Carinthia University of Applied Sciences

Degree Program: Systems Design Master's

Lecture: Data Acquisition and Transmission

FEASIBILITY REPORT

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Introduction

3D printers have taken over the world over the last decade and they have found use in industry, as well as in homes. The convenience of producing plastic parts at homes gathered attention of many hobbyists and makers. In industry, the increasing production speed of 3D printers has made them suitable for rapid-prototyping, saving immense amount of time and money. Civil engineers and architects also found use cases for 3D printers. For example, Mayorship of Istanbul has built its own 3D printed local service buildings within a week with a fraction of cost and build complexity.

This study will focus on FDM printers in which plastic filaments are employed as raw material.

Definitions

FDM Printer: *Fused Deposition Modeling* printers melt plastic to fuse them onto each other. Combined with 3 or more axis movement, this machine produces useful parts or ornaments out of plastic filaments.

PTC Thermistor: A special kind of resistor whose resistance value changes depending on its temperature. PTC stands for *positive temperature coefficient*, which indicates that the resistance of thermistor is proportional to its temperature.

Hotend: It is the component that reaches up to 260 degree Celcius to melt the plastic and deposit it. The temperature sensor is placed onto this component.

Nozzle: It is a subcomponent of hotend, through which the molten plastic meets its final destination.

Need For Temperature Sensor

Hotend temperature must be kept stable as fluctuations in hotend temperature would cause quality issues on the product, e.g. uneven surface finish and/or material deposition, or nozzle clog. Therefore, the frequency at which the temperature is measured plays an important role. Also, since the sensor is placed at the carriage, its weight plays an important role in position control. However, a PTC thermistor is never of high mass, therefore this study will assume that the mass of the carriage will remain relatively same.

Requirements - Boundary Conditions

- Measurement range: 160 - 270 °C
- Size: 2x2x2 mm
- Weight $<$ 2 grams
- Accuracy $\pm$ 1 °C
- Power consumption $<$ 2 mW

Goals

In this feasibility study, the focus will be on an FDM printer's hotend temperature measurement with a PTC thermistor. The goal is to firstly calculate the necessary measurement frequency, then prove whether it is possible to sense the temperature at this required frequency, of the component in which the raw material would melt without compromising component safety nor end-product quality, whilst remaining within the project budget. To reach these goals, requirements on the next page must be fullfilled.

Limitations

The component to which the sensor will be mounted is chosen to be *"Hotend heaterblock E3D"* [**1**]

The following table describes the requirements: