COMP2120/COMP6120 SOFTWARE ENGINEERING

Semester 2, 2021

Group Project: "CleanIT"

Final Version as of 08/08/2021 (minor clarification might be made if necessary)

Important deadlines

- Checkpoint 1 on requirements (5marks): **Week 6 Thursday** Tutorial, no submission needed
- Checkpoint 2 on designs (5 marks): **Week 9 Thursday** Tutorial, no submission needed
- Final presentation (10 marks): **Week 12 Thursday** Tutorial, no submission needed
- Project report (20 marks): submit final project report by **23:59pm Monday Week 13**

Background

"AR-Craft" is a company that guarantees a highly-skilled deep clean of the passenger compartments of aircraft. AR-Craft cleaning staff wear augmented reality (AR) headsets that enable them to use both hands for cleaning while wearing and interacting with the headsets. This enables the following sorts of functionality:

- The movements of cleaning staff can be tracked through an aircraft to enable detailed monitoring of cleaning.
- Voice communication can take place between members of the cleaning team, and between a team member and a central service desk.
- Images of cleaning tasks can be uploaded.
- Voice logging of comments can be kept for archive and analysis.
- Holographic overlays can be shown onto the real-world view of the aircraft interior through the AR Headset. This can be useful to, for example, direct cleaning staff to a particular location or to warn them to stay away from a particular area.

AR technology of the sort described here is available in headsets such as the Microsoft Hololens.[1] [2]

AR-Craft promotes itself as being a sophisticated deep cleaning service in times of pandemics. Its processes will be enabled using an information system known as "**CleanIT**" (i.e., **the system your project groups will analyze and design in this course**).

Vision Statement of CleanIT

"The CleanIT System will organise teams of aircraft cleaners and will track teams as they progress through their cleaning activities while cleaning aircraft passenger compartments. Because of the risk of infection in times of the covid19 pandemic, the cleaning process will have rigid protocols that must be followed and monitored. Logs of cleaning events will be stored for verification that cleaning has been achieved to a high standard and in a timely manner. If a passenger on an aircraft is reported to have contracted covid19 then these logs will be accessed to verify that the area surrounding that passenger has been cleaned properly and to contact impacted cleaning staff.

CleanIT will enable AR-Craft to win cleaning contracts at 80% major airports in Australia because it will offer an unrivalled level of accountability and professionalism in its cleaning services during the covid19 pandemic. CleanIT will help AR-Craft cleaning staff to have the highest reputations for their skills, efficiency and teamwork in the industry. The CleanIT system will be easily extensible for similar pandemic situations and the cleaning of buildings and public transportation vehicles."

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[1] https://www.microsoft.com/en-us/hololens

[2] Note that this technology is an area of active research in the Research School of Computer Science, ANU, in partnership with Data61/CSIRO. For example: Wennan He, Ben Swift, Henry Gardner, Mingze Xi and Matt Adcock, *Reducing latency in a collaborative augmented reality service*, in Proceedings - VRCAI 2019: 17th ACM

Potential External Systems of CleanIT

Consider (but not be limited to) the following **other AR-Craft systems** that CleanIT may interface with:

- HR system including training qualifications
- Personal Protective Equipment (PPE) warehouse
- AR Equipment warehouse
- AR-Craft finance system

Consider (but not be limited to) the following **non AR-Craft systems** that CleanIT may interface with:

- Aircraft schedules
- Airport finance system
- Airline customer satisfaction survey
- The Australian Government CovidSafe App

Business rules

The following are some of the business rules for CleanIT.

BR 1. Cleaning crews are contracted to the airport and the airport then bills the airlines for each deep clean.
BR 2. Billing is usually at a flat rate per aircraft type. In situations where an aircraft is only half full or less, then a discount will apply unless that aircraft was extremely messy (as substantiated with evidence).
BR 3. The billing cycle to the airlines is for one day of airport operation.
BR 4. Teams are formed at the beginning of each, fortnightly cleaning cycle and are confirmed at the beginning of each cleaning day.
BR 5. Cleaners are reminded of their next aircraft by text message.
BR 6. Team sizes depend on the type of aircraft being cleaned. For example, a 9-person team usually cleans a single aisle aircraft such as a Boeing 737-800. A 12 -person team will clean a double-aisle, single-level aircraft such as an Airbus A 330-200.
BR 7. A central cleaning office (CCO) monitors all cleaning crews and all equipment stores in the airport.
BR 8. Senior team members are “foggers”. Foggers have a high level of training accreditation. Foggers are first onto an aircraft and are fully covered in PPE protective gowns and face shields.
BR 9. Foggers make one pass through the aircraft to ensure that all luggage bins are open, all bathroom doors are open, and all window shades are closed half-way.
BR 10. Foggers then walk backwards from the rear of the aircraft while spraying disinfectant in very fine mist. They ensure that the mist covers all surfaces.
BR 11. Teams for two-aisled aircraft have two foggers who walk backwards while spraying in coordination with each other.
BR 12. Foggers note any special requirements for cleaning while they are spraying and communicate these requirements to the team coordinator.
BR 13. Cleaning teams must wait for 2 minutes before boarding an aircraft after fogging.
BR 14. Foggers dispose of their gowns and attend to their personal cleanliness after fogging.

After resting, foggers can join other cleaning crews as foggers. They can also back up an existing crew as an ordinary cleaner.

BR 15. All team members receive PPE, disinfected cleaning equipment and disinfected AR headsets before boarding an aircraft.

BR 16. Face masks and disposable gloves are replaced after each deep clean.

BR 17. AR Headsets are handed back to the equipment store for cleaning after each deep clean.

BR 18. AR headsets are activated by voice commands and are able to recognise the voices of all cleaning staff members. The initial activation of an AR headset will download the cleaning plan for that cleaner for the next aircraft.

BR 19. Cleaning logs are archived for each cleaner for each aircraft.

BR 20. All cleaners must wear protective clothing including face masks. This is monitored using body-facing cameras on the head-sets.

BR 21. All cleaners must be socially distanced from other cleaners to the requisite 1.5 m distance (with exceptions only allowed for short periods of time). Cleaning tasks are planned to allocate different cleaners to different parts of the aircraft. The way that cleaners enter and leave the aircraft is in a coordinated and socially-distanced manner.

BR 22. One specialist crew member will clean the economy bathrooms (two for double-aisled aircraft).

BR 23. One specialist crew member will clean the food-preparation areas.

BR 24. Carpets are not usually shampoo-cleaned every turn but are cleaned at the end of a shift. In the case of a serious spillage in part of the aircraft, carpets will be locally cleaned about that spillage.

BR 25. All team members must have the CovidSafe app running when they are active at work. The functioning of this app is monitored by the AR headsets.

BR 26. If a passenger on an aircraft is reported to have contracted covid19 then logs will be accessed to verify that the area surrounding that passenger has been cleaned properly and to contact impacted cleaning staff

BR 27. Impacted cleaning staff will be required to be tested for covid19 and to self-isolate for 14 days if testing positive.

BR 28. If impacted cleaning staff test positive, the sections of other aircraft that have been cleaned subsequently by that cleaner will also be determined, with passengers being notified and other cleaners of those other aircraft also being notified and appropriate action taken.

Some Triggers and Usage Scenarios for CleanIT

Trigger 1. The system starts up at the beginning of a cleaning day.

i. Teams are "confirmed" by contacting cleaning-crew team members by text message and letting them know what time they need to report in order to carry out the scheduled cleaning tasks for that team. Team members must respond to acknowledge that they have received and agree with their allocation for the day. All team members must certify that they are well and available for work and that they have not be asked to self-isolate by any authority. **(US1)**

Error scenario: One team member replies with ill health condition. This error scenario only needs to be carried out by the project groups who have **more than 5 members**.

Trigger 2. An Airbus A 330-200 arrives and is ready to be cleaned.

i. The system checks that the team and their equipment are ready and in the right location**. (US2)**

Error scenario: One team member's PPE is broken. This error scenario only needs to be carried out by the project groups who have **more than 5 members**.

Trigger 3. The fogger enters an aircraft and the deep clean proceeds according to the business rules.

i. The system monitors the routine cleaning of an aircraft. **(US3)**

Note: This usage scenario must be included in Task 4.

Trigger 4. During routine monitoring of aircraft cleaning, the system notices that one cleaner's mask has slipped.

i. The Central Cleaning Office (CCO) is notified and action taken. **(US4)**

Trigger 5. A cleaner discovers a very messy part of the aircraft and urgently requests carpet shampooing.

i. They send through a photograph of this mess to the CCO (using the camera on the AR headset) and another member of the crew comes to help clean this mess for a strictly limited time to minimise the potential violation of social distancing between cleaners. **(US5)**

Trigger 6. The system detects that a cleaner is not following their prescribed route for cleaning an aircraft.

i. The system notifies that cleaner and all other crew members. CCO gets in touch with crew member and suggests actions they should take. Those actions are subsequently monitored**. (US6)**

Trigger 7. A passenger on one of the flights cleaned during the previous day's cleaning shift is reported to the system as having contracted covid19.

i. Logs are checked to ensure that that area of the aircraft has been properly cleaned. Cleaners who have cleaned near that passenger are notified and asked to get checked for covid19 and self-isolate if necessary. Teams are reformed if necessary **(US7)**

Trigger 8. An airline sends through customer satisfaction survey results for a particular flight.

i. Survey results are added to the audit statistics for the relevant cleaning crew ***(US8)***

Project Tasks and marks for final project report

Task 1. Draw **ONE Feature Tree** for the CleanIT system that shows its major features. Link features in this tree to relevant use cases and business rules. (1 mark)

Note: You must provide **at least two versions** of this feature tree to explain the evolution of your thoughts about the system as your analysis of product scope has progressed. See the marking rubric.

Task 2. Draw **ONE context diagram** for the CleanIT system. Include any relevant considerations (e.g., regarding external systems and business data concepts) that you feel you need to make in your answer. (1 mark)

Task 3. Construct **ONE Business Process Flow Diagram** (an "activity diagram for the business") for one billing cycle at the level of business processes**.** This BPFM needs to be from the central perspective of AR-Craft.

Suggestion: A level-2 business process flow diagram would contain the most appropriate level of details for this task. (2 marks)

Task 4. Write out the **use cases** for the major usage scenarios of the CleanIT system as **fully-dressed use case tables**. You may have more than one use cases for a usage scenario, and/or introduce additional use cases, if you find that this makes the usage scenario clearer. (4 marks)

Note: Project groups with **four members** will write the use cases for **six usage scenarios** in total. All other groups with **five or six members** will write the use cases for **eight usage scenarios** in total.

Note: Usage scenarios must include:
For groups with four members: US3 + 3 usage scenarios selected from the list "Some Triggers and Usage Scenarios for CleanIT" + 2 new usage scenarios (not in the list "Some Triggers and Usage Scenarios for CleanIT") proposed by the groups;
For groups with five or six members: US3 + 5 usage scenarios selected from the list "Some Triggers and Usage Scenarios for CleanIT" + 2 new usage scenarios (not in the list "Some Triggers and Usage Scenarios for CleanIT") proposed by the groups

Note: Project groups with **six members** must include two usage scenarios with error scenarios. You may use US1 and US2 or propose error scenarios for other usage scenarios. Project groups with less than six members are encouraged (but not compulsory) to perform error scenario analysis.

Task 5. Assuming a four-level layered architecture for your system (UI, Application, Domain, DataBase), draw and explain a **Domain Model** for your system. (3 marks)

Note: This model must be **only** for the Domain Layer. Pay attention to the classes that should or should not be included in the domain model.

Note: You must include and explain the attributes and methods in this domain model that are critical for support of the use cases.

Note: You may split a complex domain model diagram up into smaller diagrams if you need to improve the presentation and clarity

Task 6. Draw and justify **sequence diagrams** for all of the main flows (i.e., main success cases) of all of the use cases you design in Task 4. (4 marks)

Note: You must have **at least one sequence diagram per use case**. Each sequence diagram will articulate how relevant objects interact and how information (from objects) is gathered and acted upon in order to act out the system behavior described in the use case. You can split a complex sequence diagram up into smaller diagrams if you need to improve the presentation and clarity. The sequence diagrams should provide sufficient information that help to transform your domain model in Task 5 into design class diagram in Task 7.

Note: You must also submit a short (half page) statement justifying any important design considerations or assumptions you need to make in modeling system behavior in your sequence diagrams (in particular you might need to justify why you drew the particular sequence diagram you did draw for your use case if there was a decision to be made there).

Task 7. Draw a **Design Class diagram** for your system. You must include an explanation of how you obtain this design class diagram from your domain model and sequence diagrams and how your design class diagram substantially differs from your domain model. (3 marks)

Note: Your design class diagram should be consistent with your sequence diagrams in terms of class attributes, operations and relationships. Your design class diagram will have substantially more details than your domain model.

Note: You may apply certain design patterns as you deem appropriate and relevant to certain design problems you have in the system.

Task 8. Design principles and design patterns

8.1. In a short (half page) statement, identify and explain, with reference to your design class diagram, the design principles and design patterns (if any) your system design reify. (1 mark)

8.2. The CleanIT system needs to evolve to support new requirements or new operating environments. In a short (half page) statement, describe one example of such system evolutions and justify how your system design will be able to respond well to this evolution. (1 mark)

Note: The statements must refer to specific design principles and design patterns and how they are applied in the system design and support system evolution, rather than just some general descriptions of these principles and patterns.

Marking guide

Note: mark deduction examples and indicators are by no means an exhaustive list.

Task 1. Feature Tree (Up to 1.0 mark)

a. **1.0 mark** for a fully detailed feature tree diagram (at Level 3) of professional presentation quality, together with a reflective description of how your feature tree

evolved during the course of your group working on this project and what drove its evolution. You need to show at least two versions of feature trees to illustrate the evolution of feature tree.

Remember that feature trees are useful diagrams for requirements engineering even before you have decided what the major features in your software will be; as you proceed with analysis and design you are able to identify features more readily. Note that it is considered that your feature tree will be up to three levels of detail and that it will be possible to identify the use cases easily on your feature tree (some use cases may be split across different branches of your feature tree).

One of the key profession-level qualities is that the way that the feature tree is presented needs to be consistent and well-integrated with the rest of your report. Same professional quality requirement for all other deliverables.

b. **0.5** marks for a partially-detailed and reasonable feature tree but which falls short in some of the following ways (but not be limited to)

- **i.** Your feature tree misses out some important features needed by your use cases, vision statement and business rules.
- **ii.** Not all features in the feature tree are clearly traced to relevant use cases and business rules.
- **iii.** Your reflective description of the way that your feature tree evolved is not convincing. For example, your description does not explain clearly what drove the evolution of the feature tree, and it feels like it has been quickly made up at the end of the project.
- **iv.** The visual presentation of your feature tree is scrappy and difficult to read and understand.

c. **0.0** marks for an absent or an extremely rushed feature tree.

d. 0.25 marks will be awarded between the above categories.

Task 2. Context Diagram (Up to 1.0 mark)

a. **1.0** mark for a-fully-correct and professionally-presented context diagram together with some written considerations that demonstrate that the group has thought seriously about the external systems and the data requirements of data t at will be transferred between these external systems and the CleanIT system.

b. **0.5** marks for a partially-detailed and reasonable context diagram but which falls short in some of the following ways (but not be limited to)

- i. Your context diagram misses some key system-system interactions and data requirements.
- ii. Your context diagram is not presented in a professional manner which makes it difficult to understand system interactions and data requirements.
- iii. Your report misses out on having written explanations that make it convincing to the reader that the group has thought seriously about the external systems and the data requirement.

c. **0.0** marks for an absent or an extremely rushed context diagram.

d. 0.25 marks will be awarded between the above categories.

Task 3. Business Process Flow Diagram (Up to 2.0 marks)

a. **2.0** marks for a fully-correct and professionally-presented BPFM diagram (apart from one or two minor notation isses) together with the concise descriptions that clearly justify any assumptions you have made for the business process. Your diagram must be from the business perspective and it must show that "business value" in the vision statement has resulted from the successful completion of the process shown in that diagram.

b. **1.0 mark** for a partially-detailed and reasonable BPFM diagram but which falls short in some of the following ways (but not be limited to)

i. The described business process is incomplete or has inappropriate or incorrect activities.
ii. The described business process misses important details to achieve the business value.
iii. Your report misses out on having written explanations of the key business assumptions or the explanations fail to convince the reader that the group has thought seriously about the business process and assumption.

c. **0.0** for an absent or extremely rushed BPFM diagram.

d. 0.25 marks will be awarded between the above categories.

Task 4. Use Cases (Up to 4.0 marks)

a. **4.0** marks for complete, consistently-written and professionally-presented use cases. Your use cases will be examined on how well they articulate user-system interactions that result in business value at an appropriate level of detail. Their levels of description need to be consistent and realistic and they must speak to the functionality and overall vision of the system. (Note that you can provide a short explanation about the assumptions that you made in deriving your use cases and user-system interactions.)

Note: Project groups with different numbers of members have different requirements for Task 4. Please read carefully the task requirements!

b. **3.0** marks for a well-presented submission apart from one or two serious issues, including by not limited to:

i. Unclear or inappropriate user system interactions
ii. Unclear or inappropriate system assumptions
iii. Inconsistent or incomplete use cases
iv. Fail to deliver core business values

c. **2.0** marks for a submission that is only about 50% complete, either in the number of use cases presented or in the amount of consistent detail presented for each use case, or the submission suffers from multiple serious issues as listed above.

Note: Even if your presentation is incomplete to this level, the material you present must be consistently written and professionally presented to get half marks. A very poorly presented, but, nevertheless, complete submission will also only get half marks.

d. **1.0** marks for a superficial submission but with some obvious thought involved.

e. **0.0** marks for an absent or extremely rushed submission.

f. 0.25 marks will be awarded between the above categories.

Task 5 Domain Model (Up to 3.0 marks)

a. **3.0** marks for a fully correct and professionally- presented domain model, apart from one or two very minor notation issues. Your domain model will be clearly labelled. Linkages will be reasonable and be as few as necessary to achieve the use cases. Multiplicities will be correct. You will have also submitted a short (half page) statement justifying any considerations you needed to make in domain modeling.

b. **2.0** marks for an almost complete, well-presented submission apart from one or two serious issues, including but not limited to:
   i. Misses important domain classes and relationships
   ii. Misses necessary attributes and operations to support the use cases
   iii. Incorrect domain classes, relationships, attributes and/or operations
   iv. No or superficial statement to justify the resulting domain model
   v. A large number of notation errors which makes it difficult to correctly interpret and understand the diagram.

c. **1.0** marks for a submitted domain model that is substantially incomplete or superficial, or that suffers from multiple serious issues as listed above.

d. **0.0** marks for an absent or extremely rushed domain model.

e. 0.25 marks will be awarded between the above categories.

Task 6: Sequence Diagrams (up to 4.0 marks)

a. **4.0** marks for complete, consistently and professionally- presented sequence diagrams, apart from one or two minor notation issues, together with a concise statement justifying any important design decisions in analyzing and modeling system behaviors. You must have **at least one sequence diagram for each use case** you write in Task 4**.** These sequence diagrams should clearly model how domain objects interact to "act out" relevant use cases. They should provide sufficient information that help to transform your domain model in Task 5 into design class diagram in Task 7.

b. **3.0** marks for a well-presented submission apart from one or two serious issues, including but not limited to:

i. Misses sequence diagrams for use cases
ii. Inconsistencies between sequence diagrams and use cases
iii. Unclear modeling of domain object interactions
iv. The object interactions do not support the use case behaviors
v. A large number of notation errors which makes it difficult to correctly interpret and understand the diagram.

c. **2.0** marks for sequence diagrams that are substantially incomplete, or that is rather sloppy or inconsistent in the way that they have been presented, or the submission suffers from multiple serious issues as listed above.

Note: Even if your presentation is incomplete to this level, the material you present must be consistently written and professionally presented to get half marks. A very poorly presented, but, nevertheless, complete submission will also only get half marks.

d. **1.0** marks for a superficial submission but with some obvious thought involved.

e. **0.0** marks for an absent or extremely rushed submission.

f. 0.25 marks will be awarded between the above categories.

Task 7 (Design Class Diagram) (Up to 3.0 marks)

a. **3.0** marks for a fully correct and professionally- presented design class diagram, apart from one or two very minor notation issues. Your design class diagram will be clearly labelled. Linkages will be reasonable and be as few as necessary to achieve the use cases. Multiplicities will be correct. You will have also submitted a short (half page) statement justifying any considerations you needed to make in design classes.

b. **2.0** marks for an almost complete, well-presented submission apart from one or two serious issues, including but not limited to:
i. Misses important design classes and relationships
ii. Misses necessary attributes and operations to support the use cases
iii. Inconsistent with corresponding sequence diagrams
iv. Incorrect design classes, relationships, attributes and/or operations
v. No or superficial statement to justify the resulting design classes or how design classes are related to domain model and sequence diagrams
vi. A large number of notation errors which makes it difficult to correctly interpret and understand the diagram.

c. **1.0** marks for a submitted design class diagram that is substantially incomplete or with no fundamental differences from domain model, or that suffers from multiple serious issues as listed above.

d. **0.0** marks for an absent or extremely rushed design class diagram.

e. 0.25 marks will be awarded between the above categories.

Task 8 Design Principles and Design Patterns (Up to 2.0 marks)

a. **2.0** marks for the fully-detailed, insightful statements on the application of relevant design principles and design patterns in your system design and how they enable the system to response well to the new features or new environments.

b. **1.0 mark** for some partially-detailed and reasonable statements but which falls short in some of the following ways (but not be limited to)

i. Irrelevant design principles or design patterns to the system design
ii. Unclear or vague explanation about relevant design problems to be addressed
iii. Inaccurate discussion or understanding of the applied design principles or design patterns
iv. Incorrect application of design patterns

c. **0.0** for an absent or extremely rushed statements.

d. 0.25 marks will be awarded between the above categories.

Note on "professional presentation quality"

To be professional, all deliverables will be logically coherent and consistent. Furthermore, your report will be neatly typed and that all diagrams will be drawn consistently using graphics programs (such as Visio, draw.io, Powerpoint or others). Your diagrams will have a similar look and feel (graphics appearance and use of labels) so that it appears that the document has been written by the entire group rather than by individuals working on separate parts.

Tentative plan for differential assessment for relative efforts and contributions by group members

A feedback tool will be provided so that each group member can rate themselves and other members of the group if they feel that a differential assessment should apply across group members. This feedback tool will offer three options for every group member

a) Keep their mark unchanged at the group mark.
b) Add 10% of the group mark to that group member.
c) Subtract 10% of the group mark from that group member.

Such a differential assessment can result in a differential *increase or reduction* in the marks of one or more group members up to a maximum of 10% of the group mark on the basis of a *majority vote* of all group members.

Note that no person can be voted up to have a mark greater than 20 and no person can be voted down to have a mark in the fail grade for the group project (less than 8/20). In the cases where a person fails to contribute to the group project to obtain the pass grade for the project, the decision will be made on the case by case basis and through the interviews with the members of that group. The groups report such failure potentials to their respective tutor in the project M&Ms and the checkpoints so that an early intervene could be made.