IoT based Flood Prediction System

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Chapter 1:
Problem Statement Understanding

In the year 2019, there was a heavy rainfall in the India that created much loss for 13 states, which included loss of at least 200 people and millions of them were misplaced. The most affected region was Karnataka and Maharashtra.

Floods are among the most common damaging natural disasters that affect millions of people across the world leading to severe loss of life and colossal damage to property, infrastructure and agriculture. According to the World Meteorological Organization, flooding remains the third biggest disaster in the world [1]. Due to climate change, scientists estimate a 4-inch sea level rise by 2030, which could potentially cause severe flooding in many parts of the world [2]. Based on a research conducted by Institute of Environmental Studies, more that 60% of world cities will be vulnerable to flooding in the next 30 years due to effects of the sea level rise [3]. Studies have been conducted in different areas such as flood data collection, flood prediction, flood monitoring, flood detection, flood early warning systems, and flood data visualization, with an aim of reducing the impact of flood disasters by alerting the affected societies about a flood occurrence ahead of time.

With current technological advancements in the domains of sensing systems, wireless communication networks, cloud computing, machine

learning, and data science, it is possible to develop an integrated flood disaster management system which can efficiently alert the flood affecting regions. Internet of Things (IoT) is a core technology being used in flood early warning systems. IoT characteristics provide effective guarantee for ahead of time perception and precaution, advance to reduce the impact of disasters [4]. Despite the fact that IoT technologies cannot stop the occurrence of disasters, they are exceptionally valuable apparatus for conveyance of catastrophe readiness and counteractive action data. Such data can be used for geographical flood simulation modeling [5], which aids in policy making in flood disaster risk management. For real time flood early warning systems, information delivery is key [6].

Thus, there is a need to ensure that information delivery must be concise, right to the point, useable and in timely manner. There are several factors that are attributed to the efficiency and effectiveness of early warning systems for floods. These include the correctness of prediction of a flood occurrence, the amount of time needed to make a prediction, the reliability of the communication networks used in the early warning system, the deployment and maintenance cost of the systems, etc.

In order to avoid such problems smart solution are required. Smart city infrastructure could be in terms of intelligent traffic automation, military, conveying logistic, environmental and surrounding monitoring. So in order to promote smart city infrastructure in this report we are proposing IoT based flood prediction system.

Chapter 2:
Software and Hardware Requirement

2.1-Hardware Requirements:

The table below shows hardware components to be used in our project:

Sr. No.	Hardware Components	Range	Purpose
1	DHT11- Temperature and humidity sensor	Temperature Range: 0°C to 50°C Humidity Range: 20% to 90%	This will help in getting the real time temperature and humidity from the atmosphere.
2	Water flow Sensor	Flow rate of 1-30 liters per minute	We will deploy this sensor to get the information if there is a sudden increment in the water flow.
3	Water level Sensor (HC-SR04 Ultrasonic Sensor)	2 cm to 400 cm	To measure the level of water flowing using ultrasonic waves by measuring the time between the emission & reception.
4	Rain Sensor Module	100 kΩ to 2 MΩ	To be used for measuring the amount of rain
5	Air Pressure Sensor	300hPa to 1100hPa	For measuring atmospheric pressure
6	ESP8266 WiFi Module	----------	This microcontroller board is used to control all the sensors & take their values & send the entire collected data packet to Firebase where it is stored for further use.

7	Battery	----------	For power supply to all components

Table 2.1. Tabular overview of the hardware requirements

2.2 - Software Requirements:

The table below shows Software to be used in our project:

Sr.No	Software Required	Purpose
1	Proteus	For simulation of the system with all the sensors interfaced with ESP8266
2	Arduino IDE	For Programming the code for all the hardware components in ESP8266 & to read the values from sensors.
3	Firebase	As a central database where the data of sensors will be uploaded.
4	Python	For fetching the data from Firebase & for writing the program.
5	HTML, CSS & JavaScript	For Web app UI to display the readings in the graphical format
6	Machine Learning	To build a rainfall prediction system with the help of meteorological data, history, many sensing devices etc
7	Google Colab	For training a model to predict floods Using ML.

Table 2.2. Tabular overview of the software requirements

Chapter 3:
Additions and Updates

1) Possibility of observing more futures for predictions, in addition to water level and rainfall values, to improve the performance of the model when predicting floods further in time, for short-term (e.g. 10 to 15 hours ahead).

2) Environmental conditions that affect rainfall such as humidity, air pressure, temperature, etc., could be observed by sensors to improve the performance of the model when forecasting.

3) Intelligent mesh-connected Wireless Sensor Network(WSN) can be implemented with nodes of different sensing abilities in the network and can be connected to the WiFi hotspot.

4) Early Detection of Blockages in the Drainage System can also be done to prevent floods & can also help in prediction.

5) An extra addition to this project can be the identification of victims in a flood using image processing.

6) SMS warning system can be introduced because of majority use of mobile phones or smart phones by people.

7) Solar Power Technology can be used for power supply of the entire network so that there is not any disruption in the working of the system.

8) Open Weather API can also be which will provide real time climatic information along with the integration of sensor information.

Chapter 4:
Application, Advantages & Challenges

4.1 - Application:

- Can be implemented in Smart Cities & in flood prone areas especially which are located near dams.
- NDRF team will get assistance for better preparation for tackling the flood.

4.2 - Advantages:

- Timely detection of possible flood risks and floods.
- Highly reliable and available real-time data.
- Tailored solution that can be integrated with external developments at any level (device, connectivity, cloud or user application).
- Total adaptation and integration with emergency plans.
- Creation of historic data for Administrations.
- Low energy consumption.
- An unlimited number of devices can be included in future extensions.
- Long working life of the equipment.

4.3 - Challenges:

- Implementing the system to use low power wireless communication technology so that the whole system operates on low power and can be deployed on battery power.

- The system implemented will be tested in a lab setting and not on real flooding event.

- The project focuses on short term prediction of flooding events with less focus on the dissemination techniques of the early warning messages.

- Weather conditions such as heavy rainfall or storms can disrupt the Internet.

- Internet connectivity at all times and may consume a lot of power in a deployment setting due to the hardware platforms being used.

Chapter 5: Conclusion

It is impossible to predict how and when the Natural Disasters occur. But it is possible to predict the floods that can be caused due to overflow in dams. The cause of flood Disasters depend on various factor ex: Water level in water bodies, Rainfall, water flow from dams etc.

The success of flood disaster management depends largely on how well flood related data can be collected, managed and utilized. Due to this importance, the use of IoT to facilitate flood data management is seen as a step in the right direction.

This project highlights the possibility to provide an alert system that will overcome the risk of flood. It can also contribute to multiple government agencies or authority that cam ultimately help the society and mankind about the flood like hazardous natural disaster It will monitor each and every aspect that can lead to flood. It also ensures increased accessibility in dealing and reverting to this catastrophic incident. In summary, it will help the community in taking quick decisions and planning against this disaster.

Chapter 6: References

[1] Ghapar, Azimah Abdul, Yussof, Salman, and Bakar, Asmidar Abu. “Internet of Things (IoT) architecture for flood data management”. In: International Journal of Future Generation Communication and Networking 11.1 (2018), pp. 55–62.

[2] Shah, Wahidah Md, Arif, F, Shahrin, AA, and Hassan, Aslinda. “The Implementation of an IoT-Based Flood Alert System”. In: INTERNATIONAL JOURNAL OF ADVANCED COMPUTER SCIENCE AND APPLICATIONS 9.11 (2018), pp. 620–623.

[3] E. Samikwa, “Flood Prediction System Using IoT and Artificial Neural Networks with Edge Computing,” thesis, RISE Research Institutes of Sweden, STOCKHOLM, 2020

[4] Maspo, Nur-adib, Harun, Aizul Nahar, Goto, Masafumi, Nawi, Mohd Nasrun Mohd, and Haron, Nuzul Azam. “Development of Internet of Thing (IoT) Technology for flood Prediction and Early Warning System (EWS)”. In: ().

[5] Brouwers, Lisa and Boman, Magnus. “A computational agent model of flood management strategies”. In: Regional Development: Concepts, Methodologies, Tools, and Applications. IGI Global, 2012, pp. 522–534.

[6] Pengel, BE, Krzhizhanovskaya, VV, Melnikova, NB, Shirshov, GS, Koelewijn, AR, Pyayt, AL, Mokhov, II, et al. “Flood early warning system: sensors and internet”. In: IAHS Red Book 357 (2013), pp. 445–453.

[7] Sebin Sabu1 and Nora Elizabeth, “Kerela floods- A model of rescue and rehabilitation using information technology and social media based crowdsourcing”, IEEE India info. Vol. 13 No. 3 Jul-Sep 2018