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An AI Application in Wing Chun Wooden Dummy Techniques

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ABSTRACT

Recently AI has gained a remarkable public attention globally and its development is still accelerating. AI can help a lot in many traditional industries. In this paper, we are taking our first step to try to apply AI technology into one of the traditional areas - Wing Chun. Wing Chun is one of the styles of Chinese traditional martial arts (Kung Fu). Wooden dummy techniques are very important in Wing Chun. The traditional wooden dummy tool is superb that it can help a human to practice many different techniques of Wing Chun against one single tool. Now with the power of AI, it is possible to improve the wooden dummy to be even more helpful for the practicing person to master Wing Chun techniques.

KEYWORDS

Artificial Intelligence, Robotics, Wooden Dummy, Wing Chun, Kung Fu

1 Introduction

Nowadays Wing Chun is the 2nd most popular style of Chinese traditional martial arts (Kung Fu) in the world. The number of people learning Wing Chun is only second to those of learning Tai Chi among all styles of Kung Fu.

Wing Chun Kung Fu techniques are consolidated in the standard forms, including 3 forms for bare-knuckle techniques, 1 form for knife, 1 for long pole as well as 1 wooden dummy form. Those forms construct an effective learning system of Wing Chun.

The wooden dummy is the tool for the person who learns or practices Wing Chun to train himself / herself with the Wing Chun techniques, especially for the wooden dummy form. The wooden dummy is made of wood material and has a shape of a person abstractly, with wooden arms and legs. It is a very powerful tool that can help the practicing person to perform all kinds of movements of Wing Chun techniques however with a lot of imagination required. It is due to the fact that all the dummy's arms and legs are static and cannot move. Those limitations can be addressed with the information technology and artificial intelligence.

These days AI is a very hot topic [3]. There has been a significant progress in AI research as well as the applications in the real world [6]. Many giant IT firms have made investments on AI research and some of them have already released their commercial products for sales [2][4][9]. For example, with the computer vision technology, autonomous cars are starting to run on the street without any human drivers [10]. With the speech or voice processing, IT firms have developed all kinds of voice assistants, such as Siri developed by Apple Inc. , as well as XiaoDu developed by Baidu Inc.[2][8]. Those voice assistants can understand the user's speech and then respond intelligently [7]. AI has also boosted the development in the robotics industry. In 2016, sales of industrial robots in China reached 87,000 units, accounting for around 30 percent of the global market [5].

Therefore it comes to an era that it is possible that we can have some breakthrough on the traditional wooden dummy to make some improvements with the utilization of the new AI technology. Our long-term goal is to make the traditional static wooden dummy have the new abilities to cooperate intelligently with the practicing person, so that he/she can master the wooden dummy techniques more effectively and efficiently. With that goal we have taken the first step in this paper to design a platform that connects both hardware layer and software layer. We also proposed the essential hardware requirements for the platform. Any wooden dummy providers are welcome if they can provide the required hardware and would like to collaborate with us to take this further for commercialization.

Note that although the wooden dummy is usually seen as a symbol of Wing Chun style, there are also other styles of Kung Fu that are using wooden dummy for practice as well, such as Choi Lee Fut etc. But the shapes of dummies from different styles can be different. In this paper we only talk about Wing Chun style.

2 Wooden Dummy Illustrated

Figure 1 is a photo of a Wing Chun Wooden Dummy.

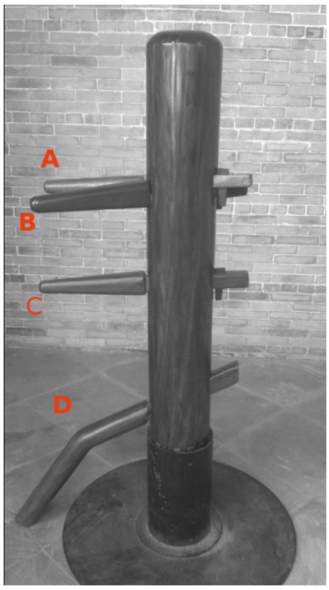

Figure 1: **The components of a wooden dummy**[1]

Wooden Dummy is a tool for imitating the opponent when the user practices Wing Chun techniques. The wooden dummy form is a collection of all essential Wing Chun techniques which can be performed against the dummy. The Wing Chun wooden dummy form currently seen publicly is usually composed of 108 or 116 movements.

When the practicing person performs the Wing Chun techniques against the dummy, he or she needs to imagine the wooden dummy is the opponent, and the arms or legs of the dummy's are the opponent's arms or legs.

From the photo we can see there are 3 arms installed on the dummy. The upper 2 arms (A and B) represents the dummy's (the opponent's) left arm and right arm. The 3rd arm (C) installed a bit lower in the center has multiple roles. It can represent either the opponent's arm or the opponent's leg. When it represents the opponent's arm, it means the opponent is placing one of his/her arm in a lower level (such as a lower straight punch). When it represents the opponent's leg, that means a relatively higher level kick by the opponent. With the purpose of easier descriptions, we sometimes refer to this component as an arm in this paper.

There is a leg component installed at the bottom of the dummy (D) . This represents the opponent's front leg.

All arms, legs, and the body of the dummy's are made of wood.

3 Current Limitations

There is a legend story that the wooden dummy originated from the Shaolin temple in ancient times in China. In the story, there were originally 108 wooden dummies in the temple rather than one as what it is now. Each of the 108 wooden dummies had its own design for a particular combat technique. A Kung Fu learner in Shaolin had to pass tests against all 108 wooden dummies in order to confirm his expertise in Kung Fu. Today it is quite difficult to verify that story was real or not. With the time past gradually, the said original 108 dummies had evolved to the single dummy as what we see today.

The single dummy has the advantages that it is much easier to be built and costs much less space to be placed. It can be installed even at home. It is an amazing tool that is so powerful in Wing Chun training. All 108 movements can be performed against the single wooden dummy. However, as the dummy has only 3 arms and 1 leg, which are in the static positions, a lot of imagination is required for the user. For example, when the user is performing a Pong Sau, he or she needs to imagine the opponent is using a straight punch from the center line [1]. Also, the dummy's arms and the leg is static without moving, which is different from the scenario of real combat where the opponent keeps moving. (Again, a lot of imagination would be required)

The above limitations are seemingly impossible to be addressed in the old years. However, it is possible in the current era of IT. With the computer science and robotics technology, we can improve the classical wooden dummy to be much more powerful. Artificial Intelligence can enable the classical wooden dummy to perform even more advanced functions such as collaborating with the practicing user. In this paper we are trying to take the first step to enable the wooden dummy with AI.

4 Platform Design

In the platform design we primarily use a multi-layer model as below. The separation of the layers enables us to focus on the software implementation and the AI development, while leaving the hardware implementation to our industry partners who have more expertise than us.

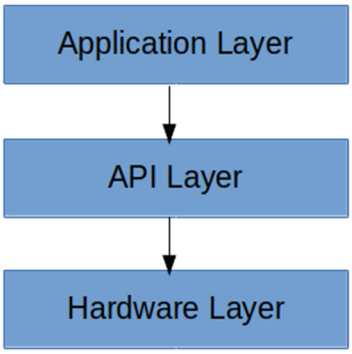

Figure 2: **The layers of the platform design**

4.1 Hardware Layer

The hardware of wooden dummy must have some basic requirements in order to work with the platform, as defined below. All of the descriptions are defined from the perspective of the wooden dummy's, rather than the practicing person's.

[1] The photo comes from the Internet

Controllable Components. The following components are required to be controllable in our model.

- ARM_0 (The middle Arm/Leg)
- ARM_1 (The left Arm)
- ARM_2 (The right Arm)
- LEG_0 (The bottom Leg)

Basic Positions. The basic positions of each controllable component.

- Center
- Left
- Right
- Up
- Down

Advanced Positions. The advanced positions are more powerful but not as easy as the basic positions for use..

- Angle (clock-wise)

Movements. To simplify our first version of the platform, movements are simply defined as moving from one position to another position, for each controllable component. Note that multiple components should be able to move simultaneously, without any impacts to each other. (For this purpose the right position of the left arm and the left position of the right arm are further adjusted to a bit smaller range, so that both arms can move simultaneously without clicking each other or the user's arm.)

Materials. The majority part of the dummy needs to be made of wood, while the type of wood can have multiple choices. There can be some parts made of metals for adjunctions of the arms and the body of the wooden dummy. However this should be minimized and organized in a way that is not harmful to the practicing person.

4.2 Platform and API layer (SDK)

We use Android as the operating system as it has already been used by many AI systems and it is open-source.

In order to develop the application described in the next section, we need to define the following APIs for the application to control the hardware components.

- Initialize
- ResetPositions
- SetPosition(Component, NewPosition)
- SetAdvancedPosition(Component, Angle)
- MoveAdvancedPosition(Component, RelativeAngle)

The APIs are included in the SDK package. They are a bridge between the hardware layer and the application layer.

4.3 Application Layer

All the functionalities are in the application layer, implemented with the help of the APIs provided in the SDK.

4.3.1 Scenarios. We define the following scenarios for the usage of the wooden dummy.

1. Form performing

The form of Wing Chun wooden dummy is composed of 108 (or 116) movements. The form performing scenario is mainly used by the user to practice the form from the beginning to the end. In this scenario the wooden dummy will make the corresponding position adjustment to cooperate with the practicing person, with a pre-configured pace. The form progress is shown on the UI panel. Rather than the static positions of the dummy's arms and the leg as in the traditional wooden dummy, the dynamic arms and the leg can help reduce the practicing person's efforts on the imagination.

2. Movement practice

This scenario is used for the user to practice only a single or a couple of movements deliberately. In this scenario, the user keeps practicing one or a couple of movements from the form repeatedly. The dummy will make the corresponding adjustments on the positions of the arms and the leg again and again.

3. Random movements

In the random movements scenario, the dummy will move the arms and the leg randomly, without any predefined pattern. This is used for helping the user to practice the reaction with the uncertainty of the movements from the opponent.

4. Pre-defined movement series

This is similar to the movement practice scenario. The difference is that the movement practice scenario is used for practicing the form, while predefined movement series scenario is mainly for other movements that are not included in the wooden dummy form.

4.3.2 Other functionalities. Here are some other functionalities in the application layer.

UI Component. There is a UI Component which is a basic LCD screen embedded in the wooden dummy for the interactions with the end user.

Voice Control. Due to the scenarios of the wooden dummy practicing, it is much more convenient for the practicing user to use voice or speech to control the wooden dummy, so that the wooden dummy can be controlled by the user immediately without any interruption of the practicing.

Strength Display. Something like a numeric feedback of how much energy the practicing person has pushed onto the wooden dummy. This may require some extra hardware support so it is optional only.

Reporting and analytics. The user can configure to save the historical data for further analysis and reporting. The trend report can be generated to see if the user is improving in some aspects (e.g. dummy’s speed) gradually. It can also help the user to find out his/her weakness for further improvements.

5 Other Topics

5.1 Safety

When the 2 arms moved close to each other, they shall not hurt the practicing person's arm. The movement should be blocked easily by the practicing person's arm without any pushing. The material used around the dummy's arm needs to be considered carefully for safety reason.

5.2 Speed

The speed of the wooden dummy's movement is limited by the Hardware. In our design we should allow the user to select the speed within the range of the hardware limitations. At first it might not be easy for the dummy to keep up with the fastest speed of its user (while ensuring the safety for the user). However, we believe this should be improved when the Robotics industry got more mature in future.

5.3 Power Supply

Power supply might be a new issue after we introduced AI into the wooden dummy. The traditional wooden dummy does not need the power supply at all. We need to investigate how much power supply is required and how we can save the energy to minimize the power consumption.

6 Conclusion and the Future

In this paper we designed a platform for adding AI elements into the traditional wooden dummy, so that it is able to perform more functions and make the practicing user to improve the wooden dummy techniques more effectively and efficiently. That is only a small step though. Looking forward there are more opportunities for improvements. For example, adding computer vision ability in wooden dummy so that it can respond to the user movements - it is not impossible. There are a lot more to do in our future research and experiments.

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