STES'S SINHGAD ACADEMY OF ENGINEERING KONDHWA, PUNE 411048

IoT based Hydroponic System

Presented by :
Project group 48

- Komal Naphade(B018)
- Pranav Gavali(B046)
- Dhiraj Shelke(B071)

Guided by :
Prof. P. R. Patil

Outline

- Introduction
- Motivation
- Problem Definition
- Literature Survey
- Software Requirements Specification
- Hardware Requirements Specification
- Project Scope
- Project Timeline chart
- Assumptions and Dependencies
- Architecture
- Mathematical model
- Algorithms
- Data Flow Diagram Level-0,
- DFD Level-1,
- DFD Level2.
- UML Diagrams
- Partial Implementation
- Conclusion.

Introduction

- Hydroponics is a technique of growing plants without soil and without the limitations of space and climate.
- In the traditional farming system, plants depend on soil to obtain all nutrients needed for their growth.
- In contrast, a hydroponic garden provides all of these nutrients without involving sunlight, soil, extra labour, allowing farmers to benefit from efficiencies and to reap large produce yields.

- Photosynthesis process :

  Carbon Dioxide + Water -> Glucose + Oxygen

  $6CO2 + 6H2O \rightarrow C6H12O6 + 6O2$

There is no mention of "soil" anywhere in there and that's all the proof you need that plants can grow without it.

- Plants require 17 essential elements to grow and reproduce
- The first three are Hydrogen, oxygen and carbon
- Other 14 are:

Macro-Elements: Nitrogen, Phosphorous, Potassium, Calcium, Magnesium, Sulphur

Microelements: Iron, Manganese, Copper, Zinc, Boron , Chlorine, Molybdenum, Nickel

Nutrient Solutions

- In Hydroponics, Nutrient control is easy
- It consists of a nitrogen rich grow formula
- A phosphorous and potassium rich bloom formula

And the results ?

Bumper crops of delicious fruits and vegetables every time.

Motivation

- Have a Mobile & Dynamic setup
- To design efficient systems in terms of water usage, and a higher crop yield.
- Reduce inefficient and Destructive farming
- To increase awareness relating to the benefits of Hydroponics.

Problem Definition

- Every plant grown using open agriculture farming, ties up a certain amount of land for a long duration (usually through the growing season).
- Agriculture uses lots of water.
- Agriculture farming takes lot of time to produce outputs.
- Conventional Farming uses lot of Manpower

Literature Survey

Sr. No	Topic	Author	Year	Major Findings
1	iPONICS: IoT Monitoring and Control for Hydroponics IEEE Conference	K. Tatas, A. Al-Zoubi Antoniou D. Zolotareva	2021	• The system is composed of a specialized Wireless Sensor Network. • This System also provides the user with a user friendly web-based tool to monitor his crops as well as being appraised by appropriate alarms and warnings.

Literature Survey

Sr. No	Topic	Author	Year	Major Findings
2	Hydroponics System for Soilless Farming Integrated with Android Application by Internet of Things and MQTT Broker – IEEE Conference	Navneet K. Bharti Mohit D. Dongargaonkar Isha B. Kudkar Siuli Das Malay Kenia	2019	• Single micro-controller and basic sensors are used. • Internet of Things is used to accumulate the data and store it on servers. • An Android application is used to fetch this data, creating a more personalized setup and data.

Literature Survey

Sr. No	Topic	Author	Year	Major Findings
3	Automated Irrigation System Using a Wireless Sensor Network and GPRS Module - IEEE Transaction	Joaquín Gutiérrez, Juan Francisco Villa-Medina, Alejandra Nieto-Garibay, and Miguel Ángel Porta-Gándara	2014	• The system consisted of two components wireless sensor units (WSUs) and a wireless information unit (WIU) • The WIU has also a GPRS module to transmit the data to a web Configuration of the automated irrigation system. • The information can be remotely monitored online through a graphical application through IoT.

Literature Survey

Sr. No	Topic	Author	Year	Major Findings
4	IoT Based Automated Hydroponic Cultivation System – IJAER Journal	Dr. Ponmurugan Sudharsan, Vargunan, Vignesh Raj , Selvanayagan	2019	• By the intervention of IoT this whole hydroponic system can be automated. • All the data from the hydroponic system are sent to the cloud data for the automation purpose. • The health condition of the crops is monitored with data collected by the sensors and actuators.

Software Requirements Specification

- Open Source Languages & Libraries
- Arduino
- Blender for Creating model

Hardware Requirements Specification

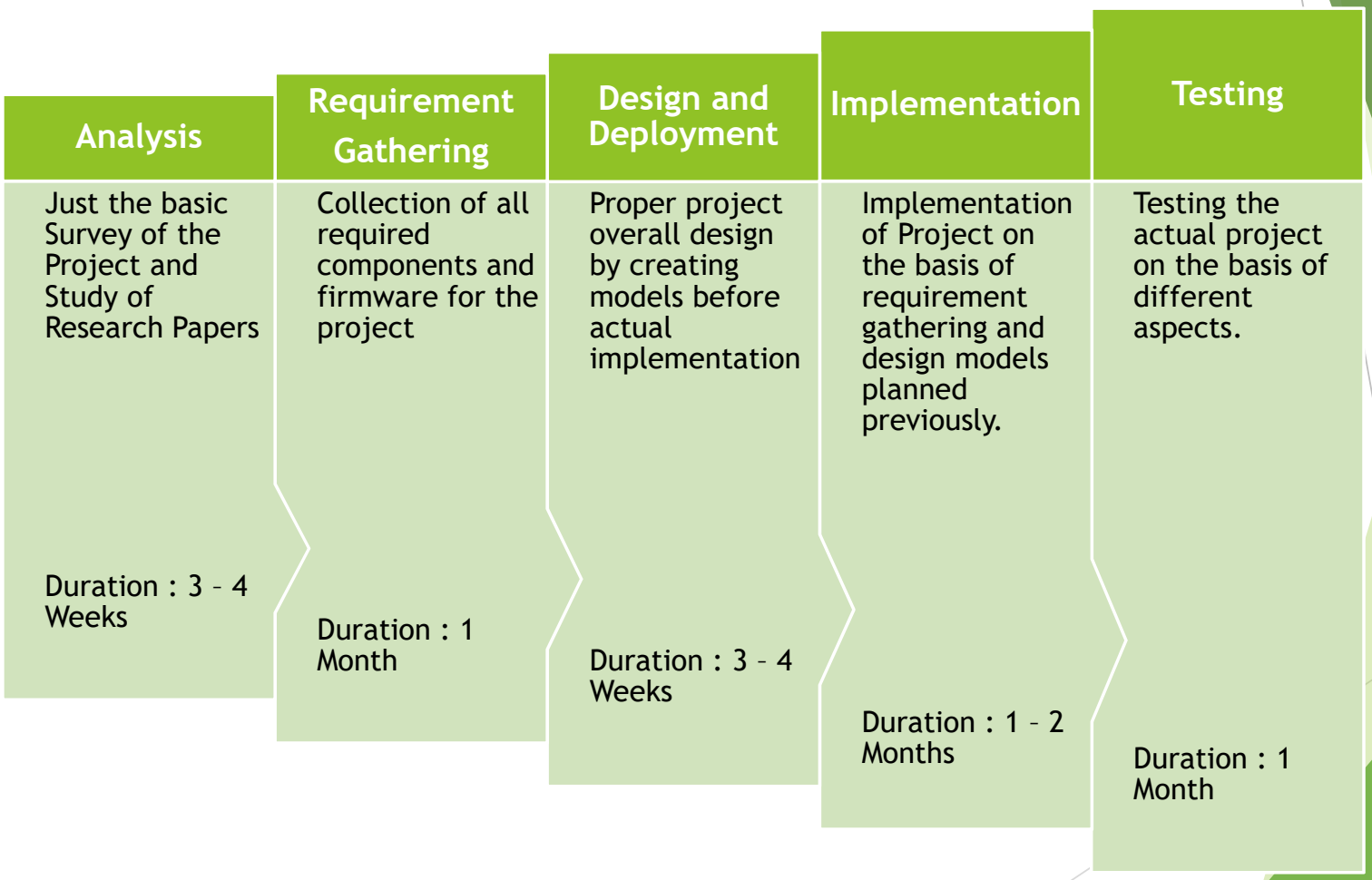
- pH Control
- Horticulture Lighting(Grow Lights)
- Pipes to transfer fluids
- A Controller to control the System (Arduino)
- Switches and Regulators

Project Scope

- Manual Integration of Sensors
- Using IoT Devices like Arduino with sensor interfacing

Besides project scope, there are intangible skills we look to gain as well.

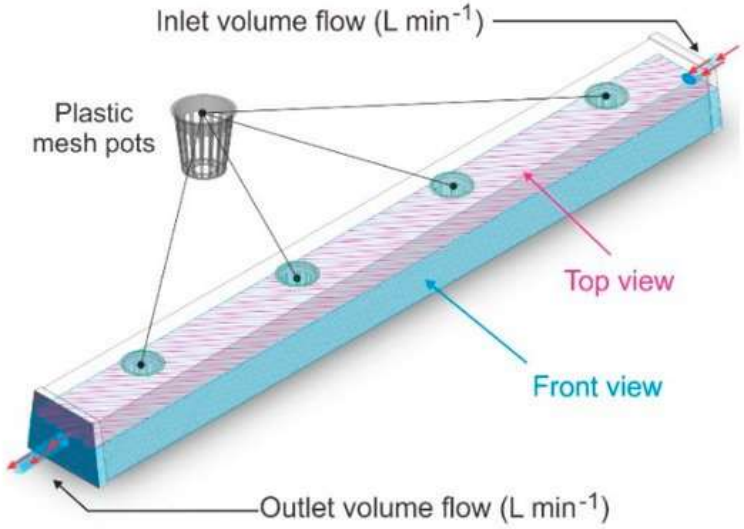
Project Timeline Chart

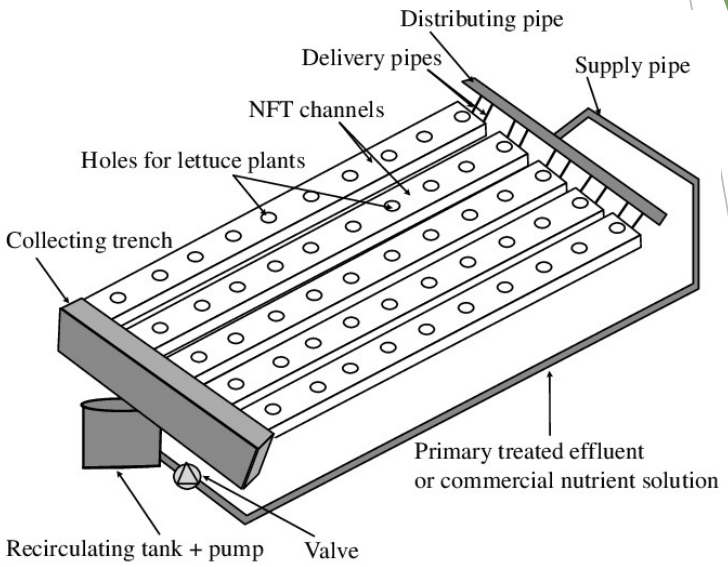


Assumptions and Dependencies

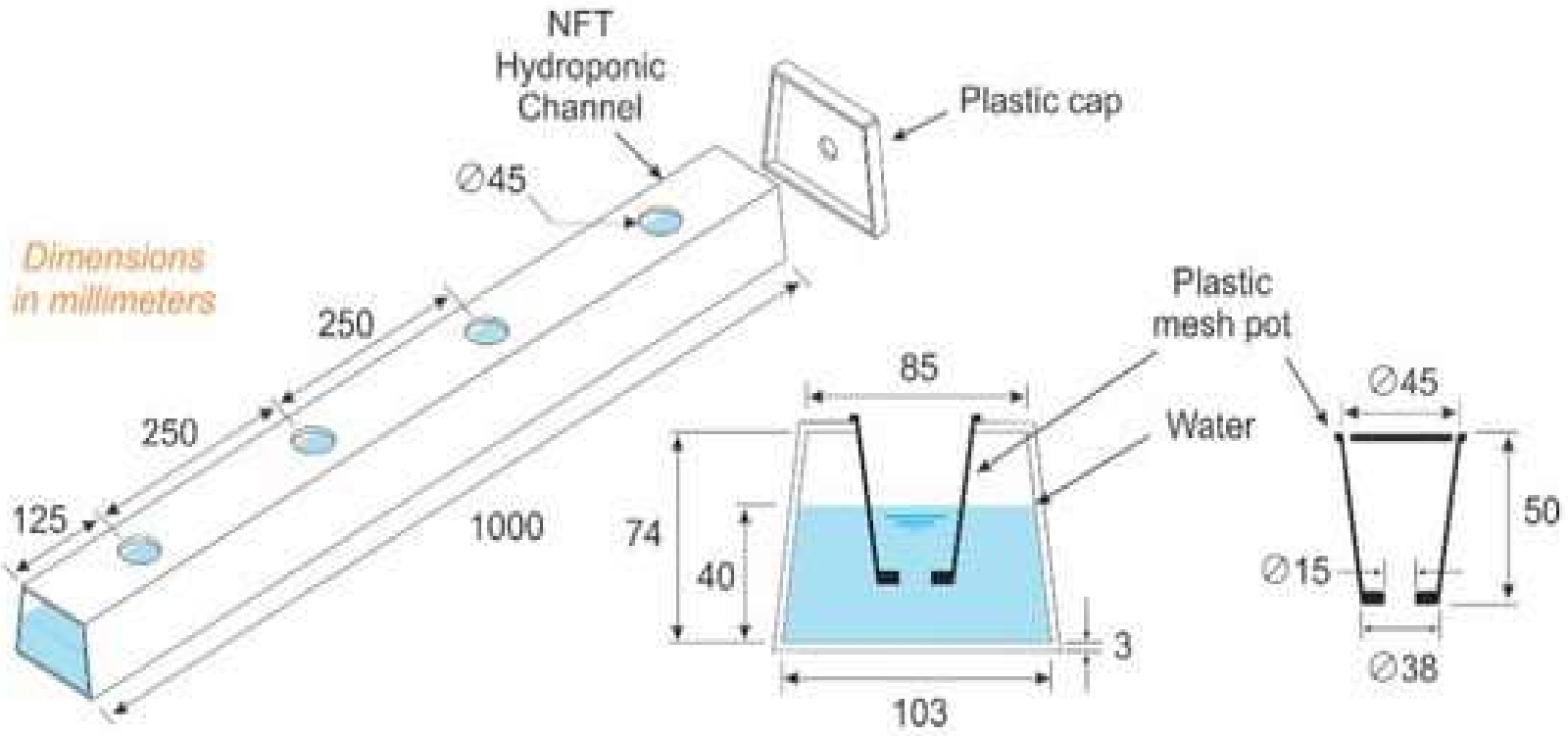
- You'll have access to all the resources you need to complete the project, both human and material.
- Project team members will have the resources they need to complete their individual tasks on time, from specialized equipment and software down to electricity during working hours.
- Personnel costs will not change during the project cycle.
- Other material and resource costs will remain consistent throughout the project.
- The overall cost of day-to-day operations will not increase.
- All equipment will be in working condition through the project cycle.
- Most important Dependency is the location where the system is built. It should be spacious enough.

Architecture





Architecture



Mathematical Model

Micronutrients + Macronutrients = Total Nutrients required(N)

Total Nutrient(N) + Water(W) = Nutrient Solution(NW)

Check Potential of Hydrogen Level(pH)

pH(NW) < 7 = Acidic Water
pH(NW) > 7 = Basic water
pH(NW) = 7 = Neutral Water

Make sure to have appropriate pH level for particular plant

G(p)= Water Circulation Time + Amount of Nutrient Solution

Where G(p) = Growth of plant

Algorithms

Step 1: Start

Step 2: Set Op-time of Grow Light with desired intensity

Step 3: Set Op-Time of Water circulation

Step 4: Set-up Temperature Sensor

Step 5: Turn on the Sensors

Step 6: Add nutrients to water

Step 7: Regulate water supply

Step 8: Check for Water Level after Circulation

    If Level is not as desired Level :

    Go to Step 7

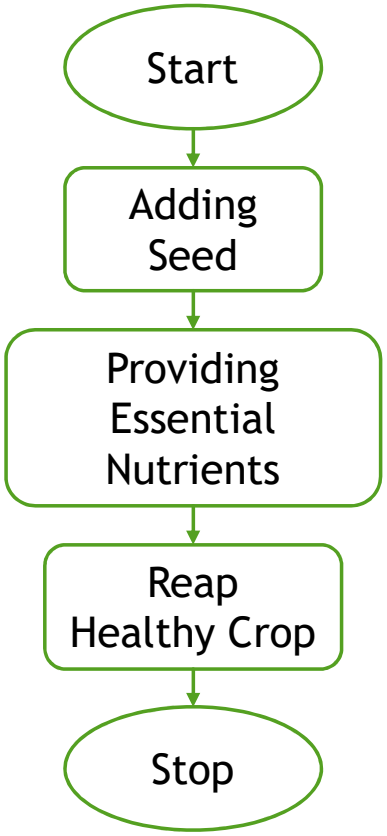
Step 9: Check pH Levels

    If pH level is not as desired:

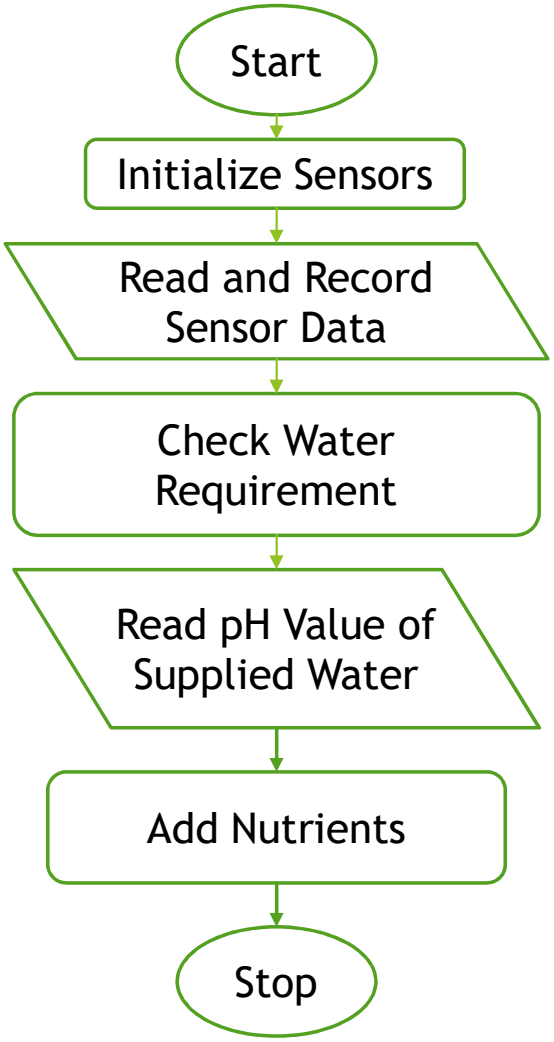
    Go to Step 6

Step 10: Stop

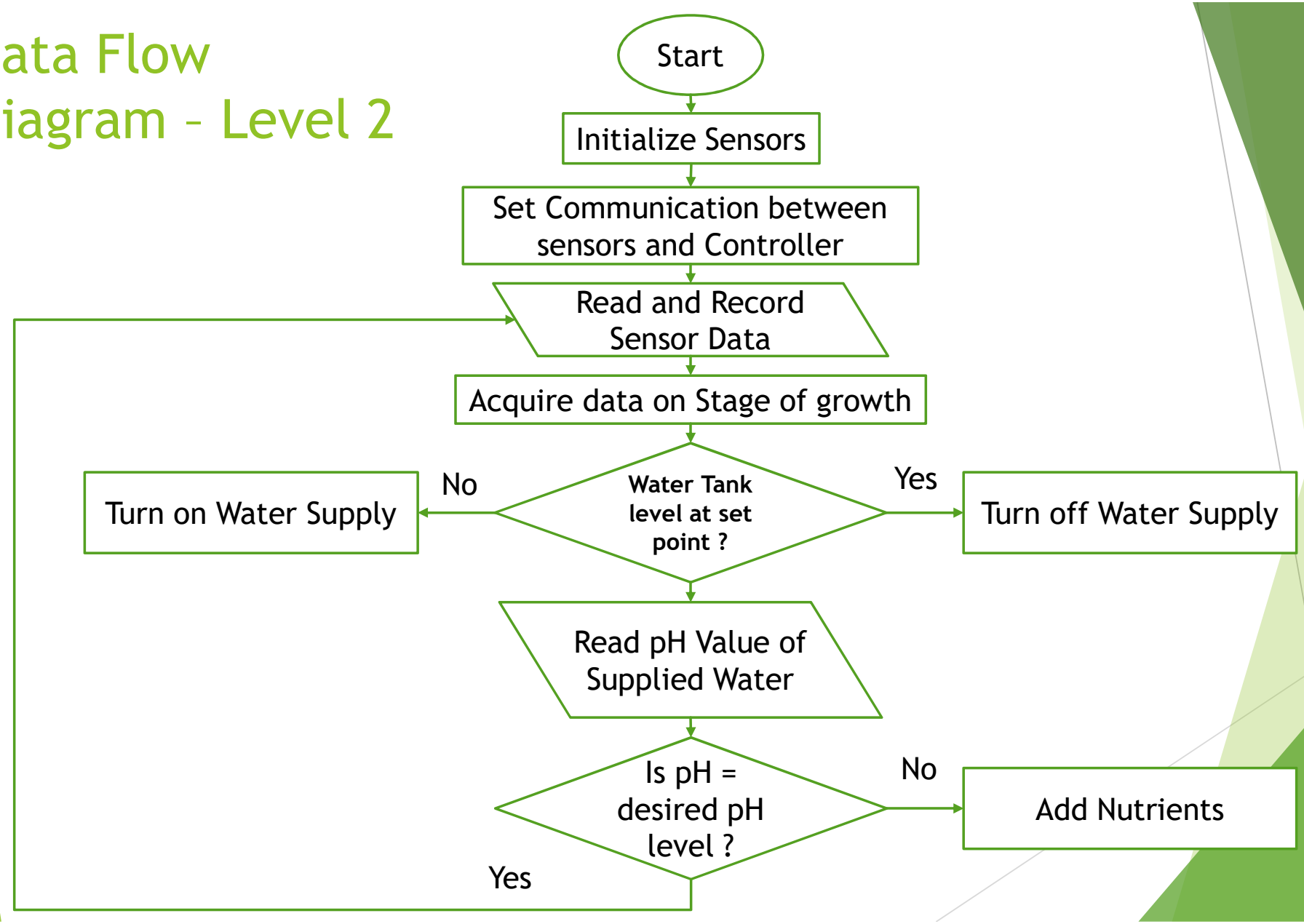
Data Flow Diagram – Level 0



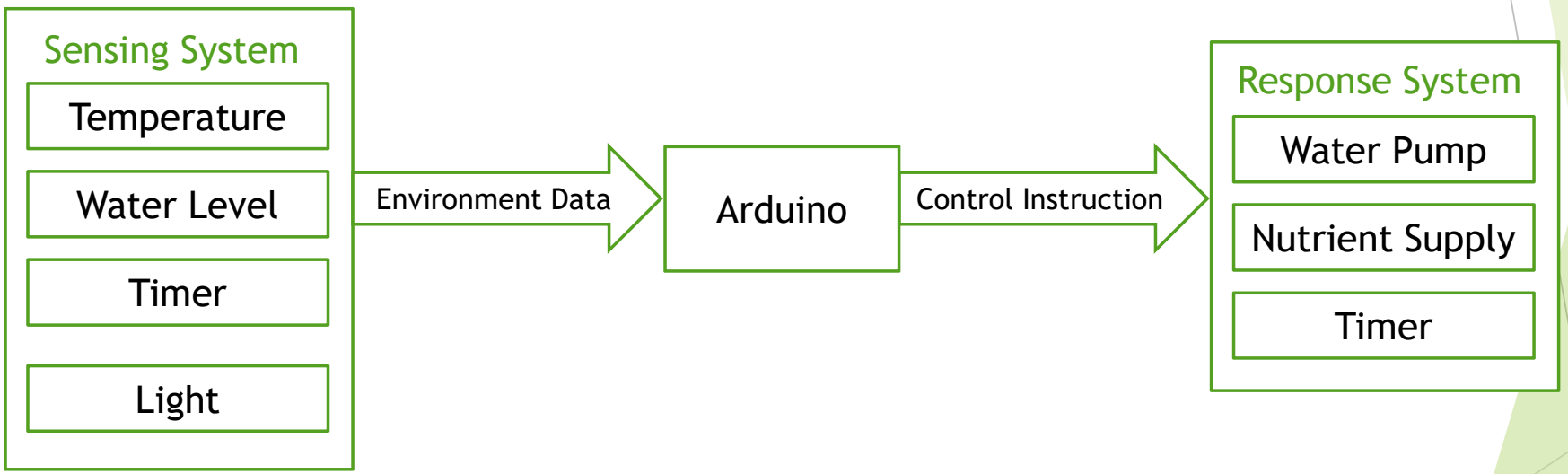
Data Flow Diagram – Level 1



Data Flow Diagram – Level 2



UML Diagram


Sensing System
Temperature
Water Level
Timer
Light
Environment Data
Arduino
Control Instruction
Response System
Water Pump
Nutrient Supply
Timer

Partial Implementation

Conclusion

- Hydroponics is the effective technology for the places of the world having scarcity of infertile and arable land for cultivation of crops. Fresh products can also be harvested through hydroponics throughout the year as it is not like traditional cultivation practices.
- Additionally technologies like Deep Learning can help to boost this sector and help deploy it for millennials. As observed, we can conclude that using such technologies can help us increase crop yield over 70% and reduce the cost significantly ‘over-time’ as well.

Thank you !