

# Automatic Taiwanese Municipal Color Map Reading System

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## Abstract

This paper introduces a map reading system to make fully automatic interpretation of the municipal maps of Taiwan. Here we use a mixed processing algorithm (bottom-up and top-down approaches) to interpret the maps. The bottom-up approach includes the color segregation, symbol recognition, road extraction, and related characters string extraction. The top-down approach guided by a priori knowledge resolves the inconsistency between the extracted objects. In the experiments, we illustrate that our system can interpret the municipal map effectively.

## 1. Introduction

Recently, automatic map reading has become an important topic in document analysis researches. The subject on map recognition can be mainly divided into several research domains: symbol recognition, road extraction, and character strings identification. Map symbols are difficult to extract. They consist of alphanumeric and various graphic signs. Symbols are positioned arbitrarily and placed with various orientations or sizes on a map. Structure analysis and pattern matching are two basic methods for symbol recognition. The first approach [1] extracts the features of a symbol within the candidates and compares with the features of the symbols to be found. The second approach [2] may be influenced by symbol sizes, orientations and touching noises.

Road extraction is another important task in map reading. Morphological operations are widely used to find the roads. Roads consist of linear features in a map. To extract roads, some researches focus on finding linear objects [3,4] but not on the semantic meaning of a single road. It is especially important for the recognition process of city map rather than the topographical maps. Interactive method can also be used to extract roads and it will improve the accuracy of results. Character string's non-fixed-sized appearance and various directions in the map

have created some difficulties for map- readers. Template matching [5] and features points [6] are used to recognize characters.

Many researchers have proposed systems to solve automatic map reading problems [7,8,9]. Their researches focus on their specific domain and proposed many ad hoc ways to solve the map reading problems. We develop a universal system for city map reading. These city maps mainly include information of streets, buildings, and some bureau of government and they are all color-printed. Different colors represent different object categories. Different graphic appearance of symbol means different semantic meaning. Symbol sizes are within a limited scale and printed in the direction of longitude lines. Characters describing an object on the map are arranged in a fixed order.

## 2. System Architecture

There are many literatures that offer many different approaches to the document processing and interpretation. They can be summarized as two different approaches: data-driven (or bottom-up) and mixed (both bottom-up and top-down) approaches. In the first approach, we start with the low-level analysis of the gray-level or colored images, in which the features are extracted. Generally, these features are grouped together as line segments, symbols, and characters. Associations between these features are detected, and high level graphic entities are constructed, guided by *a priori* knowledge. The main difficulty in our approach is how to obtain significant graphical entities from low-level operators and reliable connections rules among these features in order to have a correct interpretation. In this paper, we are interested in the second approach

We use four-level representations to interpret the color municipal maps (Figure 1): (1) pixel level, (2) vector level, (3) blocks, roads, symbols, character string level, (4) semantic levels. There are two-way inter-relationships

