International Journal of MC Square Scientific Research Vol.9, No.3, 2017

IoT Based Disaster Detection and Early Warning Device

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Abstract

Disaster-LINK is a smart IoT device that acts as an alarm and monitoring system during natural disasters that operates by communicating over internet. It comes with Wi-Fi support for internet connectivity and uses an IoT cloud platform which helps to control, monitor and manage the device. The device senses its local environment using onboard sensors and send early warnings to family, friends and colleagues immediately when it finds a disaster situation. It is also able to receive such warning alarms from other similar devices available on the internet and provide the user with voice, flashing light, SMS and E-mail alarm notifications. The ultimate aim of the project is to spread the disaster warning information quickly through internet and make it available to those who need it as early as possible. The fact that internet is faster than the seismic waves of an earthquake, and much faster than a flood or tsunami, helps the device to deliver the alert message much before the actual calamity reach the user's location giving that vital extra time to take those precautionary emergency measures.

Keywords- Wi-Fi, Wi-Fi router, mobile device, sensors.

1. Introduction

CC3200 from Texas Instruments is the world's first Wi-FI certified single chip microcontroller unit (MCU). It includes a high performance ARM Cortex-M4 processor subsystem running at 80 MHz and a Wi-Fi subsystem. The Wi-Fi subsystem consists of a dedicated ARM MCU, an 802.11b/g/n radio, baseband, and MAC with powerful crypto engine for fast, secure Internet connection. CC3200 chip supports Station, Access Point and Wi-Fi Direct modes. It also supports WPA2 personal and enterprise security and WPS 2.0. Multiple provisioning methods are supported including Smartconfig, AP mode and WPS. It includes embedded TCP/IP stack and multiple Internet protocols for easy web access. It consumes very low power and according to TI, it can run for more than a year from a single coin-cell battery.

Issn No:0975-0932

Smartconfig – Before connecting the device to an access point, it has to join the network securely. The user needs to send the predefined password. Although there are other methods such as Access point method and WPS method, here we are going to use SmartConfig method for Wi-Fi provisioning our device because of its ease of use. SmartConfig is a TI proprietary provisioning method designed for headless Simple Link devices such as Disaster-LINK device. It uses a mobile app to broadcast the network credentials from a Smartphone, or a tablet to an unprovisioned Wi-Fi device. After the network credentials are picked up by the Simple Link device, it connects automatically to the network. User can download the android mobile app from Google Play.

There are national and regional seismic and tsunami warning centres that are able to provide warning data over internet. Our device is currently not able to receive this warning directly from that websites, but this feature can be emulated using the cloud platform in our project. Nevertheless, a warning centre can receive the sensor data from our device by communicating with the cloud platform, and can analyze the data stream to get more information. The more that our devices are deployed, the more accurate and powerful its network will become.

2. System architecture:

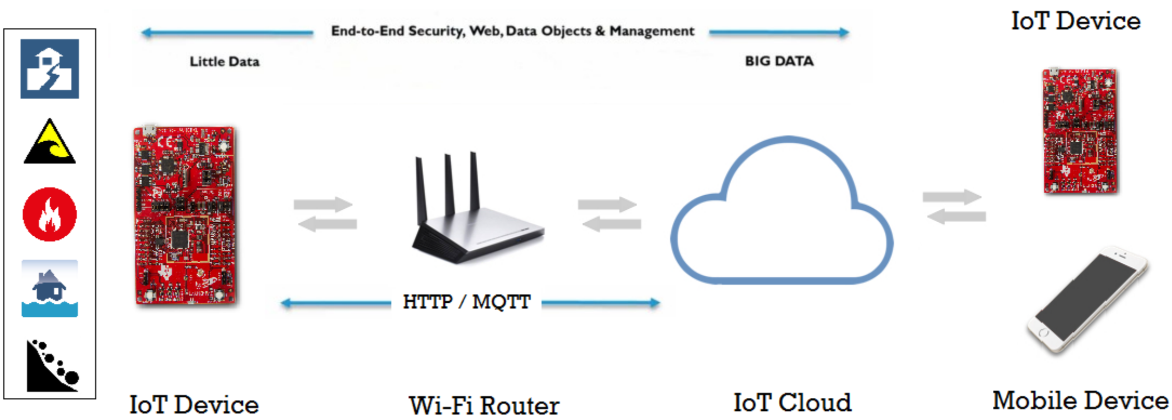

Figure.1 System architecture

Fig1 describes the architecture of the IoT via router to IoT cloud and to mobile device

Wi-Fi – The device uses Wi-Fi communication to connect to the internet. Wi-Fi is a local area wireless computer technology that allows devices to connect to the network using 2.4 GHz radio band. It connects to the internet through a wireless network access point. Typically we need a wireless router to act as the wireless access point.

Issn No:0975-0932

Cloud *Platform* – An IoT cloud platform is a server based system that is used to connect and manage an IoT product using web services that enable the device to communicate between each other and also between other web applications over internet. Exosite is the cloud platform that we are going to use for this project.

Our device acts as a client and sends its data to the exosite cloud platform through a data source channel. Any device that needs this information must subscribe to this data channel and can receive and act upon it. The communication between the cloud and the device happens through HTTP application layer protocol. Data will be sent in JSON format. Exosite provides free accounts to connect and manage the device. It also allows the user to monitor the sensor values using a web dashboard.

Sensors – A MEMS accelerometer is used to detect earthquake and landslides. A Water level sensor acts as a flood and tsunami detection mechanism. A heat sensor acts as a fire outbreak detector.

Actuators – In addition to sensing, the device can take a few defensive measures on its own like fire sprinkler control and flood water exhaust pump activation in case of an emergency. A servo motor is used as the sprinkler valve control mechanism and a DC motor as water pump activation mechanism. Both these motors are controlled using PWM signal generation.

Audio Alarm – The audio warnings can provide a loud beep alarm sound and can use a voice that tells “earthquake” or “flood” or “fire”. The audio is prestored in a memory card in MP3 format and played back using an audio codec chip. A dedicated ARM microcontroller will be used for audio playback functionality.

Light Alarm – The device has a bright RGB LED that flashes coloured lights as an alarm to indicate different disaster event.

User Interface – A Serial Terminal based on UART acts as the main user interface. Notification LED’s are used to indicate Wi-Fi provisioning and cloud server connection status.

E-Mail and SMS Alert – The cloud platform supports applying data rules on the incoming data stream from the client and can dispatch an E-mail or SMS to those recipients entered by the user. The user must manually enter the e-mail address and mobile number on the cloud platform account.

3.HARDWARE DESIGN

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Figure 2 illustrates the block diagram of the disaster link. The special feature present in our controller is WI-FI protocol which will be inbuilt in our controller. Through which we will send the alerts through message or mail in our system. In this we can note operation of UART in CORTEX M4 controller. We have effectively used 2 UART in the CORTEX M4 at uart 1 we connected the LPC1313 microcontroller which controls SPI terminals with the Audio codec in one end which is connected with the speakers to give alert during the emergency period. The recorded voice will be stored in the memory card in which is present in the audio codec board.

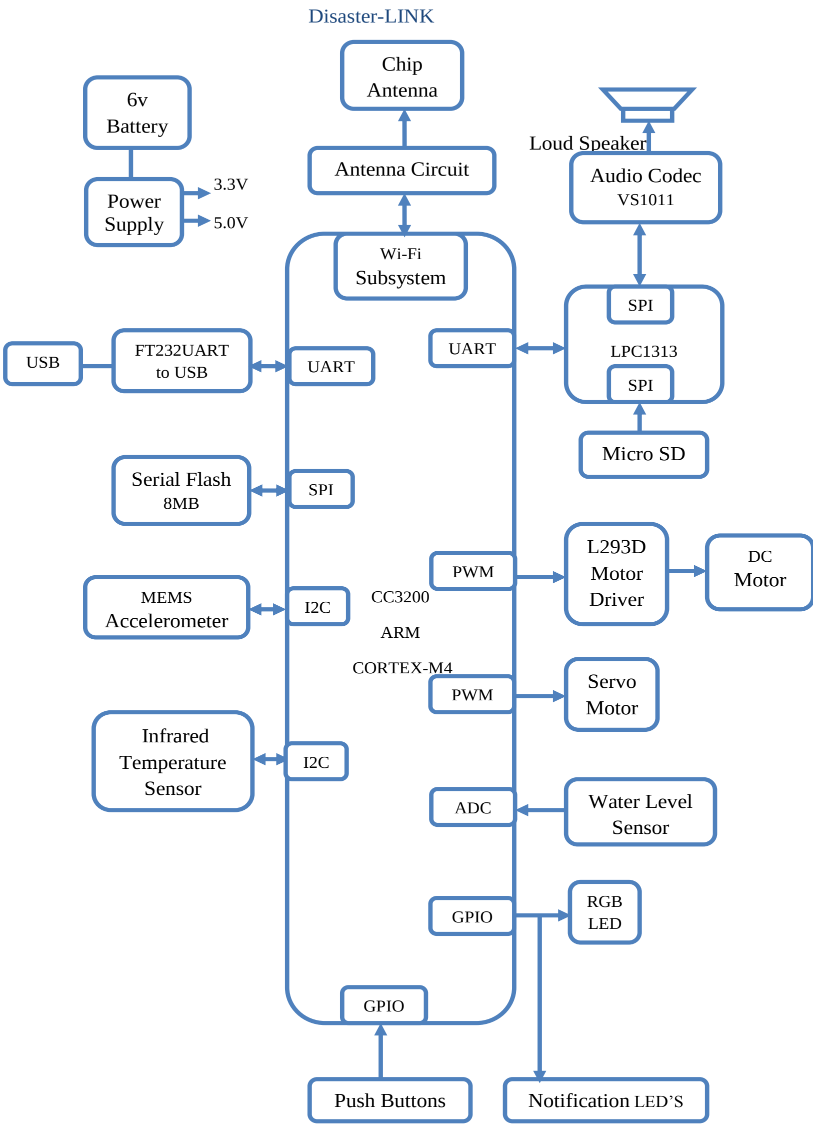

Figure.2 Block diagram

Here as shown in the fig we use the Mems accelerometer and infrared temperature sensors these sensors are connected with the I2c peripherals which will collect the serial

Issn No:0975-0932

data's and send to controller through I2C bus terminals. By this way we have all the data's to be communicated and send to our controllers to have a safe life flow for our universe.

4. Result

The fig 3 shows the detailed result of this paper in hardware. So by this way we have implemented our project and the output result has been taken out.

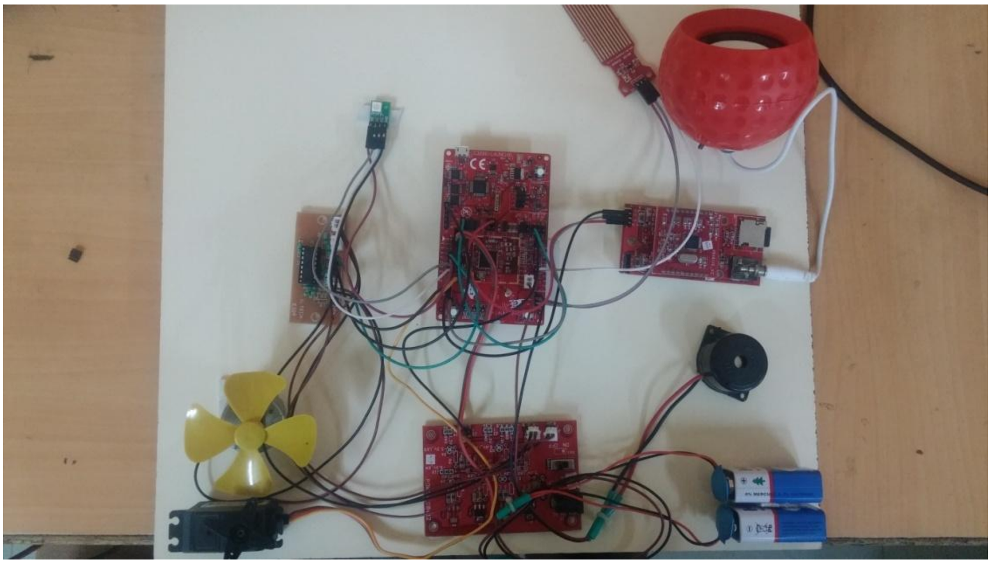

Figure.3 output image

5.Conclusion

Hereby to overcome the certain problems during a flood, earthquake or tsunami, a few minutes or even a few seconds extra notice can be the difference between life and death. Take for instance, the tsunami that struck east coast of India back in 2004 or the recent disaster like Chennai flood, where none of these unfortunate souls had received any advanced warning. Had an early detection system been in place, many lives and valuable properties could have been saved. This is actually a global problem and not confined to the borders of our country alone. Although an earthquake or tsunami cannot be prevented, the impact of them can be mitigated through community preparedness, timely warnings and effective response. We have made certain remedies through this paper and we have implemented this project.

Issn No:0975-0932

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Issn No:0975-0932