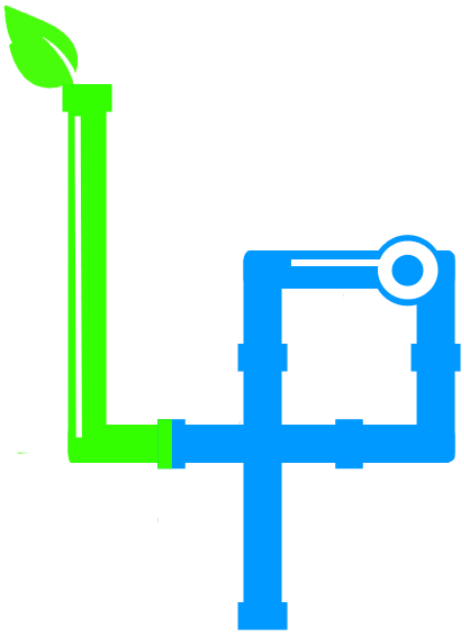
NANYANG TECHNOLOGICAL UNIVERSITY

2016 DUSA PROJECT REPORT



LIFE PLANTERS

...seeding the future together

03 September 2016 - Ongoing

Chew Bing Liang Alvin

Last update: 15-Jan-2017

About Life Planters

Life Planters represent a group of passionate youths who envisions a world of self-sustaining communities accomplished through ground-up urban farming movement. We employ a dual approach of education and capability development to engage and empower communities depicted in Fig. 1. Our overarching objectives are:

1. Raising environmental awareness
2. Enhancing food security
3. Promoting healthy lifestyles
4. Building strong communal bonds

This report elaborates two key activities that has been undertaken. In the first part, it details the Personal Food Computer workshop. While in the second part, it is the Aquaponics system prototype.

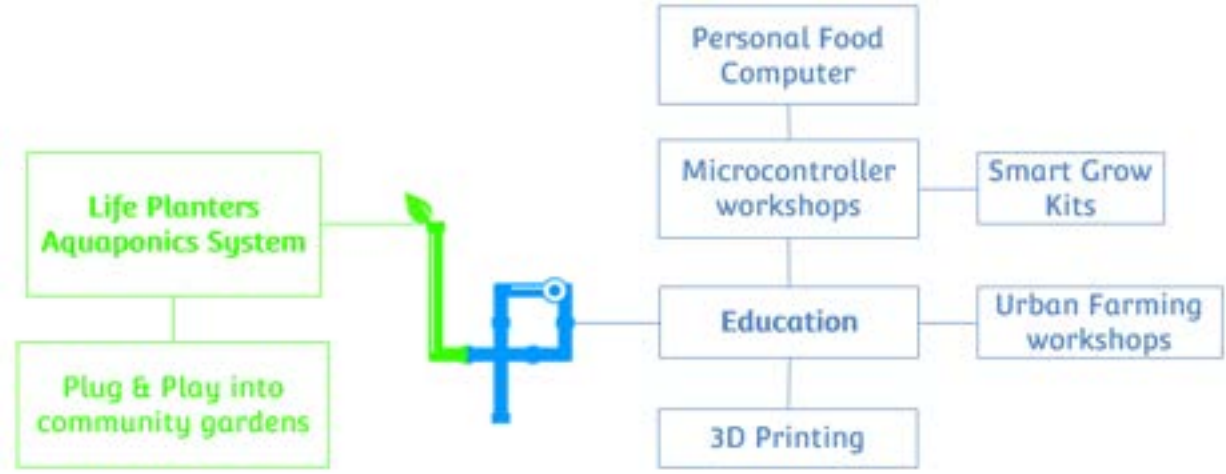


Fig. 1. Life Planters' dual approach to increase opportunities, accessibility and ease of urban farming.

Why Urban Farming?

Greater than 90% of Singapore's food are imported, making us vulnerable to market and political instabilities as seen during the 2007 – 2008 Global Food Crisis. Upon extensive consultation between our government and industry stakeholders, Singapore's Food Security Roadmap was unveiled in 2013 by the Agri-Food and Veterinary Authority of Singapore (AVA) with local production among one of the core strategies. Having a robust local production capability will not only give a supply buffer, the shorter food mileage means lesser environmental pollution, food spoilage issues, and more nutritious produce for the consumers. This is where urban farming comes in.

Through the combined efforts of National Parks (Nparks), Ministry of Education (MOE), Housing Development Board (HDB) and enthusiasts, the number of community gardens, urban farms and farming workshops has grown significantly. Beyond farming competencies and space optimization, these efforts also build stronger communities through the interactions among the participants.

Moving forward, the integration of urban farming into our way of life hinges on greater community ownership and more ground–driven support to sustain and amplify our governmental efforts. However, access and ease of entry to community farms is limited due to the use of traditional planter beds which are land and labour intensive. Hence, Life Planters seek to contribute by introducing vertical farming systems into community farms, conduct skill-based workshops to the masses and encourage more people to start their urban farming journey.

Team Profile

Life Planters currently consist of 6 members with dynamic portfolios and backgrounds. We bring with us an arsenal of network, resources and skills to dream, plan and execute our ideas for the community.

Chew Bing Liang Alvin
Team Leader
Yr 4 SBS, NTU

Alvin is the catalyst for bringing the team together and steers them towards the team's shared vision. His head is always full of ideas and in perpetual motion to get things done. He is experienced in community work and running events since his student days in Ngee Ann Polytechnic.

Johan Kok Zhi Kang
Full Stack Developer
Yr 4 REP, NTU

Johan is passionate about applied research, Internet of Things, robots and being a cool programmer. He is responsible for Life Planter's web development and user interface with the aquaponics system. He can always be seen learning and solving new problems.

Jonathan Halim
Community Liaison
Yr 1 EP, UOL – SIM GE

Jonathan holds a Diploma in Banking and Financial Services. He is passionate about serving the community and mitigating environmental issues since his Ngee Ann Polytechnic days. He is responsible for facilitating the team's operational needs and finance management.

John Lim Jia Song
Embedded Systems Engineer
Yr 4 REP, NTU

John specializes in electrical and electronics engineering and adept at using many different programming languages. He is also experienced in curriculum design and teaching coding skills to the young. A maker at heart, he is responsible for the team's electronics work and microcontroller lessons.

Adil Abdul Halim
Mechanical Engineer
Yr 4 ME, NTU

Adil is experienced in 3D technologies and its related software such as solidworks. He possesses keen eyes for beautiful designs and a strong artistic sense. He is responsible for the team's 3D course development and design needs.

Zulkarnain Sudar Man
Project Engineer

Zul marvels at the inner workings of devices and how different types of energy gets converted to another. He does not believe in an impossible engineering challenge and enjoys finding solutions. He is responsible for the hardware development of the vertical aquaponics system.

Part 1 - Technology Education: Personal Food Computer Workshops

What is a Personal Food Computer (PFC)?

The term is coined by Caleb Harper and team from MIT Media Lab who are spearheading the Open Agriculture Initiative (OpenAg). It is a table top controlled-environment agriculture technology platform that uses robotic systems to monitor and control climate, energy and plant growth inside specialized growing chambers. Every time users grow and harvest, they will contribute to a library of climate recipes that can be access by other users around the world.

Inspired by the work they do (Refer to: http://openag.media.mit.edu/education/), we will be adapting their work into our local context and challenge the residents at the rehab centre to build their very own PFC.

Event Details

Date:

- 10th, 17th December 2016 and 7th Jan 2017

Location:

- Community Rehabilitation Centre managed by Trybe

Participants' Profile:

- First-time drug offenders aged 16 – 21 given a second chance with no permanent record.
- Their needs are a therapeutic environment, experiential learning experiences, structure and role models in their lives.
- 80% of residents attended our workshops

Objectives:

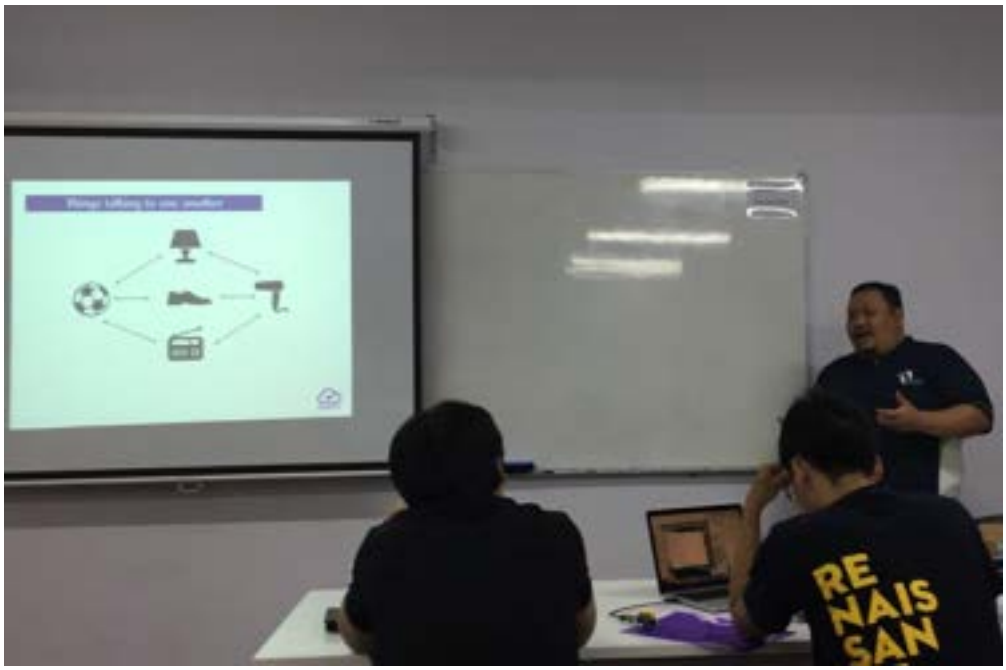
- Engage, educate and empower youth-at-risk through technology-driven urban farming
- Be the first in Singapore to build a Personal Food Computer and have us listed on the map on MIT Media Lab Open Agriculture ('OpenAg') Initiative.

Beneficiary:

Microcontroller Sponsor:

Funding:

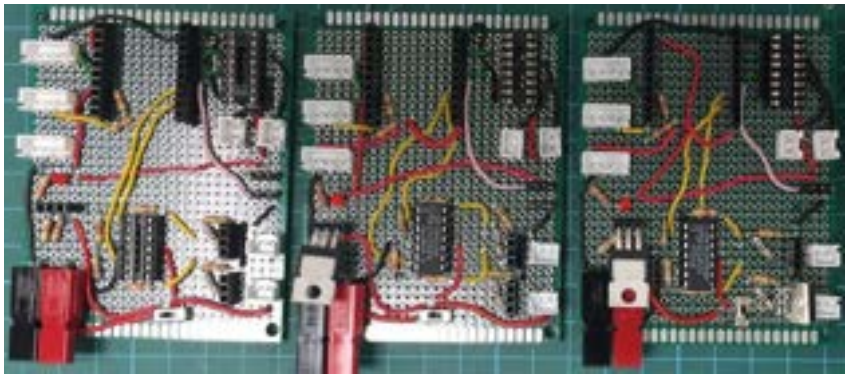
Photos (In order to protect the identity of the participants, photos with their faces and/or any identifiable elements are not selected or masked out.)



Attending the Espresso Lite v2 Workshop by William Hooi, Co-founder of Espert Pte Ltd.

Opening session of 1st Session on 10-Dec-2016

1st Session: Basic coding with Arduino using Espresso Lite v2 boards

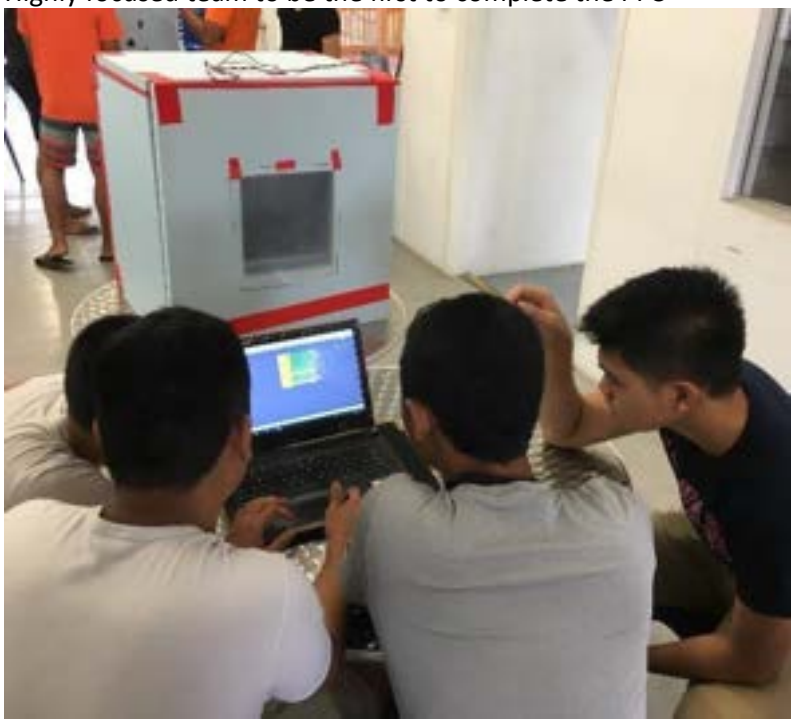


Circuit Board Prototype designed by John Lim

Materials Layout for 2nd Session

PFC Assembly for 2nd session

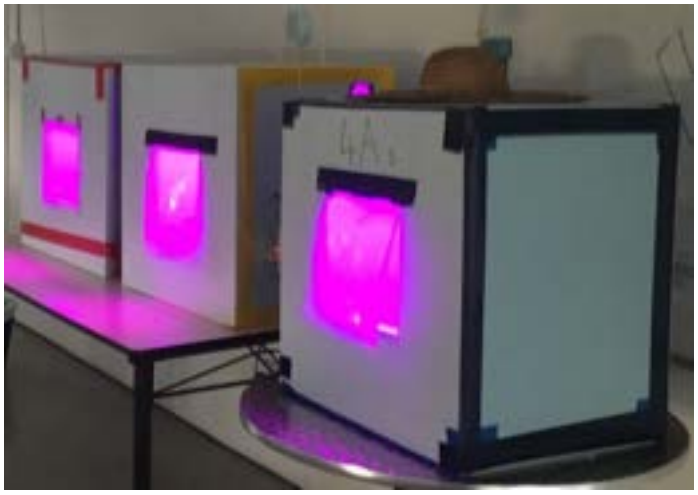
Highly focused team to be the first to complete the PFC



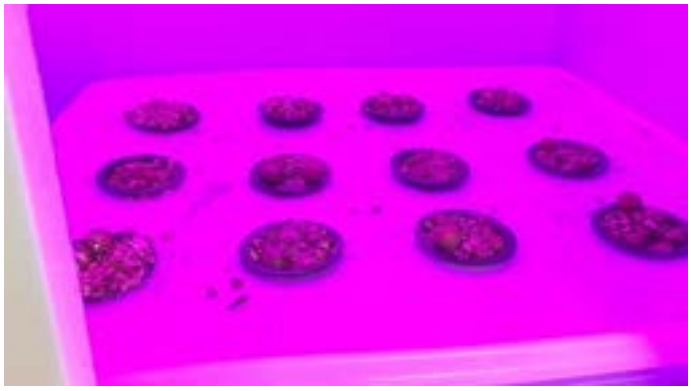
Applying what they have learnt from 1st Session to code the PFC

Another team coding the PFC during the 2nd session

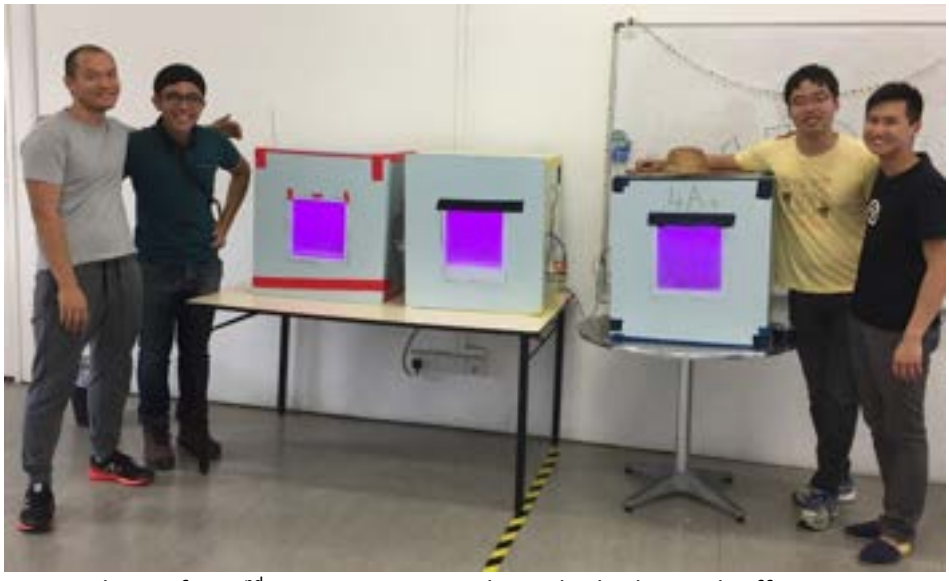
Testing out the functionality of the circuit boards and the components



All 3 completed PFCs placed side by side



Netted pots seeded with ‘mystery seeds’ for the participants to see what it is as it grows out



Group Photo after 2nd Session missing Johan who had to rush off.

Reflection #1 after 2nd PFC Session

What went well:

We were able to engage the participants through our hands-on Personal Food Computer sessions and communicate the significance of urban farming. It is also their first time experiencing the world of programming. Our adaption of Ardublock, a clean graphical user interface, for our introductory programming lesson was a good call as it aided their understanding of programming concepts. Feedback from the Trybe staff members has been positive and they recognise the value of our work. We have also gained insights of the participants and built some rapport with them. This will help us in our upcoming activities to achieve a deeper impact.

What could be done better:

We had done most of the preparations beforehand (i.e. soldering, cutting of boards, drilling) in the interest of time. However, these technical aspects could be included in the classroom activities too. Also, we were unable to use the laptops provided by CRC as we did not send to them the required software earlier for pre-setup by their administrator. Soldering our own circuit board proved to be an unwise decision as it drained too much of our time. We should stick to breadboard and/or get our Printed Circuit Board (PCB) out in time for the lesson.

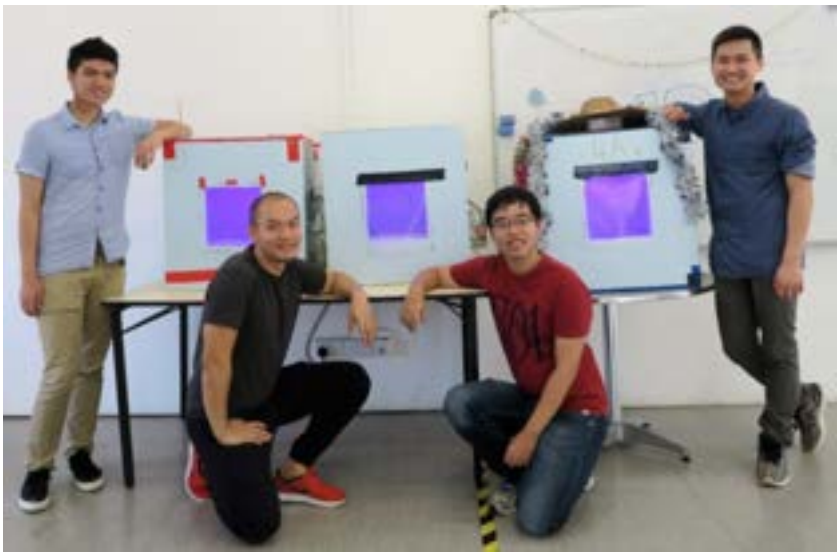
Overall:

We are looking forward to the 3rd session on Saturday, 7 Jan 2017, to harvest the produce, explore the online resources the participants can learn from to continue building the PFC or other cool things, and gather their feedback.

3rd session Opening

Team Challenge to present maker projects done by others and propose their own idea

Team presentations time



Group Photo after 3rd Session

Future Workshop: 3D Printing Workshop (Date TBA)

Assembly of the 3D Printer for our next workshop

Reflection #2 after 3rd PFC Session

What went well:

Preparation of the centre's laptops were properly done this time round and the IT staff was available to assist us in getting access to the various websites we would like the participants to explore. It was heartening to see the participants being intrigued and deeply engrossed in the projects others have done and executed their presentations with flair. We collected a total of 12 feedback forms from the participants. Of which, we had 11 indicated that they found the workshop interesting and 9 would like to attend our next workshop on 3D printing.

What could be done better:

Most of the seeds failed to grow as they were of poor quality. We did test them before and had no issues growing them up. However, our test was not robust. No detailed recording of the growth rate was done and it was conducted months prior to the event. Other microcontroller projects with more competitive value such as sumo bots or robo-soccer should be explored for future workshops to make the learning process more entertaining.

Overall:

We have achieved our first objective of engaging, educating and empowering the youths through technology-driven urban faming platform. We are excited to conduct more follow-up to build up the participants' skillsets and continue to guide their learning process for a lasting impact. It is our hope that our series of workshops would be a transformational learning process for our participants.

Due to time limitation, we have yet to achieve our second objective of being the first in Singapore to build a Personal Food Computer and have us listed on the map on MIT Media Lab Open Agriculture ('OpenAg') Initiative. To this end, we will keep working on it.

Part 2 – Life Planters' Aquaponics System: Plug and Play into community farms

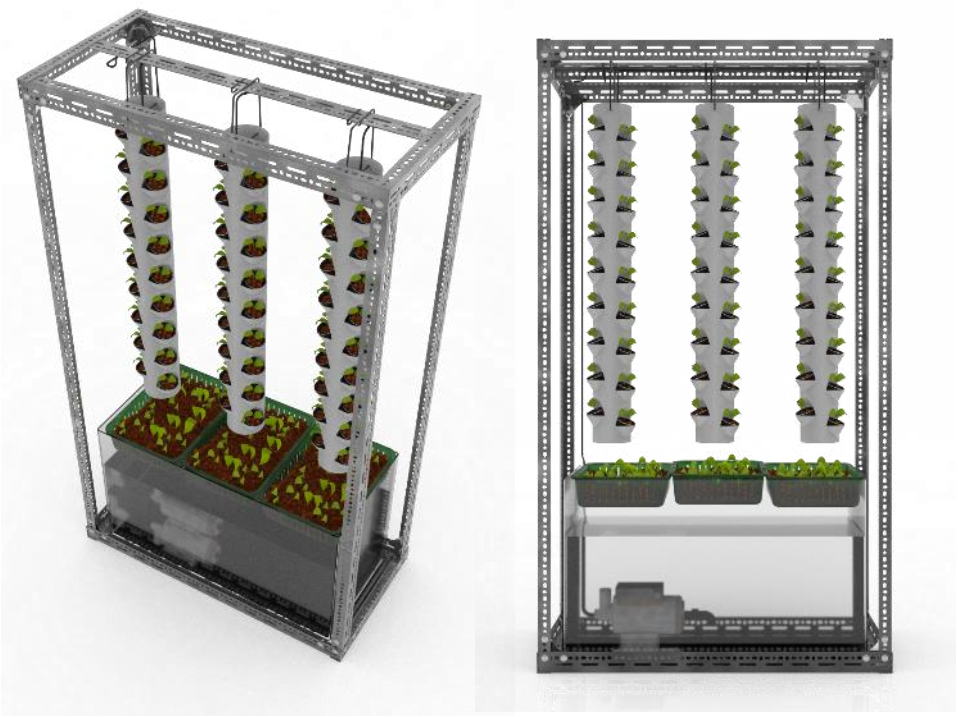
In parallel with Part 1, we are developing a modular and portable Vertical Aquaponics System (VAS) that will increase the productivity of the land space it uses by at least 500%. Similar to Part 1, it features a robotic system to carry out several tasks (e.g. pH balancing, light modulation etc.). It will be a low-cost, high yield, easy-to-use and rugged system suitable for both in- and outdoor environments.

We believe VAS would help to promote greener living, greater food security through urban space optimization, and stimulate learning and neighbourliness. Discussions with various community stakeholders are still underway to implement a "plug-and-play" concept once we are done developing the VAS prototype.

Objectives:
- Increase opportunities, accessibility and ease to urban farming for the community
- Build a network with existing aquaponics developers, urban farmers and makers

Potential Collaboration:
- Social Innovation Park (http://www.socialinnovationpark.org/; Ongoing discussion)

Photos



3D Model by Adil Abdul Halim

Reaching out to REP Makers Lab on 6-Oct-2016

Site visit and discussion with Mr Khong, Director of Social Innovation Park (SIP) and Chairman at Punggol Community Centre regarding our use of S.E.E.D. Park in Punggol to implement our aquaponics system as part of their community farm.

Attending the InnovASEAN Maker Summit to meet like-minded makers who are keen in urban farming and explore potential collaborations

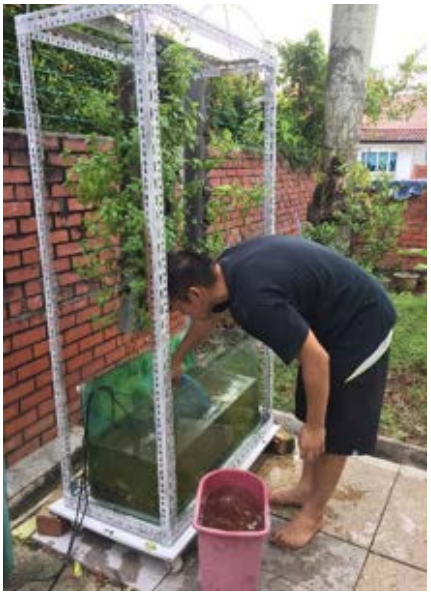
Dicussing with Andras Kristof (founder of Homegrw that developed an aquaponics farm in Chinatown) and Thomas Gorissen (experienced tech-startup builder) regarding our aquaponics design and direction.

Making the Growth Column using PVC pipes

Coding the robotics system

Stages in Prototyping and Conceptualizing

Kang Kong with its long and healthy roots



Maintaining the fish tank

Refreshing smell of mint

Harvesting the crops from the system

Spearmint Plant

Basil Plant

Group Photo with the vertical aquaponics system which we are developing

Online interface platform under development by Johan

Reflection on VAS development

What went well:

After 16 weeks of development, we are able to yield up to 60 pots of plants which is 500% higher productivity than a traditional use of the same land space. It can yield about 4 kg worth of kang kong. Herbs like Basil and Mint have produced positive results too. In the fish tank at the base, we have 15 tilapias. These fishes provide the plants with nutrients. We are currently testing out more challenging crops.

As we progress into Phase 2, the system will be upgraded with a robotic system to provide the best growing conditions for various crops. We will also firm up our collaboration with a community partner to bring our work to a higher level and achieve our objective of engaging the communities.

What could be done better:

Scalability: We need to source for more fish tanks in order for us to build more models. This will facilitate our research work and enable us to plug our system into various locations simultaneously.

Manpower: Our progress for VAS has been slow as most of our focus is on conducting workshops. Solutions such as improving our workflow and expanding our team will be undertaken.

Overall

Dear reader, do keep a look out for our work at www.lifeplanters.com! We are slowly but surely gaining ground towards introducing out our work to our community partners. The expected timeline for the completion of our VAS is in June. Our system is currently located at 70 Jalan Lokam, Singapore 537895.

If you are as excited as we are about Life Planters' work and potential, please feel free to drop us an email at lifeplanters@gmail.com to schedule for a meet up or site visit.

Acknowledgement

Thank you to the people in NTU College of Science and funding provided by OG Department Stores – Mr Tay Tee Peng Distinguished Undergraduate Award 2015 for giving me the opportunity to plan and execute various community project ideas under Life Planters. Without this support, I would not have started Life Planters and reached out to the people I had thus far.

I would like to thank Trybe for their support and advice in our Personal Food Computer Workshop for the residents at Community Rehabilitation Centre in order to engage and empower them effectively. Thank you to William Hooi from Espert Pte Ltd for the sponsorship of five Espresso Lite microcontrollers for the workshop. Also, thank you to CoLab4Good Fund for the additional support to Life Planters and spurring us on to make our work even better.

Last but not least, I would like to thank my fellow teammates whom have worked tirelessly with me towards making our projects possible and deliver positive impact to the community.