Design Document and Feasibility Study

# Hardware System:

The system would basically be a combination of 3 Raspberry Pi Pico, 2 5MP ArduCam Camera module, 2 SD Card extension, 2 SD Card, 2 Microphone module and (optional) Power Management Module like TP4050. 2 Raspberry Pi Pico used for each ‘eye’ of the stereo system and each will house their own camera, microphone and sd card connection to it. The last raspberry pi will be used to synchronize both Raspberry Pi and (optional) wireless connection.

Component List:

1. 3x Raspberry Pi Pico ( 1 possibly being Pico W, Wireless included) ([Raspberry Pi Pico | The Pi Hut](https://thepihut.com/products/raspberry-pi-pico?variant=41925332533443)) ( [Raspberry Pi Pico W | The Pi Hut](https://thepihut.com/products/raspberry-pi-pico-w))
2. 2x 5MP ArduCam Camera module, OV5642 Mini SPI Camera Module for Raspberry Pi Pico  
   ([5MP OV5642 Mini SPI Camera Module for Raspberry Pi Pico | The Pi Hut](https://thepihut.com/products/5mp-ov5642-mini-spi-camera-module-for-arduino))
3. 2x SD Card SPI Breakout Board ([Adafruit Micro SD SPI or SDIO Card Breakout Board - 3V ONLY! | The Pi Hut](https://thepihut.com/products/adafruit-micro-sd-spi-or-sdio-card-breakout-board-3v-only))
4. 2x 32GB MicroSD Card ([SanDisk MicroSD Card (Class 10 A1) | The Pi Hut](https://thepihut.com/products/sandisk-microsd-card-class-10-a1?variant=39641172377795))
5. 2x Electret Microphone Amplifier ([Electret Microphone Amplifier - MAX4466 with Adjustable Gain | The Pi Hut](https://thepihut.com/products/adafruit-electret-microphone-amplifier-max4466-with-adjustable-gain))
6. Breadboard for Pico ([Breadboard for Pico | The Pi Hut](https://thepihut.com/products/breadboard-for-pico)), to speed up prototyping as the breadboard have pin labels, as Rasp Pi Pico don’t have silkscreen labelling on its PCB.
7. 140 Degree Lens in case 60 Degree isn’t good enough for stereoscopic imaging ([M12 Lens - 140-Degree Ultra-Wide Angle with Raspberry Pi HQ Camera Adapter | The Pi Hut](https://thepihut.com/products/m12-lens-140-degree-ultra-wide-angle-with-raspberry-pi-hq-camera-adapter))
8. TP4050 Charging Board (optional if using LiPo is within scope), first prototype will be powered with power bank/AA battery first.

Related Resources:

1. [Expand Your Raspberry Pi Pico's Memory by Adding a microSD Card Reader! Plus SPI & Module Creation. - YouTube](https://www.youtube.com/watch?v=PSjzymhL4I0&t=1026s)
2. [sdcardio – Interface to an SD card via the SPI bus — Adafruit CircuitPython 9.0.0-alpha.1 documentation](https://docs.circuitpython.org/en/latest/shared-bindings/sdcardio/index.html)
3. [Arducam Mini Module Camera Shield 5MP Plus OV5642 Camera Module for Arduino UNO Mega2560 Board (uctronics.com)](https://www.uctronics.com/arducam-mini-module-camera-shield-5mp-plus-ov5642-camera-module-for-arduino-uno-mega-2560-board.html)
4. [ArduCAM/PICO\_SPI\_CAM (github.com)](https://github.com/ArduCAM/PICO_SPI_CAM#use-c-language-to-drive-spi-camera)

# Video Processing Pipeling:

<https://github.com/stoyanovgeorge/ffmpeg/wiki/How-to-Stitch-Videos-Together>

# Software System:

The software system would also consists of related pipeline/workflow required to preprocess (stitch together) the 2 images/videos pair from each different ‘eye’ camera module, most likely using ffmpeg, handbrake, or video editing tools. This will then be projected to VR (Virtual Reality) HMD (Headset Mounted Display), in my case which is Pico 4, using desktop PCVR app developed on most likely, Godot 4.0 with its newly added XR support. After getting advice from very helpful Godot Dev, Bastiaan "Mux213" Olij, from their #xr channel in their Godot Discord, it is confirmed the idea is feasible, in which SBS video player can be achieved just by modifying this tutorial ( [Godot VR Video Player Part 1 - YouTube](https://www.youtube.com/watch?v=snqoqgQy3Uk) ) and adding some shaders code that adjust the specific side of eye to corresponding headset ‘eye’ display. This is the boilerplate code kindly provided from him which I will try to implement and improvise:

shader\_type spatial;

render\_mode unshaded;

uniform sampler2D movie : hint\_color;

void vertex() {

UV = vec2(UV.x \* 0.5, UV.y);

if (VIEW\_INDEX == VIEW\_RIGHT) {

UV.x += 0.5;

}

}

void fragment() {

ALBEDO = texture(movie, UV).rgb;

}

# Budget:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Budget for 3rd Year IP = £150** | |  |  |  |  |  | |
|  |  |  |  |  |  |  | |
| **No.** | **Item** | **Function** | **Cost (£)** | **Quantity** | **Total** | **Link** | |
| **1** | Raspberry Pi Pico W | Signal/Control/Main Pico | 6.3 | 1 | 6.3 | [Raspberry Pi Pico W | The Pi Hut](https://thepihut.com/products/raspberry-pi-pico-w) | |
| **2** | Raspberry Pi Pico | Eye'/Camera Pico | 3.9 | 2 | 7.8 | [Raspberry Pi Pico | The Pi Hut](https://thepihut.com/products/raspberry-pi-pico?variant=41925332533443) | |
| **3** | 5MP ArduCam Camera module, OV5642 | Camera Module (SPI) | 35 | 2 | 70 | [5MP OV5642 Mini SPI Camera Module for Raspberry Pi Pico | The Pi Hut](https://thepihut.com/products/5mp-ov5642-mini-spi-camera-module-for-arduino) | |
| **4** | SD Card SPI Breakout Board | SD Card 'reader' (SPI) | 3 | 2 | 6 | [Adafruit Micro SD SPI or SDIO Card Breakout Board - 3V ONLY! | The Pi Hut](https://thepihut.com/products/adafruit-micro-sd-spi-or-sdio-card-breakout-board-3v-only) | |
| **5** | 32GB MicroSD Card | Storage | 8 | 2 | 16 | [SanDisk MicroSD Card (Class 10 A1) | The Pi Hut](https://thepihut.com/products/sandisk-microsd-card-class-10-a1?variant=39641172377795) | |
| **6** | Electret Microphone Amplifier | Audio recorder | 6.9 | 2 | 13.8 | [Electret Microphone Amplifier - MAX4466 with Adjustable Gain | The Pi Hut](https://thepihut.com/products/adafruit-electret-microphone-amplifier-max4466-with-adjustable-gain) | |
| **7** | Breadboard for Pico | Prototyping | 4.2 | 1 | 4.2 | [Breadboard for Pico | The Pi Hut](https://thepihut.com/products/breadboard-for-pico) | |
|  |  |  |  |  | 0 |  | |
|  |  | Shipping Fee | 3.99 | 1 | 3.99 |  | |
|  |  |  |  | Total = | 128.09 |  |

# Existing technologies, design considerations and feasibility studies:

Lifelogging, a niche hobby primarily encompassing various activities, extends beyond typical social media updates and encompasses recording various aspects of one's life. Existing consumer technologies tailored for lifelogging are limited and often come with a high price tag, leading individuals to repurpose mainstream products such as GoPro cameras or customize their smartphones with specialized hardware and software (apps) to capture images at intervals. Some dedicated lifelogging products, like the Insta360 Go series and the lesser-known Narrative Clip, do exist. Notably, lifelogging comprises not only visual data in the form of images and videos but also encompasses a wide array of personal activity data, extending to areas like music preferences and physiological data derived from sensors like heart rate monitors on smartwatches.

However, the focus of this study centers on capturing lifelogging moments in stereoscopic fashion specifically designed for VR consumption. The aim is to move beyond ubiquitous monoscopic imagery and embrace the future of stereoscopic imaging as seen in technologies like Apple Vision Pro, iPhone 15 Pro, Meta Quest 3, and XR devices. The initial design concept involves a clip-on glasses style, similar to products like Meta Rayban Glasses and Snapchat Spectacles Glasses. However, due to time and expertise constraints associated with designing custom PCBs for compact wearables, the project pivots toward a modular design, allowing for three primary wearing methods: 1) a clip-on hat/cap, 2) a lanyard or chest-mounted clip, and 3) a clip-on glasses design. While the last option is the most discreet, resembling Meta or Snapchat's designs, it necessitates extensive research and development. Accompanying software, including a VR SBS video player and a system for indexing images, videos, and daily activities, is part of the project. The software also incorporates built-in metadata tagging for object and scene detection, enhancing searchability. The primary target audience for this project comprises lifeloggers and VR/XR enthusiasts seeking to record their daily experiences and memories in the immersive Side By Side (SBS) format.

History of lifelogging and possible cause of its downfall (smartphones etc, 2013-2014), and AVP and iphone15 Pro, sony having Stereo images cameras)