VISVESVARAYA TECHNOLOGICAL UNIVERSITY

BELAGAVI, KARNATAKA-590014

INTERNSHIP REPORT

On

"DENTAL X-RAY IMAGES TOOTH DETECTION AND COUNTING USING MACHINE LEARNING"

Submitted by

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UNDER THE GUIDANCE OF

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In the partial fulfilment for the award of degree of

BACHELOR OF ENGINEERING

In

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(Affiliated to Visvesvaraya Technological University, Belagavi)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that the Internship Report entitled **"DENTAL X-RAY TOOTH DETECTION AND COUNTING USING MACHINE LEARNING"** is an authentic record of the work carried out by **Ibrahim Naseef (4DM20CS019)** student of **8th** semester in partial fulfilment of requirements for the award of Bachelor's Degree in **Computer Science & Engineering** prescribed by Visvesvaraya Technological University, Belagavi during the year **2023-24.**

Signature of the Guide	Internship Co-ordinator	Signature of the HOD
(Prof. Sleeba Mathew C)	**(Prof. Manjunath Raikar)**	**(Dr. Manjunath Kamath)**

Internal Viva

Name of the Examiner	**Signature with Date**
1.	**1.**
2.	**2.**

DECLARATION

This is to certify that I have followed the guidelines provided by the University & Institute in preparing this Internship report and whenever I have sent materials (data, theoretical analysis, figures and text) from other sources, I have given due credit to them by citing them in the text of report and getting their details in the references.

Signature of student

Name: Ibrahim Naseef

USN: 4DM20CS019

ACKNOWLEDGEMENT

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IBRAHIM NASEEF **4DM20CS019**

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CHAPTER 1

COMPANY PROFILE

Yenepoya Technology Incubator (YTI) is an initiative of Yenepoya Deemed to be University aimed towards identifying, fostering & mentoring innovators/entrepreneurs in the healthcare innovation process. It was started in May 2019 with an aim to accelerate the growth of innovation and entrepreneurial ecosystem in and around western region of Karnataka and is registered as a Section 8, not for profit, organization under the name Yenepoya Foundation for Technology Incubation.

- Customer centric approach
- Patient-centered care and services
- Innovative solutions
- Strong ethical standards

Outstanding expertise in the areas of Medicine, Dentistry, Public Health, Life Sciences, Biotechnology and Engineering. The university has received funding from various national and international funding bodies such as BIRAC, DAE-BRNS, DBT, DST, ICMR, VGST, and MoEF.

1.1 Services

- Prototyping Facilities
- ESDM Services
- FabLab
- Product Testing
- Market Intelligence
- Software Integration

1.2 Working

Yenepoya Technology Incubator (YTI) collaborates with Yenepoya University's extensive resources in Medicine, Dentistry, and Biotechnology. It focuses on cutting-edge healthcare research in areas like geriatric care, nutrition, and bioinformatics, working closely with an 1150-bed teaching hospital.

CHAPTER 2

ABOUT THE COMPANY

2.1 Vision

Creating higher impact and visibility for the Yenepoya (Deemed to be University) on a national and international stage by fostering entrepreneurial ecosystem which encourages co-creation.

2.2 Mission

The core mission of the Yenepoya Foundation for Technology Incubation is to provide a platform and act as a catalyst for ideation, translation and commercialization of technologies with societal impact.

2.3 Objectives

YTI empowers medical innovators from idea to implementation, fostering collaboration among students, faculty, and professionals. It facilitates commercialization of university research with advanced infrastructure and promotes healthcare innovation through workshops ,partnerships.

2.4 Programs offered

They provide various programs in all areas-

BIRAC Medtech Rapid Prototyping Facility

SIIP -BIRAC's social innovation fellowship program

BIRAC Early Translation Accelerator

MSME Business Incubator

2.5 Global Presence

Yenepoya Technology Incubator (YTI) serves start-ups and admire the amazing journey it comes with. We cater to every start-up be it an individual or a funded start up firm. We liketo hear their stories and ideation of their projects and run their ideas & aspirations through a well-defined design sprint, which helps us in maximizing our efficiency and decision making.

CHAPTER 3

TASK PERFORMED

3.1 Introduction

In This report introduces an efficient approach to Dental X-ray tooth detection and counting, utilizing the YOLOV8 machine learning model. In the realm of dentistry, accurate analysis of X-ray images is crucial for diagnosing and monitoring oral health. Our system integrates advanced image processing techniques with YOLOV8, optimizing images through resizing, cropping, and histogram equalization. Grayscale conversion and erosion refine images, reducing noise for effective data preparation.

YOLOV8 is then applied for region of interest detection, efficiently identifying lower jaw areas containing teeth. Subsequent fine-tuning on annotated datasets enables precise lower jaw tooth detection and counting. The model's adaptability makes it a cornerstone in dental research. This report explores the synergy between image processing and YOLOV8, enhancing accuracy in Dental X-ray analysis. Subsequent sections will delve into methodology, results, and applications, showcasing the system's potential in advancing dental research.

3.2 Objectives

The aim of the proposed system is to provide solutions to the problems stated above and help the user to manage the dental images and its quality.

The primary objective of the proposed system, leveraging the YOLOV8 model, aims to automate tooth identification within dental images. This primary objective is focused on enhancing image quality and developing an efficient automated annotation system for various computer vision applications. The system targets tasks such as standardizing image dimensions, cropping for region isolation, contrast improvement through histogram equalization, grayscale conversion for data simplification, erosion for noise reduction, and precise object localization through bounding box and polygon annotation. The machine learning model, trained with YOLOV8, is specifically tailored to detect region of interest, and then to detect the tooth of the lower jaw and count them.

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3.3 Learning Objectives

The core learning objectives of this system revolve around equipping users with the knowledge and skills necessary to proficiently work with image data in the area of medical field. These objectives encompass a comprehensive understanding of the significance of image pre-processing ,annotation and machine learning ability to apply techniques such as resizing, cropping, histogram equalization, grayscale conversion, erosion for noise reduction, annotation and yolov8 model for precise object localization and counting. Advanced learning objectives include mastering the art of converting images into masks for pixel-level segmentation and in-depth image analysis. By achieving these learning objectives, users will be well-prepared to harness the full potential of dental image data for various medical applications and enhance their expertise in this domain.

3.4 Problem Statement

In the field of computer vision and image processing, there is a pressing need for an efficient system that can automate the processing of individual tooth identification. This system aimsto address challenges related to image quality standardization, region of interest identification, enhanced image analysis, noise reduction, precise object localization, and machine learning model to detect individual tooth outlines. These issues hinder the effective utilization of image data for various medical applications, emphasizing the importance of automating the tooth extraction task in dental field.

3.5 Requirements Specifications

3.5.1 HardwareSpecifications

- Processor : Intel Core i3 and above
- RAM : 4 GB(minimum) & above
- Hard Disk : 10 GB & above

3.5.2 SoftwareSpecifications

- Language & Framework : Python for image preprocessing.
  Streamlit for web design
- Annotation Tool : Roboflow.
- OperatingSystem : Windows 7 &above.

3.6 Technologies Used

3.6.1 Python Technologies:

3.6.1.1 Image Resizing:

Image resizing is a fundamental step in your dental image preprocessing pipeline. It involves adjusting the dimensions and format of images to meet standardized requirements. Python, OpenCV, and Pillow are commonly used to perform resizing operations. This ensures that all images are processed consistently, making them suitable for analysis.

3.6.1.2 Cropping:

Cropping is the process of isolating regions of interest within images. This method is often essential when dealing with large or complex images. Using Python, OpenCV, or Pillow, youcan precisely define the areas you want to focus on, enhancing the relevance and accuracy of your dental image analysis.

3.6.1.3 Grayscale Conversion:

Grayscale conversion simplifies images by reducing them to shades of gray. Python and Pillow are often employed to convert images to grayscale, making them easier to work with for various analysis tasks, including feature extraction and object recognition.

3.6.1.4 Histogram Equalization:

Histogram equalization is a technique used to enhance the contrast of an image. It's particularly beneficial when dealing with images that have poor contrast. OpenCV and Python-based libraries offer tools to apply histogram equalization, resulting in improved image quality and better visual clarity.

3.6.1.5 Erosion:

Erosion is an image processing technique used for noise reduction, especially in binary images. OpenCV provides erosion functions that help remove unwanted noise, enhancing the quality of dental images and making subsequent analysis more accurate.

3.6.2 Machine Learning Model

3.6.2.1 YOLOV8:

YOLOv8 (You Only Look Once version 8) stands as a significant advancement in real-time object detection. Building upon the YOLO series, YOLOv8 features a CSPDarknet53 backbone architecture, enhancing feature extraction for improved detection accuracy. With various model variants, including YOLOv4-CSP and YOLOv4x-mish, users can choose models that balance speed and accuracy based on their specific needs. YOLOv8 introduces training enhancements such as mosaic data augmentation and the CIOU loss function, contributing to better bounding box regression during training. Adaptive inference, dynamic model scaling, and compatibility with previous YOLO versions make YOLOv8 a versatile and efficient choice for diverse object detection applications in images and videos, where real-time processing is paramount.

3.6.3 Frontent Technologies

3.6.3.1 Streamlit:

Streamlit is a Python library designed for quick and easy web application development, particularly in the fields of data science and machine learning. It simplifies the process with an intuitive syntax, allowing users to create interactive applications with minimal code. Popular for rapid prototyping, Streamlit seamlessly integrates with data science libraries like Pandas and Matplotlib for creating dynamic visualizations. The library offers various widgets, such as sliders and buttons, for user interaction, enhancing the exploration of data within the application. Sharing and deploying applications is straightforward, making it accessible for showcasing insights locally or on cloud platforms. Despite its simplicity, Streamlit allows for customization, and its integration with machine learning models makes it a versatile tool for interactive presentations of predictions and performance metrics. In summary, Streamlit is a user-friendly solution for building data-driven web applications efficiently.

CHAPTER 4

REFLECTION

4.1 Snapshots

4.1.1 Polygon Annotation

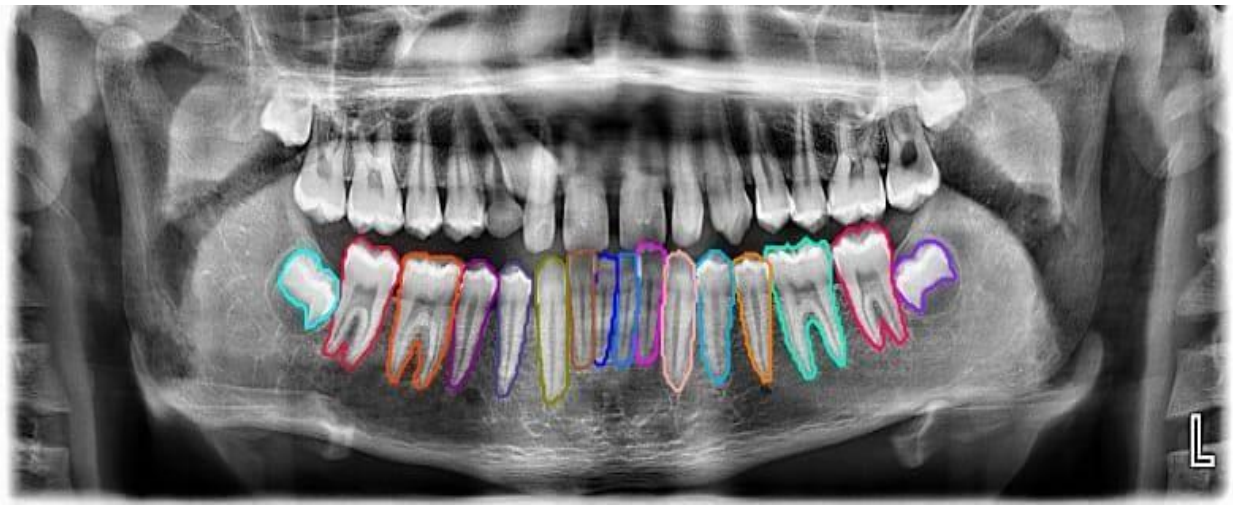

Fig 4.1.1 Polygon Annotation

4.1.2 Bounding Box Image

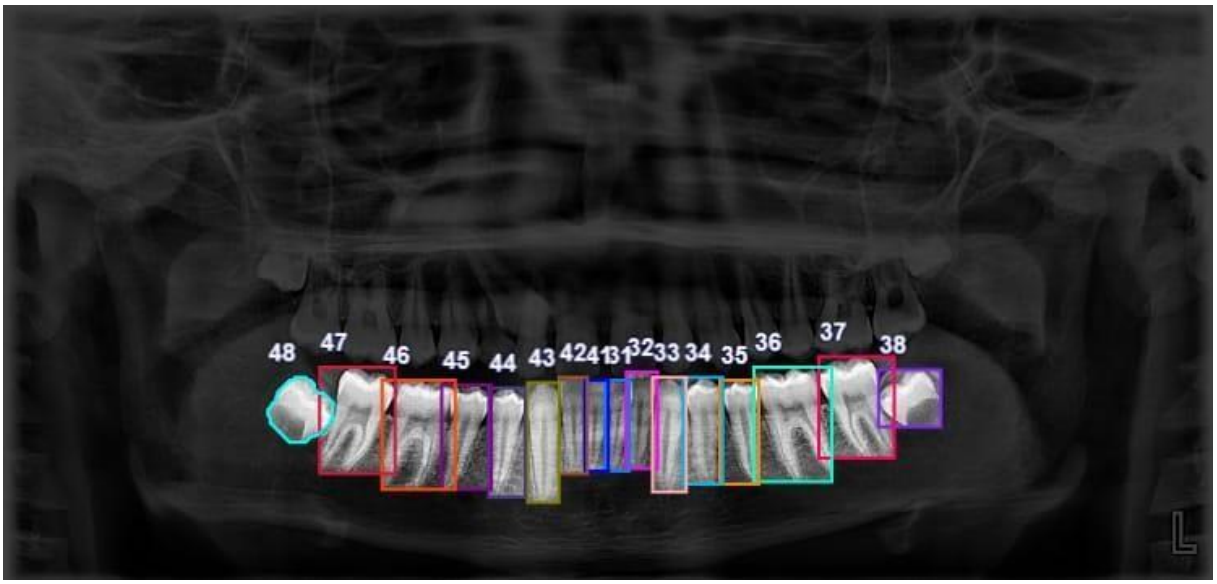

Fig 4.1.2 Bounding Box

4.1.3 Home Page

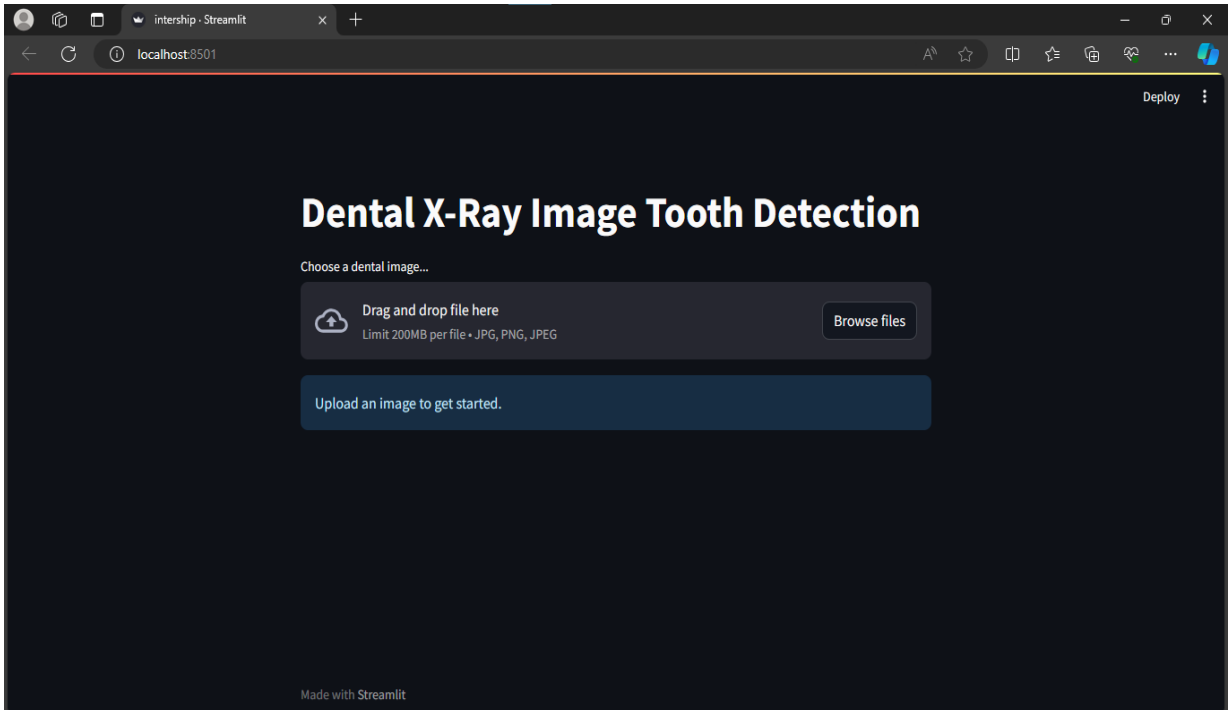

Fig 4.1.3 Home Page

4.1.4 Pre-Processed Image

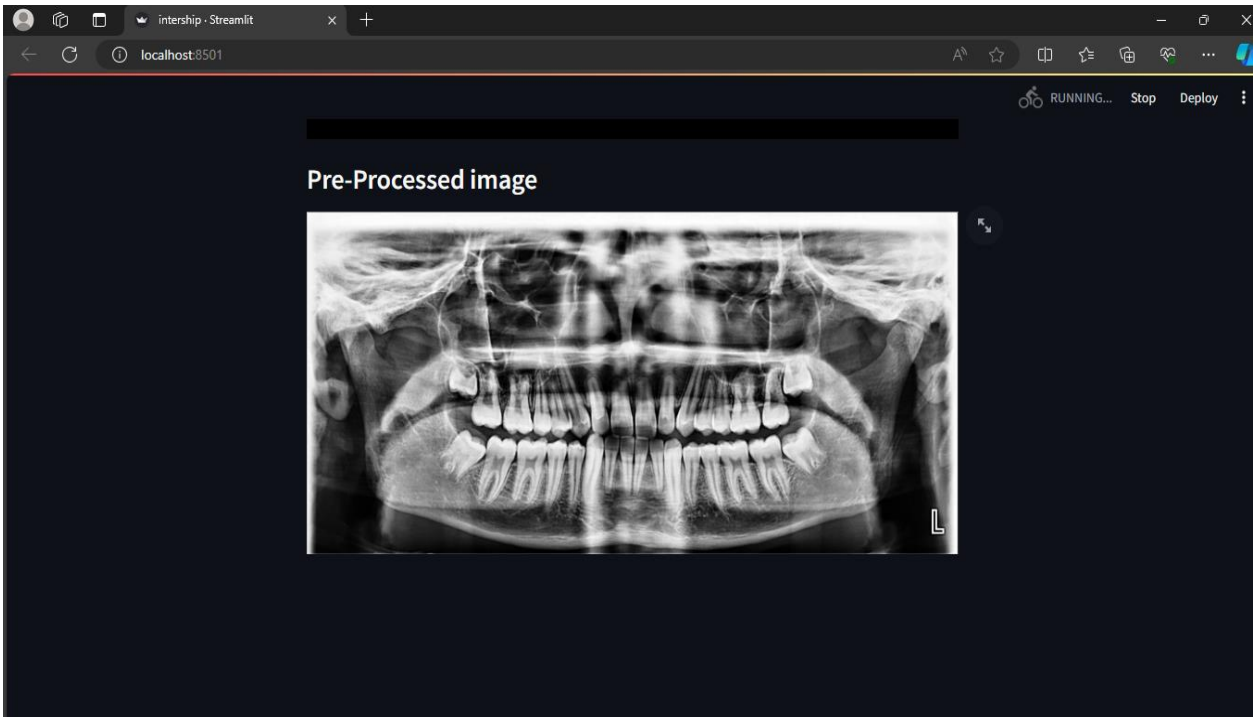

Fig 4.1.4 Home Page

4.1.5 Preicted Image

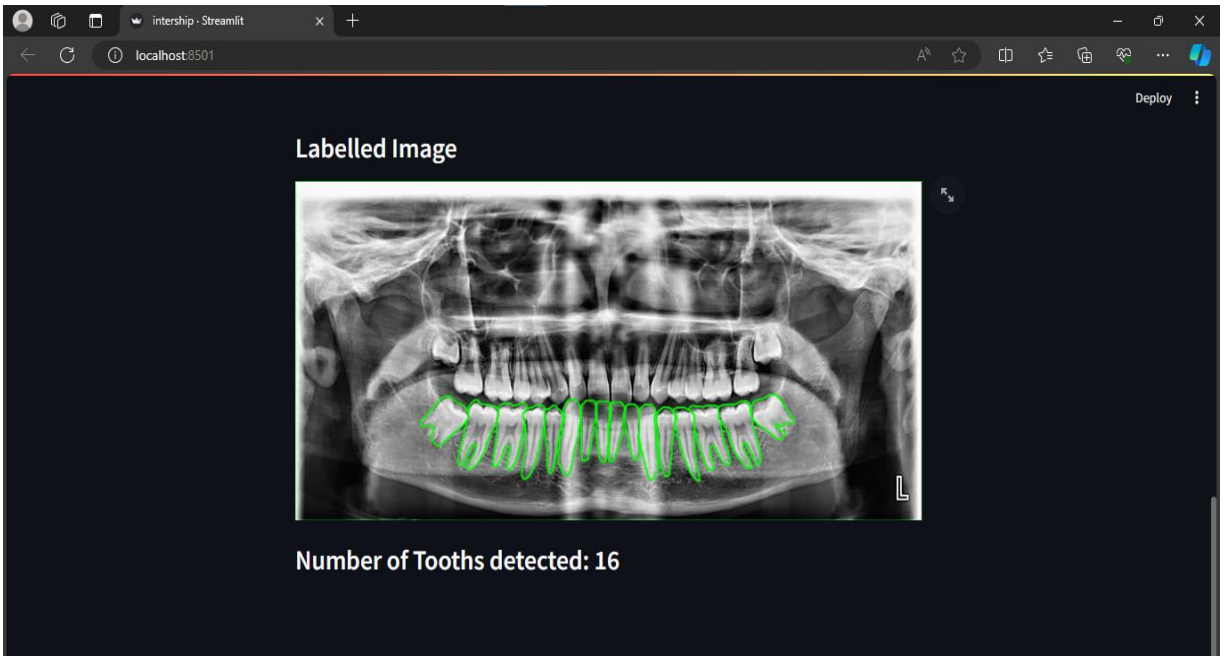

Fig 4.1.5 Predicted image

CHAPTER 5

CONCLUSION

In conclusion, our dental image pre-processing and annotation project represents a significant advancement in the field of dentistry. By harnessing the power of image processing and annotation techniques, we have streamlined the workflow for dental professionals, improving diagnostic accuracy and patient care. The ability to automate and enhance image analysis not only saves time but also opens doors to new possibilities in research and clinical practice. As we move forward, the potential for this technology to revolutionize the dental industry is boundless. We hope that our work will contribute to better patient outcomes, increased efficiency, and ultimately a healthier smile for all.

CHAPTER 6

FUTURE WORK OF THE PROJECT

Looking ahead, our project has a promising future. We can explore the advanced AI for automated diagnosis and personalized treatment recommendations, making dental care more precise. The seamless integration with Electronic Health Records (EHR) systems can streamline patient management. Collaboration with global dental institutions ensures our project's continued innovation and adoption as an industry standard. Adapting the technology for tele dentistry extends access to care. Additionally, the project can be used in education, training dental professionals effectively. The incorporation of 3D dental imaging enhances its capabilities for complex procedures and treatment planning, keeping us at the forefront of dental technology.

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