CMSC 22010 Final Project: 3D Scanner

Noah Halford
nhalford@uchicago.edu

Catherine Moresco
cmoresco@uchicago.edu

Team Scanner Planner

June 3, 2016

1 Specific Aims of the Project

One possible use case for 3D printers is object replication. While it certainly is possible to design 3D models of real-world objects in CAD software, there are a number of drawbacks to this approach: it may require many iterations to get right, it may be time-consuming, and it requires a very particular set of skills. One alternative is to use a 3D scanner, which simplifies and automates the process of digitally fabricating the desired object.

The goal of this project was to design and build a 3D scanner that could ultimately be used to produce STL file approximations of real-world objects. Of course, because we were doing this cheaply, we did not anticipate perfect results: our attempt to create a laser scanner would be considered successful if we were able to produce STL files that were recognizable as the objects they represented. We did not expect that our resulting STLs would necessarily be completely faithful representations of the original objects.

2 Background Research

Laser scanning is a technology that has already been very well-developed; going into this project, we knew that it was unlikely for us to make significant improvements over existing designs. Our goals were to design a laser scanner that would be cheap and would work (as described in Section 1), but, perhaps most importantly, to learn about how laser scanners work. Instructions for

a number of cheap DIY laser scanners already exist on the Internet, and we used these as inspiration for our project—although we did design our own hardware and software.

3 Approach

One of the challenges that we faced in this project was designing the laser scanner. We went through a number of design iterations, and the final product changed substantially from our plan from the pre-proposal stage. Our original plan was to have two webcams and the lasers between them mounted on a circular arc, with a turntable that could turn independently. The object to be scanned would sit on the turntable, which would rotate with a stepper motor. At each step of the motor, each camera would capture an image; we hoped to be able to combine data about rotation with a number of distance measurements (the distance between the cameras, between the cameras and the lasers, etc.) in order to produce a 3D model representation of the object we wished to scan. We built a prototype of this kind of scanner, but ultimately decided that it would too difficult to appropriately deal with the data that we produced. Our prototype used an Arduino attached to the stepper motor to control the turntable. A Python program communicating with the Arduino allowed us rotate the stepper motor (that is, the turntable) one step at a time, and take a photo from each webcam between steps. This produced 1024 images (512 per camera), but because of the low resolution of the webcams and the lack of precision in our constructed laser scanner, we decided that this approach would not work.

We finally settled on a different, arguably simpler design.