

# iKarate: Improving Karate Kata

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In Collaboration With:



4/7/2020

# INTRODUCTION 1/2

- ❑ Karate Kata is composed of moves.
- ❑ Moves must be done in a certain sequence.

- ❑ **Common mistakes:**

- Joints Angle.
- West Rotation.
- Hand Position.
- Leg Position.

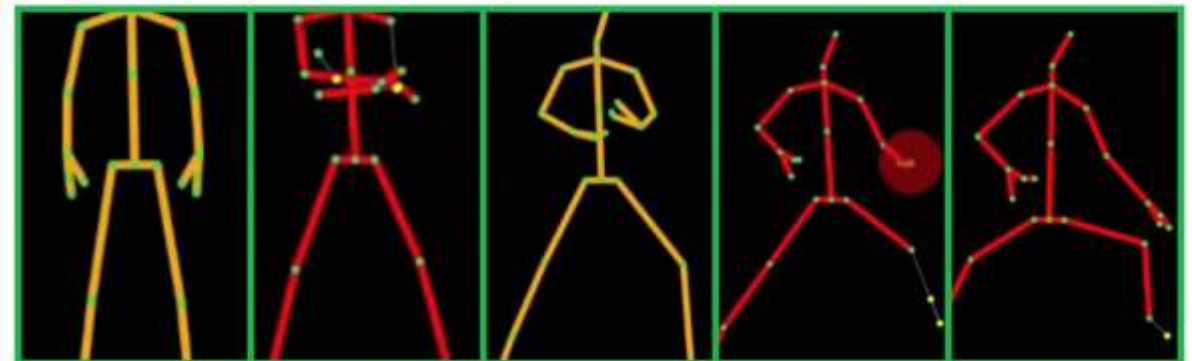
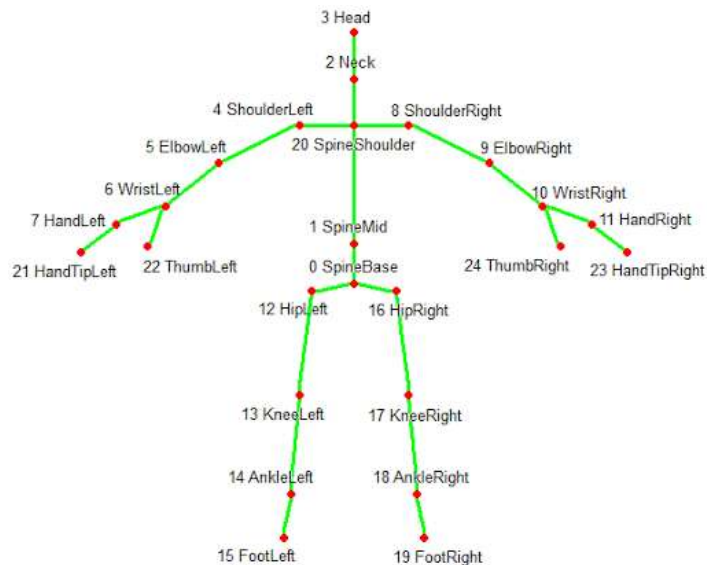


Age Uke



# INTRODUCTION 2/2

- ❑ Kinect supports the tracking of up to 25 joints.
- ❑ Each joint has its coordinates (X, Y, Z).
- ❑ Kinect is able to capture 30FPS (Frames per second).

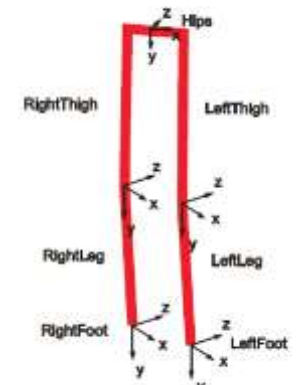
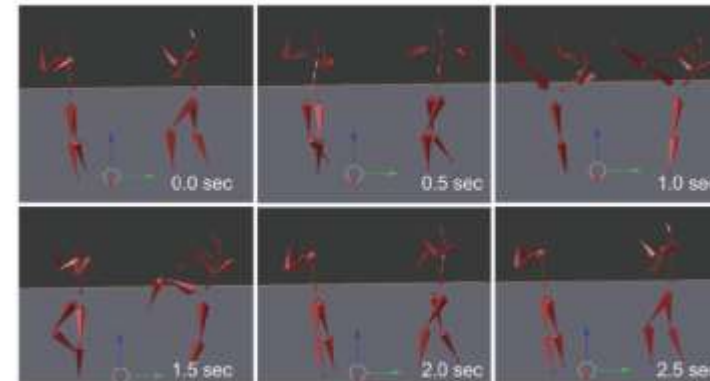


# RELATED WORK I/2

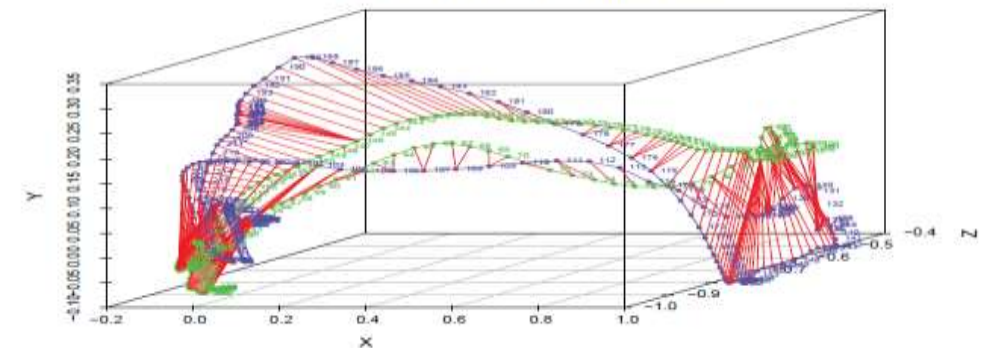
## HUMAN MOTION ANALYSIS



- ❑ Actions could be performed in **different speeds** and **different body proportions**.
- ❑ Using Shadow toolkit.
- ❑ Angle **normalization** algorithm And **DTW** alignment algorithm.
- ❑ The proposed evaluation and visualization technique seems to be a valuable tool for advanced human motion analysis.



DTW signal mapping of Hips rotation



# RELATED WORK 2/2

## VARIATION OF CLASSIFIERS AND KINECT



- ❑ Analysis of several machine learning techniques (**Accuracy** - Precision - **Time**).
- ❑ 6 Data sets used from Kinect 1 and Kinect 2 tested with **41 classifiers**.
- ❑ Computation time is higher for the Kinect 2 datasets than for Kinect 1.
- ❑ Best overall performance is **Multilayer Perceptron** (Accuracy **99.0874%**).

TABLE II: Best Classifier Results on Each of the Six Datasets Collected with Kinect 1 and Kinect 2

Dataset	K1 20M	K1 30S	K2E 20M	K2E 30S	K2R 20M	K2R 30S
Best 11 classifiers	>89%	>89%	>95%	>97%	>96%	>96%
Best Classifier (BC)	Simple Logistic	Multilayer Perceptron	Random Forest	Multilayer Perceptron	Random Forest	Random Forest
BC Precision	98.30%	97.70%	98.90%	99.10%	98.90%	99.00%
BC Accuracy	98.20%	97.60%	98.82%	99.08%	98.82%	98.95%
BC Time (sec)	5.54	33.47	0.88	65.93	0.83	1.15

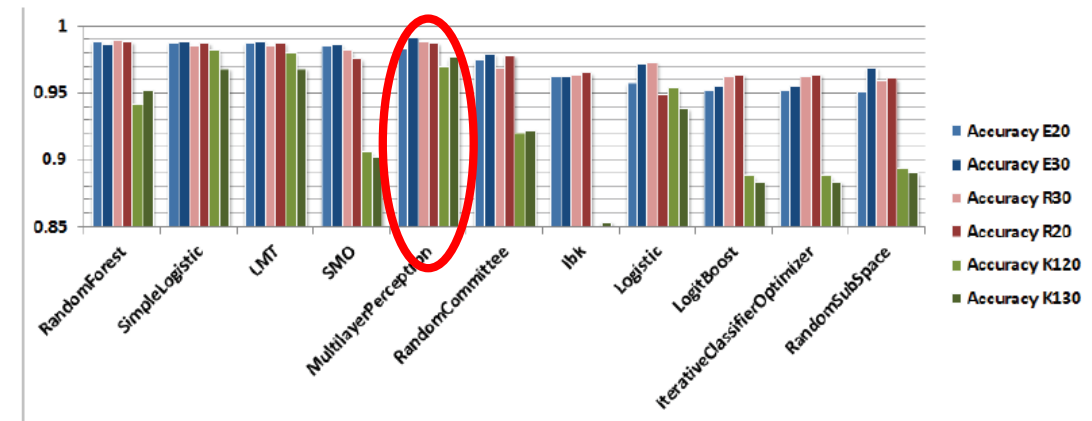


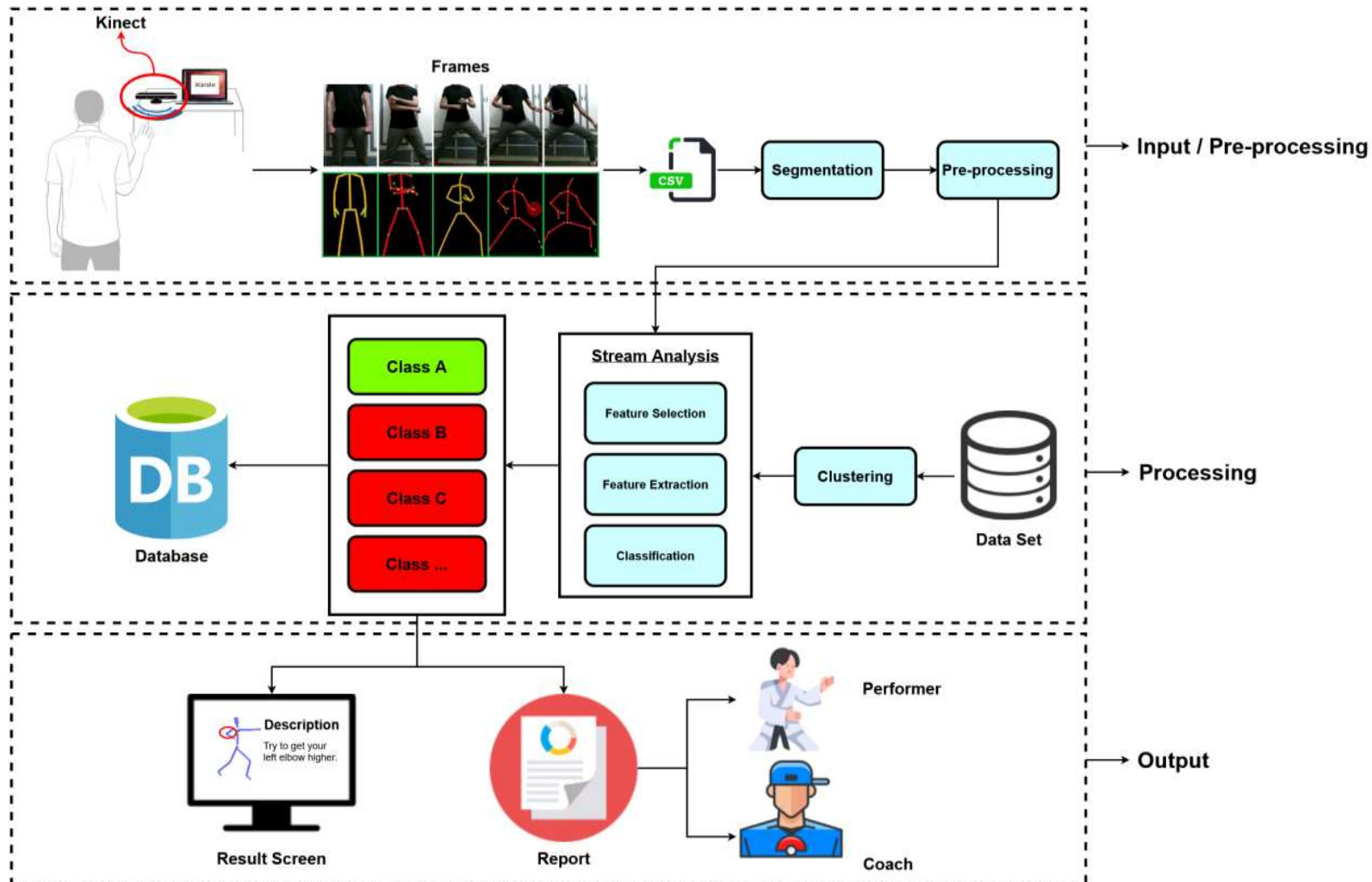
Fig. 1: Accuracy for the best 11 classifiers on the 6 datasets collected with Kinect 1: K120M (K120), K130S (K130) and Kinect 2: K2E20M (E20), K2E30S (E30), K2R20M (R20), K2R30S (R30).

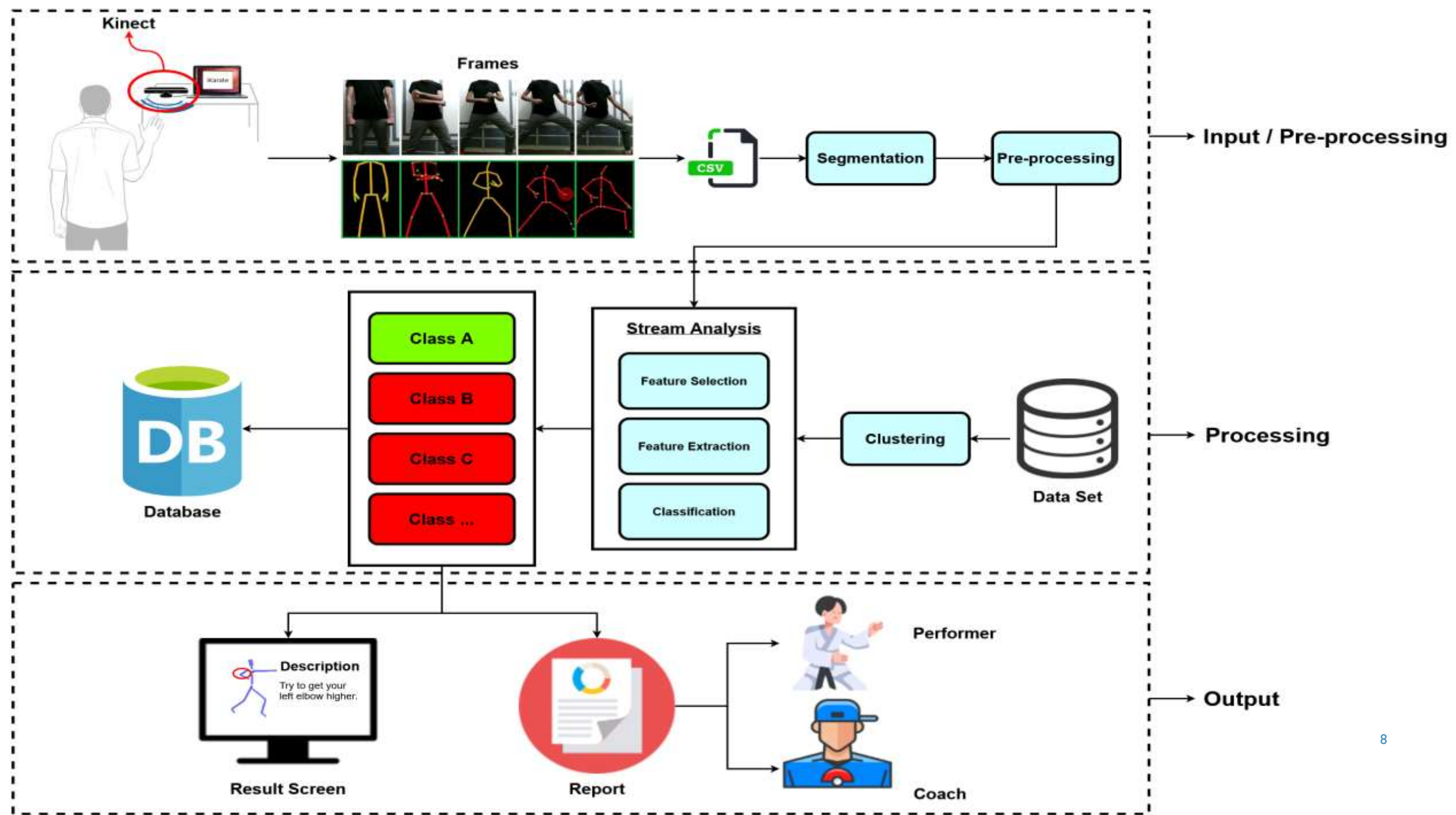
## PROBLEM STATEMENTS



Enhancing the **Classification Accuracy and Time** of karate kata, providing **Feedback** and taking into consideration the **Different Speed and Body Proportions**.

# SYSTEM OVERVIEW

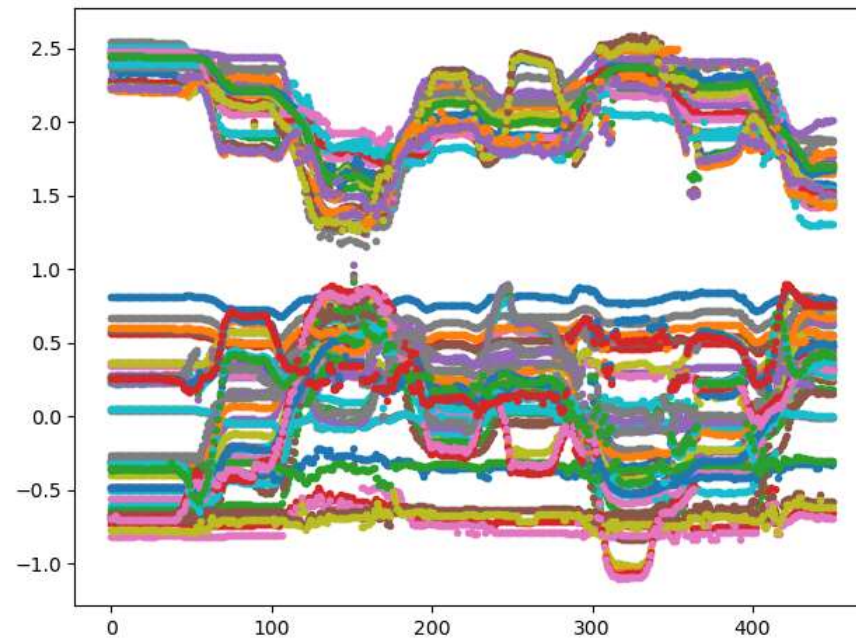




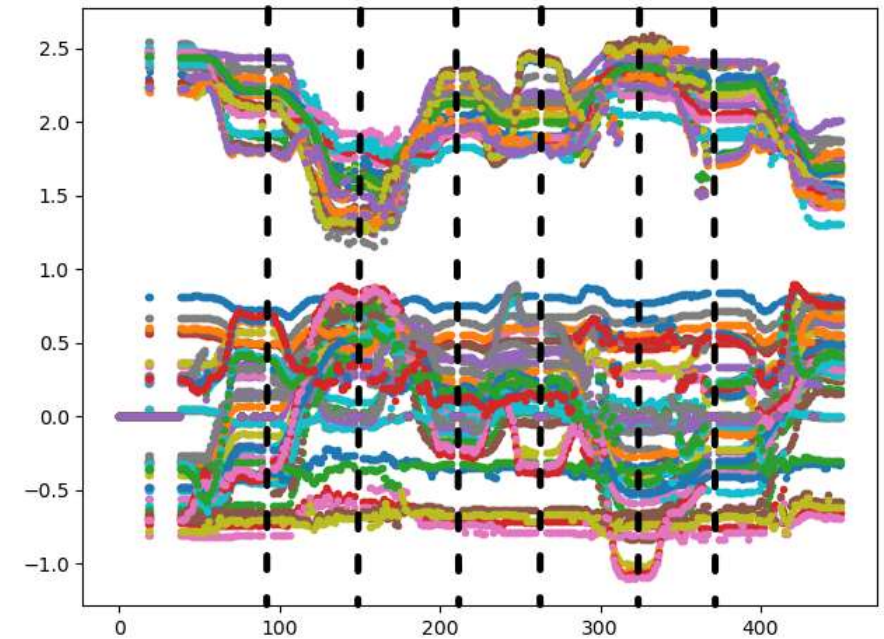


## PRE-PROCESSING I/2

- Get Xbox Kinect(s) Readings.
- Data Interpolation.
- Feature Selection.
- Data Segmentation.



**Before**



**After**

# PRE-PROCESSING 2/2

## FEATURE SELECTION & SEGMENTATION



### ❑ Feature Selection:

- Find the dominant joint in the skeleton.
- This joint will be extracted to be used in segmentation.

### ❑ Segmentation:

- Calculate the average of each 3 frames and subtract them from the previous 3 (Windowing).
- Calculate the stream threshold using ISO Data algorithm.
- Segment each movement based on the subtraction of the windows and the threshold.

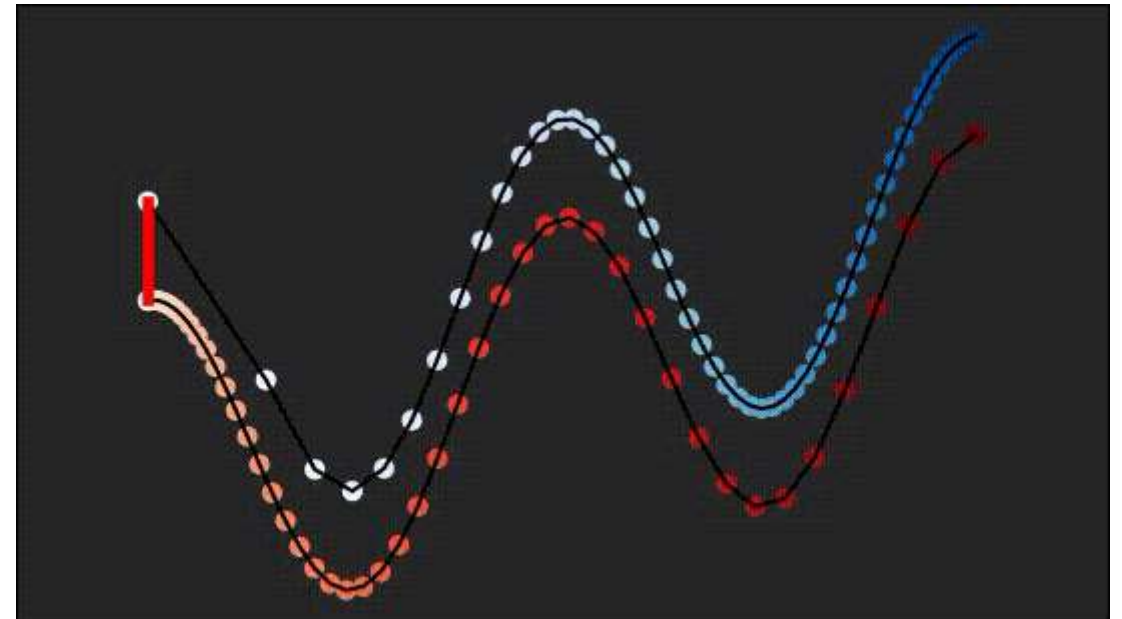
# PROCESSING

## □ Main used algorithm (F-DTW):

- Is an algorithm for measuring similarities between two signals using Euclidean equation.
- Each signal may have different speed from the other signal.
- Each signal doesn't need to be matched with its mirror.

## □ We also tried:

- K-NN (K Nearest Neighbors).
- SVM (Support Vector Machine).
- Multilayer Perceptron.
- C-NN (Conventional Neural Network).
- DT (Decision Tree).
- \$P Recognizer.



# EXPERIMENTS OBJECTIVES

- ❑ Experiment 1:
  - Data-set: 4 individual Karate moves.
  - Objective: Test F-DTW on these moves.
  
- ❑ Experiment 2:
  - Data-set: First 7 moves of Kata 1.
  - Objective: Segment the stream of movements.
  
- ❑ Experiment 3:
  - Data-set: First 7 moves of Kata 1.
  - Objective: Test multiple classifiers and cluster the moves.
  
- ❑ Experiment 4:
  - Data-set: The 21 moves of Kata 1.
  - Objective: Test new classifiers and evaluate the system with dependent and independent data.



# DATA-SET

- ❑ The data-set has been collected from multiple Karate players from Al Ahly Sporting Club.
- ❑ The data-set contains Kata 1 moves as a start.
- ❑ The data-set contains the correct version of the moves and another version that involved a common mistake.
- ❑ Cross-validation has been made to remove corrupted files.



# EXPERIMENT I RESULTS



- ❑ F-DTW was able to classify each move individually.
- ❑ The overall accuracy was 90%.
- ❑ The wrong classification was due to the small data-set.

A screenshot of the iKarate software interface. The window title is 'iKarate'. The main content area displays the following information:

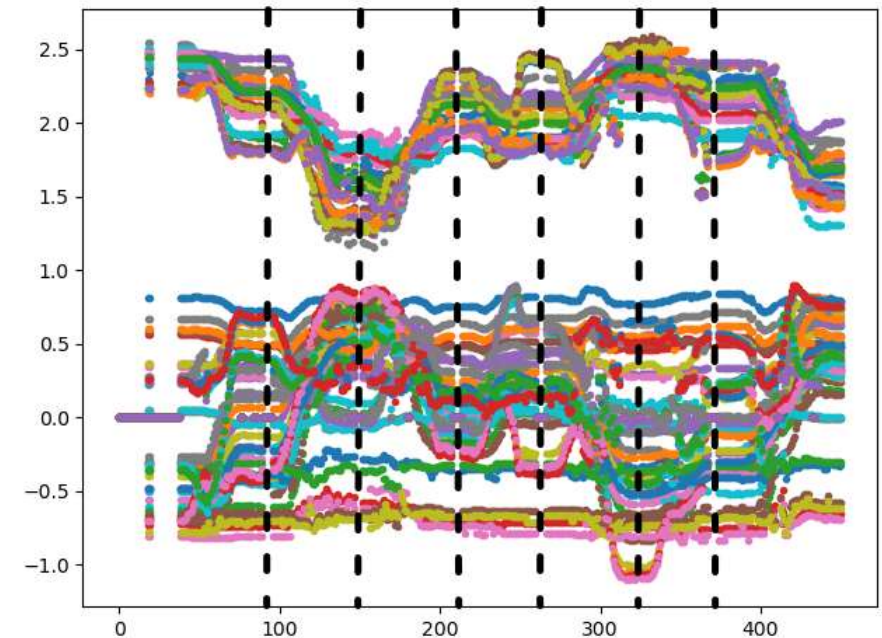
- Movement: age uke wrong 1 hand from outside
- Duration: 2.78 Seconds
- Name: Abdelrahman Yasser
- Age: 21
- Weight: 97
- Height: 168 CM

Below this information, the text 'Wrong Move' is displayed in a large, bold, red font. At the bottom of the interface, there is a button labeled 'Generate Report'.

## EXPERIMENT 2 RESULTS



- ❑ The segmentation algorithm was able to segment the stream of movements.
- ❑ The segmentation accuracy was **87.5%**.
- ❑ F-DTW overall accuracy was **91.07%**.



## EXPERIMENT 3 RESULTS



- Each move has been tested before and after clustering.
- Each move has been tested on multiple classifier.
- Classification time was improved after clustering.

- F-DTW: 73.67%
- K-NN: 60%
- SVM: 50.2%
- C-NN: 47.1%
- DT: 43.06%
- \$P Recognizer: 42%

- F-DTW: 93.65%
- K-NN: 79.36%
- SVM: 68.25%
- C-NN: 65.07%
- DT: 61.90%
- \$P Recognizer: 60.31%



# EXPERIMENT 4 RESULTS



- ❑ F-DTW: 90.32%
- ❑ K-NN: 76.03%
- ❑ SVM: 65.22%
- ❑ Multilayer Perceptron: 63.34%
- ❑ C-NN: 62.04%
- ❑ DT: 61.60%
- ❑ \$P Recognizer: 60.01%

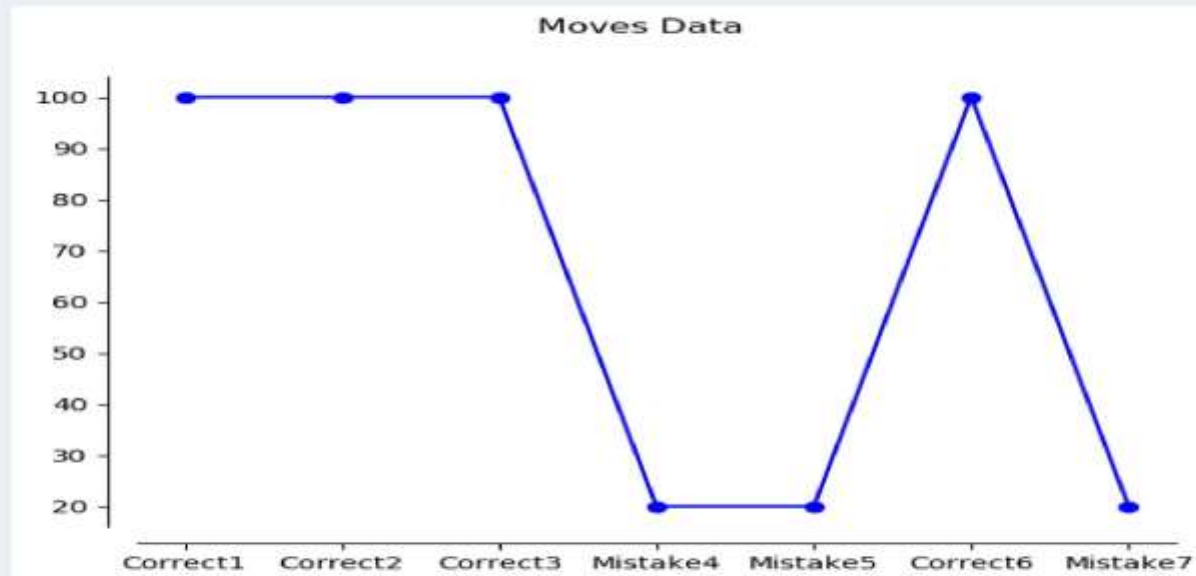
	Weak	Neutral	Agree	Strongly Agree
Was the interface pleasant ?	17%	0%	66%	17%
Did iKarate analyse all your moves ?	0%	17%	83%	0%
Did your style improve at the end of the session ?	0%	17%	33%	50%
Did you find the brief message useful after playing ?	17%	17%	17%	49%
Was the detailed report appealing ?	0%	17%	33%	50%
How accurate did you find the scores acquired in the detailed report ?	0%	17%	83%	0%
Would iKarate improve your Karate performance ?	0%	17%	33%	50%
Would iKarate help you practice Karate at home ?	0%	17%	33%	50%
Would you tell a friend about iKarate ?	0%	17%	33%	50%
Would you use iKarate frequently ?	0%	17%	83%	0%
Has your style improved after using iKarate ?	0%	17%	33%	50%

# REPORT



## Session 2

Date: 2020-05-19  
Total moves: 7  
Location: Home  
Duration: 0.23333333333333334  
Total mistakes: 2  
Accuracy: 71 %



#	Name	Duration	Mistake	State	Accuracy
1	Correct1	0.8	None	Correct	100 %
2	Correct2	0.8	None	Correct	100 %
3	Correct3	0.8	None	Correct	100 %
4	Mistake4	0.8	The mistake will be here	Wrong	20 %
5	Mistake5	0.8	The mistake will be here	Wrong	20 %
6	Correct6	0.8	None	Correct	100 %
7	Mistake7	0.8	The mistake will be here	Wrong	20 %

# CONTRIBUTIONS



- ❑ Paper 1: iKarate Improving Karate Kata.
  - Status: Published.
  - Place: Ambient Systems, Networks and Technologies (Conference).
  
- ❑ Paper 2: iKarate Karate Kata Guidance System.
  - Status: Accepted and waiting for publication.
  - Place: Mobile Systems and Pervasive Computing (Conference).
  
- ❑ Paper 3: iKarate Smart Coaching System For Karate Kata.
  - Status: Submitted and waiting for reviews.
  - Place: Journal of Ubiquitous Systems and Pervasive Networks (Journal).
  
- ❑ Paper 4: iKarate Karate Kata Aiding System.
  - Status: Submitted and waiting for reviews.
  - Place: Intelligent Networks and Systems Society (Journal).

# DELL PHASE TWO ACCEPTED



Envision the Future 2020 - Interim Design Phase Results Inbox x



**EnvisiontheFuture** <EnvisiontheFuture@emc.com>

to ▾

Sun, Mar 22, 11:17 AM



**Dell** Customer Communication - Confidential

Dear Team Leader,

The interim report and video submitted by your team have been blindly reviewed by two senior **Dell** Technologies experts from outside the region. On behalf of the 2019/20 **Dell** Envision the Future Graduation Project competition, the Steering Committee is pleased to inform you that your project made it to the top 25 in the entire region. **Congratulations!**

During this last phase of the competition, **Dell** is offering you a unique opportunity to benefit from the expertise of **Dell** Engineers and Scientists through a new Mentorship Program that you have qualified for. The **Dell** Mentors will contact you shortly to get to know you and to agree with you on the most suitable times for your team to have a conference call every other week. During these calls, which will be dedicated exclusively to your team, you will get a chance to discuss your technical ideas and seek general guidance on the various design and implementation alternatives that you may be contemplating. Please note, however, that this free support is intended to complement, not replace, your only official source of advice and direction, which is the interaction with your Professor.

Please look out for an email that you should receive from your **Dell** Mentor within the next few days. Furthermore, please check regularly the competition web site for relevant details and future announcements.

Once again, congratulations on your successful progress towards the final phase of Envisioning the Future. Good Luck!

Best regards,  
The Steering Committee

# MARKET NEED



Zoom Meeting

LIVE on Facebook

Speaker View

1/11

1/11

Unmute Start Video

Participants 251 Chat Share Screen Record Reactions

Leave

**Bassel Emad**

Fode Ndao

Mohammad Baharat

loHstosius

dell

Joven Charles Marasigan

Bryson Bande

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Bajram Osmani

merlin kazaci

Thirq & Sean Du preez

OKAY ARFA

Leonardo

Mark Nevola

Peter Hollowood

dogan and kayhan

Macaya

Cross Aca

Isabel en Carla

Richie Villacarlos

Kyle

Aidan & Aymenc Tremsa

Tyrone

# USER FEEDBACK



# MARKET COLLABORATION



- ❑ This project is in collaboration with Al Ahly Sporting club.
- ❑ They are helping us in collecting the data-set and testing our system.
- ❑ The club is giving us reviews on the system.



# DEMO





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Any  
questions ?

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**THANK  
YOU!**