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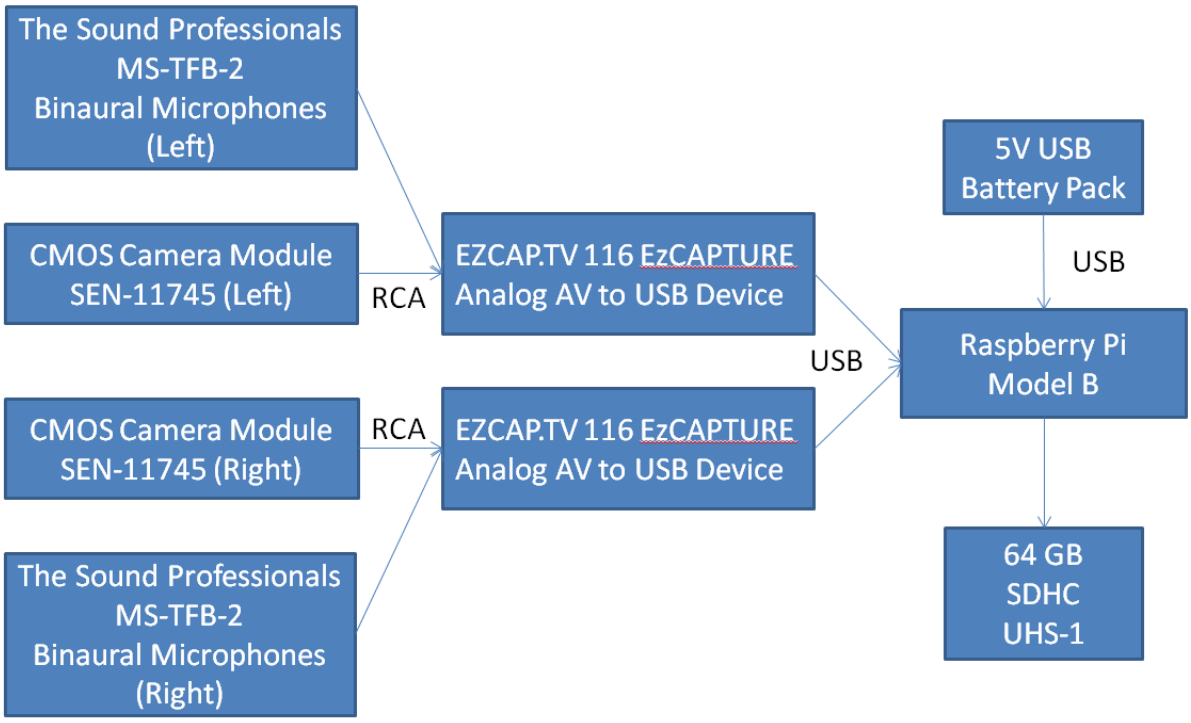
CPE 322 – Engineering Design 6
Assignment 7

Overview

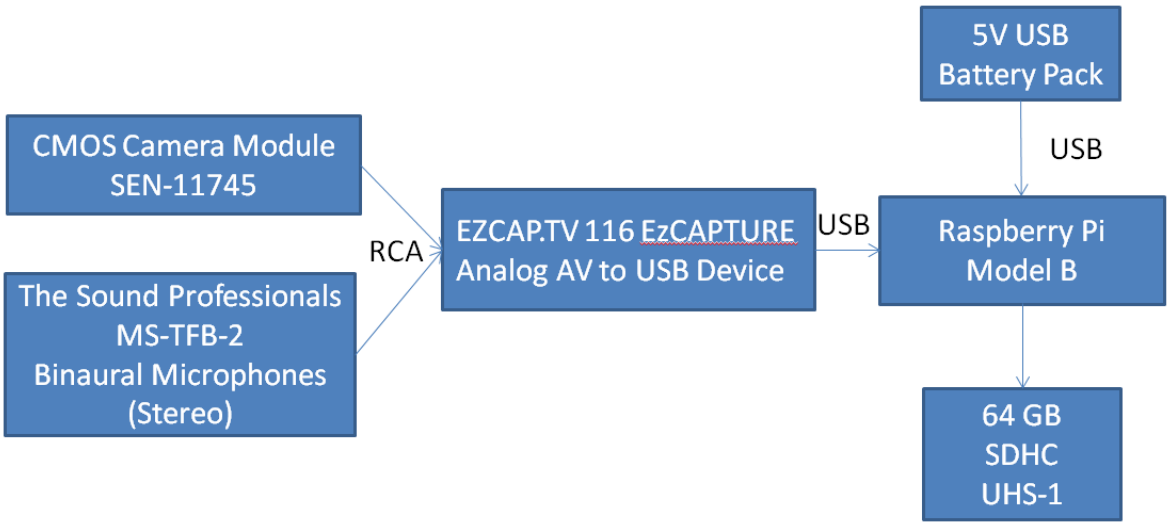
Phong Lai constructed the recorder block diagrams and associated text. Eric Chae constructed the playback block diagrams, associated text, and compiled the final report. Ajay Reddy analyzed the design constraints and ethics. Eric Pantaleon analyzed any possible multidisciplinary opportunities and the SWOT analysis.

	Eric Chae	**Phong Lai**	**Eric Pantaleon**	**Ajay Reddy**
Percentage Of Effort Towards this assignment	25%	25%	25%	25%

Recorder Implementation 1

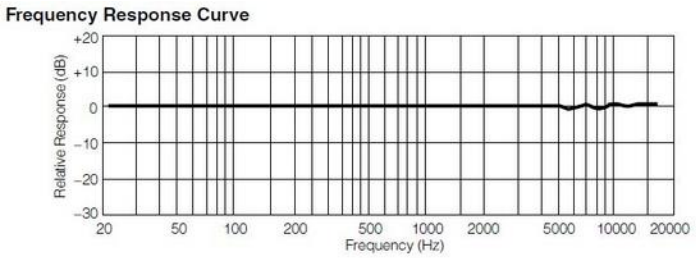


Recorder Implementation 2



MS-TFB-2 Binaural Microphones

These particular stereo microphones where chosen for a variety of desired characteristics. The extremely flat frequency response makes the audio recorded less colored by the microphone. This is an attractive attribute because we want to recreate audio of how the user heard it. Microphones will be worn within the pinna of the ear rather than binaural microphones that are warn outside the ear to recreate the most realistic rendition of what is heard from the user's perspective. Every person's pinna is different and it is our own ears and even head dimensions that will create color the audio so that our minds can recreate it with respect to space and not just left and right like typical stereo microphones would. Other reasons why this microphone was chosen and not others within the same type are because of its higher signal to noise ratio and cost. The MS-TFB-2 costs $129.00 and has a signal to noise ratio of 75 dB and uses a standard 3.5mm stereo cable.



SEN-11745 CMOS Camera Module

Ideally we would have loved to use a camera's HDMI signal and record that straight. The benefit of that is being able to use the full manual controls of the camera. This will require a more powerful hardware to handle such an input. Another reason using dedicate camera was not feasible was because of its size and cost. In order to make this product marketable, the final cost of the product must be available to the consumer or at least the pro-sumer level. The SEN-11745 would cost $31.95 and weigh 26 grams which makes it perfect for our mounting application. Another reason why we choose this camera module is because it can only record standard definition images. To have a device record two high definition videos simultaneously, the recorder components would need to be higher specs which will make our project too costly.

EzCAPTURE USB 2.0 Video Capture Device

The purpose of this device is to be able to convert our analog video and audio signals into digital signals so that it can be easily recorded and synced. The cost for each one of these analog to digital converters is 30.55 dollars. In the recorder implementation 1, the audio feed will be split up so that each video channel will have its own audio. This will just require a common stereo Y adapter. The output of this device uses the USB hub which is available in our recording module.

Raspberry Pi Model B

The Raspberry Pi will be used to create a complete file. After looking at many other microprocessors and other hobbyist boards, the Raspberry Pi allowed for the most flexibility and power for this demanding of a project. It has 512MB which can be upgradable. This feature is extremely important if the board is attempting to record two simultaneous videos, it will need a fair amount of buffer space. Having the storage drive as SD cards is very handy because these digital media cards are fairly cheap on the market for consumers. Lastly, the Raspberry Pi runs off of Debian Linux which our team can develop software for syncing and processing the video and audio feeds to be stored on the SD card.

Power

A 5V battery pack will be made to accommodate the power requirements for the Raspberry Pi. The Raspberry Pi will give 5V through its two USB ports to power the video capture devices in both single and dual configuration. The CMOS cameras will be able to get power directly from the board of the Raspberry Pi. The recording device will be a self-contained unit, only needing a single source of power.

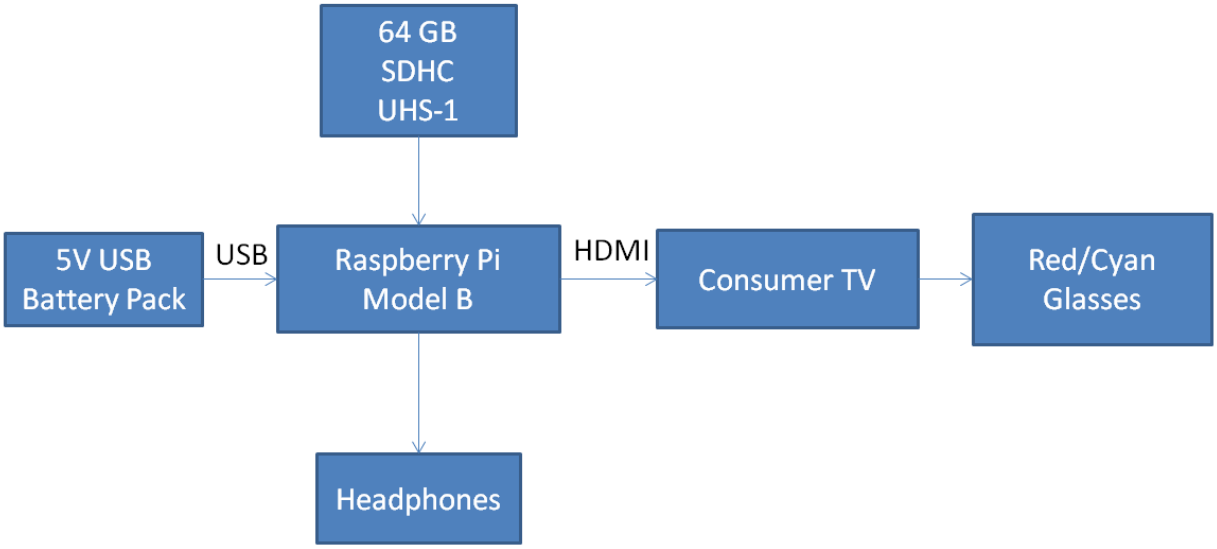
SDHC UHS-1 Cards

As mentioned earlier, the Raspberry Pi will store the 3D video onto a SD card. One thing to note is that with slower SD cards, the video will require higher buffer memory space. It will be recommended that the user inserts a class 10 SD card which will have speeds greater than 10MB/s.

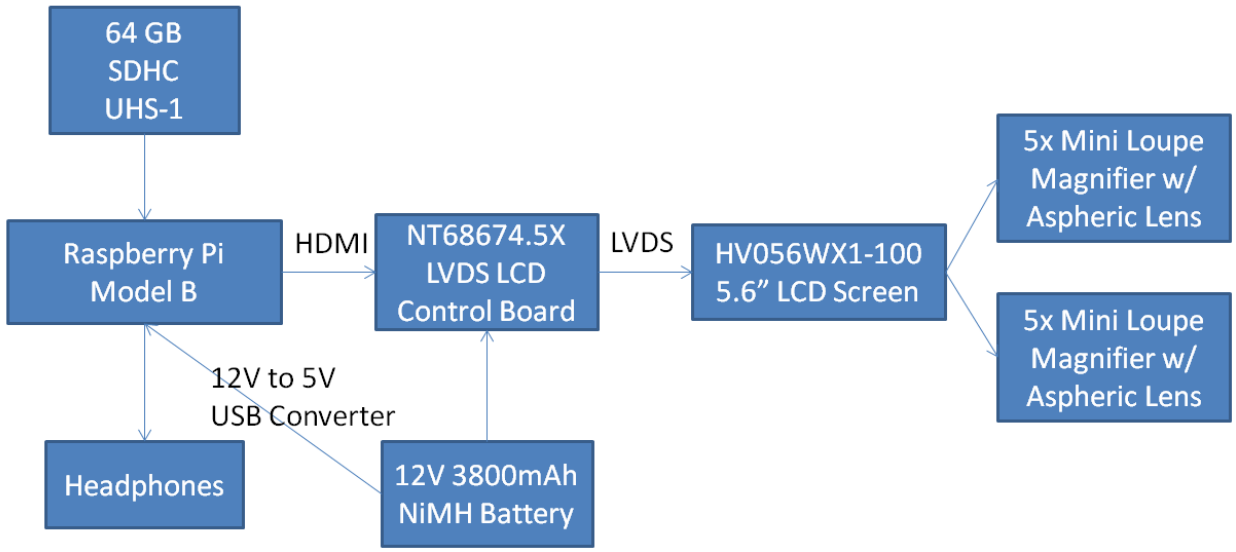
Implementation

The difference between Implementation 1 and 2 of the hardware for the recorder is the amount of video feeds being used. In the case that the project will end up costing too much to develop because 2 video feeds will require more resources (Battery, Processing Power, Buffer Memory), the project will then use a single channel implementation. In the single channel implementation, the stereo microphone and single camera feed will connect directly to a single EZcap116. This will reduce cost, and resources needed for the recording device. With a single camera feed implementation, more coding is needed in order to achieve 3d visualization. In order to generate an anaglyph, the cyan and red channel overlays will require a horizontal offset to simulate the offset of the human eyes. A dual video feed will sync each video with the audio, and create a single video with the 2 videos side by side. H.264 video compression and AAC audio compression will be used for both implementations to yield an MPEG-4 compliant file.

Playback Implementation 1



Playback Implementation 2



Raspberry Pi Model B

Playback will be controlled by the Raspberry Pi platform running Debian Linux. Since the video has already been encoded by the recording device, the software is rather simple and just needs to decode and playback whatever is on the SD card. We could even use third-party media playback software as there is absolutely no further post-processing required. As in the recording device, the Raspberry Pi will be powered by a 5V USB battery.

Headphones

For audio output, headphones will be required to preserve the 3D effect. The platform we have chosen has an analog audio output, so implementing this will be as simple as plugging in headphones. Special headphones are not required so it is up to the user to choose his preferred headphones.

Implementation 1

For image output, there are two options. The simpler option is to output to the user's own consumer-grade TV through HDMI. In this case, the video would have to be encoded as a red/cyan anaglyph beforehand by the recording device and the user would have to wear red/cyan 3D glasses.

Implementation 2

The other, more difficult, but preferable option is to have virtual reality goggles. This would require a head-mounted LCD screen at eye level with two lenses to focus each eye. This would also require an LVDS LCD controller board to take the HDMI signal and output it to the screen. The battery pack would also have to be different as the LVDS LCD board requires 12V power instead of 5V. A 12V 3800mAh NiMH battery can be used along with a 12V to 5V USB adapter to provide 5V to the Raspberry Pi.

An appropriate and ergonomic case would have to be designed to fit on the user's head. Since a part such as this must be custom-made, it cannot be purchased off the shelf as with the other components. A product designer would have to be hired in order to properly and safely design this part. For the prototype stage, a rough case made from foam and duct-tape will suffice.

Design Choice

We feel that the best design choices for both devices are the ones that require two imaging devices. Using two cameras and two screens will yield the closest result to the real-life experience we wish to achieve. Recording with two cameras will be the most realistic and accurate in simulating human vision. Using VR goggles for playback will not only allow the greatest flexibility in 3D video, but also provide the most immersion via sensory deprivation of all outside stimuli.

Design Constraints

a) As our product is a consumer good, the price point is a vital consideration in the project. Setting it too high will make it difficult or impossible to market the product to the general public; on the other hand, to have a low price point, we'd have to cut corners with respect to the quality of the product itself and risk having people think it's not a well-made good, even if it is. The best solution is to use reasonably-priced but powerful components to fabricate the product, and then price it with a wide enough buffer zone to guarantee revenue, yet not so significant that the product is unaffordable by the common person.

b) Our product does not have large environmental considerations to take into account. It's just another electronic device which will make use of other electronic and computer components. It doesn't produce any waste products, so as long as we use reasonably environmentally-friendly fabrication and distribution processes, we should not have too much to worry about.

c) There are some health and safety concerns with our product, as due to the nature of its design, it is in direct contact with the user's face. More importantly, it will provide for highly realistic movie and video gaming experiences, and this could cause problems if uses are subjected to extremely flashy, strobing effects as such things could induce seizures and other medical concerns. There's also a risk of traumatizing users if they are subjected to extremely graphic or disturbing content, and this is a risk that's more pronounced with our product than it is with normal TV or computer sets. That is because our product is designed to simulate reality. The problem is that as the fabricators of this headset, we have no way of controlling what people use to display it and all we can do is warn users of the potential issues that they might encounter if they subject themselves to graphic or strobing content.

d) We will require a factory or fabrication plant that's quite clean, as our product is a complicated electronic and computer device. Cleanliness and workflow would be modeled after plants used today to manufacture PC and other consumer electronics, but we would not require any special considerations apart from the sort of hardware and tools one would require to fabricate the product we hope to.

e) As time goes on, we expect for the market for VR headsets to only grow and for the price of the components that go into building them to diminish. Thanks to growing attention and efforts into managing the environmental impact of such products, environmental concerns should also decrease going into the future. We don't expect for health and safety concerns and the requirements for the fabrication of our headsets to change very much over time. We will manage the expanding market for better VR headsets by staying on the cutting edge of technology and constantly re-evaluating our products and their reception by their consumers. If we continue to improve our headsets and be responsive to what the consumer wants and what's available for manufacture, we should continue to have a foothold in the VR headset market.

Ethical and Professional Responsibilities

As manufacturers of a product that is designed to simulate extremely realistic audio and video experiences, we will have to ensure that our headset is secure insofar that unwelcome images and video files can't be played on it against the user's will. We will also have to ensure that they are not used by unsavory individuals and organizations to psychologically affect individuals, and we can do this by refusing to sell to such groups.

Apart from that, our responsibilities, ethically and professionally, are similar to those of any other manufacturer of consumer electronics. We will purchase our components from ethical distributors and we will ensure that they are made and distributed with consciousness towards our employees and the environment.

We will have to warn users that they will be essentially entering sensory deprivation for however long they choose to use our products. We'll have to include an extensive manual to our product as well as warning labels that strongly suggest to the user to familiarize himself with the headset's operation prior to using it.

An additional concern is that our product will almost certainly be used to display pirated material. To avoid this, it may be necessary to make our headset compatible with whatever forms of DRM (digital rights management) publishers of videogame and video media are interested in using to secure their copyrighted material. A potential solution is to make the headset a stand-alone unit instead of something with flash memory storage that operates in tandem with a computer system. That way, the headset will only play back material that it has been authorized to do so by some centralized database that would grant out licenses based on the user's purchases.

Multidisciplinary Opportunities

- Raspberry Pi board: Computer science majors and computer engineers can use their programming knowledge to work together to program the microprocessor board to combine the audio files with the video files.

- Physical Design: Mechanical engineers, electrical engineers, audio engineers can work together on the actual design of the product. Mechanical engineers will create the prototype while the audio engineer can use their knowledge of acoustics to place the audio recording devices in the best place possible to catch sound as a human ear would. Electrical engineers will make sure that each component is wired together correctly and make sure each component is receiving the correct amount of power from the power source.

SWOT Analysis

Strengths:

- Portable: Able to be stored in a travel bag and used on-the-go. No wires required.
- Hands-free: Mountable to the head, so no need to hold with hands.
- Technology: Uses up-to-date 3D video and audio technology.

Weaknesses:

- Design: We need to hire an outside source to create and manufacture a custom design to house the audio and video components.
- 3D Playback: When viewing through a TV without 3D capabilities, you would need the red/cyan glasses to get the 3D effect. Also the virtual reality would make the headset bulkier in design.
- Physical Aesthetic: Wearing this on your head will most likely not look natural. The components needed would be too heavy for glasses and would sit uncomfortably on the face.

Opportunities:

- Augmented Reality: Like Google Glass, this can be a step towards augmented reality where we can wear this headset and display valuable information on things around us.
- Virtual Reality Media: People can share their videos with other users and experience what other people have recorded. This can lead to virtual reality tours or just videos showing someone's typical day.

Threats:

- Google Glass: It's sleek and stylish design competes with our product. Google glass is similar to our product except that it is not 3D recording and has only a small view screen on the corner. Also Google Glass has access to the internet.

Appendix

- http://www.soundprofessionals.com/cgi-bin/gold/item/MS-TFB-2
- https://www.sparkfun.com/products/11745
- http://www.ezcap.tv/usb-video-capture/ezcap116-capture-card?zenid=imfggkp93omc7g5i9leleqv0p0
- http://www.raspberrypi.org/
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- http://www.adafruit.com/products/962#Description
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- http://www.ebay.com/itm/M-NT68676-2A-HDMI-DVI-VGA-AUDIO-LCD-LED-Controller-Board-LVDS-DIY-Reuse-laptop-/370794816312?pt=US_Server_Boards&hash=item565517e338
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