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| **Precision Silviculture: Real-Time Thinning Assessment** |
| **Abstract:** This project introduces a real-time thinning assessment tool for forestry silviculture, utilizing UAVs and deep learning. The tool is capable of analysing tree density, species composition, and environmental factors from various data sources, including pictures, videos, and streams. Additionally, it provides tree detection results and stocking information.  **Introduction:** The study reviews existing literature on tree counting and detection through remote sensing techniques and deep neural networks, identifying a gap in convenient and practical tree-counting software. The aim and scope of the project are to develop an intelligent tree-counting software for real-time thinning assessment.  **Methods:** The project comprises three main phases: data collection and labelling, model training, and software development.  Data Collection and Labelling: The optimal drone settings for image capture are determined, and data are collected from four different forests with varying ages and thinning conditions. A total of 25,794 instances are labelled across 80 images using an open-source library and model-assisting annotation pipeline.  Model Training: YOLOv8-m is selected as the target model due to its balance between accuracy and speed. The model is trained on 58 labelled images for training and 14 for validation, with testing conducted on 8 labelled images from a post-thinning block. Performance metrics such as precision, recall, and mean average precision are reported.  Software Development: A user-friendly software compatible with Windows operating systems is developed utilizing the OpenCV DNN module and CPU for inference. The software offers three branches for picture, video, and stream inference, providing tree detection results and stocking information.  **Results:** The trained model achieves a mean average precision of 84% on the validation dataset and 92.5% on the testing dataset. The software demonstrates high accuracy and speed in real-time thinning assessment across various data types, with the capability to save inference results for further analysis.  **Conclusion:** This project introduces a prototype tree-counting tool capable of providing real-time feedback on thinning operations, facilitating more efficient and informed decision-making for forestry managers. While the tool exhibits limitations such as model performance stability, drone platform, and output format, future work aims to address these issues and enhance the tool's functionality. |