TEAM 2022-31 AUTOMATED HYDROPONIC VERTICAL FARM

Team Members

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Problem Statement

- Setting
  - Urban and Rural Areas in Kenya
- Context
  - As a rain-fed economy, Kenya relies almost entirely on produce from small scale farmers.
  - Drought and floods have become a challenging weather trend costing small scale farmers their produce.
- Problem
  - Food is progressively lacking to supply to the market increasing food insecurity
  - Food insecurity has further led to:
    - Starvation
    - Increase in cost of living
    - Insecurity(Resort to crime)
    - Resort to human labour in tilling land due to increase in cost of living(further decreasing produce)

Why Automated Hydroponic Vertical Farms

- Project Aim and Purpose
  - To allow growth of most daily consumed produce such as:
    - Most vegetables(tomatoes, cabbage, spinach, kale, cucumber, etc)
    - Legumes(beans, peas)

    … in a small space with minimal water consumption and supervision
  - This servers to:
    - Easen the reliance on land farming
    - Easen the reliance on rain
    - Allow farming of the same amount of produce or more in smaller spaces and at a low cost.

Food and Nutrition

- Vegetables and fruits are the first foods that come into mind when considering nutrition
- In Kenya the staple food, maize, is accompanied by a vegetable
- Nutrition affects not only people in drought stricken areas but also areas with availability of water
  - These kinds of feeds are however not commonly offered among relief food because of:
    - Perishable nature
    - High storage cost due to perishable nature
- Making non arable land productive will mitigate lack of nutrition

Tower Specifications

- Exterior dimensions: 1m x 1m x 1.2m
- Plant Capacity: 20+ plants
- Daily Energy consumption (ave): 1kWh
- Daily Water consumption Range (ave): 0.5l - 3l
- Cost:
  - $150 (including solar panel, battery and charge controller)
  - Less than $100 (without solar panel, battery and charge controller)
  - This can be further reduced with economies of scale

This idea is not new

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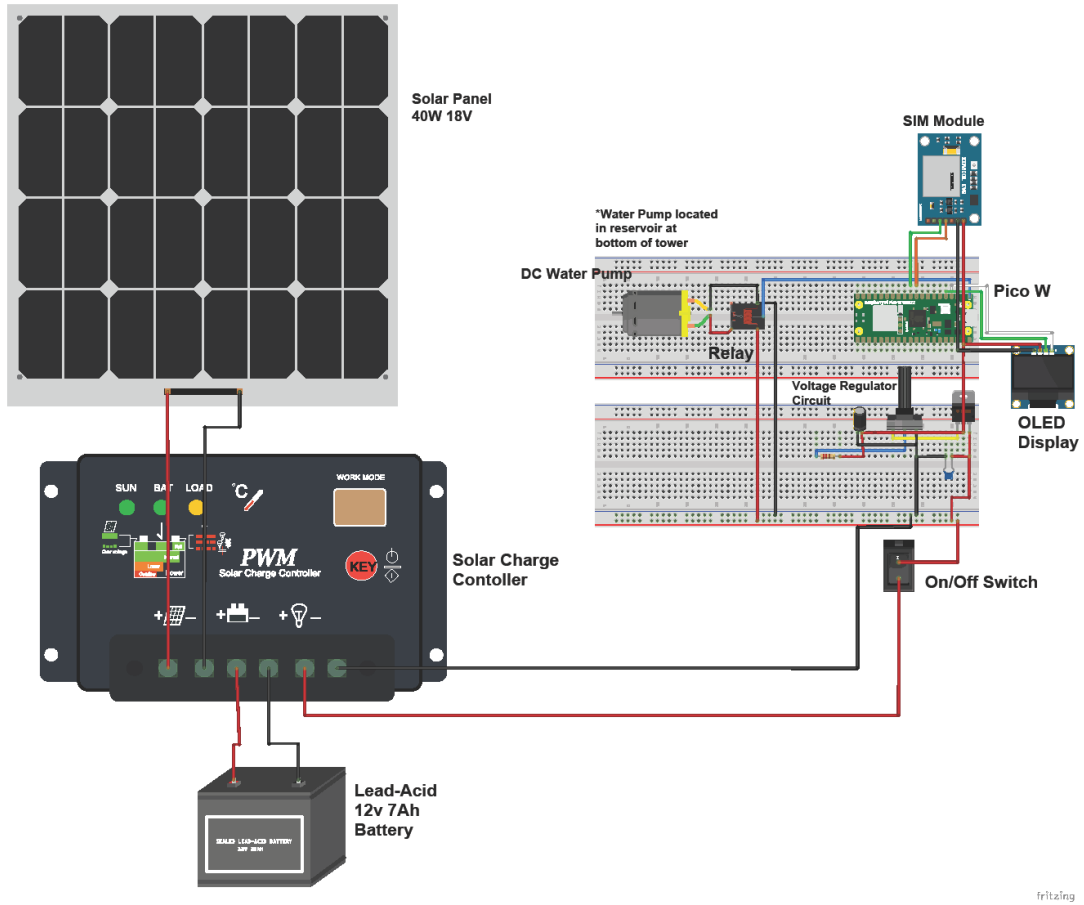
Efficient designs are coming at a cost

Example Open Source Model

Credit to:
https://www.thingiverse.com/thing:3405964

Circuit Design and Explanation



Sustainability, Usability and Social Impact

- Modular nature of product allows for:
  - Easy addition of new parts (for more plants)
  - Easy replacement of damaged parts (in case it happens).

- Owing to the simple installation and minimal labour requirement this product can be used by men, women, people with disabilities and children thus leaving no one behind.

- A general increase in quality of health and nutrition is expected with use of such a product

- Extra benefits:
  - Ability **for remote monitoring** for towers offered as aid
  - Low power consumption allows integration with **existing** solar solutions

Usability cases

- This product is ideal for:
  - People in non-arable land settings with little water resource
  - People living in urban areas
  - Landlords wishing to sell produce to their tenants
  - Restaurant and/or hotel owners requiring readily available fresh produce
  - People farming using traditional farming methods

Reaching to market

- Potential users of the product can be reached to in the following ways:
  - Product website
    - Propelled by Google Ad services
  - Meetings organised by Kenya Agricultural and Livestock Research Organization to educate farmers
  - Product display in markets, supermarkets
  - Social Media
  - Television Media

Sustainable Development Goals

- Our project works towards meeting part 7.3 on SDG 7 which is to double the rate of improvement in energy efficiency

- In extension our project works towards meeting
  - SDG 1(no poverty)
  - SDG 2(no hunger)
  - SDG 3(good health and well being)
  - SDG 12(Responsible consumption and production) primarily.

Getting the product in people's hands

- Involve people of low income, $3 daily wage, through the "nyumba kumi" groups (which are already in place) and which have proven to enable people pool their resources to keep costs manageable for each individual member.
- For middle income earners, we can make arrangements with banks to enable the bank pay part of the product cost for the customer. Further payments will be up to the customer and the bank.
- Arrangements can be made for people requiring large scale integrations

Payback period

- On average one individual will spend $0.45 on vegetables or legumes for three meals in a day
- Assuming a seller sells three meals worth of food to 10 customers on average:
  - Day's gross return: $4.5
  - Day's net return: $2.25
  - Month's net return: $67.5
  - Month's return set for paying tower: $25
  - Payback period: 4 months
- This has **not** catered for:
  - New net return considering savings of tower
  - New production scale of tower

Scalability

- This will involve contacting PVC manufacturers and electronic component assemblers both of which can be locally sourced.
- A good company example: **Geviton** (https://www.geviton.co.ke/)
- The right manufacturing processes will have the benefits of:
  - Reducing cost of product
    - Thus reducing payback time
  - Realising many structures in a short time
  - Miniaturising the electrical part of the system(further increasing robustness and reducing cost of product)

BIG THANK YOU ENGINEERS WITHOUT BORDERS UK, EFA GROUP AND ALL STAKEHOLDERS INVOLVED