DEVELOPMENT OF A COMMUNICATION TOOL USING PATTERNS OF BLINKING

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ABSTRACT

The most important problem for patients suffered from paralysis or tracheotomy is the lack of communication with others. As they cannot communicate with others, we tend to miss an important sign from patients. Possibly they feel isolate and mental stress. The aim of this study is to develop a communication tool by using blinking patterns without any adhesive sensor. In this study we have developed system to detect patients' blinking using visual sensing system, of which principle is real-time subtraction of images upon motion picture from CCD camera.

INTRODUCTION

One of the most important problems for patients suffered from paralysis or tracheotomy is the lack of communication ability. As they cannot communicate with others, doctor, nurses or their families miss important information from patients, not only pain but also fatal sign. Therefore, this situation forces attendant families and nurses to watch the patients restlessly. On the other hand, for the families and nurses, the fact that they cannot know what the patient wants to do imposes them heavy burden. Therefore, we thought this develop a communication tool by using blinking, patterns to assist the communication of them.

In general the blinking detection is used as an estimation guideline of subject's awaking level in the field of psychology or ergonomics. However in almost all case, some sensors are attached on the subject and long term monitor is difficult. So we emphasize a non-touch detection technology is necessary for reducing the burden of patients and medical attendants.

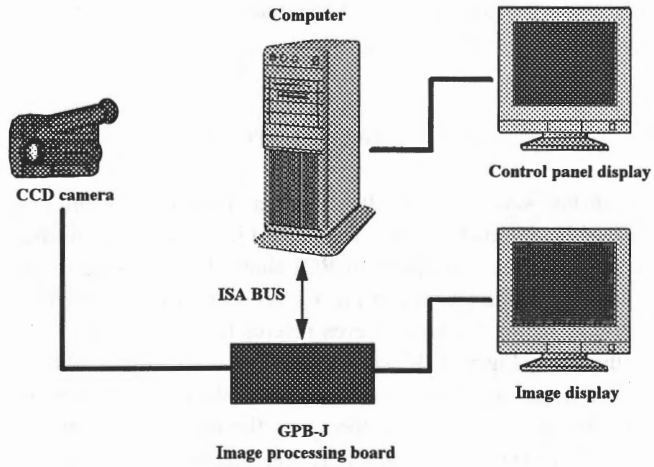

Fig.1 System Configuration

METHODS

Fig.1 shows the system configuration of our new communication tool using blinking patterns. The system consists of the image processing add-on board (GPB-J, SHARP semiconductor. Co. Ltd.), and the personal computer with WINDOWS 95. The GPB-J image processing board is plugged in ISA-bus on PC. Two displays are used; One is used as a control panel, the other is for displaying the image taken by a CCD camera. We choose a commercially CCD camera (Digital Handycam, SONY. Co Ltd.) because of reducing the cost. This system is originated from the visual sensing system by Ishihara et al [1].

At first, the subject's face is taken by CCD camera that it can be checked on the display. ROI (Region of interest) is fixed on

the subjects' eyes manually (Fig 2). By fixating the ROI, the image processing can be quicken because processing area

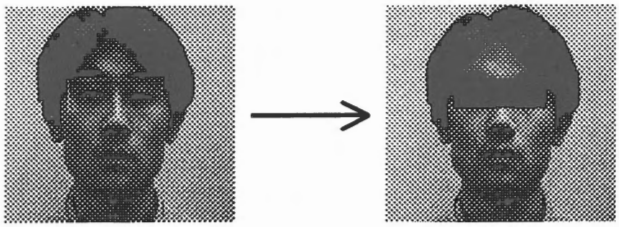

Fig.2 Fixation of ROI

become smaller. In this ROI, the blinking patterns are extracted continuously as a time series signal. As follows, (Fig. 3)

Step 1; Fixation of ROI manually.
Step 2; Sequential subtraction between new image and image in buffer.
Step 3; Binarization of subtraction image and display.
Step 4; Surface integration at the binarized image with Luminance, an extraction of velocity value.
Step 5; Rearrangement of velocity in time series.
Step 6; Display of the patterns of blinking.

In step 5, elements array in some pairs of parameters that can deal with the data as normal time series signal. And we intend to apply this method for the communication of patients with others.

EXPERIMENT

In this system, we verified whether the pattern of blinking could be detected or not. Fig.4 and Fig.5 show experimental results. The white parts in ROI show the processing result when the subject blinks in Fig.4. As seen in Fig.4, when the subject blinks, the area of eyes reveres to white blocks. The other side, Fig.5 is the case when the subject wears glasses. Even if the subject wears glasses, the blinking can be detected. In this case, however, another parts the movement of glasses were detected. These parts were seen upside in ROI. Fig.6 and Fig.7 show the detection patterns of blinking. In these figures, the horizontal line indicates the time and the vertical line indicates the velocity. In these cases, a subject blinked at about 1 second interval. Each up and down bars indicate one blinking. That is, an up bar is the opening eyes stroke and a down bar is the closing eyes stroke. In Fig.6, the blinking is detected as a clear rapid changes elements. On the other hand, Fig.7 is the case that the subject wears the glasses. In this case, the blinking is also detected as a clear rapid changes elements. The extra elements, however, are detected as short bars. Those elements correspond to the movement of glasses and nose. So, if a subject wears glasses, the wave patterns contain not only blinking, but also extra elements that are not hoped.

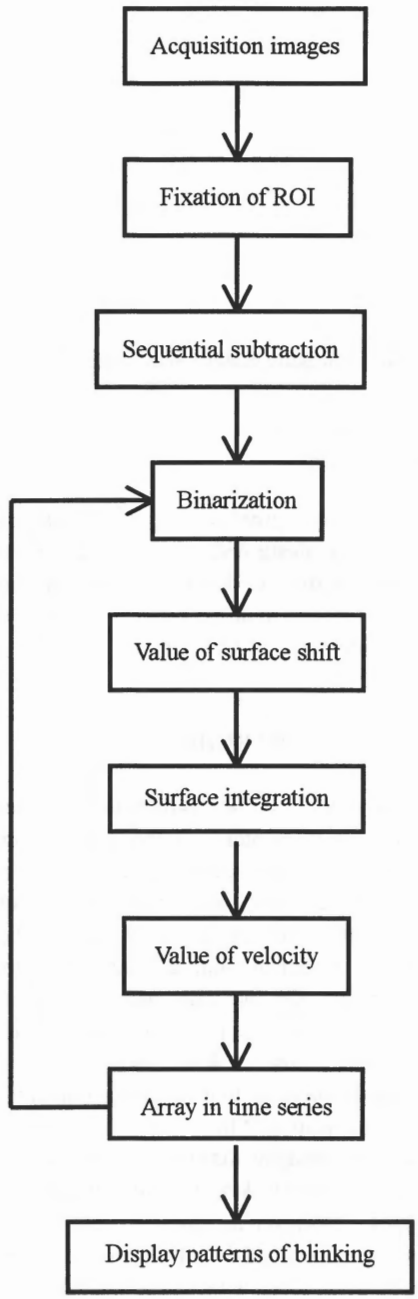

Fig.3 flowchart
A process of image processing

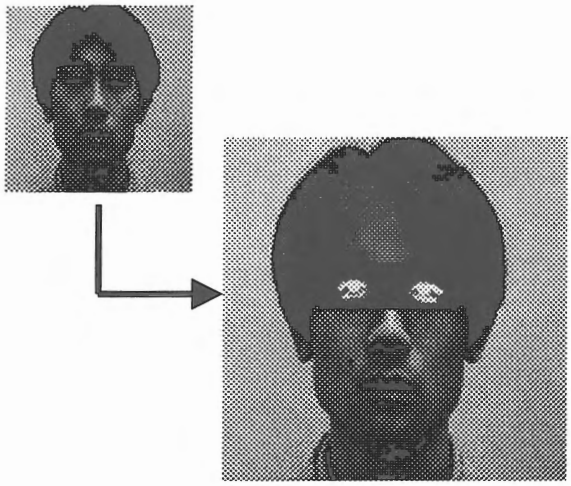

Fig.4 The experimental result of blinking detection
The case of necked

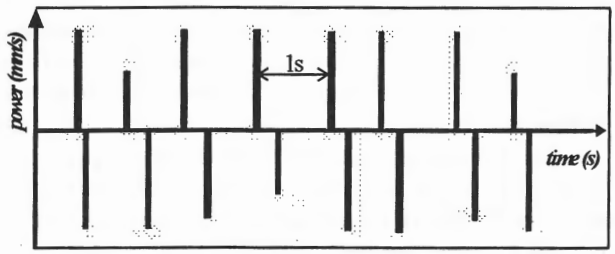

Fig.6 The pattern of blinking. A pair of up and down bar is one blinking. Element of blinking are detected as clear rapid changes.

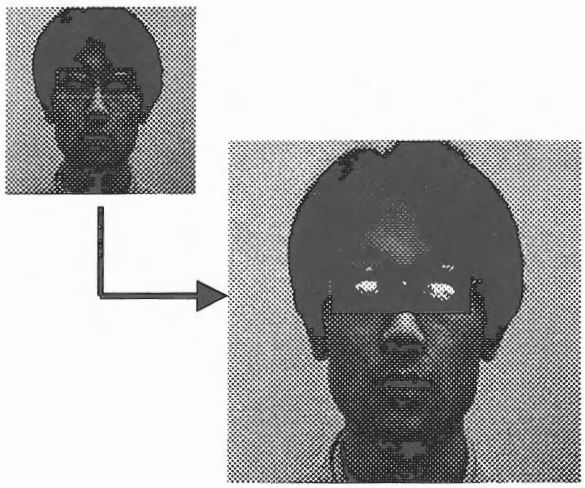

Fig.5 The experimental result of blinking detection
The case of wearing glasses

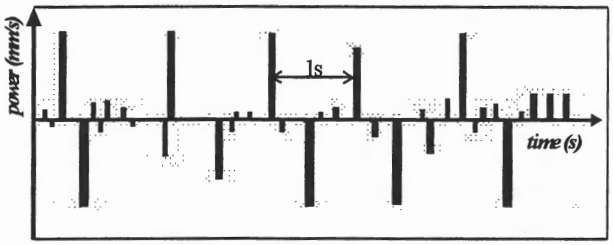

Fig.7 The case of wearing glasses. In this case, the wave pattern contains not only blinking, but also extra elements.

DISCUSSION

In this experiment, we succeeded in the detection of blinking from images that are taken by a CCD camera. When the subject doesn't wear glasses, only the blinking is detected in ROI. However, the subject needs as still as possible when the face is taken by camera for now. If the subject moves his face, the change element of face is detected helplessly. So, in regard to image processing, the auto fixed algorithms of ROI is necessary. If a subject wears glasses, small noises are detected. However in this case, the value of change is smaller than that of blinking itself. Therefore, if an appropriate threshold is decided, the noises are removed easily. This fact shows that the system is available whether one wears glasses. We could clarify that the detection of blinking patterns is possible.

SUMMARY

In this experimentation, the visual sensing system is useful for patients of paralysis or tracheotomy who are suffered from lack of communication with others. And the detection of blinking was done by only the image processing. So the aim that was non-touch and avoids any adhesive sensor was able to be achieved.

For the development of communication tool using patterns of blinking, this system is proved to be useful. And the feature of this system, that is non-touch and non-restricted, makes it possible to remove an unpleasantness of patients and medical accident, for example, electric shock from sensors. So we think that this can be used successively.

We are going to develop the communication interface to with others from now on.

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