AUTOMATIC BLOOD DRAWING AND INJECTING MACHINE

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1. INTRODUCTION:

The automatic blood drawing and injecting machine is an innovative medical device designed to streamline blood sampling and injection processes. This project aims to develop a system that can accurately and safely detect the vein and then collect blood samples and administer injections, reducing the need for manual intervention by healthcare professionals.

Brief Working Principle:

Vein detection using ultrasound guidance identifies suitable veins for medical procedures. Once a vein is located, a robotic arm controlled by AI accurately inserts the needle into the vein. The system then performs either blood sampling or injection with precision. After the procedure, the needle is safely withdrawn, and the patient's arm is released, ensuring a smooth and automated process from start to finish.

2. MOTIVATION:

The idea of developing this automatic blood drawing machine is highly motivated to improve the accuracy and efficiency of the work and also the patient experience.

3. LITERATURE SURVEY:

(1) https://www.researchgate.net/profile/Max-Balter-2/publication/283748690

(2) Ahmed, K. I., Habaebi, M. H., & Islam, M. R. (2018). *A Real-Time Vein Detection System. Indonesian Journal of Electrical Engineering and Computer Science*, 10(1), 129–137. https://doi.org/10.11591/ijeecs.v10.i1.pp129-137

(3) https://www.medicaldevice-network.com/news/vitestro-autonomous-device-blood-collection/?cfview

(4)https://www.researchgate.net/publication/382763497_A_Noninvasive_Vein_Finder_Based_on_a_Tuned_Microwave_Loop_Resonator

(5) https://www.frontiersin.org/journals/medicine/articles/10.3389/fmed.2023.1251963/full

Case Studies:

Reducing Human Error & Increasing Precision

In a pilot study conducted in collaboration with a major academic hospital and a leading technology institute (such as IIT Delhi), researchers tested an automated blood drawing prototype designed to locate veins using infrared imaging and AI.

The automated system significantly reduced the number of missed veins and repeated attempts compared to manual drawing.

Addressing the Shortage of Skilled Healthcare Workers

In rural regions of Maharashtra, a pilot project introduced a mobile automated blood collection unit to address the chronic shortage of skilled phlebotomists.

The unit successfully performed blood draws with minimal supervision, ensuring timely diagnostic services even in underserved locations.

Enhancing Safety & Hygiene

In urban clinics in Mumbai, a collaborative pilot project between healthcare providers and tech startups implemented an automated blood drawing device integrated with sterilization protocols.

The machine automatically disinfected the drawing area before needle insertion and safely disposed of used needles afterward.

The project reported a decrease in contamination incidents and needlestick injuries, contributing to a safer clinical environment.

4. SCOPE OF STUDY:

Vein detection is a crucial aspect of various medical procedures, including blood sampling, injection, and catheterization. Accurate vein detection is essential to reduce the risk of complications, such as nerve damage, bleeding, and infection. Traditional methods of vein detection rely on visual inspection, which can be challenging, especially in patients with dark skin or obesity. Automated vein detection systems have been developed to improve the accuracy and efficiency of vein detection. These systems use near-infrared (NIR) imaging or ultrasound imaging to capture images of veins beneath the skin. Machine learning algorithms are then used to analyze these images and detect vein patterns.

5. **METHODOLOGY:**

The market standards highlight the use of Raspberry Pi (2 or 3 B) for most affordable systems, while high-end models rely on laptops. The depth of penetration ranges from 1.5 mm to 3 mm, with the 940 nm wavelength being the most commonly used. This reflects a balance between image clarity, portability, and cost efficiency across different vein detection technologies**.**

6. **DELIVARABLES:**

The following are the list of material required to build the circuit for this project.

Raspberry Pi Zero W,RPi NoIR Camera V2 (8MP),940nm IR LED,940nm IR Photodiode (pre-filtered),5V 2A Power Supply, Li-ion 18650 Battery and TP4056 Module,MT3608 Boost Converter (3.7V → 5V),MicroSD Card.

The system utilizes a Raspberry Pi Zero W to run image processing algorithms, which detect veins using infrared light. The RPi NoIR Camera V2 captures high-resolution images, while the 940nm IR LED and photodiode highlight veins by detecting haemoglobin absorption. A stable power supply and MicroSD card storage support the system's operation.

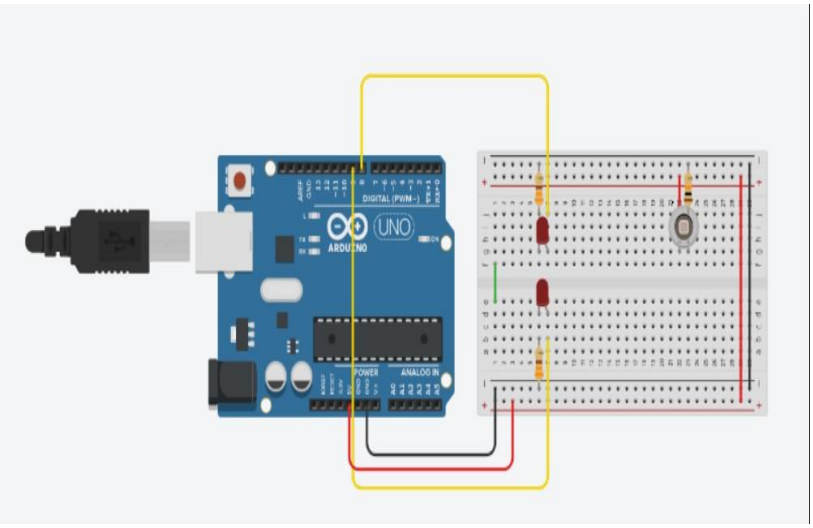

Fig: Circuit simulation

7. **FUTURE PLAN:**

“PORTABLE & AFFORDABLE VEIN DETECTOR”

As we move forward with our automated vein detection system, our future plans involve integrating the Raspberry Pi-controlled IR LED and photodiode setup with the RPi NoIR Camera V2 to capture high-quality infrared images of veins. We also plan to optimize the system's power consumption by refining the MT3608 boost converter and Li-ion battery setup, enabling longer battery life and increased portability. Additionally, we aim to develop a user-friendly interface for medical professionals to easily operate the system and interpret vein detection results. By advancing our system's capabilities and usability, we aim to improve the accuracy and efficiency of vein detection in medical settings.

At the end of the day we wanted to build a prototype which will help to detect the vein, and which also is cost effective and has intuitive interface.