جامعة عين شمس

AIN SHAMS UNIVERSITY

Design and Analysis of Algorithms

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Project Video: https://youtu.be/S1ZFlaZIBPY

A. In terms of retransmissions, what is the best and worst case scenario for a message to travel across the working field.

The Best case scenario would be if the message took the longest path or if it doesn't reach destination at all. The best case would be if it reached the destination using the shortest path, actually we can use Dijkstra algorithm before sending to make sure we always meet the best case

B. for N nodes uniformly distributed over the working field, how many re-transmissions of a single message can occur.

O(p) where p is the number of nodes in the shortest path

C. How do you design the resend algorithm so as retransmission is limited to a maximum value and what should be that value.

1) Define a global variable represents the max value
2) Define another variable inside the message, this second increases with every resend.
3) Before resending the resend message checks if the message variable < global one, if true it does not resend it

D. What should be your addition if we need the source node be sure that its message had arrived at the destination.

The message should contain the sender ID. The destination node should send an acknowledgment to this ID

E. What would be the data structure maintained by each node if any to complete your designed algorithm.

ID – Position – BatteryCharge – ArrayList Messages

F. If the node can dynamically adjust its transmit ion range by increasing its antenna power linearly as 0.05 w per meter, how can a node discover its surroundings in a range of up to 20 m. Suggest an algorithm for this step and design the data structure that must be maintained by each node.

To discover surroundings send a message with no destination, it shall cross all nodes and determine the distances between them.

G. Describe the situation obtained in E as a graph.

H. Suggest an algorithm distributed over the nodes to find the best route from a source node to a destination in terms of minimizing the total transmission power.

Dijekstra

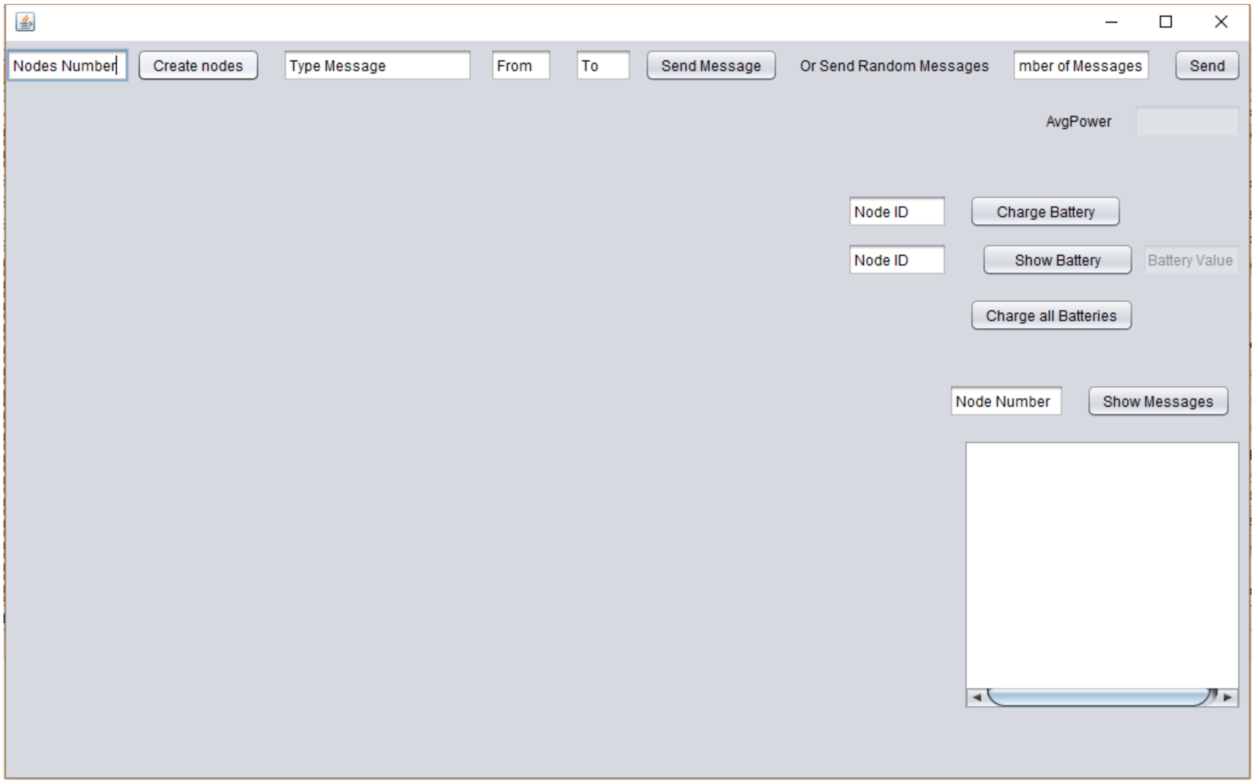
I. Implement the algorithm in H using a suitable programming language

implementation

J. Using a randomized initial location of N nodes (for N= 5, 10, 15 and 20) find the average power per message for randomly transmitting 1000 messages between nodes. You should first choice N random points on a 2_D hypothetical plane and Then in loop that repeats 1000 times pick 2 nodes randomly, one of them is the sender and the other is the receiver, go from a node to node until the message is arrived and the source is aware of the successful delivery. Count the power and at the end of your loop find the average (note that in some cases messages can be lost if the destination is more than 20 m from the nearest node).

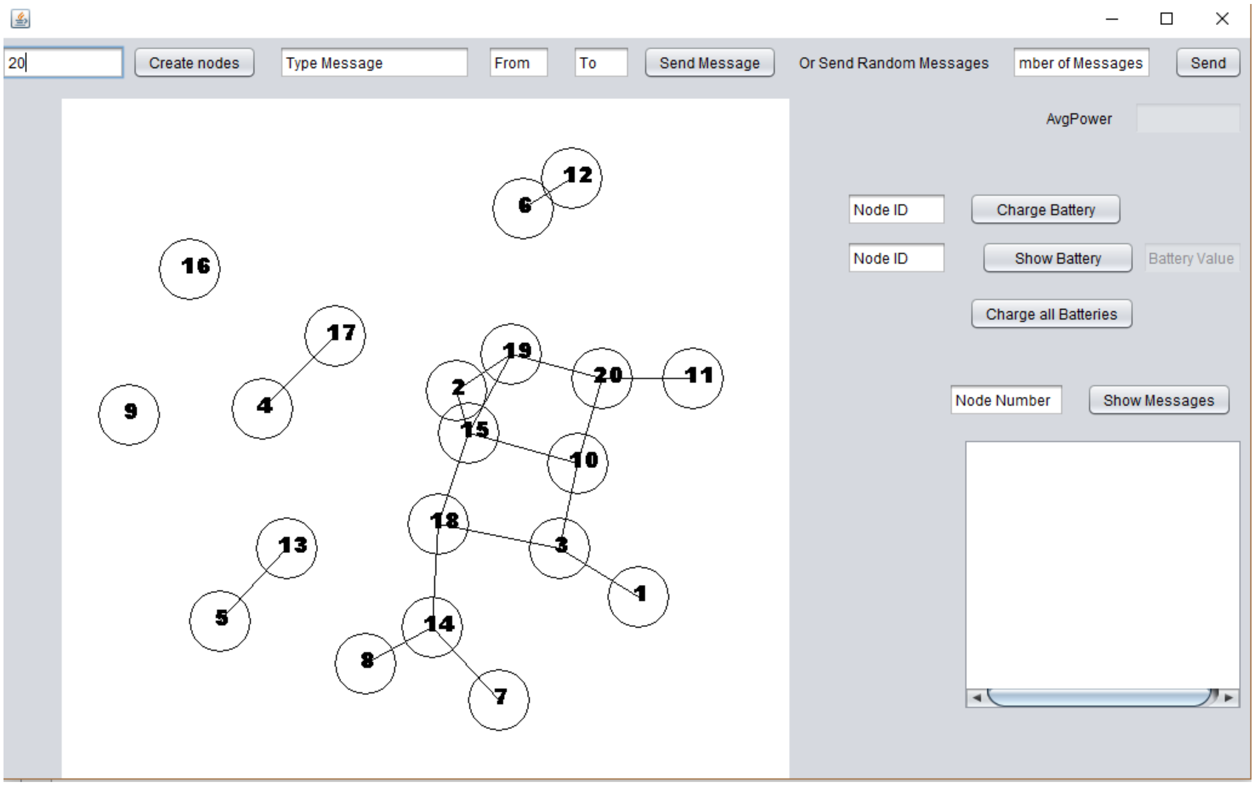
Implementation

User Interface

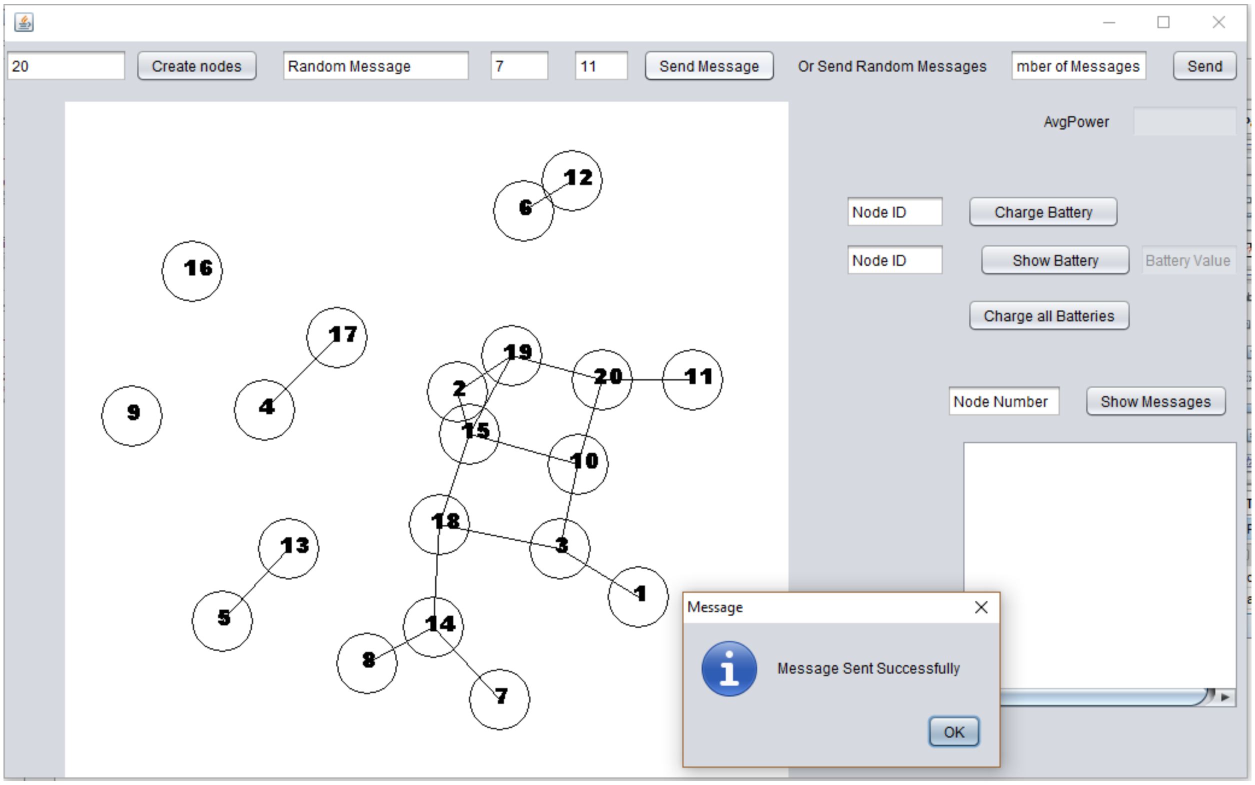


How the program Works

- **First you have to enter the number of nodes you want to generate and press create nodes**



- **Second if you need to send just one message from one node to another**
  - **Type the message you want in type message text field then enter the sender node in from text field then the node you want to send to in from text field then press send message to button just like that**



20

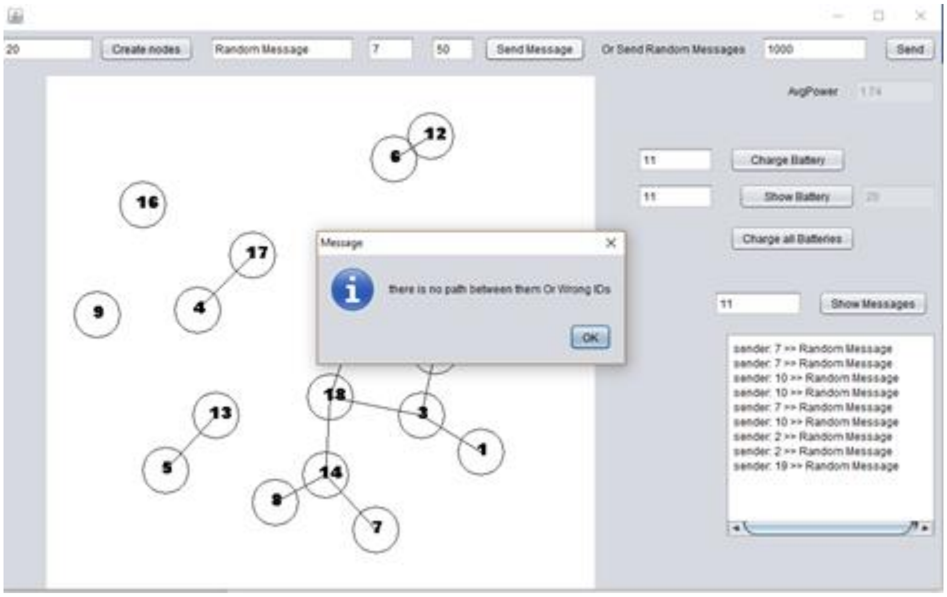
Random Message

7

11

Message Sent Successfully

But if they are not connected or node ID not exist



20

Random Message

7

50

1000

AvgPower 1.74

11

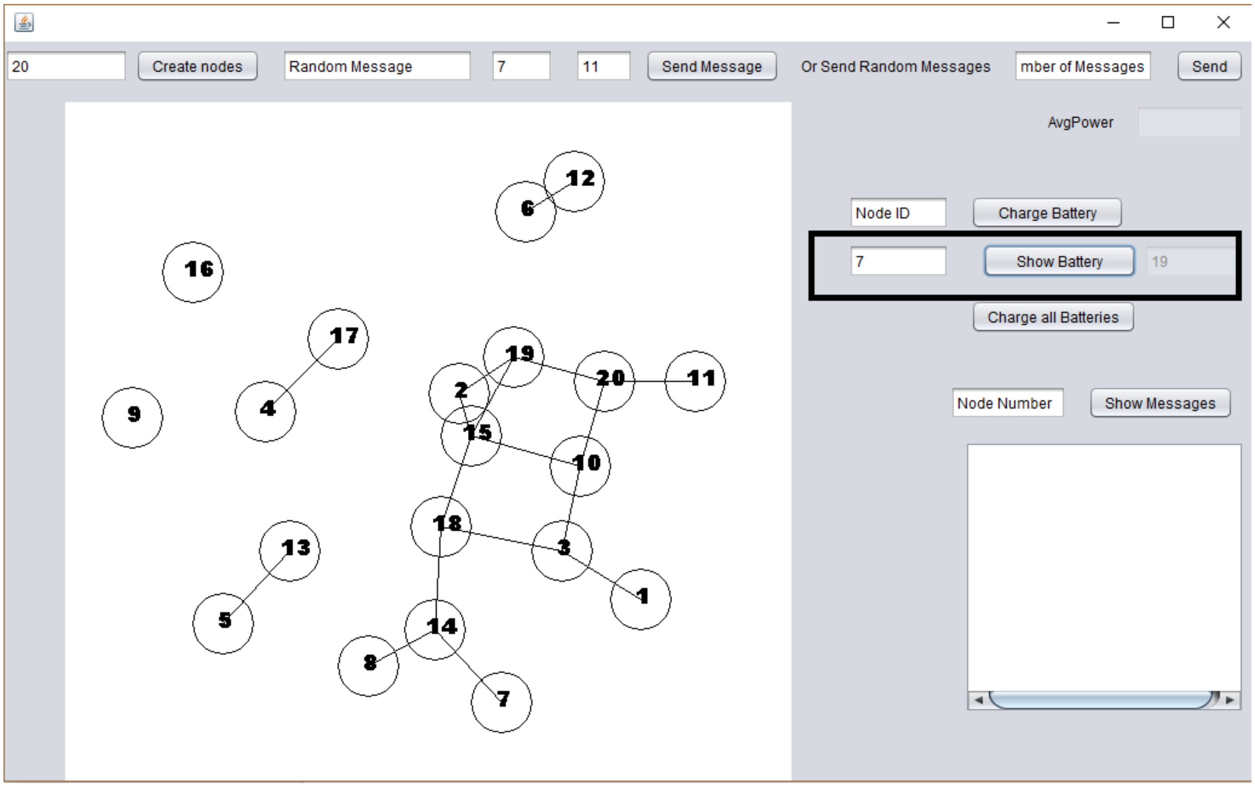
11

11

there is no path between them Or Wrong IDs

```
sender: 7 >> Random Message
sender: 7 >> Random Message
sender: 10 >> Random Message
sender: 10 >> Random Message
sender: 7 >> Random Message
sender: 10 >> Random Message
sender: 2 >> Random Message
sender: 2 >> Random Message
sender: 19 >> Random Message
```

You will notice that the battery value decreased by 1 every successful message sent



20

Random Message

7

11

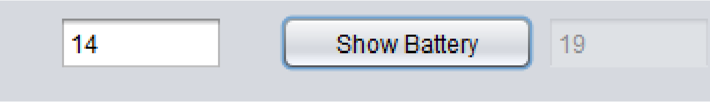
mber of Messages

Node ID

7

19

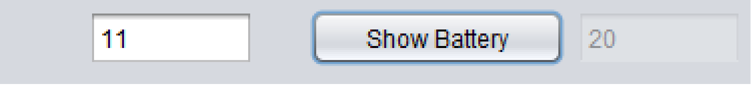
Node Number



14

19

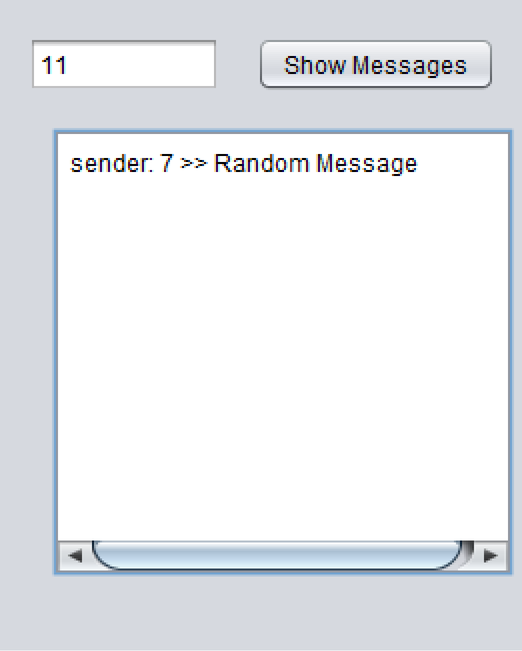
And this happens in all nodes in the path except the receiver node



11

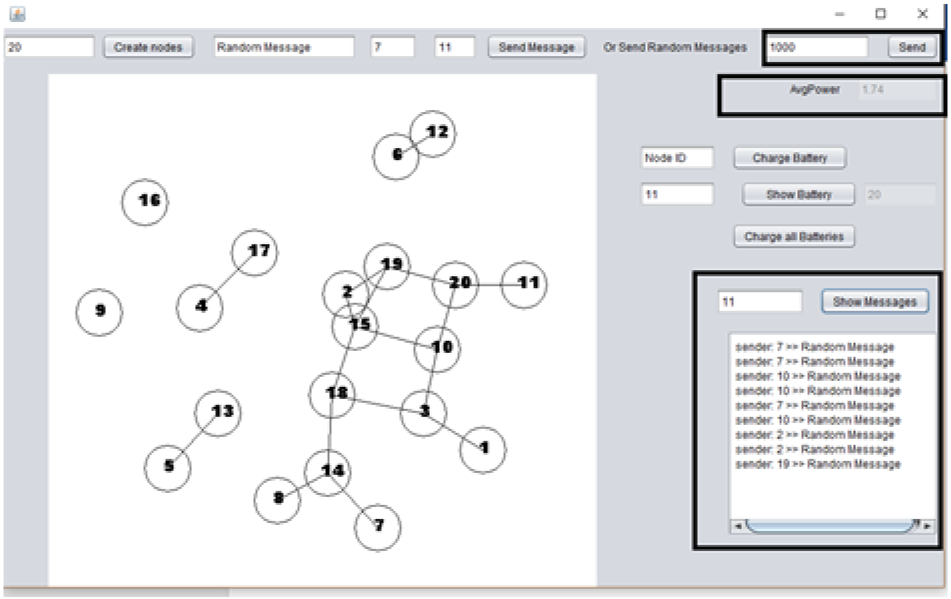
20

And you can see the sent message by typing the node number text field and press show messages like that



sender: 7 >> Random Message

- You can also send number of messages you want randomly between nodes (any node can send to other connected nodes by typing number of messages you want to send in Number of Messages text field then press send button like that



20 | Random Message | 7 | 11 | 1000

AvgPower 1.74

Node ID

11 | 20

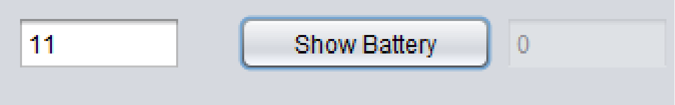
11

```
sender: 7 >> Random Message
sender: 7 >> Random Message
sender: 10 >> Random Message
sender: 10 >> Random Message
sender: 7 >> Random Message
sender: 10 >> Random Message
sender: 2 >> Random Message
sender: 2 >> Random Message
sender: 19 >> Random Message
```

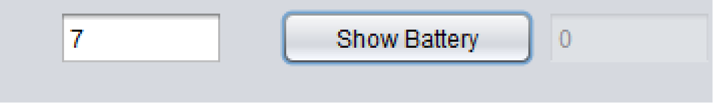
Then we can see the average power is 1.74

The messages that sent to nodes (11 is example)

And we will notice that all batteries are empty now and the 1000 messages will not completely sent because the number of messages is too big

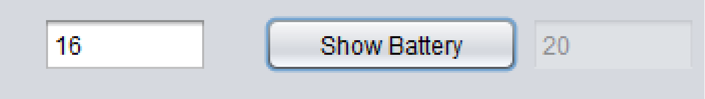


11 | 0



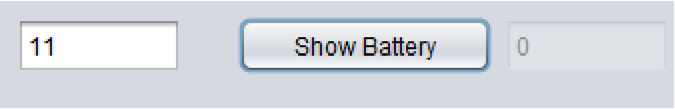
7 | 0

And that not connected node’s battery will not change

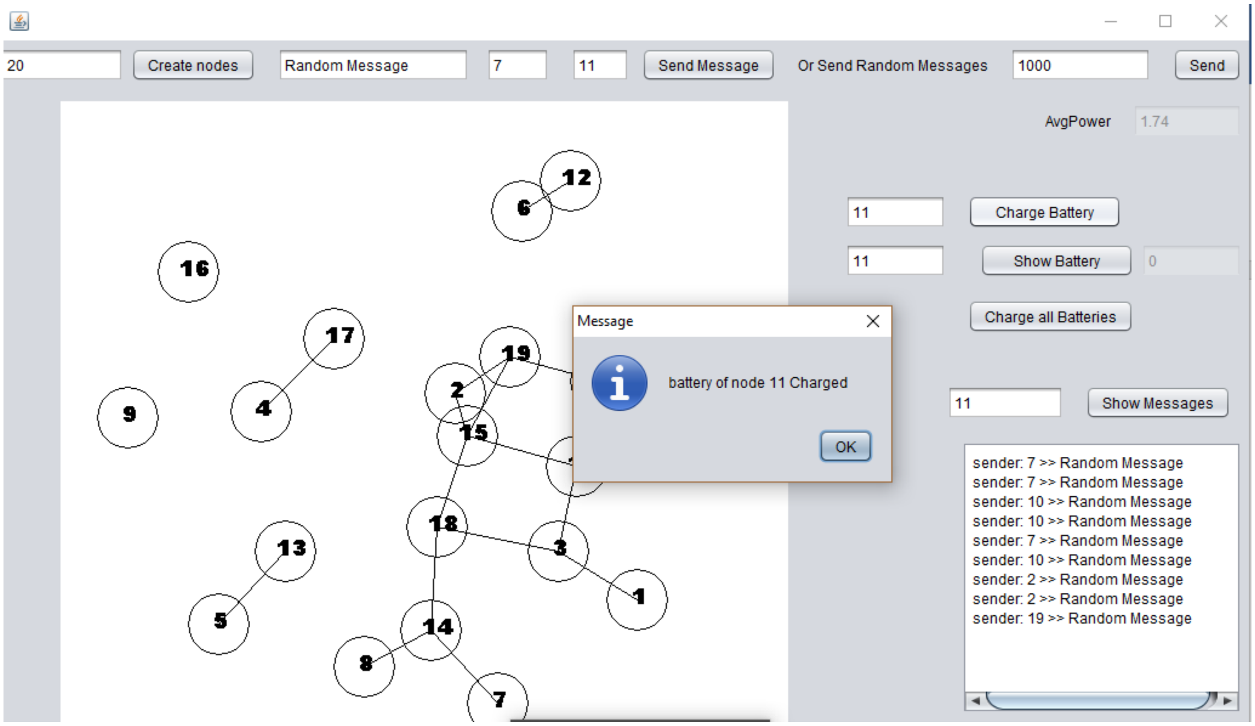


16 | 20

- **If we need to charge one battery, we can do that by typing the ID in node ID then press charge**



11 Show Battery 0



20 Create nodes Random Message 7 11 Send Message Or Send Random Messages 1000 Send

AvgPower 1.74

11 Charge Battery

11 Show Battery 0

Charge all Batteries

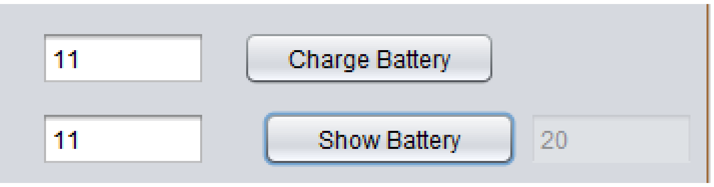
Message

battery of node 11 Charged

OK

11 Show Messages

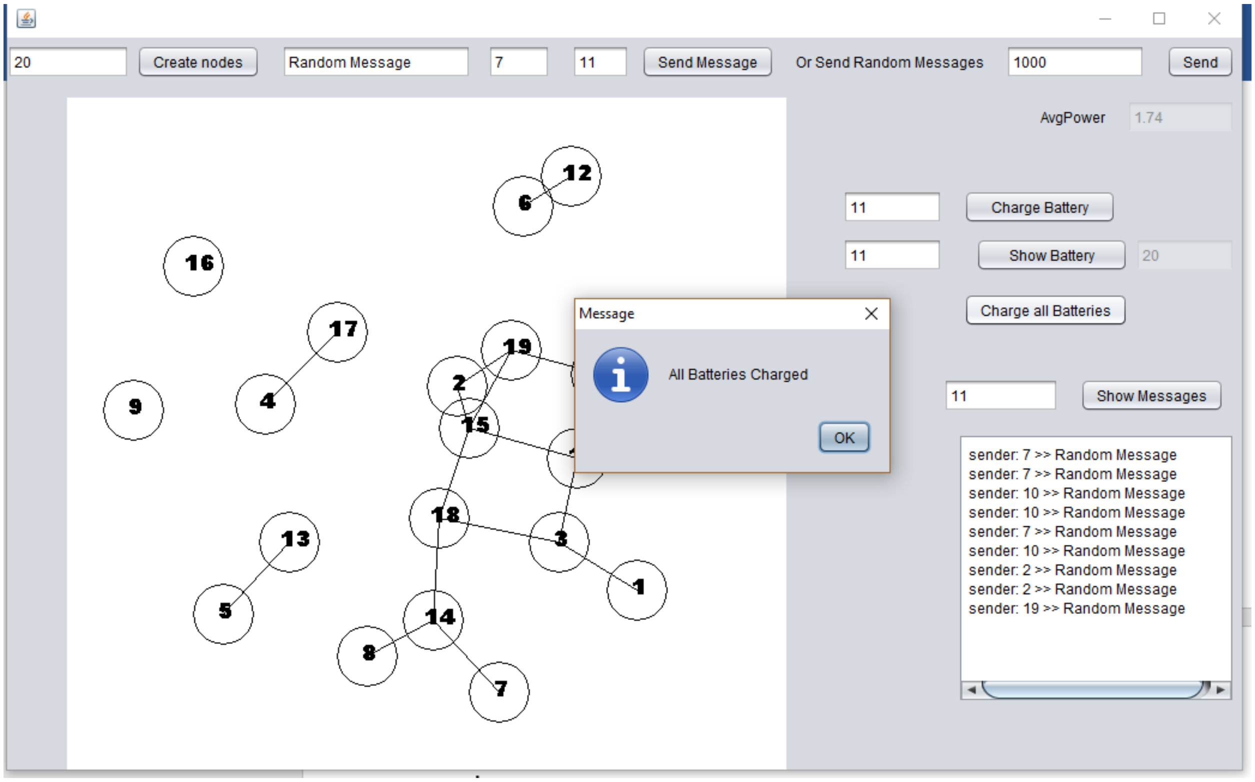
```
sender: 7 >> Random Message
sender: 7 >> Random Message
sender: 10 >> Random Message
sender: 10 >> Random Message
sender: 7 >> Random Message
sender: 10 >> Random Message
sender: 2 >> Random Message
sender: 2 >> Random Message
sender: 19 >> Random Message
```



11 Charge Battery

11 Show Battery 20

And if we need to charge all batteries at once press charge all batteries button



20

Random Message

7

11

1000

AvgPower 1.74

11

11

20

All Batteries Charged

11

```
sender: 7 >> Random Message
sender: 7 >> Random Message
sender: 10 >> Random Message
sender: 10 >> Random Message
sender: 7 >> Random Message
sender: 10 >> Random Message
sender: 2 >> Random Message
sender: 2 >> Random Message
sender: 19 >> Random Message
```

Then send again if you need