SAVITRIBAI PHULE PUNE UNIVERSITY

A PROJECT REPORT ON

"3D Modeling of X-Ray Images using Virtual Reality"

SUBMITTED TOWARDS THE
PARTIAL FULFILLMENT OF THE REQUIREMENTS OF

BACHELOR OF ENGINEERING (Computer Engineering)

BY

Mr. Kevin Jayesh Sheth	B191024346
Ms. Kadambari Jalindar Kate	B191024262
Mr. Ajay Mahesh Gaur	B191024241
Mr. Yash Arvind Paliwal	B191024298

Under The Guidance of

Mrs. Sonal Fatangare

DEPARTMENT OF COMPUTER ENGINEERING
RMD SINHGAD SCHOOL OF ENGINEERING WARJE,
PUNE -411058

Sinhgad Institutes

DEPARTMENT OF COMPUTER ENGINEERING

CERTIFICATE

This is to certify that the Project Entitled

3D Modeling of X-Ray Images using Virtual Reality

Submitted by

Mr. Kevin Jayesh Sheth	B191024346
Ms. Kadambari Jalindar Kate	B191024262
Mr. Ajay Mahesh Gaur	B191024241
Mr. Yash Arvind Paliwal	B191024298

is a bonafide work carried out by Students under the supervision of **Prof. Vina Lomte** and it is submitted towards the partial fulfillment of the requirement of Bachelor of Engineering (Computer Engineering).

Mrs. Sonal Fatangare
Internal Guide
Dept. of Computer Engg.

Ms. Vina Lomte
H.O.D
Dept. of Computer Engg.

Dr. V. V. Dixit
Principal
RMDSSOE

Signature of Internal Examiner

Signature of External Examiner

PROJECT APPROVAL SHEET

3D Modeling of X-Ray Images using Virtual Reality

(3D Modeling of X-Ray Images using Virtual Reality)

Is successfully completed by

Mr. Kevin Jayesh Sheth	B191024346
Ms. Kadambari Jalindar Kate	B191024262
Mr. Ajay Mahesh Gaur	B191024241
Mr. Yash Arvind Paliwal	B191024298

at

DEPARTMENT OF COMPUTER ENGINEERING

(RMD Sinhgad School of Engineering)

SAVITRIBAI PHULE PUNE UNIVERSITY, PUNE

ACADEMIC YEAR 2022-2023

Mrs. Sonal Fatangare	Ms. Vina M. Lomte
Internal Guide	H.O.D
Dept. of Computer Engg.	Dept. of Computer Engg.

Abstract

Nowadays, advanced medical imaging is a widely accepted scientific discipline in the healthcare industry due to technological advances and software breakthroughs. Traditionally using digital images of X-Ray for diagnosing diseases in healthcare is very common. Many researchers have proposed different methods like X-Ray, CT-scan, and MRI for bone implantation. But the problem is while implantation it does not get the actual size as original, so it causes a bad impact on the health and the person suffers from pain. Therefore, to solve this problem, the proposed system uses a canny edge detection that can sketch the edges of knee bone present in an x-ray image with the size of the bone for implantation by using a virtual reality technique. The system will convert the 2D image to 3D and then the 3D model will be shown in a VR headset. So, we can get a clear visualization of the image. This model provides accurate measurements and detailed visualization of bones in virtual reality with 95.58% accuracy. Virtual reality-based visualization using X-ray images is more effective than CT-Scan in improving radiologists' accuracy and efficiency in diagnosing certain medical conditions, leading to a preference for X-ray images in certain diagnostic scenarios.

Keywords –

Canny Edge detection, Image Processing, Digital Image, Digital, X-Ray, VR, Knee Arthroplasty, Google Cardboard.

Acknowledgments

*It gives us great pleasure in presenting the preliminary project report on **"3D Modeling of X-Ray Images using Virtual Reality"**.*

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KEVIN SHETH
KADAMBARI KATE
AJAY GAUR
YASH PALIWAL

(B.E. Computer Engineering)

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3D Modeling of X-Ray Images using Virtual Reality

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Not a Sponsored project

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Mrs. Sonal Fatangare

1.4 SPONSORSHIP AND EXTERNAL GUIDE

Sponsored by: NA

External Guide: NA

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To develop 3D framework using Canny Edge Detection and Virtual Reality for medical bone implant.

1.7 ABSTRACT

Nowadays, advanced medical imaging is a widely accepted scientific discipline in the healthcare industry due to technological advances and software breakthroughs. Traditionally using digital images of X-Ray for diagnosing diseases in healthcare is very common. Many researchers have proposed different methods like X-Ray, CT-scan, and MRI for bone implantation. But the problem is while implantation it does not get the actual size as original, so it causes a bad impact on the health and the person suffers from pain. Therefore, to solve this problem, the proposed system uses a canny edge detection that can sketch the edges of knee bone present in an x-ray image with the size of the bone for implantation by using a virtual reality technique. The system will convert the 2D image to 3D and then the 3D model will be shown in a VR headset. So, we can get a clear visualization of the image. This model provides accurate measurements and detailed visualization of bones in virtual reality with 95.58% accuracy. Virtual reality-based visualization using X-ray images is more effective than CT-Scan in improving radiologists' accuracy and efficiency in diagnosing certain medical conditions, leading to a preference for X-ray images in certain diagnostic scenarios.

1.8 GOALS AND OBJECTIVES

The goal of this project is to develop 3D framework using Canny Edge Detection and Virtual Reality for medical bone implant.

Objectives-

- To study and identify current VR application and Image processing.
- To create an adaptive 3D virtual environment.
- To develop a range of interpreting scenarios that can be run in different modes.
- To get a 3D model build using the unity tool.
- To create 3D image by use of Canny Edge image processing algorithm with improved accuracy

1.9 RELEVANT MATHEMATICS ASSOCIATED WITH THE PROJECT

System Description:

- Input: 2D X-Ray image in JPEG.
- Output: 3D model of a bone from 2D X-Ray image.
- Functions:
  - File Upload
  - Canny Edge Detection Algorithm applied
  - Inkscape SVG conversion
  - Blender to convert SVG image to 3D model
  - Unity for Visualization of 3D model
  - Deploying the 3D model .obj file in Google SDK
  - View the 3D model in VR Headset
  - Predict Sentiment
- Success Conditions: It gives clear 3D model and deployed to VR headset.
- Failure Conditions: The X-Ray image is not clear than model will not be accurate.

1.10 NAMES OF CONFERENCES / JOURNALS WHERE PAPERS CAN BE PUBLISHED

1 International Research Journal of Engineering and Technology (IRJET)

2 International Journal of Creative Research Thoughts (IJCRT)

3 Journal of Emerging Technologies and Innovative Research (JETIR)

4 International Journal for Scientific Research and Development (IJSRD)

1.11 REVIEW OF CONFERENCE/JOURNAL PAPERS SUPPORTING PROJECT IDEA

[1] **Paper Title:** "Surgical navigation systems based on augmented reality technologies"

Authors: Vladimir Ivanov1*, Anton Krivtsov1 , Sergey Strelkov1 , Dmitry Gulyaev2 , Denis Godanyuk2 , Nikolay Kalakutsky3 , Artyom Pavlov3 , Marina Petropavloskaya3 , Alexander Smirnov3 , Andrew Yaremenko3.

Description: Developed software that loads and positions the 3D model. Developed a versatile headset which will be adjusted to the individual anatomy of patient.

[2] **Paper Title:** "Lower Limb Balance Rehabilitation of Post-stroke Patients Using an Evaluating and Training Combined Augmented Reality System"

Authors: Shuwei Chen, Ben Hu, Yang Gao, Zhiping Liao.

Description: Proposed an evaluating and training integrated application for the rehabilitation of patients with lower limb balance disorder.

[3] Paper Title: "Value of Virtual Reality Technology in Image Inspection and 3D Geometric Modelling"

Authors: Longyu Lu, Jinkai Ma, Shuying Qu.

Description: New two level cascade convolutional neural network structure.

[4] **Paper Title:** "The use of augmented reality for limb and component alignment in total knee arthroplasty: systematic review of the literature and clinical pilot study."

Authors: V. Iacono1 , L. Farinelli2 , S. Natali1*, G. Piovan1 , D. Screpis1 , A. Gigante2 and C. Zorzi1.

Description: The present AR system allows the surgeon to view the tibial and femur axis superimposed on the surgical field through the smart glasses.

[5] **Paper Title:** "A novel augmented reality-based surgical guidance system for total knee arthroplasty"

Authors: Sandro F. Fucentese1, Peter P. Koch2.

Description: System measures intra operatively the effect of prosthesis alignment and positioning on soft tissue balance. The system is integrated in a pair of smart glasses and 2 small sensors and displays surgical targets directly in the field of view of surgeon.

[6] **Paper Title:** "Implementation of Canny's Edge Detection Technique for Real World Images"

Authors: Susmitha.A, Ishani Mishra, Divya Sharma, Parul Wadhwa, Lipsa Das.

Description: Implementation & Evaluation of different edge detection techniques.

[7] **Paper Title:** "Edge Detection Techniques for Image Segmentation – A Survey of Soft Computing Approaches."

Authors: N.Senthilkumaran and R. Rajesh.

Description: Survey of edge detection for image segmentation using soft computing approach based on the Fuzzy logic, Genetic Algorithm and Neural Network.

[8] **Paper Title:** "Effects of an Immersive Virtual Reality Environment on Muscle Strength, Proprioception, Balance, and Gait of a Middle-Aged Woman Who Had Total Knee Replacement: A Case Report"

Authors: Soungkyun Hong , GyuChang Lee.

Description: To apply a training program using VR to a middle-aged woman who had total knee replacement surgery and to investigate its effects on her muscle strength, balance.

[9] **Paper Title:** "Image segmentation using edge detection"

Authors: Mr.Salem Saleh Al-amri1, Dr.N.V. Kalyankar2 and Dr. Khamitkar S.D 3.

Description: Use of seven different techniques to choose the best technique for edge detection segment image.

[10] **Paper Title:** “Implementing canny edge detection algorithm for noisy image”

Authors: Ehsan Akbari Sekehravani , Eduard Babulak, Mehdi Masoodi.

Description: Implementing and also enhancing the accuracy of Canny edge detection for noisy images using the median filter to maintain the details of the image and eliminate the noise.

1.12 PLAN OF PROJECT EXECUTION

Table 1.12: Selection of Weeks

Schedule		Project Activity
August	1st Week	Discussion on Topic Selection
	2nd Week	Finalized the Project Topic
	3nd Week	Literature Survey of Research Papers
	4st Week	Studied and Analyzed Base paper
September	1st Week	Motivation, Project scope & Objective
	2nd Week	Project review - I
	3rd Week	Analyzed Problem in existing system
	4st Week	Project review - II
October	1st Week	System Architecture & UML Diagram
	2rd Week	Project review - II
November	1st Week	Report Preparation And Submission
	2nd Week	Submission
January	1st Week	Planning of Implementation.
	2nd Week	Study of algorithm.
	3rd Week	Discussion & changes to improve system.
February	1st Week	Project review
	2nd Week	Installation of APK
	3rd Week	Create Virtual room in SDK
March	1st Week	Worked on user interface.
	3rd Week	Project review
April	1st Week	Designed test cases for our module.
	2nd Week	Deployed our Obj file into VR
	3rd Week	Research Paper Implementation
May	1st Week	Report Preparation
	2nd Week	Final Report and presentation.

CHAPTER 2

TECHNICAL KEYWORDS

2.1 AREA OF PROJECT

Image Processing & Virtual Reality

2.2 TECHNICAL KEYWORDS

- **Canny Edge Detection**

  Canny edge detection is an image processing technique used to detect edges in an image. It was developed by John Canny in 1986 and has since become one of the most widely used edge detection algorithms

  - Gaussian smoothing
  - Gradient calculation
  - Non-maximum suppression
  - Double thresholding
  - Edge tracking by hysteresis

- **X-Ray**

  X-ray is a form of electromagnetic radiation commonly used in medical imaging. It can pass through the body and create an image on a photographic film or a digital detector. X-rays are often used to visualize bones and other internal structures, helping in the diagnosis of various medical conditions.

- **Image Processing**

  Image processing refers to the manipulation and analysis of digital images using computer algorithms. It involves techniques such as filtering, enhancement, segmentation, and feature extraction to extract meaningful information or improve the visual quality of an image.

- **Digital Image**

  A digital image is a representation of visual information in a discrete form, typically stored and processed on a computer. It is composed of a grid of pixels, where each pixel represents a single color or intensity value. Digital images can be captured using digital cameras or generated from other sources such as scanners or computer-generated graphics.

- **Knee Arthroplasty**

  Knee arthroplasty, also known as knee replacement surgery, is a surgical procedure to replace a damaged or diseased knee joint with an artificial implant. It is commonly performed to alleviate pain and improve knee function in individuals with severe arthritis or knee injuries.

- **Google Cardboard SDK**

  The Google Cardboard SDK (Software Development Kit) is a development platform provided by Google for creating virtual reality (VR) experiences using a smartphone and a low-cost VR headset called Google Cardboard. The SDK provides tools, libraries, and APIs to build VR applications that can be experienced through the Cardboard headset.

- **Virtual Reality**

  Virtual reality is a computer-generated simulation of a three-dimensional environment that can be interacted with and experienced by an individual. It typically involves the use of a head-mounted display (HMD) or VR headset, along with various input devices, to provide an immersive and interactive virtual experience.

CHAPTER 3

INTRODUCTION

3.1 PROJECT IDEA

The project aims to develop a virtual reality (VR) application that allows users to interactively explore and analyze 3D models generated from X-ray images. By leveraging the immersive capabilities of VR, users can gain a deeper understanding of complex anatomical structures or medical conditions by visualizing them in a three-dimensional space.

Image processing is a method to perform some operations on an image to get useful information from it. Currently, the use of digital images for diagnosis of diseases in healthcare is very common. X-ray datasets are used for analysis in order to provide a clear diagnosis. The main idea here is to build a system using canny edge detection algorithm that can sketch the edges of knee bone present in a x-ray image and identify the exact size of the bone for bone replacement by using virtual reality technique. In this system a 3D model of the bone which is to be replaced in place of original bone is to be built.

3.2 MOTIVATION OF THE PROJECT

The motivation behind this project is to enhance and visualize the x-ray in better way using the technology of AR/VR -

- The motivation behind this project is that I found knee bone replacement problems very serious in real life. My father had an injury of knee and it was very critical that, the doctor told us about the replacement of the bone with artificial bone but a problem occur after the replacement of the bone is that it is difficult to match the artificial bone size with the original bone size as replaced bone is not always accurate in size.

- So, we were motivated to solve this problem and by implementing VR in our system we will build an accurate 3D model of the replaced bone.

3.3 LITERATURE SURVEY

The article begins by highlighting the importance of 3D modeling in medical imaging and the limitations of traditional 2D X-ray imaging. The author then presents a review of various techniques for 3D modeling of X-ray images, including volume rendering, surface rendering, and hybrid methods. The article also discusses the challenges faced by researchers in this field, such as the need for accurate segmentation of images and the need for efficient algorithms for 3D reconstruction. The author concludes the article by highlighting the potential of 3D modeling in medical imaging and the need for further research in this field [2].

The paper presents a comprehensive review of various methods for 3D reconstruction of 2D X-ray images. The authors begin by discussing the limitations of traditional 2D X-ray imaging and the importance of 3D reconstruction in medical imaging. The paper then presents a review of various techniques for 3D reconstruction of X-ray images, including the voxel-based approach, the surface-based approach, and the hybrid approach. The authors also discuss the challenges faced by researchers in this field, such as the need for accurate image segmentation and the need for efficient algorithms for 3D reconstruction. They further describe various applications of 3D reconstruction in medical imaging, such as diagnosis, surgical planning, and treatment monitoring. The paper concludes by highlighting the potential of 3D reconstruction in medical imaging and the need for further research in this field [3].

Given paper presents a novel approach to naturalistic 2D-to-3D conversion, which aims to generate high-quality 3D images from 2D images that resemble the natural 3D scenes as much as possible. The authors first introduce the concept of naturalistic 2D-to-3D conversion and discuss the challenges faced by existing methods, such as the lack of accurate depth information and the difficulty in modeling natural scene structures. The approach utilizes various cues, such as texture, shading, and perspective, to estimate the depth of the scene and generate a high-quality 3D image. The authors also evaluate their approach on a variety of test images and compare it with existing methods. The results demonstrate that the proposed approach achieves superior performance in terms of both subjective and objective measures [4].

The article presents a method for converting 2D medical image files in DICOM format into 3D models using image processing techniques and analyzing the results with Python programming. The article begins by highlighting the importance of 3D models in medical imaging and the challenges faced by medical professionals in analyzing 2D medical images. The authors then describe the steps involved in converting DICOM files into 3D models, which include image preprocessing, segmentation, and 3D reconstruction. The authors also discuss the use of Python programming in analyzing the results of 3D reconstruction, such as calculating volume, surface area, and other relevant measurements. They provide code examples in Python for carrying out these analyses. The article also describes the evaluation of their method on various medical images and compares the results with existing methods. The authors demonstrate that their method produces high-quality 3D models and accurate measurements, making it a useful tool for medical professionals. The article provides a good overview of the method, and the code examples in Python make it easy to implement. However, more information on the evaluation process, including the size of the dataset and the comparison with other methods, would have been useful [5].

The paper presents a new method for reconstructing a 3D femur model from biplane X-ray images. The authors propose a novel method based on Laplacian surface deformation for reconstructing a 3D femur model. The method involves first segmenting the femur from the biplane X-ray images using a thresholding technique. Then, the segmented contours are used to generate a 3D surface mesh of the femur using the Marching Cubes algorithm. The surface mesh is then deformed using a Laplacian surface deformation method, which ensures that the resulting 3D model is smooth and preserves the surface details of the original femur. The authors validate their method on a dataset of 10 femur specimens and compare their results with those obtained using other methods. The results demonstrate that the proposed method produces more accurate and detailed 3D femur models than the other methods. The authors have also provided a comprehensive evaluation of their method and compared it with other methods, which enhances the credibility of their approach. However, the authors could have provided more information on the limitations and potential future directions of their method [6].

The article presents a method for constructing a 3D model of knee joint motion based on MRI image registration. The authors describe the process of acquiring MRI images of the knee joint during motion and segmenting the images to obtain the 3D geometry of the bones and soft tissue. They then propose a registration method to align the segmented MRI images at different time points, which is crucial for constructing the 3D model of knee joint motion. The registration method is based on a hybrid approach that combines intensity-based and feature- based registration methods. The authors also introduce a motion analysis framework to quantify the motion of the knee joint based on the 3D model. The authors evaluate their method on a dataset of six subjects and demonstrate that the proposed method can accurately reconstruct the 3D model of knee joint motion and quantify the motion parameters, such as translation and rotation [7].

The paper proposes a method for 3D reconstruction of leg bones from X-ray images using CNN-based feature analysis. The paper was published in the journal Computers in Biology and Medicine in 2021. The authors propose a method that involves first segmenting the leg bones from the X-ray images using a U-Net based segmentation network. Then, the segmented bones are used to generate a 3D surface mesh of the bones using the Marching Cubes algorithm. The authors propose a novel feature analysis method based on a convolutional neural network (CNN) to improve the accuracy of the 3D reconstruction. The CNN is trained to learn the features that represent the structure and shape of the leg bones from a set of labeled X-ray images. The learned features are then used to refine the surface mesh generated from the segmented X-ray images, resulting in a more accurate 3D model of the leg bones. The authors evaluate their method on a dataset of 50 leg bones and compare their results with those obtained using other methods. The results demonstrate that the proposed method produces more accurate and detailed 3D models of the leg bones than the other methods [8].

The authors describe the process of 3D printing and its benefits in medical applications. They highlight the advantages of using 3D printed models in preoperative planning, surgical training, and medical education. The paper focuses on the conversion of 2D medical scan data, specifically computed tomography (CT) and magnetic resonance imaging (MRI) scans, into 3D printed models. The authors discuss the steps involved in the conversion process, which includes image acquisition, segmentation, conversion to a 3D model, and finally, 3D printing. They highlight the importance of accurate segmentation and discuss various software tools that can be used for this purpose. The authors also discuss the challenges associated with 3D printing, such as the need for high-resolution imaging and the limitations of current printing technologies. However, the paper could have provided more detailed information on the challenges associated with 3D printing, as well as potential solutions to these challenges. Additionally, the paper could have provided more information on the limitations of 3D printed models and the need for further research in this area [9].

The paper discusses the process of constructing a 3D model from 2D DICOM images, which are commonly used in medical imaging. The authors describe the challenges associated with this process, including image segmentation and the need for accurate alignment of the images. The authors propose a method for constructing a 3D model using a combination of image processing techniques and 3D reconstruction algorithms. They describe the steps involved in this process, which includes image pre- processing, segmentation, feature extraction, registration, and finally, 3D reconstruction. The authors evaluate the performance of their proposed method using a set of DICOM images and compare the results with those obtained using other methods. They demonstrate that their proposed method produces more accurate and detailed 3D models compared to other methods [10].

The paper describes a method for creating patient- specific 3D bone models from 2D radiographs for use in image-guided orthopedic surgery. The authors describe the challenges associated with this process, including the need for accurate alignment and registration of the 2D radiographs. The authors propose a method for constructing a 3D bone model using a combination of image processing techniques and 3D reconstruction algorithms. The steps involved in this process include image pre-processing, segmentation, feature extraction, registration, and finally, 3D reconstruction. The authors evaluate the performance of their proposed method using a set of radiographs and compare the results with those obtained using other methods. They demonstrate that their proposed method produces more accurate and detailed 3D bone models compared to other methods [11].

Authors Ait Mansour El Houssain, Francois Bretaudeau, Stated A Novel Approach To Image Edge Detection Using Dual 2d Gaussian Binomial Filters. Proposed Approach Improved A Significant Advantage Of Gaussian Binomial Filter In Terms Of Speed And Efficiency In Comparison Than Other Known Methods. A Real-Time Edge Detection Implementation Based Fpga (Field-Programmable Gate Array) Or Gpu (Graphics Processing Unit) Is An Issue That Deserves Further Investigation [12].

In Paper An Improved Prewitt Algorithm For Edge Detection Based On Noised Image, A Prewitt Algorithm [2] For Edge Detection Based On Otsu Threshold Is Proposed In Research, Where The Edge Image Is Denoised By An 8-Neighbour Window. The Upgraded Algorithm Greatly Improves Anti-Noise Performance And Effectively Detects Edges In Randomly Noisy Images. Next Work Is To Find A More Efficient Automatic Threshold And A More Effective Denoising Method to Detect Edges Better [13].

Paper Study And Comparison Of Different Edge Detectors For Image Segmentation Included Comparison Of Different Edge Detection Operators And Analyzed Their Performance Using MATLAB Software. Output Shows That Canny Edge Detector Produces Higher Object Edge Detection Accuracy With Higher Entropy, Psnr, Mse And Running Time Compared To Sobel, Roberts, Prewitt, Zero Crossing And Log. Further We Can Carry Out More Experiments To Check Performance And Accuracy [14].

CHAPTER 4

PROBLEM DEFINITION

AND SCOPE

4.1 PROBLEM STATEMENT

To develop 3D framework using Canny Edge Detection and Virtual Reality for medical bone implant.

4.1.1 Goals and Objectives

The goal of this project is to develop 3D framework using Canny Edge Detection and Virtual Reality for medical bone implant.

Objectives –

- To study and identify current VR application and Image processing.
- To create an adaptive 3D virtual environment.
- To get a 3D model build using the unity tool.
- To develop a range of interpreting scenarios that can be run in different modes.
- To create 3D image by use of Canny Edge image processing algorithm with improved accuracy.

4.1.2 Statement of Scope

The project scope aims to develop a virtual reality (VR) application that generates a 3D model of the knee bone using X-ray images and Canny edge detection. The application will allow users to visualize and interact with the knee bone in a virtual environment, providing a realistic and immersive experience for educational or medical purposes. By using X-ray images, Canny edge detection, and virtual reality technology, this project provides a powerful tool for visualizing and exploring knee bone structures. It offers a wide range of applications in medical education, surgical planning, patient engagement, and research, contributing to advancements in orthopedics and enhancing patient care.

4.2 MAJOR CONSTRAINTS

There are some major constraints which can affect the implementation, Testing or the designing of the system.

1. The main idea here is to build a system using canny edge detection algorithm that can sketch the edges of knee bone present in a X-ray image and identify the exact size of the bone for bone replacement by using virtual reality technique.

2. In this system a 3D model of the bone which is to be replaced in place of original bone is to be built

4.3 METHODOLOGIES OF PROBLEM SOLVING AND EFFICIENCY ISSUES

- The project comprises of virtual reality technique.

- Inbuilt X-Ray dataset of Kneebone is used to train the model.

- Use of canny edge detection for identifying and removing sharp discontinuities.

- VR Google cardboard is used to visualize the 3D model.

- Unity tool is used for 3D model.

- Detecting noise and then processing it is a big obstacle.

4.4 OUTCOME

- In proposed system we have analyzed X-ray images to visualize the effect of VR.
- It gives the 3D Model of the bone which replace the artificial bone model with accuracy.

4.5 APPLICATIONS

- **In the Field of Medical Research**

  X-ray imaging plays a crucial role in medical research. Researchers utilize X-rays to study the internal structures of the human body, analyze bone density, observe anatomical variations, and track the progression of diseases.

- **Bone Crafting Industry**

  The bone crafting industry utilizes X-ray imaging and image processing techniques to create custom orthopedic implants and prosthetics. By analyzing X-ray images of patients' bones, experts can develop precise 3D models and fabricate implants that perfectly match the patient's anatomy.

- **Surgical Planning and Navigation**

  X-ray imaging, along with advanced image processing and 3D visualization techniques, is extensively used in surgical planning and navigation. These models aid in surgical planning, allowing surgeons to visualize and assess the complex anatomical structures before the actual procedure.

- **Patient Engagement**

  X-ray images and 3D visualizations derived from them can be utilized to engage patients in their treatment processes. This engagement can lead to improved patient satisfaction, better adherence to treatment plans, and increased participation in the decision-making process.

- **Medical Education and Training**

  X-ray images, along with digital image processing, are utilized in medical education and training. Medical students and practitioners can study and practice interpretation of X-rays to enhance their diagnostic skills. Digital image processing techniques can be employed to simulate various pathologies, allowing learners to gain hands-on experience in a controlled virtual environment.

4.6 HARDWARE RESOURCES REQUIRED

1. **Processor:** Intel(R) Core i7 – 4800H CPU @ 2.50 GHz

2. **RAM:** 16 GB for 64-bit

3. **Hard disk space:** 500 GB with OS

4.7 SOFTWARE RESOURCES REQUIRED

1. **Operating system:** Windows 10

2. **Coding Language :** Python

3. **Platform:** Blender , Inkscape, Unity

4. **APK:** Goggle Cardboard SDK

CHAPTER 5

PROJECT PLAN

5.1 PROJECT ESTIMATES

The Waterfall Model was the first to be introduced as a Process Model. A linear-sequential life cycle model is another term for it. It's incredibly easy to grasp and use. In a waterfall paradigm, each phase must be finished completely before moving on to the next. This technique is typically used for short projects with few ambiguous criteria. At the conclusion of each phase, a review is conducted to assess whether the project is on track and whether it should be continued or abandoned.

- **Requirement Gathering:** All the functional and non-functional requirements of the project were identified. Interaction with the users and all other stake-holders of the project was conducted to identify all the requirements. The different requirements mainly fall into categories:

  1.System features

  2.Security parameters

  3.User requirements

  4.User interface.

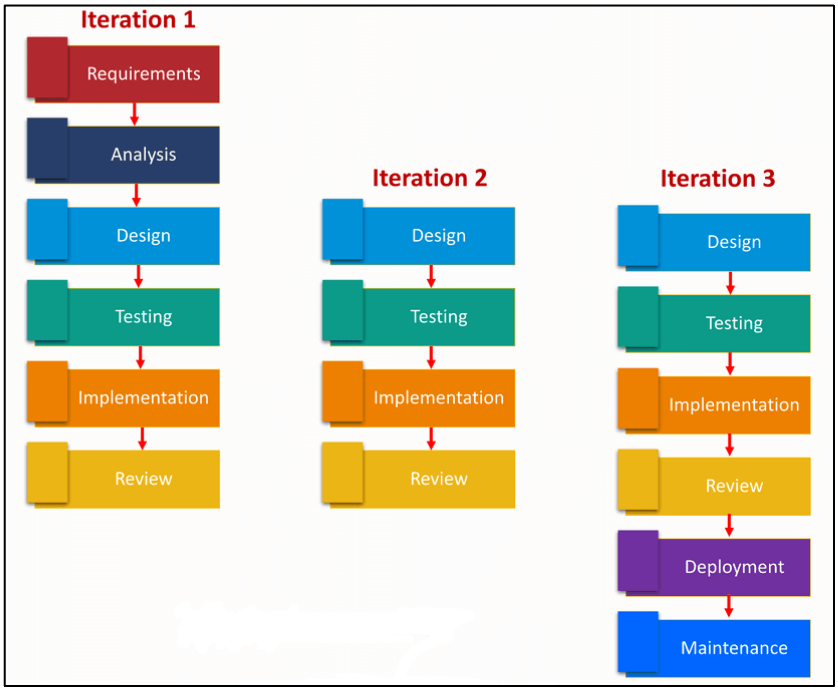

Figure 5.1: Iterative SDLC Model

- **Integration and system testing:** All the modules were integrated together. In testing phase project was tested and debugged. Various test cases were developed andthe project was tested at the developers end as well as users end. Debugging was done to discover errors and exception which were corrected.

- **Installation and maintenance:** Our system is installed on one dedicated server and it is accessible to all authenticated users. Maintenance ofour system is done on regular basis. New requirements and features can be added as and when required as long as they do not conflict with the existing features

5.1.1 Reconciled Estimates

5.1.1.1 Cost Estimate

The initial cost estimate of the project before beginning the implementation process is INR 1500 for in house resources. This cost may vary. This estimate is subject to change according to the availability and/or need of a particular item.

Basic COCOMO Coefficients

Software Project	a_b	b_b	c_b	d_b
Organic	2.4	1.05	2.5	0.38
Semidetached	3.0	1.12	2.5	0.35
Embedded	3.6	1.20	2.5	0.32

Fig 5.2: Basic COCOMO Coefficients

- Basic COCOMO compute software development effort (and cost) as a function of program size. Program size is expressed in estimated thousands of source lines of code (SLOC, KLOC).
- We have determined that our project fits the characteristics of organic mode.
- We estimate that our project will have 1000+ Delivered source instructions. Using the formulae, we can estimate:
- Effort Applied (E) = a * (KLOC)b [person/months]
- Development Time (D) = c*(Effort Applied) d [In months]
- Staffing =Effort/Duration
- Values of Variables A, B, C, D are default.
- Size of the software project: 152 KLOC
- Development mode: Organic
- Effort = a * (KLOC)^b * EAF
- For the Organic development mode, the constants are:
  - a = 2.4
  - b = 1.05

- EAF = 1.0 * 1.0 * 1.0 * 0.75 * 1.0 * 1.0 * 0.75 * 0.88 * 0.95 * 1.0 * 1.0 * 0.88 * 0.91 = 0.4208

- Now, we can calculate the effort:
  - Effort = 2.4 * (152) ^ 1.05 * 0.4208
  - **≈ 130.41 person-months**

5.1.1.2 Time Estimates

Table 5.1: Effort Estimate Table

Task	Effort weeks	Deliverables	Milestones
Analysis of existing systems & compare with proposed	4 weeks		
Literature survey	1 weeks		
Designing & planning	2 weeks		
System flow	1 weeks		
Designing modules & its´ deliverables	2 weeks	Modules: design document	
Implementation	7 weeks	Primary system	
Testing	4 weeks	Test Reports	Formal
Documentation	2 weeks	Complete project report	Formal

5.1.1.3 Project Description

Table 5.2: Project Scheduling

Phase	Task	Description
Phase 1	Analysis	Analyze the information given in the IEEE paper.
Phase 2	Literature survey	Collect raw data and elaborate on literature surveys.
Phase 3	Design	Assign the module and design the process flow control.
Phase 4	Implementation	Implement the code for all the modules and integrate all the modules.
Phase 5	Testing	Test the code and overall process weather the process works properly.
Phase 6	Documentation	Prepare the document for this project with conclusion and future enhancement.

5.1.2 Project Resources

I) Hardware -

- Processor: Intel(R) Core i7 – 4800H CPU @ 2.50 GHz
- Processor Graphics: Intel(R) HD Graphics 620
- RAM: 16 GB for 64-bit.

II) Software -

- Operating System: Windows 10
- Tools: Blender, Unity, Inkscape. Android SDK
- Hardwar unit: VR Headset
- Programming Language: Python

5.2 RISK MANAGEMENT W.R.T. NP HARD ANALYSIS

Np Hard:

NP-hard (Non-deterministic Polynomial-time hard), is a class of problems that are, informally, at least as hard as the hardest problems in NP". More precisely, a problem H is NP-hard when every problem L in NP can be reduced in polynomial time. As a consequence, finding a polynomial algorithm to solve any NP-hard problem would give polynomial algorithms for all the problems in NP, which is unlikely as many of them are considered as hard. The class NP also contains all problems which can be solved in polynomial time.

These problems need not have any bound on their running time. If any NPC Problem is polynomial time reducible to a problem X, that problem X belongs to NP-Hard class. Hence, all NP-Complete problems are also NPH. In other words if a NPH problem is non-deterministic polynomial time solvable, it is a NPC problem. Example of a NPH problem that is not NPC is Halting Problem (halting problem is undecidable and all undecidable problem is guaranteed not to be in NP and hence not NPC also).

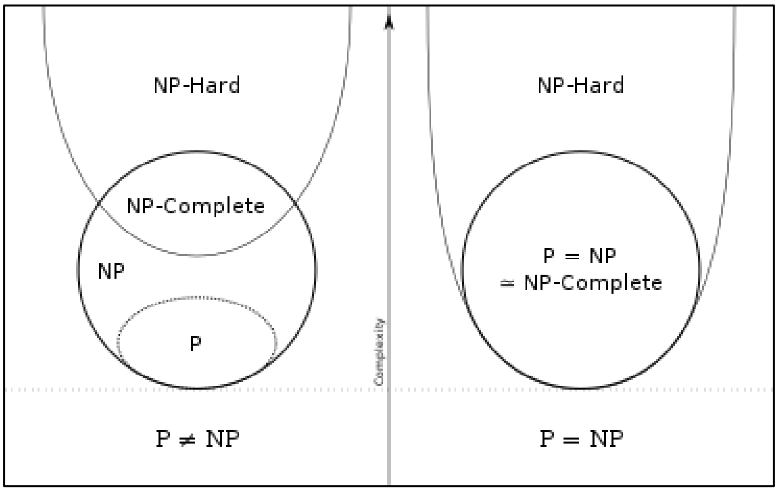

Figure 5.3: Risk Management w.r.t. NP Hard

It is clear that NPC problems are the hardest problems in NP while being the simplest ones in NPH. i.e.; NP ∩ NPH = NPC.

5.2.1 Risk Identification

- **Data Security and Privacy-**

  X-ray images contain sensitive medical information, and any virtual reality application used for 3D modeling must ensure the security and privacy of the data. Risks include unauthorized access, data breaches, or improper handling of patient information. Adequate security measures, encryption protocols, and access controls should be implemented to protect the data.

- **Accuracy and Reliability –**

  The accuracy and reliability of the 3D models generated from X-ray images are crucial. Errors in the modeling process could lead to incorrect diagnoses or treatment plans. It is essential to validate the algorithms and techniques used in the 3D modeling process and continuously monitor and improve the accuracy of the models.3. If a user is making changes in any of the modules and the user loses network connection then there is a possibility that changes made by the user may not be reflected at the database server.

- **Simulator Sickness –**

  Some individuals may experience simulator sickness or motion sickness when using virtual reality systems, especially if the VR environment involves rapid movements or visual discrepancies.

- **User Interface and Interaction –**

  Virtual reality applications rely heavily on user interfaces and interaction methods. Poorly designed interfaces or complex interactions can lead to user confusion, discomfort, or frustration. Proper user experience (UX) design principles should be applied to ensure intuitive and user-friendly interactions in the VR environment.

- **Training and Familiarity –**

  Users of VR systems for 3D modeling of X-ray images need adequate training to operate the software, understand the limitations of the models, and interpret the 3D representations accurately. Insufficient training or lack of familiarity with the technology can lead to misinterpretation or miscommunication of the data, potentially impacting patient care.

- **Technical Limitations and Failures –**

  Virtual reality systems may encounter technical limitations or failures, such as hardware malfunctions, software bugs, or compatibility issues. These issues can disrupt workflow, cause data loss, or hinder the generation of accurate 3D models. Regular maintenance, backups, and quality assurance processes should be in place to minimize such risks.

- **Ethical and Legal Considerations –**

  The use of virtual reality in healthcare involves ethical and legal considerations. It is important to comply with relevant regulations, such as patient consent, data protection, and confidentiality requirements.

5.2.2 Risk Analysis

The risks for the Project can be analyzed within the constraints of time and quality.

1. Risk Analysis:

Table 5.1: Risk Table

ID	Risk Description	Probability	Impact		
			Schedule	Quality	Overall
1.	Accuracy	High	Low	High	Medium
2.	Usability	High	Low	High	Medium
3.	Performance	Low	Low	Low	Low

2. Risk Probability definitions:

Table 5.2: Risk Probability definitions

Probability	Value	Description
High	Probability of occurrence is	> 75%
Medium	Probability of occurrence is	26 −75%
Low	Probability of occurrence is	< 25%

3. Risk Impact definitions:

Table 5.3: Risk Impact definitions

Impact	Value	Description
Very high	> 10%	Schedule impact or Unacceptable quality
High	5 −10%	Schedule impact or Some parts of the project have lowquality
Medium	< 5%	Schedule impact or Barely noticeable degradation in quality Low Impact on schedule or Quality can be incorporated

5.2.3 Overview of Risk Mitigation, Monitoring, Management

Following are the details for each risk.

Table 5.4: Risk Mitigation

Risk ID	**1**
Risk Description	Image Quality
Category	Input Data
Source	Local System
Probability	Low
Impact	High
Response	Mitigate
Strategy	Upload high Quality Image
Risk Status	Occurred
Risk ID	**2**
Risk Description	Edges Should be Clear
Category	Model
Source	System
Probability	Low
Impact	High
Response	Mitigate
Strategy	Upload .dicom file
Risk Status	Identified
Risk ID	**3**
Risk Description	VR sickness
Category	Product
Source	Wearing Long time VR Headset
Probability	Medium
Impact	High
Response	Accept
Strategy	Depend upon the Human Body
Risk Status	Identified

5.3 PROJECT SCHEDULE

5.3.1 Project Task Set

- Task 1: Literature Survey
- Task 2: Applications and Objectives
- Task 3: Platform/Technology Selection
- Task 4: Internal Presentation - 1
- Task 5: Study of Algorithms
- Task 6: Mathematical Model
- Task 7: Software Requirements Specification
- Task 8: UML Diagrams
- Task 9: Problem Definition using NP Hard/ NP Complete
- Task 10: System Architecture
- Task 11: Testing phase
- Task 12: Internal Presentation - 2
- Task 13: Report Preparation
- Task 14: Installation
- Task 15: Overview of Project Model
- Task 16: Construction of GUI
- Task 17: Module Identification
- Task 18: Test Planning
- Task 19: Testing
- Task 20: Poster Presentation
- Task 21: Research of Journals for Final Report

5.3.2 Task Network

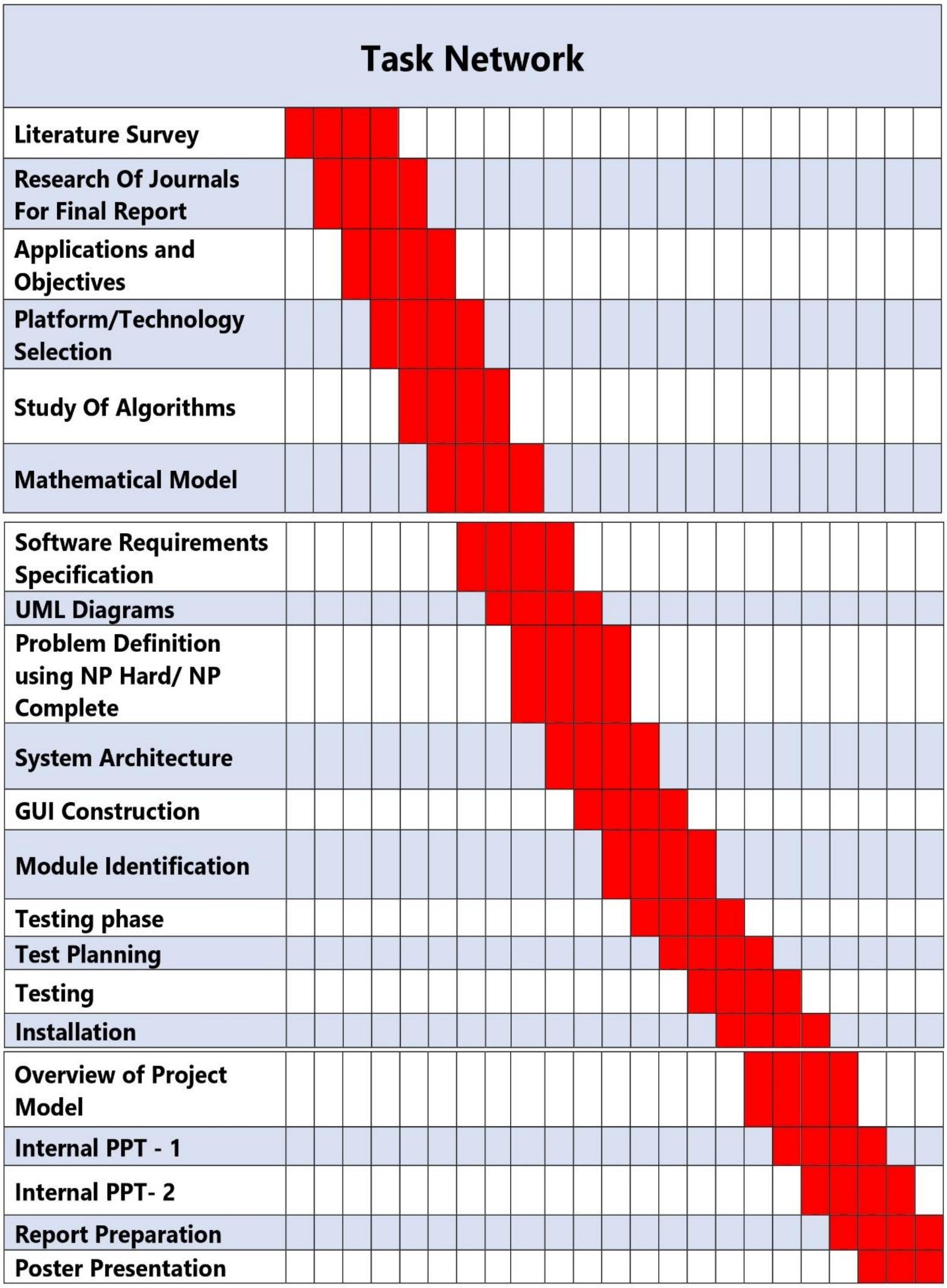

Figure 5.4: Task Network

5.3.3 Timeline Chart

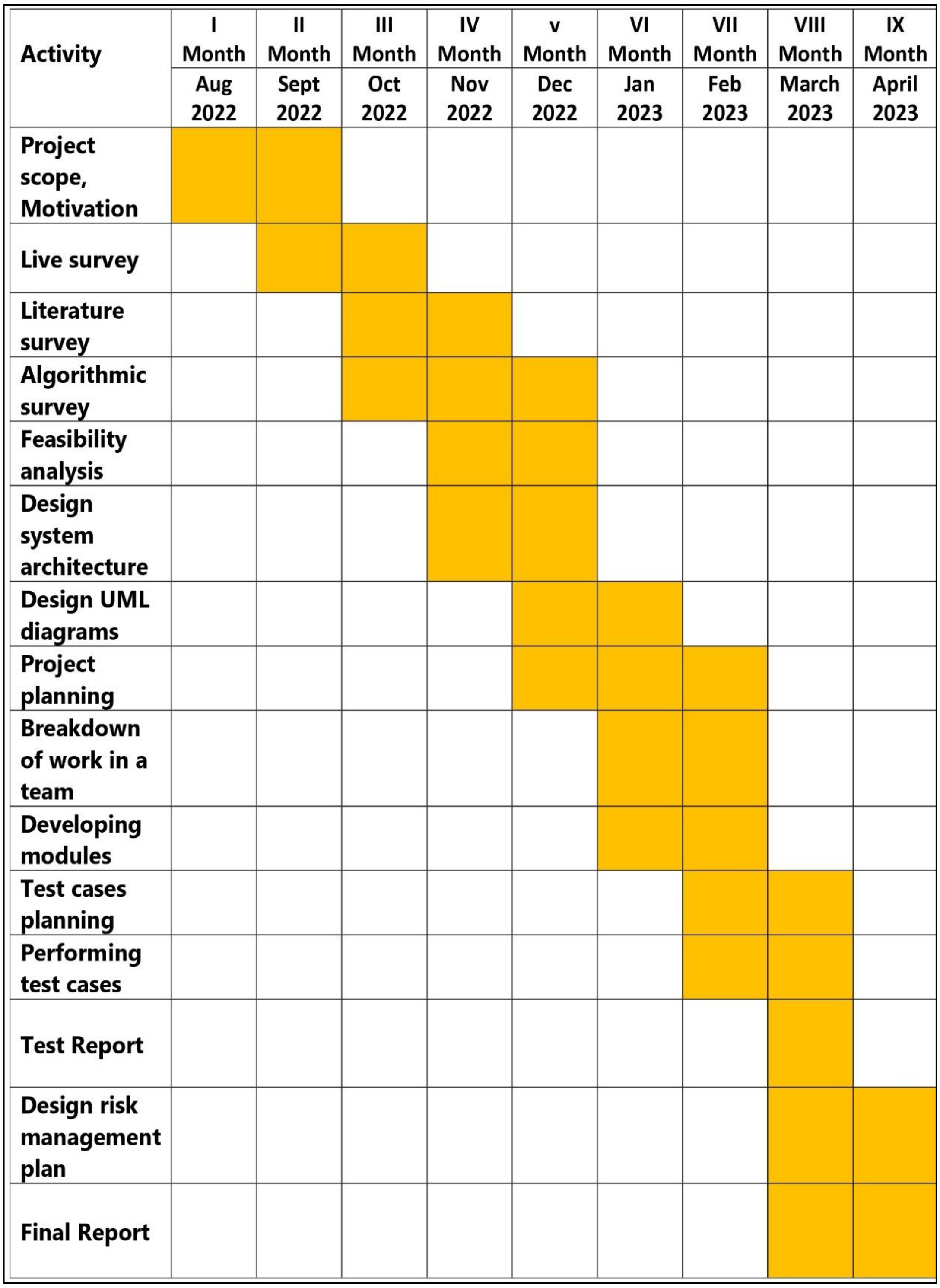

Figure 5.5: Timeline Chart

5.4 TEAM ORGANIZATION

Our strategy is to divide the tasks equally amongst four of us. We decide a dead- line for each task. In the end we combine the results of individuals into one single outcome.

5.4.1 Team structure

– The team consists of four members. Each one of them is equally contributing their share towards the project.

– All the team members work together while requirement gathering, designing, testing, coding and implementation.

– All the work is organized in an efficient manner that each member should have complete information about the project.

– The tasks are properly divided amongst the team members and all the points are discussed among themselves before making a final copy.

– Team co-operation and Team Management are considered as important aspects in Team Organization.

– Guide is allocated to groups in order to support and guide team to complete the project work and documentation.

Guide Name	Mrs. Sonal Fatangare
Software Work	1. Kadambari Kate 2. Kevin Sheth 3. Yash Paliwal 4. Ajay Gaur
Paper Work	1. Kadambari Kate 2. Kevin Sheth, 3. Yash Paliwal 4. Ajay Gaur

5.4.2 Management reporting and communication

Effective management reporting and communication of the project progress to a Project Guide are essential for maintaining transparency, ensuring alignment with project goals, and facilitating informed decision-making. Here are some key aspects to consider:

- **Project Updates –**
  - Regular Updates: Provide regular updates to the Project Guide at agreed-upon intervals, such as weekly or biweekly, to keep them informed about the project's status.
  - Highlight Accomplishments: Highlight the key milestones achieved, completed tasks, and any significant progress made since the last update.
  - Flag Challenges and Risks: Communicate any challenges, obstacles, or risks that have arisen during the project and discuss mitigation strategies.
  - Provide Data and Metrics: Include relevant data and metrics to support the project's progress, such as the number of tasks completed, budget status, or resource utilization.
- **Project Metrics and Performance –**
  - Key Performance Indicators (KPIs): Identify and track KPIs specific to the project, such as adherence to schedule, quality metrics, or customer satisfaction.
  - Dashboard or Visual Reports: Use visual representations, such as charts or graphs, to present project metrics and performance in a concise and easy-to-understand format.
  - Trends and Analysis: Analyze trends and patterns in project data to identify areas of improvement or potential risks.

- **Project Scope and Deliverables –**
  - Scope Management: Clearly communicate any changes or updates to the project scope, including additions, modifications, or exclusions, to ensure alignment with the Project Guide's expectations.
  - Deliverable Updates: Provide updates on the status of project deliverables, highlighting completed deliverables and any outstanding or delayed items.
  - Dependencies and Interactions: Discuss any dependencies on external factors or interactions with other projects or teams that may impact the project's progress or timeline.
- **Risk and Issue Management –**
  - Risk Assessment and Mitigation: Identify and communicate project risks and their potential impact on the project's success. Present mitigation strategies or action plans to address the risks.
  - Issue Reporting: Report any issues or problems encountered during the project, providing details on their nature, impact, and proposed resolutions.
  - Escalation Process: Establish an escalation process to address critical issues that require immediate attention or decisions from the Project Guide.
- **Communication Channels –**
  - Meetings: Schedule regular meetings with the Project Guide to discuss project updates, challenges, and decisions. Use these meetings to seek guidance, obtain feedback, and ensure alignment with project objectives.
  - Written Reports: Prepare concise and comprehensive written reports summarizing project progress, risks, and issues. Share these reports via email or project management tools.

- Collaboration Platforms: Utilize collaboration platforms or project management tools that enable real-time communication and document sharing, facilitating seamless communication between the project team and the Project Guide.

▪ **Stakeholder Engagement –**

- Identify Key Stakeholders: Identify other stakeholders who may need to be updated on the project's progress and ensure their inclusion in relevant communication and reporting channels.

- Tailored Communication: Tailor communication and reporting to different stakeholders' needs, providing information that is relevant and meaningful to their roles and responsibilities.

Overall, effective management reporting and communication involve regular updates, clear and concise presentation of project metrics, proactive risk and issue management, and a collaborative approach to engage stakeholders. This ensures that the Project Guide remains informed, involved, and supportive throughout the project lifecycle.

CHAPTER 6

SOFTWARE REQUIREMENT SPECIFICATION

6.1 INTRODUCTION

Medical imaging technology dates back to the 18th and 19th centuries, when Becquerel found radiation and x-rays, respectively. Both findings significantly enhanced medical practice. The practical implementation of ultrasound in medicine was made feasible by advances in the use of sound waves in the mid-twentieth century, and then came computers, which changed the game completely. Sonography, nuclear medicine technology, and radiography were used as diagnostic medical imaging methods or instruments prior to the widespread use of computer technology in health care. Bone serves as the human body's skeleton, allowing body parts to move and protecting organs. One of the largest and most complex bones in the body is the knee bone. Real life knee bone replacement problem is very serious. Replacing the knee bone or joint with a made artificial joint, known as prosthesis, requires a surgery. Damaged cartilage and bone are taken out of the knee joint during this procedure. The knee is then implanted with man-made bone.

The preferred method for evaluation and therapy planning in orthopedics continues to be traditional X-ray images, despite the growing accessibility of 3D image acquisition techniques like computed tomography (CT). However, X-rays only show a 2D projection of the anatomy of interest, making it difficult for a human viewer to evaluate its 3D characteristics like the anatomical form. (eg. the surgeon). The goal of this project is to create computer- assisted methods for creating 3D models from a single or a small number of X-rays that describe an anatomy's patient-specific form and bone density distribution. The final aim of these patient-specific models is to provide critical 3D information purely based on 2D X-rays, enabling exact joint replacement planning, follow-up, and biomechanical analysis.

The term "CT scan" is frequently used to refer to computed tomography. A CT scan is a diagnostic imaging process that creates pictures of the inside of the body using a mix of X-rays and computer technology. Any portion of the body, including the bones, muscles, fat, organs, and blood systems, is shown in depth. Compared to traditional X-rays, CT images are more comprehensive. A beam of energy is directed at the bodily portion being examined in conventional X-rays.

After the energy beam travels through the epidermis, bone, muscle, and other tissues, it varies and is captured by a plate behind the body component. While a normal X-ray can provide a lot of information, internal organs and other tissues cannot be seen in great depth.

Virtual reality, also known as VR, is a digital environment that was created decades ago but has only recently begun to take off. This is due to the fact that the technology has only recently become compact, potent, and widely accessible. Because of these factors, virtual reality is now beginning to be applied in the classroom. A new media tool called virtual reality (VR) offers the potential to make learning more engaging for pupils. But more significantly, it can also be a choice to give all pupils more chances and experiences. For example, learners with bodily disabilities or students attending institutions with limited resources can now take virtual excursions to locations they were previously unable to visit.

6.1.1 Purpose and Scope of Document

The purpose of this document is to present a detailed description of 3D modeling of X-ray Images using Virtual Reality. This document will give the usage, working and specifications of the system. This document will highlight the implementation, testing, deployment and maintenance phases of our project.

6.1.2 Overview of responsibilities of Developer

1. Requirement Analysis and Resource Planning –

The developers shall analyze all the requirements and functionalities which are to be incorporated in the system to be designed. The developer shall plan and utilize their resources as efficiently as possible.

2. Design and Prototyping –

Developers will design and prototype the given system before moving on to the implementation phase of the project. The designing of the product shall be done using relevant UML diagrams.

3. Software Development –

Software development is a comprehensive process that involves designing, creating, testing, and maintaining computer programs and applications. It begins with understanding the requirements and objectives of the software project, gathering user needs, and defining the scope of work. The development phase entails transforming these requirements into a functional system through the use of programming languages, frameworks, and tools. Skilled developers write code, following coding standards and best practices, to build the desired features and functionalities of the software.

They utilize various development methodologies such as Agile or Waterfall, depending on project requirements and team preferences. Collaboration and communication among team members are crucial during development to ensure efficient progress and alignment with the project goals. Throughout the process, developers conduct rigorous testing, including unit testing, integration testing, and system testing, to identify and rectify any issues or bugs. They also incorporate feedback and iterate on the software to improve its quality and performance. Documentation plays a vital role, providing clear instructions and explanations for future reference and maintenance.

4. Testing -

Testing is a critical phase in the software development life cycle that involves evaluating the functionality, performance, and quality of a software system. It aims to identify defects, errors, or discrepancies in the software to ensure that it meets the specified requirements and performs as expected. Here is a description of the testing phase.

Testing begins by developing a test plan, which outlines the testing objectives, strategies, and resources required. Test cases are created based on the software requirements, covering different scenarios and user interactions. These test cases define the inputs, expected outputs, and steps to be followed during testing.

5. Deployment and Maintenance –

Deployment and maintenance are crucial phases in the software development life cycle that involve the release and ongoing support of the software product. Here is a description of the deployment and maintenance phases.

Deployment -

1. The deployment phase involves preparing the software for production use and making it available to end-users or clients. Here are the key steps involved:

2. Environment Setup: The production environment is set up, including servers, databases, networking, and any necessary infrastructure components.

3. Configuration Management: The software is configured based on the specific production environment, including settings, database connections, third-party integrations, and other configuration parameters.

4. Installation and Deployment: The software is installed and deployed to the production environment. This may involve copying files, configuring servers, and performing any necessary setup steps.

5. Data Migration (if applicable): If the software requires the migration of data from an existing system or database, this step involves transferring and transforming the data to the new software.

6. Testing in Production: The deployed software is thoroughly tested in the production environment to ensure that it functions correctly and performs optimally under real-world conditions.

7. Rollout and Release: The software is made available to end-users or clients through controlled rollout strategies, such as gradual release, phased deployment, or simultaneous launch.

Maintenance –

1. Once the software is deployed, the maintenance phase begins. Maintenance involves ongoing support, bug fixes, updates, and enhancements to ensure that the software remains operational, secure, and aligned with changing requirements. Here are the key activities in the maintenance phase:

2. Bug Fixes and Issue Resolution: Any reported bugs or issues are addressed by the development team. They analyze the problem, identify the root cause, and apply fixes to resolve the issues.

3. Performance Monitoring and Optimization: The software's performance is monitored regularly to identify any performance bottlenecks or inefficiencies. Optimization techniques are applied to improve the software's speed, responsiveness, and resource utilization.

4. Security Updates and Patches: The software is regularly assessed for security vulnerabilities, and necessary updates and patches are applied to mitigate any risks. This includes staying up to date with security best practices and addressing emerging threats.

5. User Support and Training: Ongoing user support is provided to address user queries, troubleshoot issues, and assist with using the software effectively. User training materials and resources may also be updated to reflect changes or new features.

6. Feature Enhancements and Upgrades: Based on user feedback, market trends, and evolving requirements, new features and enhancements may be developed and incorporated into the software through periodic updates or version upgrades.

7. Version Control and Documentation: Proper version control ensures that changes and updates to the software are managed systematically. Documentation is maintained and updated to reflect the current state of the software, including user manuals, technical guides, and release notes.

6.2 USAGE SCENARIO

- **Objective –**

  The objective is to enhance the understanding of anatomical structures and pathologies visible in X-ray images by creating a 3D model that can be explored in a virtual reality environment.

- **Software and Hardware Setup –**

  A VR system, is set up in a dedicated training room or simulation lab. The necessary VR software and 3D modeling tools capable of working with medical images are installed and configured.

- **X-ray Image Acquisition –**

  High-quality X-ray images representing different anatomical regions or specific medical cases are obtained. These images can include skeletal structures, organs, or specific areas of interest relevant to the educational objectives.

- **Image Segmentation and 3D Modeling –**

  The X-ray images are processed using specialized 3D modeling software, where image segmentation techniques are applied to isolate the anatomical structures of interest. The segmented images are then reconstructed into a detailed and accurate 3D model.

- **VR Environment Development –**

  The 3D model is imported into a VR development environment, such as Unity or Unreal Engine. In this environment, a virtual space is created, a radiology room or an operating theater, where users can interact with the 3D model.

- **Interactivity and Navigation –**

  Users wear the VR headset and enter the virtual environment. They can use hand controllers or other input devices to navigate through the 3D model, zoom in or out, rotate and manipulate the view, and interact with different anatomical structures.

- **Educational Scenarios –**

  Various educational scenarios can be designed within the VR environment. For example, users can identify specific anatomical landmarks or pathologies in the 3D model, simulate different viewing angles and perspectives, compare normal and abnormal structures, or practice diagnosing specific medical conditions.

- **Guided Learning and Feedback –**

  Interactive tutorials, narrations, or overlays can provide guided learning experiences within the VR environment. Users can receive real-time feedback, annotations, or additional information about the anatomical structures they are observing.

- **Collaborative Learning –**

  The VR system can support multi-user functionality, enabling collaborative learning experiences. Students or healthcare professionals can interact and discuss the 3D model together, sharing insights and knowledge in a virtual classroom setting.

- **Progress Tracking and Assessment –**

  User performance and progress can be tracked within the VR system. Assessment tools, quizzes, or interactive assessments can be integrated to evaluate the user's understanding and proficiency in identifying anatomical structures or diagnosing medical conditions.

- **Continuous Updates and Expansion –**

  The VR application can be continuously updated with new X-ray images, additional anatomical structures, or more complex medical cases. This allows for ongoing learning and keeps the educational content up to date with the latest advancements in medical knowledge.

6.2.1 User profiles

1. Medical Students –

Description: Aspiring healthcare professionals in the early stages of their education.

Objectives: Enhance understanding of anatomical structures, improve diagnostic skills, and learn about X-ray interpretation.

Usage: Engage in immersive learning experiences, practice identifying anatomical structures and pathologies, and explore interactive 3D models for educational purposes.

2. Radiology Residents –

Description: Medical graduates pursuing specialization in radiology.

Objectives: Gain proficiency in interpreting X-ray images, develop advanced diagnostic abilities, and improve spatial awareness.

Usage: Utilize virtual reality to reinforce their knowledge, enhance visualization skills, and practice identifying complex anatomical structures and abnormalities.

3. Radiologists and Medical Imaging Professionals –

Description: Experienced radiologists or professionals working in the field of medical imaging.

Objectives: Stay updated with new imaging techniques, refine diagnostic expertise, and explore advanced cases.

Usage: Use VR-based 3D modeling to review challenging cases, simulate different imaging modalities, and enhance decision-making skills for patient diagnosis and treatment planning.

4. **Medical Educators –**

Description: Faculty members responsible for teaching medical students or conducting training programs.

Objectives: Provide interactive and immersive learning experiences, facilitate understanding of complex medical concepts, and promote critical thinking skills.

Usage: Incorporate VR-based 3D modeling into the curriculum, design educational scenarios, and create assessments or quizzes to evaluate students' knowledge and performance.

5. **Healthcare Simulation Centers –**

Description: Institutions or facilities equipped with simulation labs for medical training.

Objectives: Offer realistic and engaging training experiences, enable hands-on learning, and provide advanced technological resources.

Usage: Integrate VR-based 3D modeling into simulation scenarios, establish training sessions for medical professionals, and create a virtual environment for practicing X-ray interpretation and diagnosis.

6. **Medical Researchers –**

Description: Professionals involved in medical research, imaging technology development, or clinical trials.

Objectives: Explore new imaging techniques, assess the feasibility of novel technologies, and conduct comparative studies.

Usage: Utilize VR-based 3D modeling to evaluate the potential of emerging imaging technologies, simulate clinical trial scenarios, and analyze the impact of new techniques on diagnostic accuracy.

6.2.2 Use-cases

Table 6.1: Use Case

Sr.no	Use Case	Description	Actor
1.	Start System	The user will initiate the system.	User
2.	Mounting VR	The user will mount VR on the head for view of the 3D model.	User
3.	X-Ray Image Upload	The user will upload the image in the System.	User
4.	3D Model generated	The system will generate the 3D model and will deploy to VR.	System
5.	Experience VR Environment	The 3D model will view in the VR headset.	System

6.2.3 Use Case View

A use case diagram is a simple representation of a user’s interaction with the system that shows the relationship between the user and the different use cases in which the user is involved.

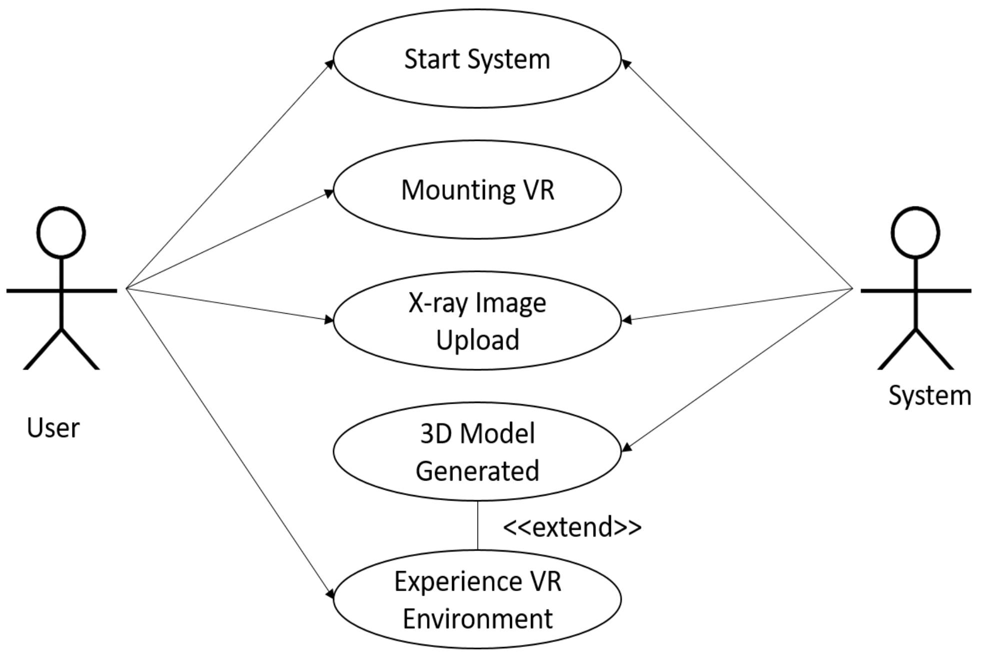

Figure 6.1: Use case diagram

6.3 DATA MODEL AND DESCRIPTION

6.3.1 Data Description

The data that we are using for this system is X-Ray Image. The sample Dataset is available on Kaggle website which will be used in our system as a input Data.

6.3.2 Data objects and Relationships

ER diagram is a data model for describing the data or information aspects of a soft-ware system. The main components of ER models are entities and the relationships that exists among the model.

6.4 FUNCTIONAL MODEL AND DESCRIPTION

6.4.1 Data Flow Diagram

A data flow diagram (DFD) maps out the flow of information for any process or system. It uses defined symbols like rectangles, circles and arrows, plus short text labels, to show data inputs, outputs, storage points and the routes between each destination. Data flowcharts can range from simple, even hand-drawn process overviews, to in-depth, multi-level DFDs that dig progressively deeper into how the data is handled. They can be used to analyze an existing system or model a new one. Like all the best diagrams and charts, a DFD can often visually “say” things that would be hard to explain in words, and they work for both technical and nontechnical audiences, from developer to CEO. That’s why DFDs remain so popular after all these years. While they work well for data flow software and systems, they are less applicable nowadays to visualizing interactive, real-time or database-oriented software or systems.

6.4.1.1 Level 0 Data Flow Diagram

It shows the input and the output of the system. This DFD shows the overall purpose of the system, that is, Sentiment Report Generation.

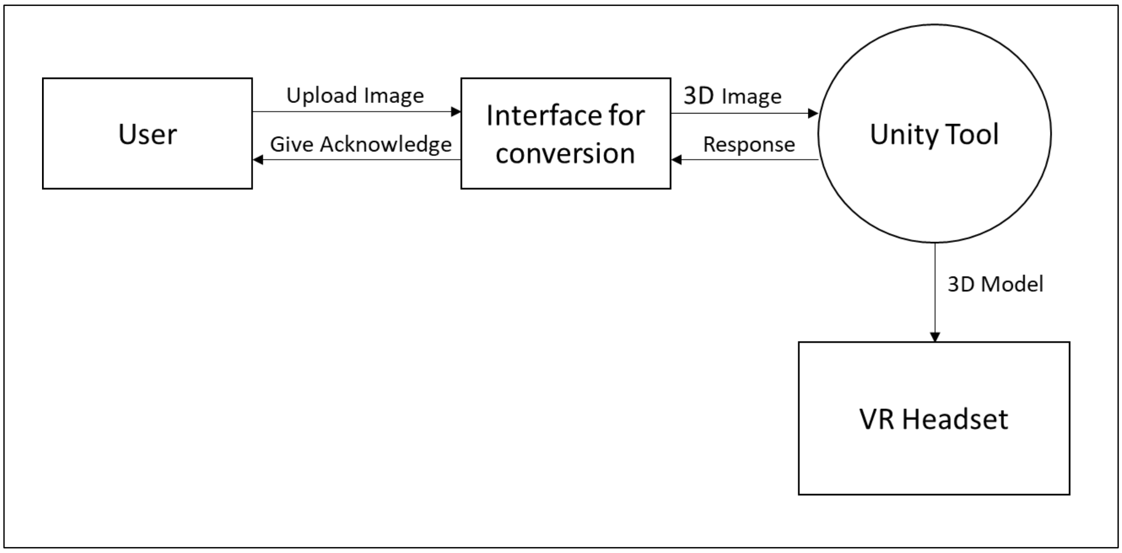

Figure 6.2: Level 0 Data Flow Diagram

6.4.1.2 Level 1 Data Flow Diagram

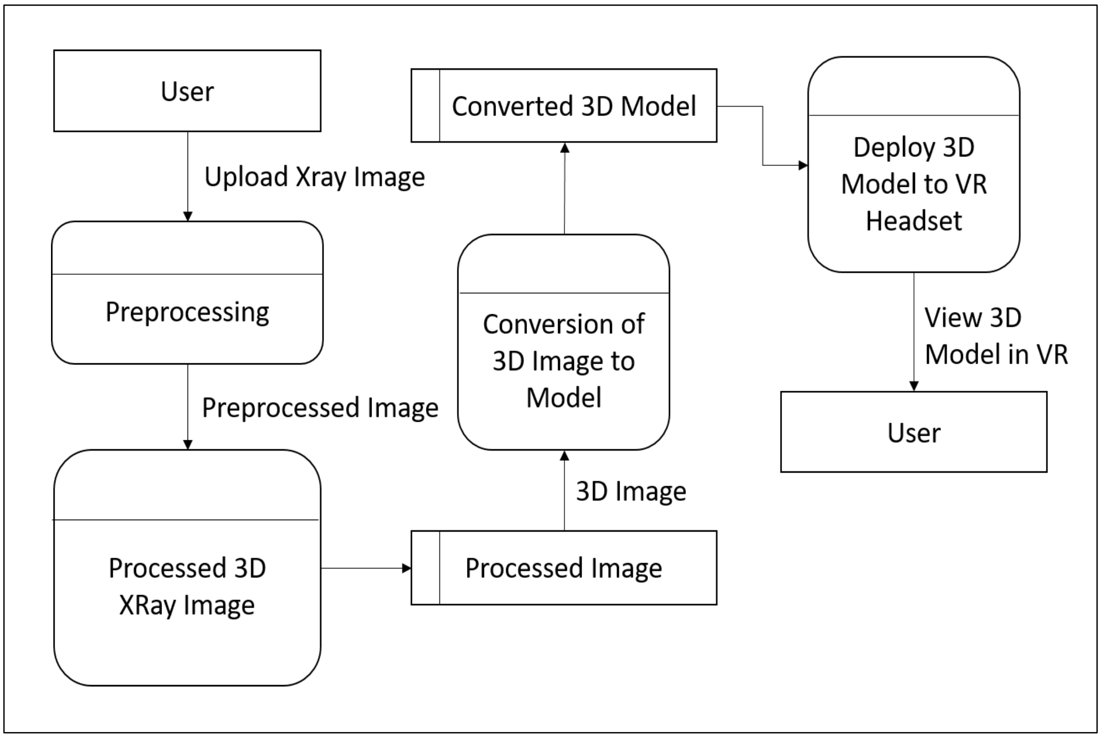

Figure 6.3: Level 1 Data Flow Diagram

6.4.2 Non-Functional Requirements:

1. **Performance Requirement:**
   - **High Speed:** System should process requested tasks in parallel for various actions to give quick response then the system must wait for process completion.
   - **Accuracy:** The system should correctly execute the process. Finally, the original retinal image is first pre-processed and then particle analysis is performed.
   - **Interoperability:** Systems should have the ability to exchange information and communicate with internal and external applications and systems. It must be able to exchange information both internally and externally.
   - **Reliability:** System should be delivering specified and required data only.
   - **Response Time:** The response time of the system should be deterministic at all times and very low, i.e., it should meet every deadline. Thus, the system will work in real time.

2. **Safety and Security Requirement:**

   The data safety must be ensured by arranging for a secure and reliable transmission media.The source and destination information must be entered correctly to avoid any misuse ormalfunctioning.

6.4.3 State Diagram:

The states are represented in ovals and the state of the system gets changed when certain events occur. The transitions from one state to the other are represented by arrows. The Figure shows important states and events that occur while creating new project.

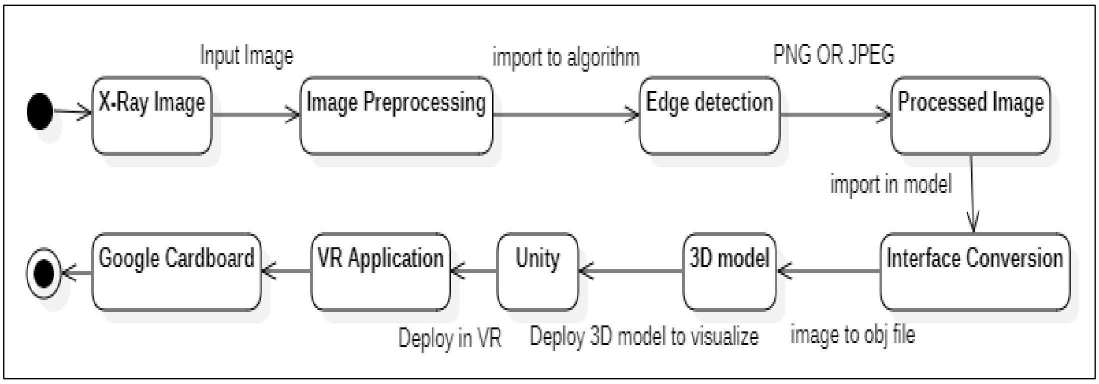

Figure 6.4: State Transition Diagram

6.4.4 Software Interface Description

I) Python 3:

Python is a high-level programming language. Python is very easy to learn the language as compared to other languages like C, C#, JavaScript, Java, etc. It is very easy to code in python language and anybody can learn python basics in a few hours or days. It is also a developer-friendly language. Also Python comes inbuilt with a large number of libraries that can be imported at any instance and be used in a specific program. The presence of libraries also makes sure that you don't need to write all the code yourself and can import the same from those that already exist in the libraries.

II) Inkscape:

Inkscape is a popular and powerful open-source vector graphics editor. It is a free software program used for creating and editing scalable vector graphics (SVG) files. Inkscape is available for Windows, macOS, and Linux operating systems, and it provides users with a wide range of tools and features for creating stunning illustrations, logos, diagrams, icons, and other graphic designs.

- Vector Editing: Inkscape uses vector graphics, which means that images are created using mathematical equations to define shapes and lines. This allows for smooth scaling without loss of quality.

- SVG Support: Inkscape natively supports the Scalable Vector Graphics (SVG) file format, which is a standard format for vector graphics on the web. It allows for compatibility with other software programs and makes it easy to export and share artwork online.

- Tools and Effects: Inkscape provides a variety of tools and effects to enhance your designs. It includes drawing tools (such as pencil, pen, and shape tools), text tools, gradient fills, pattern fills, blending modes, and transparency effects. You can also work with layers to organize your artwork and apply filters to create special effects.

- Object Manipulation: Inkscape allows you to transform and manipulate objects in your artwork. You can scale, rotate, skew, and flip objects, as well as align and distribute them with precision. In addition, you can group objects together, clone and duplicate elements, and make use of snapping and grid features for accurate positioning.

- Import and Export Options: Inkscape supports importing and exporting various file formats, including SVG, PNG, JPEG, PDF, EPS, and more. This allows you to work with files from other software programs and easily share your designs in different formats.

- Extensions and Plugins: Inkscape offers an extension system that allows users to enhance the functionality of the software. There are numerous extensions and plugins available, which can be used to add new features, automate tasks, and streamline your workflow.

- Community and Documentation: Inkscape has a vibrant and active user community. You can find tutorials, documentation, and user forums where you can seek help, learn new techniques, and share your work with others. The open-source nature of Inkscape encourages collaboration and continuous improvement of the software.

III) Blender:

Blender is a free and open-source 3D computer graphics software toolset. It is a powerful and versatile program that is widely used for creating 3D animations, visual effects, interactive 3D applications, and more. Blender is available for Windows, macOS, and Linux operating systems, and it offers a comprehensive range of features for both beginners and experienced 3D artists.

- 3D Modeling: Blender provides a robust set of tools for creating 3D models from scratch or by modifying existing models. You can use various modeling techniques such as polygon modeling, sculpting, and procedural modeling to create intricate and detailed objects.

- Animation and Rigging: Blender's animation tools allow you to bring your models to life by creating keyframe animations, character animations, and dynamic simulations. You can also rig your models, defining a skeleton-like structure that enables you to animate characters and objects more easily.

- Rendering: Blender offers a powerful rendering engine called Cycles, which supports realistic rendering with features like global illumination, ray tracing, and physically-based materials. Additionally, Blender has a real-time rendering engine called Eevee, which provides fast and interactive rendering for quick previews and animations.

- Game Development: Blender has built-in game development tools that allow you to create interactive 3D games. It supports game logic scripting, physics simulation, asset management, and integration with popular game engines like Unity and Unreal Engine.

- Visual Effects: Blender includes a wide range of tools and features for creating visual effects, such as particle systems, dynamic simulations, smoke and fire simulations, and physics-based effects. These capabilities enable you to create realistic and stunning visual effects for movies, games, and other applications.

- Video Editing and Compositing: Blender includes a full-fledged video editing and compositing workspace. You can import video footage, trim and arrange clips, add transitions and effects, and perform color grading. The compositing features allow you to combine multiple video and image elements, apply effects and filters, and create complex composite scenes.

- Community and Support: Blender has a large and active user community that contributes to its development and provides support to fellow users. There are numerous tutorials, documentation resources, forums, and online communities where you can find help, learn new techniques, and share your work.

IV) Unity:

Unity is an engine for creating games on multiple platforms. Unity was released by Unity Technologies in 2005. The focus of Unity lies in the development of both 3D and 2D games and interactive content. Unity now supports 27 different target platforms for deploying. The most popular platforms are Android, PC, and iOS systems.

- Although unity is considered to be more appropriate for creating 3D games, it can also be equally used to develop 2D games.

- In Unity, it is possible to develop games with heavy assets without depending on the additional frameworks or engines. It really enhances the experience of users.

- With the help of Unity, our game developers can access a wealth of resources like intuitive tools, ready-made assets, clear documentation, online community, etc. free of cost for creating exciting 3D contents in the games.

CHAPTER 7

DETAILED DESIGN DOCUMENT

USING APPENDIX A AND B

7.1 INTRODUCTION

Medical imaging technology dates back to the 18th and 19th centuries, when Becquerel found radiation and x-rays, respectively. Both findings significantly enhanced medical practice. The practical implementation of ultrasound in medicine was made feasible by advances in the use of sound waves in the mid-twentieth century, and then came computers, which changed the game completely. Sonography, nuclear medicine technology, and radiography were used as diagnostic medical imaging methods or instruments prior to the widespread use of computer technology in health care. Bone serves as the human body's skeleton, allowing body parts to move and protecting organs. One of the largest and most complex bones in the body is the knee bone. Real life knee bone replacement problem is very serious. Replacing the knee bone or joint with a made artificial joint, known as prosthesis, requires a surgery. Damaged cartilage and bone are taken out of the knee joint during this procedure. The knee is then implanted with man-made bone.

7.2 ARCHITECTURAL DESIGN

The proposed application is able to extract the user's sentiment through audio file given as input or text given as input. The proposed method will be used for predicting sentiment based on speech or scripted given as input.

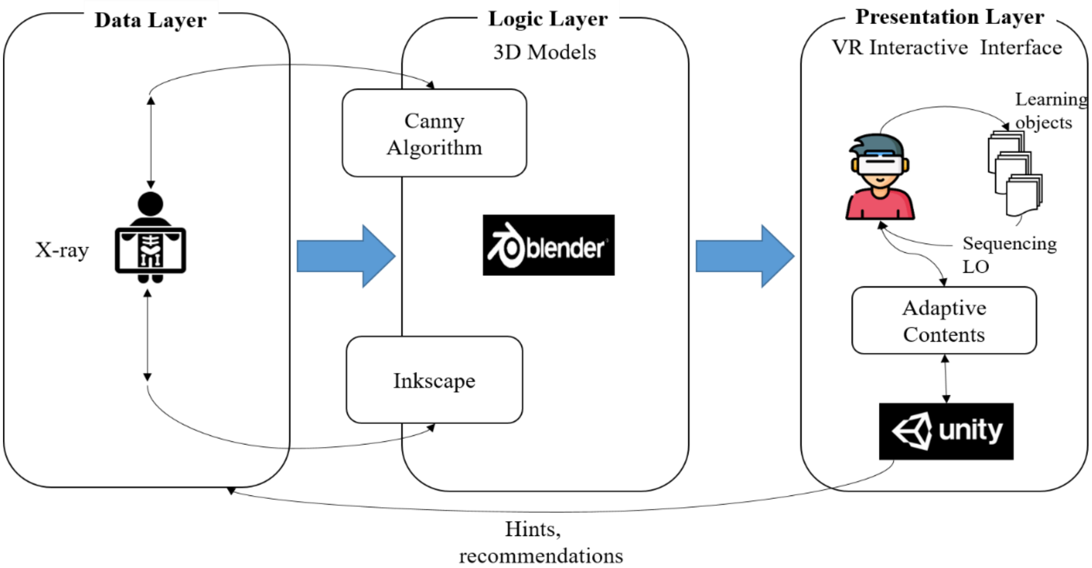

Figure 7.1: Architecture diagram

7.3 DATA DESIGN (USING APPENDICES A AND B)

A description of all data structures including internal, global, and temporary data structures, database design (tables), file formats.

7.3.1 Internal software data structure

Data structures that are passed among components the software is described.

7.3.2 Global data structure

Stack: Stacks are linear data structures used to store collections of items and objects. The Last-In-First-Out (LIFO) method is used. There are many interfaces and classes provided by the Java collection framework for storing collections of objects. The Stack class provides different operations including push, pop, search, etc. Push and pop are the two most important operations of the stack data structure and pop. Push inserts an element into the stack, while pop removes it and removes an element from the top of the stack temporary data structure
Files created for interim use are described.

7.3.3 Database description

Database will consist of a table which will store X-ray Image files from user into the database.

7.4 COMPOENT DESIGN

Class diagram shows the structure of the classes, attributes, operations and relationship among them. Given below is the class diagram of the proposed system. The class diagram shown below, includes in all 6 classes which describe the structure of the proposed system.

- Image processing
- Fetching image
- Building 3D model
- Virtual reality headset

7.4.1 Class Diagram

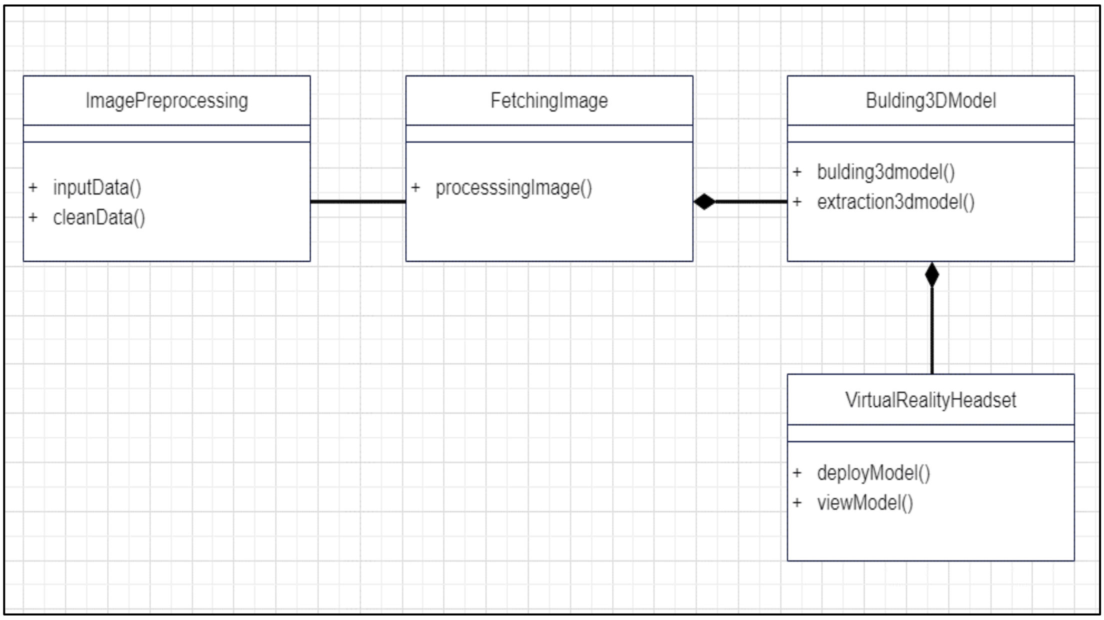

Figure 7.2: Class Diagram

7.4.2 Component Diagram

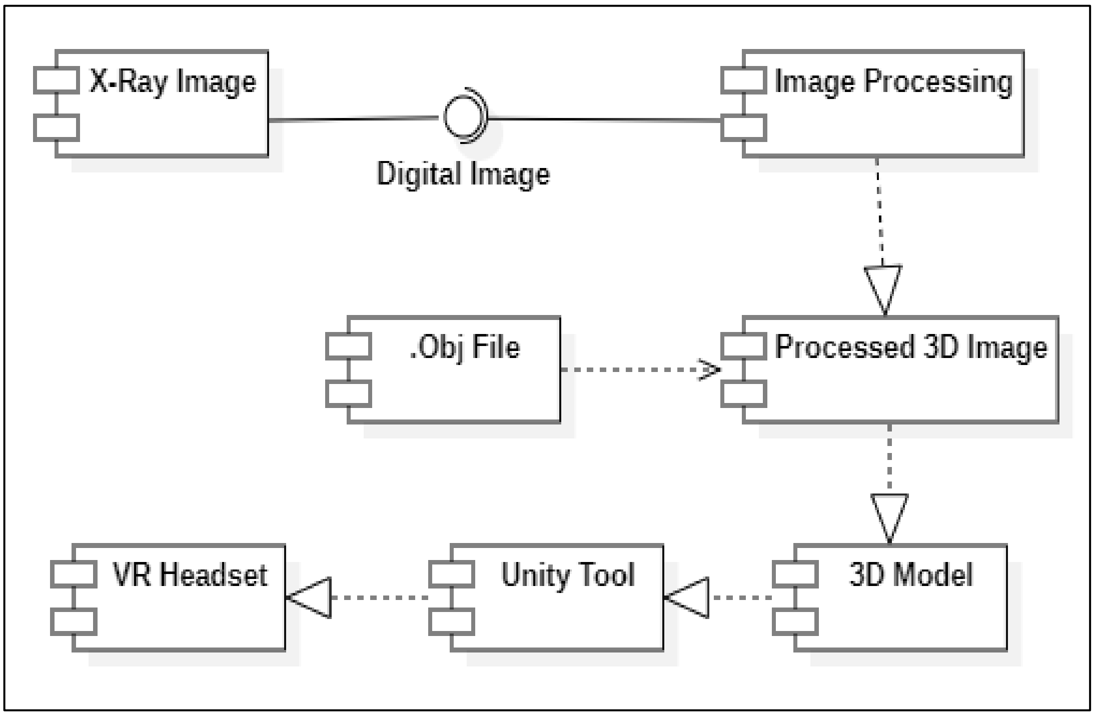

Figure 7.3: Component Diagram

7.4.3 Deployment Diagram

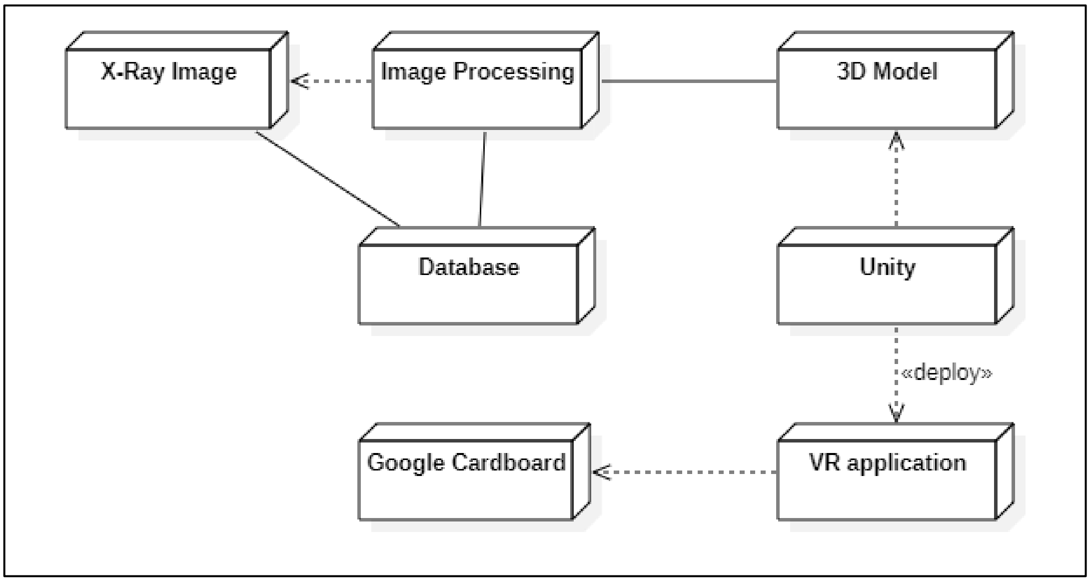

Figure 7.4: Deployment Diagram

CHAPTER 8

PROJECT IMPLEMENTATION

8.1 INTRODUCTION

Medical imaging technology dates back to the 18th and 19th centuries, when Becquerel found radiation and x-rays, respectively. Both findings significantly enhanced medical practice. The practical implementation of ultrasound in medicine was made feasible by advances in the use of sound waves in the mid-twentieth century, and then came computers, which changed the game completely. Sonography, nuclear medicine technology, and radiography were used as diagnostic medical imaging methods or instruments prior to the widespread use of computer technology in health care. Bone serves as the human body's skeleton, allowing body parts to move and protecting organs. One of the largest and most complex bones in the body is the knee bone. Real life knee bone replacement problem is very serious. Replacing the knee bone or joint with a made artificial joint, known as prosthesis, requires a surgery. Damaged cartilage and bone are taken out of the knee joint during this procedure. The knee is then implanted with man-made bone.

The preferred method for evaluation and therapy planning in orthopedics continues to be traditional X-ray images, despite the growing accessibility of 3D image acquisition techniques like computed tomography (CT). However, X-rays only show a 2D projection of the anatomy of interest, making it difficult for a human viewer to evaluate its 3D characteristics like the anatomical form. (eg. the surgeon). The goal of this project is to create computer- assisted methods for creating 3D models from a single or a small number of X-rays that describe an anatomy's patient-specific form and bone density distribution. The final aim of these patient-specific models is to provide critical 3D information purely based on 2D X-rays, enabling exact joint replacement planning, follow-up, and biomechanical analysis.

The term "CT scan" is frequently used to refer to computed tomography. A CT scan is a diagnostic imaging process that creates pictures of the inside of the body using a mix of X-rays and computer technology. Any portion of the body, including the bones, muscles, fat, organs, and blood systems, is shown in depth. Compared to traditional X-rays, CT images are more comprehensive. A beam of energy is directed at the bodily portion being examined in conventional X-rays.

After the energy beam travels through the epidermis, bone, muscle, and other tissues, it varies and is captured by a plate behind the body component. While a normal X-ray can provide a lot of information, internal organs and other tissues cannot be seen in great depth.

Virtual reality, also known as VR, is a digital environment that was created decades ago but has only recently begun to take off. This is due to the fact that the technology has only recently become compact, potent, and widely accessible. Because of these factors, virtual reality is now beginning to be applied in the classroom. A new media tool called virtual reality (VR) offers the potential to make learning more engaging for pupils. But more significantly, it can also be a choice to give all pupils more chances and experiences. For example, learners with bodily disabilities or students attending institutions with limited resources can now take virtual excursions to locations they were previously unable to visit.

8.2 TOOLS AND TECHNOLOGIES USED

- **Tools:** Blender, Inkscape, Unity
- **Language:** Python
- **APK:** Google Cardboard SDK
- **Hardware:** VR Headset

8.3 METHODOLOGIES/ALGORITHM DETAIL

8.3.1 Noise Reduction –

Canny edge detection is a well-liked method of image processing that finds edges in pictures. Before finding edges, the Canny edge detection algorithm reduces picture noise as one of its phases. This is crucial because noise might result in misleading edges or make it challenging to recognize real edges. A Gaussian filter is frequently used to reduce noise in the Canny edge detection process. The image is given a Gaussian function via the convolution kernel that makes up the Gaussian filter. The two-dimensional Gaussian kernel of size (2k+1) x (2k+1) used in image processing. This equation can be expressed as a matrix as follows:

$$\boldsymbol{H_{ij}} = \frac{\mathbf{1}}{\mathbf{2}\boldsymbol{\pi\sigma}^{\mathbf{2}}}\ \mathbf{exp}\left(-\frac{(\boldsymbol{i}-(\boldsymbol{k}+\mathbf{1})^{\mathbf{2}}+(\boldsymbol{j}-(\boldsymbol{k}+\mathbf{1}))^{\mathbf{2}}}{\mathbf{2}\boldsymbol{\sigma}^{\mathbf{2}}}\right); \mathbf{1} \leq \boldsymbol{i},\boldsymbol{j} \leq (\mathbf{2}\boldsymbol{k}+\mathbf{1})$$

…….. (1)

where H is the Gaussian kernel matrix of size (2k+1) x (2k+1), sigma is the standard deviation of the Gaussian function, and D is a matrix of distances between each pixel in the kernel and the center pixel.

To compute the distances, we can define a matrix X of size (2k+1) x (2k+1) where each element X (i, j) represents the column index of the pixel. Similarly, we can define a matrix Y of size (2k+1) x (2k+1) where each element Y (i, j) represents the row index of the pixel.

8.3.2 Gradient calculation –

Gradient calculation is a fundamental operation in image processing and computer vision. The gradient of an image represents the direction and magnitude of the change in pixel intensities across the image. The gradient is often used in edge detection, feature extraction, and object recognition. The gradient of an image can be computed using different methods, but one of the most common methods is the Sobel operator.

The Sobel operator calculates the gradient by convolving the image with two 3x3 kernels, one for the horizontal direction and one for the vertical direction. The kernels are designed to detect changes in pixel intensities in the corresponding direction.

The horizontal Sobel kernel has the following formula:

Sx = [-1 0 1; -2 0 2; -1 0 1] ……… (2)

The vertical Sobel kernel has the following formula:

Sy = [-1 -2 -1; 0 0 0; 1 2 1] ……… (3)

To calculate the gradient, we first convolve the image with the horizontal Sobel kernel and then with the vertical Sobel kernel. The resulting convolved images represent the gradient in the horizontal and vertical directions, respectively. The magnitude and direction of the gradient at each pixel can then be computed using the following formulas:

Magnitude = $sqrt(Gx2) + Gy2$ ……… (4)

Direction = atan2(Gy, Gx) ……… (5)

where Gx and Gy are the convolved images in the horizontal and vertical directions.

- **The sqrt()** function computes the square root of the sum of the squares of the two images, which gives the magnitude of the gradient.

- **The atan2()** function computes the arctangent of the ratio of the vertical gradient to the horizontal gradient, which gives the direction of the gradient.

CHAPTER 9

SOFTWARE TESTING

9.1 TYPE OF TESTING USED

Software testing is a method for examining the ability of a framework and confirms that it meets its results. It is produced by developers to keep up the quality of programming, software testing still remains a craftsmanship, because of less comprehension of the terms of testing. Fundamental issue in regards to the software testing is from the complication of programming: we can’t test entire program with less complexity.

Testing is more than just debugging. The purpose of testing can be quality assurance, verification and validation, or reliability estimation. There are 2 major types of testing’s:

Correctness testing –

Reliability testing –

Software testing has to deal between expenses, time and quality. Presently we will see the test cases for the making website. We execute functional non- functional testing system.

– **TYPE OF TESTING**

- **Unit testing:**

  Unit testing involves the design of test cases that validate that the internal program logic is functioning properly, and that program inputs produce valid outputs. This is a structural testing, that relies on knowledge of its construction and is invasive. Unit tests perform basic tests at component level and test a specific business process, application, and/or system configuration. Unit tests ensure that each unique path of a business process performs accurately to the documented specifications and contains clearly defined inputs and expected results.

- **Integration testing:**

  Integration tests are designed to test integrated software components to determine if they actually run as one program. Integration testing is specifically aimed at exposing the problems that arise from the combination of components.

- **System Test:**

  System testing ensures that the entire integrated software system meets requirements. It tests a configuration to ensure known and predictable results. An example of system testing is the configuration-oriented system integration test. System testing is based on process descriptions and flows, emphasizing pre-driven process links and integration points.

- **White Box Testing:**

  White Box Testing is a testing in which in which the software tester has knowledge of the inner workings, structure and language of the software, or at least its purpose. It is purpose. It is used to test areas that cannot be reached from a black box level.

- **Black Box Testing:**

  Black Box Testing is testing the software without any knowledge of the inner workings, structure or language of the module being tested. Black box tests, as most other kinds of tests, must be written from a definitive source document, such as specification or requirements document, such as specification or requirements document. It is a testing in which the software under test is treated, as a black box. you cannot "see" into it. The test provides inputs and responds to outputs without considering how the software works.

- **Performance Testing**

  It is designed to test the run-time performance of software within the context of an integrated system. It is used to test the speed and effectiveness of the program. It is also called load testing. In it we check, what is the performance of the system in the given load.

- **Regression Testing**

  Regression testing is a method of testing that is used to ensure that changes made to the software do not introduce new bugs or cause existing functionality to break. It is typically done after changes have been made to the code, such as bug fixes or new features, and is used to verify that the software still works as intended.

9.2 TEST CASES AND TEST RESULTS

9.2.1 GUI Test Case Scenarios

Table 9.1: GUI Test Case Scenarios

Test Case Id	1	Status
Test Case Description	Check for all GUI elements for size, position, wide, length acceptance	
Test Case Results	All elements are properly aligned on screen	Pass
Test Case ID	2	
Test Case Description	Check all error messages are displayed correctly	
Test Case Results	All the error messages are displayed correctly on the screen	Pass
Test Case ID	3	
Test Case Description	Check if buttons and input fields are placed at correct place and working properly	
Test Case Results	All the buttons and input text fields are receiving correct inputs	Pass

9.2.2 System Functionality Test Case Scenarios

Table 9.2: System Functionality Test Case Scenarios

Test Case ID	4	Status
Test Case Description	Finding Edges	
Test Case Result	Finding the edges of Bone in X-Ray	Pass
Test Case ID	5	
Test Case Description	3D Conversion	
Test Case Result	After finding edges image is converted to 3D	Pass
Test Case ID	6	

Test Case Description	Watch in VR	
Test Case Result	3D is displayed in VR	Pass

9.2.3 Rainfall Prediction Testing Scenarios

Table 9.3: Rainfall Prediction Testing Scenarios

Test Case ID	7	Status
Test Case Description	Check whether the edge is properly found or not.	
Test Case Result	Removing unnecessary data and noise from input data	Pass
Test Case ID	8	
Test Case Description	Check for data accuracy	
Test Case Result	Edge detection according to the accuracy of the system	Pass

9.2.4 Performance Testing Test Scenarios

Table 9.4: Performance Testing Test Scenarios

Test Case ID	9	Status
Test Case Description	Successful edge detection, 3D conversion, watch in VR.	
Test Case Result	Success message	Pass
Test Case ID	10	
Test Case Description	Unsuccessful image upload	
Test Case Result	System failure message	Pass

CHAPTER 10

RESULTS AND DISCUSSION

10.1 RESULTS:

Appropriate results are obtained using this proposed approach.

Figure 10.1: Input Image (Knee X-Ray)

The first step is to collect a dataset of X-ray images that will be used for developing the 3D modeling system. This dataset should include a variety of images from different patients and anatomical structures. Here we have taken knee bone X-ray.

Figure 10.2: Canny Edge Detection

The X-ray images may contain noise and artifacts that can affect the accuracy of the 3D models. Pre-processing techniques such as noise reduction and image enhancement can be applied to remove these artifacts and improve the quality and sharpness of the X-ray images. In this step using canny edge detection algorithm we have found out required edges of bone. Here our image is in PNG format.

Figure 10.3: Converting to .SVG format

The canny edge detection algorithm output can be saved as an image file (such as PNG) and imported into a vector graphics software, such as Inkscape. The software can then trace the edges increase threshold and convert the image into an SVG file, which is a scalable vector format.

Figure 10.4: 3D Model in Blender

The SVG file can be imported into a 3D modeling software, such as Blender. The software can be used to extrude the 2D image into a 3D model that represents the Knee anatomy. The final step is to export the 3D model in a format that can be imported into a VR development platform, such as Unity. Common 3D file formats include OBJ. Here we have found out actual size of the given bone.

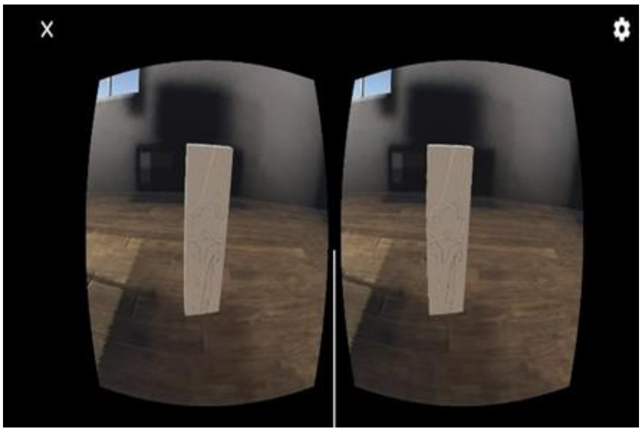

Figure 10.5: Watch in VR

The final step is to export the 3D model in a format that can be imported into a VR development platform, such as Unity. Using VR Google cardboard, we can visualize actual bone.

In this system, we have used a canny edge detection algorithm to find edges the accuracy of algorithm is 94.58%. We have converted image to SVG so accuracy is increased by 1%. So final accuracy of this system is 95.58%.

Table 10.1: System Comparison

System Comparison	Accuracy
Bone Fracture Detection and Classificationusing Deep Learning Approach [23]	94.58%
Automatic detection of fracture in femurbones using image processing [25]	87.5%
Bone Fracture Detection Using OpenCV[27]	66.7%
Proposed System	**95.58%**

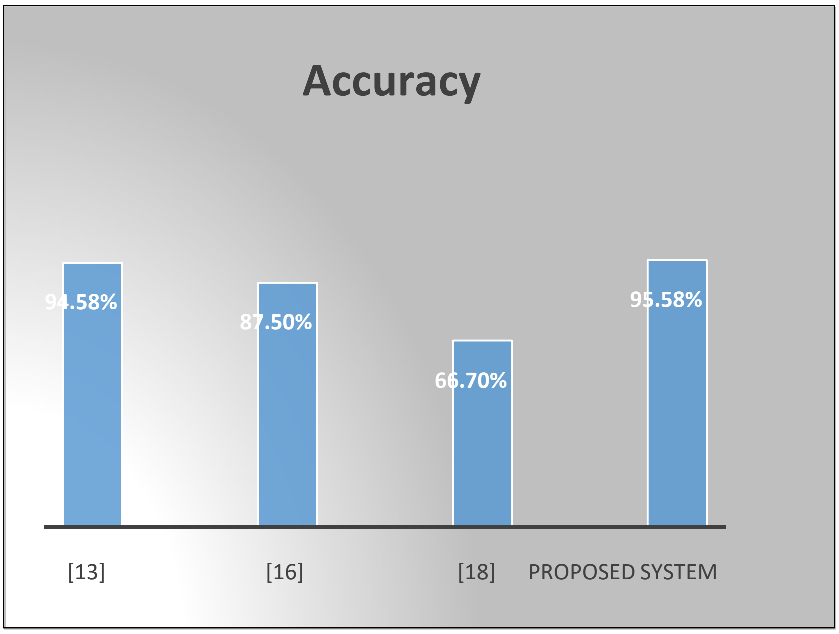

Figure10.6: System Comparison

CHAPTER 11

DEPLOYMENT AND MAINTENANCE

11.1 INSTALLATION

Installing and uninstalling software are fundamental processes for managing applications on a computer. To install software, you begin by obtaining the desired program from a trusted source, such as an official website or software repository. After confirming that your computer meets the minimum system requirements, you run the installer file, which guides you through the installation process via an interactive wizard. This involves accepting license agreements, choosing installation options, and waiting for the software to be copied and configured on your system. Once installed, you receive a notification of successful completion.

Conversely, when uninstalling software, you access the software settings or control panel on your operating system. In Windows, this can be found in the "Control Panel" or "Settings," while on macOS, you open the "Applications" folder. After selecting the software, you wish to remove, you initiate the uninstallation process by clicking on an "Uninstall" or "Remove" button. If a wizard appears, you follow its prompts to confirm the uninstallation and make any additional choices. Once the uninstaller completes its task of removing the software and associated files, you receive confirmation, and the process concludes.

Remember, the specific steps may vary depending on the software and operating system. Always consult the software's documentation or support resources for precise instructions.

11.1.1 Installing Python

1. Choose the appropriate installer: Python is available for various operating systems, including Windows, macOS, and Linux. Select the installer that corresponds to your operating system. For Windows, you'll typically choose between a 32-bit or 64-bit installer, based on your system architecture.

2. Download the installer: Click on the download link for the installer file that matches your operating system.

3. Run the installer: Locate the downloaded installer file and double-click on it to run the installer. You may need administrator privileges to install Python on some systems.

4. Customize the installation (optional): The installer may provide options to customize the installation. However, you can choose to modify the installation location or add Python to the system's PATH variable, which allows you to run Python from any directory in the command prompt or terminal.

5. Begin the installation: Start the installation process by clicking on the "Install" or "Next" button. The installer will extract files and set up Python on your computer. This process may take a few minutes.

6. Complete the installation: Once the installation is finished, you'll see a message indicating the successful installation of Python. The installer may provide an option to launch IDLE (Python's integrated development environment) or provide additional information. You can close the installer at this point.

7. Verify the installation: To confirm that Python is installed correctly, open a command prompt (Windows) or terminal (macOS/Linux) and type python --version or python3 --version. You should see the version number of Python displayed.

11.1.2 Installing Unity

1. Visit the Unity website: Go to the official Unity website at https://unity.com/ and navigate to the "Downloads" section.

2. Choose the appropriate version: Unity offers different versions, including the Personal Edition (free) and various subscription-based plans. Select the version that suits your needs. Ensure that you are downloading the version compatible with your operating system.

3. Download the Unity Hub: Unity Hub is a management tool that helps you download and manage different versions of Unity and your projects. Download the Unity Hub installer from the Unity website.

4. Run the Unity Hub installer: Locate the downloaded Unity Hub installer file and double-click on it to run the installer. Follow the on-screen instructions to install Unity Hub on your computer.

5. Launch Unity Hub: After the installation, launch Unity Hub. It will prompt you to sign in with your Unity account or create a new one.

6. Go to the "Installs" section: In Unity Hub, navigate to the "Installs" section. Here, you can choose the Unity version you want to install.

7. Select Unity version: Click on the "Add" button to choose the Unity version you want to install. Unity Hub will display a list of available versions. Select the desired version and click "Next."

8. Choose components: Unity Hub allows you to select additional components and features to install along with Unity. Make your selections based on your requirements and click "Next."

9. Specify installation location: Set the installation location for Unity. You can choose the default location or specify a custom directory.

10. Begin installation: Click "Done" to start the installation process. Unity Hub will download and install the selected version of Unity and any additional components you chose.

11. Launch Unity: Once the installation is complete, you can launch Unity from the Unity Hub by selecting the installed version and clicking "Open."

Unity is now installed on your computer, and you can start creating and developing games and applications using the Unity development environment.

Note: The exact steps and options may vary slightly depending on the version of Unity and your operating system. Always refer to the Unity documentation or support resources for specific instructions if available.

11.1.3 Installing Inkscape

1. Visit the Inkscape website: Go to the official Inkscape website at https://inkscape.org/.

2. Navigate to the Downloads section: Look for the "Download" or "Get Inkscape" button on the website. Click on it to proceed to the downloads section.

3. Choose the appropriate version: Inkscape offers versions for various operating systems, including Windows, macOS, and Linux. Select the version that matches your operating system. Ensure that you download the correct version for your system architecture (32-bit or 64-bit).

4. Download the installer: Click on the download link for the version you selected. The website may automatically detect your operating system and suggest the appropriate download.

5. Run the installer: Locate the downloaded installer file and double-click on it to run the installer. You may need administrator privileges to install Inkscape on some systems.

6. Customize the installation (optional): The installer may provide options to customize the installation. You can choose the installation location, create desktop shortcuts, and associate Inkscape with specific file types. You can either accept the default settings or modify them according to your preferences.

7. Begin the installation: Start the installation process by clicking on the "Install" or "Next" button. The installer will extract files and set up Inkscape on your computer. This process may take a few moments.

8. Complete the installation: Once the installation is finished, you'll see a message indicating the successful installation of Inkscape. The installer may provide an option to launch Inkscape immediately. You can close the installer at this point.

9. Launch Inkscape: To start using Inkscape, locate its icon in the Start menu (Windows), Applications folder (macOS), or application launcher (Linux). Alternatively, you can double-click on a desktop shortcut if you created one during the installation.

Inkscape is now installed on your computer, and you can begin creating vector graphics and editing images using its powerful features.

Note: The exact steps may vary slightly depending on the version of Inkscape and your operating system. Always refer to the Inkscape documentation or support resources for specific instructions if available.

11.1.4 Installing Blender

1. Visit the Blender website: Go to the official Blender website at https://www.blender.org/.

2. Navigate to the Downloads section: Look for the "Download" or "Get Blender" button on the website. Click on it to proceed to the downloads section.

3. Choose the appropriate version: Blender offers versions for various operating systems, including Windows, macOS, and Linux. Select the version that matches your operating system. Ensure that you download the correct version for your system architecture (32-bit or 64-bit).

4. Download the installer: Click on the download link for the version you selected. The website may automatically detect your operating system and suggest the appropriate download.

5. Run the installer: Locate the downloaded installer file and double-click on it to run the installer. You may need administrator privileges to install Blender on some systems.

6. Customize the installation (optional): The installer may provide options to customize the installation. You can choose the installation location, create desktop shortcuts, and associate Blender with specific file types. You can either accept the default settings or modify them according to your preferences.

7. Begin the installation: Start the installation process by clicking on the "Install" or "Next" button. The installer will extract files and set up Blender on your computer. This process may take a few moments.

8. Complete the installation: Once the installation is finished, you'll see a message indicating the successful installation of Blender. The installer may provide an option to launch Blender immediately. You can close the installer at this point.

9. Launch Blender: To start using Blender, locate its icon in the Start menu (Windows), Applications folder (macOS), or application launcher (Linux). Alternatively, you can double-click on a desktop shortcut if you created one during the installation.

Blender is now installed on your computer, and you can begin using its powerful 3D modeling, animation, and rendering capabilities.

Note: The exact steps may vary slightly depending on the version of Blender and your operating system. Always refer to the Blender documentation or support resources for specific instructions if available.

11.1.5 Installing Google Cardboard SDK

1. Visit the Google VR SDK GitHub repository: Go to the official Google VR SDK GitHub repository at https://github.com/googlevr/gvr-android-sdk.

2. Clone or download the repository: Click on the "Code" button and select the option to either clone the repository using Git or download it as a ZIP file to your computer.

3. Extract the downloaded ZIP file (if applicable): If you chose to download the repository as a ZIP file, extract its contents to a location on your computer.

4. Set up Android development environment: Ensure that you have a working Android development environment set up on your computer. This includes having Java Development Kit (JDK) and Android Studio installed.

5. Import the Google VR SDK into Android Studio: Open Android Studio and select "Open an existing Android Studio project." Navigate to the location where you cloned or extracted the Google VR SDK repository and select the gvr-android-sdk folder. Android Studio will import the project.

6. Configure the project: Android Studio may prompt you to install any missing dependencies or update the Android Gradle plugin version. Follow the prompts to make the necessary installations or updates.

7. Build the project: After the project is imported and dependencies are resolved, you can build the Google VR SDK by selecting "Build" from the Android Studio toolbar and then clicking on "Make Project."

8. Install the SDK on a device: Connect your Android device to your computer using a USB cable and ensure that USB debugging is enabled on the device. In Android Studio, select your device from the device dropdown menu and click on the "Run" button to install the SDK on the connected device.

11.2 UN-INSTALLATION

1. Open the software settings or control panel: Different operating systems provide various ways to access installed software. On Windows, you can go to "Control Panel" or "Settings" and look for an "Apps" or "Programs and Features" section. On macOS, open the "Applications" folder from the Finder and locate the software in question. On Linux, you can use the package manager or locate the software's specific uninstallation script.

2. Select the software to uninstall: In the list of installed software, find the entry for the software you want to uninstall. Click on it to select it.

3. Initiate uninstallation: Look for an "Uninstall" or "Remove" button or option associated with the selected software. Click on it to start the uninstallation process.

4. Follow the uninstallation wizard: If an uninstallation wizard appears, it may ask for confirmation or provide additional options. Read any prompts carefully and proceed as instructed.

5. Wait for uninstallation: The uninstaller will remove the software and associated files from your computer. This process may take a few moments or longer, depending on the size and complexity of the software.

6. Complete the uninstallation: Once the uninstallation is complete, you'll usually see a confirmation message. Close the uninstaller or exit the control pane.

Note: The exact steps may vary slightly depending on the software and operating system you're using. Some software may have their own dedicated uninstallation tools or instructions, so it's always a good idea to refer to the software's documentation or support resources for specific uninstallation instructions if available.

11.3 USER HELP

1. Gather X-ray images: Collect a series of X-ray images that capture the desired object or body part from different angles. Ensure that the X-ray images are of high quality and provide sufficient details.

2. Convert X-ray images to DICOM format (if necessary): X-ray images are typically stored in DICOM (Digital Imaging and Communications in Medicine) format. If your X-ray images are not already in DICOM format, you may need to convert them using specialized software or tools.

3. Import X-ray images into 3D modeling software: Use 3D modeling software capable of working with medical images, such as Mimics, 3D Slicer, or OsiriX, to import the DICOM files. These software tools provide advanced features for medical image processing and 3D modeling.

4. Image segmentation: Use the 3D modeling software to perform image segmentation, which involves separating the target object (e.g., bones, organs) from the surrounding tissues or background in each X-ray image. This step helps isolate the structures of interest for further processing.

5. Generate a 3D model: Once the image segmentation is complete, the 3D modeling software can reconstruct a 3D model from the segmented X-ray images. The software will align and combine the segmented images to create a cohesive 3D representation of the object or body part.

6. Clean and refine the 3D model: Depending on the quality of the segmentation and the desired level of detail, you may need to manually clean and refine the 3D model. This involves removing any artifacts or errors and enhancing the details to achieve a more accurate representation.

7. Export the 3D model: Save or export the final 3D model in a suitable file format, such as OBJ or STL. These formats are commonly used for 3D printing and virtual reality applications.

8. Import the 3D model into a VR development environment: To view the 3D model in virtual reality, import the model file into a VR development environment such as Unity or Unreal Engine. These platforms provide tools and capabilities to build VR applications and experiences.

9. Set up the VR environment: Within the VR development environment, create a virtual environment where the 3D model can be visualized. This may involve creating a virtual room or space, setting up lighting and materials, and configuring user interaction controls.

10. Test and optimize the VR experience: Once the VR environment is set up, test the VR experience with the 3D model. Make any necessary adjustments to optimize the performance, visuals, and user interaction. Iterate on the design until you achieve the desired results.

11. Deploy the VR application: Once the VR experience is finalized, you can package and deploy the VR application to the desired VR device.

Note: Remember to consult the documentation and resources specific to the 3D modeling software, VR development environment, and VR platform you are using for more detailed instructions and guidance throughout the process.

CHAPTER 12

CONCLUSION AND FUTURE SCOPE

12.1 CONCLUSION

The proposed system aims to address the problem of inaccurate bone implantation by using a canny edge detection technique to sketch the edges of the knee bone in an X-ray image and then converting it into a 3D model that can be viewed in a VR headset. This model provides accurate measurements and detailed visualization of bones with a high level of accuracy. The use of virtual reality-based visualization using X-ray images can be more effective than CT-Scan in improving radiologists' accuracy and efficiency in diagnosing certain medical conditions.

However, it is important to note that the choice of imaging modality depends on the specific diagnostic scenario, and each imaging technique has its advantages and limitations. Overall, the proposed system can be a promising approach to improve the accuracy and precision of bone implantation procedures, potentially leading to better health outcomes for patients.

12.2 FUTURE SCOPE

In future we can develop surgical navigation system which will intraoperatively space by 3D models of the target vertebrae using skin markers and real-time tracking information. Which will help to accurately identify bone of the human Body and we can visualize the different types of bones for medical implant.

ANNEXURE A

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ANNEXURE B

PROJECT PLANNER

PROJECT PLANNER

Table B.1: Selection of Weeks

Schedule		Project Activity
August	1st Week	Discussion on Topic Selection
	2nd Week	Finalized the Project Topic
	3nd Week	Literature Survey of Research Papers
	4st Week	Studied and Analyzed Base paper
September	1st Week	Motivation, Project scope & Objective
	2nd Week	Project review - I
	3rd Week	Analyzed Problem in existing system
	4st Week	Project review - II
October	1st Week	System Architecture & UML Diagram
	2rd Week	Project review - II
November	1st Week	Report Preparation And Submission
	2nd Week	Submission
January	1st Week	Planning of Implementation.
	2nd Week	Study of algorithm.
	3rd Week	Discussion & changes to improve system.
February	1st Week	Project review
	2nd Week	Installation of APK
	3rd Week	Create Virtual room in SDK
March	1st Week	Worked on user interface.
	3rd Week	Project review
April	1st Week	Designed test cases for our module.
	2nd Week	Deployed our Obj file into VR
	3rd Week	Research Paper Implementation
May	1st Week	Report Preparation
	2nd Week	Final Report and presentation.

ANNEXURE C

REVIEWERS COMMENTS OF PAPER SUBMITTED

SURVEY PAPER:

1. **Paper Title:**

   Survey On 3d Modeling of X-Ray Images Using Virtual Reality.

2. **Name of the Conference/Journal where paper submitted:**

   International Journal of Creative Research Thoughts (IJCRT)

3. **Paper accepted/rejected:**

   Accepted

4. **Review comments by reviewer:**

   NA

5. **Corrective actions if any:**

   NA

RESEARCH PAPER:

1. **Paper Title:**

   3D Modeling of X-Ray Images Using Virtual Reality.

2. **Name of the Conference/Journal where paper submitted:**

   International Conference on Recent Trends Engineering & Technology (ICRTET)

3. **Paper accepted/rejected:**

   Accepted

4. **Review comments by reviewer:**

   NA

5. **Corrective actions if any:**

   NA

RESEARCH PAPER:

1. **Paper Title:**

   3D Modeling of X-Ray Images Using Virtual Reality.

2. **Name of the Conference/Journal where paper submitted:**

   International Conference on Recent Advances in Technology, Science and Management (ICRATESM)

3. **Paper accepted/rejected:**

   Accepted

4. **Review comments by reviewer:**

   NA

5. **Corrective actions if any:**

   NA

IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Ref No : IJCRT/Vol 11/ Issue 1 / 487

To,
Kevin Sheth

Subject: Publication of paper at International Journal of Creative Research Thoughts.

Dear Author,

With Greetings we are informing you that your paper has been successfully published in the International Journal of Creative Research Thoughts - IJCRT (ISSN: 2320-2882). Thank you very much for your patience and cooperation during the submission of paper to final publication Process. It gives me immense pleasure to send the certificate of publication in our Journal. Following are the details regarding the published paper.

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Registration ID	:	IJCRT_230328
Paper ID	:	IJCRT2301487
Title of Paper	:	SURVEY ON 3D MODELING OF X-RAY IMAGES USING VIRTUAL REALITY
Impact Factor	:	7.97 (Calculate by Google Scholar) | License by Creative Common 3.0
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01st March 2023

Letter Of Acceptance

Abstract Id: ICRATESM_081526

Abstract Title: 3D Modeling of X-Ray Images using Virtual Reality

Author : Kevin Jayesh Sheth

Co-Authors: Ms Sonal Sachin Fantagare Yash Arvind Paliwal Ajay Mahesh Gaur Kadambari Jalindar Kate

Dear Kevin Jayesh Sheth,

Congratulations!!

The scientific research paper reviewing committee of **International conference on Recent Advances in Technology, Engineering, Science and Management (ICRATESM 2023), Hybrid Conference**" scheduled to take place on the **16th &17th March 2023** organized by **Dilkap Research Institute of Engineering and Management Studies, Mumbai & Institute For Engineering Research and Publication (IFERP)** at **Mumbai** is pleased to inform your research paper titled **"3D Modeling of X-Ray Images using Virtual Reality"** has been accepted after our double-blind peer review process for presenting paper at ICRATESM 2023. Authors and speakers are recommended to proceed for registration to confirm their slots in relevant scientific sessions by following the link: https://www.iferp.in/icratesm/registration.php

Acceptance Status: Yes

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ANNEXURE D

PUBLISHED SURVEY AND RESEARCH PAPER

IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)
An International Open Access, Peer-reviewed, Refereed Journal

SURVEY ON 3D MODELING OF X-RAY IMAGES USING VIRTUAL REALITY

Kevin Sheth[1], Ajay Gaur[2], Yash Paliwal[3], Kadambari Kate[4], Mrs. Sonal Fatangare[5]
Department of Computer Engineering,
Savitribai Phule Pune University, Pune, Maharashtra, India

Abstract: Virtual reality (VR) is computer-generated stereo visuals that replace the actual world surroundings of a consumer around them. Virtual reality may be supplied to consumers through headsets like HTC Vive, Oculus Rift, and Microsoft's HoloLens or through the camera of a mobile phone. Virtual reality can replace or lessen the consumer's belief in truth in practical and experimental implementations. Virtual reality has been adopted in various industries such as retail, healthcare, science education, and real estate. The motivation behind this project is to enhance the visualize the x-ray in a better way using the technology of virtual reality. The outcome of the project is to input an x-ray image into the system. The system will convert the 2D image to 3D and then the 3D model will be shown in a VR headset. So, the image can be easily visualized in 360 degrees and can get clear visualization from the image. There are many models that measure the bone size for replacement but some are less accurate. Still, our model gives proper measurement and can visualize the x-ray in a VR headset to get more information so this founds an innovation in our proposed model.

Keywords: Canny Edge detection, Image Processing & Digital Image, Digital, X-Ray, VR, Knee Arthroplasty, Google Cardboard.

I. Introduction

Image processing is a method to perform some operations on an image to get useful information from it. Currently, the use of digital images for diagnosis of diseases in healthcare is very common. X-ray datasets are used for analysis in order to provide a clear diagnosis. The main idea here is to build a system using canny edge detection algorithm that can sketch the edges of knee bone present in a X-Ray image and identify the exact size of the bone for bone replacement by using virtual reality technique. In this system a 3D model of the bone which is to be replaced in place of original bone is to be built.

1.1 Motivation:

The motivation behind this project is to enhance and visualize the x-ray in better way using the technology of AR/VR. We found knee bone replacement problem is very serious in real life. My father had injury of knee and it was very critical that, doctor told us about replacement of the knee bone with the artificial bone was necessary but there is one problem that occur after the replacement of bone is that it is difficult to match the artificial bone size with original bone size as replaced bone is not always accurate in size. So, we were motivated to solve this problem and by implementing VR in our system we will build accurate 3D model of the replacing bone.

1.2 Goals And Objectives:

– To study and identify current VR application and Image processing.
– Creation of adaptive virtual 3D environments.
– To get a 3D model build using the unity tool.
– To create 3D image by use of Caney Edge image processing algorithm with improved accuracy.

1.3 Mathematical Calculations:

1.3.1 Noise Reduction-

Edge detection results are very sensitive to image noise, as background computations are primarily based on derivatives. One way to denoise an image is to smooth it with Gaussian Blur. The formula for a Gaussian filter kernel of size (2k+1)×(2k+1) is:

$$H_{ij} = \frac{1}{2\pi\sigma^2} \exp\left(-\frac{(i-(k+1))^2+(j-(k+1))^2}{2\sigma^2}\right); 1 \le i,j \le (2k+1) \qquad (1)$$

1.3.2 Gradient Calculation-

The Compute Gradients step finds the strength and direction of edges by computing the gradients of the image using the edge detection operator. The gradient magnitude G and gradient θ are calculated as follows:

$$|G|=\sqrt{I_x^2 + I_y^2}, \quad (2)$$

$$\emptyset(x,y) = arctan\left(\frac{I_y}{I_x}\right) \quad (3)$$

II. LITERATURE SURVEY

Table 1 Literature Survey

SR. NO.	PAPER TITLE PUBLICATION DETAILS	PRE-PROCESSING	FEATURE EXTRACTION AND CLASSIFICATION	ACCURACY	POST PRE-PROCESSING	RESEARCH GAP IDENTIFIED
1	Image Segmentation Using Various Edge DetectionTechniques	Techniques used in the past required extensive computation and are time consuming.	Different techniques used for segmentation of satellite images are: 1. Sobel operator technique 2. Prewitt technique 3. Kiresh technique 4. Laplacian technique 5. Canny technique, 6. Roberts technique 7. Edge maximization technique (emt).	90%	By comparative study it is proved that Kiresh, emt and perwitt techniques respectively are the best techniques for edge detection of satellite image.	Comparative study can be explained & experiments can be carried out for different techniques on different type of images.
2	Edge Detection Techniques for Image Segmentation A Survey of Soft Computing Approaches	An analysis of recent soft computing approaches to edge detection for segmentation.	An overview of edge detection theory for image segmentation using soft computing approaches based on fuzzy logic, genetic algorithms, and neural networks.	86%	A soft-computing approach demonstrates the efficiency of image segmentation.	A combination of techniques can be further used to increase forecast accuracy and efficiency.
3	Implementation of canny's edge detection technique for real world images.	Previously used systems or algorithms had poor accuracy.	Implemented and evaluated different edge detection techniques like: 1. Image capturing 2. Application of gaussian filter. 3. Computing the gradients and directions using sobel operator. 4. Non-maximum suppression. 5. Hysteresis thresholding 6. Robert's cross operator. 7. Prewitt's operator.	92%	The Canny edge detector gives better results compared to others in some positive respects. It is less susceptible to noise, more adaptable, solves the streaking problem, provides better localization, and detects sharper edges compared to others.	This algorithm has been improved and may be improved further in the future. The improved Canny algorithm can detect edges in color images without converting to gray images, and is an improved Canny algorithm for automatic extraction of moving objects in image guides.
4	Edge detection techniques for Image segmentation.	Very large amount of edge detection techniques were available, each technique designed to be perceptive to	The relative performance of various edge detection techniques is carried out with an image by using MATLAB software.	87%	Marr-Hildreth, Log, and Canny Edge detectors produce nearly identical edge maps.	Detecting noise-free and accurate images from original images is a difficult task for the

		certain types of edges.				research community.
5	Edge detection using simple image arithmetic.	Existing methods of edge detection were complex.	The efficiency of the edge detection algorithm using image arithmetic in qualitative and quantitative terms is demonstrated.	90%	Proposed method makes the text in pictures more clear as seen in the image of detected edges, and therefore makes it easier to segment or extract.	This can prove to be a valuable resource in real world applications such as handwriting recognition and text extraction.
6	Edge Detection Based on Improved Sobel Operator.	Conventional Sobel edges are rough and imperfectly detected.	Comparing the sobel operator with several other edge detection operators used frequently and making a further study on the classical sobel operator.	87%	According to comparisons among all kinds of first order operators, the traditional sobel operator make a better improvement.	Its research findings that application system of intelligent decision-making technology in agriculture and animal husbandry.
7	Medical image Edge detection using Gauss Gradient operator.	Superiority of conventional edge detectors like sobel, perwitt, roberts, canny and log algorithm was less	the experiments was carried out on both the berkeley segmentation dataset (bsd) and real medical images, to determine the performance of the gauss gradient edge detector.	90%	Computation time of the gauss gradient approach was slightly higher than the log, canny and prewitt approaches, and in terms of the quality of edge tracing the gauss gradient outperforms the other conventional techniques.	The Gaussian gradient operator can be a powerful tool for telemedicine applications.
8	A novel edge detection method based on efficient Gaussian binomial filter.	Recent image edge detection methods are based on exploiting spatial high-frequency are strictly sensitive to noise, and their performance decrease with the increasing noise level.	A novel approach to image edge detection using dual 2D Gaussian binomial filters.	89%	Proposed approach improved a significant advantage of gaussian binomial filter in terms of speed and efficiency in comparison than other known methods.	A real-time edge detection implementation based fpga (field-programmable gate array) or gpu (graphics processing unit) is an issue that deserves further investigation.
9	An improved prewitt algorithm for edge detection based on noised image.	The traditional Prewitt edge detection algorithm is sensitive to noise.	A Prewitt algorithm [2] for edge detection based on Otsu threshold is proposed in research, where the edge image is denoised by an 8-neighbour window.	88%	The upgraded algorithm greatly improves anti-noise performance and effectively detects edges in randomly noisy images.	Next work is to find a more efficient automatic threshold and a more effective denoising methodto detect edges better.
10	Study and Comparison of Different Edge Detectors for Image	Edge detection has been a key problem in	To compare different edge detection operators and analyze their performance	95%	Canny Edge Detector produces higher object edge	We can carry out more experiments to check

	Segmentation.	image segmentation.	using MATLAB software.		detection accuracy with higher entropy, Psnr, Mse and running time compared to Sobel, Roberts, Prewitt, Zero Crossing and Log.	performance and accuracy.

III. ALGORITHMIC SURVEY

Table 2 Algorithmic Survey

Sr. No.	Paper Title	Author & Year	Algorithm Used	Image Modalities	BONETYPE	Performance Metrics	Advantage and Disadvantages
1	Analysis on Leg Bone Fracture Detection and Classification Using X-ray Images	Myint, et al 2018	Harris corner detection, Decision Tree, KNN	X-Ray Images	Leg Bone	82% accuracy	Fracture location is pointed out by Harris corner points. Decision Tree is used to classify image as fractured or non-fractured. KNN is suitable for pattern recognition and supports to classify transverse, Oblique, and Comminuted fracture types.
2	Automatic detection of fracture in femur bones using image processing	Tripathi, Ankur Mani, et al 2017	Canny edge detection, Support Vector Machine.	X-Ray Images	Thigh bone.	84.7% accuracy	Canny edge detects the bone edge accurately and Sobel operator detects the clear fractured edge. SVM is used to classify image as fractured or non-fractured.
3	Bone Fracture Detection Using Edge Detection Technique	Johari, et al. 2018	Canny Edge Detection	X-Ray Images	Human Bone	87.3% accuracy	Sobel operator with the parameter sigma 4.75 is used to enhance the efficiency of the system and it diagnoses the hairline fracture more effectively.
4	Detecting leg bone fracture in x-ray images	Myint, et al. 2016	Canny Edge Detection	X-Ray Images	Leg Bone	-	Much higher accuracy can be achieved by gaining a better dataset with high resolution images.
5	Bone Fracture Detection Using OpenCV	Kurniawan, et al. 2014	Canny Edge detection using OpenCV	X-Ray Images	Bone	66.7% accuracy	Performance and accuration of the detection system affected by the quality of the image. The better the image quality, better the results.
6	Detection of Bone Fracture using Image Processing Methods	Anu, T. C, et al. 2015	Sobel Edge Detector using GLCM features.	X-Ray/CT images	Leg Bone	85% accuracy	Gray Level Co-occurrence Matrix (GLCM) method is used to extract textural features such

							as entropy, contrast, correlation, homogeneity. Results are evaluated based on GLCM features.
7	Fracture Detection in X-Ray Images through Stacked Random Forests Feature Fusion	Cao, Yu, et al 2015	Random forests for feature fusion	X-Ray Images	Human Bone	81.2% accuracy	This system can be used for various types of fractures over different anatomical regions. SVM and single layer random forests increase the effectiveness. Accuracy could be further improved by incorporating more types of local features.
8	Multiple classification system for fracture detection in human bone xray images	Umadevi, N, et al 2012	Support Vector Machine, Back Propagation Neural Network , KNN	X-Ray Images	human bone	SVM Accuracy – 91.89 BPNN Accuracy— 90.46 KNN Accuracy— 89.76	Experimental results showed that the ensemble model that combines BPNN + SVM + KNN with both texture and shape features significant improvement in terms of accuracy and precision.
9	Bone Fracture Detection and Classification using Deep Learning Approach	D.P. Yadav et al. 2020	Deep Neural Network	X-Ray Images	Human Bone	92.44% Accuracy	In the approach long bone, short bones and flat bones fracture detection has been proposed using deep learning approach. The classification accuracy of the model is 92.44%, Large dataset not used.
10	X-Ray Bone Fracture Classification Using Deep Learning: A Baseline for Designing a Reliable Approach	Leonardo Tanzi et al. 2020	Deep Learning	X-Ray Images	Human Bone	accuracy 94%	achieved results comparable to those of humans in bone fracture classification, number of wrong diagnoses

IV. PROPOSED METHODOLOGY

Below figure is the system architecture of the proposed system.

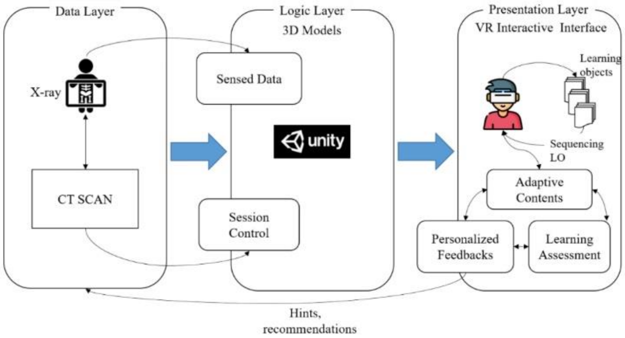

Fig 1: system architecture.

4.1 The proposed system consists of the layers i.e Data layer, Logic Layer, Presentation Layer.

i. Data Layer:

First layer is the Data layer it is the starting phase of the system. In data layer the Knee bone X-Ray image input is given to the system.

ii. Logic Layer:

In this layer the system will find the edges and measurement of the bone using Canny Edge Detection Algorithm. The output of the algorithm is in the form of image that image will be convert into 3D Model.

iii. Presentation Layer:

In Presentation layer the 3D Model is shown in Google Cardboard VR.
By using this system you can get the measurement for bone implant and visualize the bone in more precisely.

4.2 The functional requirement of the system are as follows:

1. Python:

Python is a high-level, general-purpose programming language. His design philosophy uses clear indentation to emphasize code readability. Python is dynamically typed and garbage collected. It supports multiple programming paradigms, including structured programming, object-oriented programming, and functional programming.

2. Unity: -

Unity is a cross-platform game engine developed by Unity Technologies and first announced and released as a Mac OS X game engine at the Apple Worldwide Developers Conference in June 2005. The engine has since been gradually expanded to support various desktop, mobile, console and virtual reality platforms.

3. Google Cardboard SDK: -

The open-source Cardboard SDK lets you create immersive, cross-platform VR experiences for Android and iOS.
Create entirely new VR experiences or enhance existing apps that support VR with essential VR features such as motion tracking, stereoscopic rendering, and user interaction.

4. Google Cardboard Goggle: -

Get it, fold it, take a look inside, and immerse yourself in the world of Cardboard. It's a VR experience that starts with a simple viewer that anyone can create or buy. Once you have it, you can explore the multitude of apps that surround you. And with so many viewers available, you're sure to find one that's right for you.

V. 3D CONVERSION TOOL SURVEY

1. Inkscape:

Inkscape is a free and open source vector graphics editor primarily for creating vector graphics in scalable vector graphics format. Other formats can be imported and exported. Inkscape can render primitive vector shapes and text

2. Blender:

Blender is a free and open source 3D computer graphics software toolset used to create animated films, visual effects, art, 3D printed models, motion graphics, 3D interactive applications, virtual reality and early video games.

3. SelfCAD:

SelfCAD is an online computer-aided design software for 3D modeling and 3D printing released in 2016. It's browser and cloud based. SelfCAD is a mesh-based design program.

4. FreeCAD:

FreeCAD is a general-purpose 3D parametric computer-aided design modeler and software application for modeling building information that supports the finite element method.

5. Smoothie-3D :

Smoothie-3D was one of the first widely used image conversion tools. We recently switched from 100% free to a donation model. You can upload an image and draw an outline around it using the tools provided. The program will then generate a 3D rendering based on the outline image. This can be exported as a Slicer compatible file type such as OBJ or STL. Symmetrical images are recommended, as asymmetrical images can lose detail when tracing.

6. Image to Lithophane:

Image to Lithophane is one of the easiest programs to use with lists. Simply upload your photo, select the shape you want (dome, semi-dome, heart, etc.) and download all new lithophanes for FREE! There are also customization options hidden at the top of the screen.

VI. EXPECTED RESULT

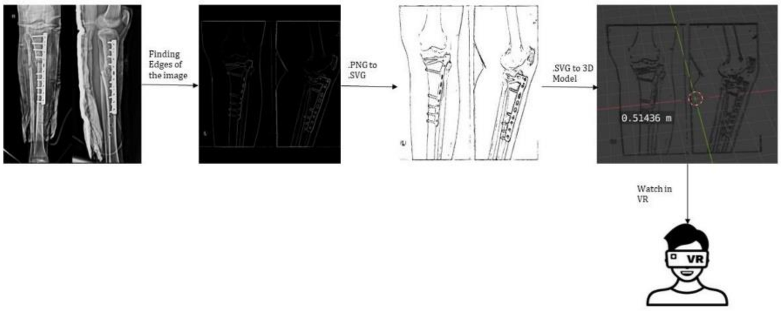

Fig 2: expected result.

VII. CONCLUSION

The digital images of X-Ray for the diagnosis of diseases in healthcare is very common. Digital X-Ray images are used for diagnosing and measuring bone size. But problems occur after the replacement of bone that does match accurately with the original bone size it was very difficult to live with replaced bone that was not accurate in size. Oversizing can result in causing anterior knee pain that can lead to problems such as instability. These techniques are costly and time-consuming. The proposed system has accurately measured the bone size of an X-Ray image that visualizes in VR application. The X-Ray digital data will be given to an application that will find the actual edge of the bone from an X-Ray image. Then the processed image will be converted into a 3D image and the measurement of accurate bone size is visualized in Google Cardboard VR.

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3D Modeling of X-Ray Images using Virtual Reality

1st Kevin Sheth
Department of Computer Engineering,
RMD Sinhgad School of Engineering,Warje
Pune, India
Email: kevinsheth1529@gmail.com

2nd Yash Paliwal
Department of Computer Engineering,
RMD Sinhgad School of Engineering,Warje
Pune, India
Email: yashplw@gmail.com

3rd Ajay Gaur
Department of Computer Engineering,
RMD Sinhgad School of Engineering,Warje
Pune, India
Email: ajay94932@gmail.com

4th Kadambari Kate
Department of Computer Engineering,
RMD Sinhgad School of Engineering,Warje
Pune, India
Email: kadambari087@gmail.com

5th Mrs. Sonal Fatangare
Department of Computer Engineering,
RMD Sinhgad School of Engineering,Warje
Pune, India
Email: sonalfatangare.rmdssoe@sinhgad.edu

***Abstract*— Nowadays, advanced medical imaging is a widely accepted scientific discipline in the healthcare industry due to technological advances and software breakthroughs. Traditionally using digital images of X-Ray for diagnosing diseases in healthcare is very common. Many researchers have proposed different methods like X-Ray, CT-scan, and MRI for bone implantation. But the problem is while implantation it does not get the actual size as original, so it causes a bad impact on the health and the person suffers from pain. Therefore, to solve this problem, the proposed system uses a canny edge detection that can sketch the edges of knee bone present in an x-ray image with the size of the bone for implantation by using a virtual reality technique. The system will convert the 2D image to 3D and then the 3D model will be shown in a VR headset. So, we can get a clear visualization of the image. This model provides accurate measurements and detailed visualization of bones in virtual reality with 95.58% accuracy. Virtual reality-based visualization using X-ray images is more effective than CT-Scan in improving radiologists' accuracy and efficiency in diagnosing certain medical conditions, leading to a preference for X-ray images in certain diagnostic scenarios.

Keywords— Canny Edge detection, Image Processing, Digital Image, Digital, X-Ray, VR, Knee Arthroplasty, Google Cardboard.

I. INTRODUCTION

Medical imaging technology dates back to the 18th and 19th centuries, when Becquerel found radiation and x-rays, respectively. Both findings significantly enhanced medical practice. The practical implementation of ultrasound in medicine was made feasible by advances in the use of sound waves in the mid-twentieth century, and then came computers, which changed the game completely. Sonography, nuclear medicine technology, and radiography were used as diagnostic medical imaging methods or instruments prior to the widespread use of computer technology in health care. Bone serves as the human body's skeleton, allowing body parts to move and protecting organs. One of the largest and most complex bones in the body is the knee bone. Real life knee bone replacement problem is very serious. Replacing the knee bone or joint with a made artificial joint, known as prosthesis, requires a surgery. Damaged cartilage and bone are taken out of the knee joint during this procedure. The knee is then implanted with man-made bone.

The preferred method for evaluation and therapy planning in orthopedics continues to be traditional X-ray images, despite the growing accessibility of 3D image acquisition techniques like computed tomography (CT). However, X-rays only show a 2D projection of the anatomy of interest, making it difficult for a human viewer to evaluate its 3D characteristics like the anatomical form. (eg. the surgeon). The goal of this project is to create computer-assisted methods for creating 3D models from a single or a small number of X-rays that describe an anatomy's patient-specific form and bone density distribution. The final aim of these patient-specific models is to provide critical 3D information purely based on 2D X-rays, enabling exact joint replacement planning, follow-up, and biomechanical analysis.

The term "CT scan" is frequently used to refer to computed tomography. A CT scan is a diagnostic imaging process that creates pictures of the inside of the body using a mix of X-rays and computer technology. Any portion of the body, including the bones, muscles, fat, organs, and blood systems, is shown in depth. Compared to traditional X-rays, CT images are more comprehensive. A beam of energy is directed at the bodily portion being examined in conventional X-rays. After the energy beam travels through the epidermis, bone, muscle, and other tissues, it varies and is captured by a plate behind the body component. While a normal X-ray can provide a lot of information, internal organs and other tissues cannot be seen in great depth.

Virtual reality, also known as VR, is a digital environment that was created decades ago but has only recently begun to take off. This is due to the fact that the technology has only recently become compact, potent, and widely accessible. Because of these factors, virtual reality is now beginning to be applied in the classroom. A new media tool called virtual reality (VR) offers the potential to make learning more engaging for pupils. But more significantly, it can also be a choice to give all pupils more chances and experiences. For example, learners with bodily disabilities or students attending institutions with limited resources can now take virtual excursions to locations they were previously unable to visit.

II. LITERATURE SURVEY

This section presents recent developments in related areas and an analysis of the work to identify the limits and scope of further work to improve the system.

The article begins by highlighting the importance of 3D modeling in medical imaging and the limitations of traditional 2D X-ray imaging. The author then presents a review of various techniques for 3D modeling of X-ray images, including volume rendering, surface rendering, and hybrid methods.The article also discusses the challenges faced by researchers in this field, such as the need for accurate segmentation of images and the need for efficient algorithms for 3D reconstruction.The author concludes the article by highlighting the potential of 3D modeling in medical imaging and the need for further research in this field [2].

The paper presents a comprehensive review of various methods for 3D reconstruction of 2D X-ray images. The authors begin by discussing the limitations of traditional 2D X-ray imaging and the importance of 3D reconstruction in medical imaging. The paper then presents a review of various techniques for 3D reconstruction of X-ray images, including the voxel-based approach, the surface-based approach, and the hybrid approach.The authors also discuss the challenges faced by researchers in this field, such as the need for accurate image segmentation and the need for efficient algorithms for 3D reconstruction. They further describe various applications of 3D reconstruction in medical imaging, such as diagnosis, surgical planning, and treatment monitoring.The paper concludes by highlighting the potential of 3D reconstruction in medical imaging and the need for further research in this field [3].

Given paper presents a novel approach to naturalistic 2D-to-3D conversion, which aims to generate high-quality 3D images from 2D images that resemble the natural 3D scenes as much as possible. The authors first introduce the concept of naturalistic 2D-to-3D conversion and discuss the challenges faced by existing methods, such as the lack of accurate depth information and the difficulty in modeling natural scene structures. The paper then presents a new approach based on a multi-stage framework that involves 2D image segmentation, depth estimation, and 3D scene reconstruction. The approach utilizes various cues, such as texture, shading, and perspective, to estimate the depth of the scene and generate a high-quality 3D image. The authors also evaluate their approach on a variety of test images and compare it with existing methods. The results demonstrate that the proposed approach achieves superior performance in terms of both subjective and objective measures [4].

The article presents a method for converting 2D medical image files in DICOM format into 3D models using image processing techniques and analyzing the results with Python programming. The article begins by highlighting the importance of 3D models in medical imaging and the challenges faced by medical professionals in analyzing 2D medical images. The authors then describe the steps involved in converting DICOM files into 3D models, which include image preprocessing, segmentation, and 3D reconstruction. The authors also discuss the use of Python programming in analyzing the results of 3D reconstruction, such as calculating volume, surface area, and other relevant measurements. They provide code examples in Python for carrying out these analyses. The article also describes the evaluation of their method on various medical images and compares the results with existing methods. The authors demonstrate that their method produces high-quality 3D models and accurate measurements, making it a useful tool for medical professionals. The article provides a good overview of the method, and the code examples in Python make it easy to implement. However, more information on the evaluation process, including the size of the dataset and the comparison with other methods, would have been useful [5].

The paper presents a new method for reconstructing a 3D femur model from biplane X-ray images. The authors propose a novel method based on Laplacian surface deformation for reconstructing a 3D femur model. The method involves first segmenting the femur from the biplane X-ray images using a thresholding technique. Then, the segmented contours are used to generate a 3D surface mesh of the femur using the Marching Cubes algorithm. The surface mesh is then deformed using a Laplacian surface deformation method, which ensures that the resulting 3D model is smooth and preserves the surface details of the original femur. The authors validate their method on a dataset of 10 femur specimens and compare their results with those obtained using other methods. The results demonstrate that the proposed method produces more accurate and detailed 3D femur models than the other methods. The authors have also provided a comprehensive evaluation of their method and compared it with other methods, which enhances the credibility of their approach. However, the authors could have provided more information on the limitations and potential future directions of their method [6].

The article presents a method for constructing a 3D model of knee joint motion based on MRI image registration. The authors describe the process of acquiring MRI images of the knee joint during motion and segmenting the images to obtain the 3D geometry of the bones and soft tissue. They then propose a registration method to align the segmented MRI images at different time points, which is crucial for constructing the 3D model of knee joint motion. The registration method is based on a hybrid approach that combines intensity-based and feature-based registration methods. The authors also introduce a motion analysis framework to quantify the motion of the knee joint based on the 3D model. The authors evaluate their method on a dataset of six subjects and demonstrate that the proposed method can accurately reconstruct the 3D model of knee joint motion and quantify the motion parameters, such as translation and rotation [7].

The paper proposes a method for 3D reconstruction of leg bones from X-ray images using CNN-based feature analysis. The paper was published in the journal Computers in Biology and Medicine in 2021. The authors propose a method that involves first segmenting the leg bones from the X-ray images using a U-Net based segmentation network. Then, the segmented bones are used to generate a 3D surface mesh of the bones using the Marching Cubes algorithm. The authors propose a novel feature analysis method based on a convolutional neural network (CNN) to improve the accuracy of the 3D reconstruction. The CNN is trained to learn the features that represent the structure and shape of the leg bones from a set of labeled X-ray images. The learned features are then used to refine the surface mesh generated from the segmented X-ray images, resulting in a more accurate 3D model of the leg bones. The authors evaluate their method on a dataset of 50 leg bones and compare their results with those obtained using other methods. The results demonstrate that the proposed method produces more accurate and detailed 3D models of the leg bones than the other methods [8].

The authors describe the process of 3D printing and its benefits in medical applications. They highlight the advantages of using 3D printed models in preoperative planning, surgical training, and medical education. The paper focuses on the conversion of 2D medical scan data, specifically computed tomography (CT) and magnetic resonance imaging (MRI) scans, into 3D printed models. The authors discuss the steps involved in the conversion process, which includes image acquisition, segmentation, conversion to a 3D model, and finally, 3D printing. They highlight the importance of accurate segmentation and discuss various software tools that can be used for this purpose. The authors also discuss the challenges associated with 3D printing, such as the need for high-resolution imaging and the limitations of current printing technologies. However, the paper could have provided more detailed information on the challenges associated with 3D printing, as well as potential solutions to these challenges. Additionally, the paper could have provided more information on the limitations of 3D printed models and the need for further research in this area [9].

The paper discusses the process of constructing a 3D model from 2D DICOM images, which are commonly used in medical imaging. The authors describe the challenges associated with this process, including image segmentation and the need for accurate alignment of the images. The authors propose a method for constructing a 3D model using a combination of image processing techniques and 3D reconstruction algorithms. They describe the steps involved in this process, which includes image pre-processing, segmentation, feature extraction, registration, and finally, 3D reconstruction. The authors evaluate the performance of their proposed method using a set of DICOM images and compare the results with those obtained using other methods. They demonstrate that their proposed method produces more accurate and detailed 3D models compared to other methods [10].

The paper describes a method for creating patient-specific 3D bone models from 2D radiographs for use in image-guided orthopedic surgery. The authors describe the challenges associated with this process, including the need for accurate alignment and registration of the 2D radiographs. The authors propose a method for constructing a 3D bone model using a combination of image processing techniques and 3D reconstruction algorithms. The steps involved in this process include image pre-processing, segmentation, feature extraction, registration, and finally, 3D reconstruction. The authors evaluate the performance of their proposed method using a set of radiographs and compare the results with those obtained using other methods. They demonstrate that their proposed method produces more accurate and detailed 3D bone models compared to other methods [11].

III. TERMINOLOGIES

A. Python: -

Python is a high-level, general-purpose programming language. His design philosophy uses clear indentation to emphasize code readability. Python is dynamically typed and garbage collected. It supports multiple programming paradigms, including structured programming, object oriented programming, and functional programming.

B. Unity: -

Unity is a cross-platform game engine developed by Unity Technologies and first announced and released as a Mac OS X game engine at the Apple Worldwide Developers Conference in June 2005. The engine has since been gradually expanded to support various desktop, mobile, console and virtual reality platforms.

C. Google Cardboard SDK: -

The open-source Cardboard SDK lets you create immersive, cross-platform VR experiences for Android and iOS. Create entirely new VR experiences or enhance existing apps that support VR with essential VR features such as motion tracking, stereoscopic rendering, and user interaction.

D. Google Cardboard Goggle: -

Get it, fold it, take a look inside, and immerse yourself in the world of Cardboard. It's a VR experience that starts with a simple viewer that anyone can create or buy. Once you have it, you can explore the multitude of apps that surround you. And with so many viewers available, you're sure to find one that's right for you.

E. Inkscape: -

Inkscape is a free and open source vector graphics editor primarily for creating vector graphics in scalable vector graphics format. Other formats can be imported and exported. Inkscape can render primitive vector shapes and text.

F. Blender: -

Blender is a free and open source 3D computer graphics software toolset used to create animated films, visual effects, art, 3D printed models, motion graphics, 3D interactive applications, virtual reality and early video games.

G. Gaussian Filter: -

Gaussian Filtering is commonly used in image processing. It is applied to images to reduce noise. We will create a 2D Gaussian Kernel in this article. The 2D Gaussian Kernel follows the Gaussian Distribution which is shown in formula . Where y is the vertical distance from the origin, x is the horizontal distance from the origin, and is the standard deviation.

H. Soble Operator: -

The Sobel operator, also known as the Sobel-Feldman operator or Sobel filter, is used in image processing and computer vision, particularly in edge detection algorithms to emphasise edges. It is a discrete differentiation operator that computes a gradient approximation of the image intensity function. The Sobel-Feldman operator produces either the corresponding gradient vector or the norm of this vector at each point in the image.

I. Digital X-Ray: -

Injuries to the musculoskeletal system, cancer, clogged arteries, stomach pain, sinusitis, spinal issues, and other abnormalities are just a few of the diseases and injuries that can be diagnosed with digital X-Rays.

J. Canny Edge Detection: -

With the use of the Canny edge detection technology, the amount of data that needs to be processed can be drastically reduced while still extracting meaningful structural information from various vision objects. It is frequently used in many computer vision systems. According to Canny, the prerequisites for applying edge detection to various vision systems are largely the same. Thus, a solution for edge detection that meets these needs can be used in a variety of contexts.

K. Arthroplasty: -

It is a surgical procedure to restore joint function. The joint can be restored by resurfacing the bones. An artificial joint (called a prosthesis) may also be used. Different types of arthritis can affect the joints. Osteoarthritis, or degenerative joint disease, is the loss of cartilage or cushion in a joint and is the most common reason for arthroplasty.

L. Image processing: -

It is the process of converting an image into digital form and performing certain operations in order to extract useful information from it. An image processing system typically treats all images as 2D signals using certain predetermined signal processing methods.

IV. PROPOSED METHODOLOGY

A. Noise Reduction -

Canny edge detection is a well-liked method of image processing that finds edges in pictures. Before finding edges, the Canny edge detection algorithm reduces picture noise as one of its phases. This is crucial because noise might result in misleading edges or make it challenging to recognize real edges. A Gaussian filter is frequently used to reduce noise in the Canny edge detection process. The image is given a Gaussian function via the convolution kernel that makes up the Gaussian filter.

The two-dimensional Gaussian kernel of size (2k+1) x (2k+1) used in image processing. This equation can be expressed as a matrix as follows:

$$H_{ij} = \frac{1}{2\pi\sigma^2} \exp\left(-\frac{(i-(k+1))^2+(j-(k+1))^2}{2\sigma^2}\right); 1 \leq i,j \leq (2k+1) \quad .....(1)$$

where H is the Gaussian kernel matrix of size (2k+1) x (2k+1), sigma is the standard deviation of the Gaussian function, and D is a matrix of distances between each pixel in the kernel and the center pixel.

To compute the distances, we can define a matrix X of size (2k+1) x (2k+1) where each element X(i,j) represents the column index of the pixel. Similarly, we can define a matrix Y of size (2k+1) x (2k+1) where each element Y(i,j) represents the row index of the pixel.

B. Gradient calculation -

Gradient calculation is a fundamental operation in image processing and computer vision. The gradient of an image represents the direction and magnitude of the change in pixel intensities across the image. The gradient is often used in edge detection, feature extraction, and object recognition. The gradient of an image can be computed using different methods, but one of the most common methods is the Sobel operator. The Sobel operator calculates the gradient by convolving the image with two 3x3 kernels, one for the horizontal direction and one for the vertical direction. The kernels are designed to detect changes in pixel intensities in the corresponding direction.

The horizontal Sobel kernel has the following formula:
Sx = [-1 0 1; -2 0 2; -1 0 1] ......(2)

The vertical Sobel kernel has the following formula:
Sy = [-1 -2 -1; 0 0 0; 1 2 1] ......(3)

To calculate the gradient, we first convolve the image with the horizontal Sobel kernel and then with the vertical Sobel kernel. The resulting convolved images represent the gradient in the horizontal and vertical directions, respectively. The magnitude and direction of the gradient at each pixel can then be computed using the following formulas:

Magnitude = $sqrt(Gx^2) + Gy^2$ .....(4)

Direction = atan2(Gy, Gx) ......(5)

where Gx and Gy are the convolved images in the horizontal and vertical directions.
The sqrt() function computes the square root of the sum of the squares of the two images, which gives the magnitude of the gradient.
The atan2() function computes the arctangent of the ratio of the vertical gradient to the horizontal gradient, which gives the direction of the gradient.

V. IMPLEMENTATION

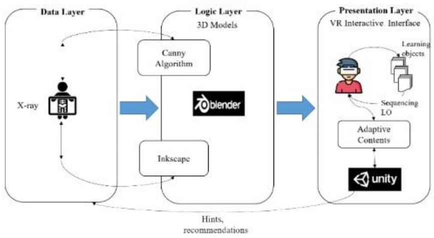

Fig. 1. Architecture of the proposed system.

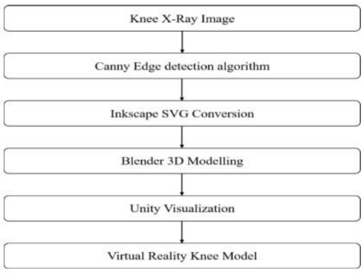

Fig. 2. Model Flow Architecture

The proposed system can be used to improve medical diagnosis and treatment planning. By creating 3D models of X-ray images using virtual reality, medical professionals can gain a better understanding of the patient's condition, leading to more accurate diagnoses and treatment plans. Here are the implementation stages as follows:

A. Data Layer: -

According to figure we will first collect X-ray images of the patient's body part that needs to be modeled. These images can be taken using traditional X-ray machine the X-rays is recommended for complex cases of the bone. In this step we are collecting the X-ray image of the bone where it will check image quality of the X-ray image. The image will be processed in the Logical layer with the help of the Canny Edge Detection Algorithm.

B. Logic Layer: -

The 3D models' accuracy may be impacted by noise and artefacts in the X-ray pictures, So to avoid this the clarity and sharpness of the X-ray pictures can be increased by removing these artefacts using pre-processing techniques such as noise reduction. We identified the necessary edges of the bone in this stage using a canny edge detection method and this result picture in the PNG format here. The image may then be transformed into an SVG file using Inkscape, which is a scalable vector format and to trace the edges raise threshold.

We have to import the SVG file into a 3D modelling tool like Blender. With the help of the blender tool, a 2D scan of the X-ray may be converted to 3D Model. In Blender tool have feature to get the coordinates of the 3D Model which will require for the measurement. The 3D model must be extrude in a way that it can be loaded into a VR development platform, such Unity, as the last stage. OBJ is one of the popular 3D file formats.

C. Presentation Layer: -

In this Stage it will import the 3D model created in Blender into a virtual reality platform such as Unity. Unity is a cross-platform game engine that allows you to create interactive 3D and 2D content for various platforms including VR headsets. Once the 3D model is imported into Unity, it can be viewed and interacted with using a VR headset.

VI. RESULT

Appropriate results are obtained using this proposed approach.

Fig. 3. Input Image (Knee X-Ray)

The first step is to collect a dataset of X-ray images that will be used for developing the 3D modeling system. This dataset should include a variety of images from different patients and anatomical structures. Here we have taken knee bone X-ray.

Fig. 4. Canny Edge Detection

The X-ray images may contain noise and artifacts that can affect the accuracy of the 3D models. Pre-processing techniques such as noise reduction and image enhancement can be applied to remove these artifacts and improve the quality and sharpness of the X-ray images. In this step using canny edge detection algorithm we have found out required edges of bone. Here our image is in png format.

Fig. 5. Converting to .SVG format

The canny edge detection algorithm output can be saved as an image file (such as PNG) and imported into a vector graphics software, such as Inkscape. The software can then trace the edges increase threshold and convert the image into an SVG file, which is a scalable vector format.

Fig. 6. 3D Model in Blender

The SVG file can be imported into a 3D modeling software, such as Blender. The software can be used to extrude the 2D image into a 3D model that represents the Knee anatomy. The final step is to export the 3D model in a format that can be imported into a VR development platform, such as Unity. Common 3D file formats include OBJ. Here we have found out actual size of the given bone.

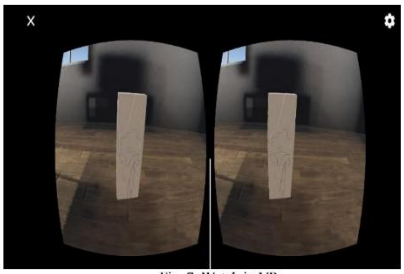

Fig. 7. Watch in VR

The final step is to export the 3D model in a format that can be imported into a VR development platform, such as Unity. Using VR Google cardboard we can visualize actual bone.

In this system, we have used a canny edge detection algorithm to find edges the accuracy of algorithm is 94.58%. We have converted image to SVG so accuracy is increased by 1%. So final accuracy of this system is 95.58%.

Table 1:- System Comparison

System Comparison	Accuracy
Bone Fracture Detection and Classification using Deep Learning Approach [23]	94.58%
Automatic detection of fracture in femur bones using image processing [25]	87.5%
Bone Fracture Detection Using Opencv [27]	66.7%
Proposed System	**95.58%**

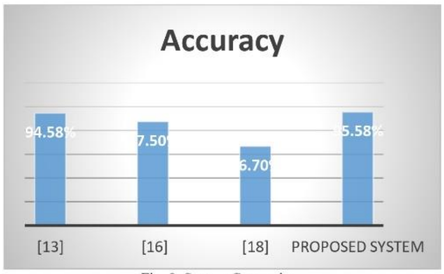

Fig. 8. System Comparison

VII. CONCLUSION

The proposed system aims to address the problem of inaccurate bone implantation by using a canny edge detection technique to sketch the edges of the knee bone in an X-ray image and then converting it into a 3D model that can be viewed in a VR headset. This model provides accurate measurements and detailed visualization of bones with a high level of accuracy. The use of virtual reality-based visualization using X-ray images can be more effective than CT-Scan in improving radiologists' accuracy and efficiency in diagnosing certain medical conditions. However, it is important to note that the choice of imaging modality depends on the specific diagnostic scenario, and each imaging technique has its advantages and limitations. Overall, the proposed system can be a promising approach to improve the accuracy and precision of bone implantation procedures, potentially leading to better health outcomes for patients.

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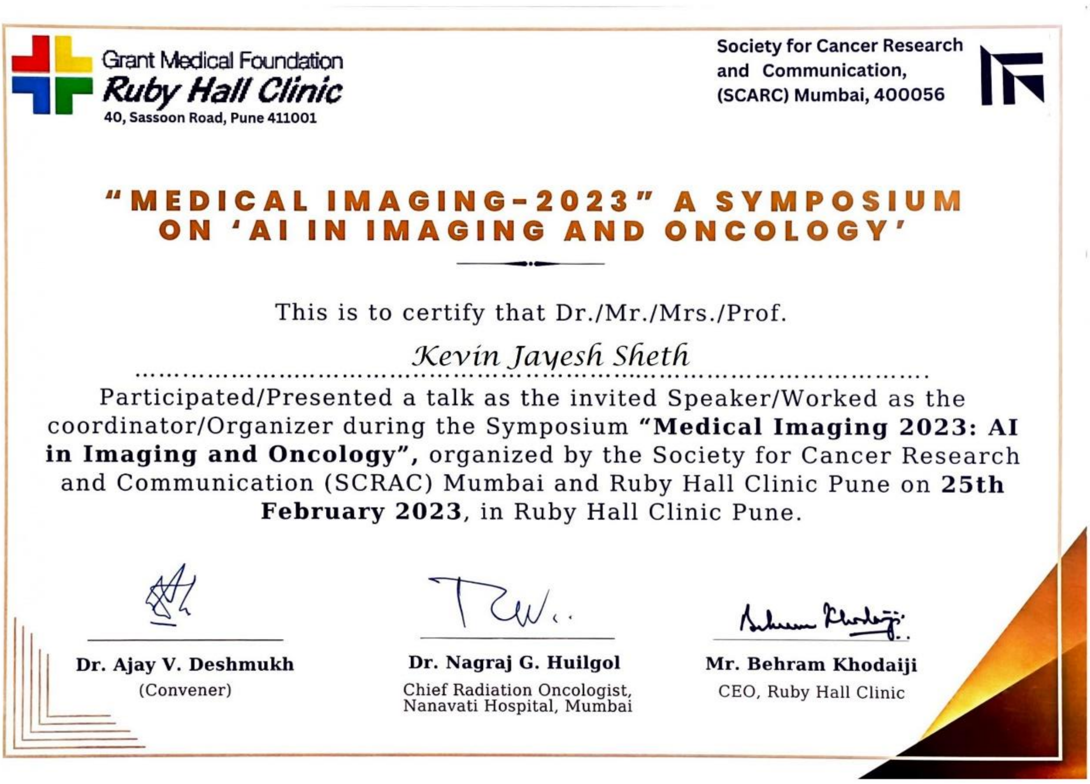

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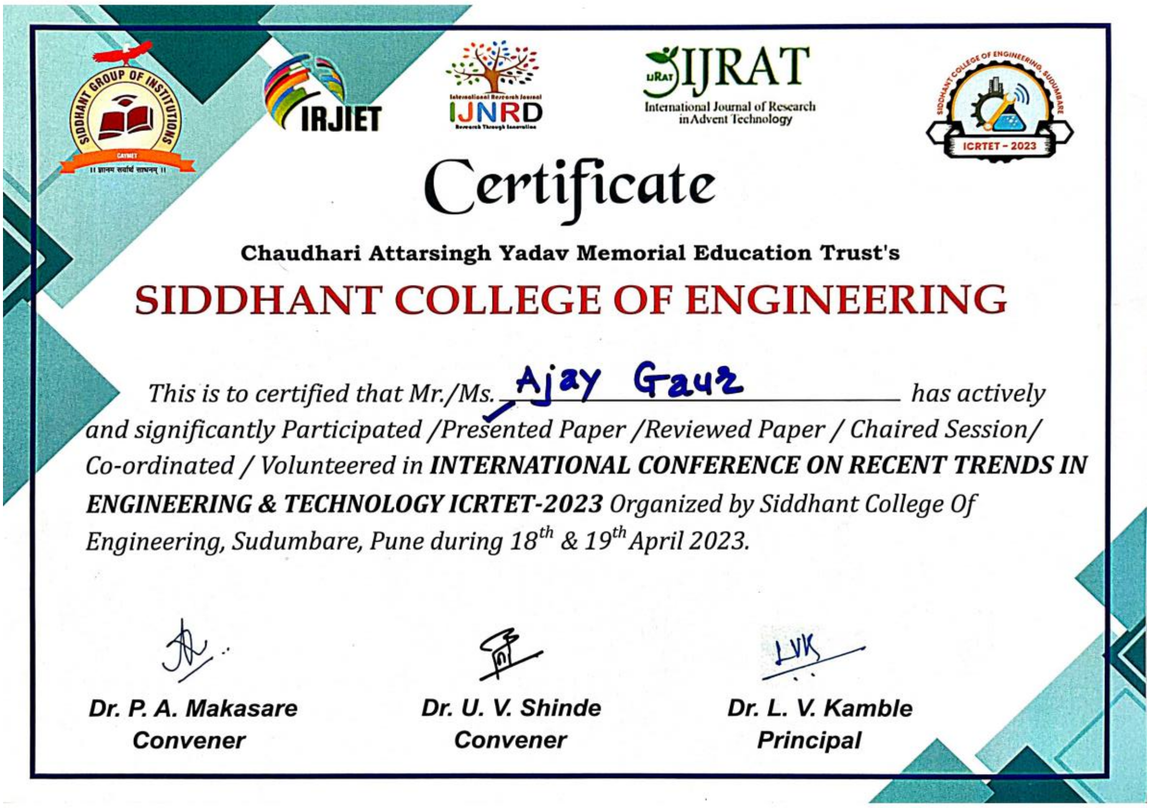

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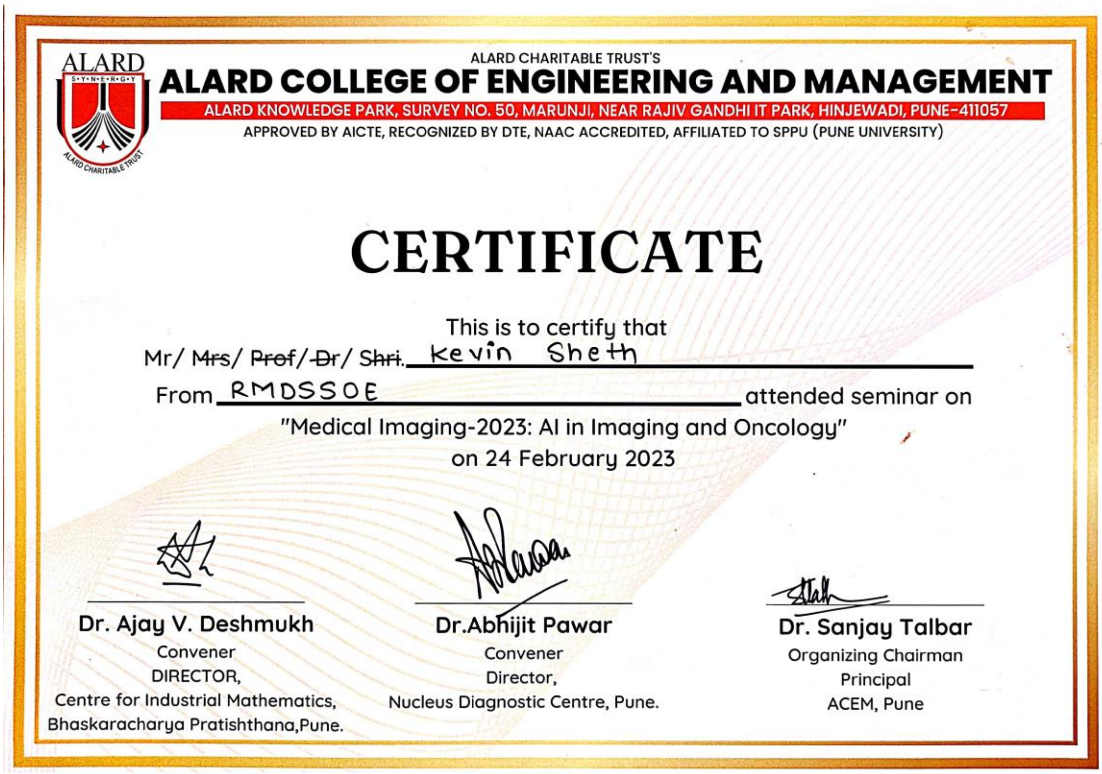
This is to certified that Mr./Ms. yash paliwal *has actively and significantly Participated /Presented Paper /Reviewed Paper / Chaired Session/ Co-ordinated / Volunteered in* ***INTERNATIONAL CONFERENCE ON RECENT TRENDS IN ENGINEERING & TECHNOLOGY ICRTET-2023*** *Organized by Siddhant College Of Engineering, Sudumbare, Pune during 18th & 19th April 2023.*

Dr. P. A. Makasare **Convener**	**Dr. U. V. Shinde** **Convener**	**Dr. L. V. Kamble** **Principal**



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ALARD KNOWLEDGE PARK, SURVEY NO. 50, MARUNJI, NEAR RAJIV GANDHI IT PARK, HINJEWADI, PUNE-411057

APPROVED BY AICTE, RECOGNIZED BY DTE, NAAC ACCREDITED, AFFILIATED TO SPPU (PUNE UNIVERSITY)

CERTIFICATE

This is to certify that

Mr/ ~~Mrs~~/ ~~Prof~~/ ~~Dr~~/ ~~Shri~~. kevin Sheth

From RMDSSOE attended seminar on

"Medical Imaging-2023: AI in Imaging and Oncology"

on 24 February 2023

Dr. Ajay V. Deshmukh Convener DIRECTOR, Centre for Industrial Mathematics, Bhaskaracharya Pratishthana,Pune.	**Dr.Abhijit Pawar** Convener Director, Nucleus Diagnostic Centre, Pune.	**Dr. Sanjay Talbar** Organizing Chairman Principal ACEM, Pune

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APPROVED BY AICTE, RECOGNIZED BY DTE, NAAC ACCREDITED, AFFILIATED TO SPPU (PUNE UNIVERSITY)

CERTIFICATE

This is to certify that

Mr/ ~~Mrs~~/ ~~Prof~~/ ~~Dr~~/ ~~Shri~~. Ajay Gawli.

From RMDSSOE attended seminar on

"Medical Imaging-2023: AI in Imaging and Oncology"

on 24 February 2023

Dr. Ajay V. Deshmukh	Dr.Abhijit Pawar	Dr. Sanjay Talbar
Convener	Convener	Organizing Chairman
DIRECTOR,	Director,	Principal
Centre for Industrial Mathematics, Bhaskaracharya Pratishthana,Pune.	Nucleus Diagnostic Centre, Pune.	ACEM, Pune

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CERTIFICATE

This is to certify that

Mr/ ~~Mrs~~/ ~~Prof~~/ ~~Dr~~/ ~~Shri~~. Yash Paliwal

From RMDSSOE attended seminar on

"Medical Imaging-2023: AI in Imaging and Oncology"

on 24 February 2023

Dr. Ajay V. Deshmukh	Dr.Abhijit Pawar	Dr. Sanjay Talbar
Convener	Convener	Organizing Chairman
DIRECTOR,	Director,	Principal
Centre for Industrial Mathematics, Bhaskaracharya Pratishthana,Pune.	Nucleus Diagnostic Centre, Pune.	ACEM, Pune

CS

SYMBIOSIS INSTITUTE OF TECHNOLOGY

PROTECH 2023

DISCOVER | PROJECT | DISRUPT

Project Competition for Diploma and Engineering Students

CERTIFICATE OF PARTICIPATION

We appreciate the participation of ~~Ms.~~/ Mr. Kevin Sheth in Protech 2023, a project competition with the project title 3D Modeling of X-Ray Images using VR held at **SYMBIOSIS INSTITUTE OF TECHNOLOGY**, Pune on 29th April 2023.

Dr. Ketan Kotecha
(Dean and Director)

SYMBIOSIS INTERNATIONAL (DEEMED UNIVERSITY)
(Established under Section 3 of the UGC Act, 1956) | Re-accredited by NAAC with 'A++' grade | Awarded Category – I by UGC

CS

SYMBIOSIS INSTITUTE OF TECHNOLOGY

PROTECH 2023

DISCOVER | PROJECT | DISRUPT

Project Competition for Diploma and Engineering Students

CERTIFICATE OF PARTICIPATION

We appreciate the participation of Ms./ Mr. Ajay Gaur in Protech 2023, a project competition with the project title 3D Modeling of XRay Images using VR held at **SYMBIOSIS INSTITUTE OF TECHNOLOGY**, Pune on 29th April 2023.

Dr. Ketan Kotecha
(Dean and Director)

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SYMBIOSIS INSTITUTE OF TECHNOLOGY

PROTECH 2023

DISCOVER | PROJECT | DISRUPT

Project Competition for Diploma and Engineering Students

CERTIFICATE OF PARTICIPATION

We appreciate the participation of Ms./ Mr. Yash Paliwal in Protech 2023, a project competition with the project title 3D Modeling of XRay Images using VR held at **SYMBIOSIS INSTITUTE OF TECHNOLOGY**, Pune on 29th April 2023.

Dr. Ketan Kotecha
(Dean and Director)

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ANNEXURE E

PLAGIARISM REPORT

Plagiarism Scan Report

Report Generated on: May 26,2023

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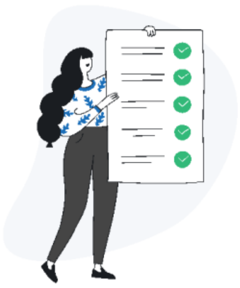
Total Words:	199
Total Characters:	1265
Plagiarized Sentences:	0
Unique Sentences:	10 (100%)

Content Checked for Plagiarism

Nowadays, advanced medical imaging is a widely accepted scientific discipline in the healthcare industry due to technological advances and software breakthroughs. Traditionally using digital images of X-Ray for diagnosing diseases in healthcare is very common. Many researchers have proposed different methods like X-Ray, CT-scan, and MRI for bone implantation. But the problem is while implantation it does not get the actual size as original, so it causes a bad impact on the health and the person suffers from pain. Therefore, to solve this problem, the proposed system uses a canny edge detection that can sketch the edges of knee bone present in an x-ray image with the size of the bone for implantation by using a virtual reality technique. The system will convert the 2D image to 3D and then the 3D model will be shown in a VR headset. So, we can get a clear visualization of the image. This model provides accurate measurements and detailed visualization of bones in virtual reality with 95.58% accuracy. Virtual reality-based visualization using X-ray images is more effective than CT-Scan in improving radiologists' accuracy and efficiency in diagnosing certain medical conditions, leading to a preference for X-ray images in certain diagnostic scenarios.



No Plagiarism Found

Figure D.1: Plagiarism Abstract

Plagiarism Scan Report

Report Generated on: May 26,2023

3%	97%
Plagiarised	Unique

Total Words:	522
Total Characters:	3298
Plagiarized Sentences:	0.78
Unique Sentences:	25.22 (97%)

Content Checked for Plagiarism

Medical imaging technology dates back to the 18th and 19th centuries, when Becquerel found radiation and x-rays, respectively. Both findings significantly enhanced medical practice. The practical implementation of ultrasound in medicine was made feasible by advances in the use of sound waves in the mid-twentieth century, and then came computers, which changed the game completely. Sonography, nuclear medicine technology, and radiography were used as diagnostic medical imaging methods or instruments prior to the widespread use of computer technology in health care. Bone serves as the human body's skeleton, allowing body parts to move and protecting organs. One of the largest and most complex bones in the body is the knee bone. Real life knee bone replacement problem is very serious. Replacing the knee bone or joint with a made artificial joint, known as prosthesis, requires a surgery. Damaged cartilage and bone are taken out of the knee joint during this procedure. The knee is then implanted with man-made bone.

The preferred method for evaluation and therapy planning in orthopedics continues to be traditional X-rayimages, despite the growing accessibility of 3D image acquisition techniques like computed tomography (CT). However, X-rays only show a 2D projection of the anatomy of interest, making it difficult for a human viewer to evaluate its 3D characteristics like the anatomical form. (eg. the surgeon). The goal of this project is to create computer- assisted methods for creating 3D models from a single or a small number of X-rays that describe an anatomy's patient- specific form and bone density distribution. The final aim of these patient-specific models is to provide critical 3D information purely based on 2D X-rays, enabling exact joint replacement planning, follow-up, and biomechanical analysis.

The term "CT scan" is frequently used to refer to computed tomography. A CT scan is a diagnostic imaging process that creates pictures of the inside of the body using a mix of X-rays and computer technology. Any portion of the body, including the bones, muscles, fat, organs, and blood systems, is shown in depth. Compared to traditional X-rays, CT images are more comprehensive. A beam of energy is directed at the bodily portion being examined in conventional X-rays. After the energy beam travels through the epidermis, bone, muscle, and other tissues, it varies and is captured by a plate behind the body component. While a normal X-ray can provide a lot of information, internal organs and other tissues cannot be seen in great depth.

Virtual reality, also known as VR, is a digital environment that was created decades ago but has only recently begun to take off. This is due to the fact that the technology has only recently become compact, potent, and widely accessible. Because of these factors, virtual reality is now beginning to be applied in the classroom. A new media tool called virtual reality (VR) offers the potential to make learning more engaging for pupils. But more significantly, it can also be a choice to give all pupils more chances and experiences. For example, learners with bodily disabilities or students attending institutions with limited resources can now take virtual excursions to locations they were previously unable to visit.

How does a CT or CAT scan work? - Medical News Today

The term "CT scan" is frequently used to refer to computed tomography.

https://www.medicalnewstoday.com/articles/153201

100%

Figure D.2: Plagiarism Introduction

Plagiarism Scan Report

Report Generated on: May 26,2023

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100% Unique

Total Words:	909
Total Characters:	5926
Plagiarized Sentences:	0
Unique Sentences:	41 (100%)

Content Checked for Plagiarism

The article begins by highlighting the importance of 3D modeling in medical imaging and the limitations of traditional 2D X-ray imaging. The author then presents a review of various techniques for 3D modeling of X-ray images, including volume rendering, surface rendering, and hybrid methods.The article also discusses the challenges faced by researchers in this field, such as the need for accurate segmentation of images and the need for efficient algorithms for 3D reconstruction.The author concludes the article by highlighting the potential of 3D modeling in medical imaging and the need for further research in this field [2].

The paper presents a comprehensive review of various methods for 3D reconstruction of 2D X-ray images. The authors begin by discussing the limitations of traditional 2D X-ray imaging and the importance of 3D reconstruction in medical imaging. The paper then presents a review of various techniques for 3D reconstruction of X-ray images, including the voxel-based approach, the surface-based approach, and the hybrid approach.The authors also discuss the challenges faced by researchers in this field, such as the need for accurate image segmentation and the need for efficient algorithms for 3D reconstruction. They further describe various applications of 3D reconstruction in medical imaging, such as diagnosis, surgical planning, and treatment monitoring.The paper concludes by highlighting the potential of 3D reconstruction in medical imaging and the need for further research in this field [3].

Given paper presents a novel approach to naturalistic 2D-to-3D conversion, which aims to generate high-quality 3D images from 2D images that resemble the natural 3D scenes as much as possible. The authors first introduce the concept of naturalistic 2D-to-3D conversion and discuss the challenges faced by existing methods, such as the lack of accurate depth information and the difficulty in modeling natural scene structures. The paper then presents a new approach based on a multi-stage framework that involves 2D image segmentation, depth estimation, and 3D scene reconstruction. The approach utilizes various cues, such as texture, shading, and perspective, to estimate the depth of the scene and generate a high-quality 3D image. The authors also evaluate their approach on a variety of test images and compare it with existing methods. The results demonstrate that the proposed approach achieves superior performance in terms of both subjective and objective measures [4].

The article presents a method for converting 2D medical image files in DICOM format into 3D models using image processing techniques and analyzing the results with Python programming. The article begins by highlighting the importance of 3D models in medical imaging and the challenges faced by medical professionals in analyzing 2D medical images. The authors then describe the steps involved in converting DICOM files into 3D models, which include image preprocessing, segmentation, and 3D reconstruction. The authors also discuss the use of Python programming in analyzing the results of 3D reconstruction, such as calculating volume, surface area, and other relevant measurements. They provide code examples in Python for carrying out these analyses. The article also describes the evaluation of their method on various medical images and compares the results withexisting methods. The authors demonstrate that their method produces high-quality 3D models and accurate measurements, making it a useful tool for medical professionals. The article provides a good overview of the method, and the code examples in Python make it easy to implement. However, more information on the evaluation process, including the size of the dataset and the comparison with other methods, would have been useful [5].

Page 1 of 2

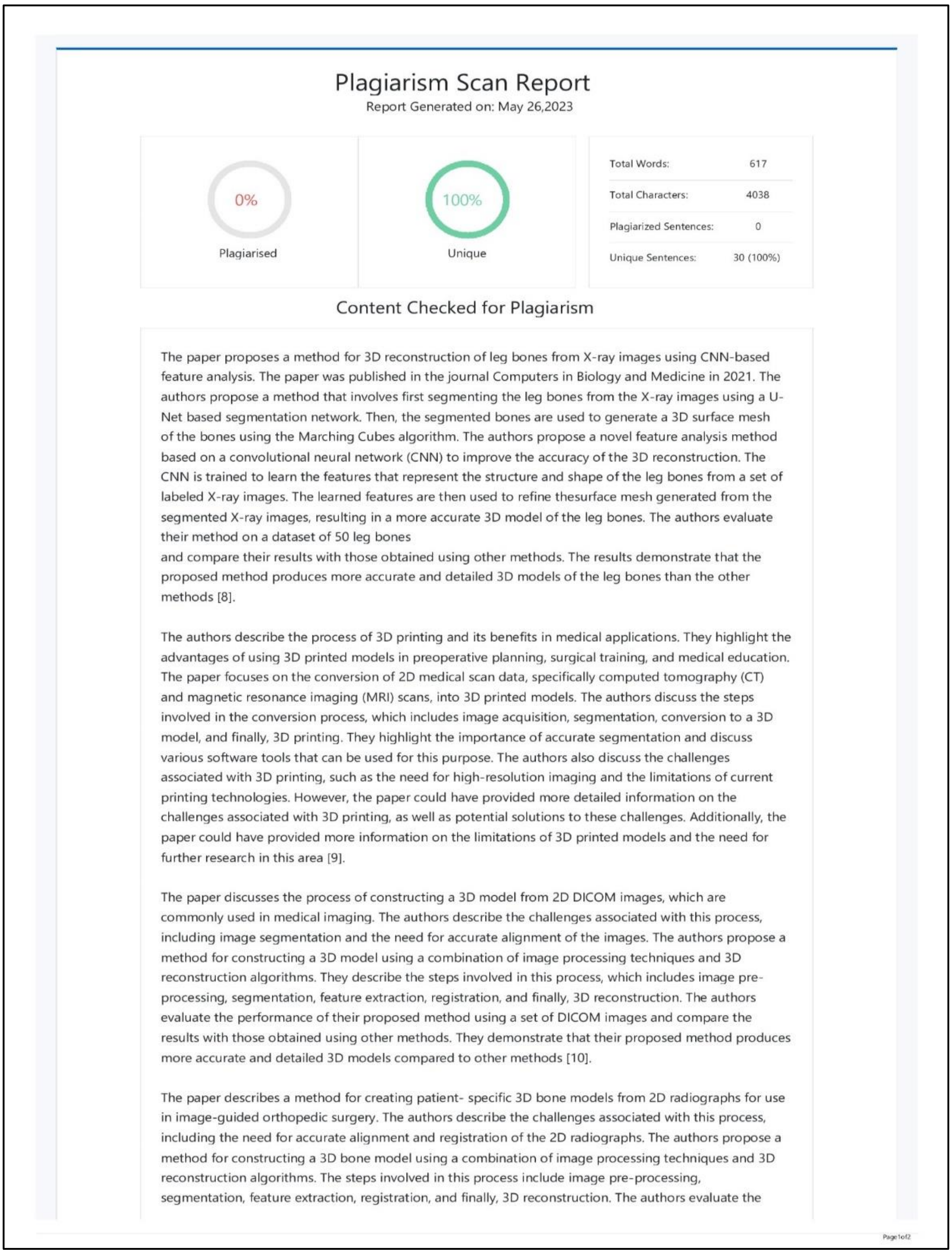
Figure D.3: Plagiarism Literature Survey

The paper presents a new method for reconstructing a 3D femur model from biplane X-ray images. The authors propose a novel method based on Laplacian surface deformation for reconstructing a 3D femur model. The method involves first segmenting the femur from the biplane X-ray images using a thresholding technique. Then, the segmented contours are used to generate a 3D surface mesh of the femur using the Marching Cubes algorithm. The surface mesh is then deformed using a Laplacian surface deformation method, which ensures that the resulting 3D model is smooth and preserves the surface details of the original femur. The authors validate their method on a dataset of 10 femur specimens and compare their results with those obtained using other methods. The results demonstrate that the proposed method produces more accurate and detailed 3D femur models than the other methods. The authors have also provided a comprehensive evaluation of their method and compared it with other methods, which enhances the credibility of their approach. However, the authors could have provided more information on the limitations and potential future directions of their method [6].

The article presents a method for constructing a 3D model of knee joint motion based on MRI image registration. The authors describe the process of acquiring MRI images of the knee joint during motion and segmenting the images to obtain the 3D geometry of the bones and soft tissue. They then propose a registration method to align the segmented MRI images at different time points, which is crucial for constructing the 3D model of knee joint motion. The registration method is based on a hybrid approach that combines intensity-based and feature- based registration methods. The authors also introduce a motion analysis framework to quantify the motion of the knee joint based on the 3D model. The authors evaluate their method on a dataset of six subjects and demonstrate that the proposed method can accurately reconstruct the 3D model of knee joint motion and quantify the motion parameters, such as translation and rotation [7].

No Plagiarism Found

Figure D.3: Plagiarism Literature Survey



Plagiarism Scan Report

Report Generated on: May 26,2023

0% Plagiarised

100% Unique

Total Words:	617
Total Characters:	4038
Plagiarized Sentences:	0
Unique Sentences:	30 (100%)

Content Checked for Plagiarism

The paper proposes a method for 3D reconstruction of leg bones from X-ray images using CNN-based feature analysis. The paper was published in the journal Computers in Biology and Medicine in 2021. The authors propose a method that involves first segmenting the leg bones from the X-ray images using a U-Net based segmentation network. Then, the segmented bones are used to generate a 3D surface mesh of the bones using the Marching Cubes algorithm. The authors propose a novel feature analysis method based on a convolutional neural network (CNN) to improve the accuracy of the 3D reconstruction. The CNN is trained to learn the features that represent the structure and shape of the leg bones from a set of labeled X-ray images. The learned features are then used to refine thesurface mesh generated from the segmented X-ray images, resulting in a more accurate 3D model of the leg bones. The authors evaluate their method on a dataset of 50 leg bones
and compare their results with those obtained using other methods. The results demonstrate that the proposed method produces more accurate and detailed 3D models of the leg bones than the other methods [8].

The authors describe the process of 3D printing and its benefits in medical applications. They highlight the advantages of using 3D printed models in preoperative planning, surgical training, and medical education. The paper focuses on the conversion of 2D medical scan data, specifically computed tomography (CT) and magnetic resonance imaging (MRI) scans, into 3D printed models. The authors discuss the steps involved in the conversion process, which includes image acquisition, segmentation, conversion to a 3D model, and finally, 3D printing. They highlight the importance of accurate segmentation and discuss various software tools that can be used for this purpose. The authors also discuss the challenges associated with 3D printing, such as the need for high-resolution imaging and the limitations of current printing technologies. However, the paper could have provided more detailed information on the challenges associated with 3D printing, as well as potential solutions to these challenges. Additionally, the paper could have provided more information on the limitations of 3D printed models and the need for further research in this area [9].

The paper discusses the process of constructing a 3D model from 2D DICOM images, which are commonly used in medical imaging. The authors describe the challenges associated with this process, including image segmentation and the need for accurate alignment of the images. The authors propose a method for constructing a 3D model using a combination of image processing techniques and 3D reconstruction algorithms. They describe the steps involved in this process, which includes image pre-processing, segmentation, feature extraction, registration, and finally, 3D reconstruction. The authors evaluate the performance of their proposed method using a set of DICOM images and compare the results with those obtained using other methods. They demonstrate that their proposed method produces more accurate and detailed 3D models compared to other methods [10].

The paper describes a method for creating patient- specific 3D bone models from 2D radiographs for use in image-guided orthopedic surgery. The authors describe the challenges associated with this process, including the need for accurate alignment and registration of the 2D radiographs. The authors propose a method for constructing a 3D bone model using a combination of image processing techniques and 3D reconstruction algorithms. The steps involved in this process include image pre-processing, segmentation, feature extraction, registration, and finally, 3D reconstruction. The authors evaluate the

Page 1of2

Figure D.3: Plagiarism Literature Survey

Plagiarism Scan Report

Report Generated on: May 26,2023

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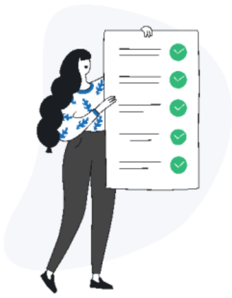
Plagiarised	Unique	Total Words:	144
		Total Characters:	919
		Plagiarized Sentences:	0
		Unique Sentences:	6 (100%)

Content Checked for Plagiarism

The proposed system aims to address the problem of inaccurate bone implantation by using a canny edge detection technique to sketch the edges of the knee bone in an X-ray image and then converting it into a 3D model that can be viewed in a VR headset. This model provides accurate measurements and detailed visualization of bones with a high level of accuracy. The use of virtual reality- based visualization using X-ray images can be more effective than CT-Scan in improving radiologists' accuracy and efficiency in diagnosing certain medical conditions. However, it is important to note that the choice of imaging modality depends on the specific diagnostic scenario, and each imaging technique has its advantages and limitations. Overall, the proposed system can be a promising approach to improve the accuracy and precision of bone implantation procedures, potentially leading to better health outcomes for patients



No Plagiarism Found

Figure D.4: Plagiarism Conclusion

ANNEXURE F

INFORMATION OF PROJECT GROUP MEMBE

Figure F.1: Kevin Jayesh Seth

1. **Name:** Kevin Jayesh Sheth
2. **Date of Birth:** 23/02/2002
3. **Gender:** Male
4. **Permanent Address:** RMDSSOE, Warje
5. **E-Mail:** kevinsheth1529@gmail.com
6. **Mobile/Contact No.:** 7030052068
7. **Placement Details:** JIO, Accenture
8. **Paper Published:** Yes

Figure F.2: Kadambari Jalindar Kate

1. **Name:** Kadambari Jalandir Kate
2. **Date of Birth:** 08/02/2000
3. **Gender:** Female
4. **Permanent Address:** RMDSSOE, Warje
5. **E-Mail:** kadambari087@gmail.com
6. **Mobile/Contact No.:** 7447630727
7. **Placement Details:** VIOS
8. **Paper Published:**

Figure F.3: Ajay Mahesh Gaur

1. **Name:** Ajay Mahesh Gaur
2. **Date of Birth:** 15/05/1999
3. **Gender:** Male
4. **Permanent Address:** RMDSSOE, Warje
5. **E-Mail:** ajay94932@gmail.com
6. **Mobile/Contact No.:** 8888016948
7. **Placement Details:** NA
8. **Paper Published:** Yes

Figure F.4: Yash Arvind Paliwal

1. **Name:** Yash Arvind Paliwal
2. **Date of Birth:** 09/11/2001
3. **Gender:** Male
4. **Permanent Address:** RMDSSOE, Warje
5. **E-Mail:** yashplw@gmail.com
6. **Mobile/Contact No.:** 7387586807
7. **Placement Details:** NA
8. **Paper Published:** Yes