taskEYE

"A Novel Approach to Help People Interact with Their Surrounding Through Their Eyes"

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Abstract **– In this paper, we've proposed a Human Computer Interaction System based on eye tracking which we called it as "taskEYE". The "taskEYE" is an Eye Ball Tracking System which is intended to assist patients that cannot perform any voluntary tasks related to daily life. Patients with spinal injuries or other with severe disabilities, who only can control their eyes can still communicate with the world using the assistive devices like one proposed. This device provides a human computer interface in order to take decisions based on their eye movement.**

Index Terms **— Eye ball tracking, image processing, MATLAB, Human Machine Interaction, Amyotrophic Lateral Sclerosis (ALS)**

I. INTRODUCTION

Communication between humans is the greatest tool that they used to maintain their sustenance in this world. Excluding other several languages, eyes of humans still plays an important role in communication.

In certain cases, human suffers from a disease or deadly injuries which makes them incapable of moving any part of their body except their eyes. In such cases eye movement is very crucial in order for the patient to communicate with the real-world and its surroundings.

Amyotrophic Lateral Sclerosis (ALS) is a fatal neuro-muscular degenerative disorder that causes weakness, paralysis, and eventually respiratory failure due to the selective degeneration of neurons responsible for voluntary movement [1]. ALS patients cannot perform even simple voluntary tasks which required actions related to limbs. In order to assist those patients, the device like eye ball tracking system is being developed [2] which could be used as a medium of communication for such patients. For example, a device that converts eye movement into speech or eye-controlled wheel chair [3]. For such kind of patients, a low-cost eye tracking system is proposed in this research work.

II. LITERATURE SURVEY

Ziad O. Abu-Faraj [2] proposed a Man Machine Interface system in which a completely locked-in patient can select varieties of options through his eyes & then the system performs the corresponding operation [2].

Margrit Betke proposed [5] a "Camera Mouse" system which provides computer access for people with severe disabilities. The system tracks body features such as the tip of the user's nose/fingers/eye movements with a video camera and translates them into the movements of the mouse pointer on the screen [5].

In the paper, Osama Mazhar [4] proposed an eye tracking system which provides human machine interaction, the aim of this system was to create a tool that can be easily interfaced with systems like electric wheelchair, moveable patient bed, eye-controlled alerting mechanisms for disabled ones etc. [4]

III. PROBLEM STATEMENT

There aren't many products for the patients with ALS, or similar diseases, which helps them to interact. Also, these products are way costly for normal people to afford. '**taskEYE**' is an application which is rather cheap & simple.

IV. PROJECT OBJECTIVE

- Extracting pupil using self-made IR Sensitive Camera.
- Detecting / tracking pupil movements by using image processing in MATLAB.
- Interfacing the movement of mouse cursor with the movement of pupil
- Controlling the cursor, user can move it over an interface in order to perform various tasks.

V. SYSTEM OVERVIEW

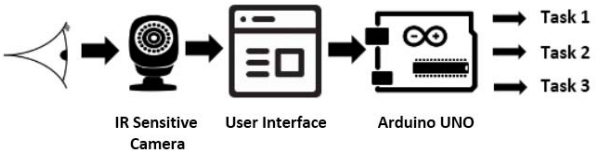

Fig 1. System

An IR camera fixed in front of one eye, will continuously track pupil. There will be a user interface projected in front of patient in which some basic templates like I'm not OK, I'm OK, yes, no etc. And some basic IOT operations like shutting on & off lights etc. will be there. As shown in Fig. B.

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User Interface –

Fig 2. User Interface

By image processing in MATLAB, the movement of the pupil is being linked with the system's cursor. The patient, all have to do is just move the eye to a required operation on the interface & the cursor will move accordingly. Then he/she have to click the operation by blinking eye. Thus, the operation will get selected, now if it is an IOT operation then the system executes it with the help of microcontroller & if a template is selected then the message is conveyed through the audio output.

A. System

Extraction of Pupil

↓

Pupil Tracking

↓

Interfacing Mouse with pupil movement

↓

Moving Mouse on Interface

↓

The appropriate task is being selected by the user

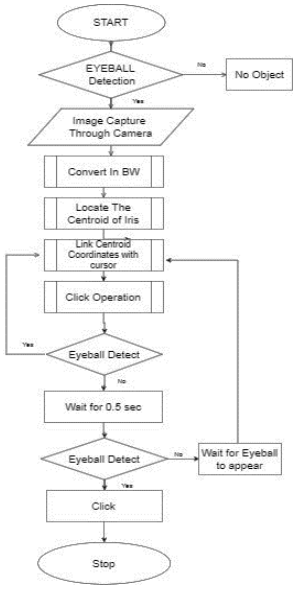
↓

The system then will send O/P for the respective task

(TASK EXECUTED)

B. Process

The system's prime aim is to interact patients with their surroundings, Firstly, eye movements are captured by the IR camera, which clearly separates the pupil. The algorithm converts the image in black & white keeping the pupil as white. These coordinates are passed as inputs to an equation which will give the coordinates of system's cursor. Now the patient has access to the cursor. The system provides an interface with various operations, where user have to select anyone it by moving cursor through eye movements, in order to select the operation, user have to blink his eye, the system then will recognize that there's no object detected, this will trigger a clock. If the clock ticks beyond the threshold, the system will perform that operation. The microcontroller is used to communicate with the outside world. And thus, overall system provides an interactive media to the patients with their surroundings.



VI. COMPONENT DESCRIPTION

Fig 3. IR Sensitive Camera

The Camera used here is 8MP Intex IT-306 WC, which has frame Rate Up to 30 fps. For IR output, the camera is being interfaced with 5 IR LED's as shown in Fig. 3, which has given power supply 0f DC 5-9V externally.

Image taken by normal camera & IR camera -

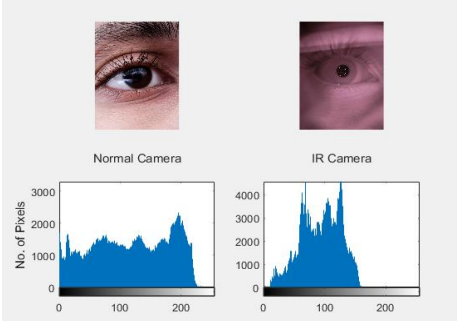


Fig 4. Output Image of IR camera

Fig. 4 shows grey scale versus Pixels graph. The histograms are obtained by converting the RGB images to Gray tone images.

Studies shows that, the images captured by the normal camera has more number of low intensity pixels compared to those captured with the IR camera i.e. the number of dark colored objects are less in IR images, by using these pixels the pupil can be detected and tracked.

VII. Test Results

A. Result. 1

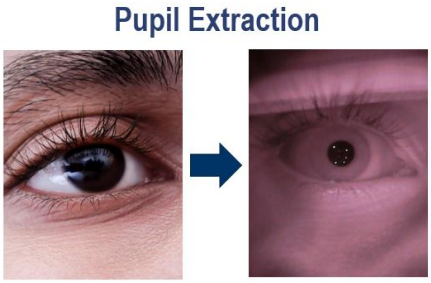


Fig 05. Result. 01

Fig. A shows the image captured by the normal camera & Fig. B by IR camera. So, we've successfully extracted the pupil from eyeball. This was done because the pupil is comparatively smaller due to which the region of movement is large i.e. it can move in all possible directions.

B. Result. II –

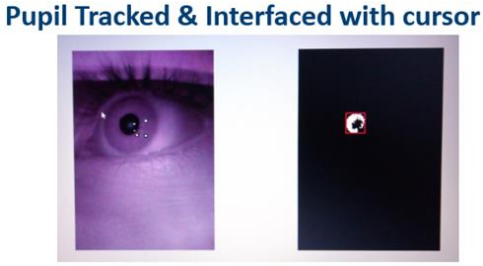


Fig 06. Result. 02

The Fig. 6 shows that the pupil is successfully detected & is linked with the cursor of the system by Image Processing in MATLAB. The centroid coordinates of the pupil are linked with the cursor controls & hence the cursor moves with respect to the eye movement.

Mathematically,

For x co-ordinate –

$$m(x) = \frac{screensize(x)}{img(x)} \times c(x) \times movement\ multiplier$$

For y co-ordinate –

$$m(y) = \frac{screensize(y)}{img(y)} \times c(y) \times movement\ multiplier$$

C. Movement of Cursor with respect to eye movement

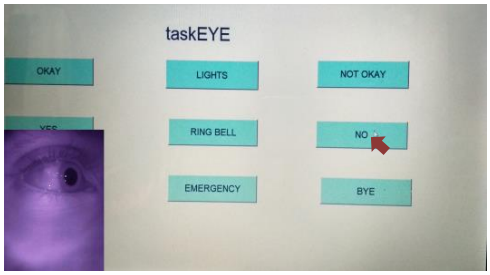


Fig 7. Test Result. 03

Fig 7 shows the movement of the cursor with respect to the eye movement, which satisfies the given formula.

VIII. Advantages & Limitations

Advantages:

1. It is not necessary to keep patient completely under observation
2. Nursing cost for keeping under observation will be reduced.
3. The system is economical, user-friendly & easy to control.

Limitations:

1. Better results are obtained in dark.
2. Difficult to detect eyes while wearing glasses.

IX. Application

- We can track finger or any other body movement for doing the same application.
- This system can also be used for physically challenged people, to make their vehicles automated.
- If this system is developed at a greater extent, it can also be used for home automations.

X. Conclusion

This shows that the **"taskEYE"** have successfully provided computer access for patients with disabilities. The system does not have any user-borne accessories & it serves the pateints with special needs.

XI. Future Scope

- GSM Module can be integrated with the system, so as to inform the respective when the user is in need.
- Utilizing natural sounds of the patients to give emergency signals through voice recognition system as well as it will provide more control over the system.
- Head Gear must be made compatible, more optimum & has a high tolerance to varying brightness.

XII. References

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