Kinect Academy

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Abstract - *Microsoft Kinect is a low cost natural user interface (NUI) device compared to other NUI solutions. Inspired by the Kinect Effect while keeping in mind the lack of educational games for kids on Kinect and lack of physical activities on other platforms, we propose Kinect Academy—a research project that fills the gap by providing educational application for children which is filled with activities. This project uses Kinect's NUI capabilities to help children learn by letting them have fun while learning. This projects aims to be a tool for educators to teach children while keeping them physically active by being to interact with educational materials in a new and fun way. Kinect Academy tries to achieve our aim by using Kinect to make learning fun and linking it with an open and collaborative web platform for education.*

Keywords: Microsoft Kinect, Kinect Academy, Natural User Interface

1 Introduction

Most of skills that children are going to use for the rest of their lives are developed during their child's formative years. During this time when they are developing their language and comprehension skills, it is of the utmost importance that they have a solid foundation of literacy and numeracy upon which they can build their further knowledge. The research of Ainley and Fleming (2000) shows that learning to read in the early primary years helps develop children's literacy skills. Also, The William and Flora Hewlett Foundation, which works towards Quality Education in Developing Countries explains the importance of education in economic developing countries by mentioning that literate and educated citizen have better economic opportunities, better productivity and better health (Global Development and Population Program). However, many children cannot access to education at this age, especially children from the poor countries due to lack of infrastructure.

To support children from poor countries to have access to education, International Monetary Fund (IMF) has been providing monetary assistance to developing countries of the world towards achieving United Nation's Millennium Development Goals (Factsheet: The IMF and the Millennium Development Goals, 2011). According to IMF's report, in developing countries enrollment of children in primary school has generally improved and the percentage of students completing primary education has also improved compared to 1990's. However, surveys conducted by IMF have found that completion of primary school does not confirm students learning basic academic skills. The surveys have found that in many low-income countries that students receiving some schooling still cannot read, write or count. (Arye L. Hillman, 2004).

In this research project, we intend to prevent open ended problems by focusing mainly on children from four to eleven years of age, which is the age of primary grade in many countries. This is because there have been studies such as Brotherson (2005) and Live and Learn (2006) showing that this age group is a critical phase for children to develop. Also, it is in line with one of the United Nation's Millennium Development Goals which is to achieve the universal primary education for children around the world. We aim not only to provide open access to learning opportunities, but also to make engaging with these learning opportunities as enjoyable as possible, so as to encourage their use. This can be supported by studies showing that children learn more affectively, even with the complex concepts, while having fun.

2 Current Work

Although the concept of helping children develop skills and assist learning using computers is not new, there are still many limitations with the existing solutions. There exists plethora of computer programs like ClickN Read, ClickNSpell, Number Munchers, Math Blasters and Tux math. There also have been several applications in gaming platforms like Body and Brain Connection, Brain challenge, Buku Sudoku, Pictionary, Little Big Planet, Brain Training, My Word Coach in PlayStation, Nintendo Ds, Wii, Microsoft XBOX as well as Microsoft Kinect. However, there is common issue in all the above mentioned applications that the applications provided on the gaming platforms lack strong focus on the educational aspect, while computer applications are not very interactive and/or lack the physical interactions provided by the gaming platforms.

Still most of those applications and their implementation in an educational setting would require funding which is scarce in developing countries. It is not just the issue of cost, providing such facilities would need various infrastructures (like physical infrastructure for storage, electricity and internet connectivity).

3 Kinect Academy

3.1 Kinect Device

The Kinect device gets 3D scene information from its 3D depth sensors. This sensor consists of an infrared laser projector combined with a monochrome CMOS sensor, which captures video data in 3D under any ambient light conditions. The device also has a RGB camera and a multi-array microphone for speech recognition.

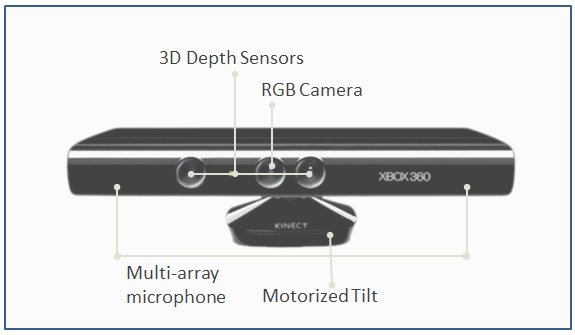

Figure 1. The Kinect device

3.2 Motivation

There has been a trend called the "Kinect Effect" where independent individuals and groups have made applications using the Kinect device using Microsoft Kinect SDK as well as open source SDK that use the Kinect device in novel contexts. Some examples of such applications in education are KineSis, Kinect Math and Kinect Paint from KinectEducation. It is noteworthy to mention Microsoft's effort to used Kinect to help teaching kids in Africa.

Following the spirit of the "Kinect Effect" while keeping in mind the lack of educational games for kids in Kinect and lack of physical activities on other platforms, we develop our project Kinect Academy to fill the gap by providing educational game for children which is filled with activities. This research project intends to use Kinect's NUI capabilities to help children learn by letting them have fun while learning. This projects aims to be a tool for educators to teach children while keeping them physically active by being to interact with educational materials in a new and fun way.

3.3 Human-Machine Interface of Kinect Academy

As the project concentrates on assisting children in learning and making learning fun for them, usability is one of the priorities. Indeed, the goals for this project, apart from the functional goals, include making the application:

- **Intuitive**: activities such as waving hands or using voices to communicate were learnt by individuals at very early age. By using Kinect which enables users to use Natural User Interface, we aim to provide users methods which they can easily intuit to interact with the application. Also, by logically laying out objects from left to right, top to bottom, use readable fonts and avoiding using technical words, we aim to make the application easy to learn to use for users. Therefore, even with children and individuals that have limited background of technology, they can easily learn to use the application without having to go through the process of trial-and-error.
- **User friendly**: the application was developed so that it provides ease of use for both children and educators by applying Neilson's 10 usability heuristics. This aims to reduce users' efforts in terms of navigation, recognition, error prevention and error recovery. Also, the color scheme was designed by applying the principal from Web Content Accessibility Guidelines 2.0 to create the distinction between objects and prevent users from feeling uncomfortable when working/using with the application for a long period.

3.4 Kinect Academy System

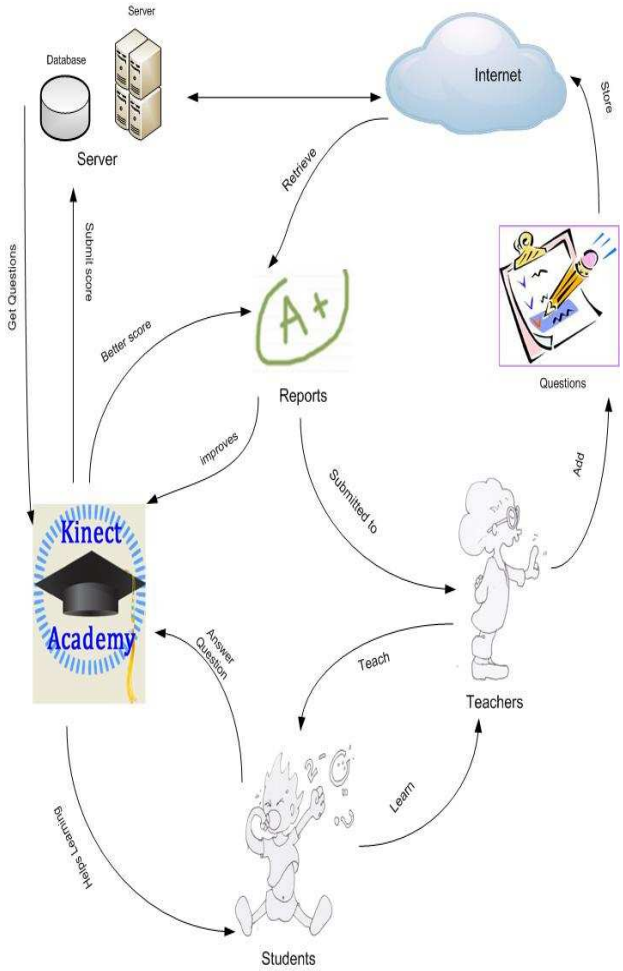

Figure 2. System architecture of Kinect Academy

Kinect Academy fully supports presence of fresh and updated data. It allows educators to collaborate, so they can modify the questions and answers to fit their purposes. This is done via the website and the changes will be visible at the application level immediately. Two-tier architecture was implemented.

Kinect Academy is focusing on two things. Firstly, using Kinect to make learning fun, and secondly, using the sharing of information to create an open, free and ever expanding platform for education. Kinect Academy allows users to provide answers to sets of quiz questions covering any topic imaginable, with the aim that using body movement and voice commands will be more engaging than traditional learning methods. Information sharing will be facilitated by the application accessing a remote data server to retrieve new question sets, organized according to category and complexity, and users will be able to add new question sets or update existing sets via a web site.

Figure 3. Kinect enables users to use Natural User Interface, waving hands or using voices to communicate.

Kinect Academy will make use of skeletal tracking as its primary form of input, tracking users' hands to interact with the application. Hands will be used to navigate the application by hovering over icons representing menu commands or answer possibilities. Skeletal tracking will also be used to implement gesture recognition for pre-conceived body gestures which will be used to activate certain functions within the application, for example to bring up the menu overlay interface or pass on a question. Wherever possible, voice recognition will augment skeleton tracking, with the menu accessible by voice commands and all icons having an associated voice command, providing multiple input options both in selecting answers and navigating the application. This dual control option gives the user flexibility, variety, and freedom.

In general use, the user will be presented with a full screen play area consisting of floating icons. On menu screens, these icons will be used to navigate between various screens in the application, sometimes accompanied by a title of brief instructional prompt. On play screens, icons will be text, polygon or image based and will represent possible answers corresponding to an on screen textual/visual question prompt. A partially transparent menu overlay will provide access to additional GUI icons on most screens. Basic use of Kinect Academy will consist of a user selecting a question set to attempt, completing the question set, and reviewing their performance.

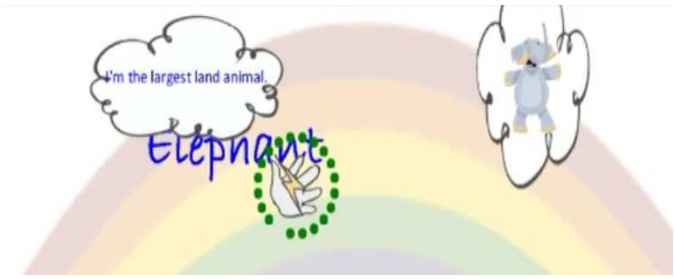

Figure 4. User friendly interface design: ease of use for both children and educators.

Kinect Academy will make use of the Gadget Accelerator Kit along with custom game engine along purpose built to provide some of the functionality required by Kinect Academy, namely per pixel collision detection, random 2D shape generation, and conversion of polygons and text to texture formats compatible with the collision detection implementation.

3.5 Benefit

Although learners, especially children from four to ten years of age, are the target group, educators can also benefit from this. Indeed, the educators will be able to quickly and easily provide for them a set of categorical questions tailored to the learning needs of their learners and presented so as to maximize fun. In an open framework for learning, these questions will then be available for free for the benefit of anyone who has access to the application, allowing children not in school the opportunity to engage their minds, learn new things and have fun while doing so. People with expert knowledge will benefit from a platform via which they can

share their knowledge, and older, post-school people will benefit from a place to learn new things or test themselves in an area of interest.

While a broad group of people will benefit, the impact will differ from demographic to demographic. While existing students will have their learning experience enriched, e.g. by creating a positive learning space or a less daunting testing environment, students with no previous access to education will be offered the chance to start learning without a teacher and get a taste for education, developing a thirst for knowledge and a positive attitude towards learning. Adults will get the benefit of optional self-education in areas of their own choosing.

3.6 Application

We believe that the solution can become realistic in the near future since it is relatively cheaper than most of the existing solutions. Indeed, all we need are a laptop, a Kinect and a couple of dependencies such as .Net framework 4.0 and XNA framework. The dependencies are free and provided by Microsoft. The cost will possibly be reduced remarkably as One Laptop Per Child (OLPC) Foundation is tackling the huge issue of providing computer access to every child in developing countries.

Although the project uses framework, it can be commercialized by leveraging the popularity Kinect devices to assist educators (parents and teachers) teach and children learn. The lack of educational software using natural user interface has been observed and there is a great potential for this application.

4 Conclusion

This research project manages to address the lack of educational software using natural user interface and making learning fun from anecdotal evidence from children who are the potential educators. However there are rooms for improvements in terms of user interface, usability and features. The project is technically open for future upgrades and collaboration and open participation. XML is implemented so that the application can communicate, retrieve and update data while the website was built to allow users to perform editing data to the server. This not only has enable users to add, edit and delete data using other device such as phones and tablets but has also made Kinect Academy platform independent which means it can be extended to other platforms in the future.

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