

Abstract

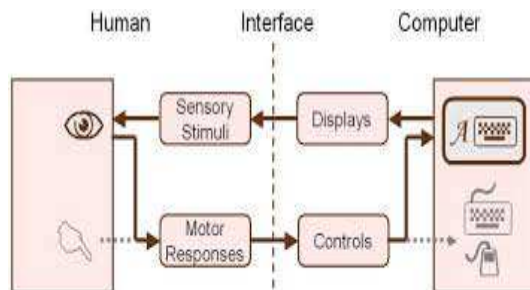
A disability is a condition or function judged to be significantly impaired relative to the usual standard of an individual or group. Effective usage of science and technology may help disable people to lead their life easy. The Solutions provided may not only erase physical or mental deficits but leave patients better off than "able-bodied" persons. In this paper we are providing valuable support for disable people in the accomplishment of hand free tasks using eye tracking. A robot whose movements are controlled by eyeballs and whose actions are triggered by eye blinks is developed. Eye based Interface is used to enhance the user-machine interaction process. For measuring eye positions and eye movement a device called eye tracker is used .Zigbee Protocol is used for Communication between transmitter and receiver.

Keywords: Eye based interfaces, Eye input, Eye tracking, , Eye blinks, Remote signal transfer, Accessibility, PCA (Principal Component Analysis)

Introduction

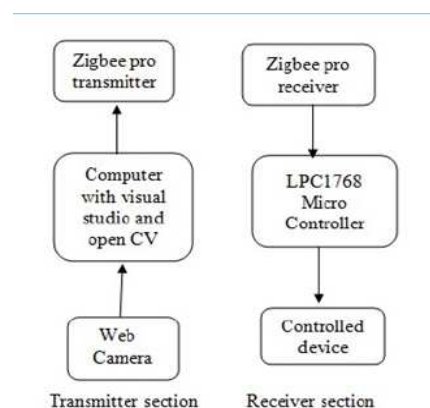
Now-a-days most existing user interfaces can only be controlled through the mouse and suffers from many accessibility issues. Human-Computer interaction can greatly benefit from machine perception leading to more natural communication experience between the user and the machine. Especially machine perception can be helpful for accessibility and eye tracking interfaces are a manifesting example of the way this can occur.

Human-computer Interaction (HCI) involves the study, planning, and design of the interaction between people (users) and computers. Interaction between users and computers occurs at the user interface which includes both software and Hardware.



There has been a great deal of work done in the area of human-robot interaction to understand how a human interacts with a computer.

Block Diagram



Transmitter Section

Web Camera:

It captures the video or image of an eye and sends to the computer.

Computer with Visual Studio & open CV

Here, the computer is with the software's Visual Studio and Open CV. Visual studio is used to develop console and graphical user interface applications along with Windows Forms applications, web sites, web applications and web services. Open CV is used for the Human -Interface interaction i.e., Facial Recognition

System.

Zigbee Pro Transmitter

Zigbee pro transmitter is used to send the signals to the Zigbee pro receiver at the receiver section. It is used for the wireless data transmission.

Receiver Section

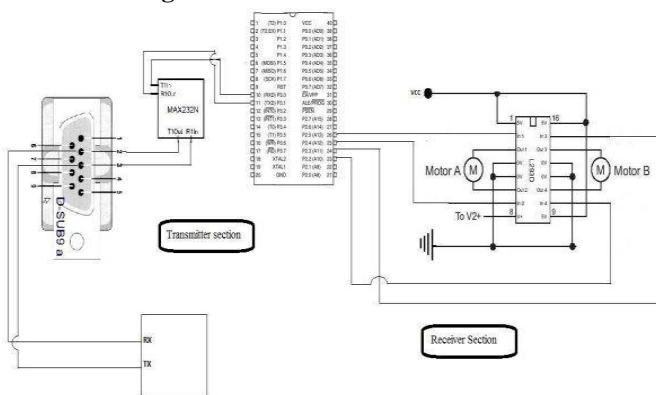
Zigbee pro Receiver

In the receiver section, Zigbee pro receiver can receive the signals from the transmitter section and gives to the microcontroller.

Microcontroller

The micro controller is used to manipulate the several operations based the program present in it the output is taken from one of the four ports.

Schematic diagram:



Hardware Components

The microcontrollers for embedded applications featuring a high level of integration and low power consumption. The ARM Cortex-M3 is a next generation core that offers system enhancements such as enhanced debug features and a higher level of support block integration. The LPC1768 operate at CPU frequencies of up to 100 MHz the PC1769 operates at CPU frequencies of up to 120 MHz the ARM Cortex-M3 CPU incorporates a 3-stage pipeline and uses Harvard architecture with separate local instruction and data buses as well as a third bus for peripherals. The ARM Cortex-M3 CPU also includes an internal pre-fetch unit that supports speculative branching. The peripheral complement of the LPC1768 includes up to 512 kB of flash memory, up to 64 kB of data memory, Ethernet MAC, USB Device/Host/OTG interface, 8-channel general purpose DMA controller, 4 UARTs, 2 CAN channels, 2 SSP controllers, SPI interface, 3 I2C-bus interfaces, 2-input plus 2- output I2S-bus interface, 8-channel 12-bit ADC, 10-bit DAC, motor control PWM, Quadrature Encoder interface, four general purpose timers , 6-output general purpose PWM, ultra-low power

Real-Time Clock (RTC) with separate battery supply, and up to 70 general purpose I/O pins.

SPI serial I/O controller:

The LPC1768 contain one SPI controller. SPI is a full duplex serial interface designed to handle multiple masters and slaves connected to a given bus. Only a single master and a single slave can communicate on the interface during a given data transfer. During a data transfer the master always sends 8 bits to 16 bits of data to the slave, and the slave always sends 8 bits to 16 bits of data to the master.

I2C-bus serial I/O controllers:

The LPC1768 each contain three I2C-bus controllers. The I2C-bus is bidirectional for inter- IC control using only two wires: a Serial Clock line (SCL) and a Serial Data line (SDA). Each device is recognized by a unique address and can operate as either a receiver-only device (e.g., an LCD driver) or a transmitter with the capability to both receive and send information (such as memory). Transmitters and/or receivers can operate in either master or slave mode, depending on whether the chip has to initiate a data transfer or is only addressed. The I2C is a multi-master bus and can be controlled by more than one bus master connected to it.

ZIGBEE PRO Module

Telegesis believes ZigBee PRO offers significant advantages for your next ZigBee design in many areas of operation such as scalability of large networks, security, network resilience and ease of commissioning. This is why we have chosen it as standard for our range of modules and peripherals to give our customers the best experience of designing with ZigBee. Telegesis was the first ZigBee module manufacturer in the world to offer certified ZigBee PRO modules and we are now in volume production of modules with this firmware. The complete range of Telegesis ZigBee products are also available with our AT Command Set based on Ember Corporation's EmberZNet PRO which is based on the ZigBee PRO Feature Set specification from the ZigBee Alliance.

Software Tools

Open CV (Free Open Source Computer Vision) is a library of programming functions mainly aimed at real time computer vision. It has a BSD license (free for commercial or research use). Open CV was originally written in C but now has a full C++ interface and all new development is in C++. There is also a full Python interface to the library. Example applications of the Open CV library are Human-Computer Interaction (HCI); Object Identification, Segmentation and Recognition; Face Recognition; Gesture Recognition; Motion Tracking, Ego Motion, Motion Understanding; Structure

From Motion (SFM); Stereo and Multi-Camera Calibration and Depth Computation; Mobile Robotics.

MS Visual Studio

Microsoft Visual Studio is an integrated development environment (IDE) from Microsoft. It is used to develop console and graphical user interface applications along with Windows Forms applications, web sites, web applications, and web services in both native code together with managed code for all platforms supported by Microsoft Windows, Windows Mobile, Windows CE, .NET Framework, .NET Compact Framework and Microsoft Silver light. Visual Studio includes a code editor supporting IntelliSense as well as code refactoring. The integrated debugger works both as a source-level debugger and a machine-level debugger. Other built-in tools include a forms designer for building GUI applications, web designer, class designer, and database schema designer. It accepts plug-ins that enhance the functionality at almost every level—including adding support for source-control systems (like Subversion and Visual SourceSafe) and adding new toolsets like editors and visual designers for domain-specific languages or toolsets for other aspects of the software development lifecycle.

Construction of Robot

It houses the electronic circuits like motor driver circuit, zigbee module, infrared sensors and buzzer circuit are placed at the front part in order to prevent collision with the obstacles. The chassis is constructed out of mild steel. The chassis has two wheels of radius 4 cm and a thickness of 1.5 cm. The usual convention of differential drive is used for changing the direction of movement of the vehicle. i.e. to turn left, the left wheel is made to rotate slower than the right wheel and to turn right, the right wheel is made to rotate slower than the left wheel. The angle of turning can be controlled by the difference in the speed of rotation of the two wheels. If the difference is more, the angle will also be more. While turning left, if the left wheel is made to rotate very slowly and the right wheel is made to rotate fast, the vehicle will take a sharp left turn. If the left wheel is made stationary while the right wheel rotates, the vehicle will take a u-turn. It has reverse motion also.

Operation:

Command	User's eye movement in the camera window (from current position)	Robot movement
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Front	Upward	Moves forward
Back	Downward	Moves backward
Left	Left side	Moves right
Right	right side	Moves left
Front-right	Diagonally upward towards right	Moves half-right and then moves forward
Front-left	Diagonally upward towards left	Moves half-left and then moves forward
back-right	Diagonally downward towards right	Moves reverse half-right , then moves backward
back-left	Diagonally downward towards left	Moves reverse half-left , then moves backward
Centre	No movement	No movement

Advantages

- The main advantage of this project is that only a simple webcam with moderate resolutions sufficient to capture the live video.
- 2. People with hand disabilities can use this project effectively
- 3. Eye control can enable more efficient interfaces with lower cognitive workload and operator monitoring for control stations.
- 4. Easier to operate the robot.
- 5. Very less connections and easier to connect.

Disadvantages

- 1. Only one person's face should be present in the camera window, else there may be a result of improper output.
- 2. Eye movements should be in a proper way otherwise there is a chance of detection of adjacent direction.

Applications

- 1. Make a sophisticated product that can be implemented in fighter jets. Pilot just has to point the target with the eyes and press the trigger when target becomes under the range.
- 2. Eye detection can be used in video games replacing the joy stick.

3. Handicapped people can operate their wheel chairs by using eye detection technique.
4. Disabled people can make use of computer without any help by using face detection.
5. In medical field, doctors can study the patient's eye movements by using this technique.

Conclusion

The project “**EYE TRACKING ROBOT**” has been successfully designed and tested. We detected the eyes of the user and controlled the robotic movements with respect to user's eye movements. It has been developed by all the hardware and software tools used. The main thesis of this project is to help disabled people if this has been implemented, more helpful for physically challenged and disabled people. Secondly, using highly advanced microcontrollers, modules and with the help of growing technology the project has been successfully implemented.

Future Scope

The frame rate in this project is low. Higher frame rates and finer camera resolutions could lead to more robust eye detection that is less restrictive to any user, while increased processing power could be used to enhance the tracking algorithm to more accurately follow the user's eye and recover more gracefully when it is lost.

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