3D Printing Proposal for Holy Family School, Malone New York

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Objective

To bring basic additive manufacturing or 3D printing into Holy Family School as part of a Science, Technology, Engineering and Math (STEM) effort.

Background

Norsk Titanium is starting to set up a 3D printing facility in Plattsburgh for the manufacture of titanium aircraft parts and will be investing $1 billion over the next 10 years. This is a joint effort between New York state, SUNY Polytechnic in Utica and Norsk Titanium. SUNY Polytechnic is doing research into the applications for additive manufacturing. Therefore there is a direct correlation between having 3D printing in the classroom and jobs in the real world.

The author of this proposal earned his BSME from SUNY Polytechnic and was named to Tau Alpha Phi national engineering honor society member. He has 10 years of experience working as an aerospace engineer. He is also a Holy Family board member and volunteering to set up the 3D printing lab and work with the students on STEM projects.

Goals

- Expose the students to the details of additive manufacturing process. (This is not to just make 3D busts of the student's for their parents.)
- Students to learn basic 3D drawing and modeling.
- Students to learn the advantages and limitations of the additive manufacturing process by direct use and experimentation.
- Hold contests for the students to practice what is learned about additive manufacturing by making parts to meet the goals of the contests.

For basic 3D printing in a school environment, there is little need for a wide range of materials. Basic plastics will suffice for learning activities. This reduces the cost of the printer, the cost of operation and maintenance.

There are many popular plastics used in 3D printing. The two most common are PLA and ABS. PLA is a very tough material that can be easily recycled and comes in a large number of colors. ABS is stronger than PLA but more difficult to work with. Acetone may be used on ABS to remove rough edges left from the printing process or to bond parts together to make larger pieces.

To achieve these goals, several things are needed.

- A basic 3D printer
- Spools of both PLA and ABS plastic filament the 3D printer consumes
- Knowledgeable staff or volunteers to set up and run the lab
- Physical space to locate the 3D printer
- Computer(s) to run the software

Of this list, Holy Family only needs the first two items.

There are a large number of 3D printers available today that fit the overall requirements. Given this is a school where young children are present, there are additional requirements:

- Clear enclosure to keep exploring hands away and still watch what is going on. The enclosure also contains the dust created in the printing process.
- Noise levels not to be excessive as to disturb other learning activities.
- Relative ease of use.
- Heated plate for greater stability of parts while printing.
- Affordable cost.

The following table gives a list of 3D printers that meet all of the criteria

Make	Pro's	Con's	Cost
Ultimaker 2+	• 20 micron accuracy • Out of the box printing capabilities • Adjustable heat & speed • Exceptional community support • Open source hardware and software • Open filament system: uses standard spools.	• High cost • Connectivity (no wi-fi)	$2,500
FlashForge Creator Pro	• Dual extruder for multiple colors in the same part • Cost • Easy maintenance	• Poor software • Needs constant fine tuning & tinkering • 100 micron resolution • Smaller print space	$899
Zortrax M200	• Build quality • Ease of use	• 90 micron accuracy • Uses non standard filament: must buy from the manufacture at near triple the cost.	$1950

The current cost of a 1kg, 3 mm filament spool, either PLA or ABS is ~$35. One spool is capable of making ~3,000 chess pieces.

Recommendations

The Ultimaker 2+ is considered to be the best in class and has all of the capabilities desired.

Costs

Item	Quality	Total
Ultimaker 2+ 3D printer	1	$2500.00
3 mm PLA spool, color TDB	2 @ $35	$70.00
3 mm ABS spool, color TDB	2 @ $35	$70.00
1.75 mm PLA spool, color TDB	2 @ $30	$60.00
1.75 mm ABS spool, color TDB	2 @ $30	$60.00
	Total costs:	$2760.00

References

Makezine review of Ultimaker 2+: http://makezine.com/product-review/ultimaker-2/

Top 10 review of 2016 3D printers: http://www.toptenreviews.com/computers/3d-printers/best-3d-printers/

3D hubs 3D printer guide for 2016: https://www.3dhubs.com/best-3d-printer-guide