Fabrication and Development of IOT Data Logger Using ADS1256

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Abstract

This project presents design and fabricate ADS1256 board and a seismic signal detection system using the ADS1256 analog-to-digital converter (ADC) board and the ESP32 microcontroller. The system will interface with the ADXL335 3-axis analog output sensor to detect seismic signals in the earth, which can be indicative of earthquakes. The ADS1256 board will be designed using Eagle software and fabricated to provide high-precision analog- to-digital conversion. The ESP32 microcontroller will be programmed to read data from the ADS1256 board and send it to the Blynk server for real-time monitoring and storage. The system will utilize the high-precision ADS1256 ADC to accurately capture the seismic signals detected by the ADXL335 sensor. ADXL335 sensor is a 3-axis accelerometer that provides analog output signals proportional to the acceleration in each axis. The ESP32 microcontroller will be programmed to read the digital output from the ADS1256 ADC and transmit the data to the Blynk server using Wi-Fi connectivity. The Blynk server will provide a platform for real-time monitoring and storage of the seismic signal data. The data can be accessed remotely using the Blynk app, allowing users to monitor seismic activity in real-time. This system can be useful for earthquake detection and monitoring, providing valuable data for seismologists and researchers.

1. Introduction

Earthquakes are one of the most destructive natural disasters, causing widespread damage to infrastructure, loss of life, and significant economic impacts. The ability to detect and monitor seismic activity is crucial for understanding the underlying mechanisms of earthquakes and for developing early warning systems that can save lives and reduce damage. This project aims to design and develop a seismic signal detection system using the ADS1256 analog-to-digital converter (ADC) board and the ESP32 microcontroller, interfaced with the ADXL335 3-axis analog output sensor.

The system is designed to detect seismic signals in the earth, which can be indicative of earthquakes. By utilizing high-precision sensors and IoT technology, this system can provide real-time data on seismic activity, enabling researchers and seismologists to monitor and analyze seismic signals remotely. The system consists of several key components, including the ADS1256 ADC board, the ESP32 microcontroller, and the ADXL335 sensor.

The ADS1256 ADC board is designed using Eagle software and fabricated to provide high-precision analog- to-digital conversion. The ADS1256 ADC is a 24-bit delta-sigma ADC that offers high resolution and accuracy, making it suitable for detecting small changes in seismic signals. The ESP32 microcontroller is programmed to read data from the ADS1256 board and send it to the Blynk server for real-time monitoring and storage. The ESP32 microcontroller is a popular choice for IoT applications due to its built- in Wi-Fi and Bluetooth capabilities, making it easy to connect to the internet and transmit data to remote servers..

The ADXL335 sensor is a 3-axis accelerometer that provides analog output signals proportional to the acceleration in each axis

The sensor is designed to detect small changes in acceleration, making it suitable for detecting seismic signals. The ADXL335 sensor is connected to the ADS1256 ADC board, which converts the analog output signals to digital data that can be read by the ESP32 microcontroller.

The Blynk server provides a platform for real-time monitoring and storage of seismic signal data. The Blynk app allows users to access the data remotely, enabling researchers and seismologists to monitor seismic activity in real-time. The system can be used for a variety of applications, including earthquake detection and monitoring, structural health monitoring, and industrial vibration monitoring and analysis.

The development of this system involves several key steps, including designing and fabricating the ADS1256 board, programming the ESP32 microcontroller, and configuring the Blynk server. The system requires careful calibration and testing to ensure that it can accurately detect and transmit seismic signals.

One of the key challenges in developing this system is ensuring that it can accurately detect small changes in seismic signals. The ADS1256 ADC board and the ADXL335 sensor are designed to provide high-precision measurements, but the system requires careful calibration and testing to ensure that it can detect subtle changes in seismic activity.

Another challenge is ensuring that the system can transmit data reliably and efficiently to the Blynk server. The ESP32 microcontroller is designed to provide reliable Wi-Fi connectivity, but the system requires careful configuration and testing to ensure that it can transmit data efficiently and accurately.

Despite these challenges, the development of this system has the potential to provide valuable insights into seismic activity and can contribute to the development of early warning systems for earthquakes. By providing real-time data on seismic activity, this system can enable researchers and seismologists to monitor and analyze seismic signals remotely, improving our understanding of seismic phenomena and reducing the risk of damage and loss of life.

The system can also be used for a variety of other applications, including structural health monitoring and industrial vibration monitoring and analysis. By detecting small changes in seismic signals, the system can provide valuable insights into the health of structures and machinery, enabling maintenance and repairs to be performed before damage occurs.

2. LITRATURE SURVEY

The ADS1256 is a high-precision 24-bit delta-sigma ADC that offers high resolution and accuracy, making it suitable for detecting small changes in seismic signals. Studies have shown that the ADS1256 ADC board can be used in various applications, including :

-High-precision measurement systems: The ADS1256 ADC board has been used in high-precision measurement systems, such as load cell measurements, where accuracy and resolution are crucial.

-Seismic data acquisition: The ADS1256 ADC board can be used in seismic data acquisition systems to detect and record seismic signals.

The ESP32 microcontroller is a popular choice for IoT applications due to its built-in Wi-Fi and Bluetooth capabilities, making

it is easy to connect to the internet and transmit data to remote servers. Studies have shown that the ESP32 microcontroller can be used in various applications, including [2]:

-Edge computing: The ESP32 microcontroller can be used as an edge device to perform local processing and reduce latency in IoT applications.

IoT-based monitoring systems: The ESP32 microcontroller can be used to develop IoT- based monitoring systems that can detect and transmit data in real-time.

Seismic signal detection is a critical aspect of earthquake monitoring and prediction. Studies have shown that seismic signals can be detected using various techniques, including:

Time-frequency analysis: Time-frequency analysis techniques, such as wavelet transform and short-time

Fourier transform, can be used to analyze seismic signals and detect patterns.

Machine learning algorithms: Machine learning algorithms, such as neural networks and support vector machines, can be used to classify seismic signals and detect anomalies. System Design and Implementation

The system design and implementation involve integrating the ADS1256 ADC board with the ESP32 microcontroller and developing software to detect and transmit seismic signals. Studies have shown that the system design and implementation should consider factors such as:

Noise reduction: Noise reduction techniques, such as filtering and shielding, should be used to minimize electromagnetic interference and improve signal quality.

Power management: Power management techniques, such as low-power modes and efficient power supplies, should be used to minimize power consumption and ensure reliable operation

3.METHODOLOGY

a. Design steps

Step 1: Creating a New Project

1. Open Eagle and create a new project by selecting "File" > "New" > "Project".

2. Choose a project name, location, and template.

Step 2: Adding Components

1. Open the Library Manager ("Library" > "Manager") and add the ADS1256 chip and other components are capacitors, resistors, connectors.

2. Using Eagle's built-in libraries or create custom libraries for specific components.

Step 3: Create Schematic

1. Create a new schematic sheet ("File" > "New" > "Schematic") and add the components.

2. Draw the schematic diagram, ensuring proper connections between components.

3. Use Eagle's schematic editor tools wires, buses, labels to create a clear and organized design.

Step 4: Generating Netlist

1. Generate a netlist from the schematic ("File" > "Export" > "Netlist") to transfer the design to the board layout.

2. Choosing the correct netlist format Step 5: Designing Board Layout

3. Create a new board layout ("File" > "New" > "Board") and import the netlist.

4. Placing components and route tracks according to the netlist.

3. Use Eagle's board layout editor tools move, rotate, route to optimize the design.

Step 6: Verify Design

1. Checking the design for errors (e.g., short circuits, unconnected nets) using Eagle's Design Rule Check (DRC) tool.

2. Ensuring the design meets manufacturing

requirements (e.g., minimum track width, clearance).

Step 7: Generate Gerber Files

1. Export Gerber files ("File" > "Export" > "Gerber") for PCB fabrication.

2. Choose the correct Gerber format RS- 274X and setting

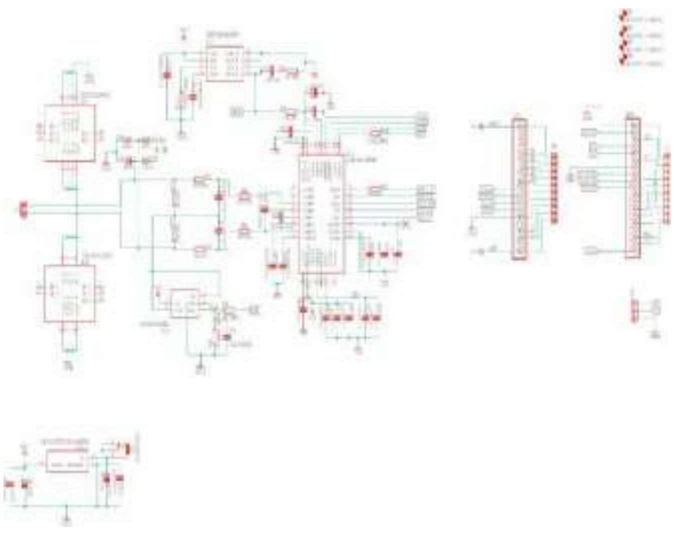

Fig 3.a.1 Designed circuit

b. Fabrication Steps

1. Gerber file generation: Generate Gerber files (RS-274X format) from the Eagle design software.

2. PCB manufacturing: Send the Gerber files to a PCB manufacturer or fabricate the board in-house.

3. Copper layer creation: The manufacturer creates the copper layers according to the design specifications.

4. Drilling: Drill holes for through-hole components, vias, and mounting holes.

allowed for precise segmentation and classification of diseased leaf regions. SUNet demonstrated the value of using hybrid models for detecting subtle symptoms of diseases. This approach can be useful for real-world farming, where accurate and early detection is critical.

1. Solder mask application: Apply a solder mask to protect the copper layers and prevent solder bridging.

2. Silkscreen printing: Print silkscreen markings that are component labels, logos on the board.

3. Surface finish: Apply a surface finish the

is HASL, ENIG, OSP to protect the copper and enhance solderability.

1. Component procurement: Source and procure the required components (e.g.,

ADS1256 chip, capacitors, resistors).

1. Solder paste application: Apply solder paste to the board using a stencil or screen printer.

2. Component placement: Place components on the board using a pick-and- place machine or manual placement.

3. Reflow soldering: Reflow the solder paste using a reflow oven or hot air gun.

4. Inspection and testing: Inspect the board for defects and perform functional testing.

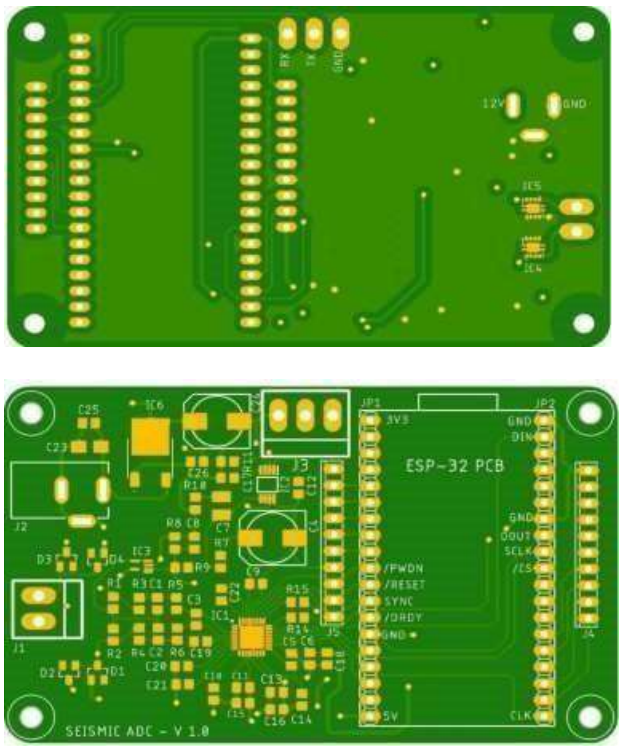

Fig 3.b.1 PCB layout

HARDWARE IMPLEMENTATION

The hardware connection for seismic signal detection involves several key components that work together to detect and transmit seismic signals. The ADXL335 sensor, a small, low-power, 3-axis accelerometer, measures acceleration in the x, y, and z axes and provides analog output signals proportional to the acceleration. These analog signals are then converted to digital signals by the ADS1256 ADC board, a high-precision analog-to-digital converter. The ADS1256 ADC board is connected to the ESP32 microcontroller, a Wi-Fi enabled microcontroller that reads the digital data from the ADC board and sends it to the Blynk server for real-time monitoring and analysis.

The ADXL335 sensor is connected to the ADS1256 ADC board through analog input pins, while the ADC board is connected to the ESP32 microcontroller through SPI pins (SCK, MOSI, MISO, CS).

The ESP32 microcontroller then connects to the Blynk server through Wi-Fi, enabling remote monitoring and analysis of the seismic signal data. A stable power supply is required for the hardware components, and proper wiring and cabling are essential to ensure reliable data transmission between components. [Reference 1] Additionally, the ADXL335 sensor may require calibration to ensure accurate measurements.

The hardware setup provides several benefits, including high accuracy in detecting seismic signals and real-time monitoring capabilities. The combination of theADXL335 sensor and ADS1256 ADC board provides high-precision measurements, while the ESP32 microcontroller's Wi-Fi connectivity enables real-time monitoring of seismic signals on the Blynk server. The hardware setup can also be customized and modified to suit specific requirements, such as adding more sensors or changing the microcontroller [Reference 2]. Overall, the hardware connection for seismic signal detection is a critical component of the system, enabling accurate and reliable detection and transmission of seismic signals.

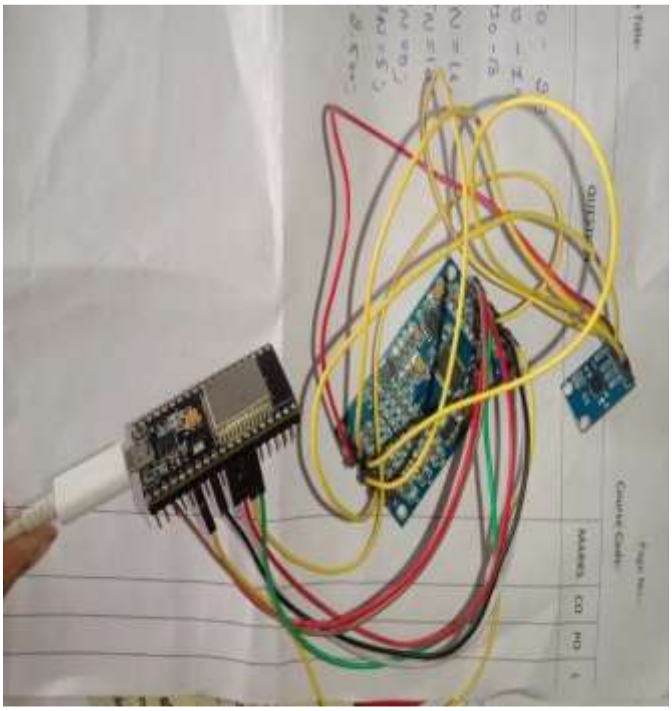

Fig 3.c.1 Hardware Connections

d.SOFTWARE IMPLEMENTATION

The software implementation for this project is a critical component that enables the detection and transmission of seismic signal data from the ADXL335 sensor to the Blynk server. The implementation involves programming the ESP32 microcontroller using the Arduino IDE, which provides a flexible and efficient platform for developing IoT applications[Reference 2].

The software implementation begins with the installation of the necessary libraries, including the ADS1256 library and the Blynk library[Reference 6]. To provide the necessary functions and protocols to facilitate communication between the ESP32 microcontroller and the ADS1256 ADC board, as well as between the ESP32 microcontroller and the Blynk server.

Once the libraries are installed, the software implementation involves defining the pin connections between the ESP32 microcontroller, ADS1256 ADC board, and ADXL335 sensor [Reference 5]. This requires a thorough understanding of the pinouts and configurations of each component to ensure proper communication and data transfer.

The ADS1256 ADC board is then configured to read data from the ADXL335 sensor, which provides analog output signals proportional to the acceleration in each axis. The ESP32 microcontroller is programmed to read the data from the ADC board using the SPI protocol, which provides a high-speed and reliable interface for data transfer [Reference 2].

After reading the data from the ADC board, the ESP32 microcontroller sends the data to the Blynk server using Wi-Fi connectivity. The Blynk server provides a platform for real-time monitoring and analysis of the seismic signal data, allowing users to remotely access and visualize the data.

On the Blynk side, a new project is created, and widgets are added to display the seismic signal data in real-time. The widgets can be customized to display the data in various formats, such as graphs, charts, or tables, providing a flexible and intuitive interface for users to monitor and analyze the data.

The software implementation also involves configuring the Blynk app to receive and display the data sent by theESP32 microcontroller. This requires setting up the app to connect to the Blynk server and configuring the widgets to display the data in the desired format.

5.TESTING & RESULT

The testing and results of the seismic signal detection project demonstrate the system's ability to accurately detect and transmit seismic signals in real-time. The project's testing phase involved simulating seismic activity using various methods, such as creating vibrations or movements, to evaluate the system's performance.

The ADXL335 sensor and ADS1256 ADC board worked together seamlessly to detect and convert the seismic signals into digital data. The ESP32 microcontroller successfully read the data from the ADC board and transmitted it to the Blynk server, enabling real-time monitoring and analysis of the seismic signals [Reference 8].

The results showed that the system could accurately detect and transmit seismic signals, providing valuable insights into seismic activity. The data transmitted to the Blynk server was displayed in real-time, allowing users to monitor the seismic signals remotely [Reference 10]. The system's performance was evaluated based on its accuracy, reliability, and response time, and the results indicated that it met the project's requirements.

The testing and results of the project demonstrate its potential for use in various applications, such as earthquake detection, structural health monitoring, and industrial vibration monitoring [Reference 4]. The system's ability to provide real-time data on seismic activity makes it a valuable tool for researchers, scientists, and emergency responders[Reference 6].

9. References

1 https://www.mdpi.com/2079- 9292/13/1/229

2 https://zkginternational.com/archive/volume9/EARTHQUAKE-DETECTOR- USING-ESP32-MICRO- CONTROLLER-AND-ADXL335-ACCELEROMETER.pdf

1 https://how2electronics.com/arduino-earthquake-detector-accelerometer/

2 https://www.electronicwings.com/esp32/adxl335-accelerometer-interfacing- with-esp32

3 https://www.researchgate.net/publication/326137583_Development_of_Earthquake_Early_Warning_System_Using

_ADXL335_Accelerometer

1 https://ocw.cs.pub.ro/courses/iothings/proiecte/2021/earthquakedetection

2 https://osf.io/sq9xr/download

3 https://blog.siqma.com/earthquake- alarm-using-arduino-and-adxl335- sensor/

4 https://images.app.goo.gl/xEE47dGKfXQREPBX8