



**INFORMATICS
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INFORMATICS INSTITUTE OF TECHNOLOGY
In Collaboration with
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**CLASSIFY SAPPHIRES NATURAL STATE BASED ON
INCLUSIONS**

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Abstract

Gem Industry is a very prominent industry in Sri Lanka, and Gem Businessmen and Customers require certifications to verify the gemstone's quality to conduct businesses. So they go to Gem Laboratories to get their certifications from authorized Gemologists. Gemologists, who are experts in gemstones, currently use microscopes to examine tiny details which are "Inclusions" within gemstones to determine their natural state, quality and authenticity. This process is time-consuming, tiring, and prone to errors. To improve this process and give Gemologists a tool to make their certification process easier and efficient I have conducted this research. In this thesis I have researched the possibility of improving certification process with the usage of CNN. Also this study assesses existing methods related to gemstone industry and CNN.

This study adopts a structured methodology to develop a machine learning model for detecting gemstone inclusions, focusing specifically on sapphires. Requirement gathering was conducted through interviews with gemologists and insights from prior experience in gem labs. The system is designed and developed using Object-Oriented principles, with Python as the primary programming language, ensuring modularity, consistency, and reusability. Data preprocessing and image processing techniques, such as resizing and contrast enhancement, are used to prepare the dataset. A CNN model is then trained and evaluated using performance metrics like accuracy and precision, with prototype testing to refine usability based on gemologist feedback. Potential risks, such as insufficient data and hardware limitations, are addressed through strategies like data augmentation and cloud computing. This methodology provides a clear path for achieving an effective, user-friendly inclusion detection model.

Evaluation of system demonstrated promising performance in classifying sapphire inclusions, indicating that CNN-based approaches can effectively assist gemologists in the gem state classification process. Though still in development, early results validate the feasibility of the proposed system. Evaluators appreciated the system's use case and ability, and they preferred more precision if they want it to be used in real working environment.