

PROJECT PROPOSAL

Design and Organisation of Autonomous Systems  
*Mobile Landmark Recognition*

Nikolaj Groeneweg      Arvid Halma  
Bernardo Quiroga      Bastiaan de Groot

{njgroene, ahalma, bquiroga, bgroot}@science.uva.nl

January 7, 2006

## 1 Introduction

In today's society mobile technology plays an important role. With the widespread use of next generation mobile phones a large percentage of the population carries a potent processing unit, which nowadays is accompanied by a high resolution camera. This setting has given rise to a number of interesting applications, but so far AI techniques have played a limited role in this setting. In this proposal we outline an innovative AI application for mobile phones incorporating techniques from the field of computer vision and pattern recognition applied to embedded systems with limited processing capacity.

The ideas we outline in this proposal are centered around the concept of landmark recognition. A user should be able to walk in an unknown environment, make a picture of a landmark/point of interest, after which our application returns on topic information. In a more particular situation a tourist walks across a large square in Amsterdam and sees an interesting church. He makes a picture of it and his mobile phone tells it's the Nieuwe Kerk situated at the Dam square, it's opened from 10:00 to 18:00, and he could visit a concert that evening.

For this project we would like to propose implementing a proof of concept of a system providing the functionality described above. This will require solving quite a few interesting problems, mainly feature extraction, image processing, pattern recognition, machine learning in an embedded environment.

## 2 Approach

We will describe our approach and some of the technical aspects of the proposed system.

At first we will have to investigate what methods to use in deciding what landmark is represented in the picture. Several feature selection and dimension reduction techniques will be considered before delivering the high dimensional image to a learner. One could for instance consider using distance metrics between images over different transformed versions of the original image (e.g. ‘edge images’). Subsequently we will have to investigate what machine learning method is optimal for this domain. We should for example find out if Support Vector Machines and AdaBoost can help us, which have become increasingly popular for this kind of complex problems.

After this, great effort will be spent on implementing the selected image processing and machine learning facilities on a low level and low resource machine. A popular development platform for mobile phones is Java 2 for Mobile Environments (J2ME). We will focus on this platform. Although the programming language can be considered high level, we have to deal with a very limited API.

Once we know what object is represented, we will show the corresponding relevant information stored in a local datastructure.

Because of the limited machine we run our application on, we can’t expect it to do the full machine learning job. That’s why we separate the training part from the decision making part. The first part is done off-line, i.e. on a pc, which results in a trained learner and is then shipped to a mobile phone. We think the representation of the trained learner and the possible outcomes can be compact enough to be stored on today’s mobile phones.

### 3 Relevance

We believe this project is perfectly suited to work on during the Design and Organisation of Autonomous Systems course. Many fields of AI have to be merged to make this application a success. The kind of problems to be solved are equal to the problem often faced by autonomous systems (i.e. robots could also be expected to recognise landmarks) and the limitations in computational resources when implementing the suggested system on a mobile phone poses problems similar to those encountered when programming for autonomous systems.

Finally, it seems that the suggested idea could yield a promising new application, exploiting AI techniques in a setting in which such techniques are not yet commonplace.