

Project Proposal Reference No.: 46S_BE_4132

**Design, Analysis and Develop of Dental Disorder Detection System using
Mask-RCNN and Image Processing**

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INTRODUCTION

Good oral and dental hygiene can help prevent bad breath, tooth decay and gum disease and can help you keep your teeth as you get older. Establishing good oral hygiene and dietary habits have been proven to be essential to achieving and maintaining, overall physical and emotional well-being throughout life. Normally the body's natural defenses and good oral health care such as daily brushing and flossing keep the bacteria under control. Without proper oral hygiene, bacteria can reach levels that might lead to oral infections, such as tooth decay and gum disease. Oral health can affect both your physical and emotional well-being as it can impact upon appearance, interpersonal relations, diet, nutrition and speech. In addition, a disease of the mouth can affect the rest of the body and is a contributing factor to several secondary conditions.

Your mouth serves as the door to the internal parts of your body. The mouth also serves as a vantage point for detecting early symptoms of systemic diseases. Systemic diseases such as diabetes, often starts to become apparent as a mouth lesion or other dental problems such as gum infection. Research from Harvard shows that patients with periodontal disease are at a greater risk of having heart disease. According to this research, periodontal disease

increases the body's burden of inflammation. Chronic inflammation may affect many parts of the body including artery inflammation.

Dental diseases (such as dental caries, periodontal disease, dental fluorosis, etc.) are becoming increasingly common. In India, about 85% to 90% of adults have dental cavities, along with about 60% to 80% children. Also, around 30% of children have misaligned jaws and teeth. However, dental diseases in many cases can be prevented, and serious problems can be avoided if teeth are regularly monitored. Moreover, the monitoring of periodontal, gingival and oral mucosa can play a significant role in monitoring the patients' cardiovascular and cerebrovascular diseases, diabetes, and other problems.

OBJECTIVES

1. To design a compact image acquisition device using CMOS image sensor.
2. Image enhancement and colour texture mapping.
3. To classify dental disorders such as dental cavity, plaque, dental fluorosis, Root Canal etc. using histogram matching.
4. Accurate target segmentation and detection of dental disorders (if any) using AI-ML.
5. To build a mobile / web app to communicate with the user and book an appointment (if required).
6. To publish paper in IEEE Journal's category or any reputed Journal with SCOPUS INDEX.

METHODOLOGY

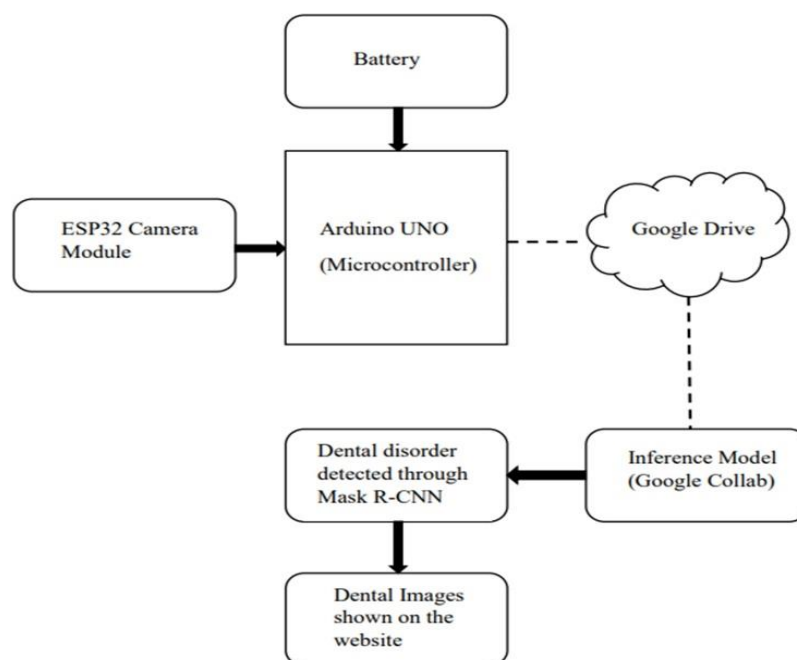


Fig 1. Block Diagram

- Collecting images suitable for training.
- Image augmentation to generate multiple variants of the images.
- Annotate the images for disorder identification and label them with appropriate classes.
- Implement model training with the help of transfer learning on coco dataset.
- Test the inference model with test images.
- Building the hardware model to take images and transfer it to google drive.
- Control and coordinate the digital data flow using Google drive API to run the inference model on captured images and to display the results on website.

RESULTS

The machine learning model based on Mask R-CNN, a deep neural network that can segment and label objects in images was trained and tested on various datasets and scenarios which were dental images to achieve high accuracy and performance in tooth segmentation and detection. The project successfully developed and tested a system that can detect and classify various dental disorders such as Dental Caries, Fluorosis and Plaque in images captured by an ESP32 camera module powered by an Arduino Uno. The images captured from ESP32 could also be viewed through the website hosted by clicking the button on the website, which redirects the webpage to Google Drive folder.

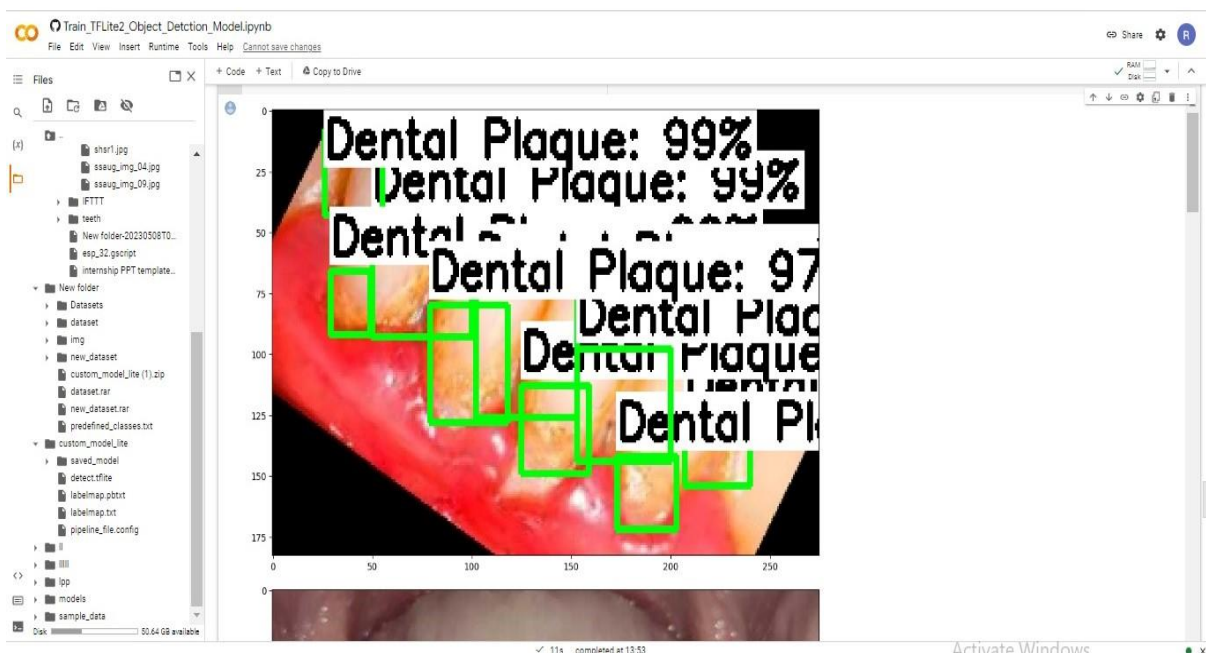


Fig 2. Test Image (Dental Plaque)

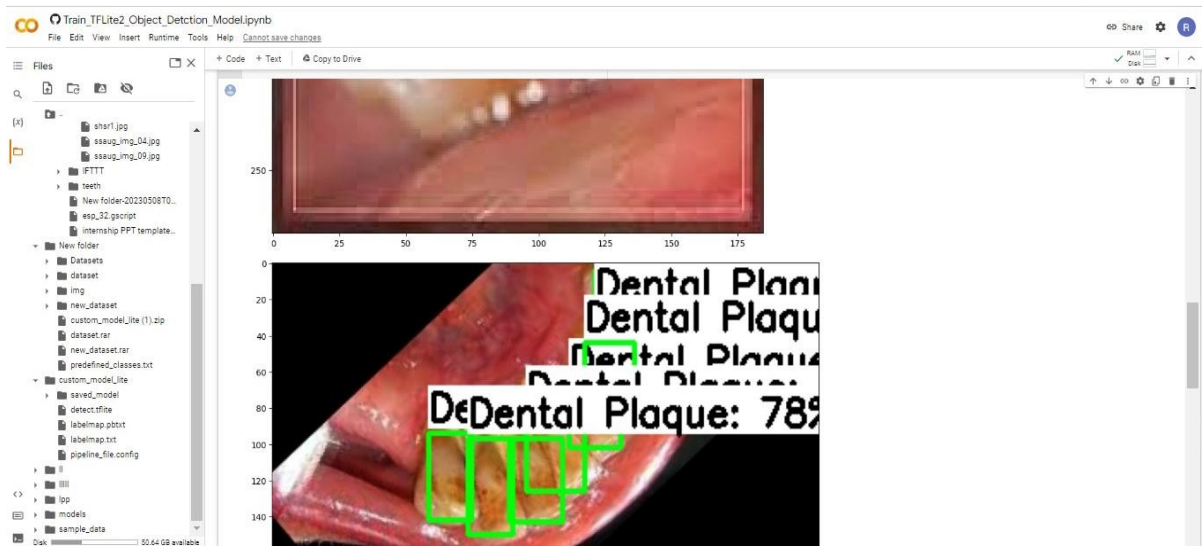


Fig 3. Test Image (Dental Plaque)

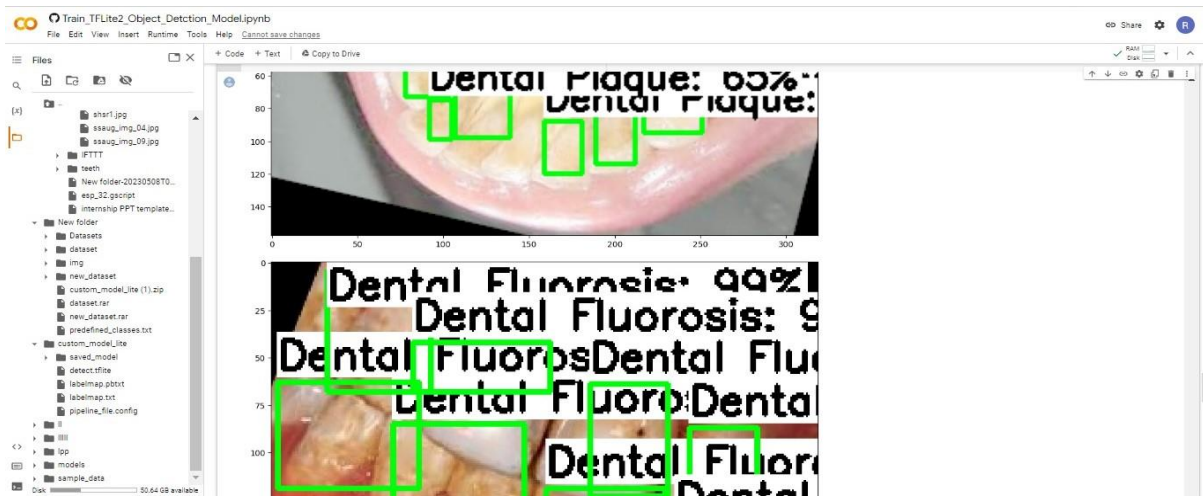


Fig 4. Test Image (Dental Fluorosis)

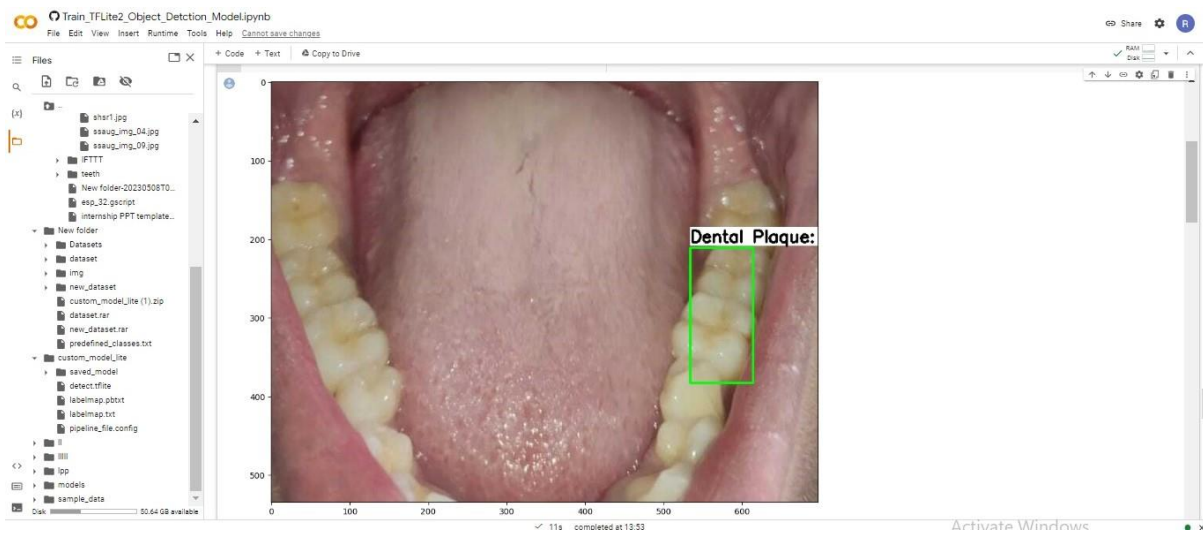


Fig 5. Real Time Test Image (Dental Plaque)



Fig. 6. Real Time Test Image (Dental Caries)

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Sl No.	Name	Disorder	Teeth Health	Recovery %	Dentist Specialized
1	Nagaraj Ganapati Bhat	Example:If Cavity	Example:95%	Example	Example
2	Chandan Kumar U	Example:If Fluorosis	Example:95%	Example	Example
3	K Keshava D Hegde	Example:If Plague	Example:95%	Example	Example
4	Adheesha S U	Example:If Caries	Example:95%	Example	Example

Example: Dental Image

[See Results](#)

Fig 7. Project Website Hosted

Drive [Sign in](#)

ESP32-CAM [Download all](#)

Name	Owner	Last modified	File size
can2.jpg		Mar 10, 2023	13 KB Download
can3.jpg		Mar 10, 2023	12 KB
den4.jpg		Mar 10, 2023	11 KB
klo.jpg		May 9, 2023	76 KB
lko.jpg		May 9, 2023	83 KB
pla_01.jpg		Apr 30, 2023	19 KB
pla_03.jpg		Apr 30, 2023	18 KB
pla_04.jpg		Apr 30, 2023	17 KB
pla_12.jpg		Apr 30, 2023	19 KB

Fig 8. Google Drive folder upon clicking See Results on website hosted

CONCLUSION

The project demonstrated the feasibility, qualitative and effectiveness of applying image processing and deep learning techniques or algorithms such as Mask R-CNN to the problem of diagnosing dental disorders from images. The project also showed that a simple and inexpensive hardware setup consisting of Arduino Uno and ESP32 camera module could be used to capture and transmit the images to Google Drive folder, where they can be processed by Google Colab using Mask R-CNN algorithm to detect objects in images.

FUTURE SCOPE

The project has a lot of potential for further improvement and extension. Some of the possible ways to enhance the project would be in increasing the size and diversity of the data set to include more types and cases of dental disorders and also fine-tuning the hyperparameters of the Mask R-CNN model to optimize its performance; more features could be added to the system.