**Concordia University Requirements evaluation and risk analysis SOEN 6481**

CS & SE Dept. Summer 2020 1/18

**SmartHome+: A Smart Home Platform**

**Task 1**

**INSPECTION SUMMARY REPORT**

**\*Note:** Each team member’s individual Defect and inconsistency lists are all appended as an Appendix to this document.

Project: Smart Home+

General:

Total Number of open defects\_\_\_\_\_\_\_\_\_\_\_

Total Number of open conflicts\_\_\_\_\_\_\_\_\_\_\_

Total Number of close defects\_\_\_\_\_\_\_\_\_\_\_

Total Number of close conflicts\_\_\_\_\_\_\_\_\_\_\_

Summarize number of defects by defect type and conflict type

|  |  |  |
| --- | --- | --- |
| Defect type | Number of open defects | Number of close defects |
|  |  |  |

|  |  |  |
| --- | --- | --- |
| Conflict type | Number of open conflicts | Number of close conflicts |
|  |  |  |

Total Person-Hours expended in inspection\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Task 2**

**DOCUMENTING CONFLICTS USING INTERACTION MATRIX**

An Interaction matrix (Kotonya & Sommerville, 1997) has been linked here which was prepared based on the information generated in task 1 (using features set listed within the vision document)

**Task 3**

**CONFLICT RESOLUTION**

Following is the list of identified conflicts which have further been taken into consideration for resolution.

**Conflict 1: Multiple users can trigger contradictory commands for the same room.**

* **Conflict Resolution:**

1. Provide a basic status of presently active conditions in the room to all the application users, so users can make more aware decisions regarding which command to execute at any given point of time.

* **Tactic used – Add new requirement to weaken the conflict**

1. Prepare an exhaustive list of contradictory commands which might be executed in the same room and define rules in the system to give an error to the users if they try to execute any such contradictory combination.

* **Tactic used – Add new requirement to avoid conflict**

**Conflict 2: Emergency Detection exploited for Intrusion.**

* **Conflict** **Resolution:**

1. In case of any fire/smoke related emergency system notifies the users and first tries to shut it off using home water sprinklers without immediately unlocking the point of entries automatically.

* **Tactic used – Add new requirement to weaken the conflict**

1. If an intrusion and smoke (fire) emergency is detected at the same time, use sprinklers but do not allow auto-unlocking of any point of entries, only users can unlock them.

* **Tactic used – Add new requirement to avoid conflict**

**Conflict 3: Automation of the Lightning of the room and Automated window blinds**

* **Conflict Resolution:**

1. Close the window blinds before adjusting the lightning of the system in self- evolving mode.

* **Tactic used – Restore conflicting statements i.e. the conflicting statements satisfy each other soon after the boundary condition has occurred.**

1. When the user tries to control light send and if the blinds are open popup a notification regarding the state of the blinds and expected action.

* **Tactic used - Add new requirement to weaken the conflict**

**Conflict 4: Emergency Notification & Safety measures**

* **Conflict Resolution**

1. In case of emergency, trigger alarms and send notifications to customers. If the alarm was not stopped within a predefined time duration (10 mins), then trigger an additional notification to 911 emergency services.

* **Tactic used - Add new requirement to weaken the conflict**

1. The controller will operate in two states armed (full protections) and disarmed (minimal protection). Automated calls to 911 will occur only during armed state.

* **Tactic used - Avoid boundary condition**

**Conflict 5: Automated irrigation, swimming pool cleaning does not correspond to the Energy management category**

* **Conflict Resolution**

1. Moving the feature to Home Automation category will resolve the conflict

* **Tactic used – Avoid boundary condition**

**Conflict 6: Door access control and main gate access control are conflicting features**

* **Conflict Resolution**

1. Providing common access control of all kind of doors in the same feature where different door control will be managed

* **Tactic used - Drop lower-priority statements**

**Conflict 7: XXXXXX**

* **Conflict Resolution**

1. XXXXX.

* **Tactic used – XXXX**

**Conflict 8: XXXXXX**

* **Conflict Resolution**

1. XXXXX.

* **Tactic used – XXXX**

**Task 4**

**CONFLICT EVALUATION**

Using **weighted matrices** the above mentioned conflict resolution suggestions have been evaluated.



**Conflict 1: Multiple users can trigger contradictory commands for the same room.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Evaluation criteria Non-Functional Requirement (NFR)** | **Significance weighting** | **Give user the present status and let them decide** | **Prepare set of contradictory rules and implement** |
| Cost | 0.7 | .7 | .3 |
| Usability | 0.3 | .6 | .4 |
| **Total** | **1.0** | **.59** | **.33** |

**Option1 -** **Give user the present status and let them decide** contributes more in terms of improving the Non-Function Requirements so is a better alternative.

**Conflict 2: Emergency Detection exploited for Intrusion.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Evaluation criteria NFR** | **Significance weighting** | **Try to tackle fire using sprinklers before auto unlocking point of entries.** | **Use sprinklers but only allow manual unlocking if intrusion and smoke (fire) emergency occur together.** |
| Security | 0.5 | .3 | .6 |
| Safety | 0.5 | .4 | .7 |
| **Total** | **1.0** | **.35** | **.65** |

**Option2 -** **Use sprinklers but only allow manual unlocking if intrusion and smoke (fire) emergency occur together** contributes more in terms of improving the Non-Function Requirements and so is a better alternative.

**Conflict 3: Automation of the Lightning of the room and Automated window blinds.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Evaluation criteria NFR** | **Significance weighting** | **Close Blinds** | **Send notifications** |
| Reliable outcome | 0.7 |  |  |
| Usability | 0.3 |  |  |
| **Total** | **1.0** |  |  |

**OptionXXX -** **XXXX** contributes more in terms of improving the Non-Function Requirements so is a better alternative.

**Conflict 4: Emergency Notification & Safety measures.**

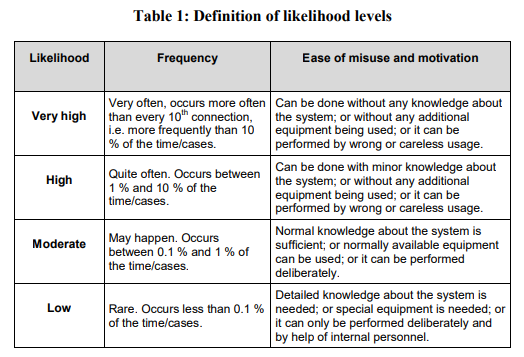
|  |  |  |  |
| --- | --- | --- | --- |
| **Evaluation criteria NFR** | **Significance weighting** | **Armed State** | **Time given to cancel alarms** |
| Reliability | 0.5 |  |  |
| Usability | 0.3 |  |  |
| Minimal inconvenience | 0.2 |  |  |
| **Total** | **1.0** |  |  |

**OptionXXX -** **XXXX** contributes more in terms of improving the Non-Function Requirements so is a better alternative.

**Task 5**

**RISK MANAGEMENT**

Below given table provides a reference for the various risk likelihood levels that have been considered here. Table reference has been taken from: <https://ehealthresearch.no/files/documents/Appendix-Definitions.pdf>



**Risk 1:** Maximizing the number of features might lead to an increase in overall cost of the solution, which defeats one of the core objectives of delivering a low cost solution.

* **Non-Functional Requirement addresses: Cost**
* **Risk Type**: Process Related Risk
* **Risk Likelihood** - High.

1. Development of this solution involves a direct relationship between adding features to increase the usability of the solution and the cost/effort invested in implementing those features.

* **Qualitative assessment:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Consequences** | **Likely** | **Possible** | **Unlikely** |
| Increase in Cost | High | Moderate | Low |
| Delay in product delivery | High | Moderate | Low |
| Business loss by losing customers | Severe | High | Low |

* **Rationale**:

1. Increasing the number of features to handle special edge and some highly customer specific scenarios would highly impact the overall increase in the cost of solution as a whole.
2. It takes time to develop new features which highly impacts the possibility of developers meeting the delivery deadlines for the solution.
3. In long run consequences like 1 and 2 get piled up and significantly increases the time to market the solution. This seriously impacts the overall business creating losses and losing presence in market to other competitors.

* **Counter Measure 1:** Try to keep the requirement set as generic as possible so it addresses the needs of a wider section of users.
* **Tactic used: Reduce risk likelihood**
* **Counter Measure 2:** Ensure the product development phase operates on Agile a based model (like KanBan, Scrum), which would prioritize important features in earlier deliveries and less important ones in later deliveries.
* **Tactic used: Reduce risk likelihood**
* **Counter Measure 3:** Try convincing the users and avoid working on any highly customer specific features which can be managed manually with minimal efforts.
* **Tactic used: Avoid risk**

**Risk 2:** Unauthorized access to any of the installed devices using default password used for connectivity.

* **Non-Functional Requirement addresses: Security**
* **Risk Type**: Product Related Risk
* **Risk Likelihood** - Low.

1. The attacker needs to possess sufficient technical skill/knowledge to exploit this security loophole and not every individual will have that kind of expertise so marking it as Low.

* **Qualitative assessment:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Consequences** | **Likely** | **Possible** | **Unlikely** |
| Loss of security | Catastrophic | Catastrophic | Severe |
| Loss of privacy | Severe | Severe | High |
| Gain access to other devices in network | High | High | Low |
| Use the devices as bots for security attacks | Low | Low | Low |

* **Rationale**:

1. Loss of privacy and security defeats the whole vision of the product and it can result in catastrophic outcomes like break in, burglary, violence etc.
2. Gain access to other devices in the network - A hacker can gain access to other devices in the network and use it inappropriately. Though it’s not catastrophic it will have a high impact on user experience of the system.
3. Use the devices as bots for security attacks - Users may not have any impact on user experience or the impact can be low like high bandwidth usage. In some cases, users may not even be aware of the impact.

* **Counter Measure 1:** Controller resets the default password of the smart device with a uniquely generated password as soon as the device is successfully paired with the controller.
* **Tactic used: Avoid risk**
* **Counter Measure 2:** Display warnings to the user via the mobile app, local monitor or the voice-based assistants that the smart device has the default password and the user needs to reset it. User is given the option to fix it or snooze the warning.
* **Tactic used: Reduce risk likelihood**

**Risk 3:** Loss of camera footages or usage pattern data when storage is full (applies to both local and cloud storage)

* **Non-Functional Requirement addresses:** Performance
* **Risk Type**: Product Related Risk
* **Risk Likelihood** - Moderate.

1. As we two levels of storage Local storage first and then cloud. So the probability of exhausting both together is possible but not very likely.

* **Qualitative assessment:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Consequences** | **Likely** | **Possible** | **Unlikely** |
| Loss of footages | Severe | High | High |
| Loss of surveillance | Severe | Severe | High |
| Improper function of devices based on out-dated usage data | Severe | High | Moderate |
| Low performance of controller in case of retries to store/upload data | Low | Low | Low |

* **Rationale**:

1. Loss of surveillance and footage are deemed severe since the customer will lose the sense of safety and security of the home.
2. If the device learns from out-dated usage data, the actual output can severely affect the user experience.
3. In some cases, multiple retries by the controller to store/update data can affect performance.

* **Counter Measure 1:** Clear the storage when it reaches a specified threshold in the order of earliest data first until the available storage comes below the threshold.
* **Tactic used: Avoid risk**
* **Counter Measure 2:** Display warning to the user that storage is full, and they need to clear it or it will result in loss of data.
* **Tactic used: Reduce risk likelihood**
* **Counter Measure 3:** Before applying modifications to the device based on the usage pattern in self-evolving mode check if the data used include the latest hour data.
* **Tactic used: Reduce risk consequence likelihood.**

**Risk 4:** System will entirely shut-down when there is a power failure and the back-up battery runs out as well**.**

* **Non-Functional Requirement addresses:** Reliability
* **Risk Likelihood:** Moderate

1. There are moderate chances of having a power outage and the back-up battery getting exhausted at the same time.

* **Qualitative assessment:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Consequences** | **Likely** | **Possible** | **Unlikely** |
| Loss of Security and Safety | Severe | High | High |
| Loss of Automation | Moderate | Moderate | Low |

* **Rationale**:

1. System shut down makes the entire house vulnerable to any types of attack (like fire, flood, theft or intrusion).
2. All the Automation would stop and the mundane activities are to be performed by the user which they might not like after getting used to of automation.

* **Counter measure 1:** Make sure that only the most necessary services are consuming the battery, when there is a power failure. This can help to extend the usage of the battery. The system can also notify the users regarding the battery levels.
* **Tactic used :** Reduce Risk Likelihood
* **Counter measure 2:** Fuel based battery can be used. The system can notify the user to refuel the battery before it runs out.
* **Tactic used:** Avoid Risk.

**Risk 5:** Unstable internet-based connectivity can interfere with smooth inter-operation between smart home solution and other connected devices.

* **Non-Functional Requirement addresses:** Reliability
* **Risk Type**: Product Related Risk
* **Risk Likelihood** – Very High.

1. Internet based connectivity issues are quite common given that it involves a third party Internet Service Provider.
2. Prone to downtimes and any other hardware failure at Internet Service Provider’s end.
3. Prone to hardware failures at user’s end, say a modem failure.

* **Qualitative assessment:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Consequences** | **Likely** | **Possible** | **Unlikely** |
| Loss of connectivity and Messaging/Notification delays | Severe | High | High |
| Devices need to be restarted and synced every-time after losing connectivity | Moderate | Low | Low |
| Impact on Intrusion Detection | Catastrophic | Moderate | Moderate |
| Loss of recorded data | Moderate | High | High |

* **Rationale:**

1. Loss of connectivity might prevent users from sending commands remotely which in case of an exigency might have serious consequences.
2. Delays in receiving notifications on proper time, might lead to consequences and customers losing their faith over the accuracy of the system.
3. Some smart devices on account losing connectivity might need to get restarted over and again which might annoy end users.
4. Any flaw in the system related to intrusion detection pose a serious threat to safety and security.
5. Poor internet connection might lead to problems related to data storage and retrieval over the cloud.

* **Counter Measure 1:** Automatically switch over to a different mode of connectivity (4G, 5G) using the SIM card installed within the controller.
* **Tactic used : Avoid risk**
* **Counter Measure 2:** Make sure all the services and devices are capable of reconnecting and synchronizing with controller automatically after regaining access to the connectivity.
* **Tactic used : Reduce risk likelihood**

**Risk 6:** Automatic window control feature needs to consider scenarios where there is any obstacle on path or resistance on the way.

* **Non-Functional Requirement addresses:** Safety
* **Risk Type**: Product Related Risk
* **Risk Likelihood** – High.

1. Automatically opening or closing the window has fair chances of some object getting stuck on window’s path.

* **Qualitative assessment:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Consequences** | **Likely** | **Possible** | **Unlikely** |
| Safety concerns for kids, elders pets and flying birds. | Catastrophic | Severe | High |
| Object providing resistance might break. | High | Moderate | Low |
| Windows might be damaged | High | Moderate | Low |

* **Rationale:**

1. Kids and elders unknowingly blocking windows with their hands or our pets like cat or some birds sitting on the window might injure themselves which might become a serious concern.
2. Either the window or the blocking object itself might get damaged, which would then incur repairing costs for both.

* **Counter Measure 1:** While opening and closing the window, windows should reverse back if any obstacle is found on the path of movement.
* **Tactic used : Reduce risk likelihood by adding a new requirement**
* **CounterMeasure-2:** Check using sensors and execute window opening and closing commands only if the pathway is free, otherwise notify user about the blockage and let them remove it first.
* **Tactic used : Avoid risk by adding a new requirement**

**Risk 7:** Automated pet feeding station can raise pet safety concerns. Food can get polluted and wasted by external factors like wind, rain, dirt, inedible particle etc.

* **Non-Functional Requirement addresses:** Safety
* **Risk Type**: Product Related Risk
* **Risk Likelihood** – Moderate

1. Environmental factors like rain, dust, dirt, heat at times can pollute the food.
2. Pets at times can try to fiddle around with the automated feeding station.

* **Qualitative assessment:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Consequences** | **Likely** | **Possible** | **Unlikely** |
| Polluted food | Severe | High | High |
| Pets getting injured while trying to fiddle with feeding station | High | Moderate | Moderate |
| Pets damaging the feeding station. | High | Moderate | Moderate |

* **Rationale**:

1. Polluted food can raise serious concern regarding pet’s health.
2. While playing with food station equipment pets might injure themselves.
3. Feeding station needs to be repaired every-time a pet damages it. This might become a recurring cost.

* **Counter Measure 1:** Notify user daily to inspect feeding station for its cleanliness, set the station indoor.
* **Tactic used : Reduce risk likelihood**
* **Counter Measure 3:** Ensure feeding stations make use of cheap more durable and harmless build material like plasticized rubber.
* **Tactic used : Reduce risk likelihood**

**APPENDIX:**

**INDIVIDUAL DEFECT AND INCONSISTENCY LISTS**

**Project: Smart Home+**

**Inspector: Apoorv Semwal Time spent by Inspector: 60mins**

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| --- | --- | --- | --- | --- | --- | --- |
| Defect # | Location | Defect/inconsistency type | Classification | Author | Status | Date corrected |
| 1 | Section - 4.1 -Product Perspective – Usage of term IOT. | Forward Reference - No prior explanation /reference to it. | Minor | Apoorv | Open | 13-Jul-2020 |
| 2 | Section - 4.3 -Needs and Features – Security Measures - Home Alarms. | Unintelligibility - Stating just a device name is not enough to define it as a feature and its purpose. | Minor | Nikhil | Open | 13-Jul-2020 |
| 3 | Missing feature for Window access control | Omission – No specific feature mentions anything about an automated Window access control | Major | Nikhil | Open | 13-Jul-2020 |
| 4 | Section - 4.3 - Needs and Features – Multi User Mode of Operation and Household Automation. | Strong Conflict – Multiple users can trigger contradictory commands for the same room. Say switch on the AC and Open Window | Major | Apoorv | Open | 13-Jul-2020 |
| 5 | Needs and Features - Security Measures – Exploiting Emergency Detection for doing an Intrusion. | Strong Conflict – An intruder might try to create an emergency like situation say a small fire to trigger Emergency Detection system to open all doors and windows. | Major | Apoorv | Open | 13-Jul-2020 |

**Inspector: Divya Bhagavathiappan Shiva Time spent by Inspector: 60mins**

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| --- | --- | --- | --- | --- | --- | --- |
| Defect # | Location | Defect/inconsistency type | Classification | Author | Status | Date corrected |
| 1 | Assumptions:  Controller and the smart devices both provide support for connectivity using Wi-Fi/Bluetooth | Poor Structuring  Assumption does not differentiate local and remote connectivity | Minor | Divya | Open |  |
| 2 | Security Measures:  Home Alarm and Intrusion detection | Overlapping - Home Alarm is triggered when intrusion is detected | Minor |  | Open |  |
| 3 | Emergency Detection | Incomplete - Does not provide insight on how to notify emergencies | Major |  | open |  |
| 4 | Automation of the Lightning of the room and Automated window blinds | Strong Conflict - Lighting in a room can be affected by natural light | Minor |  | open |  |
| 5 | Emergency notification | Omission - Emergency notifications should also be displayed in local monitors and through voice based assistants | Major |  | open |  |
| 6 | Storage | Overlapping - Local and cloud storage | Minor |  | open |  |
| 7 | Routine Activities | Overlapping - Kitchen and medicine inventory management | Minor |  | open |  |
| 8 | Emergency Notification & Safety measures | Weak Conflict - Automated calls should not happen if the customer takes responsibility for the emergency notification event. | Minor |  | open |  |

**Inspector: Sakib Shuvo Time spent by Inspector: 200 mins**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Defect # | Location | Defect/inconsistency type | Classification | Author | Status | Date corrected |
| 1 | Section: 3.2 User environment; Page 4  Self-evolving Mode | Forward Reference:  Definition of self evolving mode was given later in Appendix | Minor | sakib | open | 15 July |
| 2 | Section 4.4: Alternative and Competition:  Bell canada Description | Unintelligibility | minor | sakib | open | 15 July |
| 3 | Section 4.3: Needs and Feature  Mode of Operation  for user vs device to work | Terminology clash | major | sakib | open | 15 July |
| 4 | Section 4.2 Dependency  last point in dependency is not clear | opacity | major | sakib | open | 15 July |
| 5 | Section 4.4  Needs and Feature  Mode of access control, remote vs local | Poor Structuring:  both home and remote control are internet based | major | sakib | open | 15 July |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 6 | Section 4.4 Needs and Feature:  Security Measures Main gate access and door access | Weak conflict  Referring to the same door access feature | moderate | sakib | open | 15 July |
| 7 | Section 4.4 Needs and Feature:  Emergency detection CO level detection | Unintelligibility  CO acronym is not defined | moderate | Sakib | Open | 15 July |
| 8 | Section 4.4 Needs and Feature:  Energy Management:  Time of Day usage | Poor structuring | moderate | Sakib | Open | 15 July |
| 9 | Section 4.4 Needs and Feature:  Energy Management: | Strong conflict:  Automated irrigation, swimming pool cleaning doesn’t correspond to the category Energy management | High | Sakib | Open | 15 July |

**Inspector: Manik Hossain Time spent by Inspector: 80mins**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Defect # | Location | Defect/inconsistency type | Classification | Author | Status | Date corrected |
| 1. | Need & Features :  Automated call to 911 and fire department | **Overspecification** : Sometime fire alarm rings for a while but it can be easily control at home instead of disturbing these department | Major | Manik Hossain | Open |  |
| 2. | Need & Features:  Routine Activities like kitchen, medicine inventory management and automated feeding plan for pets. | **Opacity**: in this vision document there is no rationale, authoring or dependencies (these are invisible) for this need and features. | Minor |  | Open |  |
| 3 | Need & Features: Smart irrigation and automated gardening, swimming pool maintenance | **Noise**: There is no specification of any real world problem on these topics. | Major |  | Open |  |
| 4 | Features and Need:  Safety Measures | **Terminology / Designation Clash**: 911 and fire control department are same but used in different ways. | Minor |  | Open |  |
| 5 | Needs & Features: Automated feeding plan for pets | **Unfeasibility**: it seems unrealistic because it cannot be implemented in terms of developer perspective. | Minor |  | Open |  |

**Inspector: Nikhil Nikhil Time spent by Inspector: 120mins**

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| --- | --- | --- | --- | --- | --- | --- |
| Defect # | Location | Defect/inconsistency type | Classification | Author | Status | Date corrected |
| 1 | Features for specially-abled members of the family. | Omission | Minor |  | Open |  |
| 2 | 4.3 Needs and features:  Self-evolving mode | Forward reference | Minor |  | Open |  |
| 3 | 5.2 and 5.3 Platform requirements:  Mentions about Java and Linux which are more technical terms. | Unintelligibility | Major |  | Open |  |
| 4 | 2.2: Product Position Who: talks only about managing devices and automation of tasks.  Should mention security and other stuff. | inadequacy | minor |  | open |  |
| 6 | Consideration for privacy of the users | omission | major |  | open |  |
| 7 | User environment:  It should detail the current working environment of the user. Instead the document focuses on how user can access the smarthome+ system. | Poor structuring | major |  | open |  |
| 8 | Usage pattern Analyzer | infeasible | minor |  | open |  |
| 9 | Needs and Feature:  Automated Rain harvesting ,  Alternative energy harnessing system,  Is the same | Terminology inconsistency | major |  | open |  |