Impeller Pump Project
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Aim of the Project

The Aim of the project is to design and manufacture an impeller water pump that can successfully remove water from a 5L tank as efficiently as possible.

Background

Centrifugal water pumps are one of the most widely used machines in today's world. They play a vital role in our everyday lives by distributing different types of fluids and solids. The overall function of the centrifugal impeller pump is to transfer fluids from one area to another by conversion of energies.

Figure 1: Industry Standard Impeller Pump

The impeller's rotation propels liquid radially outward due to friction. This creates a low-pressure zone, drawing more fluid into the intake. As fluid accelerates towards the volute shell, pressure increases, converting kinetic energy to potential energy. The volute's expanding area decreases velocity, boosting pressure, allowing more fluid to converge under pressure. This generates a flow rate with suction inlet pressure lower than discharge nozzle pressure.

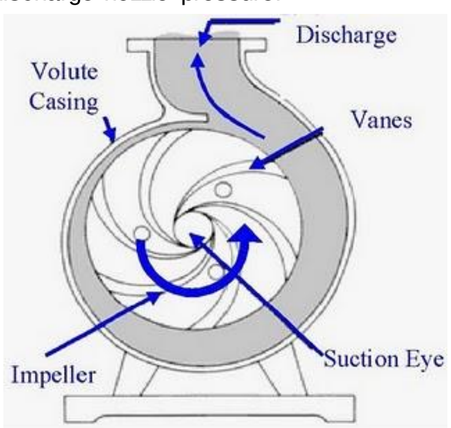

Figure 2: Physics of Impeller Pump

Design

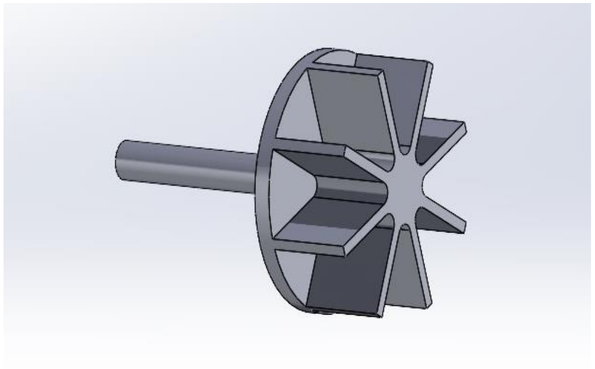

Figure 3: Straight Vane Impeller Solidworks Design

.The components stated in the brief to be designed and manufactured were the impeller, casing, stand, cap, outlet and bearing housing. The software used to design the parts was Solidworks. The casing proved to be the most challenging to design as machineability had to be closely considered. The increasing area of the volute casing had to be precisely designed to ensure that a water flow rate is generated within the casing. The design of the impeller was also another critical part in the project. The impeller's design determines how effectively it can move fluid through the pump. Its shape, size and blade configuration influence the flow rate and pressure generated by the pump.

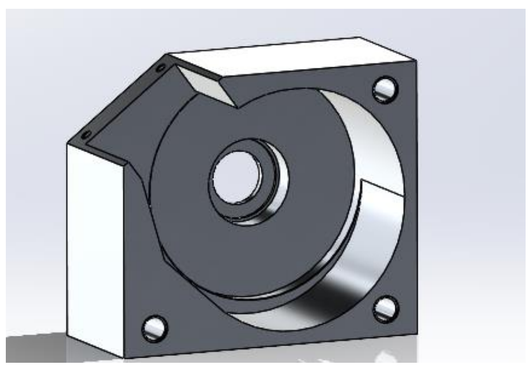

Figure 4: Pump Casing Solidworks Design

Manufacturing and Assembly

There were several various manufacturing processes utilized in the manufacturing process of this project.

CNC Machining: The components chosen to be manufactured in the CNC machine were the impeller and the stand. These parts were designed specifically to ensure clamping and machining can be completed successfully in the Limerick IT Spinner U-620 machine. SolidCam software was utilized to generate G-Code which instructed the CNC machine what operations to carry out.

Lathe and Mill Machining: The components selected to be manufactured in the lathe and mill were the casing, cap, bearing housing and shaft of impeller. Features on the lathe such as the automatic feed ensured a good quality surface finish on each part. Conventional Milling was mainly used on mill parts.

3D Printing: The complexity of design of the outlet led the team to decide 3D printing was the best manufacturing process for it. Ultimaker Cura was the software used to prepare and generate the G-Code for the 3D Printer.

The team also ordered sealed bearings, paper gaskets, nuts and bolts for the assembly of the project.

Figure 5: CNC Spinner Machine (U-620)

Conclusion

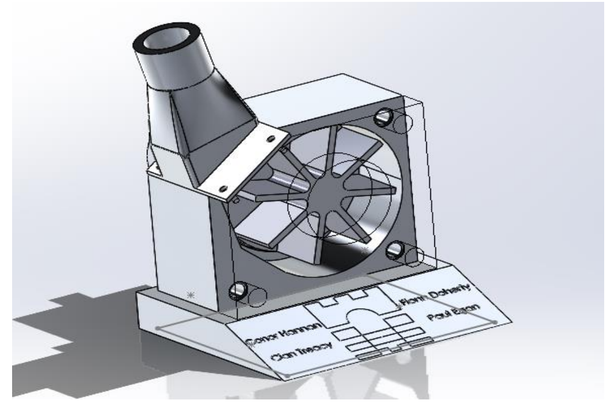

Figure 6: Solidworks Project Assembly

The team successfully designed, manufactured and assembled an operating impeller water pump. A simple straight vane impeller was machined as opposed to the more efficient curved vane design due to time restrictions. The impeller and shaft were machined as one opposed to the original key and keyway design. This transmitted the energy from the motor to the water more effectively. Overall, the project satisfied the brief by undergoing all mandatory manufacturing processes. The 5L of water was effectively removed from the tank.

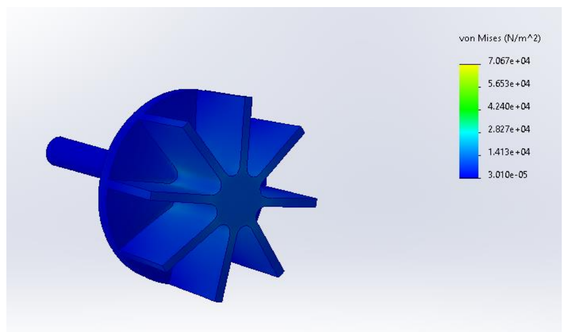

Figure 6: FEA Analysis of Impeller

References

⊡Evans, P., 2023. *The Engineering Mindset.* [Online] Available at:https://www.youtube.com/watch?v=-fCZZWwtgNM [Accessed 28 11 2023].