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# Artificial Intelligence Based Portable Robot Device for Autonomous Venepuncture

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**Abstract**

*Venepuncture is a source of medical hurt and is necessary for a wide range of therapeutic procedures. Venpuncture-related complications worsen in difficult settings, where the success rate is largely dependent on the physiology of the patient and the skill of the practitioner. It is difficult to find the vein for infants, adolescent girls, obese and elderly people and it is causing severe pain in the traditional manual blood drawing system. In this research work, a novel idea entitled "Artificial Intelligence based Portable Robot for Autonomous Venepuncture (AIPRAV)" is proposed that can automatically detect the Human Vein, Inserts Needle and Draws pre-defined amount of blood without causing any pain (by spraying local anesthesia) and without any human intervention. By creating a peripheral line for both IV drugs and blood draws, this automated equipment promotes procedure safety and accuracy. The apparatus comprises a robotic needle, computer vision software, and a near-infrared imaging system all enclosed in a portable shell. An LCD display allows users to view the device's real-time activity progress. In order to guide the needle into an exact vein, the gadget works by imaging and recording the 3D spatial coordinates of superficial veins in real-time.*

## INTRODUCTION

A basic medical technique that is generally a crucial initial step in patient treatment is the establishment of an intravenous line, which involves placing a needle into a patient's arm to take blood. The degree of difficulty associated with achieving a successful venous access varies based on the veins and physiology of the patient as well as the medical technician's ability. It frequently results in an extremely bad conclusion that calls for delays, retries, and even more assistance.

Some individuals have relatively easy venous access because they have veins that are easily palpable and visible, which makes the insertion process go more smoothly. Nonetheless, a lot of people experience problems because of things like thin or brittle veins, dehydration, obesity, or past medical procedures that might have damaged vein integrity.

In the present situation, sometimes it is very difficult to find the right vein, that results in multiple insertions of needle which is inconvenient to the patients and also causing severe pain [6–9]. This AI based portable robot can find the most appropriate vein to draw blood from and if the veins are clearly visible, the machine can draw blood with 98 percent accuracy but in case the veins are slightly difficult to spot, the number may go down to a still-commendable 90 percent. This device is having

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high potentiality to improve clinical efficacy [1–5]. Human hand is first led to the blood drawing machine.

After inserting the forearm inside the machine, he or she uses an inflated cuff to highlight the veins and limit the flow of blood (the cuff here is used to restrict venous blood flow; it will not hinder arterial blood flow) [15].

After that, the inner elbow is seen with ultrasound to identify veins, which are then analyzed by computer vision algorithms and compared to anatomical models. After a vein is chosen, an ultrasound scan verifies that it receives significant blood flow.

If it does, then the machine inserts a needle and starts drawing the patient's blood. Here a predefined arrangement is made to automatically selects the amount of blood to be drawn from the patient with an arrangement of switches. The switches are arranged in such a way that, collection of blood into the single/multiple containers can be made automatically without multiple insertions of needle into the human vein [16–20].

## NEED FOR THIS RESEARCH WORK

It is a common practice of physicians to send the patient for blood test for the preliminary diagnosis. So, an autonomous tool to collect blood is the need of the hour. At present Vein Finder Torches are available in the market to detect the veins using ultrasound Image technology. But as of now Artificial Intelligence based systems for drawing blood samples are not available in the market. This is an Integrated System and an unique idea for the development of an "Artificial Intelligence based Portable Robot for Autonomous Venepuncture [21–25]".

## LITERATURE SURVEY

In 2012, Prabhu et al. [10] used two different approaches based on a NIR Web-camera at a distance of 14 cm, and a DSLR (Digital Single Lens Reflex) camera with an external filter to block visible light, to aid intravenous delivery of haemostatic agent. The experiments focused on visualization of veins in the palm with the DSLR images having better performance. In related research, Hu et al. in [11] described a binocular vision system based on two NIR CCD cameras and several 850 nm NIR LEDs to capture IR images of the hand. They used the stereo vision to recover the hand's 3D structure. Additionally, VeinLoc by Agarwal and Vidhya [12] used a similar NIR imaging system for blood vessel detection and localization. In contrast, Meng et al. [13] developed a prototype of a wearable vein localization system using NIR imaging. Specifically, they used the Vuzix STAR 1200XL eye wear system as a headset device on which they mounted an IR CCD camera with NIR LEDs. However, this head-mounted device was large, heavy and impractical for the clinicians. Moreover, Qu et al. in [14] designed an app. for smart phones to transmit and process the captured image from a NIR camera. The study aimed to create a low-cost, accurate vein-imaging method, however, it was not completed, with the authors highlighting uncertainties that may occur during the image projection[ 26–29].

## METHODOLOGY

The methodology for proposing, designing and developing this device is

a. To prevent vein access issues that might lead to missed sticks and patient harm.
b. This tool might assist healthcare workers in obtaining blood samples in a timely, safe, and reliable manner, avoiding needless difficulties and patient discomfort from repeated needle insertion efforts.
c. To prevent hiring more staff, which would prolong procedures and incur extra expenses for hospitals.
d. How to take blood from radial forearm veins carefully
e. To identify appropriate vessels for the puncturing and robotically guide a connected needle near the lumen center, the device integrates miniature robotics and ultrasound scanning.

 

f. The amount of collection of blood can be controlled by the human and also it can be made automatic [30–33].

**CONCLUSION**

The potential indication of robotic venesuction application can be useful in emergency condition where the detection of veins or arteries becomes really challenging when they can collapse in conditions such as Hypovolemic shock, Extensive burns, Cellulitis, Anasarca, For getting ABG in cases of systemic acidosis and alkalosis, Blood collection, Venous infusions, Diagnostic blood testing.

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