Hong Kong Student Science Project Competition 2023 Template of Extended Abstract (Invention Design Proposal) (Word Limit: 1,600 words, Pages: 3 pages only)

Team Number: SABC065

Project Title: FuturVeg（種出未來）

Project Type: Invention Design Proposal

To our best knowledge, there are similar works in the market albeit few; and related product links are as below:

https://www.amazon.com/RAINPOINT-Automatic-Drip-Irrigation-IK10P/dp/B08Q8JZP6M

The enhancement our project proposed / the difference with related products are:

LED lights are included in our project, we have pH / EC / humidity probes and sensors, we can control the system using Wi-Fi, we can automate the system according to environmental changes.

I. Background

During the pandemic, the number of global trade has decreased. The reduced number of exports leads to a rising number of hunger cases across the world. According to research, the greatest cause of hunger is poverty; poverty is defined as an individual who lacks money to purchase basic necessities and to maintain a basic standard of living. Food is essential for living, and is also required for a balanced diet for good health. To solve the main hunger issue, planting pea sprouts would be the best choice as it has a short growth period and can be consumed after weeks no matter raw or cooked. Pea sprouts are also relatively cheap and would be affordable. Hence, we hope to develop a cheap, efficient and geographical mobile system in which vegetables and fruits can be planted anywhere, and at any time.

II. Objective(s)

We aim to design a system that enables a fully automatic system that can provide its own yield of aquatic plants, with a consistent growth rate with yield suited for human consumption, and adequate nutrition. By investigating the suitable wavelength of plant growth using LED with our automated system, this technology could be maximally optimised and applied to meet the United Nations' Sustainable Development Goals.

III. Methodology

Variables:
Independent: Wavelength of light
Controlled: Temperature, humidity, carbon dioxide concentration
Dependent: Yield of plants (height and biomass)

Equipment for Invention:

- Plastic racks
- Water pump and tubes for circulation
- Temperature and humidity sensors
- pH and EC sensors
- A water tank
- Five trays for planting
- Humidifiers
- LED lights
- Pea sprout seed

1. Place 80 grams of pea sprout seeds into containers each. Do this four more times to make five sets of test groups.

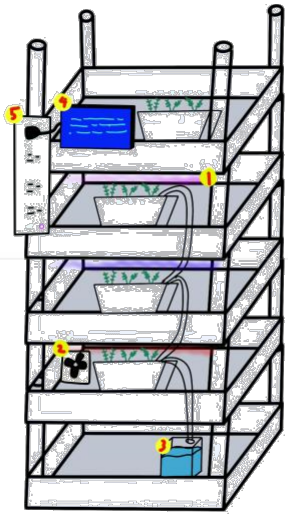
2. Place one set on the topmost layer of the rack to be the control - using natural sunlight to grow the plant. Place the other test groups into separate layers each. Other test groups include:
    - All wavelength (395-730 nm)
    - Red and Blue wavelength (410-695 nm)
    - Blue wavelength (410-485 nm)
    - Red wavelength (590-695 nm)
3. Automate the system to regulate the factors so that the experiment is a fair test.
    - Temperature is set at the range of 25C with ±1C margin of error.
    - Humidity is set at 60-70%. If humidity <60%, the sensors will detect it and activate the humidifiers.
    - Seeds are watered every day at 10:00am for 3 seconds. (The app uses seconds pumped from the water pump instead of the volume of water).
4. Record the dependent variables after seven days of automation.
    - Recorded parameters:
        - Mass (Initial, Final)
        - Height of plant (Initial, Final)

IV. Design of Invention

The invention is an automated planting system. By automating the optimal factors for plant growth, we can get the maximised plant yield in the least amount of time from this device.

The design of the system is a vertical structure. A water circulation pump is installed in the bottom layer, which uses plastic tubes to deliver water to each layer of the whole system. Each layer has two rows of LED lights, a humidifier and a fan. At the top layer, pH, EC, humidity and temperature probes are installed to monitor the conditions.

The system and probes are connected to a wifi-compatible extension unit so that it could be designed / automated to the user's own liking and preference by using the app "Tuya smart" and registering the devices. By using the Apple Shortcut app, it is also possible to use Siri to toggle the device.
Below is a drawing of the device:



1. LED lights: used to change wavelength of light
2. Humidifier and fan: used to control humidity
3. Water pump and tubes: circulation system for watering plants
4. Probes: Monitor pH, EC, humidity and temperature
5. Wifi compatible extension: used to connect probes and LED for automation.

V. Application / Market Need

As the global population continues to expand, the challenge of providing sufficient food to meet demand is becoming increasingly pressing. In order to address this challenge, innovative solutions are needed. Our automatic vegetable planting machine represents a potential game-changer in the agriculture industry, with the capability to make significant strides towards solving the problem of world hunger. What sets our inventions apart from other similar products is its high mobility, rendering it a versatile solution that can be utilised anywhere, even in space in the future. Furthermore, our product has features such as LED lights, pH/EC/humidity probes and sensors, Wi-Fi control, and automation according to environmental changes. This innovative approach enables our invention to be geographically mobile. If the market utilises this technology, we can make a significant contribution to the global effort to combat hunger and ensure sustainable food production for generations to come.

VI. If your team will compete for the Sustainable Development Award, please indicate the specific sustainable development goal the project is related to, and provide justification for competing for this award. (Word limit: 300 words)

Our team is focused on accomplishing three goals: zero hunger (SDG 2), affordable and clean energy (SDG 7), reduced inequality (SDG 10) and responsible consumption and production (SDG 12). To help alleviate global hunger, our automatic vegetable planting machine exposes pea sprouts to the optimal wavelength of light that could produce the maximised plant yield in less time, hence sustaining food security. The device can be installed at home; subsistence planting is geographically mobile. It can be carried out at home, indoors or outdoors; at any place which has a stable electricity supply to operate. With the use of mobile app, this system can be fully automated. This would be more convenient and would satisfy the demands of a family because the size of the device may be altered based on available space and the family's food consumption, reducing the number of plants that could be wasted due to overplanting. Moreover, pea sprouts are very nutritious. They contain antioxidants like vitamin A, vitamin C and vitamin K and also many other micronutrients such as protein, fibre, minerals. Overall, our simple and convenient automatic vegetable planting machine lowers the cost of people growing crops at home, and this is especially helpful for the poor.

VII. If your team will compete for the Social Innovation Award, please list the target group or social issue the project focuses on, and provide justification for competing for this award. (Word limit: 300 words)

Not applicable

VIII. Conclusion

To conclude, the variation of wavelengths in our device enables us to find out that using red and blue lights together in planting peas can result in the highest growth rate

	Initial Mass(g)	Final Mass(g)	Initial Height from seed level (cm)	Final Height from seed level (cm)	Stem width (mm)
Control	80	192	0	16.4	1.5
All wavelength	80	276	0	10.7	1.7
Red and Blue	80	282	0	12.9	1.6
Blue only	80	253	0	12.3	1.2
Red only	80	272	0	13.1	1.8