

## Human Motion Capture Interface

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### Abstract

Motion capture, or mocap, is a term used to describe the motion recording process and movement of transposition into a digital model. This type of system have been increasingly used in several areas including: sports medicine, physical therapy and entertainment industry (video games, movies and animation).

The main objective of this work is to create a computer interface that can capture the movement of the user's arms in real time and store them in a database using inertial sensors (IMU's). Using this interface, it will be possible, make several studies of movement, effort and gesture of the arms from the data recorded.

The sensors to be used are: accelerometers, gyroscopes and magnetometers.

In this paper we will use inertial sensors to capture the movement of the hand, arm and forearm user.

*Key words: motion, interface, IMU.*

### Introduction

The main idea of this work is to build a motion capture interface with the following features:

- 1- Low Cost
- 2- Small footprint
- 3- Sensor easy access market
- 4- Hardware easy access market
- 5- A digital filter with good performance
- 6- Open software written in C/C ++

The data of the captured motion will be stored in a database for future analysis. The programming language used was C / C ++ in order to have high performance. The applications of this equipment are numerous and can include: capturing musical gestures, games, physical therapy, sports medicine among others.

### Results and Discussion

Initially, a theoretical review was made on digital inertial sensor 9 axes (3D accelerometer, 3D gyroscope and 3D magnetometer) and digital noise filters. After this, was studied the mathematical model suitable for such sensors.

The best filters for this type of system were:

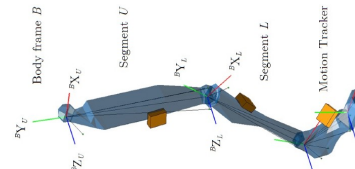
- Kalman filter: But requires a fast hardware
- S. Madgwick filter (2010): More efficient but requires a different calibration of these sensors

From the algorithm of attitude/fusion filters (3D orientation) we obtain the 3 Euler angles referring to axis: X (roll), Y (pitch), Z (yaw) for each sensor.

Each sensor is placed in a different part of the user's body: hand, arm and forearm.

Finally, each sensor sends its data to a processor (Raspberry Pi) via I2C protocol and its data is stored in a text file.

To analyze the data stored, we used the Matlab 2013.



**Image 1.** Example of position sensors on the user's legs

Product	Price	Shipping
IMU (MPU-9150)	U\$ 15	U\$ 30
Raspberry Pi B	U\$ 25	-
I2C Multiplexer	U\$ 15	U\$ 30
Products + Shipping	U\$ 85	-

### Conclusions

In this study we conclude that it is possible to capture the movements of the human body using IMU's low cost with a hardware that is easily found on the market.

Because they are inexpensive, these IMU signs has much noise and its gyroscope accumulates a significant error in time, which makes the system lose the precision of orientation in three-dimensional space.

Even with the utilization of digital filters such as Kalman filter or Madgwick filter, the quality of low-cost IMU's signal and the error level acumudado in gyroscope prevents the development of one precision motion capture system with this type of sensor.

The use of better sensors could solve the problems encountered, but would significantly increase the overall cost of the system.

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