4.4 –Light and Comfort system testing

To validate the functionality and efficiency of the Smart Light and Temperature System, testing was conducted in multiple stages:

**4.4.1** **-** **Individual Component Testing :**

1. PIR sensor: Detected motion accurately and triggered test signals .
2. Light sensors (LDR): Accurately detected ambient light levels and responded to changes.
3. Infrared Sensor : Accurately detected obstacles
4. DHT sensor : Provided consistent temperature and humidity readings.
5. Firebase realtime: Successfully connected to Wi-Fi and communicated with Firebase Realtime Database.
6. Fan for Ventilation : we could turn it on and off by the microcontroller

**4.4.2- Subsystem Integration:**

1. Using two ir to achieve the idea of entry counter :

✗When one person entered it counted it as more than one

reason : it counts just one person as many people because he spend about 400ms to pass in front of the ir so it was giving signal all this time

solution : Adding debounce delay

✓ it worked well as it was excpected .

1. Integration between the entry counter and pir :

✓ they gave the excepected results as the entry counter was increase if someone entered and decrease if someone exited and after that the pir checked the motion to check if the person in the room is doing something or he slept to turn the lights off.

1. Try to control the fan depending on DHT readings:

✓ The fan was turned on and off depending on the temperature from the sensor

**4.4.3 - All System before connecting to firebase**

We integrated all the hardware components the entry counters for two rooms ,pir for the two rooms ,LDR and it's outing LED and the DHT11 sensor with the fan .

✓ All systems worked as it was excpected which were : the rooms lighting , outing lights and the Ventilation system

**4.4.4 – All system Integration with firebase**

✗The result was right and as it was excpected until the wifi speed got slower which made the sending and receiving slow so the code was stuck at the line of waiting the acknowledgment which prevent the compiler to go to the next lines which read the sensors output .

Solution :

we decided to optimize number of bits we send and receive by :

1. Convert data types of the manipulated variables to smaller data types
2. Ignoring sending unnecessary varibales that made the sending take long time if the wifi is slow
3. Adding check line before sending each variable to make sure that it has been changed to avoid spending time in sending a value that was sent before so we reduced number of sending data via wifi
4. Adding small delay between sending times to decrease the probability of errors

✓ It worked well with no errors in both Manual and Automatic modes

Final testing included simulations of different scenarios (e.g., no motion, dark room, high temperature) to ensure all features worked as intended. After multiple trials and minor code refinements, the system achieved stable and reliable operation

Future work :

1. Add a Bluetooth connectivity option so that users can switch from Wi-Fi to Bluetooth if they experience issues or become frustrated with Wi-Fi
2. Add Automatic button for each room so each user can choose whether his room is on manual or automatic mode . Maybe all the family like the manual mode , but only one room is for children who can't use their phone so only this room will be Automatic . Maybe all the family likes the manual mode but they like the outing lights to depend on the LDR so only the outing will be Automatic