Bio-Inspired Functional Asymmetry Camera System

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Abstract. Robust tracking is the key subject to real target-tracking-cameras. In this article, we present a filtering method that can achieve the robust tracking under noisy environment. We have also developed an asymmetry camera system. The system consists of double lens modules to mimic the eye's function of watching and tracking the target with seeing the whole image concurrently. In this article, we also explain the design of the newly developed camera system and demonstrate its performance in the task of tracking a target fish among multiple fish in an aquarium.

Keywords: object tracking, moving object detection, background subtraction, electromagnetic servomechanism.

1 Introduction

Evil crimes (terrorism, abduction, public nuisance), troubles (traffic accident, explosion at a factory), and environmental affairs (hazardous substance pollution) have risen distinctly in recent years. It has become a huge issue in the world, and many researchers and organizations carry out research and development for a secure and safe society(S. C. Wong (2005); I. Matthews (2004); L. J. Latecki (2006); F. Porikli (2006); M. J. Black (1995); R. Oi (2003); S. Khan (2001)). Towards the realization of surveillant infrastructure for a secure and safe society, we focus on a surveillance camera system.

The requirements of surveillance camera systems can be classified into four main groups: range of surveillance, sufficient resolution to realize objects, crippling suspicious behavior, and keep a watch on the actions. The first two groups are relevant to human visual field because human can catch a scent of danger with one's own

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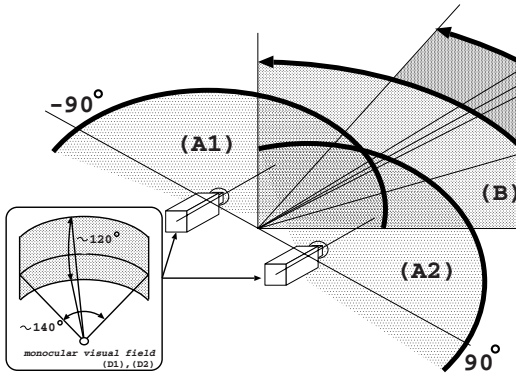

(A)	peripheral visual field	$: -94^o < \ < 94^o$
(A1)	monocular visual field	$: -94^o < \ < 62^o$
(A2)	monocular visual field	$: -62^o < \ < 94^o$
(B)	binocular visual field	$: -62^o < \ < 62^o$
(C)	symbol recognition limit	$: -30^o < \ < 30^o$
(D)	central visual field	$: -1^o < \ < 1^o$

Fig. 1. The area of a scene that can be seen at the same time

eyes on surrounding circumstances, and therefore the first point of that we should discuss is the development of a bio-inspired system that mimics the functions of a human eye. The next group is a computational technique of how the system detects specific objects. It is interesting to follow up bio-inspired smart detection algorithms further, but the point is different from our current focus that is the development of a primitive camera system. Therefore, assume that the input images are incoming signals, a simple filtering approach is used to detect and clip specified objects. The other is a driving ability of the tracking camera. Most of the off-the shelf tracking camera system adopts motors and gears for the driving system. In addition, Yorick(P. M. Sharkey (1993)), TRICLOPS(A. J. Wavering (1995)), ESCHeR(Y. Kuniyoshi (1995)), the KTH head(K. Pahlavan (1996)) are designed to control the camera direction by motors. It is easy to implement and control but the traction makes the initial velocity of the reaction reduce. Consequently, we developed a novel tracking camera with electrical-magnetic driving module.

This article is organized as follows. Section 2 discussed the issues regarding human visual field and the functions. Section 3 describes our proposed algorithm for target detection and clipping the image. Section 4 described our system and discusses the experiment, and finally Section 5 concludes this article.

2 Bio-Inspired Asymmetry Camera System

In the beginning, we will examine about the function of human visual field for realizing a surveillance camera system. The visual field shows the area of a scene that can be seen at the same time(K. Yokomizo (1987)).

In Figure 1, (A) is called *peripheral visual field* which is the combination of *monocular visual fields* (A1) and (A2). In general, each *monocular visual field* is a quadrangular pyramid whose horizontal and vertical angles are about 120 and 140 degrees, respectively. (B) is *binocular visual field*. It is only an overlapping field of (A) and (B); we can only capture the scene and not recognize the details. We can distinguish the image