FACULTY OF ENGINEERING AND INFORMATION TECHNOLOGY

Intelligent Early Warning System for Avian Influenza

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CERTIFICATE OF AUTHORSHIP/ORIGINALITY

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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Abstract

With the number of natural disasters has increased dramatically during the last decade, the early warning system (EWS) has become a necessary aid for all humankind in detecting incoming threats in good time, taking countermeasures beforehand and finally, mitigating the risks.

This research focuses on an intelligent epidemic EWS in the context of avian influenza. Computational intelligence (CI) techniques can provide cutting edge for an efficient and effective avian influenza EWS. The literature review reveals that the use of CI techniques in EWS is neither balanced nor systematic. This research proposes a conceptual framework and a technical framework as a guideline for integrating suitable CI techniques into an EWS from the aspects of structure, function and process. Following this guideline, we provide a hybrid knowledge-based prediction method which seamlessly connects case-based reasoning (CBR) and a fuzzy logic system to apply both implicit case knowledge and explicit expert knowledge in early warning prediction. In order to establish early warning in both a specific time and area, this research also puts forward two methods to address the issue. The first method is a seasonal auto-regressive based support vector regressive (SAR-SVR) time series prediction method, which applies SAR and Fast Fourier Transformation as the heuristic feature selection, and applies SVR to improve prediction accuracy. The second method employs one class classification (OCC) models by revising model combining policy and joining sub-classifiers OCC (JSC-OCC) methodology to realize the area risk mapping. Each method is followed by a validation with real world dataset.

Finally, an avian influenza intelligent early warning system (IEWS) prototype is implemented. The data used in the prototype system is real data collected from the

Internet, and thus the system could act as a validation means for this research. This prototype instantiates all the proposed approaches which can both estimate a risk level at a concrete location and map risk in a specific area in a specific time. The system realizes the consideration of involving suitable CI techniques in an EWS to form an IEWS with efficiency and effectiveness.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES