BUSITEMA UNIVERSITY
Pursuing Excellence

FACULTY OF ENGINEERING

DEPARTMENT OF WATER RESOURCES AND MINING ENGINEERING

FINAL YEAR PROJECT REPORT

DESIGN AND SIMULATION OF HYDROINFORMATICS TOOL FOR PREDICTING FAILURES IN WATER DISTRIBUTION NETWORKS CASE STUDY: BUKASA MAINS-KAMPALA

BY

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A final year project report submitted in partial fulfillment of the requirements for the award of a Bachelor of Science degree in Water Resources Engineering at Busitema University

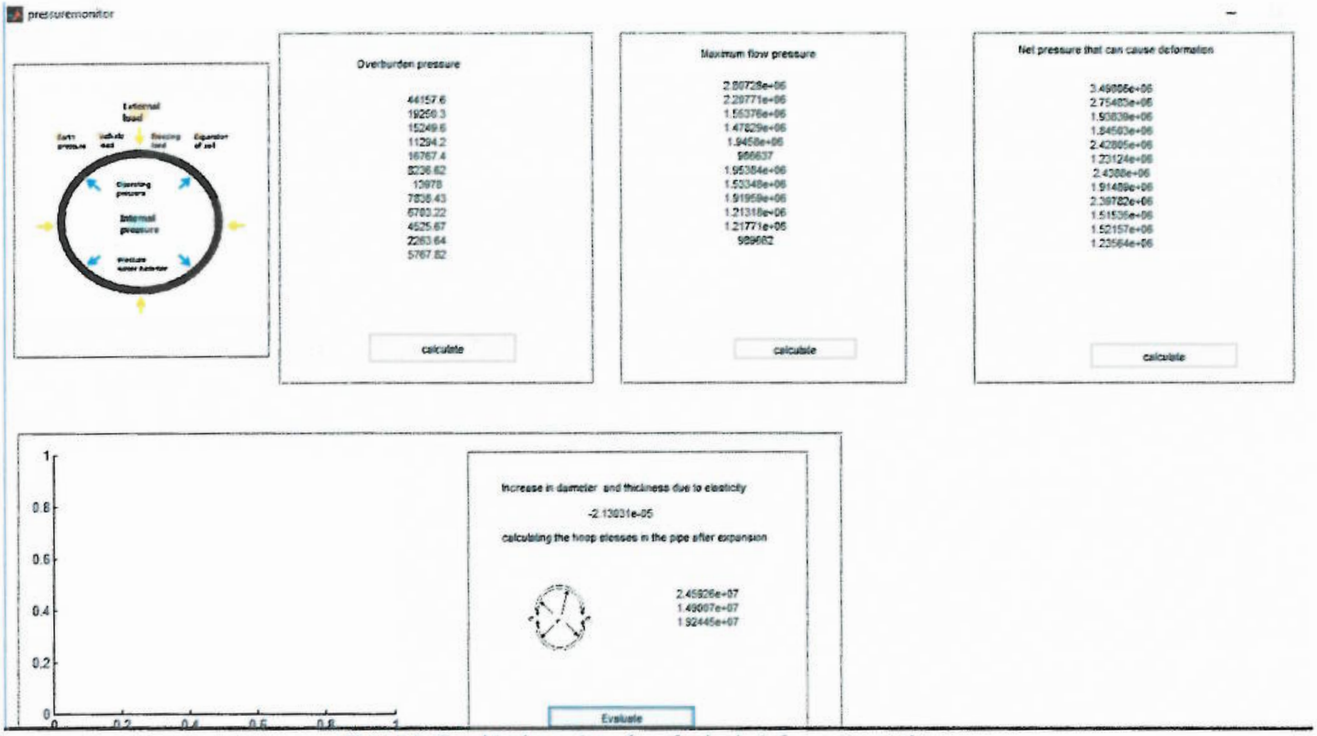

Figure 1: Graphical user interface for hydroinformatics tool

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Abstract

The need to more intelligently and efficiently manage water distribution systems is increasingly more important to agencies such as NWSC managing such networks and seeking a way to increase the reliability of their systems, the uninterrupted quality service to their customers and the cost-efficient operations and maintenance of the aging distribution networks. Repair and/or replacement of aging water mains, especially in urban environments, impose major expenditures on already financially strained municipalities and state governments, and the need to more actively engage in the monitoring and management of such networks is progressively increasing as existing distribution networks continue to age and therefore deteriorate. Current planning and maintenance strategy is furthermore challenged by insufficient knowledge and data about the prevailing water infrastructure condition and future rehabilitation demand this ignores future dynamics and planning uncertainties. A water distribution system is an important part of the social infrastructure, facilitating water transport, distribution and supply. It is a highly complicated network that combines pipelines, nodes, pumps and valves. Hence, the components in such a system should be continuously improved and updated on the basis of complete and scientific information to maintain the stability, reliability and safety of the network since they keep on deteriorating causing abrupt and recurrent failures (leakages and bursts).

The work presented in this report predicts pipe failures prior to their occurrence and gives the scientific reasons why a pipe is likely to fail and the type of failure it is undergoing. The state of a pipe at any given time is then issued to the network operators and managers through the system being developed and computer pop-ups. The condition of pipes within the network is assessed by mathematical models that were developed to check the different scenarios a pipe along the network can experience during its operation state.

The pipe network was modelled and simulated in Epanet hydraulic tool and using the mathematical models, an algorithm was developed in Matlab R2013 where the inputs are read from the Epanet network.

Declaration

I, IYEGA Hamimu Reg NO. BU-UP-2014-572 declare that all the material portrayed in this final year project report is original and has never been submitted in for award of Bachelor of Science in Water Resources engineering of Busitema University.

Signature **Date**

...H——...... 04/06/2018.....

Approval

This is to certify that this final year 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. KIMERA DAVID

Signature

Date:

June 2, 2018

CO-SUPERVISOR: Mr. MASERUKA.S. BENDICTO

Signature

Date:

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Dedication:

With grate honor I dedicate this report to my great parents Mr. BAKOLE HARUUNA AIGA and Mrs. NEIMA HARUUNA and all my caring brothers who have been supporting me since my entire life of education, thanks to you, my family, without any one of you maybe I wouldn't make it this far and for that reason I greatly appreciate all the support at your various capacities.

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My sincere gratitude goes to WAR4 class for being with me and accepting me as part of the class for the four years.

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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

PVC Polyvinyl chloride

HDPE High Density Polyethene

WDS Water Distribution System

GI Galvanized iron

1.0 CHAPTER ONE: INTRODUCTION

1.1 Background ofThe Study

A water distribution system is an important part of the social infrastructure, facilitating water transport, distribution and supply (Guen & kang, 2014). It is a highly complicated network that combines pipelines, nodes, pumps and valves. Hence, the components in such a system should be continuously improved and updated on the basis of complete and scientific information to maintain the stability, reliability and safety of the network since they keep on deteriorating causing abrupt and recurrent failures (leakages and bursts).

About 32 billion mf treated water is lost annually as leakage from urban water distribution systems (WDSs) around the world, while 16 billion m3 is used but not paid for (Agathokleous, 2015). These losses cost water utilities as much as US$ 14 billion per year, with a third of it occurring in the developing countries (Sharma, 2011). In light of global pressures (climate change, urbanization, growing populations, increasing water demand and scarcity etc.), water utilities particularly in the developing countries need to operate more efficiently to provide sustainable water services. In Uganda, the determination of these leakages and bursts is done manually by a citizen who notices leakage as a pool of water or water oozing out of the ground and notifies NWSC. Usually by this time, a lot of water is lost in wetting the soil around the pipe and the rest has seeped into the ground (Maseruka, 2015) and all these result in reduction in the water-carrying capacity of the pipes and also lead to substantial repair costs and revenue loss. In addition, water utility operators like NWSC in uganda do not have the technology to detect such failures as fast as they could to avoid extensive losses of nonrevenue water. the current methods used to deal with deteriorating pipelines involve an evaluation of the degree of deterioration based on empirical means, as well as reactive rehabilitation projects undertaken after accidents, leading to economic losses and failure to improve system functions(Guen *et al.*, 2014). The current approach to determining the rehabilitation priority order for pipelines is based only on the year of installation of the pipes, with no clear criteria for evaluating the degree of deterioration (Misiunas, 2013) According to an Engineer at NWSC, there exists a maintenance plan whereby schedule is drawn to carry out maintenance activities along the different parts of the distribution network of Kampala, looking for leakages and bursts along the network etc., however this policy is unreliable and costly. The fragmented structure of the water supply sector leads to inadequate institutional, financial and personnel resources for professional management and planning of water supply systems. Current planning and maintenance strategy is furthermore challenged by insufficient knowledge and data about the prevailing water infrastructure condition and future rehabilitation demand this ignores future dynamics and planning uncertainties.

non-functional requirements were fulfilled due to in adequate resources like funds, data, and time. Therefore, the following recommendations are suggested for future and implementation; The system should be modified to create a direct communication (link) with Epanet hydraulic tool, there should be an automatic and instantaneous detection of live loads affecting the buried pipes, the tool should in future be linked with ANN technologies to enable self-learning and prediction of future states of the network.

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