

# Gesture Recognition and Interactive Storytelling for Rehabilitation of Children with Impaired Dexterity

Kevin Harrison — Computing Science Undergraduate — School of Computing Science — Newcastle University — [k.a.harrison@ncl.ac.uk](mailto:k.a.harrison@ncl.ac.uk)

Supervisor: Gary Ushaw<sup>1</sup> Key Colleagues: William Blewitt<sup>1</sup>

<sup>1</sup>School of Computing Science, Newcastle University

## 1. Introduction

Rehabilitation of impaired upper limb dexterity is aided by repeated activity of the paretic limb. Medical practitioners have identified a framework of specific hand movements which are optimum for contributing to both assessment and intervention (Chien et al., 2009)<sup>1</sup>.

Colleagues<sup>2</sup> at Newcastle University have developed efficient software for utilising a two-dimensional camera to recognise hand gestures in three-dimensional space. Using this software on a standard Android tablet, recognition of hand movement can be achieved through the attachment of brightly coloured models to the fingers (Fig 1.), providing easily track-able elements of the image (Fig 2.).

Fig 1.



Fig 2.



The algorithms that have been developed will be used as part of an interactive storybook through which the child participating will perform hand gestures indicated on screen to progress through the storybook. Providing a fun way for the child to perform repeated specific hand skills identified by the medical professional to stimulate and assess rehabilitation of patients.

As part of this project a tool was needed to design and develop the content of the interactive storybook through which relevant gestures could be attached which would trigger events at certain stages of the story to move the story on. Through this program the interactive storybook would be output in a format which would work in conjunction with the Android tablet and the engine (developed by William Blewitt) used for the hand gesture recognition.

## 2. Approach

The definitive requirements for the storybook development tool were as follows:

- Ability to add blank pages to the storybook as and when required, which can be navigated by a directory.
- Allow the insertion and manipulation of Images and Text to a page of the Storybook.
- Components of the storybook such as images to react to the gestures performed by the user.
- Save and load functions to be provided
- Output format to be readable by the engine operating on the Android tablet.

As long as the requirements above were adhered to the development language and IDE (Integrated development environment) used were irrelevant. My experience lied with Java and the Eclipse IDE. It soon became apparent that this approach may not be the most suitable and I investigated other languages for programming a GUI (Graphical user interface) which would be able to fulfil the above requirements. After researching various languages and frameworks, and some trial and error, I settled on using the c# language, WPF framework and Visual Studio as the IDE.

## 3. Results

Figure 3 shows a screenshot of version 1.0 of the storybook development tool.

Fig 3.



The user friendly interface allows for an interactive storyboard to be created easily. Allowing new pages, backgrounds, images, and text to be added by clicking buttons situated at the bottom of the screen or by selecting menu items from the toolbar. Each page of the storybook can be navigated via the slide directory on the left hand side, when clicked on that page will appear in the main area of the GUI (Graphical user interface). When clicking with the right mouse button on images, text, and the background, additional operations are available such as assigning gestures to that component or making a choice of where the start and end position of an animation may be before playing that animation back. The save and load buttons allow for a project to be saved at any point and then resumed at a later point.

The save button also provides the output in XML (Extensible Markup Language) format which is a readable form by the engine used on the Android tablet to run the interactive storybook.

## 4. Conclusion

Version 1.0 of the storybook development tool meets all of the original requirements and the software has been tested and initial bugs identified have been resolved. The storybook development tool as of writing has not been fully integrated with the software it will be working alongside on the Android tablet, so it may be that in the future further development may be required to attend to any additional requirements that are identified at this next stage. The research scholarship has allowed me to produced a piece of software which meets all original requirements and at the current time works as a standalone program. This has greatly benefited me in terms of exposure to new programming languages and has allowed me to improve some essential skills required for future study and work. In the near future this software product will be used as part of a wider project to aid in the rehabilitation of children with impaired upper limb dexterity.

1. Chien, C. W., Brown, T., and McDonald, R. (2009). A framework of children's hand skills for assessment and intervention. *Child care health and development*, (35):873-884.

2. Ushaw, G. - School of Computing Science, Newcastle University, Ziogas, E. - School of Computing Science, Newcastle University, Eyre, J. - Department of Child Health, Royal Victoria Infirmary, Morgan, G - School of Computing Science, Newcastle University.