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P1: Analyze the system description for ambiguities, incompleteness, and contradictions

- Unstructured
 - Validity: No distinction among the three aspects (-0.1). $1 - 0/12 - 0.2 = 0.8$
 - Completeness: Missing 2 contradictions. $1 - 2/6 = 0.666$
 - Consistency: “Data and Privacy”, “Reliability and Fault Tolerance”, “User Management”, “Installation and Setup”, “Cost” are not explicitly mentioned in the description. $1 - 5/12 = 0.583$
- Structured
 - Validity: $1 - 0/15 = 1$
 - Completeness: Missing triggering. $1 - 1/6 = 0.833$
 - Consistency: “Connectivity Requirements”, “User Management”, “Privacy Considerations”, “Offline Functionality”, “System Updates and Maintenance”, “Cost and Subscription Details” are not explicitly mentioned in the description. $1 - 6/15 = 0.6$

P2: Identify and categorize the functional and non-functional requirements of the system description

- Unstructured
 - Validity: “User Interface” not FR. $1 - 1/(6+7) = 0.923$
 - Completeness: $1 - 0/6 = 1$
 - Consistency: $1 - 0/13 = 1$
- Structured
 - Validity: “User Interface” not FR. $1 - 1/(8+12) = 0.928$
 - Completeness: $1 - 0/6 = 1$
 - Consistency: “Performance”, “Security”, “Privacy”, “Maintainability”, “Localization” not explicitly mentioned. $1 - 5/20 = 0.75$

P3: Create a use case model for the smart home system

- Unstructured
 - Validity: No system boundary (-0.1). No separation of primary and supporting actors (-0.1). Relationships (includes, extends) among UCs defined. Graphical diagram provided, but in incorrect notations and inconsistent relationships with textual descriptions (-0.2). $1-0/9-0.1-0.1-0.2=0.6$
 - Completeness: $1-0/3 = 1$
 - Consistency: Missing “Notification”, “Remote Access”. $1-2/(9+2) = 0.818$
- Structured
 - Validity: Clear system boundary. Separation of primary and supporting actors. Invalid supporting actor in “Update System” (-0.1). $1-(1*0.1)/12= 0.991$
 - Completeness: $1-0/3 = 1$
 - Consistency: $1-0/12 = 1$

P4: Create use case specifications for every use case

- Unstructured
 - Validity: Unclear primary & supporting actors (-0.1). $1-(9*0.1)/9 = 0.9$
 - Completeness: $1-0/3 = 1$
 - Consistency: UCD indicating “IOT Devices” used as actors in UC1,UC3,UC5,UC7,UC8, but not. $1-(5*0.1)/9 = 0.944$
- Structured
 - Validity: $1-0/6 = 1$
 - Completeness: $1-0/3 = 1$
 - Consistency: The remaining 6 UCs not generated due to response limits, which is not considered as inconsistency. $1-6/6 = 1$

P5: Identify domain concepts and their relationships from the created use case specifications.

- Unstructured
 - Validity: 2/24 relationships include undefined classes - Feature & Home System. 4/24 relationships with no multiplicity– (User Interface, Home), (User Interface, User), (External System, Home), (External System, Device). $1 - (2 + 4 * 0.4) / (14 + 24) = 0.905$
 - Completeness: $1 - 0/6 = 1$
 - Consistency: $1 - 0/14 = 1$
- Structured
 - Validity: 15 classes defined - User, Device, Room, Automation Rule, Trigger, Action, EnergyReport, SecurityEvent, VoiceCommand, VoiceAssistant, SmartHomeEcosystem, UserInterface, SystemUpdate, PrivacySetting, UsageAnalytics. Data types defined (-0.1). Named association. $1 - (15 * 0.1) / (15 + 22) = 0.959$
 - Completeness: $1 - 0/6 = 1$
 - Consistency: PrivacySetting not explicitly mentioned in UCs. $1 - 1/15 = 0.933$

P6. Identify system operations from use case specifications of the smart home system.

- Unstructured

- Validity: 7/50 not actor-initiated – confirmDeviceAction, logDeviceError, parseVoiceRule, triggerSecurityAlert, respondToSecurityAlert, notifyUserOfUpdate, rollbackUpdate. Clear operations with parameters.
 $1 - 7/50 = 0.86$
- Completeness: $1 - 0/3 = 1$
- Consistency: Unclear mapping. (-0.3) $1 - (50 * 0.3) / 50 = 0.7$

- Structured

- Validity: Clear operations with parameters. Clear mapping to UC steps. 1/17 not actor-initiated operations. $1 - 1/17 = 0.941$
- Completeness: $1 - 0/3 = 1$
- Consistency: $1 - 0/17 = 1$

P7: Create design sequence diagrams for system operations of the smart home system.

- Unstructured
 - Validity: 3 SDs defined - sendDeviceCommand, createAutomationRule, triggerSecurityAlert. $1-0/3 = 1$
 - Completeness: Missing integration. $1-1/3 = 0.666$
 - Consistency: Missing 47 operations. $1-47/(3+47) = 0.06$
- Structured
 - Validity: 12 SDs defined - selectDevice, setDeviceState, initiateAutomation, selectTrigger, selectActions, confirmAutomationRule, viewEnergyManagement, implementEnergySuggestion, armSystem, viewCameraFeed, issueVoiceCommand, selectEcosystemToIntegrate. $1-0/12 = 1$
 - Completeness: $1-0/3 = 1$
 - Consistency: Missing 12 operations. $1-12/(9+12) = 0.428$

P8: Create design class diagrams based on the domain model and sequence diagrams of the smart home system.

- Unstructured
 - Validity: 30 classes defined - User, UserRole, Permission, PermissionType, Home, Room, RoomType, Device, DeviceType, DeviceStatus, SecurityDevice, AutomationRule, Trigger, TimeTrigger, LocationTrigger, SensorTrigger, Action, DeviceAction, SecuritySystem, SecurityMode, SecurityEvent, SecurityEventType, SecurityEventStatus, EnergyManagementSystem, EnergyOptimization, EnergyReport, UserManager, DeviceManager, RuleManager, NotificationManager. Missing multiplicity for 4/22 relationships defined (-0.1). No navigabilities (-0.1). Visibility defined. $1 - (4 \times 0.1 + 22 \times 0.1) / (30 + 22) = 0.95$
 - Completeness: Missing UserInterface, VoiceAssistant, Ecosystem, $1 - 3/6 = 0.5$
 - Consistency: 3 MCD classes not defined - External System, User Interface, System Update. 5 classes (DeviceController, UserInterface, AutomationManager, EnergyManager, EnergyMonitor, SecurityManager) used in all 3 DSDs not defined - sendDeviceCommand, createAutomationRule, triggerSecurityAlert. $1 - (3 + 3) / (30 + 3 + 3) = 0.833$
- Structured
 - Validity: 23 classes defined - System, UserInterface, DeviceManager, Device, SecurityDevice, SmartDevice, Room, Device, AutomationManager, Rule, Trigger, Action, EnergyManager, EnergyReport, SecurityManager, VoiceAssistant, IntegrationManager, SmartHomeEcosystem, DeviceType, TriggerType, UType, SecurityMode, Period. Incorrect notation for 4/10 associations (used closed arrow). No navigability (-0.1). Visibility defined. $1 - (4 \times 0.1 + 10 \times 0.1) / (23 + 10) = 0.957$
 - Completeness: Missing User. $1 - 1/6 = 0.833$
 - Consistency: 6/15 MDC classes not defined - User, SecurityEvent, VoiceCommand, SystemUpdate, PrivacySetting, UsageAnalytics. 4 classes (EnergyMonitor in setDeviceState, viewEnergyManagement) used in 2/12 DSD not defined. Inconsistent operations in 8/12 DSDs - Device Manager, UserInterface in selectTrigger, selectActions, confirmAutomationRule, implementEnergySuggestion, armSystem, viewCameraFeed, issueVoiceCommand, selectEcosystemToIntegrate $1 - (6 + 8) / (23 + 6 + 12) = 0.658$

P9. Develop a Java implementation for the system as specified in the class diagram and sequence diagrams.

- Unstructured
 - Validity: Most operations implemented. Incomplete operations - executeCommand() in Device, triggerSecurityAlert() in SecurityDevice, isTriggered() in TimeTrigger, handSecurityEvent() in SecuritySystem (4 classes). Driver implemented. $1-(4*0.6)/15 = 0.84$
 - Completeness: Missing Interface, VoiceAssistant, Ecosystem. $1-3/6 = 0.5$
 - Consistency: Inconsistent operations: User, ActivationRule, DeviceManager, Action, Trigger. Missing 16 DCD classes - Room, Home, NotificationManager, EnergyReport, EnergyOptimization, EnergyManagementSystem etc. All 3 DSDs implemented in driver – sendDeviceCommand, createAutomationRule, triggerSecurityAlert. $1-(5*0.5+16)/(14+16+3) = 0.439$
- Structured
 - Validity: Many operations implemented. Missing operations - UserInterface, AutomationManager. Incomplete operations – setState() in SmartDevice. Driver implemented. $1-(2*0.7+1*0.5)/10 = 0.81$
 - Completeness: Missing User, VoiceAssistant, Ecosystem. $1-3/6 = 0.5$
 - Consistency: UserInterface, DeviceManager, Device, SmartDevice, Room, AutomationManager, Rule, Trigger, Action, SmartHomeDriver implemented. Missing 8 DCD classes - System, SecurityDevice, EnergyManager, EnergyReport, SecurityManager, VoiceAssistant, IntegrationManager, SmartHomeEcosystem. Inconsistent operations: Trigger, Action. 3/12 DSD implemented in UserInterface. $1-(8+2*0.3+9)/(10+18+12) = 0.56$

Prompt 10: Develop tests including unit tests, integration tests, and system tests for the implementation of the smart home system.

- Solution:
- Unstructured
 - Validity: User, Device, SecurityDevice, AutomationRule tested. $1 - 0/4 = 1$
 - Completeness: Missing 3 classes. Missing "Integration" scenario. $1 - (3+1)/(6+3) = 0.555$
 - Consistency: Missing 8 classes other than User, Device, SecurityDevice, AutomationRule. $1 - 8/12 = 0.333$
- Structured
 - Validity: SmartDevice, UserInterface, Room, EnergyManager, SecurityManager, VoiceAssistant, Trigger, Action, DeviceManager, AutomationManager tested. Ecosystem tested, but not explicitly used. $1 - 0/10 = 1$
 - Completeness: $1 - 0/(6+3) = 1$
 - Consistency: Driver and 2 interfaces excluded. $1 - 0/11 = 1$