Proposal for Google Summer of Code 2017

BeagleBone Remote Seismometer Node

Goal: Working prototype remote seismometer, web-based control and display. Determine DAC bandwidth and accelerometer requirements, implement data acquisition code, integrate with control / display interface. Stretch goal: integrate device with BOINC/QCN.

About me

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- **Primary language**: English, Hindi, Marathi, Gujarati.
- **Typical work hours**: 3PM-1AM Indian Standard Time.
- **Previous GSoC participation**: No Previous Participation.
- **Reason for participation**: The reason why I am interested to participate is that, I have been using the open-source platforms for quite some time now. I want to give back to the community so that it can continue its good work. Also, I have been working on *embedded design* and have *good design experience* for many critical applications as mentioned in my resume. Also I have worked on Beagle Bone Platform and hence I find myself very well suited to contribute to this work, especially in this project.

About the project

Project name: BeagleBone Remote Seismometer Node

Description

The earthquakes are very devastating natural disasters. So, there is a need to have a system which can sense the earthquakes or the minor shocks, which may be a potential earthquake. If such a crucial information about such shocks are updated online, then there can be many similar systems that can be connected to the same online system. So in a scenario where

such devices deployed in various parts of the world are connected on the same Data Acquisition System, it becomes a good tool to predict these earthquakes before hand in many situations. Quake Catcher Network (QCN) is one such initiative to provide such a platform for online monitoring.

From the built systems, the data recorded by the system is then sent to the servers using BOINC client software. This project aims to build such an interconnected network using Beaglebone as the main controller hardware, looking at its open source community.

System consists of Beaglebone as a Remote Seismometer node and the centralized server update data from various such nodes.

The Remote Seismometer acquires the data from the accelerometer, and based on the data available to the node, a processing algorithm will run in the background that will detect if the detected signal is actually an earthquake. Also the Beaglebone logs the data to the central web data acquisition system.

The programming platform will be either on C/C++ or Python. The server system will provide a graphical interface to see the acquired data in the form of plots. Beaglebone will be interfaced with the accelerometer, using I2C or SPI protocols.

Timeline for implementation

Major milestones in the completion of the project will go as follows:

Before first milestone met, I will be working upon the understanding of Seismometer and possible project deliverables in most efficient way possible and strengthen up my bonding with the beagleboard community.

Date	Milestone
2017-06-06:	• Determine DAC bandwidth and accelerometer as per specification, • Get acquainted to BOINC/QCN
2017-06-13:	• Develop code for configuring beaglebone as data acquisition system with required interfacing
2017-06-20:	• Develop data processing algorithm along with UI for localized monitoring

2017-06-27:	• Implement the earthquake detection system. • Testing the system without web interface to check the accuracy and reliability of the system.
2017-07-04:	• Develop code for connecting beaglebone to the server for instant data upload
2017-07-11:	• Program the server back-end
2017-07-18:	• Develop the UI for web application
2017-07-25:	• Integrate the system and bug fixing
2017-08-01:	• Testing the developed prototype • Attempt to integrate it with BOINC/QCN
2017-08-08:	• Emergency buffer time for testing and debugging
2017-08-15:	• Documentation

Experience

This project requires a good mix of hardware knowledge and coding skills to turn it into a reality. As this project is largely embedded based system, I could be one of the good matches for doing this project given my previous experience in system design and embedded system design involving time critical applications. To prove my worthiness to pursue this project I have enlisted some major projects done by me in the past.

- Worked on ARM Cortex A9 based (iMX6Q) Freescale processor and developed
  applications for the same.
- Worked on a customized Circuit Board for Signal Processing Applications of the Ground Penetrating Radar (GPR). The Features of the board include
  - Freescale Processor iMX6 with operating frequency of 1 GHz
  - FPGA Virtex 7

- Worked on implementation of Quadrature Encoder Interface (QEI) on an ARM cortex-M3 (LPC1788) processor for speed monitoring and control of an Induction Motor.

A comprehensive information about projects described above are mentioned in my resume. Apart from this I have worked along side the system administrator in my institute which will help me cover the grounds for web and database management system. Looking at such relevant experience I feel I could serve the community in much better way possible through this project.

Approach

In the first place my approach would be as follows:

1. Looking the sensitivity of the accelerometer to be used.
2. Interfacing accelerometer with beaglebone depending on protocol. (I2C or SPI)
3. Interfacing LCD for offline monitoring of acquired data.
4. Developing algorithm to detect potential earthquake and generate an alarm for the same
5. Establishing communication beaglebone and local terminal like laptop using LAN.
6. Exporting data generated to the server.
7. Update data on QCN as per scheduled time.

Contingency

As per my past experience whenever I stuck somewhere, I was able to resolve it by putting extra efforts in it. Therefore I have kept an extra week for such situation when I could not find Mentor around.

Benefit

Earth quakes are the most devastating natural disaster. Due to this initiative the development of this system will lead to the deployment of many such modules all across the globe. This will give an idea of the probable earthquakes in almost real time. **As the platform is completely open source, this system has a potential to serve as a real time global earth quake monitoring system which is effectively powered by beagleboard.**