Motivation of the Capstone Project
Fabricate a custom-designed low-cost extruder for sustainable manufacturing of recyclable magnetic filaments for use as feedstock in existing Fused Deposition Modeling (FDM) 3D Printing Technology.

Additive Manufacturing for Sustainment?
Conventional laser-based Metal 3D Printers are expensive and bulky, with a limited library of precursor materials.

Novelty: Halbach Array around the Extruder Nozzle
• Produces a high magnetic field utilizing permanent magnets, arranged with a spatially rotating magnetic field vector which has the effect of focusing and augmenting the magnetic field on one side
• Used in sophisticated high-torque motors, beam focusing, research and magnetic particle separation equipment for industry

Composition of Magnetic Filaments
The Polymer
PLA (Polyactic acid) or PBSA (Polybutylene succinate-co-adipate)
Criteria: Good thermal and chemical resistance; (compostable, industrial conditions)

Magnetic Nanoparticles
Lanthanum Iron Silicide La(FeSi)_{13}
Criteria: Excellent magnetocaloric properties at room temperature

Progress to Date
Efforts are underway to build the modified Lyman Extruder (Estimated cost: < $ 1500, with magnetic field rig)
• Structural components of the extruder have been completely printed
• Main extruder subassembly has been assembled
• LCD controls subassembly has been assembled
Immediate next steps:
• Finish Halbach design iterations
• Finish remaining subassemblies
• Test proof of concept by extruding Iron-based PLA filament
• Test Halbach magnetic strength

Beyond the Project
• Lyman Extruder is merely the starting point
• Hopes for future teams/contributors:
  • Interchange and upgrade hardware to meet different demands
  • Research more into different polymer/metal composites
  • Research and Develop an additional grinder aspect to the extruder