Serious Games for Treating Arthritis in The Hands

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Abstract

The arthritis treatment consists in repeating a movement multiple times. This can become very monotonous and demotivating. With this in mind, we developed an application that allows the patients to play games while doing rehabilitation and to gather data related to the patient's performance for future analysis.

Solution

Gesture Recognition

To recognize the gestures executed by the pacient we use decision trees with the following features:

- Distance between consecutive fingers.
- Number of extended fingers.

The entire process is presented in Figure 1.

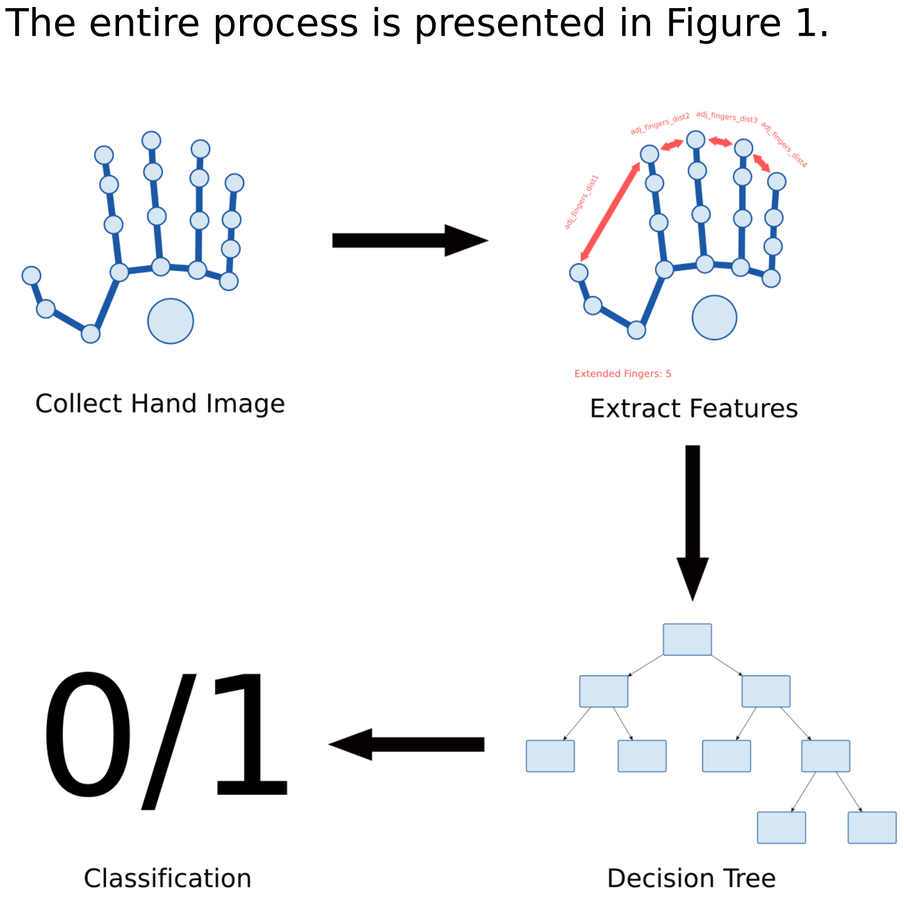

Fig 1- Gesture Recognition Complete Process.

Solution Architecture

The architecture is composed by 3 modules: the patient app, the doctor app and the manager one.

The patient app is a standalone cross-platform electron based application , that allows any patient with internet access and a leap motion to play games while doing their treatment. The patient can see his evolution and verify the completion of the treatment.

The doctor app is a hosted Django app accessible by browser. Its focus is the tracking of the patient's evolution.

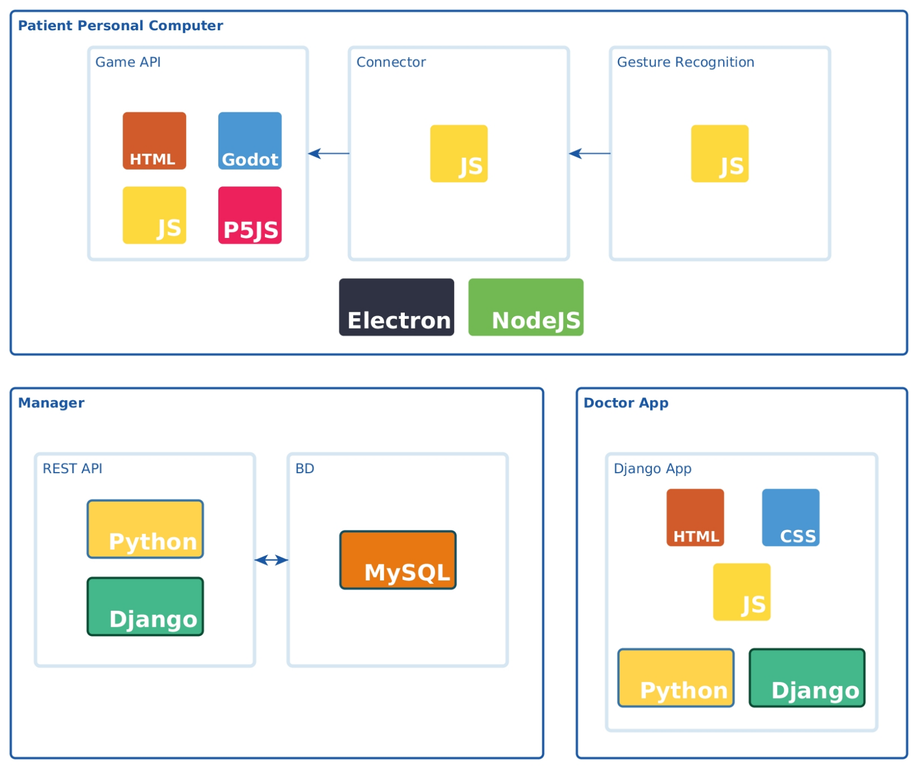

Fig 2- Technological Architecture Diagram.

The manager app is a django based application that provides an API to programmatically access the system's functionalities.

Results

In the chart below it's possible to see the results for various models at recognizing gestures, being the decision tree the one with the best results, holding a 98.75% precision.

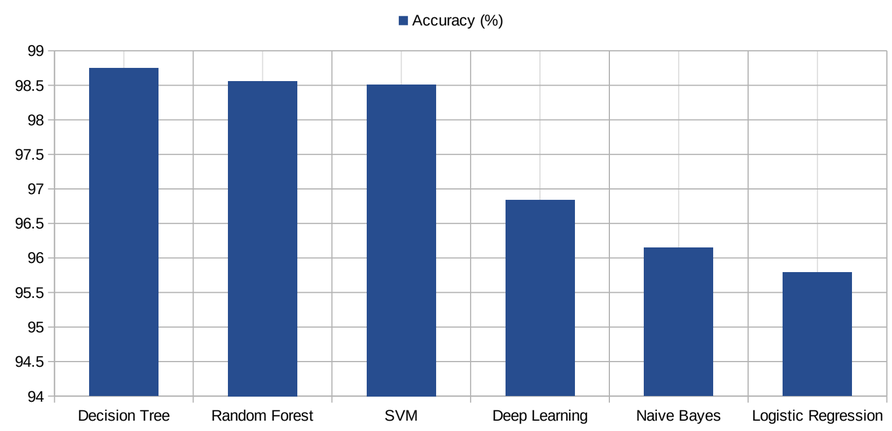

Fig 3- Accuracy of the various models recognizing the closed hand gesture.

We performed a preliminary validation with a 15 years old subject the client's app and with one doctor specialized in rheumatology to test the doctor app.

Conclusion

The good results obtained in the gesture recognition algorithm and the positive feedback received by the patient and the doctor indicate that this system has the potential to be used in a real environment for arthritis rehabilitation.

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