Senior Design / BS Project
May - 2020

iCVein

Larissa Meza, Victoria Popp, Melissa Suarez, Mary Vollmar, Hanna Wollin
Dr. Jorge Bohorquez
Department of Biomedical Engineering

Abstract

A way to avoid accidental punctures and missed veins for all patients and healthcare workers undergoing and performing any blood drawing procedures to prevent nerve damage and blood-borne infections.

Introduction

Venipuncture is the most common invasive medical procedure that is performed by clinicians. When the vein is not accurately punctured, the clinician must remove the needle and attempt to access a vein through another injection site. This process can cause discomfort to the patient as well as increase susceptibility to infections and diseases. Some of the complications caused by inadequate venipuncture include pain, nerve damage, hematomas, blood-borne infections, fainting, edema, thrombosis, and vein damage.

A device in which an accessible vein is shown on a monitor for the clinician to see decreases the likelihood of misplacement of puncture site. It would decrease the uncertainty involved in placement of an viable vein in a vulnerable patient. Current devices available for purchase are not user friendly, lack proper resolution, and projection techniques. Therefore, the objective of this project is to develop a device that will decrease complications from blood drawing procedures and improve patient safety.

Table 1: Statistical Summary of complication due to venipuncture

COMPLICATION	TOTAL (N=4050) NO. (%)	MEN (N=3200) NO. (%)	WOMEN (N=850) NO. (%)	*P* VALUE
BRUISING	416 (10.3)	176 (5.5)	240 (28.2)	< 0.001
HEMATOMA	80 (2.0)	36 (1.1)	44 (5.2)	< 0.001
PAIN	80 (2.0)	40 (1.3)	40 (4.7)	< 0.001
TOTAL	576 (14.2)	252 (7.9)	324 (38.1)	< 0.001

Methods I Design I Analysis

iCVein is a device which would serve as both a tourniquet stand, and a vein detecting system.

- Webcam with IR-blocking filter removed
- An optical daylight blocking filter of 850nm
- Tourniquet stand with forearm rest
- IR LEDs with a wavelength of 850nm

Figure 1: Implementation of design concept

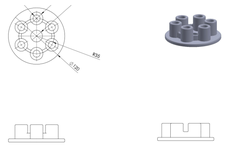

Figure 2: AutoCAD IR LED ring holder design

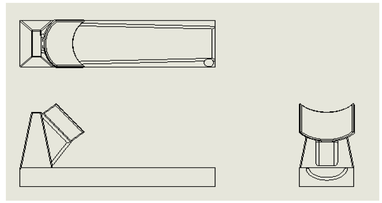

Figure 3: AutoCAD design of tourniquet stand

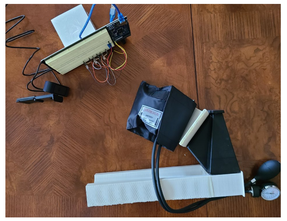

Figure 4: Device Prototype

Results

Figure 5: The image to the left demonstrates the subjects arm without the venipuncture device.The image to the right only uses the Laplacian sample as a control.

Figure 6: The image to the left demonstrates the image captured by the device. The image to the right involves the device and the use of a Laplacian filter

Conclusion

The objective of this vein detection device for venipuncture is to reduce accidental punctures for patients and healthcare workers. Nonetheless, there are a few conditions that still require further mitigation such as:

- Improve light source for better absorption of light on a wide range of skin complexions
- Heighten contrast to increase sharpness of image
- Create one software to use along device to capture grayscale images, increase image contrast, process, and display live images
- For future testing, capture more images on individuals of various age range and BMI ranges to observe detection of veins.

Acknowledgments

With immense gratitude, iCVein would like to thank Dr. Jorge Bohorquez for his contributions and guidance throughout this project. We would like to thank Dr. Ramon Montero for providing ideas and support in times of hardship. iCVein would also like to thank the Department of Biomedical Engineering for funding this project and allowing us to enhance our capabilities as engineers. Last, but not least, we are extremely thankful for our loved ones who constantly motivated us to continue to thrive on.

References

- Chiao F.B, Resta-Flarer F, Lesser J, Ng J, Ganz A, Pino-Luey D, Bennett H, Perkins C, Witek B. Vein visualization: patient characteristic factors and efficacy of a new infrared vein finder technology. *British Journal of Anaesthesia*, Volume 110, Issue 6, June 2013, Pages 966–971, https://doi.org/10.1093/bja/aet003
- Cuper, Natascha J, et al. “Visualizing Veins with near-Infrared Light to Facilitate Blood Withdrawal in Children.” *Clinical Pediatrics*, U.S. National Library of Medicine, June 2011, www.ncbi.nlm.nih.gov/pubmed/21357203.