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READING HIDDEN META-INFORMATION USING THERMAL TECHNOLOGY

HP INC

Reading hidden meta-information using thermal technology

This disclosure could be used to read internal information using thermal properties of the parts.

Multi Jet Fusion technology works by printing 2D layers of a given thickness one on top of another. For every layer, a uniform layer of powder is placed in the whole printer's build bed (print bucket), and ink agents are placed at the specific points which are to be fused (melted) to form the solid part.

When creating a 'solid' part (e.g. like a cube) the powder inside it can be either fused or be left unfused (i.e. in powder state), if the part is closed there is no way, from the external point examination of the part, to know if its interior is fused or in powder state. This allows us to 'code' information internally that can only be seen using thermal technology.

The parts are printed and when the process finishes, those parts can be 'unpacked' (retrieved, removed from inside printed bucked, which is mixed with other parts and the not-melted powder) using the Processing Station.

The basic problem solved is 'parts traceability' and 'parts identification', i.e. the ability to know which part is which, either when removing them from the print bucket or later in the part life. This traceability can be done without altering the external physical aspect of the printed part. Currently, suppliers for 3D printed parts generate a private code based on adding some shapes and patterns on the external surface of the part, which is a problem when using small and cosmetic parts due to the space and cosmetics limitations.

When unpacking the parts, it is very hard to track the position into the print bucket which the part was printed. In the same way if there are lots of jobs printed, if the parts are not labeled, it is very difficult to know in which job every part was printed.

When those parts go to the customer, the manufacturing information of the part is lost. If there is a need to do a manufacturing tracking, it could be impossible if the final part does not have visible information.

The printed parts have a visible serial number, or a label attached. This means that the final customer sees the number, and a cosmetic change that might not be desired.

Another solution seen is the use of the X-Ray technology, which enables to add the information internal in the part but it is an expensive technology, and not available for everyone.

This disclosure presents pretends to do the same as the X-Ray technology but by using thermal properties of the parts, which is much cheaper.

This solution provides a way to read hidden metadata inside the part that is inserted inside ‘not printing’ the inside of a part with the wanted meta-information. When the part is printed, the inside of the part is melted except the information we want to leave. The density of this information is different regarding the rest of the part and can be seen with the use of a Thermocamera and a heater used to create a thermal gradient on the part printed.

In the same way if the part is not printed inside because of ink saving, the information can be ‘printed’ and the density will be again different, because the powder will only be melted where the meta information is printed

The only limitation is that the area of the part where the information is printed must be in a portion when the powder cannot get out.

The process to be able to detect the serial number (SN) within a part is to locate the part above a heater and to increase its temperature by conduction until there is a thermal gradient between the solid and powdered areas of the part. When heating the part for a specific time, the solid part will obtain higher temperatures than the powdered part, where the SN will be hidden. This process is material dependent, and the results presented in this disclosure are based on PA12 material. In this case, we have seen that when the part is heated between 30-40ºC is when we can better detect the information hidden with thermal gradient differences around 0.5ºC (SN temperature around 38.4ºC and solid part around 39ºC).

It is also seen that it is important to locate the SN at the center of the part because it is easily to generate a thermal gradient as there is no convection (as it is seen at the boundaries). With this image and a post processing process of applying machine learning, the numbers on the SN can be detected and generated.

Please, note that when putting the part into an oven, as this is homogenously heated, any differences can’t be seen.

The final part has no visible manufacturing information and the information will always be there. This process can be implemented in any 3D printer machine that is able to use different densities in the same part. Also, to add the SN within the part does not increase the printing time, so we can add this functionality by increasing customer experience without affecting to the TCO.

Figure 1: Printed part where there is no sign of serial numbers nor labels

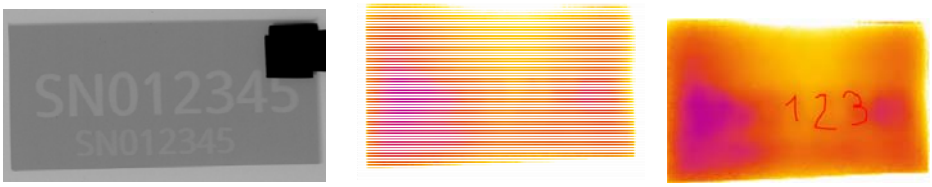

Figure 2: The metainformation (SN012345) can be read using a Thermal Camera when the part is subject to a thermal gradient

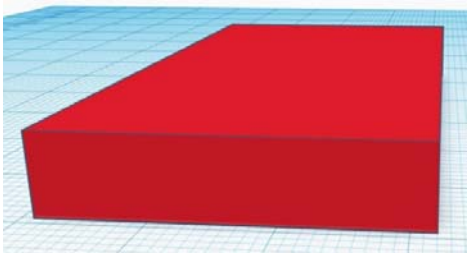

Figure 3: The figure that is going to be printed

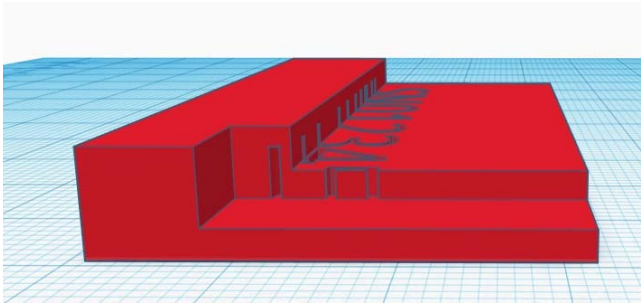

Figure 4: Detail with the part cut part to see the numbers as empty portions of the part

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