**Project “RepRap 3D printer”**

Done in Tampere University  
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1. **Introduction**  
   1.1 **Project Goal**

The primary goal of the project is to develop a fully operational RepRap 3D printer from the ground up. RepRap, short for "Replicating Rapid-prototyper," is an open-source initiative that aims to create 3D printers capable of reproducing most of their own components. The project strives to produce a cost-effective, efficient printer suited for personal or small-scale business use, emphasizing affordability and accessibility. This printer should help users reduce reliance on external manufacturers by enabling them to fabricate replacement parts on their own. In this context, the printer represents a shift towards decentralized manufacturing, granting individuals and small enterprises greater autonomy over production processes. The open-source nature of the project encourages innovation and collaboration, allowing for modifications and enhancements that will continue to drive technological advancements.

Additionally, it is necessary to learn some theoretical concepts surrounding 3D printing technologies. This included studying different types of 3D printers, materials, and software that would best suit the project goals. A thorough understanding of technical aspects, such as calibration, material properties, and software configurations, was crucial to ensure successful design and implementation.

* 1. **Overview of RepRap**

The RepRap project, which stands for "Replicating Rapid Prototyper," was launched at the University of Bath in 2005 and has since evolved into a globally recognized initiative in the field of 3D printing. The primary goal of this project is to create a 3D printer that is essentially self-replicating by being able to duplicate most of its own parts. By significantly reducing the dependency on outside manufacturers for replacements and spare components, this ground-breaking invention enables consumers to maintain their printers for relatively little additional expense. Because it can print its own parts, users can construct new printers out of an existing one, creating previously unheard-of possibilities for accessibility and cost savings.  
  
The open-source nature of RepRap printers has been a key factor in their widespread success, as all designs, software, and blueprints are freely available for anyone to use. This approach not only promotes the use of these machines but also encourages their modification and improvement. The active open-source community surrounding RepRap involves numerous developers, engineers, and hobbyists who contribute new ideas and enhancements. As a result, RepRap technology has experienced rapid innovation over the years, with each iteration becoming more efficient, cost-effective, and capable of handling complex tasks.  
  
Furthermore, this open and collaborative philosophy has allowed RepRap printers to be adapted for various uses, from personal projects and education to small-scale business manufacturing. With the affordability and flexibility of RepRap printers, users are empowered to take control of their production needs, often creating customized parts that would be difficult or expensive to source otherwise. This decentralized manufacturing model represents a shift in how people approach production, giving individuals and small businesses more autonomy over their design and fabrication processes.  
  
Ultimately, the RepRap project has had a lasting impact on the 3D printing industry, pushing the boundaries of what's possible with personal fabrication and self-sustaining technologies. The community-driven nature of the project ensures that innovation continues, as users worldwide refine, adapt, and share new advancements in both hardware and software, making RepRap a pioneering force in the world of additive manufacturing.

1. **Planning and preparation**
2. **Research of model**Following an extensive review of existing literature, academic papers, and technical articles on 3D printing technology, the Prusa i3 MK3s+ was ultimately selected as the optimal model for this project. This decision was based on a combination of factors, all of which pointed to the model’s exceptional reliability, robust design, and proven performance in various applications. Numerous academic sources highlighted the Prusa i3 MK3s+ for its structural stability, making it a highly dependable choice for both beginners and experienced users. These qualities have made it a popular option for projects that require consistent, high-quality results.  
     
   The Prusa i3 MK3s+ was chosen based on active involvement in the RepRap online communities, where numerous users have highly praised this model. These online forums and user groups offered valuable insights as individuals shared their real-life experiences with the printer, discussing its straightforward assembly, ease of maintenance, and adaptability for various printing tasks. The open-source nature of the Prusa i3 MK3s+ has facilitated a wide range of modifications and improvements contributed by the community, further establishing its reputation as a well-supported and regularly updated model.  
     
   In addition, a comprehensive evaluation of the available market choices verified that the Prusa i3 MK3s+ offered significant benefits in terms of cost efficiency. Despite the abundance of 3D printer models in the market, only a few could match the balance between affordability and superior performance provided by the Prusa i3 MK3s+. Its components are readily accessible and relatively inexpensive, which is a critical factor for a project focused on minimizing expenses while maximizing functionality. The uncomplicated assembly process was another compelling aspect, as it enables users to quickly set up the printer without requiring specialized tools or advanced technical expertise.  
     
   Furthermore, the Prusa i3 MK3s+ has become a favorite in the industry due to the strong support from the community. Both the manufacturer and the community continuously provide updates and engage in active development to keep the model current and compatible with new technologies and materials. This support network also offers a wealth of resources such as tutorials, troubleshooting guides, and design improvements, which significantly reduce the learning curve for users and contribute to the printer's widespread use.  
     
   The Prusa i3 MK3s+ was selected for this project due to its demonstrated reliability and robust design, as well as its unparalleled community support and cost-effectiveness. Its extensive availability, in terms of both hardware and software support, guarantees that it continues to be a feasible and adaptable option, fully capable of achieving the project's objectives within budgetary limitations.
3. **List of materials and components**

|  |  |
| --- | --- |
| 40x40 extrusion 400mm long | 2 |
| 20x40 extrusion 400mm long | 4 (2+2) |
| 20x20 extrusion 400mm long | 4 |
| 20x20 extrusion 220mm long | - |
| 20x20 extrusion 190mm long | - |
| 20x20 Corners brackets | 1 package |
| Corner plates | - |
| M3, M4, M5 T-Nuts | 1 package |
| PEI Bed | 1 package |
| Washer Assortment | 1 package |
| M3 \* 8 Socket Cap Screw | 1 package |
| GT2 Timing Belt with Pully and Bearings | 1 package |
| Zip Ties | 1 package |
| NEMA 17 Stepper Motors | 1 package |
| 8mm linear rods 440mm in length + bearings | 2 |
| 8mm – 295mm Lead Screws with Nuts | 1 package |
|  |  |
| Electronics and additional components on last stage |  |
| Springs | 1 package |
| Ribbon cable | - |
| MKS Gen L instead of SKR | 1 |
| 400W Power Supply (24v) | 1 |
| 240W Power Supply (24V) | 1 |
| 50mm blower fan (24v) | 1 package |
| 40mm muffin fan (24v) | 1 package |
| Limit switches | 1 package |
| V6 Hotend with Heater (24v) and Thermistor | 1 |
| Spiral Cable Wrap Spiral | 1 |
| Power Switch | 1 |
| Power Cable | - |
| Silicone Wire 16 Gauge | 1 package |
| Knurled 3mm Inserts | 1 package |
| Bondtech Style Geared Extruder | 1 |

|  |  |
| --- | --- |
|  | Was purchased |
|  | Was created |
|  | Was in the office |

Description of materials:  
**PLA Extrusions for RepRap 3D Printers**

Polylactic Acid (PLA) is a widely used material in 3D printing due to its eco-friendliness, ease of use, and compatibility with RepRap systems. In this project, PLA was used to create extrusions for structural parts like frame connectors and brackets. PLA was chosen for its biodegradability, high dimensional accuracy, and strength, which are crucial for maintaining the mechanical stability of the printer.

PLA's low printing temperature (180-220°C) makes it compatible with most RepRap printers, while its rigidity ensures durable and precise parts. Its affordability and availability make it ideal for replicating parts within the RepRap ecosystem.

**M3 M4 M5 T-slot Nuts Hammer Head Nut Slot Nuts (160 pieces)**   
This set contains 160 pieces of hammer-head T-slot nuts, available in various sizes, including M3, M4, and M5. These nuts are ideal for creating a secure connection in 3D printers or other devices using aluminum profiles with T-slots. Made from durable stainless steel, they are corrosion-resistant, offering long-lasting strength. Their hammer-head design simplifies installation, enabling easy insertion and removal without dismantling the frame, providing flexibility in customization and maintenance.

**SUNLU PEI Sheet 2 Sets (235 x 235 mm) Magnetic 3D Printer Bed**   
The SUNLU PEI sheet set includes two magnetic build surfaces, each measuring 235 x 235 mm. Designed for 3D printers, these flexible PEI plates offer excellent adhesion for a variety of filament types, especially PLA and ABS. The removable sheets allow for effortless part removal once cooled, while the black and gold reversible design enhances durability. This set also includes a base sticker for easy installation, ensuring a smooth and even surface, improving print quality.

**Stainless Steel Washers Set (684 Pieces)**   
This assortment of flat and locking stainless steel washers includes 684 pieces in 9 different sizes, ranging from M2 to M12. Made from high-quality stainless steel, these washers are designed for various fastening applications, providing excellent resistance to corrosion and wear. The locking washers ensure a secure fit, while the flat washers offer a smooth bearing surface to evenly distribute pressure. This comprehensive set comes in a convenient storage box, perfect for both industrial and DIY projects.

**Allen Screws and Screw Assortment**   
This set of Allen screws includes various sizes, perfect for assembly and repair of 3D printers and other mechanical projects. The screws are made of durable stainless steel, ensuring long-lasting resistance to wear and corrosion. The kit comes organized in a clear plastic box with labeled compartments for easy access to the correct size. These screws provide secure connections with Allen key heads, which reduce the risk of stripping during installation.

**Timing Tension Torsion Mounting Printer Kit**   
This kit includes all the necessary components to enhance the tension of timing belts in 3D printers. Featuring precision pulleys, bearings, and mounting brackets, the set is compatible with GT2 belts commonly used in RepRap and other open-source 3D printers. These parts improve the accuracy and smoothness of belt movement, reducing slipping and enhancing print quality. Made from high-quality aluminum and steel, the components are built for durability and consistent performance in high-tension applications.

**Resistant Tensile Strength Zip Ties**   
These durable zip ties are designed for indoor and outdoor applications, offering high tensile strength to securely bundle wires, cables, and components in 3D printers and other machinery. The UV-resistant nylon construction ensures long-term durability, even in harsh environmental conditions. Available in multiple lengths and colors, these zip ties are versatile and easy to use, with a self-locking design that ensures a tight grip while remaining easy to trim for a neat finish.

**iMetrx Stepper Pancake Degree Printer Motor**   
The iMetrx stepper motor is a compact "pancake" model, designed for use in 3D printers and other precision equipment. It offers high torque output in a small form factor, making it ideal for machines with space constraints. With its precise 1.8-degree step angle and smooth rotation, this motor ensures accurate movements, critical for high-quality 3D printing. The motor is compatible with NEMA 17 mounts and comes with pre-attached leads for easy installation.

**SIENOC 100-600 Linear Guide Bearing**   
The SIENOC linear guide bearing is designed to offer smooth and accurate linear motion in 3D printers and CNC machines. It is compatible with 8mm rods and provides low-friction movement, which helps maintain the precision of the printing process. Made from hardened steel, it ensures durability and long-lasting performance, even under heavy loads. This bearing is an excellent choice for projects requiring consistent and reliable linear guidance.

**Threaded Spindle Anti-Play Spring Loaded Printer Rod**   
This threaded spindle is equipped with an anti-backlash spring system, reducing play and improving precision in 3D printer movements. Compatible with T8 lead screws, it is designed for applications that require high accuracy, such as Z-axis movements in 3D printers. The spring-loaded feature ensures consistent tension, minimizing vibrations and leading to smoother, more reliable prints. Made from stainless steel, it offers both durability and corrosion resistance.  
  
**FYSETC 3D Printer Springs for Creality Ender 3**  
These high-quality compression springs, measuring 8mm in diameter and 20mm in length, are designed for precise bed leveling in Creality Ender 3 printers and variants like the Ender 3 S1, V2, Neo, and Max models. Crafted to ensure stability during printing, they provide consistent tension, improving print bed accuracy. Made of durable materials, these springs contribute to better print quality by maintaining a leveled bed, especially in longer print jobs. They're an ideal replacement for standard springs, ensuring enhanced durability and performance.

**MKS Gen L Control Board for 3D Printers**  
The MKS Gen L control board is a versatile and affordable solution for 3D printer enthusiasts and professionals alike. Designed as a more budget-friendly alternative to higher-end boards like the SKR series, it supports a variety of 3D printer configurations while maintaining a user-friendly interface. One of its key features is its compatibility with the widely used Marlin 2.0 firmware, which offers an open-source platform for customizing and optimizing printer settings. This compatibility ensures users have access to community-driven updates and advanced features, such as improved temperature control and safety mechanisms like thermal runaway protection.

In addition, the MKS Gen L boasts multiple stepper motor driver slots, making it highly adaptable to different types of drivers, including A4988, TMC2100, TMC2208, and TMC2130. This flexibility allows users to fine-tune motor movements, reduce noise levels, and increase the precision of their 3D prints. The board also supports dual Z-axis motor setups, improving bed leveling and enhancing the quality of larger prints. This makes it a great choice for users looking to upgrade their printer’s mechanics while keeping costs down.

Moreover, the MKS Gen L is designed to be easily expandable, with interfaces that support additional hardware such as touchscreens, filament run-out sensors, and automatic bed leveling probes like BLTouch. This enables users to enhance their printer's functionality, making it more automated and efficient. The board also includes multiple connectivity options like USB, SD card readers, and display interfaces, offering flexible control and interaction with the printer, whether through a traditional LCD or a modern touchscreen display.

**DUSKTEC 24V 350W Power Supply**  
The DUSKTEC power supply unit is built for high-performance 3D printers, delivering 24V and 350W of power. It features dual LED displays for real-time monitoring of voltage and current output, ensuring reliable and stable power supply during printing. Designed for durability, this PSU is ideal for users needing consistent power for long-duration printing tasks. It’s compatible with most 3D printer setups, providing efficient and reliable power delivery, making it a dependable choice for high-demand 3D printing environments.

**JZK Small Blower Fan 5015 (24V)**  
This 24V 50mm blower fan offers efficient cooling for 3D printers, improving airflow around hot components to prevent overheating. Its compact design ensures it fits into tight spaces while delivering high-speed airflow. This fan is ideal for cooling extruder assemblies or other components that generate heat during printing. It’s built for reliability and long-term performance in 3D printing applications.

**Seamuing 40mm Muffin Fan (24V)**  
This 40mm muffin fan provides excellent cooling for 3D printers and electronics. Operating at 24V, it’s designed to replace worn-out or faulty fans in various devices, ensuring effective heat dissipation.

**Hailege V-156-1C25 Limit Switch**  
This high-precision mechanical limit switch is ideal for 3D printers and CNC machines. It ensures accurate triggering of end-stop positions, providing reliability for precise operations.  
  
**V6 Hotend with Heater (24V) and Thermistor**  
This 24V V6 hotend kit is ideal for precise 3D printing at high temperatures. It includes a thermistor for accurate temperature measurement and control. The heater allows for consistent heat distribution, improving print quality for a variety of filament types, from PLA to ABS.

**Spiral Cable Wrap**  
This spiral wrap helps organize and protect cables in 3D printers, preventing tangles and wear. It’s flexible and can accommodate various cable sizes, ensuring easy routing and protection from mechanical stress.

**Power Adapter Switch**  
This power adapter switch offers a reliable solution for switching 24V power supplies on and off in 3D printers. It comes with insulated connections for added safety and ease of installation.  
  
**MMOBIEL 16 AWG Silicone Wire**  
This flexible, durable 16 AWG silicone wire is ideal for electronic projects, offering high conductivity and heat resistance. It's suitable for 3D printer wiring or any electronic setup where reliable connections are essential.

**Knurled 3mm Threaded Inserts**  
These brass inserts provide strong, reliable threads for 3D-printed parts. They are heat-set into the plastic, offering durability and a professional finish for applications like mounting components or securing enclosures.

**Iverntech Upgraded Extruder**  
This upgraded extruder is compatible with multiple 3D printers, improving filament feeding accuracy, reducing jams, and enhancing print quality for flexible and rigid filaments alike.

1. **Construction and Design Process**   
   The construction of this project involved a series of intricate design and 3D printing processes, utilizing industry-standard software and tools to ensure accuracy and efficiency. At the heart of the design phase were **AutoCAD 2025** and **Autodesk Fusion 360**, two powerful CAD programs. These tools played a crucial role in creating the technical drawings and blueprints necessary to guide the construction. AutoCAD 2025 was especially helpful for precise drafting, while Autodesk Fusion 360 allowed for detailed 3D visualization of the structural components, helping to ensure that all elements were aligned before fabrication.  
     
   After completing the design phase, the focus turned to 3D printing. Simplify3D and PrusaSlicer were used to transform the digital 3D models into physical objects. These slicing programs played a crucial role in preparing the models for 3D printing by converting the CAD files into instructions that could be interpreted by the 3D printer.  
     
   Simplify3D offered a wide range of customization options, enabling precise adjustment of print parameters like layer height, infill density, and support structures. This guaranteed that the resulting prints exhibited intricate detail and strong structural integrity. Furthermore, Simplify3D's robust simulation capabilities allowed the team to preview print layers prior to initiating the actual printing process, ultimately leading to reduced errors and minimized material wastage.  
     
   PrusaSlicer was employed to guarantee suitability with various 3D printers and materials. It was instrumental in fine-tuning print parameters for various filament varieties like PLA, ABS, and PETG. The software's adaptive layer height function, which modifies print resolution according to the model's intricacy, also bolstered efficiency by reducing print time while maintaining quality.  
     
   Through the synergistic use of these tools, the construction team successfully produced precise and dependable components, translating digital designs into reality with remarkable accuracy. This led to a flawless merging of design and manufacturing, highlighting the capabilities of contemporary 3D printing technologies in producing top-notch results.

Prepared version:   
Изображение выглядит как мебель, в помещении, письменный стол, пол

Автоматически созданное описание Изображение выглядит как в помещении, мебель, дизайн, письменный стол

Автоматически созданное описание

1. **Electronics**The electronics portion of the project faced significant setbacks due to the unavailability of all necessary materials. When I reached the stage of connecting the stepper motors, it became clear that these motors required physical drivers for operation. Unfortunately, there was not enough time to order the drivers needed to complete this part of the project. As a result, I made the decision to leave the project unfinished at this stage.  
     
   However, despite this setback, some positive progress was made. I successfully researched electronics including the wiring, power supply and limit switches. These efforts laid a strong foundation for future work on the project, allowing others to continue from where it was left off.  
     
   Though the project remains incomplete, the groundwork for the electronics was established, and I gained valuable experience in configuring and understanding 3D printer electronics, which will be beneficial for future developments.
2. **Conclusions**

The project was left incomplete, but a significant portion of the work was successfully accomplished, laying a solid foundation for future teams. The research, component procurement, and planning were carried out effectively, which will facilitate the continuation of the project by others.

The setbacks occurred primarily due to a lack of time and the inability to engage in the development and printing of the frame at earlier stages. This hindered progress, particularly in the later stages of the project.

During the course of the project, many important lessons were learned regarding procurement and preparation. Software for 3D printing and technical drafting, such as PrusaSlicer and Simplify3D, was explored in-depth. These programs were particularly valuable for adjusting slicing parameters and ensuring compatibility with various 3D printers. Furthermore, hands-on experience was gained in working with 3D printers of different types and sizes, (FDM printers), which provided a clear understanding of their mechanical functions and the importance of calibration for high-quality prints.

Additionally, the key principles of 3D printing were understood, including material selection (PLA) and the optimal temperature settings for it. Mastering these aspects is crucial for ensuring both the quality and durability of printed objects.

For future projects, it is recommended to focus on the selection of materials for the frame, thorough research, and the procurement of appropriate electronics. Emphasis should also be placed on the calibration of motors and axes, as well as ensuring the correct assembly of components to minimize errors during printing.

Although the final goal was not achieved, a substantial amount of useful knowledge and practical skills were gained, including a deeper understanding of 3D printing technologies and their applications. Moreover, a strong basis was established for subsequent projects and research related to the development of RepRap 3D printers.

1. **Literature**[LayerFused C201 3D Printer by rwmech - Thingiverse](https://www.thingiverse.com/thing:3894507)  
   [AM8 - Metal Frame for Anet A8 by pheneeny - Thingiverse](https://www.thingiverse.com/thing:2263216)  
   [Anet A8 X-Carriage Mounts by Leo\_N - Thingiverse](https://www.thingiverse.com/thing:1919544)  
   [8mm rod holder by oliemond - Thingiverse](https://www.thingiverse.com/thing:1519859)  
   [SC8UU replacement for IGUS Drylin RJ4JP-01-08 (LM8UU) by Jori - Thingiverse](https://www.thingiverse.com/thing:2404074)  
   [MKS Robin Nano using videos for beginners (Part 1): Wiring and printer installation (youtube.com)](https://www.youtube.com/watch?v=d52u0Mss7fI)  
   [Film 4 FI (youtube.com)](https://www.youtube.com/watch?v=EX62plOF-So&list=PLyYZUiBHD1QjaYx7eCEW8zXvsgwEbAykY&index=1)  
   [DIY 3D Printer Build Your Own - Part 1 The Frame (Step By Step Guide) - YouTube](https://www.youtube.com/watch?v=EX62plOF-So&list=PLyYZUiBHD1QjaYx7eCEW8zXvsgwEbAykY&index=2)