An Intelligent Water Level Detection and Automatic Control System Based on IoT, Big Data and Artificial Intelligence for Smart City

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Abstract

Affected by global warming, the precipitation in various regions changes extremely. The development of novel water management techniques of ponds, therefore, performs an important role in smart city for water collection and water supply to modify and reduce disaster losses, particularly caused by the abnormal water resources. Hence, this study proposes a low-cost, energy-saving, and high-efficiency intelligent water resource monitoring IoT system. The IoT measuring system contains a distance sensor, a turbidity sensor, a PH sensor, an oxygen sensor, a motor, a pump, a drain, an MCU, a solar panel, a battery, and a wireless communication module. A schematic representation of the pumping system used in the study may be seen in Figure 1. The standard water level height, the resource allocation threshold, and the real-time balance of water resources are the three components of the proposed system. To determine the standard water level, the area's rainfall for the previous 10 years is calculated at first. After that, a machine learning-based adaptive

adjustment of the water level sensor threshold makes it less location-specific. Then, machine learning is used to implement adaptive adjustment of the water level sensor threshold, so that it is no longer limited to a single environmental area. Finally, the threshold value controls the solenoid valve or bumping motor in the field end, which collects or releases water. This study intends to use sensors to monitor water level and quality, as well as to incorporate artificial intelligence for big data analysis, which is used to improve environmental protection and city development sustainability. According to Table 1, the measuring method used in this study can increase sensor accuracy by more than 40% when compared to state-of-the-art [1] [2] technologies. And as demonstrated in Table 2, the proposed multi-step measurement improves sensor accuracy by more than 30% compared to previous devices [3][4]. In addition, the reduction of cost is more than 60%. The significance of this study lies in the success of the detection functions of the proposed system including water quality measurement and an intelligent control system, and of the self-optimizing power-saving algorithm increasing battery life by more than 200%. Thus, the application of the proposed method can not only effectively reduce the avert disasters caused by droughts, floods, or severe rains, but also reserve and distribute water resources for smart city efficiently.

Keywords: Smart city, big data, pond, Internet of Things (IoT), water level monitoring, climate change, artificial intelligence, natural disaster

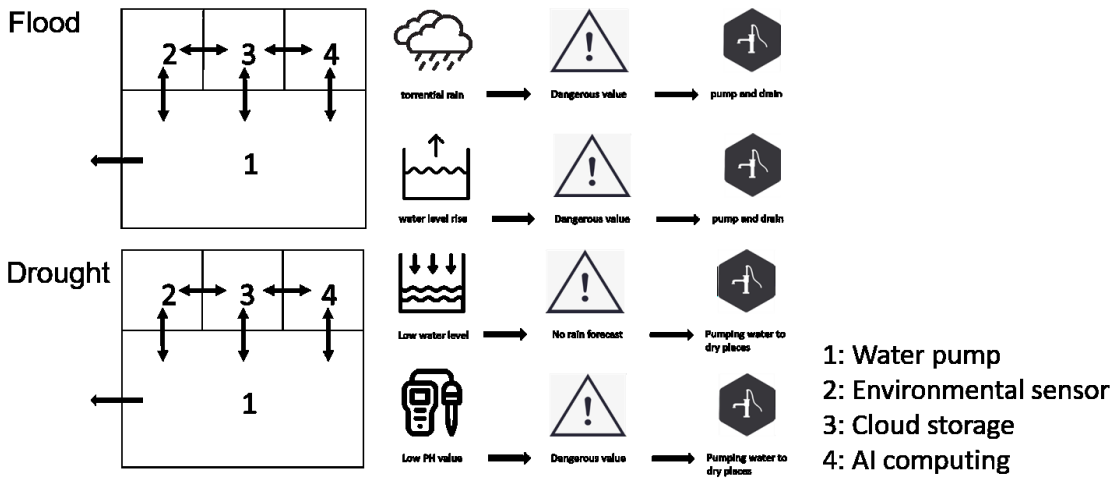


Figure 1. Schematic diagram of the operation of the pumping water

Table 1: Existing Technology Comparison Table

	Sensors J. 2021 [1]	Sensors J. 2021 [2]	**This work**
Sensor Deviation	5mm ≤1m	1.2mm≤1m 0.35%≤1m	**1mm≤1m** **0.33%≤1m**
Data Access	Wi-Fi	LORA	**LORA**
Power Supply	Battery (Solar Panel)	Battery (Solar Panel)	**Battery** **(Solar Panel)**
Application	Water Level	Water Level	**Water Level, Water Quality**

Table 2: Comparing specifications of existing products and this work

	EchoPod DL14 [3]	VEGAPULS C22 [3]	**This work**
Sensor Deviation	3mm	2mm	**1.2mm≤1m 0.35%≤1m**
Data Access	Wired	Bluetooth	**LORA**
Power Supply	Wired	Wired	**Battery (Solar Panel)**
Application	Water Level	Water Level	**Water Level, Water Quality**
Cost (US)	$298.97 (without AI)	$823.42 (without AI)	**$103.41 ($113.41 with AI)**

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