Internet of Things based Earthquake Detection using Accelerometer

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ABSTRACT

Due to earthquake and Tsunami a large amount of destruction happens, and large amount of population decreased every year. These natural calamities never give an alert before occurring. To avoid this destruction and deaths we are building a project which will alert the public about earthquake, etc. This simulation of natural calamity will be done with the help of cloud. This system keeps on monitoring the vibrations of the earth caused at each and every single second of the day, in case where the vibration of the earth is received by the system it produces a signal, thereby alerting public. In this stimulation analysis we bring into play 2 accelerometers located two to three meters away from each other. Here we are also building a movable robot so it can move easily and detect the earth vibrations and sends signal immediately.

1. INTRODUCTION

Due to earthquake & tsunami a large amount of destruction happens &large amount of population decreases every year. These natural calamities never give an alert before occurring. To avoid this destruction & deaths we have a tendency to building a project which is able to alert the public concerning earthquake, tsunami, etc. This simulation of natural disaster is through with the assistance of wifi technology.

This system keeps on monitoring the vibrations of the planet caused at every single second of the day, just in case wherever the vibration of the planet crosses the edge this technique produces an indication, thereby alerting public. When the earthquake take place the signal is produced and the accelerometer is stimulated and the signal is convey all the way through the ESP 32. These signals are generated as soon as possible and sent to the cloud. Owing to the quick signal there is a possibility of false alarming. But in this stimulation project we bring into play 2 accelerometers. When ESP32 receives same signals from each of the accelerometers then it provides a message concerning the Earthquake info. Once an alert is detected regarding the earthquake by this technique, it spreads these distinct earthquake intensity values to a cloud by victimization wifi technology. This data is then exhibited and monitored in the cloud.

The Robot moves in to the surface of the earth and simulates the results of the earthquake, the robot is made such a way that it can go in to the core surface of the earth and can predict the earthquake before it hits the main surface, there is a Earthquake in the region where the device is kept, the Accelerometer sensor's sends the 3-axis parameters that is X,Y and Z to the cloud such that the person monitoring can know from any where in the world that the earth quake took place in particular region and can alert the Emergency services and the citizens present in that region to evacuate the region as soon as possible. The 3-axis parameters is sent in to the cloud in which the X , Y and Z parameters are display in the form of charts such that if there is any deflection in the 3-axis parameters, the monitoring person can be noticed how much of magnitude of earthquake took place.

2. PROPOSED WORK

The simulation of natural calamities will be done with the help of this device inside the earth surface with help of a moveable robot which can be monitored through cloud This system keeps on monitoring the vibrations of the earth caused at each & every single second of the day, in case where the vibration of the earth crosses the threshold this system produces a signal, thereby alerting public. When the earthquake take place the signal is produced and the accelerometer is stimulated and the signal is conveyed.

- These signals are generated as soon as possible. Owing to the quick signal there is a possibility of false signal. But in this stimulation project we bring into play 2 accelerometers.
- When microcontroller receives same signals from both of the accelerometers then it displays the graphs about the Earthquake information.
- When the data is monitored in the system it also shows the directions of accelerometer.
- In the proposed system whenever there is a Earthquake in the region where the device is kept, the Accelerometer sensor's sends the 3-axis parameters that is X, Y and Z to the cloud such that the person monitoring can know from anywhere in the world that the earth quake took place in particular region and can alert the Emergency services and the citizens present in that region to evacuate the region as soon as possible
- The Movable robot which carries the device earthquake simulation device is sent in to the earth surface to identify the earthquake before it hits the main surface.
- The 3-axis parameters is sent in to the cloud in which the X, Y and Z parameters are display in the form of charts such that if there is any deflection in the 3-axis parameters, the monitoring person can be noticed how much of magnitude of earthquake took place.

Architecture

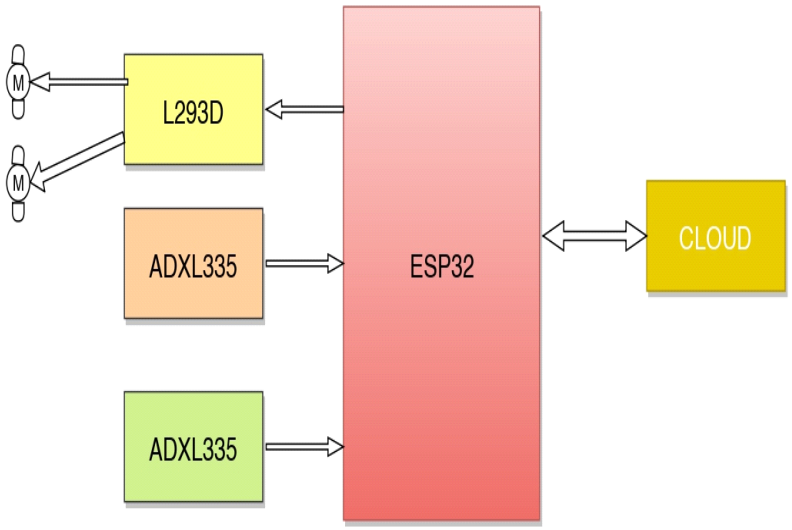

Figure1: Block diagram of the experimental setup of the proposed system

3. Hardware Description

3.1 ESP32

The block esp32 in the block diagram it is play the key role in the project. It is a microcontroller board used to connect the moters and sensors.The ESP32 is loaded with lots of new features. The most relevant: it combines WiFi and Bluetooth wireless capabilities and it's dual core. The power supply to the whole project is given through this block. The board is programmed with the source code in order to perform the operations of the project. The source code is stored in the on-chip memory available on the esp32. This block can be considered as an interface between the programmer and the user.

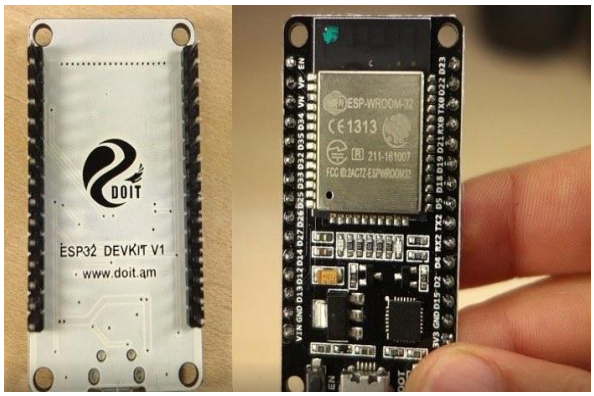

Figure 2: ESP32 DEVKIT V1 DOIT

L293D

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC. Dual H-bridge Motor Driver integrated circuit (IC). The l293d can drive small and quiet big motors as well

3.2 DC MOTORS:

An Electric DC motor is a machine which converts electric energy into mechanical energy. The working of DC motor is based on the principle that when a current-carrying conductor is placed in a magnetic field, it experiences a mechanical force. The most common types rely on the forces produced by magnetic fields. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings.

3.3 ADXL345

The ADXL345 is a small, thin, low power, 3-axis accelerometer with high resolution (13-bit) measurement at up to ±16*g*. Digital output data is formatted as 16-bit twos complement and is accessible through either a SPI (3- or 4-wire) or I^2C digital interface. The ADXL345 is well suited for mobile device applications. It measures the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion or shock. Its high resolution (4 m*g*/LSB) enables measurement of inclination changes less than 1.0°.

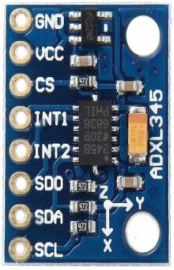

Figure 3: ADXL345 module

The ADXL345 is a small, thin, low power, 3-axis accelerometer with high resolution (13-bit) measurement at up to ±16*g*. Digital output data is formatted as 16-bit twos complement and is accessible through either a SPI (3- or 4-wire) or I^2C digital interface. The ADXL345 is supplied in a small, thin, 3 mm × 5 mm × 1 mm, 14-lead, plastic package. ADXL345-EP Supports defense and aerospace applications (AQEC).

Features and Benefits

- Ultralow power: as low as 23 μA in measurement mode and 0.1 μA in standby mode at V_S = 2.5 V (typical)
- Power consumption scales automatically with bandwidth
- User-selectable resolution
    - Fixed 10-bit resolution
    - Full resolution, where resolution increases with *g* range, up to 13-bit resolution at ±16 *g* (maintaining 4 mg/LSB scale factor in all *g* ranges)

The ADXL345 is a low-power, 3-axis MEMS accelerometer modules with both I2C and SPI interfaces. The Adafruit Breakout boards for these modules feature on-board 3.3v voltage regulation and level shifting which makes them simple to interface with 5v microcontrollers such as the Arduino. The ADXL345 features 4 sensitivity ranges from +/- 2G to +/- 16G. And it supports output data rates ranging from 10Hz to 3200Hz.

3.4 Cloudchip:

Cloudchip is an open-source IoT platform that enables rapid development, management and scaling of IoT projects. Our goal is to provide the out-of-the-box IoT cloud or on-premises solution that will enable server-side infrastructure for your IoT applications. Users can use their own transport implementations or customize the behavior of existing protocols.

Cloudchip is designed to be:

- scalable: horizontally scalable platform, build using leading open-source technologies.
- fault-tolerant: no single-point-of-failure, every node in the cluster is identical.
- robust and efficient: single server node can handle tens or even hundreds thousands of devices depending on use-case. ThingsBoard cluster can handle millions of devices.
- customizable: adding new functionality is easy with customizable widgets and rule engine nodes.
- durable: never lose your data

3.5 MQTT (MQ Telemetry Transport)

MQTT (MQ Telemetry Transport) is a lightweight messaging protocol that provides resource-constrained network clients with a simple way to distribute telemetry information. The protocol, which uses a publish/subscribe communication pattern, is used for machine-to-machine (M2M) communication and plays an important role in the internet of things (IoT).

The MQTT protocol is a good choice for wireless networks that experience varying levels of latency due to occasional bandwidth constraints or unreliable connections. Should the connection from a subscribing client to a broker get broken, the broker will buffer messages and push them out to the subscriber when it is back online. Should the connection from the publishing client to the broker be disconnected without notice, the broker can close the connection and send subscribers a cached message with instructions from the publisher.

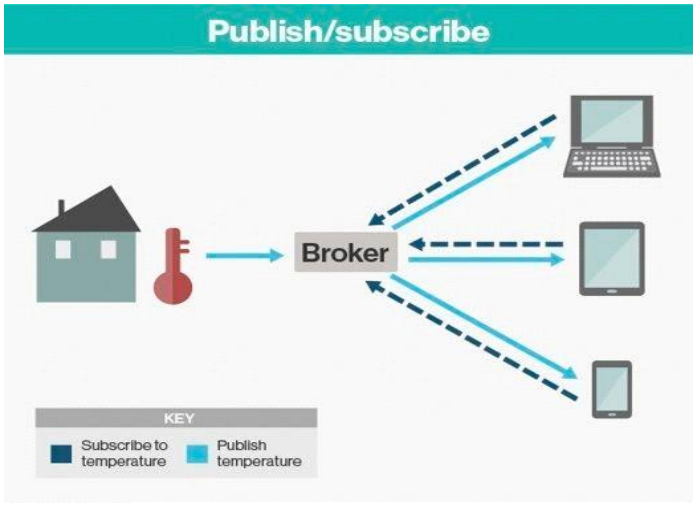

Figure 4: MQTT's publish/subscribe model

4. Result analysis

In fig. 5(a) and fig.5(b) schematic diagram, circuit connections are made and the whole setup of the robot is to be resistant of all weather conditions. Now the whole setup is mounted in respected area to track various kinds of pollutions. The accelerometer sensor's records the values of eath waves and send the information to esp 32. If there is a raise of the values of eath waves sensor detects these values respectively and gives it to esp32.

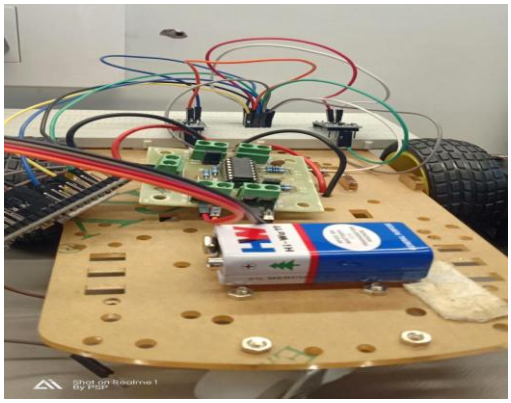

Figure 5(a). Schematic diagram for earthquake detection

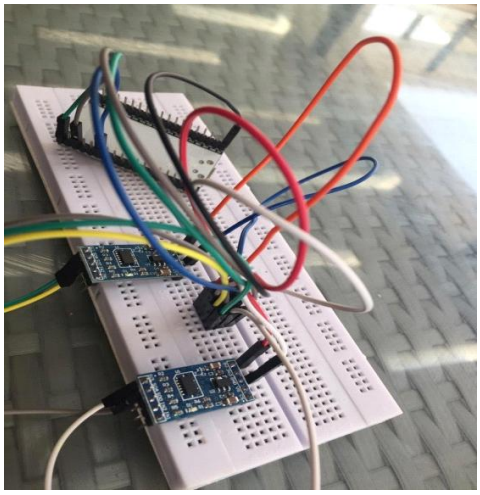

Figure 5(b). Hardware components are connected to ESP 32

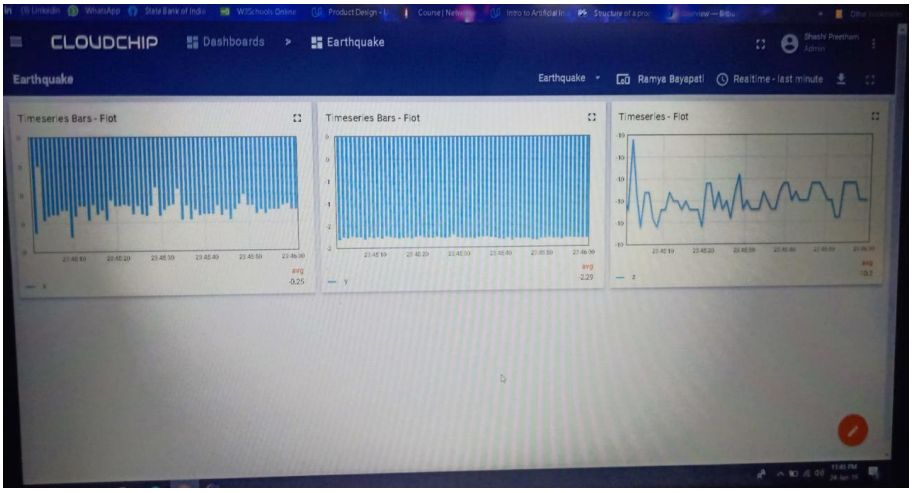

Fig 6.Cloudchip showing simulation results

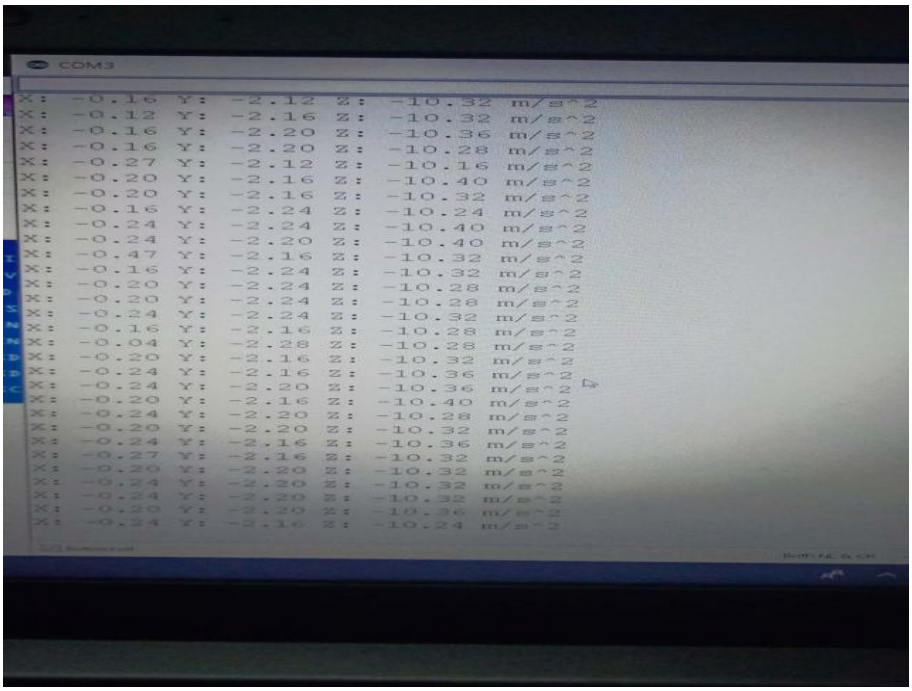

Figure 7.cloud channel showing accelerometer 3-axis parameters results

Conclusion:

Designed a robot which goes in to the earth surface and detect the earthquake before it hits the core surface. Accelerometer sensor's sends the 3-axis parameters that is X, Y and Z to the cloud such that the person monitoring can know from anywhere in the world that the earth quake took place in particular region and can alert the Emergency services and the citizens present in that region to evacuate the region as soon as possible. The location of the device can be viewed from the cloud and can be traced where the earthquake is going to occurring and can be informed to the people living over there to evacuate from the that area as soon as possible.

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