Team 5

STRYKER MEDICAL SIP TEST

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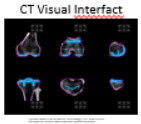
Customer Background

The MAKO Robot by Stryker Corporation is an advanced medical device enhancing joint replacement surgeries with precision. It utilizes a patient's CT scan to create a 3D joint model, guiding surgeons in real-time with visual, tactile, and auditory feedback. This technology ensures accurate implant positioning, resembling a natural joint post-surgery, and promotes faster recovery. It also aims to preserve healthy bone and tissue, contributing to better patient outcomes and longer-term joint health.

Mako Robot

CT Visual Interfact



Problem Definition

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The Sterile Interface Plate (SIP) is a plate with a fully rotatable, floating, blindly-mating connector designed to pass electrical signals from a surgical robot/machine to a robotic tool-arm. The robot is isolated from the sanitized operating room via the use of plastic sheeting in order to minimize the amount of time, resources, and effort required to sterilize all tools and equipment that will be present in the operating room. Since the robot is not sterilized, a connector is required to pass commands from the robot to the tool-arm which is itself sterilized. This connector is installed in the SIP. Stryker needs a way to measure SIP functionality before it ships a surgical robot to customers as part of its quality control program.

The team is tasked with developing an 'inspection fixture' that will be operated by a human user. The fixture must confirm that all electrical components are functioning properly via a continuity test and relay the results of the test back to the human operator. The device should conform to the working requirements set forth by Stryker's technical assembly room.

Requirements

Experimentation and Concepts

Electrical Design Iterations

Transistor based design. Simple circuitry provides a reliable test consists of a power LED and a Pass and Fail notifications.

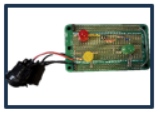
Microchip based circuitry. Allows for project expansion and upgrades. Similarly, functionality to the transistor-based circuit.

Mechanical Design Iterations

Initial "Clamshell" or "Empty" design. Inspired by Nature, and Household Items

CAD design of better. Simulating functionality and viability.

Conceptual Testing and Prototyping



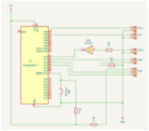
First iteration of the Transistor circuit test. Proves functionality and provides the foundation to build on.

Initial mechanical prototype for functionality test and proof of concept. "Work and Feel Test"

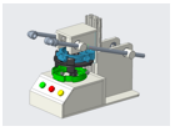
Final Design

Program and Testing Flowchart

Test Device Circuitry



Mechanical Design and Test Fixture



SIP Connection Cross Section

Final Design and Operational Test Fixture

Final Test Fixture allowing for the testing of the SIP. Easy operation for technician with recognizable pass/fail indications.

FMEA

Sip Test Interface
Effect: Improper PCB Connections
Mode: Circuit not completed when energized
Cause: False negative reading
Prevention: Proper instillation and insulation of pins

Digital Processor
Effect: Circuit over current
Mode: Faulty I/O ports
Cause: Improper data transmission
Prevention: Utilize high quality components

Power Supply
Effect: Wired Improperly
Mode: Under or Over the set voltage (5V)
Cause: Circuit Malfunction
Prevention: Proper connection of power supply to circuit

LED's
Effect: Incorrect or no input
Mode: LED doesn't notify operator
Cause: LED malfunction
Prevention: Component verification of schematic and PCB creation

Testing