

# Survey on Flooding Detection System using Internet of Things

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## ABSTRACT

To decrease the challenges that the cities face such as scarcity of energy sources, flooding prevention, healthcare, housing water and deteriorating infrastructure, making a city 'Smart' is emerging. The Internet of Things or IOT provides the ability for human and machines to interact from billions of things that include sensors, services or other Internet connected things. This paper aims to realize the security requirement and security architecture of Internet of things technology for urban flooding prevention management system and discussed the demand and overall design of urban flooding prevention management system. Finally, the application process of the Internet of things technology in Chongqing flooding prevention management system is summarized. For emergency command and dispatch there is visual management, and at the same time, network assessment management for the drainage pipe can be conducted correctly. The flood control and drainage function of Chongqing will gradually improve with smooth drainage facilities also the inspection and maintenance management will be standardized.

## Keywords

Flooding Prevention, Internet of Things, Drainage pipe, catastrophic situation, flooding condition, Flow Rate, Water Level

## 1. INTRODUCTION

The term IOT is the inter-networking of physical devices such as vehicles, buildings, or embedded items such as software, sensors, actuators, and to enable these objects to collect and exchange data network connectivity is needed. The concept Internet of Things describes a future where every day physical objects can be connected to the Internet and also is able to identify themselves to other devices. IoT is closely identified with sensor technologies, RFID, wireless technologies. Internet is a medium that connects people across the world for emailing, gaming, conferencing etc. Internet of Things allows sensing of objects and controlling objects remotely across existing network infrastructure. Floods, extreme weather events, have occurred with frequent regularity over last two decades causing severe urban flood related inundations. India is primarily an agricultural country and rural infrastructure was adequate to sustain country population. Expansion of urban sector increased due to migration of population towards mega cities. Such migrations are due to industrial growth. Every year floods affect nearly 400 million hectares of land in India. Now a day's weather information is used for monitoring and warning on urban flooding. The citizens get notification when of people check, people on vehicles check or camera check, which has the defects of poor continuity, little data, slow speed and time lag. The people living in apartment don't get waterlog information exactly and quickly and thus they are not able to take corresponding measures and

make warnings [1][2]. In the present scenario, due to migration of people from rural, rapidly expanding mega cities are facing many problems. The four major cities Mumbai, Delhi, Kolkata and Chennai are the most populated cities of India. Vulnerability of flooding increased due to uncontrolled growth of mega cities. For a better understanding of the problem, extreme rainfall events have been analyzed in the four Mega Cities [2]. Urban flooding is a mechanism of water disaster or flooding in urban caused due to continuous rainfall which exceeds the urban drainage capacity. Most of the rain water rivers flowing on urban ground, due to increasing waterproof ground which caused serious urban flooding in many cities. The rainstorm also makes urban flooding more serious, which needs urban flood prevention and control, causes property loss, personnel casualties restrict city's development and other disasters that affect citizen's work and life[3]. Many developed countries conducting researches on urban waterlog, using computer aided way to monitor, make analogue simulations and forewarn. They have made urban flooding monitoring and forewarning system based on their geographic information system and own environmental simulation model. This paper studies the use of Internet of things in management of urban flooding to save life of citizens. A summary of casualties due to floods /heavy rains is shown in Table [2].

Table1. Number of Deaths/Injured in four mega cities

| Year | Deaths |         |        |         |
|------|--------|---------|--------|---------|
|      | Delhi  | Kolkata | Mumbai | Chennai |
| 1990 | 3      | 1       | 79     | 15      |
| 1995 | 2      | 6       | 7      | 12      |
| 2000 | -      | -       | 87     | -       |
| 2005 | -      | 16      | 1000   | 13      |

## 2. LITERATURE SURVEY

### 2.1 Application of Internet of Things in Urban Flooding Prevention Management System

The Survey has analyzed the security architecture and security requirement of IOT technology. The paper describes the demand of urban waterlogging prevention management system with the help of IOT. The basic model urban waterlogging prevention has described in this article [1].

### 2.2 Urban flooding in recent decades in four mega cities of India

People are migrating from rural to urban area due to

unemployment and other reasons. The population count is increasing day by day and due to that cities are facing many new challenges. Flooding condition is one of the big challenges increased due to uncontrolled growth of mega cities. The article describe the population count and death rate due to flooding in four mega cities in India[2].

### 3. ARCHITECTURE

The flooding Prevention Management System work in three dimension, calculation of drainage flow, rainfall, and water level, second sending collected flooding information to data center for analysis and monitoring and alerting mechanism. Use the data reasonably on the management and control platform, while constructing the system and apply the data fusion technology and wireless remote intelligent monitoring technology well.

#### 3.1 System Function Design

There are five layers for the system, as shown in Figure 1. Good design management of user layer and application layer should be made. To determine the system design of perception layer data layer and network layer shall also be conducted.

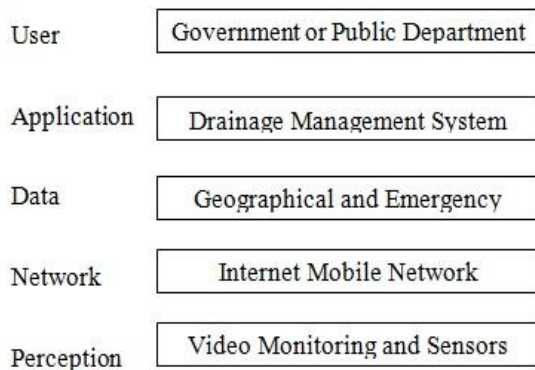


Fig 1. Flooding Detection System Requirement

#### Drainage management

An import analysis is needed based on the design of systematic drainage management system. The flow-meter calculates the rate of flow of water; simultaneously Water Level Indicator calculates the rising water level and rain sensor calculate the rainfall rate. The collected data is send to data center for analysis to determine flood condition. The analysis can also used to maintenance of drainage pipe.

#### Data Center

The data center performs statistical analysis on data collected from various sources. The analysis used for evaluation of flood condition and by Early Warning Subsystem.

#### Emergency command and dispatch

It is mainly designed in combination with the online flood situation; conduct well the analysis and management of operational data. The system should provide feedback and release flood information timely, and analyze the operation and dispatching situation of drainage facilities.

### 3.2 Components

#### Ultrasonic Flow-meter

An ultrasonic flow-meter is a volumetric flow meter which requires bubbles in the flow. Ultrasonic flow-meters are ideal for wastewater applications or any dirty liquid which is

conductive or water based. It is a type of flow meter that measures the velocity of a fluid with ultrasound to calculate volume flow.

#### 2. Water Level Indicator

Water Level Indicator detects the water level from ground or surface to determine flood condition.

#### 3. Rain sensor

A rain sensor is a switching device that gets activated by rainfall. The rain sensor detects water that completes the circuits on its sensor boards' printed leads. The sensor board acts as a variable resistor that will change from 100k ohms when wet to 2M ohms when dry. In short, the wetter the board, more current will be conducted. The rain sensor detects the velocity of rainfall.

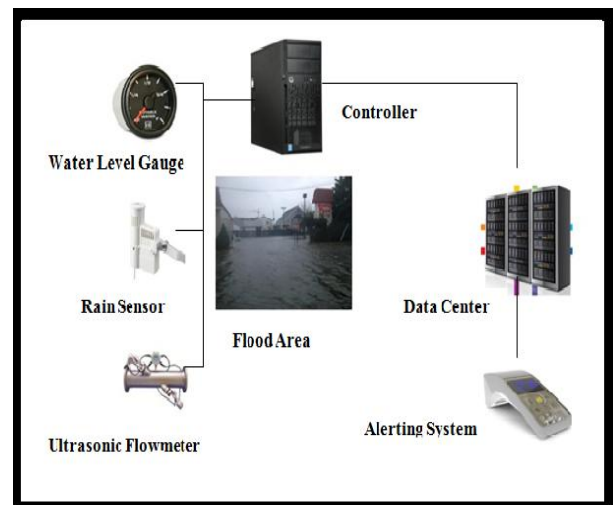


Fig 2. Flooding Detection System Using Internet of Things

### 4. MATHEMATICS

$f = \{f_1, f_2, f_3, \dots\}$  set of water flow rate measured by ultrasonic flow meter after fixed interval.

$l = \{l_1, l_2, l_3\}$  set of water level measured by Water Level Indicator after fixed interval.

$r = \{r_1, r_2, r_3\}$  set of rain fall rate measured by Rain sensor after fixed interval.

$t$  = Threshold value for catastrophic situation.

$r \propto f$  if rate of rainfall increase the water flow rate also increase due to pressure created by water level on drainage system .

$l \propto f$  if water level increase the water flow rate also increase. If water flow level cross a threshold and rain fall rate is also increasing or constant then there may be catastrophic situation.

if  $f / l = \text{constant}$  then there is less chances of catastrophic situation or flooding condition.

if  $f / l > t$  then there may be catastrophic situation or flooding condition.

F- Water flow rate

R- Rainfall Rate

A-Area

T-Fixed Time Interval

P- Perimeter of Drainage Pipe

Collected Water= $R*A*T$

Water Dispatched = $F*P*T$

Remaining Water to Dispatch(RWD)= Collected Water-  
Water Dispatched

$$RWD = \sum_{t=0}^n Rt*At*T - \sum_{t=0}^n Ft*P*T$$

Water Level =  $RWD/A$

#### 4.1 Algorithm

step 1 : if rainfall then

step 2 : Activate the system, initialize WaterLevel, FlowRate,  
RainFall with its default values.

step 3 : do repeatedly

step 4 : calculate NewWaterLevel, NewFlowRate,  
NewRainFallRate.

step 5 : if NewRainFallRate > RainFallRate Then

step 6 : if NewFlowRate= FlowRate AND NewWaterLevel>  
WaterLevel Then

step 7 : check threshold and do the necessary action for  
catastrophic situation or flooding condition.

step 8 : end if

step 9 : if NewFlowRate> FlowRate OR NewWaterLevel>  
WaterLevel OR NewFlowRate> FlowRate Then

step 10 : calculate probability of catastrophic situation by  
doing statistical analysis on available data.

step 11 : end if

step 12 : if NewFlowRate= FlowRate then

step 13 : drainage capacity gets full or there is obstacle in  
drainage system, check RainFallRate to determine flooding  
condition.

step 14 : end if

step 15 : if RainFallRate ==0

step 16 : stop system

step 17 : end if

step 18 : continue with step 3.

step 19 : end if

step 20 : end if

The FlowRate vary because of two reason, it's gets decrease  
when there is overflow in river or sea or if there is any  
obstacle in flow i.e. Chongqing flood control tunnel, and  
increase as level of water rises.

#### 5. APPLICATIONS

The system can be used in high density area where ground  
floor are mostly used for parking cars and bikes. The system  
will alert to car owners before ground level gets filled by rain  
water and they can do alternative arrangement.. In Jammu &

Kashmir, there are longer tunnels that are under construction,  
Panjal Railway Tunnel it is part of the USBRL Project having  
length 11.2 km long, passes through the Pir Panjal Range of  
middle Himalayas in Jammu and Kashmir. The system will  
effectively calculate how much time will required to fill  
tunnel so travelers get the information about flooding.

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#### 7. CONCLUSION

The application of urban flood control management system  
which is based on Internet of things technology provides  
comprehensive monitoring and pays more attention to the  
management of urban drainage and flooding prevention. It  
also provides operational services, conducts the monitoring  
and realizes the comprehensive supervision management,  
early warning management, and investigation management,  
which has not only improved the flood control decision  
making and drainage, but the city's flood control capacity is  
significantly improved. It will contribute to the security of  
society and harmonious development and construction.

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