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A Comparative Study of Machine Learning Models for Kinect-Based Data in Movement Classification

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Abstract

This thesis conducts a detailed comparative study of several Machine Learning models, with a focus on their application to Kinect-based data for classifying human movements. The primary aim of this research is to evaluate these models to determine the most effective ones for accurately classifying movements recorded through Kinect sensors.

Our research begins with a introduction to Kinect technology, highlighting its ability to capture detailed movement data. Following this, we take a look into a range of Machine Learning models, such as Support Vector Machines, Random Forest, Linear Regression, and so on. We test each model to evaluate its accuracy, processing efficiency, and robustness in accurately classifying various movements.

The core of our comparative analysis is a diverse dataset consisting of several movements captured through a Microsoft Kinect. Our research methodology involves several steps: processing the Kinect data, extracting key features that are characteristic of specific movements, and applying the selected models to this improved data. We evaluate the performance of each model using standard metrics like accuracy, precision, recall, and the F1 score, which provide a complete picture of their effectiveness.

Over this study, we gain valuable understanding into the specific strengths and limitations of each model in the context of Kinect-based movement classification. Our findings reveal that some models prove enhanced performance in certain situations, which is influenced by factors like the complexity of the captured movements and the characteristics of the dataset.

This thesis acts as a useful guide for researchers and professionals. It helps them pick the best models for similar work and sets the stage for more research in this area. This study helps improve how accurately and efficiently we can classify movements using advanced Machine Learning methods, leading to more progress in this field.

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Introduction

1.1 Problem Statement

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1.3 Dataset Overview

In this study, we utilized a Kinect Skeleton dataset, provided by the PsyComp Lab.,which plays a crucial role in the development of this research. This dataset is composed of recorded movements performed by a group of 22 individuals. The movements were performed in front of a Kinect sensor, which recorded the movements and saved them as a series of 3D coordinates. The dataset contains 10 different movements, each performed a various number of times by each individual. The movements are as follows:

- **Reach Overhead**: A movement involving the the subject rasing one of their arms above their head.
- **Chair to Chair**: A movement involving the subject sitting down on a chair, then standing up and sitting down on another chair.
- **Cross-Reach Left**: A movement involving the subject reaching their left arm across their body.
- **Reach Forward**: A movement involving the subject reaching their arm forward.
- **Hoop Walk**: A movement involving the subject walking in a circle.
- **Cross-Reach Right**: A movement similar to Cross-Reach Left, but involving the subject reaching their right arm across their body.
- **Right Leg Stand**: A movement involving the subject standing on their right leg.
- **Mat Walk**: A movement involving the subject walking on a mat.

- **Left Leg Stand**: A movement similar to Right Leg Stand, but involving the subject standing on their left leg.
- **TUG Walk**: The Timed Up and Go walk, a common test used to assess mobility and fall risk in elderly individuals.

1.4 Aims and Objectives of the Study

Bibliography