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FLOOD SENSING FRAMEWORK BY ARDUINO AND WIRELESS SENSOR NETWORK IN RURAL

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ABSTRACT

Our society is increasingly reliant on embedded systems for many critical day-to-day activities. Nowadays, Wireless Sensor Networks (WSN) are widely used almost everywhere, including both residential areas, and undeveloped areas near the river. Therefore, embedded systems can reduce risks due to an increase of climate change in rural with potentially devastating impacts of floods on local communities and their properties. Advances in embedded system, particularly in WSN, offer us critical opportunities to develop complex real-time early warning and monitoring systems. The WSN technology has been applied in monitoring natural disasters for the last couple of decades. This paper further proposes an innovative and inexpensive framework designed to provide early warning for natural disaster via a siren. It works by continuously recording and transmitting sensor data to the main server. The server processes the data and then provides the warning, so that vulnerable residents can be notified before the floods come around their houses, especially in high risk zones

INDEX TERMS - Wireless sensor networks, Rivers, Wireless communication, Embedded systems, Meteorology, Boards, Communities, Climate change, Embedded system,

Embedded systems in today's real-time response are increasingly playing an important role. An embedded system is one that is made for a particular task instead of general multiple tasks. Such systems can be applied to solve various

issues in developing countries. In particular, in many of the developing countries like Rwanda, some of the citizens are still living in high risk zones without having a real time warning mechanism. The availability of technologies for developing villages near and a little bit far away from the river, with no access to electricity, is spreading only slowly. Therefore, citizens are mostly affected by frequent river flooding, flash flooding due to heavy rainfall and lack of real-time early warning system.

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The main purpose of this framework is to save human life and reduce the loss of properties. The government will be able to expand the installation of those wireless sensor networks, since it is cost effective and easy to maintain. The government will save money by using those cheap devices like an Arduino that costs around thirty US Dollar instead of spending hundreds of thousands US Dollar in expropriation and building new houses for the victims. In this paper, we introduce an advanced, innovative framework designed to keep detecting the level of water in case of floods near the river, then send the data through Arduino which that has the control program.

II. RELATED WORKS

A. Flood Alarming

It presents a forecasting model designed using WSNs (Wireless Sensor Networks). This model helps to predict flood in rivers using simple and fast calculations to provide real-time results and save the lives of people who may be affected by the flood by ringing a alarm. Here the author used multiple variable robust linear regression which is easy to understand and simple and cost effective in implementation, is speed efficient. It has low resources utilization and yet provides real time predictions with reliable accuracy, thus having features which are desirable in any real world algorithm. The model is independent of the number of parameters, i.e.(any kind and any number of parameters may be added or removed based on the on-site requirements). The rise in water level is represented by using a polynomial from which the exceeding of the flood line in the near future can be determined. In this paper a time multiplier function is used only to decide the time interval between two successive readings. The central node is mentioned in this model but it is not taken into account. This model is only predicting the flooding situation and warning people about flood by ringing the alarm but it has no role in preventing the flooding situation. In this paper they have kept the efficient energy consumption part for future work.

B. Honduras Flood Detection

Presented a brief description about implementation of the sensor network in Honduras for an early detection of flood & alert the community. They have analyzed on the significance on sensor networks in developing countries, sensor networks for flood detection and the available current operational systems for flood detection. This paper discussed about the flood detection problem of warning communities in impending disasters quickly becomes complex due to its multifaceted nature. They studied the flood detection problem in Honduras and proposed a solution. Using wireless sensor network (WSN), they divided the solution into four tasks (event prediction, authority notification, community alert, and community evacuation) between CTSAR (name of NGO) and themselves. They have conducted different experiments to validate the proposed solution. On the communication side, they verified the usability of the 144 MHz radios. They tested it with the various ranges necessary for the system to ensure about the communication over those ranges. To communicate at these ranges reliably, the radio antennas need line-of-sight high in the air, which requires antenna towers and limits the ability to test this portion of the system in the US. This paper says that wireless sensor network can be a perfect technology to be deployed for fighting with the flood in poor and developing country. In this paper Bash et al have given a realistic idea on different situation of flood detection problem and employed different types of sensors in flood detection.

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C. Early Flood Warning System

Describes a system architecture and deployment to meet the design requirements and to allow model-driven control for optimizing the prediction capability of the system. This architecture is used to explore the application of river flood prediction and it is describing the work on a centralized form of the prediction model, network implementation, component testing and infrastructure development in Honduras, deployment on a river in Massachusetts, and results of the field experiments. In this system a few number of nodes are deployed across river basin and a unique heterogeneous communication system is used for reading real-time sensed data, integrating self-monitoring for failure and adapting measurement schedules to capture events. They proposed a model and an efficient algorithm for flood prediction that uses data from the nodes of a spatially distributed sensor network. They have prepared this model in reference to Sacramento Soil Moisture Accounting (SACSMA) which is a very efficient model that can detect flood very easily but SAC-SMA is very expensive which could not be affordable for a developing country to be employed for flood detection. This approach is computationally simpler than conventional approaches to flood models and prediction, utilizing real-time data from multiple sensor nodes. This counts the advantage of this model over SAC-SMA.

They used the multiple linear regression models for flood forecasting which gives accurate and fast computation which adds to its advantage. The model is only based on rainfall driven flood so to predict flooding, a model requires knowing how much rain falls and what the soil's time dependent response to the rainfall will be. The model requires details of the soil composition, topography and land cover, along with meteorological conditions and hydro-meteorological quantities such as soil moisture. There are too many parameters which need to be sensed by sensors. This indicates that a number of different type of sensors are need to be employed which implies the expensiveness and complicated computation. This is the drawback of this model.

D. Alternative Emergency SMS Network

Describes about an alternative network as a substitute to the usual communication links which are unavailable during major disaster. At the time of disaster, the communications for users inside the disaster zone would be almost to impossible because of no mobile network (Global System for Mobile Communications (GSM), Universal Mobile Telecommunications System (UMTS) or Long-Term Evolution(LTE)) still people need to communicate each other. So they proposed an alternative network for maintaining communications capabilities during major natural disasters and other emergency situations by a system that utilizes Short Message Service (SMS) of length upto 7bits over Wireless Mesh Sensor Networks (WMSNs). This is relatively simple and inexpensive. To create this WMSN (as in fig.3) they propose a system using the water level sensors. The integration of the two non cellular wireless networks i.e. wireless sensor network and wireless mesh backbone is denoted as Wireless Mesh Sensor Networks (WMSNs). The topology was divided into two zone i.e. safe zone and disaster zone. The aim was to establish the interconnections between the WSN inside the disaster area and the mobile network infrastructure in the safe zone. When a user initiates communication from the disaster zone, the user connects to the most nearby sensor inside a WSN using

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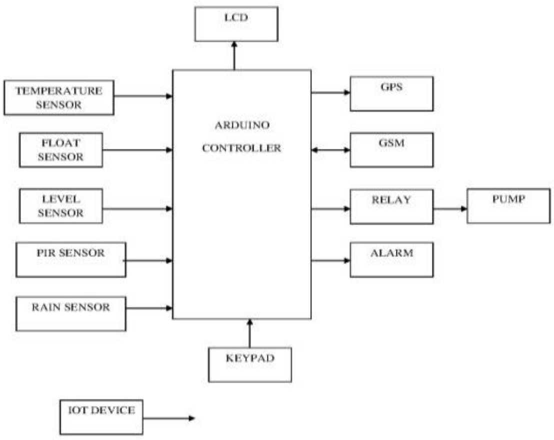
the ad-hoc application through WiFi directly to the sensor.

III. PROPOSED METHOD

From the above survey on Wireless Sensor Network (WSN), we come to know about the cost effectiveness, faster and accurate computation & easy deployment of sensor network in most of the real world phenomenon like traffic monitoring, billiard playground etc. as well as in predicting and preventing natural calamities like flooding, earth quake etc. This proposed model consists of three different types of nodes. Those are Sensing node, computational node and intermediate node. In this model the data is collected dynamically through sensing nodes, data is transferred through computational node, water is managed to predict and prevent flood at barrage. In this approach the sensing node reads the data like water level and water speed etc at a particular distance away from the barrage. Two types of computational nodes are used; first one is a local computational node which computes the volume and time of water flow to reach the barrage by using fluid flow principle [14]. Another computational node is a managing computational node which is deployed at the barrage that helps managing barrage water. The rate of flushing is computed at managing node and intimated to the local office. The intermediate node ensures the connectivity with the managing node. If the local computational node fails to transfer data to the managing computational node then the intermediate node helps in transferring the data. In this way the flood could be prevented due to sudden flushing of huge amount of water from barrage at a time.

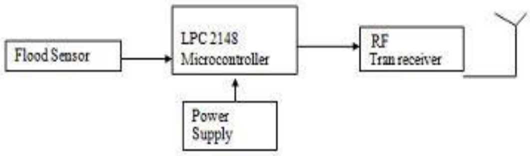
BLOCK DIAGRAM:



IV. IMPLEMENTATION

- WIRELESS SENSOR N/W

The sensor node is controlled by an ARM LPC 2148 16-bit processor running at 12MHz and it is supplied with a 3.3V (7.6 Ah) battery. It utilizes a Chip con CC2420 RF transceiver radio operating at 2.4 GHz ISM band for communications and two connectors for supporting multiple sensors: a flood level sensor.



SENSOR

In the proposed system the sensor to be used are float sensor,

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ultrasonic sensor. Sensor nodes equipped with water level and flow velocity sensors are deployed in the upstream and downstream region of rivers. Two sensor nodes are deployed basically in the upstream and downstream area of a river in order to estimate the difference between them.

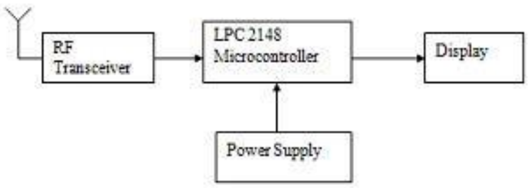
RF Transceivers

In the proposed system the RF transceivers like CC 2420 can be used together with a microcontroller and a few external passive components. This transmits & receives data from base station to wireless node & vice versa.

Microcontroller unit

The LPC2148 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine microcontroller with embedded high-speed flash memory ranging from 32 KB to 512 KB. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate.

- BASE STATION



Base station consists of the same RF transceiver, microcontroller and LCD which displays, monitor and controls the signals depending on the programmed data

V. CONCLUSION

The proposed model is an efficient model which helps in preventing flood due to sudden flush out of excess water at barrage at a time. In this model the water at barrage is flushed from the barrage in a controlled manner so that flood in the plain area will not occur. The advantages of this model are that we are using minimum number of parameter. We are also including the less battery energy consumption method. This model is a cost effective model. Hence this can be deployed by developing and poor country to fight back with flood.

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