

# Chapter 5

## Techniques for Combining Data From Multiple Sensors

**Eram Fatima Siddiqui**

 <https://orcid.org/0000-0001-7604-0373>

*Babu Banarasi Das University, Lucknow, India*

**Mohd Mugeem**

*Sandip University, India*

**Sultan Ahmad**

 <https://orcid.org/0000-0002-3198-7974>

*Prince Sattam Bin Abdulaziz University, Alkharj, Saudi Arabia & Chandigarh University, Mohali, India*

**Hikmat A. M. Abdeljaber**

 <https://orcid.org/0000-0001-9557-3933>

*Applied Science Private University, Jordan*

**A. E. M. Eljjaly**

*Prince Sattam Bin Abdulaziz University, Saudi Arabia*

### **ABSTRACT**

*Quality data delivery and communication in an ultra-latent and real-time manner are some its stringent requirements for Internet of Things (IoT). In IoT, raw data is sensed from real-world and transformed into a usable form. Collection of this raw data from multiple sensors as compared to a single one, it is found to be of better quality and high accuracy. This method of collecting same type of data is called data or sensor fusion. In this paper a meticulous study on the role of data fusion*

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have been done with respect to its application with Internet of Things, Machine Learning (ML) and Mobile Edge Computing (MEC). This paper discusses the mechanism, multi-modal fusion techniques, past proposed standard data fusion models and related issues, along with its application with support of machine learning and Edge Computing. Lastly, the paper discusses about the concept of Edge Intelligence to deliver reliable outputs with future directions and issues.

## 1 INTRODUCTION

Data fusion methods are used in the smart environment to transform unstructured data generated by smart devices, sensors, and platforms into useful forms. Originally proposed in the 1960s, they are widely used in remote sensing, military applications, traffic systems, healthcare, finance, and pattern recognition (White, 1991). Benefits of collecting data from multiple sensors include reliable data, confidence-based results, accurate and effective results, and better prediction and estimation of observational results. IoT-based sensor networks aim to sense sensitive data, sample collected data, and extract useful information for decision-making, but issues like heterogeneity, duplication, and data loss or inference exist. The Internet of Things (IoT) has transformed industries by connecting billions of digital devices and sensors, transforming manual activities into smart procedures. With up to 3 million new smart devices deployed monthly, there is a critical need for massive processing and storage hubs for data generated from these devices. Data Science techniques, including Artificial Intelligence, Machine Learning, and Data Mining, are applied to process and extract useful information from raw data (Hall & Llinas, 1997). Edge computing in two-tier IoT-Cloud environments offers minimal latency, quick responses, and data delivery within deadlines. AI and ML techniques can be applied over edge for data fusion, providing high accuracy and better prediction (Ahmad & Afzal, 2020). A summary of various IoT Technologies can be shown in Table 1.

Table 1. Summary of various IoT Technologies.

Technology Type	Description
VANET/MANET/WANET	Decentralized and dynamic wireless networks
Wireless Mesh Networks (WMN)	A kind of wireless ad-hoc networks made of radio nodes arranged using mesh topology for data communication.
Wireless Sensor Networks (WSN)	A spatially distributed autonomous kind of network used to sense various environmental conditions.

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