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IMPLEMENTED A WEB-ORIENTED KNOWLEDGE-BASED CAD MODELING SYSTEM FOR CREATING CAD MODELS OF SPUR GEARS

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ABSTRACT

The research demonstrates that Web-Oriented Knowledge-Based CAD model could be developed for industrial applications in a time-effective manner. Furthermore, the proposed system is proven to bring considerable advantages in minimizing the online real-time data transfer while generating the online CAD model. It is examined that the proposed system works satisfactorily and yields acceptable results, as well as makes accurate decisions just like as the human expert(s) for generating the CAD model. This system can simplify the design process and CAD modeling task of the design engineers who have the limited skill on working with the software. Moreover, the system does not require the physical presence of the human expert(s) at the site of the use of the system as it is equipped with the knowledge base. This knowledge base facilitates the unskilled user to use the system. With this system, the centralization of the expert's knowledge is possible and can be available all the time over the internet. Additionally, the other significant feature of the system is that the user can access the up-to-date data and the knowledge easily throughout the world and benefit from any change in the data.

KEYWORDS: Web-Oriented Knowledge-Based CAD model, CAD Software, Spur gear, design calculation

INTRODUCTION

Computer Aided Design (CAD) is the use of computer software to design and document a product’s design process. Engineering drawing entails the use of graphical symbols such as points, lines, curves, planes and shapes. Essentially, it gives a detailed description of any component in a graphical form.

A solution to many engineering problems requires a combination of organization, analysis, problem-solving principles and a graphical representation of the problem. Objects in engineering are represented by a technical drawing (also called as drafting) that represents designs and specifications of the physical object and data relationships. Since a technical drawing is precise and communicates all information of the object clearly, it has to be precise. This is where CAD comes forward.

CAD software enables the user to improve their efficiency in delivering the quality design and increases their productivity. Additionally, the CAD software is able to improve record keeping through better documentation and communication.

Today, the use of CAD has permeated almost all industries. From aerospace, electronics to manufacturing, CAD is used in all industry verticals. Since CAD encourages creativity and speeds up productivity, it is becoming more and more useful as an important tool for visualization before actually implementing a manufacturing process.

CAD software also referred to as Computer Aided Design software and in the past as computer-aided drafting software, refers to software programs that assist engineers and designers in a wide variety of industries to design and manufacture physical products ranging from buildings, ships and cars to mobile phones, TVs, computers etc. CAD software is often referred to as CAD/CAM software.

While he could never have foreseen today's CAD software, no CAD software history would be complete unless it started with the mathematician Euclid of Alexandria, who, in his 350 B.C.

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treatise on mathematics "The Elements" expounded many of the postulates and axioms that are the foundations of the Euclidian geometry upon which today's CAD software systems are built [1].

It was more than 2,300 years after Euclid that the first true CAD software, a very innovative system (although of course primitive compared to today's CAD software) called "Sketchpad" was developed by Ivan Sutherland as part of his Ph.D. thesis at MIT in the early 1960s. Sketchpad was especially innovative CAD software because the designer interacted with the computer graphically by using a light pen to draw on the computer's monitor.

Knowledge-Based System (KBS) is computer driven, which utilizes knowledge to resolve the issues that are sufficiently hard to involve human proficiency for their answer. This is the hugely considered and sensible system that raised up out of 40 years of Artificial Intelligence (AI) explore. The system has stretched enough in the engineering field and proved its proficiency in decision making processes. It has turned out to be a sensible approach for visualizing and examining the design process with the assistance of simulation tools. Thus, undoubtedly KBS is useful for mass customization strategy that is accessible for the quick design [2]. Besides, by declining the repetitive design tasks, KBS can direct the less experienced designer towards the utmost design [3]. In the field of engineering design, KBS has various applications, especially the automatic CAD modeling is an extremely knowledge needy process [4,5]. In the design process, the designers frequently depend on the past experience before the academic practice and to some degree, it remains a procedure of experimentation. In the modern competitive market where there is a lack of skilled designers [6], the necessity of superior quality product with shorter lead time and with minimal effort have stressed the necessity of developing a CAD system with implanted knowledge [7,8]. Therefore, this is an assignment that requires both traditional CAD technologies and KBS approach and this is the core point of this research.

Knowledge of the CAD systems for CAD modeling must be captured and programmed as a computer program. With the assistance of the decision logic algorithms, a CAD modeler's decision-making approach can be imitated. Additionally, the process of considering the design assumptions and computing the design calculation can be automated by utilizing the generative modeling technique.

Today, engineers do much repetitive work when designing customized solutions. They must draft each drawing manually or with CAD, execute the same kinds of calculations and select appropriate components for each project. By using knowledge-based systems, engineers can describe all the necessary calculations, the bases for selecting components and the underlying relationships determining layout in product knowledge bases called intelligent libraries.

Supported by knowledge-based systems, engineers can better utilize knowledge of the product, its design process, manufacturing and operating requirements than ever before. Utilizing knowledge-based engineering systems it is possible to create, maintain and share product know-how, which is the main task of engineers. As a result, new design projects can be carried out rapidly and with less effort. In the words of the Research and Development (R&D) manager of Tampella Power Industry, "Routine engineering is automated; engineers now serve an R&D role in our company."

The objective of a knowledge-based CAD system is to change focus from automating the drafting to automating the broad decision making and the repetitive engineering tasks in the actual design process.

SPUR GEAR

Spur Gear is the simplest type of the gear having teeth projecting radially. Generally, the efficiency of gear is nearly 98%. The formal methods for design of gear use ISO (International Organization for Standardization) or AGMA (American Gear Manufacturers Association standards). Fig. 1 illustrates the basic terminology of the Spur Gear.

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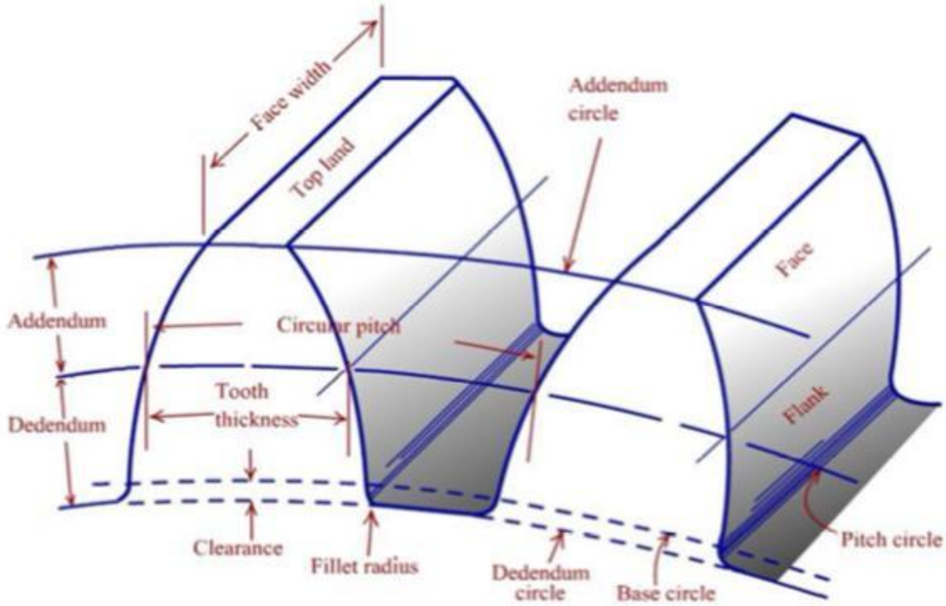

Fig. 1: Terminology of the Spur Gear

Recently, commercial CAD tools are preferred by the designers to design the gears. Modeling the gear using CAD not only helps in drawing the complex teeth curves but also makes it easy to manufacture the gear as the CAD model is the input to the present day CNC machine.

Spur Gears mesh together properly only if they are fitted to the two parallel shafts. In the gear mesh, the smaller gear is called the Pinion and the larger one is called the Gear. As the Pinion runs more number of cycles in compare with the Gear it needs to be made harder than the Gear. They are used to transmit the rotational motion power between the parallel shafts. No axial thrust is created by the tooth loads. Spur Gears are excellent at moderate speeds but tend to be noisy at high speeds.

OBJECTIVES OF THE STUDY

The research work is based on the hypothesis that Web-based approaches offer major benefits to generate the CAD model over similar desktop CAD model approaches. In the recent past, the web-based applications have turned out to be beneficial in various businesses and could pass the same benefits to the CAD modeling area too. The primary objective of the present research work is to develop a web-oriented knowledge-based CAD modeling system that should cut down the CAD modeling time and online data transfer in the early stages of the product lifecycle. The following are the specific objectives of the present research work:

- To develop an environment for automatic online CAD model generation.
- To generate a knowledge-based system for CAD modeling and establishing the parametric relations between parameters of the component.
- To develop a knowledge-based system for decision-making and design calculations.

LITERATURE REVIEW

Hak et al. [9] developed an effective reuse and retrieval system that can easily register modeled standard parts using a simple graphical user interface (GUI) for automation of mould designs. It consists mainly of three kinds of module; (a) standard part module is helpful for designers to effectively reuse or modify standard parts after registering them using a GUI, (b) parts list module generates a parts list using either standard and/or non-standard parts, (c) The retrieval-system module allows the effective retrieval and classification of standard parts.

Mermoz et al. [10] describe a parametric design methodology implemented to reduce helicopter main gearbox design time and cost. The parametric design experiences were all limited

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to isolated parts or simple assemblies but a helicopter gearbox is composed of hundreds of components, so the methodology has to be robust to the size of the CAD model used. First CAD models are created and stored in a database in which designers come to take the parametric models that fit best with the topology of their mechanical assemblies under construction. However, they stated that "It is still difficult to fix a complete methodology to the lowest level of CAD design because the topology of the main gearbox housing of helicopter is always different and features, which need to define bearing locations, fixation holes or wall thickness, are to be carried locally by the designers". They finally claim that the parametric modeling of complex housings is still a field on which the design methodology has to be improved to generate a full 3D solid model.

Li-Ming Ou and Xun Xu [11] presented a system that can analyze and utilize assembly data created using a CAD system for automatic generation available from a CAD model to generate assembly sequences plan which is a complete set of step by step procedures required to assemble a finished product. The system also considers a user input as a type of assembly constraint used in CAD assembly models which can provide essential information related to the assembly process i.e. Mate/Align, Tangent, Angle Offset and Distance Offset. The system is capable of producing a set of ranked feasible assembly sequence plans for an operator to evaluate.

Gerardo Salas Bolanõs et al. [12] presented a Web-based CAD system called WatCAD. The University of Waterloo was behind the development of this system. The system uses ASP.NET to generate the CAD models. But, the execution process takes much time as the CAD model generates on the server. The systems interpret the user inputs over the web to generate the 3D CAD model. The drawback to the system is that it requires the expert for operation as it needs much expertise.

Mourtzis et al. [13] proposed a virtual and augmented reality platform for integrating the customer into the design process and facilitated the personalization in the system. As the customer perception in the development of the product is established, the output model of the system was reaching customer satisfaction level. But, the drawback of the system is that it is not fully capable of the modification of the 3D model.

Edward Red et al. [14] introduced cloud-based computer-aided engineering application. The intention behind the development of this application is to overcome the productivity bottleneck because of the single user or designer involvement in the design process. The application is fully Web dependent and requires human to human interaction. Though the application is one of the advanced in the modern Web-based designing application, it lacks the self-designing capability.

Chamnarn et al. [16] developed a prototype of an interactive web-based system for injection mold design used for producing automotive rubber parts. The architecture of the system consists of an interactive knowledge base mold design system embedded in a program interactive web-based system. A database solution together with artificial intelligence techniques is presented in the modular structure for accessing the knowledge base and by this ensuring its further development and extension. In practice based on the rubber grommet design, the developed system can integrate different kinds of knowledge, guide an engineers' design and improve their design efficiency. With the support of the web-based technologies, the rubber injection mold design application was developed on the network. It can be easily, effectively and economically utilized by small and medium rubber injection mold manufacturing companies.

Francalanza et al. [17] introduced a framework for the novel design approach called Intelligent Changeable Manufacturing System (iCMS). The system is powered with a knowledge-base which can imitate the expert's decision-making approach. With this framework, the designers can minimize the negative effects which arise in the product design and development phase. Moreover, the system has given its contribution towards the digital factory. Despite the modern advancement of the framework, it is still lacking the assembly capability.

Akinnuli et al. [18] developed an interactive tool called "CADDgear" to facilitate the design and drafting of helical and spur gears thereby generating reliable data for use in the manufacturing process. The tool was developed with Java software. The intention behind the development of this

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tool is to reduce the production cost by reducing the time required to synthesis, analyze and document.

Laseinde et al. [19] developed a software tool for designing the plastic spur gear using virtual reality. A flawless simulated computer model for the calculation of all parameters of plastic spur gears was developed in both DOS environment and in an enhanced interface using Macromedia flash. The complete plastic spur gear profile was generated upon feeding in the major gear designing parameters.

Shashvat Mehta et al. [20] developed an automated spur gear design system using Matlab software. Authors presented the design procedure of a spur gear and the selection of appropriate module of a spur gear according to the requirements. Along with the module, the other gear and gear teeth parameters are also found and pertaining to these results, simulation and analysis are carried out to ensure the efficient working of the designed gear in the field.

RESEARCH METHODOLOGY

The research work on Web-Based CAD modeling system is extensively increased in the past two decades. For the effective usage of the potentiality of the web-based CAD modeling systems, a careful selection of the suitable technologies is needed. But, selecting the suitable technologies has become a challenging task because of the lack of flexibility, uncertainty in the potentiality of the CAD software and different cost elements. The accurate selection of the suitable technologies can only be done by the well-experienced design engineers based on the target application. On the other hand, because of the increase in the shortage of the design experts the selection of the appropriate web and CAD technologies for CAD modeling has become a critical problem.

Thus, nowadays, less experienced and more specialized designers are getting involved in the design process. Therefore, there is a clear need for the necessity of the software that can imitate the design expert's decision. Hence, this research work is an attempt for the development of a web-based CAD modeling system for the generation of the CAD model with the help of the knowledge base.

In the current research work, a web-oriented knowledge-based CAD modeling system has been proposed to reach the objectives of the present research work. Using this system the user can be able to generate a CAD model. The process of generating the CAD model can be automated in the system. In order to generate the automatic CAD model, the system has been empowered with a knowledge base. Using the system, the user can be able to generate a CAD model that is as good as the human expert generated CAD model. The system facilitates to integrates the geometrically separated user and the expert over the Internet to generate a CAD model. The system can reduce the CAD modeling time as it uses the automation tools to generate the CAD model. Thus, it can decrease the production lead-time and enhance the production quality. It imitates the decision-making process of the expert for choosing and finalizing the appropriate design process.

DEVELOPMENT OF THE KNOWLEDGE-BASED CAD MODELING SYSTEM FOR THE SPUR GEAR

The implementation of the proposed system on single CAD model generation was carried out at a designer and manufacturer of Spur Gear at the southern part of Andhra Pradesh, India. The aim of the work is to develop a CAD model of the Spur Gear as per the industry standards. As the industry is following the AGMA standards for designing and manufacturing the Spur Gear, the CAD model needs to be generated as per the AGMA standards. The input data pertaining to this industrial implementation process is the design requirements of the Spur Gear and the expected output is the fully generated CAD model of the Spur Gear.

The Spur Gear is the simplest type of gear having teeth projecting radially. Generally, the efficiency of gear is nearly 98% [21]. Conventional methods for design of gear use International Organization for Standardization (ISO) or AGMA standards [22]. Recently, commercial CAD tools are preferred by the designers to design the gears. Modeling the gear using CAD not only helps in

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drawing the complex teeth curves but also makes it easy to manufacture the gear as the CAD model is the input to the present day CNC machine. But, generating and regenerating the geometries of gear is complex using CAD software. Additionally, gear designing and CAD modeling is a time-consuming process because of complex design calculations and requirement of high-level professional approach for CAD modeling.

As per the proposed system, a knowledge-base has been developed with the knowledge and experience of Spur Gear design experts and AGMA standards. The knowledge acquisition from the AGMA standards is almost ready-made as it is available in written format from books and other literature in the form of well-defined rules. The database has been developed with all relevant tables and information regarding various standard factors, gear material properties, standard module, rules, empirical relations, constants, assumptions etc. This database is developed in such a way that, all the relevant data for Spur Gear design calculation should be available in it and will be able to retrieve the same by the computer program whenever the need arises for the proposed system.

At first, for developing the CAD model of the Spur Gear, the available input data was collected from the user using the developed WUI. Figure 2 shows the WUI for the Spur Gear.

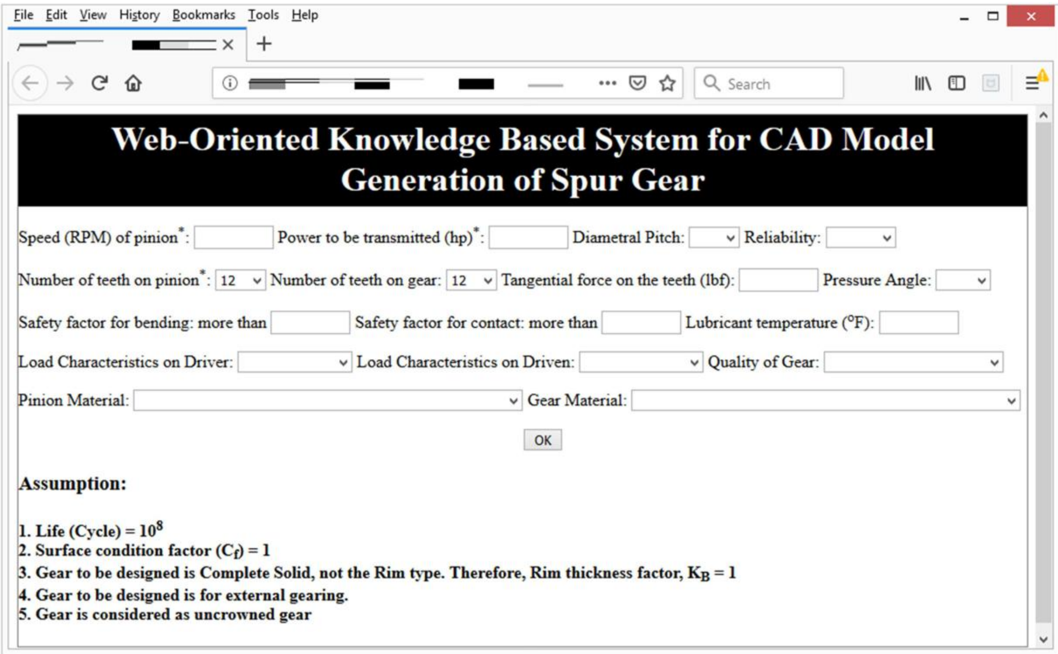

Fig. 21: WUI for CAD model generation of the Spur Gear

In the WUI there are many fields to fill-in by the user, but it is not required to fill-in all, as the user may not have all the data all the time. So, the Decision Maker subsystem in the developed knowledge-base will decide the minimum required fields for carrying out the design calculation. Therefore, the user needs to enter the available input data fields and verify the system's decision for further action. If the entered input data is enough for the design calculation, then the system will go ahead for the design process, otherwise, the system will advise the user accordingly for further action. Hence, the approach to design calculation always depends on the input data. For instance, if the user fills the input data like the number of teeth required (N), Speed in RPM (S), pressure angle (θ), power to be transmitted (P) and tangential force on teeth (TF) then, the Logical Algorithm subsystem in the developed knowledge- base will decide an approach for design calculations. The preferred approach by the knowledge-base will calculate the module (m) of the gear with the following AGMA standard relation.

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$$m = \frac{2\times\frac{P\times1000\times60}{2\times\left(\frac{22}{7}\right)\times S}\times\frac{1}{TF}}{N}$$ ....(1)

Diametral pitch can be calculated from the module value as it is the reciprocal of it. Later, by considering the pressure angle, the key parameters like pitch circle diameter, base circle diameter, dedendum circle diameter and addendum circle diameter can be calculated based on the conventional formulas that are given below.

Pitch circle diameter $= \frac{\text{Number of teeth}}{\text{Diametral Pitch}}$..................................(2)

Base circle diameter = Pitch circle diameter × Cosine (θ) ....(3)

Dedendum circle diameter = Pitch circle diameter -2 × $\frac{1.25}{Diametral\ Pitch}$............(4)

Addendum circle diameter = Pitch circle diameter +2 × $\frac{1}{Diametral\ Pitch}$............(5)

Suppose, the user requirements and input data pertaining to the generation of the CAD model of the Spur Gear are Speed, Power to be transmitted, Number of teeth on gear and pinion, Pressure angle, Gear Material, Pinion Material, Diametral Pitch, Quality of Gear, required Safety factors for bending and contact., then, the Decision Maker and Logical Algorithm subsystems of the proposed system suggests a corresponding approach for design calculations. For this approach, the vigorous use of AGMA standard empirical formulas is required for design calculation. It is the well- known fact that, in the process of gear design, pinion need to be designed first as it encounters more stress than gear in any form of the gear mechanism. Soon after completion of the design of the pinion, the corresponding gear was selected accordingly. So, the above suggested approach designed the pinion first by considering bending stress and contact stress (pitting resistance) on it. As per AGMA standards, the bending failure and pitting failure can be avoided by considering the beam strength and wear strength respectively.

PREFERRED APPROACH BY THE LOGICAL ALGORITHM SUBSYSTEM

As per the expert's knowledge and AGMA standards, the Logical Algorithm subsystem suggested the following equations (a) and (b) for a safe design.

Bending strength criteria: bending stress (σ) ≤ allowable bending stress (σ_{all}) ... (a)

Pitting strength criteria: contact stress (σ_c) ≤ allowable contact stress ($\sigma_{c\ all}$) ... (b)

where,

$$Bending\ Stress, \sigma = W^t K_0 K_v K_s \frac{P_d}{F}\frac{K_m K_B}{J}$$ ....(c)

W^t = Tangential transmitted load (lbf)

K_o = Overload factor

K_v = Dynamic load factor

K_s = Size factor

P_d = Diamtertal Pitch

F = Face width (inch)

K_m = Load distribution factor

K_B = Rim thickness factor

J = Geometry factor for bending strength

Corresponding author: **Shubham Tiwari and Dr. Rajeev Kumar**
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I = Geometry factor for pitting resistance

$$Contact\ Stress, \sigma_c = C_p \sqrt{W^t K_0 K_v K_s \frac{K_m}{d_p \times F} \frac{C_f}{I}} \ldots\ldots\ldots\ldots\ldots (d)$$

C_p = AGMA elastic coefficient √lbf/in²

d_p = Pitch diameter of the pinion (inch)

C_f = Surface condition factor for pitting resistance

I = Geometry factor for pitting resistance

$$Allowable\ bending\ stress\ \sigma_{all} = \frac{S_t}{S_F} \times \frac{Y_N}{K_T K_R} \ldots\ldots\ldots (e)$$

S_t = AGMA allowable bending stress (lbf/in²)

S_F = AGMA factor of safety

Y_N = Stress cycle factor for bending stress

K_T = Temperature factor

K_R = Reliability factor

$$Allowable\ Contact\ stress\ \sigma_{call} = \frac{S_c}{S_H} \times \frac{Z_N C_H}{K_T K_R} \ldots\ldots\ldots (f)$$

S_c = AGMA allowable contact stress (lbf/in²)

S_H = AGMA factor of safety

Z_N = Stress cycle life factor for pitting

C_H = Hardness ratio factor for pitting resistance

SUGGESTED APPROACH FOR THE DESIGN CALCULATION

- First and foremost, choose a trial module (m) and reciprocate it to get diametral pitch (P)
- Establish the face width (b). Usually, b = 4π / P. (Face width should fall between 3π / P and 5π / P)
- Calculate the bending stress (σ) on the pinion. For calculating the bending stress, choose a material and core hardness and other relevant data like different factors, a design factor of safety from the developed database.
- Solve and obtain the face width (b) by equating the calculated bending stress with the allowable bending stress. If the obtained face width is not within the range of the standard (as said in step 2.), then, redo the same calculations by considering another material (go to step 3.) or another diametral pitch (go to step 1.).
- If the obtained face width is within the standard range, then, calculate and check for the factor of safety (S_F).
- Calculate and find the necessary core hardness of gear by equating factor of safety of gear $(S_F)_G$ and factor of safety of pinion $(S_F)_P$.
- Choose the gear material corresponding to the calculated core hardness.
- Calculate and find the bending stress (σ) of the gear.
- Check the factor of safety of gear $(S_F)_G$ by considering bending stress (σ).
- Now, calculate and find the contact stress (σ_c) of the pinion.
- Calculate AGMA allowable contact stress (S_c), by equating contact stress (σ_c) and allowable contact stress ($\sigma_{c\ all}$).

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- Calculate and find attendant case hardness & select larger harness valueof pinion.
- Check the factor of safety (S^2_H).
- Calculate and find required case hardness of the gear by equating factor of safety of gear $(S_H)_G$ and factor of safety of pinion $(S_H)_P$.
- Select the larger case hardness for gear.
- Check the factor of safety (S^2_H). If the factory of safety is within the range then the design is safe for the given loadings.

After carrying out the above design calculations, the diametral pitch is obtained. By using the equations (2) to (5) and obtained diametral pitch value, the key parameters like pitch circle diameter, base circle diameter, dedendum circle diameter, addendum circle diameter are calculated by the proposed system for generating the CAD model of the required Spur Gear.

Later, the CAD Modeling Procedure Seeker subsystem chosen the step-by- step procedure for CAD modeling, soon after, the Macro Code Generator subsystem generated the dedicated macro code for CAD model generation of the required Spur Gear. The Macro code which was generated by the Macro Code Generator subsystem is given in Appendix II. Finally, the generated macro code sent to the user for generating the CAD model at the client side and the same was stored in the macro code database for future reference.

Table 1 provides the sample input data for the design of the Spur Gear. Using this input data, the proposed system has generated a Spur Gear CAD model as shown in the figure. 3 The dimensions with which the model was generated is shown in figure 4. In table 2, these dimensions are compared with the AGMA recommended dimensions for the given loads. It is observed that the proposed system recommended dimensions are nearer to the AGMA recommended dimensions. As per the records of the industry where the proposed system was implemented, the processing time to generate the CAD model of the Spur Gear by using the Industry Accessing (IA) system was 907 seconds (approximately 15 to 16 min). But, by using the proposed system the processing time to generate the CAD model of the Spur Gear was 525 seconds (approximately 8 to 9 min), when it is executed on a computer with minimum hardware requirements of SolidWorks.

Table 1 Sample inputs for the design of Spur Gear

S.No	Parameter	Input data
1	Speed (RPM) of pinion	1200
2	Power to be transmitted (hp)	15
3	Number of teeth on gear	60
4	Number of teeth on pinion	22
5	Pressure angle	20
6	Pinion Material	Gray CI class 40
7	Gear Material	Gray CI class 40
8	Diametral Pitch	6
9	Quality of Gear	Commercial Gear (Q_v = 3)
10	Safety factor for bending	>2.7
11	Safety factor for contact	>1.3

Corresponding author: **Shubham Tiwari and Dr. Rajeev Kumar**
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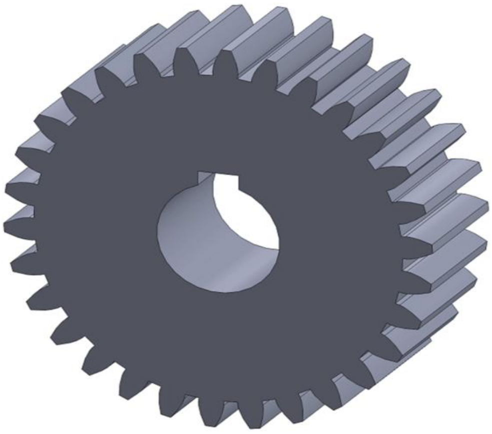

Fig. 3: Generated CAD model of the Spur Gear

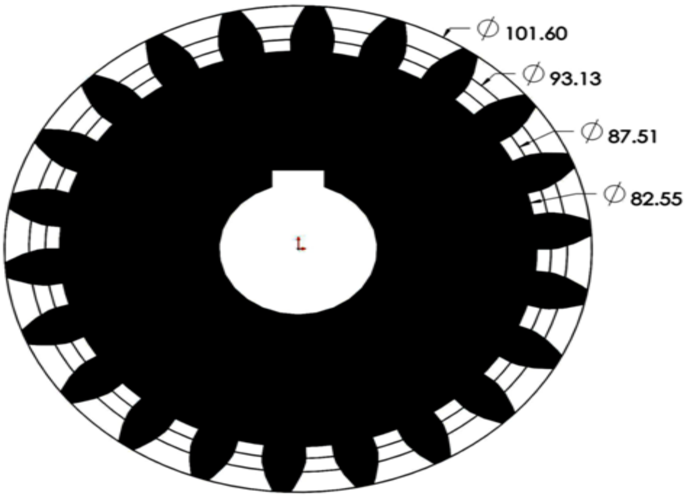

Fig. 4 Dimensions of the proposed system generated CAD model of the Spur Gear

Table 2: AGMA dimensions versus proposed system recommended dimensions

Parameters	AGMA recommended Dimension	Proposed system recommended dimension
	(mm)	(mm)
Addendum Circle Diameter	102	101.60
Pitch Circle Diameter	93	93.13
Base Circle Diameter	87	87.51
Dedendum Circle Diameter	82	82.55

Corresponding author: Shubham Tiwari and Dr. Rajeev Kumar
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CONCLUSIONS

The Web-Oriented Knowledge-Based CAD Modeling system has been developed and implemented in an industrial application for generating the CAD models of the Spur Gear and IBS by accepting the input data from the user via web. While analyzing the proposed system using the t-test, it is observed that the tStatistic values are more than the t-Critical values. Hence, it can be concluded that there is a significant difference between the proposed and IA system. In the context of CAD model generation of the Spur Gear, the multiple correlation coefficient values for the output indicators are 0.843, 0.839. Hence, as all the multiple correlation coefficient are positive, it can be concluded that all the factors have the positive impact on the output of the proposed system. On examining the Multivariate Control Charts, all the output indicators of the proposed system are found within the control as all of them are falling in the elliptical region. Hence, it is concluded that the joint control is found in control limit. Finally, the conclusion of the research work is that by using the developed system the processing time for generating the CAD model and the output file size of the system are reduced in comparison with the IA system. Hence, it can be concluded that the software methodology developed in this research work is useful for the Spur Gear design industry for developing the CAD models.

Eventually, it is concluded that the proposed system is meeting the present research work's objectives and specific objectives as given below:

- As the proposed system is equipped with Knowledge-Based System, it is noticeable that the skilled and unskilled users are able to work with it and can generate the automatic CAD model based on the loading conditions.
- As the output file size is reduced to 38.63 % in the context of Spur Gear, the user can work in low bandwidth network.
- As the proposed system is able to generate the CAD model by itself, the skilled CAD modeler presence in the design industry is not required always.
- As the processing time is reduced to 58.49 % in the context of Spur Gear, the production cost of the design industry can be reduced correspondingly.
- The inbuilt subsystems of the proposed system are capable enough to make decisions on choosing the design calculation method, CAD modeling procedure and Macro code for generating the output of the system.

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Corresponding author: **Shubham Tiwari and Dr. Rajeev Kumar**

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