1. A robotic venipuncture system comprising:
    - A dual robotic arm system, where one arm is equipped with tactile sensors for vein manipulation and stabilization, and the second arm is configured for precise needle guidance and insertion.
    - US and NIR imaging systems for vein localization.
    - An AI-based control system for harmonizing tactile and visual data to guide needle insertion.
2. A robotic breast diagnostic system comprising:
    - Tactile sensors capable of detecting tissue irregularities.
    - An AI-driven analysis system to identify anomalies based on sensor feedback.
    - A standalone design optimized for non-invasive breast cancer diagnostics.
3. A robotic prostate diagnostic system comprising:
    - Tactile sensors for detecting gland texture, elasticity, and size.
    - An AI-driven system for analyzing tactile feedback to identify irregularities.
    - A standalone design providing non-invasive prostate evaluations.
4. The system of claim 1, wherein the tactile sensors simulate human palpation for complex venous access cases.
5. The systems of claims 2 and 3, wherein the tactile sensors provide consistent diagnostic pressure and feedback for anomaly detection.

Advantages of the Invention:

1. **Specialized Precision:**
    - Each system is tailored to its specific application, ensuring optimized performance for venipuncture, breast cancer detection, and prostate exams.
2. **Patient Comfort:**
    - Minimizes invasiveness and enhances comfort, particularly for diagnostic procedures.
3. **Efficiency:**
    - Reduces dependency on clinician expertise for consistent outcomes, particularly in high-volume settings such as plasma collection.
4. **Scalability:**
    - Modular designs enable widespread adoption in diverse clinical and research settings.

Applications:

1. **Healthcare Diagnostics:**
    - Automated venipuncture for plasma donation and routine blood draws.
    - Non-invasive diagnostics for breast cancer and prostate conditions.
2. **High-Volume Plasma Collection:**
    - Seamless integration with plasmapheresis systems for enhanced efficiency.

3. **Medical Research:**
    - Platforms for advancing tactile sensing technologies in robotic systems.

Conclusion: This invention introduces a family of robotic systems that leverage tactile and visual technologies to address critical challenges in venipuncture and diagnostics. By focusing on specialized applications, it establishes a new benchmark for precision, patient comfort, and accessibility in robotic healthcare.

Inventors: Oren Raphael