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Pursuing Excellence

FACULTY OF ENGINEERING

**DEPARTMENT OF MINING AND WATER RESOURCES
ENGINEERING**

BSc. Water Resources Engineering

FINAL YEAR PROJECT

**DESIGN OF A FLOOD MONITORING AND DETECTION SYSTEM FOR
UNYAMA RIVER IN AMURU DISTRICT**

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ABSTRACT

This project research report is about Design of a Flood Monitoring and Detection System for river Unyama.

Flood being a natural disaster, can't be prevented but its impact can be reduced.

River Unyama has been massively flooding year after year; ever since 13th May 2009 causing massive destruction of both lives and property.

This work is presented in chapter form. Chapter one is composed of the introduction to the research problem. Chapter two contains a review of literature which has been produced by other scholars and researchers about monitoring and detection systems. The third chapter presents the various methods which were employed to achieve the objectives; amongst them were: to generate the hydrological model of the catchment which was generated using ArcGIS, HEC-GeoHMS and HEC-HMS soft wares, to develop the hydraulic model of river Unyama which was done using HEC-RAS software, and to design and assemble the components that make up the system and build its prototype model where Python, JavaScript, HTML, CSS and SQL were used. The Fourth chapter presents the findings from the research and also bears the design analysis of the system like determining, sizing and selecting the components of the system. It further contains the reliability determination. In conclusion, the study was able to determine achievable flood mitigation measures, design a highly reliable flood monitoring and detection system with a working prototype model.

The main purposes of the research are to serve 1) as information channel for flooding warning when conditions exceed preset thresholds and 2) as a web based information source for the public, responding to their need for information on water condition and flooding.

The developed system is composed of three major components: sensor network,

This research was developed by using Raspberry pi 3 model B ++ microcontroller using the concept of the ultrasonic waves and groove water sensor.

DECLARATION

I KALOKWERA PONSIANO declare that this project proposal is as a result of my own research and has never been presented in any academic institution for any award.

Signature:



Date:

29th/05/2017

APPROVAL

This research project on the Design of a Flood Monitoring and Detection system was done under the supervision of;

Main supervisor

Mr. Okiryia Martin

Signature

Date.....

Co-supervisor

Eng. Badaza Mohammed

Signature

Date.....

DEDICATION

This report is dedicated to my mother Akello Teddy for her tireless efforts and sacrifices throughout my education.

ACKNOWLEDGEMENT

This project research has been out of unreserved toil, restless consultation and persistent prayer. We owe profound gratitude to a number of persons.

I thank the Almighty God for the great provision and guidance towards my final year project accomplishment.

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ACRONYMS

- FMDS -Flood Monitoring and Detection System
- WSN -Wireless Sensor Network
- GUI -Graphical user interface
- FMEA -Failure Mode and Effect Analysis
- FMEA -Failure Modes Effects and Criticability Analysis
- HTML -Hypertext Markup Language
- CSS -Cascading Style Sheets
- SQL -Standard Quantum Limit
- NARO -National Agricultural Research Organization
- UNMA - Uganda National Meteorological Authority.
- GIS -Geographical Information System
- DEM -Digital Elevation Model
- DTM -Digital Terrain Model
- DWRM -Directorate of Water Resources Management
- HEC-HMS - Hydrologic Engineering Center's Hydrologic Modeling System
- HEC-GeoHMS- Hydrologic Engineering Center's Geospatial Hydrologic Modeling System
- HEC-RAS- The Hydrologic Engineering Center's River Analysis System
- HEC GeoRAS - Hydrologic Engineering Center's Geospatial River Analysis System
- AC: Alternating Current
- DC: Direct Current
- RF: Radio Frequency
- RPN: Risk Priority Number
- USB: Universal Serial Bus
- Wi-Fi: Wireless Fidelity

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CHAPTER ONE

INTRODUCTION

A flood is a disaster where massive water spills off the river banks, lake shores or even the sea. During floods, there is an overflow of water that submerges land which is always dry. Floods often occur when there is an increase in the water level; such that excess water bursts the banks and finds its own way outside to the land which is always dry. Due to the high velocity of flow of the run-off water during the floods; there is always massive destruction of life, property, and animals occupying the affected areas.

Most of the natural disasters in the world take place in the developing countries, causing massive destruction and human suffering. Due to its geographical setting and economic dependence on agriculture, Uganda is especially vulnerable to a number of natural hazards. Among all kind of natural hazards, flood is one of the devastating, widespread and frequent. River flooding is a recurrent natural phenomenon. Floods are becoming a more pronounced disaster in many parts of the country costing lives and also damaging property. (*Kitutu, 2013*)

Among all kinds of natural hazards of the world flood is probably the most devastating, wide spread and frequent. Floods resulting from excessive rainfall within a short duration of time and consequent high river discharge damage crops and infrastructure. (*Nsengiyumva, 2012*)

Structural approaches like construction of dams, reservoirs and embankments to prevent the over bank flow from reaching the nearby settlements for flood prevention have been quite popular throughout the 1950s to 70s. However, are very cost intensive. Apart from the tangible shortcomings, protection works create a false sense of security among the settlers that leads more intensive land use in the flood-prone areas. (*Ansari, 2001*)

Over 5,000 people were affected by landslides and floods in Eastern Uganda particularly in Bududa district where an estimate of 400 people were killed in the area and 105 bodies recovered. (*DREF, 31 July 2010*)

Uganda is not exceptional because Butaleja District (Eastern Uganda) on 13 March, 2013 experienced heavy rains, accompanied by hailstorm and strong winds. In less than an hour, 40

houses had their roofs removed, while many crop fields were destroyed and a 7 year boy was crushed and killed by collapsing walls. (Mulembe, 2014)

In Uganda, river flood occurs when high rate of rainfall takes place for a long period of time in a given small region and the drainage system cannot cope with increased water volumes or when river banks burst due to increased volume of water in the river leading to destruction of property, loss of lives, busting of banks, culverts and hindering effective economic activities

River Unyama in Amuru is one of the rivers in Uganda which have been flooding seasonally but vigorously. This has resulted into massive destruction of property, livestock, crops and infrastructure.

BACKGROUND

River Unyama is located at $3^{\circ}35'09''N$ $32^{\circ}02'18''E$ / $3.58581^{\circ}N$ 32.03833° in Nimule, Atiak sub-county in Amuru District a border between northern Uganda and southern Sudan with Elegu market 70 km east of northern Uganda of Gulu.

Unyama River flooded on 13th June 2009, 1st May 2011, 7th June 2013 and 11th May 2015 bursting its banks and leaving one child killed, 5000 people stranded as people were displaced, property destroyed, lodges submerged and transportation hindered as vehicles couldn't move. (Mubiru, 2015)

Nimule, in particular is facing a serious challenge with an increasing frequency of flood in recent years from River Unyama which bursts its banks leading to displacement of people, destruction of property and hindering transportation and other economic activities.

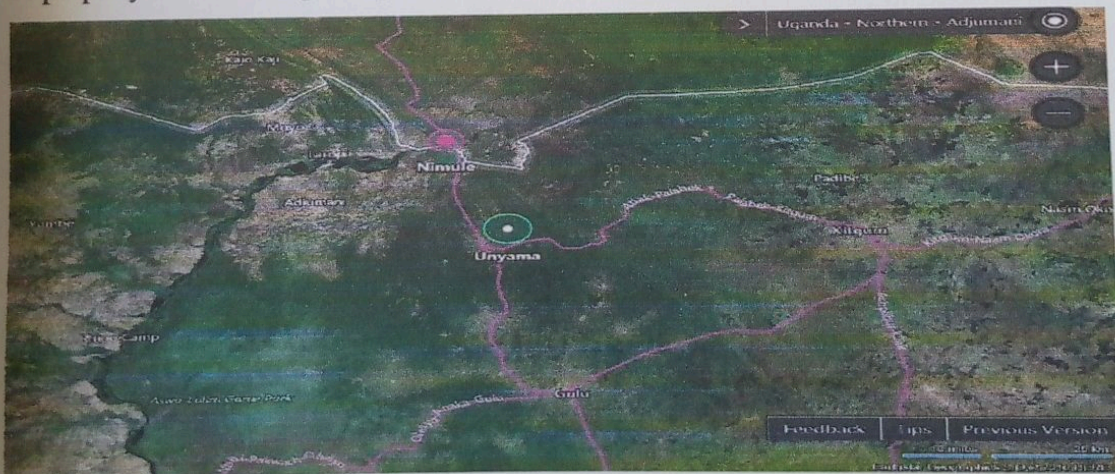


Figure 1.1 showing the location of River Unyama (Google Map, 2016)

PROBLEM STATEMENT

Due to the inadequate flood monitoring and detection system in Amuru district, River Unyama has been experiencing an increasing frequency of flood during heavy rains leading to massive destruction of lives, property and breakdown in transportation between the border thus hindering economic activities.

Causing threat to Livelihoods and infrastructure, especially Elegu market, houses, road and disruption of social and economic life of people in the area.

JUSTIFICATION

Due to the abrupt seasonal flooding of River Unyama the affected people never get time to prepare for the flood by moving to safer lands with their valuable property. This therefore results into massive destruction of both life and property season after season since floods come when people least expect them. There is need to adopt a less labor-intensive and improved water application and management technology which helps people to be aware of flooding before it occurs to minimize on the adverse effects since hydrological events are natural phenomena and may not be possible to completely avoid but can be mitigated. Designing of a flood monitoring and detection system for river Unyama is essential so that the people in the flood zone are always updated about the flood condition and also notified before flooding occurs.

This will enable people to gather in safe areas (outside flood plain zone) with their valuable property, business people to pick their goods from the market (Elegu market), vehicles to cross the border and farmers to return home before the flood.

SIGNIFICANCE OF THE STUDY

Implementation of this research project will help in designing of flood monitoring and detection system, aid future research & policy formulation and development in regards to flood mitigation; Prevention of the outbreak of water related diseases due to floods; prevent damage to property leading to improved communication, social and economic development.

OBJECTIVES

Main objective

To design a Flood Monitoring and Detection system for River Unyama

Specific objectives

To generate the hydrological model.

To develop the hydraulic model

To design and assemble the components that make up the system and test the performance of the prototype.

SCOPE OF THE STUDY.

The study was limited to designing an effective flood monitoring and detection system for River Unyama.

This research covered river Unyama in Nimule, Atiak sub county, Amuru district as a case study for developing a river level monitoring and notification system.

This research also covered designing the different parts and building a prototype for the flood monitoring and detection system.

The research was done between September 2016 to May 2017.

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