The rapid urbanisation of modern societies has led to an increased demand for efficient, sustainable, and intelligent transportation solutions. Intelligent Transportation Systems play a crucial role in addressing these challenges by leveraging emerging technologies to optimise mobility services and enhance public transport accessibility. A key component of Intelligent Transportation Systems is transport mode detection, which utilises smartphone sensor data and machine learning to infer how individuals travel. This capability enhances mobility analytics, enables real-time travel behaviour analysis, and supports automated fare collection systems, reducing reliance on manual ticketing while improving public transport efficiency. However, existing transport mode detection methods often depend on centralised processing or external infrastructure, leading to challenges such as latency, increased operational costs, and privacy concerns. Additionally, a lack of standardised methodologies and datasets results in significant discrepancies between existing approaches, complicating comparisons and limiting the generalisability of research findings. Following a Design Science research methodology, this thesis explores various facets of transport mode detection through an iterative process of model development, evaluation, and refinement, with a particular emphasis on on-device solutions for mobile devices. A key contribution of this thesis is the creation of a diverse and representative dataset, spanning multiple devices, operating systems, and transport environments, which facilitates the development of methods that generalise effectively across real-life conditions. Furthermore, a structured framework for feature importance and reduction is introduced, systematically identifying the most relevant features to enhance classification performance while minimising computational overhead, making models more suitable for resource-constrained devices. Additionally, various machine learning techniques, including deep learning and traditional classifiers, are employed and evaluated. The results demonstrate the ability to infer transport modes across a wide range of modalities and operating systems, contributing toward more practical real-life implementations. Through multiple iterations, this research develops and evaluates a lightweight, platform-agnostic framework for transport mode detection, demonstrating its practical applicability in real-life scenarios with minimal computational overhead. By contributing to the standardisation of methodologies through the creation of a diverse dataset, a structured feature-importance framework, and a platform-agnostic framework that ensures cross-platform compatibility and reduces computational overhead for mobile devices, this thesis advances the fields of Intelligent Transportation Systems and Smart Mobility. The findings provide a foundation for future innovations in data-driven mobility services, supporting the transition toward adaptive, inclusive, and more efficient public transportation networks.