Smart Shoebox
(Shoes care solution utilizing IoT concept)

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Role	Name	Task and description etc
User	Kwon Gyuhyeok	Suggest the actual features for the Smart Shoebox users can feel comfortable and interesting to use
Customer	Shin Minki	Suggest the actual features for the Smart Shoebox customers can feel comfortable and interesting to use
Software developer	Kim Junghyun	Focusing on the Technical aspects of the Smart Shoebox while developing
Development manager	Ko Byunghee	Consider the service side of the Smart Shoebox while developing the system

TABLE I
ROLE ASSIGNMENT

***Abstract*—This document is about the realization of automatic remote control for shoesthrough IoT. We will make smart shoes cabinet that provides this kind of features with other different kind of functions.**

***Index Terms*—shoebox; shoes care; shoes rack; IoT;**

I. INTRODUCTION

Many people experience difficulty managing their own shoes in a decent and pleasant form. Especially for the people living alone, keeping shoes clean and sweet smelling becomes a tough task to manage. When it rains, shoes get wet and dirty. Can you imagine the smell and feel of the shoe? Even worse the smell starts from the entrance to the place where you will go to sleep. This is when the actual management features are required.

What if someone or something could take care of my shoes periodically and automatically. If the shoes could be managed regularly with the aspects of humidity, temperature, and sterilization, it will save money and also provide a pleasant day with a cozy footwear. To realize the concepts of taking care of our shoes, we will develop a shoebox which manages shoes condition by controlling humidity and temperature automatically and periodically.

We are going to use Arduino to support with humidity and temperature recognition by receiving inputs through switches or sensors. Internet of Things (IoT) is also on the base of the idea. The ability to control things (especially shoes in this case) through internet is the main concept we are trying to realize. We are looking forward to create an integrated service tool such as situation awareness, automatic computing, self-growing.

II. REQUIREMENT

A. Optimizing environment function

When we wear shoes, they easily become in a state of high temperature and humidity which causes the disgusting smell, which is also the best environment for bacteria to grow. As a result, there is a need to control the condition of the cabinet keeping the shoes. To provide an optimized environment automatically and also on user?s demand is the goal. (There is a need for defining optimized temperature and humidity)

1) Temperature/Humidity control through electric fan (automatic): The sensor receives temperature and humidity as inputs and provides an optimized environment as an output.

2) Temperature/Humidity control through ultraviolet lamp (automatic): The sensor receives temperature and humidity as inputs and provides an optimized temperature and humidity as output.

3) Drying feature (on demand): In case the user's shoes get wet by rain or other liquids the user can request for drying will operate (1), (2).

4) Sterilization function (on demand): In case the user feels the need for sterilization, user can request for this function, which operates (1), (2). This function (4) differs from (3) in degrees of intensity.

5) Deodorization function (on demand): In case the user feels the need for deodorization, user can request for this function, which triggers a deodorant to shoot out.

6) Deodorization function (automatic): The user can set regular intervals to trigger the deodorant to shoot out.

7) Intensity control feature: The user can choose the intensity level of (1), (2). Intensity is calculated as number between 1 to 5.

B. Management function

Different type of shoes requires different type of proper cares. The shoe rack needs to understand and recognize the shoes type and provide a proper management for the shoes. (Modeling : changing ambiguous information into actual concept.)

1) Shoe categorization function (bar-code scanning): Shoe categorization through capturing the barcode for the shoes.

2) Shoe categorization function (user input based): Shoe categorization through selected category of the user.

3) Shoe categorization function (captured image): Shoe categorization through captured images of the shoes.

4) Shoe categorization function (3D scanning): Shoe categorization through 3D scanning of the shoes.

5) Setting the proper management tool: After Shoe categorization, based on the shoes category, the shoe rack provides the proper setting. (There is a need for defining proper setting for each category) The proper setting is different in the aspect of the intensity from Optimization environment function.

C. Analysis function

To keep the user's shoes in high quality we can provide an analysis for the shoes the user own.

1) Absence of shoes analysis (Base information): We have decided to analyze the absence of shoes by sensor and use it as a base information for other analysis functions.

2) Durability analysis: Durability is set to decrease by the time the shoe has been put on increases.

3) Life prediction analysis: Based on the information of (1), we provide the expected life of the shoes.

4) Preference analysis (personal): Based on the information of (1) for one user, we provide the preference information of the shoes. More the user put on, more the preference increases.

5) Preference analysis (general): Based on the information of (1) for a number of users, we provide the preference information of the shoes for general aspect. Using this Big data, the user can know which shoes are popular nowadays.

6) Frequency analysis: Based on the information of (1), we provide the frequency information for the shoes.

7) Walking habit analysis (health care): Based on the information flatness of the shoes , we provide the information about walking habit of the users.

D. Recommendation function

Smart Shoes cabinet will provide recommendation information with percentages based on different kind of aspects. Of course the final choice is up to the user.

1) Recommendation based on weather forecast : With weather API, the proper type of shoes is recommended.

2) Recommendation based on the use of shoes: Recommending the shoes type which matches with the user?s activity.

3) Recommendation based on the color of shoes: Recommending the shoes color which balances with the users clothing color.

4) Notice of recommendation rate by color: Showing the recommendation rate by different colors. For example, if the shoes are recommended, a specific color will appear on the shoe rack or on the screen the user is looking at.

5) Notice of recommendation rate by percentage: Showing the recommendation rate by percentage. If the shoes are recommended strongly, the percentage will appear on the shoe rack or on the screen the user is looking at.

E. Notification function

Shoes easily get dirty, since when people do activities, shoes are the first thing that touches the ground. The shoes cabinet will provide notification for contamination of dirt or rainwater by checking on the weight difference.

1) Recognition of contamination by sensor: With the increased weight, notification is given for contamination.

2) Notification for contamination by message: After the recognition of contamination, the information is notified to the user through messages.

F. Networking / Remote control function (UI)

Without the function for internet control, it becomes nothing more than a drying machine. With this networking function on the base, the user is able to take care of the users shoes any time, anywhere. This is the most important feature we will concentrate on. Providing the IoT environment is the main goal.

1) Control function through web programming (main): With web based program, the user can interact with the smart shoe care software and other provided information.

2) Control function through mobile (sub): With mobile application, the user can interact with the smart shoe care software and other provided information.

3) Control function through embedded system (sub): With embedded system, the user can interact with the smart shoe care software and other provided information.

III. Development Environment

A. Choice of software development platform

1) Platform used for developing: package We will use both Windows and MAC OS . Since Windows is the most popular OS used worldwide and MAC OS is the second most popular OS leaving out all the other versions of Windows. We thought MAC OS X will become more popular. We also thought using other OS besides windows will mean a lot for us to use another environment to develop a software.

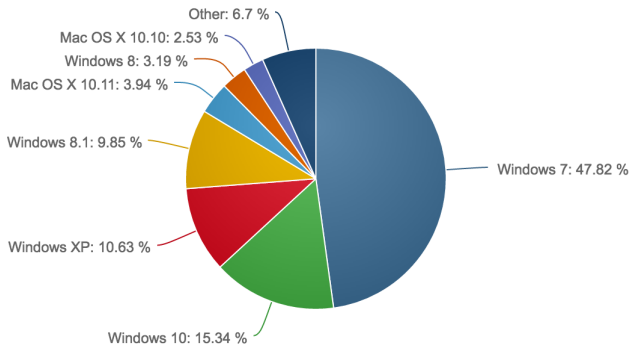

Fig. 1. Market share reports (January, 2016 to March, 2016)

Programming language	Reason
Arduino(hardware)	The main hardware part of our project is based on Arduino. The Smart Shoebox has functions to work provide behavioral motions such as recognizing the temperature and humidity of the shoebox, turning on the fan or infrared lamp as a result of it and so on.
MySQL(server side)	We need to have a database to save information about the shoes, users. To easily get and set and manage the information, we have decided to use a database management tool.
Ruby	We first thought of php for the work between the server and web side environment, since we have all learned php in another course. Though we thought it would be much better to learn a new language for this project. Ruby on rails was the interesting programming language in the aspect that it shortens and simplifies the code much more than the php.
HTML5 and CSS3(client side)	We have decided the user interface environment as a web-based structure. The functions of Smart Shoebox will be triggered and managed in the web.

TABLE II
PROGRAMMING LANGUAGE USED FOR DEVELOPING

2) Programming language used for developing: We are using Arduino, mySQL, Ruby and HTML. We are trying to provide a web service with arduino acting inside the Smart Shoebox. The frontend will be using html and css, while the backend will be using ruby and ruby on rails as a application framework. If we think of the server as a localhost, we might be using only ruby and ruby on rails for the server without MySQL.

Device	Price (won)
Arduino uno R3	7,500
Bread board	2,400
Wifi module(ESP8266)	9,000
Temperature Humidity sensor	3,000
Pressure Sensor	14,000
Fan(actuator)	4,000
Board	2,000
USB cable	500
jump wire	2,500
M-F wire	2,000
Resistance	200(5 per unit)
Small LED lamp	1,000
AA battery	1,200
transistor	500
TOTAL	49,800

TABLE III
COST ESTIMATION(HARDWARE)

Software	Task Description
Source Tree(v1.8.3)	Version control
Git(v2.8.1)	Project control
Github	Remote repository
Sublime Text3(3103)	Text editor
mockflow	Wireframe creation
Mac OS X El Capitan	Operating System
Windows 8 / 10	Operating System
Arduino(v1.6.8)	Text editor for Arduino
TOTAL	0

TABLE IV
COST ESTIMATION(SOFTWARE)

3) Cost estimation (Software / Hardware): TABLE III and TABLE IV

B. Software in use

We have researched to find out if there is any existing software or algorithm in use doing a similar task we are trying to provide. We were really surprised to find so much information related to our project. There was a lot of algorithms and systems during the research. The most interesting and related ones were the three below.

1) Temperature Humidity Control system: As anyone can think of the air conditioner or greenhouse there were already a lot of systems and devices doing the actual part of our project to control the temperature and humidity for the given environment. (For our home, or for growing plants in the optimized temperature and humidity, and so on.) Even there were a lot of information about making the Arduino actually work as we planned to.

Fig. 2. Advance Temperature Control (http://infusionva.com/)

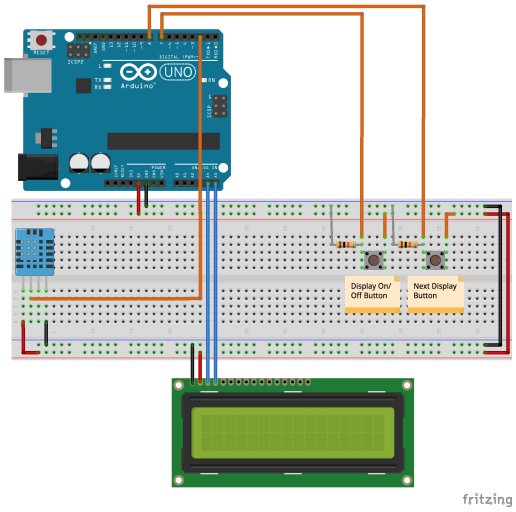

Fig. 3. Airconditioner automatic control through Arduino

2) Recommendation System : There is an extensive class of Web applications that involve predicting user responses to options. Such a facility is called a recommendation system. In Figure above we see an example utility matrix, representing users? ratings of movies on a 1?5 scale, with 5 the highest rating. Blanks represent the situation where the user has not rated the movie. The movie names are HP1, HP2, and HP3 for Harry Potter I, II, and III, TW for Twilight, and SW1, SW2, and SW3 for Star Wars episodes 1, 2, and 3. The users are represented by capital letters A through D. The goal of a recommendation system is to predict the blanks in the utility matrix. This recommendation system was in common with our project in the point that we will provide a recommendation information for the shoes with the weather APT and color of the shoes matching with the user?s clothes.

	HP1	HP2	HP3	TW	SW1	SW2	SW3
A	4			5	1		
B	5	5	4				
C				2	4	5	
D		3					3

Fig. 4. utilitymatrix

Name	Responsible Part
Kwon GyuHyeok	Arduino
Shin MinKi	MySQL
Kim JungHyun	Wireless fidelity control
Ko ByungHee	Ruby on rails

TABLE V
TASK DISTRIBUTION

3) Classification Algorithm in datamining: Basic Principle (Inductive Learning Hypothesis): Any hypothesis found to approximate the target function well over a sufficiently large set of training examples will also approximate the target function well over other unobserved examples.

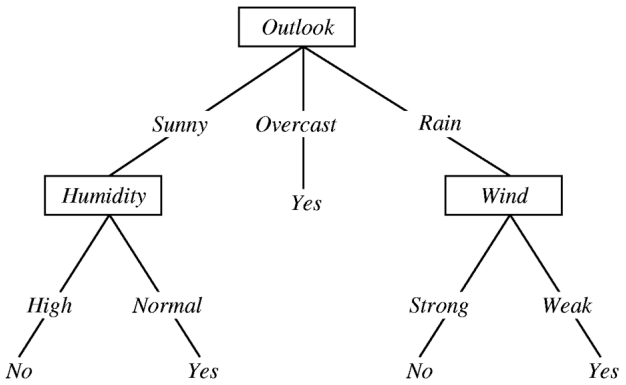

Fig. 5. decisiontree learning

This algorithm was in common with our project in the point that we will classify the shoes.

C. Task Distribution

We have decided to distribute the project in big parts to make each participants to be responsible for the assigned parts. Still every person has to know how the project is going on in a big picture while being responsible for the assigned part.

IV. Specification

The specification is mostly in pseudocode and additionally graphs and charts will be used to specify the requirements.

Particularly, mockflow will be used to wireframe the user interface. The pseudocode is a little bit close to the programming languages we have already learned during other courses while disregarding the details of the grammar.

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V. Architecture Design and Implementation

VI. Use Cases

VII. Conclusion

The conclusion goes here.

Acknowledgment

The authors would like to thank...

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