Chapter 4
Enabling Smart Farming Through Edge Artificial Intelligence (AI)

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ABSTRACT

This chapter explores the integration of edge AI in smart farming using technologies like edge computing and artificial intelligence algorithms. Process of deploying AI algorithms onto the edge devices such as sensors and IoT components to perform real-time data analysis and intelligent decision-making will be discussed in the chapter. The fundamentals of edge AI, its role and applications in smart farming including crop monitoring, livestock management, disease detection intelligent irrigation and decision-making will be focussed. The chapter also discusses the importance of implementing AI algorithms in edge considering hardware, software, network and optimization of AI algorithms. The chapter also discusses how Edge AI can help farmers by bringing intelligence directly to the field, reducing reliance on cloud computing, and improving data privacy and security. The chapter also discusses the challenges and considerations of deploying Edge AI systems in agricultural settings, such as resource constraints, connectivity issues, and algorithm optimisation.

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1. INTRODUCTION

Smart farming has emerged as a modern approach used in agricultural practices by integrating technologies like edge computing, Artificial Intelligence (AI) to enhance productivity and resource efficiency. This chapter focuses on the usage of edge AI in smart farming practices to enable real-time data analysis and smart decision-making. Edge AI technique can be used to deploy artificial intelligence algorithms directly onto edge devices like sensors, IoT devices rather than using centralized cloud servers. This technique helps farmers to monitor crops, manage livestock, detect diseases of crops, optimize irrigation and make better decisions.

This chapter will discuss the fundamentals of edge AI, role of edge AI in smart farming and its applications. Process of implementing edge AI in agriculture will be outlined discussing the hardware requirements, AI algorithm selection and optimization, data privacy and security. Further, the chapter will focus on the edge AI solutions for small-scale and large-scale farms. While edge AI holds benefits in smart farming applications there exist challenges ad limitations to be addressed. The chapter also explores the challenges and limitations of implementing edge AI in smart farming and the techniques to overcome these limitations. By addressing the limitations the users can leverage the full potential of edge AI in order to create efficient and productive farming systems.

2. FUNDAMENTALS OF EDGE AI

Edge AI, is the process of deploying artificial intelligence algorithms on local or edge devices instead of relying on centralised cloud servers. This process will reduce the latency allowing data to be processed in the local edge device itself. Edge AI can be used for applications requiring low latency and prone to high risks of privacy and security. This technique is used much in applications involving machine learning models. The flow of the steps involved in Edge AI is specified in figure 1. The training process of machine learning models involving large real-time datasets requires high computational facility for processing. After training process the model is deployed on the edge AI process facilitating AI features for real-time applications (Singh et al., 2023). Thus, the flow of Edge AI involves the deployment and execution of machine learning models on edge devices performing data processing and decision-making locally as shown in Figure 1.

Alt-text: Figure 1 displays the flow of Edge AI (Prajapati et al., 2023) is characterized by its ability to process data locally, reducing the dependency on cloud infrastructure, provide real-time decision-making capabilities, and address privacy and security concerns.

Also, it is considered a paradigm that brings intelligence closer to the source of data, enabling innovative applications across various domains such as agriculture, healthcare and more. With the increased demand for GPUs, NPUs and more edge AI technology has grown significantly. This demand is noticeable, as machine learning and artificial intelligence are currently trending technologies.

2.1 Overview of Edge Computing in Smart Farming

In smart farming, edge computing specifies the utilization of edge computing technologies to improve the effectiveness, yield, and sustainability of agricultural practices. Edge computing provides real-time data analysis and decision-making by bringing computational resources and AI capabilities closer to

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