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High Speed 3D and Colour Interface to the Real World

softeco sismat — information technology

HISCORE

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OBJECTIVES

HISCORE develop a 3D and colour camera for the acquisition of real-time images of a scene including depth information and applies the new device to two advanced and challenging human computer interaction applications: human face recognition and gesture recognition.

The new colour coding technique adopted allows to use off-the-shelf CCTV cameras and projector.

A hardware subsystem for real time processing will be developed to produce and elaborate sustained sequences of 3D and colour images at 12 fps.

Despite the extreme increases in computing power in the last few years the man – machine interface technology is in principle the same as 2 decades ago: the main interface tools are now as ever the keyboard, the mouse and the screen.

Sometimes additional information from the visible world that we inhabit is fed to the computer by means of CCTV cameras, thus reducing the inherent 3-dimensional information to a two-dimensional image of it (in black & white or colour). However, for many applications the third dimension carries valuable or indispensable information, many other applications require not only 3D but also colour in "real time", i.e. at high acquisition speed.

The main objective of the project is therefore to provide a new low-cost, high speed 3D- and colour image acquisition system ("3D & Colour Camera") that may be used as computer input device.

Among the numerous conceivable fields of application for this system, two exemplary implementations with especially challenging problems that have considerable practical relevance are carried out within the project: face recognition and gesture recognition.

FACE RECOGNITION AND VERIFICATION FOR SECURITY

Nowadays systems for the identification and authentication of persons become increasingly important, for example to control access to safety relevant areas, bank safes etc. ID-cards, PIN and passwords are often not secure enough or too complicated and inconvenient to use. A really secure system must check whether the authorised person is physically present. This is possible by implementing biometrics methods that analyse personal features. A very promising approach is face recognition. This method is accepted as a natural choice by humans and can be accomplished without physical contact. Most face recognition systems - on the market or under development - are based on the evaluation of 2D- black and white or colour images. Since the extraction of reliable features from 2D- images is difficult and suffers from a variety of possible interpretation errors, the recognition accuracy of such systems is usually limited to a rate of 95 % on a small set of individuals.

The use of 3D and colour data provided by the HISCORE camera might significantly improve the reliability. Biometrics features extracted from 3D-measurements are much more reliable, due to their independence against illumination influences, head position variations, different facial expression etc. and moreover against falsification.

GESTURE RECOGNITION FOR SIGN LANGUAGE INTERPRETATION

Normal voice communication is not always feasible. A part of our population is not able to communicate this way: the deaf mutes. Sign language allows them to communicate directly, but only with people of their kind and few other trained people. A system for the automatic interpretation of sign language would help to reduce this obvious isolation. It would capture gestures of the "speaker" and a computer would interpret and translate the signs in real-time. The result could be a text displayed on a screen or a voice output.

Although there is some research world wide on the video-based interpretation of gestures, the problem is far from being solved. The HISCORE 3D-sensor is much better suited to solve these problems compared to the 2D- sensor approaches used so far. So the proposed fast 3D & Colour Camera constitutes the optimal basis for a "gesture telephone" or, more generally, a "gesture translator".

DYNAMIC GESTURE FOR HUMAN COMPUTER INTERACTION

The need for more natural and powerful input modalities in HCI is increasing in new applications requiring the interaction with a virtual 3D environment, including robot teaching, 3D graphical interface interaction, pilot's support, document handling, virtual reality. A robust gesture recognition system serving as input device would be of interest. In contrast to the interpretation of the sign language, only a limited set of distinct gestures is usually used here together with hand tracking. The work on 3D-gesture recognition system for sign language will also lead to a very robust and versatile gesture interface for computers enabling more natural system interactivity.

The HISCORE sensor delivers the prototype of a real-time application for controlling a 3D graphical interface by tracking and interpretation of the user's gestures. Colour information simplifies image segmentation especially when integrated with 3D information. It also allows communicating specific commands to the computer by using coloured targets to recognise or to track. 3D information allows reconstruct a not ambiguous model of the hand (in 2D vision hand signs have to be recognised from 2D projections that are intrinsically ambiguous).