

**HANOI UNIVERSITY OF SCIENCE AND TECHNOLOGY**  
**SCHOOL OF INFORMATION AND COMMUNICATION**  
**TECHNOLOGY**



## **Project 3 Report**

**Topic:** Remote Controller  
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**Source code:** [GitHub Repository](#)  
**School:** Information and Communications Technology

**HANOI, 2024**

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## Abstract

In today's digital age, remote management and control of computer systems in business and educational environments has become an essential requirement. The increasing complexity of IT infrastructure and the need for efficient management solutions have driven the development of sophisticated remote control systems. This project addresses these challenges by presenting a comprehensive solution for remote computer management and control, specifically designed for educational institutions and enterprises.

The system architecture comprises three main components working in harmony. First, an agent software installed on target computers handles local operations and maintains secure communication channels. Second, a central server processes all requests, manages authentication, and coordinates system activities. Third, a modern web interface provides administrators with intuitive tools for system management and monitoring.

From a functional perspective, this solution offers a wide range of capabilities. It enables centralized management of computers organized by rooms or departments, facilitating efficient resource allocation and monitoring. Administrators can perform remote tasks such as software installation, system configuration, and real-time activity monitoring. The system also provides detailed reporting features and automated maintenance capabilities, significantly reducing the workload on IT staff.

Security and scalability are fundamental aspects of the system's design. The implementation includes robust authentication mechanisms, encrypted communications, and detailed permission controls that ensure secure operations. The system's modular architecture allows for easy expansion and integration with existing infrastructure, while its efficient resource utilization ensures optimal performance even in large-scale deployments.

Through extensive testing and real-world implementation, this system has demonstrated its effectiveness in streamlining IT management processes, reducing operational costs, and improving overall system administration efficiency in both educational and business environments.

# 1 Survey

## 1.1 Overview of Existing Solutions

Currently, there are several remote computer management solutions commonly used in educational and business environments:

- TeamViewer:
  - Popular remote control software with cross-platform support
  - Limited centralized management features
  - High licensing costs for commercial use
  - Strong security with end-to-end encryption
  - Resource-intensive for host computers
- AnyDesk:
  - Similar to TeamViewer, focused on individual remote control
  - Lower resource requirements
  - Better performance on low-bandwidth connections
  - Limited multi-machine management capabilities
- Remote Desktop Protocol (RDP):
  - Microsoft's native solution
  - Windows-only and requires complex configuration
  - Network Level Authentication for security
  - Limited to one active session per user
  - Requires open ports and proper network configuration
- VNC:
  - Open-source protocol, cross-platform compatibility
  - Lacks centralized management features
  - Multiple implementations available (TightVNC, UltraVNC, RealVNC)
  - Basic security features in free versions
  - High bandwidth requirements for good performance

## 1.2 Needs Analysis

Through comprehensive surveys of schools and businesses, the main requirements for remote computer management include:

### 1. Centralized Management:

- Unified interface to manage all computers
- Real-time system status monitoring
- Batch operations support
- Centralized logging and reporting

### 2. Detailed Permissions:

- Role-based access control
- Room/area-based permissions
- Function-specific authorizations
- Audit trail for all actions

### 3. Software Installation:

- Remote software deployment
- Silent installation support
- Installation status monitoring

### 4. Activity Monitoring:

- Real-time system metrics
- Process and application monitoring
- Network usage tracking
- User activity logging

### 5. Security:

- Secure authentication mechanisms
- Data protection compliance
- Intrusion detection and prevention

### 6. Scalability:

- Easy addition of new computers
- Support for multiple locations
- Performance optimization for large deployments
- Automated agent distribution

## 1.3 Proposed Solution

Based on the analysis, the proposed solution includes three main components with detailed technical specifications:

### 1.3.1 Agent (Windows Client)

- Core Features:
  - Python-based implementation for performance
  - Windows Service integration
  - System information collection
  - Remote command execution
  - File transfer capabilities
- Technical Implementation:
  - WebSocket client for real-time communication
  - WMI integration for system monitoring
  - Windows Service API integration
  - SQLite for local caching
  - Logging with rotation support
- Security Features:
  - SSL/TLS encryption (Full Deploy only)
  - Secure credential storage
  - Access token management

### 1.3.2 Server (Backend)

- Architecture:
  - Node.js and Express framework
  - RESTful API design
  - WebSocket server for real-time updates
  - SQLite database with migrations
- API Features:
  - User management endpoints
  - Room configuration APIs

- Computer management interfaces
- File transfer handlers
- Security Implementation:
  - JWT-based authentication
  - Role-based authorization
  - Rate limiting
  - Request validation

### 1.3.3 Web Interface (Frontend)

- Technology Stack:
  - React with Vite for fast development
  - Tailwind CSS for styling
  - React Router for navigation
  - WebSocket integration
- User Interface Features:
  - Responsive dashboard design
  - Real-time status updates
  - Interactive room layouts
  - Drag-and-drop functionality
- Management Tools:
  - Computer grouping and filtering
  - Batch operation interface
  - Activity monitoring panels
  - Report generation

## 1.4 Solution Advantages

- Architecture Benefits:
  - Modular design for easy maintenance
  - Scalable component structure
  - Platform independence
  - Efficient resource utilization

- User Experience:
  - Intuitive interface design
  - Fast response times
  - Real-time updates
  - Comprehensive documentation
- Operational Benefits:
  - Reduced maintenance overhead
  - Automated routine tasks
  - Centralized control
  - Detailed audit capabilities

## 1.5 Challenges and Solutions

### 1. Security:

- End-to-end encryption for all communications
- Multi-factor authentication support
- Regular security audits
- Automated vulnerability scanning
- Access control matrix implementation

### 2. Performance:

- WebSocket protocol optimization
- Connection pooling
- Load balancing support
- Resource usage monitoring
- Caching strategies

### 3. Reliability:

- Automatic agent recovery
- Database backup automation
- Error handling protocols
- Network resilience features
- Failover mechanisms

#### 4. Scalability:

- Horizontal scaling support
- Database optimization
- Connection management
- Resource allocation strategies

### 1.6 Implementation Metrics

- Performance Benchmarks:

- Response time < 100ms for API requests
- Support for 1000+ simultaneous connections
- Real-time updates within 1 second
- < 1% CPU usage for idle agents

- Security Metrics:

- 256-bit encryption for all data
- Zero trust architecture
- Regular penetration testing
- Compliance with data protection standards

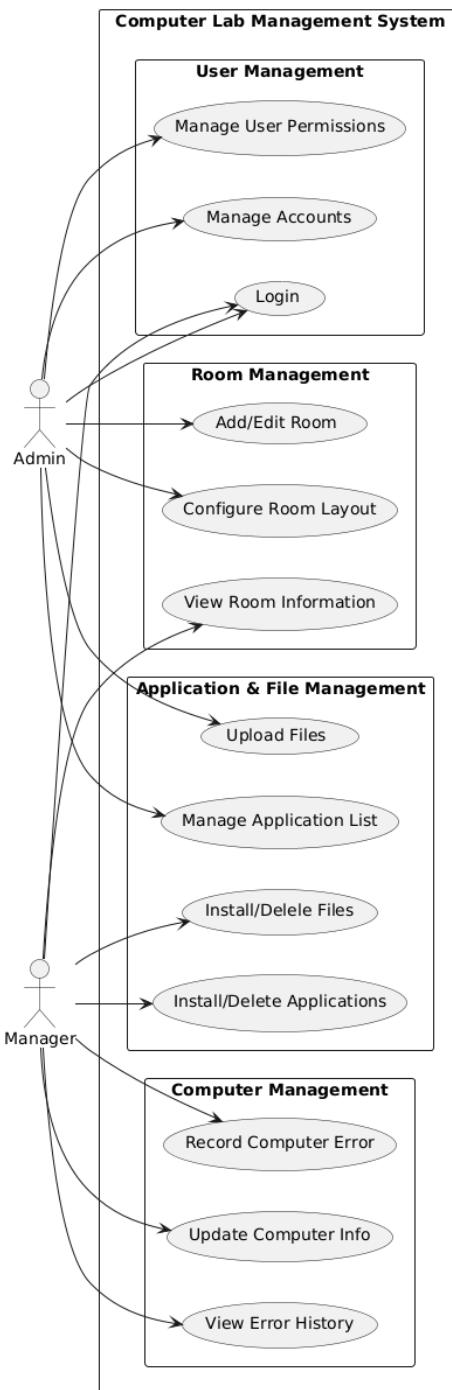
- Reliability Targets:

- 99.9% uptime for server components
- < 5 minute recovery time for agents
- Automatic failover within 30 seconds
- Daily backup retention for 30 days

## 2 System Analysis and Design

### 2.1 System design

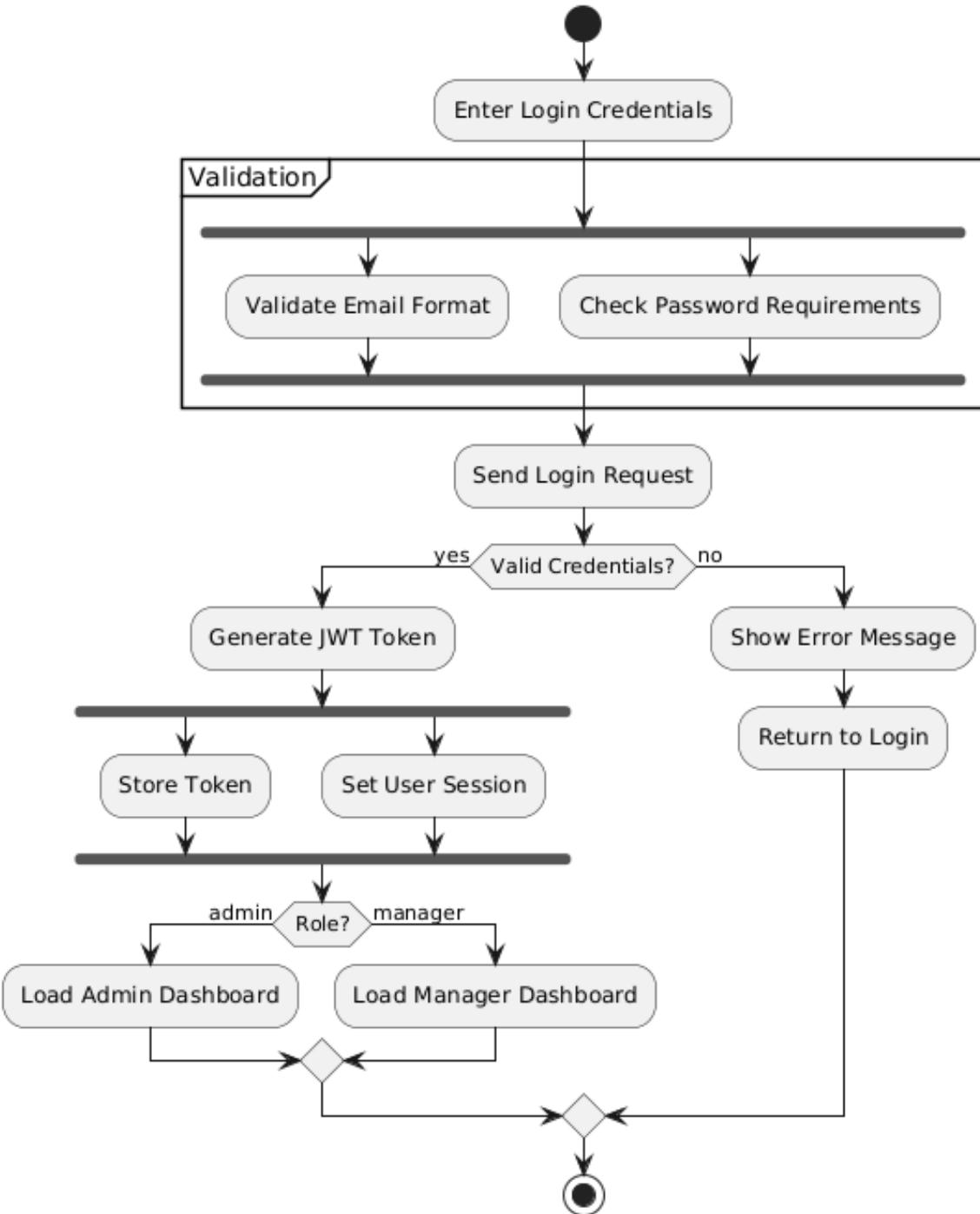
#### 2.1.1 Usecase diagram



**Fig. 1.** Usecase diagram

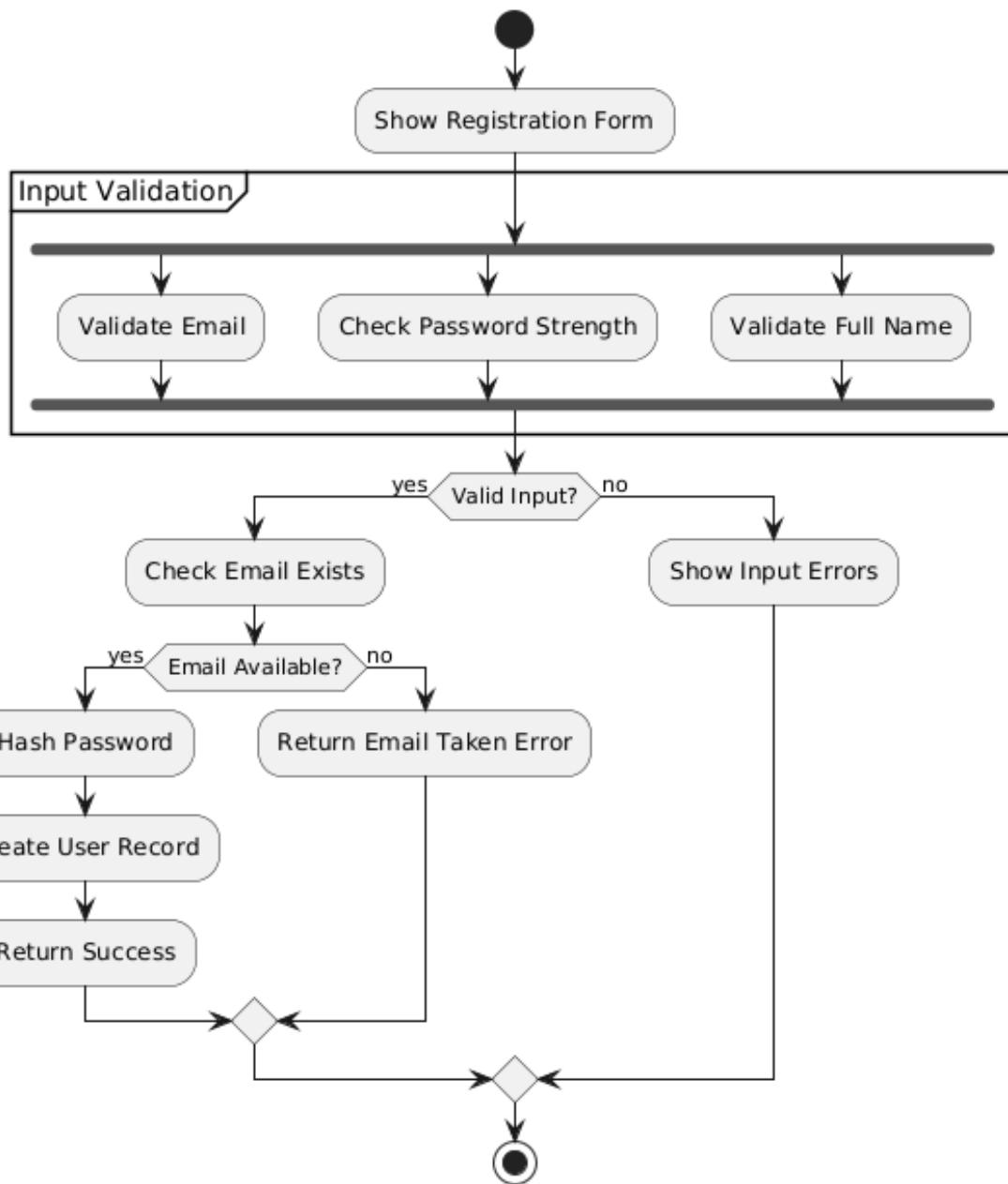
### 2.1.2 Activity diagram

#### a. Login



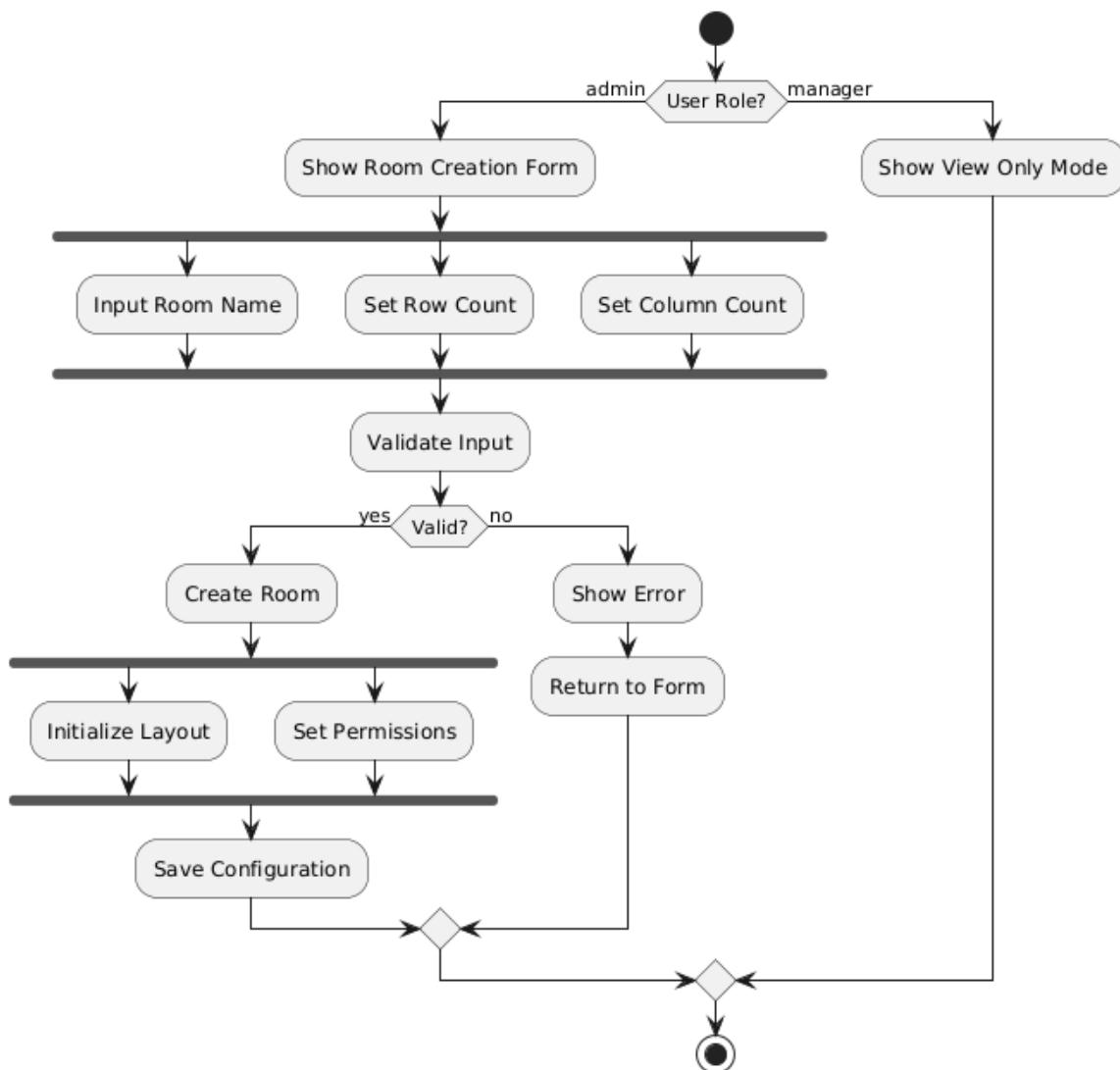
**Fig. 2.** Activity diagram: Login

#### b. Create Account



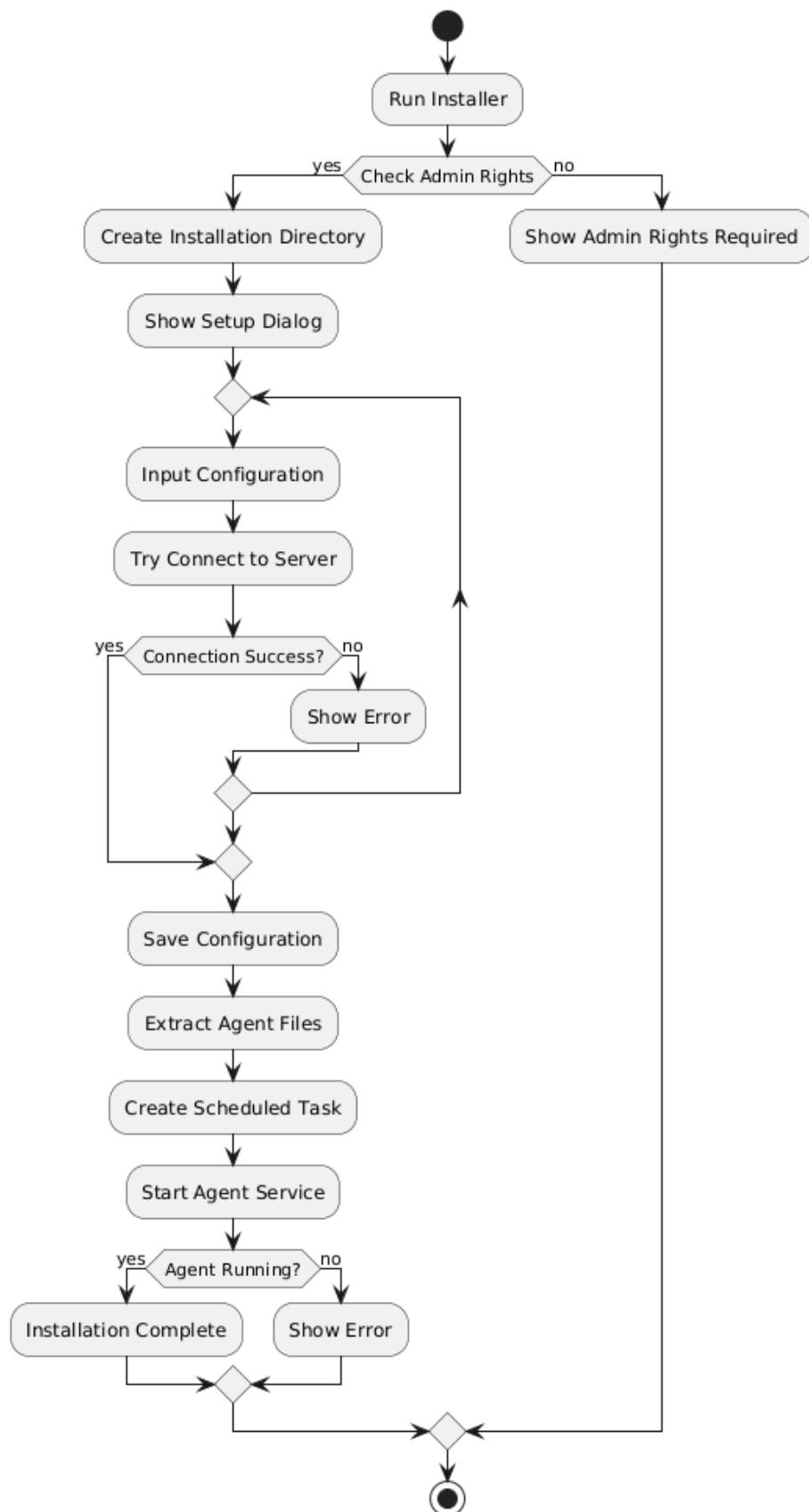
**Fig. 3.** Activity diagram: Create Account

c. Create Room

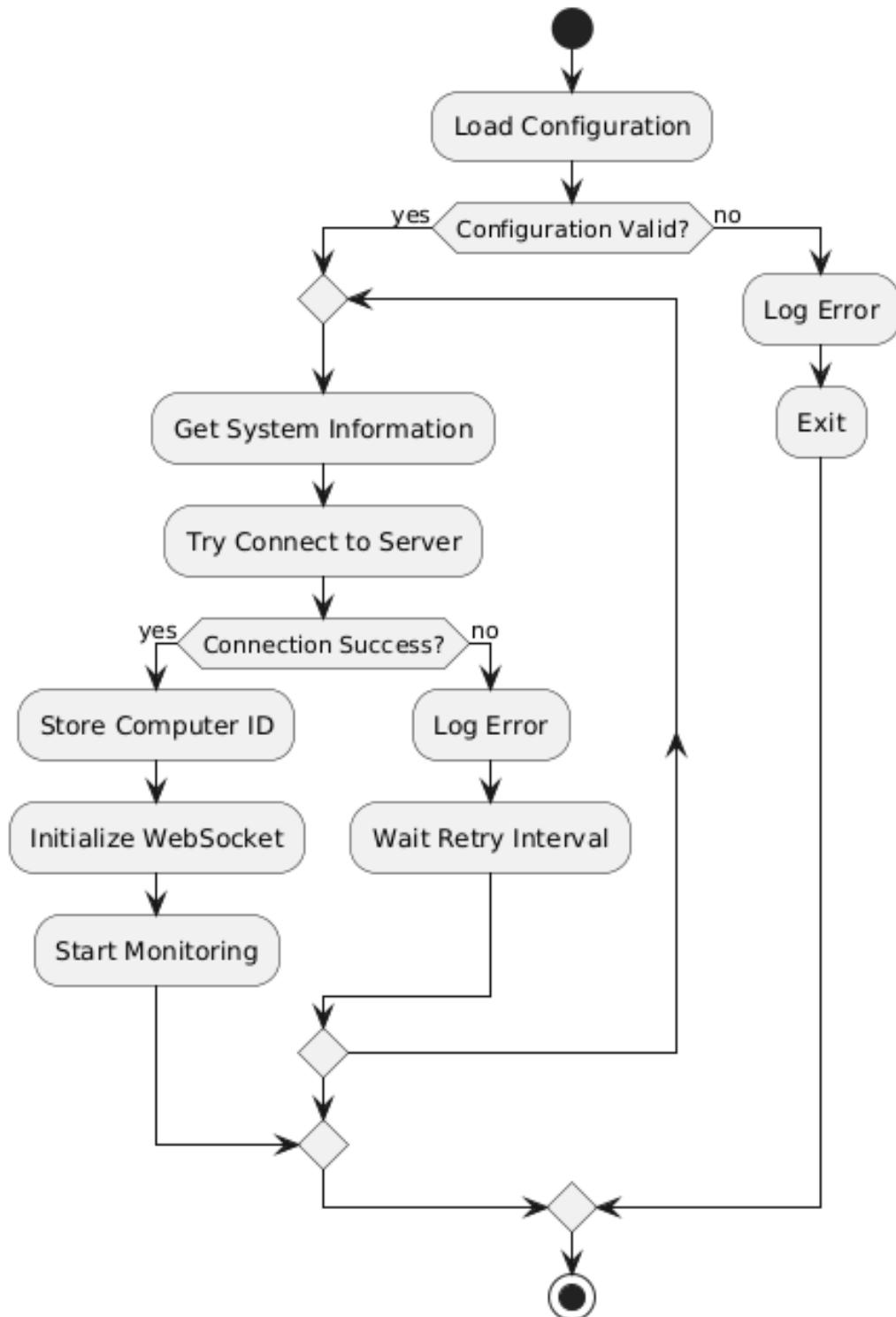


**Fig. 4.** Activity diagram: Create Room

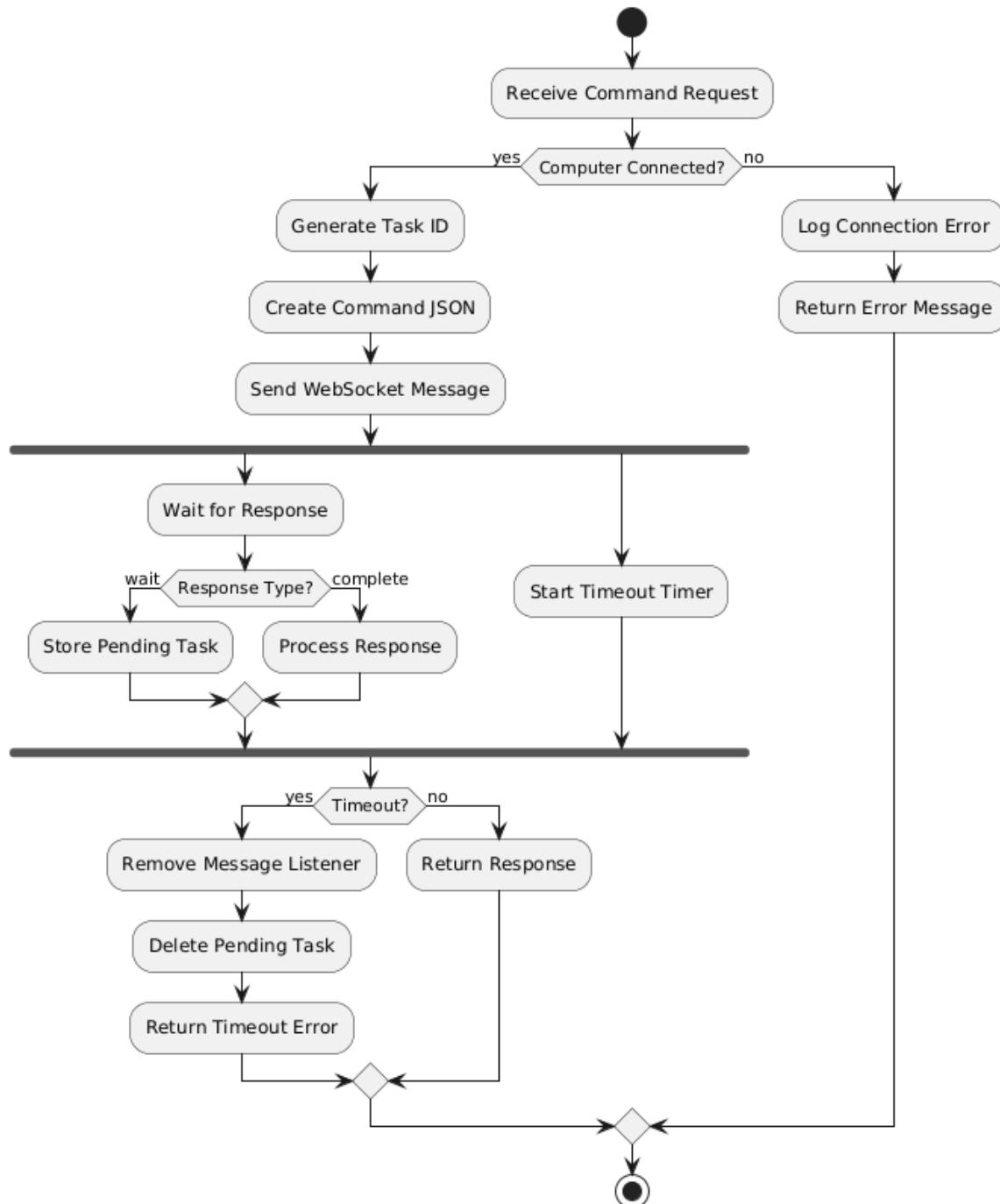
d. Install Agent


**Fig. 5.** Activity diagram: Install Agent

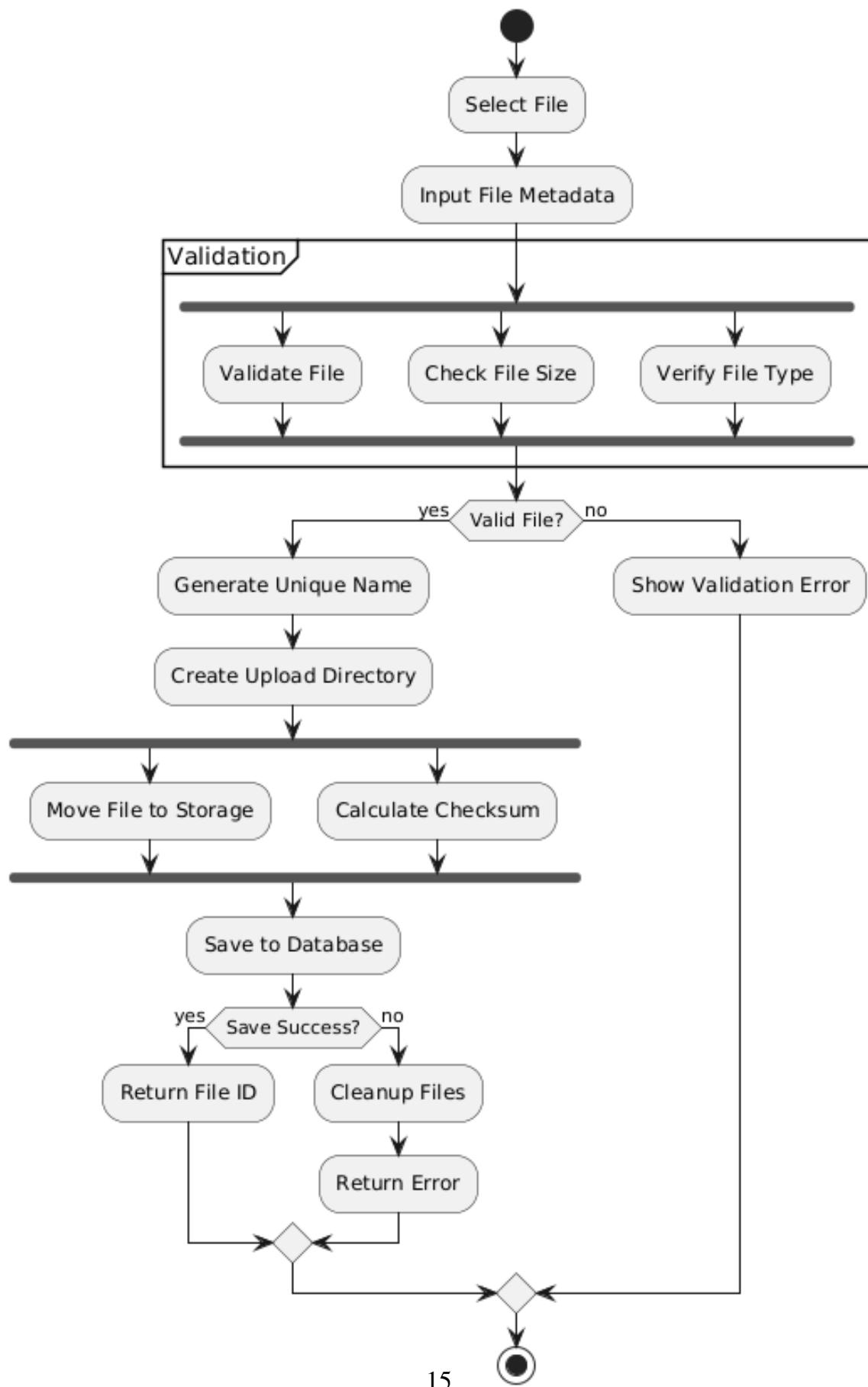
## e. Agent Connect


**Fig. 6.** Activity diagram: Agent Connect

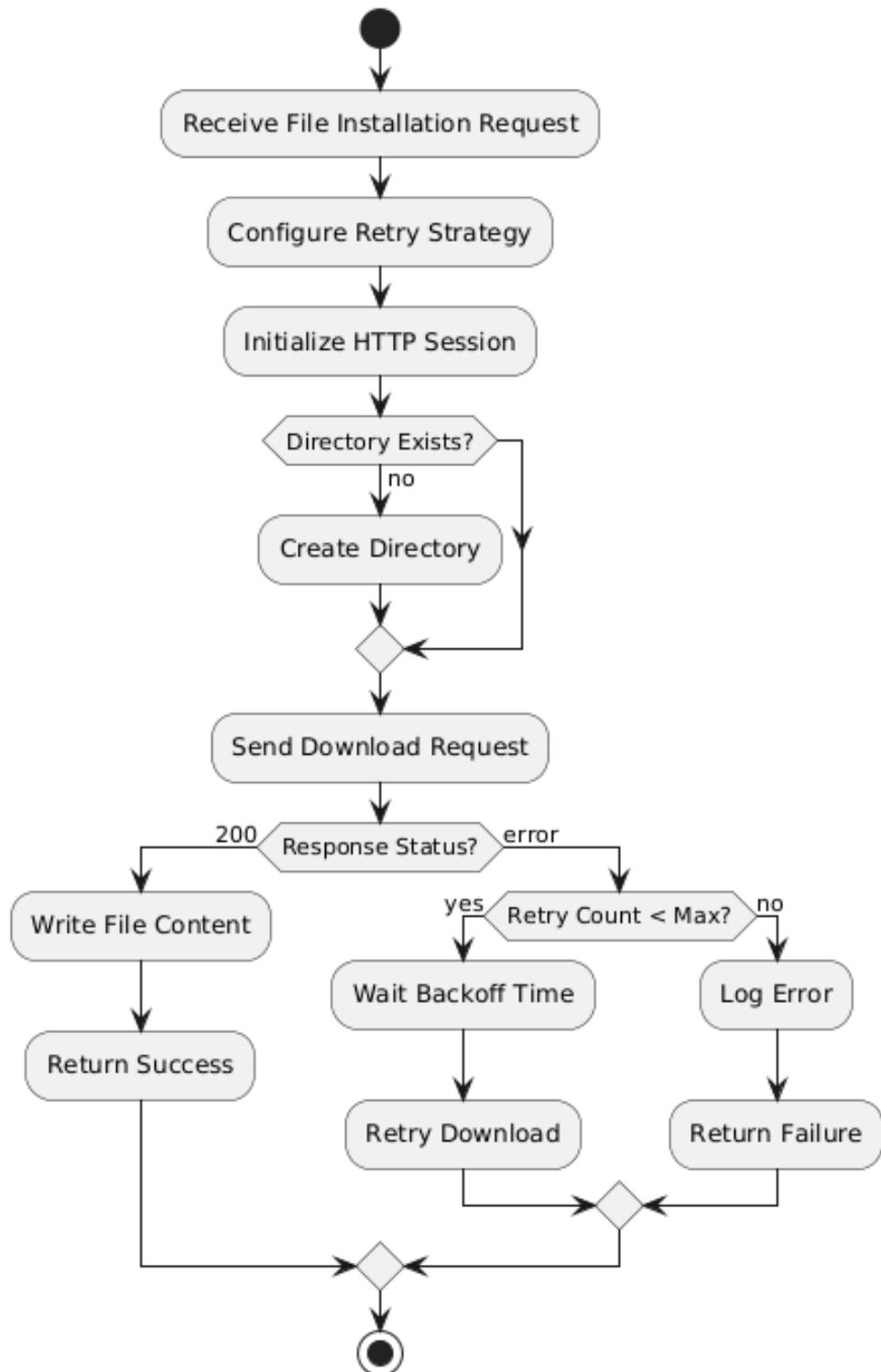
## f. Command to Agent


**Fig. 7.** Activity diagram: Command to Agent

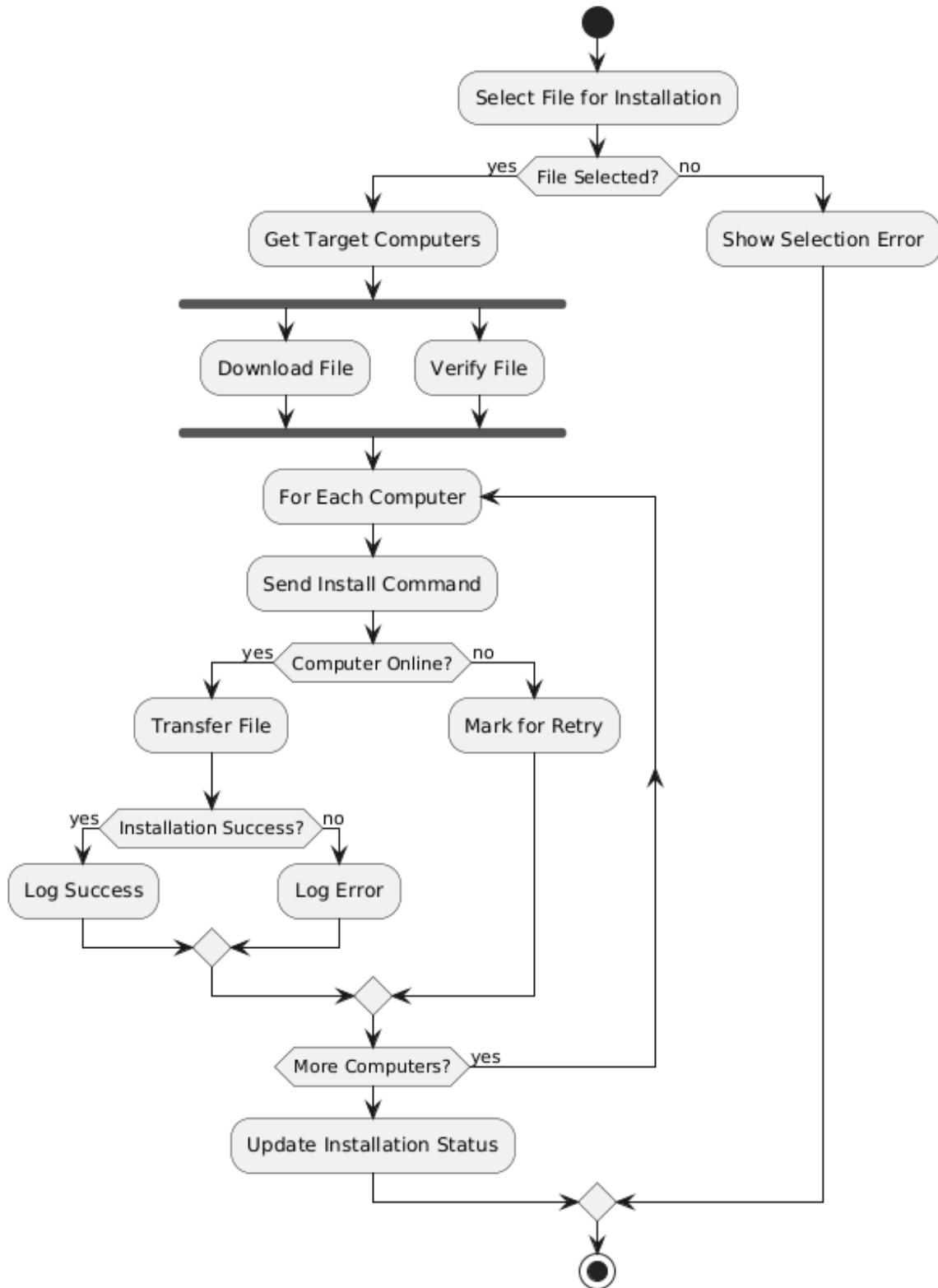
## g. Upload File


**Fig. 8.** Activity diagram: Upload File

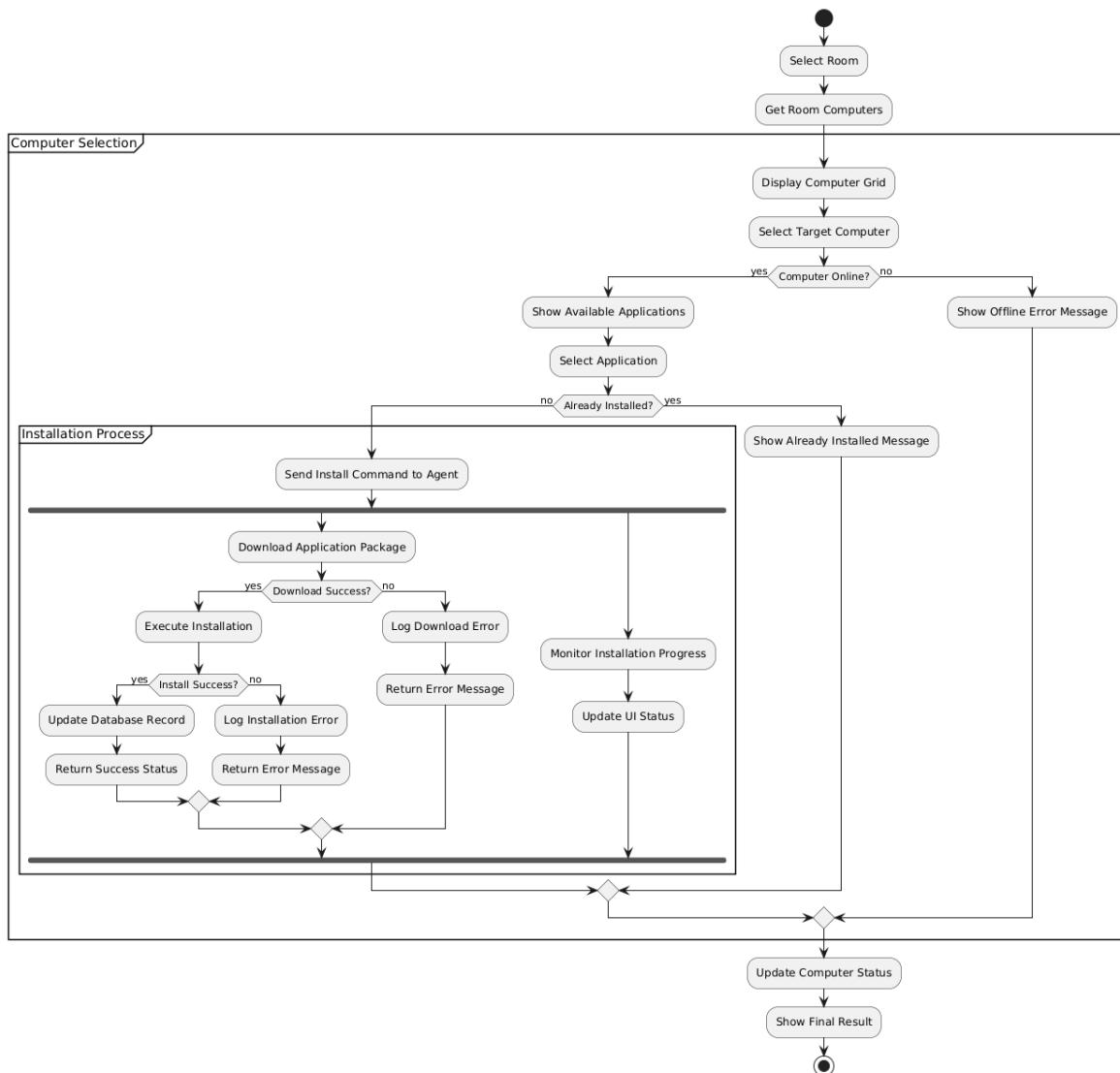
## h. Install File


**Fig. 9.** Activity diagram: Install File

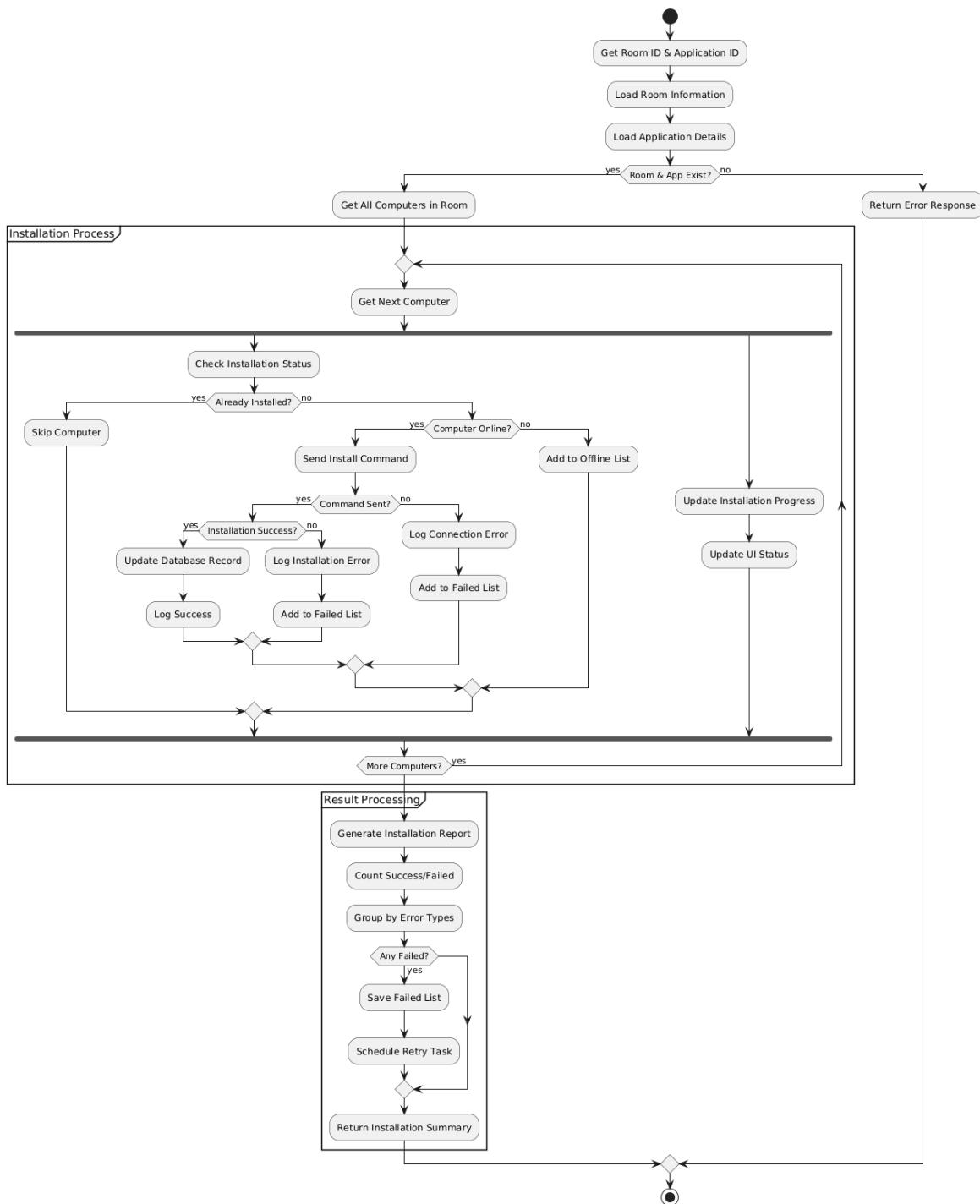
## i. Install File (batch for room)


**Fig. 10.** Activity diagram: Install File (batch for room)

## j. Install Application

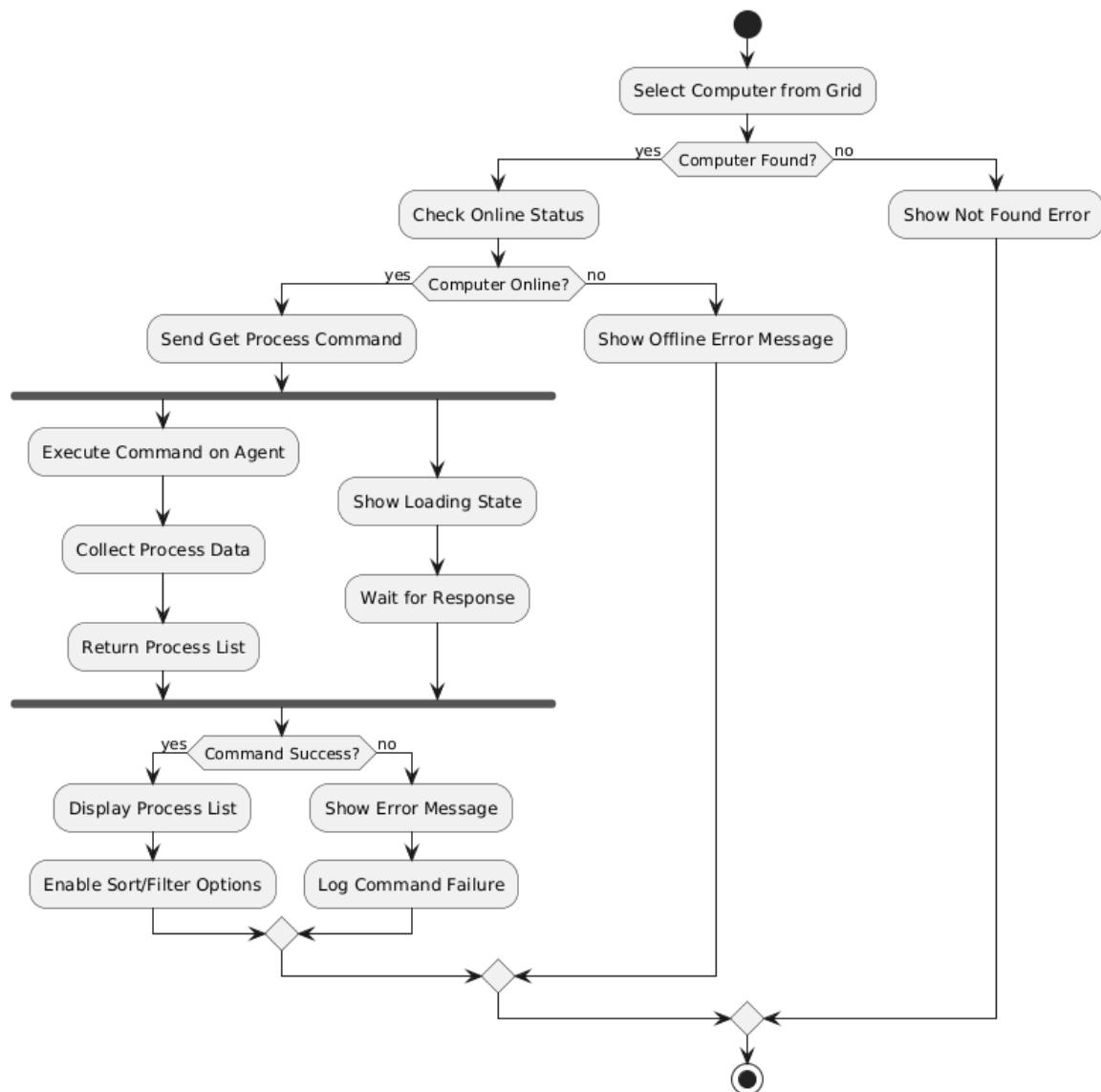

**Fig. 11.** Activity diagram: Install Application

## k. Install Application (batch for room)



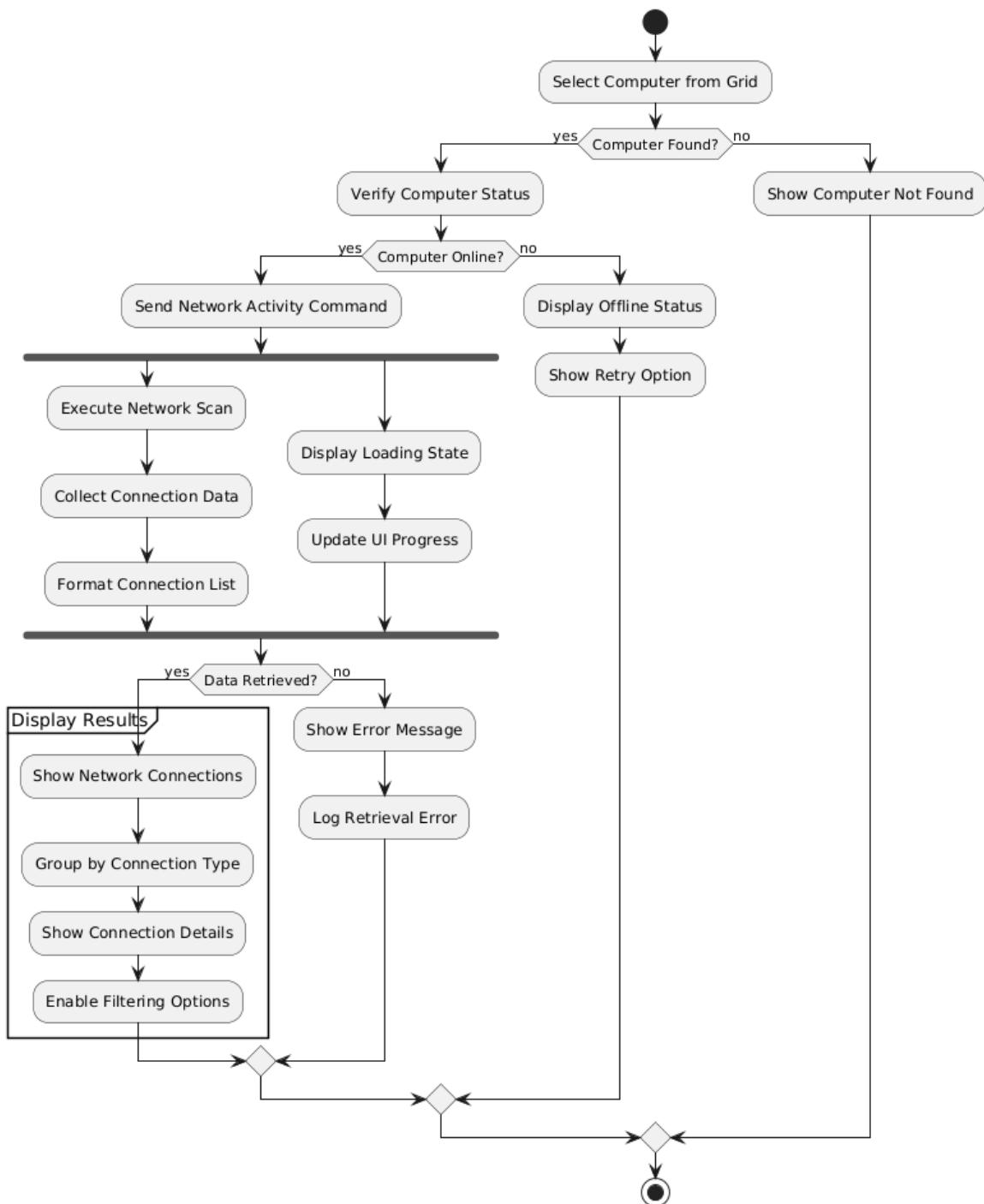
**Fig. 12.** Activity diagram: Install Application (batch for room)

## 1. Process Monitor



**Fig. 13.** Activity diagram: Process Monitor

m. Network Connection Monitor



**Fig. 14.** Activity diagram: Network Connection Monitor

## 2.2 Database design

- **Users Table:**

- id: INTEGER PRIMARY KEY AUTOINCREMENT
- full\_name: TEXT NOT NULL
- email: TEXT NOT NULL UNIQUE
- password: TEXT NOT NULL
- role: TEXT NOT NULL DEFAULT 'manager'
- created\_at: TIMESTAMP DEFAULT CURRENT\_TIMESTAMP

- **Rooms Table:**

- id: INTEGER PRIMARY KEY AUTOINCREMENT
- name: TEXT NOT NULL UNIQUE
- row\_count: INTEGER NOT NULL
- column\_count: INTEGER NOT NULL
- description: TEXT

- **Permissions Table:**

- user\_id: INTEGER NOT NULL (FK → Users.id)
- room\_id: INTEGER NOT NULL (FK → Rooms.id)
- can\_view: INTEGER DEFAULT 0
- can\_manage: INTEGER DEFAULT 0
- PRIMARY KEY (user\_id, room\_id)

- **Computers Table:**

- id: INTEGER PRIMARY KEY AUTOINCREMENT
- room\_id: INTEGER NOT NULL (FK → Rooms.id)
- row\_index: INTEGER NOT NULL
- column\_index: INTEGER NOT NULL
- ip\_address: TEXT NOT NULL
- mac\_address: TEXT NOT NULL
- hostname: TEXT NOT NULL
- notes: TEXT DEFAULT NULL
- updated\_at: TIMESTAMP DEFAULT CURRENT\_TIMESTAMP

- UNIQUE (room\_id, row\_index, column\_index)

- **Computer Errors Table:**

- id: INTEGER PRIMARY KEY AUTOINCREMENT
- computer\_id: INTEGER NOT NULL (FK → Computers.id)
- error\_type: TEXT NOT NULL CHECK(IN ('hardware', 'software', 'network', 'system', 'security', 'peripheral'))
- description: TEXT NOT NULL
- created\_at: TIMESTAMP DEFAULT CURRENT\_TIMESTAMP
- resolved\_at: TIMESTAMP DEFAULT NULL

- **Applications Table:**

- id: INTEGER PRIMARY KEY AUTOINCREMENT
- name: TEXT NOT NULL UNIQUE
- description: TEXT DEFAULT NULL
- version: TEXT DEFAULT NULL

- **Installed Applications Table:**

- computer\_id: INTEGER NOT NULL (FK → Computers.id)
- application\_id: INTEGER NOT NULL (FK → Applications.id)
- installed\_at: TIMESTAMP DEFAULT CURRENT\_TIMESTAMP
- installed\_by: INTEGER NOT NULL DEFAULT 1
- PRIMARY KEY (computer\_id, application\_id)

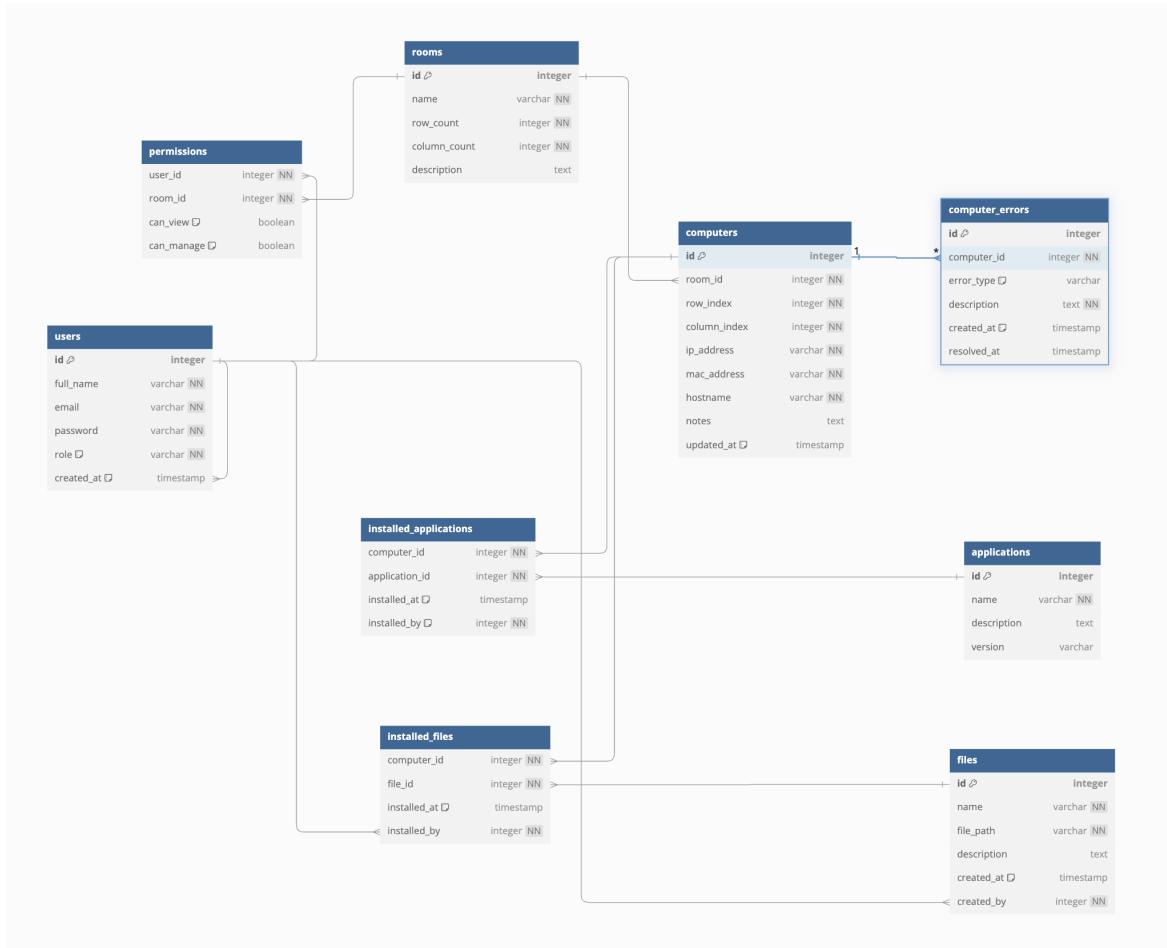
- **Files Table:**

- id: INTEGER PRIMARY KEY AUTOINCREMENT
- name: TEXT NOT NULL UNIQUE
- file\_path: TEXT NOT NULL
- description: TEXT
- created\_at: TIMESTAMP DEFAULT CURRENT\_TIMESTAMP
- created\_by: INTEGER NOT NULL (FK → Users.id)

- **Installed Files Table:**

- computer\_id: INTEGER NOT NULL (FK → Computers.id)
- file\_id: INTEGER NOT NULL (FK → Files.id)

- installed\_at: TIMESTAMP DEFAULT CURRENT\_TIMESTAMP
- installed\_by: INTEGER NOT NULL (FK → Users.id)
- PRIMARY KEY (computer\_id, file\_id)



**Fig. 15.** Sequence diagram: Register working time

### 3 Technology Stack

The Remote Control project is developed based on a client-server architecture with modern technologies, enabling efficient and secure remote computer management and control. The project is built with the following technologies and libraries:

#### 3.1 Backend

The backend is built with the following technologies and libraries:

- **Node.js**: JavaScript runtime platform used to build the server.
- **Express.js**: Web framework for Node.js, used to build REST API and handle requests.
- **SQLite**: Lightweight database used to store information about users, computers, and rooms.
- **JWT (JSON Web Token)**: Used for user authentication and authorization.
- **WebSocket**: Real-time communication between agent and server.

#### 3.2 Frontend

The frontend is developed with the following technologies and libraries:

- **React.js**: JavaScript library for building user interfaces.
- **Material-UI**: UI component library for React, providing modern user interface.
- **Axios**: HTTP client for browser and Node.js, used for API calls.
- **React Router**: Handles routing in React applications.

#### 3.3 Agent

The agent installed on client computers uses these technologies:

- **Python**: Main programming language for agent development.
- **PyInstaller**: Packages Python applications into executable files.
- **psutil**: Collects Windows system information.
- **WebSocket**: Network communication between agent and server.
- **Tkinter**: Builds user interface for the installer.

### 3.4 Development Tools

Tools supporting development and deployment:

- **Git**: Version control system.
- **Docker**: Containerization for easy deployment.

## 4 Quality Assurance

### 4.1 Computer Management

Test Case	Scenario	Input	Expected Output	Result
TC01	View process list for online computer	• Computer ID: 12345	• Status: 200 • Process list data	Pass
TC02	View process list for offline computer	• Computer ID: 12345	• Status: 503 • Message: "Computer is offline"	Pass
TC03	View network activities	• Computer ID: 12345	• Status: 200 • Network connections data	Pass
TC04	Install application	• Computer ID: 12345 • Application ID: 67890	• Status: 200 • Message: "Installation successful"	Pass
TC05	Uninstall application	• Computer ID: 12345 • Application ID: 67890	• Status: 204	Pass
TC06	Install file	• Computer ID: 12345 • File ID: 67890	• Status: 200 • Message: "File installed successfully"	Pass
TC07	File installation timeout	• Computer ID: 12345 • File ID: 67890	• Status: 408 • Message: "Request timed out"	Pass

### 4.2 Error Management

<b>Test Case</b>	<b>Scenario</b>	<b>Input</b>	<b>Expected Output</b>	<b>Result</b>
TC01	Add hardware error	<ul style="list-style-type: none"> <li>• Computer ID: 12345</li> <li>• Error type: "hardware"</li> <li>• Description: "RAM failure"</li> </ul>	<ul style="list-style-type: none"> <li>• Status: 201</li> <li>• Message: "Error added successfully"</li> </ul>	Pass
TC02	Add software error	<ul style="list-style-type: none"> <li>• Computer ID: 12345</li> <li>• Error type: "software"</li> <li>• Description: "Application crash"</li> </ul>	<ul style="list-style-type: none"> <li>• Status: 201</li> <li>• Message: "Error added successfully"</li> </ul>	Pass
TC03	Add invalid error type	<ul style="list-style-type: none"> <li>• Computer ID: 12345</li> <li>• Error type: "invalid"</li> <li>• Description: "Test error"</li> </ul>	<ul style="list-style-type: none"> <li>• Status: 400</li> <li>• Message: "Invalid error type"</li> </ul>	Pass
TC04	Resolve error	<ul style="list-style-type: none"> <li>• Computer ID: 12345</li> <li>• Error ID: 67890</li> </ul>	<ul style="list-style-type: none"> <li>• Status: 200</li> <li>• Message: "Error resolved successfully"</li> </ul>	Pass

### 4.3 Agent Connection

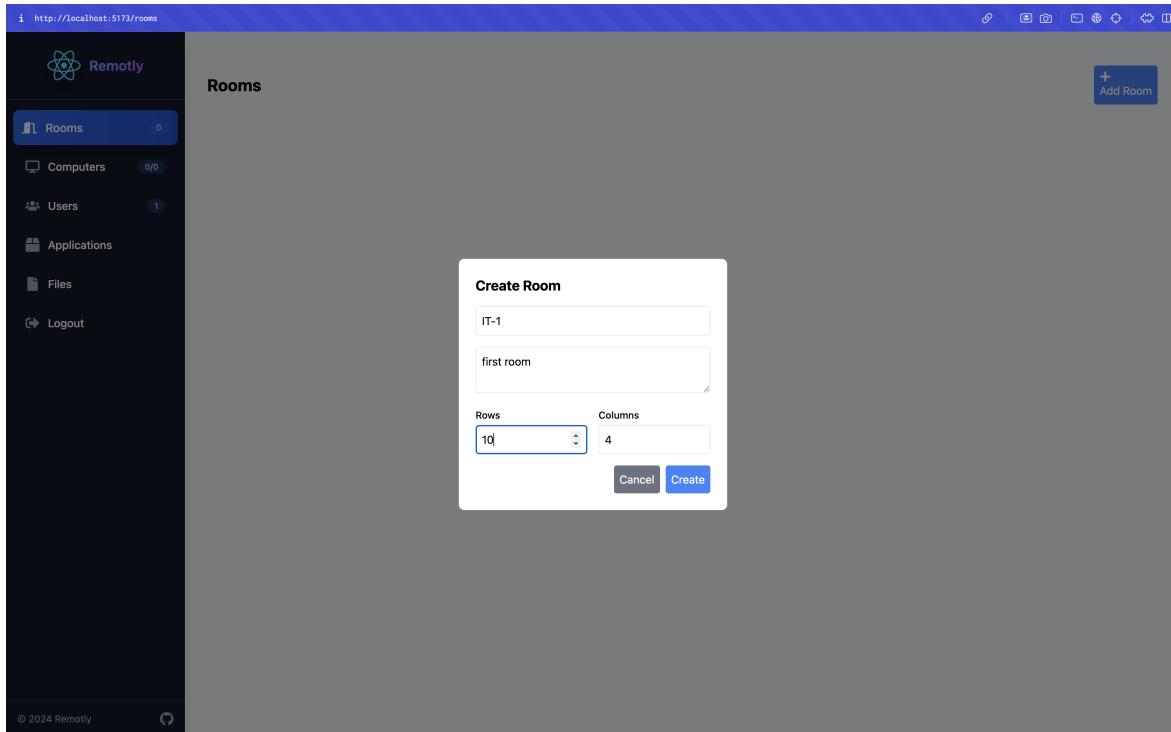
<b>Test Case</b>	<b>Scenario</b>	<b>Input</b>	<b>Expected Output</b>	<b>Result</b>
TC01	Successful connection	<ul style="list-style-type: none"> <li>• Room name: "Lab 1"</li> <li>• Row index: 0</li> <li>• Column index: 0</li> <li>• IP address: "192.168.1.1"</li> <li>• MAC address: "00:11:22:33:44:55"</li> <li>• Hostname: "PC-01"</li> </ul>	<ul style="list-style-type: none"> <li>• Status: 200</li> <li>• Message: "Connected successfully"</li> <li>• Computer ID returned</li> </ul>	Pass
TC02	Missing room name	<ul style="list-style-type: none"> <li>• Room name: ""</li> <li>• Row index: 0</li> <li>• Column index: 0</li> </ul>	<ul style="list-style-type: none"> <li>• Status: 400</li> <li>• Message: "Room name is required"</li> </ul>	Pass
TC03	Invalid row index	<ul style="list-style-type: none"> <li>• Room name: "Lab 1"</li> <li>• Row index: -1</li> <li>• Column index: 0</li> </ul>	<ul style="list-style-type: none"> <li>• Status: 400</li> <li>• Message: "Invalid row index"</li> </ul>	Pass
TC04	Position occupied	<ul style="list-style-type: none"> <li>• Room name: "Lab 1"</li> <li>• Row index: 0</li> <li>• Column index: 0</li> <li>• MAC address: "00:11:22:33:44:66"</li> </ul>	<ul style="list-style-type: none"> <li>• Status: 400</li> <li>• Message: "Position occupied"</li> </ul>	Pass
TC05	Connection timeout	<ul style="list-style-type: none"> <li>• Room name: "Lab 1"</li> <li>• Row index: 0</li> <li>• Column index: 0</li> </ul>	<ul style="list-style-type: none"> <li>• Status: 408</li> <li>• Message: "Connection timeout"</li> </ul>	Pass

## 5 Implementation Results

### 5.1 Room and User Management

#### a. Create New Room

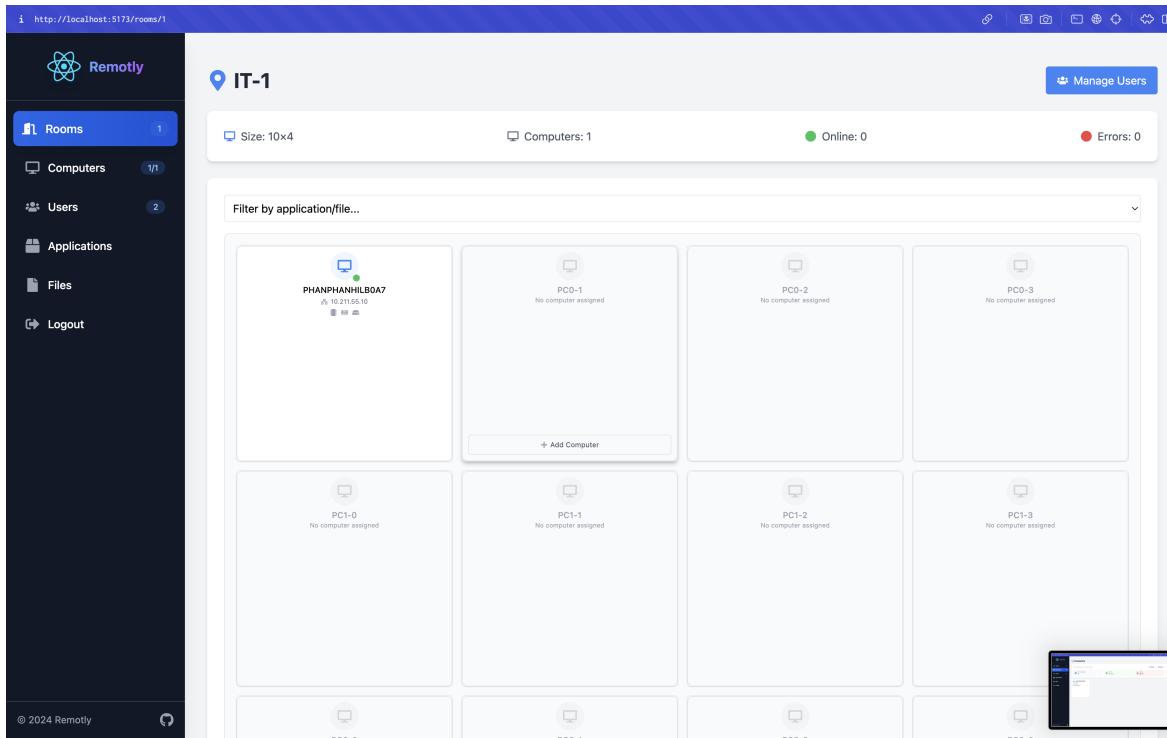
The Create New Room Interface (Figure 16) allows creation and configuration of new computer rooms.



**Fig. 16.** Create New Room Interface

#### b. Room Details

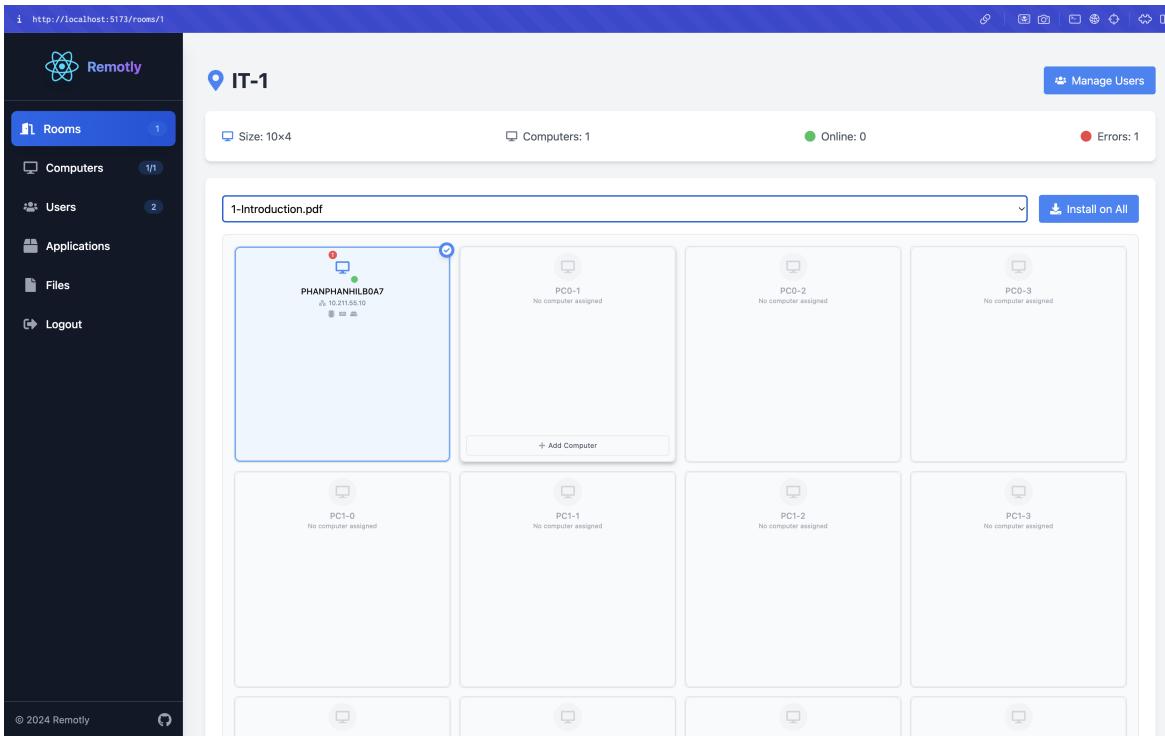
The Room Details Page (Figure 17) shows the computer layout diagram and operational status.



**Fig. 17.** Room Details Page

### c. Filter by Application/File

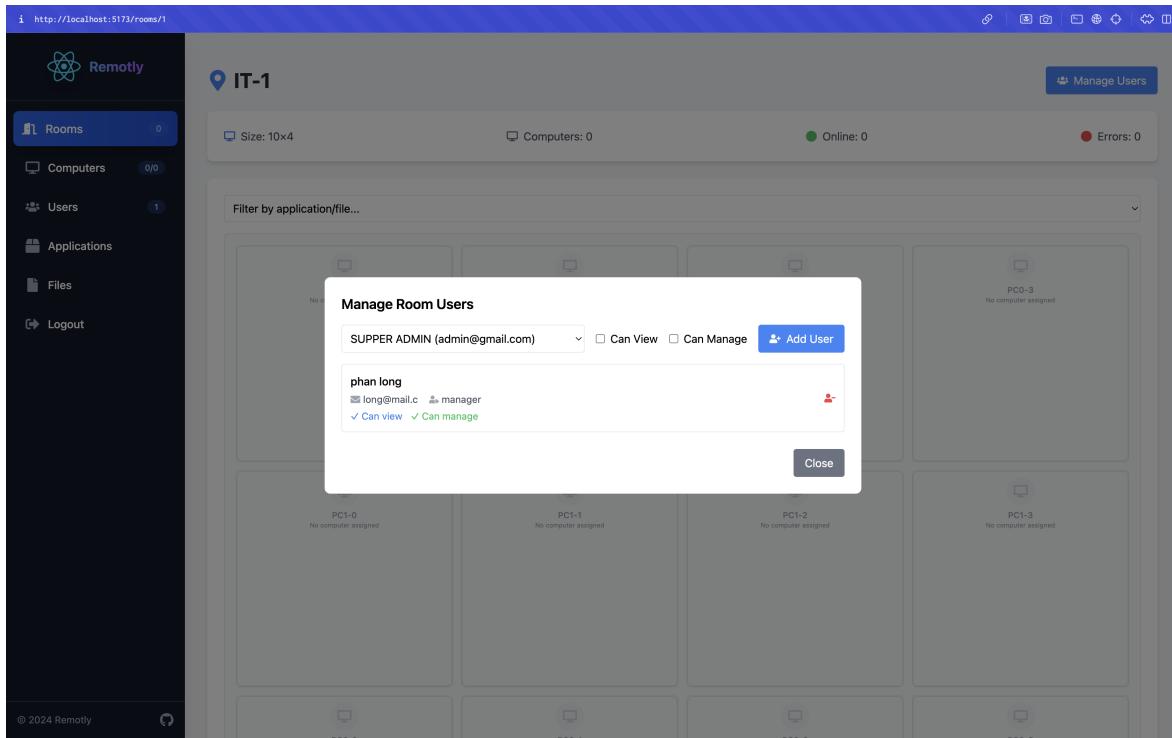
The Filter Function (Figure 18) enables filtering computers by installed applications or files.



**Fig. 18.** Filter Computers by Application/File

#### d. Room User Management

The User Management Interface (Figure 19) allows managing user permissions within rooms.

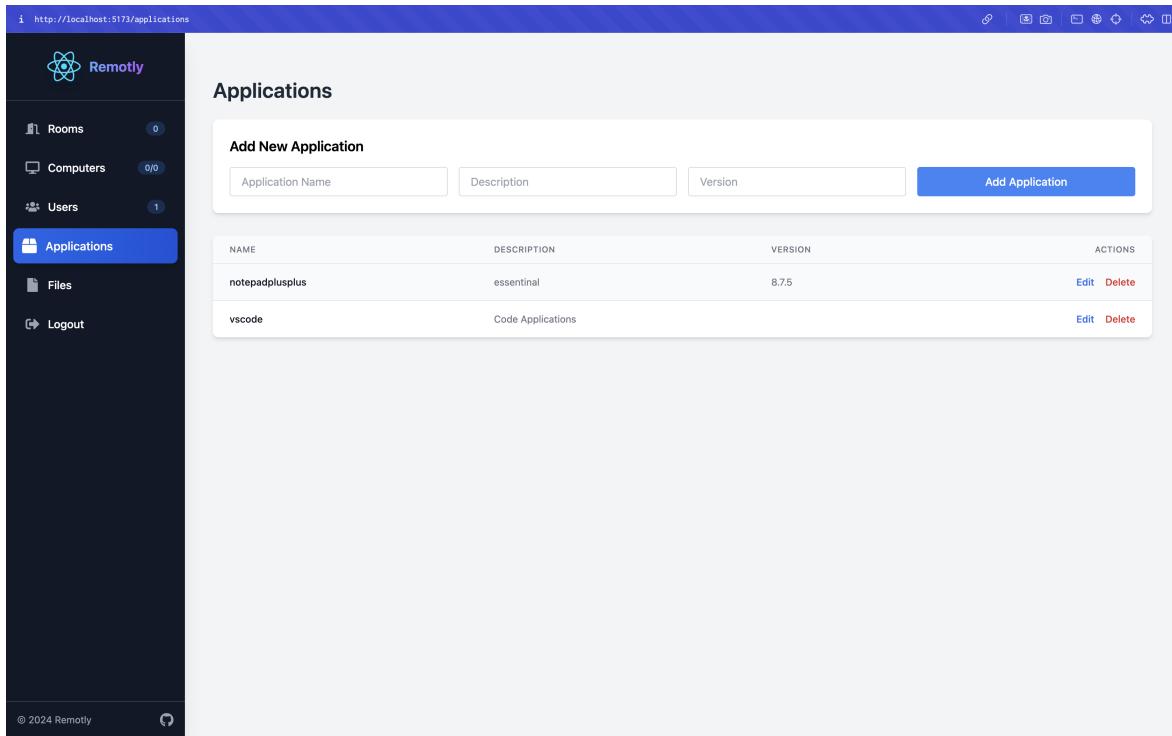


**Fig. 19.** Room User Management

## 5.2 Application and File Management

### a. Application Management Page

The Application Management Page (Figure 20) enables managing the list of available applications in the system.



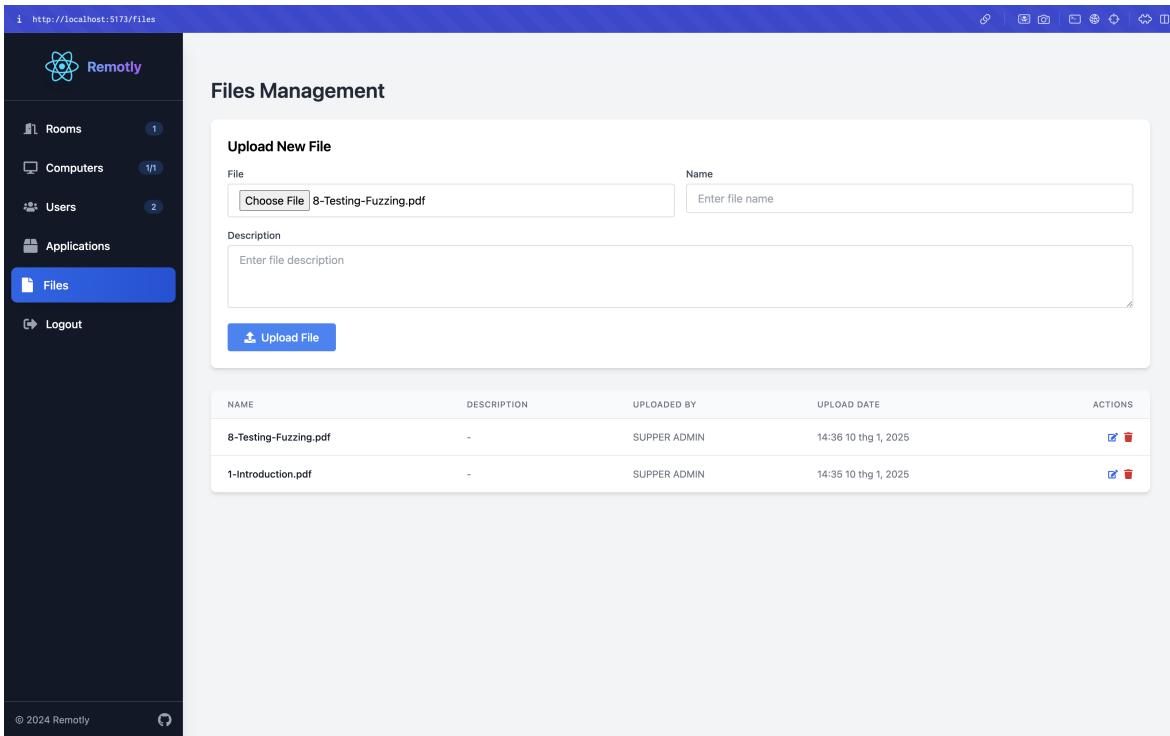
The screenshot shows a web application interface titled "Applications". On the left, there is a sidebar with the "Remotely" logo and navigation links: Rooms (0), Computers (0/0), Users (1), Applications (selected), Files, and Logout. The main content area has a header "Add New Application" with input fields for Application Name, Description, and Version, followed by a "Add Application" button. Below this is a table listing applications:

NAME	DESCRIPTION	VERSION	ACTIONS
notepadplusplus	essential	8.7.5	Edit Delete
vscode	Code Applications		Edit Delete

**Fig. 20.** Application Management Page

### b. File Management Page

The File Management Page (Figure 21) allows uploading and managing files in the system.



The screenshot shows a web-based file management interface. On the left, there is a sidebar with the 'Remotely' logo and navigation links: Rooms (1), Computers (1), Users (2), Applications, Files (selected), and Logout. The main area is titled 'Files Management' and contains a 'Upload New File' form. It includes fields for 'File' (with a 'Choose File' button showing '8-Testing-Fuzzing.pdf'), 'Name' (text input 'Enter file name'), 'Description' (text input 'Enter file description'), and a 'Upload File' button. Below this is a table listing uploaded files:

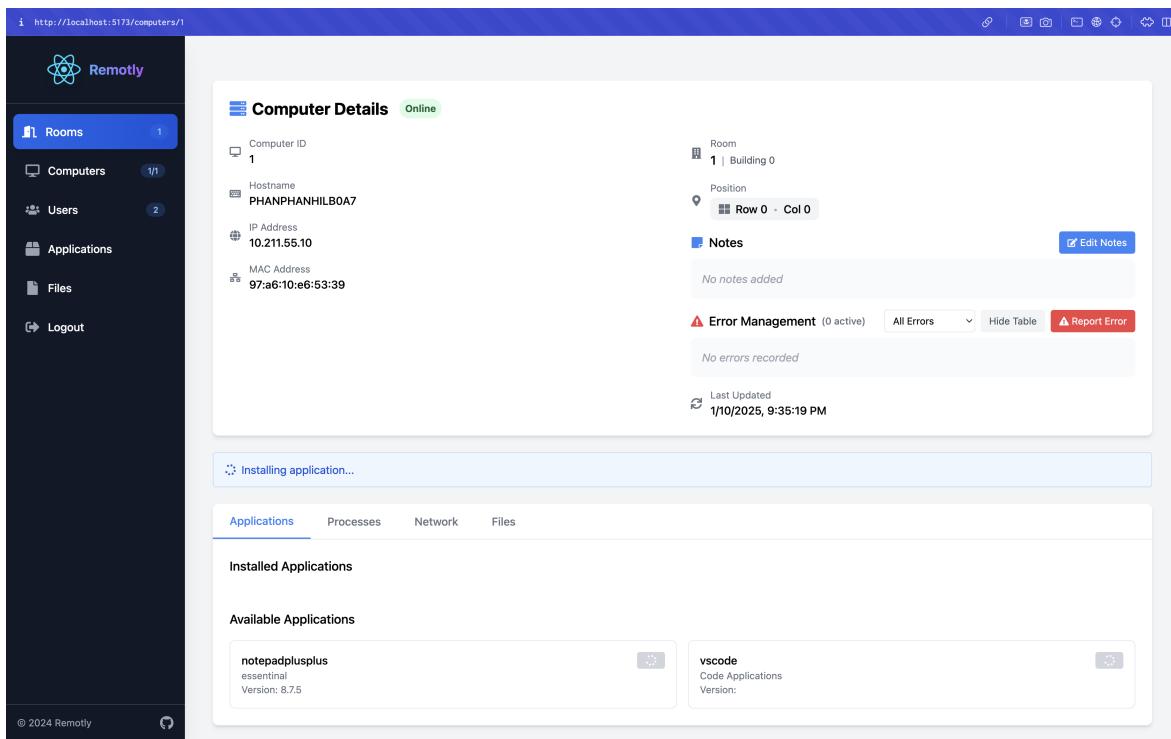
NAME	DESCRIPTION	UPLOADED BY	UPLOAD DATE	ACTIONS
8-Testing-Fuzzing.pdf	-	SUPPER ADMIN	14:36 10 thg 1, 2025	<input checked="" type="checkbox"/>
1-Introduction.pdf	-	SUPPER ADMIN	14:35 10 thg 1, 2025	<input checked="" type="checkbox"/>

At the bottom left of the main area, it says '© 2024 Remotely'.

**Fig. 21.** File Management Page

### c. Application Installation Process

Interface showing the application installation progress (Figure 22).

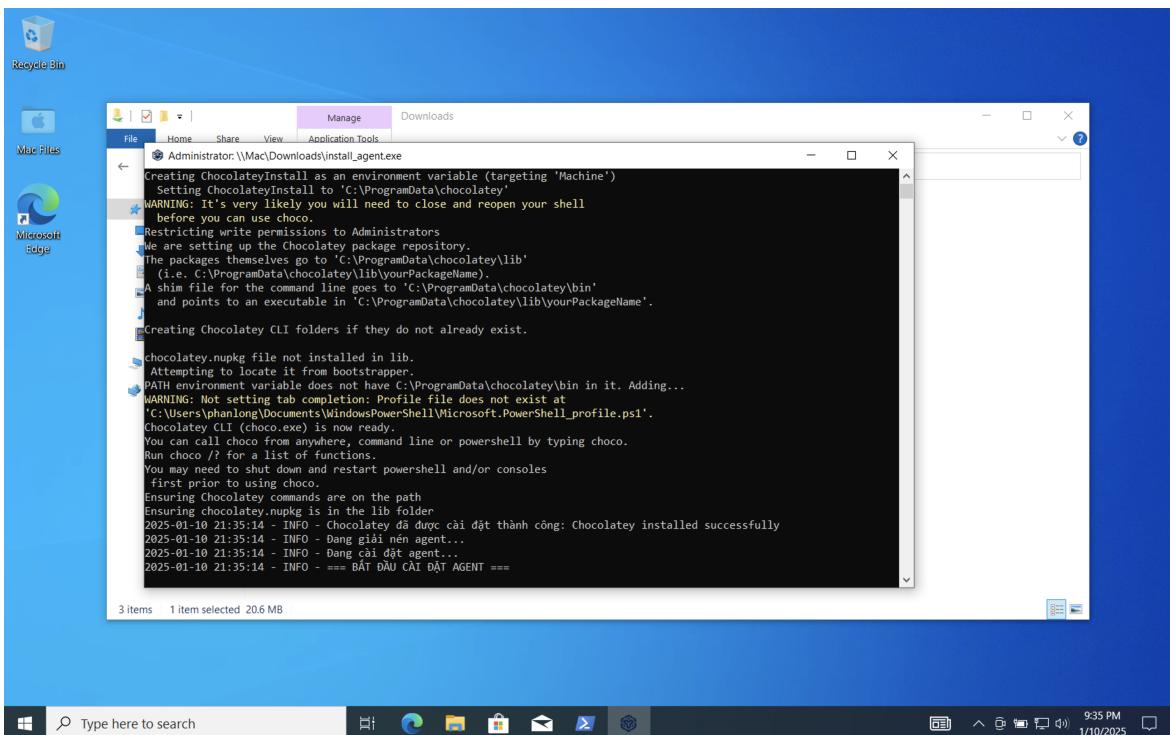


**Fig. 22.** Application Installation Process

## 5.3 Agent Installation

### a. Successful Installation

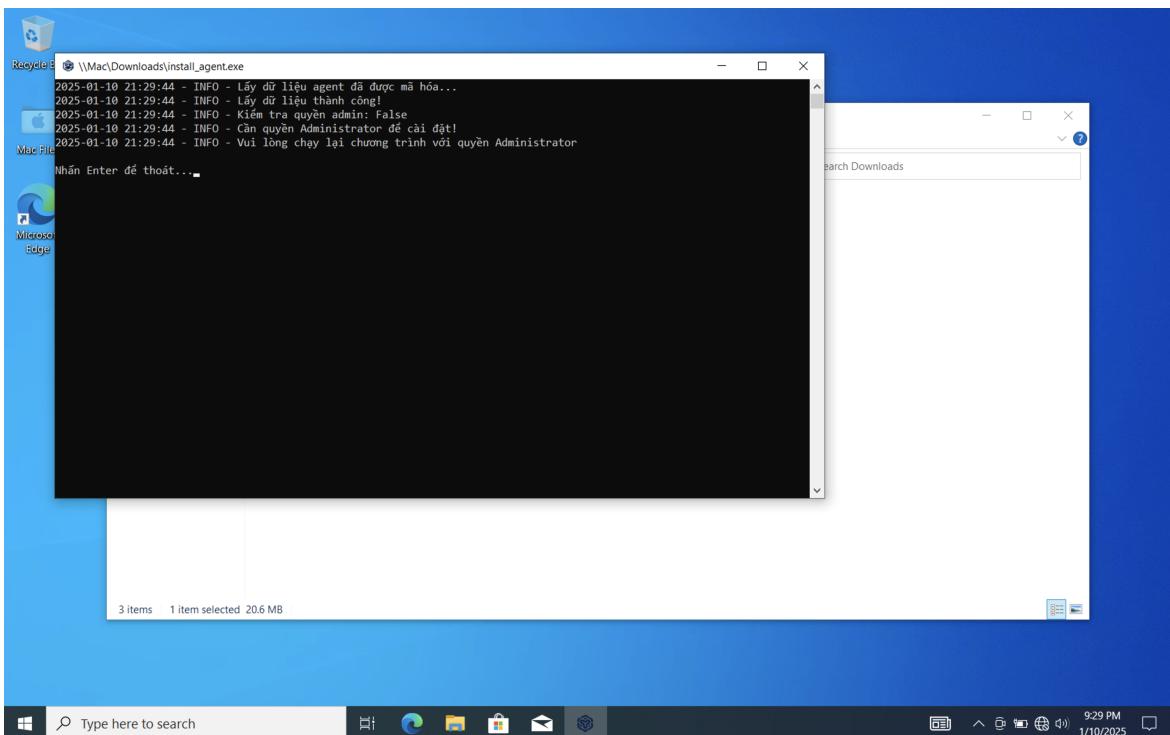
Agent installation success notification (Figure 23).



**Fig. 23.** Successful Agent Installation

### b. Admin Permission Error

Admin rights requirement notification during agent installation (Figure 24).

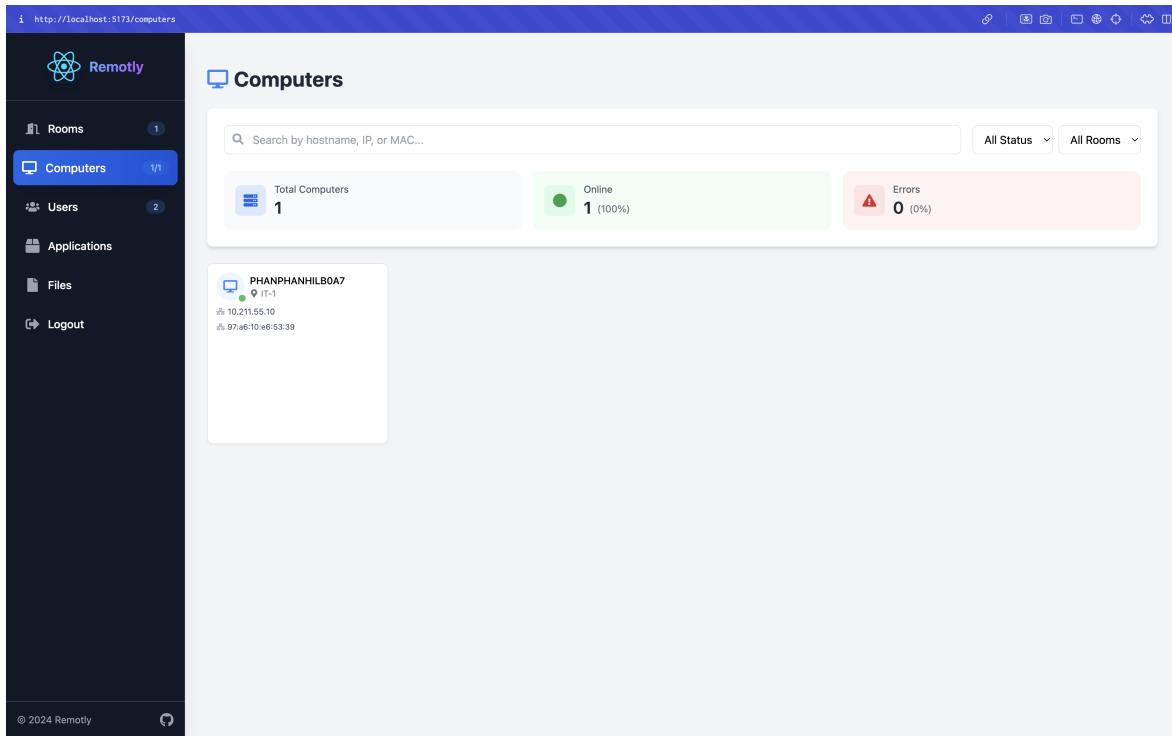


**Fig. 24.** Admin Permission Required for Agent Installation

## 5.4 Computer Management

### a. Computer Overview Page

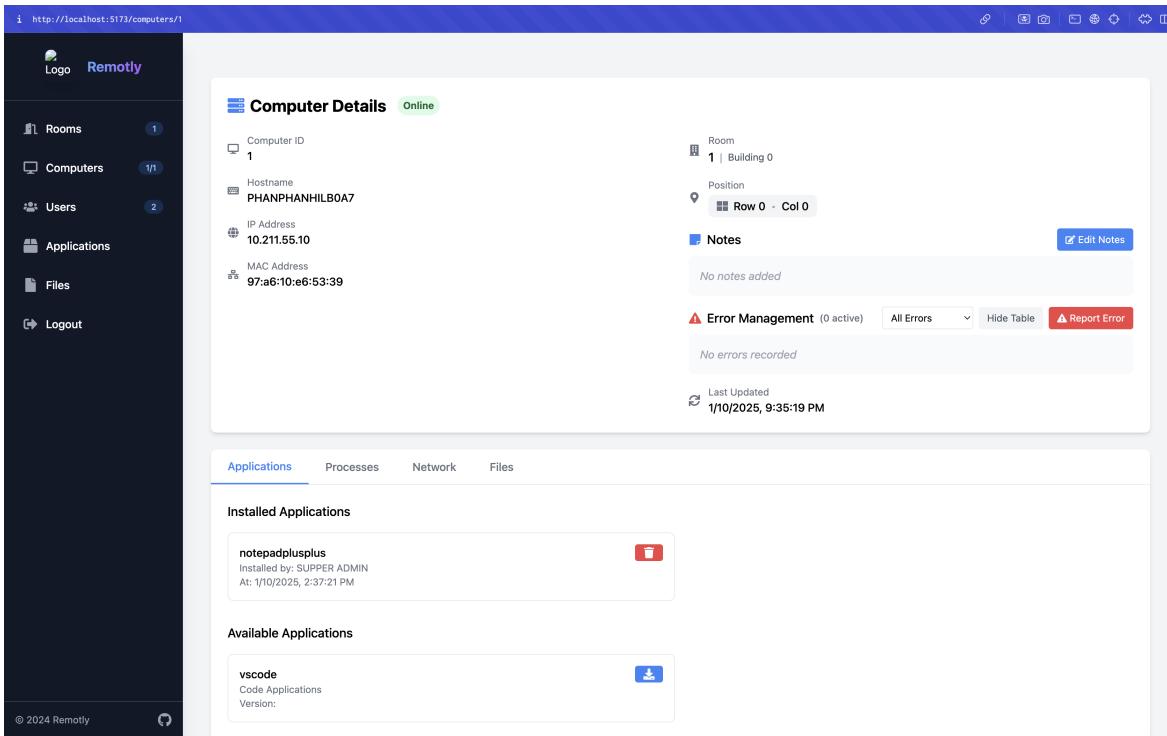
The Computer Overview Page (Figure 25) displays a list of all computers in the system along with their operational status and basic parameters.



**Fig. 25.** Computer Overview Page

### b. Application Management Tab

The Application Management Tab (Figure 26) shows the list of installed applications and enables installation/uninstallation of applications.



The screenshot shows the 'Computer Details' section with the following information:

- Computer ID: 1
- Hostname: PHANPHANHILBOA7
- IP Address: 10.211.55.10
- MAC Address: 97:a6:10:e6:53:39
- Room: 1 | Building 0
- Position: Row 0 - Col 0
- Notes: No notes added
- Error Management: 0 active
- Last Updated: 1/10/2025, 9:35:19 PM

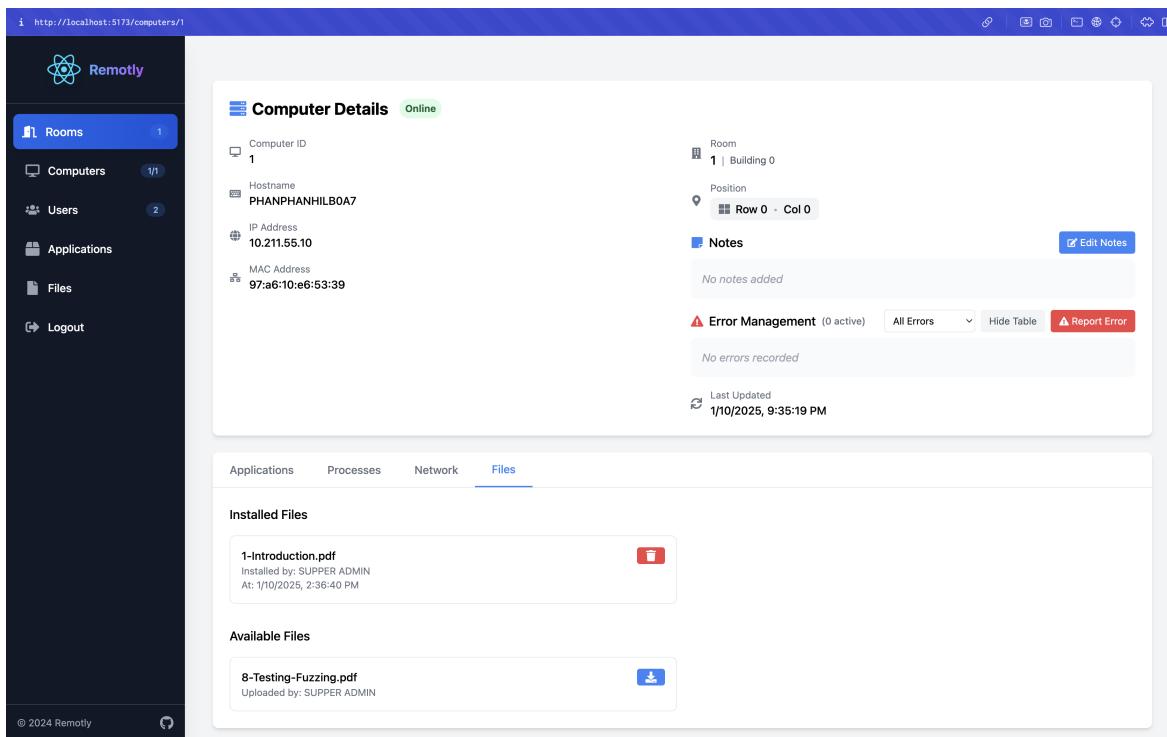
The 'Applications' tab is selected, showing:

- Installed Applications:** notepadplusplus (Installed by: SUPER ADMIN, At: 1/10/2025, 2:37:21 PM)
- Available Applications:** vscode (Code Applications, Version: )

**Fig. 26.** Application Management Tab

### c. File Management Tab

The File Management Tab (Figure 27) allows viewing and managing files installed on the computer.



The screenshot shows the Remotely software interface. On the left is a sidebar with the following navigation items:

- Rooms** (1)
- Computers** (1)
- Users** (2)
- Applications**
- Files**
- Logout**

The main content area is titled "Computer Details" and shows the following information for Computer ID 1:

- Hostname: PHANPHANHILBOA7
- IP Address: 10.211.55.10
- MAC Address: 97:a6:10:e6:53:39
- Room: 1 | Building 0
- Position: Row 0 - Col 0
- Notes: No notes added
- Error Management: 0 active
- Last Updated: 1/10/2025, 9:35:19 PM

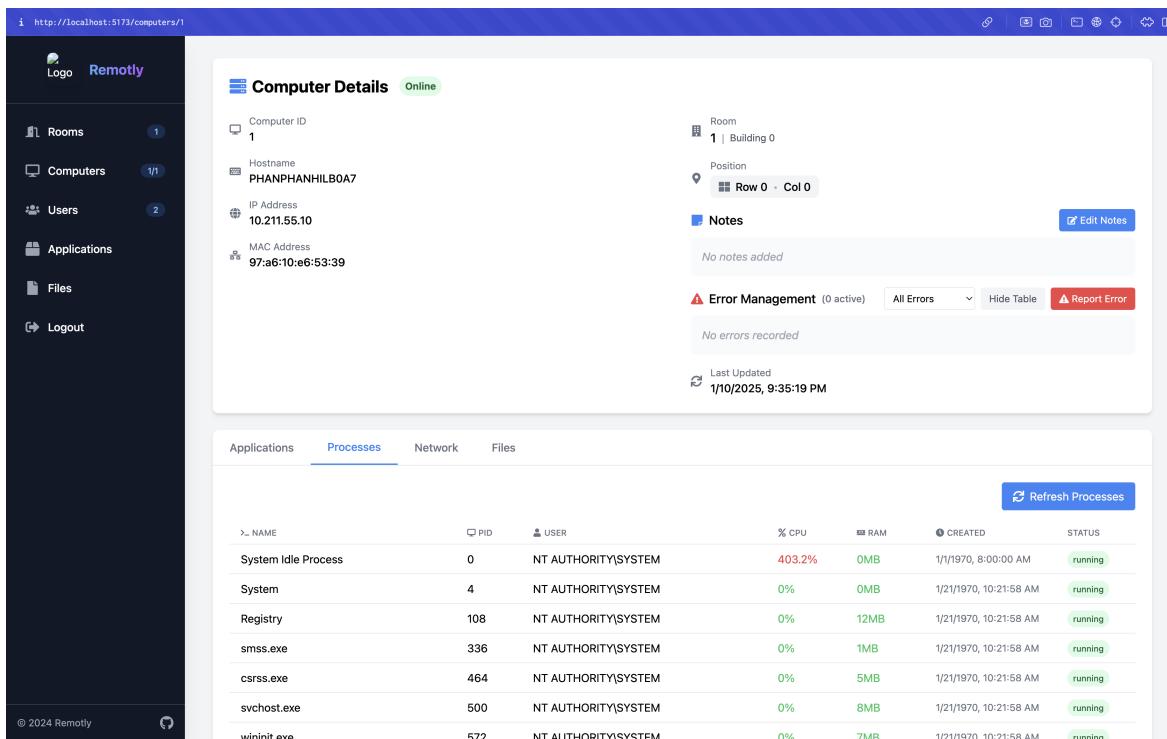
Below the computer details, there are tabs for Applications, Processes, Network, and Files. The Files tab is selected, displaying two sections:

- Installed Files:** 1-Introduction.pdf (Installed by: SUPPER ADMIN, At: 1/10/2025, 2:36:40 PM) with a delete icon.
- Available Files:** 8-Testing-Fuzzing.pdf (Uploaded by: SUPPER ADMIN) with a download icon.

**Fig. 27.** File Management Tab

#### d. Process Management Tab

The Process Management Tab (Figure 28) allows viewing and managing running processes on the selected computer.



The screenshot shows the Remotely software interface. On the left is a sidebar with icons for Rooms (1), Computers (1/1), Users (2), Applications, Files, and Logout. The main area is titled "Computer Details" and shows the following information:

- Computer ID: 1
- Hostname: PHANPHANHILBOA7
- IP Address: 10.211.55.10
- MAC Address: 97:a6:10:e6:53:39
- Room: 1 | Building 0
- Position: Row 0 - Col 0
- Notes: No notes added
- Error Management: 0 active (All Errors, Hide Table, Report Error)
- Last Updated: 1/10/2025, 9:35:19 PM

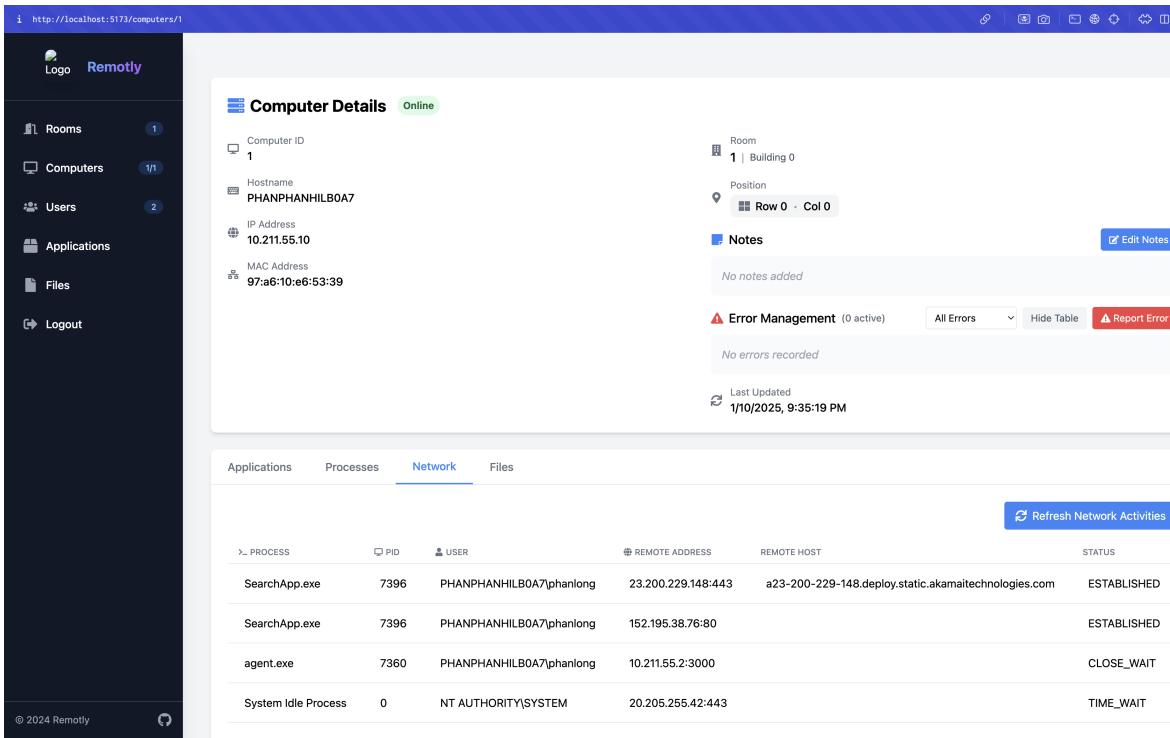
Below this is a table titled "Processes" with the following data:

NAME	PID	USER	% CPU	RAM	CREATED	STATUS
System Idle Process	0	NT AUTHORITY\SYSTEM	403.2%	0MB	1/1/1970, 8:00:00 AM	running
System	4	NT AUTHORITY\SYSTEM	0%	0MB	1/21/1970, 10:21:58 AM	running
Registry	108	NT AUTHORITY\SYSTEM	0%	12MB	1/21/1970, 10:21:58 AM	running
sms.exe	336	NT AUTHORITY\SYSTEM	0%	1MB	1/21/1970, 10:21:58 AM	running
csrss.exe	464	NT AUTHORITY\SYSTEM	0%	5MB	1/21/1970, 10:21:58 AM	running
svchost.exe	500	NT AUTHORITY\SYSTEM	0%	8MB	1/21/1970, 10:21:58 AM	running
wininit.exe	572	NT AUTHORITY\SYSTEM	0%	7MB	1/21/1970, 10:21:58 AM	running

**Fig. 28.** Process Management Tab

### e. Network Monitoring Tab

The Network Monitoring Tab (Figure 29) displays information about network connections and bandwidth usage.



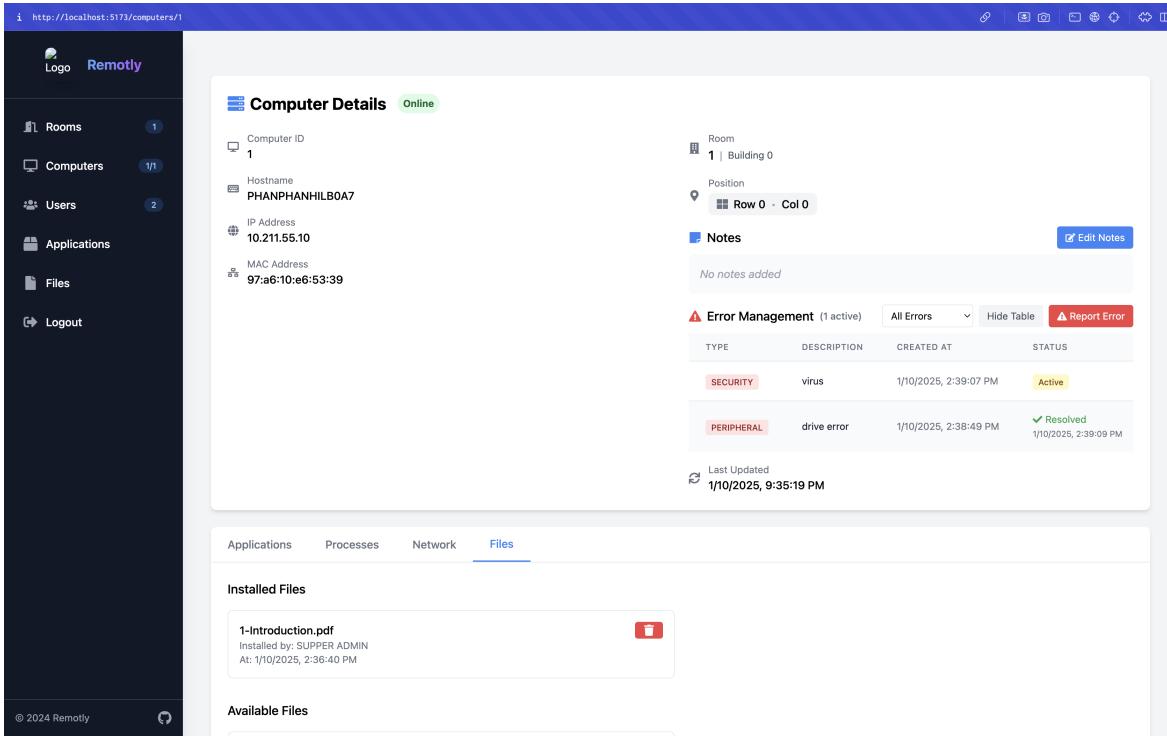
The screenshot shows the Network Monitoring Tab of the SOICT Doctor Appointment Booking Website. On the left, there's a sidebar with navigation links: Rooms (1), Computers (1), Users (2), Applications, Files, and Logout. The main area displays 'Computer Details' for Computer ID 1, which is online. It shows the Hostname as PHANPHANHILB0A7, IP Address as 10.211.55.10, and MAC Address as 97:a6:10:e6:53:39. It also lists Room 1 | Building 0, Position Row 0 - Col 0, and Notes (No notes added). Below this is an 'Error Management' section with 0 active errors, a 'Refresh Network Activities' button, and a table of network activities.

PROCESS	PID	USER	REMOTE ADDRESS	REMOTE HOST	STATUS
SearchApp.exe	7396	PHANPHANHILB0A7\phanlong	23.200.229.148:443	a23-200-229-148.deploy.static.akamaitechnologies.com	ESTABLISHED
SearchApp.exe	7396	PHANPHANHILB0A7\phanlong	152.195.38.76:80		ESTABLISHED
agent.exe	7360	PHANPHANHILB0A7\phanlong	10.211.55.2:3000		CLOSE_WAIT
System Idle Process	0	NT AUTHORITY\SYSTEM	20.205.255.42:443		TIME_WAIT

**Fig. 29. Network Monitoring Tab**

#### f. Error List

The Error List Page (Figure 30) displays recorded errors on the computer.



The screenshot shows the Remotely software interface for managing computer resources. On the left, a sidebar lists 'Rooms' (1), 'Computers' (1), 'Users' (2), 'Applications', and 'Files'. The main area displays 'Computer Details' for Computer ID 1, which is online. It shows the hostname as PHANPHANHILBOA7, IP Address as 10.211.55.10, and MAC Address as 97:a6:10:e6:53:39. The 'Position' is listed as Row 0 - Col 0. A 'Notes' section indicates 'No notes added'. Below this is the 'Error Management' section, which lists two active errors:

TYPE	DESCRIPTION	CREATED AT	STATUS
SECURITY	virus	1/10/2025, 2:39:07 PM	Active
PERIPHERAL	drive error	1/10/2025, 2:38:49 PM	Resolved 1/10/2025, 2:39:09 PM

Below the error management is a 'Last Updated' timestamp of 1/10/2025, 9:35:19 PM. The interface also includes tabs for Applications, Processes, Network, and Files, with the Files tab currently selected. Under 'Installed Files', there is one entry: '1-Introduction.pdf' installed by SUPER ADMIN at 1/10/2025, 2:36:40 PM. The 'Available Files' section is empty.

**Fig. 30.** Computer Error List

## 6 Conclusion

The remote computer management system has been successfully developed with all necessary features for managing computers in educational and business environments. Based on a three-component architecture - Agent, Server and Web Interface, the system provides a comprehensive solution for remote management and monitoring.

From a management perspective, the system allows administrators to easily monitor computer operational status, remotely install software and files. The intuitive interface is designed with a focus on user experience, helping to simplify complex tasks and increase work efficiency.

Regarding security, the system implements strict authentication and authorization mechanisms to ensure information security and access control. The integration of JWT, SSL/TLS encryption and other security measures helps protect the system from potential threats.

Through testing, the system has proven effective within the scope of testing:

- Reduced time and effort in system management
- Enhanced monitoring and control capabilities
- Optimized software installation and update processes
- Improved computer resource management efficiency

In the future, the system can be further developed with new features such as:

- Extended support for other operating systems
- Add more features to manage and monitor more computer systems more efficiently
- Performance optimization for large-scale computer networks
- Development of additional analytics and reporting tools