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DESIGN AND IMPLEMENTATION OF A CONTROLLING SYSTEM FOR PHYSICAL DISABLED PEOPLE

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ABSTRACT

To issues related to Accessibility, which should eliminate, or at least reduce, the distance between disabled people and technology. However, particularly for severely-impaired persons, there are still many challenges that must be overcome. In this paper we present eye tracking as a valuable support for disability in the accomplishment of hands-free tasks. Moreover, we stress the potentials of eye-based interfaces to enhance the user-machine interaction process in “traditional” activities based on keyboard and mouse. Through the description of some of the projects we have recently developed a robot which can move according to the movements of the eye balls and can be triggered with some actions based on the eyeblinks

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. Eye tracking can be used for evaluation purposes

allowing a great amount of data about user’s behaviors to be obtained while interacting with an interface. 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 (or simply *interface*), which includes both software and hardware. The human-computer interaction is as in figure 1.1.

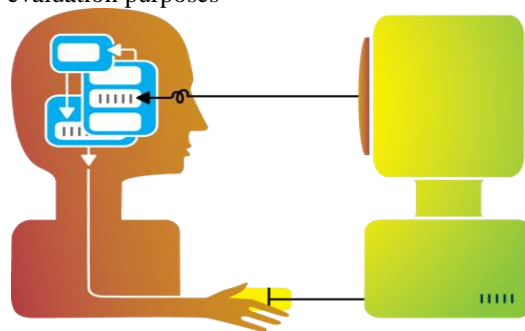


Figure 1.1: Human-computer interaction

Human-robot interaction (HRI) is the study of interactions between users and robots. HRI is multidisciplinary with contributions from the fields of

human-computer interaction, artificial intelligence, robotics, speech recognition, and social science. There has been a great deal of work done in the area of human-robot interaction to understand how a human interacts

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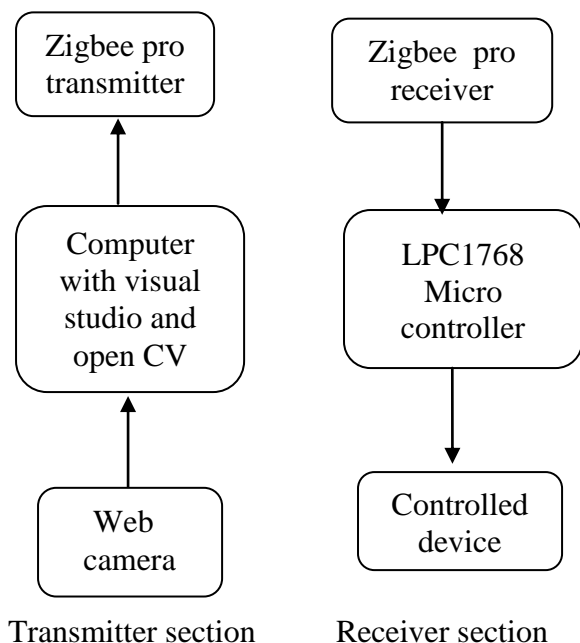
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with a computer. However, there has been very little work done in understanding how people interact with robots. For robots becoming our friends, these studies will be required more and more.

2.BLOCK DIAGRAM



2.1 TRANSMITTER SECTION

Web Camera

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

Computer with Visual Studio and 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.

2.2 Receiver Section

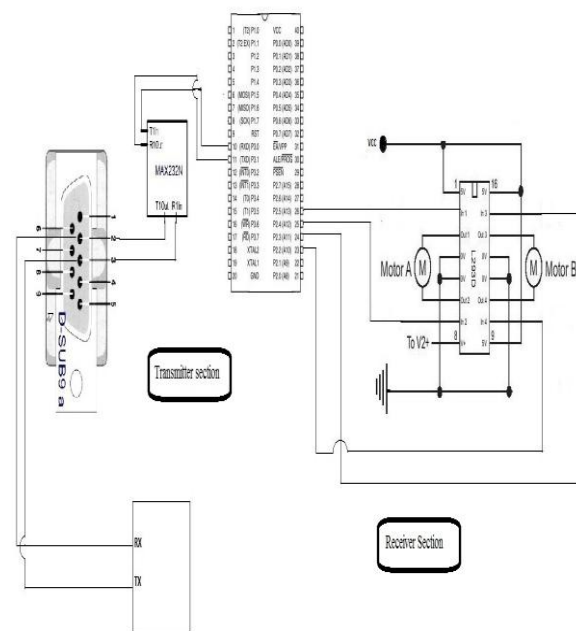
Zigbee pro Receiver

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.

2.3 SCHEMATIC DIAGRAM



3.HARDWARE COMPONENTS

The LPC1768 is ARM Cortex-M3 based 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 LPC1769 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.

1.1 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.

3.2 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.

3.4 ETHERNET

The Ethernet controller is available on parts LPC1769/68/67/66/64. The Ethernet block supports bus clock rates of up to 100 MHz (LPC1768/67/66/64) or 120 MHz (LPC1769). The Ethernet block contains a full featured 10 Mbit/s or 100 Mbit/s Ethernet MAC designed to provide optimized performance through the use of DMA hardware acceleration. Features include a generous suite of control registers, half or full duplex operation, flow control, control frames, hardware acceleration for transmit retry, receive packet filtering and wake-up on LAN activity. Automatic frame transmission and reception with scatter-gather DMA off-loads many operations from the CPU.

The Ethernet block and the CPU share the ARM Cortex-M3 D-code and system bus through the AHB-multilayer matrix to access the various on-chip SRAM blocks for Ethernet data, control, and status information. The Ethernet block interfaces between an off-chip Ethernet PHY using the Reduced MII (RMII)

protocol and the on-chip Media Independent Interface Management (MIIM) serial bus.

3.5 USB OTG controller

USB OTG is a supplement to the USB 2.0 specification that augments the capability of existing mobile devices and USB peripherals by adding host functionality for connection to USB peripherals. The OTG Controller integrates the host controller, device controller, and a master-only I2C-bus interface to implement OTG dual-role device functionality. The dedicated I2C-bus interface controls an external OTG transceiver.

3.6 CAN CONTROLLER AND ACCEPTANCE FILTERS

The CAN controllers are available on parts LPC1769/68/66/65/64. The Controller Area Network (CAN) is a serial communications protocol which efficiently supports distributed real-time control with a very high level of security. Its domain of application ranges from high-speed networks to low cost multiplex wiring.

The CAN block is intended to support multiple CAN buses simultaneously, allowing the device to be used as a gateway, switch, or router among a number of CAN buses in industrial or automotive applications.

3.3. 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.

4. MOTOR DRIVER CIRCUIT

L293D is a dual H-Bridge motor driver. So with one IC, two DC motors can be interfaced which

can be controlled in both clockwise and counter clockwise directions and its direction of motion can also be fixed. The four I/O's can be used to connect up to four DC motors. L293D has output current of 600mA and peak output current of 1.2A per channel. Moreover for the protection of the circuit from back EMF, output diodes are included within the IC. The output supply (VCC2) has a wide range from 4.5V to 36V, which has made L293D a best choice for DC motor driver.

The name "H-Bridge" is derived from the actual shape of the switching circuit which controls the motion of the motor. It is also known as "Full Bridge". H-Bridge motor driver circuit.

5.SOFTWARE TOOLS

5.1 OPEN CV

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.

4.2 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

5.1. OPERATION

Command	User's eye movement in the camera window (from current position)	Robot movement
Front	Upward	Moves forward
Back	Downward	Moves backward

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 (like the Team Foundation Server client: Team Explorer).

5. 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.

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

Table: Commands and their respective movements

6.1 ADVANTAGES

1. 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.

6.2 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.

6.3 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.

7. CONCLUSION

The project "Design & Implementation Of A Controlling System For Physical Disabled People" 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 intervening features of all the hardware and software tools used. Presence of every component and module has been reasoned out and placed carefully thus contributing to the best working of this project. Secondly, using highly advanced microcontrollers, modules and with the help of growing technology the project has been successfully implemented.

8. 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.

This can be extended to control the devices or robots by detection facial features like facial expressions. This has great applications in military applications.

The ease of use and potential for rapid input that this system provides could be used to enhance productivity by incorporating it to generate input for a task in any general programs.

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