Part 1 (Team)

Team Leader: Bassel Emad Salah (Bassel1600604@miuegypt.edu.eg)

Team Members:

1. Ahmed Mohamed Sherif El-Kerdany (Ahmed1606318@miuegypt.edu.eg)
2. Omar Atef Hashem (Omar1603910@miuegypt.edu.eg)
3. Yehya Shams El-Din Hamzawy (Yehya1605639@miuegypt.edu.eg)

Faculty Advisor Name: Ayman Atia (Ayman@fcih.com)

University: Misr International University (MIU)

Country of Residence: Cairo, Egypt

Part 2 (Project)

Project Title: *iKarate: Improving Karate Kata*

What general areas does your project fall under?

- Artificial Intelligence
- Educational Systems

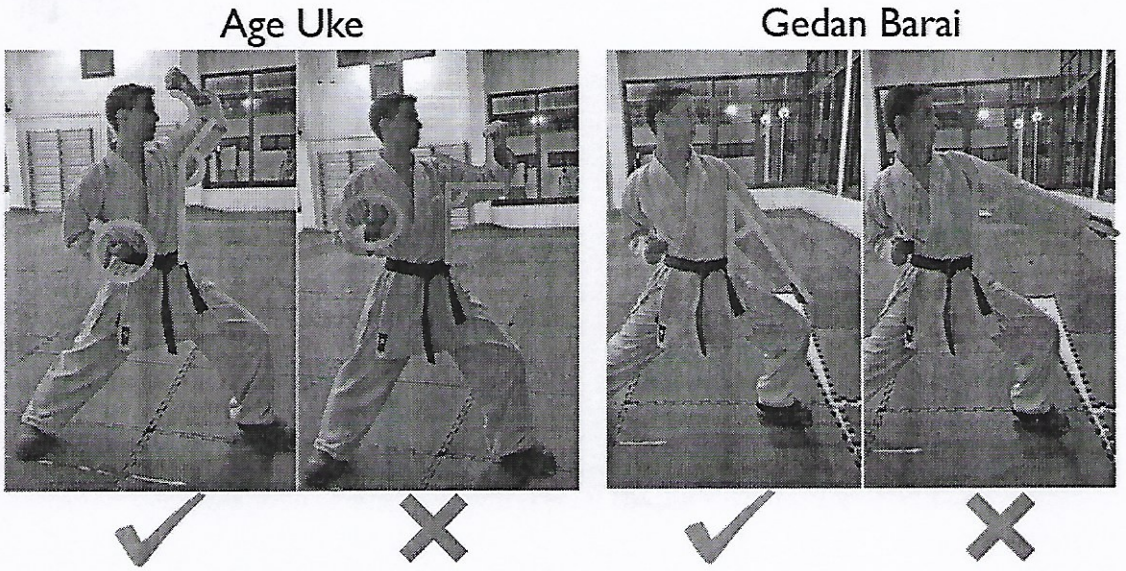
What specific areas does your project fall under?

- Real-time Feedback
- Machine Learning
- Image Recognition
- Human Movement Analysis

Misr International University
MIU
جامعة مصر الدولية

What is the main problem that you are solving?

Karate moves are combination of physical moves. Its methods are qualitative not quantitative that makes it hard to make the perfect copy of the motion and harder to judge it. Also, kids nowadays may find difficulties learning those moves at a young age, also, since the training may consist of a large number of players so the trainer himself may not be able to focus on every detail of every player's move, which may result in taking more time for learning the move or to be precious to master the move or it may lead to learning that move in a wrong way from the beginning. Below is an example of two movements done in wrong and right way.



What is the importance of this problem?

Karate is a martial art that can be practiced using hands and feet to deliver and block strikes. The moves are combination of physical movements. Its methods are qualitative not quantitative that makes it hard to make the perfect copy of the motion and harder to judge it. Also, kids nowadays may find difficulties learning those moves at a young age, also, since the training may consist of a large number of players so the trainer himself may not be able to focus on every detail of every player's move, which may result in taking more time for learning the move or to be precious to master the move or it may lead to learning that move in a wrong way from the beginning. However, moves must be done in a certain way, many wrong moves are done in the training itself. We discussed these problems with Al-Ahly karate team.

What are the current solutions?

A system that was proposed by Mitsuhashi, el. in "Educational system of physical motion based on 3D bio mechanism evaluation" presents a support system of body motion based on three-dimensional bio mechanism evaluation. The most important problem they face was imperfect imitation problem that human cannot attain the perfect copy or imitation of the referenced motion because of skeleton size, each skeleton has different size from the other skeletons.

How will your solution solve the problem? What is new?

Our solution involves using a virtual recognition device to capture movement data from the karate player and a report system.

- The motion capture data is then sent to the classifier after being processed to be classified and report back to the player in real time if the karate move is performed correctly.
- After the player is finished performing, the system generates a report of the overall performance of the player
- The report system analyzes the mistakes done by the player and shows how to correct the mistake, and highlight where the mistake is done on the player's body.

What is the expected impact of your solution from various perspectives (social, commercial, environmental, etc.)?

Technologically: capturing motion data with a virtual device and using it to enhance the performance of karate players can change how virtual recognition devices are designed only for limited fields and expand its uses.

Give a high level functional description of your solution. How will it be used?

- iKarate uses the Kinect sensor as the virtual recognition device that has an infrared Emitter to track the body.
- The virtual recognition device should be facing the player and have a full view of the player's entire body.
- Twenty five joints is captured by the virtual device, enabling us to capture to X, Y, Z coordinates of each joint without any accessories attached to the player.
- Karate players can perform their movements while the virtual device is facing them as if they are performing normally while training with a coach.
- The system receives the movement data, classify it, and analyze it in real time. And generate a full report of the player performance.

Give a high level technical description of your solution: architecture, technology, integration, innovative components, etc.

- Data capturing (Using Kinect to detect human body joints)
- Feature Extraction (Detecting important frame)
- Human body motion analysis and classification
- Real-time feedback and detailed report

Give a high level description of your solution development environment, platform, tools, etc.*

- The environment of using the system will be in home or sporting club, but will need at least a free 6x6 area for the practitioner to move freely and for the Kinect to have full view of his body.
- The tools to be used will mainly be the Kinect as mentioned before, it is the core of our project since we intend to make our project free from any wearable devices. Also the user will need a PC with Microsoft Windows and good internet connection.

How will you manage your product development cycle, your quality assurance process, your solution deployment logistics, etc.?

The project should be developed according to function and non-functional requirement which are defined in the Software Development Document (SRS). The project should have a perfect efficiency and performance in real-time with nearly no mistakes. Moreover, the Graphical User Interface (GUI) should be easy to use. We assure that by breaking down the project modules into smaller modules, each module has a specific iterative process, every process's input and output are well-defined along with their testing criteria to ensure that there are no errors. By following these steps, we will deliverer a fully functional system that is very well tested.

Give the most relevant plans that you have developed for your project (for example, time schedule, resource plan, training plan, risk management, contingency plan, etc.)

Time Schedule:

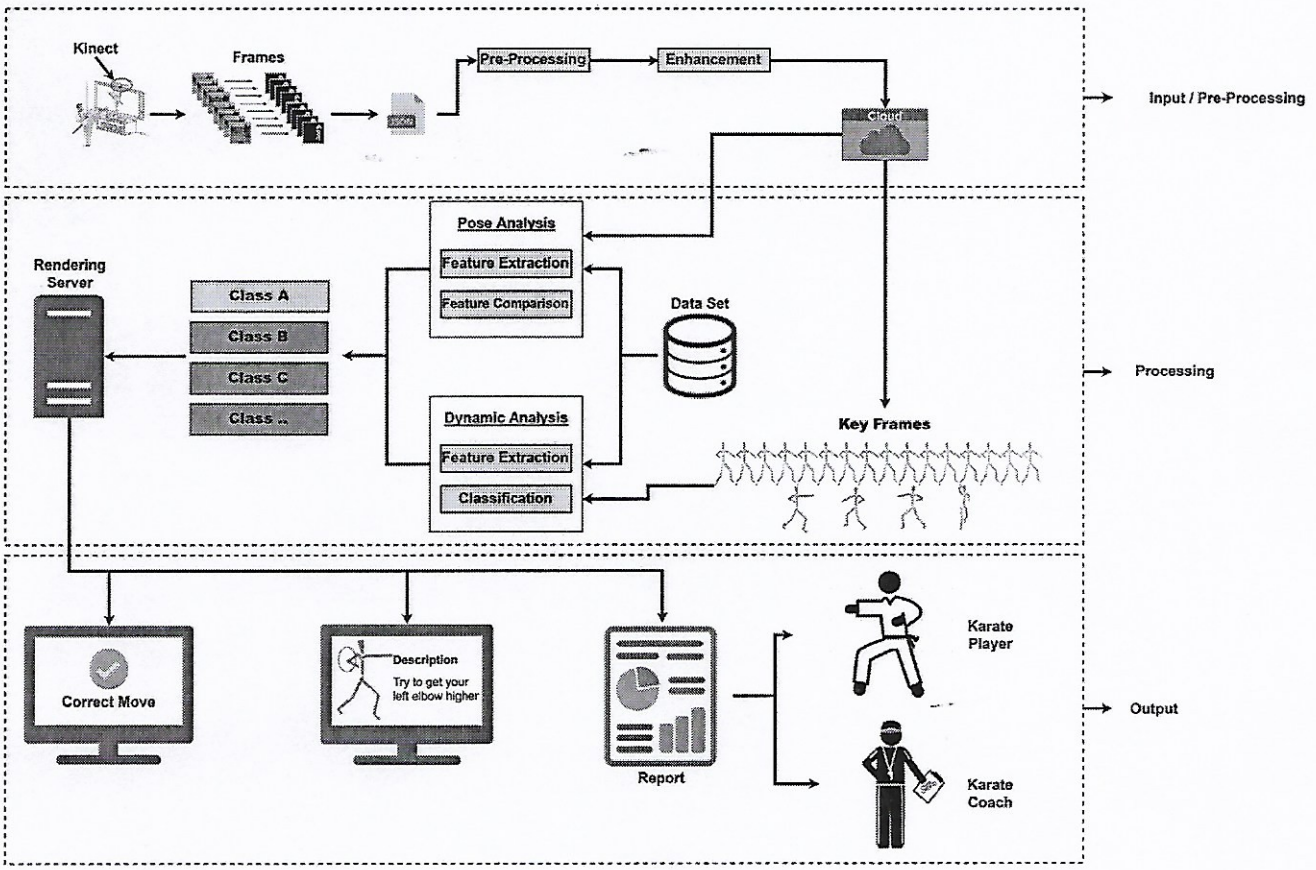
- Idea Discussion: (01 Jul 2019 – 22 Jul 2019)
- Idea Research: (15 Jul 2019 – 29 Jul 2019)
- Implementing Prototype: (29 Jul 2019 – 09 Sept 2019)
- Survey and Proposal: (29 Sept 2019 – 14 Oct 2019)
- Writing Paper: (30 Sept 2019 – 14 Oct 2019)
- Designing Application: (07 Oct 2019 – 21 Oct 2019)
- Implementing GUI Design: (14 Oct 2019 – 28 Oct 2019)
- Designing Database: (21 Oct 2019 – 04 Nov 2019)
- Designing Class Diagram: (23 Oct 2019 – 11 Nov 2019)
- Dataset Collection: (04 Nov 2019 – 18 Nov 2019)
- Dataset Classification: (11 Nov 2019 – 25 Nov 2019)
- SRS: (14 Oct 2019 – 16 Dec 2019)
- Implementing Application: (09 Dec 2019 – 03 Feb 210202)
- SDD: (27 Jan 2020 – 24 Feb 2020)
- Validation and Testing: (17 Feb 2020 – 23 Mar 2020)
- Writing Second Paper: (23 Mar 2020 – 27 Apr 2020)
- Writing Final Thesis: (01 Jun 2020 – 06 Jul 2020)

Resource Plan:

We need multi resources to help us regarding enriching our work, and considering the output that we could get information from and use it. This resources include the following:

1. Kinect Sensor And Adapter Bundle: 280$.
2. Server & Cloud (Google App Engine): 400$/Month.

Kindly upload images of diagrams or flowcharts which explain better your ideas.



If you uploaded any images of diagrams or flowcharts, please provide a description for each image.

As shown in the uploaded image:

- The system is composed of one or multiple Kinect(s). The Kinect(s) is facing the user while he/she performs a sequence of moves. Then the frames and the skeleton are extracted from the Kinect.
- After that the Pre-processing, Enhancement, saving data on the cloud starts along with computing the key frames, feature extraction and finally the classification.
- After every move has been played, the player is presented with the move name and whether it was done correct or not. The player is given a score to know how good he/she performed the move after it has been analyzed. The score evaluation is based on the player's motion while performing the move and his/her speed.
- Dynamic analysis of the movement gives real-time feedback and a report to the player or the coach, making the application more interactive. The report contains the player name, age, weight, height, belt color, movement name, movement duration, how good the player preformed the move, how to improve the move and if any mistake were made it will be shown in the report.

Faculty Advisor Signature: