Department Project Information

Department Name	*Mechanical Engineering and Engineering Science Department*	Date Submitted	*5/9/2022*
Project Title	*Filament-based 6 axis 3D printing head design controlled by a robotic arm* **(UNCC_ME_PRINT)**	**Planned Starting Semester**	*Fall 2022*

Funding

What is the source of funds that will be used to cover all direct costs of this project?

Is this source of funds already secured? Yes__ X__   No____

Work Space

Have you secured a lab/work space for the project to be built? Yes__X__   No____

Faculty Mentor/Grading Instructors *

	Name	**Email**	**Phone**
1	Erina Baynojir Joyee	ejoyee@uncc.edu	7046878930
2	Amirhossein Ghasemi	aghasem1@uncc.edu	7046877017
3	Towfiq Rahman (Grader)	mrahma18@uncc.edu	7046878932

*List any graduate student that will be working on the project as a grading instructor so that they may be added to Canvas.

Senior Design Project Description

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project. Assume 10 hours per week per student.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills:

Discipline	Number	Discipline	Number
Mechanical	1	Electrical	1
Computer	2	Systems	
Other ( )			

Project Overview and Requirements:

Additive manufacturing (AM), also known as 3D printing, is the process of fabricating objects from 3D model design in a layer by layer manner, as opposed to subtractive manufacturing technologies like traditional manufacturing. AM creates great potential to fabricate complex parts with intricate geometries, facilitates reduced material waste and fast-tracks prototype to market timeline.

Despite recent developments in using AM systems for the fabrication of large-scale structures, most of the commercial AM machines are 3-axis Cartesian coordinate robots or control systems with limited construction platform dimensions and degrees of freedom. External support structures are often required depending on the object's shape and dimensions, which can increase the fabrication time, cost, and material consumption. Moreover, the 3-axis AM devices have a strict layer-by-layer fabrication approach that leads to a typical stair-step effect.

In conventional manufacturing one of the most useful tools and support structures is the multi-axis robot-manipulated systems, often used for welding and pick-and-place tasks, offering consistency, maximum productivity, greater safety for repetitive tasks and reduced labor costs. The flexible functionalities of robots serve the dynamic demands of mass-manufacturing.

Therefore, the combined use of multi-axis robot systems and AM technologies offers the possibility for multi-axis AM and fabrication of complex geometries in different manufacturing environments. This is the overall focus of this proposed project.

The overall methodology for completing this project can be divided into two main tasks.

Task 1: System Design – The first task will include the design of the hybrid system, which will consist of a six degrees of freedom robotic arm, printing head with extruder and an integrated manufacturing platform to support the AM process.

Task 2: System control - The hybrid manufacturing process will require new software to be developed for (1) process planning, (2) controlling the elements of the printing head, (3) controlling the printing path through the robot arm controller, and (4) communicating between the robot arm controller and the printing head. It is important that the robot arm controller and the printing head controller can synchronize and communicate for providing robust and high quality printed parts.

Expected Deliverables/Results:

Deliverables include:

- Design of print head for attaching to the robotic arm controller
- Development of control system software so that the robotic arm and print head can work synchronously
- Design of a manufacturing platform/build area equipped with necessary features to support AM

Disposition of Deliverables at the End of the Project:

The hardware developed in this project will be the property of the mentors and the department.

List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):

- Familiarity or interest in 3-D printing and control system