Project Title: FLOOD MONITORING AND EARLY WARNING SYSTEM

Phase 1: Project Definition and Design Thinking

Project Definition:

The project involves deploying IOT sensors near water bodies and flood-prone areas to monitor water levels and provide early flood warnings through a public platform. The objective is to enhance flood preparedness and response by issuing timely warnings to both the public and emergency response teams. This project includes defining objectives, designing the IOT sensor network, developing the warning platform, and integrating them using IOT technology and Python.

Introduction:

A flood is an overflow of water that submerges land. 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.

The human are still not able to battle the natural calamities besides huge development in technologies. The fact is that the natural calamities can neither be abolished nor be prevented. But the technology has been developed gigantically in order to prevent loss of life. This project is totally based on informing the civilians about the upcoming flood so that they can evacuate the danger area before the flood hits

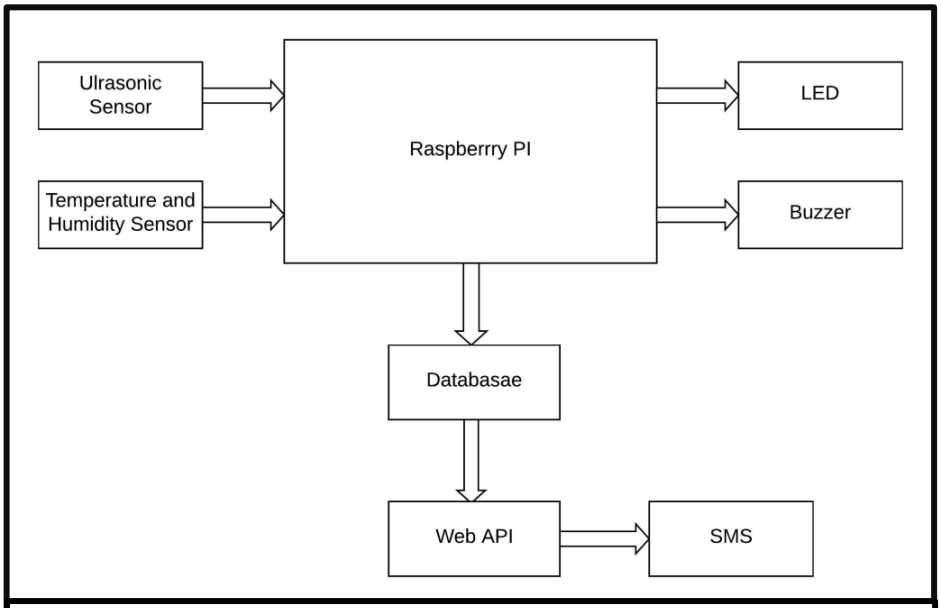
Objectives:

The main objectives of the project are:

- To read the real time temperature and humidity of the environment continuously.
- To give early information about the flood.
- To warn the people about the flood through SMS system using web API.
- To detect the level of water in real time.

IOT Sensor Network Design and Early Warning Platform:

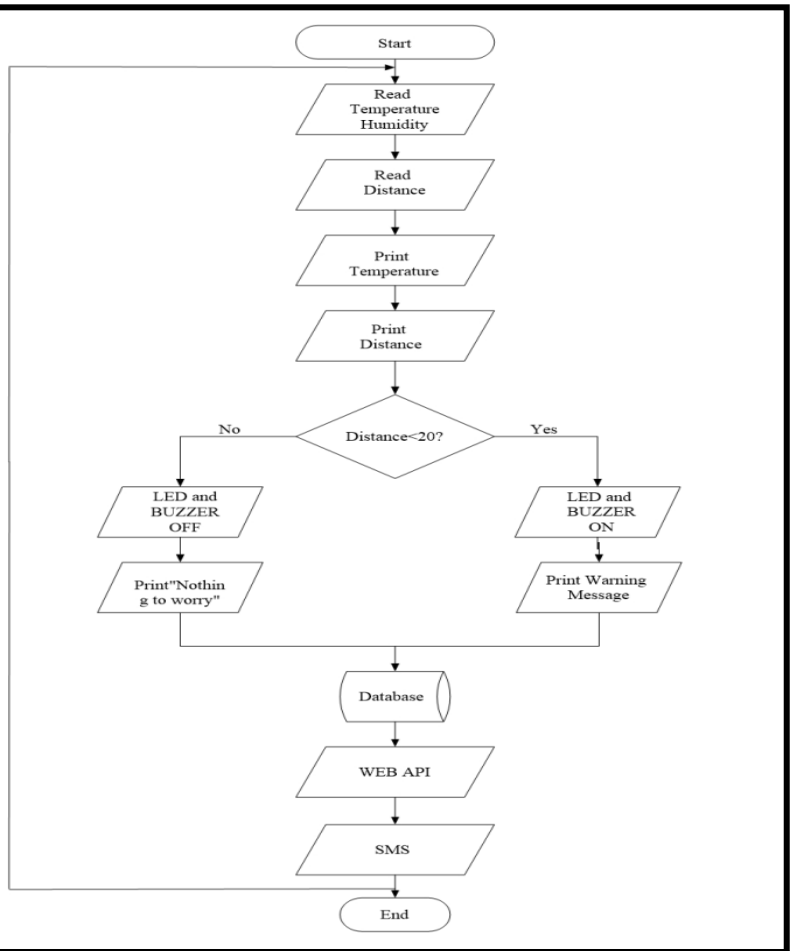
The sensors placed at the different places reads the data which are manipulated through the microcontroller and the values of the sensors are displayed. The values obtained repeatedly are send to database and through the web API, warning message is sent into the phone.



System Block Diagram

The raspberry Pi used is the brain of the project. It is responsible for acquiring, processing, storing and communicating the information from sensors, and then executing the events respectively. Raspberry reads the data from the Ultrasonic sensor (HCSR04) and Temperature and Humidity sensor (DHT11). Then the Raspberry pi processes the obtained value of the sensor and displays it. The value from the Ultrasonic sensor is used to determine the level of water. The certain threshold value for the distance between the ultrasonic sensor and the river is fixed. The value of distance obtained from the ultrasonic sensor is updated repeatedly with the change in the water level. If the value of the distance is less than the fixed threshold value then the led and buzzer will turn on which signifies that there is high chances of occurring flood. If the value of distance is greater than the fixed threshold value then the LED and the buzzer will remain off which signifies that there is nothing to worry about. The Raspberry pi displays the value of temperature, humidity and the distance between the sensor and the river in its local terminal too.

The values of the sensors are obtained repeatedly in the certain interval of time. So the real time values of the sensors are obtained. The values obtained are uploaded to the local server of the Raspberry Pi using the MySQL database. The data obtained in MySQL database from the Raspberry pi are date and time, temperature, humidity, distance of ultrasonic sensor and river and the remarks regarding the flood. The date and time is auto incremented since it doesn't require any sensor input data. The values of temperature and the humidity changes corresponding to the changes in the environmental temperature and humidity and gets updated in the database table. The main role here is of the ultrasonic sensor. The value of the ultrasonic sensor is updated repeatedly in certain interval of time and shows the distance. If the value of the distance is less than the threshold value then the warning message regarding flood will be displayed in the remarks and if the value of the distance is greater than the threshold value then remarks will display default message. The data in the database table are updated automatically every 6 seconds.



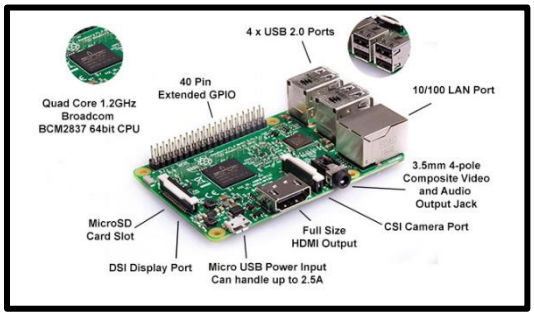
Flow Chart

Now, the main motive of the system to alert the people about the coming flood is done by the web API. The data from the database is linked to the web API. What the web API does is, it continuously keeps on reading the value of sensors from the data base. And when the value of distance becomes less than the threshold value the web API indicates it so by changing the color the trigger used there. The contact or phone number of the residents are also uploaded in the web API so, it quickly informs the local people about flood by sending the warning SMS to the people whose numbers are registered in it.

Hardware Description:

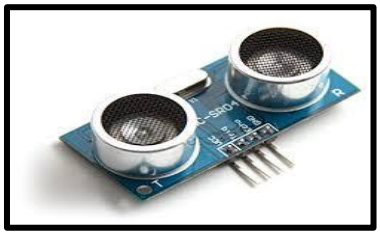
➢ Raspberry Pi:

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. The Raspberry Pi has the ability to interact with the outside world, and has been used in a wide array of digital maker projects, from music machines and parent detectors to weather stations and tweeting birdhouses with infra-red cameras.



➢ Ultrasonic Sensor:

The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. Ultrasonic Sensors measure the distance to the target by measuring the time between the emission and reception.

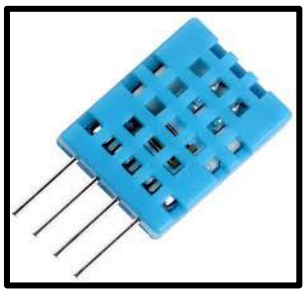


- **Buzzer:**

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or key stroke

- **Temperature and Humidity Sensors (DHT11):**

The DHT11 temperature and humidity sensor is a nice little module that provides digital temperature and humidity readings. It's really easy to set up, and only requires one wire for the data signal.



- **LED:**

The circuit consists of a power supply (the Raspberry Pi), an LED that lights when the power is applied.

Software Description:

➢ Python:

Python is an interpreted, object-oriented programming language that has gained popularity because of its clear syntax and readability.

➢ Raspbian:

Raspbian is a Debian-based computer operating system for Raspberry Pi. There are several versions of Raspbian including Raspbian Buster and Raspbian Stretch.

➢ MySQL Database :

MySQL is a fast, easy-to-use RDBMS being used for many small and big businesses. MySQL uses a standard form of the well-known SQL data language. It is very friendly to PHP, the most appreciated language for web development. The value obtained from external sensors can also be uploaded to the MySQL database and through which it can be monitored in web page, mobile application, SMS, etc.

➢ Cayenne:

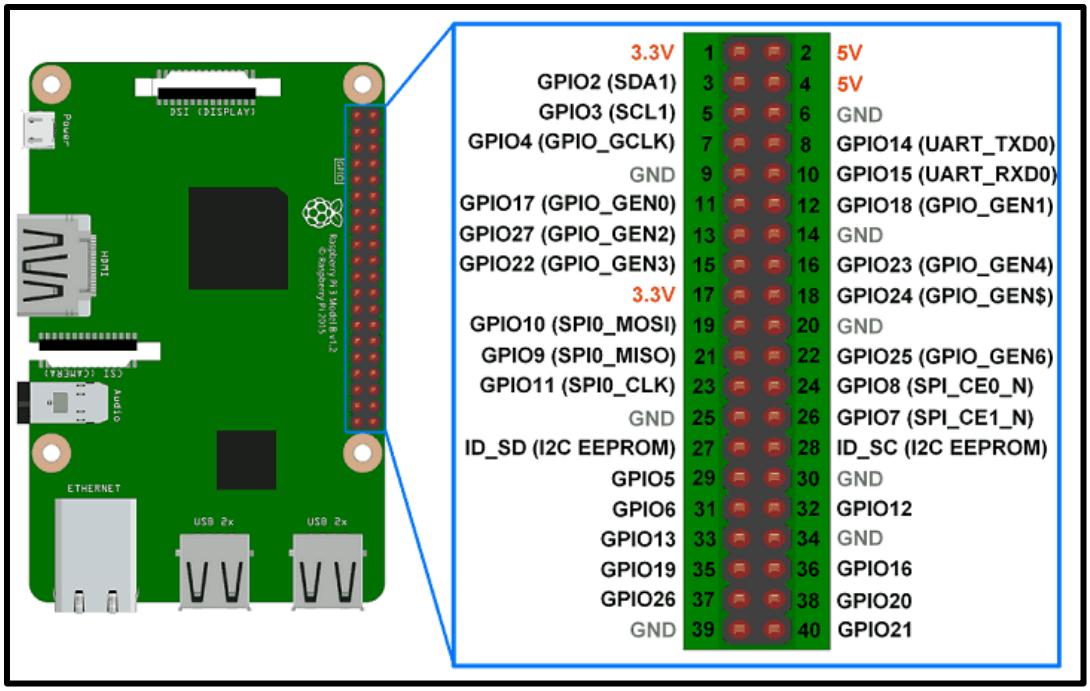
Cayenne is a very useful web API, through cayenne any database can be linked it any web sites, mobile app, SMS system etc. This is very applicable since it is free of cost of very easy to use.

Design And Implementation:

➢ Raspberry Pi:

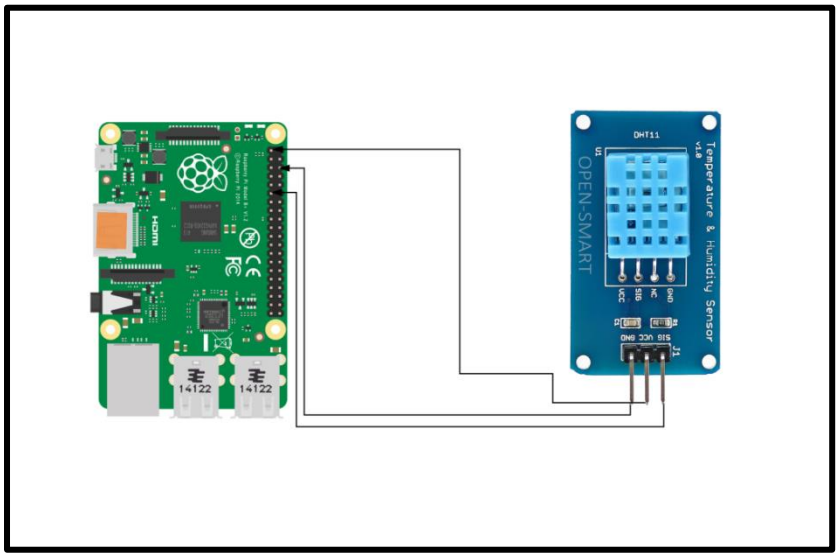
Every complex embedded system needs a microcontroller or a microprocessor. This project uses a Raspberry Pi because it was the best fit for the needs of the project.

It is an ultra-cheap minicomputer with 5.5 cm width and 9 cm length. It consists of a component named System on Chip (SoC) which comprises of single core CPU with a supportive processor for computing floating points, GPU and RAM with 512 MB size (SD-RAM). Moreover, it consumes less power, which is just around 5 Retracted -7 watts.



➢ DHT11 Sensor:

The DHT11 temperature and humidity sensor is a nice little module that provides digital temperature and humidity readings. It's really easy to set up, and only requires one wire for the data signal. These sensors are popular for use in remote weather stations, soil monitors, and home automation systems. Programming the DHT11 and connecting it to a Raspberry Pi is pretty simple too.



➢ Buzzer:

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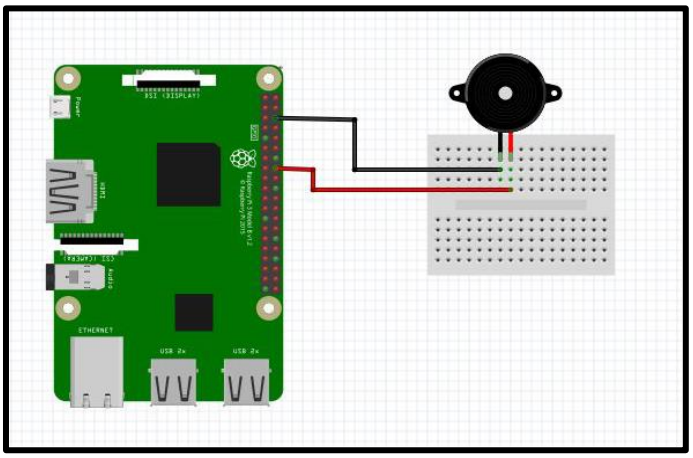
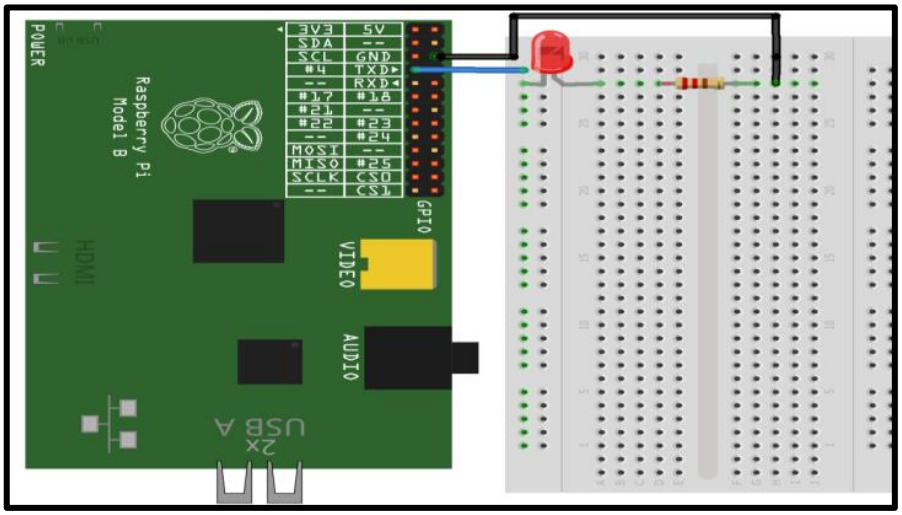


➢ LED:

The circuit consists of a power supply (the Raspberry Pi), an LED that lights when the power is applied, and a resistor to limit the current that can flow through the circuit. You will be using one of the ‘ground’ (GND) pins to act like the ‘negative’ or 0 volt ends of a battery. The ‘positive’ end of the battery will be provided by a GPIO pin. Here we will be using pin 18. When they are ‘taken high’, which means it outputs 3.3 volts, the LED will light.



➢ Ultrasonic Sensor With pi:

There are four pins on the ultrasound module that are connected to the Raspberry .The pins are connected as following example:

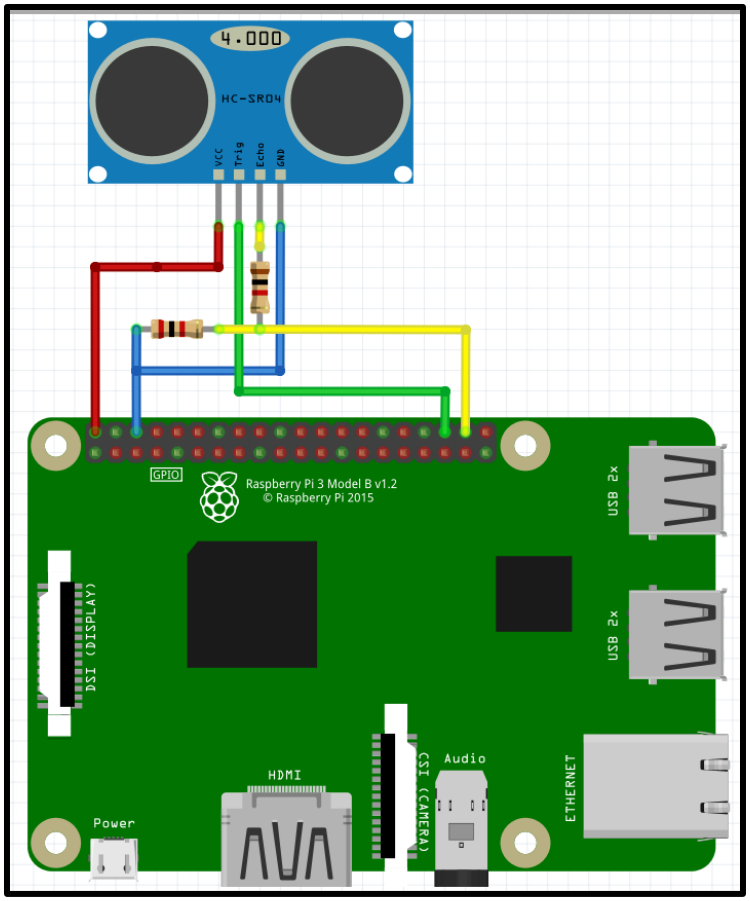
VCC to Pin 2 (VCC)

GND to Pin 6 (GND)

TRIG to Pin 12 (GPIO18)

connect the 330Ω resistor to ECHO. On its end you connect it to Pin 18 (GPIO24) and through a 470Ω resistor you connect it also to Pin6 (GND).

The GPIO pins only tolerate maximal 3.3V. The connection to GND is to have an obvious signal on GPIO24. If no pulse is sent, the signal is 0 (through the connection with GND), else it is 1. If there would be no connection to GND, the input would be undefined if no signal is sent (randomly 0 or 1), so ambiguous. Below here is the structure as a circuit diagram:



Integration Approach:

For detecting the rise in water level Ultrasonic Sensor and Water Level Sensor is used. For detecting the change in humidity and temperature Humidity and Temperature Sensor is used. The data from the DTH11 and HC-SR04 is read by the microcomputer and analyze the data in order to detect the level of water. If the level of water is less than the defined threshold value then the microcomputer turns the LED and buzzer on. Furthermore, the data obtained from the microcomputer is uploaded to the database. The values of the sensors updating in real time can be monitored in database table. The content of the database table is now linked with the web API (Application Programming Interface) and trigger is set. And now when the level of water crosses the threshold value the trigger is triggered and the web API sends the SMS to the phone number registered to it.