Flood Detection and Avoidance System using IoT

Mallangi Surya Prakash Reddy[a], N. S. Fizal[b], A. Lokesh[c], and K. Kishore Kumar[d]

a,b, c
Student, Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology. Avadi, Chennai-600062, Tamil Nadu, India,
[d]Asst. Professor, Department of Computer science & engineering, Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology. Avadi, Chennai-600062, Tamil Nadu, India,

Article History: Received: 10 January 2021; Revised: 12 February 2021; Accepted: 27 March 2021; Published online: 20 April 2021

Abstract: Flooding is one of the major disasters across major geographical locations in the world. Due to this disaster majority of people had lost their livelihood. In recent times we can see the major natural disaster occurred in our country in those disasters flooding in the major one, due to this natural calamity all over India majority of people have lost their survival and lost their beloved one's heavy property damage has also occurred. To rectify this major problem, we have developed a solution with the help of IoT and data sciences. This model is very much useful in monitoring the water level variations in various water resources like rivers, dams, reservoirs. The sensor technology values are monitored and stored regularly in the cloud server which is useful to visualize flood and with the help of IFTTT alerts to corresponding authorities like nearby police stations and NSS, CRPF camp people to take proper action. With the help of data visualizations and the KNN algorithm, we will find the place where we can place this device. These complete data are going to be updated to our web page we are developing for this project. In addition to this model, we are again going to use sensors and automatically lift the dam gates. The model was designed and developed to monitor and control the disaster in this Intelligent system that will control the overall water management. Subsequently, the system will alert the authorities to reduce the impact that is going to happen when the flood is going to occur.

Keywords: Thingspeak cloud, IFTTT, Internet of things (IoT), KNN algorithm, Data visualization, Web development.

1. Introduction

Disasters are the natural phenomenon that attracts major global interest. In those disasters, flooding is the major one it results in tremendous environmental destruction and loss of livelihood and many other day-to-day activities. Flooding is a result of substantial rainfalls, structural failures, and a large number of human factors. Floods play on precipitation amounts and rates, topology, geology, land use, and antecedent moisture condition. In 2020 during the time of pandemic we have seen major natural disasters in those disaster floods have played a major role. This is due to the abnormal change in the climatic conditions all over the world mainly rains occurred during the rainy seasons i.e. From September to December every year. Early rainfall is usually in June with full commencement in September, and stops in November each year, with a few showers in December to herald the dry season and the typical monsoon winds in sea bed zone areas.

Due to global warming and changes in the climatic condition's rains are not coming in the months where rainfalls have to come. Due to this flooding has occurred in major rivers occupied areas and hilly regions like Tamil Nadu, Kerala, Vishakhapatnam, Mumbai, Gujarat, and other regions of India. There are three major forms of flooding regions in India they are: coastal, river, and urban flooding. Coastal flooding happens in a low-lying belt and freshwater swamps along the coast. River flooding happens in the floodplains of bigger rivers. Flash floods are also attributed to rivers in the inland areas where sudden heavy rainfall in a short period can turn into destructive torrents. Also, urban flooding happens in towns, on flat or low-lying surfaces mostly where surface drainage more or less does not exist, or where existing 1drainage has been blocked with waste. Dams are among the most important human creations in the hydrological cycle built to impound water in reservoirs amid times of high flow, with the goal that it can be utilized to meet human water prerequisites amid times that natural flows are deficient in disasters.

In this proposed model with the help of an intelligent sensor system, we are going to keep a close watch over various natural factors to predict a flood, so we can embrace ourselves for caution, and minimize the damage caused by the flood. Natural disasters like a flood can be devastating leading to property damage and loss of lives. To eliminate or lessen the impacts of the flood, the system uses various natural factors like temperature, humidity, and water raise in level. After building up this smart object we are going to find out the place where we can fix our smart object with the help of the KNN algorithm. Finally, these complete data will be going to be updated and make available to all people in real-time with the help of our web page that we have created.

2. Methodologies

2.1 Physical Design: -

2.1.1 NODEMCU:NODEMCU is an open-source firmware and development kit that helps you to prototype or build IoT products. It includes firmware that runs on the ESP8266 Wi-Fi modulations from ESP Systems and hardware which is based on the ESP8266 module. This firmware was developed with the help of Lua and c scripting language. It is based on the Elua project and built on the ESP modulations of Non-OS SDK files for ESP8266[5][6]. MCU stands for Microcontroller Unit - which means it is a computer that processes the data on a single chip. A microcontroller contains one or more CPU processors along with memory and programmable input/output peripherals. They are used to automate automobile engine control, implantable medical devices, remote controls, office machines, appliances, power tools, toys.

2.1.2 DHT11:DHT11 is a temperature and humidity sensor where the climatic conditions can be recognized by this sensor. There are threepin configurations to the sensor where the VCCpin will get the power supply, OUT pin will show the result i.e., climatic condition report, and GND pin will neutralize or grounds the unwanted activities.

2.1.3 Ultrasonic Sensor:Ultrasonic sensor is used to find the depth and height of water. The basic principle of ultrasonic sensor is related to that of laws of reflection i.e., the Tring pin will transmit the signal and those signals will be reflected to echo pin after touching the upper surface of the water or any object that is stable this will help us to find the distance or raise in water level. In the ultrasonic sensor, there are 4 pins where the two extreme pins will be used for the transmission and receiver of depth and also the rise in the water level.

2.2 Logical Design:

2.2.1 Arduinocompiler:The Arduino IDE is a cross-platform application for Windows that is written in functions from C and C++. It is used to integrate the sensors that can be programmed and operatable according to the surrounding environmental condition with the help of Arduino compatible software. It is the place where the main operations are going to be done i.e. Data uploading to the cloud and the message transmission to the phone through IFTTT.

2.2.2 Thingspeak cloud:Thing speak is an IoT analytics platform service that allows you to aggregate, visualize, and analyze live data streams in the cloud. You can send data to Thingspeak from your devices, create instant visualizations of live data, and send alerts using web services like Twitter and Twilio. With Thing-speak, you can write and execute Arduino code to perform pre-processing, visualizations, and analyses [9]. Thing-speak enables engineers and scientists to prototype and builds IoT systems without setting up servers or developing web software.

2.2.3 IFTTT:If This Then That is an IoT platform where certain actions are going to be triggered when the action has occurred. This is predefined in the code and these all are going to be completely integrating with the WIFI module that we are going to be used in the project development.

2.2.4 R Studios: This a data science platform tool that is used to visualize. R Studio is an integrated development environment for R, a programming language for statistical computing and graphics. It is available in two formats: R Studio Desktop is a regular desktop application while R Studio Server runs on a remote server and allows accessing R Studio using a web browser.

2.2.5 XAMPP: XAMPP is a free and open-source cross-platform web server solution stack package developed by Apache Friends, consisting mainly of the Apache 8HTTP Server, MariaDB database, and interpreters for scripts written in the PHP and Perl programming languages. Since most actual web server deployments use the same components as XAMPP, it makes transitioning from a local test server to a live server possible.

2.2.6 KNN:K-Nearest Neighbor (KNN) Algorithm for Machine Learning K-Nearest Neighbor is one of the simplest Machine Learning algorithms based on the SupervisedLearning technique. K-NN algorithm assumes the similarity between the new case/data and available cases and puts the new case into the category that is most similar to the available categories.

3. Implementation

3.1 Basic Architecture: -

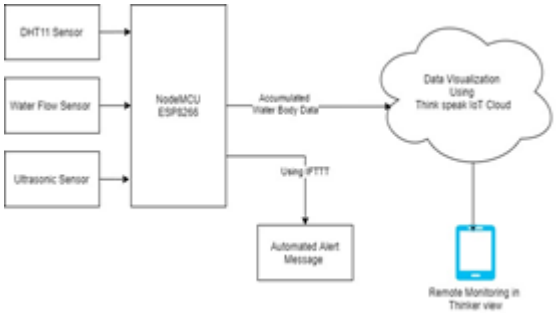

Fig 1 General architecture flow diagram of the model

Fig. 1 will focus on the complete structure of the proposed work; Hear We used three sensors with a controller for analysis of the water-body status. Moreover, based on sensor threshold data we may trigger an automated message passed to the user of the system.

3.2 System Setup

There are three different phases in the proposed model they are

Phase 1: Hardware and Cloud setup.

Phase 2: Place identification using KNN.

Phase 3: Placing all the data on a webpage.

3.2.1 Hardware and Cloud setup

In this model, the NODEMCU board is the place where all sensors are going to be integrated and the collected sensors data is going to be sent to the cloud and IFTTT to android phones. Here the DHT11 sensor will calculate the temperature and humidity for every 1 hour in a day and those data will be uploaded to the cloud with the help of NODEMCU with integrating ESP8266 module. That data is also getting uploaded to the cloud and stored in the form of graphs. In thing speak cloud the collected data is going to be stored in the form of graphs. The ultrasonic sensor will help find the raise in the level of water. The basic working of ultrasonic sensor is similar to that of reflection laws i.e. The Echo pin will send the signal to the water level depth or the surface of the water and the Tring will receive the reflected signal and will calculate if there is any raise in the level of water. Finally, the main function Water flows sensor where the water flow data is going to be stored and going to be represented in the form of graphs in thing speak cloud represents in Fig.3. These all modules are going to be integrated into NODEMCU in such a way that all the sensors will help in finding the flood occurrence Fig.2.

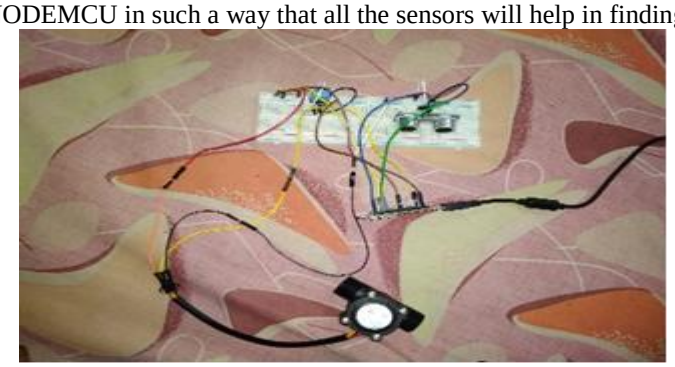

Fig.2 Physical Design of Flood Monitoring System

Fig.3 Thing Speak Cloud Configuration.

3.2.2 IFTTT

In Fig.4. We are going to find the area and the place where major floods have occurred from the past 50 years' data. We have applied the KNN algorithm to find the most flood occurred area so that we can place the smart object near to that place.

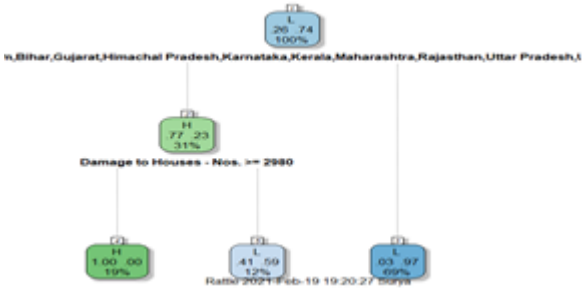

Fig.4 Decision tree

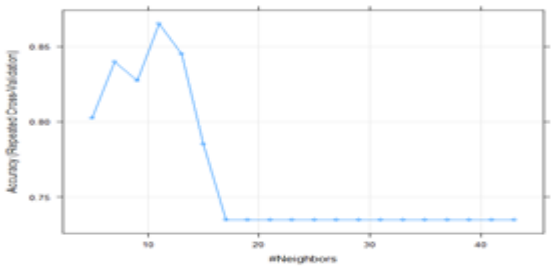

Fig.4.1 KNN algorithm output

Fig 4.1 Gives the output of the KNN algorithm output

d(x,y) = sqrt((y1-x1)^2-(y2-x2)^2)

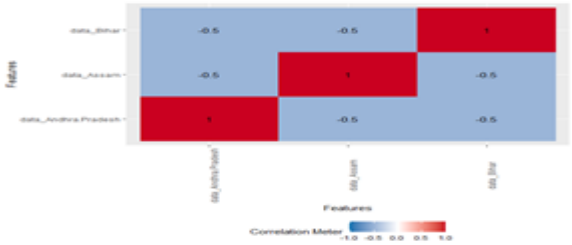

Fig.4.2 Confusion matrix

In 4.2 We can see the output of the confusion matrix and also we can find the accuracy and error rate.

Accuracy = 0.9531

Error = 0.0469

3.2.3 Message Transmissions

Finally, after developing the smart object and finding out a place we are going to update those data on our web page. So that every common people alert themselves and also alert others.

4. Results and Discussion

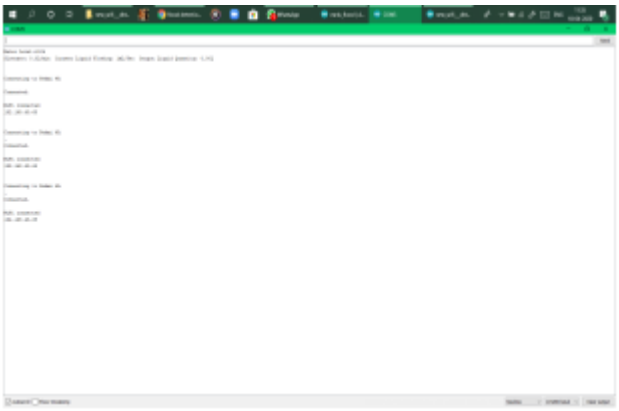

Fig. 5 Serial Monitor view in IDE

Fig. 5 will give you the idea of whether the sensors and WIFI are connected or not. It is available in the Arduino compiler or namely known as the Arduino IDE.With the help of a serial monitor, we can also normally view and check the connection to WIFI and speed in the flow and level of water.

Fig. 6. Thing Speak Cloud Data Visualization

Fig. 6. will indicate the data accumulation of sensor data which is located in water bodies. Hear data has been visualized in Thinker Speak IoT Cloud and the same has visualized any remote location using Thinker View for Android Application.

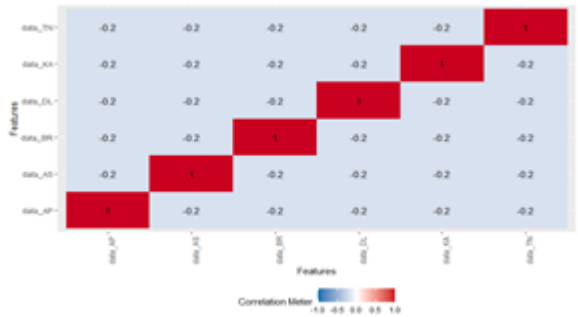

Fig.7 Confusion matrix

In Fig.7 The above confusion matrix will givethe output of the various performance metrics accuracy and error rate.

Accuracy: 0.8934

Error: 0.1066

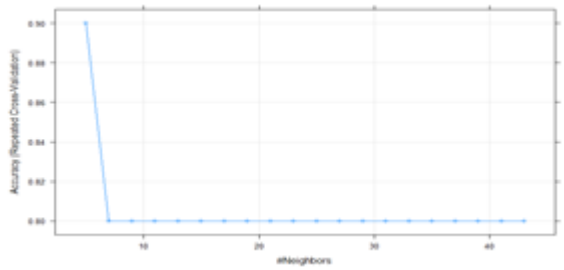

Fig.7.1 KNN algorithm

In Fig.7.1 We will find the KNN algorithm output that will give the idea of what is happening and what is not going to happen.

d(x,y) = sqrt((y1-x1)^2-(y2-x2)^2)

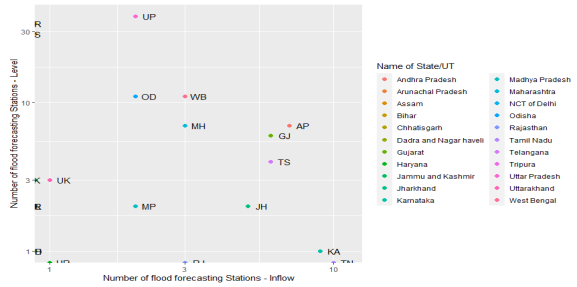

Fig.7.2 Sanitation controls

From the above figures, we came to know that we are going to focus mainly on the low sanitation control areas where major floods have occurred.

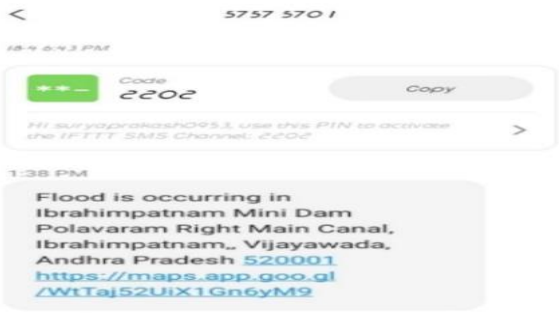

Fig.8. Alert Message in Mobile Phone

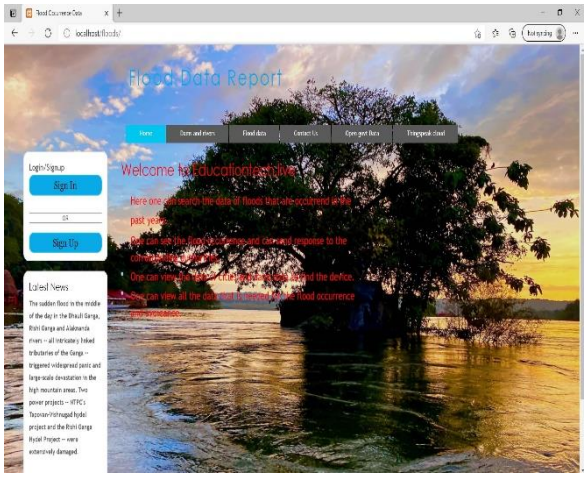

Fig 8.1 Web page

In Fig.8. Represents the alert message communicated to the authorities of the expert system. Moreover, it will lead to taking immediate action to save guard the human life [7]. Also contains the information the people need whether a flood is occurring or not. This confidential information can be accessed only by authorized persons. So that it will provide in the security of the data.

5. Conclusion

At present India is facing a devastating flood in many parts of India, there arise a need for efficient flood monitoring systems. Flood forecasting and the issuing of flood warnings are effective ways to reduce damage. The proposed system will be efficient because it has better coordination of monitoring, communication, and transmission technologies which are adaptable to background conditions. The proposed system also ensures increased accessibility for the assessment of emergencies and enhances effectiveness and efficiency in responding to a catastrophic situation. In summary, the proposed system would be beneficial for decision-making and evacuation planning purposes.

References

1. R. Becker, "A future of more extreme floods, brought to you by climate change," May 2017. [Online]. Available: https://www.theverge.com/2017/5/18/15658342/flooding-sealevel- rice-meltingice- climate-change-extreme.

2. Z. M. Taib, N. S. Jaharuddin, and Z. D. Mansor, "A review of flood disaster and disaster management in Malaysia," International Journal of Accounting Business Management, vol. 4, no. 3, 2016.

3. Al-Fuqaha, M. Guizani, M. Mohammadi, M. Aledhari, and M. Ayyash, "Internet of things: A survey on enabling technologies, protocols, and applications," IEEE Communications Surveys Tutorials, vol. 17, no. 4, pp. 2347–2376, Fourth quarter 2015.

4. S. J. Priya, S. Akshaya, E. Aruna, J. A. M. Julie, and V. Ranjani, "Flood monitoring and alerting system," International Journal of Computer Engineering Technology (IJCET), vol. 8, no. 2, p. 15, Mar 2017.

5. D. Satria, S. Yana, R. Munadi, and S. Syahreza, "Prototype of google maps-based flood monitoring system using Arduino and gsm module," International Research Journal of Engineering and Technology (IRJET), vol. 4, no. 10, Oct 2017.
6. M. Madhumathi and R. Grace, "Flood alert management system using IoT and microcontroller," International Journal of Innovative Research in Computer and Communication Engineering, vol. 5, no. 4, April 2017.
7. K. Rose, S. Eldridge, and L. Chapin, "The Internet of Things: An Overview: Understanding the Issues and Challenges of a More Connected World," www.internetsociety.org, October 2015.
8. E.A. Basha, S. Ravela, and D. Rus, "Model-Based Monitoring for Early Warning Flood Detection," SenSys'08, November 5–7, 2008, Raleigh, North Carolina, USA.
9. J. Sunkpho and C. Ootamakorn, "Real-time flood monitoring and warning system," Songklanakarin J. Sci. Technol., vol. 33, no. 2, Mar-Apr. 2011, pp. 227-235.