Group 01

Control Environment Monitors

Product Proposal

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Product Goals

Function: What do we need?

A product to read the temperature and the humidity inside an outdoor propagator and display on a LCD screen and store the data on a SD card on an hourly basis. Further, based on two separate thresholds, an alarm should be triggered when those thresholds are exceeded.

The product comprises of three main components:

1. **Sensor Unit**: A unit with humidity and temperature sensor that is battery powered and transmits the data to the Display Unit

2. **Display Unit**: A battery powered unit with display, removable storage, a key pad and communicating capabilities with the sensors

3. **Alarm Unit**: A unit with a light and a buzzer that will be triggered when the temperature and/or humidity goes beyond the corresponding thresholds

Estimated Cost

The cost of the product will be approximately 2500 including 3 sensor units, main display unit and alarming unit. The profit will be a 20% margin of this. (Selling price = LKR 3000)

Expected Volume of production

5000 products per annum for 5 years. 100 units to be produced during the initial trial period of 6 months

Design Specifications

Performance:

1. Sensing and displaying the temperature with an accuracy around $\pm$ 2 ℃ and humidity with an accuracy $\pm$ 3% inside the propagator at the corresponding locations of the propagator
2. Storing the temperature and humidity data hourly during the day on a SD card that can be removed
3. Alarming the farmer when the temperature exceeds its threshold or humidity goes below the threshold to take necessary actions
4. Battery powered with the ability to operate a minimum of 1 day duration by one battery
5. Three Sensor units being enough to accurately represent the temperature and humidity distribution of the propagator

Impact from the environment

6. The sensor units should be water proofed
7. Anti-rusting
8. Should not interact with any chemicals used for the plants in the propagator as fertilizer
9. Should be able to operate at a moderate range of temperature from $10℃$ to $60℃$
10. Damages from the farmers due to the negligence when using the sensors and Display Unit
11. RF communication between the Display Unit and the sensors should not be susceptible to the interference

Impact on the environment

12. Device is made of non-toxic materials
13. Micro particles occur from the wearing and tearing will not alter the controlled environmental factors inside the propagator
14. No poisonous by-products
15. Minimum wastage during the production

Lifetime

16. The Display Unit and the alarming unit should last a minimum of 2 years while the sensors are to last a minimum of 1 years.
17. The product should ideally last the duration of three cultivations of plants

Maintenance

18. The battery's should be replaced when the indicators displays a charge of 5%
19. Modular components. Burned out or broken parts are easily replaceable
20. Zero Day to Day maintenance
21. It should not require a maintenance for more than 2 weeks
22. One technical person who is aware about the product will be needed to maintain the product

Production Cost

23. Maximum cost per sensing unit LKR 530: Max cost of sensing units per product LKR 1650
24. Maximum cost per Display Unit LKR 750
25. Maximum cost per alarming unit LKR 100

Package, Size and Weight

26. One package will include 3 sensor units, a Display Unit and an alarming unit
    - Sensor Units: 3 x 1.5 x 2 inches 200g
    - Display Unit: 5 x 6 x 3 inches 500g
27. No packaging needed post installation

Appearance and Finish

28. Able to input the temperature and humidity thresholds manually using the key pad

29. The temperature and humidity values for each 3 points in a propagator should be displayed separately on the LCD screen
30. The battery level is indicated using few levels with three different colors of LEDs (i.e. Red – 2% to 20%, Green – 20% to 100%)

Types of material

31. Plastic
32. Acrylic
33. Wood

Reliability/ Accuracy

34. 6 sigma Standard failure rate 1 in a million

Safety

35. Surge Protection
36. Water proofed sensor and Display Units
37. Accurate Battery Level indicator

Installation

38. Can be installed during or after the construction of the propagator
39. Can be scaled down to smaller propagators that read values using one sensor unit only
40. Extendable even to the mass scale Green House production
41. Do not require expertise knowledge for installation
42. Installation cost is free of charge
43. Less than 1 man hours to set up the product per propagator

Operations

44. Autonomous in sensing and displaying the temperature and humidity values inside the propagator
45. Saving the logs in the main frame is manual i.e. the SD card need to be removed and read manually in the computer to save the data in the main frame
46. The LCD screen will be switched off automatically after 5 min and can be switched on using a button

Reuse

47. Modular design that makes it easily removable for use elsewhere

Disposal

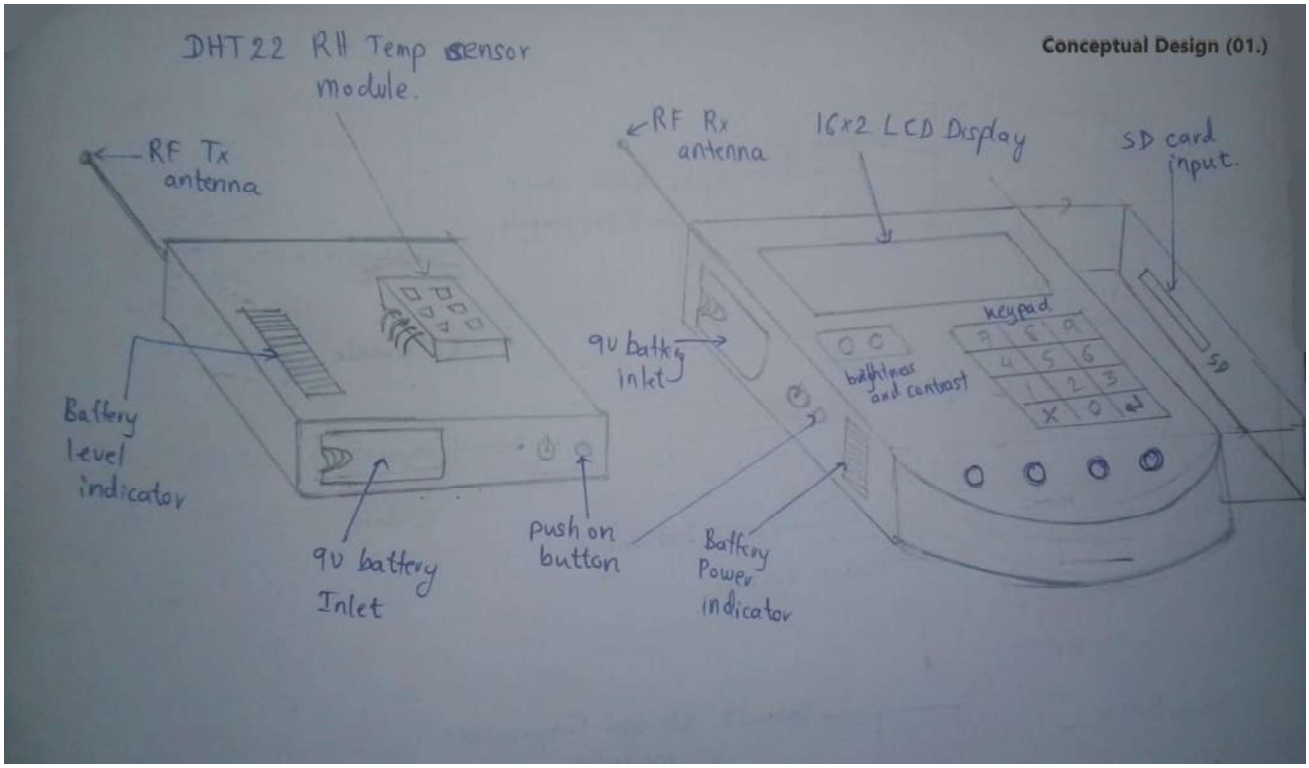
48. E waste centers
49. None of the components are classified as hazardous waste

Recycling

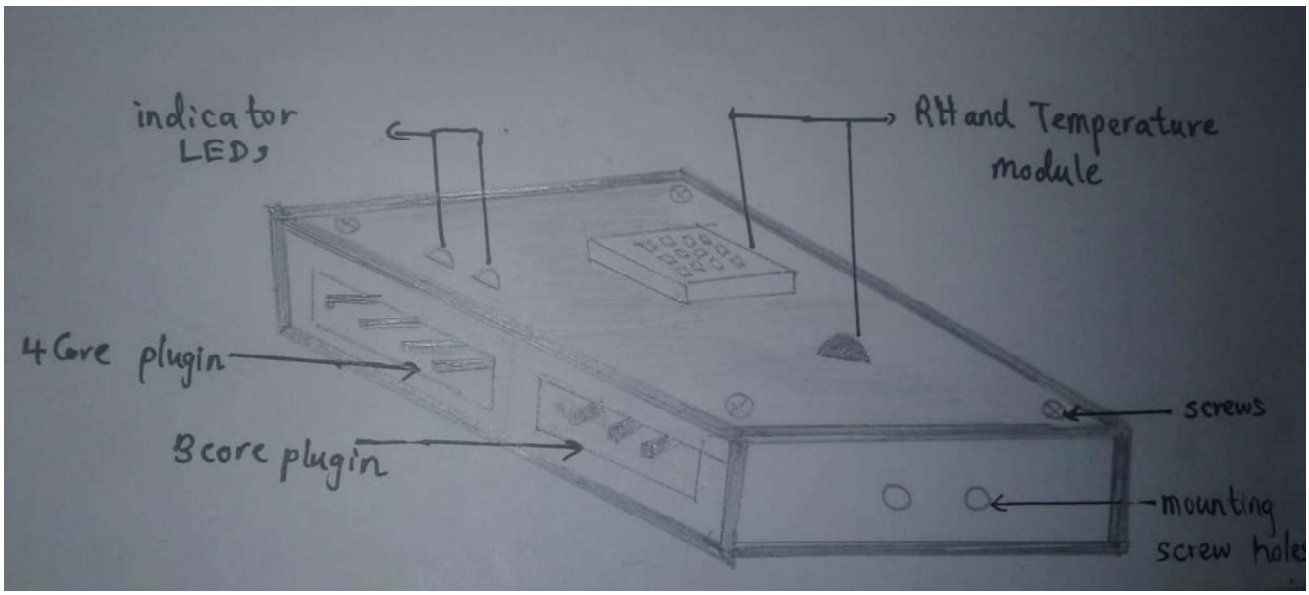
50. 80% recyclable

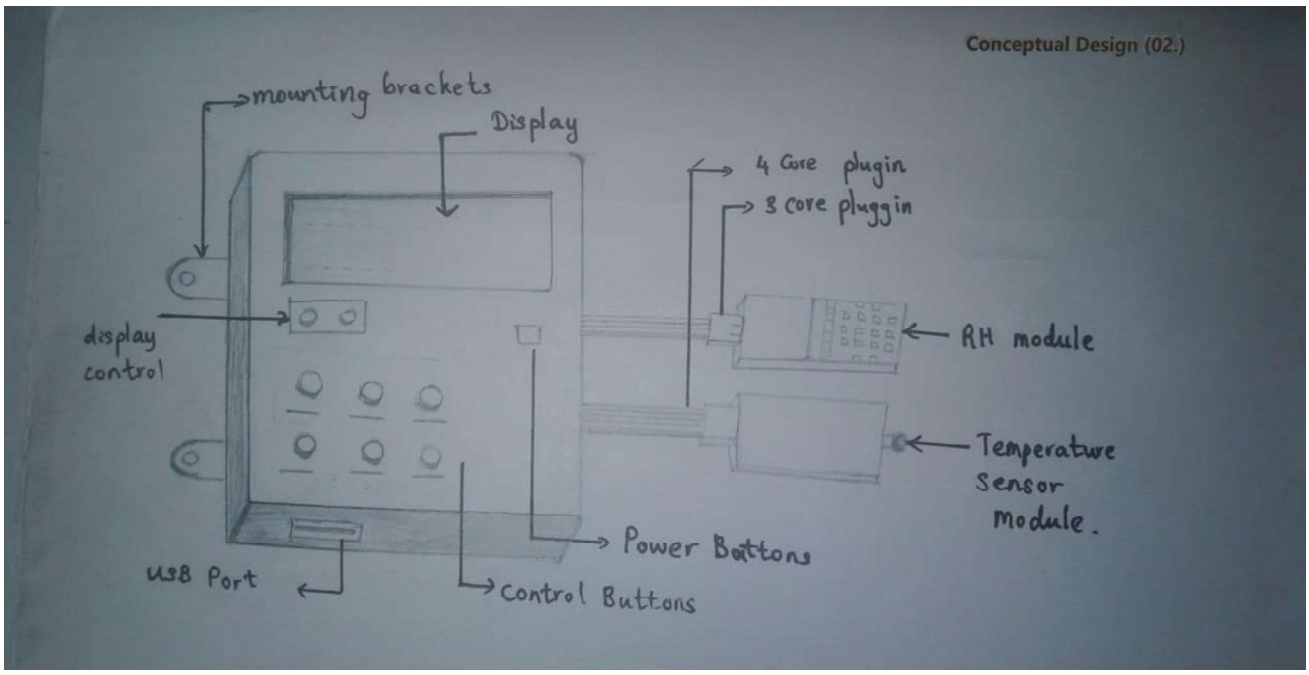
How do we do it? – Conceptual Designs

Conceptual Design 01

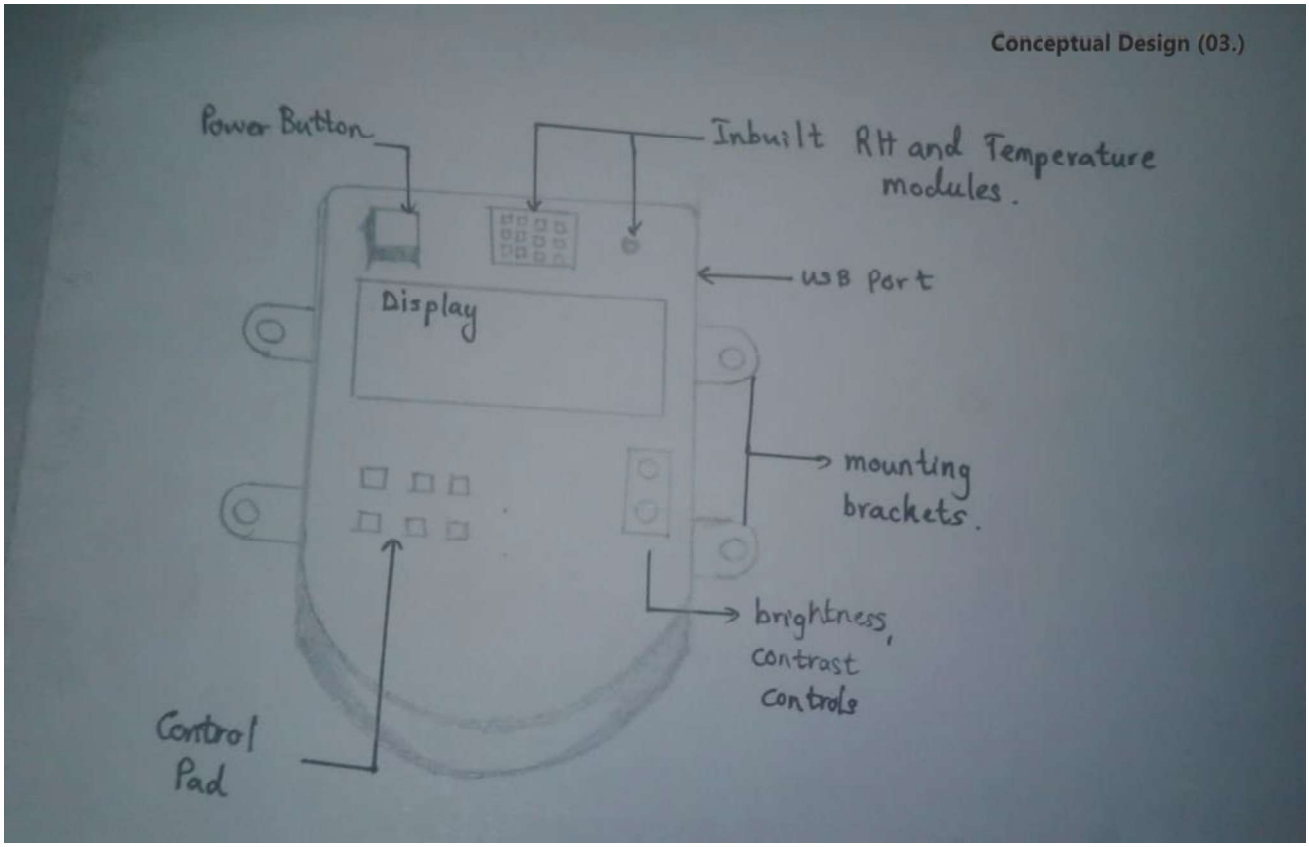


Conceptual Design 02





Conceptual Design 03



Evaluation of the conceptual designs

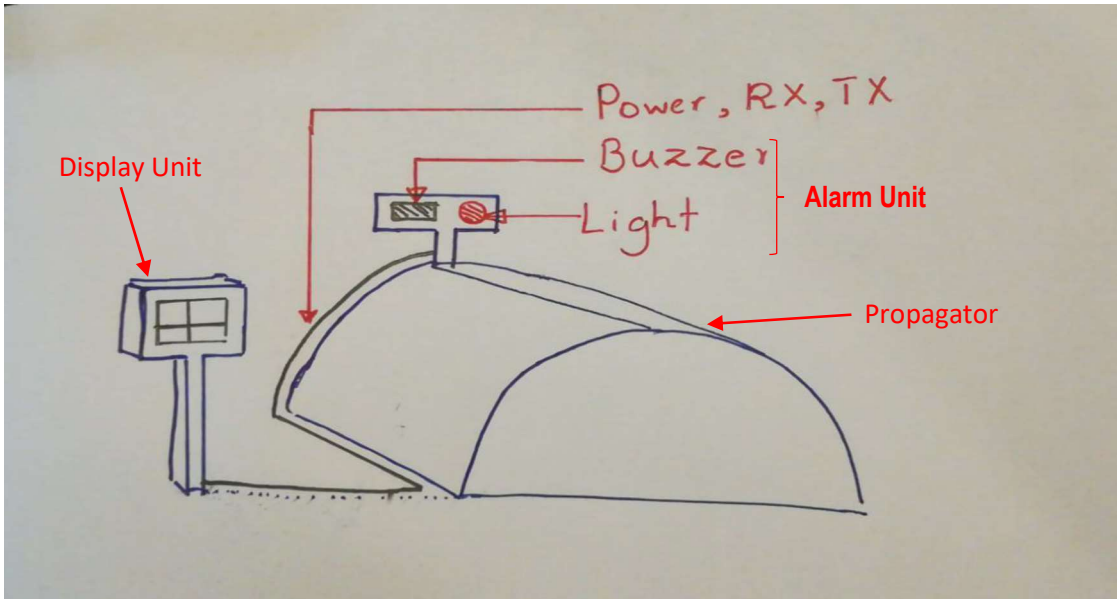
Conceptual Design	Advantages	Disadvantages
01	• The sensor units and Display Units are portable (both are battery powered) • Wireless communication hence less bulky in wiring • Can input the threshold values manually using the key pad of the Display Unit • Can detect the battery charge level using the indicator • The Display Unit can be installed further from the propagator due to wireless communication • Installation and maintenance is easy	• The data can be erroneous due to certain interferences caused by other frequencies • Batteries need to be replaced on a daily basis/ more bulky and expensive batteries need to used • Communication Latency can be high • If multiple propagators are located nearby, occurrence of errors can be high due to interferences
02	• Wire Connections between the sensors, alarm and the display unit hence the latency is less • Less susceptible to the interferences • More accurate performance in temperature and humidity reading and displaying and alarming	• Bulky as more wires need to be installed • The Display Unit needs to be located very close to the propagator • External power should be given which makes the portability an issue • No SD card slot – hence the computer to store the values should be closer to the propagator • More electronic components (for example, a step-down transformer, rectifier) is needed as external power is being used • Costly installation
03	• All in one unit – Less manufacturing cost • Sensor unit, Display Unit and alarm should be installed within the propagator • Can read and store the temperature and humidity values directly from the unit on to a computer using the USB cable	• The damages that can occur due to the negligence of farmers can occur frequently • High cost to be undertaken to safeguard them against the chemicals, water and fire • No SD card slot – hence the computer to store the values should be closer to the propagator • Not a modular design – If a part is burnt the whole product needs to be replaced. • More electronic components (for example, a step-down transformer, rectifier) is needed as external power is being used

Conclusion:

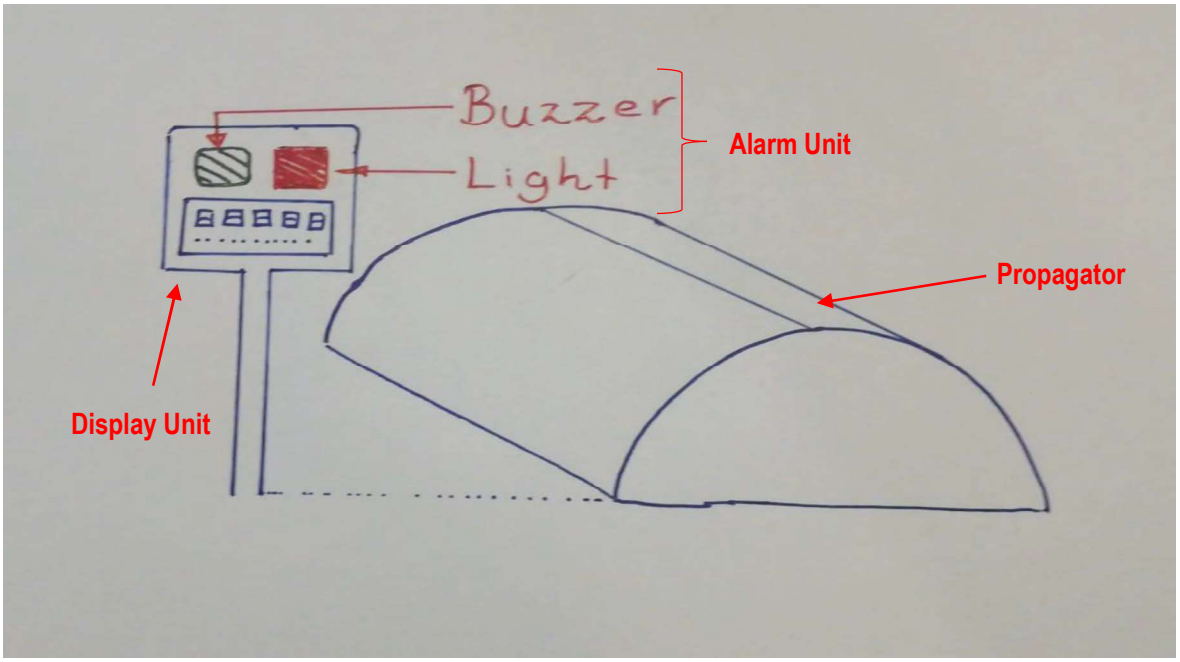
Since our product is to sense the temperature and the humidity in an outdoor propagator, and that the pros outweighs the cons, we choose the Conceptual Design (01.) as our design to proceed the project.

How do we do it? – Conceptual Designs (Alarm Unit)

Conceptual Design 01



Conceptual Design 02



Evaluation of the Conceptual designs

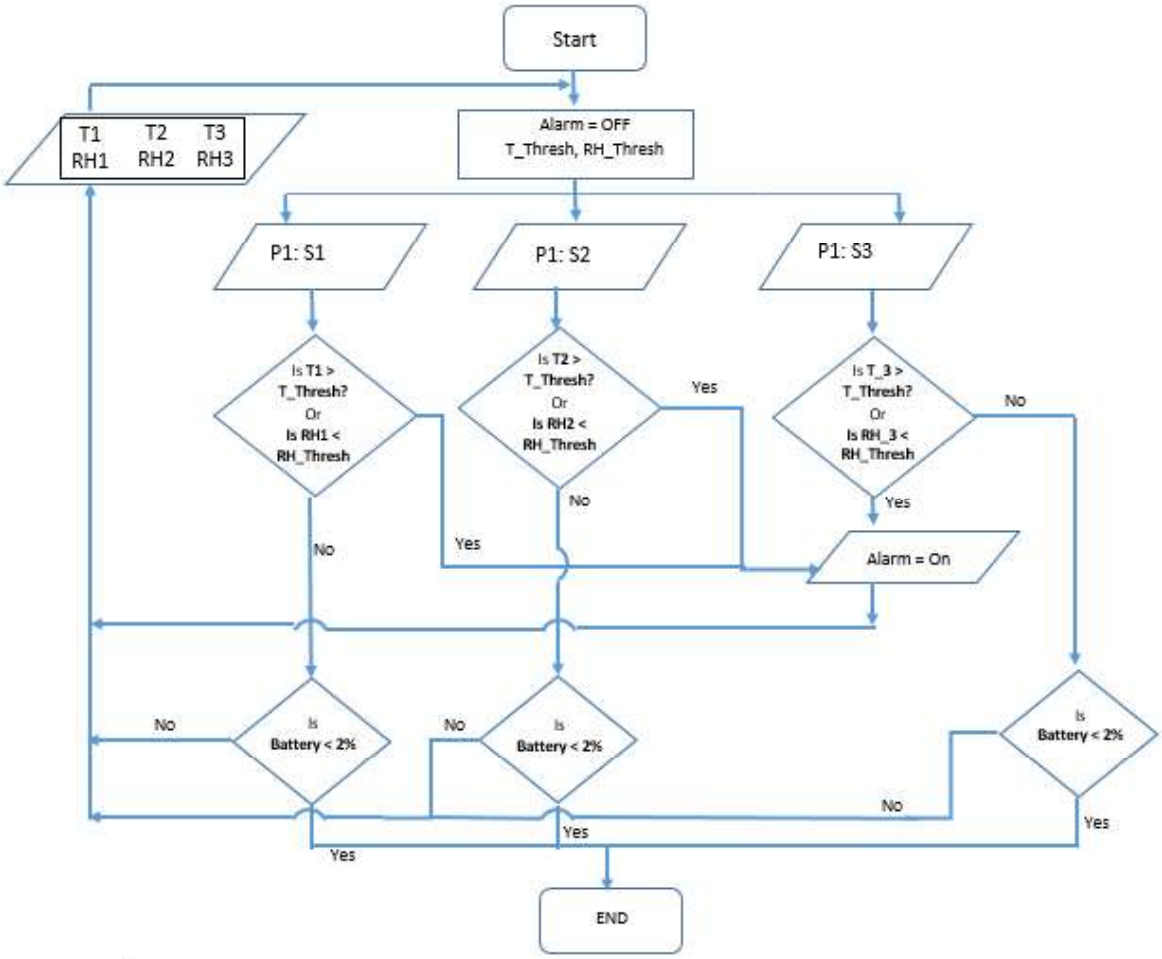
Conceptual Design	Advantages	Disadvantage
01	• The alarm and the light is installed near the respective propagator • Separate Alarm Unit hence any modification to alarm unit can be made separately	• Need to power up the alarm unit either using separate battery or from the display unit power • Need the wires to connect the two units hence bulky • Damages are possible as the alarm unit is installed near the propagator
02	• Alarm Unit is installed inside the display unit – hence powering the alarm unit is convenient • Less wires (or no wires) needed to connect the microcontroller output to the buzzer and light • Easy installation • Can identify the region where the temperature and the humidity exceeds the thresholds as display unit and alarm unit is at the same place	• Battery can drain much quicker than the design (01.) • Modular designing is not achieved – modifications to the alarm unit cannot be separately done

Conclusion:

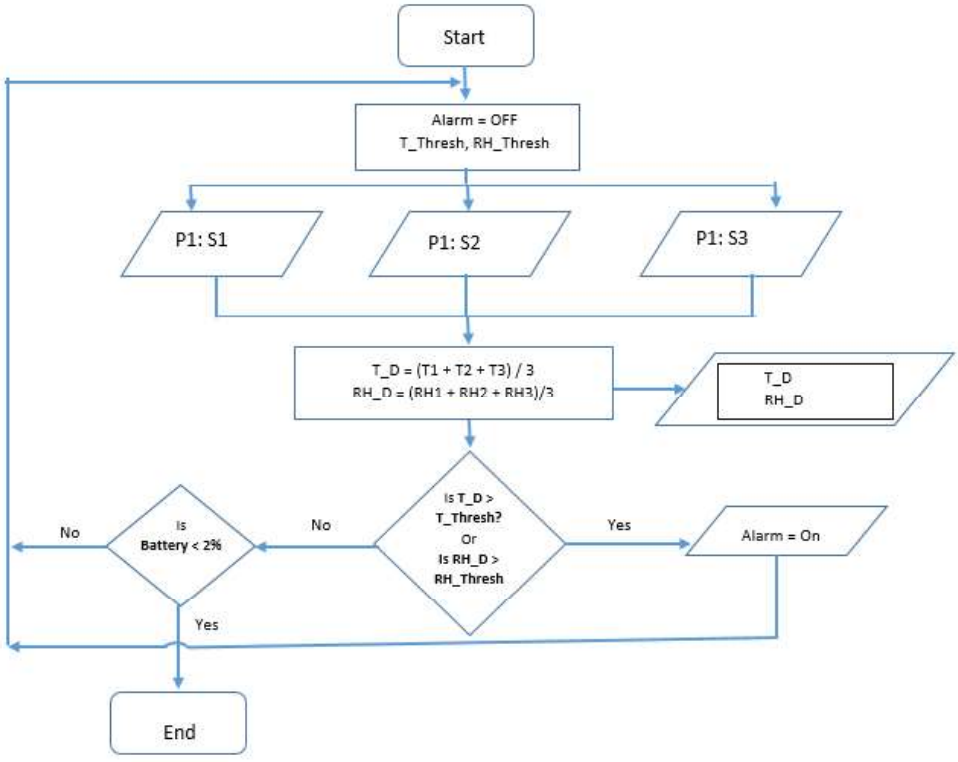
Since it is not feasible to have wires drawn between the display unit and alarm unit and that the farmers need to identify where the corresponding region is the conceptual design (02.) is chosen. Hence the Alarming unit will be embedded in the display unit chosen in the previous section and the buzzer and the light will be powered using the same 9V rechargeable battery used in display unit.

How do we do it? – Flow Charts (For one product)

Flow Chart 01



Flow Chart 02



Evaluation of the Flow Charts

Flow Chart	Advantages	Disadvantages
01	• Considers the temperature and the humidity at each point of the propagator (from 3 sensors installed) • Better accuracy in detecting the temperature and humidity exceeding the thresholds • Display showing the temperature and humidity for each sensor in the propagator	• Logics should be evaluated for each sensor in the propagator hence computationally heavy
02	• Computationally easy • A single value represents the temperature and the humidity of the propagator	• The alarm get triggered when the average exceeds the threshold – For longer propagators, assuming the temperature and humidity distribution is uniform might be erroneous • 2 of the sensors are redundant – this type of algorithm can be run using one sensor • Less Accurate

Conclusion:

Based on the information gathered from the interpreter, it would be great if we can read and display the temperature and humidity at three different points in the propagator. This helps the farmer to locate the region at which the temperature has risen above the threshold and rectify it at that region. Hence the most appropriate flow chart is the Flow Chart 01.

Apart from the main functionality, the product will sample the temperature and humidity values at each points hourly and store it in a SD card for further purposes.