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Isomizer – Reconstruction of static 3D objects using 2D views

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Abstract - *Reconstruction of solids from hand-drawn engineering drawings is the most effective technology for a drastic developing generation also important research topics in both computer graphics and artificial intelligence. In Industries like Machinery manufacturing, Automation engineering, etc. Engineers are having difficulty visualizing the model by just seeing its 2D orthographic views /engineering drawings. Several legacy designs were available as engineering drawings rather than software-generated CAD models. Even in civil engineering, many of the earlier plans are available as drawings rather than BIM/CAD models Converting paper-based engineering drawings into CAD model files is not only a tedious process but also creating the detailing process might develop heavy expenses for engineers by hiring designers and increase the project cost. Automating the conversion of such drawings reduces tremendous time and labour savings. With the increasing need for geometric 3D models for educational and business sectors, to advance software solutions that can ease the process of model building. The methods proposed in this project can help convert such drawings easily into 3D CAD and BIM models using camera capture or scanned drawing data. This algorithm generates a 3-Dimensional model from its respective 2-Dimensional drawings where the combination of B-rep (Boundary representation) and CSG (Constructive Solid Geometry) approaches will solve issues of previous work done by various computer engineers.*

Key Words: Reconstruction, engineering drawing, computer graphics, 3D, CAD modelling, Computer Engineering.

1.INTRODUCTION

The development of 3D modelling tools over the previous decade has aided rapid 3D prototype utilising Computer-Aided Design (CAD). 2-D Computer Aided Drawing (CAD) drawings and 3-D solid models are two typical techniques to describe geometries in engineering. Several interpreters for converting between formats have been created throughout the years, all of which have been designed for minimal data loss during the conversion process. However, the rapid shift to the digital era necessitated a shift away from paper sketches and toward computer models.

Today's computer-aided engineering (CAE) systems provide efficient ways to automate the product development chain. Solid modelling data and multi-physics analysis can now be used by designers, engineers, manufacturing experts, and researchers in ways that were previously unthinkable.

Among CAE techniques, such as computer-aided analysis (CAA), computer-integrated manufacturing (CIM), computer-aided manufacturing (CAM), material requirements planning (MRP), computer-aided planning (CAP), and Computer-aided design (CAD) is a central issue in the mechanical design field since it provides designers with a set of tools for streamlining design processes such as drafting, visualization, simulation, documentation, and manufacturing processes. As a result, converting 2D orthographic view engineering drawings to 3D CAD models (also known as the "reconstruction" challenge) remains a critical effort in a variety of applications.

The project's main purpose is to convert 2D (Orthographic) views into isometric 3D (Isometric) objects. So, the procedure is as follows: initially, Model requires 2-3 orthographic views of the object to be examined in 3D. So, using an application, scan the 2D (Orthographic) views one by one as input, and then process them to get the 3D object (Isometric) as an output result. It can retrieve the output in either .obj or .scad format, depending on the user's preferences.

2. Literature Survey

In the paper conferred by Yong-Jin Liu, Xi Luo, et al propose a way to retrieve CAD knowledge supported 2nd pen-based sketch inputs. Sketching may be a common and convenient technique for communication style intent throughout the early stages of product style, e.g., abstract style. to realize this purpose, gift a user-adaptive sketch-based retrieval technique during this paper. The contributions of this work are twofold to propose applied mathematics live for CAD file retrieval: the measure is predicated on sketch similarity and accounts for users drawing habits within the sense the kind of paper pattern is dominated or plain used is handwriting is decipherable or not for taking dimensions. However, the limitation for lines retrieval from sketch wherever dash lines and center lines have a confusion [1].

The paper conferred by R. Furferi, L. Governi, and Y. Volpe proposes laptop power-assisted Engineering (CAE) techniques that give effective solutions for automating the entire development chain method. Orderly, unambiguous, and automatic procedure covering the required steps for retrieving 3D models from mechanical drawings is provided. in keeping with their analysis, the works projected at the state of the art are often divided into 2 completely different families: one. Wireframe-oriented approaches, which are referred to as B-rep (Boundary representation) methods; a pair of. Volume-oriented approaches are conjointly referred

to as CSG (Constructive Solid Geometry) strategies. For each of those approaches' researchers opt for the B-rep reason CSG approach is a smaller amount appropriate to support advanced shapes and frequently needs heavier user interaction compared to the B-rep one. However, B-rep conjointly has the limitation of simply making the wireframe structure of the model [2].

Within the paper conferred by Hamid Haghshenas Gorgani, Alireza Jahantigh Pak Associate in Sadegh Sadeghi propose symbolic logic as a mathematical tool supported data of a skilled one amongst the foremost outstanding benefits of victimization the symbolic logic is that uncertainty in connected equivalent components in numerous orthographic views is reduced. Another necessary feature of this technique is that solely 2 orthographic views area units won't reconstruct the 3D model, whereas, in previous strategies, 3 orthographic views were used. This reduces the other algorithm-based model limitations that couldn't deduce the value estimations. {the solely|the sole} limit of the symbolic logic of solid modeling was because it was only applied to planate surfaces that don't embrace flexuous surfaces [3].

Within the paper conferred by Long Hoang projected technique has been enforced Associate in Nursingd verified responsibleness by an ObjectARX program obstructed into AutoCAD 2018. The 3D models are checked for their compatibility with 3D CAD/CAM systems. recently, the B-rep-based reconstruction approach is additionally appreciated than the CSG-based approach. that's in the main a result of CSG-based strategies area units less appropriate for advanced shapes and structures (especially once basic blocks act, which is able to be troublesome to spot them) and infrequently need additional user interaction than the B-rep-based technique. However, their area unit still has some limitations that exist within the B-rep-based. to get rid of the constraints featured following techniques area unit applied: a) victimization solely 2 given views. b) using the B-rep approach rather than the metric system. c) Extending the item domain into the solids shaped by planes, cylinders, and cones. d) Outputting all solutions of the 3D solid whereas reducing the consumed time. e) making the 3D solid compatible with CAD/CAM/CAE systems. However, the orientating of the model isn't correct [4].

Within the paper conferred by Ajay Banglore Harish and Abhishek Rajendra Prasad projected a word that demonstrates the appliance of OpenCV towards feature extraction from 2nd engineering drawings. The extracted options area unit is employed in the reconstruction of 3D CAD models in carangid format and generation of 3D purpose cloud knowledge that's resembling measuring system scan knowledge. This technique facilitates converting engineering drawings simply into 3D CAD and BIM models victimization camera capture or scanned drawing knowledge supported relevance for straightforward shapes and doesn't nevertheless account for the presence of hidden lines in CAD drawings and limits on overlapping shapes and rounded corners wherever the generation of .SCAD file model is dimensionally too low therefore it had been troublesome to check the enforced style model [5].

3. Proposed System

The elaborate system design is shown in Figure 1. Isomizer may be a style application with associate improved reconstruction methodology supported BREP and CSG. Scanning and reconstruction are created easier with this hybrid methodology. The designer might submit a photograph of pen-based hand drawn orthographic drawings to Isomizer, and it will instantly recreate Isomizer models with the dataset's mistreatment FFAG. The archived model could also be saved in .obj format.

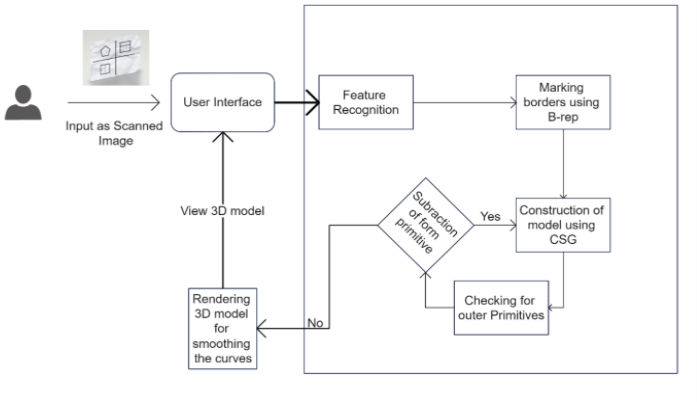

Fig -1: System design of Isomizer

3.1 B-REP (Boundary Representation) Approach

Topological elements (faces, edges, and vertices) and their connections, in addition as geometric definitions for those elements, structure a model's boundary illustration (surfaces, curves and points, respectively). A face may be a phase of a surface that's finite; a position may be a bounded piece of a curve; and a vertex may be a purpose. The shell (a cluster of joined faces), the loop (a circuit of edges encompassing a face), and loop-edge links (also referred to as winged edge links or half-edges) are more components that are utilized to create edge circuits.

3.2 CSG (Constructive Solid Geometry) Approach

Process binary geometry, erstwhile referred to as process binary geometry, may be a solid modelling approach. CSG could also be done on plane figure models in addition, and it may be procedural or constant. Compare and distinction CSG with plane figure mesh and box modelling. Constructive geometry permits a modeler to get a posh surface or object by merging easier things with mathematician operators, probably leading to visually advanced things from some rudimentary ones.

3.3 STEPS

STEP1: Obtaining views input by scanning:

At first, the user needs to scan the orthographic views. Then the item is going to be captured if the conditions are fair as an alternative user are going to be asked to rescan it.

STEP2: Understanding lines mistreatment pattern recognition rule and storing the info for future reconstruction:

When scanning the orthographic grid, the most role of recognition rule is to grasp lines by storing the info and to reconstruct the model in future.

STEP3: Mistreatment reconstruction rule to get 3D model:

As before long because the scanning and line recognizing half is completed, the reconstruction rule takes place that constructs the Isometric model by taking reference of the orthographic views.

STEP4: Saving Mistreatment multiple objective file formats:

Finally, the output obtained may be downloaded in varied file formats like (.obj, .CAD).

4 Results and Discussion

Figure 2. shows about the precision of our model. The model is tested based on how accurate and effective model is. The datasets consist of 3 side views of CAD drawing. There are many different ways where this Machine Learning Model can check the accuracy of some of them used are Logistic Regression, Random Forest and XG Boost (Gradient Boost Decision Tree Algorithm) which are one of most famous Machine Learning Algorithm to test or train the model. As shown in below graph, it can be observed that Random Forest and XG Boost are showing an impressive performance after 60% of data used but logistic fails to gain much precision until complete dataset set is trained.

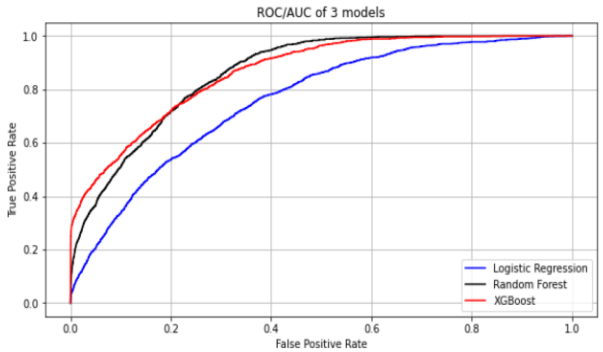

Fig -2: Precision tested by 3 Machine Learning Algorithms

The snapshot of the user interface is very simple. The snapshots henceforth are of Isomizer home page. Fig 3. shows the GUI of taking inputs by going to open file where our 2 views or 3 views orthographic drawings is present. End-user need to load it in our application.

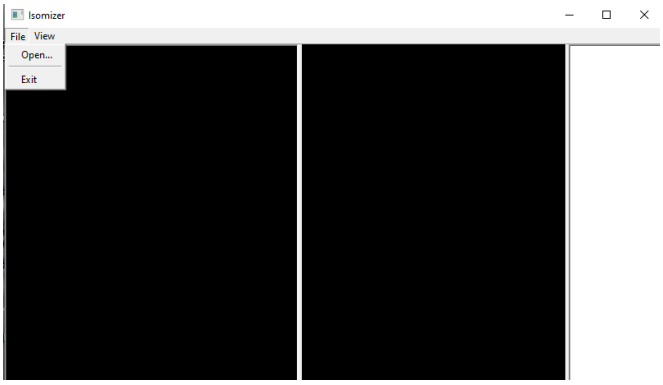

Fig -3: Home Page of Isomizer

Figure 4. Below represents the input provided by the user to the application which does not contain the cross section of the object or any type of cutting present on it. Dashed lines and center lines should be mentioned properly so that it won't mix up with either of reverse cases. Any text on the image is ignored by the application for optimized results.

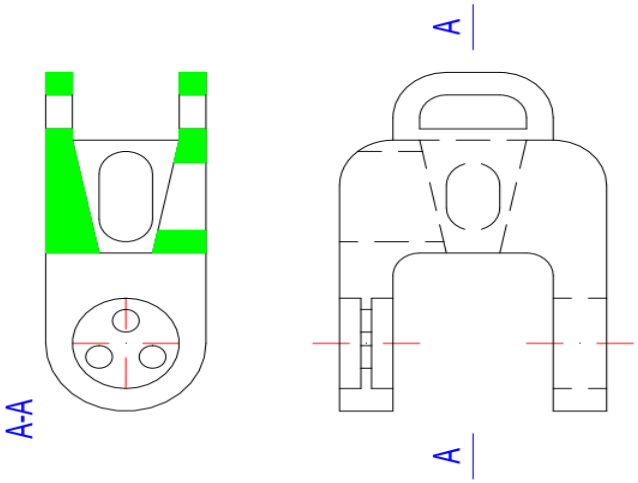

Fig -4: Input DXF File

Figure 5. represents the output provided on the both GUI screens. The one at the left column shows the input representation of the DXF file and the right column displays the 360^0 viewable object which can be scalable to view every detail of the object.

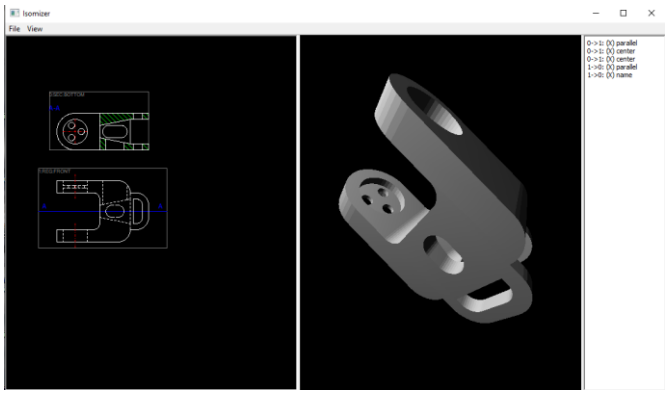

Fig -5: Final output of our orthographic image in right section of an application.

3. CONCLUSION

To ease the work for the mechanical industry sector of building and Visualizing the Machinery parts and objects in 3D is our main purpose of Building and designing the project "Isometric 3D Viewer" that converts 2D orthographic to Isometric object (3D) by scanning the orthographic views with the Isomizer the output will be received as per the user's requirement in.OBJ file format and scad file format. In this paper, the newly proposed method to retrieve 3-D CAD models with orthographic input. Compared to previously reported methods with orthographic input that either require three orthogonal views to be there or requires having both outline and skeleton information, our method uses simple orthogonal sketches that naturally express the user's design intent as input. Further development can also generate an algorithm that results from great accuracy and gets results even faster and more accurately.

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