STANDARD OPERATING PROCEDURE

VeinFinder

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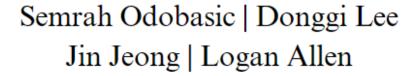
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The Project

This project is a vein finder which assists people in finding veins using IR. Blood carries hemoglobin which absorbs IR light. When you apply IR light to the arm and take an image you can see the veins. We then want to take those images and segment them using a machine learning model. This is because the future goal is to use the onboard projector to project the veins back onto the arm. We will specifically use the U-Net designed by Rich Baird. This allows us to use lower quality hardware to get an image we can use.

Hardware

Included
- Raspberry Pi 2
- NoIR PiCam 2
- IR Emitter Array
- Projector
- IR Pass Filter
- Voltage Regulator
- Custom 3D Printed Hardware

Required for Operation
- Keyboard
- Mouse
- Monitor
- HDMI Cable

Software

Dependencies
- Picamera 2 Python Library
- OpenCV
- Numpy

The Software
The script "cameratesting.py" is the main file that you will use. It takes an image and outputs it on the screen. Overall it is very simple. It fixes the exposure, gain, contrast, auto white balance, and auto exposure to be fixed. They are currently set to the values that gave us the best results. There is also a file which has our first segmentation model. This model only uses OpenCV and doesn't use any machine learning. It works to an extent but the machine learning segmentation model works better.

cameratesting.py & segmentation.py

Operation

The operation of the camera is very simple. First, a keyboard and mouse should be connected to the raspberry pi. You also want to connect a monitor to the pi using an HDMI cable. Ideally you want to have a non IR reflective background so that the arm is clearly visible. You then want to turn on the projector. It powers everything from its internal battery so ensure that it is on. When the Pi powers up you want to run the "cameratesting.py" file which will run the script that uses the U-Net.

Key Notes

The IR light has a switch on the bottom if you don't see any output check to make sure the switch is on. To confirm the IR is enabled you can open your camera app on your phone and look at the IR. It should look like it emits a purple light.

The vertical distance from the camera is important and varies from person to person. Move your hand up and down to ensure you get the best possible image.

Results vary. Some people can get great images while others struggle to get any veins to show up.

Future Plan Recommendations

If anyone takes over this project we have a number of recommendations. First is that the Raspberry Pi should be upgraded to a newer model. This is because to do live segmentation using the U-Net model we need PyTorch. The PI 2 can only have a 32 bit OS so it cannot do it. Once you have a new PI on a 64 bit OS you can implement this part easily as it is documented in Rich's code.

Once that is done we recommend doing the projection. The camera module can be rotated slightly which can help with making this work.