NOVATEUR PUBLICATIONS
INTERNATIONAL JOURNAL OF INNOVATIONS IN ENGINEERING RESEARCH AND TECHNOLOGY [IJIERT]
ISSN: 2394-3696
VOLUME 7, ISSUE 4, Apr.-2020

FLOOD MONITORING AND PREDICTION BY USING WSN

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ABSTRACT

Among the natural disasters faced by mankind often one is flood. There are many sophisticated systems for monitoring flood level in flood prone regions, but the systems which are already implemented are not cost effective. The system we implemented makes use of Wireless Sensor Network which consists of sensors like ultrasonic sensors which will use NRF module for communication between the nodes. The sensors will sense the current level of water and sends the data to the coordinating node and the coordinating node sends the data to the local system or server with the help of node MCU. The local system will make use of machine learning algorithm and will predict the severity of the water level in current future. Our system helps both government and private organizations to work on evacuation and helping people to move to a safer place.

KEYWORDS: Wireless Sensor Network, Machine Learning, Ultrasonic sensor, Flood Prone Areas.

INTRODUCTION

One of the natural disasters that occurs rather often around the world is floods. There are various factors that lead to floods some of them are increase in precipitation level, water leaking from dam etc. To avoid flooding there are some parameters that we need to take under consideration for coming to decision or conclusion as a solution to the situation. Parameters like having real time data of water level, precipitation level, water level in the dam etc. Currently the alerts or the warning of the flood come in time when there is no way to escape or reduce the damage, which end up with flood taking lives of many citizens and animals and it affects the economy as well. All these reason make flood monitoring as well as alerting about the

same a very important matter. In a country like India, where the population is humongous even small floods inflict a massive amount of damage to the economy as well as life risk to the citizens. We have seen past incidents like in the month of August last year where flood affected over 2.85 hundred thousand people living in 5 districts of Maharashtra. In the same month in 2018 flood affected hundreds of thousands of people in the state of Kerala. Such incidents have also been seen in Delhi, Bihar, Assam, Mumbai, UP, Punjab.

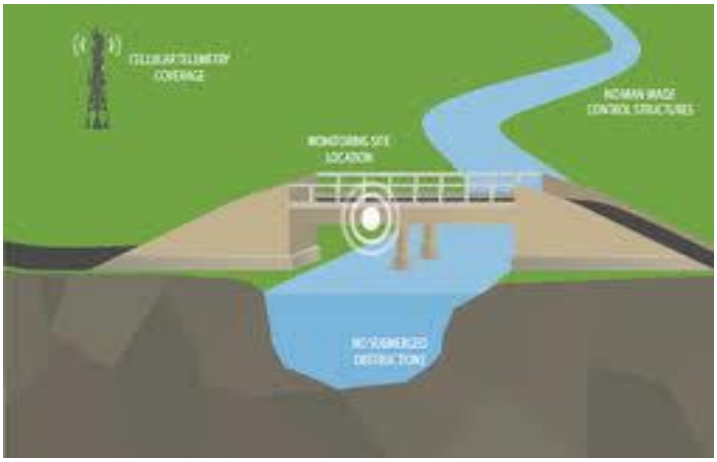

Figure 1.Flood monitoring system [Source : Fondriest Environmental]

LITERATURE SURVEY

1. "Real-time WSN Based Early Flood Detection and Control Monitoring System"[1]

The increase in water level of the river due to discharge of water from dams due to various reasons, causes destruction to the people living near the river bank. Thus there is need to record the water level in the dam as well as if there is any leak from the dam. This will help in evacuation of the citizens in the danger area reducing the total damage. Considering the old times where the measurement was done manually it lacks a lot of accuracy and has a lot of short comings. It also isn't real time which would lead to delay in the measurement. This paper presents a real time Wireless sensor network based early detection of flood and control monitoring system designed with the facility of Real Time Monitoring and guaranteeing connectivity in low cost. This system collects data as images from CMOS image sensors through wireless sensor nodes which transmit these images to a remote monitoring centre via Zigbee network and GSM network. The remote centre processes the data by analyzing it and giving necessary alert to the clients.

2. "Development of Flood Monitoring System using WSN and IoT based on Cloud"[2]

The impact towards mankind due to flooding makes it one of the most common occurring natural disaster. There are many modern systems that are widely in practice by organizations and responsible authorities for monitoring water level in the flood prone regions. Most of these systems make use of sensors of devices that are very costly to be used and have high maintenance. The proposed system makes use of N-mote and N-gateway, data that that sensed by the sensors such as temperature, humidity, rainfall rate and water level can be sent to cloud and if threshold values of any of the environment change threateningly, a warning message will be sent to the responsible authorities and residents of the flood prone region. Such a system enables both private and government organizations to work on their emergency evacuation and figuring out a safer move before the flood situation get worse.

3. "Flood Detection using Sensor Network and Notification via SMS and Public Network"[3]

This paper gives us an overview of an alert generating system for flood detection. This paper focuses on the development of the system which sense the current water level by means of sensors and by using WSN, the system will then provide notification via GSM modem. The system sends not only the SMS but also makes use of social media sites like Face and Twitter to spread awareness. It is shows that notification systems such

as flood warning systems need to increase their scope for spreading awareness about the situation. With the help of social media we can notify to a larger audience. The architecture of the proposed system improved further to a fully functioning system in alerting the public of an upcoming disaster caused by flood.

4. "Flood Detection System Using Wireless Sensor Network"[4]

Terrestrial wireless sensor networks are currently being extensively researched and development of the same is in process. Currently there are multiple applications that make use of TWSN nodes, for their properties, to monitor, detect, and track a different variety environmental phenomena and events. The development in the past few years in electronics and sensor to reduce their size and low power technologies enabled TWSNs to expand their domain to underwater applications. The role of the designed Flood Monitoring and Evasion System based on WSN is to continuously monitor the water level, detect for changes and report the environment's status to a controller unit using parameters like relative water level, thrust and intensity of water as flood indicators, whose values are collected by the sensors that are deployed. The FMES monitors and computes the status of flood with the help of threshold values and sends flood notification message to the control station of such zones for them to take necessary action. The system majorly consists of 3 important modules which are the sensor module, observation module and the transponder module. The developed system is stout and gives alerts of flood occurrences in good time and controls the flood gate so as to control the flood in coastal area.

5. "A New WSN Paradigm for Environmental Monitoring and Data Collection"[5]

Collecting data of any environmental phenomenon has normally been done manually. Even with the introduction of electronic data logging devices hasn't reduced the workload for managing devices in the field by a considerable amount. Recently however, low-cost microcontroller systems with the facility of wireless connectivity, called wireless sensor networks (WSNs) are being used and developed. With the huge increase of cost effective sensing elements, WSNs are able to transform environmental monitoring, but certain shortcomings in the current WSN paradigm have caused issues in widespread deployment. Some of the shortcomings are limited battery capacity, need of exclusive wireless protocols that exclude WSNs from easily integrating into existing data networks; and not very customizable designs. In this paper they try to find the effectiveness of a new paradigm for remote data collection systems, by using alternative power sources to significantly extend the service interval, WiFi wireless communications to make it easy for remote management, and open sourced design which can be customised as well as extended as per the need. The comparison of WiFi and similar ZigBee radios with the new paradigm, evaluating on features such as signal range and battery utilization under various sensor and radio configurations.

OBJECTIVES

The objectives are as follows:

a. Reduction of the amount of damage done by floods.
b. Monitor the situation, detect for anomalies and warn the society.
c. Predict the severity of the flood in the future.
d. Building a warning system by making use of WSN and notify the residents.
e. Make it easy for user or authorities to monitoring water level by using WSN.

IMPLEMENTED SYSTEM

As we know all the systems which are in use are either not very efficient or they are very costly for practically use, or have a high maintenance, our system uses collection of ultrasonic sensor to measure the water level, ultrasonic sensor are very efficient and cost effective. The system architecture of the system we implemented is given below.

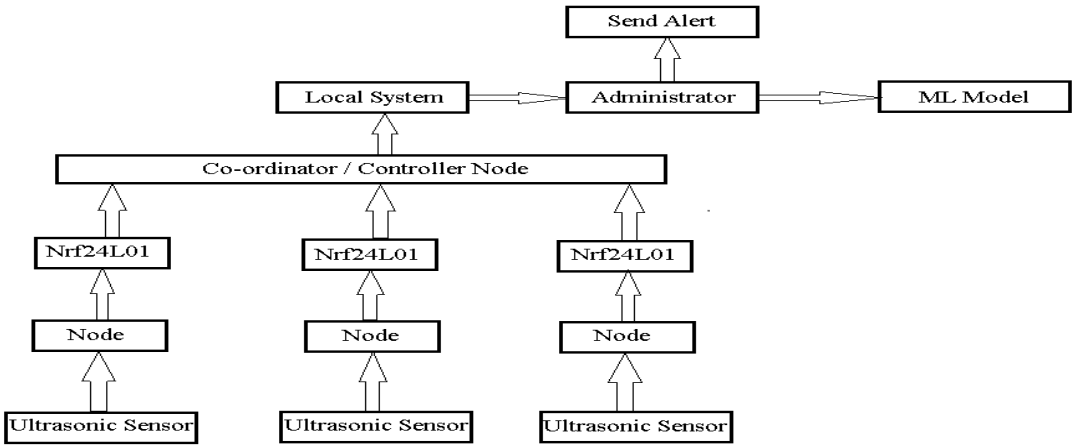

Figure 2. System Architecture.

We have implemented a system in which we are making use of Wireless Sensor Network (WSN) to gather the data from multiple sensors like ultrasonic sensors that will be deployed on site. The sensors will sense the water level send it to the node. From the node this data will be sent to the coordinator / controller node. The communication between the nodes and the coordinator / controller node will be done with the help of Nrf24L01 module. At the coordinating / controller node the data will be collected and then sent to the local system. The data will be sent from the coordinating / controller node with Putty to the local system. At the local system the data will be stored in a format that can be used for the machine learning model as well as of help in the future. The admin can use the data that is formatted to input in machine learning model where the model will predict the severity from the data is being given to it. The model will provide the severity which will be in 3 types namely normal, threatening, severe. The types are divided by the use of threshold. The normal type is set at less than 50% of the average water level. The threatening type is set at higher than 50% but less than 75% of the average water level. The severe type is set at more than 75% of the average water level. The administrator can then notify the related authorities or organizations.

SYSTEM FLOW DIAGRAM

The flow diagram related to our project is explained below. It is divided into following parts like sensing the data, coordinating node (Gateway) and local system/server.

Sensing Operation: In the sensing operation, ultrasonic sensors are deployed at various flood prone areas like bridges, dam etc. These sensors sense the data and passes it to the coordinating node. The WSN kit have one node MCU, with the help of node MCU the sensed data by ultrasonic sensor is transmitted to the Coordinating node.

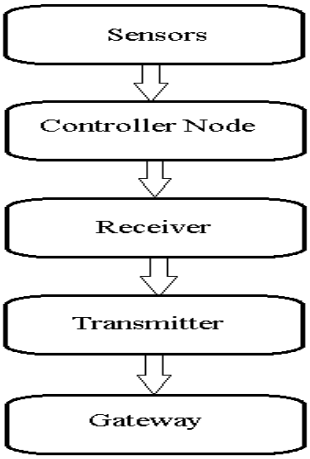

Figure 3.Flow diagram for sensing the data.

Gateway: As we know the node MCU is used for communication purpose. It is used for communicating the various sensor nodes, because it is mandatory to communicate between n-Sensor nodes and gateway. After receiving the monitored data from sensor nodes, it displays the monitored data values on computer system. After that the data is send to cloud through WiFi module.

Local System: The local system acts as a server that can store the data that the controller node sends. From the local system we can use the stored data and format it in a way that we can provide it to the ML module for further procedure.

ML model: The stored data is used as an input to the model that has being trained on data previously and the result is going to be the prediction of severity of the flood with respect to the input given.

MATHEMATICAL MODEL

- Let S be the System for Flood Monitoring and Prediction
- S = (I, D, F, O)
  L = Set of inputs.
  D = Database.
  F = Process on data using the preferred algorithm.
  O = Set of Outputs.
- I = (i) : i is the sensed data by the sensor.
- D = (d1 , d2)
  d1 - Sensed data ,.
  d2 : Timestamp.
- F = (f1, f2, f3)
  f1 : Sensing the data.
  f2 : Sending the data to the coordination node.
  f3: Notifying the people about the flood.
- O = (o) :- Notification to the people.
- Success Condition :- Notify the government bodies about the rising danger.
- Failure Condition :- Failure of sending notification , delay in sending notification and wrong prediction.

RESULT AND DISCUSSION

The accuracy of the models that were trained by using random forest algorithm was 89.5 % with it not correctly predicting 10.5 % times. But the accuracy of the model that was trained by using the decision tree algorithm was 92.17 % with it not correctly predicting 7.83 % times. The model was trained on 460 instances and only took 4 features in consideration. The model can be improved further provided more data is used which is also more relevant that the one that is being used for these models. With a better dataset we can reduce the recall to the point where the model can predict the flood more or less precisely which would lead to better management and decision making for the citizens which are affected as well as the organizations that are involved.

CONCLUSION

The system that implemented will be able to detect and monitor the flood for the regions which are often affected by flood. The system makes use of ultrasonic sensor in order to sense the level of the water at different areas. Our System consists of major components like Sensor Networks, transporting module and local system server. The sensors in the sensor network will sense the current level of water and then send it to the controller node of the Wireless Sensor Network which will send the data to the local system which implements a decision tree algorithm which will help to predict the future course of the flood in terms of severity of the water level. Based on the prediction alert will be issued to the nearby people. We used WSN nodes due to their tiny size, low power consumption and cost effective. Our system will play a crucial role in providing warning to the people which are living in the flood prone areas.

FUTURE SCOPE

In the current system that we have implemented there are improvisations that can be made. We can further make the WSN more effective by adding multiple nodes so that the data of the water level is more accurate. Along with the multiple nodes we can provide better sensors so that the data collected from the sensors is more accurate which will lead to even better prediction. We can replace the local system by cloud. With the help of cloud we can store data in it, deploy the machine learning model on it. With cloud we can further better the system with real time prediction to reduce the amount to time required to notify the citizens and organizations involved.

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