Development of Detection and Flood Monitoring Via Blynk Apps

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Article Info	ABSTRACT
	Flash flood is a common disaster event occured at Jalan Ilmu 1/1, Universiti Teknologi MARA Shah Alam Campus when there is a heavily raindrops. This paper describes the development of prototype used for detection and monitoring purposes. Flash floods can lead to destruction of properties and infrastructures.This system is based on two NodeMCU based technology integrated using Blynk application (IOS or android). The wireless sensor network systems can help the citizens by detecting the water levels and give an early warning when a flood occurs faster and easy. Basically, there are two part of the system which are the sensor node and the base station. The sensor node detects the water level using an ultrasonic sensor and displays the current water level.The first NodeMCU is placed at the identified flood area, whilst the second NodeMCU acts as the control unit. Data detected from the ultrasonic sensors are sent to the Blynk application via wireless connection.Two test have been conducted to test the effectiveness of the propose system. It can be found that this prototype able to detect, monitor and give alarm to the affected area if the flash flood happens in the future.

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1.   INTRODUCTION

Floods are one of the common natural disasters that occur all around the globe. Natural floods disaster is said to be associated wih continuous downpour of heavy rains for a period of time. Malaysia, which is located at the tropical region receives average annual rainfall of 2500 mm for the Peninsula area while Sabah and Sarawak receive 3500 mm [1]. Flash floods happened when there is a heavily rainfall occurred in a short of period and can caused massive traffic jam in the affected area. Thus, it is important to be able to warn the people who are most at risk, so that the effects of these disasters can be reduced. Some cases in Selangor, the level of flood rises rapidly and the people only have limited time to prepare for their evacuation. There also some place that has the flood alert system for early warning to citizen, but most of it, usually intended for the respective organizations, plus limited distance that the system can cover [2]. Therefore, when there is flooding cases happen, it takes time to reach the people living nearby, and the people cannot save most of their belonging as water rises quickly. The worse case happens from the flood when buildings, houses, the school and bridges also affected by the flood and faced the instant damages. Generally, flooding cannot be stopped and unavoidable, but early detection or warning system can be used to reduce losses faced by the citizen and government.

Recently, there is an issues of flash flood all over Malaysia including Shah Alam (Selangor), Manek Urai (Kelantan), Penampang (Sabah), Geogetown (Penang) and Sibu (Sarawak). However, the way people react during the flood occurance is not immediately due to detection and information gathered reaction is

slow. In this advance technology, some project of flood monitoring already existed in order to inform people when flood happen. A project about flood level indicator and risk warning system for remote location monitoring using flood observatory system was studied [2] via GSM modem in order to send information about flood level and receive commands from the monitoring station. A smartphone is defined as a phone enabled for email and internet use. Applications (apps) are downloadable items of software which fullfil a specific role [3]. Flood warning system with Wi-Fi network based on smartphone o access data of rainfall, water level and flood status in Palembang city and Kudus district was designed [4],[5]. Today wireless sensor network (WSN) technology has become an integral part of any developing country as it is being used nowadays as the primary monitoring system in various applications. A real-time flood monitoring which can monitor the real-time data of water condition remotely using WSN was studied [6]. WSN eliminate the hazards associated with the wiring systems and make data measurement and monitoring process much easier and cost effective [7]. The Internet of Things (IoT) is developing tremendously day by day because of the continuous effects of a wide community. The IoT tends to have unlimited applications, as there are seemingly unlimited needs in every sphere of life [8]. The IoT is network of native devices communicating with each other over the internet to perform a unified task in a smarter way. NodeMCU ESP8266 has been used as the basis device which integrated and communicate with the internet for monitoring of heart rate, heart pulse sensor as well for ambient environment purposes [9],[10]. The IoT platform for remote monitoring and sensing data that provides a very basic and easy setup using Blynk server [11]. Based on this, the purpose of this research is to develop a low cost WSN for flood monitoring and warning system in UiTM Shah Alam based on Blynk applications (apps). The NodeMCU-based technology and inexpensive ultrasonic sensor network components via Blynk apps is designed to detect flood and send an alert to the user smartphone through the WIFi.

2. RESEARCH METHOD
2.1. Case Study
Flash flood occurs in the Klang Valley when there is unusually intense rainfall over a short period of time. However, intense rainfalls conspires with other factors such as drainage characteristics, which involve rock, soil types, vegetation and land use, all of which contribute to the occurrence, location and intensity of flash floods. Floods can have economic, social and environment impacts. However, in the case of flash floods, damage and losses from these events are sometimes higher than from other ordinary floods [12]. First history of flood happened in Selangor was at TTDI Jaya, Shah Alam. The Damansara River which flows through TTDI Jaya is 21 km long and TTDI Jaya falls within Shah Alam Council boundaries. Two years after the first residents moved into TTDI Jaya, in March 2006, they were shocked when the first flash flood hit the area after an hour of heavy rain. Between 1994 and 2005, twelve flash floods, six have infiltrated people's homes. The flash floods that happened in 1996 and 2000 was the worst: 90 per cent of the area was covered with water.

Figure 1 shows the picture taken five hours after the Damansara River overflowed its banks. To overcome this crisis of flash flood, the Department of Irrigation and Drainage (DID) had introduced a mechanicm in TTDI Jaya area. The mechanism introduced such as reseivour, the installation system consisting of ultrasonic sensor as well as digital camera in the middle of Damansara River as shown in Figure 2 supported by SCADA system to deliver the status of the river to the respective authority.

Figure 1. The Flash Flood Situation on Sunday Morning, 26th February 2006 in TTDI Jaya

Figure 2. The Mechanism Taken by DID to Overcome Flood issue in TTDI Jaya

Flooding is a common problem that Universiti Teknologi MARA or UiTM faced every year especially along Jalan Ilmu 1/1 as shown in Figure 3. Drainage which lies between Office International Affair Building and UiTM Health Centre cannot accommodate a sudden heavy rainfalls, causing the area around flooded quickly. There are a lot of damages caused by these floods such as sinking cars at the parking area and a traffic jam. This area has been experiencing severe flash flood since December 2011 until now if heavy rain does not stop for three hours. Universiti Teknologi MARA or UiTM Shah Alam suffered a severe flooding after three hours.

Figure 3. Flood Area Along Jalan Ilmu 1/1 at UiTM Shah Alam Campus

This location experienced a flash flood every time when the rain is heavily in two to three hours of duration. The articles regarding the events of flash floods can be referred to Figure 4 which happened in 2014 and 2015 in the area of Jalan Ilmu 1/1.

(a) Flash Flood in 2014   (b) Flash Flood in 2015

Figure 4. Flash Flood HAPPENED at Jalan Ilmu 1/1 in year 2014 and 2015

Wireless Sensor Network (WSN) Flood Monitoring is developed to observe the status flooding which could alert people who were in the area frequently affected by floods in UiTM Shah Alam. The system consists of a transmitter and receiver, known as sensor node and base station. The sensor node will detect the water level using an ultrasonic sensor and displays the current value on the LCD. When the water level reaches a certain level that reflects the hazards, both devices will generate an alarm system to notify people that the water level is increasing and could endanger life.

Figure 5 shows the overall block diagram of the system. Initially, first NodeMCU attached with ultrasonic sensor will detect the flood level. Then, it will display the data on the LCD screen. The data will be send to Blynk application via wireless connection. The data also will be display in the Blynk application. At the same time, the data is stored in a CSV database, through email this data can be converted into excel form, as well as being transmitted to the second NodeMCU via Blynk Bridge. This data will alert the local authority for further action once the level reaches warning and critical level which triggers the buzzer and LED. The concept of the proposed work are based on the existing system installed in Damansara River, TTDI Jaya.
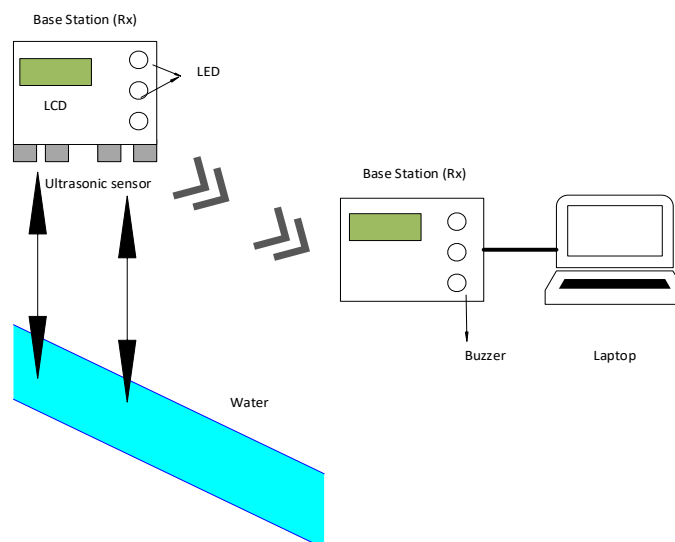

Figure 5. Block Diagram of the System

2.2. Blynk Application

Blynk is a platform with IOS and Android application to control Arduino, Raspberry Pi and the likes over the internet [1]. It's a digital dashboard where it can build a graphic interface for the user by simply drag

and drop the widgets. Blynk is another supporting device which is linked to the internet over Wi-Fi and ESP8266 modules. Blynk was designed to control hardware remotely where it can diplays data, store the data and motor the data. There are three major stages in the Blynk platform; Blynk cloud, Blynk apps and Blynk database as shown in Figure 6.
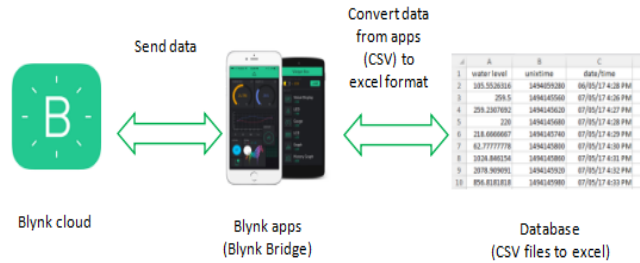

Figure 6. The Flow of Database via Blynk Application

First, designing the application where the designer can select the widget for their apps. Through these apps the flood's level also will be display. There will be LCD to display the level indicator (safety, warning and critical level). Next, the value display will display the flood's level sense by ultrasonic sensor. Besides that, the LED will lights up according to the current level. Lastly the history graph will track the flood's level and save it into database. Figure 7 shows the layout design of Blynk used in this work.
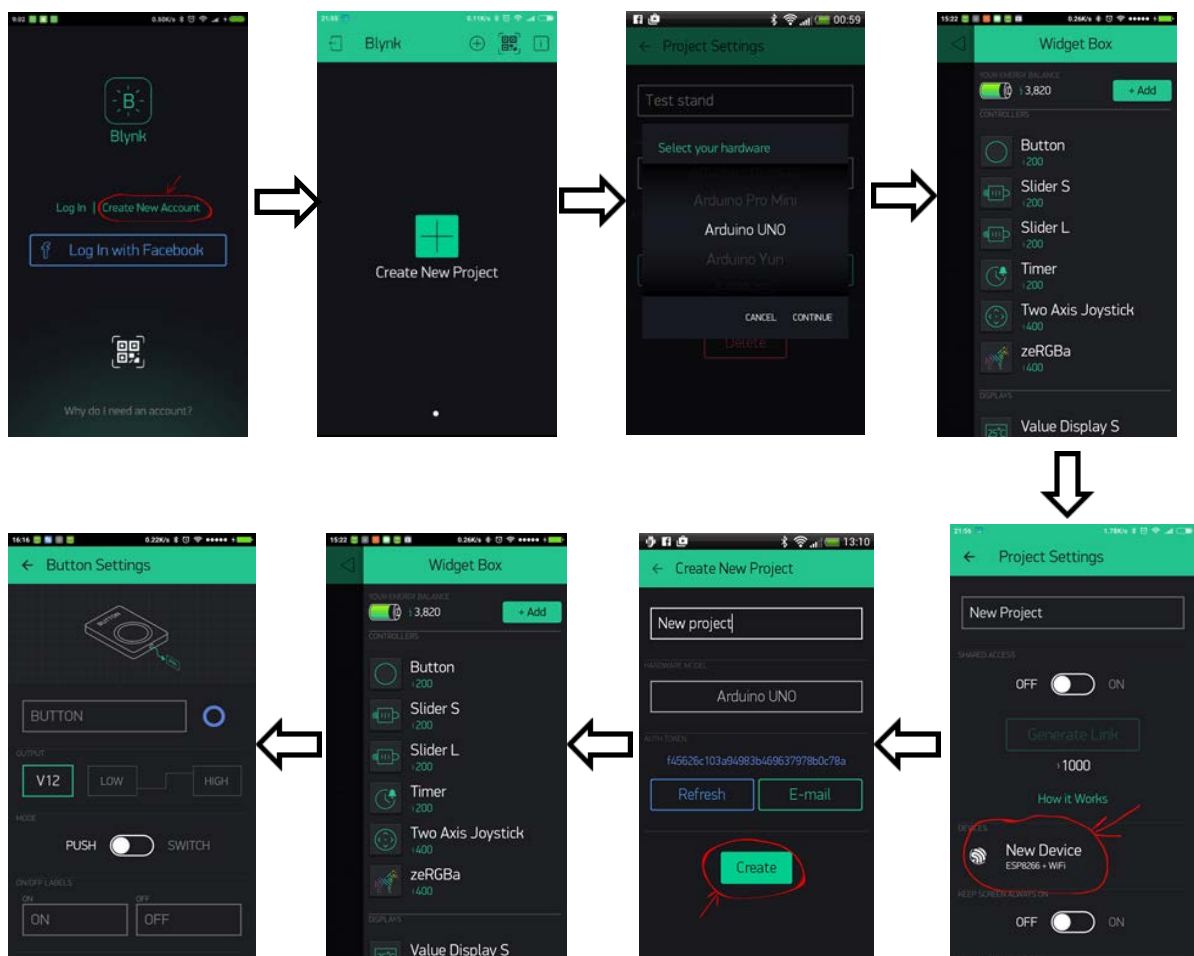

Figure 7. Step to Build WSN Flood Monitoring of Blynk Application

In Figure 7 it illustrates the step by step procedures in building the Blynk apps using a smartphone. Firstly, install or download Blynk apps for android or iOS at Google plays store or app store. To interface with Arduino, user needs to install Blynk library at library folder of Arduino IDE. After finish the installation, open the apps on the smartphone and create a new account to login for a new project. For this project, the hardware selected is NodeMCU and the communication type is WiFi ESP8266. To build a project, the authtoken needs to be obtained first. Once the user obtaining the authtoken, user can proceed to design the Blynk apps. Once confirmed, the user can setup the button widget as shown in Figure 7 where each of the widgets has its own settings.

Figure 8 shows the reading of data sense from the ultrasonic sensor from the first NodeMCU in Blynk application platform. There are three mode displays on the screen of the LCD which also reflects on the screen of the smart phone using Blynk application. On the screen, it displayed level of water either in safety, warning or critical level to alert the person in charge. The distance of the water is also displays on the widgets which used LED as the indicator (green for safety, orange for warning and red for critical). This history graph can be used to track the flood level over the time. There will be three states which are level 1, level 2 and level 3 to give alarm to the people. At first NodeMCU, the data sensed by the sensor will be display at the LCD reflecting the level indicator as well as the distance. Once the data being received by the second NodeMCU, when level 1 detected there were nothing happen, level 2 LED will blink and buzzer triggered, lastly, at level 3 LED turn ON, as well as the buzzer. Table 1 tabulates the range of level indicator that indicates the distance of sensor for safety purposes.
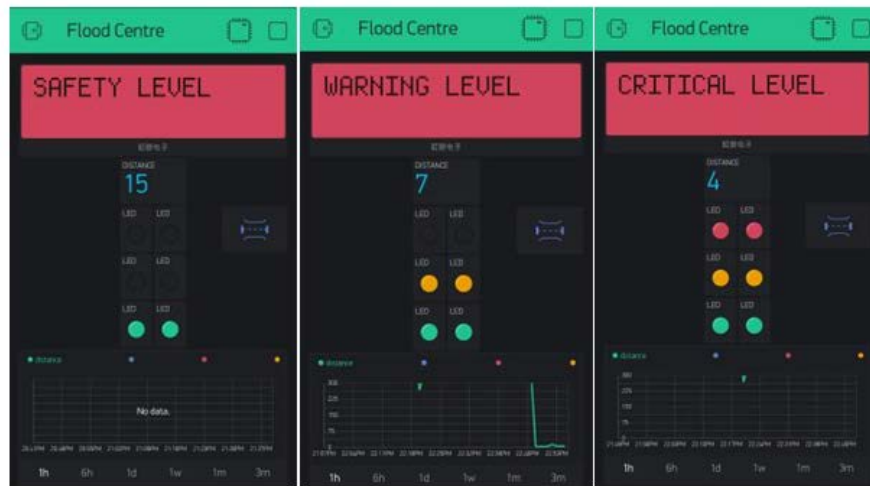

Figure 8. Flood Status Display via Blynk Apps

Table 1. Distance vs Level

Distance (cm)	Level Indicator	Warning signage
< 10	1	Safety
6 – 10	2	Warning
> 5	3	Critical

The database is used to store the data tracked by the history graph. The data which in a form of CSV will be converted in excel format as shown in Figure 9. All the information is needed in order to monitor the flood level and for future improvement of the system.

Water level	Unixtime	Date/ Time
4.00	1494427680	10/05/17 10:48 PM
4.5	1494427740	10/05/17 10:49 PM
5	1494427860	10/05/17 10:51 PM
6	1494427980	10/05/17 10:53 PM
6.6	1494428100	10/05/17 10:55 PM
7	1494428160	10/05/17 10:56 PM
7.5	1494428220	10/05/17 10:57 PM
8	1494428340	10/05/17 10:59 PM
8.6	1494428460	10/05/17 11:01 PM
9	1494428520	10/05/17 11:02 PM
9.8	1494428760	10/05/17 11:06 PM
10	1494428820	10/05/17 11:07 PM
10.8	1494429000	10/05/17 11:10 PM
11	1494429060	10/05/17 11:11 PM
11.7	1494429300	10/05/17 11:15 PM
12	1494429360	10/05/17 11:16 PM
12.7	1494429600	10/05/17 11:20 PM
13	1494429660	10/05/17 11:21 PM
14	1494429900	10/05/17 11:25 PM
14.7	1494430140	10/05/17 11:29 PM
15	1494430200	10/05/17 11:30 PM
15.9	1494430440	10/05/17 11:34 PM
16	1494430500	10/05/17 11:35 PM
16.6	1494430680	10/05/17 11:38 PM

Figure 9. The Example of History graph in Blynk Application

2.3. Hardware Set-Up

In hardware circuit, there are two NodeMCU used. Figure 10 (a) acts as a transmitter while in Figure 10 (b) acts as the receiver. The data is displayedon the labtop to monitor the satus of water level at the tested location.

(a) Hardware Setup at Receiver

(b) Hardware Setup at Transmitter

Figure 10: Hardware for Flash Flood Detection and Monitoring via Blynk Apps

3.   RESULTS AND ANALYSIS
3.1. Test Rig
3.1.1. Indoor Water Level Detection

This indoor experiment was conducted at Robotic Laboratory located at Level 4, Faculty of Electrical Engineering, UiTM Shah Alam Campus. To test whether the prototype works accordingly, an experimental was conducted to test the signaling and measurement of water detected by transmitter and receiver. From Figure 11 and Figure 12, it can be seen that as the water increases over time the distance between the sensor and the surface of the water decreases. The distance detected by the sensor node is then transmitted to the base station. This means that the base station manages to receive the data from the sensor node.
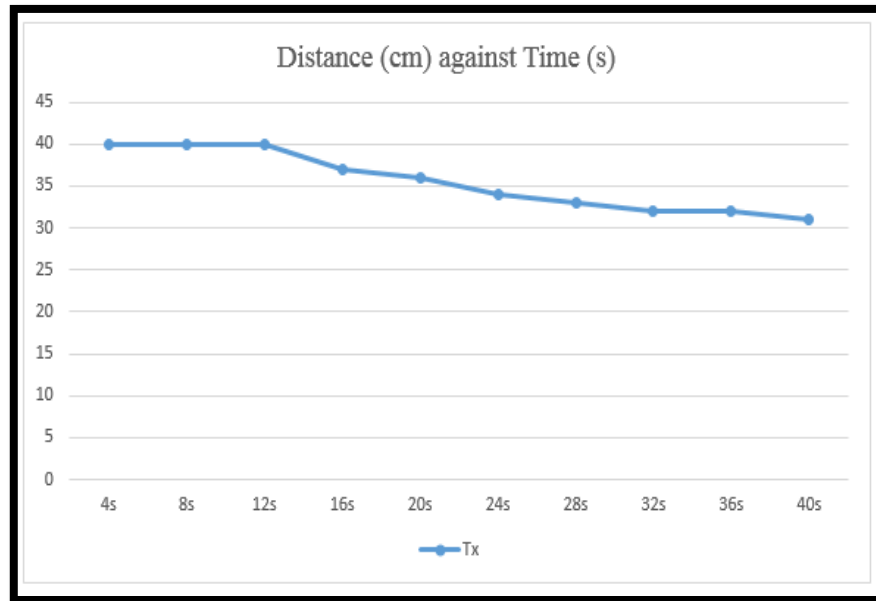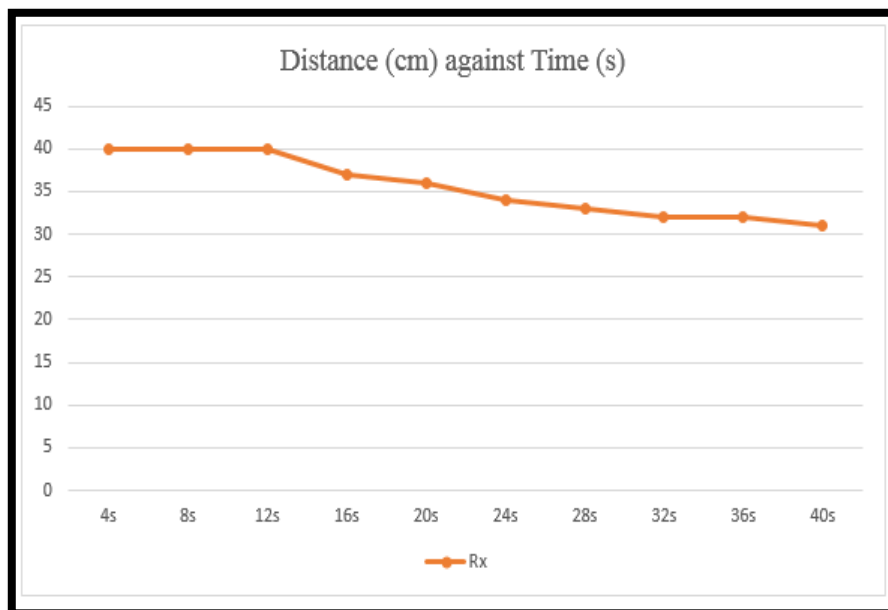
Figure 11. Water Level Readings for Transmitter

Figure 12. Graph of Water Level for Receiver

3.1.2. Outdoor Water Level Detection

Real-time monitoring of water level was conducted at Jalan Ilmu 1/1, UiTM Shah alam Campus. The hardware for first NodeMCU was hanging at the drainage system while the hardware for second NodeMCU was placed at the bridge nearby. Figure 13 shows the data recorded taken on the 3rd, 6th and 7th June 2016. The average distance for the first day is 165 cm, for the second day is 168 cm and the last day is 167 cm. The distance increases on the second day when compared to the first test and on the third day it decreases when comparing to the second day.

Date	Tx (cm)	Rx (cm)
03/06/2016	165	165
	166	166
	165	165
	166	166
	166	166
	165	165
	166	166
	166	166
	165	165
	165	165
	165	165
	166	166
	164	164
	165	165
	167	167
06/06/2016	168	168
	168	168
	168	168
	169	169
	168	168
	168	168
	169	169
	168	168
	168	168
	168	168
	169	169
	168	168
	168	168
	170	170
07/06/2016	167	167
	167	167
	169	169
	169	169
	167	167
	167	167
	168	168
	167	167
	167	167
	168	168
	167	167
	167	167
	169	169
	168	168

Figure 13. Drain Water Level Measurement at Jalan Ilmu 1/1 UiTM Shah Alam Campus

4.   CONCLUSION

This project based on the development of a smart flood monitoring system using ultrasonic sensor with NodeMCU and Blynk application which used the WSN concept. The result is a single control system that provides flexibility, low cost and easy access. WSN based on Blynk platform is an ideal platform to monitor flash floods and also as early warnings. Through the experiment conducted, it shows that this system can be used for detecting, monitoring and alerting the community in UiTM Shah Alam in case of flash flood.

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