GESTURE RECOGNITION USING A LASER POINTER

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Abstract

This work proposes an alternative computer control method based upon a standard laser pointer and LCD projector, used to control applications and recognise specific contextual gestures at a significant stand-off distance. The use of a 1-d left-to-right hidden Markov model allows a range of predefined gestures to be identified, and interpreted according to the application being used. Additionally, the laser pointer can be used as a traditional mouse for controlling the computer remotely.

1 Introduction

A number of alternative input methods have been proposed for controlling a computer. An arts based project[1] used a high powered laser pointer to draw virtual graffiti onto the sides of skyscrapers, but this was restricted to a single drawing application. One group has proposed a method for detecting and tracking a laser spot projected onto a screen [2], whilst others have used the laser pointer to control a mouse [3]. This work aims to build upon these ideas to create a system that is capable of recognising specific gestures that can then be used to control an application.

2 Implementation

A colour CCD camera, with a resolution of 1280x1024 pixels, is used to record the location of the laser spot, whilst a LCD projector is used to display the actions and location information onto a screen. The laser spot is detected using a combination of brightness thresholding and colour analysis in HSV space. Once a spot has been detected its trace is recorded spatially until the laser pointer is switched off. The trace is then interpolated to produce a set of equidistant points. Using standard labels, the direction from one spot to the next is defined as a chain code (Figure 1). The chain code is then passed to a Hidden Markov Model (HMM), which uses the Viterbi segmentation algorithm to compute a score by comparing the input with each possible pre-trained gesture (figure 2). The output from the HMM can be used to trigger specific actions, such as a keyboard event to turn to the next slide in a presentation. The HMM is initially trained using examples of traces for each gesture.

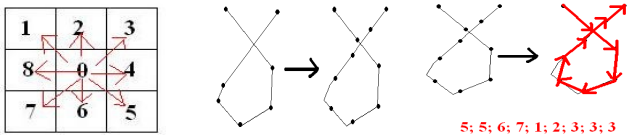


Figure 1: Definition of direction code, interpolation of laser pointer track and final gesture chain code

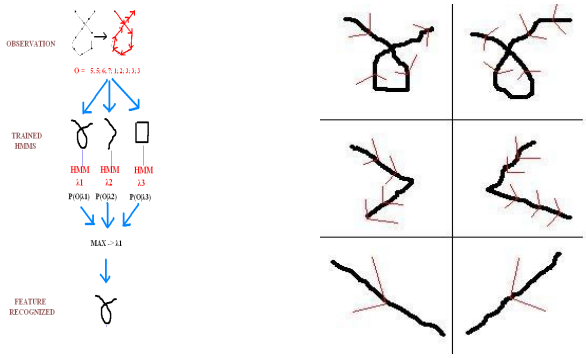
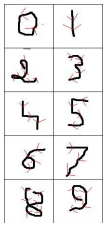


Figure 2: Recognition scheme and pool of potential gestures

3 Results

Results from the gesture testing were very good, showing near perfect classification even with poorly formed symbols. We also present some results from interpreting individual numbers drawn on the screen with the laser pointer. We were able to positively recognise 97% of the numbers during testing, with only a few issues due the similarity between some of them.



Results for each number symbol	
0 – 100%	1 - 100%
2 – 100%	3 - 90%
4 – 100%	5 – 95%
6 – 100%	7 - 100%
8 – 85%	9 - 100%

Figure 3. Using the HMM to recognise number symbols

4 Conclusions & Further Work

We have shown a range of successfully recognised gestures, both of abstract shapes and symbols. The recognition process is sufficiently robust to produce very good classification results, being both scale and position invariant. However, the ability to track the laser spot is highly dependent upon the illumination intensity of the projector, and further work is needed to improve the robustness of the spot detection stage.

References

[1] T. Watson, "GRL Laser Tag", 2007, web last visited: 17/9/2008, url: http://muonics.net/blog/index.php?postid=15

[2] J.F. Lapointe, G. Godin, "On-screen Laser Spot Detection For Large Display Interaction", IEEE Int. Workshop on Haptic Audio Visual Environments and their Applications, pp. 72-76, (2005).

[3] C. Kirstein, H. Muller, "Interaction with a Projection Screen Using a Camera-tracked Laser Pointer", Multimedia Modeling, 1998. MMM '98. Proceedings. pp. 191-192, (1998)