A Review on Fuzzy Based Flood Warning Expert System using IoT and LoRa Technology

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Abstract – *Flood is the most destructive natural hazard. Unsafe or dangerous rainfall is not only the reason for flood, but it is the most basic reason for flood. Other than rainfall different parameters are also responsible for flood. These parameters includes temperature, water flow speed, humidity, moisture level of land. Including rainfall and other parameters are always uncertain so that developing a system to predict the flood situation is a challenging task. As parameters of flood are uncertain so that algorithm which deals with uncertain inputs that is fuzzy logic is used to develop flood detection system. The main advantage of using fuzzy logic is its ability to deal with nonlinearities and uncertainties. Fuzzy logic produces results that have resemblance with human results. It reduces time and complexity of this system. As mentioned earlier different parameters are responsible for occurrence of flood so that use of IoT with power of different sensors is appropriate. LoRa is an emerging technique which is a wireless technique accepts data from sensors and transfer this data to main controlling system where this data is processed using fuzzy logic and result is produced.*

Key Words: **Flood, Fuzzy logic, expert system, IoT, LoRa**

1. INTRODUCTION

Flood situation have long destructive impact and it destroys human life, society and infrastructure also. During last decade in the area of Sangli and Kolhapur we experience the situation of flood and its impact. So it becomes necessary to have a system that gives early warning about flood and so as to save the human life as well as infrastructure.

Flood situation is not only related with river water level. This is the basic parameter. Flood situation also depends on different parameters like soil moisture, rainfall, Surface run flow of water, water flow speed.

To extend the thought of developing flood detection system I am going to construct IoT sensor based system which gives early prediction and alert to nearby society. In this system I am going to make use of Fuzzy Logic System (FLS) which easily operates on imprecise, distorted, noisy input information to produce acceptable output. LORA (Long Range) technology is used. LORA is free platform which is used to connect multiple sensors to main controller in wireless fashion. It's power consumption is very less and it can operate over a long distance about 1 to 2 km and it operates on 3.7 v battery with 10mA consumption while transmitting data.

2. LITERATURE SURVEY

A Fuzzy Logic-Based Flood Detection System Using LoRa Technology[1]

For detecting a flood situation fuzzy logic is applied on the data which is received from sensors. Here fuzzy logic is used for decision making. LoRa technology is used for wireless, economic and effective method of collection of data from sensors. Difference between classical logic system and fuzzy logic system is that fuzzy logic works on uncertain, changing data and result produced by fuzzy logic are resemblance with human thought process. It uses three input and two output FLS(Fuzzy Logic System).While developing the FLS three inputs namely surface water runoff, rainfall and type of monsoon season were used. Two outputs were flood probability and flood consequences. Multiplication of these two outputs produces the associated flood risk. This flood detection system makes use of microcontroller, LoRa node, soil moisture sensor node and ultrasonic sensor in branch node. Master controller which is fully preprogrammed and it implements fuzzy logic system, take decision and send it to cloud system where it can be observed on any IOS or Android smart phone device.

B A basic review of fuzzy logic applications in hydrology and water resources. [2]

Fuzzy logic is a logical system which gives you an opportunity to build an algorithm to develop a model which works on uncertain and vulnerable data as like in hydrology. Father of Fuzzy logic was Professor L. A. Zadeh but its practical use was made by Dr. E. H. Mamdani in 1974. Today fuzzy logic is greatly used in the domain of hydrology for water resource assessment and hydrologic analysis. The next step of fuzzy logic is fuzzy rule based modeling. This is used for system with no feedbacks. After lot of research and study presently fuzzy logic system becomes an emerging tool for hydrological analysis, water resource management. In the field of surface water hydrology fuzzy rule based system is greatly used. It is applied for drought evaluation, rainfall pattern. Flood disaster risk was assessed by using fuzzy

based methods and found very useful. Data is available which shows application of fuzzy logic in the field of ground water hydrology. Due to capability of handling uncertain data fuzzy based modeling is used mostly in the field of hydrology. This fuzzy based modeling shows better performance when combined with other models.

C Rainfall Prediction using Fuzzy Logic. [3]

Fuzzy logic is quite different than classical logic. Classical logic produce result like true or false but fuzzy logic produce result in between true and false and hence it is likely used in filed of AI. Fuzzy logic system has great resemblance with human perception. Fuzzy logic are easy to understand, flexible, intuitive. Apart from different areas like control system, design system fuzzy logic system can be effectively used in hydrology and meteorology also. Fuzzy logic system with five linguistic rules and triangular membership function is build. Fuzzy logic system is always useful in decision making system, analysis system and controlling system. In rainfall prediction system two inputs namely temperature and wind speed were given to fuzzy logic system which uses triangular membership function to predict the output in terms of prediction of rainfall.

D Advance flood detection and notification system based on sensor technology and machine learning algorithm. [4]

Variations in water level or water runoff is possible to detect with different sensors like ultrasonic sensors. It is possible to receive this sensor data in microcontroller and analyze the same to predict about flood situation and using wireless communication like SMS this result is expected to send to website so that early warning of flood is possible. Three water level sensors are used to detect the change in water level. This sensor data is collected in microcontroller (PIC). Here analog sensor data is converted into digital signal with a analog to digital convertor. Then whatever data received by microcontroller is send to flood management system using SMS. At flood control system machine learning algorithm is used to determine whether water level is normal or flood situation is arise. To analyze the data at flood control system four machine learning algorithms were used namely Random Forest, Bagging, Decision Tree and HyperPipes.

E Fuzzy Logic for Flood Detection System in an Embedded System. [5]

Embedded system works like a mini computer. In flood detection system using embedded system two hydrological parameters namely water altitude and water flow velocity are measured. To achieve this task ultrasonic sensor and water flow sensors were used. Where sensor data is actually sense is called as node.As water level and water flow speed are always not constant and they are not predictable at all so to predict the flood situation a special algorithm called as fuzzy logic is used. It is the best algorithm for complex

decision making. Sensor data is analyzed by fuzzy logic and then it is transmitted to master node which accordingly show RGB LED. For water speed three membership functions were used slow, average and fast. For water level four membership functions were used very low, low, high and overflow. With three membership functions for water speed and four membership functions for water level evaluation rules were designed. For normal condition green LED is used, for cautious condition blue LED is used and for flood situation red LED is used.

F IoT Based Flood Detection and Notification System using Decision Tree Algorithm. [6]

Water level sensors are used at three different positions. Data from these sensors is collected and it is provided to machine learning algorithm to decide whether flood situation arise or not. Decision tree algorithm is used to train the machine.Along with water level sensor two more sensors namely humidity sensor and temperature sensors are also used. The data collected form sensors is send to microcontroller and then it is transmitted to cloud using wi-fi module. Data from sensors is continuously send to cloud system. Decision tree algorithm is used to predict the flood situation. Data is classified as normal condition and dangerous condition.

3. CONCLUSION

Hence the early flood warning or flood detection system can be successfully achieved using different ways. One can use different algorithms for data that has been sensed from different sensors. Algorithms like decision tree, random forest, fuzzly logic system can be used along with machine learning, embedded systems. Sensors, microcontroller and suitable algorithm are basic requirements for flood detection system. So with the help of different algorithms and IoT sensors one can predict about flood situation in advance.

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