Design of Water quality checking product

- Yogesh patankar
- Project-II

Project is sponsored by Media lab Asia

People are involved from departments like
Electrochemistry
Biomedical
Microelectronics
IDC

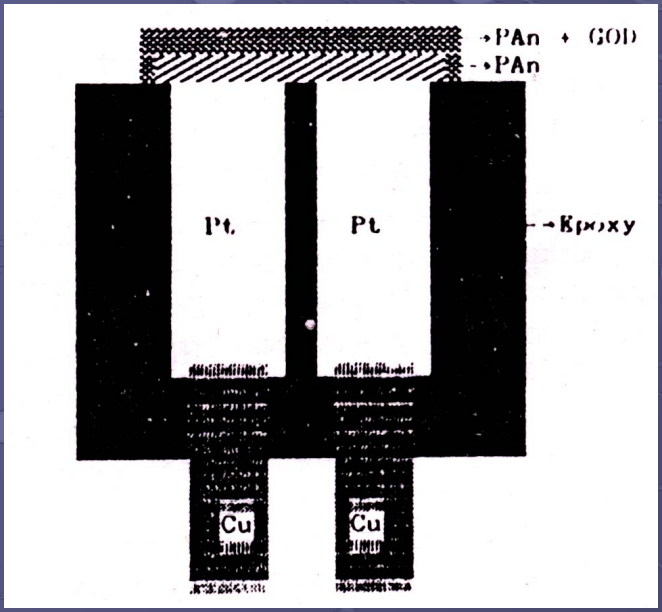
Every Friday meeting is held to review the work

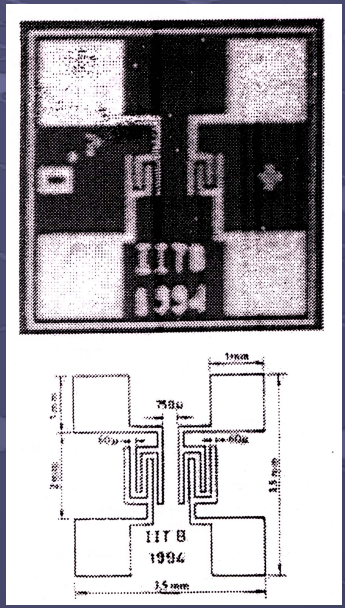
What was expected from my side ?

Identify the areas in which product can be used
Enclosure for the biosensor
product based on Biosensor technology

What is Biosensor ???

Conducting polymer-Polyanniline
It works on principle of change in conductivity
For each element specific enzymes are used





Actual sensor fabricated in IIT powai .

What is status of project now ?

Chemistry department :

doing testing for sensor sensitivity, repeatability

Sensor life

Microelectronics department :

Sensor PCB design is over.

Main PCB design without microcontroller going on.

t started with …..

Collecting information about present water quality checking methods and its parameters required in various fields.

Visits to

District public health lab Thane
Sewage water treatment plant –Thane
Water treatment plant –Bhiwandi
Taluka place Sahahapur-Thane district

Need for new product…

Heavy metal checking - manpower ,energy and time .
Heavy metal ions checking is costly and cannot be done on site .
Results from district lab to reach villages take lot of time .
The instruments in labs are not portable.
Old instruments-manual calculation.
Present electrodes and instruments–big, costly.
Present products are not compact ,costly–check few parameters
The flow of samples - long and time consuming.
Difficult to manage the samples at taluka level.

Present products

Handheld portable products

Major players

Thermo Orion
Horiba
Hach instruments

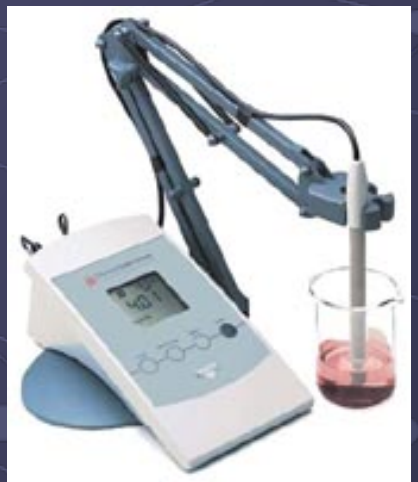
Single parameter
Requires training
Very sophisticated
Squarish forms

Present products

Tabletop products

Major players

Thermo Orion
Horiba
Hach instruments



High cost
Few parameters
Requires skilled people
Very sophisticated
Not portable
Squarish forms
Maintenance

Present products

Major players

Thermo Orion
Horiba
Hach instruments

Troublesome to carry
Complicated
Costly

Product Brief

To design a portable water quality checking product

Product Brief

Hardware components :

Connectors : 20 point connector

PCB : 120 square cm

Batteries : 1.5 V X 4

Display: LCD 5 line display

Standard liquids :

Calibration liquids -2

Regeneration -1

Rinse-1

Product Brief

Parameters :

pH
Potassium
Chloride
Fluoride
Conductivity
Urea

Users :

He is PHC worker -12th pass out

Moves around villages

Does chlorination of wells

collects samples for biological quality

He is lab attendant

Product Brief

What product needs ??

Cost should be in between 5000 Rs to 10000 Rs

Calibration to be done when changing the sensor cartridge

The connector for sensor to be absolutely water proof

Minimizing the steps to be followed while measuring

Saving data &Noting down the place details where reading is taken

Sensor active surface should be protected from any contact .

Product Brief

What product can achieve ??

Decentralization of water quality .
Decision making can be done at Grampanchayat level.
Time saving –reports take 15 days from district level.
Replaces very costly instruments .
Replaces old time consuming processes (Titration).
Manual calculation is not needed.

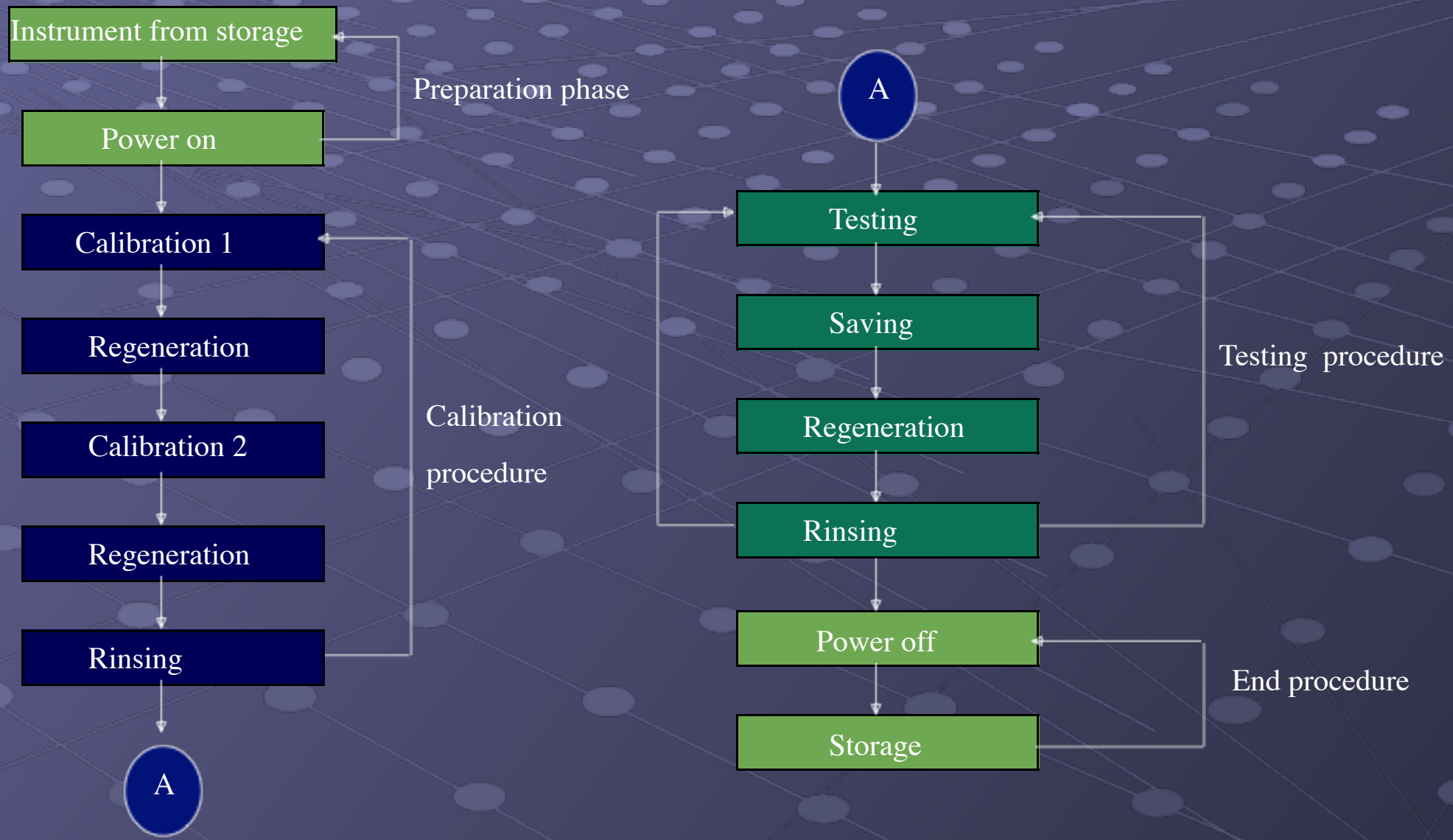
Product Brief

Form considerations

It should not be just enclosure for the technology.
It should have proper arrangement of elements considering the user.
Development of form considering the field environment.

Product Brief

Activity analysis



What my product is ???

It’s a family of total eight components

Electronics and batteries

Probe containing sensor and connector

Calibration liquid 1

Calibration liquid 2

Regeneration liquid

Rinse liquid

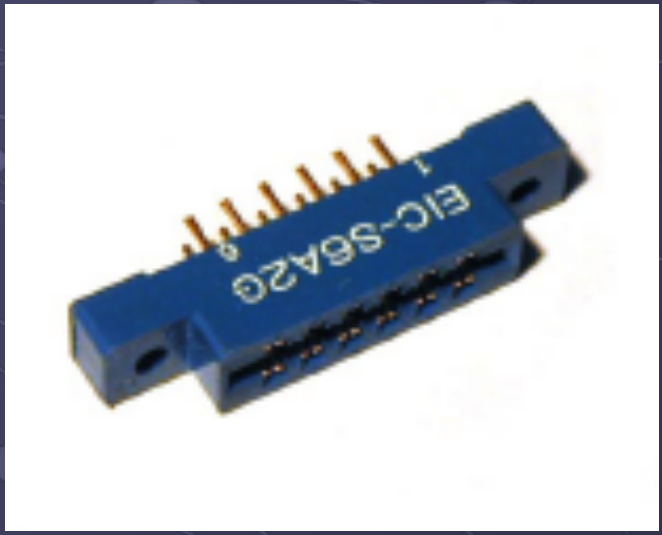
Sample taking beaker/dropper

Concept development

- Identifying the various functional issues –solving independently
- Identifying usability issues –solve them independently

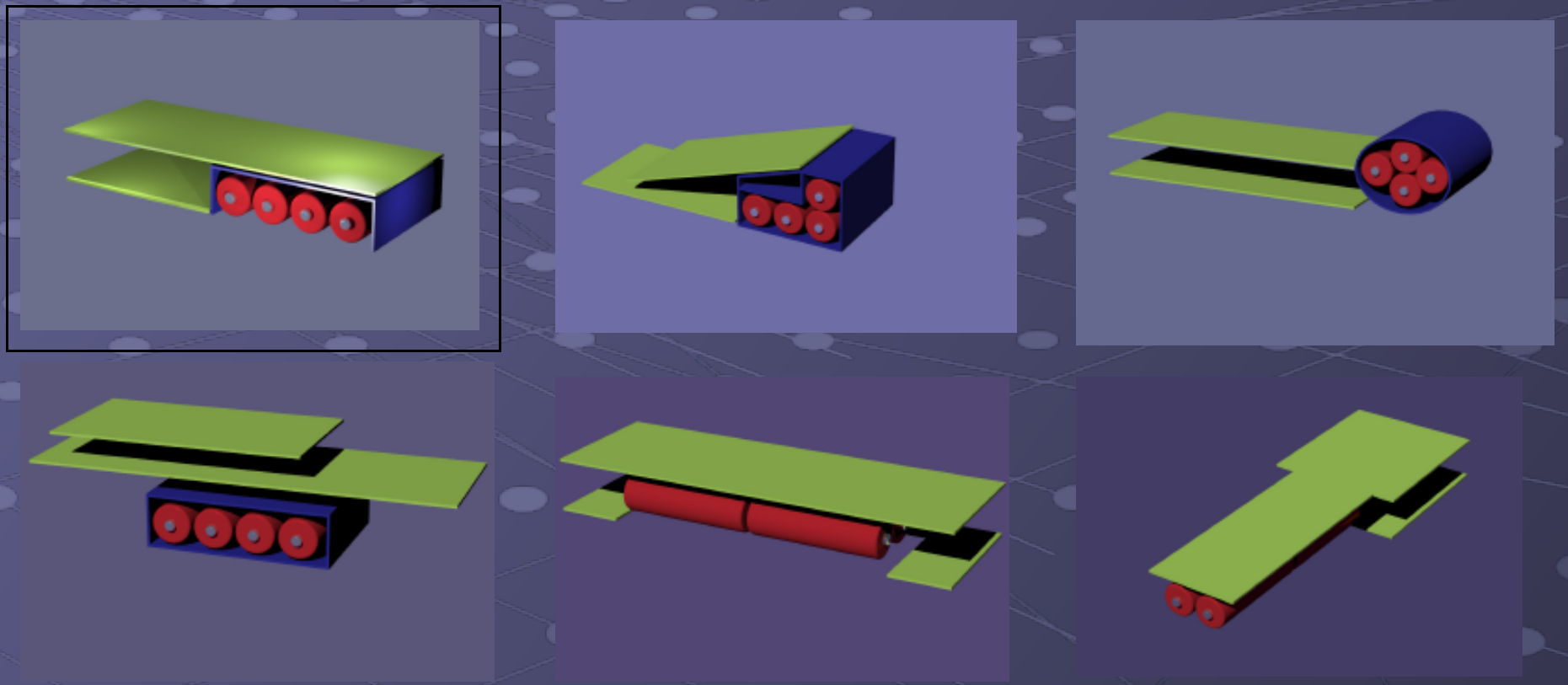
Functional issues

How to connect the sensor to the electronics
Replacement and protection of sensor
Composition and layout of inside parts



Concept development

Composition and layout of inside parts



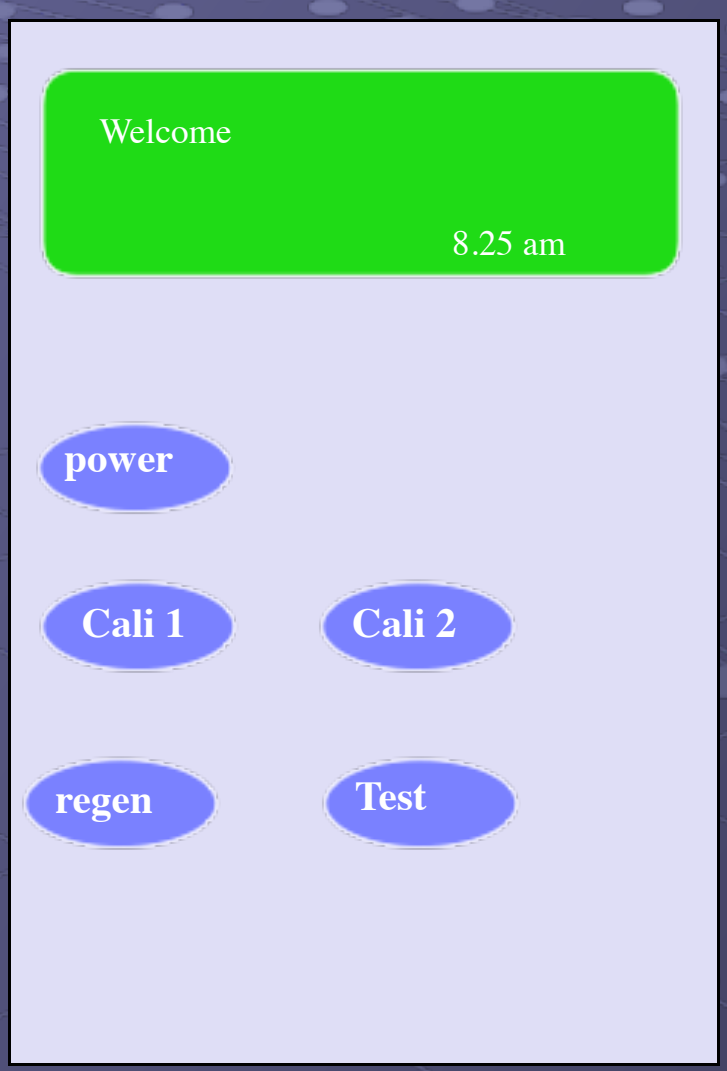
PCB area required is 120 squ. cm.

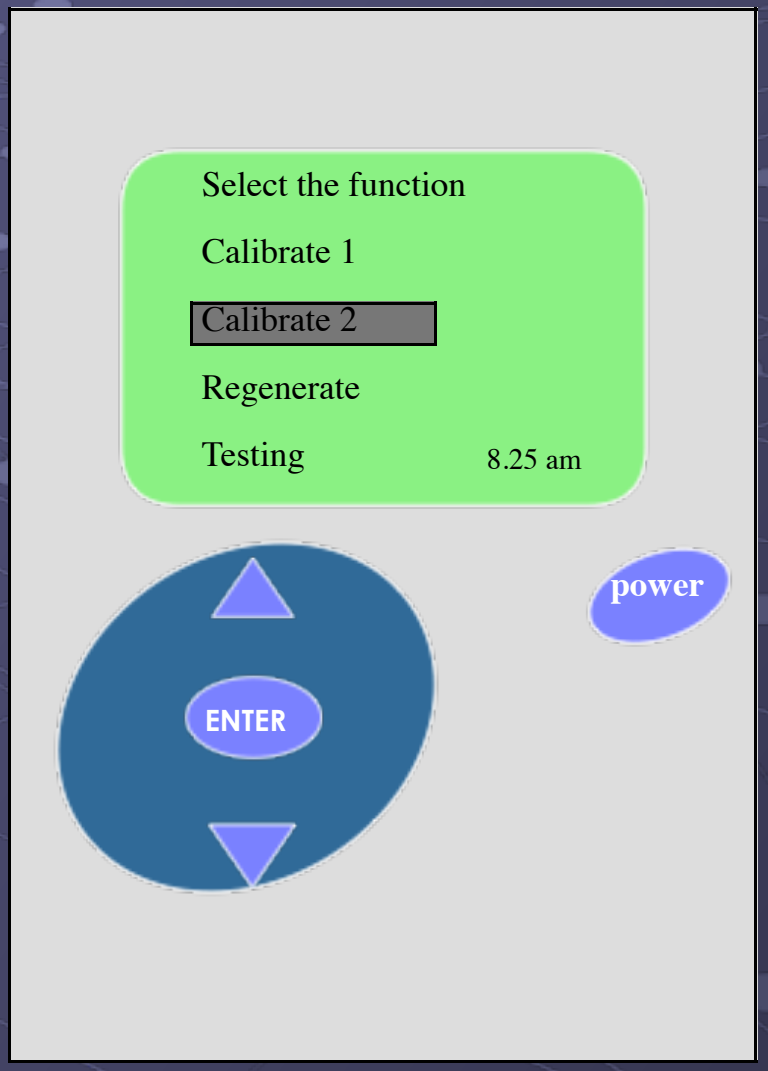
Usability issues

How the interface design will be considering the user education.
How to note down and store the reading .
How to measure samples in dip type sensor.

Concept development

How the interface design will be considering the user education.





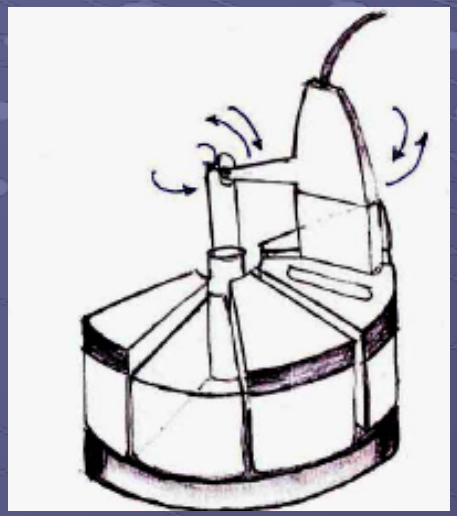
Concept development

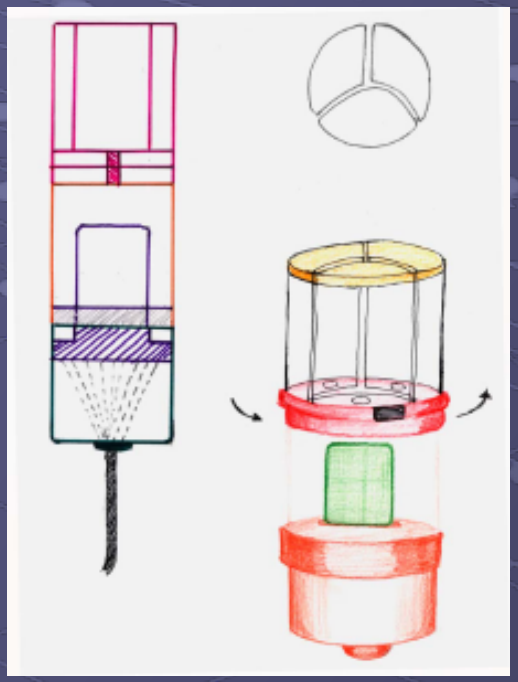
How to note down and store the reading .

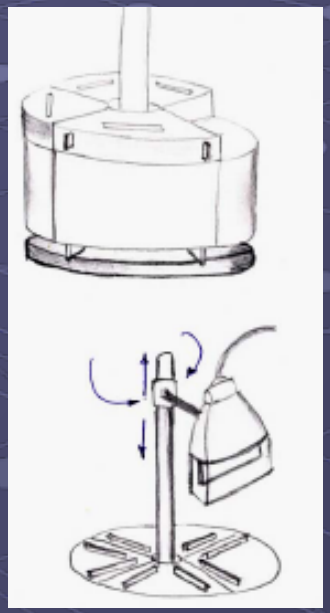
Giving diary to note down reading
Web cam
Sound recording
Stylus and digital screen
GPS system

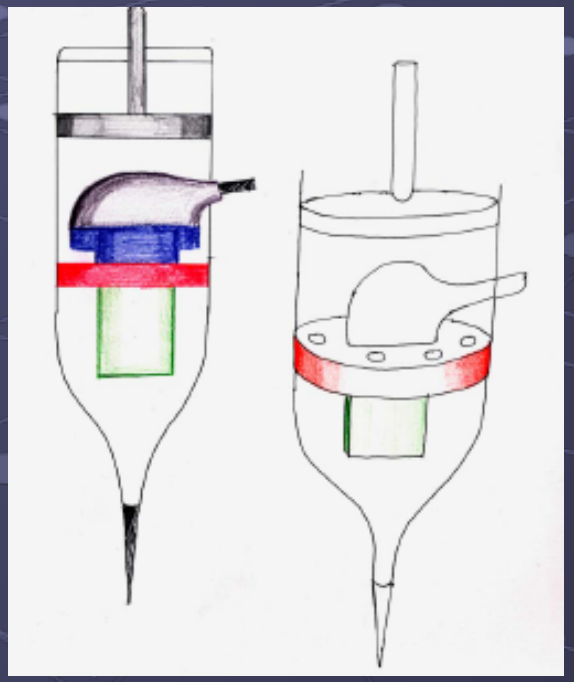
Concept development

How to measure samples in dip type sensor.









Concept generation

Two approaches considered

Bring sensor to water
Dip sensor in water

Bring water to sensor
Put drops of water on sensor

All elements separate

Sensor and bottles integrated
Instrument probe integrated

All elements integrated
in one

Water quality checking product

Concept generation

All elements separate

Instrument
Probe
Standard liquids
Sample collector

Instrument

Initial exploration in thermocole
for volume study and form generation

Bring sensor to water /Dip sensor in water

Concept generation

All elements separate: instrument

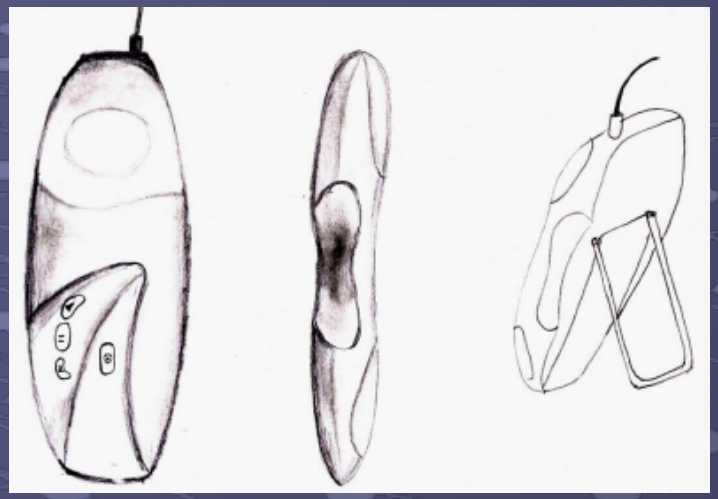
Steps followed :
Finalizing two layouts of elements out of six
Generating concepts for each layout
Finalizing two concepts
Selecting one and generating three alternatives
Finalizing one concept

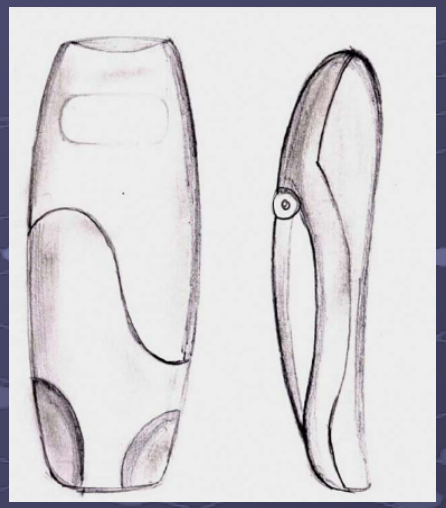
Bring sensor to water /Dip sensor in water

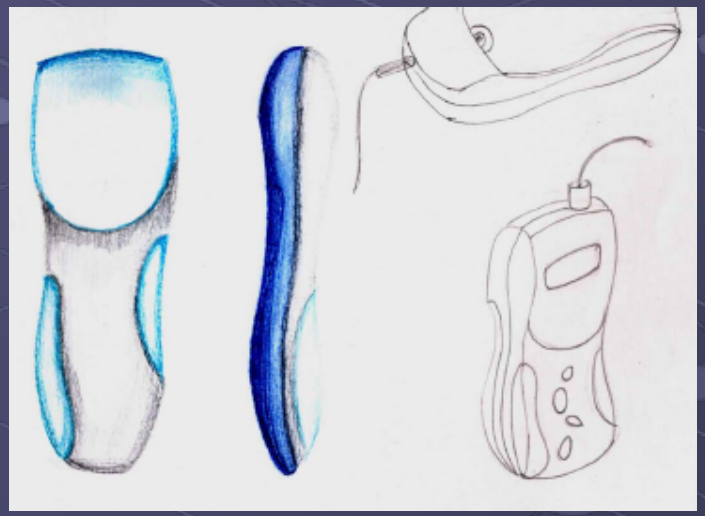
Concept generation

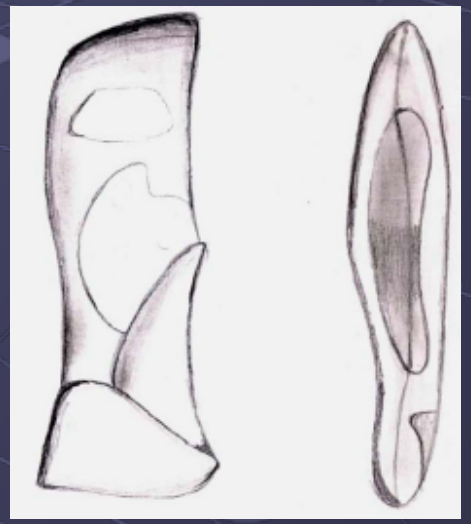
All elements separate: instrument

Some concepts of layout









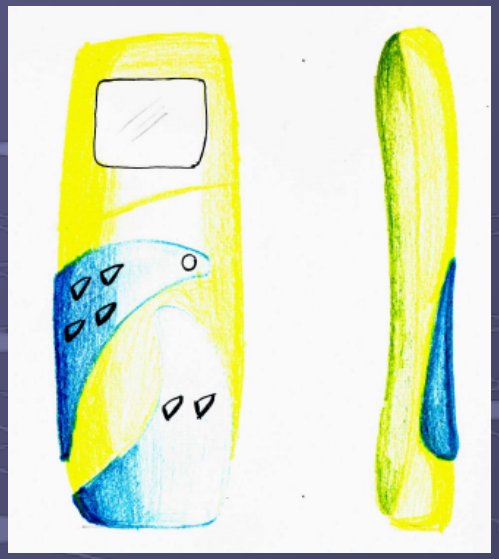
Bring sensor to water /Dip sensor in water

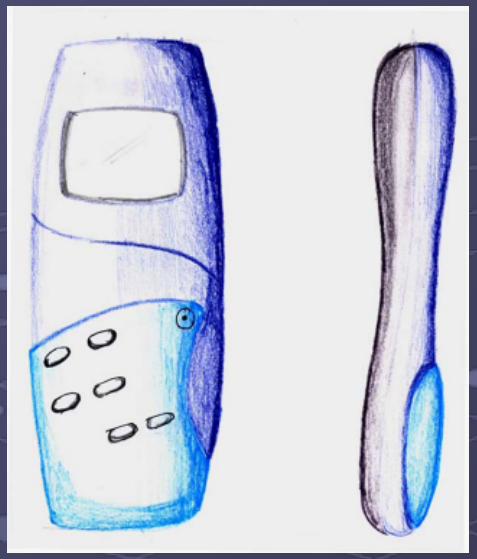
Water quality checking product

Concept generation

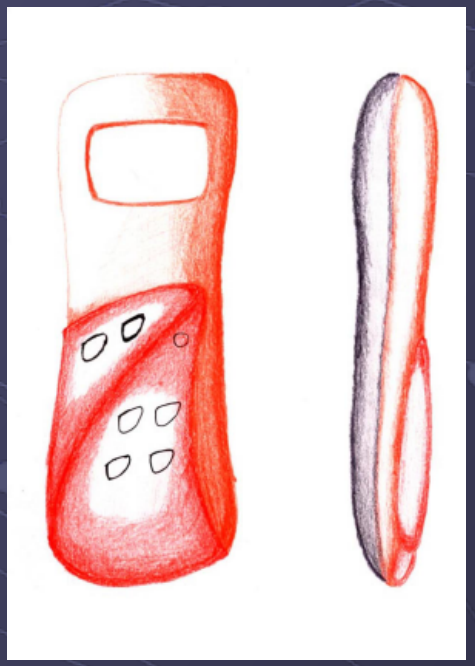
All elements separate: instrument

Chosen concept out of six





Variations of chosen concepts



Bring sensor to water /Dip sensor in water

Concept generation

All elements separate: instrument

Final concept and thermocole model

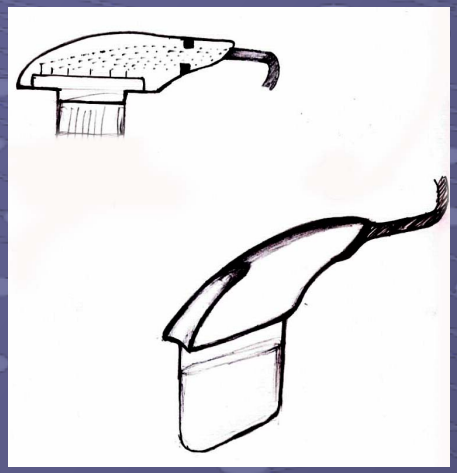
Criteria for selection

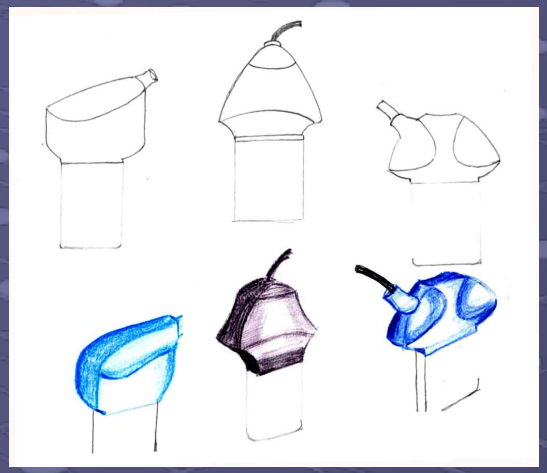
Stability on table
Interface
Aesthetic appeal
Visual elements
size ,compactness
comfortable to hold

Bring sensor to water /Dip sensor in water

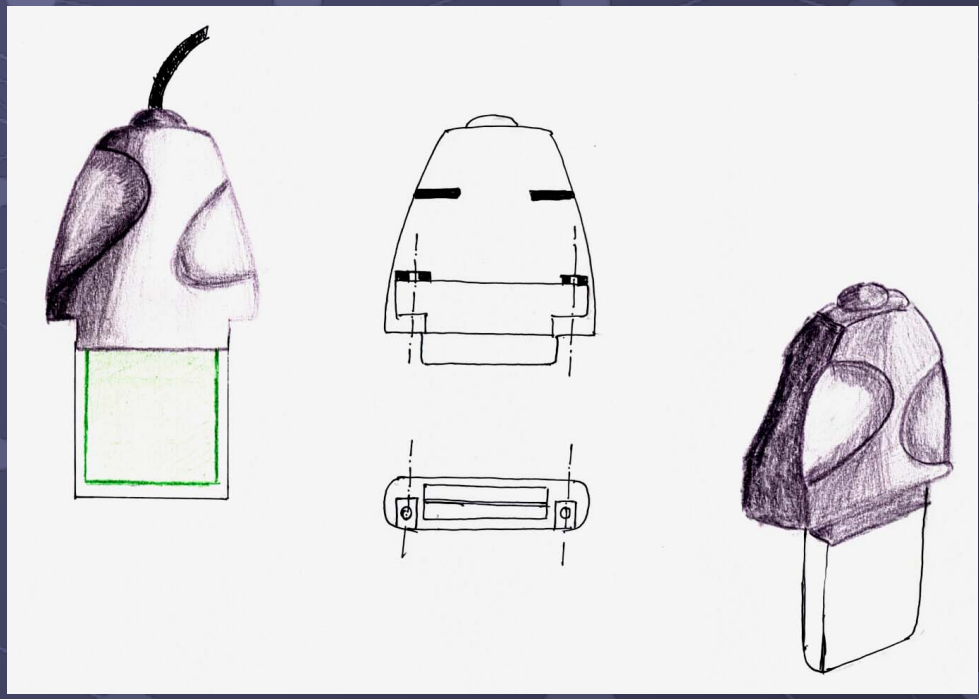
Concept generation

All elements separate: probe





Some concepts for probe



Selection criteria

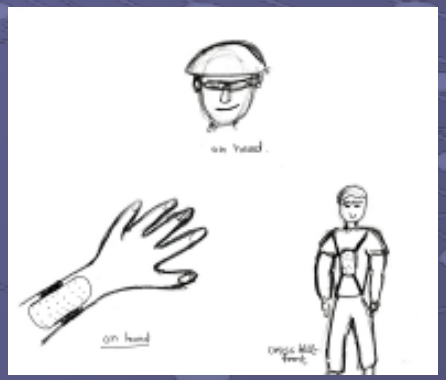
Sensor cartridge Connector
Grip
Compactness
Wire outlet
Manufacturing

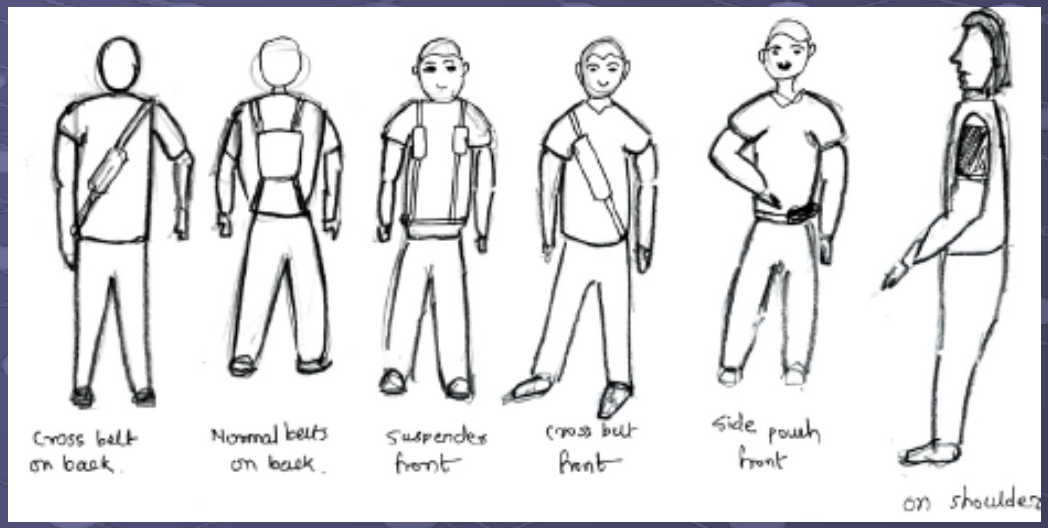
Bring sensor to water /Dip sensor in water

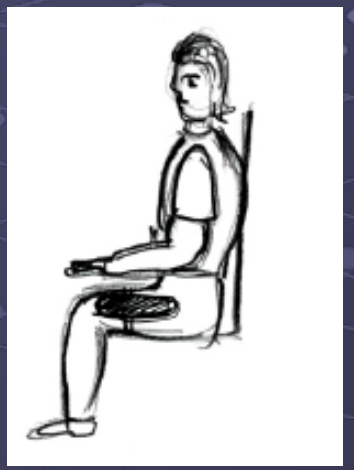
Concept generation

All elements separate: storage and carrying of all elements

How many ways person can carry product on his body????







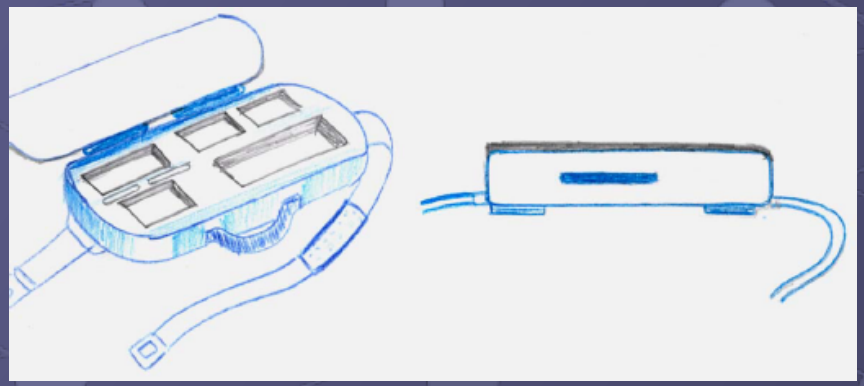
Bring sensor to water /Dip sensor in water

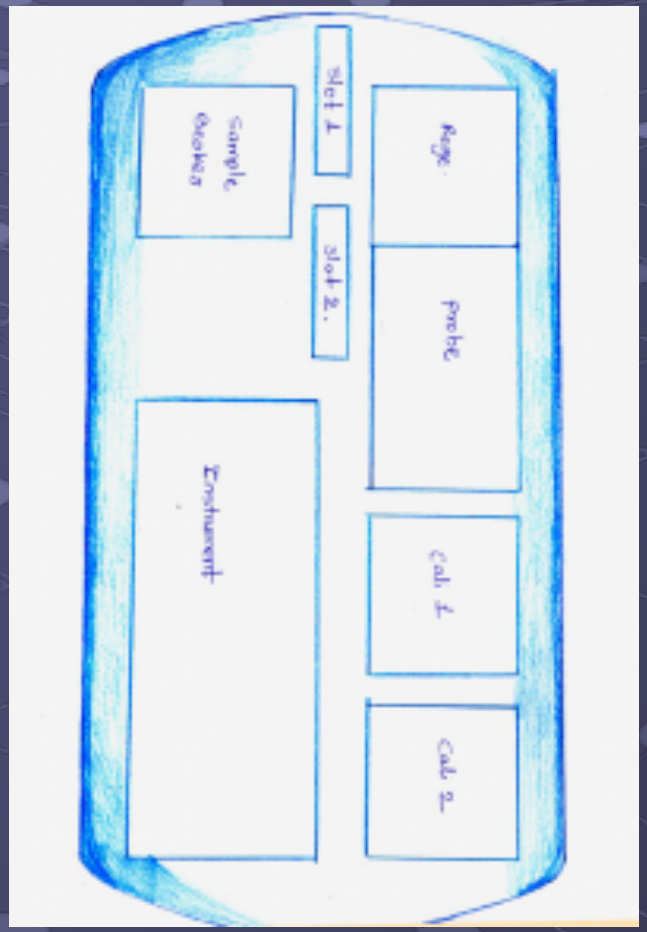
Concept generation

All elements separate: storage and carrying of all elements

1

Liquid bottles arranged horizontal
Bag carried on Back with cross belt
Kit
Thickness wise compact





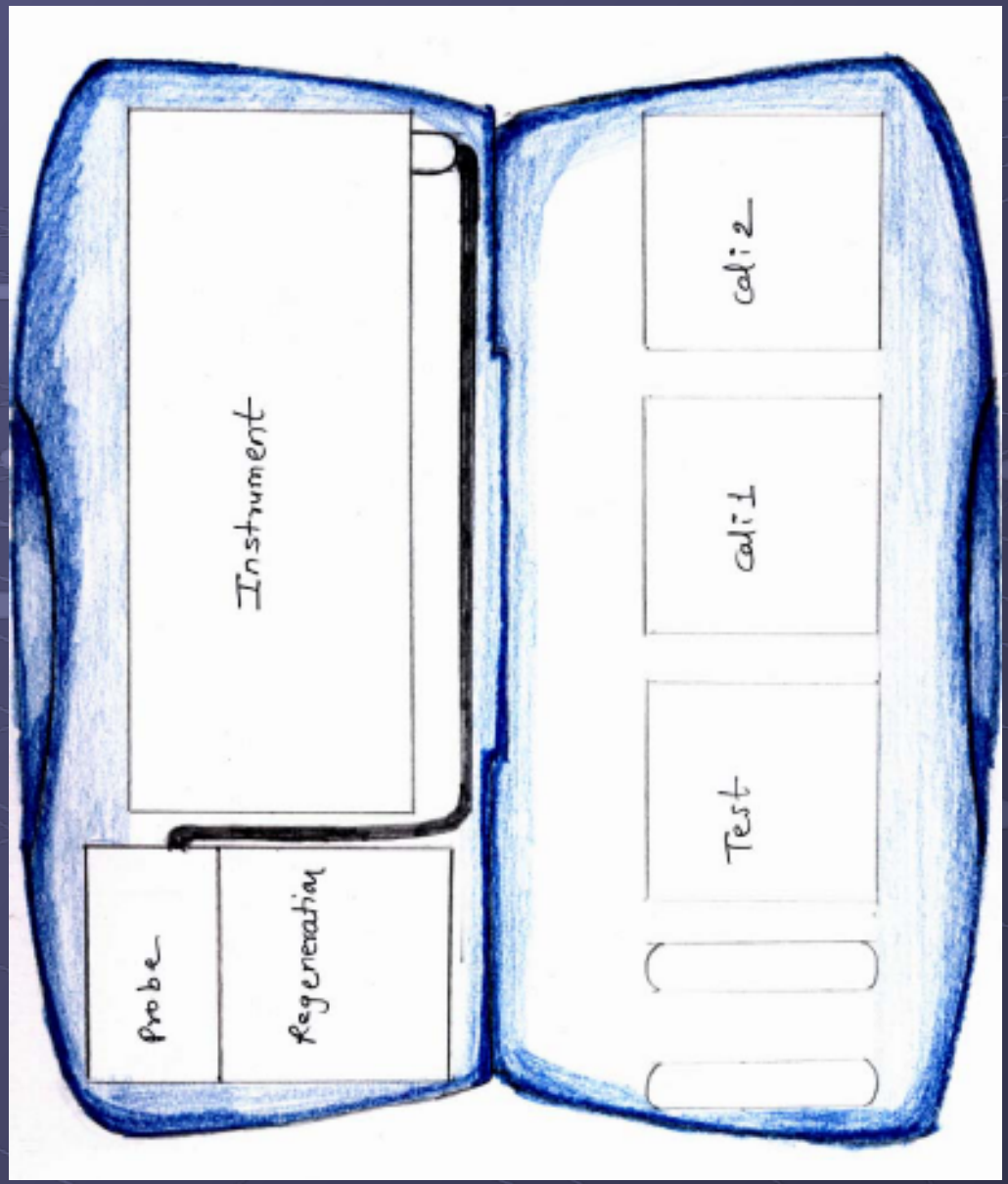
Bring sensor to water /Dip sensor in water

Concept generation

All elements separate: probe

2

Elements arranged in two halves of bag
Probe is connected by wire
Lengthwise compact



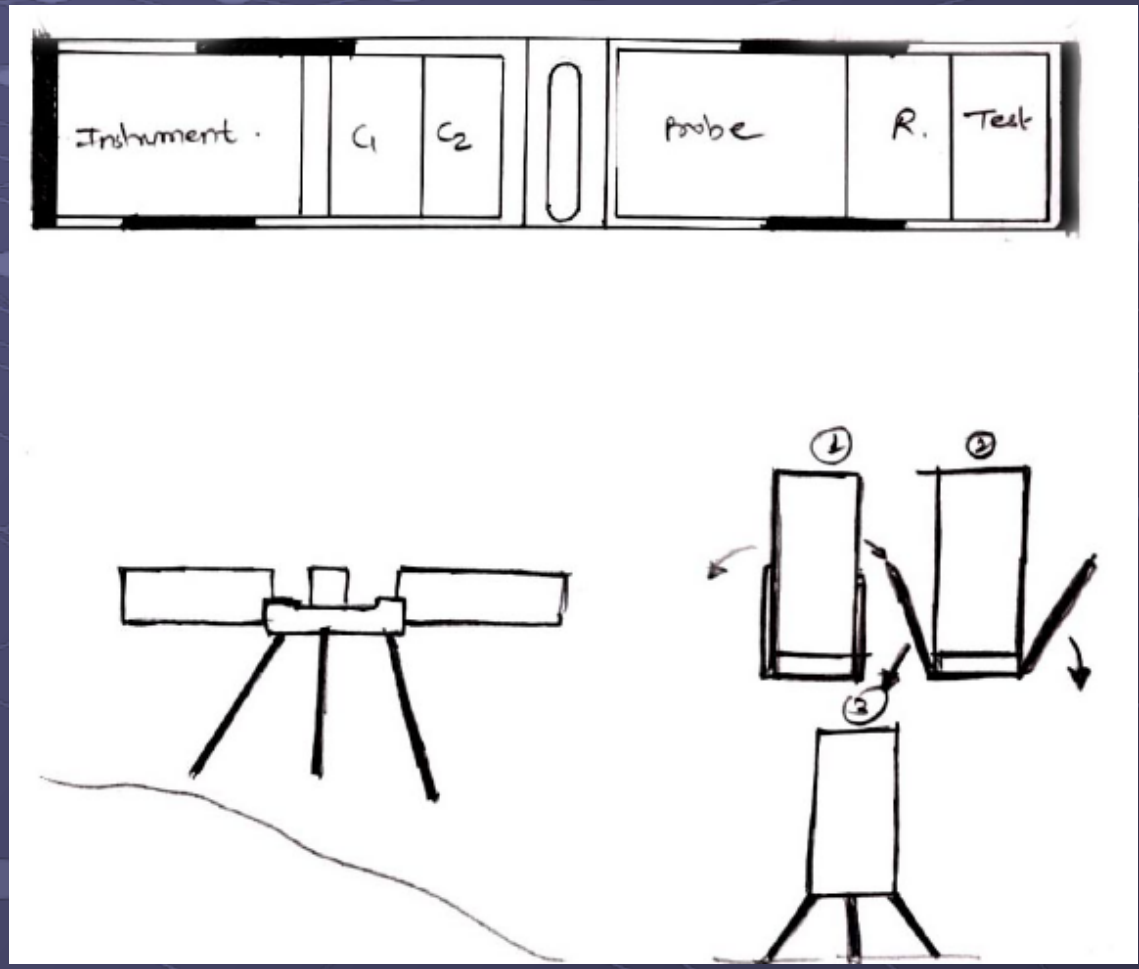
Bring sensor to water /Dip sensor in water

Concept generation

All elements separate: probe

3

Tripod kind of arrangement
collapsibility



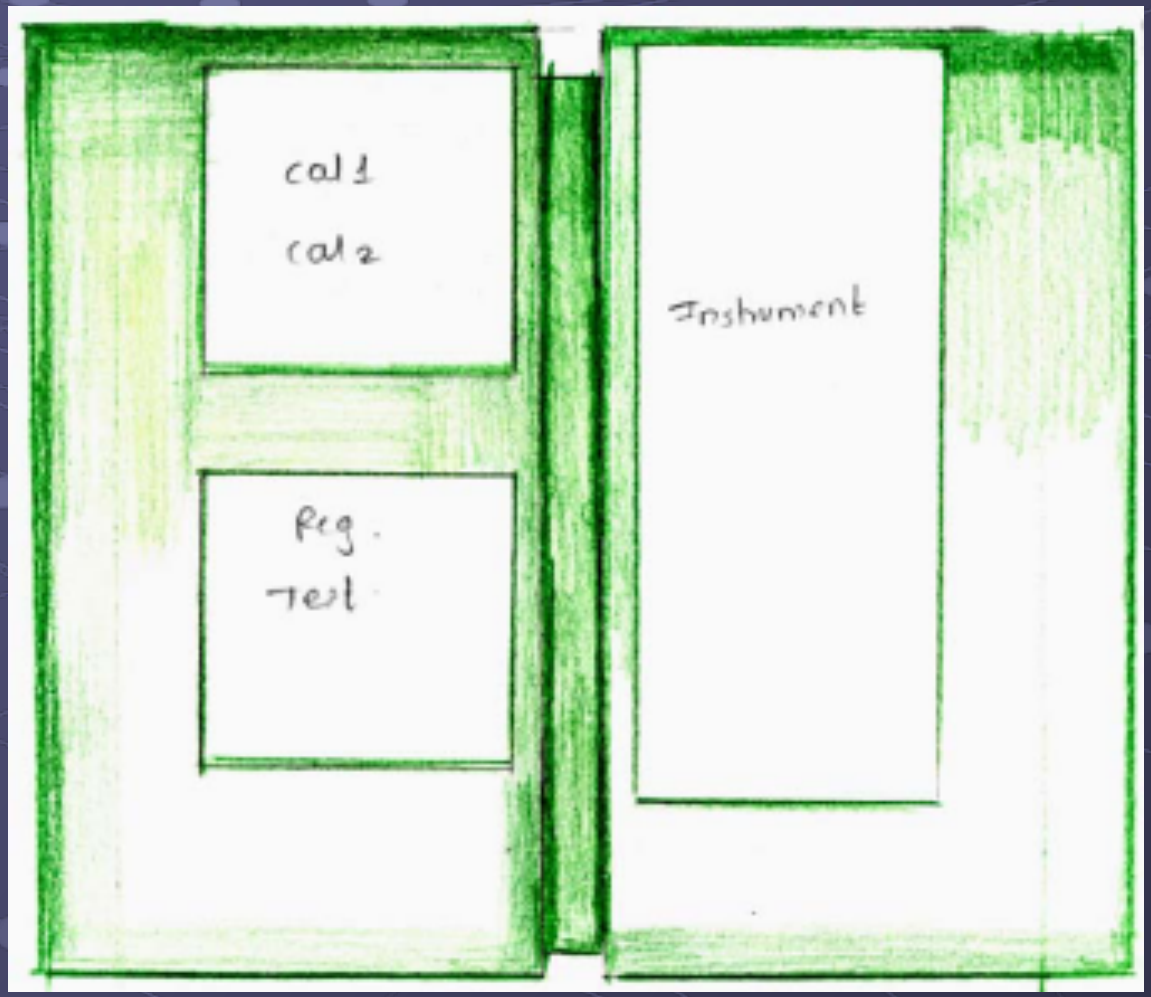
Bring sensor to water /Dip sensor in water

Concept generation

All elements separate: probe

4

Carried along waist
bottles to be kept in one flap
instrument and probe in other flap



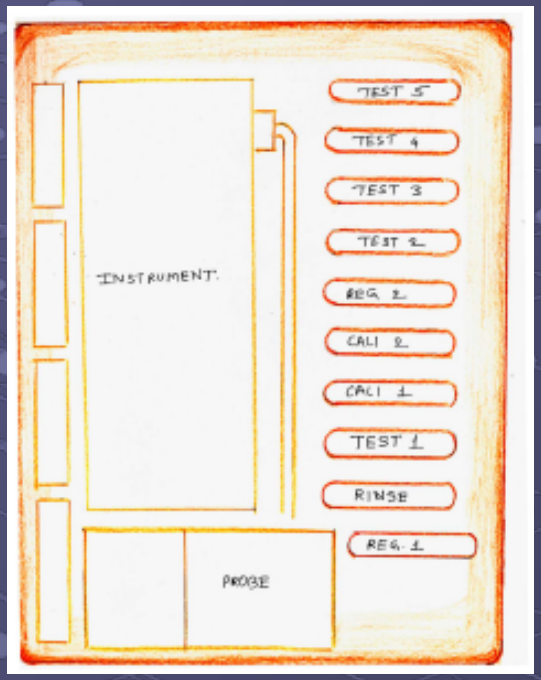
Bring sensor to water /Dip sensor in water

Concept generation

All elements separate: probe

5

Kit
bottles arranged vertically



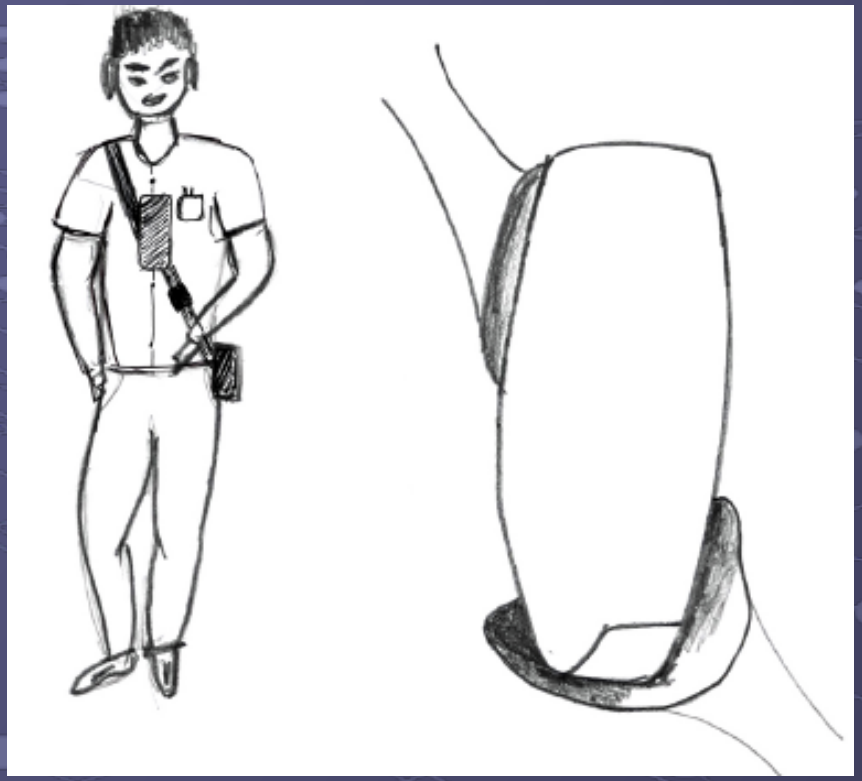
Bring sensor to water /Dip sensor in water

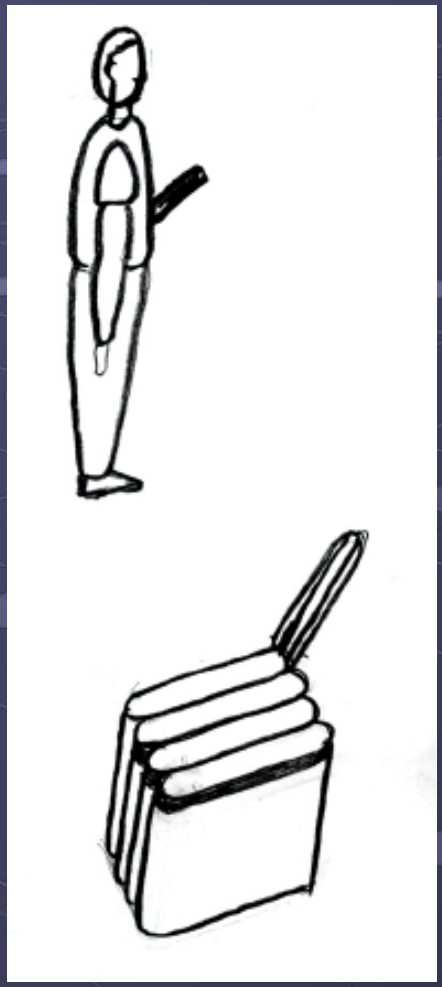
Concept generation

Integration of probe and liquids

Bottles and sensor kept on waist

instrument near chest

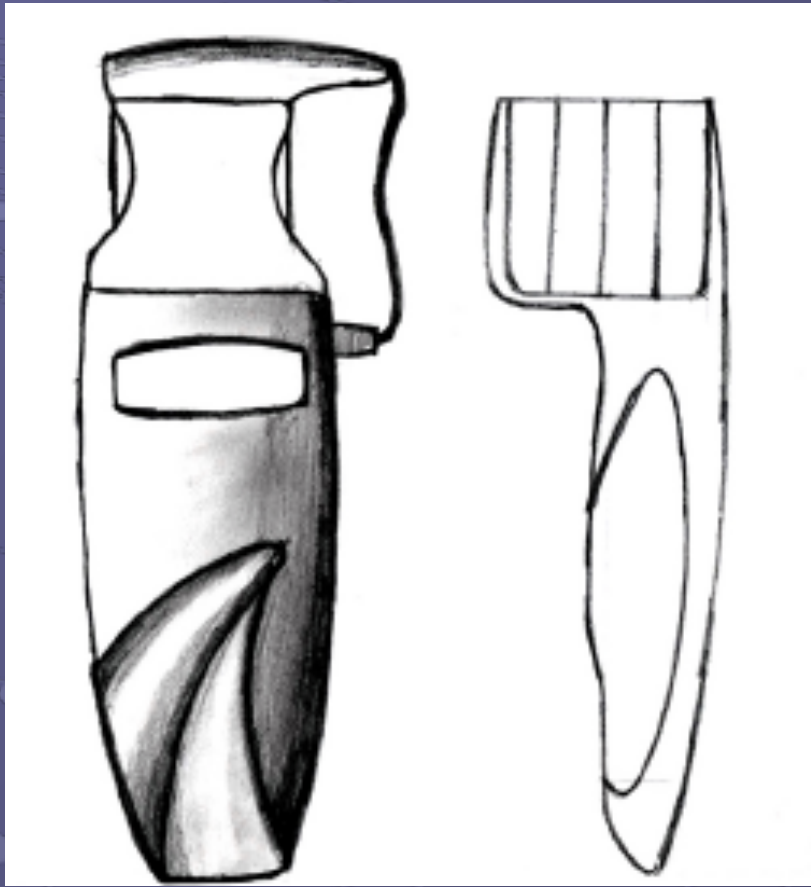


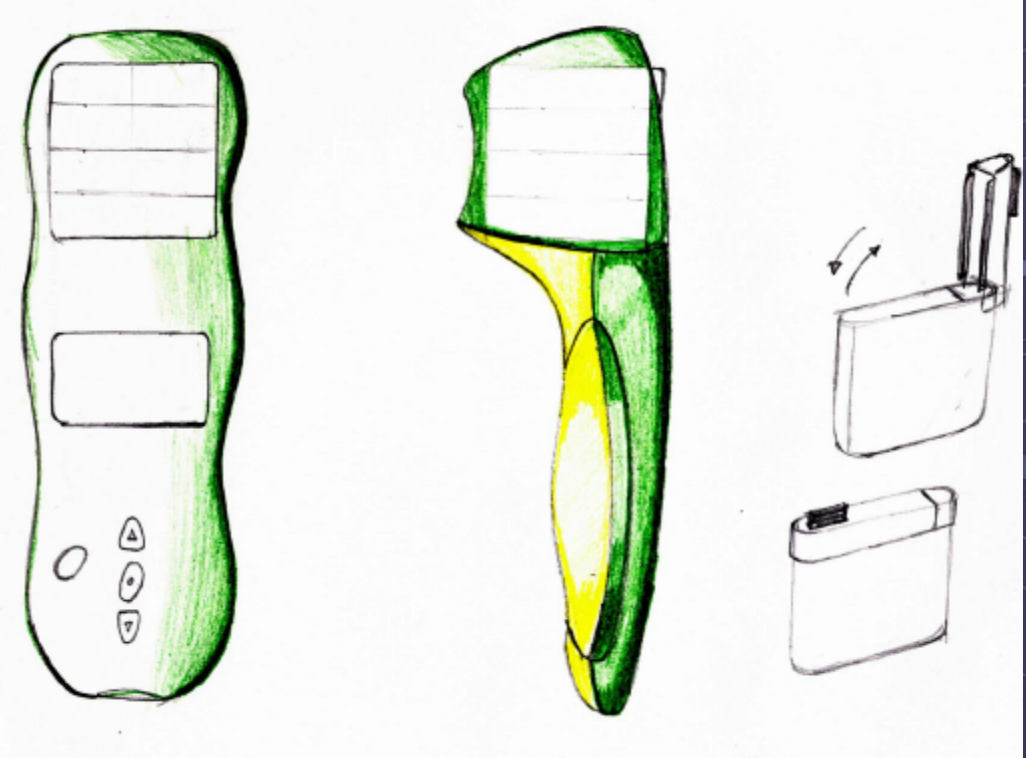


Bring sensor to water /Dip sensor in water

Concept generation

All integrated into one





Bring sensor to water /Dip sensor in water

Concept generation

Why to drop the idea of dipping sensor

Contamination of liquid
The liquid bottles difficult to carry –leakage problems
While taking reading chances of spillage
water sticks to surface of sensor –loss of standard and regenerative liquids more
while transferring sensor from one bottle to another chances of spillage
Removing cap from bottle while in standing position is difficult
more chances of shorting connections

Bring sensor to water /Dip sensor in water

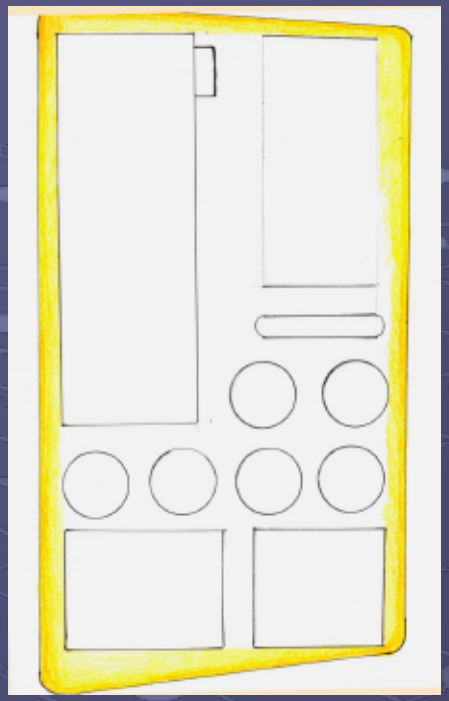
Concept generation

1

Dropper bottles used

Sample collected in dropper

Space required less than dipping type

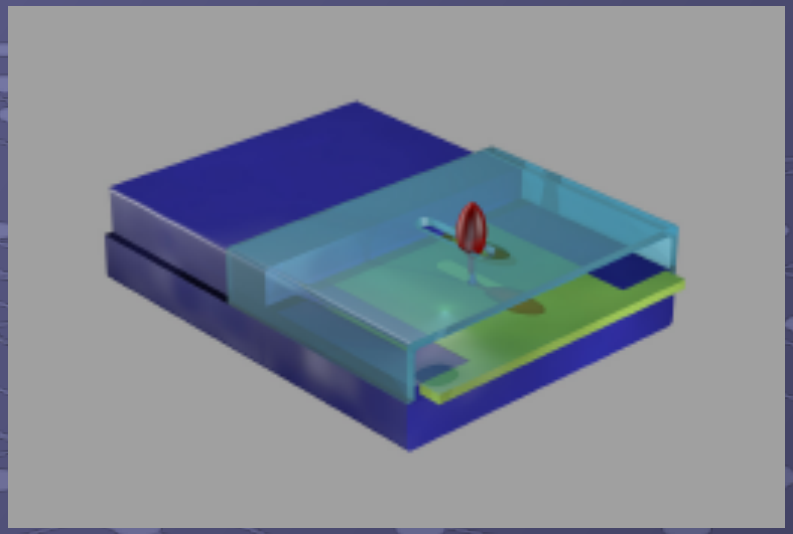


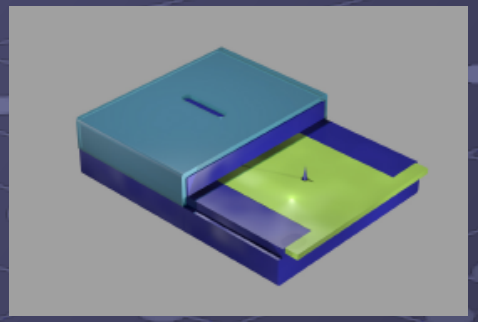
Bring water to sensor / put drops on sensor

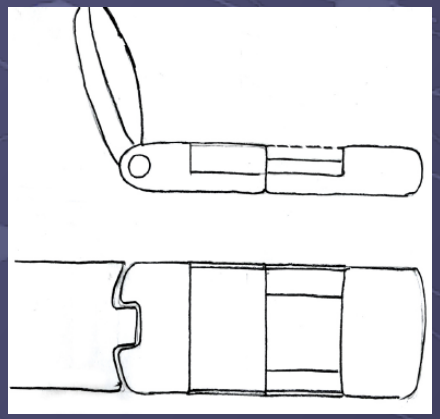
Concept generation

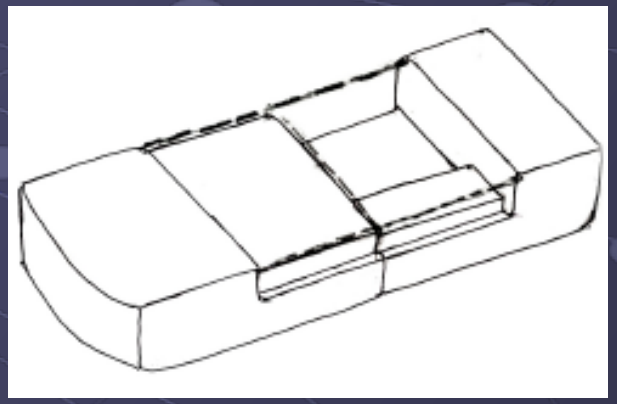
2

Using capsules instead of dropper bottles
puncturing the capsules
putting a sliding door on the top
space required reduced to half









Bring water to sensor / put drops on sensor

Concept generation

3 Notepad

Using capsules to carry standard liquid
total integrated product
like notepad

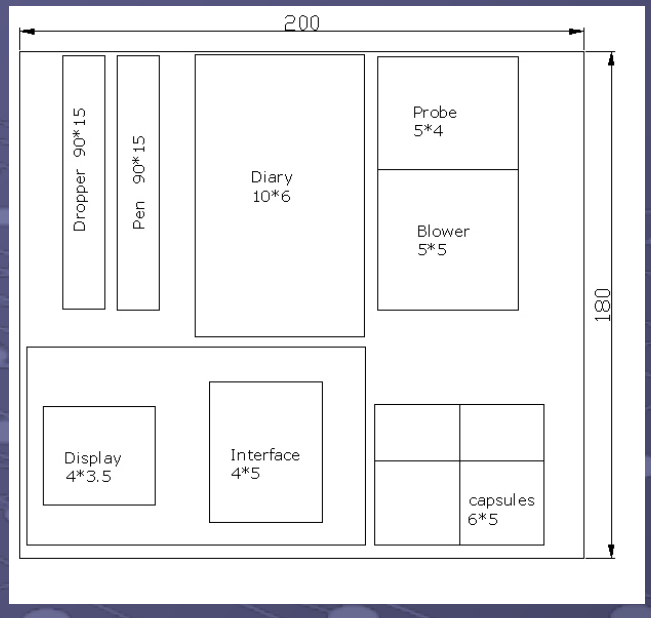
Total elements to be considered

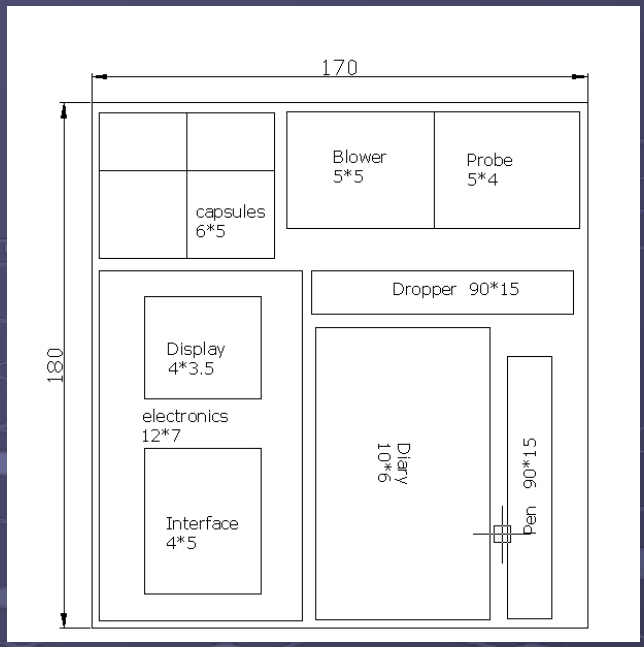
sensor
diary
display and switches
capsule compartment
dropper
air forcing bubble

Bring water to sensor / put drops on sensor

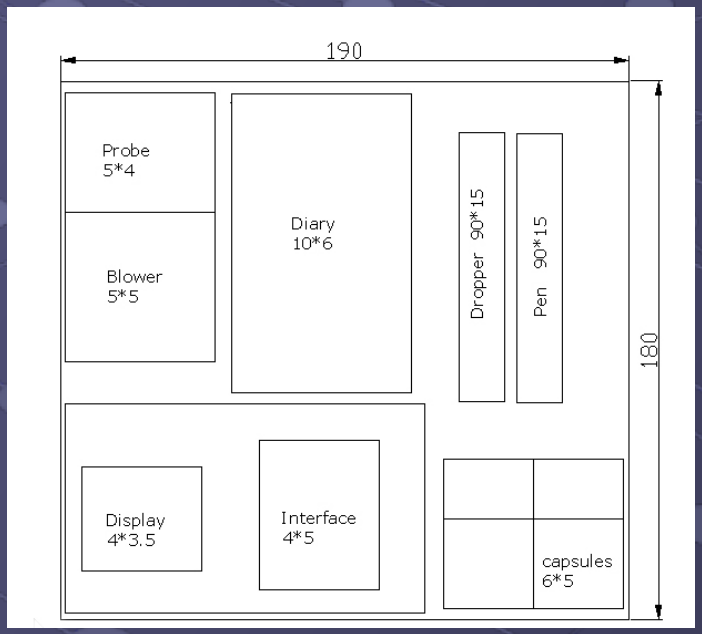
Concept generation

3 Notepad





Considering layouts



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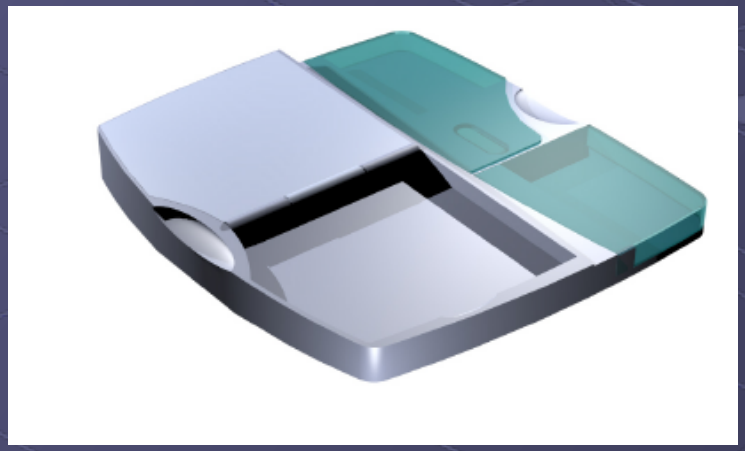
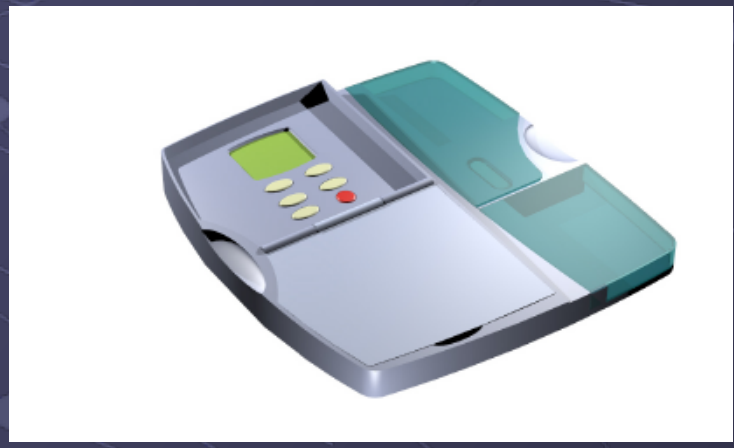
space required reduced to half



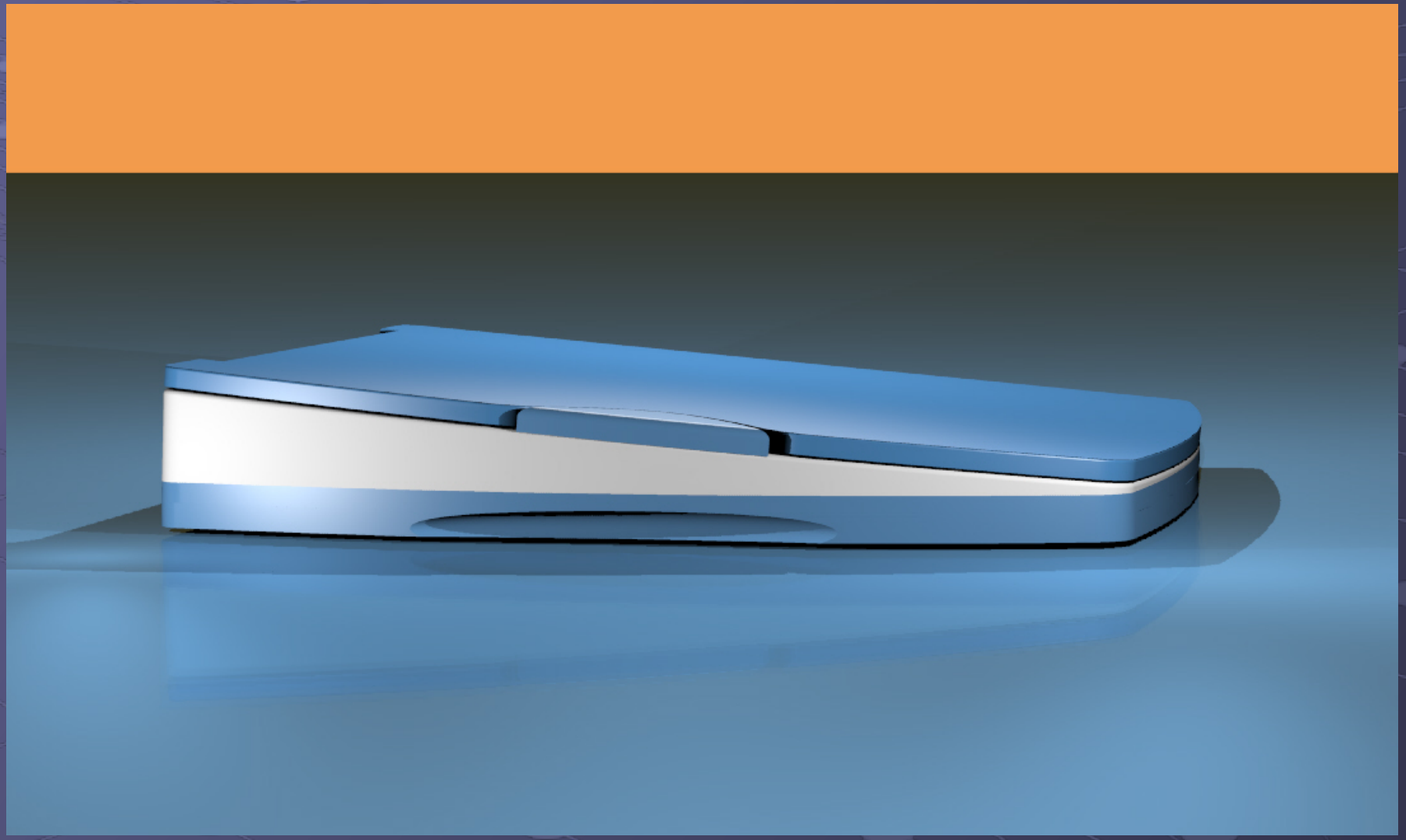


Bring water to sensor / put drops on sensor

Water quality checking product

Concept generation

Final concept

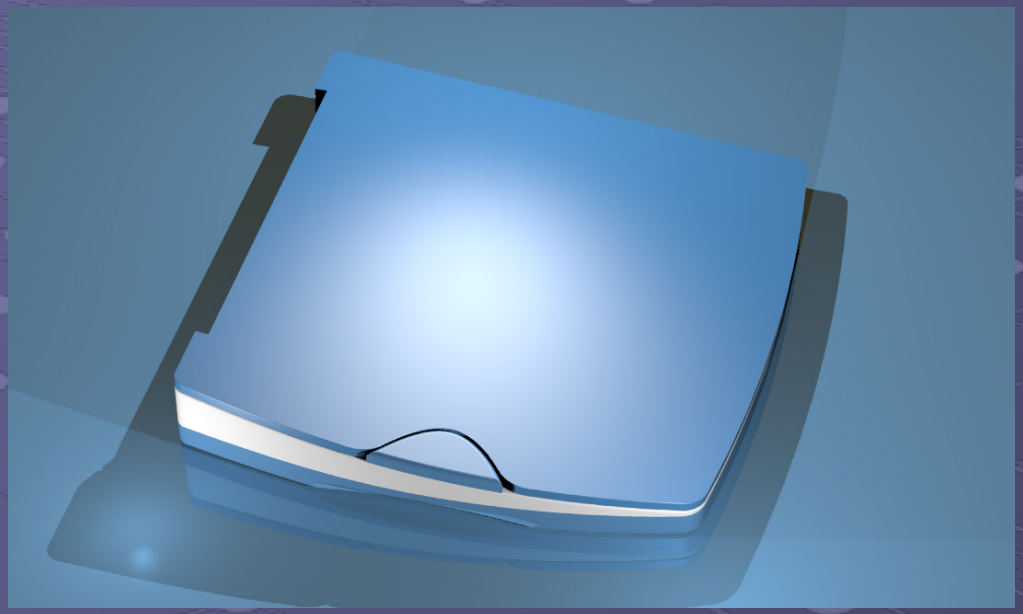


Bring water to sensor / put drops on sensor

Water quality checking product

Concept generation

Final concept



Rhino 3 –D model

Final model

Bring water to sensor / put drops on sensor

Water quality checking product

Concept generation

Final concept

Form development

Finalizing layout of the elements
Finalizing dimensions of all parts
creating grid
adding simple curves
dividing the space equally – empty space is reduced
adding elements for proper grip

Bring water to sensor / put drops on sensor

Water quality checking product

Concept generation

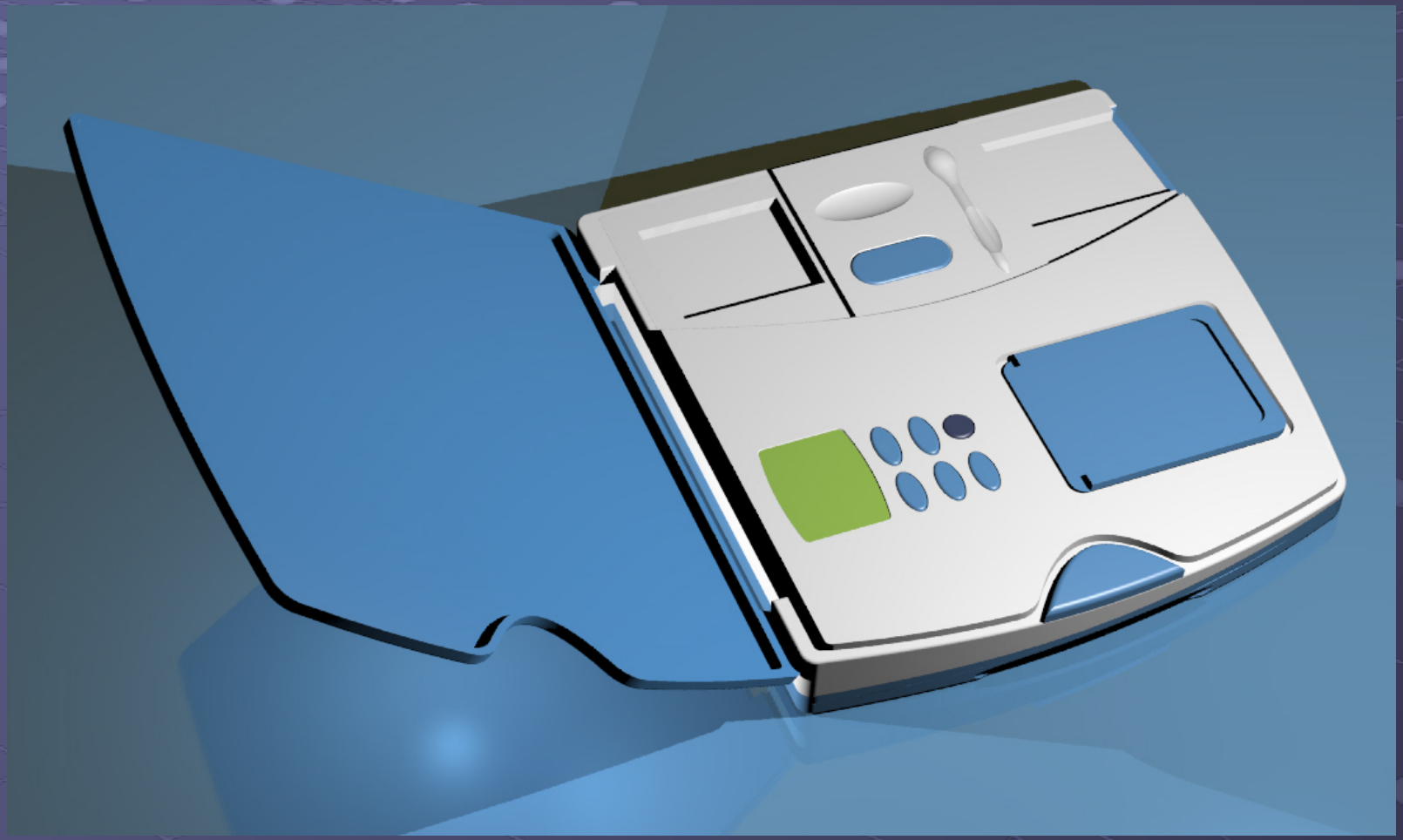
Final concept

Bring water to sensor / put drops on sensor

Water quality checking product

Concept generation

Final concept

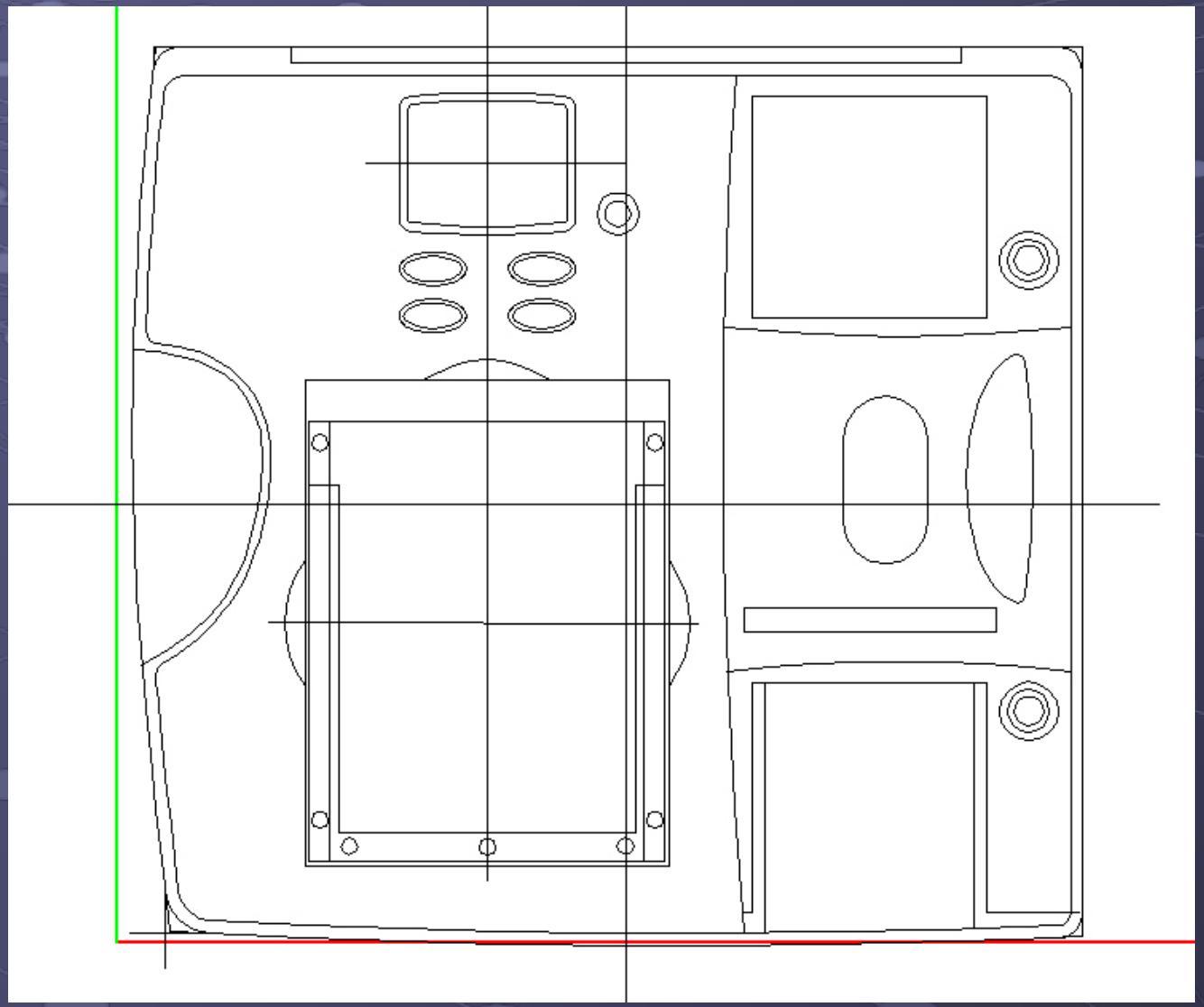


Bring water to sensor / put drops on sensor

Concept generation

Final model

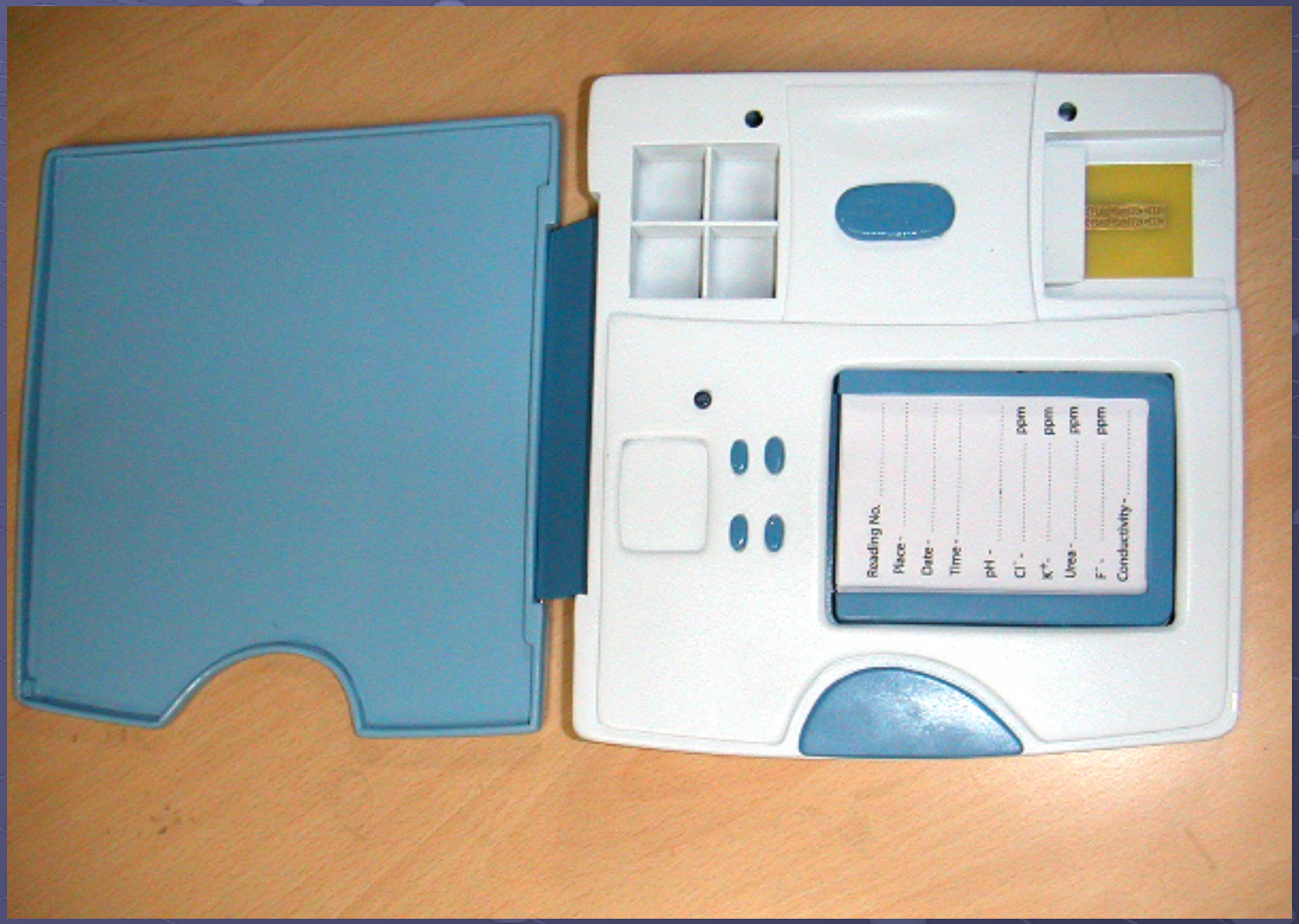
Making template (2 –d drawing)



Bring water to sensor / put drops on sensor

Concept generation

Water quality checking product



Gentle Curves

Bring water to sensor / put drops on sensor

Water quality checking product

Concept generation

Final concept

Bring water to sensor / put drops on sensor

Grip as interesting element

Concept generation

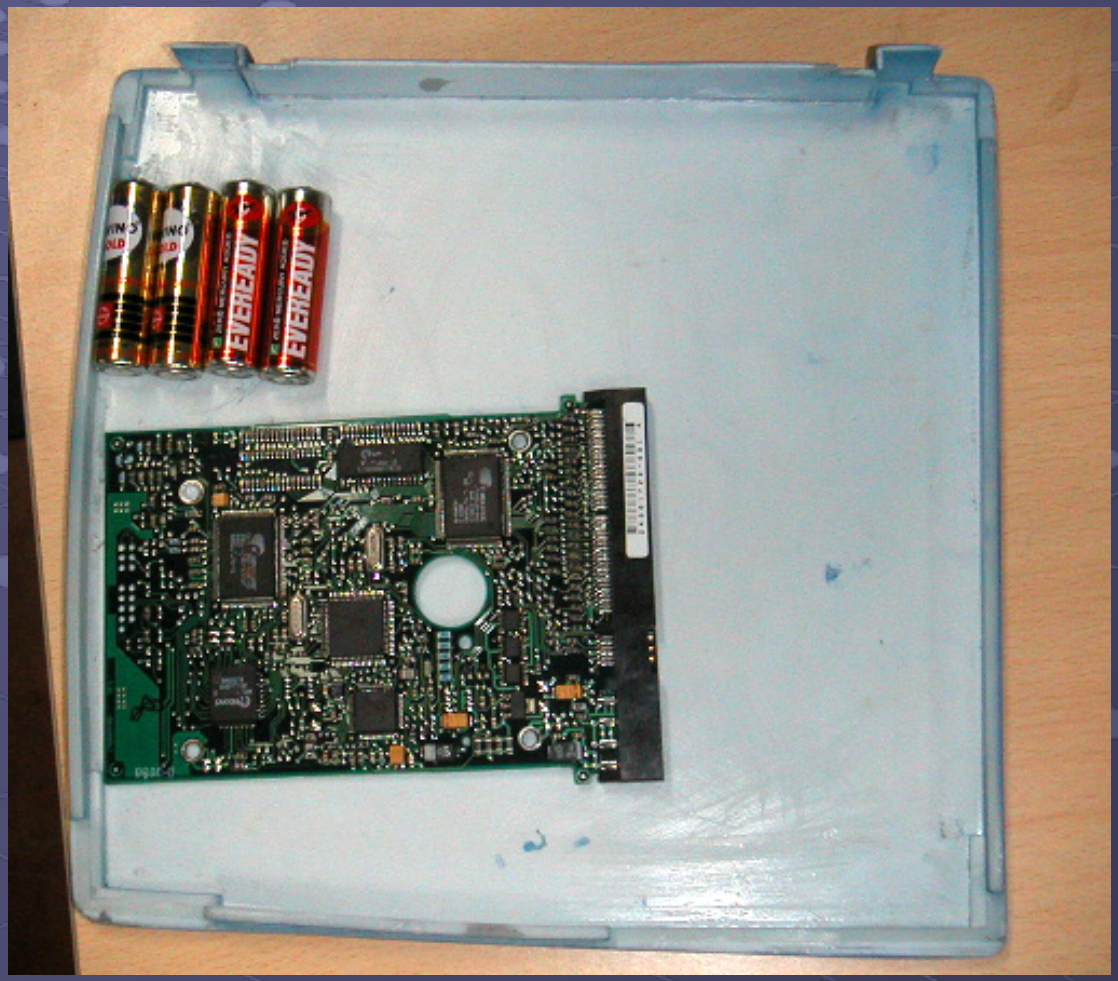
Final concept

Double Hinge details

Bring water to sensor / put drops on sensor

Concept generation

Final concept



Battery and electronics placement

Bring water to sensor / put drops on sensor

Concept generation

Final concept

Forcing air on sensor

Bring water to sensor / put drops on sensor

Concept generation

Final concept

Bring water to sensor / put drops on sensor

Grip in operation

Concept generation

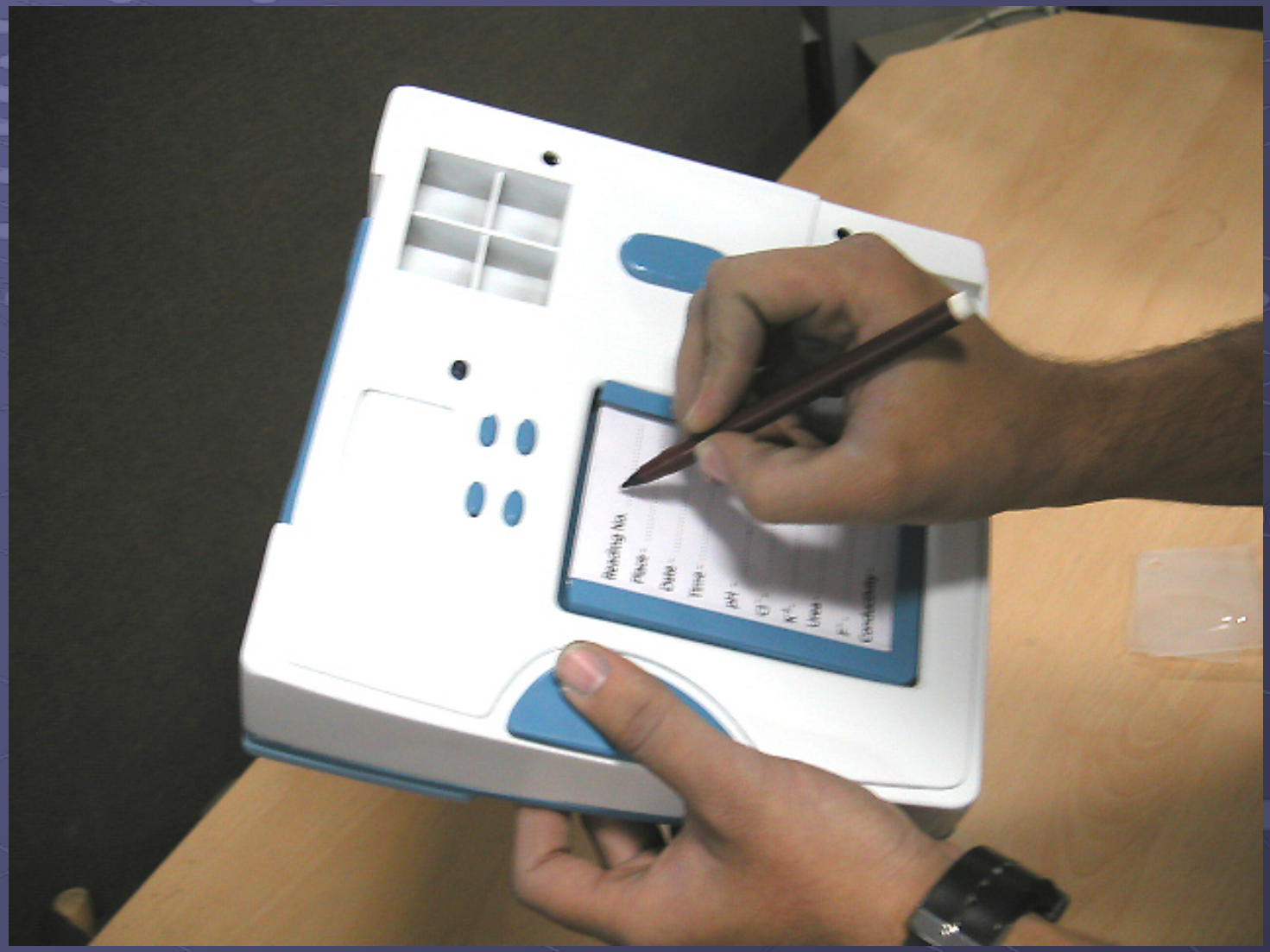
Final concept

Grip in operation

Bring water to sensor / put drops on sensor

Concept generation

Final concept



Bring water to sensor / put drops on sensor

Noting down the readings

Water quality checking product

Concept generation

Final concept

Tripod stand as accessory

Bring water to sensor / put drops on sensor

Concept generation

Final concept

Tripod stand as accessory

Bring water to sensor / put drops on sensor