IMIK FILAMENT EXTRUDER FOR RAPID PROTOTYPE

PROJECT REPORT
Submitted By

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In partial fulfillment of the requirements for the Award of the Degree of

POST GRADUATE DIPLOMA IN ROBOTICS

Department of Computer Science

Dr. G. R Damodaran College of Science (Autonomous)
(Autonomous, affiliated to the Bharathiar University and recognized by UGC)
Re-accredited at the 'A' Grade level by the NAAC
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Certificate

This is to certify that this project report entitled

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is a bonafide record of project work done by

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Faculty Guide Head of the Department

Submitted for Viva-Voce Examination held on ____________________

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Internal Examiner External Examiner

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IMIK FILAMENT EXTRUDER FOR RAPID PROTOTYPE

ABSTRACT

The project is **IMIK filament extruder for rapid prototype,** Make own 3d printer filament, cheap and high quality at a decent speed of 150-190 IPM (4-5 meters per minute). This process includes melting the pellet's at the temperature of (200 f) , after melting the pellets it need to be cool at the temperature of (60 c) , this will create the filament. The machine utilizes advanced technology to ensure precise filament diameter control, material consistency, and production efficiency. Key features include automated processing, customizable settings for various filament types, and a user-friendly interface for easy operation. The abstract highlights the significance of this innovation in advancing the capabilities of additive manufacturing and meeting the growing demand for reliable filament materials.

Keywords: filament making machine, 3D printing, additive manufacturing, precision control, material consistency, automation, user interface.

CHAPTER-1

INTRODUCTION

Filament Making Machine:

Filament making machines are integral to the production process of 3D printing filaments, which serve as the raw material for additive manufacturing. These machines are designed to convert plastic pellets or other raw materials into precisely sized and shaped filaments suitable for use in various 3D printers.

The process of filament making typically involves several key steps:

Raw Material Feeding: Plastic pellets or granules, often composed of materials like PLA (polylactic acid), ABS (acrylonitrile butadiene styrene), PETG (glycol-modified polyethylene terephthalate), or others, are fed into the filament making machine's hopper.

Melting and Extrusion: The raw material is heated to its melting point within the machine's extruder. Once molten, it's pushed through a precisely sized die or nozzle to form a continuous filament strand of the desired diameter.

Cooling and Sizing: The freshly extruded filament is then rapidly cooled to solidify it. It passes through a series of cooling mechanisms such as water baths or air streams to ensure proper solidification and prevent deformation. Simultaneously, the filament is sized to meet specific diameter requirements using precision measurement and control systems.

Winding: The filament is wound onto spools or coils for packaging and storage. Winding mechanisms ensure uniform winding tension and alignment to prevent tangling or breakage.

Quality Control: Throughout the process, various quality control measures are implemented to ensure the filament meets the required specifications for diameter, consistency, and mechanical properties. This may involve real-time monitoring systems, visual inspection, or automated testing equipment.

Filament making machines come in various sizes and configurations, catering to different production capacities and filament materials. Some machines are designed for small-scale or prototyping applications, while others are capable of high-throughput production for commercial use.

Advancements in filament making technology continue to improve efficiency, precision, and the range of materials that can be processed, contributing to the expansion and diversification of the 3D printing industry. As the demand for customized manufacturing grows, filament making machines play a crucial role in enabling cost-effective and accessible production of 3D printed parts across various industries.

CHAPTER-2

TECHNICAL ASPECTS

2.1 DETAILED DESCRIPTION

A filament-making machine is a device used primarily in the field of 3D printing to produce filaments, which are the raw materials used by 3D printers to create physical objects. Here's a detailed description of such a machine:

Structure: The filament-making machine typically consists of a sturdy frame or chassis to support its components. The design may vary based on the manufacturer and specific model, but it generally has a robust and stable structure to ensure precise filament production.

Extruder: At the heart of the filament-making machine is the extruder. This component melts down raw thermoplastic material, such as ABS (Acrylonitrile Butadiene Styrene) or PLA (Polylactic Acid), and forces it through a nozzle to form a continuous filament strand. The extruder's temperature can be precisely controlled to melt the material at the correct temperature for optimal filament quality.

Raw Material Handling: The machine typically includes a feeding system to supply raw thermoplastic material to the extruder. This can be in the form of pellets, granules, or even recycled plastic flakes. The raw material is fed into the extruder through a hopper or feeding mechanism.

Heating System: To melt the raw material, the extruder is equipped with a heating system. This system usually consists of electric heaters or heating elements that surround the extruder barrel. The temperature is carefully regulated to ensure proper melting and flow of the thermoplastic material.

Cooling System: After the melted material is extruded through the nozzle, it needs to cool down and solidify into a filament strand. A cooling system, such as fans or air vents, is often incorporated into the machine to rapidly cool the filament as it emerges from the extruder. This helps maintain the filament's diameter and prevents deformation.

Filament Sizing and Control: To ensure consistent filament diameter, the machine includes a sizing system. This system may consist of a series of rollers or pulleys that pull the filament at a controlled speed, shaping it to the desired diameter. Additionally, sensors and feedback mechanisms may be integrated to monitor and adjust the extrusion process in real-time, ensuring uniform filament dimensions.

Spooling Mechanism: Once the filament is produced, it needs to be wound onto spools for storage and use in 3D printers. The filament-making machine typically includes a spooling mechanism that automatically winds the filament onto a spool or reel. This mechanism may also feature tension control to prevent tangling or breakage of the filament during spooling.

Safety Features: Since filament-making machines involve heating elements and moving parts, safety features such as thermal sensors, emergency stop buttons, and protective enclosures are often incorporated to ensure safe operation and prevent accidents.

Control System: Modern filament-making machines are usually equipped with a control system, which may include a microcontroller or computer interface. This allows operators to set parameters such as temperature, extrusion speed, and filament diameter, and monitor the machine's operation in real-time.

Optional Features: Depending on the specific model and manufacturer, filament-making machines may offer additional features such as multiple extruders for producing filaments of different colors or materials, automatic cleaning systems, filament quality inspection tools, and connectivity options for remote monitoring and control.

Overall, a filament-making machine is a sophisticated piece of equipment designed to produce high-quality filaments for use in 3D printing, offering precise control over the extrusion process to ensure consistent filament dimensions and material properties.

2.2 COMPONENTS

1. **1x Wiper Motor (EU - 15€) / 5€ from the junkyard**
2. **1x Auger bit(diameter = 16mm ; length = 460mm)**
3. **1x PID Temperature Controller - DC 12V version**
4. **1x SSR-25DA Solid State Relay 3-32V DC / 24-380V AC / 25A**
5. **1x K-type thermocouple**
6. **1x Motor Controller 20A**
7. **1x Power Supply 12V, 240W+**
8. **1x Heating band (200-Watt 25mmx30mm)**
9. **2x Fans (80mm) 12V**
10. **1x Fitting 3/4" US Inch UNC --- 1/2" German Inch - 18cm long**
11. **1x Water tap extension - 3/4" UNC threads --- 1/2" German Inch - 50mm long, 27mm diameter (one core thread and one exterior thread)**

2.3 WORKING PRINCIPLE

A filament-making machine is typically used in the context of 3D printing, where it produces the filament material that is fed into a 3D printer for object creation. The working principle of such a machine involves several steps:

Material Preparation: The raw material, usually in the form of plastic pellets or granules, is loaded into the filament-making machine. These pellets could be made from various types of polymers like PLA (polylactic acid), ABS (acrylonitrile butadiene styrene), PETG (polyethylene terephthalate glycol), etc.

Melting: The material is then melted using heating elements within the machine. The temperature required for melting depends on the type of material being used. For example, PLA typically melts around 180-220°C, while ABS melts at a higher temperature range of 210-250°C.

Extrusion: Once the material reaches its melting point, it is pushed through a nozzle or die using a screw mechanism. This process is called extrusion. The nozzle/die determines the diameter of the filament being produced. Filament diameters commonly used in 3D printing are 1.75mm and 2.85mm.

Cooling and Solidification: As the melted material exits the nozzle, it is rapidly cooled using a cooling system, typically involving fans or water baths. This rapid cooling solidifies the material into a continuous filament strand.

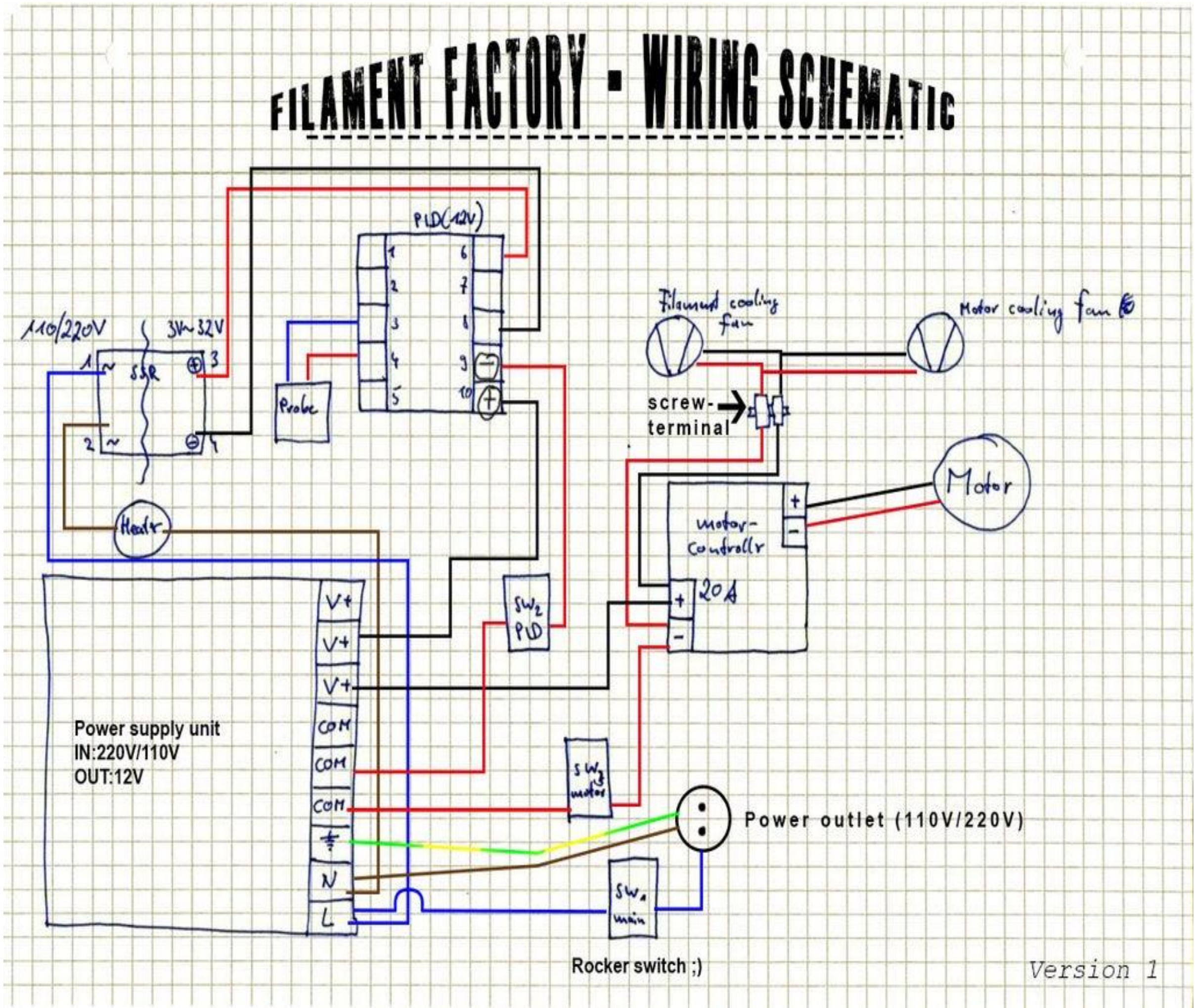
Sizing and Winding: The filament is then passed through a sizing mechanism to ensure its diameter is uniform and within the desired tolerance range. After sizing, the filament is wound onto a spool or coil for storage and transportation.

Quality Control: Throughout the process, quality control measures such as diameter monitoring, tension control, and visual inspection may be implemented to ensure the produced filament meets the required standards.

Packaging: Once wound onto spools, the filament is usually packaged and labeled with relevant information such as material type, diameter, and color.

This process allows for the continuous production of filament material suitable for use in 3D printing applications. The efficiency and precision of the filament-making machine play a crucial role in ensuring the quality and consistency of the filament, which ultimately impacts the print quality and performance in 3D printing processes.

2.4 CIRCUIT DIAGRAM



2.4.1 CIRCUIT DIAGRAM DESCRIPTION

A filament making machine circuit diagram typically includes various components necessary for controlling and regulating the process of filament production. Here's a description of the key components and their functions that you might find in such a diagram:

1. Power Supply: The power supply unit provides the necessary voltage and current to operate the entire circuit. It may involve transformers, rectifiers, and regulators to ensure stable power delivery to the components.

2. Temperature Control System: Filament making often involves heating materials to specific temperatures for extrusion. This system includes temperature sensors (such as thermocouples or thermistors) to measure the temperature at various points along the process. A PID (Proportional-Integral-Derivative) controller may be used to regulate the temperature accurately. The controller adjusts the power supplied to the heating element based on the difference between the desired temperature setpoint and the actual temperature readings.

3. Heating Element: This is the component that generates heat to melt the filament material. It could be a resistive heating element like a coil or cartridge heater.

4. Extruder Motor Control: The extruder motor is responsible for pushing the molten filament material through the nozzle. The circuit includes motor drivers or motor control circuits to regulate the speed and direction of the motor. This may involve PWM (Pulse Width Modulation) techniques for speed control.

5. Safety Features: Safety features are crucial in any industrial process. This may include emergency stop buttons, thermal cutoff switches, or circuitry to detect overcurrent or overtemperature conditions and shut down the system to prevent damage or hazards.

6. User Interface: A user interface may include elements such as buttons, switches, knobs, and displays to allow the operator to set parameters like temperature, speed, and monitor the status of the process.

7. Control Logic and Microcontroller: A microcontroller or a PLC (Programmable Logic Controller) may be at the heart of the system. It runs the control algorithms, reads sensor inputs, and sends commands to various components based on the desired parameters and feedback from sensors.

8. Interfacing Components: These components facilitate communication between different parts of the system. This could involve relays, optocouplers, or other interface circuits to isolate sensitive components or handle different voltage levels.

9. Cooling System: Depending on the design of the filament making machine, a cooling system might be necessary to cool down the extruded filament after it leaves the nozzle. This could involve fans, heat sinks, or even water cooling systems.

10. Filament Diameter Measurement: In some advanced systems, there might be sensors or mechanisms to measure the diameter of the extruded filament continuously. This information can be fed back into the control system to make real-time adjustments to ensure consistent filament diameter.

These components work together under the control of the microcontroller or PLC to ensure precise control over the filament-making process, resulting in high-quality filament suitable for 3D printing or other applications. The circuit diagram illustrates how these components are interconnected and powered to achieve the desired functionality.

CHAPTER-3

COMPONENTS

3.1 COMPONENTS DESCRIPTION

A filament making machine, typically used in the context of 3D printing, consists of several components, each serving a specific purpose in the filament manufacturing process. Here are some common components found in such machines:

1. Extruder: The extruder is the main component responsible for melting and extruding the raw material, usually plastic pellets or granules, into a filament form. It consists of a barrel, a screw, and a heater.

2. Barrel: The barrel is a cylindrical chamber where the raw material is fed and heated. It provides a controlled environment for melting the material.

3. Screw: The screw, also known as an auger, is located inside the barrel and is responsible for pushing the raw material forward while it is being melted by the heater. It also helps in mixing and homogenizing the material.

4. Heater: The heater is used to heat the barrel and melt the raw material. It's typically a resistive heating element wrapped around the barrel.

5. Die: The die is a nozzle or small opening through which the molten material is forced out to form the filament. It shapes the filament to the desired diameter and ensures uniformity.

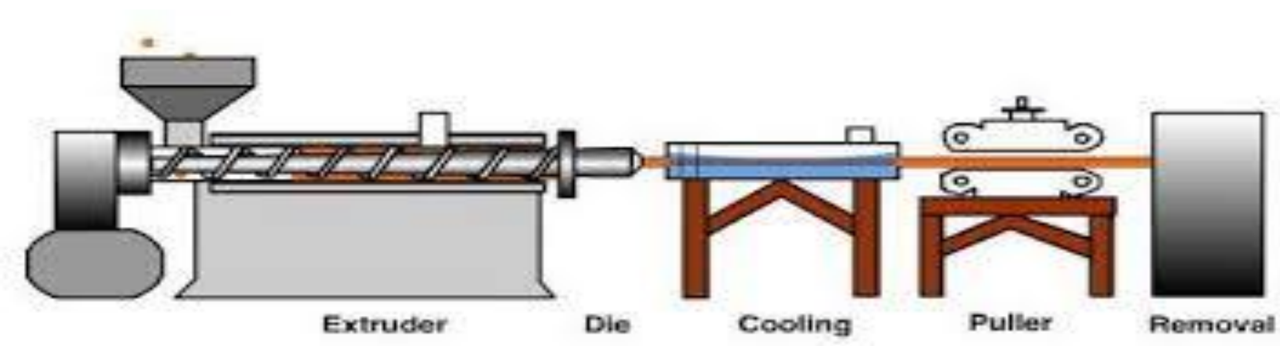
6. Cooling System: After extrusion, the filament needs to be rapidly cooled to solidify it. Cooling systems such as fans or water baths are used for this purpose.

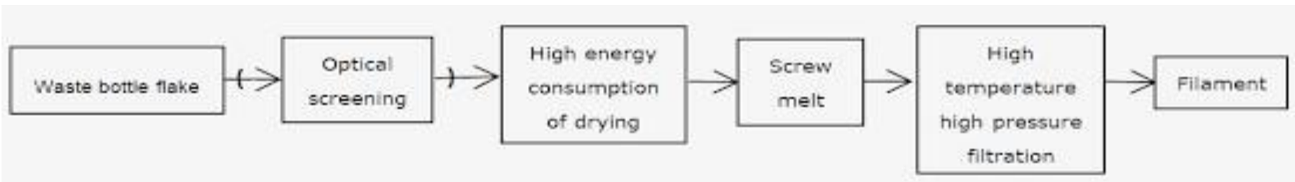
7. Puller/Cutter: Once the filament is solidified, it needs to be pulled at a controlled rate and cut to the desired length. This is usually achieved using a puller mechanism followed by a cutting mechanism.

8. Spooling Mechanism: Finally, the produced filament is wound onto spools for storage and later use. A spooling mechanism ensures that the filament is neatly wound and ready for use in 3D printing.

CHAPTER-5

BLOCK DIAGRAM





CHAPTER-6

RESULTS

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Filament Extractor

CHAPTER-7

CONCLUSION AND SCOPE FOR FUTURE ENHANCEMENT

It seems like you're interested in filament-making machines for 3D printing and the potential future developments or inheritances related to this technology. Let's break down each aspect:

1. Filament Making Machine: These machines are used to produce filament, which is the material used in 3D printing. Filament can be made from various materials including ABS, PLA, PETG, nylon, and more. The process typically involves melting the raw material and extruding it through a nozzle to create a continuous filament strand. The filament is then spooled onto a reel for use in 3D printers. When considering building or using a filament-making machine, you'd need to consider factors like the type of materials you want to use, the diameter and tolerance of the filament, the production capacity, and the quality control measures.

2. Calculation: Calculations involved in filament-making machines would include determining the melting point and flow characteristics of the raw material, designing the extrusion system to maintain consistent filament diameter, calculating the cooling requirements to solidify the filament quickly, and estimating the production rate based on the extrusion speed and spooling mechanism. Additionally, cost calculations would be necessary to determine the feasibility of the machine, considering factors like raw material cost, energy consumption, maintenance, and labor.

3. Future Developments: In the future, filament-making machines could see improvements in several areas:

Material Diversity: More materials could become available for filament production, including advanced composites and biodegradable polymers.

Precision and Efficiency: Advances in extrusion technology could lead to even tighter control over filament diameter and quality, resulting in higher precision prints.

Automation: Filament-making machines may become more automated, reducing the need for manual intervention and increasing production efficiency.

Integration with Recycling: There might be a greater integration of recycling processes into filament-making machines, allowing for the use of recycled materials in filament production.

Smart Features: Integration with sensors and data analytics could enable real-time monitoring and adjustment of production parameters, optimizing performance and reducing waste.

4. Inheritances: In the context of future inheritances related to filament-making machines, it's important to consider the impact of this technology on various industries:

Manufacturing: Improved filament-making machines could lead to advancements in additive manufacturing, allowing for the production of more complex and functional parts.

Sustainability: With the integration of recycling processes, filament-making machines could contribute to reducing waste and promoting a circular economy.

Education and DIY Communities: Access to affordable filament-making machines could empower individuals and communities to experiment with new materials and designs, fostering innovation and creativity.

In summary, filament-making machines are essential components of the 3D printing ecosystem, and future developments in this technology could lead to advancements in various industries while also addressing sustainability concerns.

CHAPTER-8

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