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Spatial Monitoring of River Discharge Using Low-Cost Sensors

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Abstract

Water scarcity is increasingly becoming a major and worrying concern in various global locations. In many rural regions within Kenya, the provision of reticulated water supply derived from reservoirs is either unavailable or inadequate, leading a significant proportion of households to rely on groundwater, precipitation, river runoff, or a mix thereof for their water needs. Nevertheless, the impacts of climate change have significantly diminished the accessibility of this vital resource. In recent years, there has been a noticeable global increase in population growth, resulting in high demands for both surface and groundwater extraction. This phenomenon has led to increased pressure on water resources through increased abstraction of river water, especially in the upper Tana basin, leading to diminished water availability downstream in certain streams. The escalation of abstraction rates presents a substantial peril to the economy, social, environmental, and ecological equilibrium of ecosystems. The primary objective of this research is to optimize river water abstraction spatially within the hydrological reference units. This study presents a novel river discharge monitoring system that enhances the efficiency, size, reproduction, deployment approach, and data transmission capabilities of existing systems. The primary components of the system consist of the flow velocity sensor, temperature sensor, and water level sensor. The system utilizes an Arduino Nano, which is a programmable microcontroller using an ATmega328P chip. This microcontroller is connected to a GSM SIM800L module,

enabling the transmission of data in real time to the server. The river discharge monitoring system is deployed across the hydrological reference units just before the confluence points within the Muringato catchment. In conclusion, this study integrates GIS and IoT technologies to produce low-cost prototype hardware that improves the efficiency and effectiveness of water resource abstraction by measuring discharge at various hydrological reference units. The research has the potential to provide crucial real-time data on river discharge, which contributes to the expansion of the national spatial data infrastructure and enables the efficient and sustainable extraction of water resources. Moreover, this will facilitate the informed decision-making of relevant stakeholders. The information gathered will be used to assess the applicability of the deployed system in accurately facilitating abstraction within the Muringato catchment.

Keywords: Water abstraction, Geographic Information System (GIS), IoT, and Monitoring