Image Rendering For 3D Printing

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Abstract - *The 3D scanning system is increasingly employed in various fields. The generation of 3D models is required in various applications like in manufacturing industry to reverse engineering the prevailing components, to examine the standard of producing components, animation industry to model the character from the $64000 world. The 3D scanning ends up in ease within the inspection process and hence decreases the manufacturing costs. The employment of 3D scanning is enhanced by lowering the price of 3D scanning devices. During this paper the past studies done on the event of 3D scanning system are studied and also the varied scanning factors are studied which ends in increase the standard of 3D scanning system and so printing the 3D object using 3d printer. the method of 3D printing is followed by the generation of 3D model then converting it into printable form i.e. .STL file, then it's given to the slicer, also called slicing software, could be a computer software employed in the bulk of 3D printing processes for the conversion of a 3D object model to specific instructions for the printer.*

Key Words: **3D Scanning, 3D printing, Reverse Engineering, Laser Light scanning, 3D rendering.**

1. INTRODUCTION

3D models are required in various applications like in manufacturing industry to reverse engineering the existing components, to inspect the quality of manufacturing components, animation industry to model the character from the real world etc. Manufacturing industry uses reverse engineering along with rapid prototyping of the existing product to achieve the highest level of accuracy for the production of new parts. The 3D scanning is the process of obtaining the 3D shapes of the component whose physical attributes are difficult to measure, the 3D scanning obtains the 3D data in the form of 3D point cloud data or triangular mesh, these 3D data is used to create the 3D model of the component by using some CAD software. 3D scanning is a fast and accurate method of putting physical measurements of an object onto the computer in a manner, resulting in 3D scan data.3D data obtained from 3D scanning is the exact replica of the existing product. The 3D scan data obtained can be used for various purposes like obtaining the physical attributes of the existing components, for inspecting the various parameters of the components against existing drawing. 3D Laser Scanning or 3D Laser Scanners can generally be categorized into three main categories:

- Time of flight
- Phase Shift
- Laser triangulation

These laser scanning techniques can be used independently, but can also be used in combination to create a more versatile scanning system [1].

Time of flight laser scanners emit a pulse of laser light that is reflected off of the object to be scanned. The resulting reflection is detected with a sensor and the time that elapses between emission and detection yields the distance to the object since the speed of the laser light is precisely known.

Phase shift laser scanners work by comparing the phase shift in the reflected laser light to a standard phase, which is also captured for comparison. This is similar to time of flight detection except that the phase of the reflected laser light further refines the distance detection, similar to the vernier scale on a caliper.

We have used the laser triangulation method for 3D scanning using SIFT(scale invariant feature transform). So, what is laser triangulation?

Laser triangulation is accomplished by projecting a laser line or point onto an object and then capturing its reflection with a sensor located at a known distance from the laser Source. The resulting reflection angle can be interpreted to yield 3D measurements of the part [1].

2. LITERATURE SURVEY

2.1 *Application of 3D Printing For Building Prototype Model of Osmania University Arts College – A Case Study*

The aim of this paper is to present the application of 3D printing in civil engineering field for developing prototype models of complex building structures, stadiums, city planning etc. This helps the civil engineers to explain clearly the details of the entire project to the clients before it is actually executed on the field. As a case study this paper presents the application of 3D Printing for building prototype models of Iconic osmania university arts college building [2].

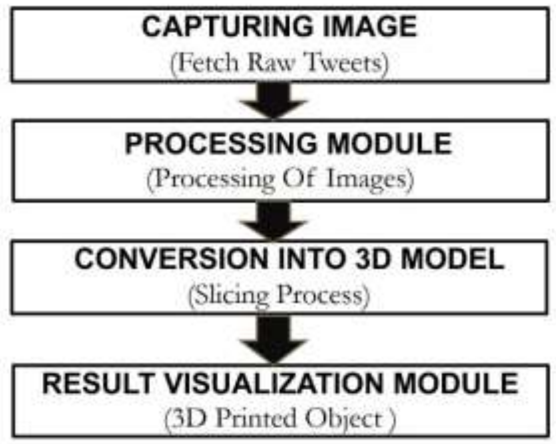
2.2 Infrared sensor based 3D image construction

This paper explains the use of two infra-red sensors to obtain the accurate shape of an object with low implementation cost. The sensors are controlled using a PIC micro controller which obtains the data measured using sensors and will transmit it to the PC serially for plotting the 3D image of the object using MATLAB software. The data acquired by the IR sensor should be accurate to obtain the correct data and for that the distance is set to 5 cm. The data obtained are transmitted and plotted without any delay. The paper aims at developing a low-cost prototype of a 3 dimensional scanner, which can scan real world objects and plot it on a computer screen. This kind of scanners will be useful in the research, design, manufacturing fields[3].

2.3 From 3D scanning to 3D printing: Application in fashion industry

In this paper the use of 3D scanning and 3D printing for digital and physical 3D replication of fashion accessories. A passive system, such as photogrammetry was developed to acquire 3D geometries, with the use of one DSLR camera, a kit lens and close up lenses. Due to reflection, jewelry shows problems capturing the model details. One of the main advantages of the adopted scanning method is the possibility to create the 3D geometry of different accessories by planning a proper scanning strategy based on high resolutions pictures taken from different angles. The obtained 3D models will be used to create physical replicas of different accessories, by additive technology[4].

3. PROPOSED MODEL



3.1 Capturing images

It consists of a number of images which have been captured using a rotating table, in this the object is placed at the center of the rotating table, which rotates 1° and captures images and a vertical line laser is used. The table rotates 360° and makes a set of databases of objects.

3.2 processing module

This can be done using MeshLab, python, MATLAB and then the file is converted into printable form I.e. STL file. The algorithm used is scale-invariant feature transform (SIFT)

3.3 conversion into a 3D model

Licing process is formed using a slicer. A **slicer** is a software required to convert a digital **3D** model into machine readable code for the **3D printer**. The **slicer** cuts the model into horizontal layers (slices) and generates the toolpaths needed to fill them.

3.4 3D object

After slicing it is ready for printing. This suitable format is then fed to a 3D printer.

4. SCALE-INVARIANT FEATURES TRANSFORM

The scale-invariant feature transform (SIFT) is a feature detection algorithm in computer vision to detect and describe local features in images. It was patented in Canada by the University of British Columbia and published by David Lowe in 1999. Applications include object recognition, robotic mapping and navigation, image stitching, 3D modeling, gesture recognition, video tracking, individual identification of wildlife and match moving [5].

1. Scale-space extrema detection

First stage searches over all scales and image locations. It is implemented efficiently by using a difference-of-Gaussian function to identify potential interest points that are invariant to scale and orientation.

- Firstly, the Laplacian of Gaussian (LoG) was used to detect blobs in various sizes.
  - As LoG is costly, SIFT algorithm uses Difference of Gaussians (Dog) which is an approximation of LoG.

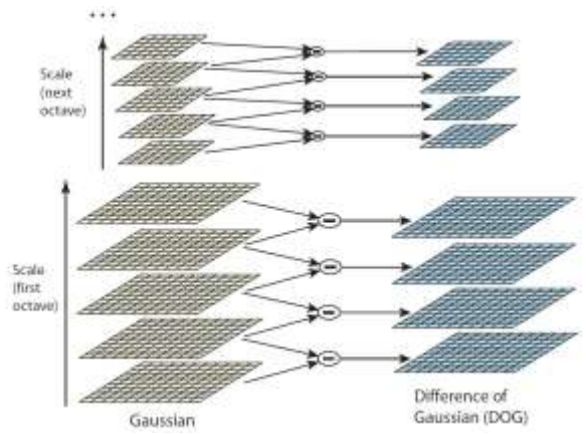


Figure 1: For each octave of scale space, the initial image is repeatedly convolved with Gaussians to produce the set of scale spaces shown on the left. Adjacent Gaussian images are subtracted to produce the difference-of-Gaussian images on the right. After each octave, the Gaussian image is down-sampled by a factor of 2, and the process repeated.

Once DoG are found, images are searched for local extrema over scale and space.

- If it is a local extrema, it is a potential keypoint.

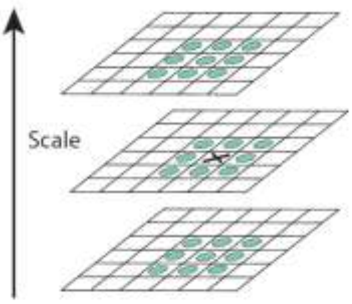


Figure 2: Maxima and minima of the difference-of-Gaussian images are detected by comparing a pixel (marked with X) to its 26 neighbors in 3x3 regions at the current and adjacent scales (marked with circles).

2. Keypoint localization

At each candidate location, a detailed model is fit to determine location and scale. Keypoints are selected based on measures of their stability.

- Once potential keypoints locations are found, it has to be refined to get more accurate results.
  - SIFT use Taylor series expansion of scale space to get more accurate location of extrema
  - If the intensity at this extrema is less than a threshold value, it is rejected.
- DoG has higher response for edges, so edges also need to be removed.
  - For this, a concept similar to Harris corner detector is used.
- So it eliminates any low-contrast keypoints and edge key points and what remains is strong interest points.

3. Orientation assignment

One or more orientations are assigned to each keypoint location based on local image gradient directions. All future operations are performed on image data that has been transformed relative to the assigned orientation, scale, and location for each feature, thereby providing invariance to these transformations.

- A neighbourhood is taken around the keypoint location depending on the scale, and the gradient magnitude and direction is calculated in that region.
  - An orientation histogram with 36 bins covering 360 degrees is created.
  - The highest peak in the histogram is taken and any peak above 80% of it is also considered to calculate the orientation.
  - It creates keypoints with the same location and scale, but different directions, and it contributes to stability of matching.

4. Keypoint descriptor

The local image gradients are measured at the selected scale in the region around each keypoint. These are transformed into a representation that allows for significant levels of local shape distortion and change in illumination.

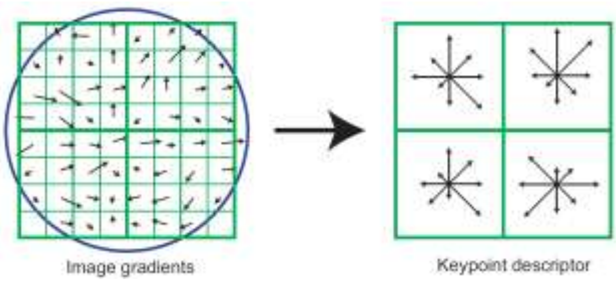


Figure 3: A keypoint descriptor is created by first computing the gradient magnitude and orientation at each image sample point in a region around the keypoint location, as shown on the left.

These are weighted by a Gaussian window, indicated by the overlaid circle. These samples are then accumulated into orientation histograms summarizing the contents over 4x4 subregions, as shown on the right, with the length of each arrow corresponding to the sum of the gradient magnitudes near that direction within the region.

Keypoint Matching

Keypoints between two images are matched by identifying their nearest neighbours.

- If the second closest-match may be very near to the first, the ratio of closest-distance to second-closest distance is taken and if it is greater than 0.8, they are rejected.

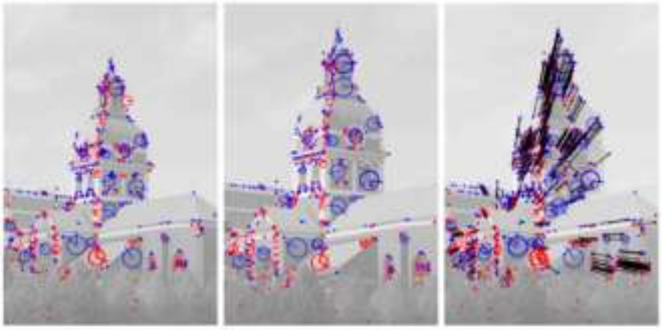
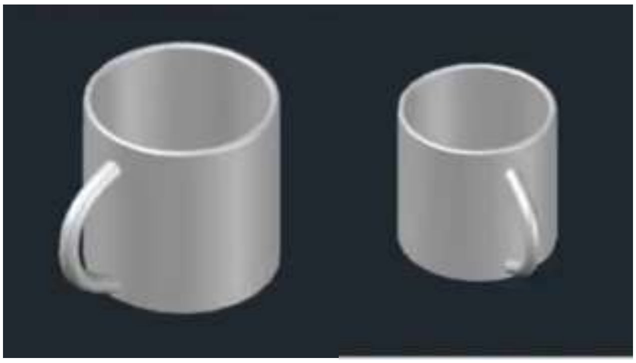


Figure 4: Interest points detected from two images of the same scene with the computed image matches drawn as black lines between corresponding interest points. The blue and red arrows at the centers of the circles illustrate the orientation estimates obtained from peaks in local orientation histograms around the interest points[5].

Scanned Object :



5. ADVANTAGES AND DISADVANTAGES

PLA AND ABS plastic have different melting points, elasticity, texture, so depending on the usage printing material is chosen.

PLA is harder than ABS, melts at a lower temperature (around 180°C to 220°C), and includes a glass transition temperature between 60-65 °C, so is potentially a awfully useful material. It does exhibit higher friction than ABS however which may make it difficult to extrude and more prone to extruder jams.

A company that's making parts for machines are happier when choosing ABS, thanks to its lifespan, its strength and its higher temperature. On the other hand, an artist who is making 3d models reception, are happier choosing PLA thanks to its ease-of use, its appearance and since you don't need ventilation.

6. RESULTS:

7. FUTURE SCOPE

3D printing, or additive manufacturing, has the potential to democratize the assembly of products, from food to medical supplies, to great coral reefs. Within the future, 3D printing machines could make their way into homes, businesses, disaster sites, and even space.

8. CONCLUSION

There could also be various sorts of lighting conditions,Object arrangement. Most of those conditions are tested on the system and system have shown better accuracy for many of the cases. Thus, it is often concluded from the above discussion that a reliable, fast and an efficient system has been developed replacing A stereo camera and unreliable system. This technique is often implemented for better results. The system will save time, reduce the quantity of time and can replace the stereo camera with the laser triangulation technique. P

9. ACKNOWLEDGE

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