Assistance and control system for Polyhouse Plantation

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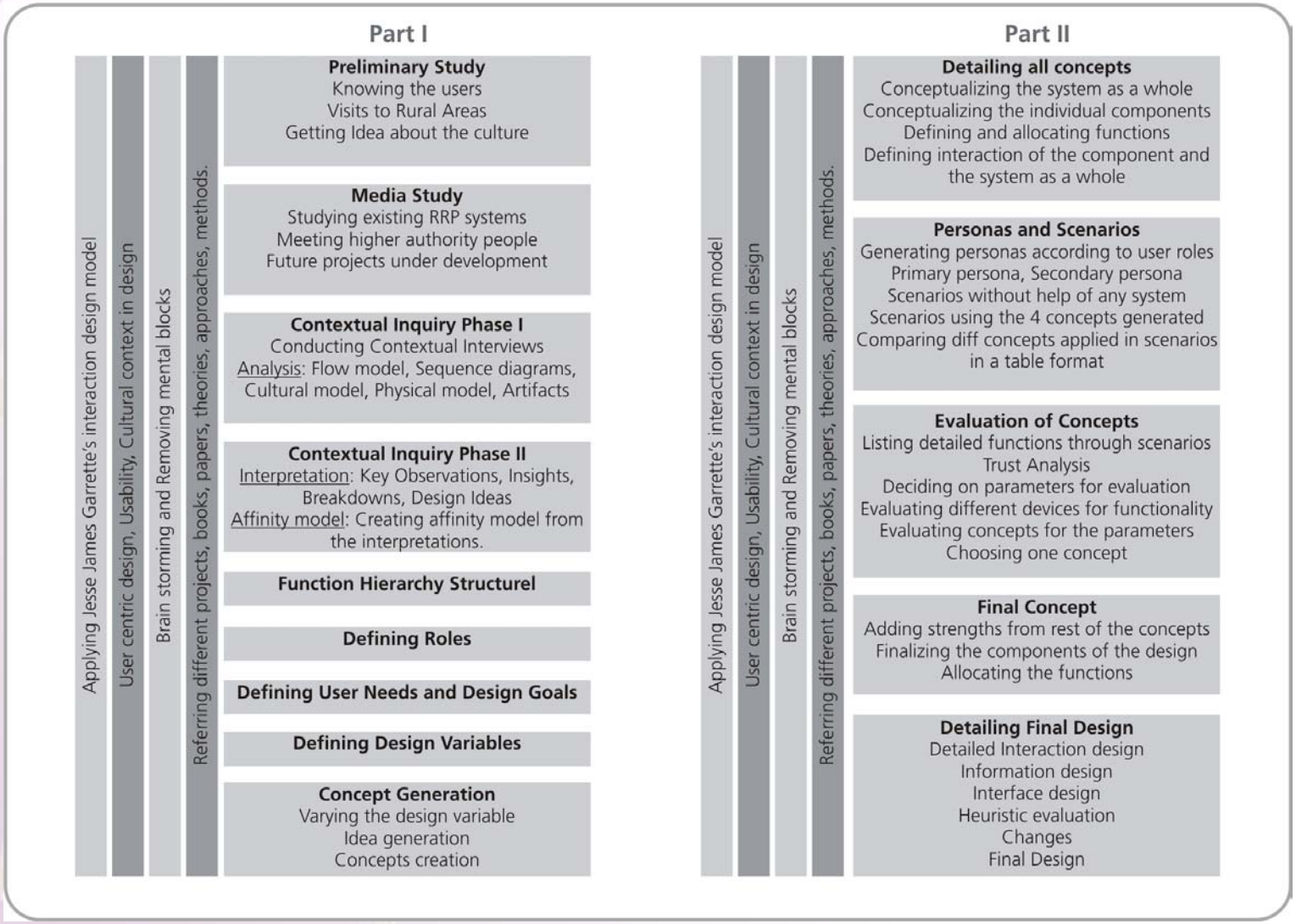
Project Objective

The objective of this project is to

- Help farmers in carrying out complex everyday tasks involved in Polyhouse Farming.
- Assist them in monitoring, irrigating, fertilizing, planning, maintaining, cultivating high profit oriented crops inside a Polyhouse which provides a controlled environment for farming.
- Providing assistance and backbone support in case of emergency situations.
- To help farmers with less experience and low education to use this complex hi-tech crop production.

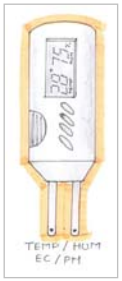
Process


Part I
Applying Jesse James Garrette's interaction design model
User centric design, Usability, Cultural context in design
Brain storming and Removing mental blocks
Referring different projects, books, papers, theories, approaches, methods.
Preliminary Study
Knowing the users
Visits to Rural Areas
Getting Idea about the culture
Media Study
Studying existing RRP systems
Meeting higher authority people
Future projects under development
Contextual Inquiry Phase I
Conducting Contextual Interviews
Analysis: Flow model, Sequence diagrams, Cultural model, Physical model, Artifacts
Contextual Inquiry Phase II
Interpretation: Key Observations, Insights, Breakdowns, Design Ideas
Affinity model: Creating affinity model from the interpretations.
Function Hierarchy Structurel
Defining Roles
Defining User Needs and Design Goals
Defining Design Variables
Concept Generation
Varying the design variable
Idea generation
Concepts creation
Part II
Applying Jesse James Garrette's interaction design model
User centric design, Usability, Cultural context in design
Brain storming and Removing mental blocks
Referring different projects, books, papers, theories, approaches, methods.
Detailing all concepts
Conceptualizing the system as a whole
Conceptualizing the individual components
Defining and allocating functions
Defining interaction of the component and the system as a whole
Personas and Scenarios
Generating personas according to user roles
Primary persona, Secondary persona
Scenarios without help of any system
Scenarios using the 4 concepts generated
Comparing diff concepts applied in scenarios in a table format
Evaluation of Concepts
Listing detailed functions through scenarios
Trust Analysis
Deciding on parameters for evaluation
Evaluating different devices for functionality
Evaluating concepts for the parameters
Choosing one concept
Final Concept
Adding strengths from rest of the concepts
Finalizing the components of the design
Allocating the functions
Detailing Final Design
Detailed Interaction design
Information design
Interface design
Heuristic evaluation
Changes
Final Design

Final concept based on evaluation

Mobile PDA (ONLINE)

- All offline / online functions
- Assist daily activities by giving alarms/ reminders.
- Real-time suggestions over changes in Temp/ Hum / EC / PH
- Precautions / help
- Integrating visuals / audio/ scribbles/ schedules to make case file/ documentation
- Connect to the expert system
- Communication with expert system
- Sending case files to experts
- Receiving answers from the experts
- Integrating visuals / audio/ schedules to make case file/ documentation
- Disease prediction system
- Disease database access
- Searching for references / contacts



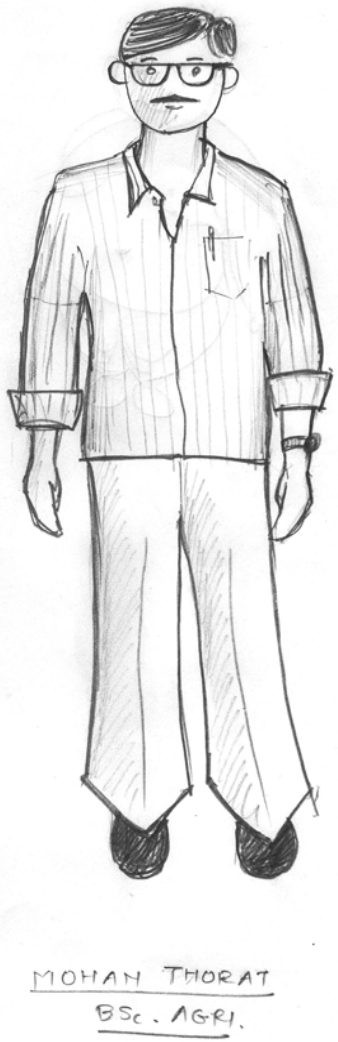
Temp / Hum / EC / PH Digital Meter

- Measuring Temp/ Hum/ EC/ PH
- Communicating the values to Personal Assistant

Persona A :

Name: Mr. Mohan Thorat

- Mohan comes from a village Chandoli near Manchar, District Pune.
- He is 29, married and stays in a joint family.
- His family is native of that place, and they are settled there since many generations.
- He spent his childhood in the village and learnt in Marathi medium school.
- Since childhood he was fond of going to his father’s fields and play in the lush green crops.



Persona A :

- Mohan’s thought he should now start practising the modern crop farming and develop their existing traditional fields.
- So Mohan did his graduation in agriculture and set up a polyhouse in his village. He started with 5000sq. ft. of polyhouse 7 years ago and today he has expanded them up to 1 acre.
- For the first polyhouse installation, he purchased a package deal from KF-Bioplants. He planted rose plants.
- After two years of polyhouse plantation he had enough experience and technical knowledge to expand the business. This time he decides to do it on his own to save the cost.
- As the time progressed, he went on expanding both the businesses.

Persona A :

Now about how much technical savvy Mohan is

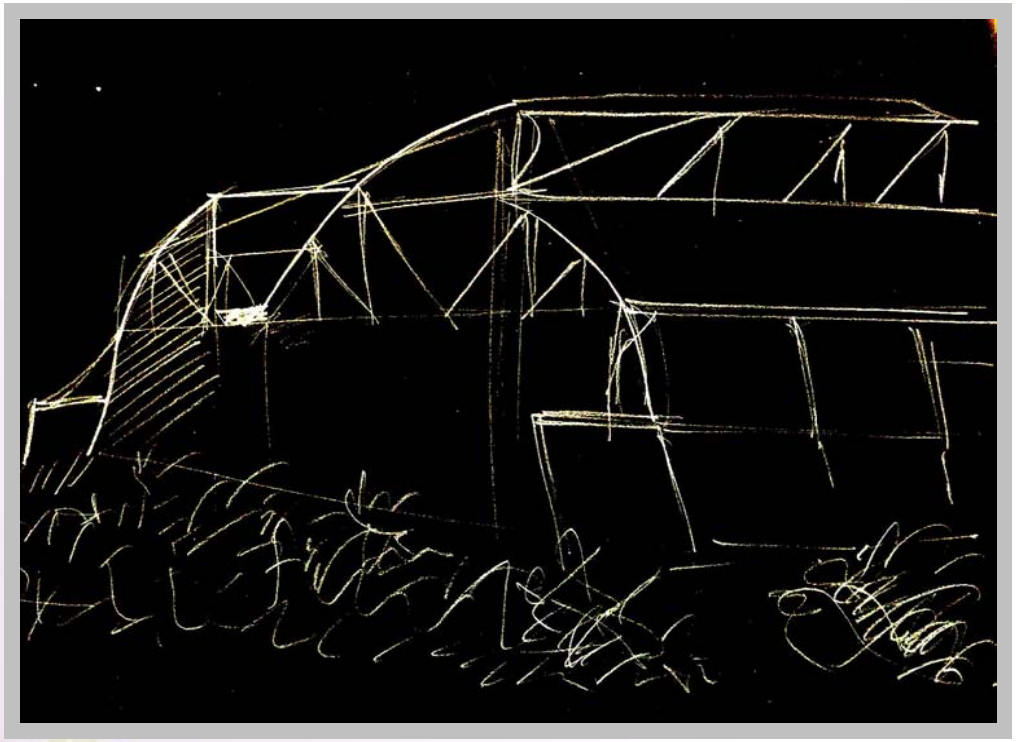
- Mohan uses a mobile phone since he started receiving mobile range in his the village.
- He uses a computer from 2 years for accounting.
- He knows about internet and wants a connection at his home, but currently it is not available in his village.
- He has ICICI bank account but he does not use ATM.
- He has a TV, Fridge, Music System, DVD player in his house. He can use all the required basic functions.
- He is good in understanding the biology behind a plants growth and uses his logic behind his activities.

Persona A :

Languages: Ratings Excellent / Good / Medium (with some difficulty) / bad
0 = can't do

Language	Speak	Read	Write	Meaning Understanding
Marathi (Mother tongue)	Excellent	Excellent	Good	Excellent
Hindi	Medium	Good	Medium	Good
English	Bad	Good	Medium	Good

Before scenario : Mohan Thorat



Mohan has planned roses in his polyhouse 5years back

Before scenario :

Because of his efforts and care that all the plants are survived till now and all of them are healthy.

Before scenario :

Today he calls up his exporter and finds the rate of flowers.

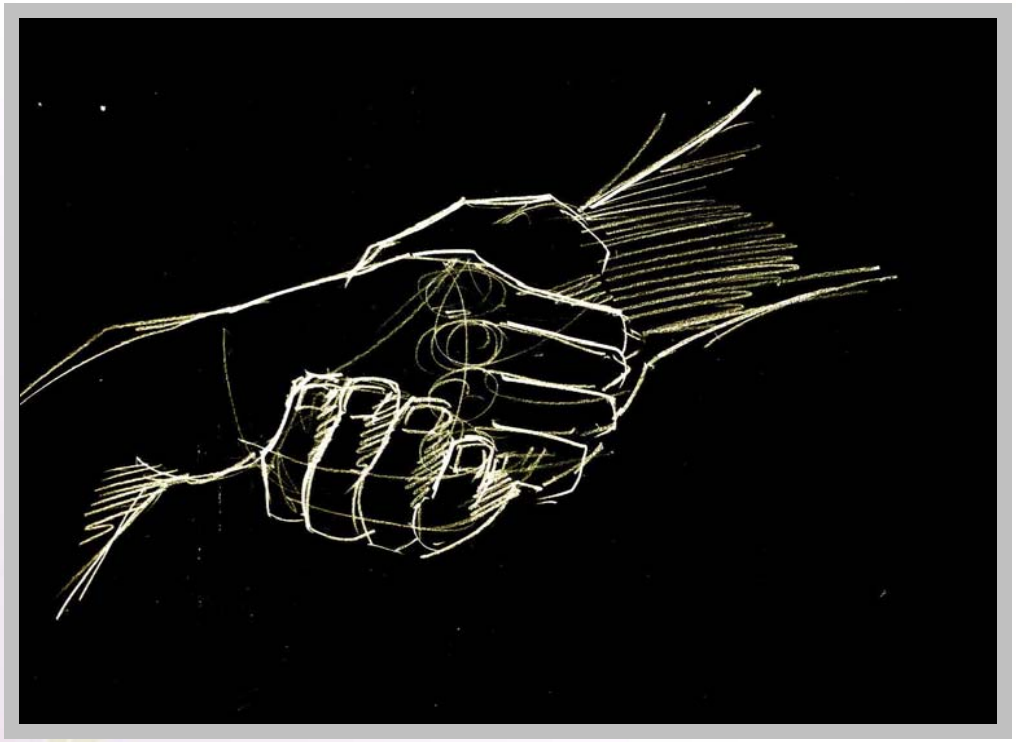
Exporter says only 2 Rs per flower.

Only 2 Rs?

Yes, but you will soon be fortunate to get good rates. Its November started now. Valentines Day is 3 months away.

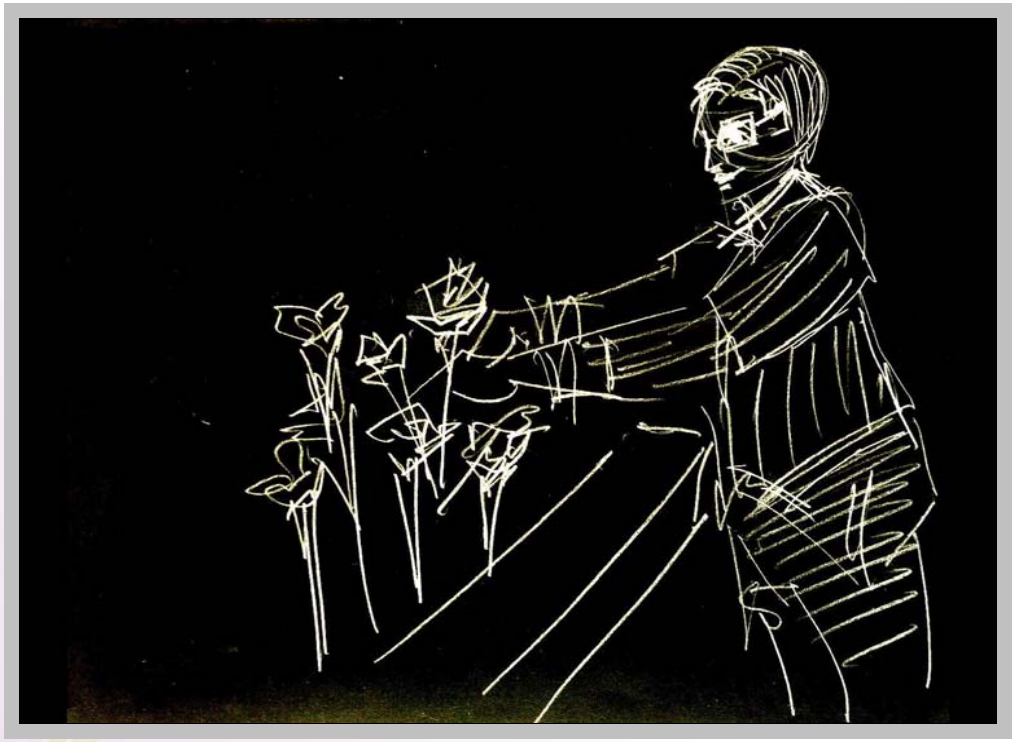
If you give me large quantity of good flowers, I'll give you 10 to 12 Rs per flower at that time.

Before scenario :



Thus Mohan makes a deal with his exporter for sending 25000 closed rose flowers in the 2nd week of February.

Before scenario :



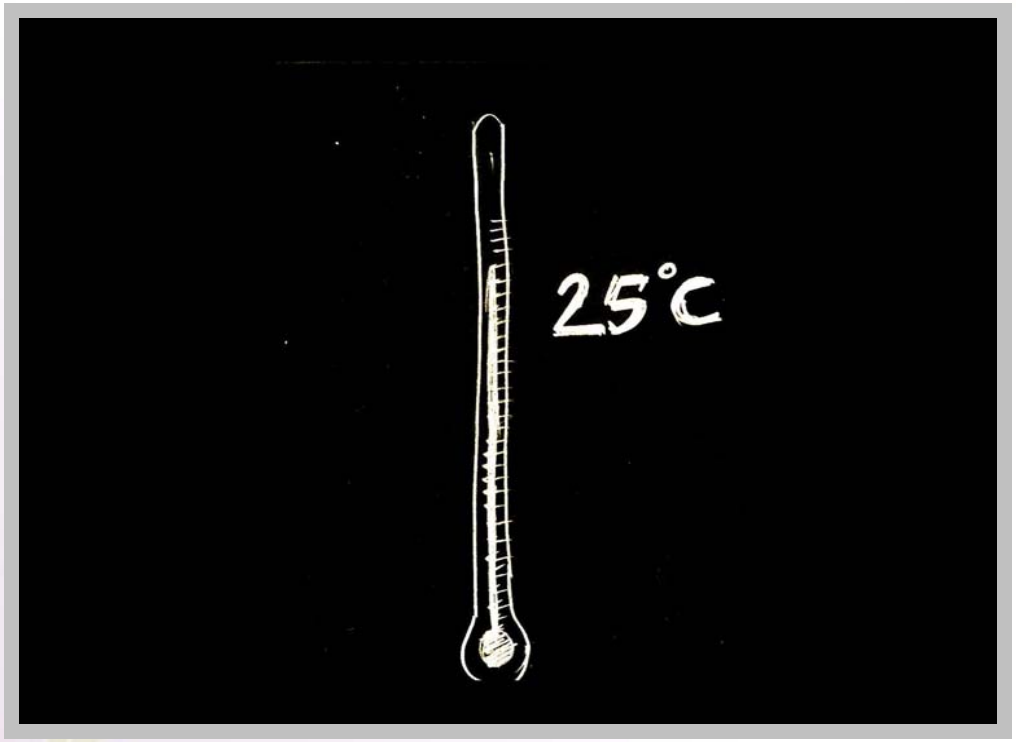
He goes around in the polyhouse and checks the plants.

Before scenario :

He finds that many plants do not have strong shoots to bear 3-4 flowers.

For sending 25000 flowers each of the 3000 plants must give approximately 8-10 good flowers with long stem. He calculates in his mind.

Before scenario :



He decides to give plants rest for 2 months to make shoots stronger.

He keeps low temperature which facilitates stem growth and reduces flowering

Before scenario :

If a flower grows, he bends the stem, cuts the flower off, it is worth throwing a flower now to get 2-3 flowers from the same shoot during Valentines Day season.

Before scenario :

He plucks leaf below the bent and after 2-3 days new 2-3 shoots start growing.

Thus for 2 months he does not allow flowers to grow. He lets the no. of shots increase and grows strong & healthy. So, that each can bear 2-3 flowers.

Before scenario :

2 months are over by now, after 3 weeks he has to start delivering flowers.

Now he stops the rest period and keeps the temp little higher so that flowering starts.

Before scenario :

Ratings Excellent / Good / Medium (with some difficulty) / bad

0 = can’t do

Before scenario :

He turns on the halogen lamps to increase temp. To let the plants begin flowering.

Before scenario :

He gets the soil testing report.
He sees that,
EC
Nitrogen
Potasium
Sodium
Calcium are slightly high.

He adds 0:0:50 K 160 gm in the existing 14:6:24 schedule.

He adds CaNO3, 300 gm once a week to compensate Calcium & nitrogen.

He thus makes changes in his schedule.

He observes that some of the leafs have gave blacken.
It may deficiency.

He adds 2% magnesium sulfide in his daily schedule.

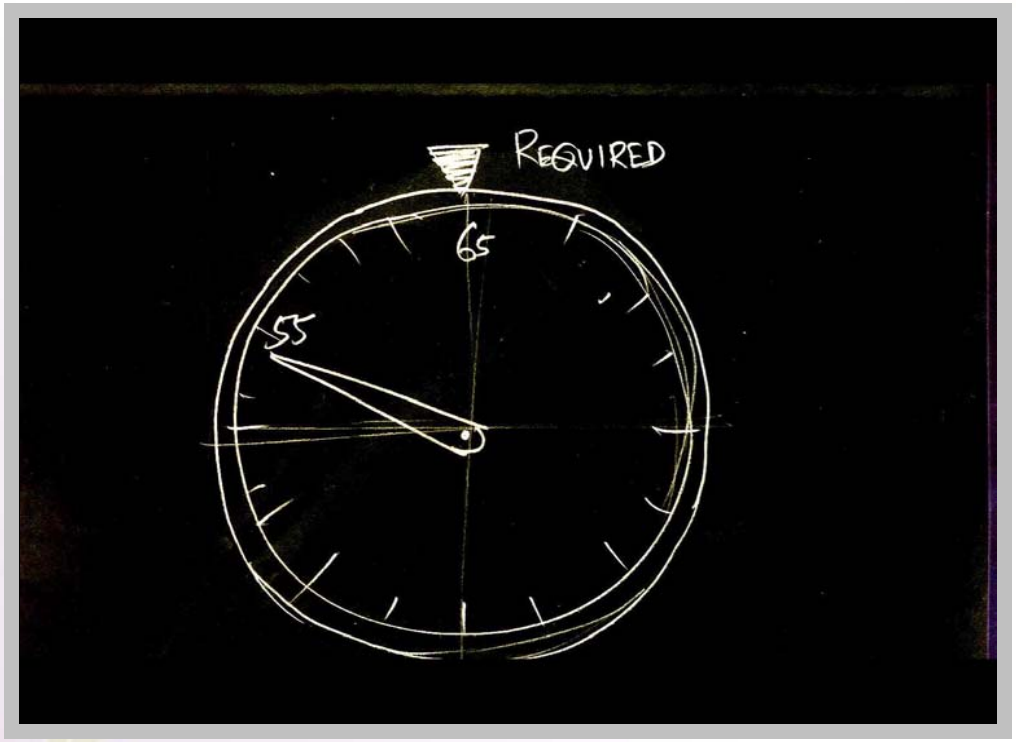
Before scenario :

His day begins,

1…
2…
3…
4…
5…
6…
7…
8….
9….

So many different chemicals and insecticides per day.

Before scenario :



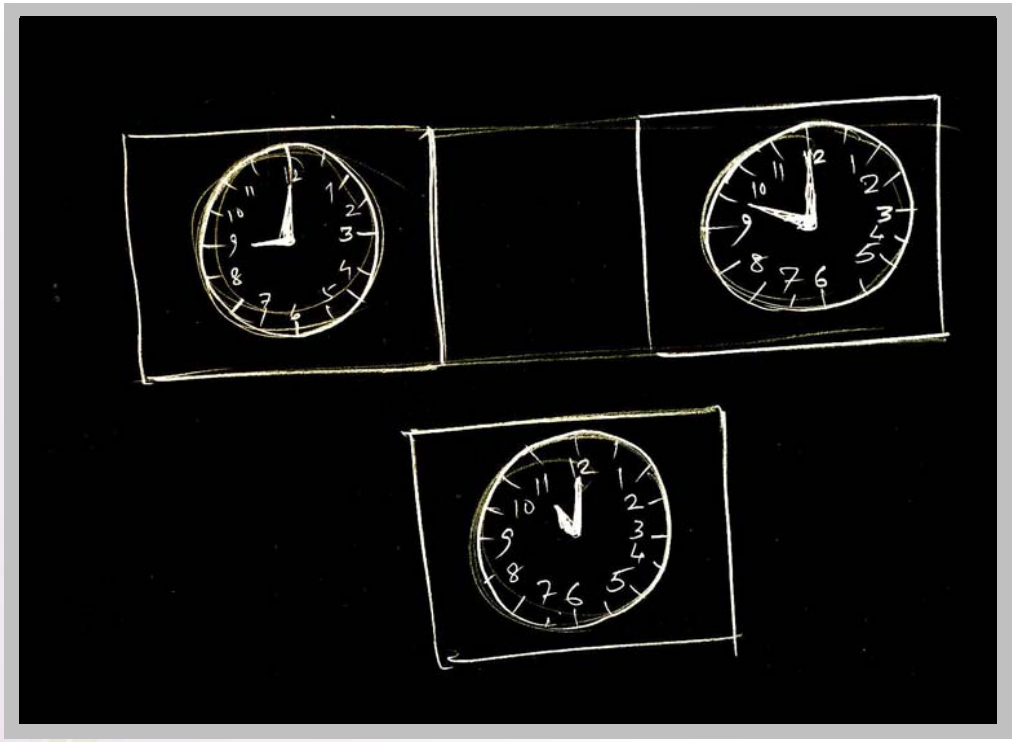
Hum. is low today. It’s dry weather.

Before scenario :

Turns on foggers for 5 min.

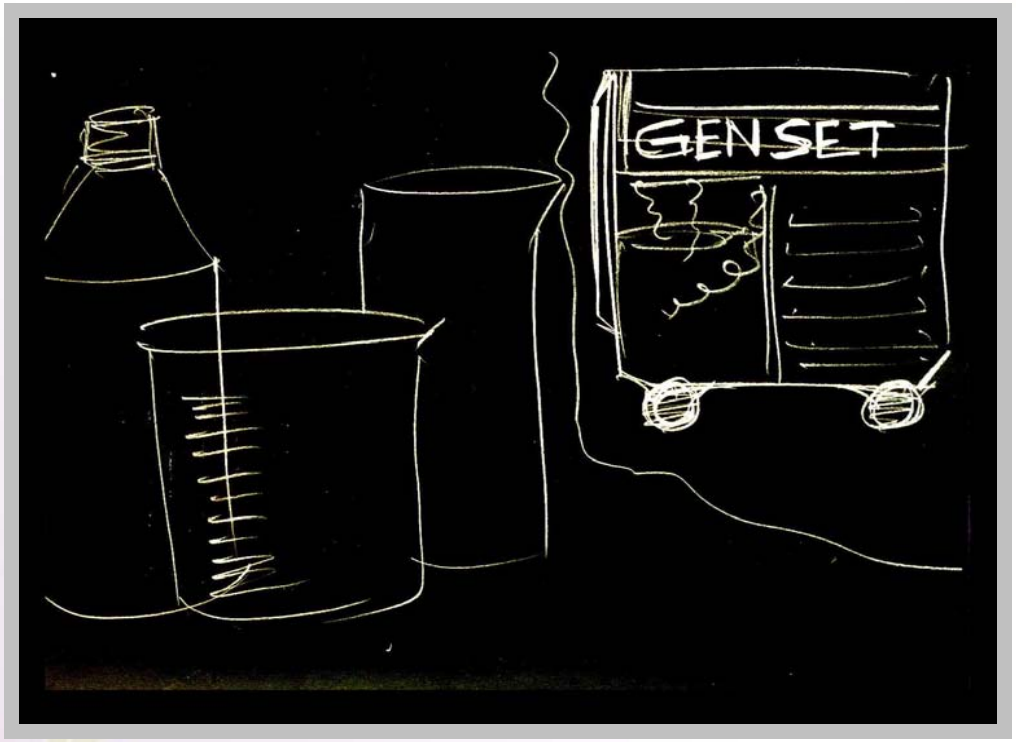
After ever hour he runs it for 2-3 min to maintain humidity.

Before scenario :



The last week.. The routine is going to be fast

Before scenario :



He keeps stalk of fertilizers, water & electricity(generator backup) ready.

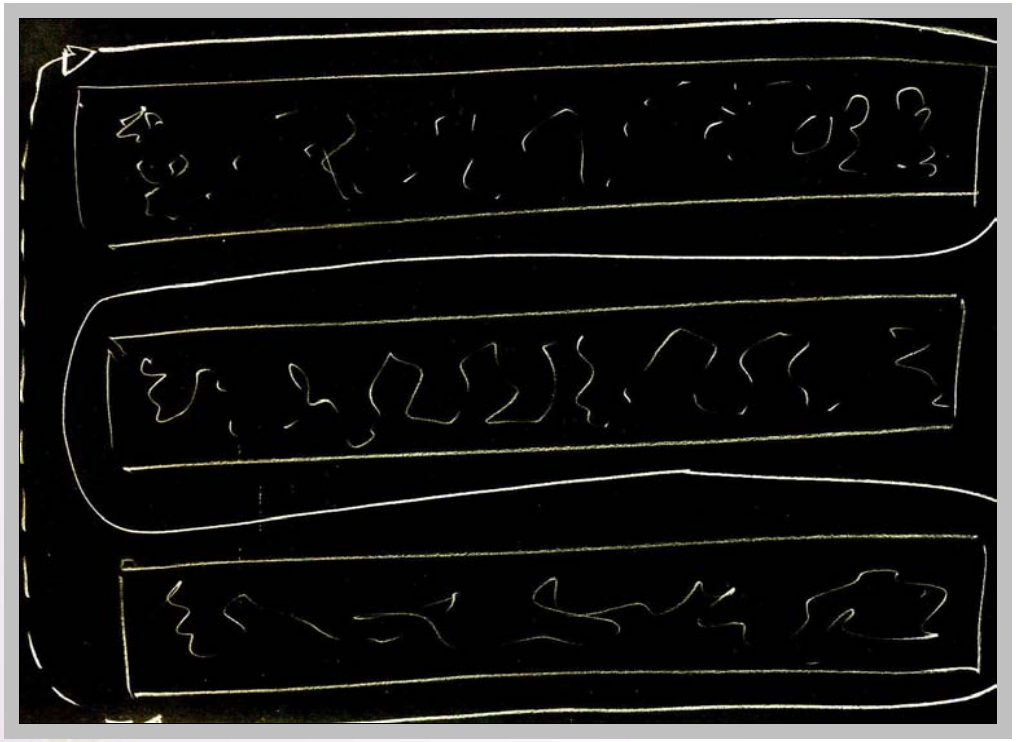
Before scenario :

The work is fast.

Temp is max.

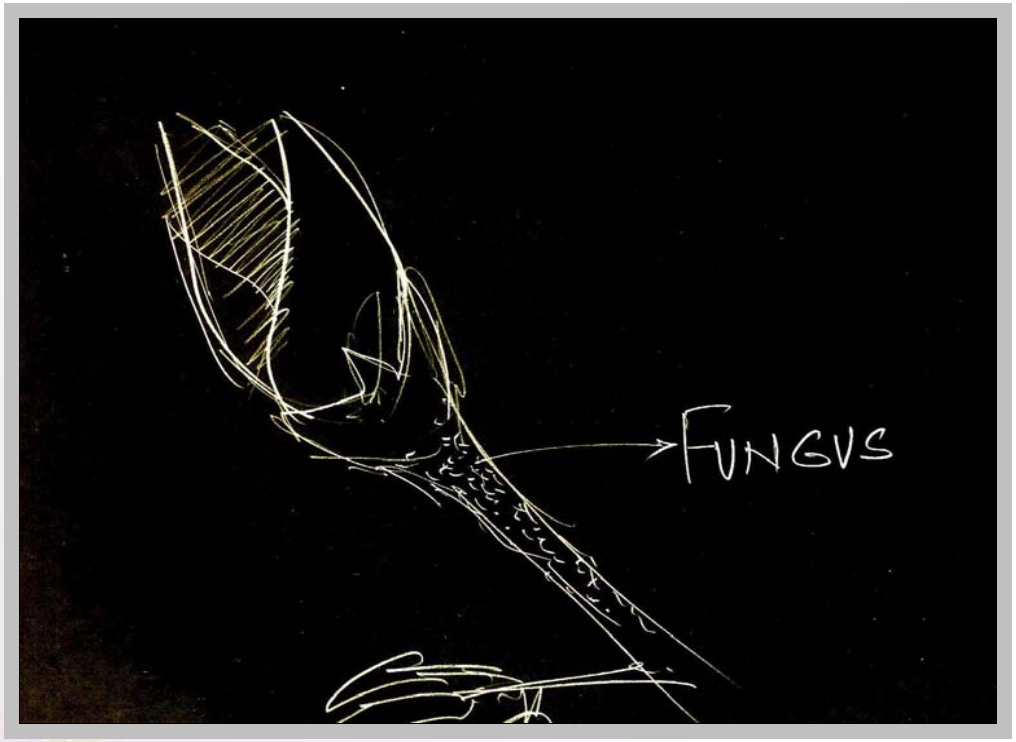
Growth is fast.

Before scenario :



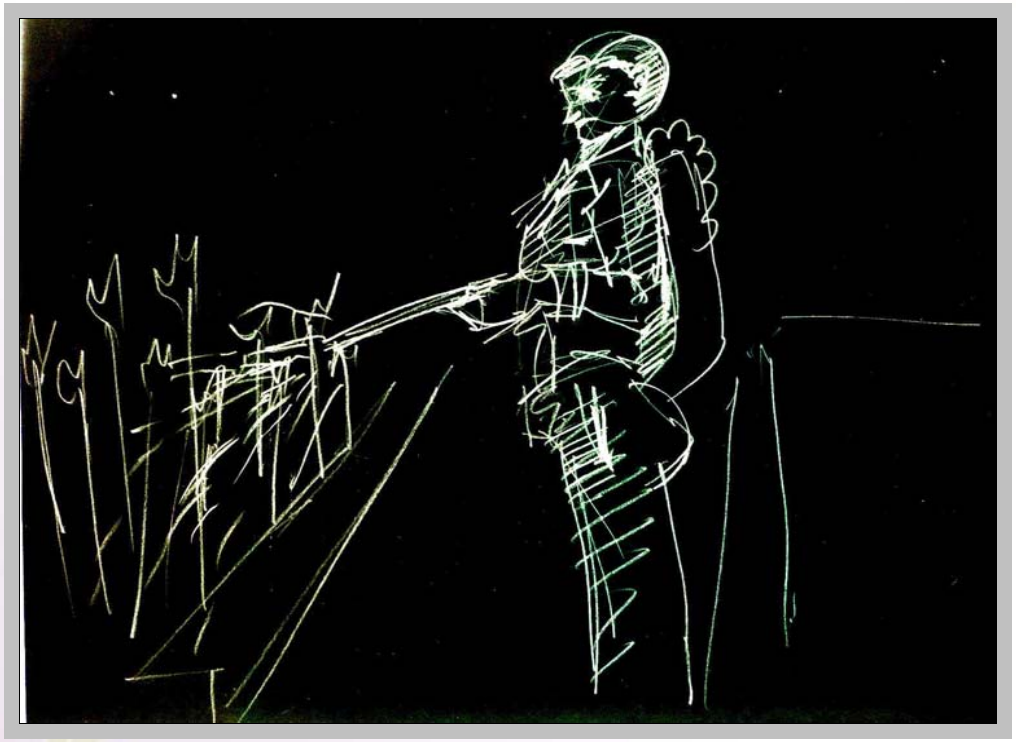
His servants start from one end to other again starts from beginning to cut flowers.

Before scenario :



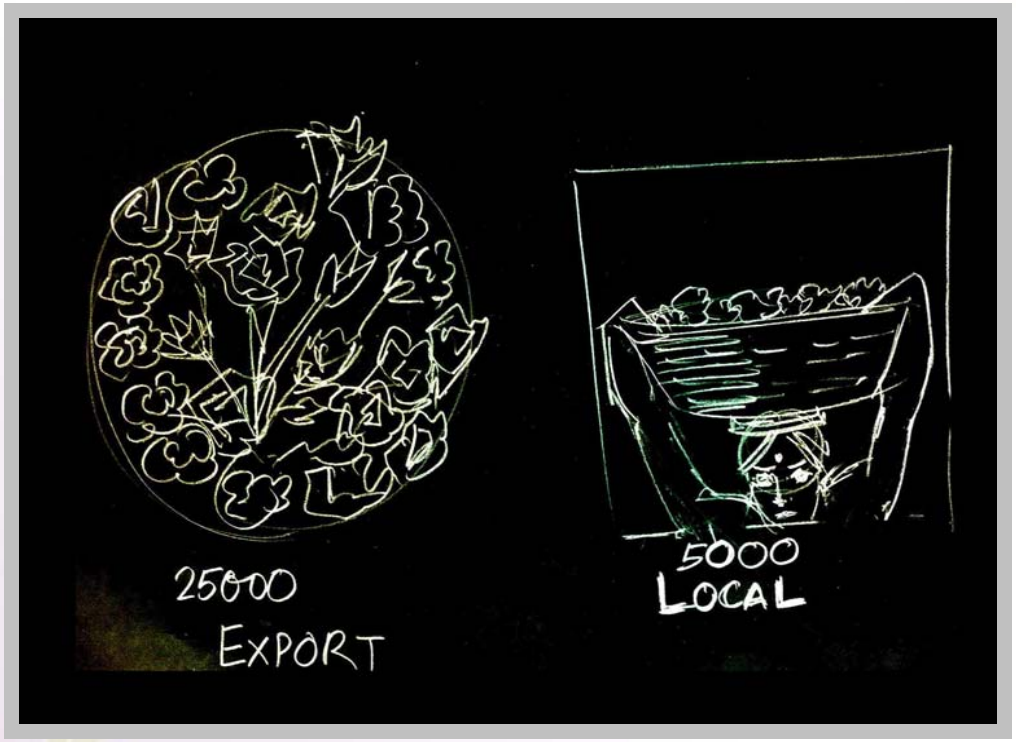
Suddenly he notifies amount of white fungus on some of the flowers.

Before scenario :



He immediately tells the workers to stop for the day and do insecticide spraying. He reduces the temp for delaying growth till next day.

Before scenario :



Next day he again increases temp and starts working normally. He could complete the order.

In the total 30000 he produced 5000 were slightly of lower quality, because of the fungus. Still he could complete the promised order of 25000 flowers.

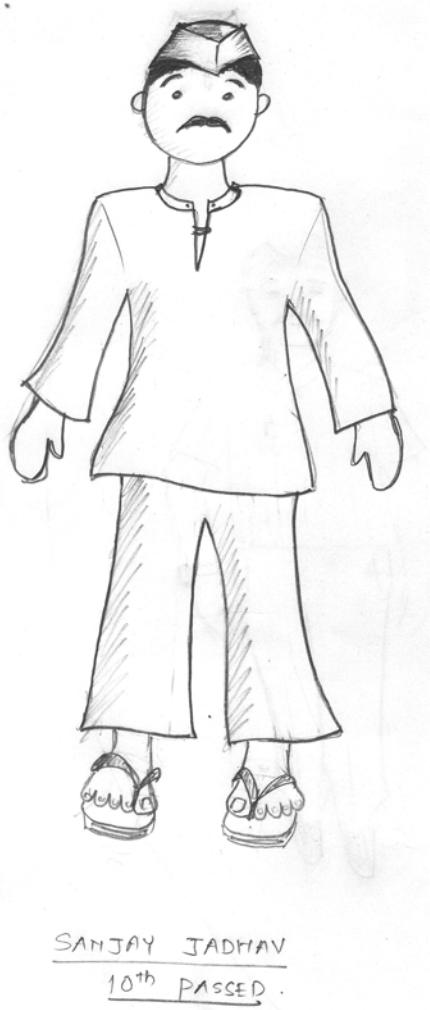
He sends the 5000 flowers to the local market.

Before scenario :

Persona B :

Name: Mr. Sanjay jadhav

- Sanjay comes from a village Dhamani near Rajgurunagar, District Pune.
- He is 34, married and stays in a joint family.
- His family is native of that place, and they are settled there since many generations.
- He spent his childhood in the village and learnt in Marathi medium school.
- Sanjay studied till 10th standard in the village Marathi medium school. Then he joined his father in his traditional farming business.



Persona B :

- Sanjay has total 6 acres of land. Out of which 4 acres are for sugarcane. He is a member and shareholder of Bhimashankar co-operative sugar factory. The sugar factory takes all his sugarcane every year at pre-decided rate.
- Sanjay has sufficient water for his 4 acre sugarcane farm. Sugarcane requires more water than other plants. He also has electricity supply in his farm, to run pump on his well.
- The remaining 2 acres, he uses for rose plantation.
- Although he has rose plantation over 2 acres and market demand for roses is consistent over the years, he cannot earn good margin. Because the flowers he produce are sold in the local market.
- To produce export quality flowers, plants need well nutrition, fertilisers and suitable climatic conditions. He is not converting this land into sugarcane farm, because he thinks the water available might not be sufficient for 6 acres of sugarcane.

Persona B :

- To get a good yield he must feed the plants properly, keep them disease-free and provide protection from external factors. Well, since he is not very educated, he has difficulty to understand the scientific information related to farming.

- He produces good crop in sugarcane farming, because sugarcane does not require much care other than watering them regularly. It follows the traditional farming methods which he has seen since childhood.

- He was surprised about Mohan’s Polyhouses in Chandoli. He has seen the quality of flowers and the quantity produced in that small area of land. Mohan produces 3 to 4 times more flowers than him. And also sells them at higher price for export market. That too in a very limited land.

Persona B :

- He has a TV, cassette player with radio and a local made MP3 CD player in his house. He can use the basic minimal functions. Beyond the basic functions, he does not even know what else the device can do.

- He knows where in his locality one would find mobile phone range.

Languages: Ratings Excellent / Good / Medium (with some difficulty) / bad

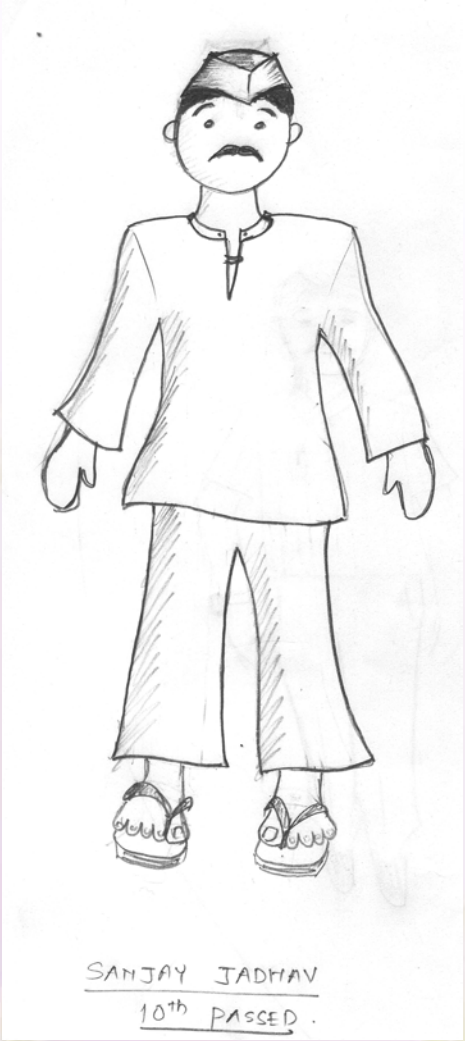
0 = can't do

Language	Speak	Read	Write	Meaning Understanding
Marathi (Mother tongue)	Good	Good	Medium	Good
Hindi	Bad	Medium	Never done	Medium
English	0	Medium	0	Bad

Design Brief :

- Device should work for people with low experience and education factor.
- It should provide updates on Daily schedule / Weekly activities / monthly activities based on changes in soil and climate
- It should measure Temperature, Humidity, sunlight and give necessary warnings and alerts
- Can be Operated by low-educated users like Sanjay.
- The executers should be able to work in the absence of supervisor/consultant
- Emergency disease treatment information / communication with remote consultant
- Help in tasks like Water / Resources management
- Provide data analysis to help farmer in predicting crop production, selecting better crops, comparing and combining different crop plantations together and thus provide flexibility to farmers.

After scenario :



Sanjay Jadhav

Polyhouse since 1 year

Consultant : Prof. Thigale, DCN Rajgurunagar

Assistance : **My Device**

After scenario :

In last few weeks, the Rose flower rates were very low in the market, around 2-3Rs a flower

Sanjay is worried and calls up his consultant Prof. Thigale.

S: " Saheb, The market rate is very low these days… I am worried"

T: "Yes, that's true… but this is off season… and you will be soon fortunate to get very good rates… valentines day is just 3 months away"

S: Oh, ok. So what should I do till that time?

T: "Ah, you can give your plants rest for 2 months. Let them grow stronger and healthier… so that they will be able to bear maximum flowers when rates are highest…"

After scenario :

New schedule recieved

Prof. Thigale sends him a new schedule for Rest period.

Sanjay confirms the reception by clicking OK on his assistant.

After scenario :

Sanjay Recieves beep alert and the Future Requirement menu opens and blinks…

Sanjay checks for the new chemicals to be purchased.

Goes to the fertilizer shop with device, shows him the list and bys chemicals.

Navigation features-

Simple Navigation-

Less Hierarchy- info pushed upward

The Blinking-

Auto updating / adding

Visual aid-photos-

Calculated quantities-

Future Requirements

....

....

other materials

click ok to see further information

After scenario :

Sanjay Recieves beep alert and the Today's Tasks menu opens and blinks…

Sanjay does the task and says "completed"… acknowledges the instruction.

Acknowledgement from the user-

Simple Navigation-

Less Hierarchy- info pushed upward

The Blinking-

Auto updating-

Visual aid-photos-

Today's tasks
...
...
...

Today's tasks
...
Is the task completed ?
complete/incomplete

After scenario :

The process goes on, and thus the device guides him for every step.

It also guides him about the handling instructions and care taken.

It describes the process in detail with visuals

Today's tasks
...
...
...

Today's tasks
...
Is the task completed ?
complete/incomplete

After scenario :

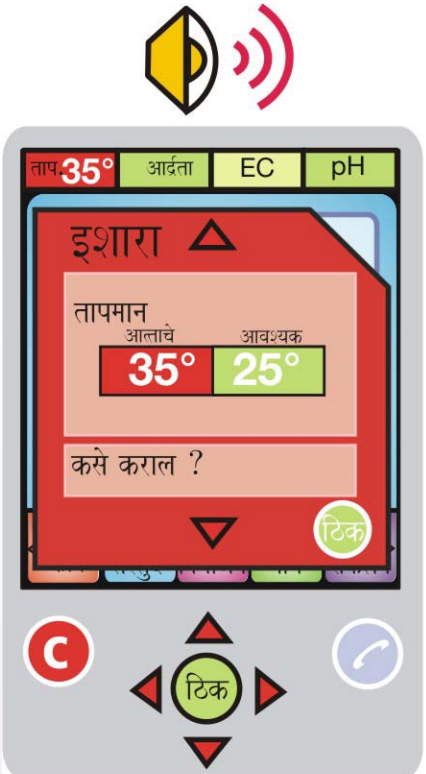
Temp in the polyhouse is higher than the required.

The temperature required for rest period is low… the device gives him warning about the existing and required condition.

Modal messege

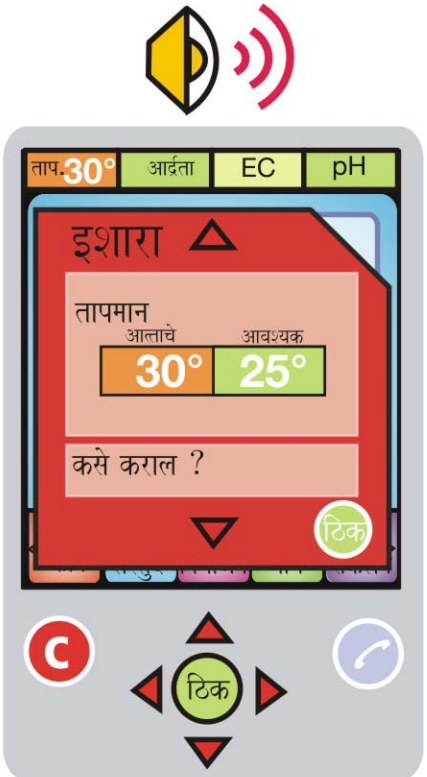
The temp-hum-EC-pH indicator

It describes the process in detail with visuals



Warning: Temperature out of range !
temp
Current Required
35deg 25deg

How to reduce?



Warning: Temperature out of range !
temp
Current Required
30deg 25deg

How to reduce?

After scenario :

2 months are over and rest period is stopped. The device alerts him to send soil for testing.

Send soil for testing

...

...

...

After scenario :

Sanjay gets new schedule for the last month.

New schedule recieved

After scenario :

The device alerts him about the new chemicals to be bought

Future Requirements
....
....
other materials

click ok to see further information

After scenario :

Sanjay begins with new routine, and follows the instruction as given.

He finds that the lives are blackened at the edges…

He contacts Mr. Thigale.

Today's tasks
...
...
...

Today's tasks
...
Is the task completed ?
complete/incomplete

After scenario :

Thigale tells him to use the feature “ problem Compilation” and send him photographs of the leaves.

Sanjay follows the process.

problem compilation

click a snap...

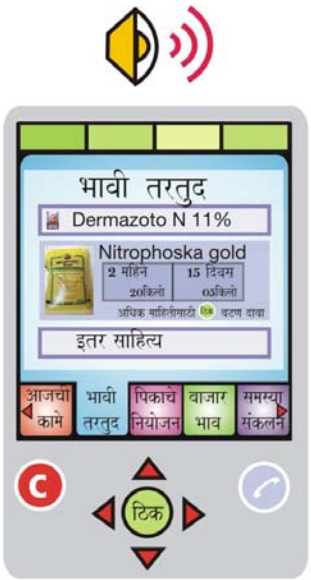
problem compilation

click one more ?

After scenario :

Sanjay receives modified schedule from Thigale. He buys the chemicals and starts following the instructions.

New schedule recieved



Future Requirements
....
....
other materials

click ok to see further information

After scenario :

The valentines day is over… Sanjay produced 25000 flowers, all of them were exported… at rate of 10Rs. Per flower.

Sanjay is now confident about his business.

He now frequently checks market information updates, starts using some more features of the device like disease prediction updates etc.

After scenario :

The device has a WLL connectivity… Sanjay now started using the phone feature to make calls… cause the rates for calling has gone cheap in his region.

make phone call

Type Number
or
choose from list

Calling

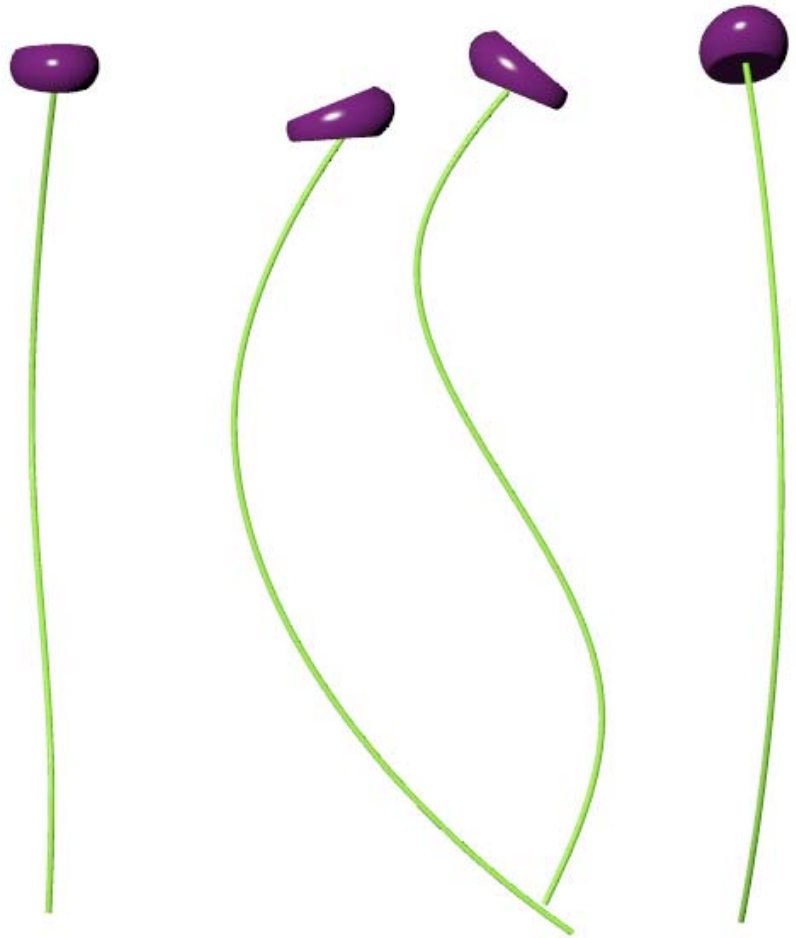
Connected.
click phone button to
disconnect

Form Design : The coolest part of the project

The temperature-humidity-EC-pH meters

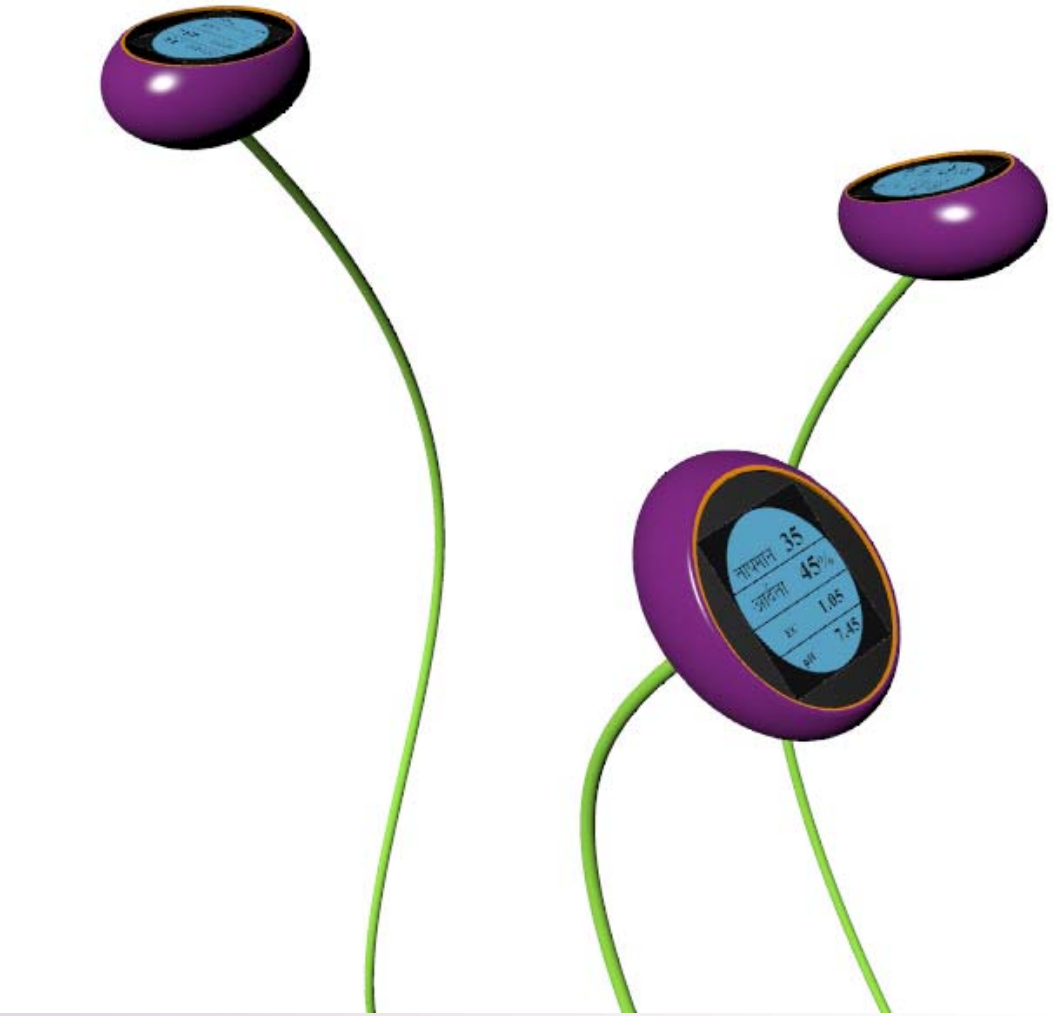
Form Design : The coolest part of the project

The temperature-humidity-EC-pH meters



Form Design :

The temperature-humidity-EC-pH meters



Form Design :

The temperature-humidity-EC-pH meters

Form Design :

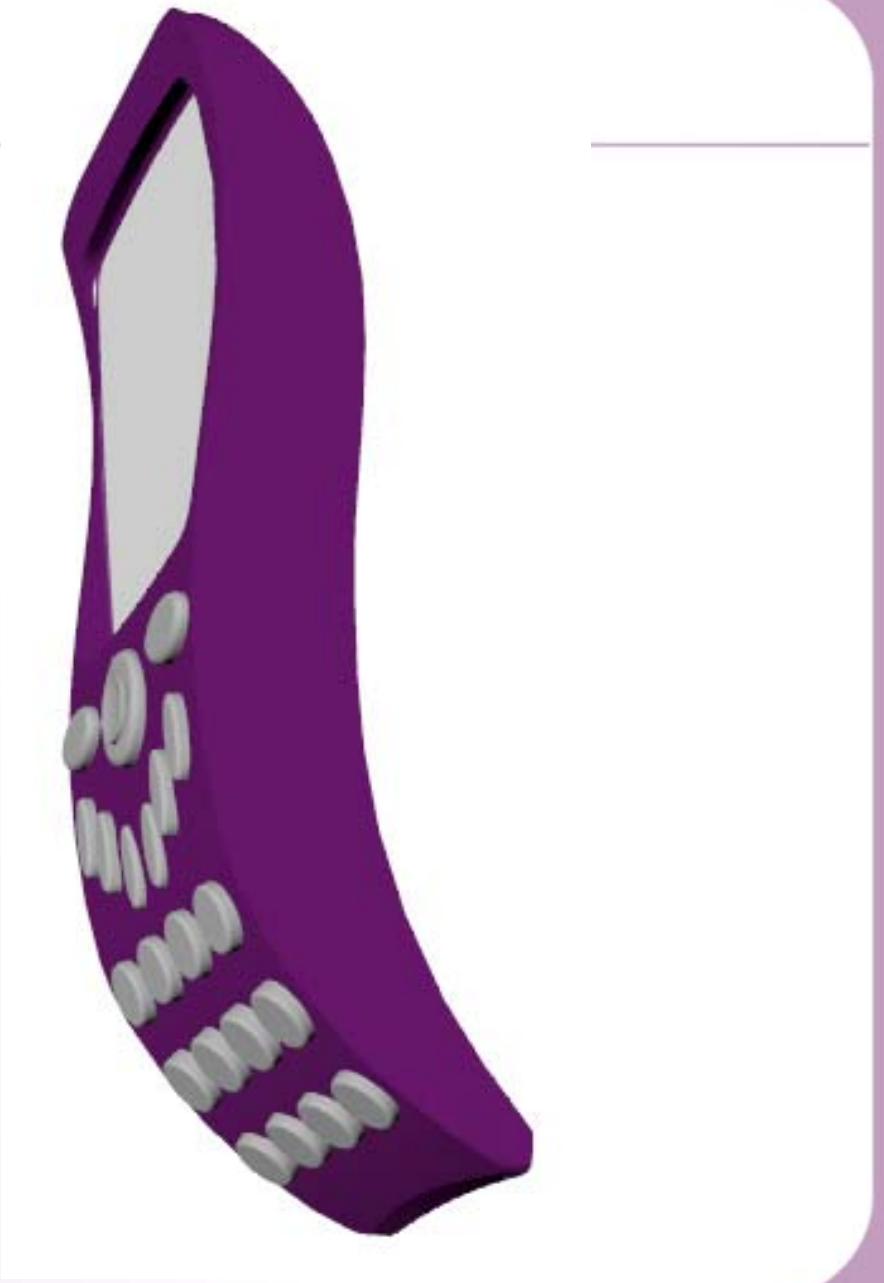
The Assistant Device:

Form Design :

The Assistant Device:

Form Design :

The Assistant Device:



Thank You

The inspiration and initiation for this project has been my Project guide **Prof. Anirudha Joshi** and I am thankful to him for his invaluable guidance and inspiration throughout the project.

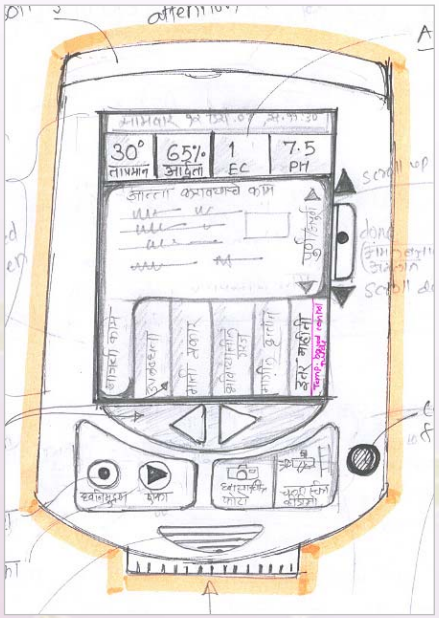
Also I am grateful to Prof. Chaugule (Agriculture College Pune), Soil analysis Lab (Krishi Bhavan, Pune), Dr. Y. S. Nerkar (Director of Research, VSI), Vigyan Ashram (Pabal), Krishi Vigyan Kendra (Baramati), Media Lab Asia (IIT Bombay).

Also I thank users I interviewed especially, Mr. Mohan Thorat, Sangita Kale, Namdev kale, Prof. Thigale (Agriculture officer, District Central Nursery, Rajgurunagar) for giving me useful information and feedback.

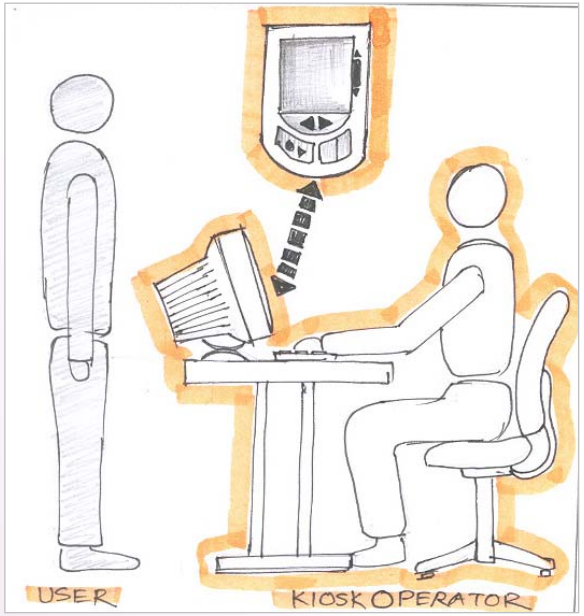
Thanks to all IDC faculties, staff and my classmates, especially Pranav, Amisha, Priti, Shilpa, Anchal, Samraat, Chitranshi, Sushil, Sanket, Preetal for their support and help.

Thank You

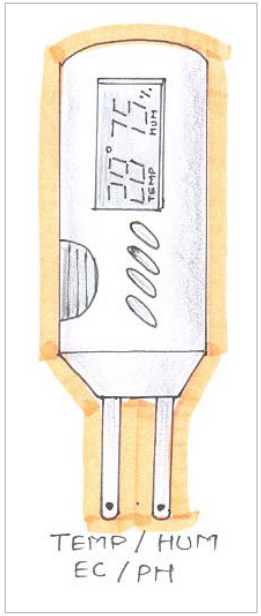
Concept 1



Dedicated personal Assistance (OFFLINE)



Shared Kiosk (ONLINE)

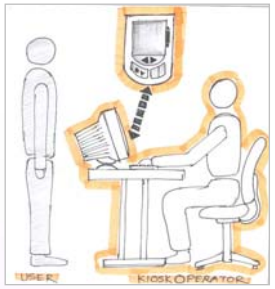


Temp / Hum / EC / PH Digital Meter

Concept 1 Functions:

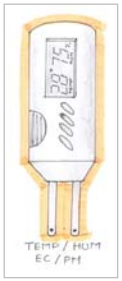
Dedicated Personal Assistance (OFFLINE)

- All functions which does not require network connection
- Assist daily activities by giving alarms/ reminders.
- Real-time suggestions over changes in Temp/ Hum / EC / PH
- Precautions / help
- Making changes in the schedule according to changes in Temp/Hum/EC/PH
- Integrating visuals / audio/ scribbles/ schedules to make case file/ documentation



Shared Kiosk (ONLINE)

- Connect to the expert system
- Communication with expert system
- Sending case files to experts
- Receiving answers from the experts
- Video conferencing with experts
- Disease prediction system
- Disease database access
- Searching for references / contacts
- Transfer information to Personal Assistant.

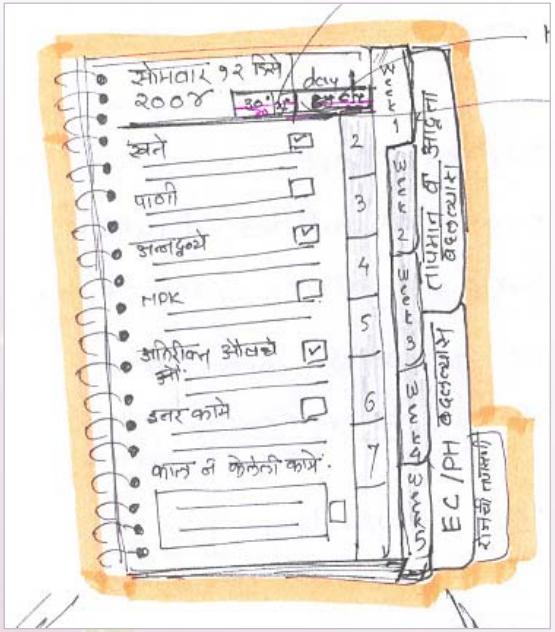


Temp / Hum / EC / PH Digital Meter

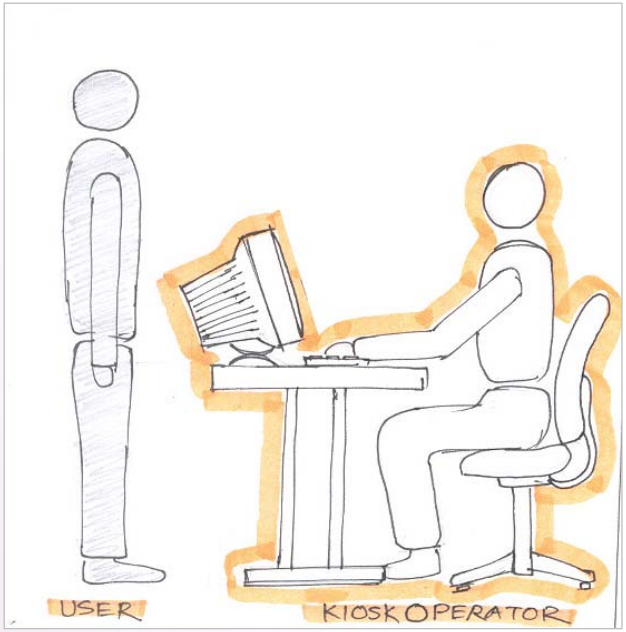
- Measuring Temp/ Hum/ EC/ PH
- Communicating the values to Personal Assistant

.

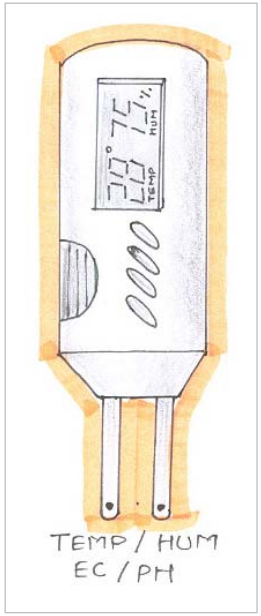
Concept 3



Printed Schedule Booklet

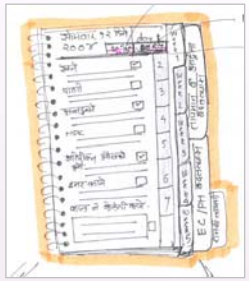


Shared Kiosk
(ONLINE)



Temp / Hum / EC / PH
Digital Meter

Concept 3 Functions:



Printed Schedule Booklet

- Assist daily activities by giving daily schedule in reference booklet format.
- Suggestions over changes in Temp/ Hum / EC / PH
- Precautions / help
- Data is updated by changing the printed leaves at shared kiosk.

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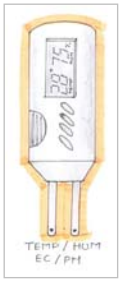
Shared Kiosk (ONLINE)

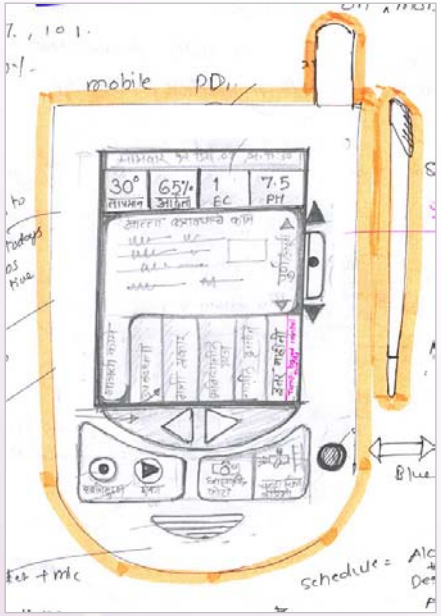
- Connect to the expert system
- Communication with expert system
- Sending case files to experts
- Receiving answers from the experts
- Integrating visuals / audio/ scribbles/ schedules to make case file/ documentation
- Video conferencing with experts
- Disease prediction system
- Disease database access
- Searching for references / contacts
- Printing the information



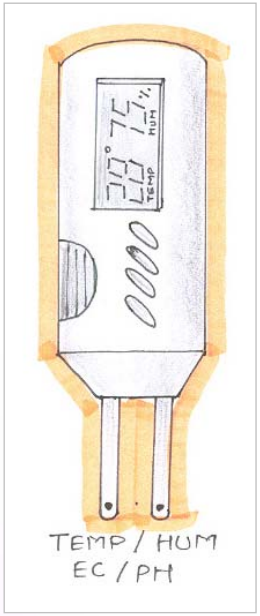
Temp / Hum / EC / PH Digital Meter

- Measuring Temp/ Hum/ EC/ PH

Concept 4



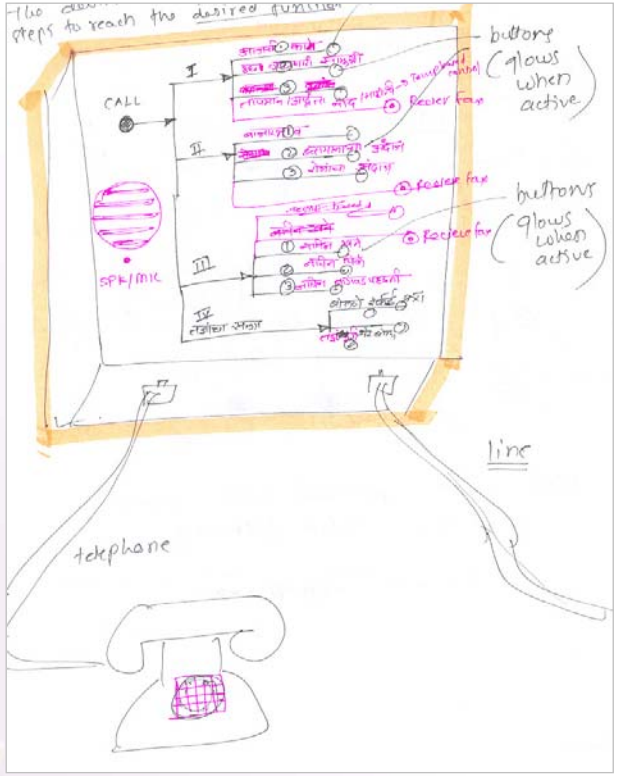
Mobile PDA based Software (ONLINE)



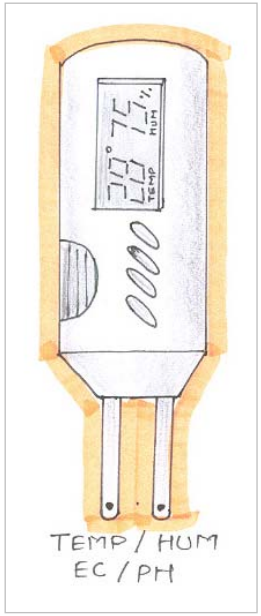
Temp / Hum / EC / PH Digital Meter

Concept 5

Telephone / FAX



Visual aid for telephone based audio interface

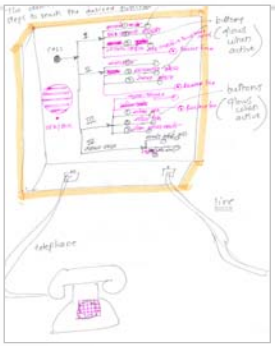


Temp / Hum / EC / PH Digital Meter

Concept 5 Functions:

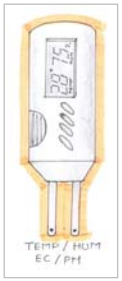
Telephone / FAX

- Calling an expert.
- Assist daily activities by receiving telephone based help.
- Communication with expert system
- Sending requests for information
- Receiving answers from the experts as FAX-ON-DEMAND.
- Audio conferencing with experts
- Printing received FAX–ON-DEMAND received answers.



Visual aid for telephone based audio interface

- Provide visual conceptual model for the telephone based interface.
- Sending audio recordings of problems to expert system
- Sending requests for information
- Retriving / storing / playback of audio messeges
- Provide function shortcuts for direct access of information.



Temp / Hum / EC / PH Digital Meter

- Measuring Temp/ Hum/ EC/ PH
- Communicating the values to Personal Assistant

Evaluation of concepts:

Deciding on Parameters other than usability, economy and functionality for Evaluation

Trust Analysis to get parameters like:

- Familiarity in interaction
- Direct interaction with expert
- Ability to produce personalised information
- Ability to develop personal relation with expert
- Familiarity in Media

Evaluation of concepts: functionality

	FUNCTION \ AVAILIBILITY	Ded. Pers device	Kiosk	Print Schedule	mobile PDA	Tel interaction	TeleFax	Vis/aud aid	Temp/Hum/EC/PH	Concept 1 Ded pers device + kiosk	Concept 3 Print + kiosk	Concept 4 Mobile PDA	Concept 5 TelFax + vis/aud aid
1	Display daily actiities / schedule	1	1	1	1	1	1	1		1	1	1	1
2	Alarms/ reminders for daily activities	1			1			1		1		1	1
3	Warning alerts	1			1		1	1		1		1	1
4	Realtime suggestions oer changes in Temp/ Hum / EC / PH	1			1			1		1		1	1
5	Give calculated results (Black box approach)	1			1					1		1	
6	Giving calculated / statistical crop prediction	1			1					1		1	
7	Connect to the expert system		1		1	1	1	1		1	1	1	1
8	Sending case files to experts		1		1			1		1	1	1	1
9	Receiving answers from the experts		1		1	1	1	1		1	1	1	1
10	Suggestions based on available infrastructure	1			1			1		1		1	1
11	Counting the flowers according to the growth stage	1			1					1		1	
12	Disease prediction system		1		1	1	1	1		1	1	1	1
13	Disease database access	1	1	1	1			1		1	1	1	1
14	Taking a photograph	1	1		1					1	1	1	
15	Recording audio	1	1		1	1		1		1	1	1	1
16	Writing / Scribbling notes/diagrams	1	1	1	1					1	1	1	
17	Integrating visuals/audio/scribbles/schedules to make casefile/documenta	1	1		1					1	1	1	
18	Autoupdates of the schedule		1		1					1	1	1	
19	Prompt for new chemicals / fertilisers added in the schedule	1			1			1		1		1	1
20	Searching for references / contacts		1		1		1	1		1	1	1	1
21	Statistical data visualisation and analysis	1			1					1		1	
22	Storing infrastructure information	1	1		1					1	1	1	
23	Recording the logs of problems / warnings	1	1		1			1		1	1	1	1
24	Printing the information		1				1			1	1	1	1
25	Giving help at different stages / activities	1		1	1			1		1	1	1	1
26	Precautions / warnings about handling dangerous chemicals	1		1	1		1	1		1	1	1	1
27	Guide for buying chemicals / fertilisers e.g. checking expiry date etc.	1	1	1	1	1	1	1		1	1	1	1
28	Making changes in the schedule according to changes in Temp/Hum/EC/	1			1			1		1		1	1
29	Monitoring of EC / PH								1	1	1	1	1
30	Monitoring of Temp / humidity								1	1	1	1	1
31	Video conferencing with experts		1		1					1	1	1	
32	Clock	1			1					1		1	
33	Acknowledgement from users upon completion of the task	1			1					1		1	
34	Audio interface	1	1		1	1		1		1	1	1	1
35	Making a phone call		1		1	1		1		1	1	1	1
36	Making receiving FAX						1						1
37	Sending Email		1		1					1	1	1	
38	Receiving Email		1		1		1			1	1	1	1
39	Retriving / storing / playback of audio messeges							1					1
40	Instant two way communication full duplex				1	1		1				1	1
	Total functions available	24	21	6	35	8	11	21	2	37	25	38	27
	RANK	2	3	7	1	6	5	4	8	2	4	1	3

Evaluation of concepts: varied parameters

Parameter \ Rank out of 4	Concept 1	Concept 3	Concept 4	Concept 5
	Ded pers device + kiosk	Print + kiosk	Mobile PDA	TelFax + vis/aud aid
Functionality	3	1	4	2
Familarity in interaction	1	4	3	2
Direct interaction with expert	3	2	4	1
Literacy level required	1	3	2	4
No of components used in system	1	2	4	3
Functions other than polyhouse management	2	1	4	3
New Hardware/software to be developed	1	2	4	3
Use of existing infrastructure	1	2	4	3
Economy of the device/system	1	2	3	4
Cost of operation	3	4	1	2
Portability	2	3	4	1
Ease of use	2	4	1	3
Function SUM col 3 to 15	21	30	38	31
Familarity in Media	1	4	3	2
Ability to develop personal relatn with expert	2	3	4	1
Ability to produce personalised information	3	1	4	2
Black box approach	4	1	3	2
Providing good conceptual model	1	2	3	4
Integrity of source of information	1	2	4	3
Interface complexity	1	4	2	3
Ease of installation	1	4	3	2
Feasibility of implimentation in today's context	1	4	3	2
Implimentation complexity	1	4	3	2
Sustainibility in system failure	1	4	3	2
Dependency on other elements in the system	2	3	4	1
Function SUM col 16 to 28	19	36	39	26
Function col 15+28	40	66	77	57

Thank You