Design and Manufacturing of Chair Leg Floor Protector

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Abstract : There is a need for a device that effectively shields hard floor surfaces from damage. An effective floor protector device would offer a soft and sufficiently thick material to act as a buffer between the floor surface and the furniture to prevent scratches and gouges, and it would offer a more durable design to prevent the device or its components from detaching from the furniture to which it is attached.
These leg caps can be used on home, office, hotel, restaurant, apartment, garage. Suit for chair legs. Typically used on tables, desks, chairs, cabinets, sofas, benches,
armchairs, folding chairs, stools, and so on.
To develop chair leg protector using injection moulding process by employing in-house workshop facility.
The project aims to create public chair leg protector by using plastic or rubber which is durable
The objective is to prevent the legs of chair from scratching and damaging all floor and carpet types

Keywords: HDPE, LDPE, Wire Cutting, Drilling, Machining, Surface Grinding, Milling, Shaping
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I. INTRODUCTION

The floor of your chair is the first place that you touch when you sit in it, so it's important to keep it clean and free of debris. Chair leg floor protectors are a great way to do this. When your chair legs are covered in protectors, they're less likely to collect dirt and dust, which can lead to scratches on the floor. Additionally, if there are any cracks or chips in the flooring, these will be hidden by the protectors. The Chair Leg Floor Protector can be made by using injection moulding machine.

The main components of the injection moulding machine are

- Pneumatic Double acting Cylinder
- Hooper
- Barrel
- Heating Coil and regulator
- Direction control Valve
- Flow control valve
- L-Angle
- Nozzle

- Die and
- Hose connectors

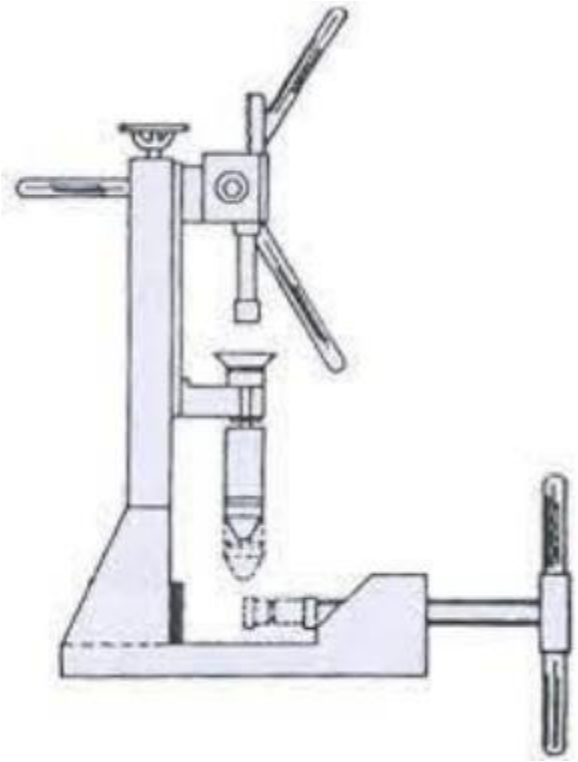


FIGURE . INJECTION MOULDING MACHINE

Description of Components :

Pneumatic Double Acting Cylinders :

A double acting cylinder is employed in control systems with the full pneumatic cushioning and it is essential when the cylinder itself is required to retard heavy messes. This can only be done at the end positions of the piston stock. In all intermediate position a separate externally mounted cushioning derive most be provided with the damping feature.

Hooper :

The hopper is used to pour the plastic raw materials into the barrel.

Barrel :

The barrel is used to hold the molten and unmated plastic raw materials.

Direction Control Valve :

To control the to and from motion of cylinder, the fluid energy has to be regulated, controlled and reversed with a predetermined sequence in a pneumatic system. Similarly, one may have to control the quantity of pressure and flow rate to generate the desired level of force and speed of actuators. To achieve these functions, valves are used. Valves are fluid power elements used for controlling and regulating the working medium. The main functions of the valves are:

1. Start and stop the fluid energy
2. Control the direction of flow of compressed air
3. Control the flow rate of the fluid
4. Control the pressure rating of the fluid

Flow Control Valve:

These are used to control the rate of flow of a fluid through the valve.A directional control valve on the receipt of some, external signal, which might be mechanical, electrical or a fluid pilot signal, changes the direction of stops, or starts the flow of fluid in some part of the pneumatic/hydraulic circuit. They can be used to carry out such functions as:

1. Controlling the direction of motion of an actuator
2. Selecting alternative flow paths for a fluid.
3. Stopping and starting the flow of fluid

- Purpose: This valve is used to speedup the piston movement and also it acts as a one-way restriction valve which means that the air can pass through only one way and it can't return back.
- By using this valve, the time consumption is reduced because of the faster movement of the piston.

II.LITERATURE REVIEW

Injection Moulding (IM) appears to [1] be one of the most important techniques for manufacturing plastics products worldwide. As IM is a complicated process, so it is technically very difficult to take into account all the changes taking place during the process. To enhance efficiency of the process and to have consistent product quality, proper input parameter's setting is critically important. The numbers of input process parameters are: melt temperature, mold temperature, injection pressure, injection speed, injection time, holding pressure, holding time and cooling time. The responses/output may be mechanical properties, defects e.g., warpage, shrinkage, sink mark, residual thermal stress etc., and aesthetic requirement for example surface finish/roughness. Literature review shows that most of the researchers have optimized the process parameters and established a correlation between the parameters and the behavior of the material under investigation. Others performed optimization research regarding some specific areas of IM viz. cooling channel design, location of the gate, runner system design etc. Some of the studies were focused on monitoring control system to monitor the process during production to ensure quality and minimize the defects. Researchers have used many different techniques to model and optimize the IM manufacturing process. These techniques include mathematical modelling, simulation, design of experiments (DOE) and artificial intelligence (AI). Some of the examples of these techniques are Taguchi Method, evolutionary algorithm (EA), artificial neural networks (ANN), genetic algorithms (GA), fuzzy logic, response surface methodology (RSM), particle swarm optimization (PSO), analysis of variance (ANOVA) etc. This paper aims to review and present the various studies concerning the process parameters and their influence over the quality of product. Throughout this review, the process parameters, response, material used and the technique applied to optimization research in the field of IM are highlighted.In mass production of parts characterized by complex geometry, IM is a frequently chosen production method. On the other hand, the IM process consumes significant amounts of energy, which is why different approaches for energy efficient and sustainable IM have been investigated in the following studies. Raouf et al. (2020) presented a life cycle inventory unit process for the metal and polymer IM process. Their work provides the computational tools for estimating energy consumption in a sequence of manufacturing processes used to produce a metal or polymer IM product.

The term quality has become a “catch all”[2] term used in describing the various characteristics of an object. It is nearly impossible to define the term consistency. The quality is any particular or specific characteristics of a product development design object that contains or relates information about the object. This is primarily a chunk of geometry distinguished by its ability to perform a function with one or more other. In this primary processing conditions are studied from concept development to manufacturing of the product. Effect of different factors studied on the basis of processing parameters. Since quality and productivity are the two important contradictory objectives in any machining process. Some extent of quality has to be compromised while assurance giving for high productivity. Similarly productivity will be decreased while the efforts are channelized to enhance quality. To ensure high quality and productivity, it is necessary to optimize machining parameters. Various responses of quality of injection moulding process has been studied on the basis of performance parameters and methods. This paper aims to present plastic injection moulding process conditions. The processing conditions satisfied quality based product manufacturing.While in micro-composites, the presence of the fillers often impair the processability via IM, in nano-composites the processability of the material is just slightly modified, with respect to the polymer matrix, due to the addition of relatively small quantities of nano-particles (see, for example: [[12], [13], [14]]. This makes the nano-composites ideal candidates for manufacturing high value miniaturized components by means of micro-injection molding (μIM). μIM is one of the key manufacturing technologies for the mass production of miniaturized components in thermoplastic polymers with applications in several industrial fields, such as biomedical [15,16], optics [17,18], and high-precision mechanical industry [[19], [20], [21]]. With respect to the more traditional IM, in a generic μIM process the polymer melt is forced to flow in non-isothermal conditions at much higher shear rates through channels characterized by higher surface to volume ratios. This results in different thermo-mechanical histories undergone by the material.

The term quality has become a “catch all”[3] term used in describing the various characteristics of an object. It is nearly impossible to define the term consistency. The quality is any particular or specific characteristics of a product development design object that contains or relates information about the object. This is primarily a chunk of geometry distinguished by its ability to perform a function with one or more other. In this primary processing conditions are studied from concept development to manufacturing of the product. Effect of different factors studied on the basis of processing parameters. Since quality and productivity are the two important contradictory objectives in any machining process. Some extent of quality has to be compromised while assurance giving for high productivity. Similarly productivity will be decreased while the efforts are channelized to enhance quality. To ensure high quality and productivity, it is necessary to optimize machining parameters. Various responses of quality of injection moulding process has been studied on the basis of performance parameters and methods. This paper aims to present plastic injection moulding process conditions. The processing conditions satisfied quality based product manufacturing

In the Injetction Moulding process,[4] the output product quality is dependence on various attributes such as product geometry, the material used for manufacturing, and the machining parameters (process parameters). Here it is an exaggeration to say that the parameters associated with the molding process play a crucial role in the production of high-quality products. In the present study, the causal approach is

used to recognize the problems associated with the injection molding components to cause defects such as shrinkage, flow lines, sink marks, burn marks, short shots, warpage, etc. This study aims to reveal the basic understanding of the injection molding process and the importance of machining parameters in moldings. This study will brief the type of defects and their causing machining parameters to the industrial practitioners/researchers. In addition, the study will suggest the parameters to set out on the machine so that the final product will be free from any defect.

Long-term product improvement[5] requires detailed analysis that includes information from the entire product life cycle. Life cycle assessment according to the standards ISO 14040 and ISO 14044 provides information on the environmental impact of products throughout their life cycle. The aim of the study is to analyze the environmental impact of a multicomponent plastic product in two variants and the associated customized tools using life cycle assessment. The subject of this analysis is the previous and the improved design of a multicomponent plastic cap for 19 l water bottles and the associated custom-manufactured tools. The main improvements of the custom-made tools are in the larger number of cores, and the new cap design was improved with fewer components and mass. The results show that the production and packaging of the improved multicomponent plastic cap has more than two times lower environmental impacts in the categories of global warming potential, freshwater eutrophication, terrestrial acidification ozone formation, human health and non reneweable, fossil. The environmental impact of custom injection moulding tools is strongly influenced by the capacity of the injection moulding machine and the number of cores or number of products that can be produced in a batch. In addition, the results of the improved 19 l multicomponent plastic cap showed a lower environmental impact compared to previous studie of the 5 l plastic cap.

Polymeric drug delivery devices are among[6] the most promising avenues to improve the equitable distribution of life-saving medications throughout the world. At present, most research into manufacturing these devices relies heavily on solvent-based methods, limiting scalability, reproducible manufacture, and potentially leading to cytotoxicity. Solvent-free polymeric biomedical implants manufactured through traditional thermal processing methods eliminate the bulk of these concerns. However, they are difficult to manufacture in a research laboratory setting. Investigation of manufacturing techniques such as injection molding has been limited in the past due to the high upfront cost of polymer equipment and the large scale necessary to conduct pilot experiments. This study describes a low-cost bench-top milliliter-volume vacuum injection-molding system capable of pilot-scale injection molding of small shapes of arbitrary geometry. The plans presented herein open this convenient and scalable manufacturing technique to academic research laboratories interested in pilot-scale experiments with polymeric devices. Polymers relevant for polymeric drug or vaccine delivery are investigated, and a demonstration of the fabrication of simple geometric parts and solvent-free polymeric .

III.PROBLEM STATEMENT,OBJECTIVES AND SCOPE

Problem statement:

To develop chair leg protector using injection moulding process by employing in-house workshop facility

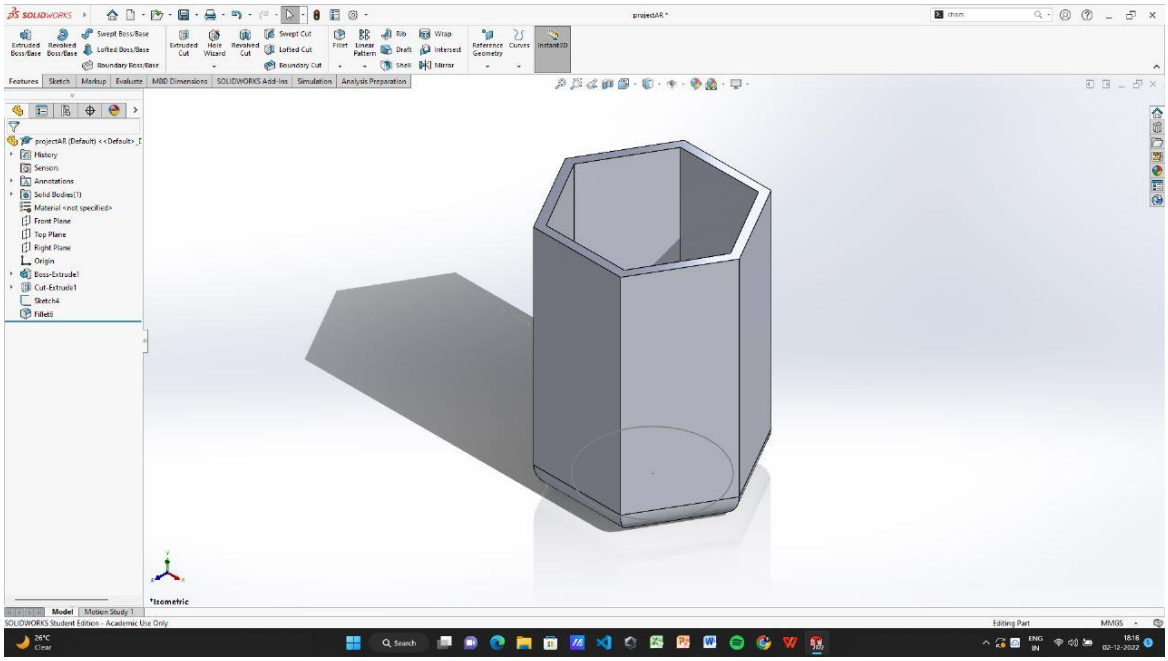
Objectives:

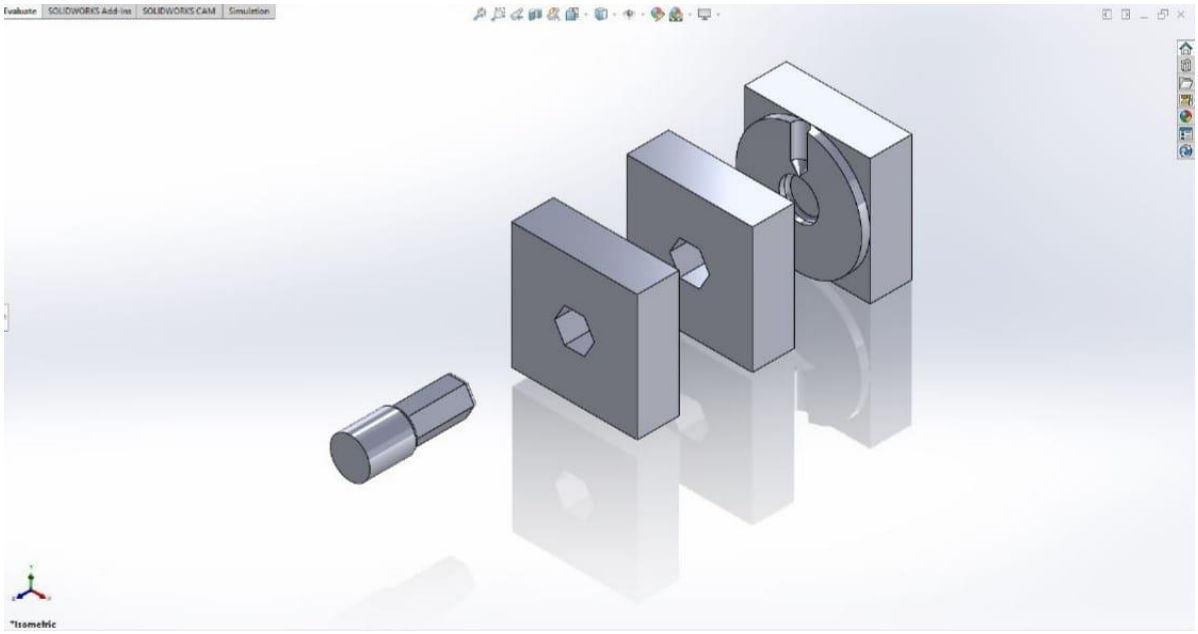
- The project aims to create public chair leg protector by using plastic or rubber which is durable.
- The objective is to prevent the legs of chair from scratching and damaging all floor and carpet types.

Scope:

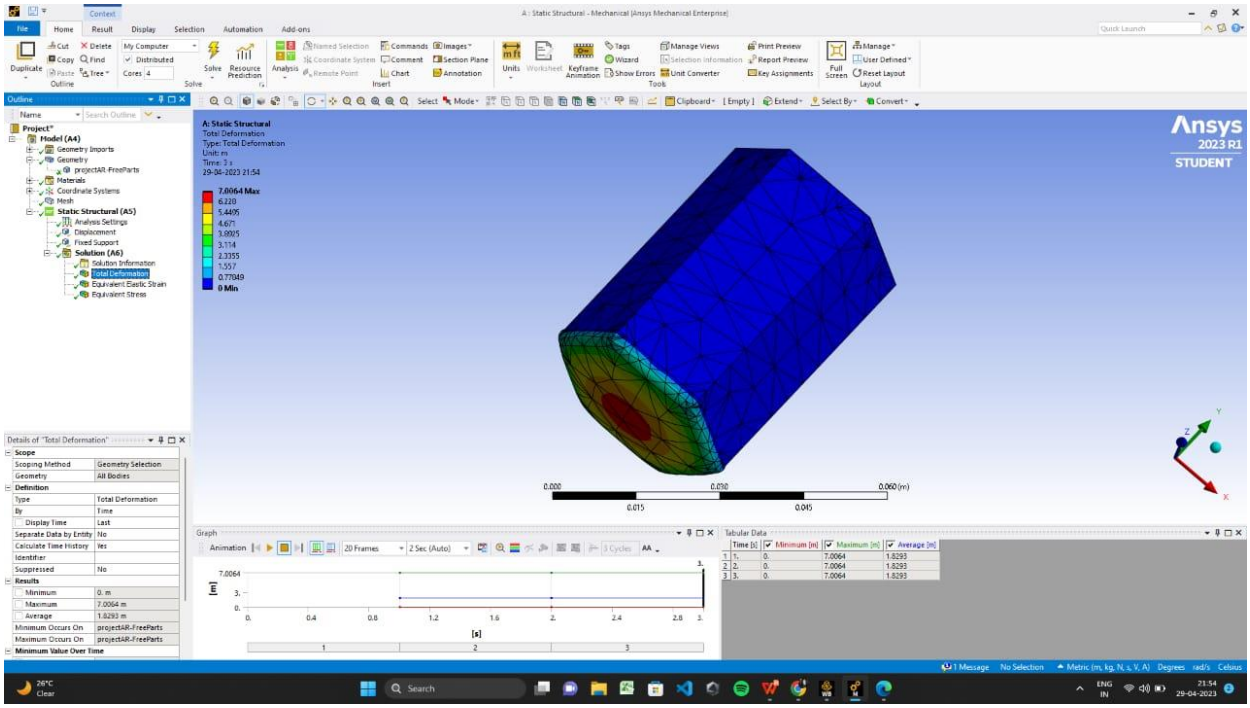
- It is used for rough chair feet, makes it smoother, so that prevent your floor surface from scratching, and keep chair balance, items on desk or cabinet do not slide easily.
- Compared with nail pads, has the advantage of easy install and do no harm to your chair. More maintainable and last longer than stick-on pads.
- This feet cover can keep it out of the water, so that water cannot enter the inner of the chair.

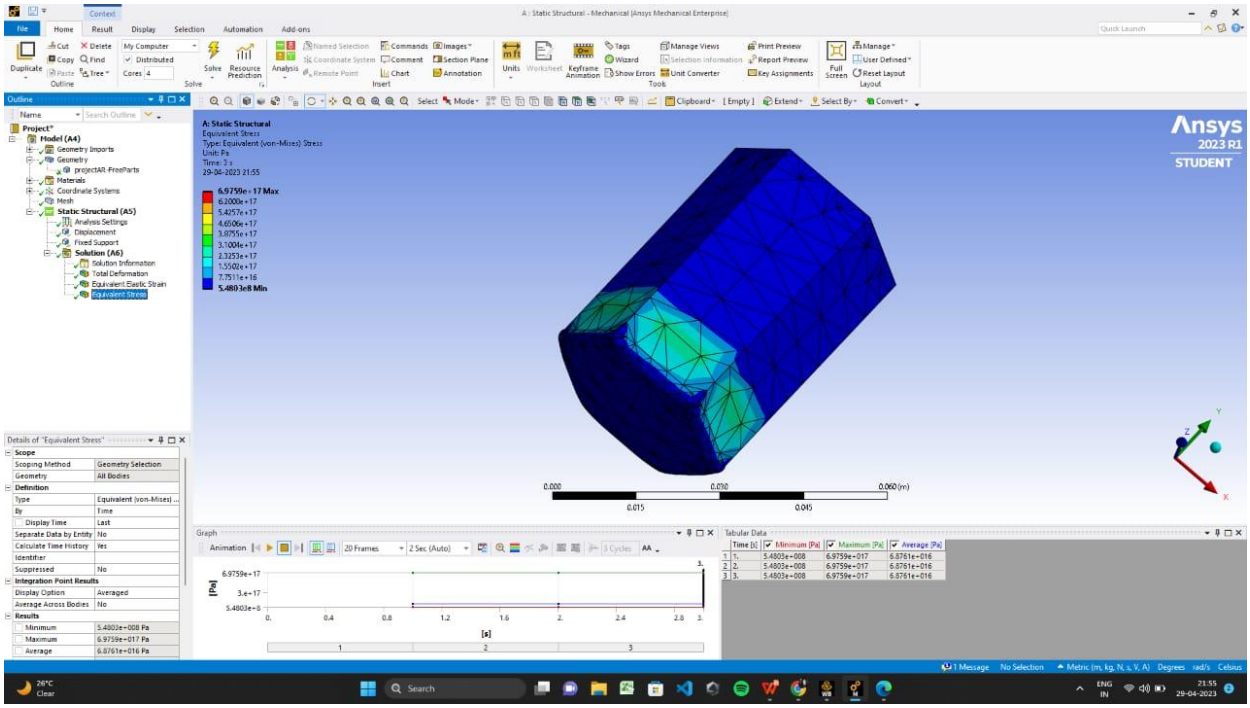
CAD Modelling





Design Analysis with Ansys





IV.Experimental Work

1. Design and Analysis of Prototype :

The initial stage involved designing a prototype for the chair leg floor protector. The design was based on a comprehensive review of existing literature and patents, including the reference patent US20120097818A1. The prototype design incorporated key features such as a cushioning material, a rigid base, and a secure attachment mechanism. The design was analyzed using computer-aided design (CAD) software to ensure proper dimensions and functionality.

2. Calculation of Design and Working Principle :

To ensure the chair leg floor protector's effectiveness, several calculations were performed. These included determining the optimal size and thickness of the cushioning material based on the weight of an average chair and the desired compression properties. Additionally, calculations were conducted to ensure the attachment mechanism provided a secure fit while allowing for easy installation and removal.

3. Calculation and Design of Product :

Building upon the prototype design, further calculations were made to refine the product design. This involved considering factors such as material strength, durability, and cost-effectiveness. The final product design incorporated the necessary dimensions and specifications based on the calculated parameters.

4. Manufacturing of Product :

The manufacturing process consisted of several steps. First, the base material was selected, considering its durability, stability, and compatibility with the attachment mechanism. Then, the cushioning material was cut and shaped according to the design specifications. Finally, the attachment mechanism was manufactured separately, ensuring it met the required strength and ease of use.

5. Assembly of Materials :

The assembly phase involved combining the base material, cushioning material, and attachment mechanism. The cushioning material was securely attached to the base, and the attachment mechanism

was integrated into the design, allowing for easy installation and removal.

6. Testing and Performance Checking :

To evaluate the performance of the chair leg floor protector, rigorous testing was conducted. This included subjecting the product to various loads and performing simulated chair movements on different types of flooring surfaces. The performance was assessed based on factors such as floor protection, stability, ease of installation, and resistance to wear and tear. The test results were compared to industry standards and the intended requirements to validate the product's effectiveness.

Fig. Damage Product

Fig. Perfect Product

V. Result

This project study provides a replaceable floor protector for the leg of a chair or table to protect floors which compensates for the unevenness of the chair, table or floor. It is another objective of this project to provide such a protector in the form of a removable pad so it can be replaced when worn out and one or more shims for varying the angularity of the chair or table leg with respect to the floor.

Thus all objectives are preferably accomplished by providing a floor protector which fits onto the legs of a chair or table and includes an insert receivable in the bottom of the leg. The insert includes a removable floor protector retaining member. A floor protector of a pad of a soft floor protective material is removably mounted in the retaining member having a portion extending downward from the retaining member in contact with the floor or the like on which the chair or table is disposed. The pad can be quickly and easily replaced when worn out. One or more removable shims are provided for compensating for the unevenness of the floor or chair or table legs.

VI. Conclusions

The experimental work conducted for the design and manufacturing of the chair leg floor protector resulted in the development of a functional and reliable product. The prototype design, calculations, manufacturing process, material assembly, and testing procedures were systematically executed to ensure the product meet the desired requirements. The chair leg floor protector demonstrated effective floor protection, stability, and ease of use. Further improvements and refinements can be considered based on specific application requirements and customer feedback. This Chair leg cap can greatly reduce the noise, you could no longer worry about suffering a harsh sound when moving the chair. The bottom of rubber leg cap anti-slip thread surface will be effective anti-skid than the original rubber feet. Rubber material chair leg cap is very dense and has good tensile strength, resists impact deformation

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