EE/ CprE/ SE 492 - sddec23-17

Simulated Design of Quantum Networks

Biweekly Status Report

October 26 - November 8

Client: Dr. Durga Paudyal

Faculty Advisor: Dr. Durga Paudyal

Team Members:

Benjamin Amick - Network security engineer

Derrick Wright - System integration engineer

Ohik Kwon- System component designer

Steven Tompary- Network engineer

Past Week Accomplishments

-Integration progress.

We are currently in the process of integrating the two parts of our project together. This process involves the creation of three things, a python script to run the node, a python script to run the router, and a windows batch script to run and manage them both. This process is proceeding smoothly and we are approximately 65% complete in this endeavor. What remains is to call upon a specialized function that performs the quantum computation, additionally we must take some feedback from the computation and feed it back into itself. This presents a unique challenge that may prove tricky to solve. We do not anticipate further delays and we have even decided upon multithreading of nodes as a stretch goal.

```python
from router import Router



r = Router('127.0.0.1', 5001)
r.bind()
print("Router Open")
r.run()
print("Router Open")
```

```
@echo off
start /b python integration_router.py
timeout /t 10
start /b python integration_node.py
timeout /t 5100
taskkill /im python.exe /f
```

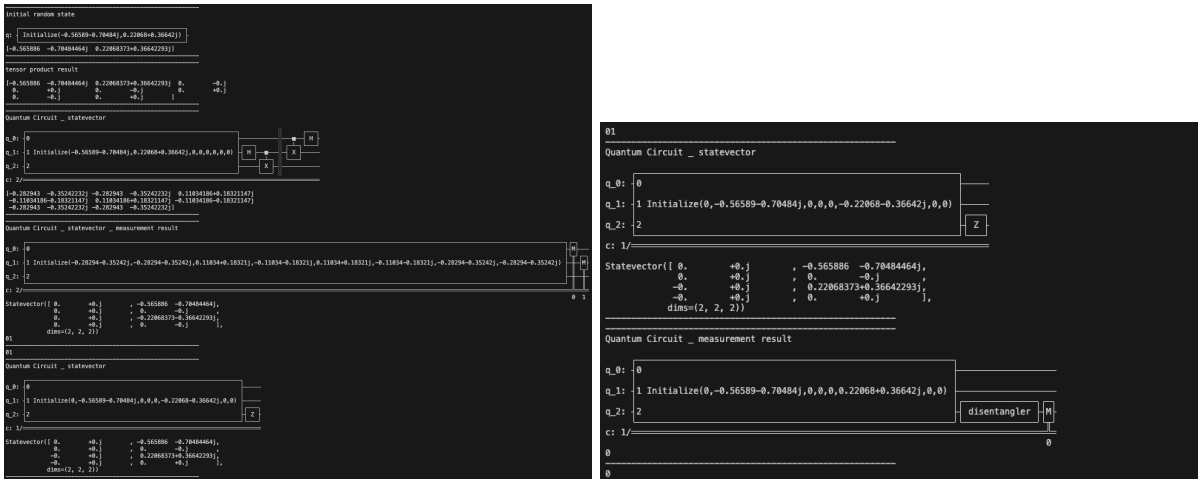
```python
from node import nodeComputer
import random
import time

nodes = []
for i in range(1000):
    host = '127.0.0.1'
    ip = '127.' + '.'.join(str(random.randint(1, 9)) for _ in range(3))
    node = nodeComputer(host, 5001, ip)
    print("Node " + node.ip + " created")
    nodes.append(node)



for n in nodes:
    n.connect()
    print("Node", n.router_host, "connected")
    n.doWorkTest()
    print("Node", n.router_host, "on standby")
```

[figure: simple integration code for testing. Further implementation of quantum teleportation is needed.]

-Quantum teleportation progress.

After we modularized our quantum teleportation code, we found that there are some issues about the result. According to our design, we have to measure “0” as an output for all cases, but it wasn’t. To verify our quantum teleportation design, we decided to rebuild quantum teleportation code from the beginning, but try to reuse it as much as possible. Since at that time we focused on verification, we modularized further and added “debug” mode as possible to see what’s going on, so at each time we can compare the matrix calculation by our hands and the Qiskit simulation outcome. The entire code for the quantum teleportation and result for simulation is the same as below. We also had a meeting with Gavin, a graduate student from Dr. Durga’s lab, to verify whether our quantum simulation works well or not, and got confirmation from him that our quantum teleportation works well.

In conclusion, quantum teleportation is done, and we’re planning to implement “Entanglement verification” code which is an additional feature from what we have to implement.



[figure : quantum wire code for debugging purposes. By using this version, we could verify our code works well following our intention.]

- **Ben** - Worked with Steven to build classical network protocol and finished to make our first primitive classical network. Assisting Derrick with integration.

- **Ohik** - Worked to simulate quantum networks by parts. Evaluated that it is now fully working. Rebuilt entire code to make it easy to implement in our classical network batch code.

- **Steven** - Worked with Steven to build classical network protocol and finished to make our first primitive classical network.

- **Derrick** - Preparing visual aid and primarily in charge of integration.

Resources

Our git repository
https://github.com/Kcops11/SeniorDesignQuantum17

Books we are reading

- Quantum Computation and Quantum Information, Michael A. Nielson

Articles we found this week and reading

- Github Qiskit Community Tutorials
- When Entanglement meets Classical Communications: Quantum Teleportation for the Quantum Internet, IEEE Transactions on Communication, 2020, 10.1109/TCOMM.2020.2978071
- The controlled SWAP test for determining quantum entanglement, Quantum Science and Technology, 2021, *https://doi.org/10.1088/2058-9565/abe458*

Pending Issues

- There are no pending issues for this week since we all agreed on detailed functionalities of our first iteration network.
- We will proceed to the integration phase. That will be our main focus for a couple weeks.

Individual Contributions

Team Member	Contribution	Weekly Hours	Total Hours
Benjamin Amick	Worked on classical network coding	10	76
Derrick Wright	Made visualization tool for presentation	10	76
Ohik Kwon	Worked on quantum teleportation simulation coding	10	76
Steven Tompary	Worked on classical network coding	10	76

Plans for Coming Week

- Continue to work on the communication between router and nodes then ensure that they can communicate quantum instructions.
- We will make GUI for plotting histogram for our final outcome.
- ***For the quantum part, we're working on quantum entanglement verification.***