# ORAL CANCER DETECTION USING RASPBERRY PI AND CNN FOR EARLY DIAGNOSIS

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**Keywords:**

CNN (Convolutional Neural Network), Raspberry Pi 4, Image Classification, Camera Module V2, LCD Display, Benign, OPMD, Cancer Detection


**Introduction:**

Oral cancer is one of the most common and life-threatening diseases, especially in regions where tobacco and alcohol consumption are high. Early detection plays a crucial role in improving survival rates, but most cases are diagnosed at later stages due to lack of accessible and affordable screening methods. Traditional diagnostic procedures require expert medical professionals, laboratory testing, and advanced equipment, which are not always available in rural or low-resource areas.

To address this problem, this project proposes a simple and portable oral cancer detection system using a Raspberry Pi and Convolutional Neural Network (CNN). The system captures images of the oral cavity using a Raspberry Pi Camera Module V2 and processes them locally without requiring internet connectivity.

The CNN model is trained to identify patterns such as color changes, texture variations, and irregularities in oral tissues. Based on this analysis, the system classifies the condition into categories such as benign, OPMD (Oral Potentially Malignant Disorder), cancer, and non-cancer.

The result, along with the captured image, is displayed on an LCD screen, providing immediate feedback. This approach reduces dependency on complex infrastructure and enables early screening. The project highlights the use of artificial intelligence in healthcare and demonstrates how low-cost embedded systems can be used for real-time medical applications.

**Objectives:**

The main objective of this project is to develop a portable and efficient system for early detection of oral cancer.

The system aims to capture oral images using a camera module and process them using a trained CNN model. It is designed to classify images into benign, OPMD, cancer, and non-cancer categories.

Another objective is to display the results clearly on an LCD screen for easy understanding. The project also focuses on creating a low-cost and user-friendly solution that can be used in rural and remote areas.

**Methodology:**

The system begins with image acquisition using the Raspberry Pi Camera Module V2, which captures oral cavity images in real time. These images are sent to the Raspberry Pi 4, where the trained CNN model is stored in the microSD card.
Before feeding the image into the CNN model, preprocessing steps such as resizing and normalization are performed to ensure consistency in input data. These steps help improve the accuracy of the model by reducing variations caused by lighting and positioning.

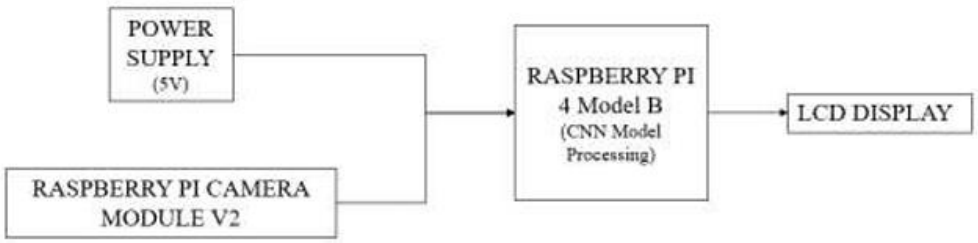


Figure 1: Block Diagram

The processed image is then given as input to the CNN model. The model analyzes important features such as texture, color, and irregular patterns present in the oral tissue. Based on these features, the model classifies the image into one of the predefined categories: benign, OPMD, cancer, or non-cancer.
After classification, the output result is generated and sent to the LCD display. The LCD shows both the captured image and the corresponding classification result, making it easy for the user to understand.
The entire system works as a standalone device without requiring external computing resources. The integration of hardware and software ensures smooth operation and real-time performance.

**Result and Conclusion:**

The developed system successfully captures oral images and processes them using the trained CNN model. The model is able to classify images into different categories such as benign, OPMD, cancer, and non-cancer with satisfactory accuracy.
The results are displayed in real time on the LCD screen along with the captured image, providing clear and immediate feedback. The system demonstrates stable performance under different conditions and shows good consistency in classification.
Graphs obtained during training indicate that the model improves accuracy over time while reducing loss, showing effective learning behavior. The classification results also highlight

that the model performs better for certain classes while having scope for improvement in others.
Overall, the project proves that a combination of CNN and Raspberry Pi can be effectively used for early-stage oral cancer detection. It provides a simple, fast, and cost-effective screening solution.

**Project Outcome & Industry Relevance:**

The project demonstrates a practical implementation of an AI-based oral cancer detection system using low-cost hardware. It shows how deep learning models can be deployed on embedded systems for real-time healthcare applications.
This system can be used in hospitals, clinics, dental camps, and rural healthcare centers for early screening. It reduces dependency on specialized equipment and supports quick preliminary diagnosis.
Industries such as healthcare technology, medical devices, and telemedicine can adopt this approach to develop affordable diagnostic tools. The project contributes to the growing field of AI in healthcare and supports the development of smart medical devices.

**Working Model vs. Simulation/Study:**

This project is a physical working model.
It includes hardware components such as Raspberry Pi 4, Camera Module V2, micro SD card with trained CNN model, and LCD display. The system captures real-time images, processes them, and displays results, demonstrating a complete working prototype.

Figure 2: Prototype

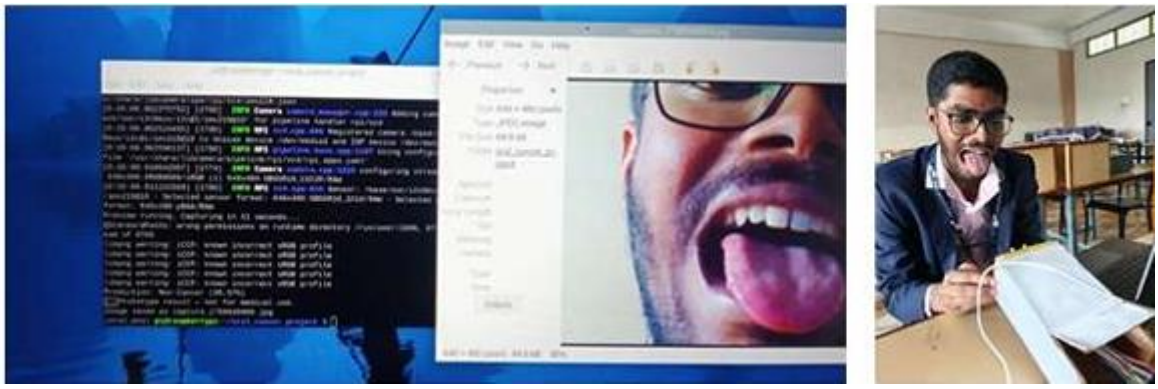

Figure 3: Prototype Functionality

**Project Outcomes and Learnings:**

The project successfully implements a real-time oral cancer detection system using CNN and Raspberry Pi. It demonstrates the feasibility of deploying AI models on embedded systems for healthcare applications.

Through this project, we learned how to collect and preprocess image datasets, train CNN models, and deploy them on hardware. We also gained experience in integrating camera modules and display units with embedded systems.

Additionally, we understood challenges such as model accuracy, real-time processing, and system optimization. The project enhanced our knowledge in artificial intelligence, image processing, and embedded system design.

Figure 4: Results

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## Future Scope:

The future scope of this project includes improving the accuracy of the CNN model by training it on larger and more diverse datasets. This will help the system generalize better and detect conditions more reliably.

The system can be enhanced to provide more detailed classifications, such as identifying whether the condition is caused by smoking or tobacco usage. Integration with cloud technology can enable remote monitoring and data storage for medical analysis.

A mobile application can also be developed to connect with the system, allowing doctors to access results remotely. The hardware design can be further miniaturized to make the device more compact and user-friendly.

Advanced features such as voice assistance, multilingual support, and automated report generation can be added to improve usability. Future work can also focus on integrating additional sensors or imaging techniques to enhance diagnostic capability.