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Earth Quake Detection and Alerting Using Iot

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Abstract: An earthquake is haphazard natural disaster that causes harm to lives and property. It happens all of a sudden and that wecannot stop ithowever we will be alerted from it.
In the present time, there are numerous advancements which can be utilized to identify the little shakes and knocks of the earth. In order to prevent that we can takeprecautions before some major vibrations takes place within the earth. Lives can be saved by giving an early cautioning of earthquake.
Here we are using analogue sensor GY-61to detect the pre-earthquake vibrations using NODEMCU ESP8266 board.It connects to Cayenne app. If the device triggers a pre-determined threshold, Cayenne generates an SMS and EMAILcautioning of an earthquake.
Keywords:NODEMCU ESP8266, GY-61, MQTT, IOT

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I. Introduction

An earthquake could be a development ensuing from the sharp unleash of keep energy within the earth's crust that creates seismic waves. These elastic waves radiate outward from the "source" and vibrate at the bottom.One of the foremost scary and damaging phenomena of nature could be a severe earthquake. For many lotsof years,theforcesof tectonicshave formed theworld becausethe immense plates
that kind the layer slowly yield,under,andpast oneanother. Typically themovementisgradual.At alternative times, the plates are locked together, unable to release the accumulating energy.

Earthquakes represent one in every of the most important potential supply of casualties and injury for populous areas attributable to a natural hazard. Throughout history, they have destroyed innumerable cities and villages round the world and caused the death of thousands of individuals.

As well as the threat that earthquakes create to life and property, the economic threat is additionally terribly vital.

It's useful to possess sensors as near to the geographic point as potential so the maximum amount warning may be provided as potential. This needs more number of sensors distributed over the earthquake affected zones.

The project has created a prototype using a low cost sensor with the esp8266. It uses a GY-61 sensor which is sampled by the esp8266's 10-bit ADC. It connects to Cayenne app to generate the cautioning to the people.

II. Hardware

2.1 NODEMCU ESP8266

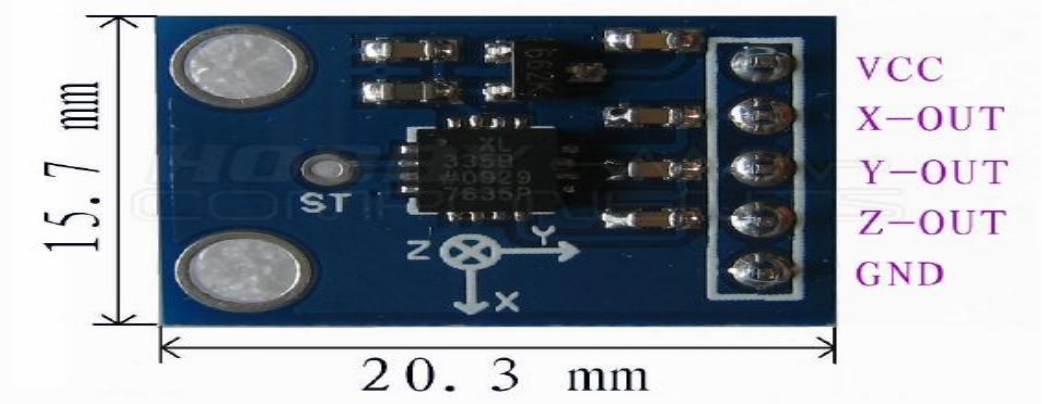
TheNodeMCU (Node Microcontroller Unit) is open source software and hardware development atmosphere that is engineered around a System-on-a-Chip (SoC) referred to as the ESP8266. The ESP8266, designed and created by Espressif Systems, contains all crucial components of a computer: electronic equipment, RAM, networking (wifi), and even a modern operating system and SDK.

The Development Kit supported eLua primarily based code for the ESP8266 WiFi SOC from Espressif, integrates GPIO, PWM, IIC, 1-Wire and ADC all in one board. And hardware that is predicated on the ESP-12 module. The firmware uses the Lua scripting language.

2.1.1 FEATURES

- An open source ESP8266 firmware that is built on top of the chip.
- Manufacturer's proprietary SDK. The firmware provides a simple programming environment based on eLua (embedded Lua), which is a very simple and fast scripting language with an established developer community.
- For new comers, the Lua scripting language is easy to learn.
- Arduino like hardware I/O
- Event driven API for network applications
- 10 GPIOs D0-D10, PWM functionality, IIC and SPI communication, 1- Wire and ADC A0 etc. all in one board
- USB-TTL included, plug and play.

2.2GY-61



GY-61 DXL335 3-Axis Accelerometer Module is a three axis accelerometer sensor module based on ADXL335 integrated circuit. It is a triple axis accelerometer with low noise and power consumption. The sensor has a full sensing range of +/- 3g. It can measure the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration.

There is an on-board 3.3V voltage regulator to power the ADXL335 so power provided should be between 3.3V and 6V DC.

2.2.1 Working Principle

ADXL335 is measuring system sensing element that works on the principle of piezoelectricity. Whenever we'll tilt the sensing element the ball is meant to maneuver in this direction owing to gravitation. The walls area unit fabricated from electricity components.

So, when ball is touching the wall an electrical current are created which is able to be taken within the variety of values in any 3D house.ADXl335 may be a triple axis measuring system i.e. it'll offer three values in output.

2.2.2 Applications

- Cost sensitive, low power, motion, and tilt-sensing applications
- Mobile devices
- Gaming systems
- Sports and health devices

III. Software

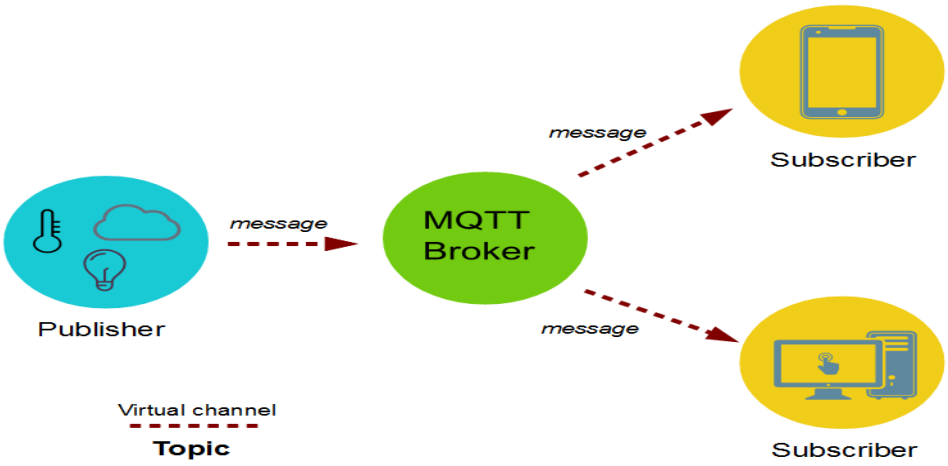
3.1 MQTT Protocol

MQTT is a machine-to-machine (M2M)/"Internet of Things" connectivity protocol. It absolutely was designed as a very light-weight publish/subscribe electronic communication transport that's optimized to attach physical world devices and events with enterprise servers and other consumers. . It's helpful for connections with remote locations wherever alittlecodefootprintis needed andnetwork informationmeasure isat premium. It will transmit information over so much reaching, typically intermittent networks.

3.1.1 Working Principle

It is high-level architecture with 2 main parts

1. Broker
2. Client



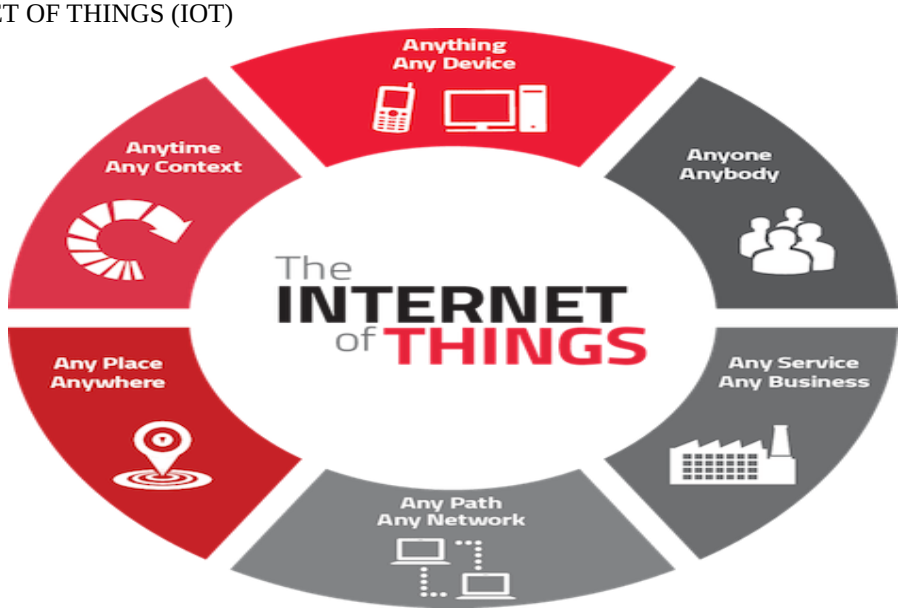
Broker

A broker will do the vital job with capabilities for each subscribing and publication. Its primary function is to queue the received messages from the publisher and transmit the messages received to the subscriber client consequently.

Client

MQTT client does very simplified tasks as most of the key handling is completed by the broker. They can run on any software system starting from mackintosh, Windows to mobile OS like automaton and IOS. The publisher client publishes messages employing a TOPIC and QOS. Similarly, a subscriber client subscribes to messages with a subject and QOS.

3.2 INTERNET OF THINGS (IOT)



The Internet of Things (IoT) is a system of interconnected computing devices, mechanical and digital machines, objects, animals or people that are provide with distinctive identifiers and therefore the ability to transfer data over a network while not requiring human-to-human or human-to-computer interaction.

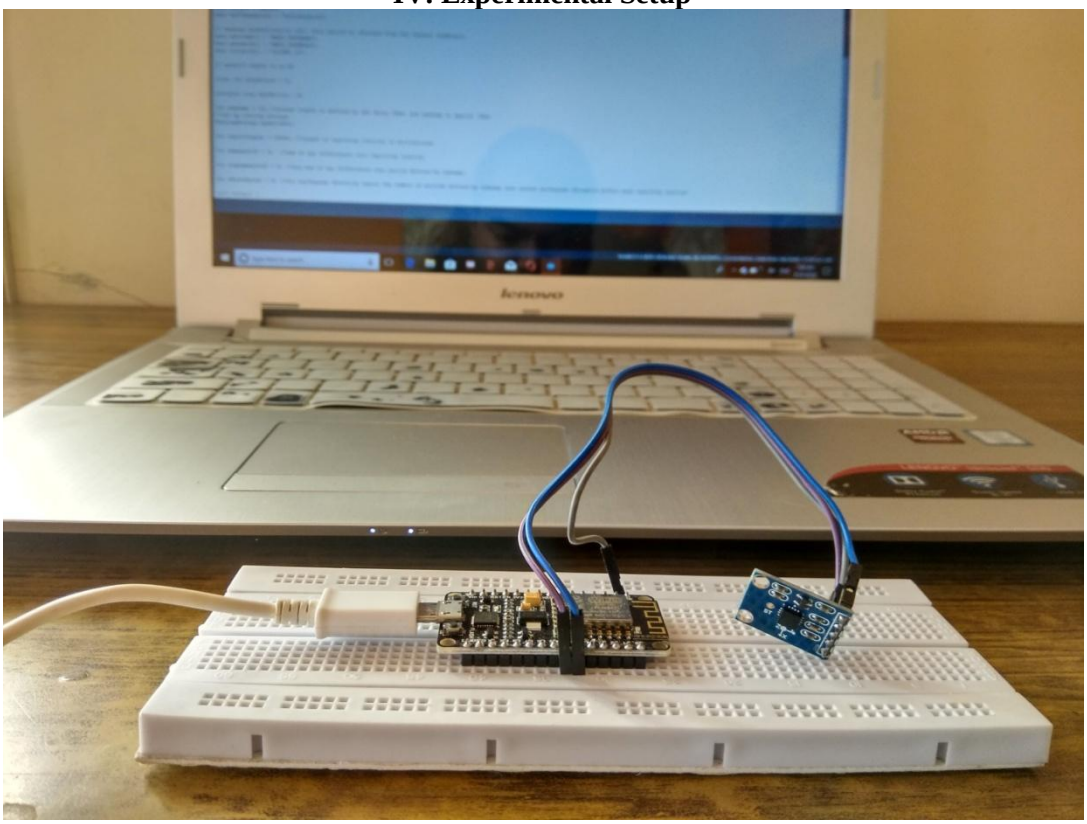
Programming Language

3.3 Lua

Lua is a powerful, efficient, lightweight, embeddable programming language. Lua was originally designed in 1993 as a language for extending software applications to satisfy the increasing demand for personalization at the time.

Lua combines easy procedural syntax with powerful data description constructs supported associative arrays and extensible semantics. Lua is dynamically written, runs by interpreting bytecode with a register-based virtual machine, and has automatic memory management with progressive trash collection, creating it ideal for configuration, scripting, and fast prototyping.

IV. Experimental Setup



A NodeMCU board contains the esp8266 the board provides convenient connections to power and GY-61 contains the three analogue outputs. Use of the NodeMCU additionally simplifies esp8266 programming and power is provided through the USB interface. The association between the NodeMCU and the GY-61 board is a straight forward three wire interface (power, GND and analogue device output). The GY-61 sensor needs a provide voltage within 1.8 to 3.6V that the NodeMCU will provide. The Z-axis sensor output is connected to the A0 port of the NodeMCU.

4.1 Earthquake detection

There are several types of measures of earthquake. Earthquake intensity is measures by Richter scale.The acceleration is measured using analogue device accelerometer. The ADXL335 incorporates a sensitivity of 300mV/g. The sensor bandwidth is set using a capacitor. On the GY-61 board the capacitor is 100nF that sets the bandwidth as 0.5Hz to 50Hz.

To determine the earthquake it is calculated using sum of square variations is calculated approximately every 48ms. This time is calculated by the variable numsamp (12) and the delay (4ms). The delay roughly controls the sample rate (approx. 250samples/sec).

If sum of square variations calculated throughout every 48ms amount exceeds a pre-defined threshold then the counter ‘abovethrcnt’ is incremented by one. The threshold has been set to ‘strong’ earthquakes

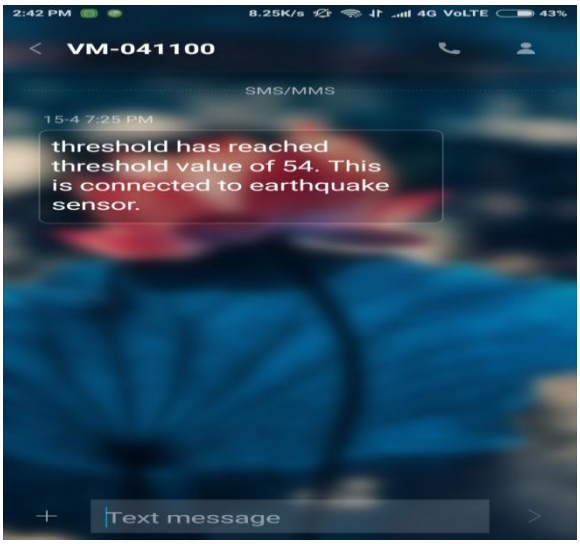
(>0.092g)The average total of variations is repeatedly calculated till last Millis is greater than Reportingint. Reportingint defines the reporting interval set to ten thousand milliseconds.

4.2 Experimental Result

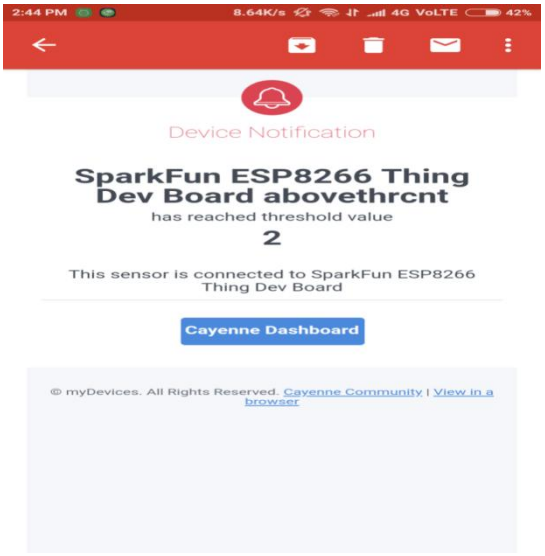
If abovethrcnt exceeds fifty two at the top of the reporting interval then earthquake are going to report to Cayenne by setting channel three (earthquake alert) to the value of 2. If the abovethrcnt doesn't exceed fifty two then channel is set to zero. The quantity fifty two corresponds to 25% of the 48ms windows exceeding the threshold throughout the ten second reporting interval.

When the value of the channel changes from zero to two, it generates an alert sends a SMS, EMAIL and gives warning of an earthquake.

SMS



EMAIL



V. Conclusion

This project proposes a low cost earthquake alerting system. A NodeMcuEsp8266 with GY-61 board is placed at the epicenter of the earthquake location. The warning system can be provided to the recipients before the earthquake reaches their localities.

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