


Chapter 2

Improving Water Efficiency in the Beverage Industry With the Internet of Things

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ABSTRACT

The food and beverage industry is one of the most water-intensive industries, with water required for various processes (e.g., washing, cooking, cleaning) at almost every stage of the production, as well as being a key constituent in many food and drink products. Therefore, a real-time efficient water management strategy is imperative, and the novel internet of things (IoT)-based technologies can be of significant help in developing it. This chapter presents the architecture of an IoT-based water-monitoring system followed by the demonstration of a case study of a beverage factory wherein the monitoring system helped understand the detailed water usage as well as finding solutions and addressing overconsumption of water during the manufacturing processes. The successful deployment of IoT helped reduce the annual water consumption by 6.7%, monitor water usage in real-time, and improve it.

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INTRODUCTION

Background

Out of the total existing water on earth's surface 97% is ocean water, 2.5% is entrapped in glaciers and ice and only 0.5% is accessible as freshwater (Mullen, 2012). From the abstracted freshwater about 70% is used for irrigation, 19% is used for manufacturing purposes and the 11% left is consumed for domestic usage (Luckmann, Grethe, McDonald, Orlov, & Siddig, 2014). With respect to manufacturing, water is extensively used in the food industry (Poretti, 1990). In more detail, it is estimated that food and drink industries consumption of water in 2010 was between 185.5-195.7% (Bromley-Challenor, Kowalski, Barnard, & Lynn, 2013) as shown in Table 1. With the rising world population, which is set to reach 9.7 billion by 2050 (United Nations, 2017), an increasing amount of freshwater will be needed for drinking, food production, hygiene and sanitation. This increases pressure on water resources and exposes the food industry vulnerability to water scarcity.

Problem Overview and Scope of Work

Water is an essential resource for food and drink sector as it is embedded within the food product, is needed for processing or for cleaning purposes (Casani, Rouhany, & Knøchel, 2005). This sector considers water efficiency and sustainability as the topmost priority in decision-making processes for Food Supply Chain (FSC) stakeholders (Jagtap, 2019; Jagtap, & Rahimifard, 2018). To meet both demand and supply for freshwater, a well-aware and responsive water management system is required. Only through communication, collaboration, and collective actions of all the stakeholders within the FSC, water efficient practices can be implemented (Skouteris et al. 2018; Webb, Skouteris, & Rahimifard, 2018). Hence, a real-time water consumption tracking system is needed through which a detailed information on water usage activities can be monitored to identify wastage and find the opportunities to reduce the consumption.

Table 1. Food and drink sector water use

Food and Drink Industry	Total Water Use (million m ³ /annum)	
	2007	2010
Food and Drink Manufacturing	230.9 (56.1%)	185.5-195.7 (53.4%)
Retail	10.1 (2.5%)	6.9-10.1 (2.0-2.8%)
Wholesale	1.6 (0.4%)	1.1-1.7 (0.3-0.5%)
Hospitality and Food Service	169.0 (41.1%)	153.7-158.8 (44.3 -43.3%)

Source: (Bromley-Challenor, et al., 2013)

The Internet of Things (IoT) is accepted as one of the most important areas of future technology and is gaining careful attention from a wide range of industries (Lee & Lee, 2015). The IoT concept, which aims to support the transparency and visibility, could be utilized to provide detailed information on water consumption in FSC through smart sensors and meters from each machine component to whole of the supply chain (Jagtap, et al., 2021a; Jagtap, Garcia-Garcia, & Rahimifard, 2021b). Thus, real-time water

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