BUSITEMA UNIVERSITY
Pursuing Excellence

FACULTY OF ENGINEERING

DEPARTMENT OF MINING & WATER RESOURCES ENGINEERING

A FINAL YEAR PROJECT REPORT

AN AUTOMATED WATER METERING, BILLING AND MONITORING SYSTEM

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EXECUTIVE SUMMARY

Water supply is one of the booming businesses in the world today since it involves supplying of water which is an essential and basic need to the general public. This business is carried out by water utility operators who are vested with task of extracting this resource from a raw water source, treating it and supplying it to the customers.

Most water distribution companies do not sustainably manage this resource due to low technological advancement and thus follow the conventional water meter reading and billing that follows a manual process where agents of the utility physically visit the premises of the users and manually record the consumption data for bill development and delivery for payment. This is inefficient since human errors and estimation of customers' consumption information can be made during meter reading and also a lot of time and money is invested by the company during this process. The process also being manual, it has aided theft of water by bypassing the meter. In the case of leakages, water lost in due process goes unnoticed.

An Automated Water Metering, Billing, and Monitoring System that automatically takes meter readings at customers' homes and transmits them to the water office where the billings are prepared eradicates this problem. With this, the customers are given due notification of their water consumption bills through text messages having their corresponding amount to be paid. Payments are issued as usual through the bank, mobile money services, etc. and in case the bill is not paid within the grace period, the system automatically disconnects the customer. Once the bill is paid including the connection charges, the reconnection is done automatically. In case of monitoring, the system detects leakages and illegal connections in dead end water networks and then notifies the operators in office of where the problems are.

This system eradicates estimated meter readings, errors made by mechanical meters due to wrong calibration or being faulty and human errors during taking of the customers' readings. It fastens the process of metering and billing, enables quick notification of leakage points to the service provider and enables an overall better management of the service by the service provider.

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Above all, I would love to thank the Almighty God for giving me wisdom, knowledge, health and patience to learn.

Declaration

I MASERUKA S. BENDICTO, declare that all the material portrayed in this project report is original and has never been submitted in for award of any Degree, certificate, or diploma to any university or institution.

Signature **Date**

.....Maseruka B..... .....25th - May - 2016.....

Approval

This is to certify that the project has been carried out under my supervision and this report is ready for submission to the Board of examiners and senate of Busitema University with my approval.

MAIN SUPERVISOR: Mr. DAVID KIMERA

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List of Acronyms/Abbreviations

AMI	Advanced Metering Infrastructure
Etc.	Et cetera
GIS	Geographic information system
GPS	Global Positioning System
GSM/GPRS	Global System for Mobile / General Packet Radio Services
NRW	Non-Revenue Water
NWSC	National Water and Sewerage Cooperation
RF	Radio Frequency
SCADA	Supervisory Control and Data Acquisition
VAT	Value Added Tax
WALOPU	Joint Water Loss Prevention Unit
WIS	Water Billing and Information System
WSD	Water Supplies Department
dll	Direct Link Library

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f_0, f_1 Pipe friction factors without and with leakage

e pipe roughness

D pipe diameter

Q pipe flow

ΔH Increment in pressure/head loss along path

A cross sectional area of pipe

g acceleration due to gravity

ΔQ Increment in flow of water in pipe caused by leakage

Q_o Simulated flow in pipe derived by epanet

L length of pipe

L_1 length from start node of pipe segment/pipe to leakage point

a,b,c,d start and end x, y coordinates of a pipe segment or pipe

x, y leakage coordinates

m gradient of pipe segment or pipe

CHAPTER ONE: INTRODUCTION

1.0 Background of the study

Water is an essential resource for all nature to be able to sustain life and plays many important roles (MARTYUSHEVA, 2014). This resource is supplied to general public and most industries today through pipe networks which are one of the largest infrastructure assets of industrial society today (Poulakis, et al., 2003). These networks are interconnections of various components which are but not limited to transmission pipes, distribution pipes, service connection pipes, pumps, joints, valves, and fire hydrants.

The management of this vast process of supplying this resource which encompasses its extraction from a source, its transmission to a treatment plant, its treatment to desired quality standards, to its final distribution to the end user who can be an individual for domestic use or an industry for its day to day production schedule, is vested and entrusted to a water distribution company. National Water and Sewerage Cooperation (NWSC), a Government parastatal, is responsible for the distribution of Piped water to the general public in Uganda. The water utility manager or operator is tasked with planning, organizing, staffing, leading or directing, and controlling the organization to accomplish a goal. With the growth in population over the years, a strain on the water resource becomes paramount and entails this manager to derive ways on how to make sure that his resource is sustainably utilized. For such an enormous goal to be reached, optimization of these systems is done. Managers and water utility companies have also invested in many research methods that can help optimize systems today (Poulakis, et al., 2003; The Water Herald, 2014). This optimization covered by many research papers is categorised in four categories; reducing of costs of operation, loss of the precious resource, increase in precision of the whole process of operation and accuracy of measurements.

Conventionally, water meter reading and billing in many countries have largely followed a mechanical process where agents of the utility physically visit the premises of the users and manually record the consumption data for bill development and delivery for payment (MILLS, et al., 2012). This process has demerits of high operation costs to the utility companies which are through payments to the labour that takes the readings, over estimation of consumption readings at customers' premises when they are not at home, delay in

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