"Efficient Data Processing and Analytics Frameworks for Internet of Things (IoT) Applications"

Abstract:

The exponential growth of the Internet of Things (IoT) is generating vast amounts of data, creating both opportunities and challenges in data processing and analytics. Efficient management of this data is essential for enabling real-time decision-making, optimizing system performance, and unlocking the full potential of IoT applications across diverse sectors such as smart cities, healthcare, industrial automation, and agriculture. This research aims to develop novel data processing and analytics frameworks that can efficiently handle the unique characteristics of IoT data, including its high volume, variety, and velocity.

The first component of this dissertation focuses on the design of efficient data processing architectures tailored for IoT environments. A key challenge in IoT systems is the need to process data in real-time while minimizing resource consumption, particularly in resource-constrained devices. This research will explore the integration of edge and fog computing paradigms, which move data processing closer to the source of data generation, reducing latency, and bandwidth consumption. Techniques for data aggregation, filtering, and compression will also be examined to reduce the volume of data transmitted to the cloud, thus optimizing the overall system performance.

The second focus of this research is on the development of advanced analytics frameworks that leverage machine learning and artificial intelligence (AI) to derive actionable insights from IoT data. The dissertation will explore techniques such as predictive analytics, anomaly detection, and pattern recognition to enable intelligent decision-making in real-time. Special attention will be given to the application of lightweight machine learning models that can operate efficiently on edge devices, allowing for faster and more responsive analytics without relying on cloud infrastructure.

Additionally, this research will address key challenges in the integration of heterogeneous IoT data sources. Data fusion techniques will be employed to combine information from multiple sensors and devices, improving the accuracy and robustness of analytics. Furthermore, the dissertation will investigate the balance between data privacy, security, and the need for accessible, high-quality data for analysis. The proposed solutions will be evaluated through case studies in smart cities, healthcare, and industrial IoT settings, demonstrating their practical impact on enhancing system efficiency and real-time decision support.

By addressing the critical need for scalable, efficient, and intelligent data processing and analytics frameworks, this research aims to contribute to the development of next-generation IoT systems capable of supporting a wide range of applications, while ensuring optimal performance, real-time insights, and secure data management.