Tiny Machine Learning For Development (TinyML4D)

Human-Computer Interaction: Hand Gesture Recognition Using Tiny Machine Learning

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Problem Presentation

Current approach of users' interactions with different electronic devices through different inputs, such as keyboard, mouse, controllers...etc might seem inflexible and limited for some users;

Many nowadays' platforms such as interactive environments require more natural and intuitive user interaction, such as hand gestures.

Accurate interactions between humans and machines can be achieved using hand gestures.

Use Case

Fields of application of this technology:

Virtual Environment Interaction



Smart house

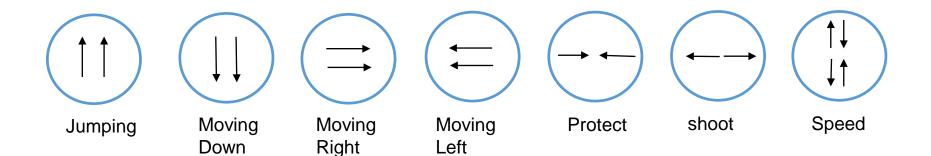


Proposed solution

the solution is simulating the interaction with a game using gestures recognition.

Using two Arduino Nano 33 BLE Sense, we propose to control a game control with some gestures:

- jumping
- moving left
- Moving right
- Shooting
- Protecting
- Speed

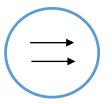






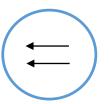






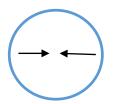
Moving Right





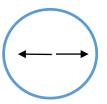
Moving Left





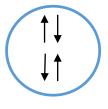
Protect





shoot





Speed







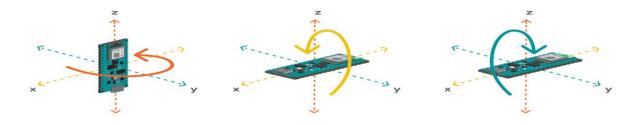
Collection of the data is performed by :

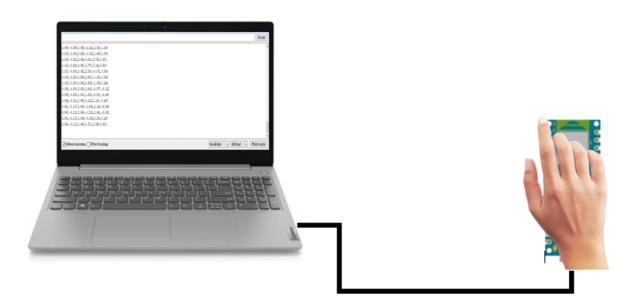
Taking for each gesture a number of repetitions, where each repetition returns 119 samples.

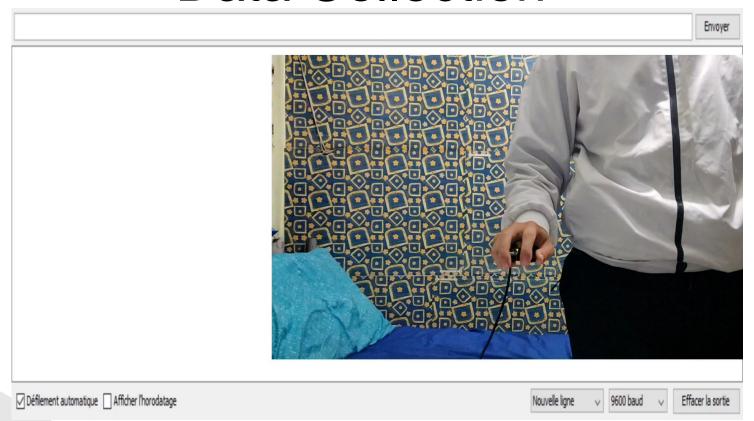
Each sample represent:

3 values of the acceleration (aX, aY, aZ) and 3 values of the gyroscope (gX, gY, gZ).

Each gesture is saved in a csv file, and used in the training process.



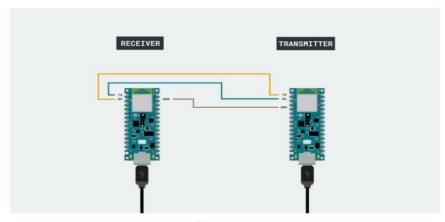




Arduinos Communication

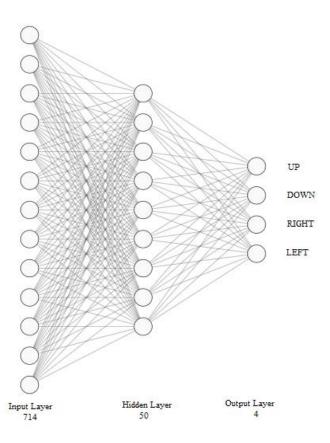
To set the communication between the two Arduino, we use the *UART* (*Universal Asynchronous Receiver-Transmitter*) communication protocol.

It allows an asynchronous serial communication in which the data format and transmission speed are configurable .[https://docs.arduino.cc/].

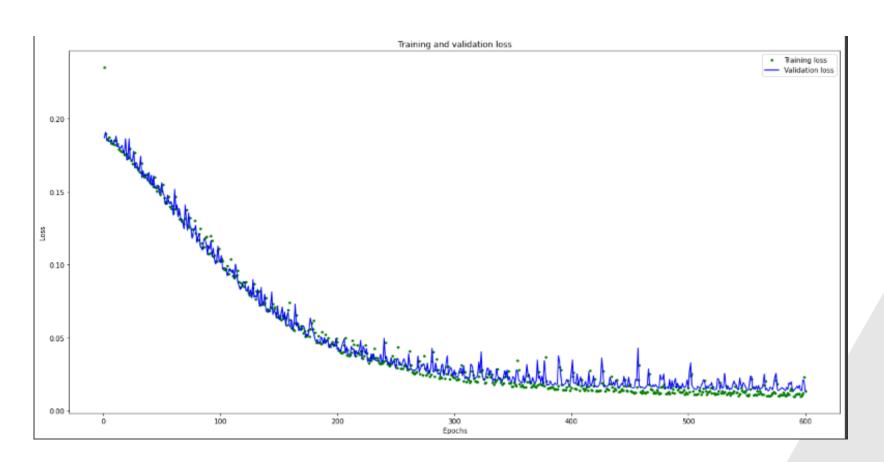


The circuit.

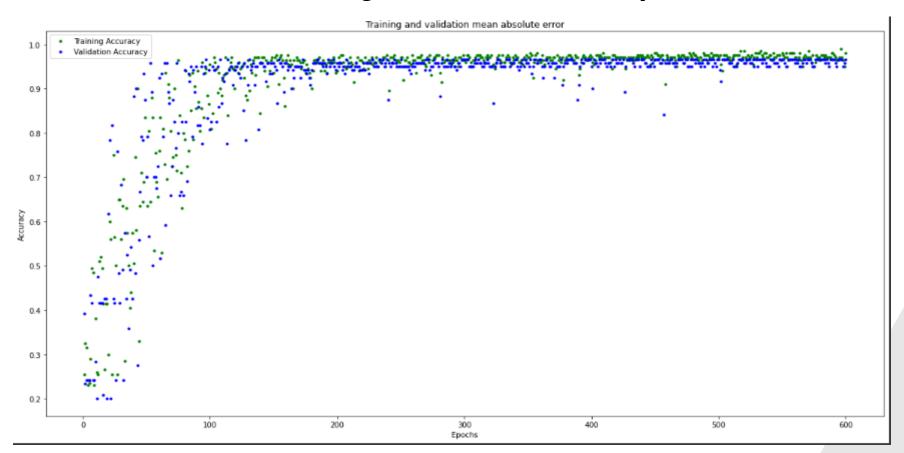
Model Architecture



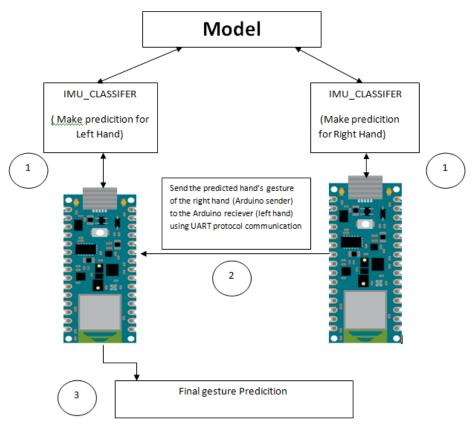
Training and validation Loss



Training and validation Accuracy



Gestures' Classification

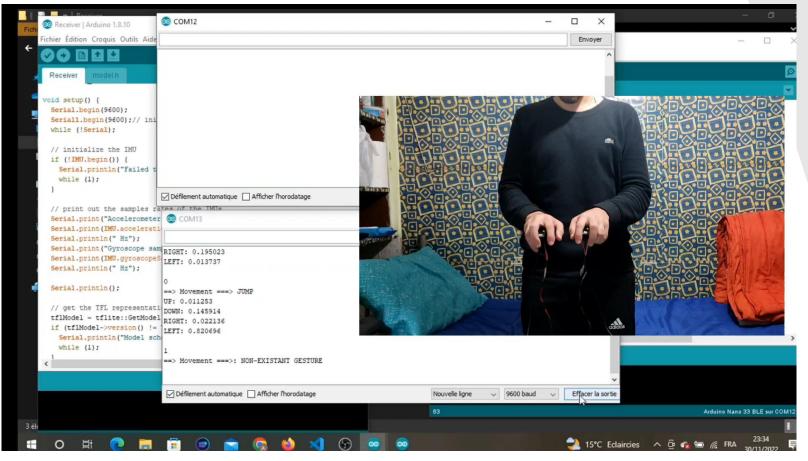


Demonstrative video



09

Video of test



Conclusion

Thanks

We express our appreciation to our teacher Pr. LARABI Slimane for his unlimited advices and supervision.

We express our gratefulness to Edge impulse and ICTP Institute who supplied us with this technology.

We also want to express our thanks to Don Coleman, Sandeep Mistry and Dominic Pajak who created the Arduino Classification Code example.