Development of Digital Pulse Emulator

Group Members

Muskaan Gupta

Simran Koul

Ayush Suri

Vishal Kothari

Acknowledgement

Internal Guide : Mr. Gopal Sonune Sir

External Guide : Mr. Jaydeep Gore Sir

AGENDA

- Problem Definition
- Scope
- Software/Hardware Requirements
- Literature Survey
- Proposed System
- Design of Proposed system(Use case Diagram)
- Implementation
- What we will do next ?
- References

Problem Definition

Reality :

“Information is the oil of the 21st century, and analytics is the combustion engine.”

Problem:

Testing is challenging for large scale data acquisition system

SCOPE

- Development of digital pulse emulator
- Data that needs to be analyzed and probed will be considered
- Involves developing routines in C
- Input: Probability and amplitude spectrum
- Output: Generation of pulses

SOFTWARE REQUIREMENTS

- Xilinx Vivado
- Gcc compiler

HARDWARE REQUIREMENTS

- Zynq development board with FMC connectors
- High speed data acquisition
- FMC card with on board two analog inputs and outputs
- Power supply adapter

Literature Survey

- **Configurable Digital Emulation of Radiation Sources**
  [Abbiati, Sebastiano Scarpaci, Angelo Geraci, Giancarlo Ripamonti 2009 IEEE Nuclear Science]

- *Output of the FPGA device enters an analog front-end that plays the role of a classic preamplifier.*

- *In this way, the system actually can emulate the cascade of source, detector and preamplifier section.*

Literature Survey

- *Occurrence time values that occur according to an assigned statistic distribution.*

- **Multichannel Digital Emulator of Radiation Detection Systems**

  [J.Millman, A.Grabel, Microelectronics", McGraw-Hill, 198]
- *The performances of the instrument mainly depend on a good pseudorandom generation process.*

Literature Survey

- In order to test the realized LFSR statistic generator, different realizations of streams of pseudorandom values have been extracted from the FPGA.

- In order to verify uniformity and independence of the generated values, chi-square tests have been performed.

Literature Survey

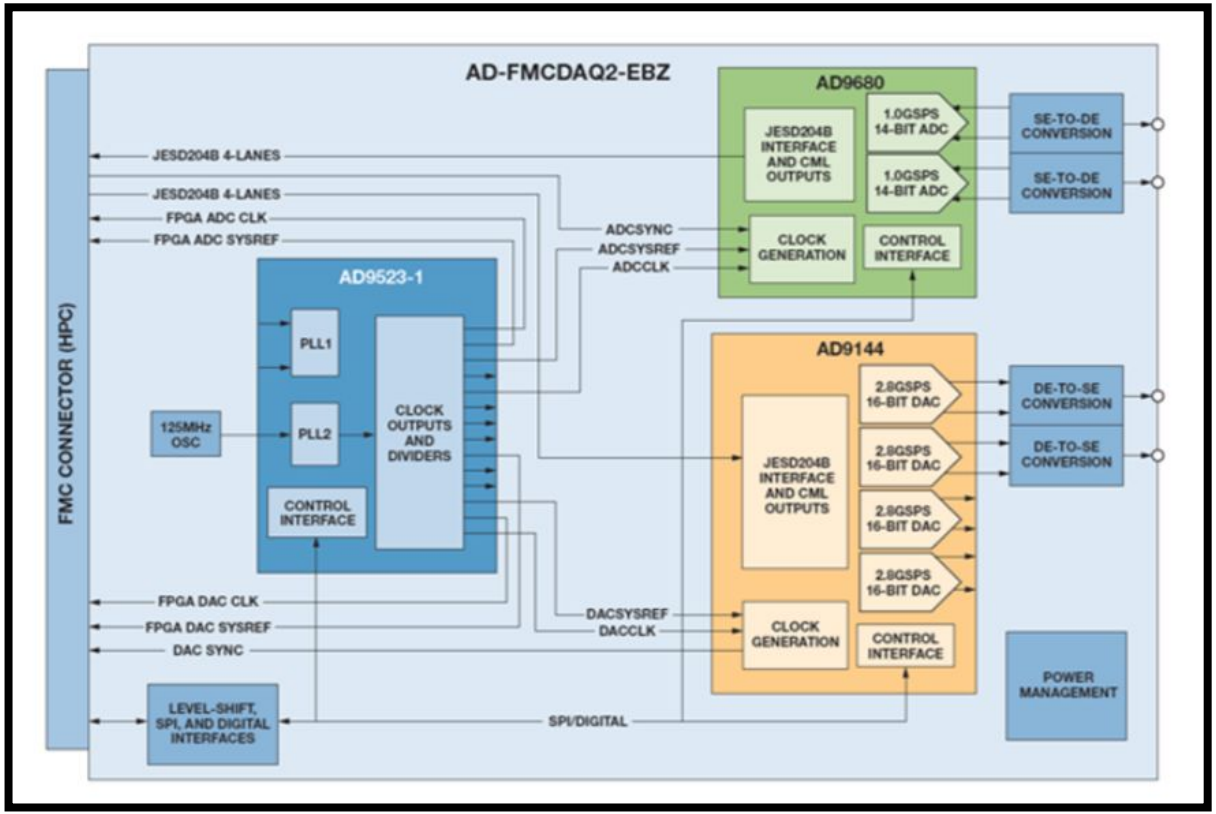
- FPGA-based random pulse generator for emulation of a neutron detector system in a nuclear reactor.

  [Abbiati, Sebastiano Scarpaci, Angelo Geraci, Giancarlo Ripamonti 2009 IEEE Nuclear Science]

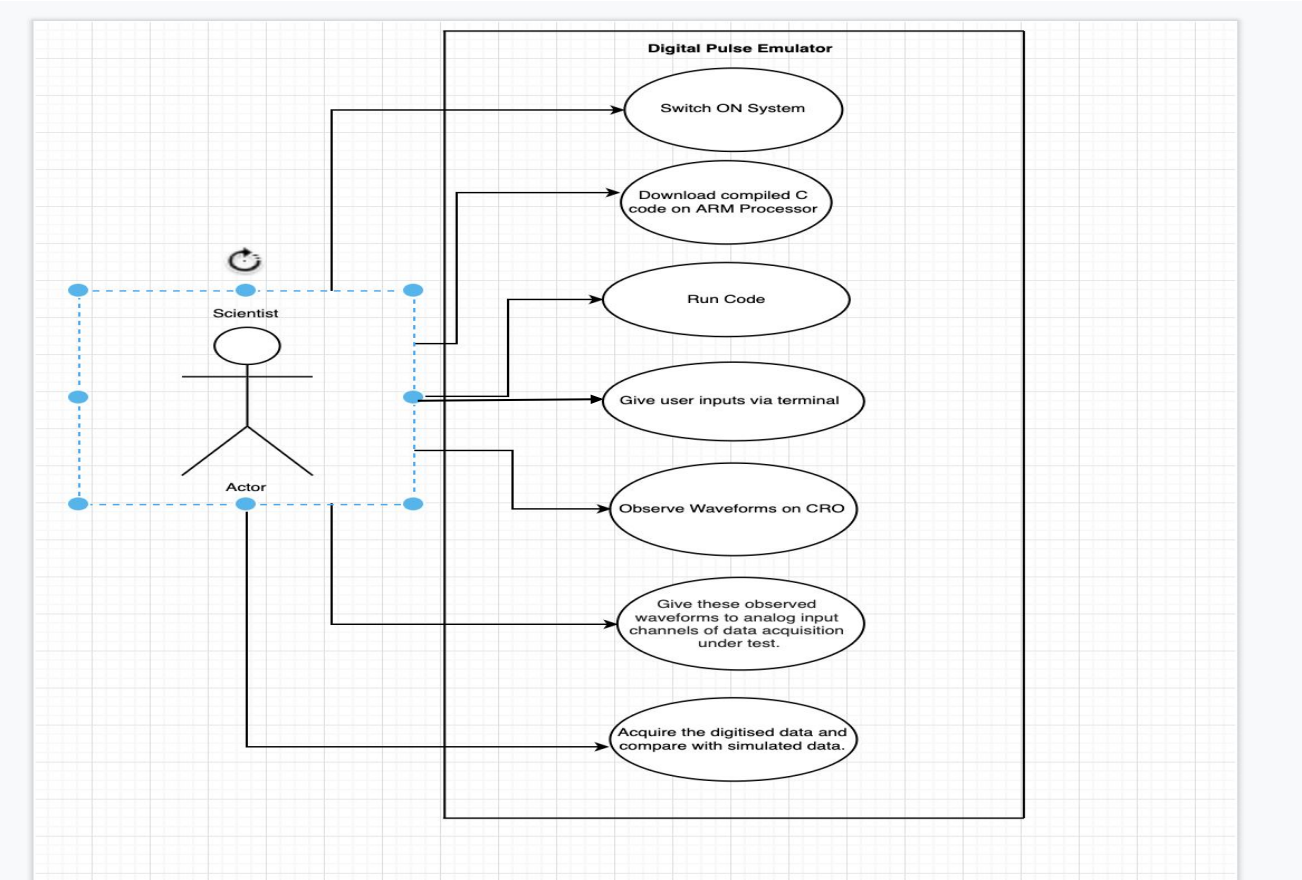
- A Fast, Programmable, Stand-Alone Pulse Generator Emulating Spectroscopy Nuclear Events

  [J.Millman, A.Grabel, Microelectronics", McGraw-Hill, 198]

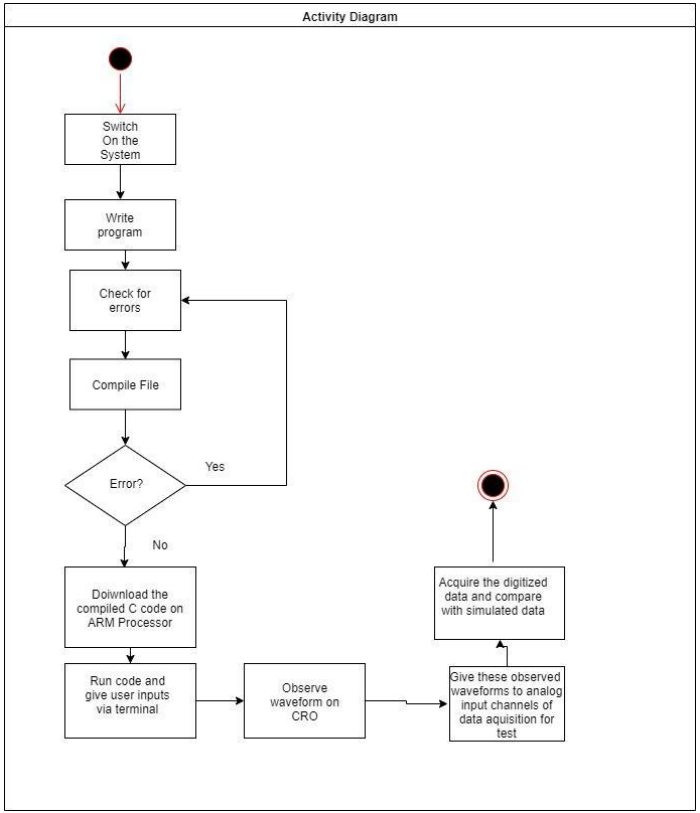
Proposed System



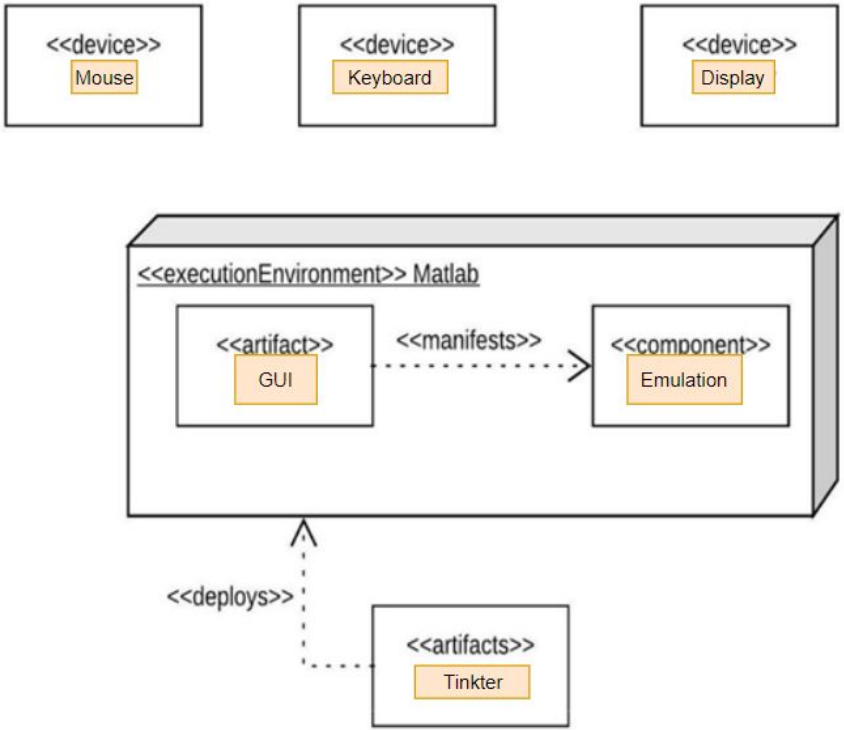
Design of Proposed System



Activity Diagram



Deployment Diagram



Implementation

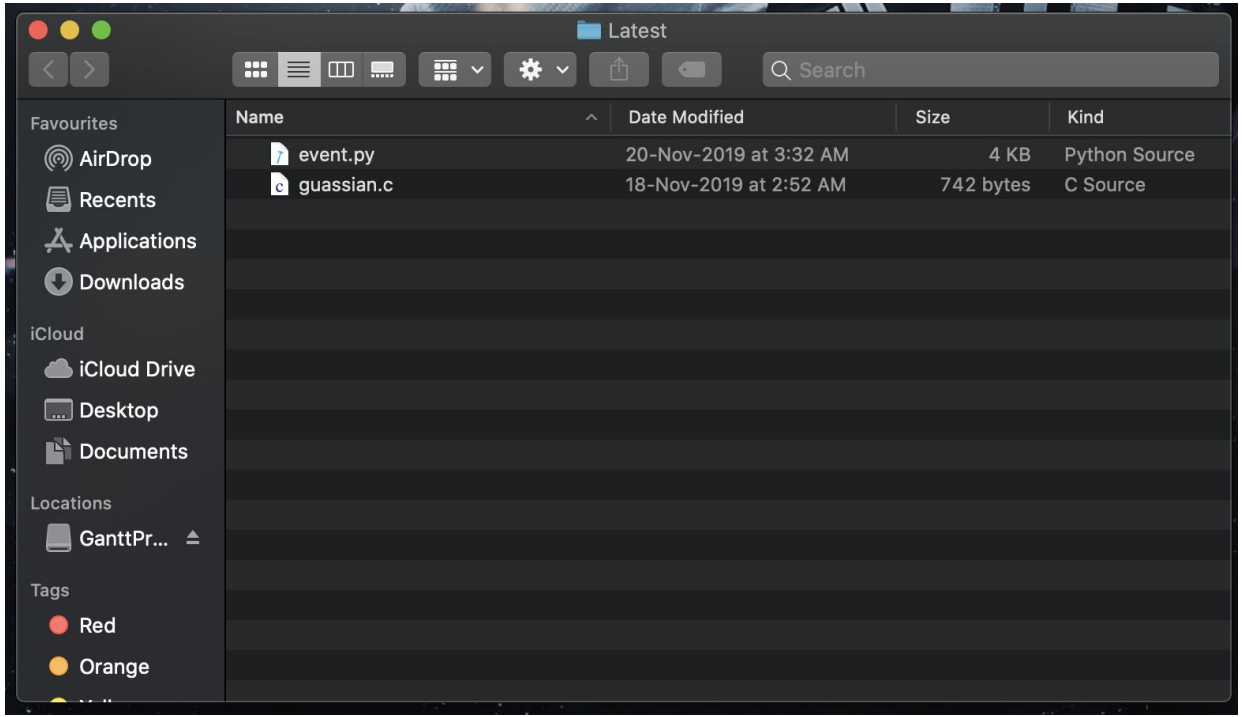
Drive Link

- https://drive.google.com/drive/folders/1hHNOQVkdC4wC8A_7jJK6jPLPAvFuIax1?usp=sharing

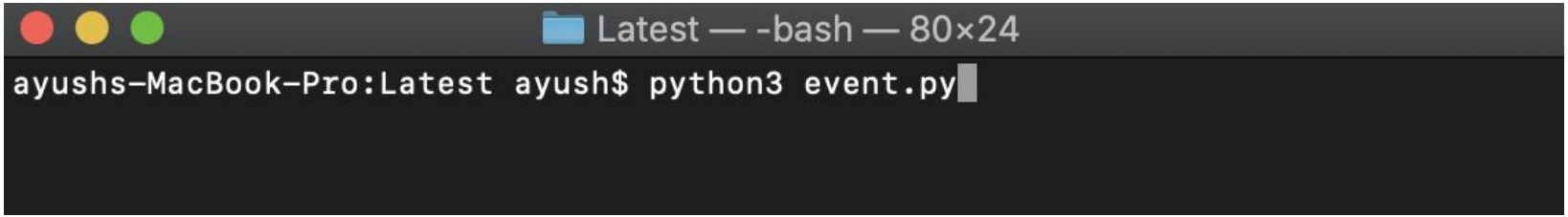
Tools used

- GCC Compiler, Python3, Tkinter GUI Tool and Matplotlib

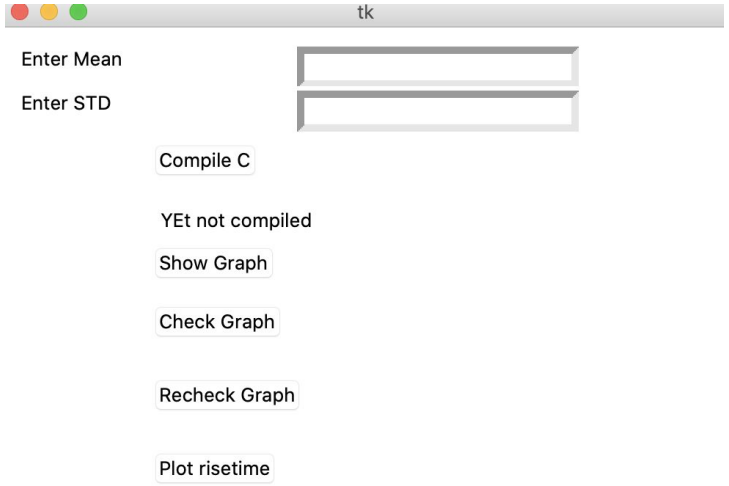
Output


Latest
Search
Favourites
AirDrop
Recents
Applications
Downloads
iCloud
iCloud Drive
Desktop
Documents
Locations
GanttPr...
Tags
Red
Orange
Name
Date Modified
Size
Kind
event.py
20-Nov-2019 at 3:32 AM
4 KB
Python Source
guassian.c
18-Nov-2019 at 2:52 AM
742 bytes
C Source

Output


Latest — -bash — 80×24
ayushs-MacBook-Pro:Latest ayush$ python3 event.py

Output


tk
Enter Mean
Enter STD
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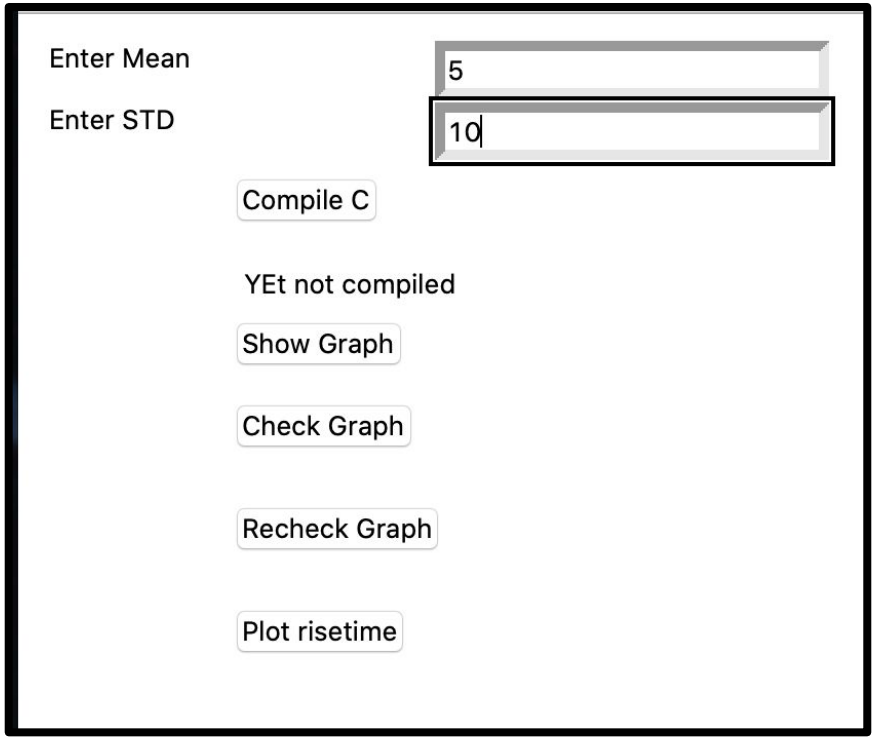
Show Graph
Check Graph
Recheck Graph
Plot risetime

Output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10
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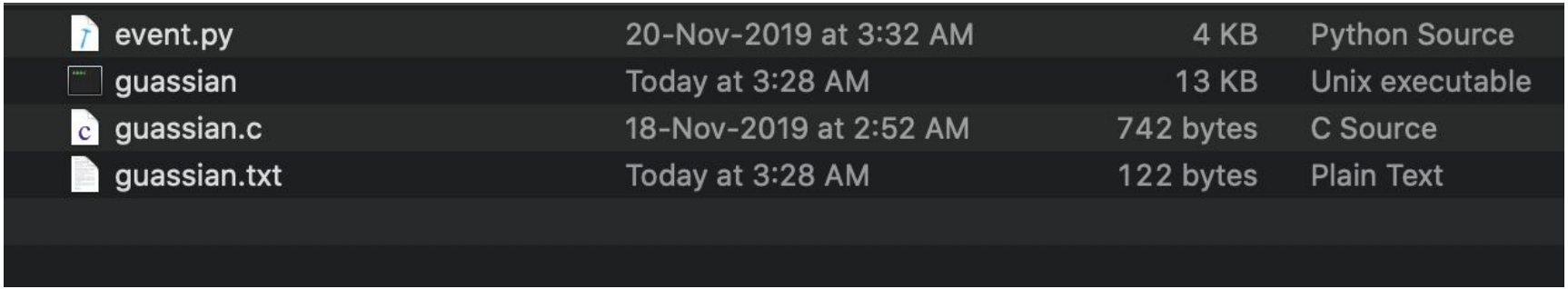
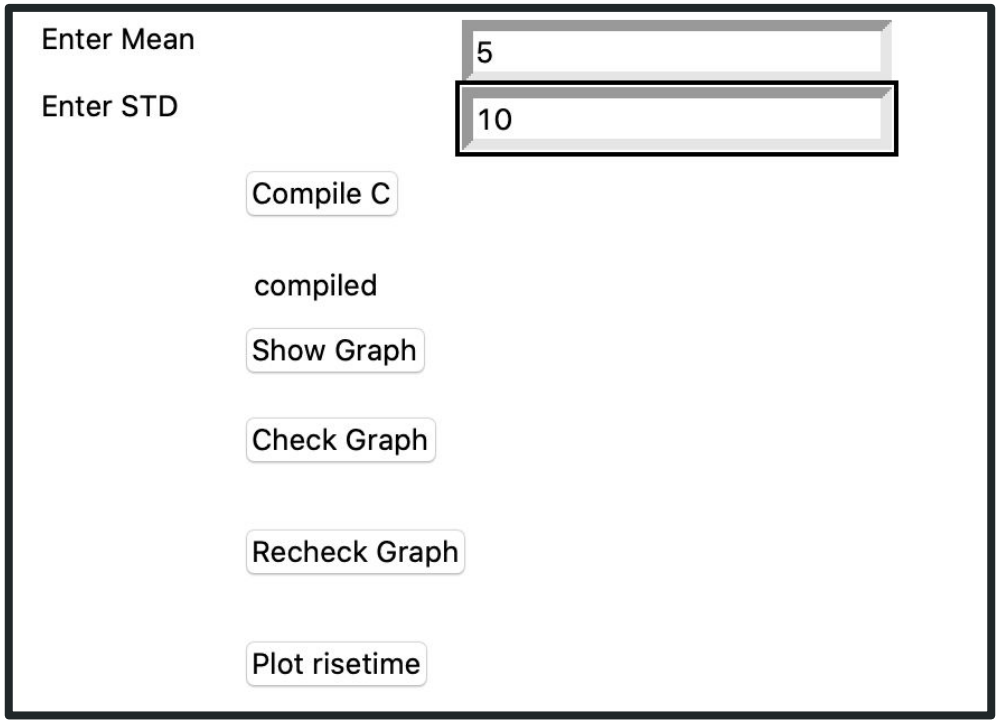
Show Graph
Check Graph
Recheck Graph
Plot risetime

Output



event.py	20-Nov-2019 at 3:32 AM	4 KB	Python Source
guassian	Today at 3:28 AM	13 KB	Unix executable
guassian.c	18-Nov-2019 at 2:52 AM	742 bytes	C Source
guassian.txt	Today at 3:28 AM	122 bytes	Plain Text

Output


Enter Mean
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Compile C
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Show Graph
Check Graph
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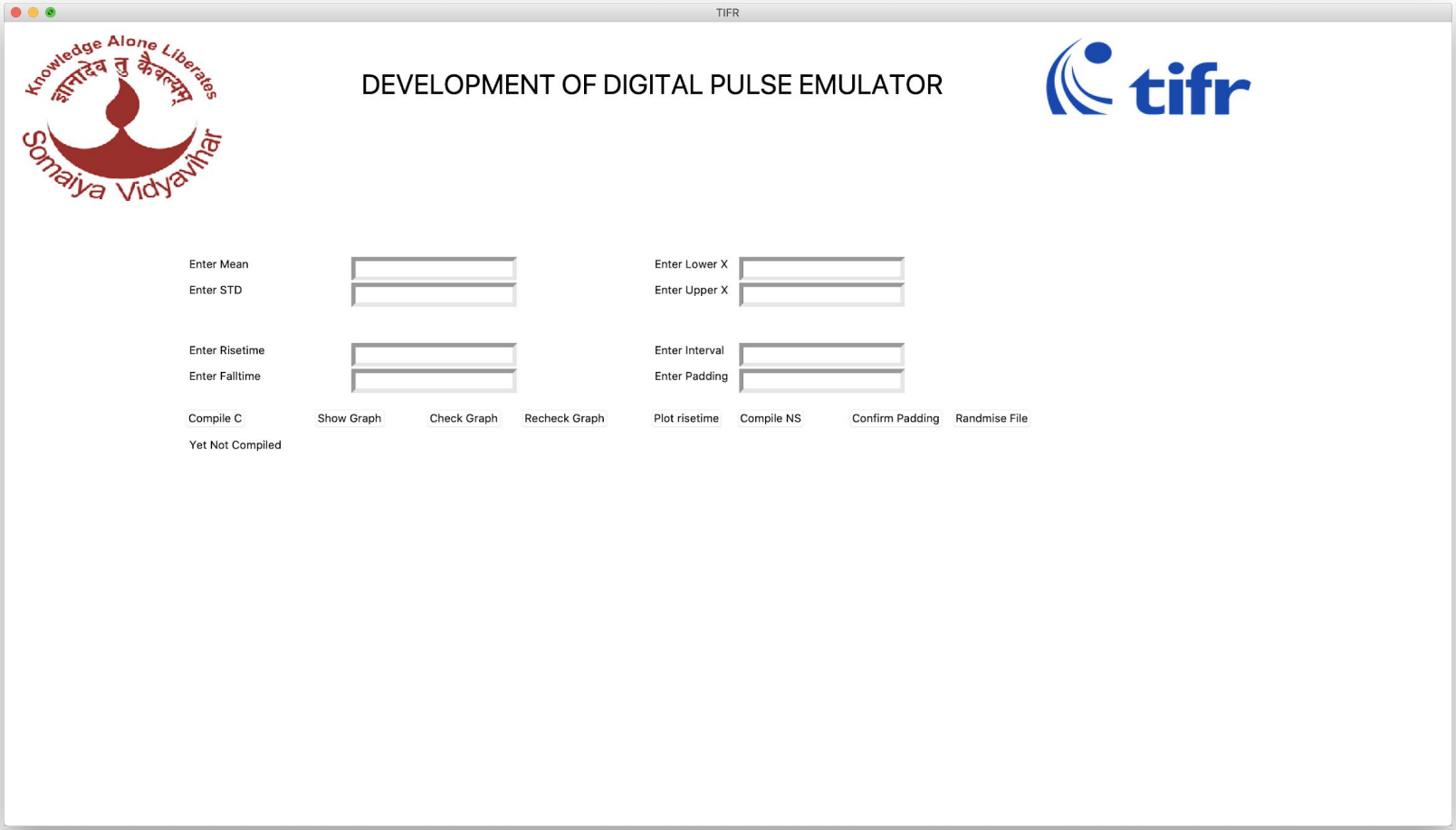
Plot risetime


TIFR
Knowledge Alone Liberates
ज्ञानादेव तु कैवल्यम्
Somaiya Vidyavihar
DEVELOPMENT OF DIGITAL PULSE EMULATOR
tifr
Enter Mean
Enter STD
Enter Lower X
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Enter Falltime
Enter Interval
Enter Padding
Compile C
Show Graph
Check Graph
Recheck Graph
Plot risetime
Compile NS
Confirm Padding
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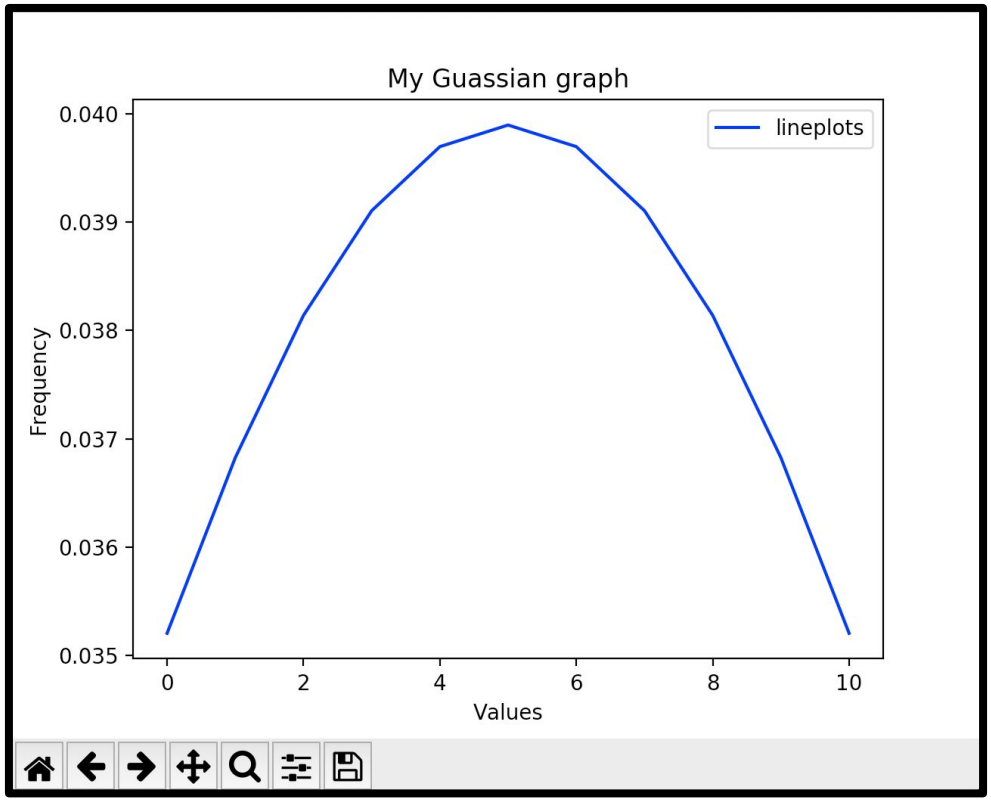
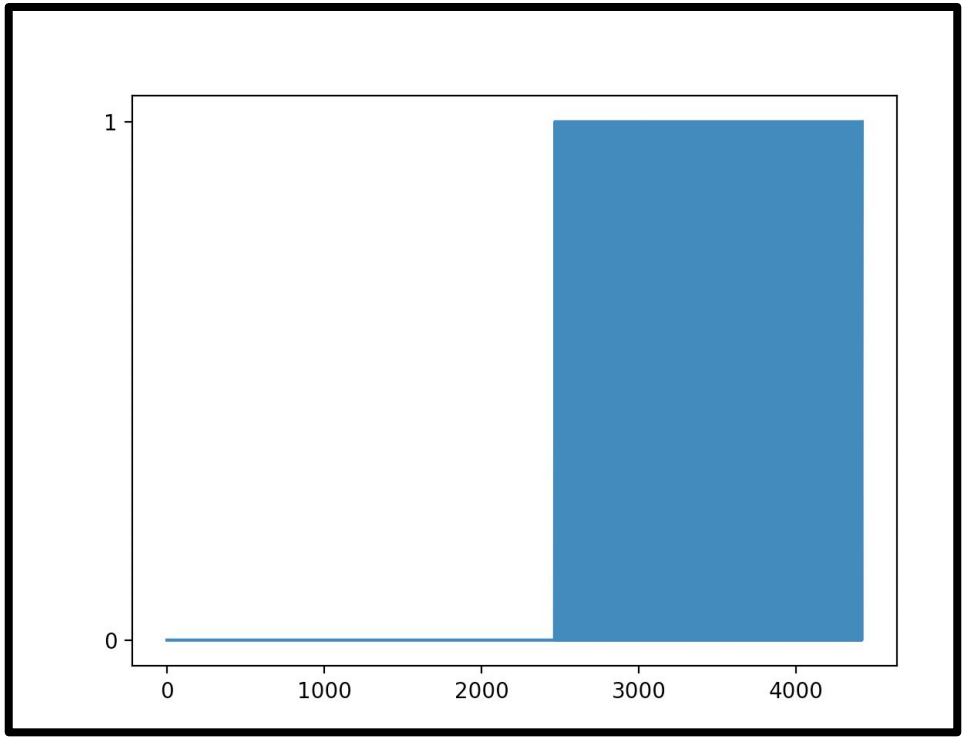
Yet Not Compiled

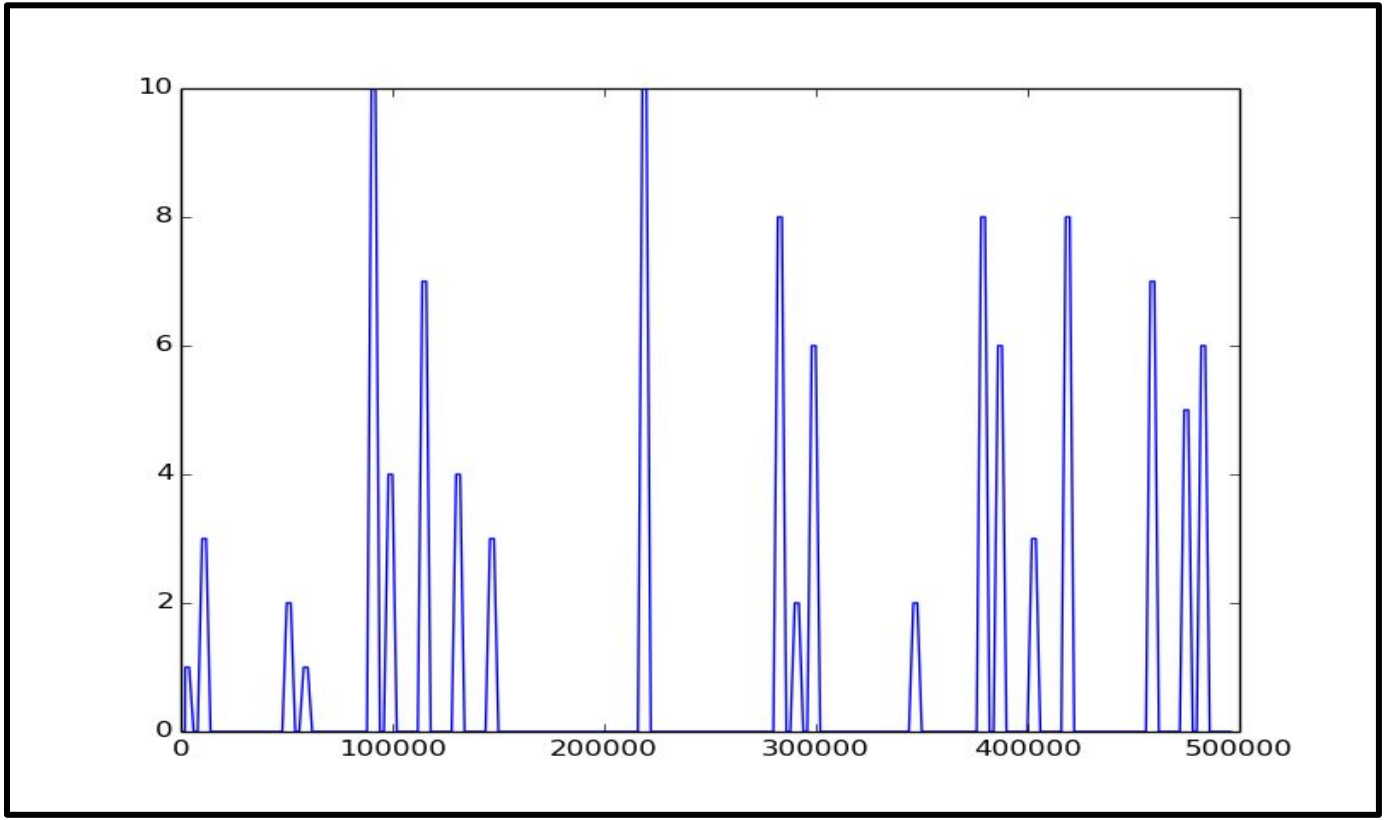
Output


My Guassian graph
lineplots
0.040
0.039
0.038
0.037
0.036
0.035
Frequency
0
2
4
6
8
10
Values

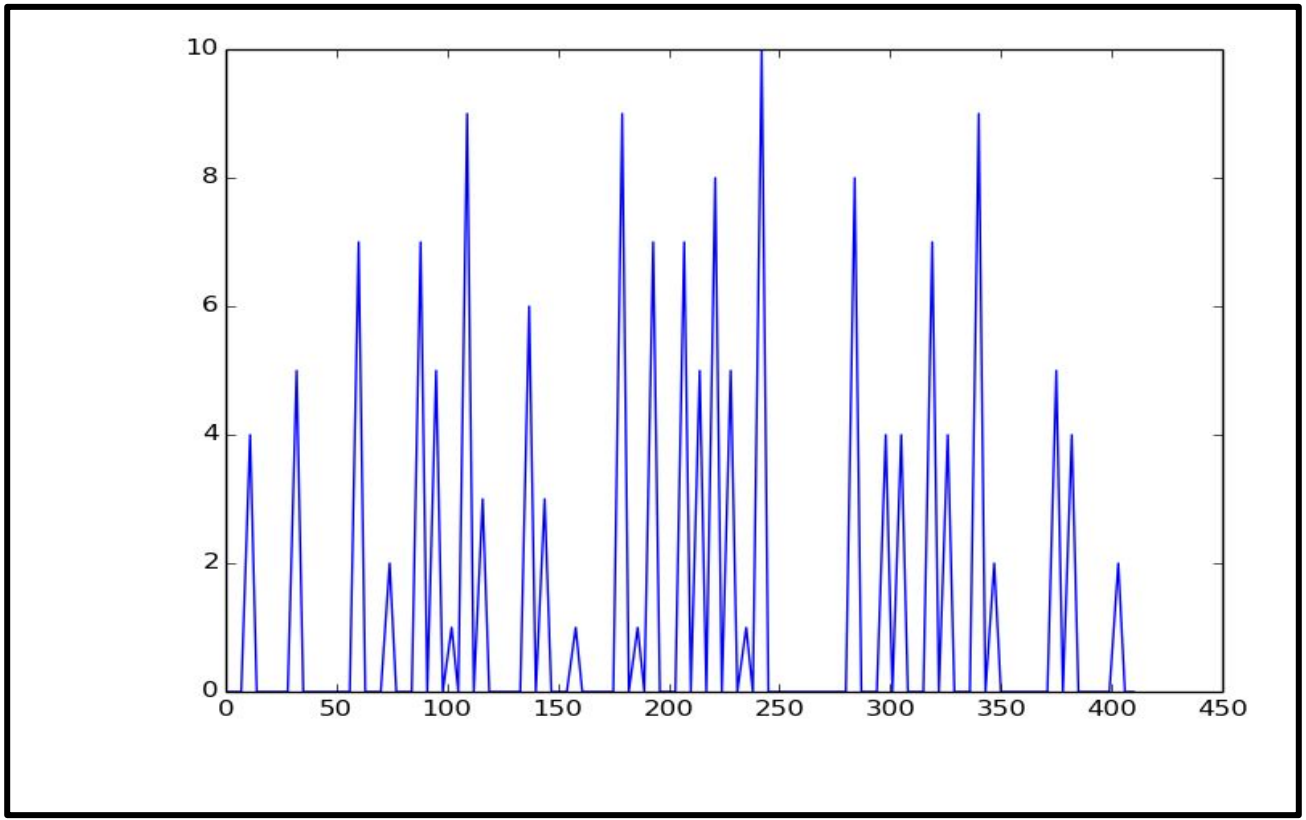
Output



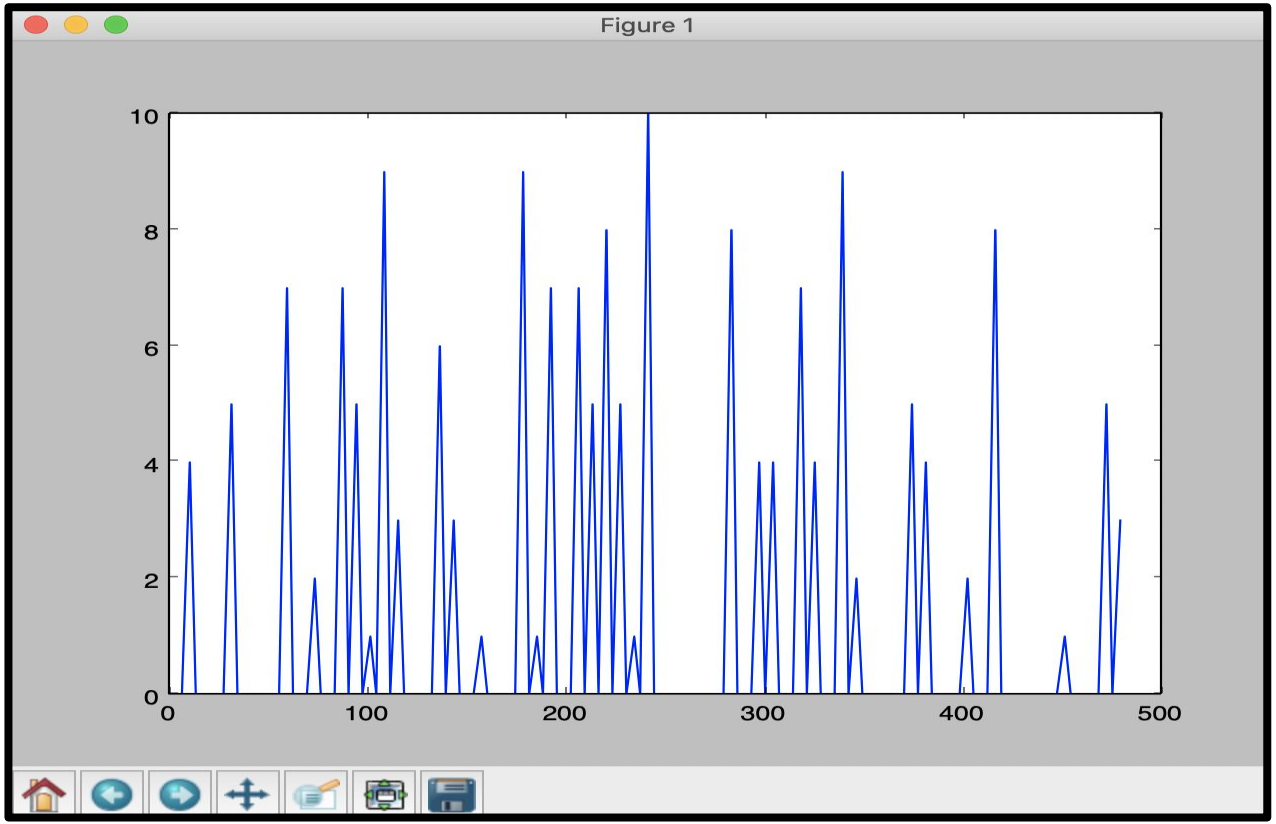
Amplitude spectrum



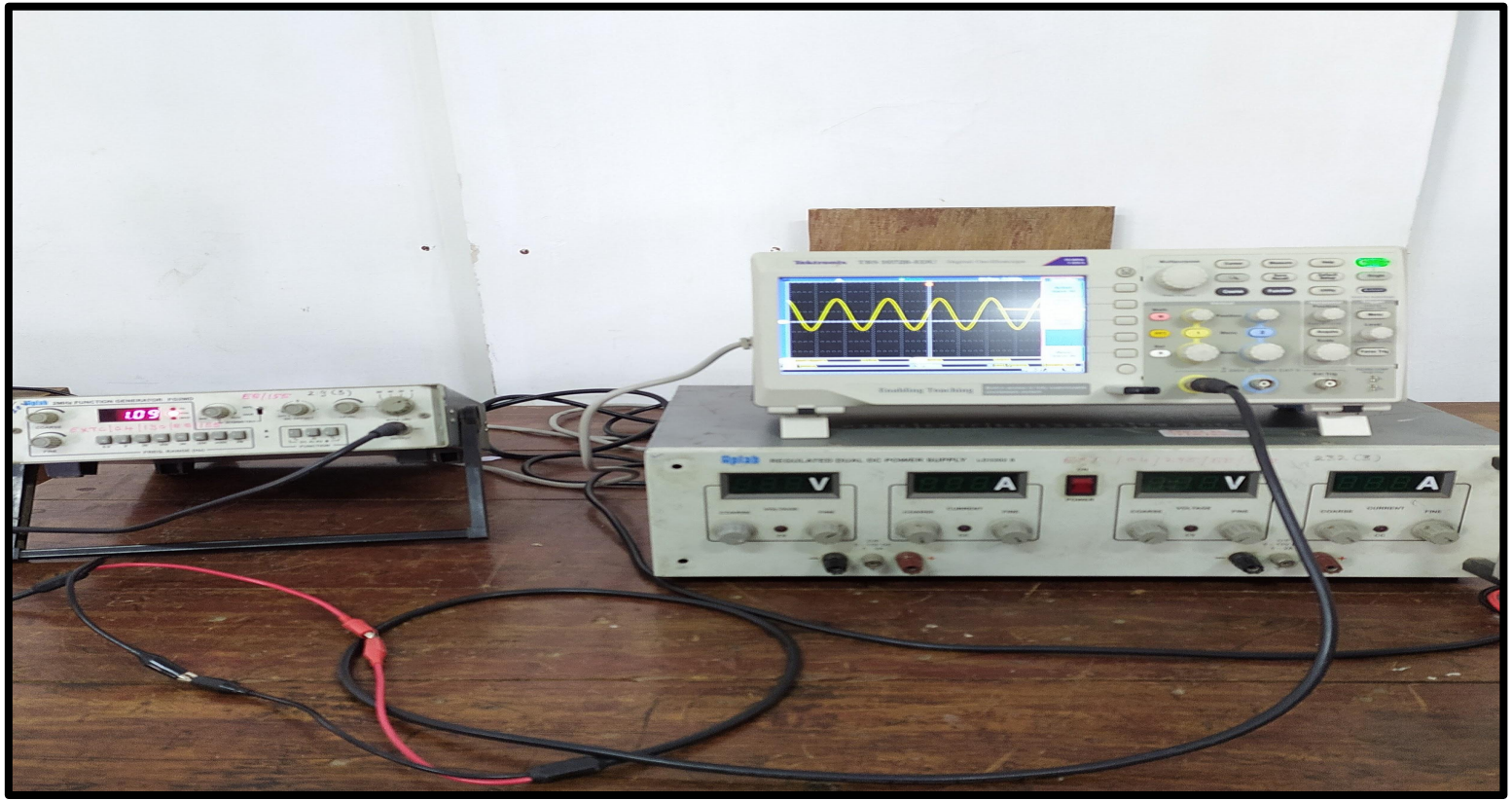
Amplitude spectrum



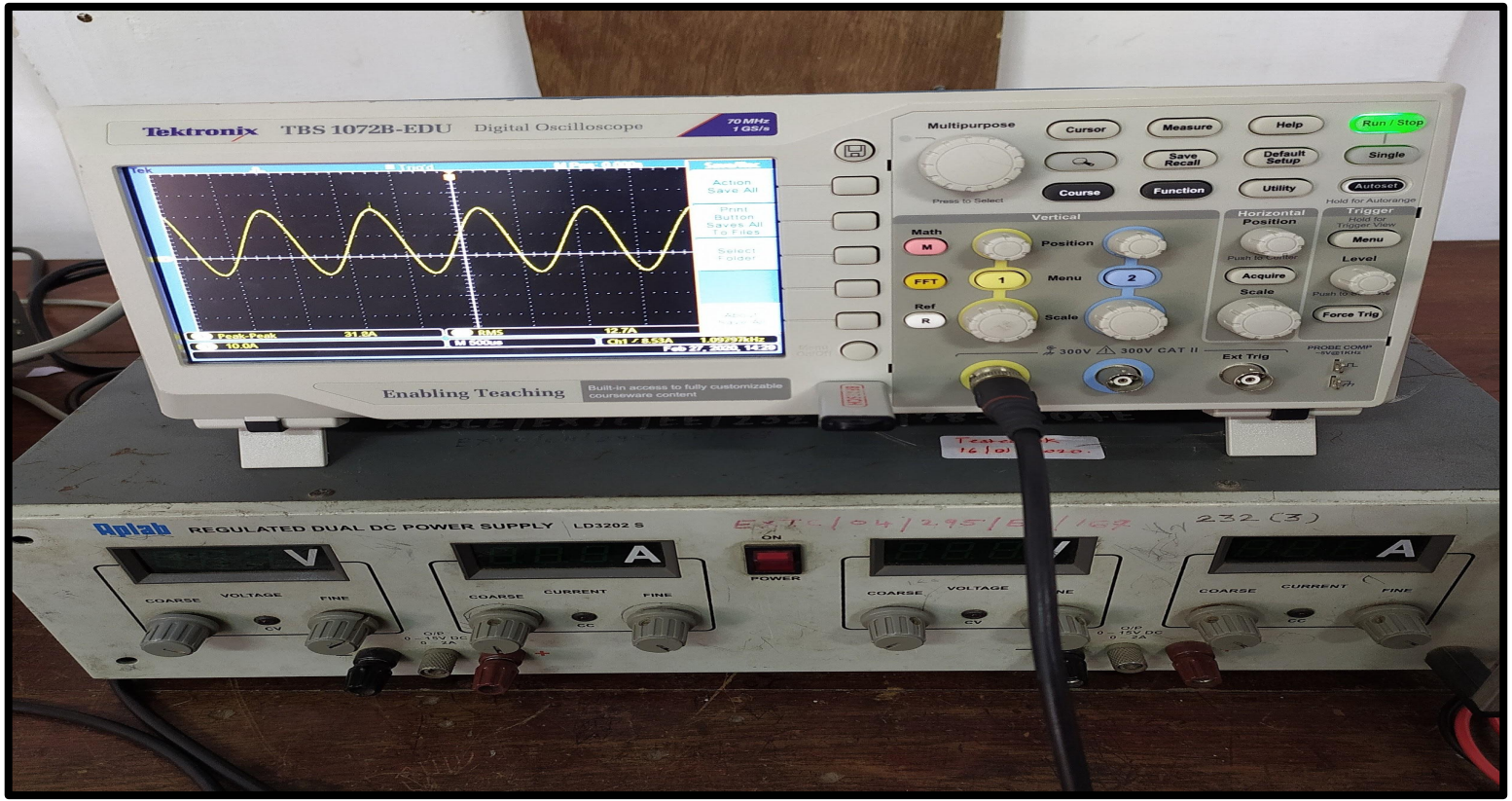
Amplitude spectrum



Hardware Implementation



Hardware Implementation



Conclusion

This project would involve the development of routines required for the generation of digitized pulses given the information pertaining to the process that needs to be probed and analyzed.These pulses could in turn be used for testing data acquisition systems and associated signal processing techniques.The algorithm is initialized by a reference pulse shape, with statistical distribution of amplitude and time.

Future Works

Encouraged by the results, the next part we will be performing is implementation of peak amplitude generation of events from a given probability distribution in petalinux environment. After implementing it in petalinux environment,we will interface DAC(Digital to Analog Converter) by using FMC expansion connector to Zync. After this we will generate pulses from DAC and acquire these pulses and plot the analog spectrum.

References

- Pramana Journal - https://www.ias.ac.in/Journals/Pramana_%E2%80%93_Journal_of_Physics/
- System Design made on: www.draw.io
- Paper references - Multichannel Digital Emulator of Radiation Detection Systems, A Fast, Programmable, Stand-Alone Pulse Generator Emulating Spectroscopy Nuclear Events
- Tkinter GUI Tool Guide - https://datatofish.com/matplotlib-charts-tkinter-gui/
- Matplotlib Guide - https://matplotlib.org/