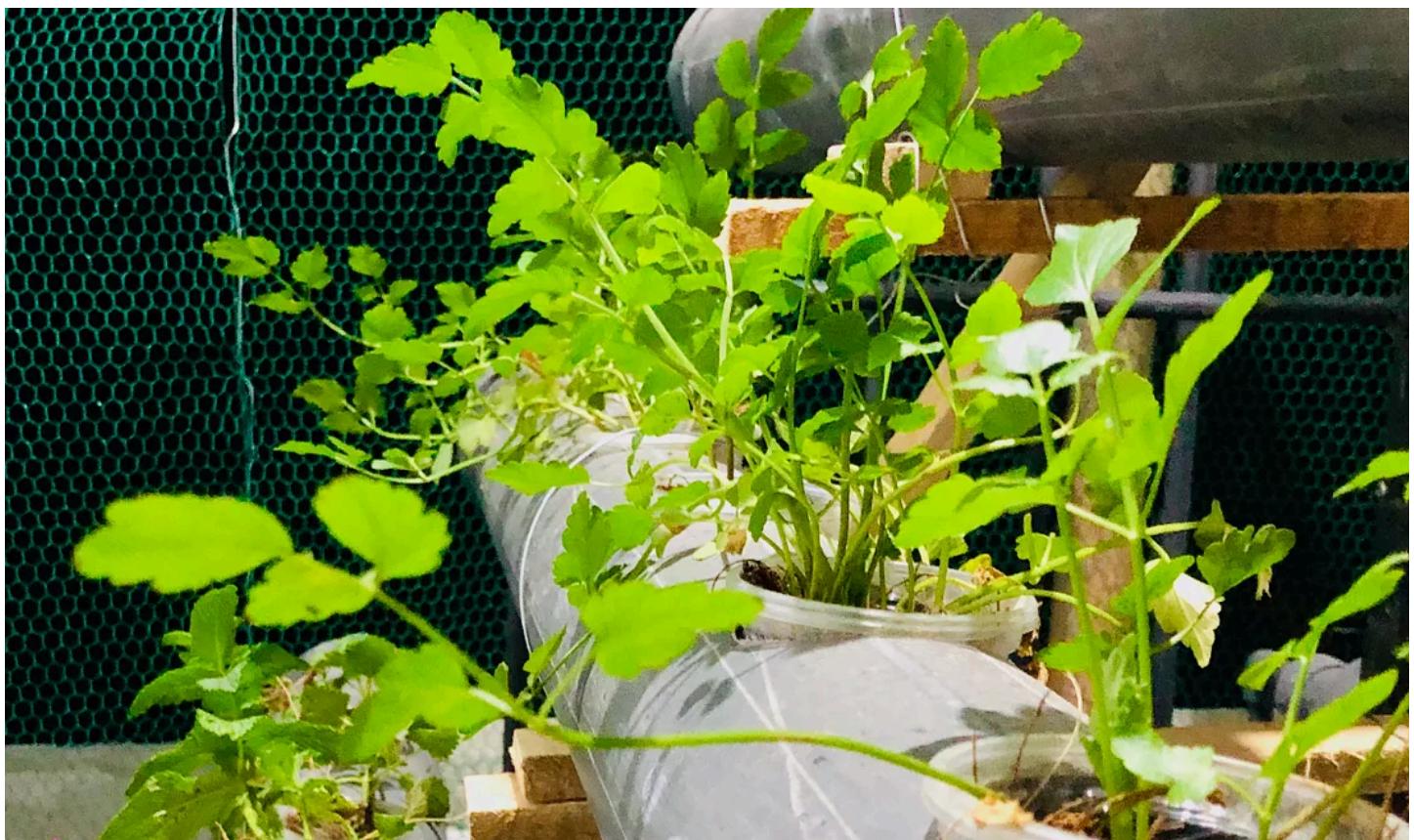


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IoT enabled Hydroponics for Smart Farm

Nuwan Wijewardane · [Follow](#)

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February 2020 I was on a vacation in Sri Lanka as I got a one month holiday during my job transition. It was a long awaited holiday with my family where we decided to visit the parents in my hometown. They lived in a city called Nuwara eliya surrounded by breathtaking mountains and waterfalls known for its lush green environment and splendid beauty . Which also attracts lots of tourists from all over the world for its fascinating weather conditions, More importantly popular among locals for growing specialised vegetables and fruits ideally suites the weather conditions.

But I never thought things will change so fast in last few weeks of my holiday due to covid-19 outbreak and travel restrictions. It was an amazing timing to get stuck in a

such a disconnected and beautiful place.

I had plenty of time to be with my entire family and ample time to catch up with my dad where I enjoyed spending lots of time in his farm. I found it very interesting to visit the farm and it was a good opportunity for me to learn something really important and I thought it may be a demanding subject area after the outbreak. My dad's farm inspired me to think something towards agricultural point of view. As a software professional I wanted to invest more time towards this specific area and learn something new, Problems they face and probably provide some answers which can be benefited to the whole farming community.

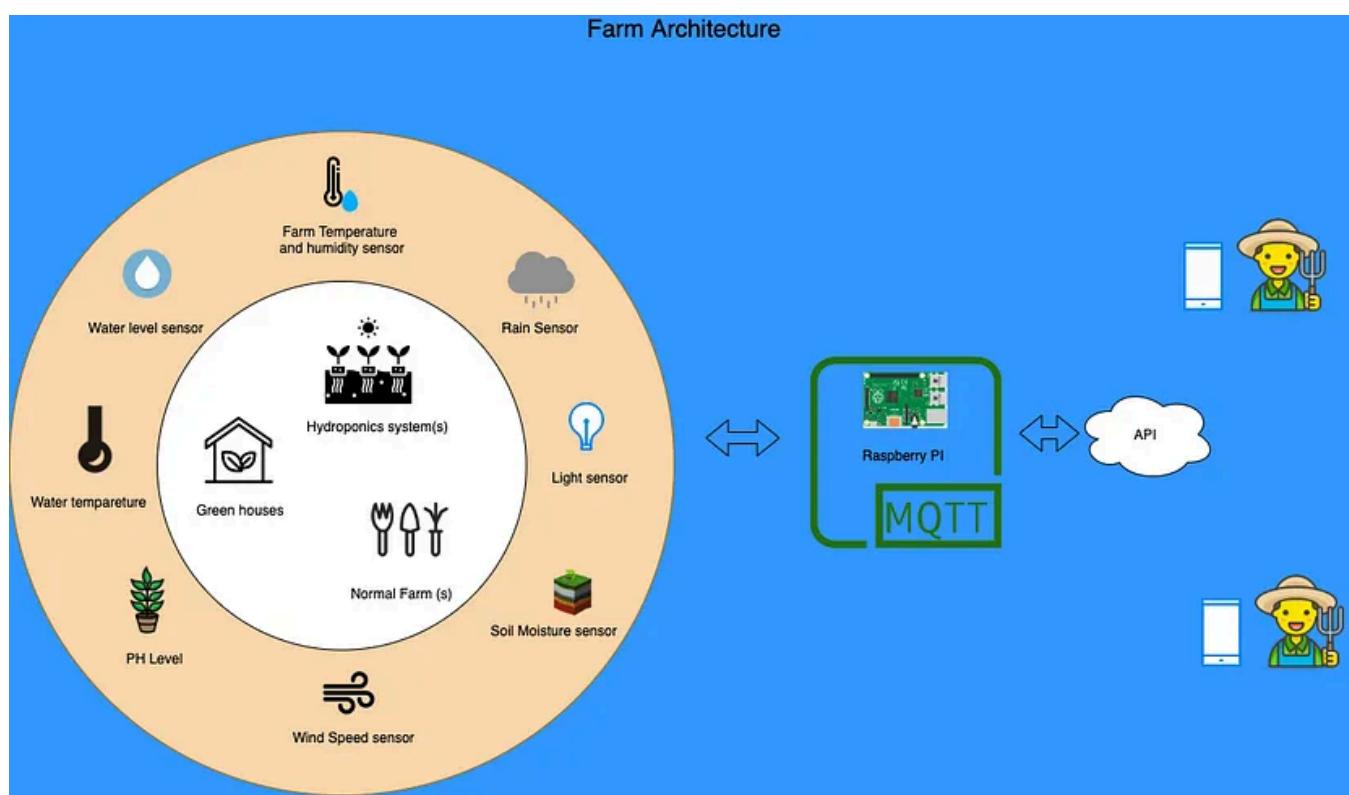
After few visits I have listed down some of the common problems that my dad and his friends are facing and in general this list might applicable for most of the local farmers in the community as well.

1. Fertiliser usage is not scientific where farmers do the calculations according to their own choice.
2. In most cases farmers are disconnected, Where there is very less communication with other farmers.
3. They use conventional farming techniques where an uninterrupted water supply is required.
4. Farmers heavily rely on monsoon weather, Which is highly unpredictable due to the climate change.
5. Crop selection was based on farmers past experience and in harvesting time there isn't a good market demand as majority of farmers shares same thinking pattern and end up growing same crops.
6. Current techniques requires considerable involvement of labor where the labour prices has gone up rapidly over the time.

I wanted to provide some solutions to the problems that my father and other farmers in the community are facing. Where I did a small research and observed some interesting things and modern farming technologies which can be used to overcome lots of problems. I thought of designing a hybrid technology combination with the help of some emerging concepts. A technology like a hydroponic system would easily solve lots of problems. But would hydroponic system itself can solve all

of these problems , Using basic hydroponic systems will reduce the water requirement by almost 90%. Solution should be a combination of different modern techniques which will help lots of local farmers.

I started on designing a solution which is an intelligent hydroponic farming solution which automatically detect the farm temperature, humidity, EC, pH, light intensity, watering and fertilising. For Eg : Water has tendency to change the temperatures due to various environmental constraints which will hamper the rooting or plants altogether. Water temperature sensors can be deployed over the hydroponics farm and farmers can be alerted accordingly.



Combination of farming technologies and IoT sensors

Similarly PH sensor can alert the PH level and the farmers can change in the nutrition levels and can be pump minerals in suitable amounts. An assortment of sensors and controllers like ESP-8266, Arduino and Raspberry Pi etc. can be used to instrument and automate a hydroponics farm.These smart farming IoT solutions allow farmers to use sensors, gateways, and monitoring systems to collect and analyse data and make informed decisions.

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Phase 1 — Hydroponics system , IoT device installation and node-red dashboard for temperature and humidity sensors.

Phase 2 — IoT devices installation for greenhouse and complete dashboard.

Phase 3 — IoT device installation for normal farm with mobile app and portal.

In this article i am going to focus on the hydroponics part (Phase 1) , I have designed the initial structure by considering the factors such as mobility, space utilisation , cost effectiveness.



Basic structure of the smart hydroponic system



3.5 ' PVC pipes layered to utilize the space effectively



Pvc pipe layout

Once the pipes are placed properly they should interconnected using reducers.



Continuous water supply from submersible pump

Submersible water pump installed inside the bucket which controls the flow of water.



Strawberries

Plants started to grow as normal with very less amount of water and especially without soil.



Sensors used in the hydroponics system

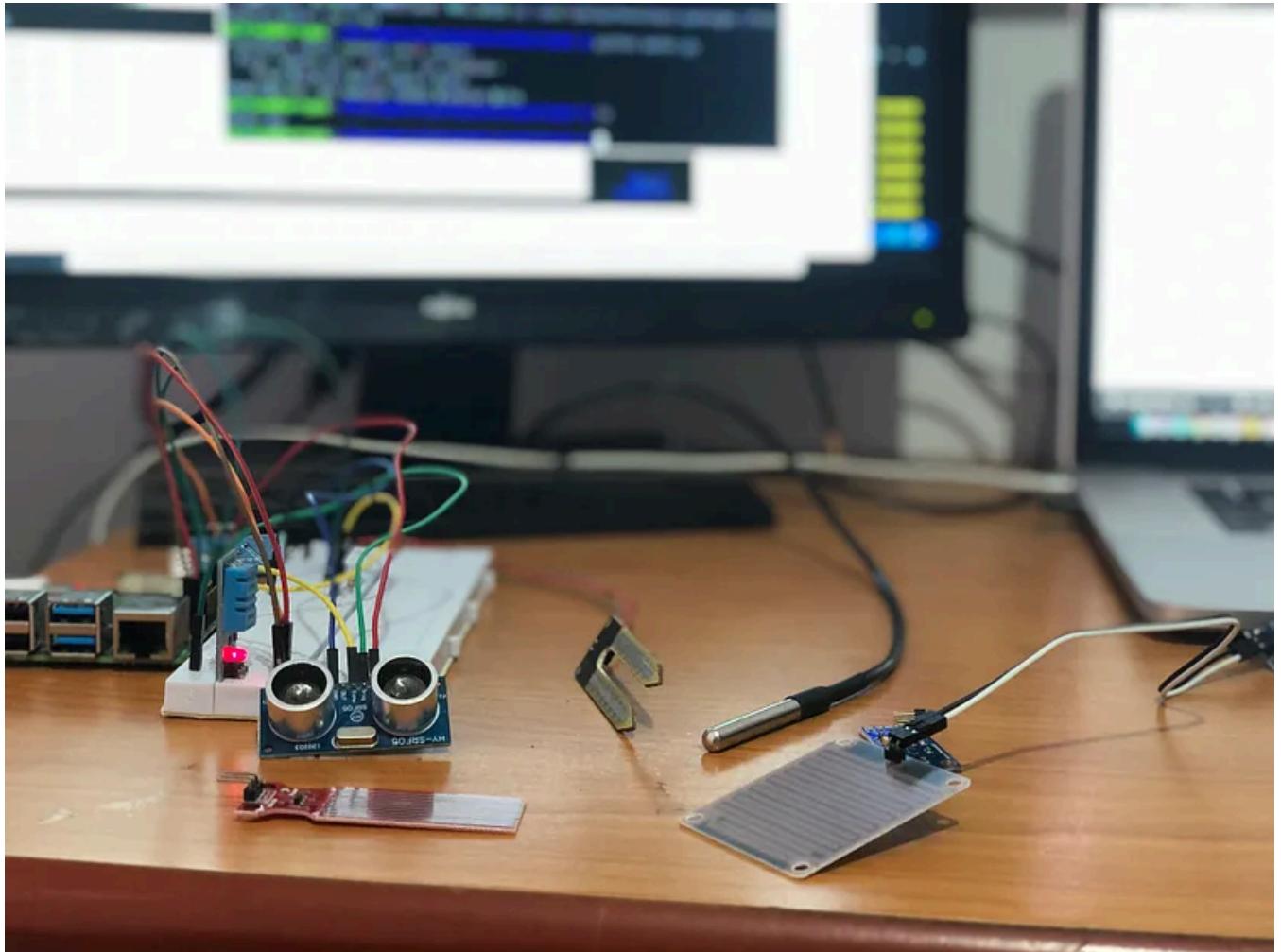
1. Ultrasonic sensor to determine the water level.
2. PH sensor.
3. Room temperature and humidity sensor.

4. Water temperature sensor.

5. Soil moisture sensor.

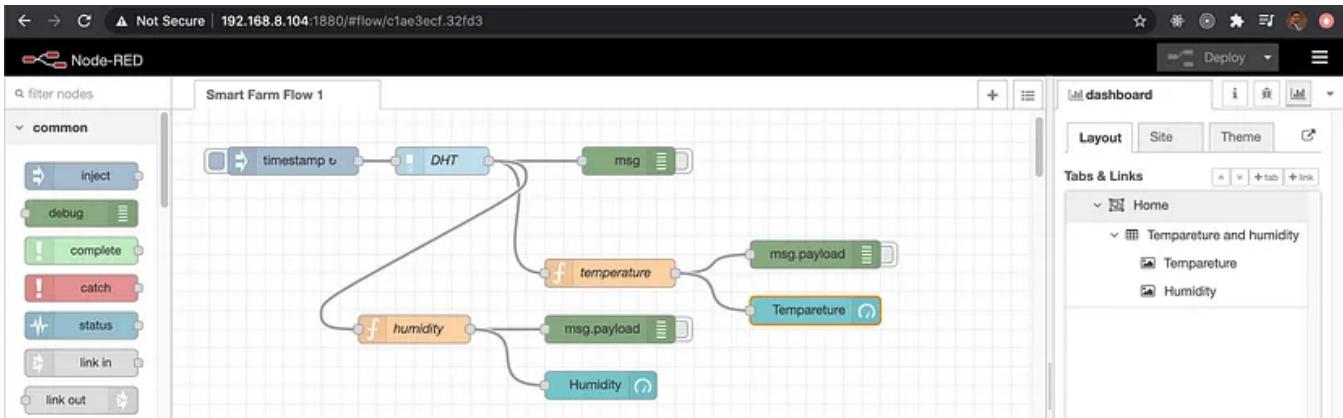
6. Light intensity sensor.

7. Rain sensor.



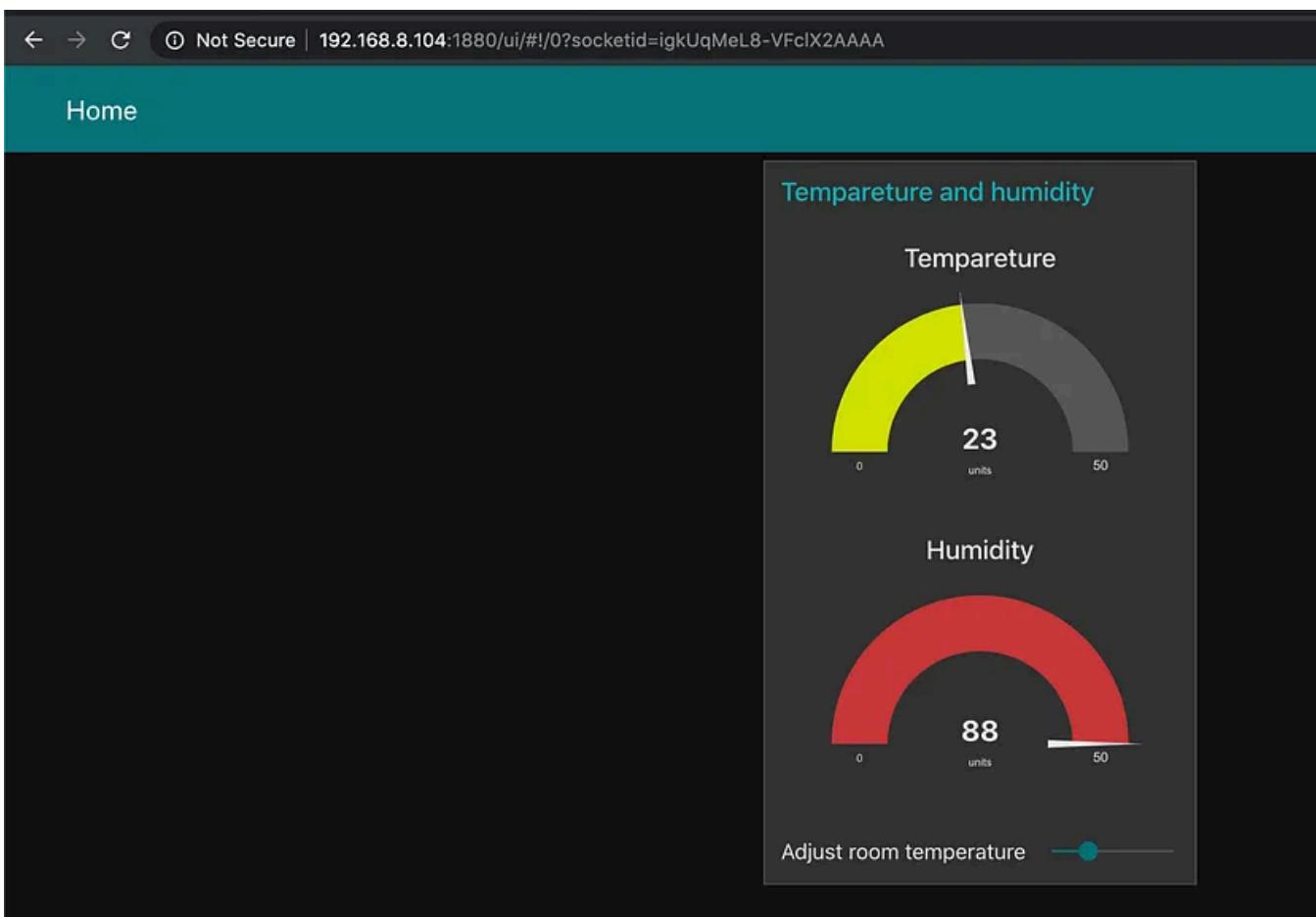
Sensors required for hydroponic system

In the first phase i am going to connect room temperature sensor (DHT11 sensor) with Raspberry PI 4 Model B, Which will push current temperature and humidity to the dashboard and accordingly room temperature can be adjusted.



Hydroponics farm — Node-Red flow

Following is the Dashboard with the desired action buttons.



Smart farm Dashboard

Accordingly all other sensors can be connected to Raspberry PI and the Node-Red flow should be adjusted accordingly as per the architecture diagram.

By introducing IoT based hydroponics system, Lots of issues or problems can be addressed,

1. Fertiliser usage can be controlled by analyzing the PH level from the dashboard.

2. Farmers in the community can be connected through a portal.
3. Water supply problem can be addressed through the hydroponics system as it uses very little amount of water and the water level sensor allows to detect the water leakage or low water levels.
4. With the help of hydroponics system farmers has the liberty to choose the crop regardless of the season.
5. IoT enabled system allows to reduce lots of manual work.

This approach will help the farmers at least minimize some of the burning issues that they were facing for long time. I will be covering Phase 2 and Phase 3 in future articles which will eventually enables farmers to produce good harvest.

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Written by Nuwan Wijewardane

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Software Architect