Survey on Flooding Detection and Avoidance System using Internet of Things

Aman Kumar Jain[1] Gaurav Singh[2] Gopal[3]
[1,2,3]SRM Institute of Science and Technology, India

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 standardized.

Keywords: Flooding Prevention (Avoidance), Internet of Things (IoT), Drainage Pipe, Catastrophic Situation, Flooding Condition, Flow Rate, Water Level

I. 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 obtain and exchange data network connectivity is required. The concept Internet of Things(IOT) describes a future where every day physical objects can be connected to the Internet and also is able to identify themselves to various other devices. Internet Of Things (IoT) is closely identified with sensor technologies, RFID, wireless technologies. Internet is a medium that connect people across the world for emailing, social activities gaming, conferencing etc. Internet of Things (IOT) allows sensing of objects and controlling objects remotely across various existing network infrastructures . Floods, extreme weather events, have occurred with frequent regularity over last three decades causing severe urban flood related inundations. India is primarily an agricultural country and rural infrastructure with adequate functions to sustain country population. Expansion of urban sector has increased due to migration of population towards mega cities. Such migrations are attributed to the industrial growth. Every year floods affect nearly 500 million hectares of land in India. Now a day's weather information is utilized for monitoring and warning on urban flooding. The citizens get notified whenever 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 required warnings. In the present scenario, due to migration of people from rural citities, rapidly expanding mega cities are facing many problems. The four major cities Mumbai, Delhi, Kolkata and Chennai are the most populated cities in India. Vulnerability of flooding has increased due to uncontrolled growth of mega cities. For a better understanding of the problem, extreme rainfall situations have been analyzed in the four Mega Cities [2]. Urban flooding is a mechanism of water disaster or flooding in urban places caused due to continuous rainfall which exceeds the urban drainage capacity. Most of the rain water rivers flow on urban ground, due to increased waterproof ground which causes 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 various other disasters that affect citizen's work and life[3]. Many developed countries are conducting researches on urban waterlog, using computer aided way to monitor, make analogue simulations and forewarn. They have made urban flooding monitoring and forewarning systems based on their geographic information system and own environmental simulation model. This paper studies the use of Internet of things(IoT) in management of urban flooding to save precious life of citizens.

II. LITERATURE SURVEY

A. Application of Internet of Things (IoT) in Urban Flooding Prevention Management System.

YEAR	DEATHS			
	DELHI	KOLKATA	MUMBAI	CHENNAI
1990	4	1	80	16
1995	3	7	6	13
2000	-	-	85	-
2005	-	15	1001	12

Table 1: Number of Deaths/Injured in four mega cities

The Survey has analyzed the security architecture and security requirements of Internet of Things (IOT) technology. The paper describes the demand of urban waterlogging prevention management systems with the help of IOT. The basic model urban waterlogging prevention has been described in this article [1].

B. Urban flooding in modern decades in four mega cities of India

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

1) Architecture

The flooding Prevention Management System work in three Dimension, calculation of drainage flow, rainfall, and water

All rights reserved by www.ijsrd.com

level, second sending collected flooding information to data center for research and monitoring and alerting mechanism. Use the data reasonably on the management and control platform, while constructing the system and also apply the data fusion technology and wireless remote intelligent monitoring technology well.

C. System Function Design

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

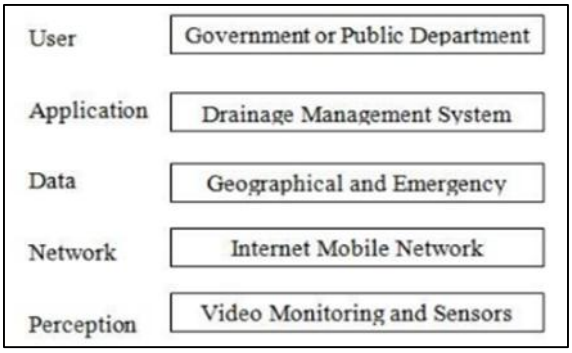

Fig. 1: Flooding Detection System Requirement

III. MATHEMATICS

f={f1,f2,f3...} set of water flow rate measured by ultrasonic flow meter after fixed intervals.
l={l1,l2,l3} set of water level measured by Water Level Indicator after fixed intervals.
r={r1,r2,r3} set of rain fall rate measured by Rain sensor after fixed interval.
t= Threshold value for catastrophic situations.
r ∝ f if rate of rainfall increase the water flow rate also increases due to pressure created by water level on drainage system.
l ∝ f if water level increases 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 =constant then there is less chances of catastrophic situations or flooding condition.
if f / l>=t then there may be catastrophic situation or flooding conditions.
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 = ∑nt=o Rt*At*T - ∑nt=o Ft*P*T
Water Level = RWD/A

A. Algorithm

1) step 1 : if rainfall then
2) step 2 : Activate the system, initialize WaterLevel, FlowRate, RainFall with its default values.
3) step 3 : do repeatedly
4) step 4 : calculate NewWaterLevel, NewFlowRate, NewRainFallRates.
5) step 5 : if NewRainFallRate > RainFallRates Then
6) step 6 : if NewFlowRate= FlowRate AND NewWaterLevel> WaterLevels Then
7) step 7 : check threshold and do the necessary actions for catastrophic situation or flooding condition.
8) step 8 : end if
9) step 9 : if NewFlowRate> FlowRate OR NewWaterLevel> WaterLevel OR NewFlowRate> FlowRate Then
10) step 10 : calculate probability of catastrophic situations by doing statistical analysis on available data.
11) step 11 : end if
12) step 12 : if NewFlowRate= FlowRate then
13) step 13 : drainage capacity gets full or there is obstacle in drainage systems, check RainFallRate to determine flooding condition.
14) step 14 : end if
15) step 15 : if RainFallRate ==0
16) step 16 : stop system
17) step 17 : end if
18) step 18 : continue with step 3.
19) step 19 : end if
20) step 20 : end if

The FlowRate vary because of two reason, it 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.

IV. COMPONENTS

A. Drainage Management

An import analysis is needed based on the design of systematic drainage management systems. The flowmeter calculates the rate of flow of water; simultaneously Water Level Indicator calculates the rising water levels and rain sensor calculate the rainfall rate. The collected data is send to data center for analysis to determine flood conditions. The analysis can also use to maintenance of drainage pipes.

B. Data Center

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

C. Emergency Commands and Dispatch

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

D. Ultrasonic Flow-Meter

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

All rights reserved by www.ijsrd.com

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

E. Water Level Indicator

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

F. Rain sensor

A rain sensor is a switching device that gets activated by rainfalls. The rain sensor detects water that completes the circuits on it's sensor board printed leads. The sensor board acts as a variable resistor that will change from 101k ohms when wet to 4M ohms when dry. In short, the wetter the board, even more current will be conducted. The rain sensor detects the velocity of rainfall.

V. APPLICATIONS

The system can be utilized 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 11.4 km long, passes through the Pir Panjal Range of middle Himalaya in Jammu and Kashmir. The system will effectively calculate how much time will required to fill tunnel so travelers get the information about floodings.

ACKNOWLEDGMENTS

We would like to thank Mr.Goutham sir for his contribution in offering guidance for this project. We also thank Dept. of Information Technology, SRMIST, NCR, India for valuable suggestions.

CONCLUSION

The application of urban flood control management system which is based on Internet of things (IOT) technology which 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 the 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 constructions.

REFERENCES

[1] Qinggong Ma, Bo Yang, Jipeng Wang, "Application of Internet of Things in Urban Flooding Prevention Management System", Scientific Research Publishing, Advances in Internet of Things, 2017, 7, 1-9, ISSN Print: 2161-6817.
[2] U.S. De, G. P. Singh and D. M. Rase, Urban flooding in recent decades in four mega cities of India, J. Ind. Geophys. Union, April 2013,Vol.17, No.2, pp. 153-165.
[3] Xue, X.G., Jiang, S.F., Li, M., et al.(2016) Application Trend of GIS in Urban Drai-nage and Flooding Prevention. Science & Technology Vision, No. 1, 71-72.
[4] Tong, L.G. (2015) Urban Drainages and Flooding Prevention Intelligent Controlling Platform Based on Internet of Things and GIS. Science & Technology Information,13, 10-12.
[5] Asogwa, C.O., Zhang, X.M., Xiao, D.G., (2011) Experimental Analysis of AODV, DSR and DSDM Protocols Based on Wireless Body Area Network. The 2011 International Workshops on Internet of Things' Technology and Innovative Application Design, 597-602.
[6] Qian, Z.H. and Wahg, Y.J. (2012) Study on Internet of Things and Its Application. Chinese Journal of Electronics , 40, 1023-1029. [7] Gao, J., Zhu, Y.L., Li, L.M., et al . (2011) Routing Optimization Based on Ant Colony Algorithm for Wireless Sensor Networks with Long-Chain Structures.

All rights reserved by www.ijsrd.com