DESIGN AND DEVELOPMENT OF 3D PRINTED WASTE TO 3D FILAMENT MAKER

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College : REVA University, Bengaluru
Branch : Department of Mechanical Engineering
Guide(s) : Prof. Ashwini M V
Student(s) : Mr. Manoj S
Mr. Pramod V
Mr. Sujeeth S K
Ms. Chandana S V

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Introduction:

3D printing, especially Fused Deposition Modelling (FDM), has become very popular in recent years. It is widely used in industries, colleges, and even by hobbyists because it allows users to quickly convert digital designs into physical objects. However, along with its advantages, one major issue is the generation of plastic waste.

In a typical 3D printing setup, around 10–20% of the filament is wasted. This waste mainly comes from failed prints, support materials, brims, rafts, and trial prints. Even though materials like PLA, ABS, and PETG can technically be recycled, in reality, they are rarely reused at small-scale or lab environments. Because of this, plastic waste keeps accumulating, which is harmful to the environment and also increases material costs.

Another important issue is the high cost of filament. In India, a 1 kg spool of filament usually costs between ₹900 and ₹1200. For students, labs, and small workshops that use 3D printing frequently, this becomes expensive over time.

To solve both problems, recycling filament in-house is a good solution. It can reduce costs significantly (by more than 60%) and also help in managing plastic waste. However, most of the available recycling machines in the market are expensive, bulky, or not suitable for small-scale use.

This project focuses on designing and building a compact and low-cost machine that can convert 3D printing waste into reusable filament of 1.75 mm diameter. The system includes a shredder, an extrusion unit with temperature control, and a mechanism to maintain consistent filament thickness. The main aim is to prove that recycled filament can be produced economically while still maintaining acceptable print quality.

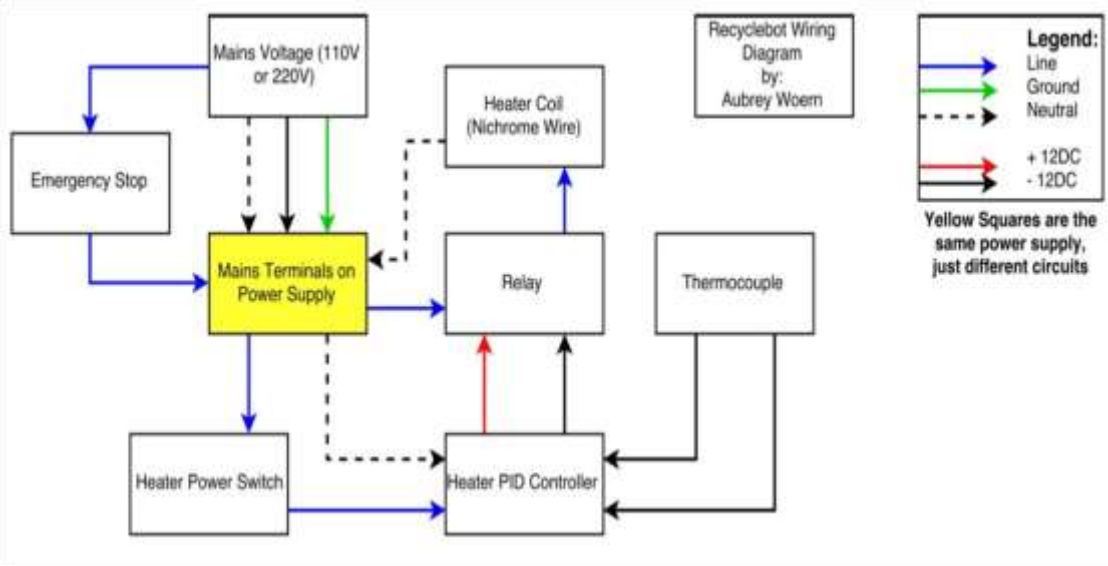

Figure 1: Stages Involved in Recycled Filament Manufacturing and Monitoring

Objectives:

1. To design and develop a low-cost filament recycling machine
2. To convert 3D printing waste into reusable filament
3. To use PID control for maintaining stable temperature
4. To achieve consistent filament diameter suitable for 3D printing.

Methodology:

The project is carried out in different stages by combining mechanical design, thermal control, and basic electronics.

Phase 1: Component Selection

- A 12V DC wiper motor with high torque is selected to handle the extrusion process.
- A 18 mm auger bit is used as the screw mechanism inside a GI pipe barrel.

Phase 2: Fabrication and Assembly

- The motor shaft is connected to the auger using a custom-made coupler.
- Mica band heaters are installed around the barrel for heating, with proper insulation.
- A brass nozzle is designed and drilled to achieve approximately 1.75 mm extrusion diameter.

Phase 3: Control System

- A PID controller (Rex C100) is used along with a thermocouple and SSR to maintain temperature.
- A PWM controller is used to adjust motor speed and control the extrusion rate.

Phase 4: Testing and Calibration

- Initial trials are performed using PLA material.
- Cooling rate and pulling speed are adjusted to maintain uniform filament diameter within acceptable limits.

Result and Conclusion:

Result:

The developed machine successfully converted waste 3D printing material into reusable filament suitable for FDM 3D printers. The extrusion system operated smoothly, maintaining a stable temperature and producing filament with a nearly uniform diameter of 1.75 mm. The machine demonstrated effective recycling of plastic waste while reducing material costs and supporting sustainable manufacturing practices.

Conclusion:

This project proved that 3D printing waste can be effectively recycled into usable filament using a low-cost and compact system. The developed machine helps reduce plastic waste, lowers filament expenses, and promotes environmentally friendly manufacturing. Overall, the project provides a practical and economical solution for students, laboratories, and small-scale industries using 3D printing technology.

References:

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Future Scope:

The future scope of this project includes:

- Adding an automatic filament diameter monitoring system
- Improving cooling and spool winding mechanism
- Integrating IoT for monitoring and control