

Team 9

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GE 401

18 November 2011

PRODUCT REQUIREMENT DOCUMENT



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Company Overview

EyeCue has been established in 2011 by 6 shareholders with the target of integrating high technology into medical products in an innovative way with high quality. The main aim of the company is to produce qualified medical products for disabled people by using eye-tracking technology to contribute to the lives of disabled people and their relatives.

In this context our major project Assistant Eye is aroused to advance the movement capability of motor neuron patients(ALS), fully paralyzed people, many people who suffer from stroke and have lost the ability to use their muscles or war veterans who lost two or more parts of their bodies with the help of eye-tracking technology. The project product Assistant Eye is an eye-tracking controlled wheelchair detects where the patient is looking at. Main idea behind our system is to capture the movements of pupil and translate these movements into the motion of wheel-chair.

EyeCue is housed in Ankara which is regarded as the center of the sector with the help of Ministry of Health, the biggest medical companies and the most famous hospitals, also provides us an opportunity to be a part of competition. EyeCue is a brand new firm that will enter the market with the power of unattempted innovative product in Turkey. So, with that desire, we are targeting to built up untried projects responding the emerging trends in sector and make a complementary affect for the gaps of the market. We regard our biggest advantage as the energy of a team with young, talented, equipped and appetited for success individuals.

Introduction

This document is prepared by the EyeCue Co. In this report what the product is going to be is defined in order to provide product specifications to the person or entity ordering the product or the people in the company who asks for the product, such as marketing.

The characteristics of the components may change during the project term due to the possible unexpected requirements, but there would not be major changes. The purpose of this report is to help the reader to find information about what the product does, what the physical characteristics are and what the interfaces are.

What is expected ?

The philosophy of EyeCue is to provide disabled people an unobstructed and new world by designing innovative medical devices. In this respect, the idea of Assistant Eye has come up to help the people who cannot use a standard wheelchair due to some health problems. During the designation of Assistant Eye, using the eye-pupil movement as a trigger effect for the motor of the wheelchair is decided. So, the working discipline of Assistant Eye can be summed up as “observed movements of the eye-pupil navigate to the wheelchair” . The product is expected to identify the movements via micro cameras placed around a spectacle frame and transfer the information into microprocessor. The flow of the information passes through microprocessor to motor drive and then motor. Lastly, the journey of the information gathered by the cameras ends up with determination of the direction of the wheels. In other words, the Assistant Eye suggests to patients comfortable, safe and effortless moving capability.

Physical Characteristics

Assistant Eye consists of variety of parts, therefore major characteristics of per part can be founded in following branch.

Infrared camera

- It is used for detecting the eye movements of the user.
- The camera will have the capability of detecting the movements of eye pupil both the day time and at nights with its infrared specialty.
- It will not be so big, it will not cover the whole view of the user since its location is planned to be in front of the eye.

- Dimensions will be about to 3x3x5 cm.
- Resolution will be at least 640x480 (VGA format).
- Weight will be as small as possible to minimize the pressure to head, maybe maximum 0.25kg.
- Works on about 12V DC voltage.
- The life of the camera must be longer than 2 years of continuous usage.

Helmet to head for camera

- This part will be mainly used for handling to carry the micro camera and will be put on user's head.
- It will have an extra part which goes ahead of eyes and hold the camera in an angle of seeing the eye's pupil in a constant and clear way.
- The distance of the camera will be close enough to provide an efficient image processing and far enough not to effect the sight of the user significantly. The distance of the camera to the eye will be adjustable between 7-15 cm.
- It should handle to carry the micro camera.
- It must be soft, ergonomic, aesthetic and light and should not corrode easily.
- The usage of it should be suitable for different users.
- Can be stabilized, should not slip over the head.
- It enables the user to adjust its tightness.
- The life of the helmet must be longer than 2 years of continuous usage.

Wheelchair

- To be able to used properly by all of the patients, wheelchair's weight capacity should be at least 135 kg.
- Its own weight shouldn't be more than 20 kg. so that it can be carried if needed.
- To be able to used by everyone, height to the ground should be 90 cm. for handles and 55cm. for seat, height of the back side should be 40cm. and seat width should be 45 cm.

- Since it will be used mostly indoor, the maximum overall width shouldn't exceed 75cm. to avoid situations like getting stuck to other stuff while moving.
- It should contain lifting mechanism and elevating largest to make the patient feel more comfortable.
- Sitting place should be comfortable and ergonomic for the user.
- The life of the wheelchair must be longer than 5 years of continuous usage.

Motor

- The wheel chair has to contain 2 DC Motors.
- Both of the DC Motors must have 12v voltage and a power capability of 0,75 kW or 1 kW.
- Both of the DC Motors must have no more than 6 kilograms weight.
- They should be easy to carry and shouldn't affect the movement of wheelchair.

Battery

- There must be 2 accumulators in order to feed motors.
- Both of them have to operate at 12 volts.
- Batteries have approximately 8 centimeters height.

DSP (Digital Signal Processor)

- It provides a computing power up to 1.2 GHz clock speed and fast-access two level large data caches.
- DSP supports multiple arithmetic instructions execution and hardware controlled looping which largely used in image processing therefore provides significant performance in such tasks.
- It must enables to execute the eye-tracking software in almost real-time. With its optimal architecture for complex arithmetic and matrix calculations, highly complicated tasks of the system that will be used in the software, will be able to performed in a reasonable time.

- The dimensions of the card must be fairly small that resolves the portability issue.
- It should work on around 12V.
- It can have 44.1, 48, 88.2, 96, 176.4, 192kHz sample rate support
- High-bandwidth x1 PCI Express (PCIe) card (can be used in x1/x4/x8 and x16 slots, PCIe 2.0 compatible)
- The life of the DSP card must be longer than 2 years of continuous usage.
- Multi-card support for up to 8 cards - mix and match up to 4 UAD-2's and 4 UAD-1/Ie/Xpanders in one system/group
- UAD-2 individual plug-in instances per DSP chip will vary based on the plug-in combination selected with the average session being around 2.5x
- Real-time and faster than real-time processing for mix bounces
- High-speed memory bus for running reverb/delay type effects.

Interface of the product

The infrared camera used to detect eye movements will be placed to the user's head and directed to the right eye. The apparatus, where the camera is attached, is used to prevent the change in angle between the camera and right eye caused by the movement of the head. Therefore, the camera will always facing the eye in constant angle, which avoids the complexity in eye-tracking software. The infrared feature in the camera will enable the usage of the wheelchair even at night. User will move his/her eyes left or right to move the wheelchair left or right, and up or down to accelerate or slow down it. The system will be shut down by keeping the eyelids closed for 3 seconds but turning on the system will be manual for safety reasons such as accidental system start.

The eye-tracking software will be programmed into a microprocessor "DSP" that is specialized for image processing applications because the system must work almost in real-time otherwise late response might cause dangerous situations in emergencies while driving the wheelchair. The software will be able to process 10 images in one second and decide the direction and angle of the eye movement. Afterwards, the software will send corresponding signals to the engine as an output from the microprocessor where it is compiled.

Direction changes of the wheelchair will not be disturbingly sharp but rather smooth to provide a comfortable ride. The angle of the turns and changes in the speed will be decided according to the amount of position change of the eyes. In other words, more the user moves his/her eyes to a direction, sharper the turns and speed changes will be.

Since the comfort of user is very important in the wheelchair, the helmet will be soft, easy to put on and the camera will be in optimal distance from the eye. The distance of the camera will be close enough to provide an efficient image processing and far enough not to affect the sight of the user significantly.

Conclusion

This report is prepared to provide product specifications to the person or entity ordering the product or the people in the company who asks for the product, such as marketing while exhibiting an insight of what the product does, what the physical characteristics are and what the interfaces are. The major components of the product that are infrared camera, helmet for camera, wheelchair, motor, battery and digital signal processor are explained in a detailed way. For further information please do not hesitate to contact with mail addresses given below.