

# POLITECNICO

## MILANO 1863

### IoT Project Report

KEEP YOUR DISTANCE

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## Introduction

This project was created due to the situation created by Corona virus pandemic. It is aimed at helping people keep their distance in enclosed areas such as museums and galleries. The model is based on TinyOS as operating system, Cooja as the simulation environment, Node-red as connection between the nodes and the internet for sending notifications to a mobile phone.

In the simulation phase, if two nodes come to a certain range from another mote an alarm procedure is triggered as follows.

1. The Node ID of the other node in the proximity is saved in an array inside the node.
2. The red LED on the node starts to blink while showing on its own screen and sending an alarm message containing the Node ID of the violating node to Node-red.
3. In Node-red the message is then converted to a message format suitable for mobile phone notification and sent as one using the IFTTT platform.
4. The notification that contains first the ID of the violating node and then the ID of the other node is sent to be viewed on the handset of the phone.

## Implementation

One code has been used for the nodes which starts by booting the devices then turning on the radio interface. After making sure that the radio is on the mote sets a timer of 500ms. As the timer expires a message containing the Node ID of the mote is broadcasted in its proximity. Soon as two motes become close to each other, they receive the broadcast message so they extract the Node ID of the other node and store it in an array as in Figure 1 while toggling on and off the red LED of the mote, Figure 2.

The alarm message is shown on the screens of the violating motes that breached the distance limit which is demonstrated in Figure 3. Using a unique socket for each mote we connect them to Node-red. In Figure 4 the architecture is depicted for 5-motes scenario. In Node-red first the received messages from each TCP socket must be cleaned from the unwanted characters due to the bogus function of printf in Cooja. After trimming the messages, they are displayed in Node-red and then a switch statement classifies them according to which node is the conflicting mote, then we use a rate limiter to control the flow of notifications to the phone. The function after the limiter creates a template for each notification providing the event name and values which are the Node IDs to trigger the notification using the IFTTT platform. All the outputs of the template creator function are collected in a log.txt file in the directory of the program. In the end using a HTTP

POST node we post the request to trigger the notification on the IFTTT website. Figure 5 shows the Node-red program. The messages printed in Node-red are in Figure 6, plus a screenshot of the notifications received on the cellular phone handset can be found in Figure 7.

## Figures

00:08.881	ID:2	~EdMemeory write: 1
00:09.229	ID:1	~EdMemeory write: 2
00:15.077	ID:1	S~~EdMemeory write: 5
00:15.230	ID:5	~EdMemeory write: 1
00:21.910	ID:4	~EdMemeory write: 5
00:22.034	ID:5	w~~EdMemeory write: 4
00:26.921	ID:3	~EdMemeory write: 4
00:26.977	ID:4	~~EdMemeory write: 3
00:33.155	ID:1	~~EdMemeory write: 2
00:36.565	ID:1	S~~EdMemeory write: 5
00:36.714	ID:5	~~EdMemeory write: 1
00:52.680	ID:4	~~EdMemeory write: 2
00:52.793	ID:2	w~~EdMemeory write: 4
01:00.972	ID:4	S~~EdMemeory write: 5
01:01.101	ID:5	w~~EdMemeory write: 4
01:01.136	ID:5	~~EdMemeory write: 1
01:01.588	ID:5	w~~EdMemeory write: 4
01:01.623	ID:5	~~EdMemeory write: 1

Figure 1 : Node ID of the violating mote is being written in the memory array of each node.

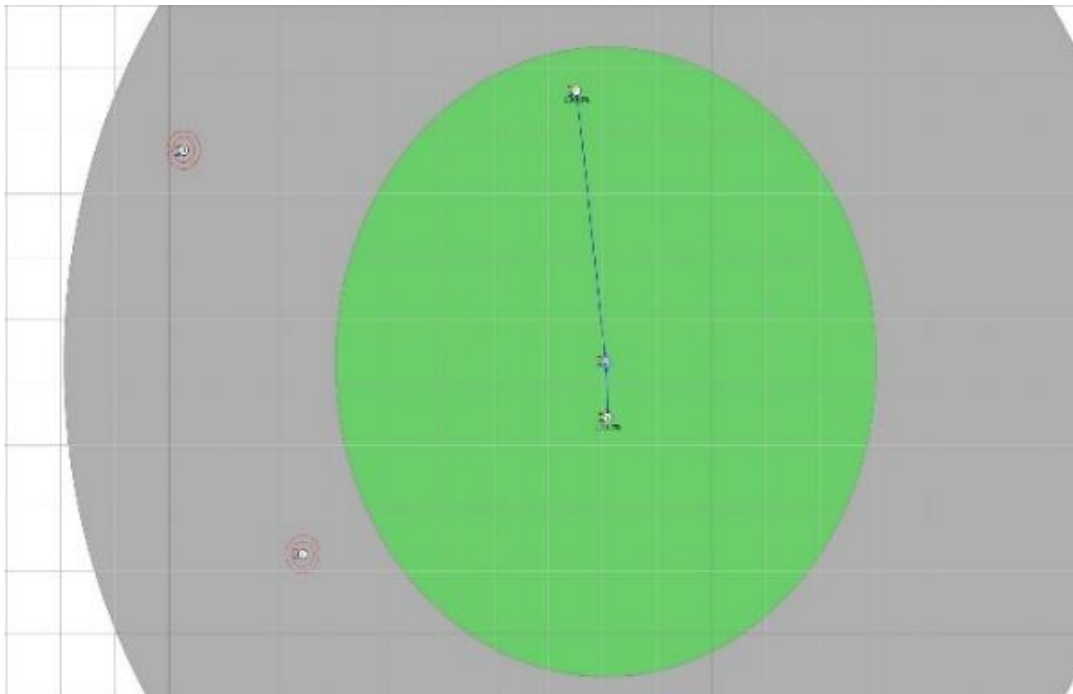


Figure 2: The red LEDs of the close motes are blinking.

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00:12.640 ID:1 _--EdAlarm! The violating mote is--Ed: 5
00:12.759 ID:1 >--EdAlarm! The violating mote is--Ed: 4
00:12.793 ID:5 ---EdAlarm! The violating mote is--Ed: 1
00:12.793 ID:4 ---EdAlarm! The violating mote is--Ed: 1
00:13.129 ID:1 _--EdAlarm! The violating mote is--Ed: 5
00:13.138 ID:1 >--EdAlarm! The violating mote is--Ed: 2
00:13.283 ID:2 -EdAlarm! The violating mote is--Ed: 1
00:13.283 ID:5 ---EdAlarm! The violating mote is--Ed: 1
00:13.622 ID:1 z--EdAlarm! The violating mote is--Ed: 5
00:13.631 ID:1 >--EdAlarm! The violating mote is--Ed: 2
00:13.737 ID:1 z--EdAlarm! The violating mote is--Ed: 4
00:13.773 ID:5 ---EdAlarm! The violating mote is--Ed: 1
00:13.773 ID:3 -EdAlarm! The violating mote is--Ed: 1
00:13.773 ID:2 ---EdAlarm! The violating mote is--Ed: 1
00:13.773 ID:4 ---EdAlarm! The violating mote is--Ed: 1
00:13.801 ID:1 _--EdAlarm! The violating mote is--Ed: 3
00:14.115 ID:1 e--EdAlarm! The violating mote is--Ed: 2
00:14.256 ID:3 ---EdAlarm! The violating mote is--Ed: 1
00:14.256 ID:2 ---EdAlarm! The violating mote is--Ed: 1
00:14.292 ID:1 z--EdAlarm! The violating mote is--Ed: 3
00:14.599 ID:1 e--EdAlarm! The violating mote is--Ed: 5
00:14.603 ID:1 Alarm! The violating mot--Ede is: 2
00:14.716 ID:1 _--EdAlarm! The violating mote is--Ed: 4
00:14.746 ID:2 ---EdAlarm! The violating mote is--Ed: 1
00:14.746 ID:5 ---EdAlarm! The violating mote is--Ed: 1
00:14.746 ID:4 ---EdAlarm! The violating mote is--Ed: 1
00:15.080 ID:1 _--EdAlarm! The violating mote is--Ed: 5
00:15.206 ID:1 >--EdAlarm! The violating mote is--Ed: 4
00:15.233 ID:4 ---EdAlarm! The violating mote is--Ed: 1
00:15.233 ID:5 ---EdAlarm! The violating mote is--Ed: 1
00:15.574 ID:1 _--EdAlarm! The violating mote is--Ed: 5
00:15.689 ID:1 >--EdAlarm! The violating mote is--Ed: 4
00:15.726 ID:5 ---EdAlarm! The violating mote is--Ed: 1
00:15.726 ID:4 ---EdAlarm! The violating mote is--Ed: 1
00:16.061 ID:1 _--EdAlarm! The violating mote is--Ed: 5
00:16.176 ID:1 >--EdAlarm! The violating mote is--Ed: 4
00:16.210 ID:5 ---EdAlarm! The violating mote is--Ed: 1
00:16.210 ID:4 ---EdAlarm! The violating mote is--Ed: 1
00:16.547 ID:1 _--EdAlarm! The violating mote is--Ed: 5
00:16.671 ID:1 >--EdAlarm! The violating mote is--Ed: 4
00:16.698 ID:4 ---EdAlarm! The violating mote is--Ed: 1
00:16.698 ID:5 ---EdAlarm! The violating mote is--Ed: 1
00:17.030 ID:1 _--EdAlarm! The violating mote is--Ed: 5
00:17.154 ID:1 >--EdAlarm! The violating mote is--Ed: 4
00:17.185 ID:2 ---EdAlarm! The violating mote is--Ed: 1
00:17.185 ID:4 ---EdAlarm! The violating mote is--Ed: 1
00:17.185 ID:5 ---EdAlarm! The violating mote is--Ed: 1
00:17.521 ID:1 _--EdAlarm! The violating mote is--Ed: 5
00:17.522 ID:2 ---EdAlarm! The violating mote is--Ed: 5
00:17.532 ID:4 ---EdAlarm! The violating mote is--Ed: 2
00:17.532 ID:1 >--EdAlarm! The violating mote is--Ed: 2
00:17.532 ID:5 ---EdAlarm! The violating mote is--Ed: 2
00:17.644 ID:1 z--EdAlarm! The violating mote is--Ed: 4
00:17.644 ID:2 >--EdAlarm! The violating mote is--Ed: 4
00:17.676 ID:5 z--EdAlarm! The violating mote is--Ed: 1
00:17.676 ID:4 z--EdAlarm! The violating mote is--Ed: 1
00:17.676 ID:2 _--EdAlarm! The violating mote is--Ed: 1
00:17.708 ID:2 ---EdAlarm! The violating mote is--Ed: 3
00:18.006 ID:1 _--EdAlarm! The violating mote is--Ed: 5
00:18.132 ID:1 >--EdAlarm! The violating mote is--Ed: 4
00:18.164 ID:5 ---EdAlarm! The violating mote is--Ed: 1
00:18.164 ID:4 ---EdAlarm! The violating mote is--Ed: 1
00:18.502 ID:1 _--EdAlarm! The violating mote is--Ed: 5
00:18.623 ID:1 >--EdAlarm! The violating mote is--Ed: 4
00:18.654 ID:4 ---EdAlarm! The violating mote is--Ed: 1
00:18.654 ID:5 ---EdAlarm! The violating mote is--Ed: 1
00:18.987 ID:1 _--EdAlarm! The violating mote is--Ed: 5
00:19.106 ID:1 >--EdAlarm! The violating mote is--Ed: 4
00:19.147 ID:5 ---EdAlarm! The violating mote is--Ed: 1
00:19.147 ID:4 ---EdAlarm! The violating mote is--Ed: 1
00:19.479 ID:1 _--EdAlarm! The violating mote is--Ed: 5

```

Figure 3: The alarm message shown on the node screens (Here in Cooja simulator).



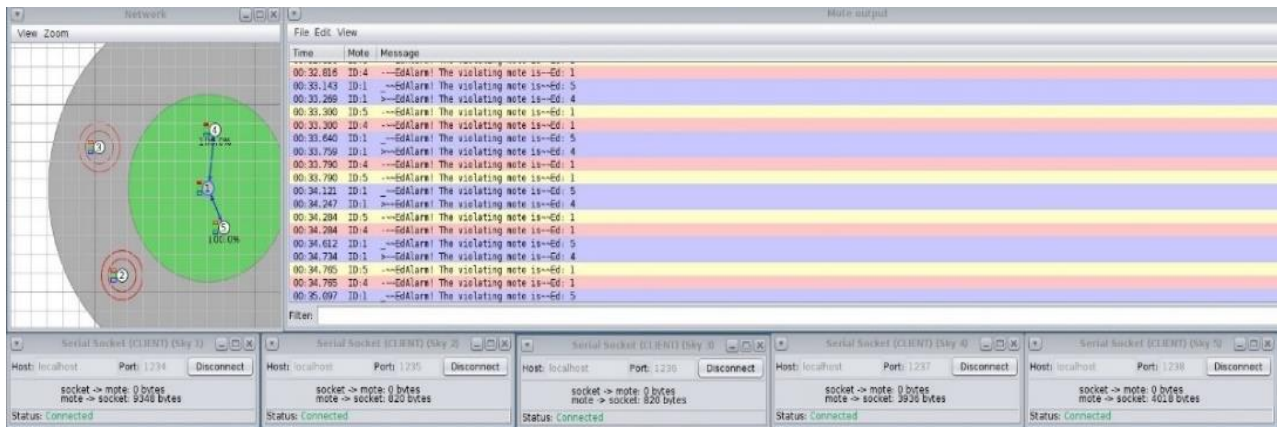


Figure 4: The 5-mote scenario architecture that each mote is connected to Node-red using a unique socket.

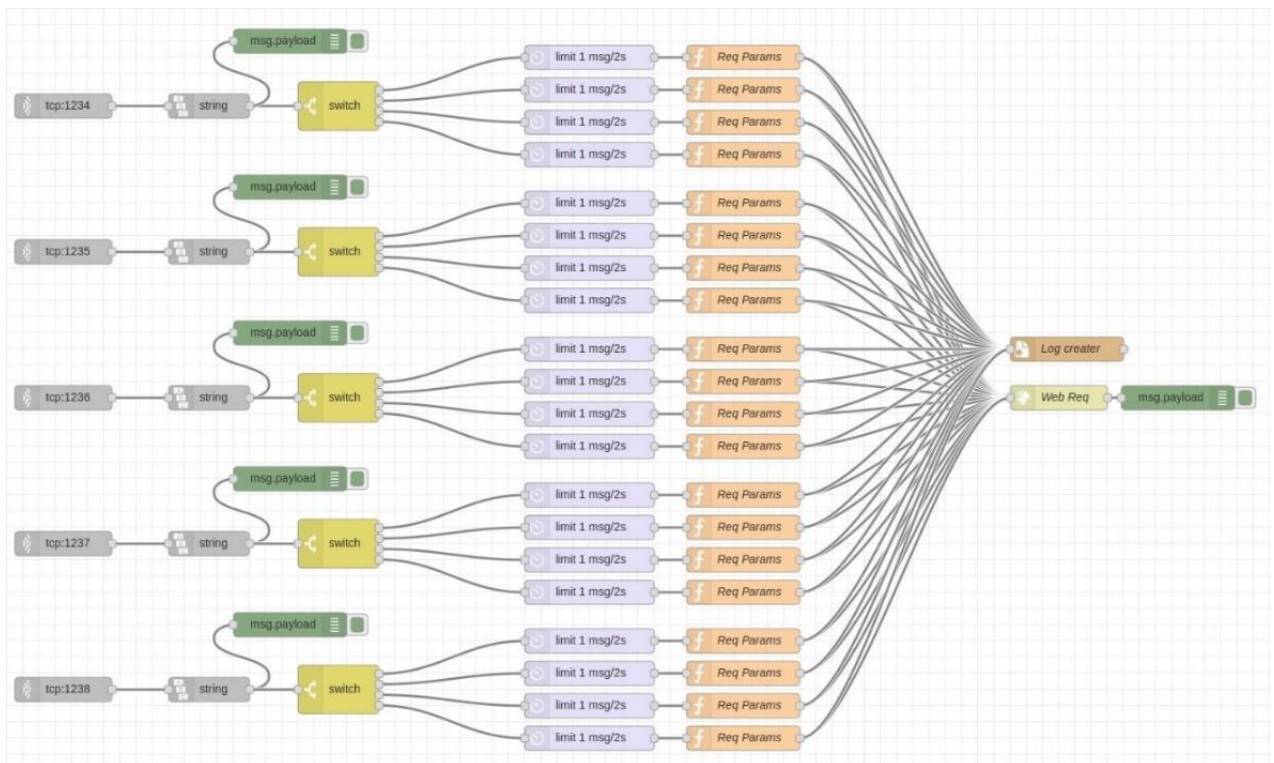


Figure 5: Node-red design of the 5-mote program with a unique socket for each mote.

20/08/2020 00:54:31 node: 5864b9c4.a6d448 msg.payload : string[41] <b>"Alarm! The violating mote is: 2"</b>	
20/08/2020 00:54:31 node: fb140c78.7159a msg.payload : string[41] <b>"Alarm! The violating mote is: 1"</b>	
20/08/2020 00:54:32 node: 5864b9c4.a6d448 msg.payload : string[65] <b>"Alarm! The violating mote is: 2"</b>	
20/08/2020 00:54:32 node: fb140c78.7159a msg.payload : string[66] <b>"-Alarm! The violating mote is: 1"</b>	
20/08/2020 00:54:32 node: 5864b9c4.a6d448 msg.payload : string[65] <b>"Alarm! The violating mote is: 2"</b>	
20/08/2020 00:54:32 node: fb140c78.7159a msg.payload : string[66] <b>"-Alarm! The violating mote is: 1"</b>	
20/08/2020 00:54:33 node: 5864b9c4.a6d448 msg.payload : string[65] <b>"Alarm! The violating mote is: 2"</b>	
20/08/2020 00:54:33 node: fb140c78.7159a msg.payload : string[66] <b>"-Alarm! The violating mote is: 1"</b>	
20/08/2020 00:54:34 node: ae0314d9.4824e8 msg.payload : string[41] <b>"Alarm! The violating mote is: 1"</b>	
20/08/2020 00:54:35 node: 5864b9c4.a6d448 msg.payload : string[65] <b>"Alarm! The violating mote is: 5"</b>	
20/08/2020 00:54:35 node: ae0314d9.4824e8 msg.payload : string[66] <b>"-Alarm! The violating mote is: 1"</b>	
20/08/2020 00:54:35 node: 5864b9c4.a6d448 msg.payload : string[65] <b>"Alarm! The violating mote is: 5"</b>	
20/08/2020 00:54:35 node: ae0314d9.4824e8 msg.payload : string[66] <b>"-Alarm! The violating mote is: 1"</b>	
20/08/2020 00:54:36 node: 5864b9c4.a6d448 msg.payload : string[65] <b>"Alarm! The violating mote is: 2"</b>	
20/08/2020 00:54:36 node: fb140c78.7159a msg.payload : string[66] <b>"-Alarm! The violating mote is: 1"</b>	
	<div> <div>61% </div> <div> <div>1:25 AM</div> <div>Thu, Aug 20</div> </div> <div> </div> <div>vodafone IT</div> <div> <div>IFTTT ^</div> <div>1m ^</div> <div>Too close</div> <div>Mote 5 is too close to Mote 4 .</div> <div>At : August 20, 2020 at 12:59AM .</div> </div> <div> <div>1m ^</div> <div>Too close</div> <div>Mote 1 is too close to Mote 2 .</div> <div>At : August 20, 2020 at 12:58AM .</div> </div> <div> <div>1m ^</div> <div>Too close</div> <div>Mote 2 is too close to Mote 4 .</div> <div>At : August 20, 2020 at 12:59AM .</div> </div> <div> <div>1m ^</div> <div>Too close</div> <div>Mote 3 is too close to Mote 4 .</div> <div>At : August 20, 2020 at 12:58AM .</div> </div> <div> <div>1m ^</div> <div>Too close</div> <div>Mote 5 is too close to Mote 1 .</div> </div> </div>

Figure 6 (Left): Messages printed in Node-red. Figure 7 (Right): Notifications on the phone.