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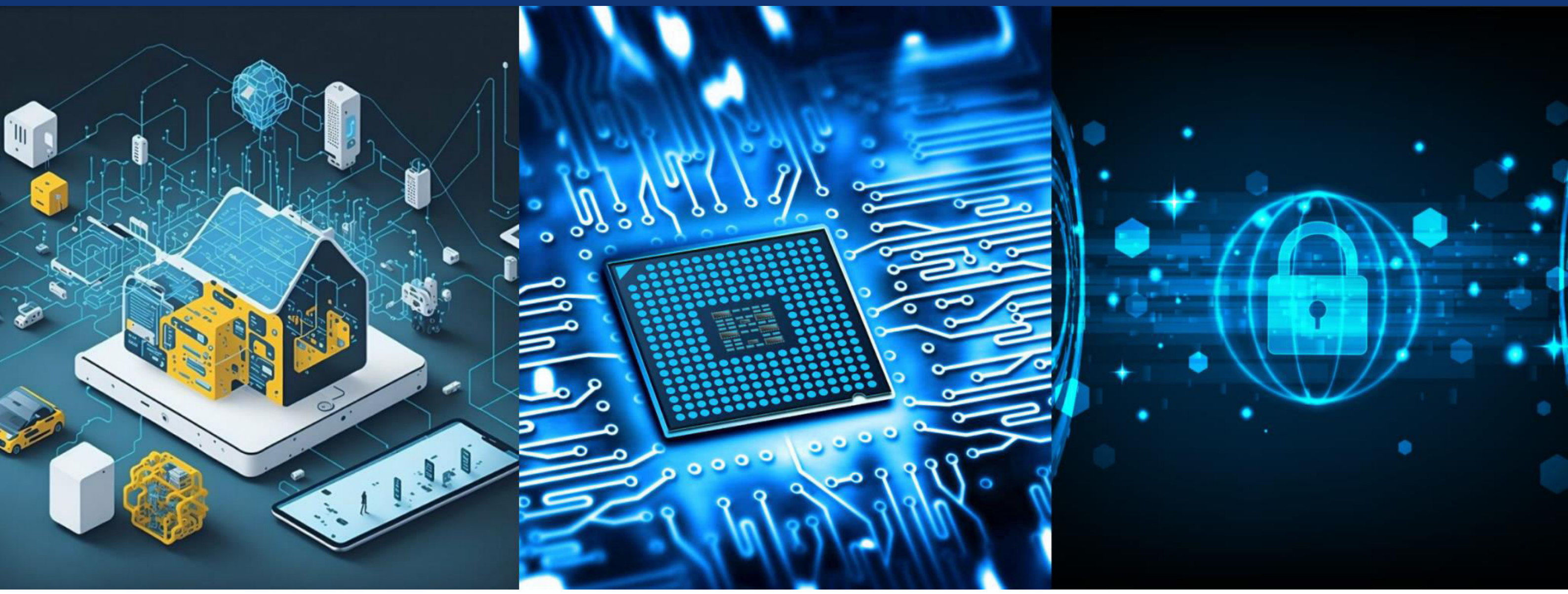

International Journal of Innovative Research in Computer and Communication Engineering

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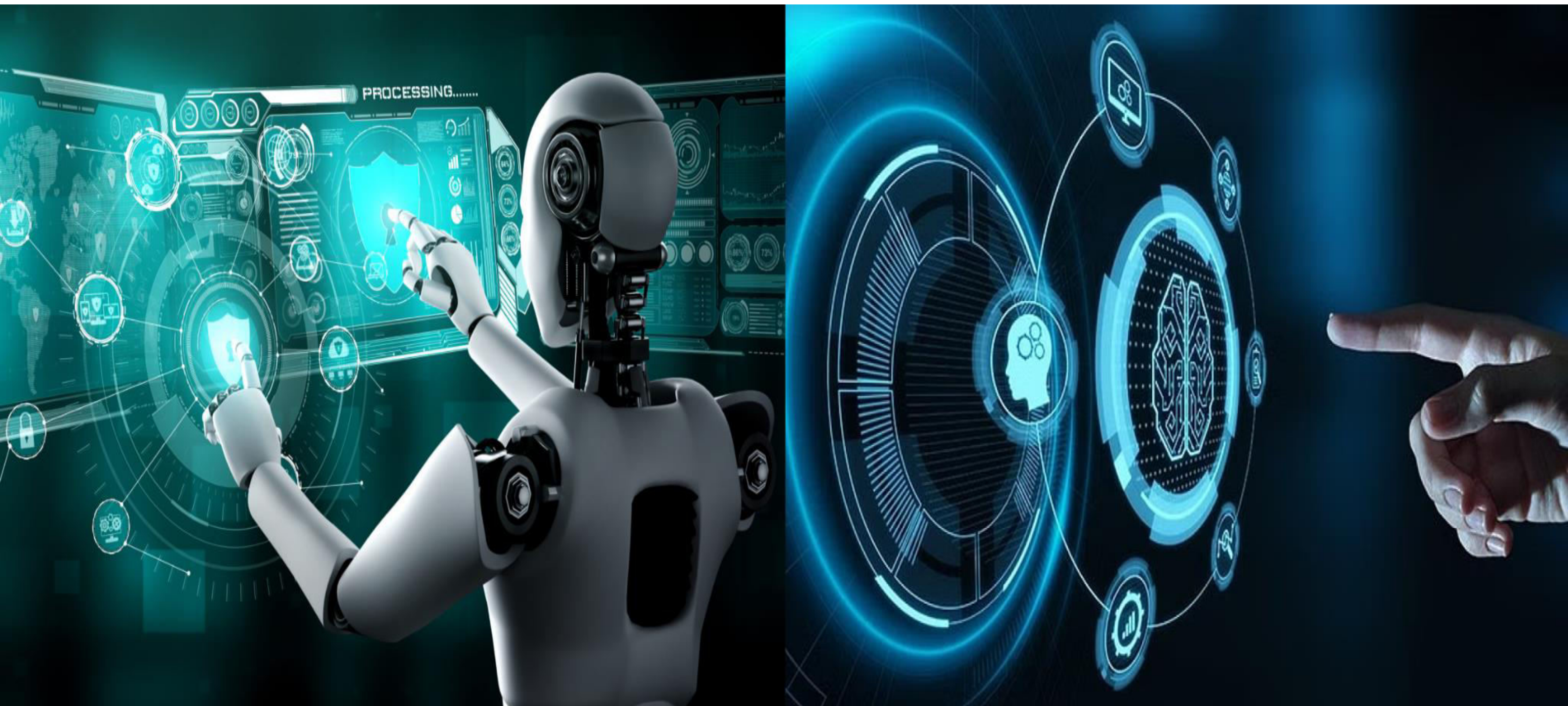

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Anomaly Detection in Manufacturing Process using Vision Transformer

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ABSTRACT: This project utilizes Vision Transformer (ViT) deep learning models for automated defect classification in screw manufacturing. The dataset includes four anomaly classes: scratch_head, scratch_neck, thread_side, and thread_top. The model, trained using TensorFlow with data augmentation, achieves an 84.2% accuracy on the test set. A Flask-based web application enables real-time defect classification from uploaded images. This automated solution enhances quality control, reduces human effort, and improves defect identification efficiency, contributing to a more consistent and cost-effective manufacturing process.

KEYWORDS: Anomaly Detection, Vision Transformer, Quality Control, Deep Learning.

I. INTRODUCTION

Manufacturing industries require precise and efficient quality control to detect defects and minimize production costs. Traditional inspection methods are labour-intensive and prone to errors, making automated defect detection a valuable solution. This project employs a Vision Transformer (ViT) model to classify screw defects into four categories: scratch_head, scratch_neck, thread_side, and thread_top. Using deep learning and data augmentation, the model improves defect identification accuracy. A Flask-based web application enables real-time image classification, enhancing quality control efficiency while reducing human dependency in manufacturing.

II. RELATED WORK

Traditional anomaly detection in manufacturing relied on manual inspection and rule-based methods, which were error-prone and inefficient. With deep learning advancements, CNN-based models like VGG19 and ResNet improved defect classification but struggled with capturing long-range dependencies. Vision Transformer (ViT) has emerged as a superior alternative, excelling in fine-grained defect detection by leveraging global spatial relationships. Recent studies highlight ViT's effectiveness over CNNs in industrial applications. This project builds on these advancements by employing ViT for screw defect classification and integrating a Flask-based web application for real-time detection.

III. METHODOLOGY

Data Preprocessing

Data preprocessing is a crucial step in preparing raw images for training the Vision Transformer (ViT) model. This module involves resizing images to a standard dimension of 224x224 pixels to meet the input requirements of the model.

Data Augmentation

To enhance model generalization and reduce overfitting, data augmentation techniques are applied to the dataset. This module involves transformations such as rotation, width and height shifts, shear, zoom, and horizontal flips. By increasing the diversity of training samples, data augmentation ensures that the model performs well on unseen images.

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ViT Model Training

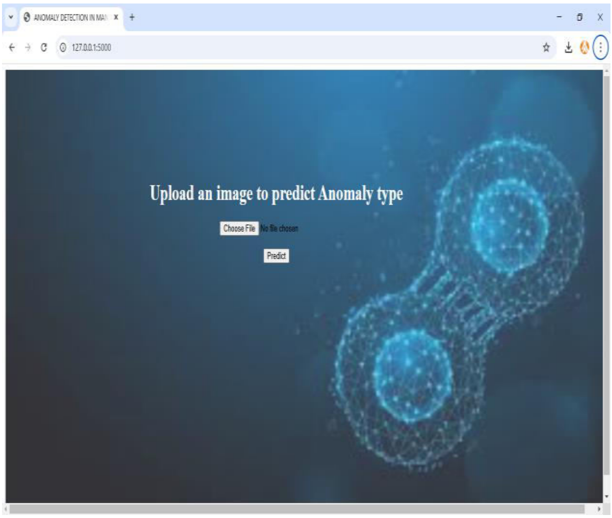
The Vision Transformer (ViT) model is trained using the pre processed and augmented dataset. This module involves fine-tuning a pre-trained ViT model on the screw defect classification task. The model is compiled with categorical cross-entropy loss and optimized using the Adam optimizer for efficient learning.

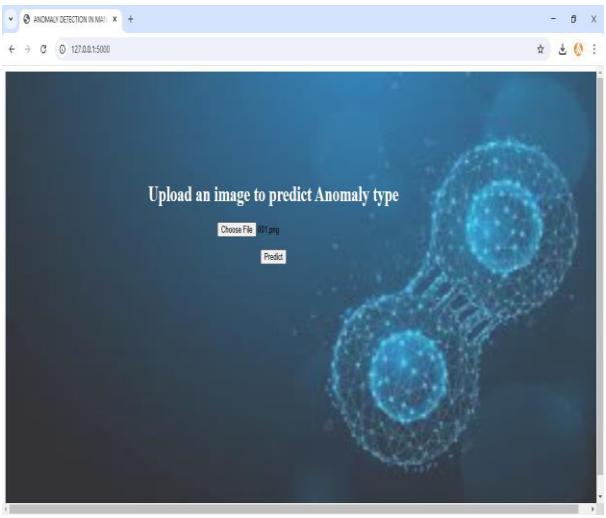
Model Performance

This module evaluates the trained ViT model using standard performance metrics such as accuracy. The model's predictions on the test dataset are analysed to determine its effectiveness in defect classification. A confusion matrix is generated to assess the classification accuracy for each defect category.

Classification

The classification module is responsible for real-time defect detection using the trained ViT model. A Flask-based web application allows users to upload images, which are processed and classified instantly. The system takes the uploaded image, applies the necessary preprocessing steps, and feeds it into the trained model for prediction.





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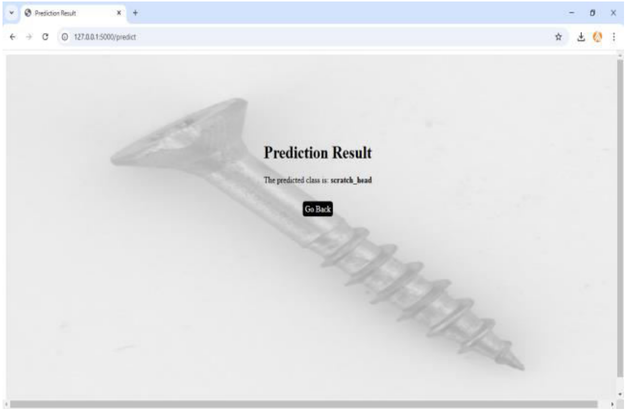

IV. CONCLUSION

This project successfully applies Vision Transformer (ViT) for automated screw defect classification, achieving an accuracy of 84.2%. By using deep learning and data augmentation, the model effectively detects four types of screw anomalies. A Flask-based web application enables real-time defect detection, streamlining quality control. The solution reduces reliance on manual inspection, improving efficiency and consistency. Overall, it offers a cost-effective, scalable approach to enhancing manufacturing quality.

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