses stop button, the data is formatted to json and posted to the backend. Json contains only the total values and name of the user with a timestamp.

Total values can be later accessed by the same user via history activity. Activity opens when the user presses history button.

Bluetooth Protocol Communication

Arduino - Android

The Smart shovel doesn't work independently only with just Arduino. Arduino has to be connected to an android device at all times. This is done via Bluetooth.

- Arduino sends pre-processed data via serial line at 9600 baud rate. When Android bluetooth connection service (Master) is paired with Arduino bluetooth module (Slave), Android device will start to receive data in its buffer automatically.
- When shovel changes state to 1, Arduino sends a string that contain one character which indicates the type of the data, followed with the measured value and finally ending the string with a # symbol.

Serial string example

S1#T24#W2.4#

First value is:

State changed from 0 to 1

S1#

Followed with temperature if available:

Temperature value of 24 degrees

T24#

Followed with weight if available:

Weight value of 2.4 kg

W2.4#

Components

Arduino Nano, Cheaper if you don't buy the official one

Load Cell 20kg, In this project we used 20kg load cell and its very delicate strain gauge wires broke. Should have used at least 40kg load cell.

Load Cell Amplifier HX711, This helps you to receive accurate values from the load cell. Open source code easily available for arduino and other platforms.

Bluetooth module HC-06, Had trouble with newer phones. Not sure why.

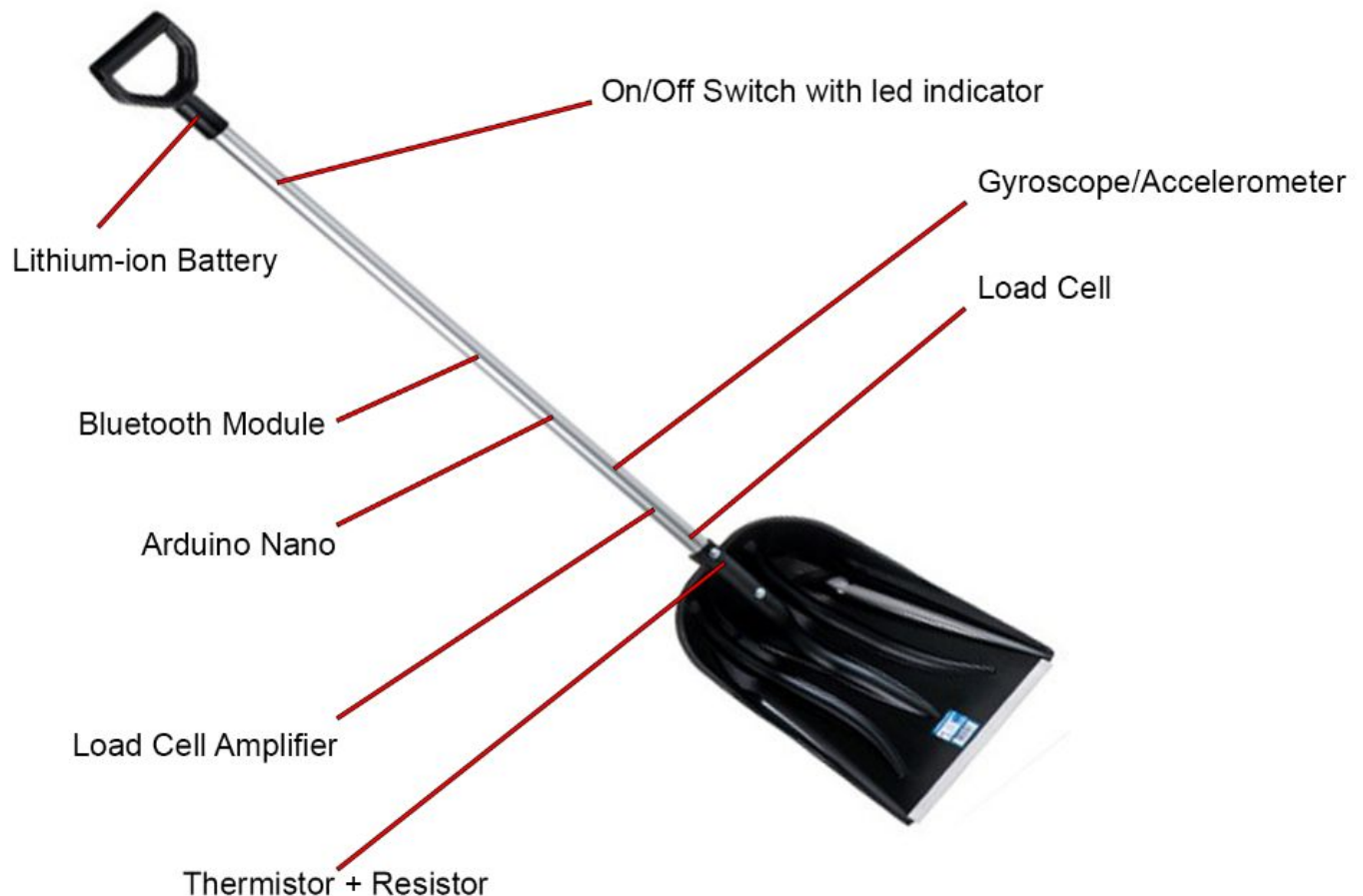
Gyroscope/Accelerometer MPU-6050, Open source code easily available for arduino and other platforms.

Thermistor 5k Ω , The resistor and thermistor has to be same size, but don't have to be 5k ohm.

Resistor 5k Ω

Lithium-ion Battery, Standard usb 5V in / 5V out lithium battery from an used power bank.

Led/Switch, This one is nice to have a led to see when it's powered on.



Schematic

Power supply from the usb connector

