**Test Demo Plan 1:**

**Software requirements:**

* Set up Thingspeak channel
* Hard code sensor signal communication to Thingspeak
* Have test stubs which emulate the functionality of the hardware components ready

**Entry access**

**Scenario 1:** Building accepting entries, employee with valid NFC card, authorized status, normal body temperature, ideal distance away from temperature sensor and building accessible after entry

**Features to be tested:**

* Communication between control server and Thingspeak
* Communication between door node and Thingspeak
* Communication between the NFC card reader and door node
* Communication between time of flight range finder and door node
* Communication between LED display and door node
* Communication between temperature sensor and door node
* Communication between the electronic lock and door node

**Test scenario steps:**

1. Control server checks for the number of people in the building and sends an DOOR\_STATE\_UPDATE to Thingspeak channel
2. Door node receives the DOOR\_STATE\_UPDATE from Thingspeak channel and if available, displays green light to indicate door node accepting entries on the LED display
3. NFC reader identifies NFC id card being tapped and sends ACCESS\_REQUEST with card id to Thingspeak channel
4. Control server receives ACCESS\_REQUEST from Thingspeak channel and validates NFC card id and identifies employee id by querying the database for the NFC card id
5. Once acquiring the valid employee id, the control server queries the database for recent employee status, access type and validity to consider entry access
6. If recent status is authorized, access type was exit and validity is less than 3, control server determines current access type to be entry and sends INFROMATION\_REQUEST to determine if employee in distance range to Thingspeak channel
7. Door node receives INFROMATION\_REQUEST from the Thingspeak channel and activates the LED display and displays orange to indicate that the access entry process is in progress
8. Door node activates the rangefinder to identify users range from temperature sensor
9. Door node records the range value and sends an INFORMATION\_RESPONSE to the Thingspeak channel
10. Control server receives the INFORMATION\_RESPONSE and compares the received range value with the ideal range value
11. If in ideal range, control server sends an INFORMATION\_REQUEST to measure the user’s body temperature
12. Door node receives the INFORMATION\_REQUEST and activates the temperature sensor to record the user’s body temperature
13. Door node then sends an INFROMATION\_RESPONSE with the recorded temperature measurement to the Thingspeak channel
14. Control server receives the INFORMATION\_RESPONSE from the Thingspeak channel
15. Control server compares recorded temperature value to acceptable temperature range and determines the status of the entry request
16. If in acceptable temperature range, control server updates the status of the employee to “authorized” and saves all the information for access entry in the database and sets the validity field to 0
17. Control server increments the number of people in the building by 1
18. Control server sends an ACCESS\_RESPONSE to the Thingspeak channel
19. Control server re-evaluates the number of people in the building and sends a DOOR\_STATE\_UPDATE based on the accessibility status of the building to the Thingspeak channel
20. Door node receives the ACCESS\_REPONSE and DOOR\_STATE\_UPDATE from the Thingspeak channel
21. From ACCESS\_RESPONSE received by the door node, if access is authorized, door node activates LED display to display a flashing green light to indicate employee’s access has been authorized
22. Door node also unlocks the electronic lock for 30 seconds
23. After 30 sec, Door node locks the electronic lock
24. From the DOOR\_STATE\_UPDATE received by the door node, if the building is accessible, door node activates LED display to display a green light to indicate system is accepting entry

**Expected test scenario result:** Proper communication between door node and control server occurred to authorize employee access to the workplace.

**Scenario 2:** Building accepting entries, employee with valid NFC card, authorized status, normal body temperature, ideal distance away from temperature sensor and building not accessible after entry

**Features to be tested:**

* Communication between control server and Thingspeak
* Communication between door node and Thingspeak
* Communication between the NFC card reader and door node
* Communication between time of flight range finder and door node
* Communication between LED display and door node
* Communication between temperature sensor and door node
* Communication between the electronic lock and door node

**Test scenario steps:**

1. Control server checks for the number of people in the building and sends an DOOR\_STATE\_UPDATE to Thingspeak channel
2. Door node receives the DOOR\_STATE\_UPDATE from Thingspeak channel and if available, displays green light to indicate door node accepting entries on the LED display
3. NFC reader identifies NFC id card being tapped and sends ACCESS\_REQUEST with card id to Thingspeak channel
4. Control server receives ACCESS\_REQUEST from Thingspeak channel and validates NFC card id and identifies employee id by querying the database for the NFC card id
5. Once acquiring the valid employee id, the control server queries the database for recent employee status, access type and validity to consider entry access
6. If recent status is authorized, access type was exit and validity is less than 3, control server determines current access type to be entry and sends INFROMATION\_REQUEST to determine if employee in distance range to Thingspeak channel
7. Door node receives INFROMATION\_REQUEST from the Thingspeak channel and activates the LED display and displays orange to indicate that the access entry process is in progress
8. Door node activates the rangefinder to identify users range from temperature sensor
9. Door node records the range value and sends an INFORMATION\_RESPONSE to the Thingspeak channel
10. Control server receives the INFORMATION\_RESPONSE and compares the received range value with the ideal range value
11. If in ideal range, control server sends an INFORMATION\_REQUEST to measure the user’s body temperature
12. Door node receives the INFORMATION\_REQUEST and activates the temperature sensor to record the user’s body temperature
13. Door node then sends an INFROMATION\_RESPONSE with the recorded temperature measurement to the Thingspeak channel
14. Control server receives the INFORMATION\_RESPONSE from the Thingspeak channel
15. Control server compares recorded temperature value to acceptable temperature range and determines the status of the entry request
16. If in acceptable temperature range, control server updates the status of the employee to “authorized” and saves all the information for access entry in the database and sets the validity field to 0
17. Control server increments the number of people in the building by 1
18. Control server sends an ACCESS\_RESPONSE to the Thingspeak channel
19. Control server re-evaluates the number of people in the building and sends a DOOR\_STATE\_UPDATE based on the accessibility status of the building to the Thingspeak channel
20. Door node receives the ACCESS\_REPONSE and DOOR\_STATE\_UPDATE from the Thingspeak channel
21. From ACCESS\_RESPONSE received by the door node, if access is authorized, door node activates LED display to display a flashing green light to indicate employee’s access has been authorized
22. Door node also unlocks the electronic lock for 30 seconds
23. After 30 sec, Door node locks the electronic lock
24. From the DOOR\_STATE\_UPDATE received by the door node, if the building is not accessible, door node activates LED display to display a red light to indicate system is not accepting entry

**Expected test scenario result:** Proper communication between door node and control server occurred to authorize employee access to the workplace and restrict entry to additional employees after the process.

**Scenario 3:** Building accepting entries, employee with invalid NFC card, authorized status, normal body temperature, in ideal distance range away from temperature sensor at entry node and building accessible after entry attempt

**Features to be tested:**

* Communication between control server and Thingspeak
* Communication between door node and Thingspeak
* Communication between the NFC card reader and door node
* Communication between time of flight range finder and door node
* Communication between LED display and door node
* Communication between temperature sensor and door node
* Communication between the electronic lock and door node

**Test scenario steps:**

1. Control server checks for the number of people in the building and sends an DOOR\_STATE\_UPDATE to Thingspeak channel
2. Door node receives the DOOR\_STATE\_UPDATE from Thingspeak channel and if available, displays green light to indicate door node accepting entries on the LED display
3. NFC reader identifies NFC id card being tapped and sends ACCESS\_REQUEST with card id to Thingspeak channel
4. Control server receives ACCESS\_REQUEST from Thingspeak channel and queries the database for the NFC card id to be associated to the employee id
5. If no valid employee id acquired, the control server sends an ACCESS\_RESPONSE indicating invalid id card being scanned to the Thingspeak channel
6. Control server re-evaluates the number of people in the building and sends a DOOR\_STATE\_UPDATE based on the accessibility status of the building to the Thingspeak channel
7. Door node receives ACCESS\_RESPONSE and DOOR\_STATE\_UPDATE from the Thingspeak channel
8. From the ACCESS\_REPONSE received, door node locks the electronic lock and displays flashing red light to indicate that the access entry attempt is invalid
9. From the DOOR\_STATE\_UPDATE received by the door node, if the building is accessible, door node activates LED display to display a green light to indicate system is accepting entry

**Expected test scenario result:** Proper communication between door node and control server occurred to let the employee know invalid access entry attempt.

**Scenario 4:** Building accepting entries, employee with valid NFC card, authorized status, normal body temperature, not in ideal distance range away from temperature sensor and building accessible after entry attempt

**Features to be tested:**

* Communication between control server and Thingspeak
* Communication between door node and Thingspeak
* Communication between the NFC card reader and door node
* Communication between time of flight range finder and door node
* Communication between LED display and door node
* Communication between temperature sensor and door node
* Communication between the electronic lock and door node

**Test scenario steps:**

1. Control server checks for the number of people in the building and sends an DOOR\_STATE\_UPDATE to Thingspeak channel
2. Door node receives the DOOR\_STATE\_UPDATE from Thingspeak channel and if available, displays green light to indicate door node accepting entries on the LED display
3. NFC reader identifies NFC id card being tapped and sends ACCESS\_REQUEST with card id to Thingspeak channel
4. Control server receives ACCESS\_REQUEST from Thingspeak channel and validates NFC card id and identifies employee id by querying the database for the NFC card id
5. Once acquiring the valid employee id, the control server queries the database for recent employee status, access type and validity to consider entry access
6. If recent status is authorized, access type was exit and validity is less than 3, control server determines current access type to be entry and sends INFROMATION\_REQUEST to determine if employee in distance range to Thingspeak channel and increments validity by 1
7. Door node receives INFROMATION\_REQUEST from the Thingspeak channel and activates the LED display and displays orange to indicate that the access entry process is in progress
8. Door node activates the rangefinder to identify users range from temperature sensor
9. Door node records the range value and sends an INFORMATION\_RESPONSE to the Thingspeak channel
10. Control server receives the INFORMATION\_RESPONSE and compares the received range value with the ideal range value
11. Since not in ideal range, control server checks the validity field to see if its less than 3, if yes then it sends an INFORMATION\_REQUEST to check again if employee in range and increments the validity by 1
12. Door node receives the INFORMATION\_REQUEST from the Thingspeak channel and activates the rangefinder again to identify if employee in range of temperature sensor
13. Door node sends an INFORMATION\_RESPONSE with the recorded range value
14. Control server receives the INFORMATION\_RESPONSE from the Thingspeak channel and compares the received range value with the ideal range value
15. Since not in ideal range, control server checks the validity field to see if its less than 3, if yes then it sends an INFORMATION\_REQUEST to check again if employee in range and increments the validity by 1
16. Door node receives the INFORMATION\_REQUEST and activates the rangefinder again to identify if employee in range of temperature sensor
17. Door node sends an INFORMATION\_RESPONSE with recorded range value to the Thingspeak channel
18. Control server receives the INFORMATION\_RESPONSE from the Thingspeak channel and compares the received range value with the ideal range value
19. Since not in ideal range, control server checks the validity field to see if its less than 3, if not less than 3 then control server determines the access entry is invalid and determines the ACCESS\_RESPONSE to be sent
20. control server updates the validity field for the access entry to 3 and saves all the information for access entry in the database
21. Control server re-evaluates the number of people in the building and sends a DOOR\_STATE\_UPDATE based on the accessibility status of the building to the Thingspeak channel
22. Door node receives the ACCESS\_REPONSE and DOOR\_STATE\_UPDATE from the Thingspeak channel
23. From ACCESS\_RESPONSE received by the door node, since access is invalid, door node locks the electronic lock and displays a red light to indicate access denied
24. From the DOOR\_STATE\_UPDATE received by the door node, if the building is accessible, door node activates LED display to display a green light to indicate system is accepting entry

**Expected test scenario result:** Proper communication between door node and control server occurred to let the employee know to stand in an ideal distance range away from the temperature sensor.

**Scenario 5:** Building accepting entries, employee with valid NFC card, authorized status, in ideal distance range away from temperature sensor, body temperature indicating fever and building accessible after entry attempt

**Features to be tested:**

* Communication between control server and Thingspeak
* Communication between door node and Thingspeak
* Communication between the NFC card reader and door node
* Communication between time of flight range finder and door node
* Communication between LED display and door node
* Communication between temperature sensor and door node
* Communication between the electronic lock and door node

**Test scenario steps:**

1. Control server checks for the number of people in the building and sends an DOOR\_STATE\_UPDATE to Thingspeak channel
2. Door node receives the DOOR\_STATE\_UPDATE from Thingspeak channel and if available, displays green light to indicate door node accepting entries on the LED display
3. NFC reader identifies NFC id card being tapped and sends ACCESS\_REQUEST with card id to Thingspeak channel
4. Control server receives ACCESS\_REQUEST from Thingspeak channel and validates NFC card id and identifies employee id by querying the database for the NFC card id
5. Once acquiring the valid employee id, the control server queries the database for recent employee status, access type and validity to consider entry access
6. If recent status is authorized, access type was exit and validity is less than 3, control server determines current access type to be entry and sends INFROMATION\_REQUEST to determine if employee in distance range to Thingspeak channel
7. Door node receives INFROMATION\_REQUEST from the Thingspeak channel and activates the LED display and displays orange to indicate that the access entry process is in progress
8. Door node activates the rangefinder to identify users range from temperature sensor
9. Door node records the range value and sends an INFORMATION\_RESPONSE to the Thingspeak channel
10. Control server receives the INFORMATION\_RESPONSE and compares the received range value with the ideal range value
11. If in ideal range, control server sends an INFORMATION\_REQUEST to measure the user’s body temperature
12. Door node receives the INFORMATION\_REQUEST and activates the temperature sensor to record the user’s body temperature
13. Door node then sends an INFROMATION\_RESPONSE with the recorded temperature measurement to the Thingspeak channel
14. Control server receives the INFORMATION\_RESPONSE from the Thingspeak channel
15. Control server compares recorded temperature value to acceptable temperature range and determines the status of the entry request
16. If not in acceptable temperature range, control server checks the validity field to see if its less than 3, if yes then it sends an INFORMATION\_REQUEST to measure the user body temperature again and increments the validity by 1
17. Door node receives the INFORMATION\_REQUEST from the Thingspeak channel and activates the temperature sensor again to record user body temperature
18. Door node sends an INFORMATION\_RESPONSE with the recorded body temperature value
19. Control server receives the INFORMATION\_RESPONSE from the Thingspeak channel and compares the received temperature value with the ideal temperature value
20. Since not in ideal range, control server checks the validity field to see if its less than 3, if yes then it sends an INFORMATION\_REQUEST to record user body temperature again and increments the validity by 1
21. Door node receives the INFORMATION\_REQUEST and activates the temperature sensor again to record body temperature of user
22. Door node sends an INFORMATION\_RESPONSE with recorded temperature value to the Thingspeak channel
23. Control server receives the INFORMATION\_RESPONSE from the Thingspeak channel and compares the received temperature value with the ideal temperature value
24. Since not in ideal range, control server checks the validity field to see if its less than 3, if not less than 3 then control server determines the access entry is invalid and determines the ACCESS\_RESPONSE to be sent
25. control server updates the validity field for the access entry to 3, updates the status to unauthorized and saves all the information for access entry in the database
26. Control server re-evaluates the number of people in the building and sends a DOOR\_STATE\_UPDATE based on the accessibility status of the building to the Thingspeak channel
27. Door node receives the ACCESS\_REPONSE and DOOR\_STATE\_UPDATE from the Thingspeak channel
28. From ACCESS\_RESPONSE received by the door node, since access is unauthorized, door node locks the electronic lock and displays a flashing red light to indicate access denied
29. From the DOOR\_STATE\_UPDATE received by the door node, if the building is accessible, door node activates LED display to display a green light to indicate system is accepting entry

**Expected test scenario result:** Proper communication between nodes and control server occurred to unauthorize employee and restrict access to workplace.

**Scenario 6:** Building not accepting entries, employee with invalid NFC card, authorized status, in ideal distance range, normal body temperature and building accessible after entry attempt

**Features to be tested:**

* Communication between control server and Thingspeak
* Communication between door node and Thingspeak
* Communication between the NFC card reader and door node
* Communication between time of flight range finder and door node
* Communication between LED display and door node
* Communication between temperature sensor and door node
* Communication between the electronic lock and door node

**Test scenario steps:**

1. Control server checks for the number of people in the building and sends a DOOR\_STATE\_UPDATE to Thingspeak channel
2. Door node receives the DOOR\_STATE\_UPDATE from Thingspeak channel and since entry not available, displays red light to indicate door node not accepting entries on the LED display
3. NFC reader identifies NFC id card being tapped and sends ACCESS\_REQUEST with card id to Thingspeak channel
4. Control server receives ACCESS\_REQUEST from Thingspeak channel and validates NFC card id and identifies employee id by querying the database for the NFC card id
5. Once acquiring the valid employee id, the control server queries the database for recent employee status, access type and validity to consider entry access
6. If recent status is authorized, access type was exit and validity is less than 3, control server determines current access type to be entry and sends INFROMATION\_REQUEST to determine if employee in distance range to Thingspeak channel
7. Control server receives ACCESS\_REQUEST from Thingspeak channel and since building not the control server sends an ACCESS\_RESPONSE indicating entry not available
8. Control server re-evaluates the number of people in the building and sends a DOOR\_STATE\_UPDATE based on the accessibility status of the building to the Thingspeak channel
9. Door node receives ACCESS\_RESPONSE and DOOR\_STATE\_UPDATE from the Thingspeak channel
10. From the ACCESS\_REPONSE received, door node locks the electronic lock and displays red light to indicate building not accepting entries
11. From the DOOR\_STATE\_UPDATE received by the door node, since building still not accessible, door node activates LED display to display a red light to indicate system is not accepting entry

**Expected test scenario result:** Proper communication between door node and control server occurred to let the employee know entry not available.

**Scenario 7:** Building accepting entries, employee with invalid NFC card, unauthorized status (over 14 days ago), in ideal distance range away from temperature sensor, normal body temperature and building accessible after entry attempt

**Features to be tested:**

* Communication between control server and Thingspeak
* Communication between door node and Thingspeak
* Communication between the NFC card reader and door node
* Communication between time of flight range finder and door node
* Communication between LED display and door node
* Communication between temperature sensor and door node
* Communication between the electronic lock and door node

**Test scenario steps:**

1. Control server checks for the number of people in the building and sends an DOOR\_STATE\_UPDATE to Thingspeak channel
2. Door node receives the DOOR\_STATE\_UPDATE from Thingspeak channel and if available, displays green light to indicate door node accepting entries on the LED display
3. NFC reader identifies NFC id card being tapped and sends ACCESS\_REQUEST with card id to Thingspeak channel
4. Control server receives ACCESS\_REQUEST from Thingspeak channel and validates NFC card id and identifies employee id by querying the database for the NFC card id
5. Once acquiring the valid employee id, the control server queries the database for recent employee status, access type and validity to consider entry access
6. If recent status is unauthorized, access type was entry and validity is 3, control server determines current access type to be entry and queries the database for date of most recent entry attempt
7. If most recent entry attempt date over 14 days ago, control server sends INFROMATION\_REQUEST to determine if employee in distance range to Thingspeak channel
8. Door node receives INFROMATION\_REQUEST from the Thingspeak channel and activates the LED display and displays orange to indicate that the access entry process is in progress
9. Door node activates the rangefinder to identify users range from temperature sensor
10. Door node records the range value and sends an INFORMATION\_RESPONSE to the Thingspeak channel
11. Control server receives the INFORMATION\_RESPONSE and compares the received range value with the ideal range value
12. If in ideal range, control server sends an INFORMATION\_REQUEST to measure the user’s body temperature
13. Door node receives the INFORMATION\_REQUEST and activates the temperature sensor to record the user’s body temperature
14. Door node then sends an INFROMATION\_RESPONSE with the recorded temperature measurement to the Thingspeak channel
15. Control server receives the INFORMATION\_RESPONSE from the Thingspeak channel
16. Control server compares recorded temperature value to acceptable temperature range and determines the status of the entry request
17. If in acceptable temperature range, control server updates the status of the employee to “authorized” and saves all the information for access entry in the database and sets the validity field to 0
18. Control server increments the number of people in the building by 1
19. Control server sends an ACCESS\_RESPONSE to the Thingspeak channel
20. Control server re-evaluates the number of people in the building and sends a DOOR\_STATE\_UPDATE based on the accessibility status of the building to the Thingspeak channel
21. Door node receives the ACCESS\_REPONSE and DOOR\_STATE\_UPDATE from the Thingspeak channel
22. From ACCESS\_RESPONSE received by the door node, if access is authorized, door node activates LED display to display a flashing green light to indicate employee’s access has been authorized
23. Door node also unlocks the electronic lock for 30 seconds
24. After 30 sec, Door node locks the electronic lock
25. From the DOOR\_STATE\_UPDATE received by the door node, if the building is accessible, door node activates LED display to display a green light to indicate system is accepting entry

**Expected test scenario result:** Proper communication between door node and control server occurred to authorize employee access to the workplace.

**Scenario 8:** Building accepting entries, employee with invalid NFC card, unauthorized status (not over 14 days ago), in ideal distance range away from temperature sensor, normal body temperature and building accessible after entry attempt

**Features to be tested:**

* Communication between control server and Thingspeak
* Communication between door node and Thingspeak
* Communication between the NFC card reader and door node
* Communication between time of flight range finder and door node
* Communication between LED display and door node
* Communication between temperature sensor and door node
* Communication between the electronic lock and door node

**Test scenario steps:**

1. Control server checks for the number of people in the building and sends an DOOR\_STATE\_UPDATE to Thingspeak channel
2. Door node receives the DOOR\_STATE\_UPDATE from Thingspeak channel and if available, displays green light to indicate door node accepting entries on the LED display
3. NFC reader identifies NFC id card being tapped and sends ACCESS\_REQUEST with card id to Thingspeak channel
4. Control server receives ACCESS\_REQUEST from Thingspeak channel and validates NFC card id and identifies employee id by querying the database for the NFC card id
5. Once acquiring the valid employee id, the control server queries the database for recent employee status, access type and validity to consider entry access
6. If recent status is unauthorized, access type was entry and validity is 3, control server determines current access type to be entry and queries the database for date of most recent entry attempt
7. If most recent entry attempt date not over 14 days ago, control server sends ACCESS\_RESPONSE indicated access unauthorized to the Thingspeak channel and no information for the entry attempt is saved in the database
8. Control server re-evaluates the number of people in the building and sends a DOOR\_STATE\_UPDATE based on the accessibility status of the building to the Thingspeak channel
9. Door node receives the ACCESS\_REPONSE and DOOR\_STATE\_UPDATE from the Thingspeak channel
10. From ACCESS\_RESPONSE received by the door node, since access is unauthorized, door node locks the electronic lock and displays a flashing red light to indicate access denied
11. From the DOOR\_STATE\_UPDATE received by the door node, if the building is accessible, door node activates LED display to display a green light to indicate system is accepting entry

**Expected test scenario result:** Proper communication between door node and control server occurred to let the employee know invalid access entry attempt.

**Scenario 9:** employee with valid NFC card and at exit node

**Features to be tested:**

* Communication between the NFC card reader and Thingspeak
* Communication between the control server and Thingspeak
* Communication between Thingspeak and the electronic lock at exit node

**Test scenario steps:**

1. NFC reader identifies NFC id card being tapped and sends ACCESS\_REQUEST with card id to Thingspeak channel
2. Control server receives ACCESS\_REQUEST from Thingspeak channel and validates NFC card id and identifies employee id by querying the database for the NFC card id
3. Once acquiring the valid employee id, the control server queries the database for recent employee status, access type and validity to consider entry access
4. If recent status is authorized, access type was entry and validity is 3 or less than 3, control server determines current access type to be exit
5. If most recent access type is entry attempt control server sends ACCESS\_RESPONSE indicated exit access to the Thingspeak channel, logs information for the exit attempt in the database and subtracts1 from the number of people in the building
6. Control server re-evaluates the number of people in the building and sends a DOOR\_STATE\_UPDATE based on the accessibility status of the building to the Thingspeak channel
7. Door node receives the ACCESS\_REPONSE and DOOR\_STATE\_UPDATE from the Thingspeak channel
8. From ACCESS\_RESPONSE received by the door node, since access type is exit, door node unlocks the electronic lock at exit node
9. From the DOOR\_STATE\_UPDATE received by the door node, if the building is accessible, door node activates LED display to display a green light to indicate system is accepting entry

**Expected test scenario result:** Employee successfully exits the building an accessibility of building updated.