

Natural user interfaces in modern education

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ABSTRACT: Nowadays, when advanced technologies accompany us in every aspect of our life, it is more difficult to interest students in listening to static lectures and lessons, which have been conducted in this way for many years. To avoid the decreasing dependency on and frequency of lectures, the authors invented the concept of a project called Board 2.0. The concept relies on the creation of a fully interactive board applied so that students along with teachers are able to communicate and influence the course schedule. The Board 2.0 project uses the latest technologies such as SmartGlass, rear projection and touch detection, using infrared cameras to create the board. Due to the availability of this board, the user will be able to work in a natural and intuitive way, while conducting a lecture or presentation. Moreover, the project establishes the possibility of placing images directly into the system using the touch screen surface that the user does not have to wonder how to use the device.

INTRODUCTION

The aim of the project board was to create an interactive board, which will display the image using back projection. Communication with the board proceeds with a MultiTouch interface and provides the ability to introduce new items directly through the screen plate. The figure below shows the principle of the board.

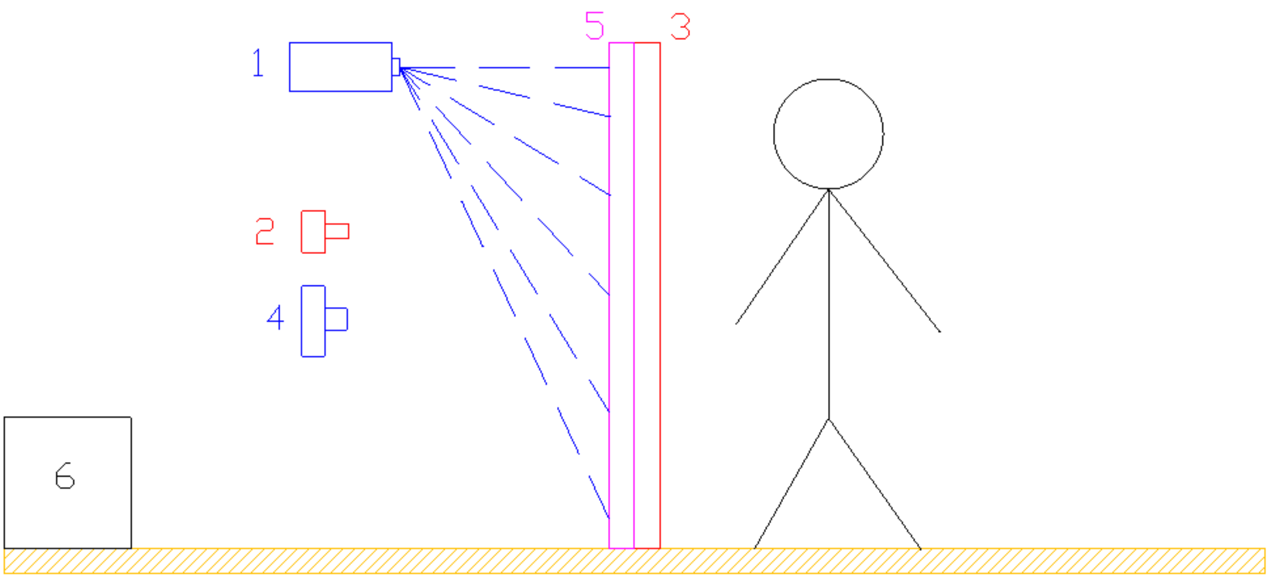

Figure 1: The concept of the board.

Description of the project elements:

1. Graphic projector - a standard projector for rear projection, short focal length and a resolution of 1920x1080 pixels is used to display the image on the SmartGlass.
2. The camera working in the infrared band acts as a MultiTouch interface by reading shapes of the items, which will be applied to the glass projection.

3. Glass with embedded LEDs on the edges works in the infrared band. The glass provides adequate lighting for the infrared camera riding fingers applied to the glass. Fingers will scatter infrared light using the *Frustrated Total Internal Reflection* phenomenon. The operating principle can be seen in the Figure 2, below.

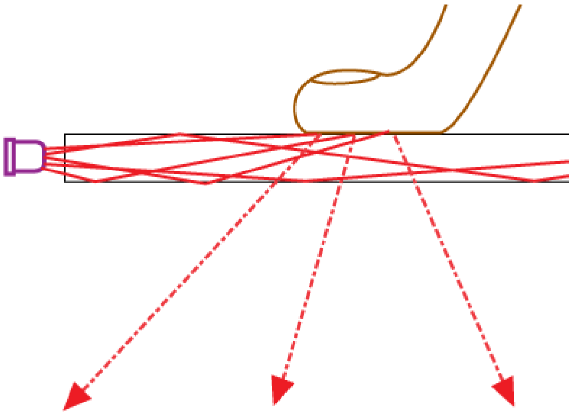

Figure 2: Frustrated Total Internal Reflection [2].

4. A high resolution camera - camera to collect colour images of items, which are intended to be digitised.
5. SmartGlass - glass, on which back projection images will be shown. SmartGlass can change itself from a fully transparent to milky glass under the influence of the applied voltage. The frequency of changes from the transparent glass into the milky one is 100Hz. Using this effect, it will be possible to display simultaneously the image scattered on the glass, when it is energised and opaque. There will be also downloading images in cycles in which the glass is completely permeable.

The principle of SmartGlass is illustrated in Figure 3, below.

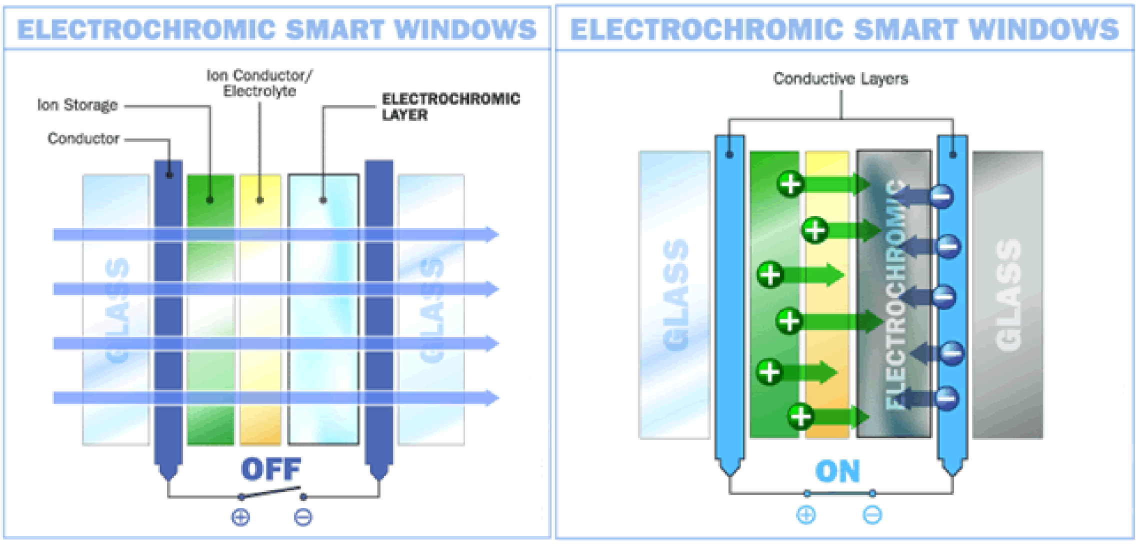

Figure 3: Electrochromic smart windows [4].

6. Control Unit - the computer, which will control the operation of the whole device in real time.

The basic problem in building this device is to ensure proper synchronisation between the various components of the project. To ensure that the system works properly, the projector should display the image only in those cycles of SmartGlass in which the glass is opaque (in order not to dazzle the users). A similar assumption must be made also for the high-definition camera, which should take pictures only in cycles in which the glass is transparent to avoid photographing the image. Of course, all of this is possible because SmartGlass can change its state at a frequency of 100Hz, which is large enough. The picture displayed on the screen will appear completely smooth to the user, and will not cause any eyestrain while working.

Communication with the device using the MultiTouch interface will take place using the Frustrated Total Internal Reflection phenomenon. The diodes, which emit infrared light, will be installed on the edges of the acrylic glass, in the way shown in Figure 4, below.

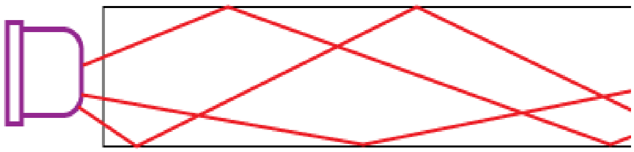

Figure 4: Light diffusion in acrylic glass [2].

Infrared light LEDs are installed so that they emit light, which by internal reflection will fully pass through the glass, while being invisible to the camera, which acts in the infrared.

When applying a finger to the acrylic glass, a part of the light will be dispersed and directed down towards the camera, which operates in the infrared band, and the dispersed infrared light goes to the camera (as shown in Figure 2).

The camera, which operates in the infrared, will be able to read such a signal and, then, converts it into the user interface control commands. Figure 5 below shows the effect of light scattering by applying fingers to acrylic glass, which is read by the infrared camera.

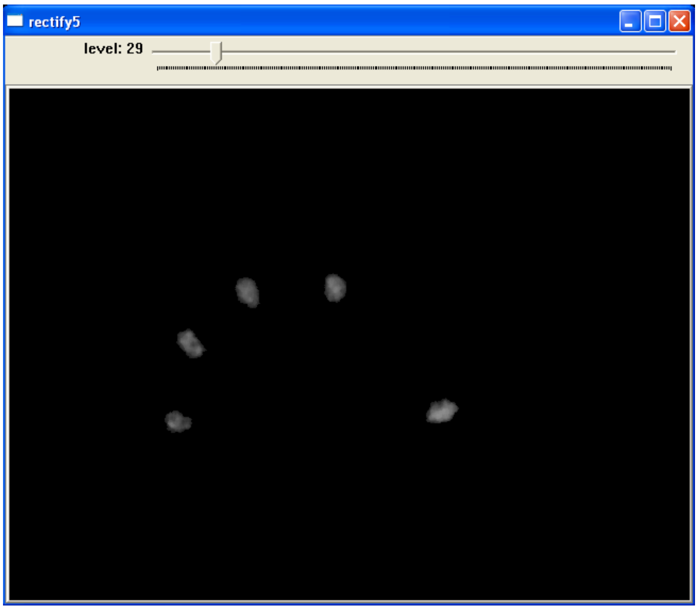

Figure 5: Reading the hand position by the infrared camera [2].

The construction of the Board 2.0 project will allow different work with a computer in the classroom through increased interaction and involvement in interacting with more users simultaneously. Classes can be conducted in a more natural way, where the teacher can keep introducing new facilities to the lecture, which may be achieved using the board. It should be emphasised that the user does not need to learn about the interface. The user can operate the system by his/her own hands, and use the items which need to be introduced to the digital world.

In addition to the scientific world, the project could also be a solution in many commercial applications. For instance, it could be used as an interactive storefront, allowing certain visualisation; for example, in advertisements, which could be projected on to a specific user standing in front of the shop window. Advertisements could be chosen based on physical characteristics of the person and, then, displayed on the screen. Another example of commercial application is a virtual dressing room, where a potential customer could see his/her reflection apparently in an outfit, without having removed any clothing.

The project is now at the conceptualisation stage, in which all the technical details are refined, but the project is feasible already. All the components of the Board 2.0 project exist, and can be purchased. Therefore, its implementation should not cause any major problem. The control software system, however, will be designed from scratch to ensure the quickest and most convenient devices for users. During the first meeting of the board's users, it was noted that they could easily figure out how to use it.

CONCLUSIONS

Building of the user interface will enable replacement of the mouse and the keyboard, and at the same time will be much more natural for users that have no experience with working with a computer. This is not a simple issue, but it is possible to do. Thanks to use of the latest hardware and software technology, the authors are able to create a project that will give not only a new dimension of human contact with the computer, but also give additional attraction to presentations and lectures. The Board 2.0 project allows the user to alter what is currently displayed on the screen by touching it. This new approach to using the computer during presentations and lectures will have a positive impact on receipt of the materials presented to students.

REFERENCES

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