TrainIT:

Detection and classification of wrong played strokes in table tennis

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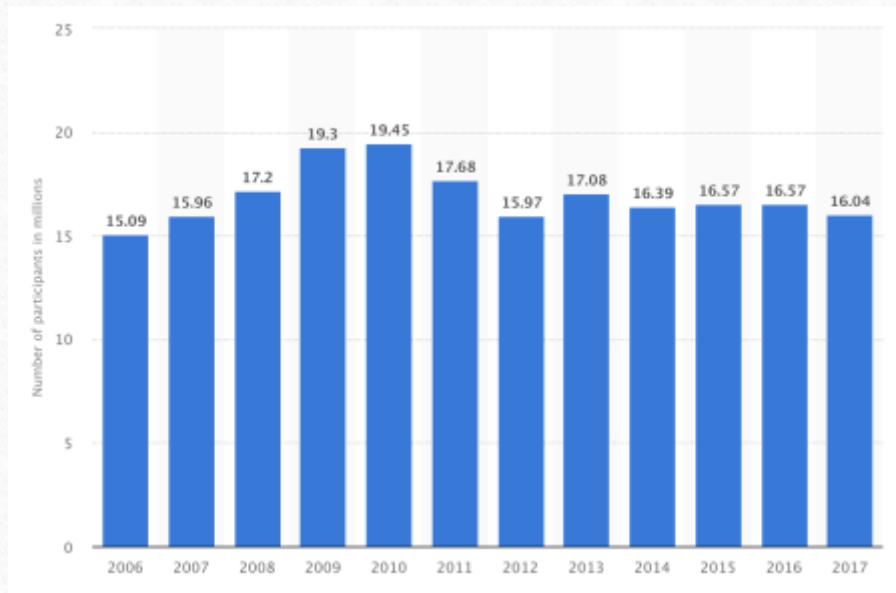**Supervised By:** Dr Ayman Ezzat, Dr Ayman Nabil
Teacher Assistant: Youmna Ismail
Date: 08/10/2019

Introduction (1/2)

❑ Table Tennis became popular to reach 16 million players.

❑ Some Basic Table Tennis Stroke Types:

Number of participants in table tennis in the United States from 2006 to 2017

1- Forehand push
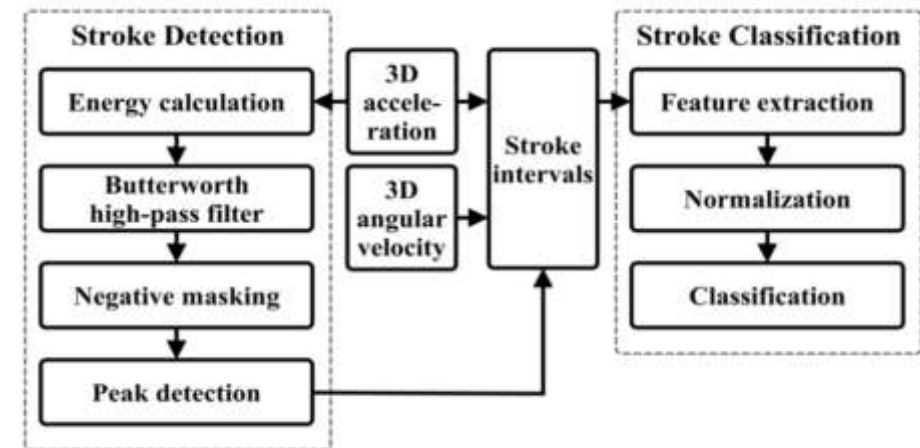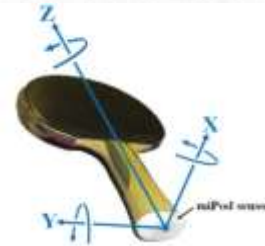

2- Backhand push

3- Forehand topspin

4- Backhand topspin

Introduction (2/2) – Common Mistakes

Video is Uploaded

Related Work (1/3)

► Used *miPod* sensor attached to the racket handle.

► Detected and classified 8 types of strokes with <u>overall Precision of 95.7%</u>

► Best accuracy was SVM RBF algorithm.

► Classification based on the player movement of the racket.

► Offline Feedback.

Blank, P., Hoßbach, J., Schuldhaus, D., & Eskofier, B. M. (**2015**). Sensor-based stroke detection and stroke type classification in table tennis. Proceedings of the <u>2015</u> <u>ACM</u> International Symposium on Wearable Computers - ISWC '15.

Related Work (2/3)

► Using wearable IMU (accelerometer and gyro) wearable device.

► The system detects and classifies tennis strokes: serve, forehand, and backhand.

► Overall 98.1% average stroke classification accuracy was achieved.

► Offline Feedback.

Figure 1. IMU device placement and sensor orientation.

TABLE I.		RESULTS OF TENNIS STROKE CLASSIFICATION			
	Serve	Foreh.	Backh.	Unkn.	Acc (%)
Serve	41				100,0
Forehand	2	51			96,23
Backhand			52	1	98,11

Kos, M., Zenko, J., Vlaj, D., & Kramberger, I. (2016). *Tennis stroke detection and classification using miniature wearable IMU device. 2016 International Conference on Systems, Signals and Image Processing (IWSSIP).*

Related Work (3/3)

► Device used: low-quality camera.

► A basic proposed algorithms was used to analyze the performance of a table tennis player.

► accuracy of the proposed algorithms is 96.29% in average.
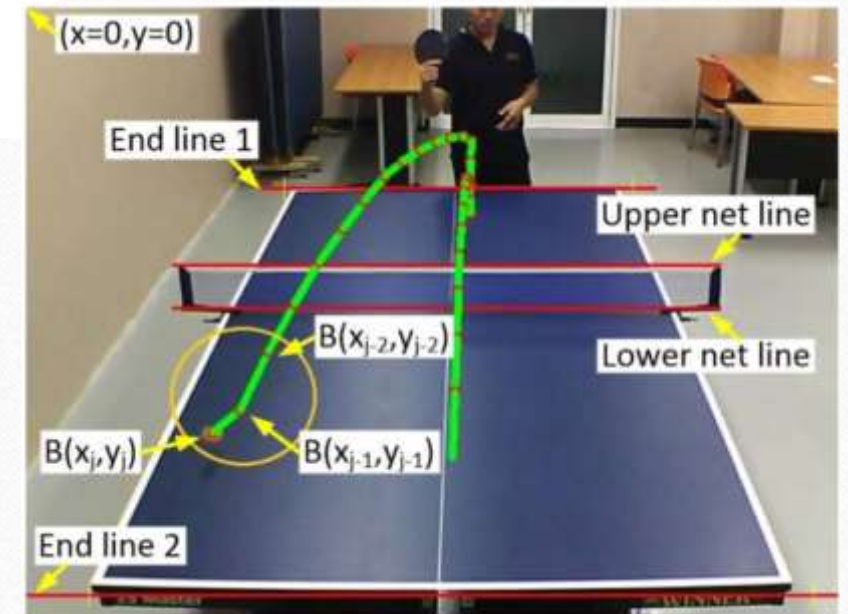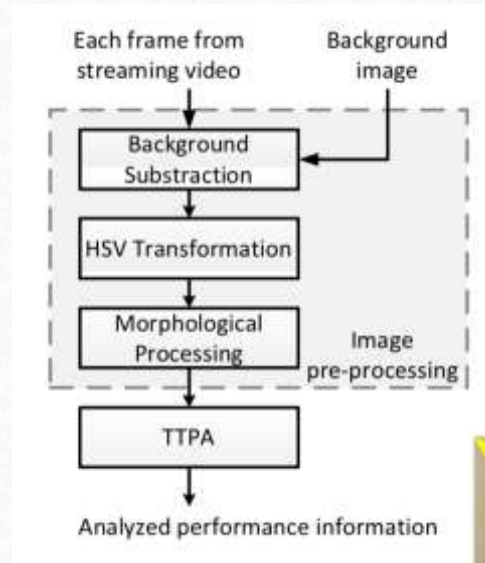
Triamlumlerd, Sirichai & Pracha, Manoch & Kongsuwan, Pauline & Angsuchotmetee, Pongtorn. (2017). A table tennis performance analyzer via a single-view low-quality camera. 1-4. 10.1109/IEECON.2017.8075888.

Problem Statement

Provide **online real-time** feedback for enhancing the player stroke shooting style by classifying the correct and **anomalous strokes** using sensor device and **IR depth camera**.

System Overview
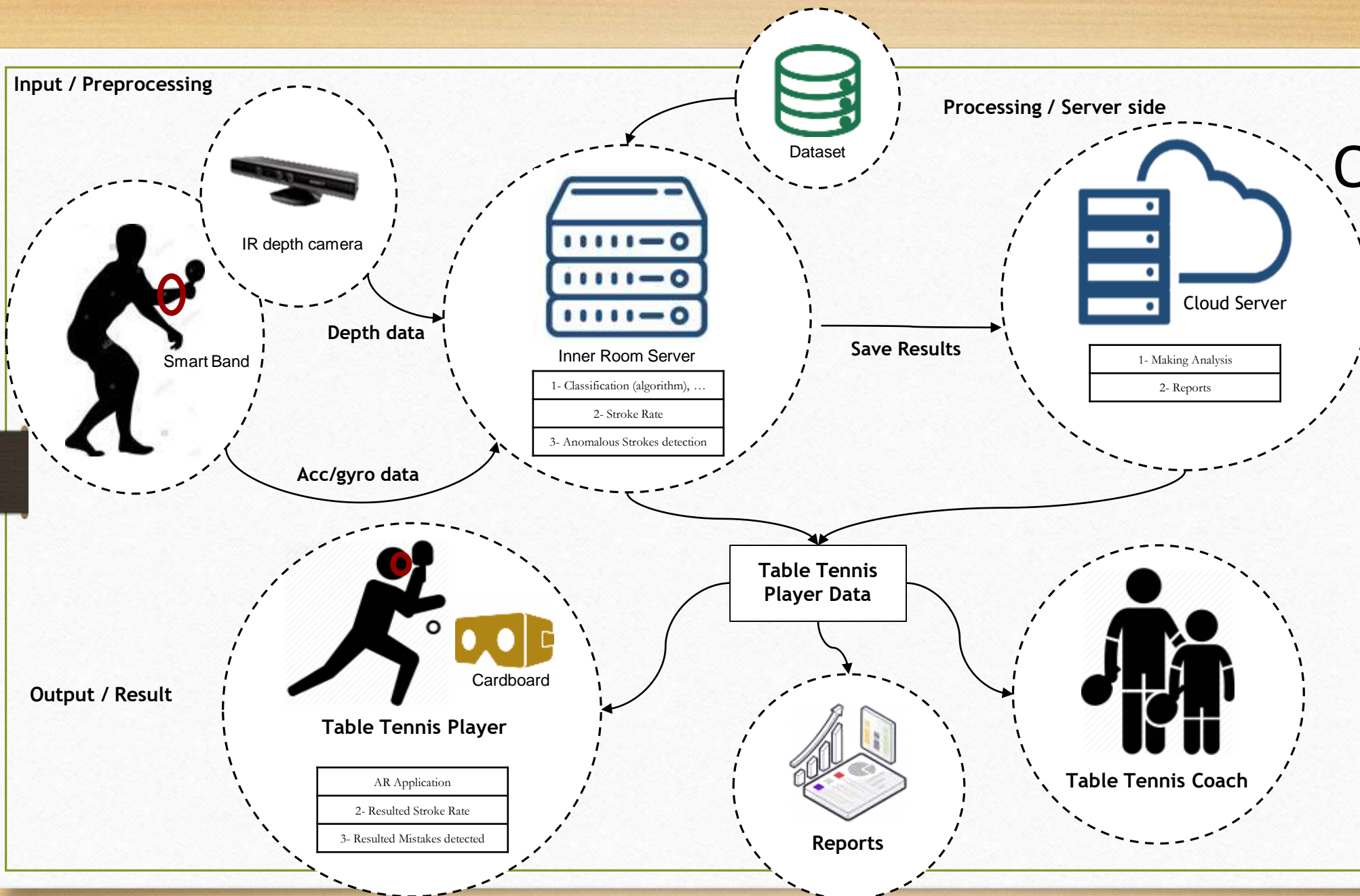
Preprocessing

❑ Automatic stroke detection.
  ➢ Get sensor (accelerometer and gyro) readings.
  ➢ Get IR depth Camera Readings.
❑ Kalman Filter.
❑ Signal interpolation/extrapolation.

IR depth camera

Smart Band
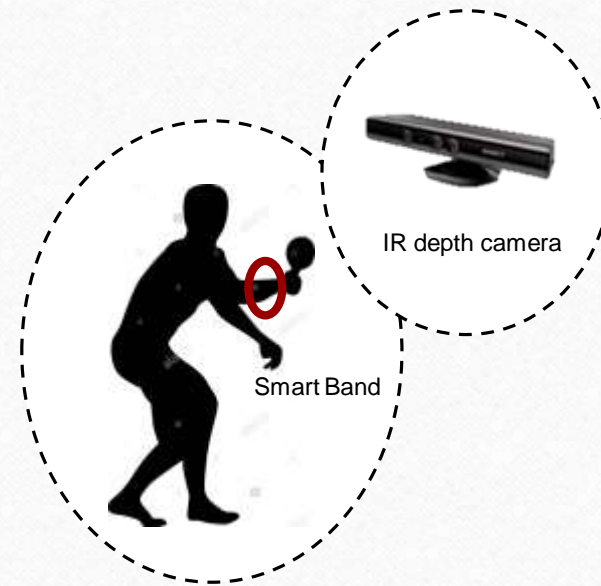
Classification

❑ Stroke classification in different layers.

- Layer (1) - classify the stroke movement type (backhand or forehand)
- Layer (2) – classify the stroke type (push, topspin … etc)
- Layer (3) – classify the errors if exist.

❑ Algorithms (fastDTW, SVM, RCNN, Deep learning time sries …)

❑ Player behavior analyzed and stored.

Dataset

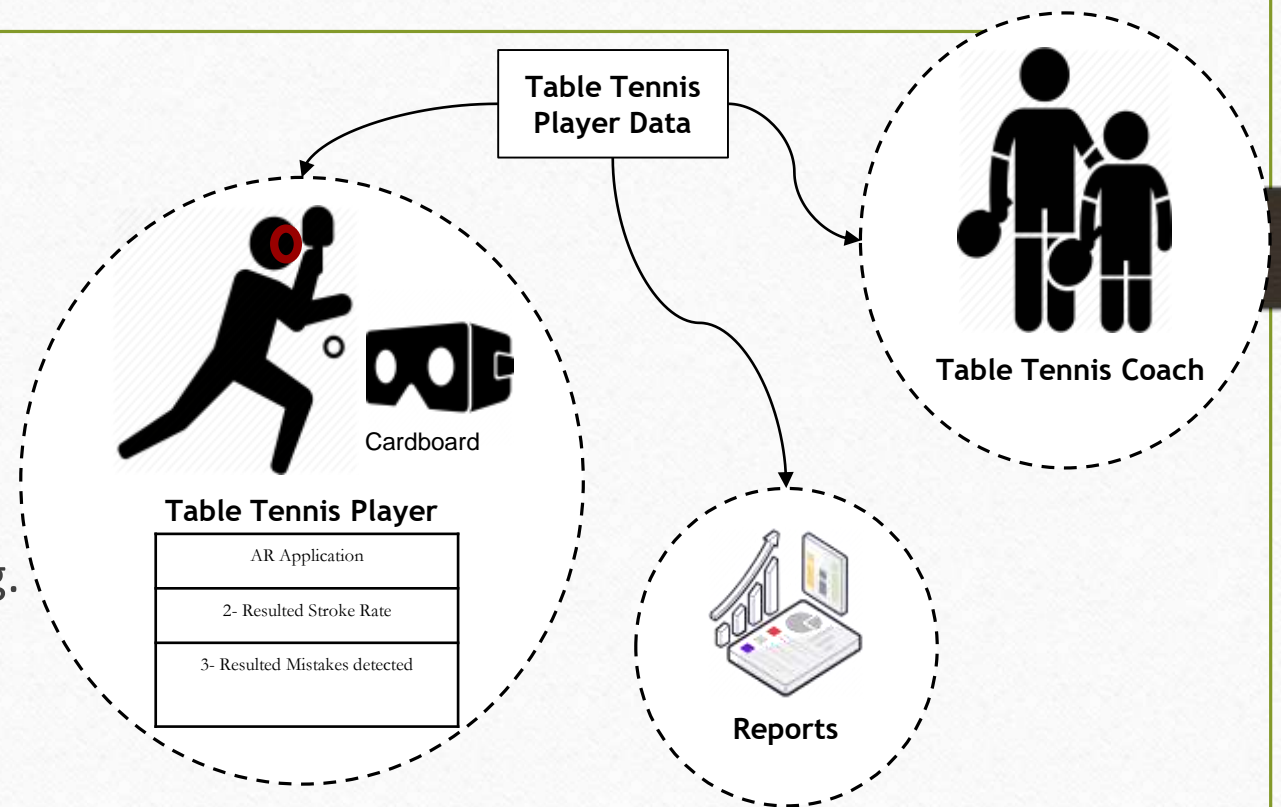1- Classification fastDTW

2- Stroke Rate

3- Mistakes detected
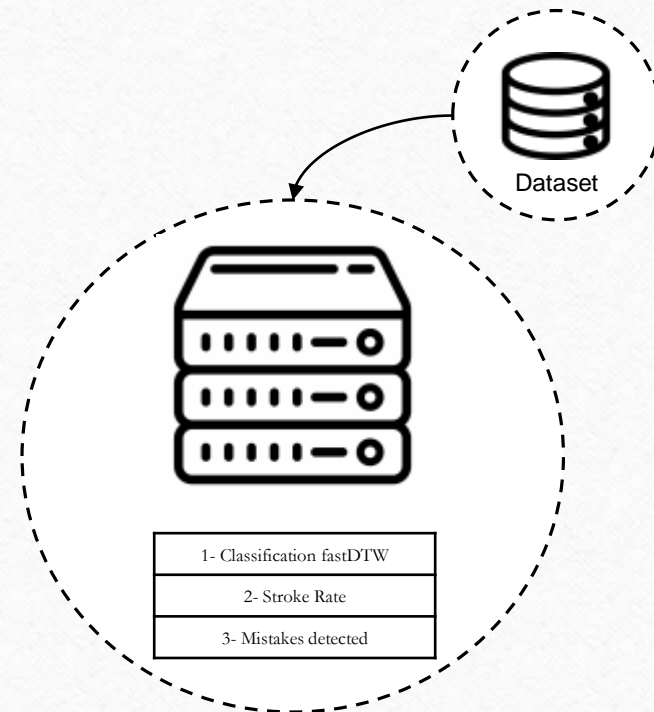
Output

❑ Couch module:
 ❖ Strokes made by player.
 ❖ Real-time player rating.
 ❖ Mistakes took place.

❑ Player module:
 ❖ Vibration.
 ❖ AR Application for data viewing.

❑ Reports Module.

Table Tennis
Player Data

Table Tennis Coach

Cardboard

Table Tennis Player

| AR Application |
| 2- Resulted Stroke Rate |
| 3- Resulted Mistakes detected |

Reports

Expected Results

❑ Output a guidance for the player with AR application and smart band vibration.

❑ Real-time feedback and analysis about player behavior.

❑ Full report about the player for the coach.
   ➢ Number correct and anomalous strokes made.

Demo

Video is Uploaded

Any Questions?