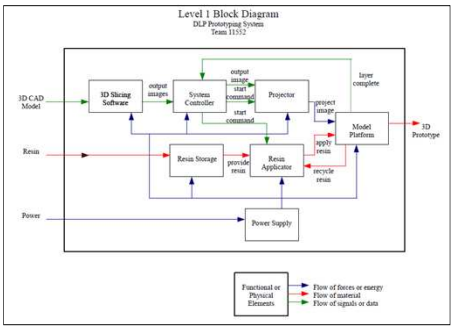
DLP PROTOTYPING SYSTEM
P11552 2010-2/3

Project Objective

The main objective of this project is to design and fabricate a projected image photopolymer 3D printing system. In order to fabricate a 3D printed part, the system will repeatedly cure a thin layer of resin, building upon the previously cured layers until the finished part is produced. The system will use a Texas Instruments digital light projector (DLP) system to project visible or UV light images onto a thin layer of curable photopolymer in order to selectively cure sections of the polymer. Deliverables of the project are to design and construct a resin-spreading sub-system, an optics sub-system capable of transmitting and focusing a suitably powered visible or UV light source, and the software needed to slice a 3D CAD model into the individual black and white images to be cured. The 3D printing system will expand the rapid prototyping capabilities at RIT and will primarily be used in the Brinkman Lab.

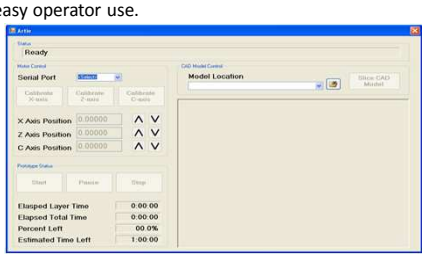
Concept Selection

In order to allow for the use of multiple materials in future iterations of the project track a design was selected that would maintain precise control over the resin. Although systems are currently available that implement a bath of resin, this would not be conducive to the use of multiple resin types, due to the potential of unintentionally combining resins, compromising the accuracy of the finished part. Therefore, the design calls for a self-contained resin cartridge to dispense a small amount of resin to be cured and then immediately removed to a catch basin. A build platform will lower into the resin and the DLP projector will display an image on the underside of the resin through a transparent film. Once the resin is cured to the build platform, the excess resin will be removed and the process will repeat until the part is finished.



System Control/User Interface

The motor control system was developed using the open source development environment by Arduino. In addition to motion control, limit switches were also attached to the micro-controller for an added layer of safety and security. A simple user interface was developed in order to allow for easy operator use.



Testing

Testing was done to ensure that both the doctor blade and scraper adequately control the resin. The doctor blade is designed to spread the resin in a thin layer and the scraper is designed to completely remove any excess resin. In order to achieve the desired layer thickness of .010 inches, the doctor blade was designed with micrometer adjustments on both ends. This resulted in a satisfactory resin layer thickness. The motors that controlled the resin platform and build platform required an accuracy of .001 inches, specifically for the build platform which is immerged into the resin layer. Both motors performed within this accuracy tolerance. Future testing will exam the accuracy of a fabricated part.

Motion Control Testing

Stepper Motor	Acceptable Accuracy	Measured Accuracy
Resin Platform (x-axis)	.0010 in	.000625 in
Build Platform (z-axis)	.0010 in	.00015625 in

Motivation

Although various projected image photopolymer 3D printing system are commercially available, these systems do not have the capability to produce a part that is fabricated using multiple resin types, limiting the functionality of a finished part. The ultimate goal of this project track is to design and fabricate a system that will allow for the use of multiple resins, placing RIT at the forefront of the 3D printing/rapid prototyping industry.

Doctor Blade / Scraper

Resin Platform

Build Platform

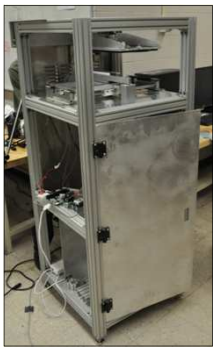
Resin-Spreading Sub-System

System Fabrication

The majority of the system components were fabricated from material provided by Peko Precision, a local manufacturing company. In order to further reduce the total budget of the system, parts were also taken from another rapid prototyping system located at RIT, known as the Fab-At-Home system.

Solidworks Design

Fabricated System



Future Work

-Improve upon cartridge design to allow for greater control of resin
-Develop software control sub- system to allow for fully automated DLP system
-Develop increased feedback capabilities to improve build accuracy
  -flow rate of resin, build height of part, etc.
-Develop resin filtration system to allow for reuse of uncured resin and reduce waste
-Modify resin dispensing technique to allow for use of multiple resin

Team Members
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