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## Notice for the PhD Viva-Voce Examination

Ms M Lalasa, Registration Number: 2170277, PhD Scholar at the Department of Computer Science and Engineering, School of Engineering and Technology, CHRIST (Deemed to be University) will defend her PhD thesis at the public viva-voce examination on Thursday, 26 February 2026 at 10.30 am in the CDI Conference Hall, Block V, Bangalore Kengeri Campus, CHRIST (Deemed to be University), Bengaluru - 560074, Karnataka, India.

- Title of the Thesis** : **A Multimodal Temporal Hybrid Deep Learning Model for Cervical Cancer Detection**
- Discipline** : **Computer Science and Engineering**
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The members of the Research Advisory Committee of the Scholar, the faculty members of the Department and the School, interested experts and research scholars of all the branches of research are cordially invited to attend this open viva-voce examination.

**Place:** Bengaluru  
**Date:** 10 February 2026



**Registrar**

## ABSTRACT

Cervical Cancer (CC) is a major contributing factor of mortality caused by cancer in women across the world. It is a malignancy that appears in the lower reproductive tract of females due to a virus transmitted sexually, called Human Papillomavirus (HPV). Artificial Intelligence (AI) has the potential to support the medical field in divisions like diagnosis, prognosis, personalized treatment and drug discovery etc. Machine Learning (ML) and Deep Learning (DL) are two such subfields that have methods that can aid in the same. In this research, a mix of both ML and DL models is used in combination with a nature-based metaheuristic optimizer to identify CC by analysing the colposcope images. Initially, a crucial preprocessing step of removing Specular reflections (SR) is carried out using a SWIN Transformer following which the colposcope images are segmented using an Enhanced Gaussian Mixture Model (EGMM) optimized with a Mexican Axolotl Optimization (MAO) Algorithm to extract the cervix Region of Interest (ROI). Subsequently, a hybrid modal attention module that complementarily amalgamates clinical information attributes extracted through a Random Forest (RF) with the multi-state image features extracted through an EfficientNet model. The weighted final feature vectors of each case are classified into 'Cancer' and 'Normal' cases. During the SR removal stage, dice score of the SWIN transformer is 0.948564 and Jaccard index is 0.697252 implying the specular areas are removed appropriately without loss of information. The GMM enhanced with mexican axolotl optimizer has a sensitivity of  $0.9514 \pm 0.0366$ , specificity of  $0.968 \pm 0.0338$ , Dice score of  $0.9082 \pm 0.0926$ , Jaccard index of  $0.735 \pm 0.0943$  along with loss value of  $0.264 \pm 0.0943$  and accuracy of  $0.9491 \pm 0.0296$  confirming high overall correctness in segmentation, with low variability indicating reliable performance across the dataset. The hybrid modal attention-based classification demonstrated an precision of 93.32%, accuracy of 93.96%, F1 score at 94.21, recall rate of 95.13%. The outcome indicates that the developed model attains remarkable results and the clinical validation of the model shows its robustness. The conclusions drawn from this thesis support the hypothesis that the incorporation of colposcopic image data with DL frameworks enhances the diagnostic accuracy of CC identification. The proposed methods enable the identification of subtle morphological patterns, thereby facilitating early diagnosis and timely clinical intervention. These contributions advance not only the development of new knowledge and approaches in CC research but also the potential for innovative technologies in medical image-based cancer diagnostics.

**Keywords:** *Cervical cancer, Gaussian mixture model, segmentation, classification, Efficientnet, attention mechanism, multimodal data.*

### Publications:

1. **Mukku, L., & Thomas, J. (2025).** EGMM: removal of specular reflection with cervical region segmentation using enhanced Gaussian mixture model in cervix images. *Multimedia Tools and Applications*, 84(9), 6273-6294.
2. **Mukku, L., & Thomas, J. (2024).** CMT-CNN: colposcopic multimodal temporal hybrid deep learning model to detect cervical intraepithelial neoplasia. *International Journal of Advances in Intelligent Informatics*, 10(2), 317-332.
3. **Lalasa, M., & Thomas, J. (2022, December).** A review of deep learning methods in cervical cancer detection. In *International Conference on Soft Computing and Pattern Recognition* (pp. 624-633). Cham: Springer Nature Switzerland.