

THE UNIVERSITY OF SYDNEY
FACULTY OF ENGINEERING AND INFORMATION TECHNOLOGIES
Integrated Engineering (ENGG2111)

Assignment Cover Sheets

Group Number: W13A-CCS1

Semester/Year: Semester 2/2018

| Assignment Title: ENGG21111 EOI Submission Group Assignment | |
|--|-------------|
| NAMES OF GROUP MEMBERS | STUDENT IDs |
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Before handing in your report:

1. TICK the criteria that you feel you have met in the report format checklist.
2. SIGN this cover sheet in the appropriate places on the next page to certify that this report is entirely your own work. **A report will not be considered to have been handed in until all students have signed this declaration.**
3. Fill in your Lecture, group name, Semester / year, your names and IDs where indicated above. (The names must be legibly printed in BLOCK CAPITALS, SURNAME FIRST and underlined.)






Report Format Checklist:

- ✓ The pages are consecutively numbered.
- ✓ This form is completed as specified in the box above and appears as the first pages of your report.
- ✓ Each entry in the reference list is explicitly referenced at least once within the main body of the text.
- ✓ The report has been carefully *proof-read*. We have paid attention *spelling, punctuation, grammar choice of words and writing brevity* in this report. *Acronyms* and *jargon* are used only if there is good reason and have been clearly explained at their first appearance in the report.

[To the marker] Please take into account the following additional features or special circumstances when marking out report [explanation follows]:

Certification

We certify that this report is entirely our own work*, except where we have given fully documented references to the work of others, and that the material in this report has not previously been submitted for assessment in any formal course of study.

| | | | | | |
|--------------|----------------|----------------|---|--------------|------------|
| Name: | Vishant Prasad | Signed: |  | Date: | 27/08/2018 |
| Name: | Poddar Gaurav | Signed: |  | Date: | 27/08/2018 |
| Name: | Cindy He | Signed: |  | Date: | 27/08/2018 |
| Name: | Alex Ngo | Signed: |  | Date: | 27/08/2018 |
| Name: | Jordan Wan | Signed: |  | Date: | 27/08/2018 |

* *Plagiarism* means copying another's work, either verbatim or with only minor changes of wording or content, and presenting the result as if it were your own work. It is dishonest and is grounds for disciplinary action in this University. To avoid plagiarism, reports must be in your own words, except for direct quotations. All source material (including ideas, diagrams, etc.) should be explicitly acknowledged.






2.1 Form A1 - Expression of Interest, Pitch and Full Tender Submission Cover Sheet

Description of Proposed Works

The aim of the project is to maintain the comfort and well-being of our client utilizing methods or regulating humidity, temperature and light. This project is differentiated from competitors as we strive to reduce the dependency of air conditioning and carrying out the project requirements with a passive solution.

Name of Tenderer (Company Name & Team Member Names):

| | |
|-----------------------------|---|
| <u>Company Name:</u> | Think Comfort |
| <u>Team Members:</u> | <ul style="list-style-type: none"> • Poddar Gaurav • Alex Ngo • Cindy He • Jordan Wan • Vishant Prasad |

| | |
|--|--|
| Cost: Total Tender Price (Not Required for Expression of Interest) | \$ (Excl. GST) |
| Date: | 27/08/2018 |
| Signature of Tenderer(s): | <div>  </div> <div>  </div> <div>  </div> <div>  </div> <div>  </div> |

| | |
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2.2 Form A2 - Expression of Interest Submission Form

Company Expertise

Think Comfort is a robust company that is seeking to improve the standard of thermal comfort in homes with innovative and high-end technology. The company includes highly skilled associates which are not only qualified at their own respective fields but display effective expertise. The associates within the company specialise in fields of engineering listed below:

- Electrical Engineering
- Mechatronic Engineering
- Aeronautical Engineering
- Mechanical Engineering
- Civil Engineering

Our associates consist of the following participants:

Poddar Gaurav is a civil engineer professional in passive designs and the modifications of the existing buildings and structures. He is very knowledgeable in the physical influences experienced by the systems in the project and the materials being employed in the project's components.

Alex Ngo is a mechanical engineer that is skilled in the equipment designs and maintenance of the systems to enhance the reliability of the system. He is experienced in the creation of the components and the hardwares functionality in the project.

Cindy He is an aeronautical engineer specialising in aerodynamic analysis and designs to ensure appropriate ventilation of the rooms within the project. She is particularly skilled in the physical design of the systems in the project and is very knowledgeable in the effects of the surroundings on the particular components and systems as a whole.

Jordan Wan is an electrical engineer who is particularly experienced in the construction and management of the electrical aspects within the major components of the systems being utilized in the project. He is specialised in the simplification and implementation of the electrical components.

Vishant Prasad is a mechatronic engineer skilled in the programming of various systems to reinforce components to be more autonomous within the project. He is particularly experienced in languages such as MATLAB programs, C coding and Python script.

Proposed Project Personnel

Within this project various consultants are required to be employed for their skills to increase the capability of the participants (particularly fulfilling the required skills) to complete the tasks at hand within the various stages of the project. Required consultants include the following:

| Personnel | Role |
|----------------------------------|---|
| Project Manager | Allow for supervision over the project. |
| Doctor | To provide expertise on the human body. |
| Biomedical Engineer | To design and assist on the armband and analysis of the data. |
| Civil Engineer | To provide site installation assistance and construction assistance. |
| Architect | Will be utilized for the handling of passive designs of buildings. |
| Software Engineer | To assist with the coding of the systems computerized and more autonomous components. |
| Mechanical/Mechatronics Engineer | To design photometers and sensors. |
| Electrical Engineer | Can be employed for the handling and designing of circuits including wiring. |

Project Definition

The project, proposed by Created Community Services (CCS), intends to achieve a thermal comfort system for individual with severe disabilities, which will reduce the dependency of the people on carer support. The system to be built will be based on the requirements by each individual and the type of the house owned. There are 35 systems to be installed in which includes:

- Category A: 12 detached owner - occupied or government - owned houses.
- Category B: 6 privately rented detached houses.
- Category C: 11 owner - occupied or government - owned strata title apartments
- Category D: 6 privately rented strata title apartments

An automated or semi-automated system is to be proposed for the project personalized for each high need individual. The thermal system requires a reduced load on the thermal

system which can be made possible via the introduction of passive design solutions which will reduce the operational cost.

General Timeline of Proposed Project/Solution

| Task | Month | | | | | | | | | | | |
|-------------------------|-------|---|---|---|---|---|---|---|---|----|----|----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Investigating the sites | | | | | | | | | | | | |
| Renovations | | | | | | | | | | | | |
| Manufacturing | | | | | | | | | | | | |
| Installation | | | | | | | | | | | | |
| Testing | | | | | | | | | | | | |
| Data collection | | | | | | | | | | | | |
| Feedback and Analysis | | | | | | | | | | | | |

Investigating the sites is expected to take approximately one week which will involve the surveying of the house's and structures as well as the surrounding environment. This will allow for all information to be properly collected first hand. This task runs sequentially as it will require important information for the ordering of components and planning for the rest of the system construction.

Renovations is estimated to run parallel to manufacturing and both have to be completed prior to the beginning of the testing stage of the project. Manufacturing of parts runs parallel to the previous activity as some components may need to be re-created, adjusted or custom built for the conditions or situations at the time of renovation.

Installation requires a large amount of time and runs alongside the manufacturing and renovation as some components can be directly added into the structure of the house or maybe required to be placed early in the system installation.

Testing will run parallel to data collection as part of testing would include confirming that the data collected is correct and realistic further affirming that the system is operating as expected and is installed correctly. Similarly, testing runs parallel to installation as well as some components can be immediately tested when installed.

Feedback and analysis runs parallel to data collection as the data would be utilized for this stage and some elements of the system can be immediately analyzed and given feedback when the data is collected.

Proposed Approach

The project proposed by Think Comfort is dependent on natural light. Such light levels and heat signatures on the bodies of the buildings can be detected utilizing a combination of light detective sensors, humidity sensors and UV sensors. The data collected, therefore, can be utilized to coordinate with the system. Such a passive design system can be achieved by employing technology that gains data from the path of the sun and temperature over the local address/area of the building. Furthermore, the direction of light at different times of the day (for example sunset and dawn) can be transformed into information to be utilized by the individual components.

The main component of the housing thermal system is to finally regulate the size of the window, control blinds (if required depending on the survey of the house's local area) and the transparency of the glass so that sufficient amount of light can enter the home allowing for comfort. Furthermore, the window system can adjust temperature of air that is on the interior side of the window to emit either heat in the uncomfortable cold times of the year and, similarly, cool the air that radiates from the window into the house at times of the year when the temperature is uncomfortably warm. Examples of such times include winter and summer respectively, as well as in events of rain and storms, cold nights, heat waves and foggy occasions dropping temperatures.

Furthermore, the humidity within the house can be adjusted using sensors that are capable of detecting the moisture in the air and adjust the humidity level to an optimal and comfortable level in the house. This can be accomplished similar to humidifiers that are utilized in tropical countries which are compact machines that operate by *"pulling in air with an internal fan and pass it across a water-saturated wick filter to absorb moisture"* (Sylvane, 2018). The system however will include humidifiers installed within the interior of the homes into the structure of the buildings (for example in walls and roofs) allowing for a simplistic design that does not extrude from the walls of the home and avoid redefining the shape of rooms.

For this system to operate, information concerning the client's comfort is required which can be collected using a bracelet capable of monitoring heart rate, body temperature, time and rest patterns. The bracelet, therefore, feeds this information back to the system so that the client's comfort levels can be adjusted using the light entering the home. This system would not need for the client to put any feedback into the components themselves making the system autonomous.

Within the system a manual override is to be in place that is proposed to be implemented via a remote control that will operate the entire thermal system of the whole house. Operation costs will be reduced with long run modifications of the systems such as the installation of controlled blinds. The type of system to be installed will be dependant on the category of the house which will be based on the size of the house and whether or not it is an owned or rented by the occupants. Therefore, there are proposed to be two types of systems one with an individual unit in every room of the house and the other one is a HVAC system which is

Heating Ventilation and Air Conditioned. For category A,B the system will be better suited with a HVAC system due to the houses size (large enough, owned by the occupants).

Requirements of the bracelet:

- Aesthetically appealing for everyday use.
- Waterproof for versatility and ease-of-use.
- Internet connection to send information in real-time.
- Lightweight and robust material for durability.
- 24/7 monitoring in case of emergencies.
- Ability to notify local authorities and make emergency calls.
- Differentiate from when the bracelet is worn and not.

Finally, the lighting within the house will affect the temperature to a minute and most likely negligible degree however, but will be regarded as part of the system. Therefore, it is recommended that lower power LED down lights are to be installed into the house and rooms for reduction of noise being read by the system. Based on the budget of the client, a further more expensive package system can be employed with heating floor system and heated blankets.

Anticipated Project Issues and Risks

This project as a whole employs methods of risk avoidance, reduction, protection, management and transfer on the variety of risks that are at hand in the system.

| Nr | Risk Description | Source | Probability | Impact | Risk Mitigating Actions | Risk Owner |
|----|---------------------------------|--|-------------|--------|--|-----------------------------------|
| 1 | Extreme weather conditions. | High humidity. High temperature. | Medium | Medium | Plan installation of exterior components via weather reports ahead of date. Backup installation. | Facilities & Team Leader. |
| 2 | Faulty & low quality components | Sensors not operating properly. Power failures. | Low/Medium | Medium | Quality control of created components. Create a standard for all equipment employed. | Facilitators, Agents & Investors. |

| | | | | | | |
|---|--|--|--------|--------|---|---------------------------------|
| 3 | Project delays | Unexpected regulations involved. Lack of resources. | High | High | Prepare plan before and account for delays within the timeline with room for adjustment of schedule. | Team Members & Project Manager. |
| 4 | Planning issues | Lack of research. Careless analysis. | Medium | Medium | Schedule for a flexible timeline in case of steps required to be repeated. | Team Leader & Team Members. |
| 5 | Subjective evaluation | Conditions of comfort is different among individuals. | Low | Medium | Have a universal standard that accounts for the comfortability of most individuals. | Clients. |
| 6 | Physical injuries from creating components | Cuts from broken equipment such as glass. Electrical shocks from live components. | Medium | Medium | Clean up broken equipment and check all equipment's condition. Wear protective equipment such as high visibility vests, closed shoes, eyewear and gloves | Team Members, Facilities. |

Further Risks & Basic System Instructions

- When the system seems to be working properly but the temperature or humidity increases (decreases) unexpectedly. Carers should contact our company assistance hotline and switch off the system by manual override.
- If any devices or sensors have stopped working, do not try to fix or open those components, check the warranty tag and call the company assistance hotline.
- Avoid smoking, burning food or any substances that may lead to false readings in the system.

Additional Information

Packages:

- Basic system:
 - Blind Control
 - Humidifier
 - Air Conditioning
- HVAC system:
 - Heating Ventilation
 - Air Conditioning
 - Light Control
 - Humidifier
 - Blind Control
- Full system:
 - Light Control
 - Air Conditioning
 - Humidifier
 - Blind Control
 - Thermal Flooring
 - Heated Blanket System

Further Information Concerning the System

Areas within the homes such as kitchens would be heating up in certain areas at a greater rate than other areas in the home therefore necessary monitoring of these areas would have to be accounted for by the system which can be made via mapping systems coded into the components for each home. This would be applicable to the government-owned housing and apartments as most of the buildings would have a similar layout, however for the clients with self-owned homes built from third party organisations and realtors the system would have to be custom built/mapped increasing cost and labour. Alternatively, components can be made with differing capabilities and settings in these areas where thermal noise would be greater. This would increase labour and cost but similarly to mapping, would require to be custom built for each home or room that has abnormal thermal traces.

Furthermore, electronic noise from internet connections, bluetooth devices and other electronics may interfere with the readings of the systems therefore, less crowded bands of the EM spectrum must be employed in the monitoring of the light such as UV or Infrared technology. Alternatively, filtering can be used to cut out the noise such as low-pass filters, LFO's and band-pass filters.

Most houses would have ready placed insulations in the roofing as well as differing materials (based on the categories) that make up the structures roofing and walls, such as tiled or steel roofing and brick or concrete design. Differing materials would need to be considered for their thermal qualities and heat retention and emission on the interior and exterior of the

house. (Does the materials absorb or reflect heat and light? If so to what extent? How can we measure such materials qualities?) This would require the expertise of a civil engineer who would be experienced in the physical qualities of materials in most of the structures to answer such questions.

In some circumstances blinds may not be able to be placed on the houses due to the areas size restrictions therefore, the packages must be versatile to suit each client. It is therefore, proposed that automated blackout curtains and shades must be included in this category of blind control. Having such a variety would increase costs but also allow for furthering client and customer comfort and would in the long run allow for greater business reach.

Finally, the bracelet system needs to be updated online with the current season of the year to adapt the changes needed to be done. Hence, regular updates are to be made to its operating system when the gadget is not being used by the client. Furthermore, the system operating on the bracelet would have to be easy to use for the elderly and disabled clientele as well as have a simple and professional design for everyday wear. Keeping a minimalistic design will allow the bracelet to remain low profile and unnoticeable, complementing the attire of the client.

Remaining Categories

Category C within the project which consists of 11 owner - occupied or government - owned strata title apartments would require a thermal system consisting primarily of air conditioning, autonomous blind control as well as humidifiers. This is due to the estimated budget of the clients and size of area would not be able to facilitate the extras in the more expensive packages.

Category D within the project consists of six privately rented strata title apartments which would be able to facilitate the basic system package due to the size of the homes and area being limited. Therefore, consisting of the light and blind control, air conditioning and humidifier controls.

Additional Information Required from the Client

1. Materials

- a. The living area of the client, specifically the house structure, material make-up and already existing modifications would have to be accounted for in case of possible influences such things would have on the system.

2. Health

- a. The client's health would have to be taken into account when installing the system such as if the client is disabled or suffers from any health problems that may influence the operation of the system and bracelet design.

3. Living

- a. A survey of the client's living area is required both the exterior, surrounding area, interior to identify any unique factors that may impact the system and the package selected.

References

- Sylvane. (2018). *Frequently Asked Questions About Humidifiers*. [online] Available at: <https://www.sylvane.com/humidifier-frequently-asked-questions.html> [Accessed 26 Aug. 2018].
- Ndis.gov.au. (2018). *NDIS*. [online] Available at: <https://www.ndis.gov.au/providers/assistive-technology-strategy.html> [Accessed 26 Aug. 2018].
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