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A General Purpose Model for Context Aware based Flood Monitoring System

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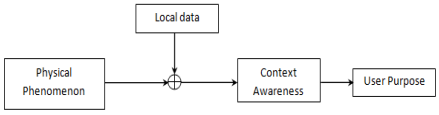
Graphical abstract



Abstract

One of the natural disasters that often occur is flood. Flood causes many victims both materially and fatalities, especially in poor and developing countries where people are less concerned with the surrounding natural environment. In this research we will build a model for the detection and monitoring system of the flood disaster that will explore the context obtained through the sensor. The model of Wireless Sensor Network (WSN) based flood detection and monitoring system includes four main functional components: physical phenomena, local data, context awareness, and user purposed. The system develop some useful insight information prediction scheme based on contexts and time dependent data models.

Keywords: Context aware; flood monitoring

1.0 INTRODUCTION

The development of information technology today continues to increase in all sectors, including agriculture, health, education and even in the field of disaster. Information technology continues to evolve and intended to be enjoyed by everyone, including in remote areas (inland). The development of information technology is expected to continue to rise and more useful for humans. Information technology allows information to be processed and enjoyed every layer of society in a relatively short time. Research on information technology is also much to do, one of which is the emergence of the notion of context-aware systems by Schilit [1]. Any information that can be used to characterize (characterize) the situation of the entities referred to as context (context). Some context may characterize the situation of entities include: Identity Awareness (WHO): The introduction of the environment to the identity of the user, ie among others, user profile, user personalization, and user capital. Location Awareness (Where): The ability of the environment to identify where the user either in open or closed spaces. Mobility Awareness: The ability of the environment to handle and mobile communications systems, which can be known to the user transfer from one location to another location. Activity Awareness (What): The level of sensitivity and responsiveness of the environment to the daily activities of the user. An application is said to be context-aware if the system uses context to provide information and services that are relevant to the task [2]. Context aware system has also been developed on disaster response system (disaster response) [3] [4] and disaster management [5].

One of the natural disasters that often occur is flood. Flood causes many victims both materially and fatalities, especially in poor and developing countries where people are less concerned with the surrounding natural environment. Many attempts have been made to develop a system that helps to minimize the damage caused by flood disasters through early prediction system [6]. The system is designed to monitor the development of flooding in key areas such as disaster-prone countryside. Some flood detection systems are used for example is flood detection system

with the submission of the form-based data logger GSM gateway [7]. Another system that has been developed is a flood detection system using radio waves [8]. Such systems are designed to monitor other areas such as central offices and government.

Monitoring of floods in a large scale has a few things to note, for example: environmental conditions can change quickly. These conditions will increase the amount of data that must be processed so that needs to be made for a system to evaluate and update the information. In response to the disaster in which the user environment can change rapidly, context awareness is one important element. Context awareness is a computation used to obtain information situational and environment of the people, places and things that used to anticipate the immediate needs and offers updated information proactively with the ability service network to know the various contexts, namely the collection of the relevant parameters from the user and network users and provide services in accordance with these parameters [9] [10] [11]. Some contexts may be used are precipitation, water flow and water surface elevation. With the information obtained from the relevant context in accordance with the context awareness events could be part of the decision making process to facilitate collaboration and task management. Thus context awareness can be used to monitor the incidence of flooding and provide a warning if there will be a flood. By using context-aware systems, the accuracy and efficiency of emergency response delivery time may be increased in view of the changing situation of emergency conditions that can change very quickly and dynamically in an emergency when a disaster occurs [4].

One of the devices that can be used to detect the occurrence of floods is Wireless Sensor Network (WSN). Wireless Sensor Network can be defined as a network that requires low power, low cost, multi-hopping systems that are independent of external service providers that can form a network without a line of sight coverage, but were able to find the shortest alternate data path when the connection between the sensor disconnected. Wireless Sensor Network can be used in the geographical area using a two-tier approach that has a group of nodes to communicate over short distances along with some nodes are able to communicate in a wider range. Node in Wireless Sensor Network communicate only with neighboring nodes to reduce the power required by due process of data transmission so that it can reduce the need for the cost of providing expensive repeaters and transmitters used in traditional telemetry systems. Each node in Wireless Sensor Network can act as a data acquisition device, router data and a data aggregator. Wireless Sensor Network also maximizes redundancy so as to improve reliability in data transmission.

In this research will build a model for the detection and monitoring system of the flood disaster that will explore the context obtained through the sensor. Context which will be used to establish flood warning information is rainfall, water flow rate and water level in one location. Design framework designed capable of providing an early warning of floods by collecting all the context and processed into a web server that can be accessed as a system of information on the development status of flooding in a given location.

2.0 PREVIOUS RESEARCH

Nan Jing et al [4], establish a disaster response system based context-aware. The system was built to improve the accuracy and efficiency of the delivery time of disaster emergency response. Disaster response system analyzing contextual information about the user and the environmental disaster to then be processed to send instructions to the mobile device handset. In this study do not build / send information via the web, and not build a framework that will facilitate / accelerate the development of similar systems. In the study Suman Saha [12] which establish a framework for disaster management, the system is divided into two subsystems, namely mitigation and rescue operations. The proposed framework includes collecting data that consider both subsystem of the disaster management system. In addition, also presented a protocol used for data collection from the affected areas for rescue operations using WSN. The study does not address the processing context acquired and processed into information to the user so it cannot get the information up-to-date about the progress of the detection of floods that may lead to greater losses and casualties more. Another study conducted by Basha [13] and Hughes [14] using several parameters which are statistically processed to create a flood prediction model. In these studies the authors use several parameters including the contour of the land, soil composition, the high ground along with measurements of atmospheric conditions and logical as soil moisture. In the study did not discuss about the processing context information that can be accessed by the user. Luqman [3], Jing [4] and Bouguessa [5] to build context-aware systems for disaster management system, but not specific to the flood disaster.

3.0 RESEARCH METHOD

This research is directed to a floods detection system in areas which is prone to flooding through context-aware mechanism and response to victims during and after the floods. Data collection in the flood monitoring is performed as follows:

a. For data relating to non-technical planning and technical planning be obtained from the relevant authorities and surveys or direct observation in the field.
b. the approach is set out by reviewing the results of the field survey.

According to how to get the data used to detect floods can be divided into two, includes:

a) Primary Data
Primary data is data obtained by conducting surveys or direct observation in the field. The review carried out by several observations, including: The location and condition of the buildings existing Flood Control and the condition of the channel in the study area.

b) Secondary Data
Secondary data is data obtained by contacting the agencies associated with construction planning. On the Flood Mitigation Efforts requires secondary data as follows: Situation Map, Map Network Drainage, Land use planning map, Map Watershed, Data rainfall, Altitude Sea-level data.

While the existing data by function can be divided into two, includes:

1. Technical Data
Technical data is data that is directly related to flood prevention efforts, such as rainfall data, topographic maps, land use maps, maps of drainage channels, soil data and so on.
2. Non Technical Data
Non Technical Data is data that serves as a support for the consideration of flood prevention efforts.

The next step is to conduct the analysis and data processing both primary and secondary data. Accumulation of data covering the activities continued with the grouping based on the type of data and then performed the analyst as follows:

a. Analysis of Hydrology
Hydrological analysis was conducted to determine the flood discharge due to rainfall in the watershed.

b. Analysis of Hydraulics
Hydraulics analysis intended to determine water surface profiles that occur in river elongated pieces. It is also to determine how much influence the tides coming back (back water) to the mainland via rivers or channels that exist and building flood control what is to cope with the flooding.

4.0 PROPOSED MODEL

Figure 1 shows the model of WSN based Flood detection and monitoring system. It includes four main functional components: physical phenomena, local data, context awareness, and user purposed. We explain the function of each component in the following subsections.

4.1 Physical Phenomena

At this step, the measurement of the physical conditions includes rainfall, water flow rate, and the height of the water surface. Each measurement is performed by utilizing the Wireless Sensor Network, with several sensors that will communicate to obtain the data in accordance with a predetermined context. The Sensors include rainfall measuring sensors, water flow rate sensor and water level sensor which are used to determine the position of the sensor in a location prone to flooding in order to work optimally will be part of this study. This is related to the limitations of the limited battery life of sensors, communication lines, security against the likelihood of water flow or flood.

4.2 Local Data

Local information is the data obtained by collecting information related to the geographical conditions, which include ground surface elevation and distance to the beach or the river. Other data required are soil absorption of water, drainage conditions and the condition of the river (narrowing, silting) near the site of flooding and topographical conditions. The data will be obtained by taking the data that already exists in the relevant parties.

4.3 Context awareness

At this step of context-aware systems associated pre-disaster and post-disaster flood will be designed. In the pre-disaster systems will be designed to detect early potential for flooding at a predetermined point. Data required in this application is the great speed of the water, the water level and geographic location position measured water velocity. Data rainfall, altitude and speed of the water is treated with fuzzy algorithm to streamline the delivery of the data is then stored in a database server so that it can be read in a web application. In the aftermath, this stage is associated with flood preparedness and flood monitoring, to anticipate the subsequent flooding.

Context aware system here is associated context environment which includes rainfall, water flow and water surface elevation. From the context, it will be determined that the rule will be applied to the system to declare the flood situation and the status of the flood. The rules include a calculation of all the parameters or context that will be used is the water level, rainfall and water velocity. In addition there are other parameters that will be used to support the flood disaster status is accommodating capacity of water in a flood-prone locations. Rules that will be used are as follows:

1. The sensor reads all the data obtained from the context used, namely precipitation, water velocity which affects the water level of a location.
2. Choose a method to perform calculations continuously using all the parameters or context used.
3. Determine the value of all the parameters and then predicts the water level is based on the last calculation.

4. Determine the interval time to read the next data.
5. Build a table that will be used to draw up water elevation data versus time and monitoring the development trend of the water level is increased in value or not.
6. If the result of the calculation, the water level does not rise, then the likelihood of flooding decreased conversely if the water level increases, the likelihood of flooding will be high.
7. Determine the status of flood alert, alert and watchful in accordance with the results of calculation of all the parameters or context used.

4.4 User Purpose

At this stage, built a web server that will provide real time information related to the development of flood events. The system will give a warning (alert) if the conditions will be floods or flood emergency. Warnings can be received via the web or SMS that is sent to all parties of unrelated send data to the server, use web HTTP. Application protocol used by end users to get the data of rainfall, water discharge and the height of the water level, by making a request to the server. When an application sends data to the server, the server will automatically send a response to the client application.

Wireless sensor network, a network of sensors that are used to obtain the data context, then the data obtained is processed in a server to get the status of the flood disaster. Inside there is a server database that stores all data. Disaster information status is displayed by the web server via a web application. By using a web application, information can be accessed via PC, laptop or smart phone.

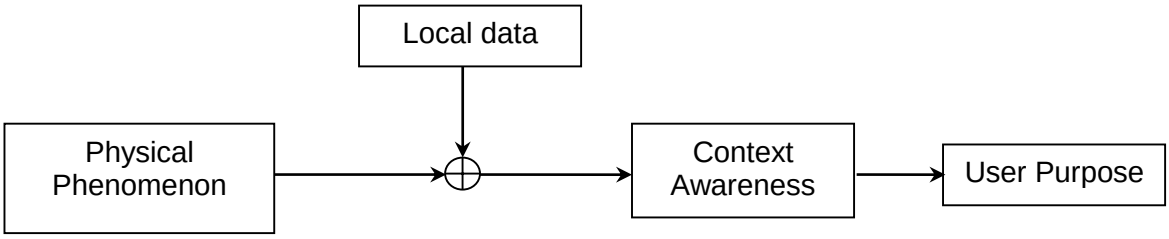


Figure 1 General process for context awareness flood monitoring

Detailed process flow is illustrated in Figure 2. The status of flood disaster is determined by the flood rule . This rule is obtained from the process in machine learning. Having obtained the flood rule then the data context will provide real time information on the condition of the flood disaster.

As shown in fig 2, in the early stages of the course of this research, the sensors will sense the all contexts which will be used to determine the danger of flooding. The contexts are rainfall, water levels and water discharge (run off). In addition to context, local data is also needed to determine the physical condition of an area. Local information is the data obtained by collecting information related to the geographical conditions, which include ground surface elevation and distance to the beach or the river. Other data required are soil absorption of water; drainage conditions and the condition of the river (narrowing, silting) near the site of flooding and topographical conditions. The data will be obtained by taking the data that already exists in the relevant parties. The data is then stored in a database and then be processed using machine learning. Machine earnings will use Naive Bayesian method to process all the local context and data to be used

5.0 CONCLUSION

In this research we will build a model for the detection and monitoring system of the flood disaster that will explore the context obtained through the sensor. The contexts will be used to establish flood warning information are rainfall, water flow rate and water level in one location. System is designed to be capable of providing an early warning of floods by collecting context and processed into a web server that can be accessed as an information system on the development status of flooding in a given location. The system will develop some useful insight information prediction scheme based on contexts and time dependent data models. This approach is tightly integrated into big data analytics system will be addressed to improve the current disaster event analysis methods for faster and reliable insight information.

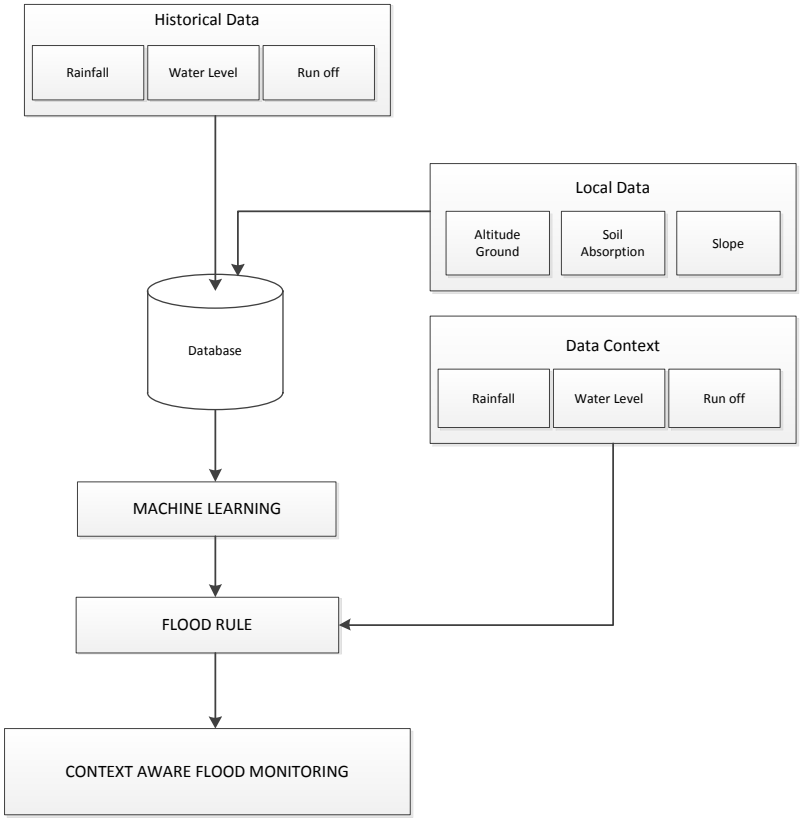


Figure 2 Context awareness flood monitoring diagram

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