Executive Summary

The sponsor of the SonoHand project, Dr. Preetham Suresh, specializes in anesthesiology at UCSD's School of Medicine and often works with ultrasound machines. Ultrasound machines obtain real time images through waves sent and received by a probe in order to guide a needle to a target for various operations, such as central venous access, nerve blocks, joint injections and aspirations, and biopsies. In these operations there are 3 tasks involved: holding the probe to consistently see the image, holding the needle, and injecting or aspirating on the syringe. The project's motivation was to design and fabricate a one of a kind medical device that acts as a "3rd" hand that holds onto the probe in order to reduce the need of an assistant during operations.

Primary requirements for the arm included the following:

- Maintains contact during the operation between the probe and patient
- Size is limited to 2-3 feet to keep the arm within the sheath's sterile field
- Ability to hold different types of probes (SonoSite's C60, HFL38XI, etc.)
- Flexible arm that can lock/unlock in place
- As low cost as possible
- The probe will unlock if the patient suddenly moves during the procedure

The design for the SonoHand was split up into four separate assemblies:

- The hand clamp
- The base clamp
- The locking mechanism
    - Comprised of an electrical system due to a desire for a foot pedal
- The articulated arm

The hand clamp is a metal phone clamp with an adhesive sponge that is attached to a spring pressure application to achieve constant skin contact for the sonogram. The base clamp is a machined aluminum fixture that has a threaded screw attachment that will allow for attachment to the probe holder or railing of the ultrasound machine. The articulated arm is a linkage of square aluminum rods and ball and socket joints that connects the other assemblies together. The locking mechanism locks and unlocks the arm through a foot pedal and Arduino interface that is powered by an external power supply. A block diagram detailing the assembly of the SonoHand can be seen in Figure J.1.

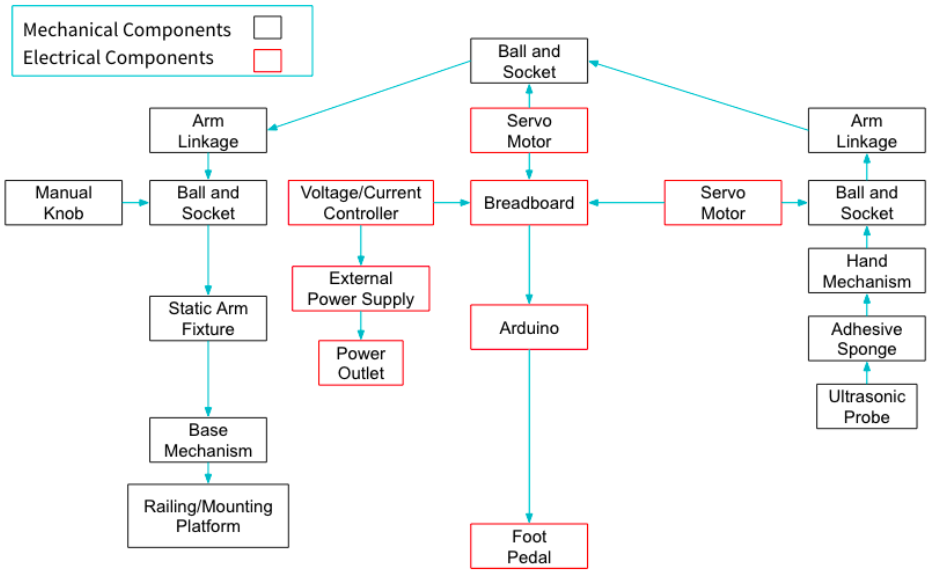

Figure 1: Block Diagram of the SonoHand

Successes from the project are as followed:

- Constant skin contact through a spring pressure mechanism that has a force of 2 N/mm
- 3 feet total radius that tested successfully with a Sonosite sheath
- Universal probe holding with a press fit adhesive material
- Accurate mechanical system with 6 DOF
- Locking of the base, arm joints, and hand by foot pedal with a torque of 1.96 N*m
- Easy to machine
- Springs retract when struck with a hard force and do not break

The SonoHand device satisfies all assigned performance requirements, and partially meets the secondary requirements of having wire management and having a versatile base.

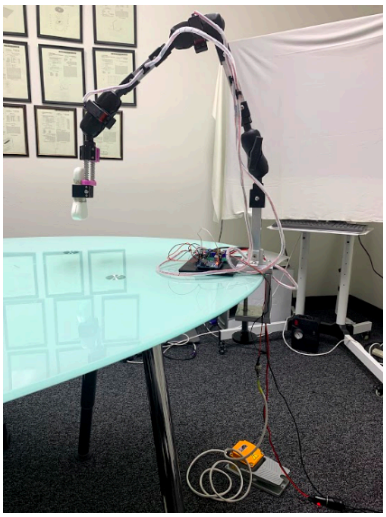

Figure 2: Final design of the SonoHand