

SCHOOL OF COMPUTING (SOC)

IOT CA2 Step-by-step Tutorial

DIPLOMA IN BUSINESS INFORMATION TECHNOLOGY
DIPLOMA IN INFORMATION TECHNOLOGY
DIPLOMA IN INFOCOMM SECURITY MANAGEMENT

ST0324 Internet of Things (IOT)

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Prepared for: Ms Dora Chua

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Section 1

Overview of project

A. Where we have uploaded our tutorial

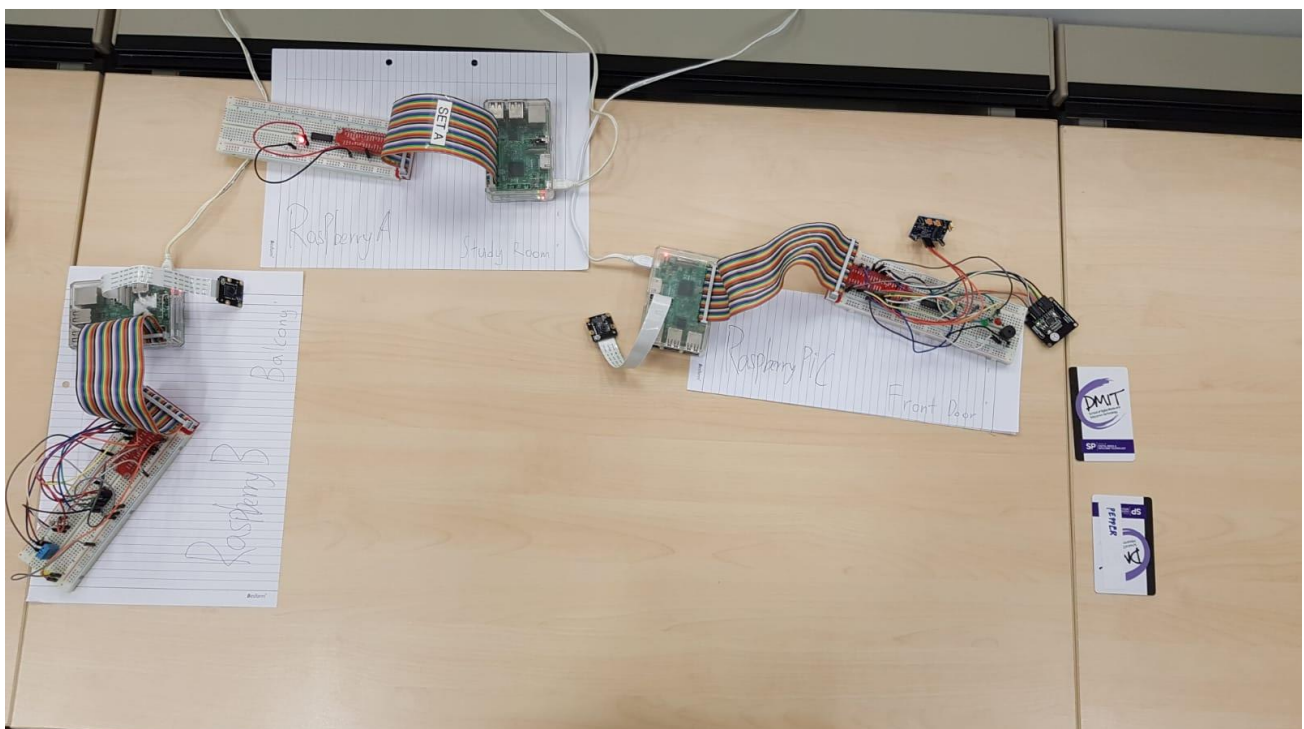
<https://youtu.be/vW1W-uVw8EY>

<https://github.com/DamianTanXianKai/Team-Basic-IOT-CA2>

B. What is the application about?

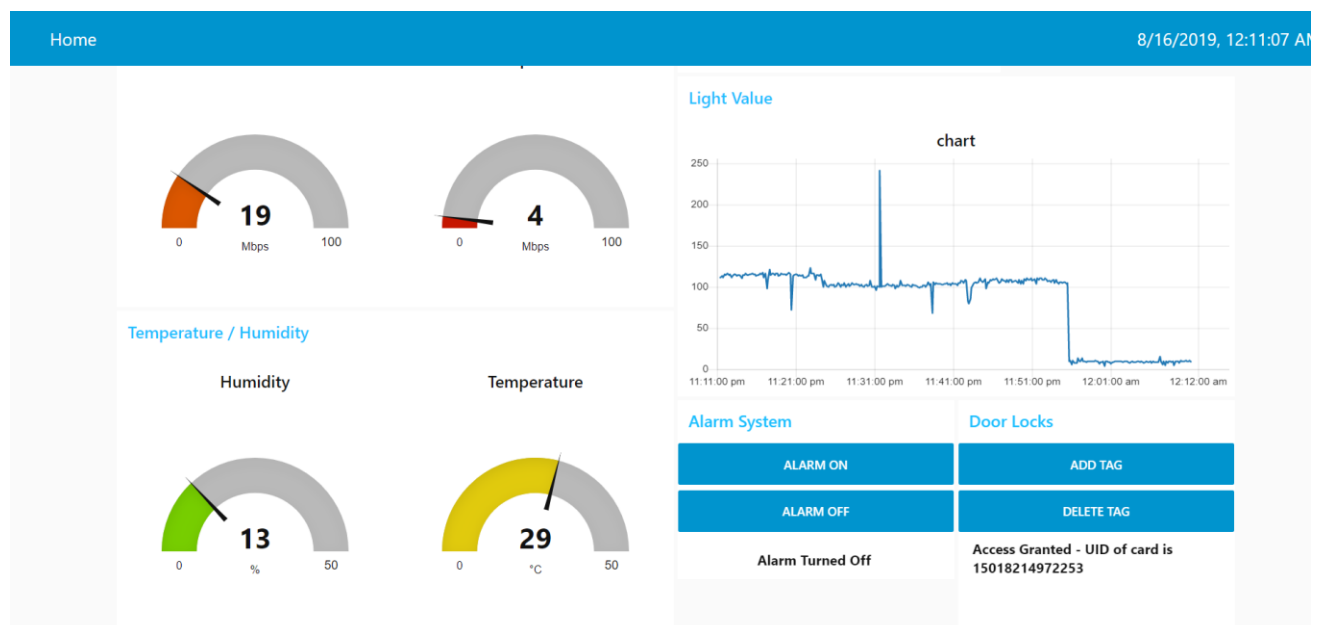
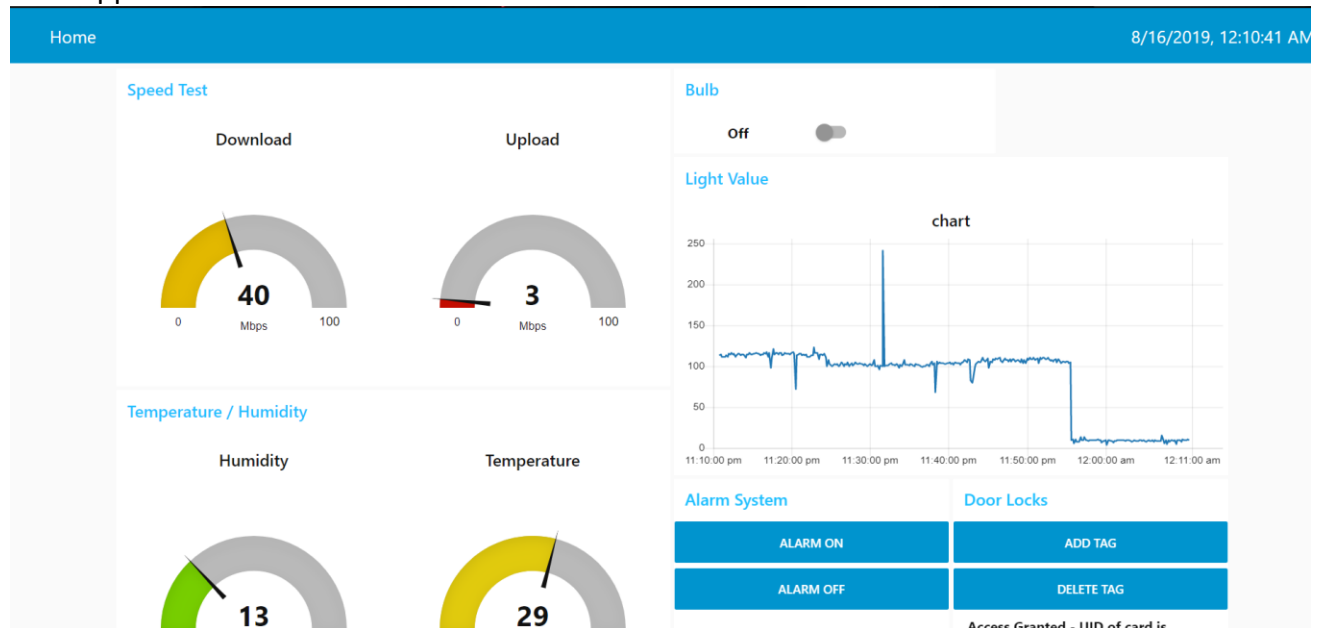
Our application aims to assist users in life. Our application has a wifi speed test, motion sensor, light detector, card reader and temperature sensor. Users can on and off their room light from the dashboard which is very convenient if the user feels that the room is dark and find their switch really far from their seats. The wifi speed test is there to ensure user has a stable connection at all times and when the wifi speed drops user will be able to see from the gauge and save their data before they get disconnected and lose all their progress. The temperature sensor is to tell user what is the temperature outside like and users will be able to gauge if it is a sunny day or a cloudy day. The card reader is to unlock the house door. Lastly, the motion sensor allows user to on the alarm which will trigger when it detects motion and then the user will receive an image on their telegram and email, and a message from twilio saying that there is an intruder

C. How does the final RPI set-up looks like?

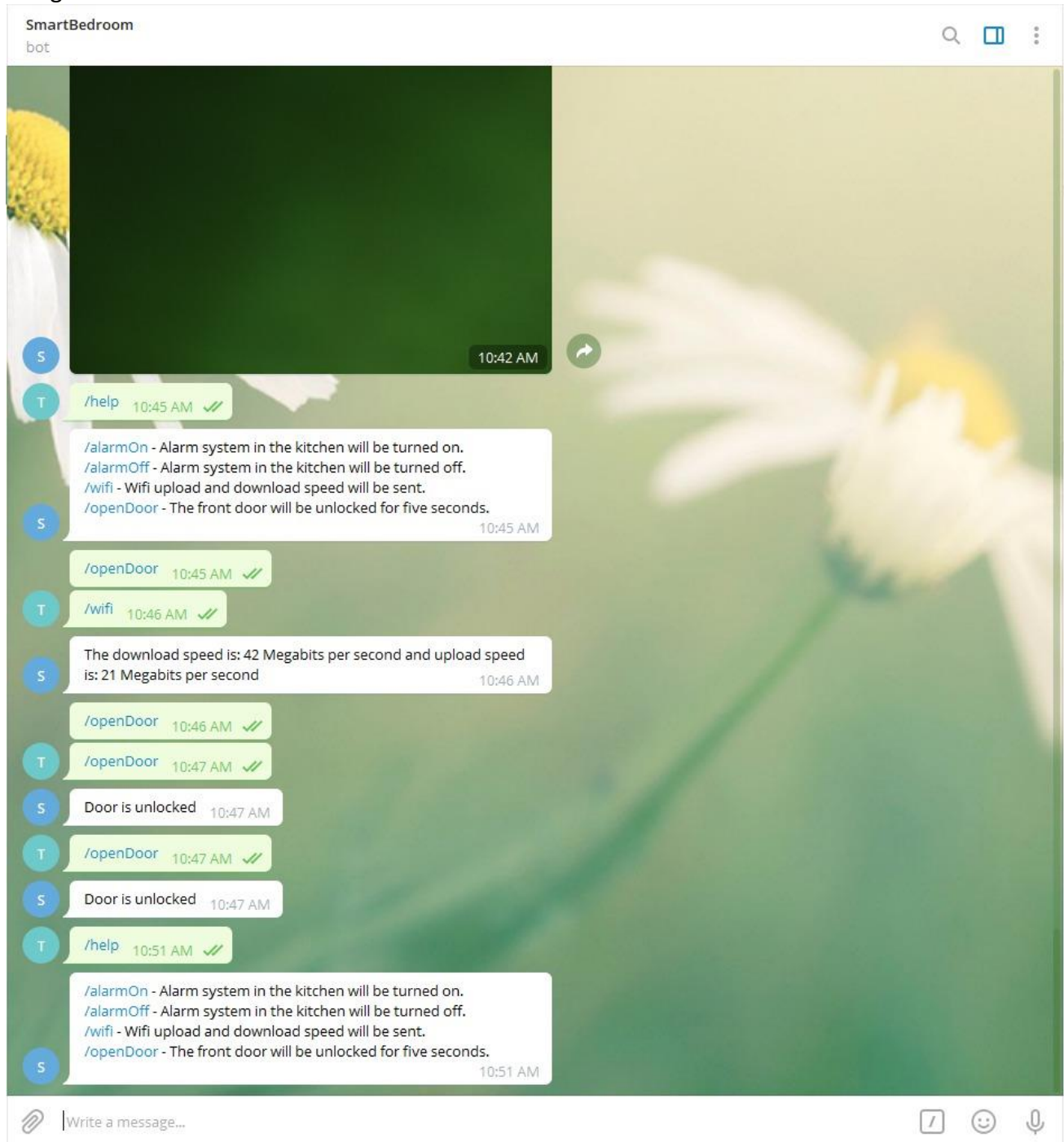


D. How does the web or mobile application look like?

Web App

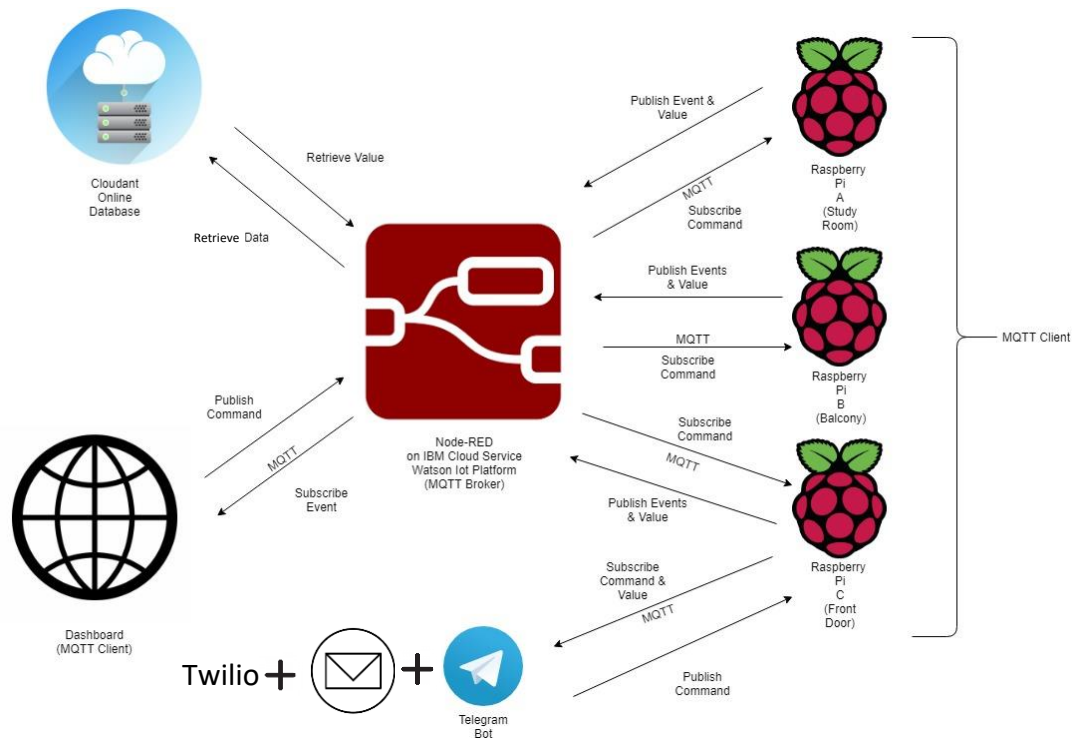


TelegramBot



E. System architecture of our system

Provide a hand-drawn or computer-drawn system architecture diagram please. Example given below.



F. Evidence that we have met basic requirements

Provide bullet list to describe how your group has met basic requirements

Requirement	Evidence
Used three sensors	Used light sensor, wifi adapter, temperature sensor, motion sensor
Used MQTT	Our MQTT endpoint. Examples will be speedtest-download, speedtest-upload Example of data sent through MQTT : Light value, Temperature value, Wifi Speed value
Stored data in cloud	Stored light data in Cloudant database in IBM cloud
Used cloud service	Hosted web server on ibm
Provide real-time sensor value / status	Show the real-time value of temperature sensor and wifi adapter
Provide historical sensor value/ status	Show historical value of light sensor
Control actuator	Placed button on webpage to control light bulb

G. Bonus features on top of basic requirements

Provide bullet list of the bonus features you have added on top of basic requirements

- a) Telegram bot can check wifi speed by pulling data from IBM
- b) Telegram bot can activate alarm.
- c) Telegram will receive image when motion is detected.
- d) Email will receive image when motion is detected.

A. Quick-start guide (Readme first)

Give a few lines of basic instructions on how I need to run your app, e.g

- 1) First connect hardware as in Section 3 for Raspberry Pi A, B and C.
- 2) Install nodes needed after copying the codes for the node red to separate devices. Copy code A for Raspberry Pi A's node red, code B for Raspberry Pi B's node red, code C for Raspberry Pi C's node red and Code IBM to IBM's node red.
- 3) Create gateways and add a device for each gateway.
- 4) Authenticate the 3 different Raspberry Pi and each Pi will be linked to one gateway and one gateway can only be linked to one Raspberry Pi.
- 5) Change all watson iot output node's credential from all Raspberry Pi and connect them with IBM's node red.
- 6) Change all watson iot input and output nodes from IBM respectively to the Raspberry Pi that sends out the values to IBM or takes the values from IBM.
- 7) Create databases from cloudant with names 'download', 'upload', 'access', 'light', 'temp' and 'hum'.
- 8) Select the service from the cloudant node to your own cloudant service
- 9) Reconfigure telegram nodes with your own Bot-Name, Token, User and Chat Id
- 10) Reconfigure email node and add your own email.
- 11) Reconfigure twilio and use your own account and add your own phone number.
- 12) Download the 3 js file and move it to Raspberry Pi C's root directory.
- 13) Reconfigure the Daemon node and add the route for the js files to the arguments.

Section 2

Hardware requirements

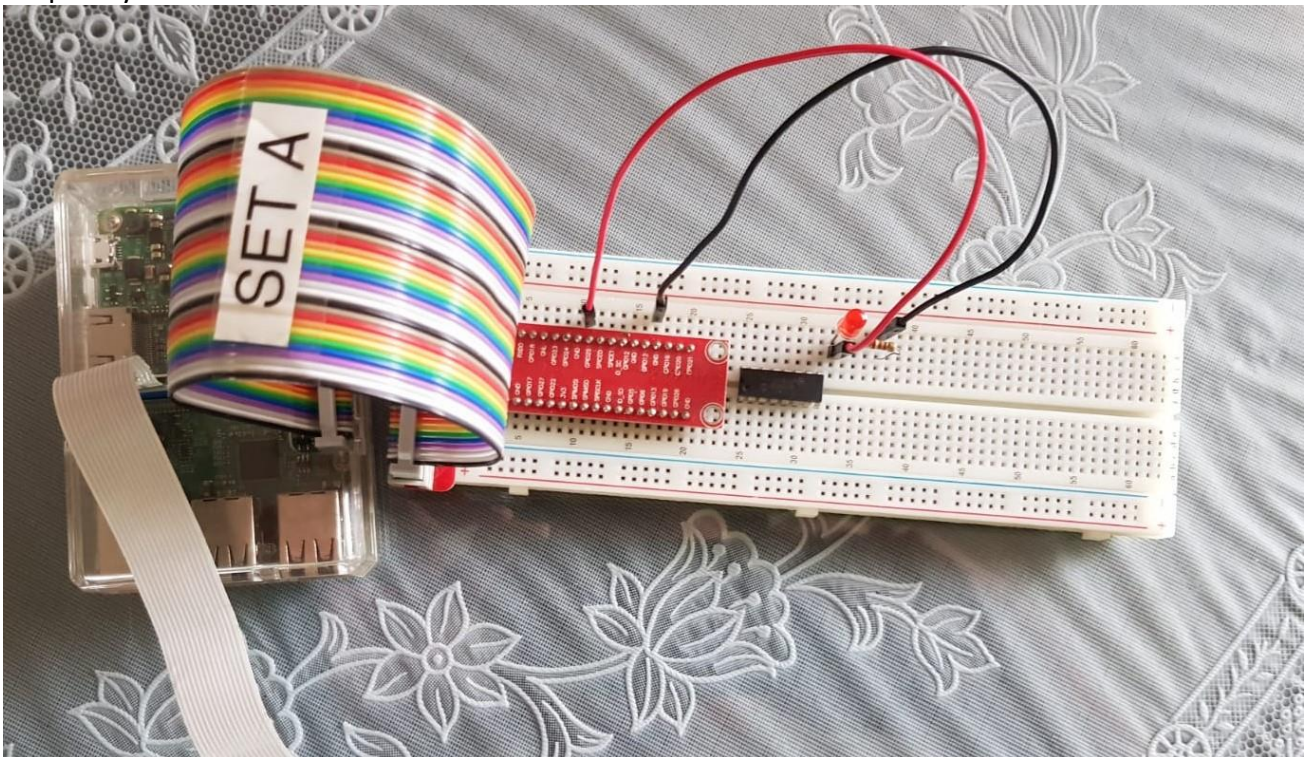
Hardware checklist

4 Bulb, 1 DHT 11, 1 LDR, 1 Motion Sensor, 1 Buzzer, 1 RFID reader, 1 RFID card,
3 Raspberry Pi 3 Model B set with NoIR Camera Board

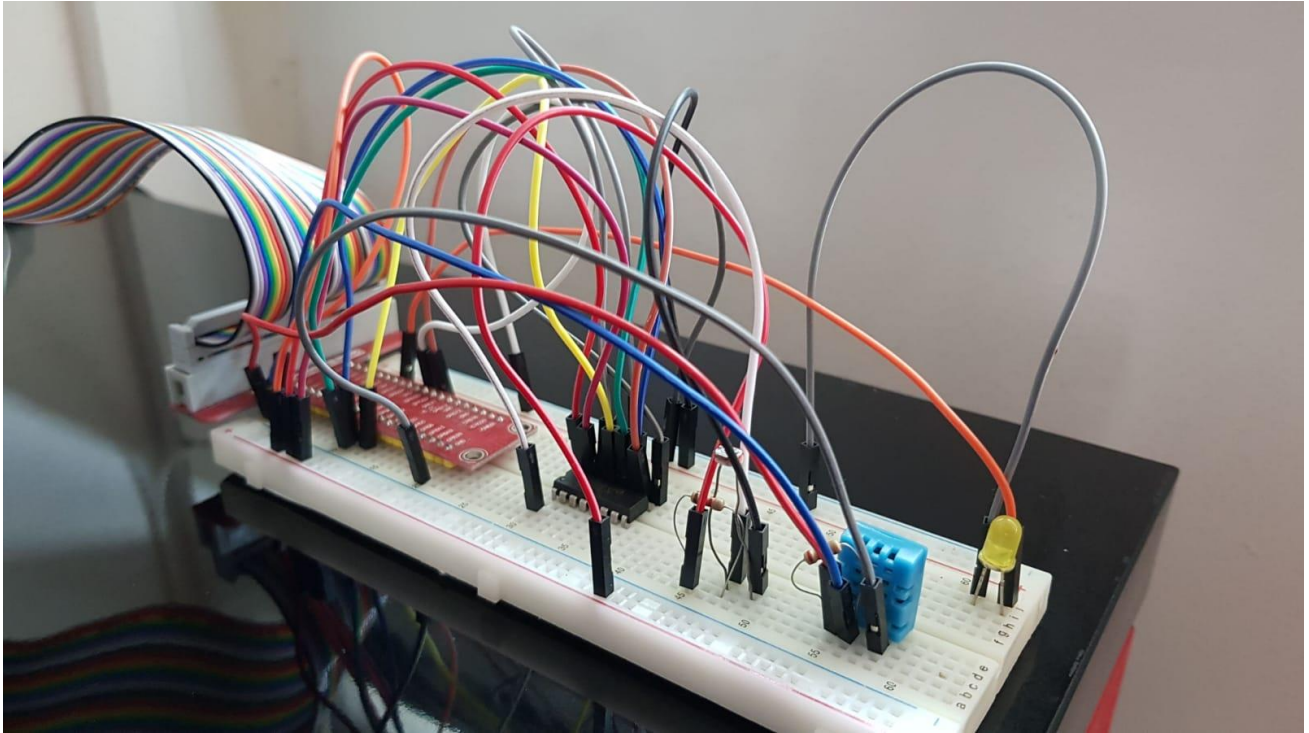
Section 3

Setup

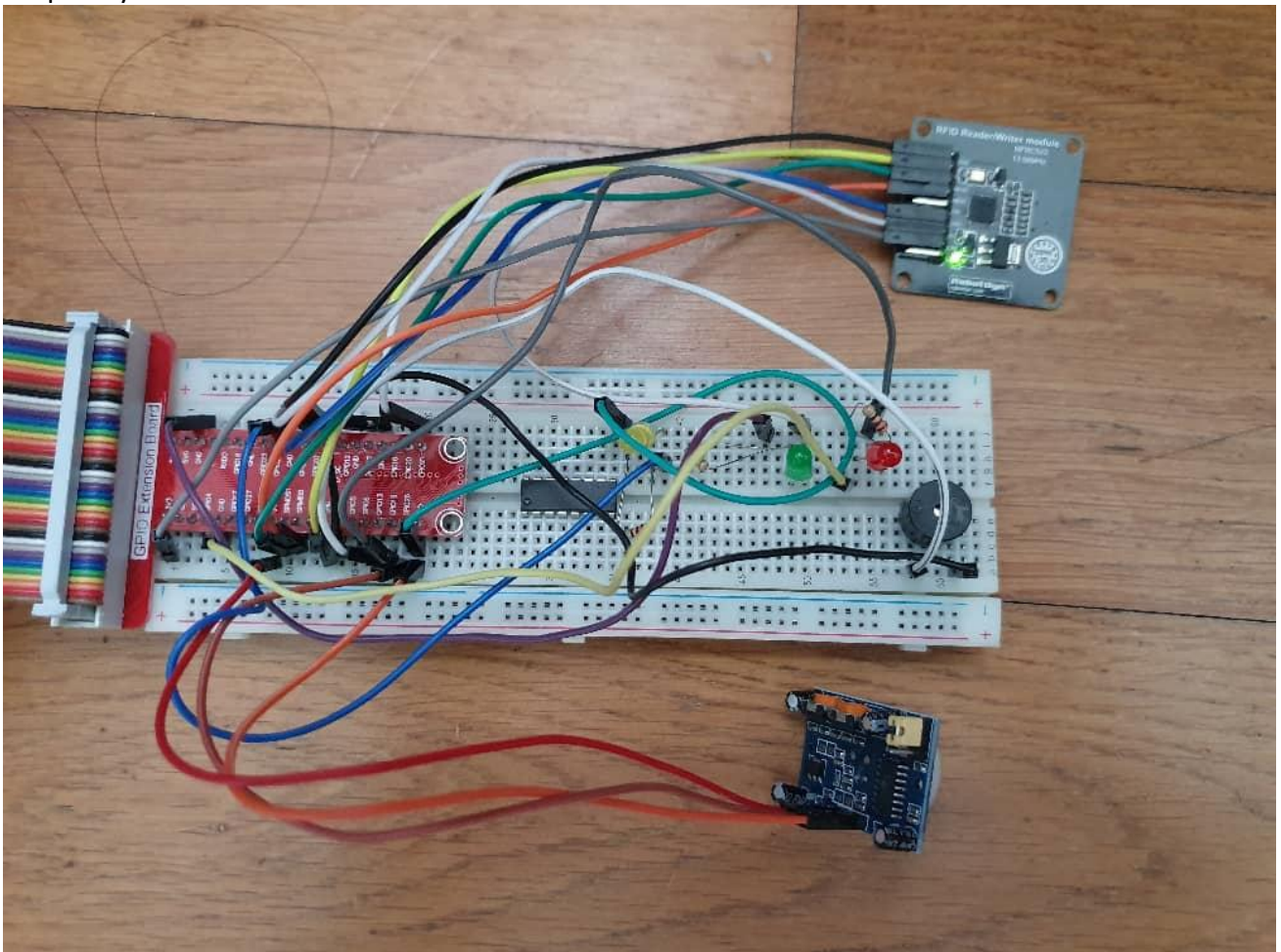
Raspberry Pi A



Raspberry Pi B



Raspberry Pi C



Section 4

Node red codes

Raspberry Pi A's Node Red Code:

```
[{"id":"13a78b57.773d35","type":"tab","label":"Raspberry Pi A","disabled":false,"info":"","{
  "id":"7498066b.0fd4b8","type":"inject","z":"13a78b57.773d35","name":"Poll for internet speed every 15s","topic":"","payload":"","payloadType":"date","repeat":"15","crontab":"","once":false,"onceDelay":0.1,"x":180,"y":60,"wires":[["46536ca5.b4cff4"]]},
  {"id":"b80eb915.d38688","type":"function","z":"13a78b57.773d35","name":"set download values","func":"var download = msg.payload.speeds.download;\n\nmsg.payload = Math.ceil(download);\n\nglobal.set('downloadval', msg.payload)\n\nreturn msg;","outputs":1,"noerr":0,"x":580,"y":80,"wires":[["f5320a92.50f7b8"]]},
  {"id":"ffc8b466.bd1238","type":"inject","z":"13a78b57.773d35","name":"Send upload value to Bluemix","topic":"","payload":"","payloadType":"date","repeat":"30","crontab":"","once":false,"onceDelay":0.1,"x":670,"y":160,"wires":[["43d9f408.fbdb4c"]]},
  {"id":"43d9f408.fbdb4c","type":"function","z":"13a78b57.773d35","name":"Format msg for speedtest","func":"speed2 = global.get('uploadval')\n\nmsg.payload = speed2\n\nreturn msg;","outputs":1,"noerr":0,"x":650,"y":220,"wires":[["8bea1e7a.778d3","39402e8f.f6ca22"]]},
  {"id":"f5320a92.50f7b8","type":"debug","z":"13a78b57.773d35","name":"","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"payload","targetType":"msg","x":770,"y":80,"wires":[[]]},
  {"id":"8bea1e7a.778d3","type":"debug","z":"13a78b57.773d35","name":"","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"false","x":870,"y":280,"wires":[[]]},
  {"id":"739f96c.1fe7868","type":"inject","z":"13a78b57.773d35","name":"Send download value to Bluemix","topic":"","payload":"","payloadType":"date","repeat":"30","crontab":"","once":false,"onceDelay":0.1,"x":180,"y":160,"wires":[["15875458.e7b1bc"]]},
  {"id":"15875458.e7b1bc","type":"function","z":"13a78b57.773d35","name":"Format msg for speedtest","func":"speed1 = global.get('downloadval')\n\nmsg.payload = speed1\n\nreturn msg;","outputs":1,"noerr":0,"x":150,"y":220,"wires":[["9c521b1e.3d2cd8","f78a0afc.c678e8"]]},
  {"id":"9c521b1e.3d2cd8","type":"debug","z":"13a78b57.773d35","name":"","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"false","x":370,"y":280,"wires":[[]]},
  {"id":"ceb9174a.f3add8","type":"function","z":"13a78b57.773d35","name":"set upload values","func":"var upload = msg.payload.speeds.upload;\n\nmsg.payload = Math.ceil(upload);\n\nglobal.set('uploadval', msg.payload)\n\nreturn msg;","outputs":1,"noerr":0,"x":570,"y":40,"wires":[["494cd6e1.b66318"]]},
  {"id":"494cd6e1.b66318","type":"debug","z":"13a78b57.773d35","name":"","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"payload","targetType":"msg","x":770,"y":40,"wires":[[]]},
  {"id":"de2a6cb3.e1b37","type":"rpi-gpio out","z":"13a78b57.773d35","name":"LED","pin":"22","set":true,"level":"0","freq":"","out":"out","x":590,"y":360,"wires":[[]]},
  {"id":"c71af0a1.30e7f","type":"debug","z":"13a78b57.773d35","name":"","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"false","x":610,"y":400,"wires":[[]]},
  {"id":"caaaebb3.f80f48","type":"function","z":"13a78b57.773d35","name":"Filter the
```

```
command","func":"msg.payload = msg.payload.led\nreturn
msg;","outputs":1,"noerr":0,"x":410,"y":360,"wires":[["de2a6cb3.e1b37","c71af0a1.30e7f"]],{"id":
"46536ca5.b4cff4","type":"speedtest","z":"13a78b57.773d35","name":"","maxTime":5000,"x":400,
"y":60,"wires":[["b80eb915.d38688","ceb9174a.f3add8"]],{"id":"d4514f9a.ef6cf","type":"wiotp
in","z":"13a78b57.773d35","authType":"g","deviceKey":"4615215c.6cf4d","deviceType":"","devicel
d":"","command":"Bulb","commandType":"g","qos":"1","name":"Listen to LED command from
IBM","x":170,"y":360,"wires":[["caaaebb3.f80f48"]],{"id":"39402e8f.f6ca22","type":"wiotp
out","z":"13a78b57.773d35","authType":"g","qs":"false","qsDeviceId":"","deviceKey":"4615215c.6c
f4d","deviceType":"gw-p1804375","deviceId":"gwid-p1804375","event":"speedtest-
upload","format":"String","qos":"1","name":"Sending To
IBM","x":620,"y":280,"wires":[],{"id":"f78a0afc.c678e8","type":"wiotp
out","z":"13a78b57.773d35","authType":"g","qs":"false","qsDeviceId":"","deviceKey":"4615215c.6c
f4d","deviceType":"gw-p1804375","deviceId":"gwid-p1804375","event":"speedtest-
download","format":"String","qos":"1","name":"Sending To
IBM","x":120,"y":280,"wires":[],{"id":"4615215c.6cf4d","type":"wiotp-
credentials","z":"","name":"","org":"k6be3c","serverName":"k6be3c.messaging.internetofthings.ib
mcloud.com","devType":"gw-p1804375","devId":"gwid-
p1804375","keepalive":"60","cleansession":true,"tls":"","usetls":false}}
```

Raspberry Pi B's Node Red Code:

```
[{"id":"c03da4a.c92c858","type":"tab","label":"CA2","disabled":false,"info":""},{
{"id":"11ccae22.d877f2","type":"function","z":"c03da4a.c92c858","name":"store light value","func":"global.set('light',
msg.payload)","outputs":1,"noerr":0,"x":600,"y":80,"wires":[["382200f0.61e7f"]],{"id":"b329c567.
605718","type":"inject","z":"c03da4a.c92c858","name":"poll for light values every 3
secs","topic":"","payload":"","payloadType":"date","repeat":"","crontab":"","once":false,"onceDela
y":0.1,"x":130,"y":80,"wires":[["fcc6e6bc.4af258"]],{"id":"fcc6e6bc.4af258","type":"pimcp3008","z
":"c03da4a.c92c858","name":"","dev":"3008","pin":0,"dnum":0,"bus":0,"x":390,"y":80,"wires":[["1
1ccae22.d877f2"]],{"id":"382200f0.61e7f","type":"debug","z":"c03da4a.c92c858","name":"","activ
e":true,"tosidebar":true,"console":false,"tostatus":false,"complete":false,"x":800,"y":80,"wires":[
],{"id":"c0051b6a.ffae68","type":"wiotp
out","z":"c03da4a.c92c858","authType":"g","qs":"false","qsDeviceId":"","deviceKey":"bafc303a.c5c
a9","deviceType":"gw-p1828555","deviceId":"gwid-
p1828555","event":"light","format":"json","qos":"0","name":"Send Light Value to
IBM","x":790,"y":200,"wires":[],{"id":"478ac592.37374c","type":"debug","z":"c03da4a.c92c858","n
ame":"","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"payload","targe
tType":"msg","x":750,"y":260,"wires":[],{"id":"91a8f62c.bd2d08","type":"function","z":"c03da4a.c
92c858","name":"format the msg","func":"light = global.get('light')\nmsg.payload = {'d': {'light':
light}}\nreturn
msg;\n","outputs":1,"noerr":0,"x":400,"y":220,"wires":[["2b9fec80.d9e214"]],{"id":"fa35ee58.353
7b","type":"inject","z":"c03da4a.c92c858","name":"Send light values to IBM
Cloud","topic":"","payload":"","payloadType":"date","repeat":"10","crontab":"","once":false,"once
Delay":0.1,"x":150,"y":220,"wires":[["91a8f62c.bd2d08"]],{"id":"2b9fec80.d9e214","type":"json","
z":"c03da4a.c92c858","name":"","property":"payload","action":"","pretty":false,"x":590,"y":220,"w
ires":[["c0051b6a.ffae68","478ac592.37374c"]],{"id":"256cef5f.c68f5","type":"debug","z":"c03da4
a.c92c858","name":"","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":tr
ue,"targetType":"full","x":570,"y":340,"wires":[],{"id":"b102330b.c2bf3","type":"rpi-
dht22","z":"c03da4a.c92c858","name":"","topic":"rpi-
```



```

dht22","dht":"11","pintype":"0","pin":4,"x":380,"y":340,"wires":[["256cef5f.c68f5","d503cdd2.319
38","9adac46d.7a18f8"]],{"id":"a8ab7be.74c0388","type":"debug","z":"c03da4a.c92c858","name":
":"","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"false","x":730,"y":440
,"wires":[]},{"id":"a6da5c31.630e9","type":"debug","z":"c03da4a.c92c858","name":"","active":true,
"tosidebar":true,"console":false,"tostatus":false,"complete":"false","x":710,"y":560,"wires":[]},{"id
":"d503cdd2.31938","type":"function","z":"c03da4a.c92c858","name":"humidity","func":"msg.payload
ad=msg.humidity;\nreturn
msg;","outputs":1,"noerr":0,"x":520,"y":500,"wires":[["a6da5c31.630e9","4915662a.554eb8"]],{"id
":"12e946d2.5d1ae9","type":"wiotp
out","z":"c03da4a.c92c858","authType":"g","qs":"false","qsDeviceId":"","deviceKey":"bafc303a.c5c
a9","deviceType":"gw-p1828555","deviceId":"gwid-
p1828555","event":"temperature","format":"String","qos":"0","name":"Send Temperature Value
to IBM","x":790,"y":380,"wires":[]},{"id":"4915662a.554eb8","type":"wiotp
out","z":"c03da4a.c92c858","authType":"g","qs":"false","qsDeviceId":"","deviceKey":"bafc303a.c5c
a9","deviceType":"gw-p1828555","deviceId":"gwid-
p1828555","event":"humidity","format":"String","qos":"0","name":"Send humidity Value to
IBM","x":760,"y":500,"wires":[]},{"id":"9adac46d.7a18f8","type":"function","z":"c03da4a.c92c858",
"name":"temperature","func":"msg.payload = msg.payload\nreturn
msg;","outputs":1,"noerr":0,"x":550,"y":420,"wires":[["a8ab7be.74c0388","12e946d2.5d1ae9"]],{"i
d":"5c4798f8.c065a8","type":"inject","z":"c03da4a.c92c858","name":"poll for light values every 5
secs","topic":"","payload":"","payloadType":"date","repeat":"5","crontab":"","once":false,"onceDel
ay":0.1,"x":160,"y":340,"wires":[["b102330b.c2bf3"]],{"id":"bd48a069.ace49","type":"wiotp
in","z":"c03da4a.c92c858","authType":"g","deviceKey":"bafc303a.c5ca9","deviceType":"","deviceId
":"","command":"led","commandType":"g","qos":0,"name":"Recieve LED Status FROM
IBM","x":150,"y":620,"wires":[["fc261bd5.064838"]],{"id":"fc261bd5.064838","type":"function","z
":"c03da4a.c92c858","name":"Convert","func":"msg.payload = msg.payload.led\nreturn
msg;\n","outputs":1,"noerr":0,"x":360,"y":620,"wires":[["c6593605.fb1da8","389ff4f4.aa3f8c"]],{"i
d":"389ff4f4.aa3f8c","type":"debug","z":"c03da4a.c92c858","name":"","active":true,"tosidebar":tr
ue,"console":false,"tostatus":false,"complete":"false","x":570,"y":620,"wires":[]},{"id":"c6593605.fb
1da8","type":"rpi-gpio out","z":"c03da4a.c92c858","name":"LED
OUTPUT","pin":"12","set":false,"level":"0","freq":"","out":"out","x":580,"y":680,"wires":[]},{"id":"b
afc303a.c5ca9","type":"wiotp-credentials","z":"","name":"My Raspberry Pi
Gateway","org":"k6be3c","serverName":"k6be3c.messaging.internetofthings.ibmcloud.com","devT
ype":"gw-p1828555","devId":"gwid-
p1828555","keepalive":"60","cleansession":true,"tls":"","usetls":false}]

```

Raspberry Pi C's Node Red Code:

```

[{"id":"88adc5ee.65ea88","type":"tab","label":"Telegram Bot and Alarm
System","disabled":false,"info":""},{"id":"ee0b8aa6.b73c38","type":"rpi-gpio
in","z":"88adc5ee.65ea88","name":"motion","pin":"37","intype":"tri","debounce":"25","read":true,
"x":90,"y":160,"wires":[["25d8bb36.db2334","a8787a4d.0d8be8","dbe6c2f6.59152"]],{"id":"8eb3f
2b.19cc91","type":"debug","z":"88adc5ee.65ea88","name":"","active":true,"tosidebar":true,"conso
le":false,"tostatus":false,"complete":"payload","targetType":"msg","x":770,"y":100,"wires":[]},{"id":
"b633a6a1.f08d08","type":"rpi-gpio
out","z":"88adc5ee.65ea88","name":"","pin":"12","set":true,"level":"0","freq":"","out":"out","x":78
0,"y":40,"wires":[]},{"id":"25d8bb36.db2334","type":"trigger","z":"88adc5ee.65ea88","op1":"1","op
2":"0","op1type":"str","op2type":"str","duration":"10","extend":true,"units":"s","reset":"","name":

```

```

    "x":410,"y":40,"wires":[["b633a6a1.f08d08"]]],{"id":"a8787a4d.0d8be8","type":"function","z":"8
8adc5ee.65ea88","name":"Send 1 if motion is detected","func":"motion = msg.payload;\nif (motion
== 1){\nreturn
msg;\n}","outputs":"2","noerr":0,"x":460,"y":160,"wires":[["8eb3f2b.19cc91"],[]]],{"id":"17827811.f
1b2b8","type":"inject","z":"88adc5ee.65ea88","name":"","topic":"button","payload":"1","payloadT
ype":"num","repeat":"","crontab":"","once":false,"onceDelay":"","x":100,"y":240,"wires":[["dbe6c2
f6.59152"]]],{"id":"dbe6c2f6.59152","type":"function","z":"88adc5ee.65ea88","name":"Alarm On
Off Logic","func":"context.motion = context.motion || 0;\ncontext.button = context.button ||
0;\n\nif (msg.topic === 'button') {\n context.button = msg.payload;\n} else {\n context.motion =
msg.payload;\n}\n\nif (context.motion == 1 && context.button == 1 ) {\n return
msg;\n}","outputs":1,"noerr":0,"x":910,"y":240,"wires":[["c902727a.a94c7","1859c3d8.f4240c","13
f518ba.50c047"]]],{"id":"505adb39.2bb4d4","type":"inject","z":"88adc5ee.65ea88","name":"","topi
c":"button","payload":"0","payloadType":"num","repeat":"","crontab":"","once":false,"x":100,"y":2
80,"wires":[["dbe6c2f6.59152"]]],{"id":"6793a51a.ba16fc","type":"rpi-gpio
out","z":"88adc5ee.65ea88","name":"Buzzer","pin":"33","set":true,"level":"0","out":"out","x":1380
,"y":240,"wires":[]],{"id":"c902727a.a94c7","type":"trigger","z":"88adc5ee.65ea88","op1":"1","op2
":"0","op1type":"str","op2type":"str","duration":"1","extend":true,"units":"s","reset":"","name":"","
"x":1120,"y":240,"wires":[["6793a51a.ba16fc"]]],{"id":"ccd8fac4.c61cb8","type":"camerapi-
takephoto","z":"88adc5ee.65ea88","filemode":"1","filename":"foto.jpeg","filedefpath":"0","filepat
h":"/home/pi/Pictures/","fileformat":"jpeg","resolution":"3","rotation":"0","flip":"0","flipv":"0","b
rightness":"50","contrast":"0","sharpness":"0","quality":"80","imageeffect":"none","exposuremode
":"auto","iso":"0","agcwait":"1.0","led":"0","awb":"auto","name":"Take
photo","x":1390,"y":340,"wires":[["6717e098.5b241","2ccf2c0b.0ff9e4","560ab77e.b3ba38","c706
661d.66c738"]]],{"id":"623057e1.3bb918","type":"telegram
sender","z":"88adc5ee.65ea88","name":"","bot":"73f1a0a8.7affa","x":2150,"y":340,"wires":[]],{"i
d":"4ec6bce5.530504","type":"function","z":"88adc5ee.65ea88","name":"Send
photo","func":"msg.payload = {}\nmsg.payload.chatId = 634903049\nmsg.payload.type =
'photo'\nmsg.payload.content = '/home/pi/Pictures/test.jpeg';\nreturn msg;\n/* type can be one
of the
following\nphoto\naudio\nvideo\nsticker\nvoice\ndocument\n*/","outputs":1,"noerr":0,"x":1890,
"y":340,"wires":[["623057e1.3bb918"]]],{"id":"6717e098.5b241","type":"delay","z":"88adc5ee.65e
a88","name":"","pauseType":"delay","timeout":"2","timeoutUnits":"seconds","rate":"1","nbRateU
nits":"1","rateUnits":"second","randomFirst":"1","randomLast":"5","randomUnits":"seconds","drop
":false,"x":1660,"y":340,"wires":[["4ec6bce5.530504"]]],{"id":"2ccf2c0b.0ff9e4","type":"function","
z":"88adc5ee.65ea88","name":"Send alert","func":"msg.payload = {}\nmsg.payload.chatId =
634903049\nmsg.payload.type = 'message'\nmsg.payload.content = 'Intruder detected!';\nreturn
msg;\n\n","outputs":1,"noerr":0,"x":1670,"y":520,"wires":[["d890ab26.b7f408"]]],{"id":"d890ab26.
b7f408","type":"telegram
sender","z":"88adc5ee.65ea88","name":"","bot":"73f1a0a8.7affa","x":2150,"y":520,"wires":[]],{"i
d":"1859c3d8.f4240c","type":"delay","z":"88adc5ee.65ea88","name":"","pauseType":"rate","timeo
ut":"5","timeoutUnits":"seconds","rate":"1","nbRateUnits":"10","rateUnits":"second","randomFirst
":"1","randomLast":"5","randomUnits":"seconds","drop":false,"x":1140,"y":340,"wires":[["ccd8fac4
.c61cb8"]]],{"id":"6a3fab56.8307e4","type":"telegram
command","z":"88adc5ee.65ea88","name":"","command":"/alarmOn","bot":"73f1a0a8.7affa","stri
ct":false,"x":100,"y":400,"wires":[["f9750fc.d26b5f","b4d254a7.7a3108"],[]]],{"id":"f9750fc.d26b5f"
,"type":"function","z":"88adc5ee.65ea88","name":"Activate alarm","func":"msg.topic =
'button'\nmsg.payload = '1'\nreturn

```

```

msg;,"outputs":1,"noerr":0,"x":500,"y":320,"wires":[["5d53b897.871058"]]],{"id":"ac379f93.92763",
"type":"telegram
command","z":"88adc5ee.65ea88","name":"","command":"/alarmOff","bot":"73f1a0a8.7affa","strict":false,"x":100,"y":540,"wires":[["ba161e33.b2eb2","64cf0689.82da48"],[]]],{"id":"ba161e33.b2eb2",
"type":"function","z":"88adc5ee.65ea88","name":"Deactivate alarm","func":"msg.topic =
\\\"button\\\"\\nmsg.payload = '0'\\nreturn
msg;,"outputs":1,"noerr":0,"x":490,"y":460,"wires":[["dbe6c2f6.59152"]]],{"id":"5d53b897.871058",
"type":"change","z":"88adc5ee.65ea88","name":"","rules":[{"t":"set","p":"topic","pt":"msg","to":"button","tot":"str"}],"action":"","property":"","from":"","to":"","reg":false,"x":710,"y":320,"wires":[["dbe6c2f6.59152"]]],{"id":"b4d254a7.7a3108",
"type":"function","z":"88adc5ee.65ea88","name":"Response to user(Alarm Activated)","func":"msg.payload = {}\\nmsg.payload.chatId =
634903049\\nmsg.payload.type = 'message'\\nmsg.payload.content = 'Alarm Activated';\\nreturn
msg;\\n\\n","outputs":1,"noerr":0,"x":440,"y":400,"wires":[["946e96fc.49ada8","8a223c13.0bc78"]]],
{"id":"946e96fc.49ada8","type":"telegram
sender","z":"88adc5ee.65ea88","name":"","bot":"73f1a0a8.7affa","x":710,"y":360,"wires":[[]]],{"id":"64cf0689.82da48",
"type":"function","z":"88adc5ee.65ea88","name":"Response to user(Alarm Deactivated)","func":"msg.payload = {}\\nmsg.payload.chatId = 634903049\\nmsg.payload.type =
'message'\\nmsg.payload.content = 'Alarm Deactivated';\\nreturn
msg;\\n\\n","outputs":1,"noerr":0,"x":450,"y":540,"wires":[["9ed95cdd.52906","54ffbee1.40e7f"]]],{"id":"9ed95cdd.52906",
"type":"telegram
sender","z":"88adc5ee.65ea88","name":"","bot":"73f1a0a8.7affa","x":730,"y":520,"wires":[[]]],{"id":"15c6751f.81d66b",
"type":"telegram
command","z":"88adc5ee.65ea88","name":"","command":"/help","bot":"73f1a0a8.7affa","strict":false,"x":90,"y":640,"wires":[["9ca0b63f.677ae8"],[]]],{"id":"9ca0b63f.677ae8",
"type":"function","z":"88adc5ee.65ea88","name":"Response to user(Help)","func":"msg.payload =
{}\\nmsg.payload.chatId = 634903049\\nmsg.payload.type = 'message'\\nmsg.payload.content =
'/alarmOn - Alarm system in the kitchen will be turned on.\\n/alarmOff - Alarm system in the
kitchen will be turned off.\\n/wifi - Wifi upload and download speed will be sent.\\n/openDoor -
The front door will be unlocked for five seconds.';\\nreturn
msg;\\n\\n","outputs":1,"noerr":0,"x":410,"y":640,"wires":[["5da83faa.3fc7f"]]],{"id":"5da83faa.3fc7f",
"type":"telegram
sender","z":"88adc5ee.65ea88","name":"","bot":"73f1a0a8.7affa","x":730,"y":640,"wires":[[]]],{"id":"4b6a1e0c.09e71",
"type":"wiotp
in","z":"88adc5ee.65ea88","authType":"g","deviceKey":"cea8d751.87d4e8","deviceType":"","deviceId":"","command":"buttonOn","commandType":"g","qos":0,"name":"Waiting command to turn on
alarm from
IBM","x":210,"y":320,"wires":[["f9750fc.d26b5f","b4d254a7.7a3108"]]],{"id":"13f518ba.50c047",
"type":"debug","z":"88adc5ee.65ea88","name":"","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":false,"x":1130,"y":140,"wires":[[]]],{"id":"2ce87b05.eede84",
"type":"wiotp
in","z":"88adc5ee.65ea88","authType":"g","deviceKey":"cea8d751.87d4e8","deviceType":"","deviceId":"","command":"buttonOff","commandType":"g","qos":0,"name":"Waiting command to turn
off alarm from
IBM","x":210,"y":460,"wires":[["ba161e33.b2eb2","64cf0689.82da48"]]],{"id":"d0c9464a.186718",
"type":"wiotp
out","z":"88adc5ee.65ea88","authType":"g","qs":false,"qsDeviceId":"","deviceKey":"cea8d751.87d4e8","deviceType":"gw-p1843059","deviceId":"gwid-p1843059","event":"alarmon","format":"json","qos":0,"name":"Sending Alarm Status To

```



```

IBM", "x":1140, "y":420, "wires":[]}, {"id":"8a223c13.0bc78", "type":"function", "z":"88adc5ee.65ea88",
, "name":"Send status of alarm system to Ibm Cloud", "func":"msg.payload = 'Alarm turned
on\n\nreturn
msg;\n", "outputs":1, "noerr":0, "x":780, "y":460, "wires":[["d0c9464a.186718", "fc85c70a.fb8df8"]]}, {"
id":"40a47310.94d42c", "type":"wiotp
out", "z":"88adc5ee.65ea88", "authType":"g", "qs":"false", "qsDeviceId":"","deviceKey":"cea8d751.87
d4e8", "deviceType":"gw-p1843059", "deviceId":"gwid-
p1843059", "event":"alarmoff", "format":"json", "qos":"0", "name":"Sending Alarm Status To
IBM", "x":1140, "y":580, "wires":[]}, {"id":"54ffbee1.40e7f", "type":"function", "z":"88adc5ee.65ea88",
, "name":"Send status of alarm system to Ibm Cloud", "func":"msg.payload = 'Alarm turned
off\n\nreturn
msg;\n", "outputs":1, "noerr":0, "x":800, "y":580, "wires":[["40a47310.94d42c", "fc85c70a.fb8df8"]]}, {"
id":"fc85c70a.fb8df8", "type":"debug", "z":"88adc5ee.65ea88", "name":"","active":true, "tosidebar":t
rue, "console":false, "tostatus":false, "complete":"false", "x":1090, "y":500, "wires":[]}, {"id":"b8ad7d6b
.b0cae", "type":"telegram
command", "z":"88adc5ee.65ea88", "name":"/wifi", "command":"/wifi", "bot":"73f1a0a8.7affa", "stric
t":false, "x":90, "y":820, "wires":[["b8d4d49d.3fd6d8"], []]}, {"id":"9db14cb.153bdb", "type":"telegram
sender", "z":"88adc5ee.65ea88", "name":"","bot":"73f1a0a8.7affa", "x":990, "y":720, "wires":[[]]}, {"id
":"72533360.6ef86c", "type":"wiotp
in", "z":"88adc5ee.65ea88", "authType":"g", "deviceKey":"cea8d751.87d4e8", "deviceType":"","devic
eld":"","command":"wifi", "commandType":"g", "qos":0, "name":"Retrieving Wifi Speed from
IBM", "x":170, "y":720, "wires":[["ca94df91.b3128"]]}, {"id":"ca94df91.b3128", "type":"function", "z":"
88adc5ee.65ea88", "name":"Retrieve message information from IBM Cloud ", "func":"return
msg;\n", "outputs":1, "noerr":0, "x":600, "y":720, "wires":[["9db14cb.153bdb", "98966b7a.24d6f8"]]}, {
"id":"b8d4d49d.3fd6d8", "type":"function", "z":"88adc5ee.65ea88", "name":"Send signal to parse
wifi info to local RPI", "func":"msg.topic = 'wifisend'\nmsg.payload = '1'\n\nreturn
msg;", "outputs":1, "noerr":0, "x":420, "y":820, "wires":[["7c3770c0.daab2"]]}, {"id":"7c3770c0.daab2",
, "type":"change", "z":"88adc5ee.65ea88", "name":"","rules":[{"t":"set", "p":"topic", "pt":"msg", "to":"
wifisend", "tot":"str"}], "action":"","property":"","from":"","to":"","reg":false, "x":730, "y":820, "wires"
:[["14743ed6.7f1f11"]]}, {"id":"14743ed6.7f1f11", "type":"wiotp
out", "z":"88adc5ee.65ea88", "authType":"g", "qs":"false", "qsDeviceId":"","deviceKey":"cea8d751.87
d4e8", "deviceType":"gw-p1843059", "deviceId":"gwid-
p1843059", "event":"wifisend", "format":"json", "qos":"0", "name":"Send command to retrieve wifi
info to IBM", "x":1140, "y":820, "wires":[]}, {"id":"560ab77e.b3ba38", "type":"file
in", "z":"88adc5ee.65ea88", "name":"Snapshot
photo", "filename":"/home/pi/Pictures/test.jpeg", "format":"","chunk":false, "sendError":true, "enco
ding":"none", "x":1680, "y":260, "wires":[["875f8ed3.36478"]]}, {"id":"875f8ed3.36478", "type":"functi
on", "z":"88adc5ee.65ea88", "name":"Email-subject: Someone has
arrived", "func":"msg.topic=\"Someone has arrived\"\nmsg.filename=\"test.jpeg\"\n\nreturn
msg;", "outputs":1, "noerr":0, "x":1970, "y":260, "wires":[["b4fc881f.5f07e8"]]}, {"id":"b4fc881f.5f07e8
", "type":"e-
mail", "z":"88adc5ee.65ea88", "server":"smtp.gmail.com", "port":465, "secure":true, "tls":false, "na
me":"jackyso2000@gmail.com", "dname":"","x":2310, "y":260, "wires":[]}, {"id":"6a54d045.57b81", "t
ype":"twilio
out", "z":"88adc5ee.65ea88", "twilio":"6295e48a.8fee5c", "twilioType":"sms", "url":"","number":"+65
81789275", "name":"","x":2250, "y":180, "wires":[]}, {"id":"c706661d.66c738", "type":"template", "z":"
88adc5ee.65ea88", "name":"Activity is

```

```

detected","field":"payload","fieldType":"msg","format":"handlebars","syntax":"mustache","templa
te":"Some activity is being detected in front of your
house","x":1690,"y":180,"wires":[["6a54d045.57b81"]]],{"id":"98966b7a.24d6f8","type":"debug","z
":"88adc5ee.65ea88","name":"","active":true,"tosidebar":true,"console":false,"tostatus":false,"co
mplete":false,"x":630,"y":760,"wires":[]},{"id":"73f1a0a8.7affa","type":"telegram
bot","z":"","botname":"SmartBedroom","username":"Titan","chatids":"634903049","baseapiurl":"
","updateMode":"polling","pollInterval":"300","useSocks":false,"socksHost":"","socksPort":"6667","
socksUsername":"anonymous","socksPassword":"","bothost":"","localBotPort":"8443","publicBotP
ort":"8443","privateKey":"","certificate":"","useSelfSignedCertificate":false,"verboseLogging":false},{
"id":"cea8d751.87d4e8","type":"wiotp-credentials","z":"","name":"My Raspberry Pi
Gateway","org":"k6be3c","serverName":"k6be3c.messaging.internetofthings.ibmcloud.com","devT
ype":"gw-p1843059","devId":"gwid-
p1843059","keepAlive":"60","cleanSession":true,"tls":"","usetls":false},{id":"6295e48a.8fee5c","ty
pe":"twilio-
api","z":"","name":"","sid":"AC587183b028f06526fc4a0348534c8c17","from":"+12055283983"}}

```

Raspberry Pi C's Node Red Code for RFID:

```

{"id":"cb977296.ed02","type":"tab","label":"RFID
Reader","disabled":false,"info":"","z":"cb977296.ed02","na
me":"","topic":"","payload":"true","payloadType":"bool","repeat":"","crontab":"","once":false,"onc
eDelay":0.1,"x":110,"y":460,"wires":[["9be46cc6.96b78"]]],{"id":"9be46cc6.96b78","type":"exec","z
":"cb977296.ed02","command":"sudo python
Add.py","addPay":false,"append":"","useSpawn":false,"timer":"","oldrc":false,"name":"Execute
Add.py","x":540,"y":400,"wires":[["e9deacb4.259cf","ce01d4b0.efa3a8"],[],[]]],{"id":"f456a1ed.2d4
6b","type":"inject","z":"cb977296.ed02","name":"","topic":"","payload":"true","payloadType":"boo
l","repeat":"","crontab":"","once":false,"onceDelay":0.1,"x":110,"y":660,"wires":[["51563678.f3f16
8"]]],{"id":"51563678.f3f168","type":"exec","z":"cb977296.ed02","command":"sudo python
Del.py","addPay":false,"append":"","useSpawn":false,"timer":"","oldrc":false,"name":"","x":650,"
y":600,"wires":[["7f81e1f6.ca1d6","ce01d4b0.efa3a8"],[],[]]],{"id":"d67c6ee7.22db5","type":"functi
on","z":"cb977296.ed02","name":"If access denied then execute this","func":"access =
msg.payload;\nif (access.includes(\"Denied\")){\nreturn
msg;\n}","outputs":1,"noerr":0,"x":500,"y":120,"wires":[["26d3a7b0.fd7b18","285adc4d.418054"]]]
,{"id":"28bd9160.06572e","type":"rpi-gpio out","z":"cb977296.ed02","name":"Sound the buzzer for
one
second","pin":"33","set":true,"level":"0","freq":"","out":"out","x":1220,"y":40,"wires":[]},{"id":"26d
3a7b0.fd7b18","type":"trigger","z":"cb977296.ed02","op1":"1","op2":"0","op1type":"str","op2type
":"str","duration":"1","extend":true,"units":"s","reset":"","name":"","x":900,"y":40,"wires":[["28bd
9160.06572e","2e210300.ffb15c"]]],{"id":"83dbea37.719b08","type":"function","z":"cb977296.ed0
2","name":"send picture","func":"msg.payload = {}\nmsg.payload.chatId =
634903049\nmsg.payload.type = 'photo'\nmsg.payload.content =
'/home/pi/Pictures/foto.jpeg';\nreturn msg;\n/* type can be one of the
following\nphoto\naudio\nvideo\nsticker\nvoice\ndocument\n*/","outputs":1,"noerr":0,"x":1530,
"y":120,"wires":[["67439fe.4dc4e6"]]],{"id":"e8b637b7.435458","type":"delay","z":"cb977296.ed02
","name":"Wait for 2
seconds","pauseType":"delay","timeout":"2","timeoutUnits":"seconds","rate":"1","nbRateUnits":"1
","rateUnits":"second","randomFirst":"1","randomLast":"5","randomUnits":"seconds","drop":false,
"x":1250,"y":120,"wires":[["83dbea37.719b08"]]],{"id":"ad1f938d.37d77","type":"function","z":"cb

```

```

977296.ed02","name":"Send alert","func":"msg.payload = {}\nmsg.payload.chatId =
634903049\nmsg.payload.type = 'message'\nmsg.payload.content = 'Intruder detected!'\nreturn
msg;\n\n","outputs":1,"noerr":0,"x":1230,"y":220,"wires":[["eb38bce4.30c"]]},{"id":"3a075bcf.53e
124","type":"wiotp
in","z":"cb977296.ed02","authType":"g","deviceKey":"53fc2239.01438c","deviceType":"","deviceId
":"","command":"AddTag","commandType":"g","qos":0,"name":"Waiting command to trigger add
card process from
IBM","x":260,"y":360,"wires":[["9be46cc6.96b78"]]},{"id":"b2c3711a.83a2e","type":"wiotp
in","z":"cb977296.ed02","authType":"g","deviceKey":"53fc2239.01438c","deviceType":"","deviceId
":"","command":"DelTag","commandType":"g","qos":0,"name":"Waiting command to trigger
delete card process from
IBM","x":270,"y":560,"wires":[["51563678.f3f168"]]},{"id":"f6bf6ec4.8e2a7","type":"wiotp
out","z":"cb977296.ed02","authType":"g","qs":"false","qsDeviceId":"","deviceKey":"53fc2239.0143
8c","deviceType":"gw-p1843059","deviceId":"gwid-
p1843059","event":"card","format":"json","qos":"","name":"Send RFID reader status to
IBM","x":516,"y":225,"wires":[[]]},{"id":"e9deacb4.259cf","type":"wiotp
out","z":"cb977296.ed02","authType":"g","qs":"false","qsDeviceId":"","deviceKey":"53fc2239.0143
8c","deviceType":"gw-p1843059","deviceId":"gwid-
p1843059","event":"addcard","format":"json","qos":"","name":"Send add card details to
IBM","x":1000,"y":380,"wires":[[]]},{"id":"7f81e1f6.ca1d6","type":"wiotp
out","z":"cb977296.ed02","authType":"g","qs":"false","qsDeviceId":"","deviceKey":"53fc2239.0143
8c","deviceType":"gw-p1843059","deviceId":"gwid-
p1843059","event":"delcard","format":"json","qos":"","name":"Send delete card details to
IBM","x":1010,"y":580,"wires":[[]]},{"id":"ce01d4b0.efa3a8","type":"debug","z":"cb977296.ed02","n
ame":"","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"false","x":950,"
y":480,"wires":[[]]},{"id":"39016711.c913d8","type":"debug","z":"cb977296.ed02","name":"","active
":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"false","x":430,"y":280,"wires":[
]},{"id":"285adc4d.418054","type":"camerapi-
takephoto","z":"cb977296.ed02","filemode":"1","filename":"foto.jpeg","filedefpath":"0","filepath":
"/home/pi/Pictures/","fileformat":"jpeg","resolution":"3","rotation":"0","flip":"0","flipv":"0","brig
htness":"50","contrast":"0","sharpness":"0","quality":"80","imageeffect":"none","exposuremode":
"auto","iso":"0","agcwait":"1.0","led":"0","awb":"auto","name":"Take
photo","x":910,"y":160,"wires":[["e8b637b7.435458","ad1f938d.37d77"]]},{"id":"67439fe.4dc4e6",
"type":"telegram
sender","z":"cb977296.ed02","name":"","bot":"f108c9de.685a88","x":1817,"y":116,"wires":[[]]},{"i
d":"eb38bce4.30c","type":"telegram
sender","z":"cb977296.ed02","name":"","bot":"f108c9de.685a88","x":1499,"y":221,"wires":[[]]},{"i
d":"2e210300.ffb15c","type":"rpi-gpio
out","z":"cb977296.ed02","name":"","pin":"16","set":true,"level":"0","freq":"","out":"out","x":150
7.5,"y":56,"wires":[[]]},{"id":"ac08eefe.b8758","type":"rpi-gpio
out","z":"cb977296.ed02","name":"","pin":"18","set":true,"level":"0","freq":"","out":"out","x":104
9,"y":291,"wires":[[]]},{"id":"404d251.58031dc","type":"function","z":"cb977296.ed02","name":"If
access denied then execute this","func":"access = msg.payload;\nif
(access.includes(\"Granted\")){\nreturn
msg;\n\n","outputs":1,"noerr":0,"x":547,"y":174,"wires":[["ac08eefe.b8758"]]},{"id":"5a04582a.c47e
d8","type":"daemon","z":"cb977296.ed02","name":"RFIDReader","command":"python","args":"-u
/home/pi/Read.py","autorun":true,"cr":false,"redo":true,"op":"string","closer":"SIGKILL","x":129,"y

```

```

":60,"wires":[["d67c6ee7.22db5","f6bf6ec4.8e2a7","39016711.c913d8","404d251.58031dc"],[],[]],
{"id":"53fc2239.01438c","type":"wiotp-credentials","z":"","name":"My Raspberry Pi
Gateway","org":"k6be3c","serverName":"k6be3c.messaging.internetofthings.ibmcloud.com","devT
ype":"gw-p1843059","devId":"gwid-
p1843059","keepalive":"60","cleansession":true,"tls":"","usetls":false},{id:"f108c9de.685a88","ty
pe":"telegram
bot","z":"","botname":"SmartBedroomBot","usernames":"Titan","chatids":"634903049","baseapiur
l":"","updateMode":"polling","pollinterval":"300","usesocks":false,"sockshost":"","socksport":"666
7","socksusername":"anonymous","sockspassword":"","bothost":"","localbotport":"8443","publicb
otport":"8443","privatekey":"","certificate":"","useselfsignedcertificate":false,"verboselogging":fals
e}}]

```

IBM's Node Red Code:

```

{"id":"deb0d57.1c46528","type":"tab","label":"Flow
1"},{"id":"f452e733.427168","type":"tab","label":"Flow
A","disabled":false,"info":""},{id":"2d231251.1597be","type":"tab","label":"Flow
B","disabled":false,"info":""},{id":"248e193f.1584f6","type":"ui_tab","z":"","name":"Home","icon
":"dashboard","disabled":false,"hidden":false},{id":"c5f2b6c0.6b2b48","type":"ui_group","z":"","na
me":"Speed
Test","tab":"248e193f.1584f6","disp":true,"width":"12","collapse":false},{id":"511cd361.6efb4c","
type":"ui_base","theme":{"name":"theme-
light","lightTheme":{"default":"#0094CE","baseColor":"#0094CE","baseFont":"-apple-
system,BlinkMacSystemFont,Segoe UI,Roboto,Oxygen-Sans,Ubuntu,Cantarell,Helvetica Neue,sans-
serif","edited":true,"reset":false},"darkTheme":{"default":"#097479","baseColor":"#097479","base
Font":"-apple-system,BlinkMacSystemFont,Segoe UI,Roboto,Oxygen-
Sans,Ubuntu,Cantarell,Helvetica Neue,sans-
serif","edited":false},"customTheme":{"name":"Untitled Theme
1","default":"#4B7930","baseColor":"#4B7930","baseFont":"-apple-
system,BlinkMacSystemFont,Segoe UI,Roboto,Oxygen-Sans,Ubuntu,Cantarell,Helvetica Neue,sans-
serif"},"themeState":{"base-color":{"default":"#0094CE","value":"#0094CE","edited":false},"page-
titlebar-backgroundColor":{"value":"#0094CE","edited":false},"page-
backgroundColor":{"value":"#fafafa","edited":false},"page-sidebar-
backgroundColor":{"value":"#ffffff","edited":false},"group-
textColor":{"value":"#1bbfff","edited":false},"group-
borderColor":{"value":"#ffffff","edited":false},"group-
backgroundColor":{"value":"#ffffff","edited":false},"widget-
textColor":{"value":"#111111","edited":false},"widget-
backgroundColor":{"value":"#0094ce","edited":false},"widget-
borderColor":{"value":"#ffffff","edited":false},"base-font":{"value":"-apple-
system,BlinkMacSystemFont,Segoe UI,Roboto,Oxygen-Sans,Ubuntu,Cantarell,Helvetica Neue,sans-
serif"}},angularTheme":{"primary":"indigo","accents":"blue","warn":"red","background":"grey"}},
site":{"name":"Node-RED
Dashboard","hideToolbar":false,"allowSwipe":false,"lockMenu":false,"allowTempTheme":true,"dateFormat":"DD/MM/YYYY","sizes":{"sx":48,"sy":48,"gx":6,"gy":6,"cx":6,"cy":6,"px":0,"py":0}}},{"id":"bfba4656.e918d8","type":"ui_group","z":"","name":"Light

```

```

Value", "tab": "248e193f.1584f6", "disp": true, "width": "12", "collapse": false}, {"id": "32309db9.fac42",
"type": "ui_group", "z": "", "name": "Temperature /
Humidity", "tab": "248e193f.1584f6", "disp": true, "width": "12", "collapse": false}, {"id": "639213ac.dfbd
3c", "type": "ui_group", "z": "", "name": "Temperatuur
Node", "tab": "9de499dc.508098", "order": 1, "disp": true, "width": "12"}, {"id": "9de499dc.508098", "typ
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[15,17,18.5,20,21.5,23,24,22.2,19,18];\n\n// Array of pseudo random relative humidities\nvar
humidity1 = [50,55,61,68,65,60,53,49,45,47];\n\n// Counter to select from array.\nvar counter1 =
context.get('counter1') || 0;\nncounter1 = counter1+1;\nif(counter1 > 9) counter1 =
0;\ncontext.set('counter1',counter1);\n\n// Create MQTT message in JSON\nmsg = {\n payload:
JSON.stringify(\n {\n d: {\n \"temp\" : temp1[counter1],\n \"humidity\" :
humidity1[counter1],\n \"location\" : {\n \"longitude\" : longitude1,\n
\"latitude\" : latitude1\n },\n }\n }\n }\n );\nreturn
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```



```

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loadClock();\n  }else setTimeout(loadClock, 500)\n});\n\nfunction loadClock(){\n
$('#clock').remove();\n  var toolbar = $('.md-toolbar-tools');\n  \n  var div = $('<div/>');\n  var p
= $('<p/ id='\"clock\"'>');\n  \n  div.append(p);\n  div[0].style.margin = '5px 5px 5px auto';\n
toolbar.append(div);\n\n  function displayTitle(lh) {\n    p.text(lh); \n  }\n  \n  function
upTime() {\n    var d = new Date();\n    p.text(d.toLocaleString());\n  }\n\n  if(document.clockInterval){ \n    clearInterval(document.clockInterval);\n
document.clockInterval = null;\n  }\n  \n  document.clockInterval =
setInterval(upTime,1000);\n}\n\n</script>","storeOutMessages":false,"fwdInMessages":false,"tem
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command from Raspberry Pi C's

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-- End of CA2 Step-by-step tutorial --