Chapter 29
Automated Analysis of Nursery School Observations

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ABSTRACT

This chapter introduces an ongoing project with the goal of measuring and analyzing children's behavior automatically. Some key technologies, including methodologies for acquiring data, tracking a target across different cameras over time, identifying individuals, activity recognition, interaction analysis, and behavior summarization for a target child are presented. Some encouraging results from a real system developed in a nursery school environment are also described. As these technologies enable the content-based retrieval, comparison, and summarization of large-scale observational data, they are applicable to various purposes, such as healthcare, diagnosis, and the assessment of children's development.

INTRODUCTION

The measurement and analysis of children's behavior, especially of those behaviors related to social and communication skills, are important for assessing children's development. For example, as remarked by some specialists, children with Autism Spectrum Disorder (ASD) exhibit significant deficits in social interaction and communication (Charman, 2002). The early recognition of risk for ASD may enable the at-risk children to benefit from therapy, which might effectively help to reduce the tremendous morbidity associated with this disorder.

To assess children's development in an objective way, it would be extremely helpful if the behavioral data of children could be measured in a natural environment across populations (e.g., a playground or a classroom in schools). In addition, it is also important to obtain long-term observational data of children's behavior as trend information over time is critical for the accurate assessment of children's developmental progress. Using conventional methods, it is not feasible to accumulate such a large quantity of data (for months or years) and to further extract valuable information from it. Fortunately, in recent years, there have been great advances in the areas of computational sensing, modeling, and computer vision

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that have resulted in the capability to efficiently support the capture, measurement, analysis and understanding of human behavior with a minimal requirement of human efforts (Aggarwal, 2011).

From this viewpoint, we are conducting a project called MIMAMORI[1], which aims to study children's behavior by developing a system to automatically record and analyze the daily life of children in a nursery school environment. In this chapter, we present some key techniques that we have developed, including methodologies for acquiring data, tracking a target across cameras over time, identifying individuals, recognizing activity, analyzing interactions, and summarizing behavior for a specific target child during a certain period of time (Ishikawa, 2011; Kato, 2011).

CORE TECHNOLOGICAL PROBLEMS

In the MIMAMORI project, we record children's daily lives by the use of video, audio and temporal-spatial tags of moving targets. However, to protect privacy, we have not yet utilized the audio portion. As described above, our goal is to obtain an automated measurement and analysis of children's behavior to enable the content-based retrieval, comparison, and summarization of large-scale observational data. To achieve this goal, we face the following technological problems:

- Tracking a target child across multiple cameras over time.
- Identifying individual children across populations.
- Recognizing a target child's activities.
- Analyzing a target child's interactions with people.

These technologies are applicable to various purposes, such as parenting support, healthcare, and diagnosis, and are useful not only for the assessment of children but also for the elderly and other populations.

System Setting

In this work, the observational data of children's behavior are acquired in a noninvasive manner. We set up a data-sensing system in the nursery school within Nagoya University campus, which consists of seven cameras, each integrated with a RFID (Radio Frequency Identification) receiver. All of the seven camera-receiver pairs are installed in places where the children regularly appear: one in the entrance, four in the nursing rooms, one in the resting room and one in the passageway, as shown in Figure 1. Data recording from these seven locations occurs ten hours a day throughout the year.

Each camera is placed adjacent to an RFID receiver, which catches the signals sent by

Figure 1. Hardware configuration for data sensing