I-Tub (Intelligent-Tub)

bathtub service platform that combines bigdata and iot-technology

Semester : 2020-1
Subject : CapstonDesign1
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TeamName : Ultimate
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Members : Jeong Haemin (20144748)
: Seo Jeonguk (20154199)
: Park Jisu (20154280)

Contents

Team Introduction

I-Tub Team Introduction

Lim Daein (Leader)

Computer Engineering
2015
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- Web back-end
- IoT coding
- Data analysis
- Prototype modeling

Seo Jeonguk (Member)

Computer Engineering
2015
junguk7880@naver.com

- Web front-end

Park Jisu (Member)

Computer Engineering
2015
xrl0603@naver.com

- Database design
- Prototype modeling

Jeong Haemin (Member)

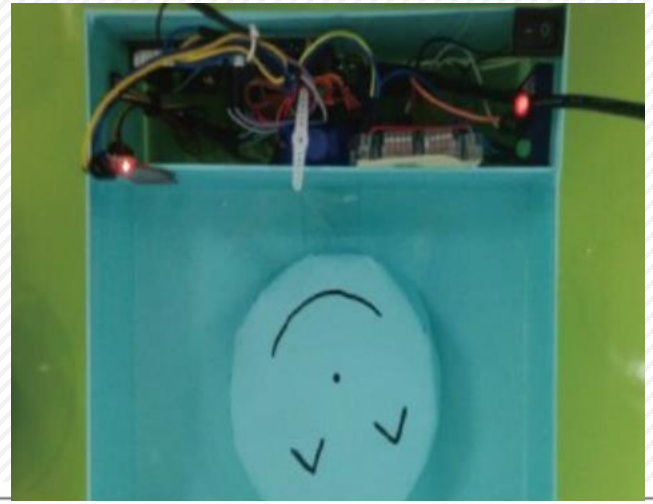
Computer Engineering
2014
jhm0828@gmail.com

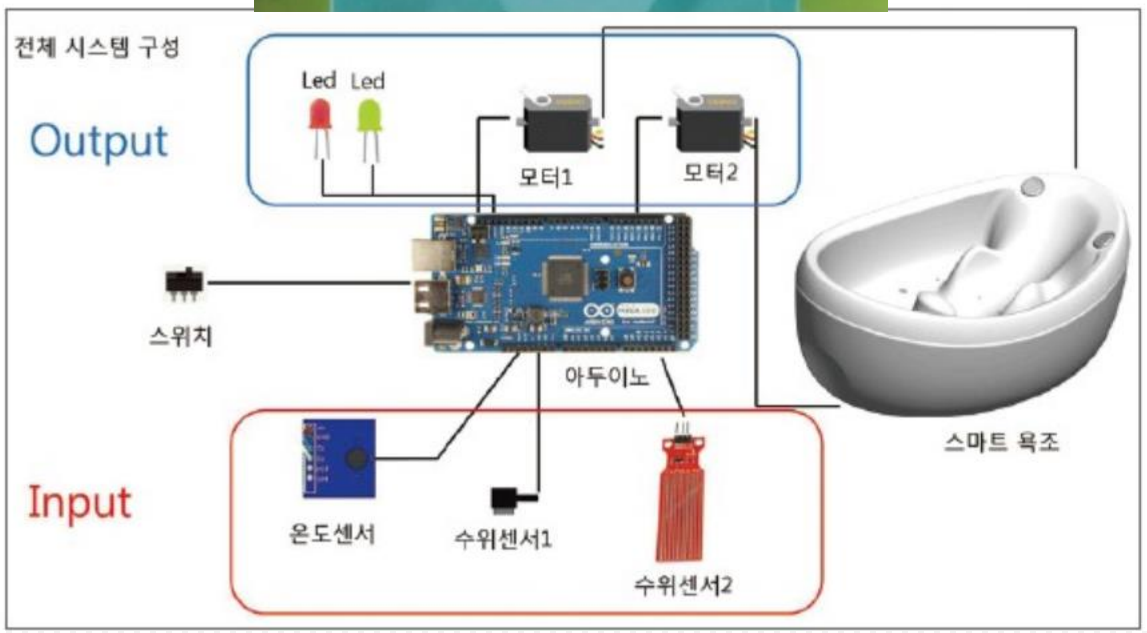
- Web front-end
- Data collecting

Topic Selection

I-Tub Relevant Research or Project

- http://www.ntrexgo.com/archives/31916 <Smart bathtub>





- **Pusan National University In 2016**

ICT Convergence Project Contest

- **Topic : Bathtub that added smart function**
- **Function List :**
  1. **Waterlevel control**
  2. **Setting and maintaining the temperature of water**
  3. **Automatical drainage**
- **Summary : A one click of a button proceeds with three functions sequentially**

I-Tub Relevant Research or Project (Differentiation point)

Bathtub with simple temperature of water and water level control and drainage function

Smart bathtubs with bigdata and machine running,

Including temperature of water and water control with . customizing

I-Tub Topic selection

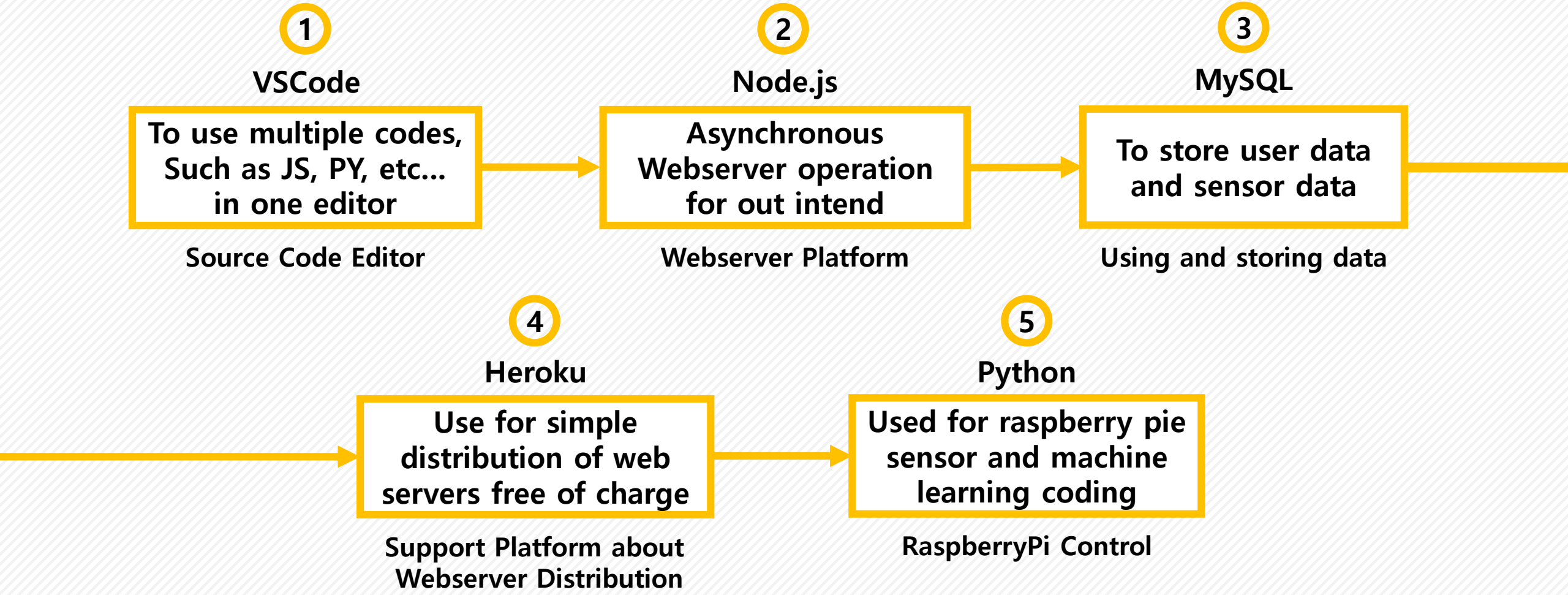
Simply bathing → Getting Rest and Enjoyment

- **Development motivation**
  - To make the bath ate the start and end of the day more valuable
- **Development purpose**
  - Automated system for more convenient use
  - To allow users to take a bath in their favorite environment
  - To maximize user convenience by combining with big data
- **Expectancy effects**
  - Satisfy the needs of younger generations
    who want customized services and convenient use
  - Expected that will be contents
    such as Jimjilbang instead of ending in simply bathing

I-Tub Project Introduction

1. I-Tub Development Environment
2. I-Tub System Architecture

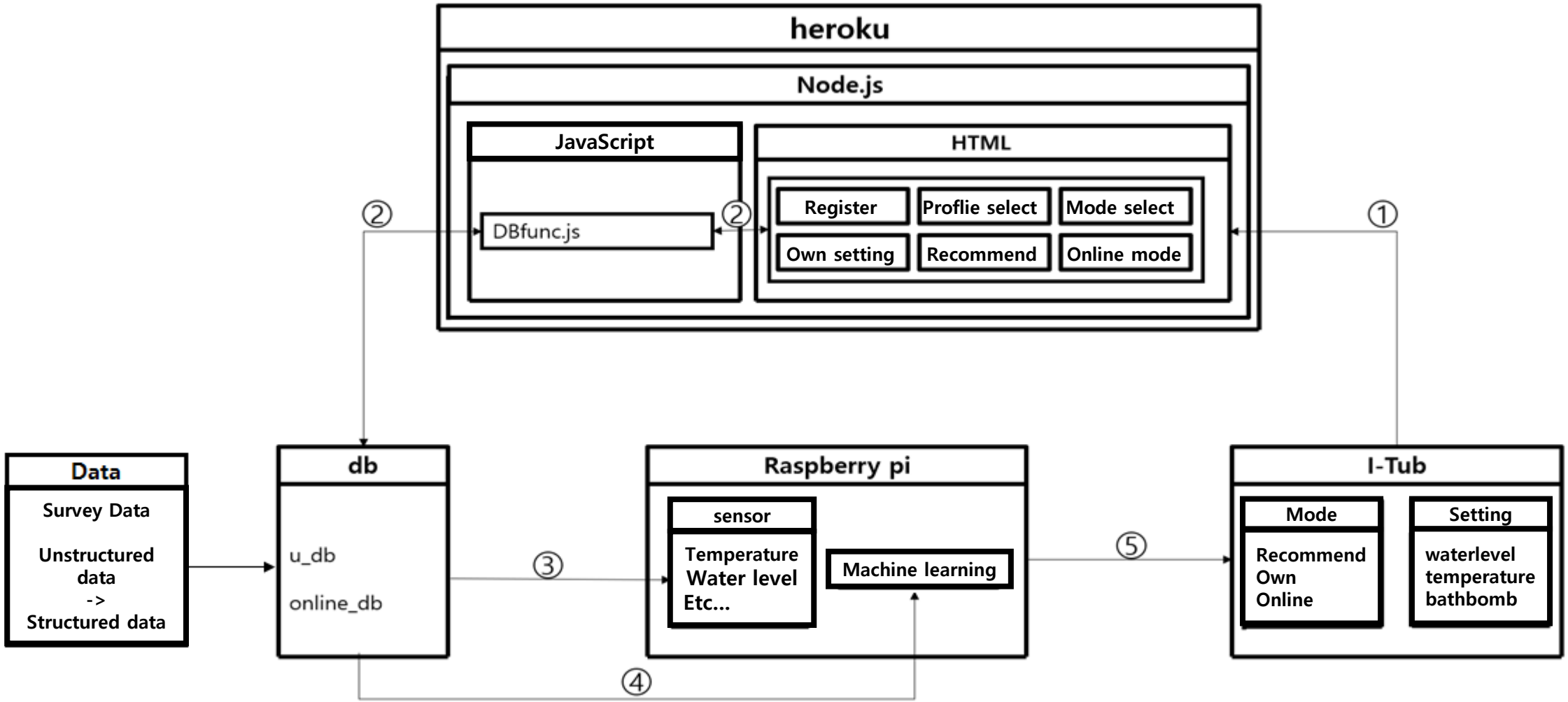
I-Tub Development Environment



I-Tub Development Environment

Install	Program	Version	Description
1	VSCode	1.44.2	When writing HTML files, there are real-time previews, many convenience features, and Java scripts are supported.
https://code.visualstudio.com/			
2	Node.js	12.16.2 LST	A web server platform for creating and serving web pages and can open and close servers with a few lines of code.
https://nodejs.org/ko/			
3	MySQL	8.0	To use the CRUD(Create, read, update, delete) function for the user's information or the user's information.
https://www.mysql.com/			
4	HEROKU	7.39.5	As a platform that supports web distribution, it is easy to distribute the web and supporting uses Node.js.
https://www.heroku.com/			
5	Python	3.6	Required for temperature and water control via various sensors in raspberry pie, also it use interprinter language
https://www.python.org/			

I-Tub System Architecture



I-Tub Data of using

1. I-Tub Data Collecting way
2. I-Tub Data preprocessing and analysis
3. I-Tub Data Learning Model
   Comparing and Selecting

I-Tub Data Collecting way

● Select items that are considered important and collect data through surveys using Google Form because there is no variable data for I-Tub (total : 3290)

Question <Total 7 items>	Answer
What is your gender?	Male/female
What is your age?	Write age
What is your preferred temperature?	Write temperature
What`s the Average bath start time?	Write average bath start time
How long does it take to take a bath?	Write bath time
Do you use bath bombs?	Check yes or not
What is your job?	Write job

I-Tub Result of Data Collecting

- Survey and survey result

In GoogleForm

- It`s total recode: **991 EA**

We add randomly data

For accurate analyses

So our total recode is **3290EA**

I-Tub Result of Data Collecting

- Requires data preprocessing about unanswered in the intended format

Gender	① Age	② Temperature	③ Bath start time	④ Bathing time	bathbombs	job
남	68	따뜻함	5	40	무	무직
여	65	따뜻함	9	30	무	자영업자
여	63	따뜻함	8	20	무	주부
남	62	미지근함	6	20	무	사무직
남	61	시원함	18	20	무	자영업자
여	60	따뜻함	12	20	무	자영업자
여	58	따뜻함	9	30	무	농민
남	57	미지근함	19	10	유	공무원
남	57	따뜻함	6	20	무	사무직
남	57	따뜻함	19	20	무	공무원
여	57	따뜻함	20	10	무	주부
여	57	미지근함	6	5	무	주부
남	56	미지근함	19	20	무	사무직
여	56	따뜻함	5	25	무	주부
남	55	따뜻함	20	30	유	자영업자

I-Tub Data Preprocessing

① Age ② Temperature ③ Bath start time ④ Bathing time

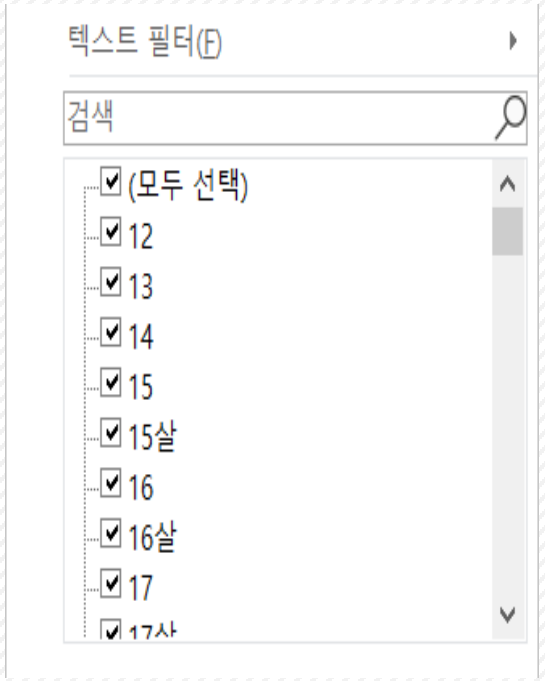
Table1 : age

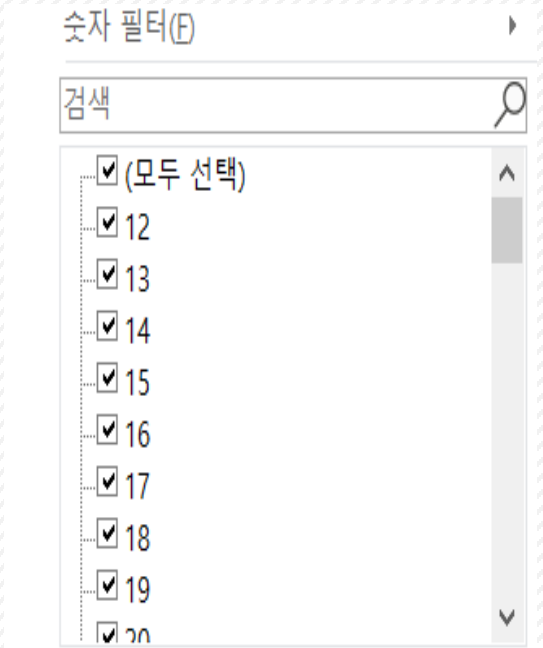
① Age
Column3
귀하의 나이는?
25
24
24
24
34
25
24
28
29
29
25
29세
25
19
25
29세
23
24
30
25
26
29
25
29
25짤
25
25
25
25
25
24
41

29세

Average	MIN	MAX
28	12	68

● Remove all characters to save to an integer field





I-Tub Data Preprocessing

① Age ② Temperature ③ Bath start time ④ Bathing time

Table2 : Temperature

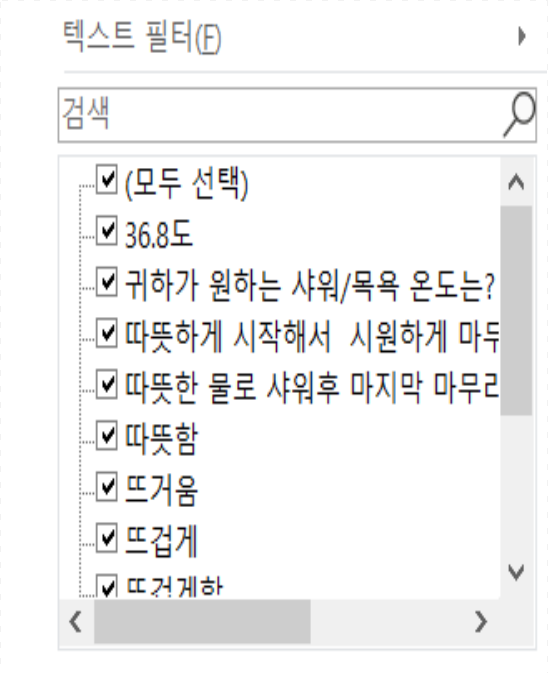
② Temperature

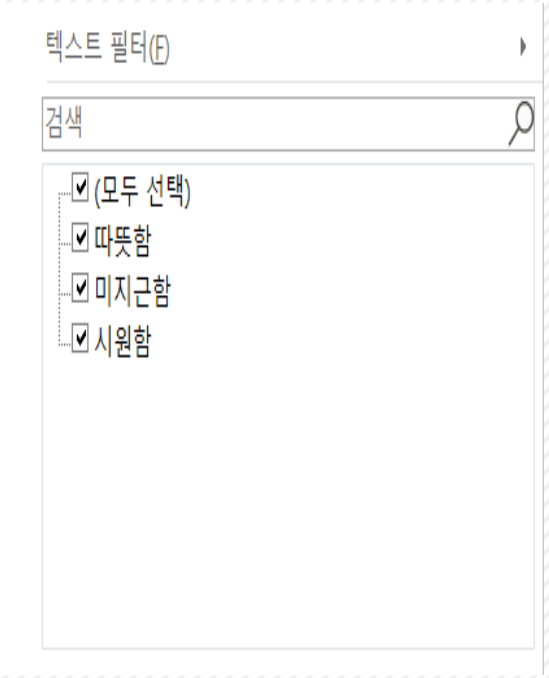
Column4
귀하가 원하는 샤워/목욕 온도는?
따뜻함
따뜻함
따뜻함
따뜻함
따뜻함
따뜻함
따뜻함
따뜻함
따뜻함
따뜻함
따뜻함
미지근함과 따뜻함 사이
따뜻함
36.8도
미지근함
미지근함
미지근함
미지근함
미지근함
따뜻함
따뜻함
따뜻함
따뜻함
따뜻함
미지근함
따뜻함
따뜻함
따뜻함
따뜻함
미지근함
따뜻함
따뜻함

미지근함과 따뜻함 사이

according to number of columns
Hot > Cold > Normal

● Too many answers come out and merge into similar items in the same





I-Tub Data Preprocessing

① Age ② Temperature ③ Bath start time ④ Bathing time

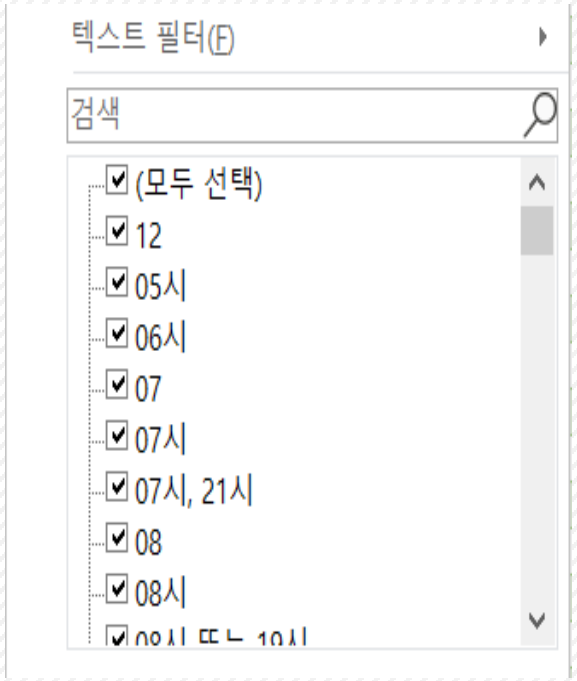
Table3 : bath strat time

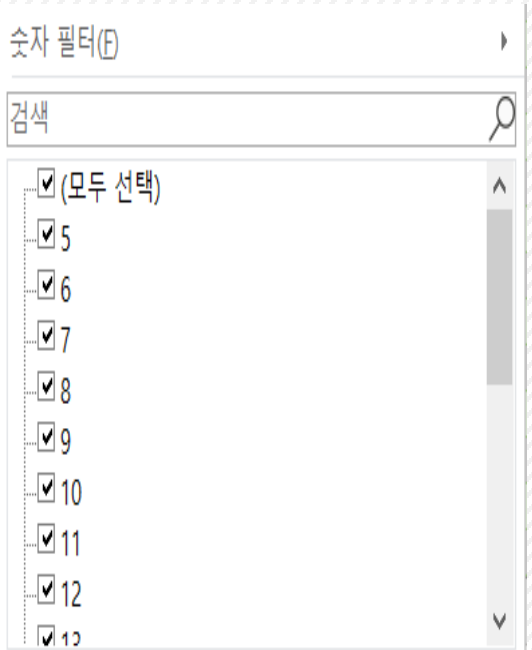
3	Bath start time
	Column5
	귀하의 샤워/목욕 시작 시간대
	30분
	15분
	20분
	아침 출근전. 저녁 퇴근후
	퇴근 후 6시,
	아침 출근전 저녁 퇴근후
	기상후 07시 귀가후 20시
	7시 30분
	오후 10시 오전 7시반
	아침 저녁
	12시 or 23
	밤 아홉시, 아침 열한시
	10am
	5
	22:00~23:00
	오전7시, 오후8~9시
	저녁
	저녁9시
	아침 기상 10시
	14시
	매일 다름
	기상 후, 취침 전
	9pm
	저녁
	하고싶을때
	22시~23시
	저녁 8시
	9pm
	20시
	5~10사이
	저녁10시

오후 10시 오전 7시반

Average	MIN	MAX
16	5	23

● Convert all to 24-hour integers for storage in integer fields





I-Tub Data Preprocessing

① Age ② Temperature ③ Bath start time ④ Bathing time

Table4 : Bathing time

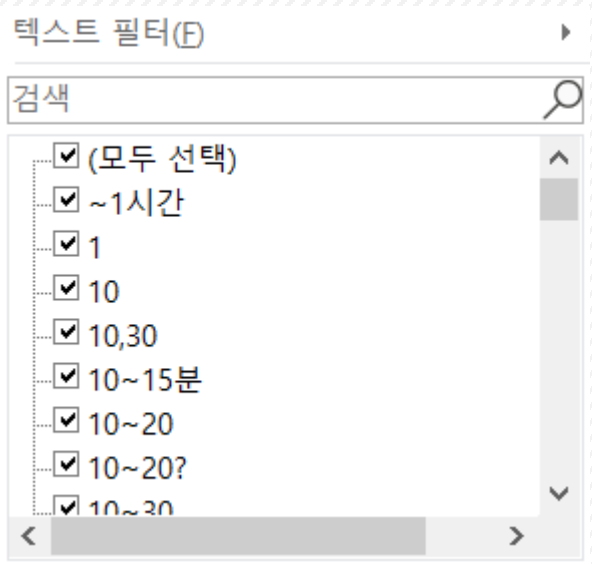
④ Bathing time

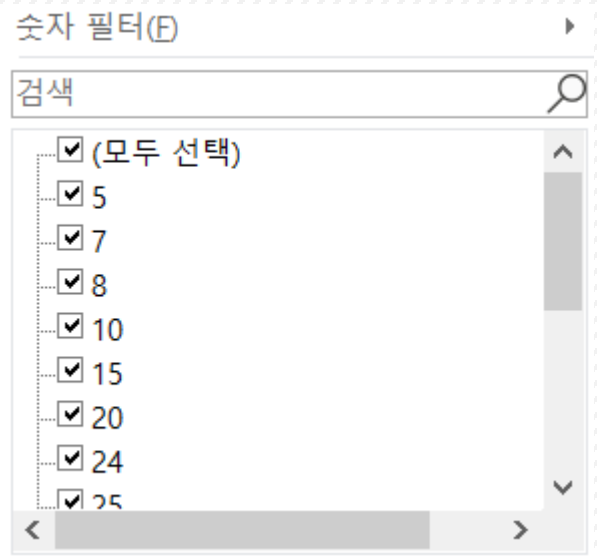
Columns
귀하의 샤워/목욕 하는데 걸리는
30분 2트
15분
20분
샤워 10분 목욕 25분
20분
샤워 10분 목욕 25분
20분
20분
15분
20분
20
샤워 10분 - 15분
30m
10
30분
5~10분
10분
15분내외
20-20분
10분
30분
20분
30분
20분 내외
15분
20분이내
7분
20
20분
30~1시간
30분

20분

Average	MIN	MAX
23	5	120

● Remove all characters to save to an integer field





I-Tub Result of Data Preprocessing

s_date	s_gender	s_age	s_temp	s_start	s_during	s_perfume	s_job	s_weather
2020-04-17	남	12	시원함	16	10	무	학생	16.30 ℃
2020-04-14	남	12	따뜻함	17	10	무	학생	20.10 ℃
2020-04-14	남	13	시원함	17	15	무	학생	20.10 ℃
2020-04-17	남	14	따뜻함	21	10	무	학생	13.80 ℃
2020-04-04	남	14	시원함	17	20	무	학생	11.10 ℃
2020-04-14	남	15	미지근함	16	10	무	학생	20.40 ℃
2020-04-02	남	15	따뜻함	20	10	무	학생	10.90 ℃
2020-04-17	남	15	시원함	22	10	무	학생	12.30 ℃
2020-04-17	남	15	따뜻함	17	20	유	학생	16.40 ℃
2020-04-26	남	15	따뜻함	21	20	무	학생	14.10 ℃
2020-04-26	남	16	따뜻함	17	7	무	학생	18.10 ℃
2020-04-14	남	16	시원함	20	10	무	학생	13.80 ℃
2020-04-24	남	16	따뜻함	19	20	무	학생	12.90 ℃
2020-04-28	남	16	따뜻함	20	30	유	학생	14.30 ℃
2020-04-28	남	17	미지근함	20	5	무	학생	14.30 ℃
2020-04-17	남	17	따뜻함	12	10	무	학생	14.50 ℃
2020-04-17	남	17	시원함	23	10	무	학생	11.00 ℃
2020-04-27	남	17	미지근함	7	15	무	학생	7.60 ℃
2020-04-14	남	17	따뜻함	11	15	무	학생	15.70 ℃
2020-04-28	남	17	미지근함	21	15	무	학생	13.60 ℃
2020-04-17	남	17	따뜻함	23	15	무	학생	11.00 ℃
2020-04-17	남	17	따뜻함	10	20	무	학생	11.80 ℃
2020-04-08	남	17	따뜻함	16	20	무	학생	15.70 ℃
2020-04-09	남	17	미지근함	17	20	무	학생	12.90 ℃
2020-04-29	남	17	따뜻함	22	20	무	학생	15.00 ℃

Basic table columns of survey

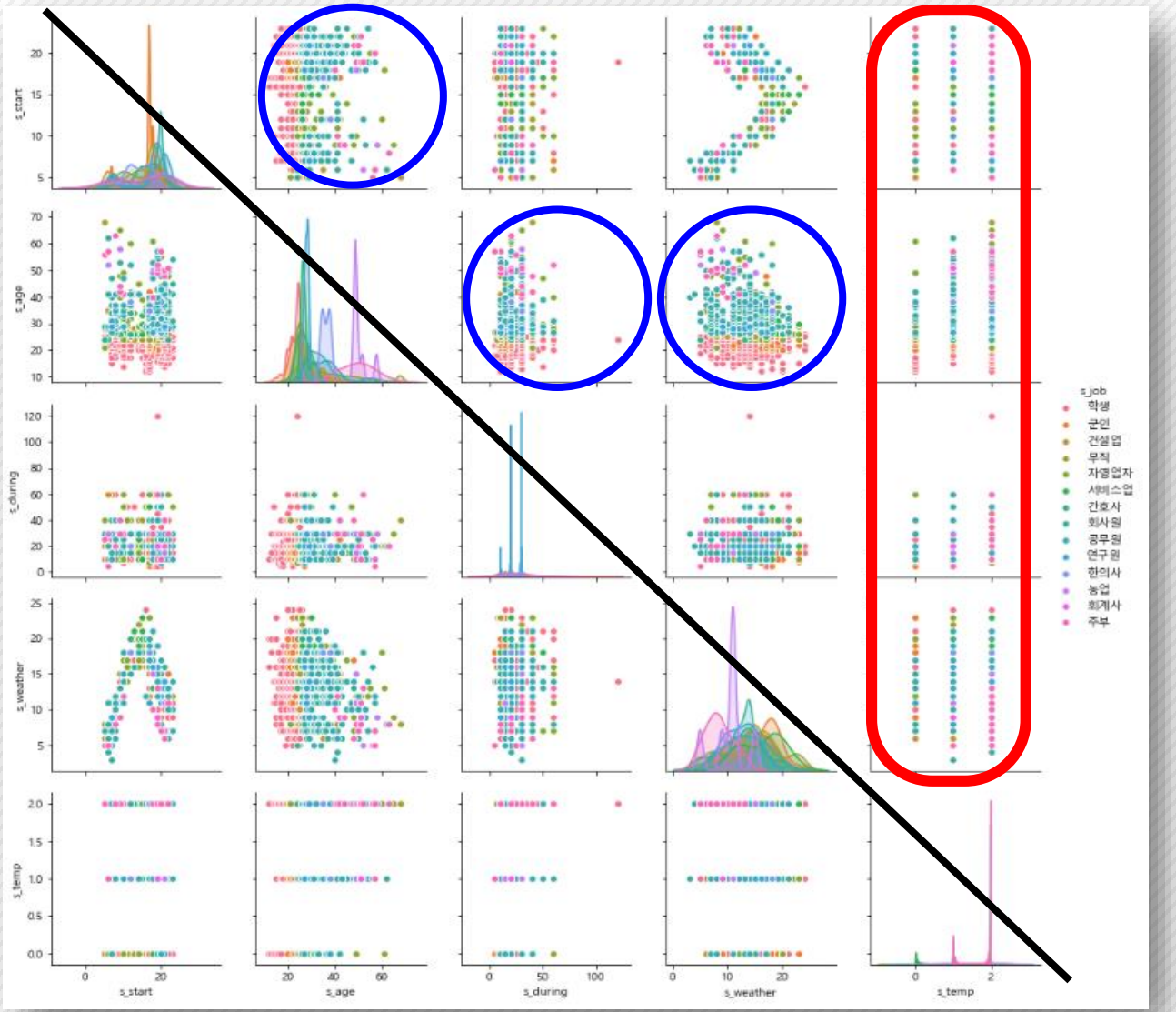
name	Description
s_gender	Surveyor`s gender
s_age	Surveyor`s age
s_temp	Surveyor`s temperature
s_start	Surveyor`s start bath time
s_during	Surveyor`s bath time
s_perfume	Surveyor`s bath bomb use status
s_job	Surveyor`s job

Add colums to basic table

name	Description
s_date	Surveyor`s date surveyed
s_weather	Weather of the date surveyed

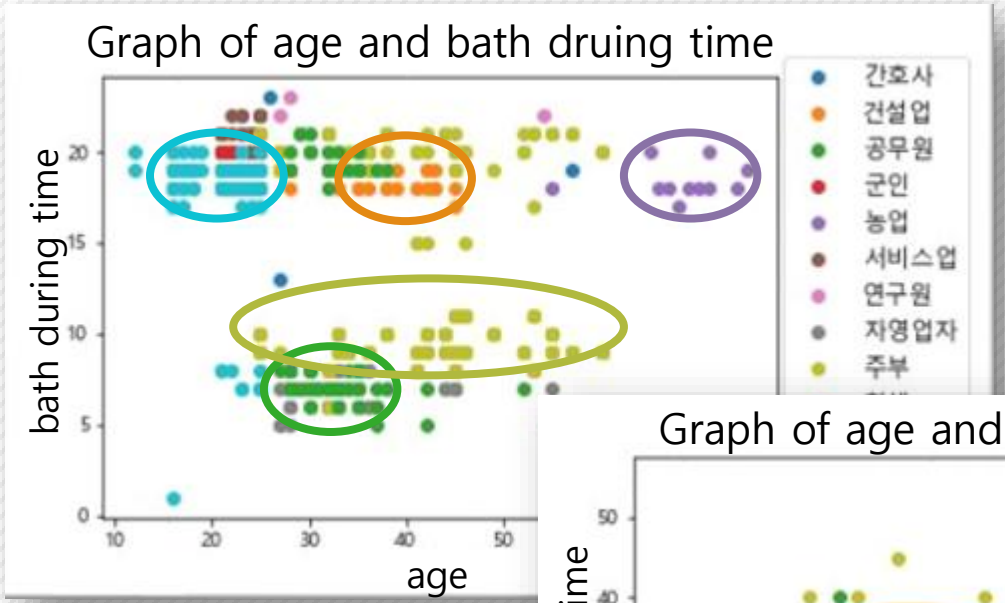
I-Tub Data Visualization (Scatterplot between all elements)

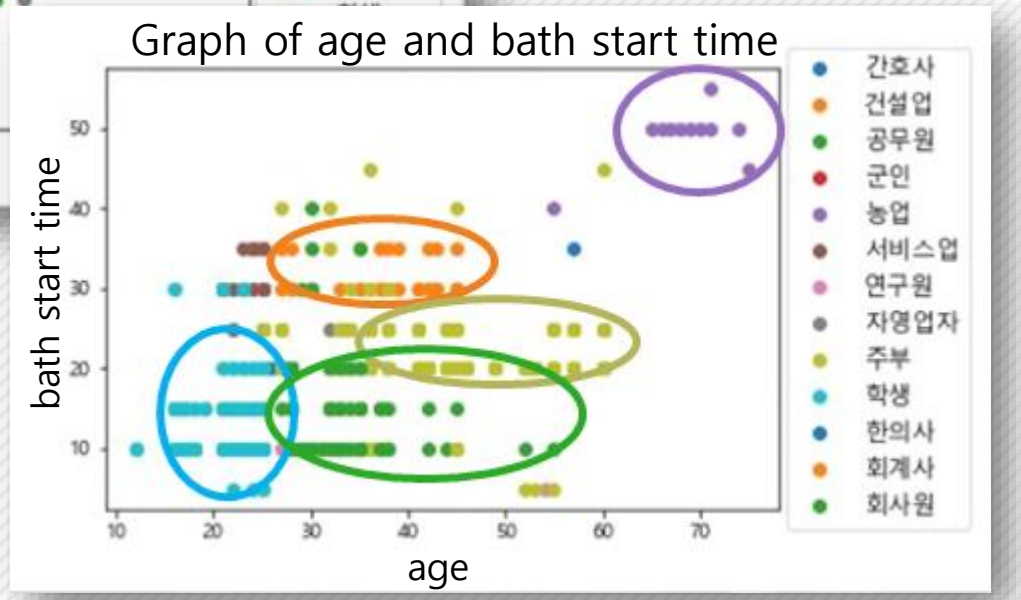
To represent the relationship between two variables using orthogonal coordinates



- Based on data of job, we found that bath time and temperature were randomly distributed as **unnecessary** factors,
- But in the case of bath start time by age was clustered and **necessary** for prediction

I-Tub Data Visualization (relationship between age and bath during time or bath start time)



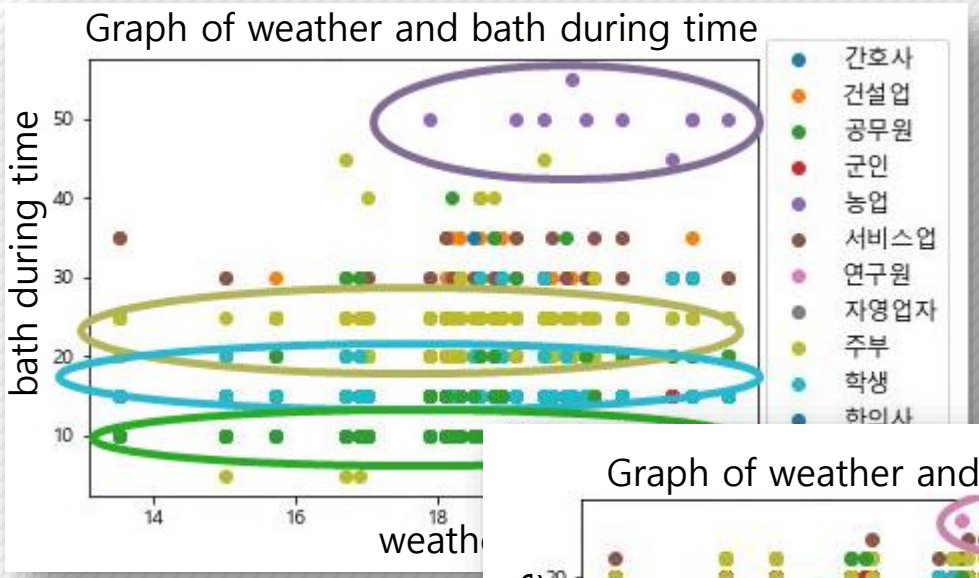


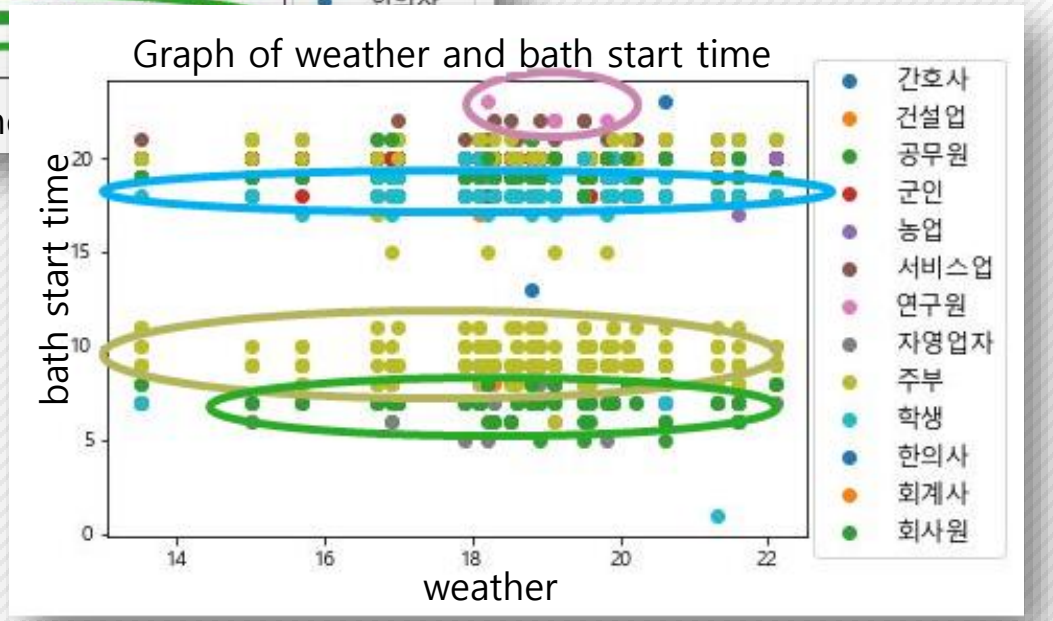
Depending on the age,

Can see that bath time or bath start time is clustered

Judging that the factors related to the age and bath time are correlated

I-Tub Data Visualization(relationship between weather and bath during time or bath start time)





Depending on the weather,

Can see that bath time or bath start time is clustered

Judging that the factors related to the weather and bath time are correlated

I-Tub Result of Data Analysis

1. The time elements of shower are distinguished by age

2. The time elements of shower are distinguished by job

3. The time elements of shower are distinguished by weather

▶ Knowing age, job and weather can distinguish and

Predict elements related to shower time

I-Tub Data Learning Model Comparing and Selecting

The best model has higher precision and recall than another models

- **Accuracy : A figure of correct answers matched by model`s predictions**
- **Precision : A figure of how many include of correct answer by model`s predictions**
- **Recall : A figure of correct answers predicted by model**
- **F1-score : Harmonic mean of precision and recall**

(A figure obtained by Harmoinic mean of precision is overwhelmingly higher than recall or vice versa)

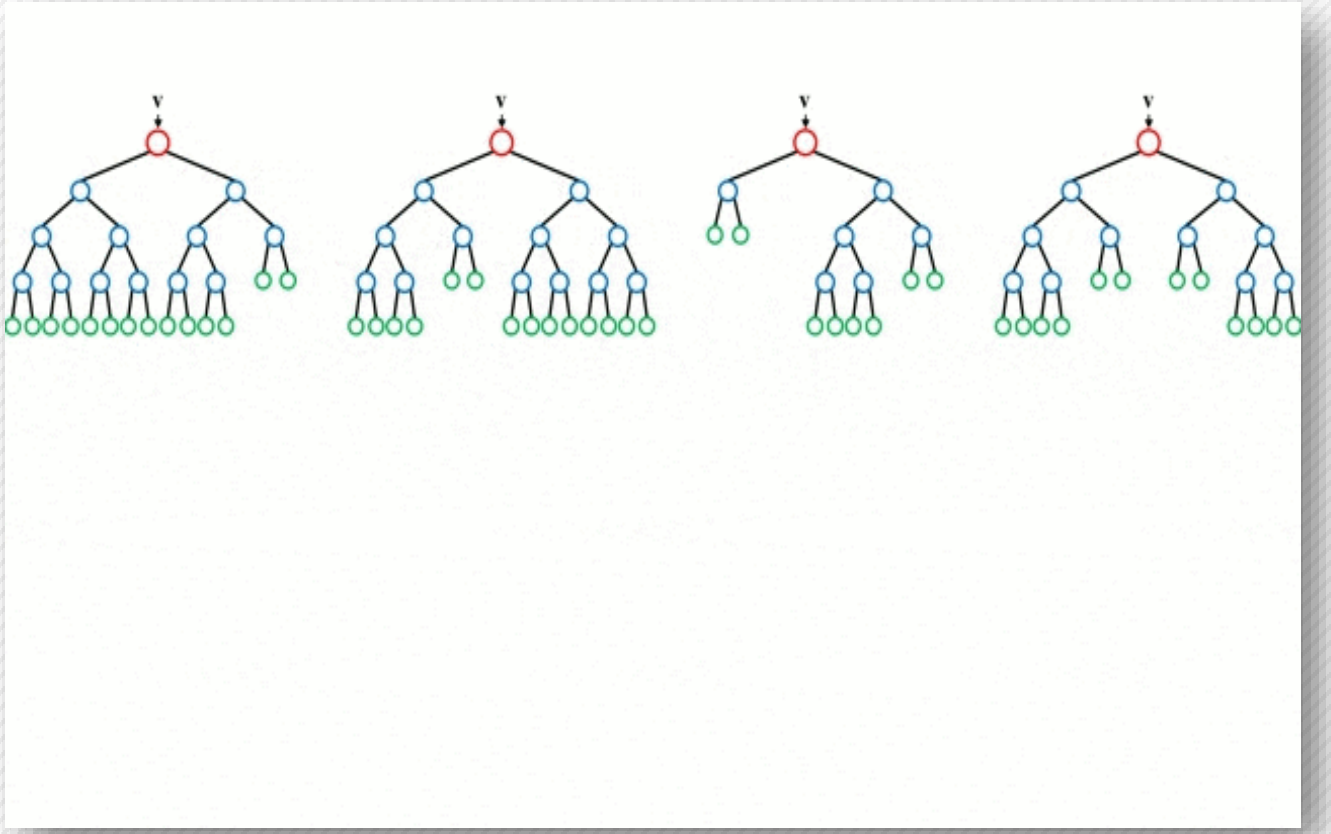
I-Tub Data Learning Model Comparing and Selecting

● **Comparisons show that the XGBoost model has the best figures, but it takes the longer to predict, so we select the faster and the next best model, RandomForest**

Model name	Accuracy	Precision	Recall	F1-score
DecisionTree	65% (train : 76%)	66%	65%	64%
RandomForest	**65% (train : 77%)**	**66%**	**65%**	**64%**
XGBoost	66% (train : 76%)	66%	66%	66%
K-nearest-neighbors	50% (train : 50%)	51%	50%	49%

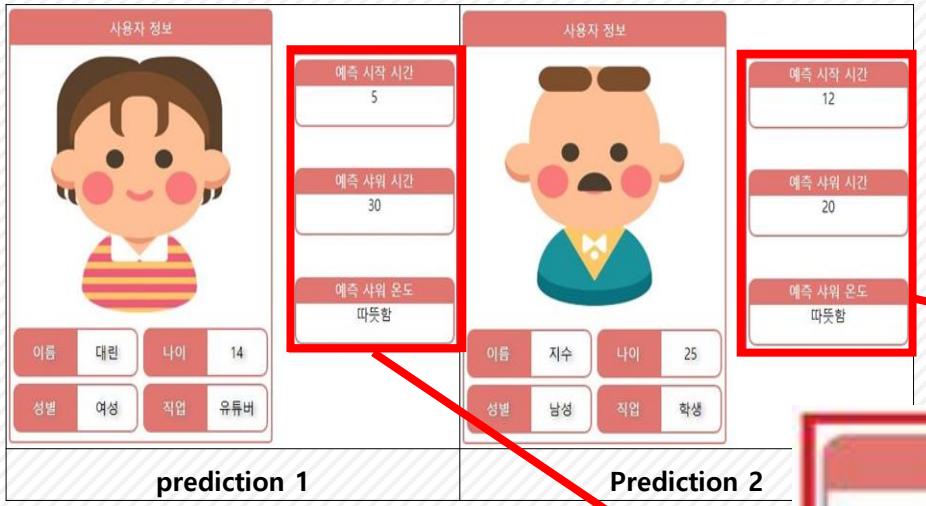
I-Tub Data Learning Model Selection

RandomForest



▶ The method of determining characteristics as ‘yes’ or ‘no’ by the tree is user to estimate the final values and to collect all the predicted trees and select the forecasts on the principle of average or majority rule

I-Tub Result of Model Prediction



prediction 1 | Prediction 2

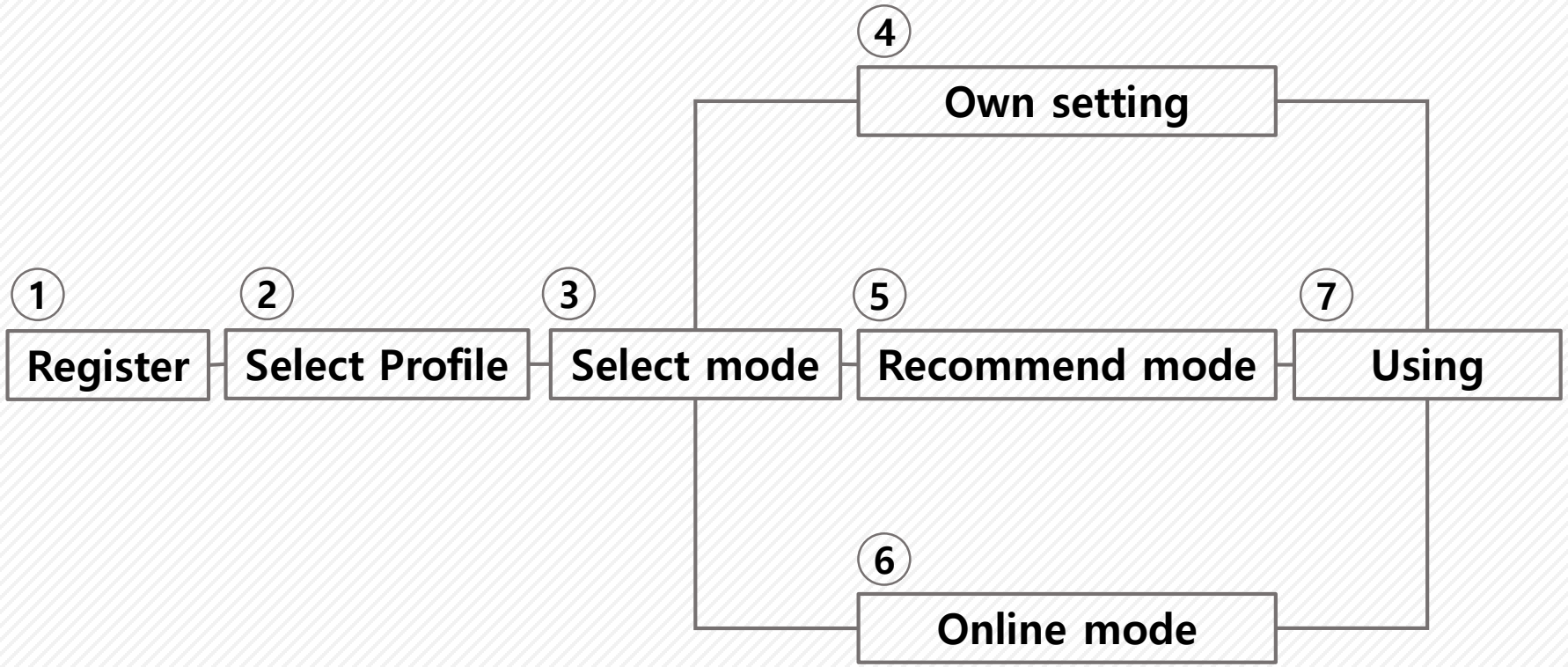
- Using information about user`s age, gender, job and day`s weather,

  We can predict different predictions

I-Tub Service Implement and Prototype Modeling

1. I-Tub Website Diagram
2. I-Tub Website Implementation
3. I-Tub Prototype Modeling

I-Tub Website Diagram



Website Configuration

① New registration

② Select user

③ Select about three modes

④ User can setting own favorite options

⑤ Recommend options that matched user

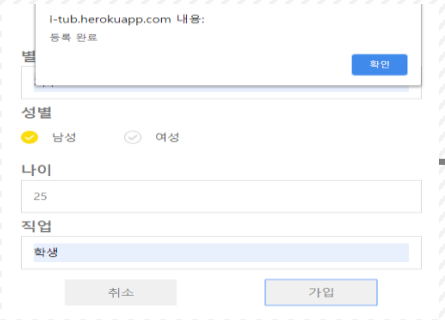
⑥ Show statistical of age, gender, etc..

⑦ Show options that user use and use additional function

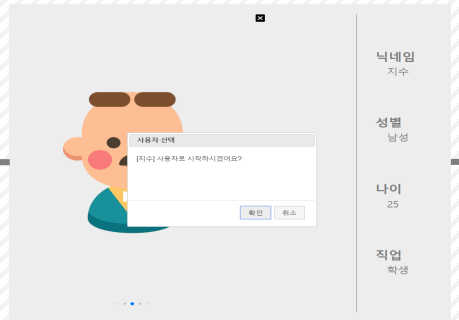
I-Tub Website Diagram

Own setting mode

Register



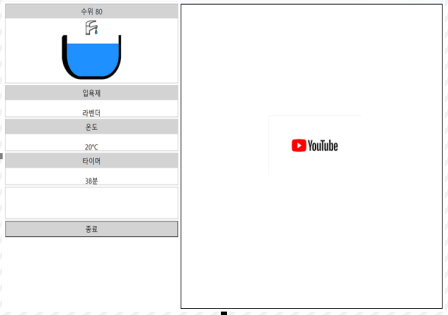
User select



Mode select

Recommend mode

Using



Online mode

I-Tub Website Implementation (register page)

① Register

(When write user information and register, to send data at server)

▶ Member registration screen

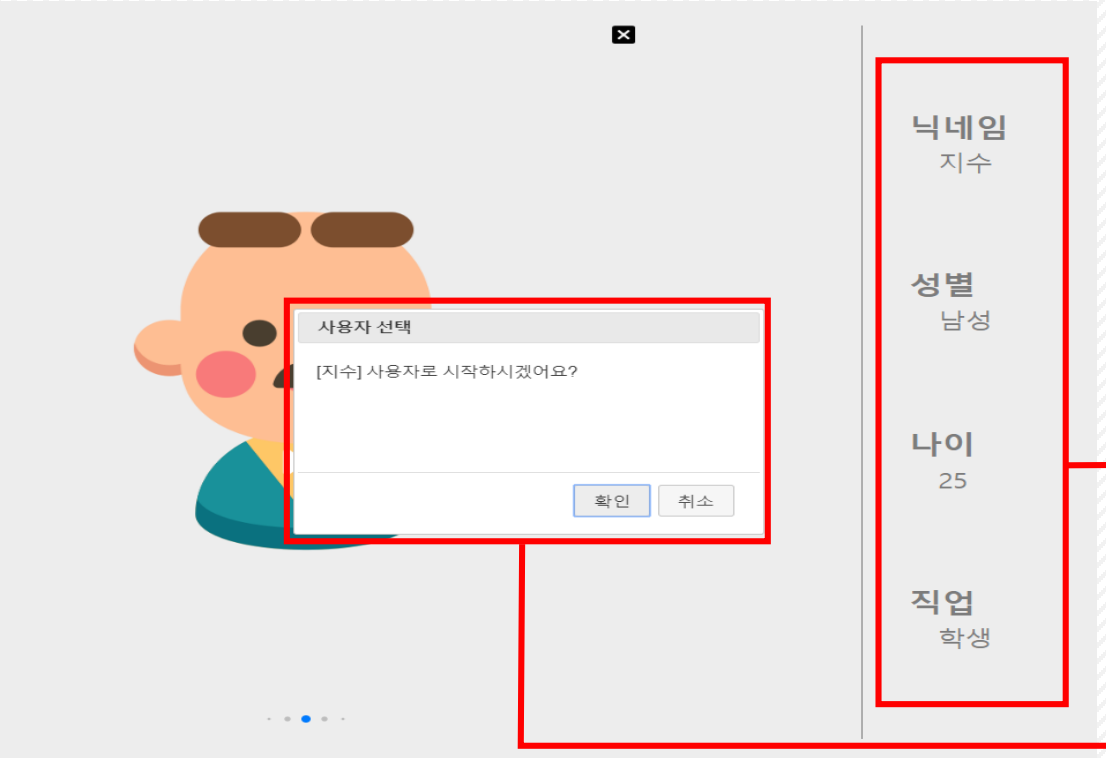
For new user registration

● Information for registration

1. Name(Nick Name)
2. Gender
3. Age
4. Job

I-Tub Website Implementation (user select page)

② User select



(When you choice user, brings up user data stored on the server)

▶ **Select users page where**

You can select registered users

(Show user`s information on the right)

(When the user click, page is asking whether to select it through the dialogue window.)

I-Tub Website Implementation (mode select page)

③ Mode select ▶ Mode select page that Have three modes

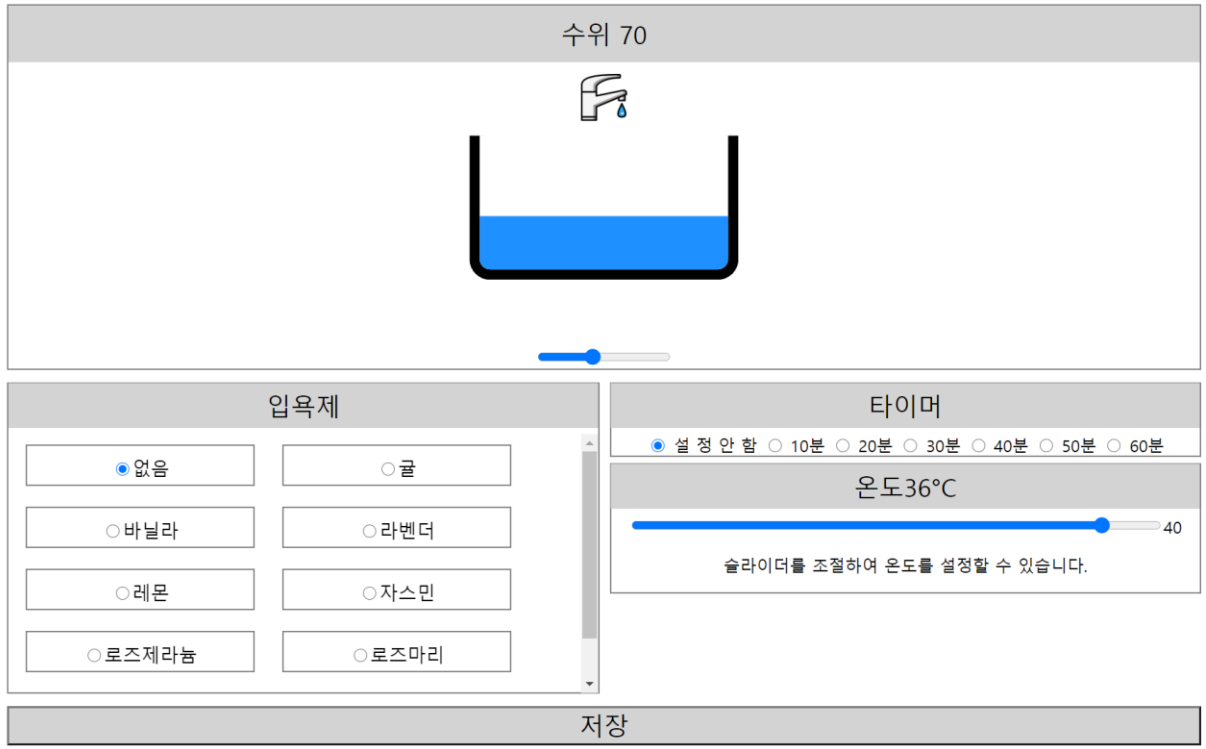
(Press mode to go to that page)

I-Tub
Website Implementation (custom setting page)

③ Mode select

④ Own setting ⑤ Recommend mode ⑥ Online mode

④ Own setting



(When select options that you want and submit, data stored to server)

▶ My own setting page where

You can select and save the options

you want

● Option list

1. water level [0~100 height]
2. select bathbomb [by perfume]
3. select timer [0 ~ 60minute]
4. temperature level [0 ~ 40℃]

I-Tub
Website Implementation (user recommend page)

③ Mode select
④ Own setting ⑤ Recommend mode ⑥ Online mode

⑤ Recommend mode

(When select one in various modes , be started)

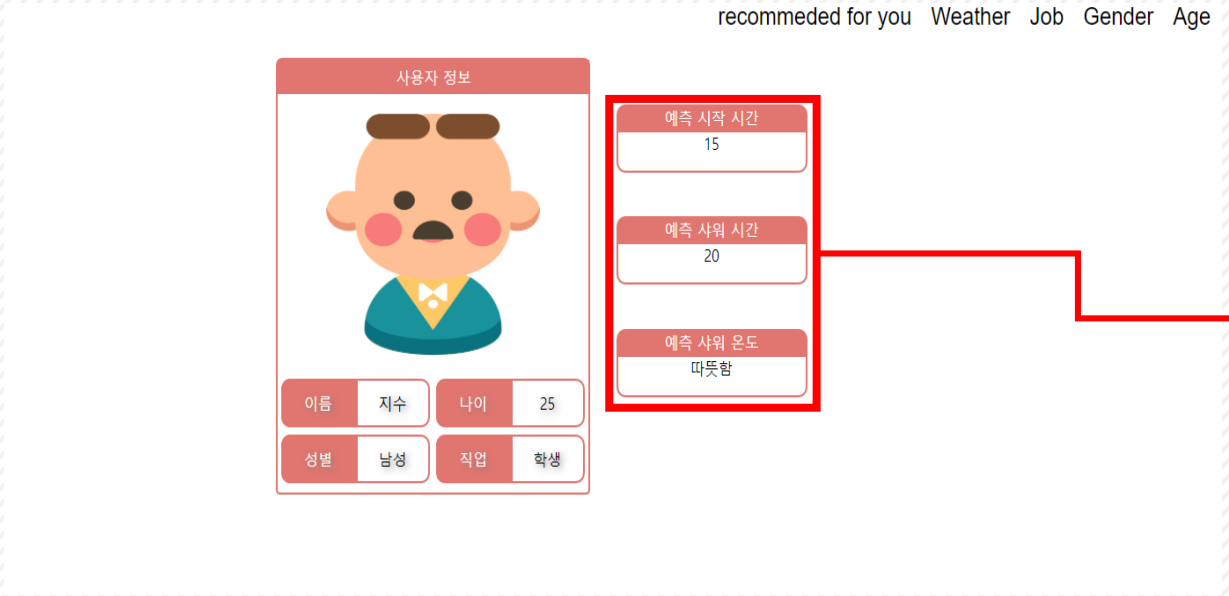
▶ A page that is

Simple to use for pre-created themes

I-Tub
Website Implementation (online mode page)

③ Mode select
④ Own setting ⑤ Recommend mode ⑥ Online mode

⑥ Online mode



(Reads data stored on the server and shows it in charts by categories)

▶ Show bath data which are

Statistics by gender, age, job, and weather

Show that recommended values predicted

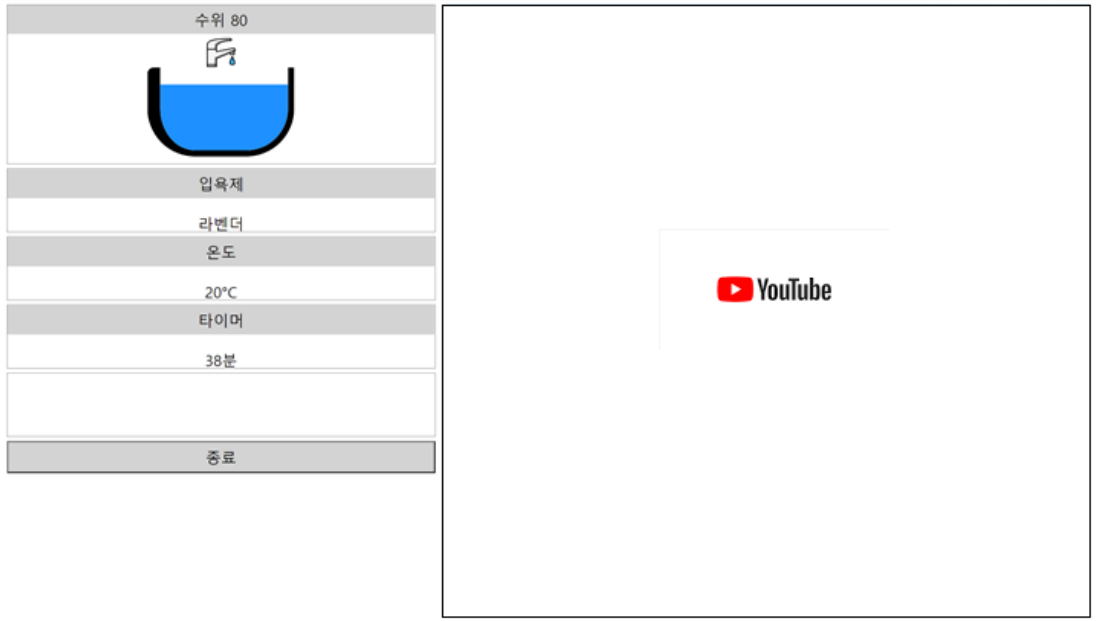
by models learned by machine learning

● [Statistic list]

gender : male, female
age : 10s~70s
job : student, housewife, etc..
(Total : Thirteen)
weather: 5 ~ 40℃

I-Tub Website Implementation (user using page)

⑦ Using



(Show options that user using now, provide media on the right)

▶ **Check options that oneself select**

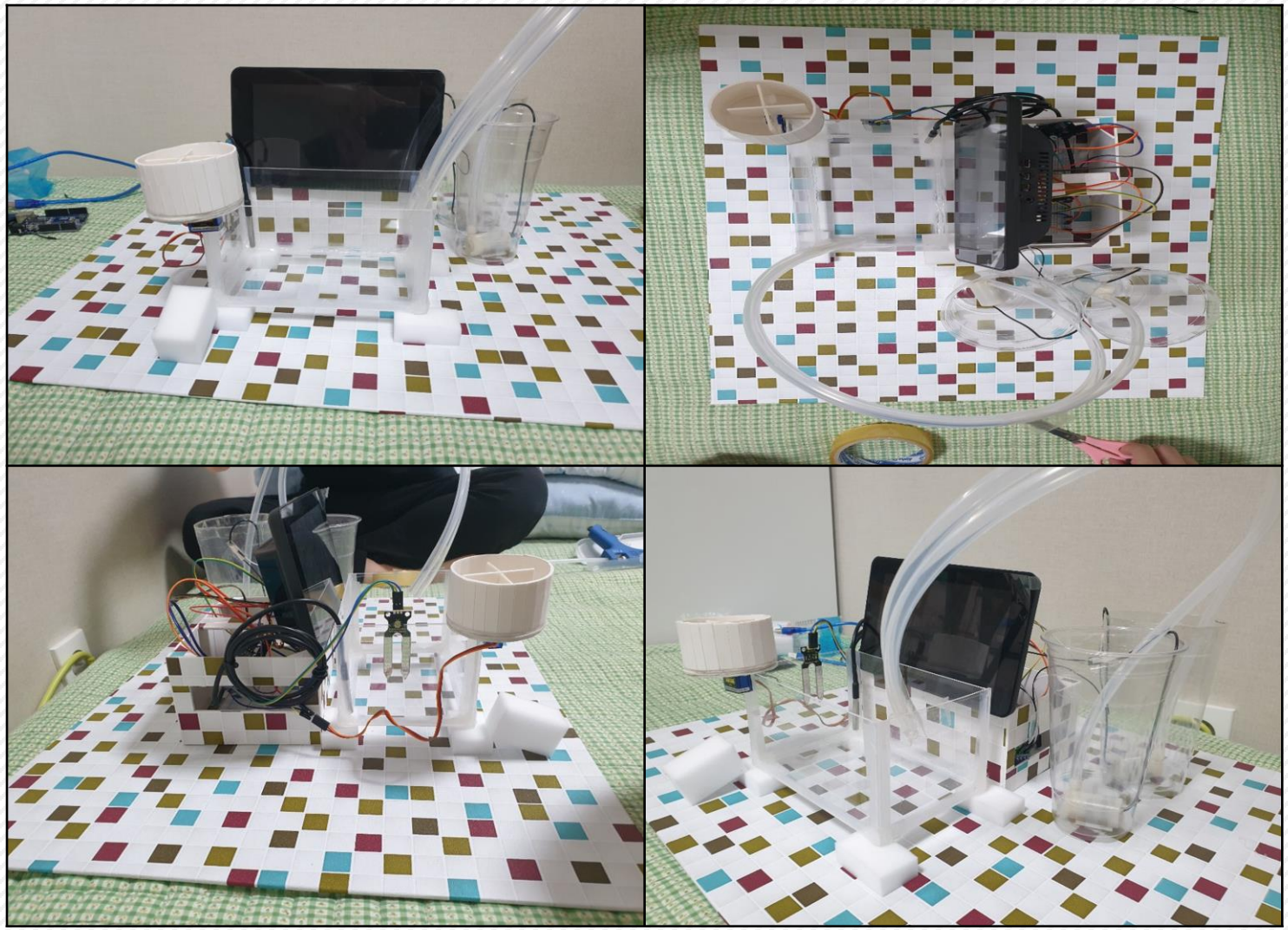
[water level, bath bombs,

temperature, timer]

Showing you a something like

video site to enjoy when you take a bath

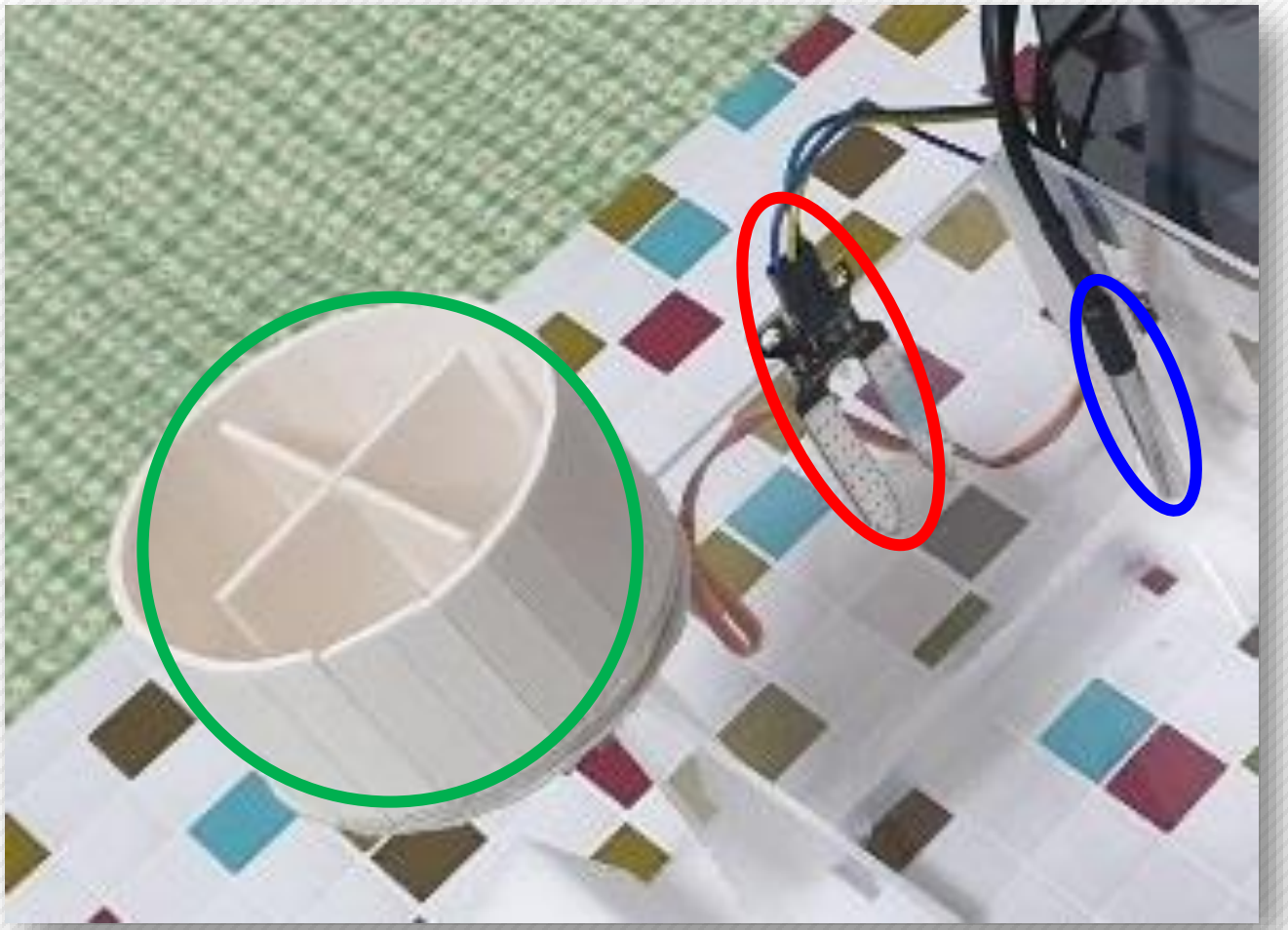
I-Tub Prototype Modeling



▶ **Parts of Prototype**

- **Water pump**
- **Water level and temperature sensor, servo motor**
- **Raspberry Pi and monitor**

I-Tub Prototype Modeling



▶ Waterlevel sensor,

temperature sensor,

Measure the water level and

temperature of the bathtub

▶ Servo motor

Input bathbombs into the bathtub

I-Tub Prototype Modeling

▶ **Pumping the water**

by using water pump

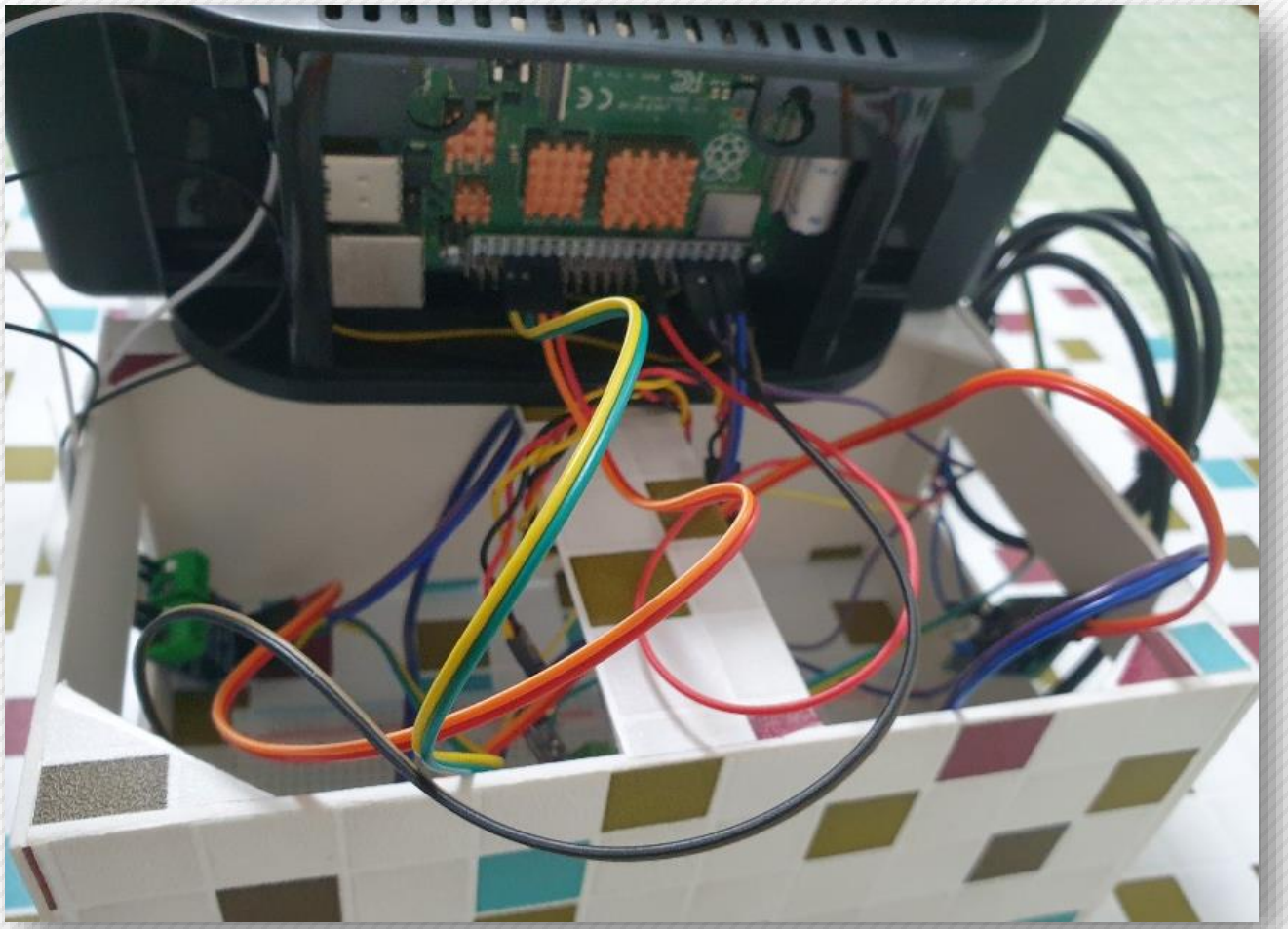
To supply water to the bathtub,

adjusting to the set temperature

and water level

Hot water, Cold water

I-Tub Prototype Modeling



▶ Provide Web service for user and

Control various sensor

I-Tub Service Result

▶ I-Tub service Demo (Video)

I-Tub Supplement Points

- Data did not exist, it was collected directly. So the data lacks validity
  - Expect to be able to solve the problem through professional surveyors or through cooperation with bathtub operators
- Hot water cannot be used due to functional problems of sensors
  - Solve the problem by investigating and replacing with a suitable part

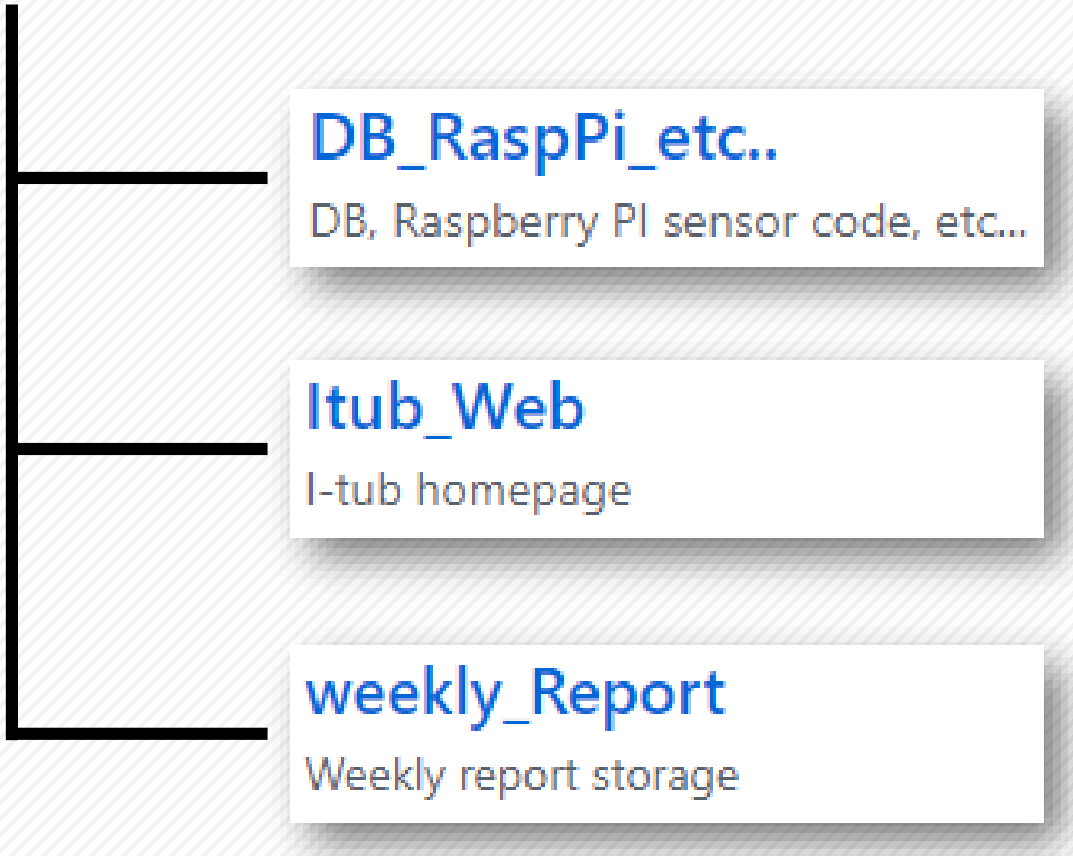
References

- https://opentutorials.org/course/1 (to using javascript)
- https://opentutorials.org/course/3780/18031 (html and css guide)
- https://github.com/dabeng/OrgChart (orgchart open source of to show statistical on online mode)
- https://dabeng.github.io/OrgChart/ (orgchart example)
- https://win.adrirobot.it/sensori/moisture_sensor/moisture_sensor.html(soil mosture sensor example)
- https://blog.naver.com/elepartsblog/221726825667 (rasbian install to use raspberry pi)
- https://www.raspberrypi.org/ (rasbian install reference library to use raspberry pi)
- https://www.circuitbasics.com/raspberry-pi-ds18b20-temperature-sensor-tutorial/ (temperature sensor example)
- https://blog.naver.com/rhrkdfus/221373635978 (rasbian wireless mouse solving an obstacle)
- https://www.kocoafab.cc/fboard/view/1089 (understanding the principles of mini-breadboard)
- https://www.inflearn.com/course/node-js-%EC%9B%B9%EA%B0%9C%EB%B0%9C# (understanding node.js for webserver to handle user requests)
- https://swiperjs.com/api/ (swiper API to use profile select page)

Github Introduce

dnfwlxo11	Jisup	haemin-jeong	Seojeonguk Seojeonguk
Lim Daein	Park Jisu	Jeong Haemin	Seo Jeonguk

https://github.com/Ultimate-ItubProject



Repository that storage of databases, raspberrypi codes, and ambiguous files to categorize

Repository that Storage of I-Tub Webpage code consists of HTML, JS, PY codes

Repository that Storage of Weekly, Middle, Final reports

Question?

Thanks.