GIS-Based Automated Flood Forecast Modelling Application Using Climatic Data in Daduru Oya River Basin

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August 2021

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Dissertation submitted to the Faculty of Information Technology, University of Moratuwa, Sri Lanka for the partial fulfilment of the requirements of the Master of Science Degree in Information Technology

August 2021

Declaration

I declare that this thesis is my own work and has not been submitted in any form for another degree or diploma at any university or other institution of tertiary education. Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.

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	Date:

Dedication

To my loving parents for being the guiding light that illuminate the path of knowledge throughout my life.

Acknowledgment

First and foremost, I would like to express my sincere gratitude towards my supervisors, Professor H. M. R. Premasiri, Senior Lecturer, Department of Earth Resources Engineering, Faculty of Engineering, University of Moratuwa and Mr. B. H. Sudhantha, Dean, Faculty of Information Technology, University of Moratuwa for their guidance, supervision, advice, and support by spending their valuable time thorough out the research project to make it a success.

Furthermore, I would like to thank Mr. S.C. Premaratne, Head of the Department of Information Technology, Faculty of Information Technology and Mr. C. Wijesiriwardana, MSc. In IT Course Coordinator, Faculty of Information Technology for their support throughout the project. Not only that my thanks should go to all the lecturers in MSc. in Information Technology degree program of Faculty of IT, who gave their hands to sharpen our knowledge and ideas over the course of two years as they were the light that illuminated our path to success.

Irrigation Department contribute to this research by giving their rainfall and water level data. Special thanks to Eng. S.P.C. Sugeeshwara, Director of Irrigation (Hydrology) for his kind support without which the success of the project was not possible, and Eng. (Ms.) T. Kodippili, Eng. N. De Silva, Engineers of the Irrigation Department for initiating the contact with the department and helping to receive data needed, Eng. K.A.S. Samarajeewa, Divisional Irrigation Engineer, Wariyapola for his kind assistance and the staff of Hydrology division in Colombo for their support. So, thank you all for your great support.

Eng. N. Ranaweera, Systems Engineer, Centre for IT Services, University of Moratuwa and Mr. R. Ferdinando, Mr. S. Siriwardane GIS Solutions (Pvt.) Ltd., Esri Sri Lanka staff, Ms. U.N. Kodithuwakku, Ms. D.N.T. Gunawardhana, Mr. C.N.D. Punchihewa, Senior Assistant Librarians of the University of Moratuwa Library thank you for your valuable support in ArcGIS licensing and providing access to e-learning resources.

A big thank goes to Dr. G.V.I Samaradivakara, Head of the Department, Department of Earth Resources Engineering, Faculty of Engineering, Eng.(Ms.) S. Thiruchittampalam, Lecturer, Department of Earth Resources Engineering, Faculty of Engineering, and Ms. P. Dissanayake, Technical Officer, and Mr. S.D. Sumith, Lab Attendant, Geology Laboratory of Department of Earth Resources Engineering, Faculty of Engineering, Ms. Hashini Hemanjalee, Instructor, Shamika Ariyasinghe, Isuru Mahesh, past students and staff of Faculty of Information Technology, University of Moratuwa for their support in various stages of the project.

My heartfelt gratitude for family and friends for the support they provided me through the entire research project. I must acknowledge my husband's encouragement and all the assistance, and my two son's patience and help without which I would not have finished this thesis.

Abstract

Flood is the most common and deadliest form of disaster that affects lives and properties all around the world. Predicting natural disasters is very complex due to lack of proper methods and resources in countries like Sri Lanka. But if there is an efficient prediction system it helps to save not only lives but the environment and infrastructure too. Therefore, the aim of this study is to pave the pathway to build an efficient and effective flood prediction system through analysing available flood modelling techniques and their applications to find their strengths and weaknesses. Then the result of the study could be used to put the foundation for the main requirement of building the system to predict natural disasters. To achieve this the GIS technology, Big data analytic and IoT with machine learning techniques, two-dimensional hydrodynamic flood models, statistical models, rainfall-runoff models, Fuzzy-neuro approach and data mining and data analysis applications were analysed by a thorough review of available recent literature.

A generic model was developed to take any DEM data and a pour point feature class layer for the specific DEM to generate outputs based on other variable that could input to the model. It gave model calibration capability as well as significant time saving on tasks. Use of special tools like ‘Parse Path’ tool, gave the capability to name outputs easily and quickly. And it also made saving so efficient because it automatically saves all the results to the file path of the DEM. Due to these factors, when it starts raining in upper catchment area, could forecast due inundation area in minutes.

Including the GIS technology could improve the data quality and availability while incorporating different data sources for more in-depth analysis could give more accurate predictions. Using GIS based hydrological model, a suitable system to implement in Sri Lanka could be developed.

Abbreviations

2D – Two Dimensional

3D – Three Dimensional

AI - Artificial Intelligence

ANN - Artificial Neural Networks

API - Application Programming Interface

AWS - Automatic Weather Stations

CDMA - Code Division Multiple Access

CEB - Ceylon Electricity Board

CNN - Convolutional Neural Network

CRML - Convolution Regression based on Machine Learning

DDMCU - District Disaster Management Coordinating Units

DEM – Digital Elevation Model

DMC - Disaster Management Centre

DSTA - Dynamic Spatiotemporal Attention

ELM - Extreme Learning Machine

GIS – Geographical Information Systems

GUH - Geomorphologic Unit Hydrograph

GWO - Grey Wolf Optimizer

HEC-HMS - Hydrologic Engineering Centre's-Hydrologic Modelling System

HEC-RAS – Hydrologic Engineering Centre's-River Analysis System

HMM – Hidden Markov Model

ID – Irrigation Department

KNN - K-Nearest Neighbour

LSTM - Long Short-Term Memory

MAE - Mean Absolute Error

MAPE - Mean Absolute Percentage Error

MASL - Mahaweli Authority Sri Lanka

ML – Machine Learning

MWOA - Mutated Whale Optimization Algorithm

NBRO - National Building Research Organisation

NCDM - National Council for Disaster Management

RH - Relative Humidity

RMSE - Root Mean Square Error

RNN - Recurrent Neural Networks

SVM – Support Vector Machine

SWAT - Soil and Water Assessment Tool

UH – Unit Hydrograph

WMO – World Meteorological Organisation

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