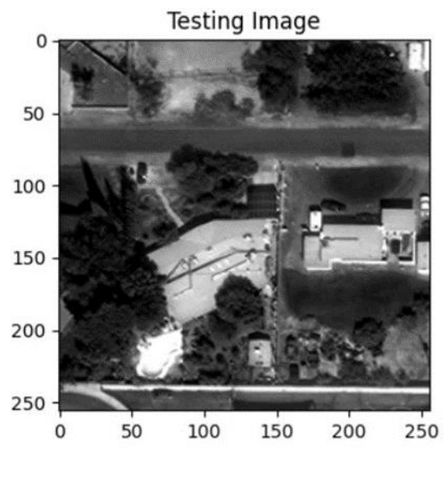
Classification of satellite images to create a map of the settlement area

ABSTRACT

This study aims to use advanced deep learning algorithms to automate the classification of satellite-taken land images, in order to facilitate the creation of detailed urban area maps. The study was conducted using object detection algorithms like AlexNet, VGGNet, InceptionNet, and ResNet. Classification of satellite images was done using the TensorFlow machine-learning framework [1]. Key performance metrics, such as Intersection Over Union (IOU), Dice Coefficient, and Pixel Accuracy [2], were employed to evaluate the accuracy of the classification.



PROJECT DESCRIPTION

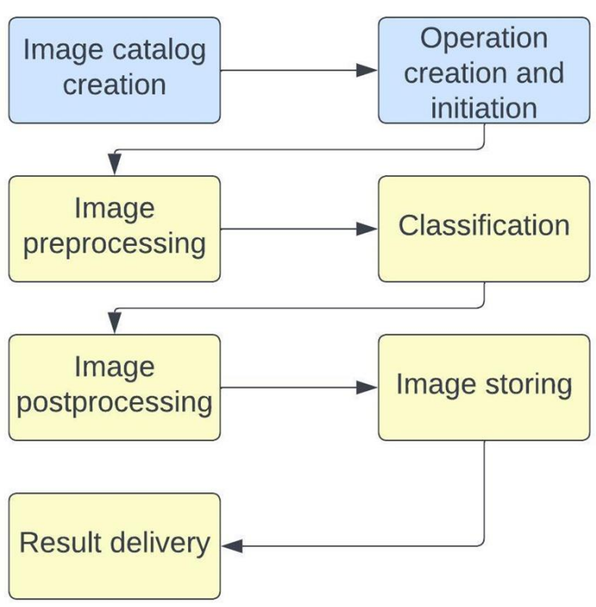
The aim of this study is to innovate and push forward in the field of urban mapping by blending state-of-the-art deep learning techniques with user-oriented software design. Users can upload satellite images to the system, which then utilizes cutting-edge algorithms for building detection, enhancing the precision of urban structure maps.

Central to this methodology is tackling the binary semantic segmentation challenge using specialized neural network models such as U-Net, optimized for high-precision image classification.

OBJECTIVES

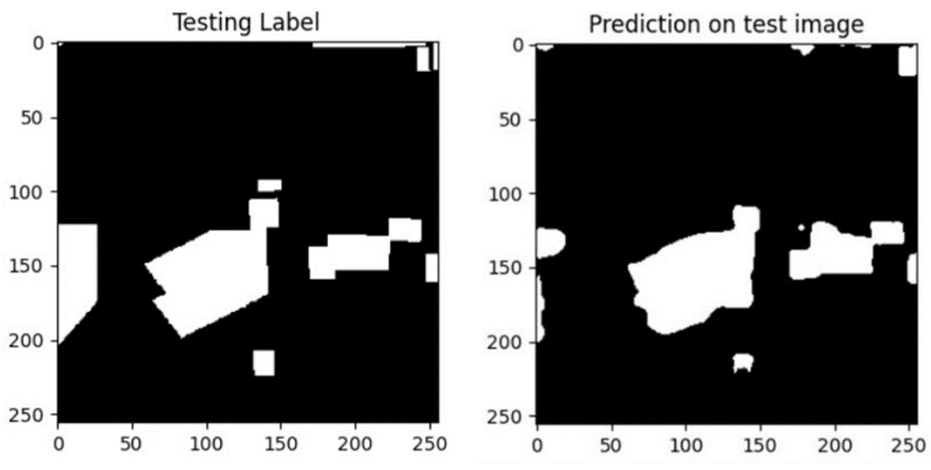
1. **Development of an automated classification platform.** A system allows users to submit satellite images effortlessly. Technologies: .NET 6 and C# with Blazor server framework.
2. **Data gathering.** This study emphasizes acquiring high-quality satellite images. It is crucial for the accuracy and effectiveness of the urban classification system.
3. **Data processing and model training.** The project focuses on refining data processing techniques and training robust deep learning models. Technologies: Python and TensorFlow.

FLOW DIAGRAM

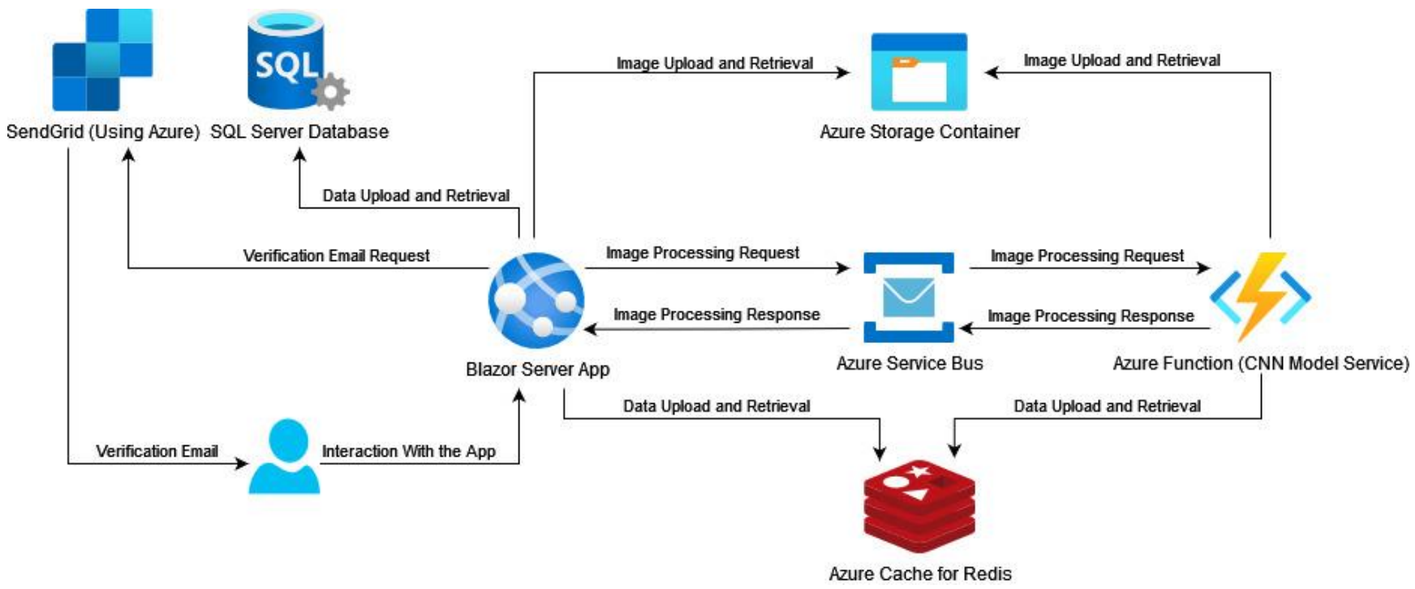


RESULTS

Convolutional Neural Network (CNN) models were used classification of satellite images in urban mapping. Metrics such as Intersection Over Union (IOU) and Pixel Accuracy were evaluated to ensure the accuracy of building segmentations in satellite images.



PLATFORM ARCHITECTURE

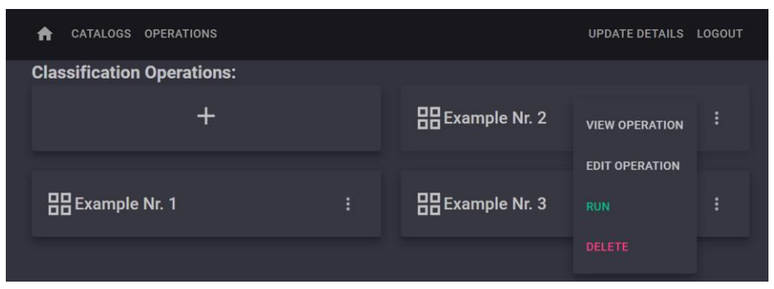


Azure Cloud: Serves as the foundational cloud environment, integrating and supporting all system components for efficient and scalable system workflow.
Azure Blob Storage Container: Stores large volumes of image data, offering scalability and easy access for processing satellite images.
Azure App Service: Hosts the system's main web application, ensuring scalable, secure user interactions and streamlined updates.
Azure SQL Server Database: Manages relational data, including user details, operation configurations, image metadata, and processing results, with robust capabilities.
Azure Function: Executes the CNN model, managing the intricate image analysis and calculation logic within a scalable, serverless environment.
Azure Service Bus: Facilitates asynchronous messaging between the main application and CNN function, enhancing communication and service decoupling.
Azure Cache for Redis: Provides high-speed caching to reduce latency and speed up data access in frequent operations.
SendGrid SaaS: Manages automated email communications such as verification emails and password resets, enhancing user engagement and system security.

CONCLUSIONS

The proposed classification system demonstrates the potential to efficiently identify buildings from other objects in each area that could be used for more precise urban planning and infrastructure development strategies. The presented system is capable of generating accurate urban maps and identifying unauthorized constructions, thereby contributing to enhanced infrastructure planning.
Future research should include other one-stage and two-stage deep learning-based object detection algorithms, post-processing techniques. Additionally, we are planning to increase the diversity of the training dataset in order to improve the generalizability of the model.

PROTOTYPE OF THE SYSTEM



REFERENCES

[1] N. Weir, D. Lindenbaum et.al. SpaceNet MVOI: a Multi-View Overhead Imagery Dataset. Computer Vision Foundation. 2019
[2] H. Choi, L. Hyun-Jik et.al. Comparative Analysis of Generalized Intersection over Union and Error Matrix for Vegetation Cover Classification Assessment. Sensors and Materials, vol. 31, no. 11 2019.

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