LSU College of Engineering
Department of Mechanical & Industrial Engineering

College of Engineering
School of Electrical Engineering & Computer Science

To Predict ▶ To Design ▶ To Perform

ME, ECE Capstone Design Programs

Hybrid Manufacturing System for Axisymmetric Components

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NCAM National Center for Advanced Manufacturing

SIVAD INCORPORATED

Jack

Objective

The goal of this project is to demonstrate a successfully integrated hybrid manufacturing system that utilizes a Haas CNC lathe, Fanuc robotic arm, and a Fronius smart welder to produce an axisymmetric shaft and pulley component.

Engineering Specifications

Metric for Project Success	Goal Description	Testing Method
Hybrid Manufacturing	Identify all necessary weld parameters for each layer of additive manufacturing required to achieve an outer diameter of 5 in	Weld Parameter Layer Test
Autonomous Integration	All machines working simultaneously without interference from any outside sources	Full System Test (dry runs)
System Repeatability	Successfully create 5 parts consecutively	Full System Test (live runs)
Component Accuracy	All part measurements within +/- 0.005 of subtractive part measurements	Tolerance Test
Component Mechanical Integrity	Material properties within 90% of parent material	Rockwell Hardness Test; Microstructure Analysis
Safe operation	All safety equipment properly performing job function	Functionality and Continuity Tests
Efficiency Comparison	Determine if this process is more efficient than a purely subtractive process to make the same part	Process Analysis

Safety Considerations

Protect The User

Concerns: Arc flash, flying debris, Autonomous Machine Movements

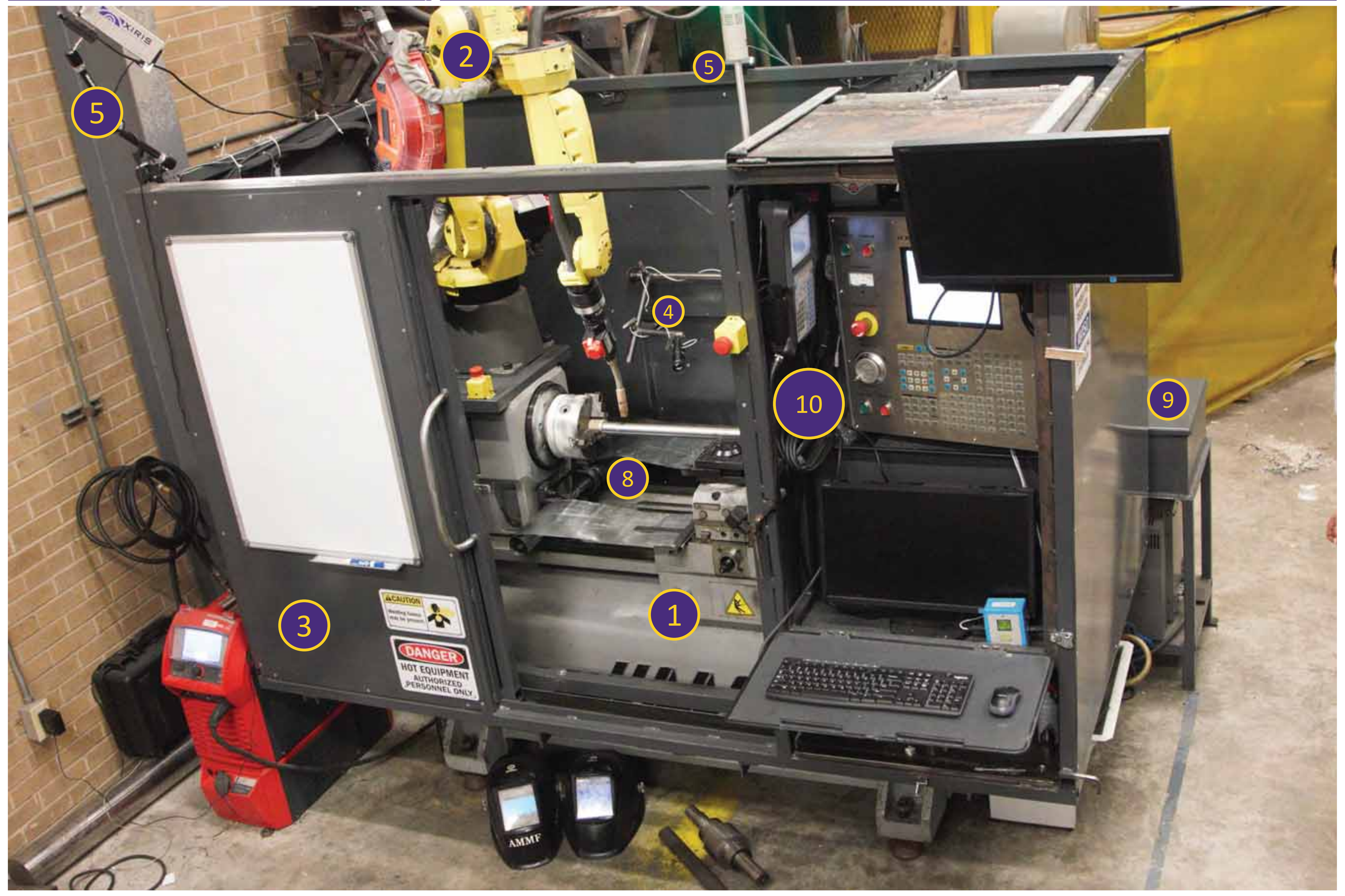
Features: Safety Enclosure, Door Permissive Sensors, Emergency Off Switches, Applicable Safety Placards

Protect the Machines

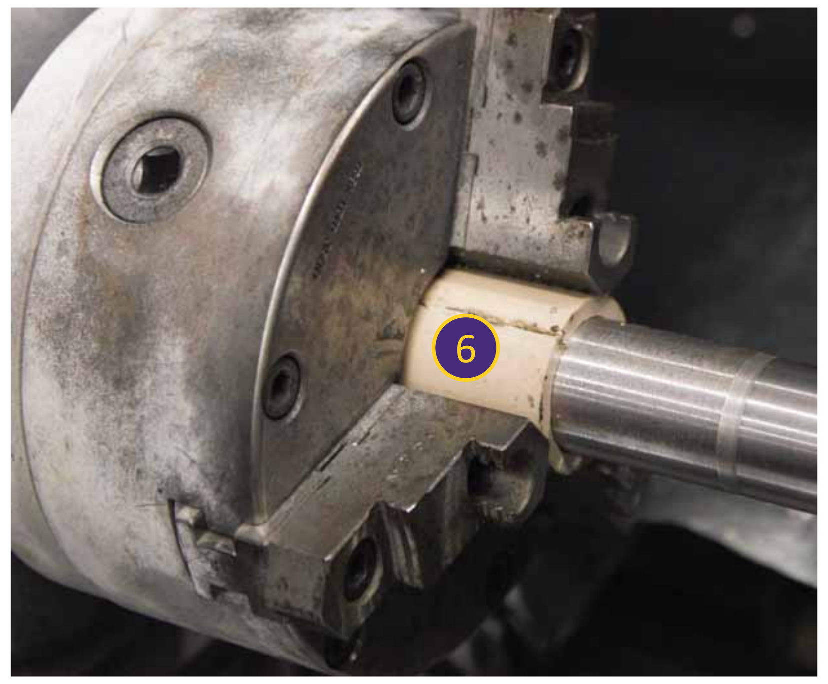
Concerns: Current flow causing bearing arcs or control panel shortage, improper grounding during welding

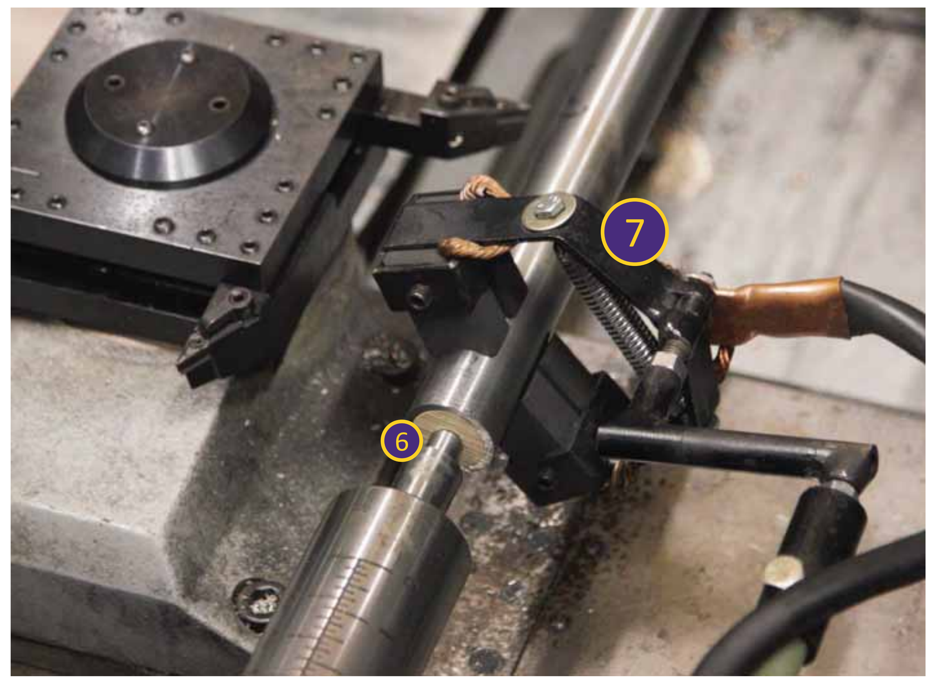
Features: Specially designed isolation and grounding mechanisms with proper placement to ensure intended current flow

System Features

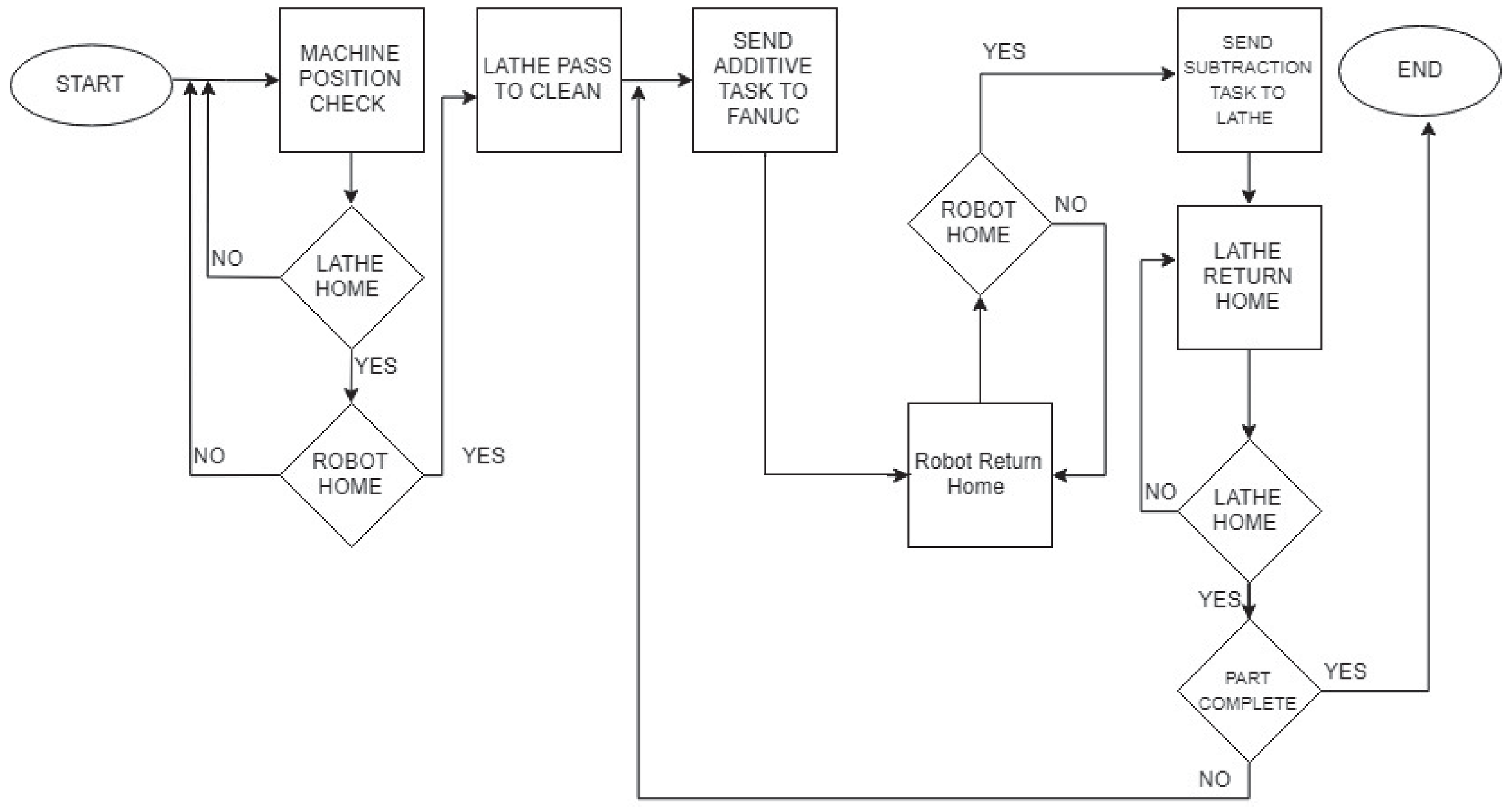


Number	Feature	Description
1	Lathe	Method of subtractive manufacturing
2	Robot Welder	Method of additive manufacturing
3	Safety Enclosure	Completely surrounds the system to protect operators
4	Temperature Sensor	Tracks the temperature of the demonstration part versus time
5	Cameras	Allows operators visual access to system while in operation
6	Isolation Pieces	Protect the lathe from any unwanted current flow
7	Grounding Clamp	Ensures a solid ground connection necessary for welding
8	Spatter Guard	Protects the rails of the lathe form any spatter or other debris
9	Control Tower	Safely houses necessary electrical equipment
10	Control Center	Provides operator full access to all system controls





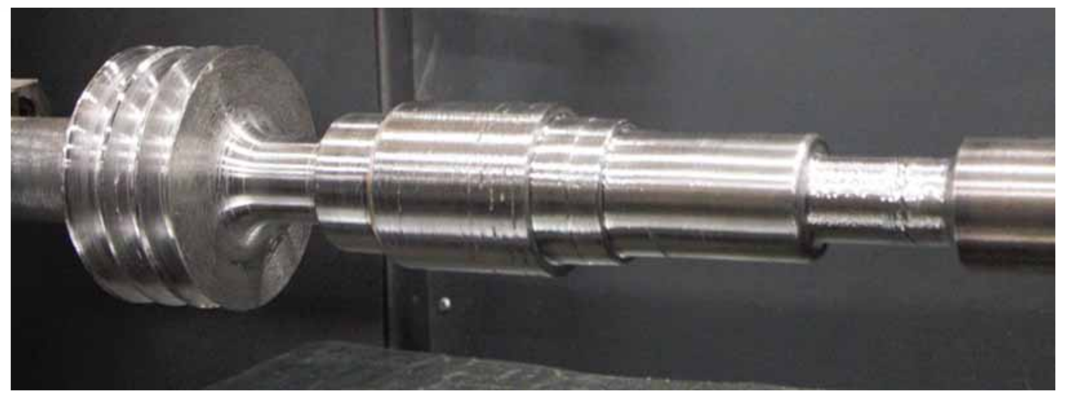
Communication Process



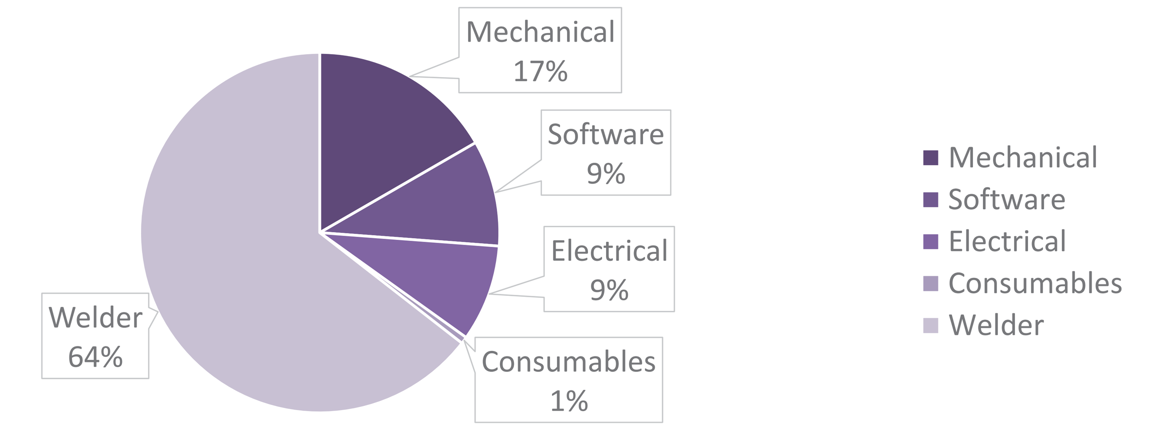
Hybrid Manufactured Part

SolidWorks Model

Actual Part



Project Expenses



September	October	November	December	January	February	March	April
Background research, define project objectives, and identify engineering specifications	Concept generation, evaluation, and selection; Identified further constraints for the system	Design synthesis, engineering analysis, and purchase welding power supply	Purchase parts for manufacturing and revise design based on feedback	Build safety enclosure, control tower, and manufacture system components	Continue manufacturing, integrate communication systems and physical machines, test weld bead geometries	Complete manufacturing, program and code system for operation, complete all component and sub-system tests	Complete all coding and programming, complete all manufacturing, complete all full system testing and analysis

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