AUN/SEED-Net JICA

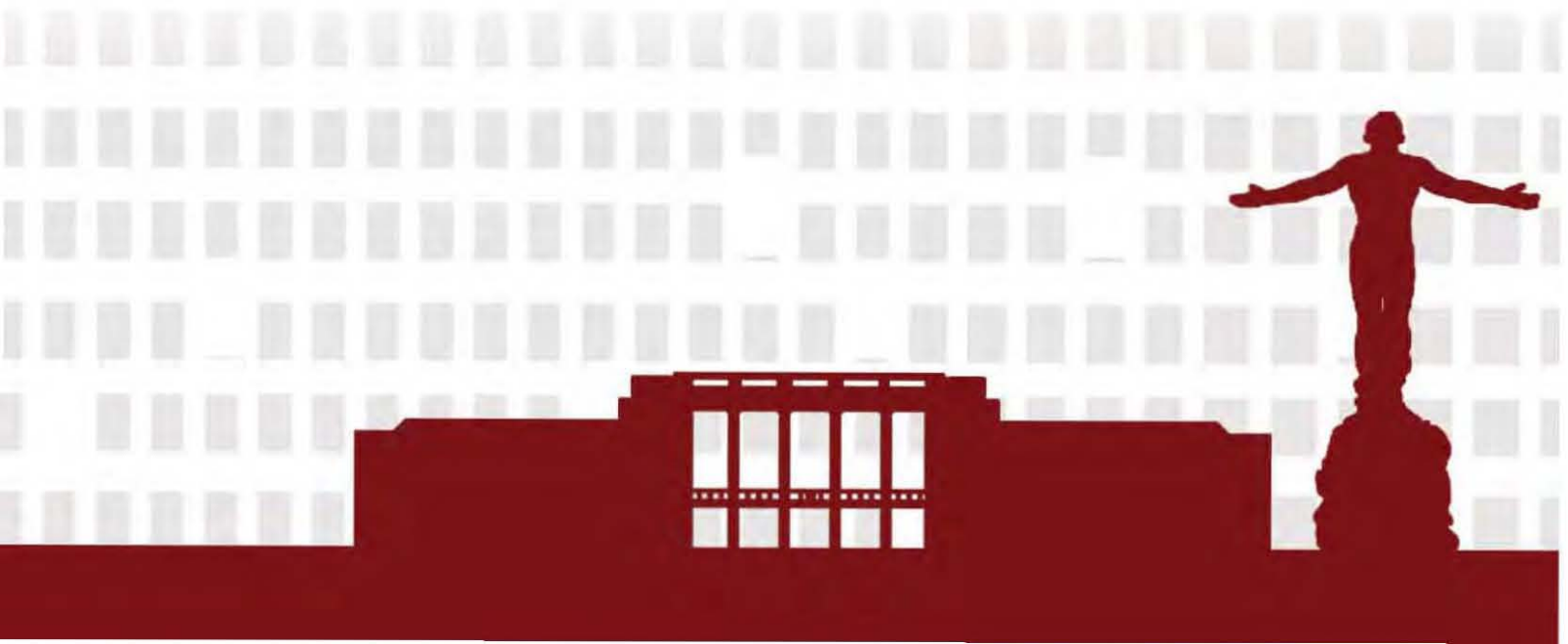
8th AUN/SEED-Net
REGIONAL CONFERENCE ON ELECTRICAL AND ELECTRONICS ENGINEERING

Envision, Enable, and Empower
Smarter and Resilient Societies

co-located with

11th ERDT Conference
on Semiconductor and Electronics, Information and Communications Technology and Energy

16-17 November 2015
Metro Manila, Philippines



Proceedings of the 8th AUN/SEED-Net RCEEE 2015 and 11th ERDT Conference
on Semiconductor and Electronics, Information and Communications Technology, and Energy

Editors:
Dr. Joel Joseph S. Marciano Jr.
Dr. Jhoanna Rhodette I. Pedrasa
Dr. Rhandley D. Cajote

ISBN: 978-616-406-075-3

Published by: ASEAN University Network / Southeast Asia Engineering Education Development Network (AUN/SEED-Net) JICA Project
Faculty of Engineering, Bldg. 2
Chulalongkorn University, Bangkok
Thailand 10330

Printed in the Philippines by: ERZALAN PRINTING PRESS
45 Cotabato Street, Luzviminda Village, Batasan Hills, Quezon City, Philippines

8th AUN/SEED-Net Regional Conference
on Electrical and Electronics Engineering 2015

co-located with

11th ERDT Conference
on Semiconductor and Electronics, Information and Communications Technology, and Energy

Envision, Enable and Empower Smarter and Resilient Societies

Published by: ASEAN University Network / Southeast Asia Engineering Education Development Network (AUN/SEED-Net) in partnership with Engineering Research and Development for Technology (ERDT) and University of the Philippines Diliman.

ISBN: 978-616-406-075-3

WIRELESS FLOOD MONITORING USING INTEGRATED HYDROLOGICAL SENSORS AND FLOOD PREDICTION VIA ARTIFICIAL NEURAL NETWORK

Timothy M. Amado* and Febus Reidj G. Cruz

School of Graduate Studies, Mapua Institute of Technology, PHILIPPINES.
*E-mail: tim.amado08@gmail.com

ABSTRACT

Flooding is a natural phenomenon that is very difficult to model into an equation because of its nonlinear characteristics. As a result, early warning flood prediction systems are seldom developed and often rely on meteorological satellites and hydrological maps. However, in the advent of technology, randomness and nonlinearity can now be modelled using artificial neural network. The goal of this study is to develop a wireless flood monitoring and prediction system using artificial neural network, specifically the Nonlinear Autoregressive Network with External Inputs (NARX) neural network that can be used in a small community as flood early warning system. The flood monitoring system was developed by integration of different hydrological sensors such as rain gauge, float sensor, flow meter, soil resistivity meter, air humidity and temperature sensors. The wireless communication was achieved by the use of Zigbee modules. Training of ANN was done via the backpropagation algorithm and an MSE of 0.0032 was achieved using seven epochs having the fourth epoch having the best validation. During the field testing, an average prediction rate accuracy of 98.65% was achieved. A two-sample t-test was done to see if the actual field test is different from the predicted values and the result was there is no significant difference between the two that validates the accuracy of the prediction.

Keywords: flood prediction system, ANN, hydrological sensors, backpropagation, NARX model.

Literature Review

Many works are done in the past to combat flooding. One of the earliest attempts to mitigate flooding with the modern technology is through the study of Lien et al. [1]. They used the Grid technology, a similar technology to the cloud computing in the present day, to implement a web-based flood forecasting system in the Tan-Shui River basin in Taiwan. The forecasting system uses typhoon, reservoir and river calculation data to correlate the corresponding flood level. Today, most of the flood monitoring and prediction systems are based mainly on the use of satellite and microwave imaging techniques [2]. These techniques, however, are very expensive and require complex algorithms to be implemented, such as Multiple Input Single Output (MISO) Autoregressive Exogenous Input (ARX) algorithms [3].

Hardware Development Of Flood Monitoring System

The researcher developed a flood monitoring system through the interfacing of the different hydrological sensors such as rain gauge meter, flood level sensor, soil moisture sensor, air humidity, and flow meter and temperature sensors.

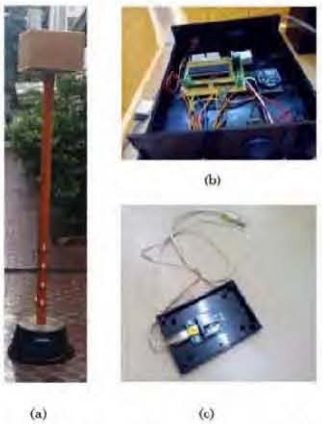


Figure 1. (a) Actual prototype of the flood monitoring system; (b) MCU circuit with Zigbee transmitter; (c) Zigbee receiver for the personal computer

Actual Field Test of Flood Prediction System

The flood prediction system is subjected the system to an actual field test. Figure 2 below shows the comparison of the actual and predicted flood levels. The test achieves a prediction rate accuracy of 98.65% and using t-test, it can be concluded that the there is no significant difference between the predicted and the actual flood level.

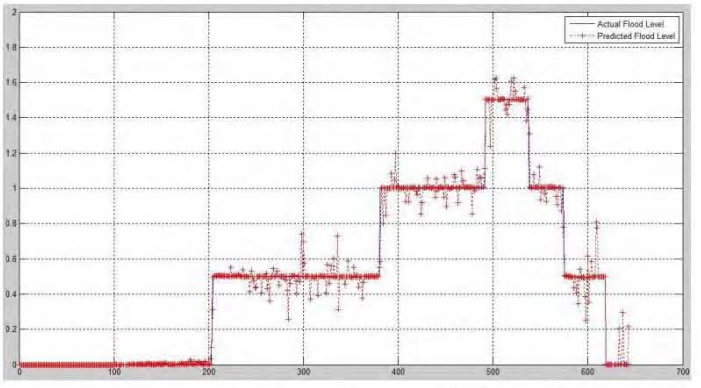


Figure 2. Comparison of actual flood level to predicted flood level in a two-hour lead time prediction

References

[1] Lien, H., Shiau, Y., Huang, C., Wu, J., & Tsai, W. (2004). The integration and application of the computational grid structure in flood forecast system. *High Performance Computing and Grid in Asia Pacific Region, 2004. Proceedings. Seventh International Conference on,* 328-331.

[2] Gandla, S., Al-Assadi, W., Sedigh, S., & Rao, R. (2008). Design and FPGA Prototyping of a Flood Prediction System. *Region 5 Conference, 2008 IEEE,* 1-6.

[3] Ruslan, F., Samad, A., Md Zain, Z., & Adnan, R. (2013). Flood water level modelling using Multiple Input Single Output (MISO) ARX structure and cascaded Neural Network for performance improvement. *Systems, Process & Control (ICSPC), 2013 IEEE Conference on,* 219-223.