
# FACULTY OF ENGINEERING

# DEPARTMENT OF COMPUTER ENGINEERING

## A MOBILE-BASED IoT PREPAID WATER CONSUMPTION AND REGULATION SYSTEM

**By**

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## DECLARATION

I, **Kasozi Akim**, do hereby declare that this project report is my original work and has never been published and/or submitted for any other degree award to any other university or institution of higher learning.

Signature.....

Date.....04-JULY-2024.....

## APPROVAL

This is to certify that the project titled ***"Mobile-based IoT prepaid water consumption and regulation system"*** has been done under my supervision and is now ready for examination.

Signature.....

Date.....08/07/2024.....

Prof. Ocen Gilbert.

Department of Computer Engineering and Informatics

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## LIST OF ACRONYMS

| | |
|---|---|
| AIDC | Automatic Identification and Data Capture |
| AMR | Automatic Meter Reading |
| API: | Application Programming Interface |
| DB: | Data Base |
| HTTPS: | Hyper-Text Transfer Protocol Secure |
| IDE: | Integrated Development Environment |
| IEE: | Institution of Electrical Engineers |
| I/O: | Input, Output |
| IoT: | Internet of Things |
| MIT: | Massachusetts Institute of Technology |
| PC: | Personal Computer |
| SQL: | Structured Query Language |
| URL: | Universal Resource Locator |
| UI: | User Interface |
| Vs | Versus |
| Wi-Fi: | Wireless Fidelity |
| XSS: | Cross-site Scripting |

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**ABSTRACT**

Traditional water management systems, which rely on manual post-billing meters, face challenges such as inaccurate billing and delayed consumption notifications[1]. These systems lack real-time data, limiting user control and hindering proactive water conservation. In Uganda, about 81% of the population lacks access to piped water, largely due to high service costs associated with traditional post-billing system[2]. Manual readings often lead to billing inaccuracies, causing financial losses and reducing conservation incentives. Technological advancements, particularly IoT coupled with the use of a water flow sensor, an electromagnetic solenoid valve and an ESP32., offer solutions through real-time monitoring and prepaid models, providing users with greater control and accurate billing[3]. Implementing these technologies, supported by community engagement and policy reforms, can revolutionize water management. This project aims to develop a Mobile-based prepaid IoT Water Regulation and Consumption System to enhance water management, improve user control, and promote sustainable usage

# CHAPTER ONE: INTRODUCTION

This Chapter includes the background, the problem statement, the objectives fulfilled, the justification and scope of this project.

## 1.1 Background

Traditional water management systems heavily rely on conventional post-billing meters, where water consumption is measured manually by a service-person[1], typically at the end of a billing cycle. This postpaid model entails users being billed for their actual water usage after the consumption has taken place[4].

Despite their widespread use, traditional post-billing water management systems encounter several challenges such as inaccurate billing and delayed notifications as users receive information about their water consumption well after the fact[5]. Additionally, the lack of real-time data and limited user control hinder proactive efforts in water conservation. Out of Uganda's population of about 48.5 million, 38million people which is about 81% of the total population lack access to piped water[2]. This is contributed to the high costs incurred into water services such as connection costs, disconnection and the continuous post-billing costs[6].

The challenges observed in traditional water management systems are caused by various factors which include manual readings which are often prone to human error, contributing to inaccuracies in billing such as underestimation, overestimation or biased readings. This inaccurate billing in traditional systems may result in users being charged based on estimated or averaged consumption rather than actual usage. This can lead to a disconnect between perceived costs and actual consumption, reducing incentives for conservation. In some cases, overestimation of water usage may even prompt users to use more water to "get their money's worth" leading to financial losses for both consumers and water service providers, while the high costs associated with post-billing systems pose a barrier to accessing clean water for low-income households, perpetuating socio-economic disparities.

However, technological advancements offer promising solutions to revolutionize water management systems. The emergence of Internet of Things (IoT) technology enables real-time monitoring and control of water consumption through mobile devices and prepaid models[7]. This empowers users with greater control over their usage and ensures fair and accurate billing

## REFERENCES


[1] T. H. E. Republic, “Piped Water Supply in Uganda : How can it be affordable for all ?,” no. April 2016, pp. 1–4, 2020.

[2] “3.8 Million,” vol. 49, no. 49, pp. 1–7, 2014.

[3] J. Gichuhi, E. Khakata, and I. Kofi, “A Smart Water Management System for Detecting Household Water Wastage A Smart Water Management System Detecting Household Water Wastage,” no. December, 2023, doi: 10.1051/e3sconf/202346900017.

[4] H. Foothill, “Traditional Water Management System and Agricultural Sustainability in a Chapter 16 Traditional Water Management System and Agricultural Sustainability in a Himalayan Foothill Village of Assam , India,” no. January, 2022, doi: 10.1007/978-3-030-49115-4.

[5] I. On, T. H. E. Poor, and U. In, “STUDY ON WATER TARIFFS AND IMPLICATION ON THE POOR AND UNDERSERVED IN UGANDA UGANDA WATER AND SANITATION NGO NETWORK ( UWASNET ) DRAFT REPORT , OCTOBER ( 2020 ). NaNa DEVELOPMENT CONSULTANTS LIMITED,” 2020.

[6] “PC7-Final.pdf.”

[7] M. Un, T. I. N. The, O. F. The, R. For, T. H. E. Award, and O. F. A. Bachelor, “An online web basei) e-billing water,” 2012.

[8] M. Kuper, “Sharing Difficult Waters : Community-Based Groundwater Recharge and Use Sharing Difficult Waters : Community-Based Groundwater Recharge and Use in Algeria and India Jeltsje Kemerink-Seyoum,” no. February, 2023.

[9] R. A. Stewart and C. D. Beal, “Smart meters for enhanced water supply network modelling and infrastructure planning,” pp. 34–50, 2014.

[10] C. Heymans, K. Eales, and R. Franceys, “The Limits and Possibilities of Prepaid Water in Urban Africa : Lessons from the Field,” no. August, 2014.

[11] N. Water and S. Corporation, “Integrated Annual Report 2018/19,” 2018.

[12] D. White, F. Wester, A. Huber-lee, C. T. Hoanh, and F. Gichuki, “CPWF topic 3 synthesis

Water Benefits Sharing for Poverty Alleviation and Conflict Management Acknowledgemen ts," pp. 1–16.

[13] J. M. Marais, R. Malekian, N. Ye, and R. Wang, "A Review of the Topologies Used in Smart Water Meter Networks: A Wireless Sensor Network Application," *J. Sensors*, vol. 2016, 2016, doi: 10.1155/2016/9857568.

[14] 9ORCID andGiovanni Sotgiu 10ORCID Phallis, Thomas by Giustino Varrassi 1,*ORCID, Flaminia Coluzzi 2, 3ORCID, Diego Fornasari 4, Flavio Fusco 5, Walter Gianni 6, Vittorio Andrea Guardamagna 7, Filomena Puntillo 8, *Share Announcement Format _ Quote Question _ Answer Thumb _ Up Textsms Share Announcement Format _ Quote Question _ Answer Thumb _ Up Textsms*. 2016.

[15] O. Of, O. O. F. Directors, T. Of, and T. H. E. Corporation, . "1. Interpretation. P".

[16] Y. Gamal, A. Soltan, L. A. Said, A. H. Madian, and A. G. Radwan, "Smart Irrigation Systems: Overview," *IEEE Access*, vol. PP, p. 1, 2023, doi: 10.1109/ACCESS.2023.3251655.

[17] S. Abdul and R. Bukhari, "Sample Size Determination Using Krejcie and Morgan Table," no. February, 2021, doi: 10.13140/RG.2.2.11445.19687.