START BUILDING THE IOT FLOOD MONITORING AND EARLY WARNING SYSTEM

G. RAJKUMAR
V. POOVIZHI
B. SURYA
K. NARAYANAN

MENTORED BY
P. SUJATHA

Flood Monitoring and Early Warning Systems – An IoT Based Perspective

Abstract

One of the most frequently occurring calamities around the world is a flood. For flood prone areas or countries, an essential part of their governance is flood management. The necessity to continuously review and analyze the adverse or ambient environmental conditions in real-time demands developing a monitoring system so that floods could be detected beforehand. This paper discusses different Internet of Things (IoT) based techniques and applications implemented for efficient flood monitoring and an early warning system and it is observed that in the future, the combination of IoT and synthetic aperture radar (SAR) data may be helpful to develop robust and secure flood monitoring and early warning system that provides effective and efficient mapping during natural disasters. The emerging technology in the discipline of computing is IoT, an embedded system that enables devices to gather real-time data to further store it in computational devices using wireless sensor networks (WSN) for further processing. The IoT-based projects that can help collect data from sensors are an added advantage for researchers to explore in providing better services to people. These systems can be integrated with cloud computing and analyzing platforms. Researchers recently have focussed on mathematical modelling-based flood prediction schemes rather than physical parametric-based flood prediction. The new methodologies explore the algorithmic approaches. There have been many systems proposed based on analog technology to web-based and now using mobile applications. Further, alert systems have been designed using web-based applications that gather processed data by Arduino Uno Microcontroller which is received from ultrasonic and rain sensors. Additionally, the machine learning (ML) based embedded systems can measure different atmospheric conditions such as temperature, moisture, and rains to forecast floods by analyzing varying trends in climatic changes.

Keywords: IoT, Wireless Sensor Networks, Sentinel Image, Flood Monitoring, Early Warning System, Machine Learning Model.

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1. Introduction

The impact of global warming prompt decision making authorities to enhance flood-risk management processes to address issues related to the causes of floods. Risk mitigation can be done simultaneously with multiple factors [1]. Floods occur when water levels of rivers exceed and there is sea rise during heavy rains. A very common natural disaster that affects the lives of people, and private and public properties are floods, especially in inhabited areas but in urban and rural areas, this could jam road networks disrupting commuters from reaching their destinations. Although the flood rescue teams from the local government units provide support to the people using different communication channels, the dissemination of flood related information needs to be conveyed quickly. Humans have been trying for a long, but not always have been fully successful in controlling and foiling the destructive consequences of floods. Synthetic flood banks have been made and river courses have been straightened. Further, the riverbed is deeply dredged. These methods are effective but likely to have adverse effects on the river

*Corresponding author. Email: tasneemrkc@gmail.com

hab. There is an obligation on the part of national and international environmental organizations with an important role in controlling floods and protecting public and private properties. Moreover, the situation has further deteriorated due to the increase in the number of flash floods. Most of these organizations have blamed global warming where the melting of ice glaciers and heavy snow results in rising inundation levels rapidly causing 'flash floods' [2]. It is common these days to hear major floods making news due to the impact they inflict upon human lives and property. Further, the satellite-based flood assessment to detect the severity of the damage can be crucial in decision making and addressing mitigation plans by the respective risk management authorities.

The remote sensing data with diverse areas acquired from satellites such as the Sentinel-1 series can be used effectively in tackling severe real-time flood levels and mapping them more appropriately. This has been analysed by researchers by using various mapping and monitoring techniques on large remote sensing datasets of floods [3]. The Sentinel images (i.e., C-band SAR images) could be used for regular flood monitoring. Further, classifying and evaluating the data in flood-prone regions over a particular duration can pave the way for detecting and evaluating the changes using time-series analysis [4]. The SAR satellite sources have been increasing and have enhanced their provisions in flood extent mapping. The sensor features for the predictive modelling techniques to analyze the flood dynamics need to be developed for complete SAR image-based information extraction. The process of flood mitigation can be achieved through various hybrid machine learning (ML) techniques such as support vector machine (SVM) combining it with metaheuristic optimization procedures. Some of these procedures are the imperialist competitive algorithm, grey wolf optimization (GWO), and differential evolution [5].

In this paper, an overview of the problem of monitoring floods and various techniques addressing this issue is presented. Section 2 presents the reviews on various IoT-based flood monitoring techniques that includes monitoring the air quality and environment, flood forecasting, early flood warning, and applications of ML techniques. Section 3 covers existing IoT-based flood monitoring and alert systems over IoT sensors, computer vision, and cellular communications. Section 4 provides the possibility of developing an IoT-based flood monitoring with satellite images and proposed a framework for the development of a new Flood Monitoring and early warning system (FMEWS). Section 5 exhibits the conclusions and future work required for the development of FMEWS based on the conducted study.

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2. IOT-based Flood Monitoring Techniques

There are different models from some of the existing research that is based on different flood predicting methods which highlight the importance of implementing different approaches in tackling floods. These models use WSNs to build energy efficient monitoring and early alert systems. These models can support in designing of an efficient system to predict and prevent damages caused by floods [6].

2.1. Monitoring of Air Quality using Smart Sensors

A smart sensors network for monitoring indoor and outdoor air quality was designed by Postolache et al. in 2009 [7]. They installed nodes of some of the sensors inside rooms which consisted of sensors such as tin dioxide connected to the central unit through hardwires or wirelessly [8]. For the accuracy of the result, the concentration of gas in the temperature and humidity is measured. In order to compensate for the influence of the above measurements, they applied MISO neural network (NN) which is based on multiple inputs single output. IEEE 802.11 (Wi-Fi) technology was used for communication between sensors.

2.2. Monitoring Environment using Controller Area Network

Controller Area Network (CAN) based environmental monitoring system was proposed by Rao et al. in 2012 [9]. The CAN and ZigBee technology was utilized for effective communication among the sensors [10]. The sensors are connected to the microcontroller, ATMEL-89S52 through an interface of CAN to further share this data to the server using ZigBee Communication. This is used since the CAN protocol provides a higher data rate. For any specific area, the benefit of this system is that it uses a precise and dependable method for data broadcast. Communication is inexpensive and there is no loss in terms of data.

2.3. Flood Forecasting

A flood forecasting model that uses Wireless Sensor Networks was created by Seal et al. [11]. This design used simple and fast calculations using multiple variable robust linear regression methods for flood forecasting. Its implementation is very cost-effective and also simple and easy to understand. It used very low-cost hardware resources. It has all the features desired by any real-world algorithm such as real-time predictions and reliable accuracy. This model does not specify the number of parameters required which means that any kind of parameter can be added or removed. A polynomial represented the rise in water level based on which flood warning level can be determined easily. In order to identify the time interval between each successive reading, a time multiplier function was added. The design strategy does not prevent floods or damage caused by them. It can only predict the occurrence of floods and send a warning to people by methods such as ringing an alarm bell. it is observed that the Wireless Sensor Network is effective when flood warnings are to be communicated. Nevertheless, it is necessary to collect and analyze the sensor data since the calamity alerts could be given to the public at risk with sufficient time to respond during relief operations.

2.4. Early Flood Warning

Flood Detection using WSN: An early detection of flood system was implemented by Basha et al. [12] by means of a short description of sensor networks in Hondurasi meant for the people who are at risk of getting affected by the flood [12]. It included the analysis detailing the significance of sensor networks, available operational applications, and their lower cost in developing countries. The issues pertaining to the detection of floods and cautioning people in the events of disasters were discussed since it can turn into a complex situation. After in-depth analysis, a solution was proposed that uses WSNs. This solution contains four different categories such as flood prediction, notification to the authorities, alerting the community, and evacuation of people. The proposed solution was validated by conducting various experiments. The tests were carried out for different communication ranges such as 144 MHz radio usability. The testing activity requires US antenna towers with line-of-sight for reliable communication in the air available between sensors at those ranges. According to them, sensor network technology could be the best way to prevent damage by detecting floods in developing countries.

An early flood warning system described the architecture and deployment strategy to meet the requirements. It permits enhancing the forecasting capability of the system using model-driven control. The design was created in Honduras with its utilization to detect and analyze the flood forecast. An integrated form of the forecasting technique that includes network design and testing of the attached components was utilized by the developer of this system. By deploying the system on the banks of the river in Massachusetts, they achieved a successful outcome in the field examinations. According to the framework, a very unique heterogeneous communication system was utilized by setting sensors over the river basin. These sensors could read real-time data and auto-monitor to adjust their readings if required. These readings help in estimation techniques to address disasters such as floods.

The proposed model as shown in Fig. 1 has an innovative procedure to forecast floods and which utilizes information received from installed sensors that are spatially distributed in nature. A productive Sacramento Soil Moisture Accounting (SACSMA) model has been utilized for detecting floods effectively. Nonetheless, in the case of flood detections in developing countries, SACSMA is an expensive strategy for deployment. Their methodology has easier calculations in comparison to the traditional method to handle floods, using continuous data from sensor hubs. It has an advantage over the SACSMA model. An early warning system is shown in Figure 1.

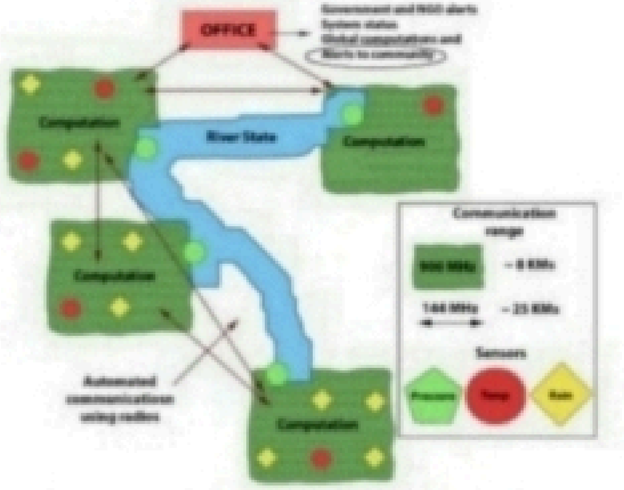

Figure 1. Early Flood Warning Model [12]

By alluding to the model executed as a reference, certainly, developing and underdeveloped nations are greatly influenced by floods on an annual basis. A low-cost and efficient flood detection mechanism can be created and effectively deployed using currently accessible technologies such as WiFi and ZigBee. Additionally, planning and securely documenting the identified information for further flood prediction. The IoT and cloud computing efficiently store and helps in analyzing the sensor data.

2.5. Applications of Machine Learning Techniques in the Environmental Field

The deep learning (DL) variant of the artificial neural network (ANN) can be used to detect flood-prone regions which can elucidate complex methods such as classification and regression. Traditional hand-crafted methods have been used to automate inundation detection from satellite images. However, these methods do not produce the accuracy required for precise flood detection. To address this limitation, Pallavi et al. [13] proposed a model that combines the water index feature with the generalizable features based on deep convolutional neural networks (DCNN). This combination technique and the DCNN model use Sentinel-2 images for training and testing. This model was implemented on the blend of green/SWIR and blue/NIR water indices. The outcomes depict that the VGG16 model-based trained proposed model outperformed when compared with the NDWI, MNDWI, AWEI, Mishra & Prasad's [14], and Li et al.'s [15] indices.

Satellite images and observations of hydrology are important sources of information for early warning systems regarding flash floods. This information is supported by DL models such as UNET, a convolutional neural network (CNN) approach in the segmentation process with higher performance. A combination of the particle swarm optimization algorithm (PSO) and the UNET model known as particle swarm intelligence optimized UNET deep learning (PSO-UNET) was proposed which strives for the maximum layers with parameters over the PSO architecture [16]. By comparing the UNET model, the Dice coefficient value was found to be 79.75% which was approximately 8.59% higher. The dataset used for the implementation from the year 2019 comprised 984 Sentinel-2 images acquired from the national project. The result obtained was found to be based on the best hyper-parameters providing higher accuracy.

Intelligent and efficient drought and crop productivity prediction can be achieved using ML techniques based on IoT. An IoT-based WPART (Wrapper Partial Decision Tree) method is based on the wrapper feature selection combined with the partial decision tree algorithm. An intelligent farming system integrated with the WPART method was proposed for predicting crop yield and drought situations [17]. This system applied SVM and neural network (NN) supervised ML algorithms for the data classification. In total, five datasets were processed and classified which achieved higher accuracy, precision, and F-score in contrast to the traditional ML techniques.

The prediction of drought using weather data has been attempted using various ML models. However, it is not certain which model performs better. A detailed study was carried out by using a real-world open Kaggle publicly available dataset [18]. Three months of 18 meteorological indicators were used to predict drought levels which included evaluating around 16 ML and 16 DL models. Based on the results indicating max, mean, and standard deviation values, the DL models performed better than the ML models. The extreme gradient boost (EGB) algorithm attained maximum accuracy and the SVM model had a maximum F1 score as well as Matthews Correlation Coefficient (MCC). The Gated Recurrent Unit (GRU), Long Short-Term Memory (LSTM), and XceptionTime models achieved higher accuracy, F1 score, and MCC respectively. These results represent that the multiple models are recommended to achieve the highest accuracy. The satellite images-based flood monitoring system normally provides lower accuracy when compared with unmanned aerial vehicles (UAV) imaging systems. The CNN based flood management system was developed that detects flooded regions using feature selection [19]. The landmarks identified from spatial rich information-based UAV images are studied using the Haar cascade classifier by adding them to the training dataset for implementing the CNN algorithm. The classification process detected flooded regions and the outcomes evaluated represented that the roads and buildings identified showed 94% and 91% accuracy. Additionally, landmark detection can help rescue stranded people. However, a huge dataset of UAV images consumes a lot of memory. To address this limitation, they are distributed into smaller patches. This dataset cannot analyze the extent of the inundation intensity. Therefore, the depth in the flooded region can be detected using Digital Elevation Model (DEM) and Light Detection and Ranging Equipment (LiDAR) technologies.

3. Existing IOT-based Flood Monitoring and Alert Systems

3.1. The Implementation of an IoT-Based Flood Alert System

A system to detect inundation stages by measuring the upsurge in water levels and alerting local residents was proposed by Shah et al. [20]. The waterfall model as a methodology with Raspberry Pi was used to gather information from deployed sensors which transmitted it to the Global System for Mobile communication (GSM) module. The system further would alert the resident by sending an SMS as an outcome. As quoted by the author, researchers have estimated that if the sea level rises by 4 inches by 2030, it could be a reason for dangerous flooding that could be affecting many parts of the world. There is an emphasis on the usage of the GSM module since there is an increment trend in the usage of mobile users have been positive. This makes it easier for the system to alert authorized people when in an emergency. This system followed a waterfall model and discusses the use of different technologies as mentioned below. The authors used a water sensor, SEN113104 model, and USB 3G modem Huawei mobile broadband E173. This was set up along with a resistor 10K, and a jumper cable to connect with Raspberry Pi. The sensors were placed at different heights and the water height increased; they triggered data to the Raspberry Pi. This data is added to GSM Module for additional processing. This system calculates the time and speed with which the water level rises. IoT-based flood alters system is shown in Figure 2.

The performance testing shows that the performance is evaluated using delay in time. The first type of test was carried out with 30 series of data captured manually and automatically using the system. The results verify the system has been accurate in fetching the data using sensors. The second test was to identify the delay time in sending SMS to alert authorities in case of emergency and the third test was to identify the range of water increment which summarized the findings. The system highlights the importance of using sensors that can help gather relevan

Flowchart

Start
Read
Temperature
Humidity
Read
Distance
Print
Temperature
Print
Distance
Distance<20?
No
Yes
LED and
BUZZER
OFF
LED and
BUZZER
ON
Print"Nothin
g to worry"
Print Warning
Message
Database
WEB API
SMS
End

data helping authorities in Malaysia to take necessary measures.

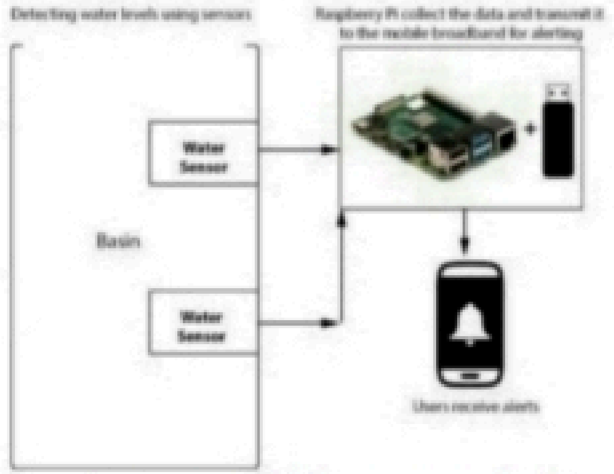

Figure 2. An IoT-Based Flood Alert [20]

3.2. IoT- Based Flood Information Monitoring System

Another system was designed for monitoring information related to floods. This was based on IoT which helps users to identify flood activity by reviewing weather conditions and inundation levels [21]. The ultrasonic sensor HC-SR04 and another type of rain sensor were used to gather information related to flood altitude. It uses an Arduino Uno microcontroller to generate web-based data. The wireless router, TL-MR3020 is connected to the controller and linked with the gathered data and is shared with the users. This system was developed to address the situation of floods in Indonesia. The Ultrasonic and rain sensors are part of the input section whereas, the Arduino Uno Microcontroller is part of the process. An IoT-based flood information monitoring system is shown in Figure 3.

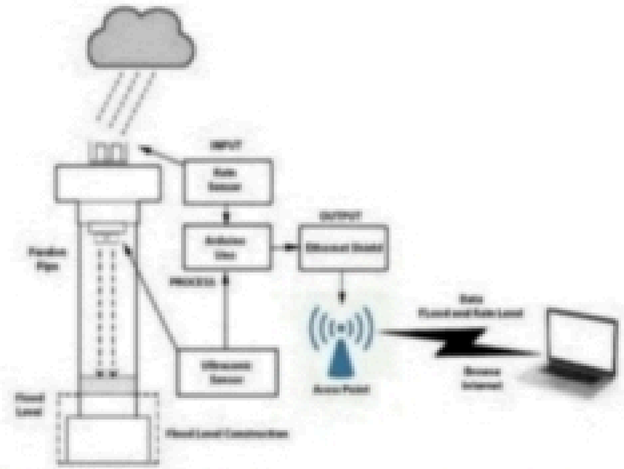

Figure 3. Design of an IoT-Based Flood Information Monitoring System [21]

The Ethernet shields and the wireless access points constitute the output section which is well integrated. Both sensors are placed upper side of the system with a cork float inside which will reflect an echo signal which sensor acknowledges through its trigger. The rain sensors will detect rain conditions and the water height is checked in the pipe. The Arduino Uno Microcontroller receives the data from sensors that are saved in the web server. The early warning system is a web-based system that users can access which includes web flood information.

3.3. RiverCore: IoT Device for River Water Level Monitoring Over Cellular Communications

The Development of the IoT system "RiverCore" is intended to monitor the river for flooding through data acquisition and data processing. This was implemented for a particular area of the Colima state of Mexico. The data was retrieved using a 3G cellular network and used Message Queuing Telemetry Transport (MQTT) protocol. The system uses a database with data being secured using encryption. A graphical representation displays flood analysis and prediction. Floods are a significant threat in many countries, and it is increasing due to climate change which is confirmed by United Nations Office for Disaster Risk Reduction (UNISDR). The monitoring of floods is based on IoT technology that uses ML and artificial intelligence supports improving data acquisition methods [22]. An ultrasonic sensor with cellular transmission is installed by using telemetry methods to reduce the load of input data. An IoT device for river water level monitoring is shown in Figure 4.

paving the way for effective comparative analysis and an enhanced outcome. The system will help in evaluating the quality of service based on the results generated. Further, using this integrated system can greatly influence the decision making of relevant authorities to mitigate the floods in the concerned areas and safeguard life and properties. The proposed framework can be improved further to address other potential risks such as landslides and emergency mapping support during earthquakes. The researchers should explore different ways with a strong commitment to study climate change and its impact based on data from hydrological, meteorological, and satellite-based information. This would help in measuring the inundation levels across different regions and address the issues accordingly.

5. Conclusion

IoT sensors-based flood monitoring systems tend to be lower cost, consistent and portable. However, when there are large areas, these systems are not recommended due to the fact that every sensor is generally invigorated by a vitality restricted battery. This paper reviewed and clarified different ecological and flood monitoring systems and various communication technologies that support enhancing the detection of viable floods and identifying cautioning issues. Further, these systems that are having highly reliable sensors with powerful IoT cloud platforms can be fundamentally utilized for large-scale environmental monitoring, and flood prediction and prevent damage caused by it. Even though the methodology of utilizing IoT in flood monitoring is not extensively explored at this point, we will see a colossal utilization of IoT and some new advancements in the near future. For example, AI and 5G techniques meet up for the prediction of floods as well as other natural calamities. The use of satellite images could be very helpful in flood monitoring as they help to keep an eye on the water bodies and the change in their behaviour from above. Some researchers have utilized data based on Google Maps to build a detection model. GSM modules also have been used in different ways similarly. Close consultation with hydrologists and learning machine-learning algorithms can further support building efficient monitoring and alert system. In the future, the usage of SAR data from the Sentinal-1 satellite is an added advantage in handling rescue operations and damage assessments based on data before and after floods. The wireless sensors can help in gathering flood related data by creating a database for further analysis. As a recommendation, there is a tremendous opportunity to explore the combination of IoT systems and SAR data to classify the images from flood-prone areas and develop robust and secure Flood monitoring and early warning system.

Declaration

This manuscript has not been submitted to, nor is under review at, another journal or other publishing venue.

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Warning systems

Acquisition and communication electronics continuously control the level of water and the delivery of data to the control center at planned intervals.

If a preset level or flow is surpassed, it generates data communication through SMS or e-mails to the authorized users.

The solution can be integrated with the early flood warning systems (EFWS) of Public Administrations.

2. BACKGROUND

An overflow of a large amount of water beyond its normal limits, especially over what is normally dry land. A flood is an overflow of water that submerges land.In the sense of "flowing water", the word may also be applied to the inflow of thetide. Floods are anarea of study of the discipline hydrology and are of significant concern in agriculture, civil engineering and public health. Flooding may occur as an overflow of water from water bodies, such as a river, lake, or ocean, in which the water overtops or breaks levees, resulting in some of that water escaping its usual boundaries, or it may occur due to an accumulation of rainwater on saturated ground in an area flood. While the size of a lake or other body of water will vary with seasonal changes in precipitation and snow melt, these changes in size are unlikely to be considered significant unless they flood property or drown domestic animals. Somefloods develop slowly, while otherssuch as flash flood scan develop in just a few minutes and without visible signs of rain.

3. PROPOSED SYSTEM

In this proposed system, the raspberry pi-4model is used. It gets the values from Ultrasonic sensors and compute the values. The data will be sent to Wi-Fi device. Further the WIFI device sends all the sensed information to the client people through wireless communication. The water level readings will be stored in the cloud. For Prediction purposes we need the data in csv format. From the cloud we can convert the data in csv format because we need historical data for prediction purposes. Processed data will be sent to thecloud using Raspberry pi 4. Cloud will store the data and can be further used to predict the chances of floodpriorly.

4. METHODOLOGY

In this Block Diagram we will discuss about the connections of all other circuits with raspberry pi 4.And Raspberry pi 4 is the brain of the above circuit. In this methodology the Raspberry pi is connectedwith the buzzer,ultrasonic,temperatureand humidity sensor,dam gate control. To produce outputs at the respective blocks.

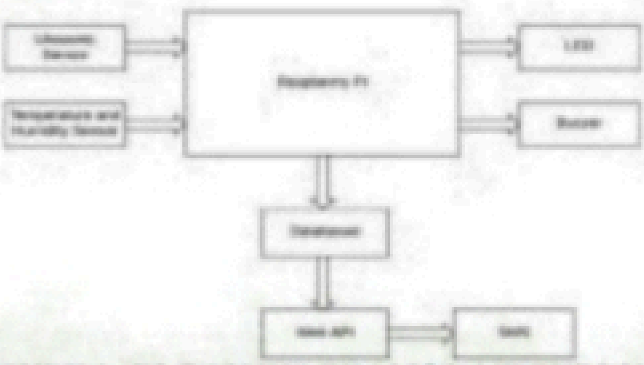

FIGURE 1:-BLOCK DIAGRAM5.RASPBERRY PI

The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It's capable of doing everything you'dexpect a desktop computer to do, from browsing the internet and playing high definition video, to making spreadsheets, word- processing, and playing games.

2.5 DESIGN OF WIRING DIAGRAM

This design consisted of the actual overall project wiring diagram. This wiring diagram showed how to combine and connect the main components of this project. This design was done early in the next stage to ensure that a prototype of this project will not be mistaken. A software called as Fritzing was implemented for this design where this software consisted of many electronic components for easy design. Figure 4 demonstrated the layout of the wiring diagram.

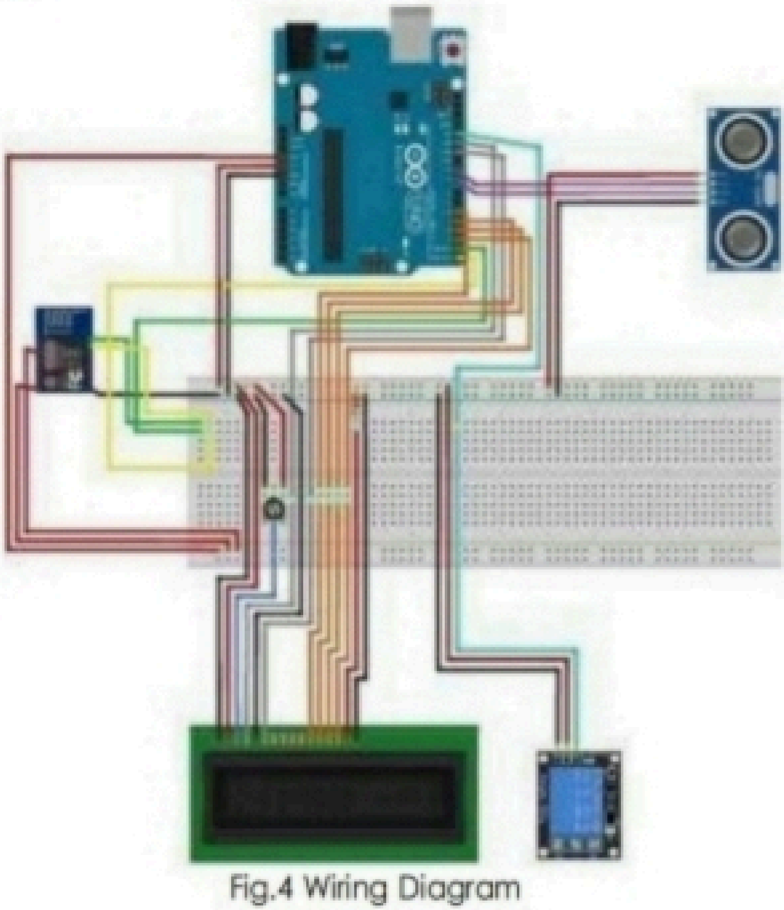

Fig.4 Wiring Diagram

```
import cv2
import time
import numpy as np
cap = cv2.VideoCapture(0)

while True:
    ret, frame = cap.read()
    cv2.imshow("frame", frame)

    img_hsv = cv2.cvtColor(frame,
cv2.COLOR_BGR2HSV)

    # red color mask creation
    upper_red1 = np.array([20, 255, 255])
    lower_red1 = np.array([0, 50, 50])
    mask1 = cv2.inRange(img_hsv, lower_red1,
upper_red1)
    upper_red2 = np.array([179, 255, 255])
    lower_red2 = np.array([170, 50, 50])
    mask2 = cv2.inRange(img_hsv, lower_red2,
upper_red2)
    mask_red = mask1 + mask2
    count_red = cv2.countNonZero(mask_red)

    # blue color mask creation
    lower_blue = np.array([94, 80, 2])
    upper_blue = np.array([130, 255, 255])
    mask_blue = cv2.inRange(img_hsv,
lower_blue, upper_blue)
    count_blue = cv2.countNonZero(mask_blue)

    # mask creation for green color
    lower_green = np.array([25, 52, 72])
    upper_green = np.array([102, 255, 255])
    mask_green = cv2.inRange(img_hsv,
lower_green, upper_green)
    count_green =
cv2.countNonZero(mask_green)

    # mask creation for white color
    lower_white = np.array([0, 42, 0])
    upper_white = np.array([179, 255, 255])
    mask_white = cv2.inRange(img_hsv,
lower_white, upper_white)
    op_img = cv2.bitwise_and(frame, frame,
```

```
mask = mask_white)

    cv2.imshow("Colors", op_img)

    red = mask_red.sum()//100000
    green = mask_green.sum()//100000
    blue = mask_blue.sum()//100000

    time.sleep(1)
    print("red : ", red)
    time.sleep(1)
    print("Blue : ", blue)
    time.sleep(1)
    print("Green : ", green)
    time.sleep(1)

    if red >= 100 & red <= 985:
        print("RED color")
        time.sleep(1)
    elif green >= 40 & green <= 930:
        print("GREEN  color")
        time.sleep(1)
    elif blue >= 60 & blue <= 990:
        print("BLUE color")
        time.sleep(1)
    else:
        print("Color not detected.")
        time.sleep(1)

    if cv2.waitKey(1) & 0xFF == ord('q'):
        break

cv2.destroyAllWindows()
```

The calculation of the air humidity does not directly influence a wind site assessment, but knowing this parameter helps assessing the potential danger ofice build-up at the measuring location. Temperature sensors should always be mounted at a height of at least 10m to ensure sufficient distance from heat radiating from the earth. This DHT11 Temperature and Humidity Sensor features a calibrated digital signal output with the temperature and humidity sensor capability. It is integrated with a high- performance 8-bit microcontroller.

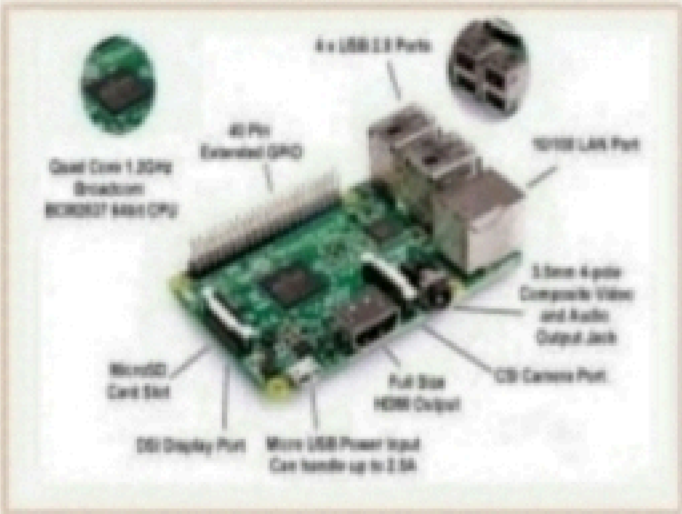

FIGURE 2:-RASPBERRY PI

7. SOFTWARE DESCRIPTION

Python was created by Guido van Rossum, a former resident of the Netherlands, whose favorite Circus. The source code is freely available and open for modification and reuse. Python has a significant number of users. Python is an interpreted, object-oriented programming language similar to PERL, that has gained popularity because of its clear syntax and readability.

8. BLYNK APPLICATION

Blynk platform powers low-batch manufacturers of smart home products, complex HVAC systems, agricultural equipment, and everyone in between. These companies build branded apps with no code and get the full back-end IoT infrastructure through one subscription.

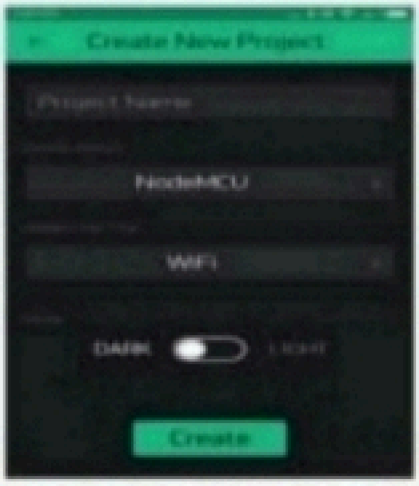

FIGURE 3:-BLYNK APPLICATION

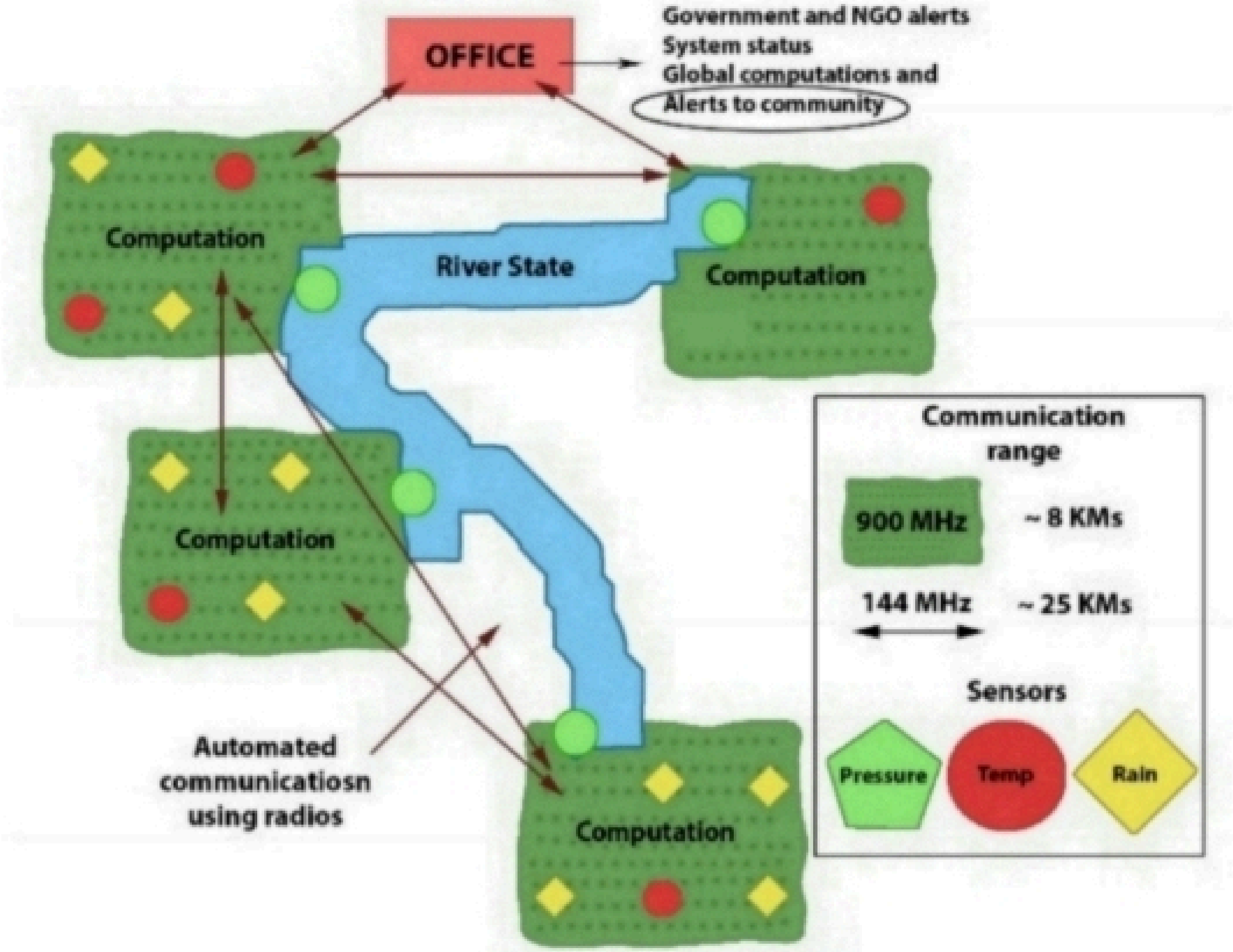

Figure 1. Early Flood Warning Model [12]

By alluding to the model executed as a reference, certainly, developing and underdeveloped nations are greatly influenced by floods on an annual basis. A low-cost and efficient flood detection mechanism can be created and effectively deployed using currently accessible technologies such as WiFi and ZigBee. Additionally, planning and securely documenting the identified information for further flood prediction. The IoT and cloud computing efficiently store and helps in analyzing the sensor data.

Fig. 2. Lightning risk map, based on historical damage, historical lightning detection and exposure information

Factors such as regional total rainfall, drainage capacity, topography and vulnerabilities are integrated to provide a comprehensive risk map of torrential rain and flooding (Fig. 3).

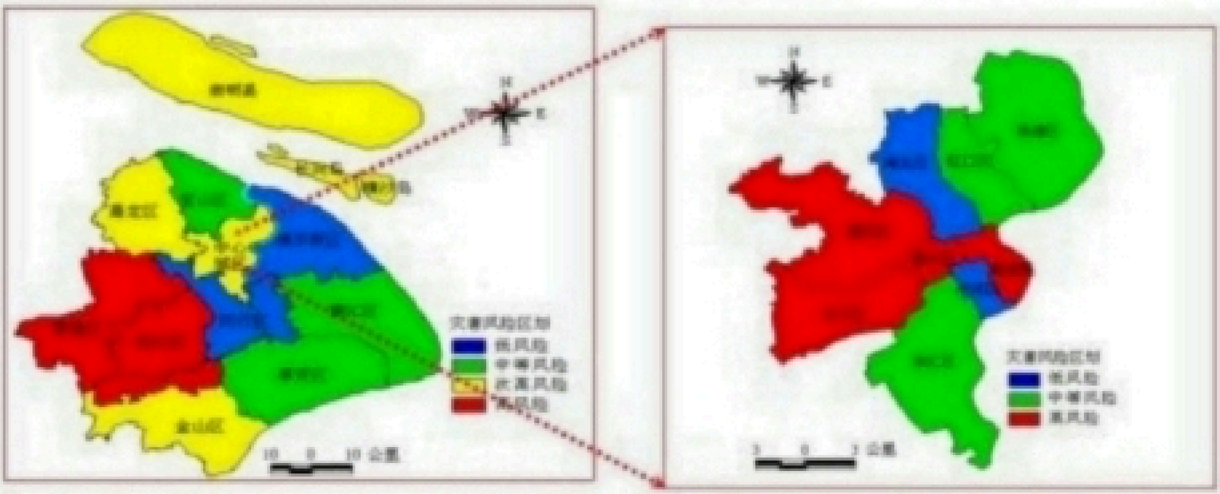

Fig. 3. Flood risk maps of greater Shanghai (left) and city center (right)

The flood risk map contributes to guidelines for land use planning and strengthening the infrastructure for specific regions, and provides guidance for multi-agency cooperation and coordination. Other agencies also identify potential risks; for example, The Safety Administration map risks related to dangerous chemical sources and The Real Estate Department provide risk surveys and maps of buildings and houses, which are vulnerable to disasters.

MHEWS in the Structure of the Emergency Management System

The follow illustrates the role of the Shanghai MHEWS in the Emergency Management System (EMS) (Fig. 4).

9. APPLICATIONS

- The early flood detection and avoidance systemhas following applications.
- Early information about flood.
- Gives the real time temperature and humidity dataalong with level of water.

10.CONCLUSION

Finally, it is concluded that, the system can detect and hypothesize the flood earlier. The project is based on embedded system and close loop control system. System consists of hardware and software applicationsto detect water level of rivers, dams etc. System automatically detects the change in level of water and alerts the system when it crosses the threshold value(less than 15cm). The system include ultrasonic sensor to detect the rise in water level and alert if distance between water and sensor is less than 15 cm. DHT11 sense the temperature and humidity which helpto analysis the environmental factor for flooding.

If the water level crosses the threshold value than Raspberry pi turns the buzzer and led turn on which symbolizes the warning for early flood.

11.RESULT

After all the complete connections of the system weremade successfully along with the required software, the system was ready for testing. Individual models were tested at the beginning of the project. The systemwas tested for analyzing the various parameters such as temperature, humidity and level of water.

FIGURE 4:- EXPERIMENTAL SET UP

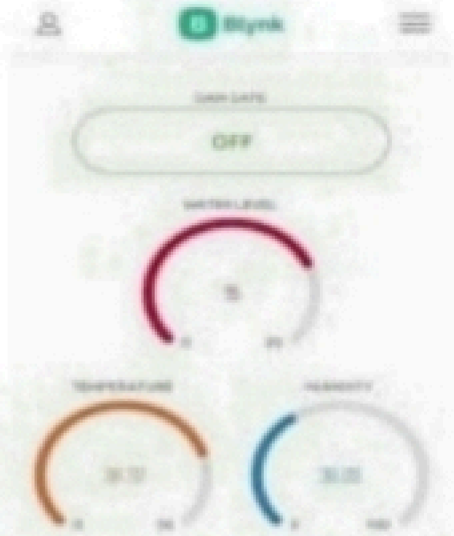

FIGURE 5:-OUTPUT RESULTS

THANK YOU