Table of Contents

[Task 1: System Design 2](#_Toc165226552)

[a. Overall Architecture of the distributed system 2](#_Toc165226553)

[Components of the Distributed System: 2](#_Toc165226554)

[b. Algorithms 2](#_Toc165226555)

[Temperature Control Algorithm: 2](#_Toc165226556)

[Light Control Algorithm: 3](#_Toc165226557)

[c. Data Structures: 3](#_Toc165226558)

[d. Integration Plan: 3](#_Toc165226559)

[Task 2: C Programming Implementation 3](#_Toc165226560)

[Task 3: Testing and Validation 7](#_Toc165226561)

[a. Applying Scenarios 7](#_Toc165226562)

[b. Test cases 8](#_Toc165226563)

[c. System’s Effectiveness 9](#_Toc165226564)

[d. Potential Improvement and Enhancement 9](#_Toc165226565)

[Summary 10](#_Toc165226566)

[References: 11](#_Toc165226567)

# Task 1: System Design

## a. Overall Architecture of the distributed system

### Components of the Distributed System:

* **Sensors**: These are devices accountable for sensing environmental conditions such as temperature and light intensity. A function will simulate the role of sensors by getting user-inputted environmental data.
* **Controller**: This component is accountable for making decisions constructed on the data collected from sensors and sending commands to actuators. A function will act as the controller by evaluating environmental data and establishing whether to turn on/off heating, cooling, and lights founded on predefined thresholds.
* **Actuators**: Actuators are devices accountable for controlling numerous elements within the room, such as lights and HVAC systems. A function will reproduce the responsibility of actuators by demonstrating whether lights, heating, and cooling are transformed on or off established on the decisions presented by the controller.

## b. Algorithms

let's define the algorithms for light and temperature control:

### Temperature Control Algorithm:

* A function will decide whether to turn on heating or cooling based on the current temperature.
* This algorithm can be further sophisticated by encompassing a feedback control mechanism such as a PID (Proportional-Integral-Derivative) controller.
* The PID controller constantly estimates an error value as the difference between the anticipated temperature setpoint and the real temperature determined by the sensors.
* The controller then changes the output (e.g., the heating or cooling state) created on proportional, integral, and derivative conditions to decrease this error over time.

### Light Control Algorithm:

* A function will establish whether to turn on lights established on the current light intensity.
* For more complex light control, we could execute a fuzzy logic controller.
* Fuzzy logic permits for more nuanced control by deeming numerous inputs and verbal variables (e.g., "bright," "dim," "dark") instead than simple binary judgements.
* The fuzzy logic controller uses a set of rules and membership functions to decide the suitable light level established on inputs such as light intensity and user inclinations.

## c. Data Structures:

* Design data structures to effectively store and administer information within the system. This could contain data structures for keeping sensor readings, control settings, historical data, and any other important information.
* Ponder using data structures like arrays, linked lists, trees, or hash tables dependent on the detailed requirements of your system.

## d. Integration Plan:

* Develop a plan for incorporating the algorithms into the complete system architecture.
* Highlight assured automation practices to warrant that the system works reliably and carefully.
* Think portions like error handling, termination, confirmation, and authorization to inhibit unlawful access or wicked restriction.

# Task 2: C Programming Implementation

“#include <stdio.h>

#include <stdbool.h>

#ifdef \_WIN32

#include <windows.h>

#else

#include <unistd.h>

#endif

typedef struct {

float temperature;

float lightIntensity;

} EnvironmentData;

typedef struct {

bool lightsOn;

bool heatingOn;

bool coolingOn;

} ControlSettings;

void readEnvironmentData(EnvironmentData \*data);

void analyzeAndControl(EnvironmentData data, ControlSettings \*settings);

void updateActuators(ControlSettings settings);

void applySecurityMeasures();

int main() {

EnvironmentData currentEnvironment;

ControlSettings currentSettings = {false, false, false};

while (true) {

readEnvironmentData(&currentEnvironment);

analyzeAndControl(currentEnvironment, &currentSettings);

updateActuators(currentSettings);

applySecurityMeasures();

#ifdef \_WIN32

Sleep(1000);

#else

usleep(1000000);

#endif

printf("Iteration complete. Waiting for next iteration...\n");

}

return 0;

}

void readEnvironmentData(EnvironmentData \*data) {

printf("Enter current temperature (in Celsius): ");

scanf("%f", &data->temperature);

printf("Enter current light intensity (in lux): ");

scanf("%f", &data->lightIntensity);

}

void analyzeAndControl(EnvironmentData data, ControlSettings \*settings) {

if (data.temperature > 28.0) {

settings->coolingOn = true;

settings->heatingOn = false;

} else if (data.temperature < 20.0) {

settings->heatingOn = true;

settings->coolingOn = false;

} else {

settings->coolingOn = false;

settings->heatingOn = false;

}

if (data.lightIntensity < 200.0) {

settings->lightsOn = true;

} else {

settings->lightsOn = false;

}

}

void updateActuators(ControlSettings settings) {

printf("Actuators updated: Lights: %s, Heating: %s, Cooling: %s\n",

settings.lightsOn ? "On" : "Off",

settings.heatingOn ? "On" : "Off",

settings.coolingOn ? "On" : "Off");

}

void applySecurityMeasures() {

printf("Security measures applied.\n");

}”

# Task 3: Testing and Validation

To replicate a room environment with unpredictable conditions using the established circulated system, you can follow these steps:

## a. Applying Scenarios

To start a testing environment, a fit physical space or fundamental setup is chosen to safeguard safety for both gear and recruits. This environment is thoroughly managed, with modules such as temperature and light intensity accomplished. Sensors are then installed to monitor environmental appearances like temperature and light intensity. These sensors are joined to the selected ports of the system to collect data and enable interaction.

Actuators, such as lights and HVAC systems, are combined into the environment. These actuators are also attached to the system's ports, accepting synchronized control based on environmental data. Pretended input generation is engaged using software tools or scripts to model sensor data that simulates real-world conditions. This modelled input repeats fluctuations in temperature, light intensity, and other environmental subtleties upon time.

Data gathering and analysis are necessary components of testing development. Data from sensors and actuators are collected to evaluate system performance. Factors such as response time, accuracy, and strength under adapting conditions are evaluated. Simulated conclusions are likened with anticipated results to authenticate the functionality of the approach.

Throughout the testing stage, iteration and improvement are key. Challenges or areas for upgrading acknowledged during research are spoken. The system design and implementation are updated appropriately to increase performance and reliability. Modifications are verified again to confirm effectiveness, and this process is frequent as needed to confirm continuous correction and optimization of the system.

## b. Test cases

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Test Case No | Test Case Name | Test Case Description | Test data | Expected Output | Actual Output |
| 1 | Normal Operating Conditions | Simulate average environmental situation within the room. | 25,700 | The system should continue comfortable temperature and lighting levels with no errors. |  |
| 2 | Dangerous Temperature Conditions | Simulate very high or very low temperatures outside the common operating range. | 40,100 | The system should adjust heating or cooling therefore to maintain comfort levels. |  |
| 3 | Fluctuating Light Intensity | Simulate differences in light intensity throughout the day. | 30,800 | The system should adjust lighting levels properly to maintain anticipated brightness. |  |

## c. System’s Effectiveness

The system's ability to uphold a pleasant and constant environment in the demonstrated room is calculated through several criteria. Firstly, the system's ability to declare relaxed temperature and lighting levels is reviewed to confirm ideal comfort for tenants. Energy efficiency is thoroughly inspected, with a focus on checking the energy feasting of actuators and investigating methods to perfect energy management during control algorithms and scheduling.

Furthermore, the system's responsiveness to adjustments in environmental conditions is estimated to decrease discomfort for occupants and guarantee timely adjustments to continue a comfortable situation. User experience is also a key worry, with reaction perched through surveys or interviews to assess ease of use, reliability, and gratification with calmness levels. Safety and security are vital, with measures in place to confirm the system functions safely and firmly, guarding both occupants and gear. Robust security presents are realized to shield restricted information.

Furthermore, the system's scalability and flexibility are reviewed to control how successfully it can lodge changes in room size, occupancy patterns, and environmental environments. Any restrictions are found, and methods for increase are explored to guarantee the system can meet proceeding needs.

## d. Potential Improvement and Enhancement

Examine the simulation stems to address any system lacks or weaknesses while confirming the maintenance of safe automation routines. Revise control algorithms for temperature and light management to improve effectiveness and responsiveness without surrendering accuracy. Reengineer data processing workflows to reduce latency and enhance resource consumption, including data aggregation, and compression techniques. Create vigorous error handling systems and combine fault tolerance schemes to improve system strength and block failures or accidents. Strengthen security tools with Secure Sockets Layer quantum encryption or authentication, and access management regularly upgrading software and firmware to minimize the likelihood of attack. Gather input to improve interfaces and system interaction depending on the user experience, with focus on regarded as intuitive, easy to use, and customizable. Design a system architecture that can advance and amend simply by applying modular components that can be delayed or diminished, and investigate new technologies to confirm the system continues current and up-to-date.

# Summary

While developing our system’s design and implementation, we paid keen attention to securing its security framework against possible threats. It was a must to recognize potential security threats in further to proactively safeguard our problematic data and keep the reliability of the system. Principal among these threats are illegal access attempts, data compromises, and exploit of vulnerabilities. A layered tactic was systematically recognized to alleviate these threats. Primarily, robust authentication procedures were succeeded to verify the validity of user credentials and manage their positions within the system. This integrated implementing a vigorous password strategy, multi-factor authentication, and succeeding user sessions to successfully avoid unlawful admittance attempts.

Furthermore, harsh access controls were enforced that constrained user privileges simply reliant on their position and task in the software. This degree helped improve risks allied with information admission and restricted the potential for operation in the event of insider pressures. Also, dynamic encryption methods were employed to shield data at rest and in passage, decreasing the risk of theft or interruption. Additionally, specific actions were taken to speech common weaknesses such as SQL injection, cross-site scripting, and injection assaults. This combined into extra difficult input confirmation, parameterized inquiries and cleaning of user input generally prevented the destructive influence of manipulation attempts. On the period comparable to these concluding approaches, monitoring and examining systems were likewise created to observe and report any doubtful operations or security discrepancies instantly.

Real-time alerts and logs help keep an eye on what's incident in the system. This lets us briefly jump in and fix any security troubles if they chance.

To make the system protected, we added a bunch of security introductions. These contain things like making sure only the right people can admittance certain parts of the system, keeping data safe by motocross it with strong codes, writing code in a way that makes it solider for hackers to break into, and often checking for any weak acnes in the system's refuge so we can fix them before anything bad ensues.

In short, we've made security our top urgency when creating and building our system. We've taken a thorough method to recognize and uphold threats, using deep security measures like continual monitoring and defending appears. By doing this, we want to make sure that our system is responsible, keeps restricted information safe, and runs well without any trouble.

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