Zen and the Art of Glitter Deposition

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Integrity Industrial Inkjet Integration provides services to companies who need a printing manufacturing process that can print on a wide range of surfaces.

Our contacts at Integrity are Rich Baker, Mackinley George, and Myles Duncanson. Their company uses Inkjet printing for various applications such as, industrial graphics, material deposition, printed electronics, bioprinting, and many more, to ensure their clients receive the highest quality prints.

Background

The client currently has a method of layering adhesive and various powders on an inkjet conveyor that does not meet their standards.

Problem

Provide proof of principle, using glitter as a substitute for various powders. The module is to be attached to a conveyor belt along with an Inkjet printer head that will dispense a uniform coating of glitter on an adhesive with a method to recover and reuse any additional glitter that is not used.

Benefits

A fully functional module will prevent material waste and reduce cost while producing high quality/ high resolution prints for clients across several industries.

Client Requirements

- Maintain clean workspace and ensure minimal glitter escapes the box
- Maximize glitter use to create less waste and reduce cost on materials
- A way to easily control device to stop or divert the glitter flow
- Must only remove excess glitter and not glitter that has been adhered
- Be able to do multiple colors of glitters and multiple layers of glute/glitters
- Must not exceed surface area of conveyer belt plate: 7.5" x 7.5"

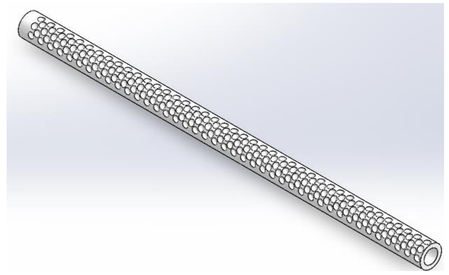
Acknowledgments

- **Mentor**: Jeffery Marshall
- **Instructors**: Dustin Rand, Ken Burkman
- UVM Fablab

Working Design Concept

Product Functionality

Our product is a proof of concept for a new method of additive manufacturing. This method of depositing and mixing powder to coat an adhesive can be applied to a wide variety of industries. Any application that requires a coating, patterned coating, 3D printed build, or 3D printed gradient is possible with this process. Our module accomplishes this by first depositing a dusting of glitter onto the substrate as it enters the coating chamber. Then the air blade gently blows across the entire width of the conveyor belt to cause any loose glitter to tumble backwards and coat empty areas of adhesive. As the substrate exits the chamber, any extra glitter continues to tumble backwards and can be used for the next coating

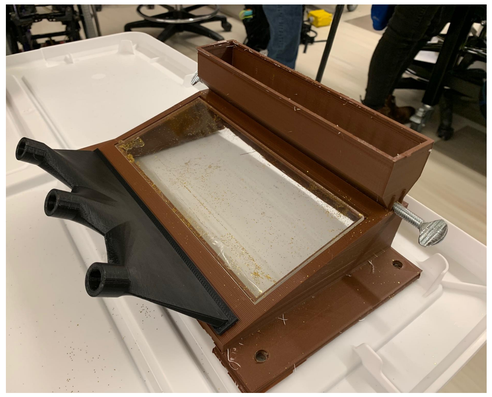


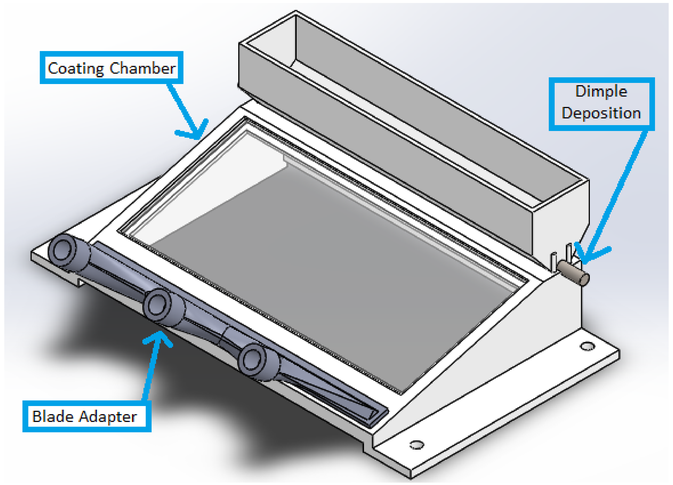
Dimple Deposition

The roller covers the entire width of the conveyor belt to begin the coating process with a shower of glitter. The dimple design on the surface allows it to collect a controlled amount of glitter from the hopper and deposit a dusting instead of a clump with each revolution. The dusting makes coating and mixing much easier as clumps would be difficult to separate. The roller slides onto a ¼ inch metal shaft where it is secured with glue. The additional material that sticks out is used to hand-turn the roller. The team used this for testing to control the deposition, additionally, this is useful for breaking jams in the hopper/roller.

Coating Chamber

The coating chamber is designed to resemble a wedge shape. There are two main benefits to this geometry. Firstly, it allows our air blade to be very close to the substrate. This allows for easier blowing of glitter due to less distance for the blade to separate before hitting the substrate. Secondly, the high end towards the conveyor inlet allows the air flow to expand and slow down, this prevents glitter from being blown out of the box.





Air Blade Adaptor

The air blade adaptor takes the flow through the air pump tubing and flattens it out to resemble more of a blade. This allows us to clear glitter off the entire width of the conveyor belt. By spreading the flow across a larger area, we also reduced the strength of the flow, allowing for more precise calibration to ensure we aren't blowing glitter out of the chamber.

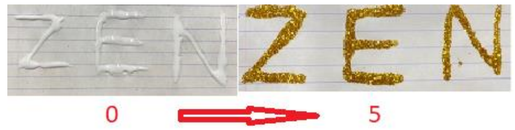
Results

After refining the requirements stated by our client, specifications were developed, and a verification plan was prepared to document results.

In order to ensure image quality, a visual scale was created to quantify the amount of adhesive removed from the substrate. Scoring a 4 or higher on the scale resulted in a pass, ensuring the final product would not be distorted.

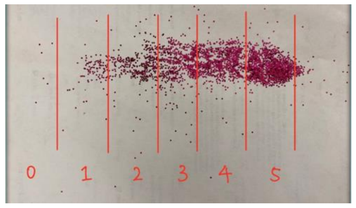
After testing the system with just adhesive several times, we consistently scored a 5 which indicated no adhesive removal or distortion.

With a second scale, the coating quality was verified to show that the entire adhesive surface was being coated.



Scoring a 4 or higher on this scale was considered a pass. Our testing showed an average coating quality of above a 4 which indicated successful coating.

Finally, to gauge the quantity of glitter that escaped the device during the coating process, a scale to measure glitter escape was produced. To pass this verification a score of 2 or lower was required.



This was the most trying of the verifications as we ran into difficulty producing a uniform flow from our air blade. We averaged a score of 3, indicating that improvement is needed in this area

Conclusion

With the conclusion of the SEED program the team has delivered a product that performs all the main functions required by the client. Apart from some auxiliary functions that the team wanted to include, we consider this project a success.
Our product met almost all the determined specifications with a pass rate of 86%.
Although we consider our product an overall success, we have several suggestions for improving this design. Firstly, better automation for the deposition process would improve the user experience for the conveyor technician. Integrating motor control into the existing control platform of our client would improve usability. Additionally, if the deposition was adjustable for different materials that would result in a more adaptable product for varied applications. Finally, a more uniform and thinner air blade would more efficiently and consistently clear glitter from the substrate and prevent material escape from the conveyor outlet.

Continuing Development

Automated deposition has just recently been added to the prototype. While this is not yet fully integrated, we have begun taking steps in the right direction and this is certainly a solid foundation for further development. The addition of roller bearings has also reduced rotational friction in the deposition assembly, improving the process further.