

Section One

Executive summary

1.1 Proposed Product or Service name:

T.R.E.E.

(Transportable Respiratory Environmental Equipment)

1.2 Product or Service aims:

T.R.E.E. aims to reduce air pollution during Medellin's smog seasons alongside the government air quality improvement plan. The objective of T.R.E.E. is to increase expat's satisfaction with Medellin's living standard in order to attract more skilled workers to the city.

1.3 Product or Service summary:

A smart synthetic plant which is a season-responsive air filtering system called T.R.E.E. It is a modular system consisting of air filtering, mist spreading and an interactive information display.

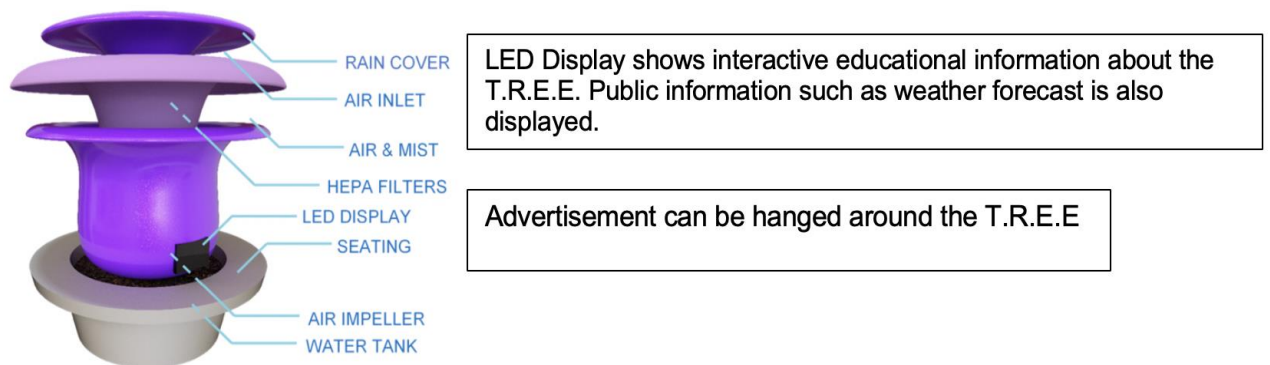


Figure 1. Overview of the T.R.E.E.

- Harmless water droplets are released by the mister. Mist attracts pollutants and falls down to the ground.
- Air is sucked in by a vacuum and filters out particulate matter. (PM10 & PM 2.5)
- Sensors and microcontroller are used to control the system

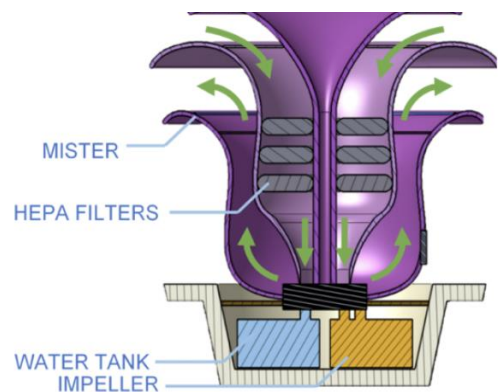


Figure 2. Cross Section of the T.R.E.E.

T.R.E.E can be transported manually or via automation system by an A.I.

1.4 Strapline:

Clean to Dream

1.5 Elevator Pitch (Maximum 150 words):

Severer smog seasons have become a major concern to the expats in Medellin.^[1] Nearly 3000 people died from the pollution. What if the air we breathe in is in the same situation?

Therefore, we come up with T.R.E.E. It is a smart, mobile, season responsive air filtering system aims to reduce air pollution in Medellin.

The system mists and filters the air during peak smog season, giving the opportunity to rent itself to cities in Latin America the rest of the year. Our unique aesthetic design is a community asset and sparks conversation for education.

By improving the air quality, we can reduce expats' concerns, attracting more skilled labour to the area and boost Medellin's economy.

Our design is reconfigurable and transferable. Therefore, we can deploy our system in other cities according to their needs.

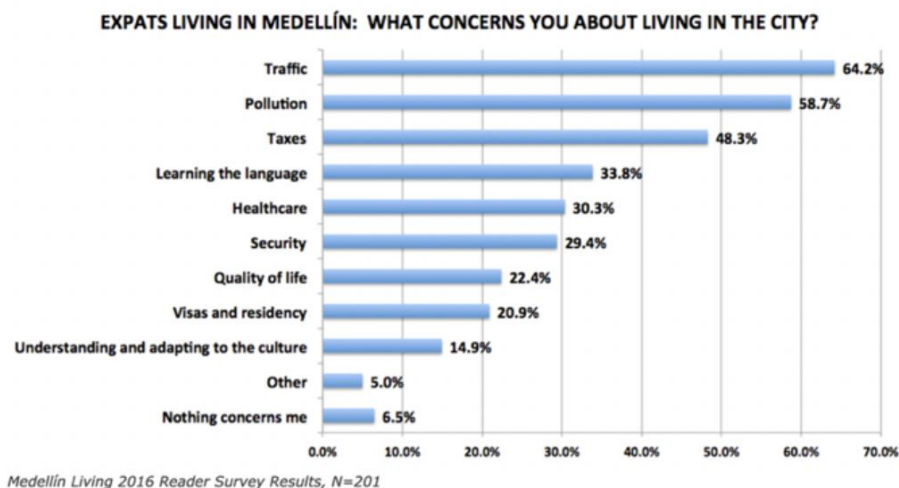


Figure 3. Expats Living Concerns in Medellin

Section Two

Team background

2.0 Name of team member:

Chi Cheong Tony Siu

2.1 Why have you chosen this approach?

The team comes from different background across Engineering Faculty --- EEE, CS, Mechanical Engineering. We interested in building an innovative solution in Medellin and it is transferable to countries suffer from air pollution. With EEE and CS members working together, we can build a smart system in our solution, maximises usage of disciplinary knowledge. Mechanical Engineering helps us to consider the material we used in our design and physical property of our solution.

Choosing this approach allows the team to put in their strengths into the solution.

My personal interest in this project is how can I use my knowledge learnt from my connected system minor to build a smart city, using my knowledge in a practical way.

2.2 Previous relevant work experience:

- CS IXN project: Medical Organisation Education Android App development with USB extraction function for remote area. The App can download videos from a USB. A quiz system to test the knowledge of the user. Results of quizzes are sent to a supervisor by SMS.
- CS IXN project: Ocado 3D object recognition for shop automation. Using machine learning technique and image processing API to develop a live product detection in a grocery store.
- Connected System IEP minor project: A smart home security system using IBM cloud service. Develop a network of sensors to detect whether there are intruders to the house/apartment.

2.3 What do your qualifications, education and experience offer your proposed solution:

I am a Computer science undergraduate minor in Connected system. With the knowledge I learnt from my department, I am able to design a route optimisation algorithm for the product automation. From my minor experience and the security module, I can help the team to develop a secure communication system for Data transfer and a smart system control. As we are implementing a monitor to our solution, my app development experience allows me to help the team to design an interactive system for information display.

2.4 Hobbies and interests:

- IoT challenges: I interested in how to build an efficient network of IoT to perform a specific task.
- Google Code Jam: A code and algorithm challenge allows me to improve my coding and problem-solving skills.
- Social Data analysis: As we constantly using our personal data in the internet, I am interested in how we use data mining and machine learning through a social-media platform to create a profile of a person.

2.5 Additional information:

- 2017/2019 President of UCL Brewers and Vintners Society
- Attended UCL career day elevator pitch session

Team background

2.0 Name of team member:

Yuxuan Li

2.1 Why have you chosen this approach?

Our team has 2 EEE, 1 MechEng and 2 CS students. We all interest in how to reduce air pollution in Medellin. We can combine our disciplinary knowledge to come up with some creative ideas.

EE and CS can work together to develop IoT techs and MechEng student can build a 3D model of our design.

I choose this approach because in my country China, it is a viable solution and I can offer my disciplinary knowledge in this design.

2.2 Previous relevant work experience:

- Global Health Care-bioreactor controlling Project, A bioreactor is built to produce the vaccines. Worked on the controls of pH level, temperature and stirring speed, all of which integrated into one user interface.
- Microsoft AI/Deep learning with Cortana Project, Incorporate AI to enable Cortana to learn from people's behaviour and make recommendations. Integrate a chatbot to enable people to interact with Soundscape and learn to use it effectively.
- Great Ormond Street Hospital 3D VR tour Project, Users can interact with the app by looking at a specific item in the VR.

2.3 What do your qualifications, education and experience offer your proposed solution:

Sets of data of Medellin air quality in recent years in different areas are available online through an API. These data can be used to analysis and predict the areas have most pollutions so that to deploy T.R.E.E in these areas. Database and sub-symbolic AI can be used to achieve this. I can apply HCI (human computer interface) design principles to make the design more user friendly. For graph algorithms, I can use route optimisation algorithms to schedule deploying and transferring routes. When designing the T.R.E.E. I implemented security principles such as open design, psychological acceptability and economy of mechanisms.

2.4 Hobbies and interests:

- UCL Economics & Finance Society
- Technology Society
- Technology Society
- Volunteering

2.5 Additional information:

Team background

2.0 Name of team member:

Anna Turitsyna

2.1 Why have you chosen this approach?

Our team consists of 2 EEE students, 2 CS students and 1 MechEng student that have all been involved in a wide range of projects. By utilising our combined knowledge of materials, big data analysis and microcontrollers, we have taken the strengths of all disciplines to create a solution that is both functional, aesthetic and can be used for education. The use of carbon filters is an interesting aspect of nanotechnology (one of my modules) and the design of the microcontroller system is what I felt a key contribution of my discipline was.

2.2 Previous relevant work experience:

- Created espresso machine monitors in scenarios using microcontrollers that monitored optimum coffee flow
- Collaborated with CS students previously in constructing a bioreactor through a modular design

2.3 What do your qualifications, education and experience offer your proposed solution:

Studying EEE has allowed me to learn about renewable energies and understanding the appropriate settings to use alternatives. This has been useful in eliminating renewable energy sources that would not be feasible in Medellin. Knowledge of microcontrollers and sensors provides me with the base knowledge of IoT technology. Our system would require monitoring of water and filter levels using microcontrollers to ensure it functions properly, as well as ensuring the correct placement of our system.

2.4 Hobbies and interests:

- Outreach/Sales & Promotions Executive of Climate Action Society – organise talks and workshops where people can educate themselves on current climate issues and changes, they can make daily
- Vice President of Women Engineering Society, where I organise events that allow students to learn about emerging technologies, work companies are doing and making informed choices about their future

2.5 Additional information:

I attended a conference in "Building Sustainable Cities and Communities" this October as part of the Women Engineering Society. I had the chance to network with many companies who are making sustainable designs and again when I attended their panel as part of the UCL careers session on Thursday afternoon. While I usually focus on the small changes people can make in their daily lives, it is fascinating to see how Climate Action can be made through a larger design scale.

Team background

2.0 Name of team member:

Amir Hakeem Bin Sahrir

2.1 Why have you chosen this approach?

An interdisciplinary approach would allow us to bring in all our expertise, between engineering & computers science students, which would result in a more holistic design. Each of our team members not only contributed knowledge within their discipline but also knowledge on other areas of interests/expertise (i.e. our IEP minors). As a result, different aspects of the challenge such as the design stage, prototyping and the financial feasibility could be catered effectively with this form of approach.

2.2 Previous relevant work experience:

- Scenarios & engineering challenges within undergrad program: Electromagnet design, Refining quality of signal transmission, transmission line design (with CST) & a temperature monitoring system. These interdisciplinary group projects have allowed me to improve my collaboration skills & to fully realize my role within a team- a mediator who would ensure each member could comfortably work to the best of their ability.
- Project management skills, moderate mastery of coding language (C++ & Java) & procedures to produce Printed Circuit Board (PCB). The mentioned technical would be useful to complement the coding/software design skills of my Computer Science colleagues.

2.3 What do your qualifications, education and experience offer your proposed solution:

As an EEE student worked with a microcontroller that could be used to various functions of the system.

Circuit implementation that involves sensory & regulatory (feedback) functions; skills built throughout my undergrad program.

A minor in Entrepreneurship- Marketing strategies, matching our solution with the local business sector through suggestions on possible alteration to the design to cater the interest of companies with similar aspirations.

2.4 Hobbies and interests:

- Entrepreneurial pursuits: Currently handling a winter apparel sale among the Malaysian community in London.
- Education: A personal area of interest hoping to pursue at a policy level as to introduce new approaches towards conventional education system in home country.
- Sustainable living: Relating to the mentioned winter sale as to minimize new clothing production-reducing wastage of material.
- Communal events: Handled events within the Malaysian-London community relating to career development, communal gatherings & students fresher's fair.

2.5 Additional information:

Team background

2.0 Name of team member:

Syed Taha Haider

2.1 Why have you chosen this approach?

UCL's Integrated Engineering Programme builds engineers that are trained in a number of skills including teamwork, communication, and problem-solving. As a result, the team's layout between engineering disciplines (two Electrical engineers, two computer scientists, and one mechanical engineer) lends itself to a very tech heavy solution via the symbiotic relationship to let each student play to their strengths.

2.2 Previous relevant work experience:

- Engineering intern at Robotics/AI company Emotech to CAD model and program prototype devices and refine the robotic drive system in the main device.
- Robotics/Design Lead at UCL Mars Rover team leading a team of five engineers to redesign and manufacture a new robotic arm.
- Scenarios projects including CAD modelling, material selection and analysis, and manufacturing processes.

2.3 What do your qualifications, education and experience offer your proposed solution:

As a student studying mechanical engineering with a minor in intelligent systems, my academic course has allowed me to have a wide understanding and appreciations of all disciplines, allowing me to apply my blank-page engineering skills towards refining the problem and developing an effective solution. The minor in intelligent systems includes a module on robotic systems learning their environment via sensors and dynamically moving to achieve team goals. Through my work experience and time at the Mars Rover team, I have developed my CAD skills as an engineer to design simple manufacturable products including material selection and prototyping. Lastly, as a design specific skill, understanding of fluid mechanics and thermodynamics (especially psychrometrics) is useful in making an effective product as the solution requires pushing air and combining air with water mist.

2.4 Hobbies and interests:

- Marketing Director at Zero Food Waste UCL
- Freelance Graphic Design

2.5 Additional information:

I suffer from hay fever, so public installations of devices such as these would be personally beneficial.

Section Three

The Market

3.1 Are your Users:

- Individuals
- Businesses
- Government

3.2 List your Stakeholders

Select Residents:

1. Expats (skilled immigrants) – InterNations (Expatriate group)
2. Drivers – Ministry of Transport
3. Children – Fundación Poder Joven
4. Elderly

Select Government Services and Departments:

1. EPM – public utilities company
2. Airport
3. AMVA – local government
4. SIATA – conducts air quality monitoring

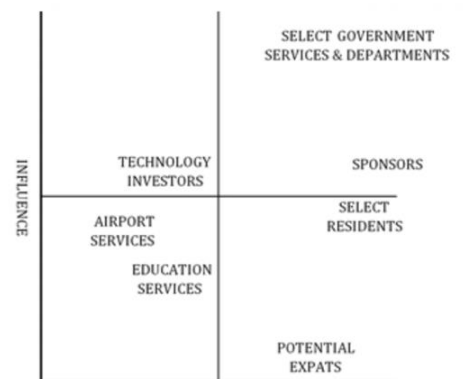


Figure 4. Stakeholders Power-Interest Map

3.3 Is your most important stakeholder different from your end users? (If yes please explain how)

- yes
- no

The end users will be citizens in Medellin as T.R.E.E. is deployed on the pedestrian area. The citizens such as locals and expats benefit from the cleaner air produced by T.R.E.E. Our primary stakeholders (EPM, local government) use our system to improve air quality, providing citizens a better living standard.

Section Four

Market research

4.1 What are the Key findings from your desk research:

- Pollution related problems:
 - 3000 deaths by respiratory diseases annually related to pollution.^[2]
 - Periods of outdoor activity banned by government.^[2]
 - Airport shut down.^[2]
 - Air quality during smog seasons constantly at an unhealthy level.^[3]
- Feasibility:
 - Government is willing to tackle air pollution with a scheme called PIGECA. The plan is to reduced PM level through policies by 2030. ^[4]
 - A national royalties system introduced, whereby revenues from mining activities is allocated to a newly-established STI (Science, Technology and Innovation) fund.^[5]
 - Local organizations such as AMVA allocate funds to address air pollution.^[5]
- PIGECA: ^[4]
 - Promotion of bicycle use, public bicycle system in place
 - Restricting the use of vehicles by number plates
 - Public transport encouragement
 - Continuous air quality monitoring

Section Five

Competitor analysis – Are there any existing solutions out there / How do they compare with your proposal?

5.1 SWOT analysis:

Strengths <ul style="list-style-type: none">• Seasonal solution reduces costs• Modular design allows easy reconfiguration and transportation• Aesthetically pleasing, creates a talking point for education	Weaknesses <ul style="list-style-type: none">• Competitors can capture more carbon, larger amounts of air cleaned more efficiently• Design needs local's input• Occupies pedestrian space
Opportunities <ul style="list-style-type: none">• Rent system during non-peak seasons• Rent out advertising space	Threats <ul style="list-style-type: none">• Council may limit pavement space• Locals may reject design due to cultural conflict• Competitors may come to Medellin

5.2 Unique Selling Point (USP):

Unique Selling Point (USP)

Our modular design focuses on reducing pollution seasonally and redesigning the aesthetics depending on the culture.

5.3 Are there any competing interests?

Beijing implements large scale vacuum ^[7] and mist cannons ^[8]. The scale of these would not be suitable for Medellin's pollution level and aren't economically feasible.

Section Six

Funding strategy

6.1 Main sources of funding

- EPM & AMVA funding our innovation helps to solve a common issue of interest.
- Local incentives (funds) within existing incubator/project funding programs.
- Future maintenance cost from renting the device to other cities out of Medellín's smog season.
- Advertisement on the screen of the device.

6.2 Steps to find funding

- Engage directly with city council through Cultura E – a local program offering financial support for entrepreneurs proposing ideas for trial-runs. The prototype made would be passed to relevant organizations (e.g. EPM & AMVA).
- Consult Tecnova for advice to match the demands of the business sector [9].
- Apply for seed capital fund created by the government for entrepreneurial initiatives. [10].
- Collaborate with local research universities, like Universidad de Antioquia. This would allow better access to government financial.
- When the solution is fully set up, renting the solution to other cities to generate its own maintenance fees.

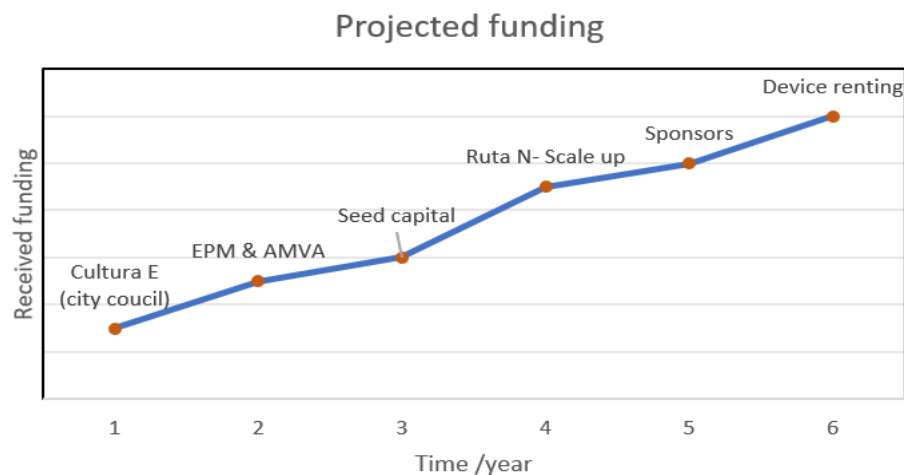


Figure 5: Timeline graph of projected funding

Section Seven

References

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