

Internet of Things Based Real Time Flood Monitoring and Alert Management system

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Abstract

Flooding is one of the major disasters occurring in various parts of the world. The model is very much useful to monitor the water level variations in rivers, dams, reservoirs and the monitored values regularly stored in the web server which is useful to send flood alerts to corresponding authority for proper action and the same can be viewed through the web. This research investigates the use of wireless sensor network (WSN) for monitoring of river and flood conditions. The wireless sensor network system can also be used for real-time monitoring of water conditions like water flow level and precipitation levels. The model was developed and engaged in monitoring flood

Keywords: Raspberry Pi3, ARM Cortex A53, Analytics software, Application program Interface, Sensors and Python programming.

1 INTRODUCTION

Natural disasters happen everywhere in the world, and they can be completely disturbing the human life and the economy of the country. Economy and growth of any country depend upon the agriculture

proper alert forecasting makes the farmer to protect the crop from flooding. The system is much advantaged for protecting the lives of people and animals. The proposed model is very much utilized for monitoring of the water level, flow variations in rivers and the same can be used for measuring of the water level at Dam/ Reservoirs. The measured values are regularly updated on the web server which is very much useful to send flood alerts to consistent authority and people for faster action. The project mainly constitute a wireless sensor nodes which called as a mote and the motes are placed along the river beds to monitor water condition. Each Node is connected with a GSM module. The measured parameters are processed by the Raspberry pi3 which contains 64-bit ARM Cortex A53 processor. The processed information transmitted from corresponding node to alert management system using GPRS. Google spread sheet Application program interface (API) created and this API is used as a data logger. The google spread sheet is mapped to free analytics software which will be called as the alert management system. The alert management System can be used to observe, record and send a message to the people before disaster knockouts.

2 CHALLENGES

In India, especially in coastal regions floods are a constant problem during cyclones and monsoon seasons. The Placing of the sensor nodes and connection of this sensor nodes will be big challenging task across the river bed. The complex algorithms should be executed for finding the shortest path. The main challenging part will be the coordination between the sensor nodes as the nodes collecting diverse information from different geospatial locations and consolidating of data without repletion is a huge task. Desion making will cumbersome and more complex and needs high degree of accuracy because data are scattered from different sources.

There are two essential requirements for the development of an SDI (spatial data infrastructure (Rajabifarad ad Williamson, 1999; Masser 2005) in the context of flooding.

1. Interoperability need to integrate the heterogeneous data sources

2. Flexibility: the ability to adapt to the wide range of situations and specific needs of different scenarios

3 APPROACH

A. HARDWARE IMPLEMENTATIONS

The design of a WSN involves of a set of nodes for sensing and a base station that link with each other and collects confined data to make actual results about the environment. The wireless sensor node involves of an ARM 32 micro controller, sensors and wireless transceiver. Sensing unit senses the flow of water, temperature, and its level. The sensor nodes are connected to GPIO of raspberry pi3 and programmed accordingly to transmit information using wireless systems. Each node will update its information in regular intervals and data stored in the google web server.

The main hardware components are Raspberry Pi, Temperature Sensor, Flow Sensor

Level Sensor, Rainfall Sensor, and GSM

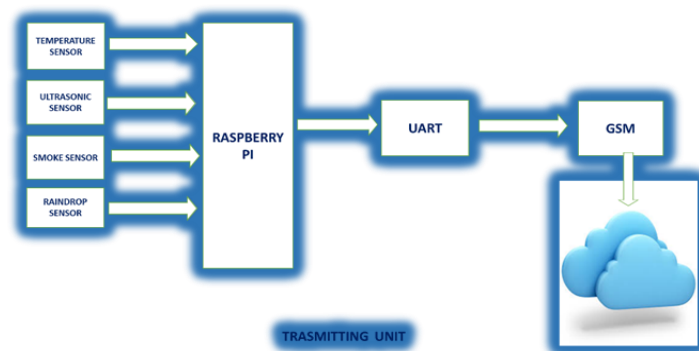


Fig1: Block Diagram

The full specs for the Raspberry Pi 3 include:

CPU: Quad-core 64-bit ARM Cortex A53 clocked at 1.2 GHz and supports GPU: 400MHz Video Core IV multimedia

Memory: 1GB LPDDR2-900 SDRAM (i.e. 900MHz) and supports 4 USB ports, Bluetooth 4.1V.



Fig 2: Raspberry Pi 3

Video outputs: HDMI, composite video (PAL and NTSC) via 3.5 mm jack

Network: 10/100Mbps Ethernet and 802.11n Wireless LAN

Peripherals: 17 GPIO plus specific functions, and HAT ID bus

Power source: 5 V via Micro USB or GPIO header

Size: 85.60mm × 56.5mm

Weight: 45g (1.6 Oz) and low power device

Temperature Sensor

A temperature sensor perceives the hotness and the coldness of the environment. The recognizing of the temperature can be done with the straight contact or an indirect contact.

Level Sensor

Level sensors are used for the measurement of the water level. Such substances can be liquids like water, oil, slurries as well as solids which can flow.

Flow Sensor

The flow sensor is a device for observing the rate of fluid flow. Regularly a flow sensor is the sensing element used in a flow meter for the footage of the flow rate.

Rainfall Sensor

The rainfall sensor detects the amount and intensity of rain in the environment. A rain sensor or rain switch is an exchanging gadget initiated by precipitation.

B. Software Implementation:

Raspberry pi3 modules work with python language and raspbian comes with python the official programming language of raspberry pi3 and IDLE3, a python integrated development environment. The sensors like temperature sensor, flow sensor, level sensor and rainfall sensor are connected to the GPIO ports of the raspberry pi 3. Sensor data are read by the processor and by using API integrated in raspberry pi 3 will communicate the data with help Internet to that google URL. Simple google spread sheet designed and processed data will be stored according to the importance given by the program in google Cloud. Tiny RTOS program will control execution of entire node with preemptive based scheduling algorithm. Google cloud is connected to the Tableau for proper analytics of the data.

Pin#	NAME		NAME	Pin#
01	3.3v DC Power		DC Power 5v	02
03	GPIO:02 (SDA1, I ² C)		DC Power 5v	04
05	GPIO:03 (SCL1, I ² C)		Ground	06
07	GPIO:04 (GPIO_GCLK)		(TXD0) GPIO14	08
09	Ground		(RXD0) GPIO15	10
11	GPIO17 (GPIO_GEN0)		(GPIO_GEN1) GPIO18	12
13	GPIO27 (GPIO_GEN2)		Ground	14
15	GPIO22 (GPIO_GEN3)		(GPIO_GEN4) GPIO23	16
17	3.3v DC Power		(GPIO_GEN5) GPIO24	18
19	GPIO10 (SPI_MOSI)		Ground	20
21	GPIO:09 (SPI_MISO)		(GPIO_GEN6) GPIO25	22
23	GPIO11 (SPI_CLK)		(SPI_CE0_N) GPIO:08	24
25	Ground		(SPI_CE1_N) GPIO:07	26
27	ID_SD (I ² C ID EEPROM)		(I ² C ID EEPROM) ID_SC	28
29	GPIO:05		Ground	30
31	GPIO:06		GPIO12	32
33	GPIO13		Ground	34
35	GPIO19		GPIO16	36
37	GPIO26		GPIO20	38
39	Ground		GPIO21	40

Fig 3: Raspberry Pi 3 GPIO

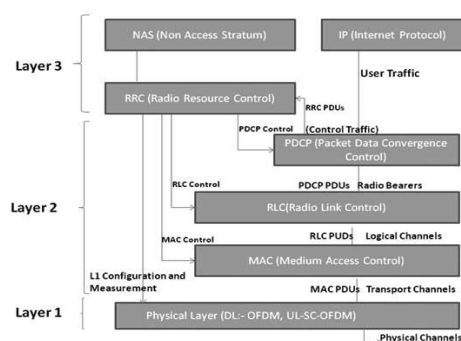


Fig 4: TCP/IP Protocol

4 RESULTS

Total six nodes are deployed at the river site each prototype will communicate individually with API try stores the data as per sequence given temperature, flow, water level and rain fall occurrence simultaneously. Data will logged in spread sheet as shown below.

Date	Time	Node 1 Temperature	Node 1 Flow	Node 1 Level	Node 1 Rain	Node 1 Temperature	Node 1 Flow	Node 1 Level	Node 1 Rain	Node 2 Temperature	Node 2 Flow	Node 2 Level	Node 2 Rain	Node 3 Temperature	Node 3 Flow	Node 3 Level	Node 3 Rain
3/10/2017	2:24:57 PM	30	0	0	0	30	0	0	0	30	0	0	0	30	0	0	0
3/10/2017	2:25:01 PM	30	25	0	0	30	25	0	0	30	25	0	0	30	25	0	0
3/10/2017	2:25:05 PM	30	30	0	0	30	30	0	0	30	30	0	0	30	30	0	0
3/10/2017	2:25:10 PM	30	32	0	0	30	32	0	0	30	32	0	0	30	32	0	0
3/10/2017	2:25:44 PM	30	21	25	0	30	21	25	0	30	21	25	0	30	21	25	0
3/10/2017	2:25:48 PM	31	50	25	0	31	50	25	0	31	50	25	0	31	50	25	0
3/10/2017	2:25:53 PM	31	50	25	0	31	50	25	0	31	50	25	0	31	50	25	0
3/10/2017	2:25:57 PM	31	58	25	0	31	58	25	0	31	58	25	0	31	58	25	0
3/10/2017	2:26:01 PM	30	58	25	0	30	58	25	0	30	58	25	0	30	58	25	0
3/10/2017	2:26:06 PM	30	60	25	0	30	60	25	0	30	60	25	0	30	60	25	0
3/10/2017	2:26:11 PM	30	60	25	0	30	60	25	0	30	60	25	0	30	60	25	0
3/10/2017	2:26:16 PM	31	100	25	0	31	100	25	0	31	100	25	0	31	100	25	0
3/10/2017	2:26:21 PM	30	100	25	0	30	100	25	0	30	100	25	0	30	100	25	0
3/10/2017	2:26:26 PM	30	100	25	0	30	100	25	0	30	100	25	0	30	100	25	0
3/10/2017	2:26:31 PM	31	100	25	0	31	100	25	0	31	100	25	0	31	100	25	0
3/10/2017	2:26:36 PM	30	100	25	0	30	100	25	0	30	100	25	0	30	100	25	0
3/10/2017	2:26:41 PM	31	100	25	0	31	100	25	0	31	100	25	0	31	100	25	0
3/10/2017	2:26:46 PM	30	100	25	0	30	100	25	0	30	100	25	0	30	100	25	0
3/10/2017	2:26:51 PM	31	100	25	0	31	100	25	0	31	100	25	0	31	100	25	0
3/10/2017	2:26:56 PM	30	200	75	0	30	200	75	0	30	200	75	0	30	200	75	0
3/10/2017	2:27:01 PM	31	200	75	0	31	200	75	0	31	200	75	0	31	200	75	0
3/10/2017	2:27:06 PM	30	200	75	0	30	200	75	0	30	200	75	0	30	200	75	0
3/10/2017	2:27:11 PM	31	242	75	0	31	242	75	0	31	242	75	0	31	242	75	0
3/10/2017	2:27:16 PM	30	244	75	0	30	244	75	0	30	244	75	0	30	244	75	0
3/10/2017	2:27:21 PM	31	200	50	0	31	200	50	0	31	200	50	0	31	200	50	0
3/10/2017	2:27:26 PM	30	200	50	0	30	200	50	0	30	200	50	0	30	200	50	0
3/10/2017	2:27:31 PM	31	200	50	0	31	200	50	0	31	200	50	0	31	200	50	0
3/10/2017	2:27:36 PM	30	200	50	0	30	200	50	0	30	200	50	0	30	200	50	0
3/10/2017	2:27:41 PM	31	200	50	0	31	200	50	0	31	200	50	0	31	200	50	0
3/10/2017	2:27:46 PM	30	100	50	0	30	100	50	0	30	100	50	0	30	100	50	0
3/10/2017	2:27:51 PM	31	85	50	0	31	85	50	0	31	85	50	0	31	85	50	0
3/10/2017	2:27:56 PM	30	25	50	0	30	25	50	0	30	25	50	0	30	25	50	0

Figure 6: Spread sheet

Tableau is the analytic software where user can monitor the values gradually and alerts can be set and message will set to the corresponding people via mail or SMS The following picture are the examples of the tableau analytic part

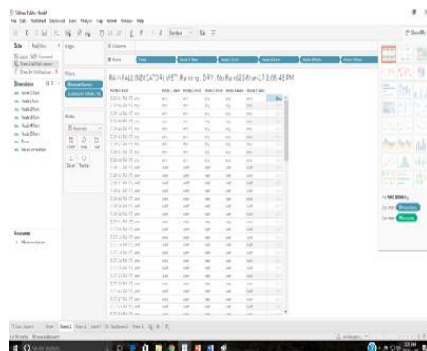


Fig7: Tableau software



Fig 8: Complete hardware

5 CONCLUSION AND FUTURE WORK

The system provides a real world application of internet of things and offer services like accurate level monitoring directly are indirectly benefited by the system. Sensors are important elements in the Flood Observatory System. Further studies on wireless sensor technology will be best to replace the current sensors. Precise and accurate detection of water level will improve the data collection system for the monitoring station. The flood alert information's can be displayed on LED display boards for road users and for safety reasons could be placed at strategic locations. Such information's should be in real time and transmitted wirelessly from the measured location. A possible means of power supply for the sensors and centralized control unit is via solar cells. The Flood Observatory System will be easy to install and maintained if it is powered by solar cells. The use of solar energy will also provide cheaper source of power to the entire system.

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