[[1]](#footnote-1)

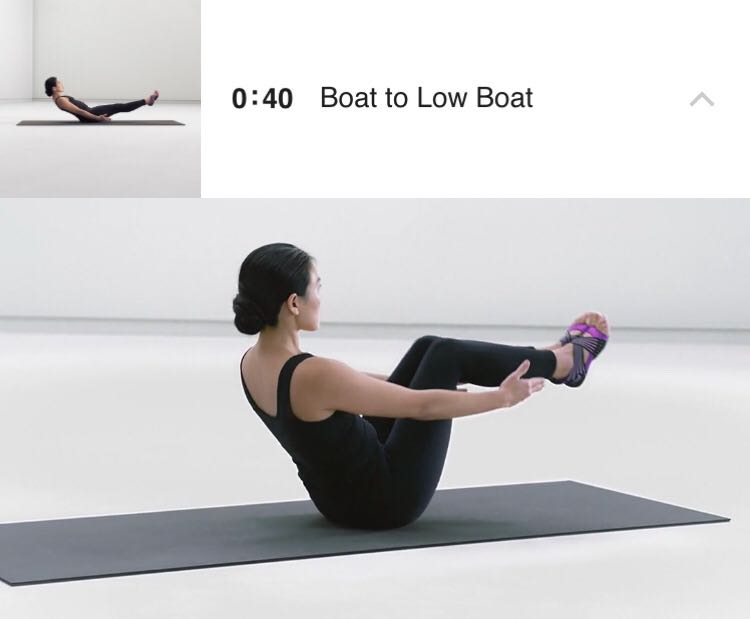
**Exercise and Mixed Reality – Virtual Human**

Kiran C Shettar (Author), (M.Sc.,) Dept. of Computer Science  
University of Massachusetts, Lowell, MA, United States – 01851  
KShettar@cs.uml.edu

*Abstract*—During the 21st century, exercise and health are two main things that play major role in a human life. There are many different types of people in the real world. Some of them are obese who are are willing to exercise to become fit. We can also see several people who are normal but want to be fit to maintain a healthy life. In the medical field we know that physiotherapy is where many exercises are taught to patients to restore movement and function when someone is affected by injury, illness or disability. People can become fit by doing different types of exercise which is proven scientifically. Whereas, some people will be shy to go to the gym, some will have financial issues, some cannot afford personal trainers. People who need physiotherapy treatment may not be able to afford the medical expenses. All these issues can be solved by creating a virtual human that can train you anywhere, anytime just by learning how to use a Mixed Reality device. In this paper, I am presenting a mixed reality system that translates physical demonstration of various exercise protocols into movements which can be done by a holographic human.

# Introduction

Mixed reality is a rapidly expanding field. Fitness represents a tiny fraction of the AR effort, which focuses primarily on entertainment. We have all seen many exercise apps which demonstrates different types of exercise with human animation.

  
 image: Nike Training App

A mixed reality human (MRHs) hologram can be developed to perform different exercise actions like one mentioned in the image above. This could be viewed with the Mobile AR technology or by wearing a physical HoloLens device in real time.

When it comes to the medical field, physiotherapy treatment is something that can be performed with two persons. The first person would be the patient and the second person would be the person who is helping the patient perform different exercises. A research is being done on something similar like this. The recent research on medical team training with mixed reality humans (MRHs) has investigated how medical professionals speak up to MRHs [4], how medical professionals gaze at MRHs [5]. Some of the researches have also investigated how MRHs can influence communication skills during training [3]. MRHs can be developed as models with communication behavior.

# System description

## Implementation

The implementation of a CNUI has a 3D gesture interface, a multitouch-interface, and a paper based instance. Here, we will be using a paper that can be transferred into a virtual interface. A camera placed on the top of a paper, will be used to capture the sheet. A different object can also be used in place of a sheet of paper. For the device continuity a touch table is connected so that the user can move the sheet of paper in multiple directions. The content is inserted into the corner of the table we are using. Then, the user can then access it from there. After some time, the content disappears thinking that the user did not remove it intentionally.

## Description

The major part of the system is AR-based 3D hand gesture interface for all possible actions with the real-world objects. Using the hand gestures, the user can interact with the object like selecting parts of the object just like how we do it on devices like Microsoft HoloLens. User can pull information by ‘grab’ and ‘move away’ hand gestures. The gestures being used in the system are like pointing, grabbing, dragging, and dropping to interact with the virtual paper. For the hand gesture detection, an extension of hand posture classification is being used here. There are two fixed cameras, one above the table, and the second one near user’s head location.

As you place the virtual piece of paper, the content of the virtual piece of paper is printed in an Anoto pattern where the user can take real-world instance and he can use the grab-and-pull procedure. By doing this a consistent look and feel of a real paper can be achieved.

What’s an Anoto pattern? The Anoto pattern activates a respective optical pen to identify the piece of paper and it precisely locates the pen’s position on the paper during handwritings. This pen is equipped with wi-fi. A paper can be transferred into the virtual interface in a similar way.

## Demonstration

To demonstrate how a continuation between devices could look like, a touch table is connected to the system. To transport a virtual sheet from the AR-based interface to the touch table, the user just moves the sheet out of the demonstrator in the direction of the table while the content is still being grasped. At this point of time, the content is inserted into the touch table at the corner, closest to our demonstrator. The users can then access it from there else it’ll disappear after a short period of time, if the user did not remove it intentionally.

Basically, the entire process could be explained as - A sheet of paper is placed on the table, then the sheet is captured by the camera placed above the paper when it’s put up on to the table. Once the content is printed on it, then can be picked up from where it’s as a virtual instance within the AR-interface. At the end, this can be demonstrated as an object.

# Concept

CNUI is an extension of natural user interface. By keeping the continuation, it helps the user in keeping the complexity low.

During the paper based continuation (using it in the system designed) there are some additional advantages. 1) Even though there is lack of electronic infrastructure, the interface is present. And, 2) A paper is a hard copy where you can sign and submit.

Continuous natural user interface can be felt in the system for the following reasons

* Domain continuous – Content is transferrable in the real world
* Device continuous – Content can be transferred between connected devices
* Interaction continuous and consistent – The way of interaction remains constant when switching between different domains and devices
* Content centered (Non-Interface centered) – Object oriented user interface
* Ubiquitous – Interface can be extended to real world objects like paper and other
* Natural – Interaction is oriented on real world objects

# Results

Most of the users in this experiment completed the task using the gesture interface on the first or second attempt. They did not face any issues while operating the user interface.

After considering the overall test results that were carried out for a maximum of 3 minutes, we could conclude that the gesture-interface gave much better results when compared to GUI-interface for both trained and non-trained users. We could also observe that gesture-interface gave better results than mouse-interface for trained users.

Most of the users chose GUI as very intuitive and liked using this interface compared to any other user-interface where the results were poor. Very less people mentioned that they would prefer using the gesture-interface.

# Conclusion and Future Work

Here we have presented the natural user interface concept that follows continuous user experience approach of connecting devices with real world objects like paper. The major thing in our system is a 3D-gesture control interface for getting information from real world objects. A touch table and the paper is used here to demonstrate this model.

Future work includes things like testing and implementing this system in the industries. To get better results, a long-term study is required. More gestures can be added to the system and can also be tested on different real-time objects apart from the paper. The test we conducted with the help of Probands with the three different interfaces was only for 3 minutes. This process can be enhanced in future where the test will last longer.

# Acknowledgement

This paper was written as a part of Computer Graphics 2 course at the University of Massachusetts, Lowell, MA

# References

[1]

[2]

[3] A. Cordar, A. Robb, A. Wendling, S. Lampotang, C. White, and

B. Lok. Virtual role-models: Using virtual humans to train best

communication practices for healthcare teams. In Intelligent Virtual

Agents, pages 229–238. Springer, 2015.

[4] A. Robb, C. White, A. Cordar, A. Wendling, S. Lampotang, and

B. Lok. A Qualitative Evaluation of Behavior during Conflict with

an Authoritative Virtual Human. In Intelligent Virtual Agents, pages

397–409, 2014.

[5] A. Robb, A. Kleinsmith, A. Cordar, C. White, S. Lampotang,

A. Wendling, and B. Lok. Do variations in agency indirectly affect

behavior with others? an analysis of gaze behavior. IEEE transactions

on visualization and computer graphics, 22(4):1336–1345, 2016.

[6]

[7]

[8]

1. [↑](#footnote-ref-1)