Self-Orthotherapy program using Arduino and pressure sensor

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Group Name : 'Healpers'

Role	Name	Task description and etc.
User	Minsoo Choi	– Test the application in various postures. – Require bugs to be fixed. – Demand the all of data about user. – Require additional functions.
Software Developer	Taejin Kim	– Develop the application using Arduino and pressure sensor. – Fix bugs. – Develop additional functions according to users' needs.
Development Manager	Hakjun Kim	– Monitor the progress of the project. – Make a overall plan about developing program and managing the budget – Reflect users' needs

***Abstract*—This project is about self-orthotherapy system using Arduino with a built-in bluetooth 4.0 communication chip and pressure sensor which communicates with an Android application. This program can definitely detect users' incorrect postures and can be used for long-term postural analysis and correction as saving users' postural data in database.**

***Keywords*—Self-orthotherapy, Arduino, Pressure sensor, Android application**

I. Introduction

In modern society, most office workers spend over 12 hours each day sitting on a chair. This immoderate sedentary lifestyles and incorrect posture can cause many severe health problems. For instance, incorrect posture can lead to turtle neck syndrome, scoliosis, chronic low back pain, cervical disc and herniated disc. In particular, crossing legs can twist the pelvis which induces pelvis inflammation and may change the shape of spine and trigger crooked legs, all of which are the reason for an asymmetrical body. In other words, correct posture will be the most effective way to prevent the above diseases.

Therefore, maintaining a good posture in a forced sedentary lifestyle has a great significance to keep them healthy. Nevertheless, when office workers concentrate on working or loosen the tension, posture would be disturbed. So we would like to develop an application to help them correct their wrong postures.

The application can recognize the position by using Arduino and pressure sensor. The application will perform the correction of posture immediately by informing the users' incorrect postures. This application is expected to greatly contribute to maintaining a healthy posture and lifestyle of the modern office workers.

II. INDEX

III. Requirements

A. Required hardware and software

-Arduino Uno R3 Board
-FSR 406(Pressure sensor)
-Connecting pin
-Bread Board
-HC 06(Bluetooth Module)
-USB cable
-Arduino Sketch(Using C)
-Android Studio(Using Java)
-MySQL
-pgAdmin(Using ProgreSQL)

B. Requirements for Developers

– Making pressure recognizing cushion

First, we have to make proper pressure recognizing cushion to recognize users' posture. So, we are going to make cushion with pressure sensors fitted to the chair's size. Now, we have plan to use 'FSR 406(Pressure sensor)' that the size is approximately 38mm x 38mm. So, we are going to make cushion with four(2x2) pressure sensors or more to recognize users' posture properly.

– Connecting pressure sensor with Arduino Board

Second, we have to connect pressure sensor with Arduino Board to get pressure value. And we have plan to use 'Arduino Uno R3 board'. So, we are going to connect 'FSR pressure sensor' with 'Arduino Uno R3 board' and test whether we get proper pressure value when user changes the posture.

– Making orthotherapy algorithm using pressure value

If we succeeded in getting proper pressure value, we make our own orthotherapy algorithm. We will analyze pressure values and set cases to correct users' posture. For example, when the right side's pressure value is low we show alert message ("Your body is tilted to the left" or "Don't let your right leg crossed").

– Developing Front-end Android Application

After we make orthotherapy algorithm we have to develop android application. So, we will develop the application according to our UI/UX and architecture design. We have two parts in our front-end application. The first is the Self-Orthotherapy part and the second is showing analyzed result using users' personal data.

– Constituting Database for saving users' data

We should design database tables for saving users' data. And we make sign-up form for user to register in our application. And we get essential data such as ID, PW, Phone number and put it into the our database.

– Developing Server to manage users' data

We will provide analyzing service using users' personal data. So, we have to manage users' own Id and Password by server and save the users' specific data. For example, if the user got some alert messages or moves out the users' seat, we save that data and we will provide graph or chart by analyzing that data.

C. Requirements for Users

– Getting alert message when having bad posture

If user had bad posture, program recognizes that and shows the alert message to fix that posture. Bad posture means i) sit with one's legs crossed. ii) the waist is bended iii) the body is tilted to right or left too much.

– Approaching users' personal data

User needs authority to approach to own personal data. So, user should sign-up for our application. After that, user could check own personal data any time. For instance, how many times the user sit with right leg crossed today or how long the user left the seat during the work concentration time.

D. Requirements for Application

– Sign Up

This application uses the ID to the user by storing the time information of the server to be able to store and view the information, if not the own device. The user can easily sign up only your name, E-mail, if you ever forget your ID and Password can be easily found via E-mail.

– Log In / Out

When running this application, user has to log-in in order to record the time sitting on the cushion on a server. But, to shorten the log-in procedure, user can log-in easily after log- in once because the information of ID and password is saved. If the User wants to log-out, user can logs out in the Setting Page.

– Statistics

The application stores the users' data on the server. The application stores the users' data on the server. Then this application produces statistics on a weekly, monthly, yearly. These statistics will help determine whether seeing how much work they have kept for themselves some attitude.

– Data Visualization

User allows to easily identify their own data through the application using the data visualization. The application will use the visualization techniques, such as Android Chrono-meter, Chart, VideoView.

– Guide to Good Posture

This application shows the right postures using some kind of videos and images and introduces stretching and exercises which are good to correct wrong posture.

– Suggest to Rest

If user overworks, this application will show the message likewise ”Take a Break! Do strectch!”.

– Push Alarm

If user keeps wrong posture over certain time, this application will warn to the user about that wrong posture by push alarm.

– Customize Setting

User can set the status of getting push alarm(On/Off) and the time when the user gets push alarm while the user keeps wrong posture. And the user could use ”Initializing” function. ”Initializing” means the user's own pressure values saved in the database (when user does 'normal' posture) are initialized.

– Provide Scores

Users can grasp how well they have sat for today as this application provides today's posture score. Users can also check whether their postures are improving or not.

– Body Balance Measurements

Users can measure their current body balance status by taking a photo of their upper body. If, users take picture by using this function, the program would offer the information about how much their body is twisted.

– Searching An Orthopedic Office Near Users

Users can have information about where an orthopedic office is near themselves. They can have their spine or neck treated if they want.

IV. Development Environment

A. *Choice of software development platform*

1. Which platform and why?

– Windows for android application developing

Our target is office workers who want to correct their sitting posture. For ortho-therapy, it is the most important and efficient to maintain correct posture intentionally. Considering this, developing mobile application is appropriate rather than either web or computer program operated in window OS because time with mobile phone is longer than time using computer. If there is only our posture-correcting cushion, users can notice that they sit in incorrect posture by push alarm at anytime and anywhere, even while watching TV and reading a book at home. And this data is saved in server automatically so they can check the statistics how long they were sitting and how many times they sat incorrectly. Because Android OS is being used much more than IOS, as the below Figure 1 is showing, we develop our application in Android application.

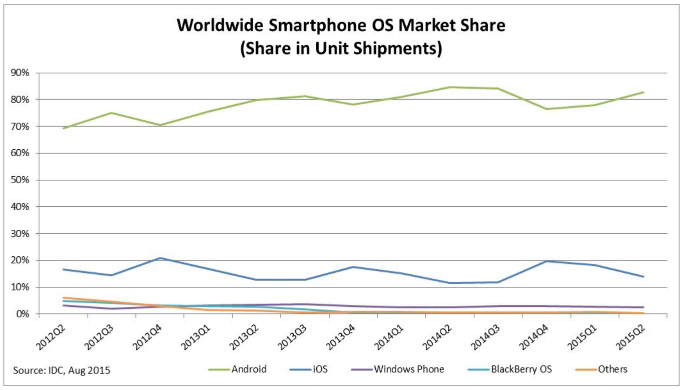


Fig. 1. Worldwide Smartphone OS Market Share

2. Which programming language and why?

– Java for android application developing

Java is a general-purpose computer programming language that is concurrent, class-based, object-oriented, and specifically designed to have as few implementation dependencies as possible. As of now, Java is one of the most popular programming languages in use, particularly for client-server web applications, with a reported 9 million developers. Java was originally developed by James Gosling at Sun Microsystems (which has since been acquired by Oracle Corporation) and released in 1995 as a core component of Sun Microsystems' Java platform. The language derives much of its syntax from C and C++, but it has fewer low-level facilities than either of them. And Java is the best suitable language to develop the application in android OS.

– C for IDE

We should do many tests to recognize various users' postures using pressure values getting from FSR-406 pressure sensors. So, we use the open-source Arduino Software (IDE) and the best proper language to use this program is C. The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-source software. This software can be used with any Arduino board.

– JSON

We use JSON for data parsing between server and database. JSON is an open standard format that uses human-readable text to transmit data objects consisting of attribute and value pairs. It is used primarily to transmit data between a server and web application, as an alternative to XML. Although originally derived from the JavaScript scripting language, JSON is a language-independent data format.

– JavaScript and Apache Tomcat for server

We use JavaScript language and Apache Tomcat library for building a server. The reason why we need the server is to save users' account information and their time data of posture, and to show those data in statistics analysis. JavaScript is the programming language of HTML and the Web.

JavaScript is the programming language of HTML and the Web. JavaScript is a high-level, dynamic, untyped, and interpreted programming language. Alongside HTML and CSS, it is one of the three core technologies of World Wide Web content production; the majority of websites employ it and it is supported by all modern Web browsers without plug-ins. JavaScript is prototype-based with first-class functions, making it a multi-paradigm language, supporting object-oriented, imperative, and functional programming styles.

Although there are strong outward similarities between Javascript and Java, including language name, syntax, and respective standard libraries, the two are distinct languages and differ greatly in their design. Javascript was influenced by programming languages such as Self and Scheme.

The Apache Tomcat software is an open source implementation of the Java Servlet, JavaServer Pages, Java Expression Language and Java WebSocket technologies. The Apache Tomcat software is developed in an open and participatory environment. The Apache Tomcat project is intended to be a collaboration of the best-of-breed developers from around the world. Apache Tomcat software powers numerous large-scale, mission-critical web applications across a diverse range of industries and organizations.

– PostgreSQL for database using pgAdmin

The reason why we use PostgreSQL is that it has strength in inheritance and function. When an upper table is searched, all data of lower tables can be searched as well as the upper table. And when a lower table is created, a column that belongs to only the lower table can be added inheriting the upper table's column at the same time. Sometimes, the function written in the SQL statement that is called as 'Save procedure' can be used in server environment. Although control statement and iteration statement cannot be used, differs from other language, postgreSQL can be combined with other language.

PostgreSQL, often simply Postgres, is an object-relational database management system (ORDBMS) with an emphasis on extensibility and standards-compliance. As a database server, its primary function is to store data securely, supporting best practices, and to allow for retrieval at the request of other software applications. It can handle workloads ranging from small single-machine applications to large Internet-facing applications with many concurrent users.

PgAdmin Portable is the PgAdmin whatever it is packaged with a launcher as a portable app, so we can manage PostgreSQL and above running on any platform, as well as commercial and derived versions of PostgreSQL such as Postgres Plus Advanced Server and Greenplum database. It has all the same features as PgAdmin, plus, it leaves no personal information behind on the machine we run it on, so we can take it with us wherever we go.

3. Provide a cost estimation for your built.

– Cost for Server :

1 year for free. And after 1 year, there will be additional prices. We predict maybe about 1,000 people will use our service, and DAU (Daily Activity User) will be 300 around. So we will use t1. micro instance (AWS), and its prices are about 30 dollars per month: So may be there will be additional 360 dollars per year.

– Cost for hardware

1) Arduino

The Uno is a micro-controller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analogue inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the micro-controller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

2) Pressure Sensors

The model 406 FSR is a single-zone Force Sensing Resistor optimized for use in human touch control of electronic devices such as automotive electronics, medical systems, and in industrial and robotics applications. FSRs are two-wire devices. They are robust polymer thick film (PTF) sensors that exhibit a decrease in resistance with increase in force applied to the surface of the sensor. It has a 39.6 mm square active area and is available in 4 connection options. Interlink Electronics FSR 400 series is part of the single zone Force Sensing Resistor family.

3) Bluetooth Module

HC-06 is a serial port module composed in SMD form which is possible to be replaced easily. It also uses the connection between the bluetooth Master module in either PC or mobile device and embedded system in substitution of the serial port.

Arduino receives the input values, which the four pressure sensors perceive, through the breadboard and sends those values to the Android Application via bluetooth communication with the mobile phone. The system flow is shown in Figure 2.

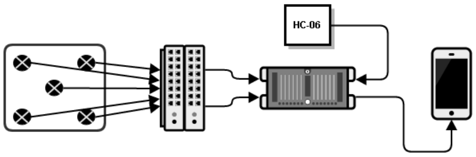


Fig. 2. System Flow

Therefore, we need 4 pressure sensors, Arduino, bluetooth module, bread board, USB cable and jump wire MM. The specific products' cost is shown in Table 1.

TABLE I
THE SPECIFIC PRODUCTS' COST

Products	Prices	Quantities	Costs
Pressure Sensor (FSR-406)	15,000	4	60,000
Arduino Uno (R3)	7,500	1	7,500
Bluetooth Module (HC-06)	6,000	1	6,000
Bread Board	4,500	2	9,000
USB Cable	500	1	500
Jump Wire MM	70	50	3500
Cushion	10000	1	10000
Total			96,500

4. Provide clear information of your development environment. (e.g., version of software, OS version, your computer resources)

- Android develop
1) Windows : Windows 10
2) Android Studio 1.5.1 / Android 4.4.4 Kitkat

- Arduino develop
3) Windows : Windows 10
4) Arduino 1.6.8 (IDE)

5. Using any commercial cloud platform (e.g., Amazons EC2) is definitely a BONUS.

1) Amazon Web Server
We will use Amazon Web Server because it is the world's most widely used web server software. As of June 2013, Apache was estimated to serve 54.2 percent of all active website and 53.3 percent of the top servers across all domains. (The most important reason is we have already Amazon web server.)

Apache Web Server has some features:
- easy and fast customizing using module.
- It can handle many traffic easily.
- It can control web server more delicately
- It is tested enough, so it is very stable.

2) Google Clould Messaging (GCM)
We use Google Cloud Messaging for using push alarm function. Because getting push alarm is important function in our application. Users could recognize whether their sitting posture is right or wrong by push message.

Google Cloud Messaging (commonly referred to as GCM) is a mobile service developed by Google that enables third-party application developers to send notification data or information from developer-run servers to applications that target the Google Android Operating System, as well as applications or extensions developed for the Google Chrome internet browser. The GCM Service was first announced in August 2013 as a successor to Google's now-defunct Android Cloud to Device Messaging (C2DM) service, citing improvements to authentication and delivery, new API endpoints and messaging parameters, and the removal of limitations on API send-rates and message sizes.

B. Software in use

- Footlogger
3L-Labs, internal venture corporation, developed a smart wearable device 'FootLogger'. It is insoles with some pressure sensors which analyze users' steps. This device can be used for health care, sports and entertainment.

Healthcare
- Monitors recovery after surgery
- Assesses balance of diabetics
- Allows for monitoring of prescribed exercises
- Monitors safety and activity of senior citizens
- Activity tracking (calories, distance, time)
- Early prediction of dementia and spinal disease
- Early prediction of accidents from falling
- Monitors rehabilitation (stroke, paralysis)

Sports
- Can monitor distance traveled
- Monitors golf stance and gives coaching
- Marathon/jogging aid
- Out-toeing/in-toeing gait identification, provides gait coaching
- Kids' correct posture coaching
- Can be applied to every sport

Entertainment
- Daily log (standing, sitting, walking)
- Personality analysis
- Daily mood analysis
- Smartphone game input device

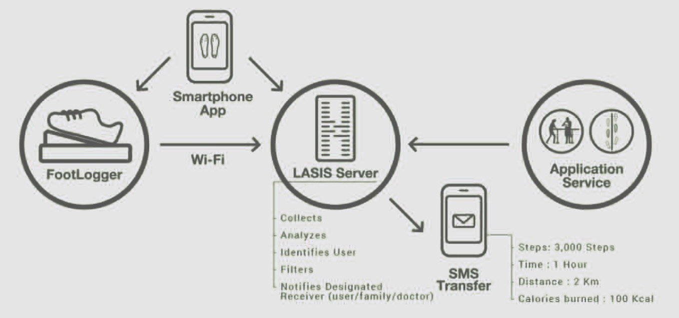


Fig. 3. Footlogger

C. Task distribution

TABLE II
TASK DISTRIBUTION

Role	Name	Task description and etc.
User	Minsoo Choi	– Test the application in various postures. – Require bugs to be fixed. – Demand the all of data about user. – Require additional functions.
Software Developer	Taejin Kim	– Develop the application using Arduino and pressure sensor. – Fix bugs. – Develop additional functions according to users' needs.
Development Manager	Hakjun Kim	– Monitor the progress of the project. – Make a overall plan about developing program and managing the budget – Reflect users' needs

V. Specifications

A. Modeling for Specifications

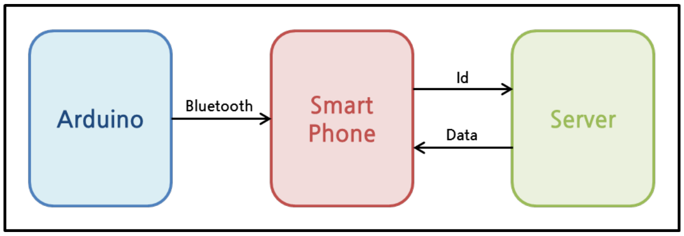


Fig. 4. Basic structure

Arduino receives some of the pressure value from the pressure sensor. And arduino sends the values to smart phone using HC-06. HC-06 is a Bluetooth Module. Then smart phone application determines posture of the user by analyzing the values. After that, smart phone calculates the time for holding the posture. The data of time will be sent to server, and saved at server. At the same time, the application will receive the user's whole data from server. Then, the application will display the data by data visualization.

B. Posture Recognition using pressure sensor

We made a kind of cushion for measuring pressure force. The dimensions of the chair and cushion are shown in Table 3. And we used FSR-406 pressure sensor model to get proper pressure value for recognizing person's changing posture. The dimensions of FSR-406 are shown in Figure 5.

TABLE III
DIMENSIONS OF THE CHAIR AND CUSHION

Width of the chair	45cm
Height of the chair	42cm
Depth of the chair	47cm
Width of the cushion	30cm
Height of the cushion	30cm

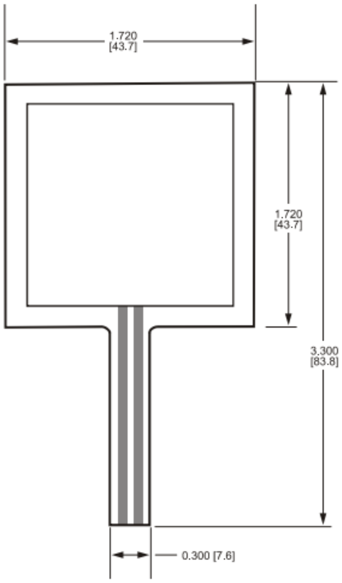


Fig. 5. Dimensions of FSR-406

The reason why we choose the FSR-406 is the specifications of FSR-406 are suitable to make the posture recognition cushion. This sensor is very thin and hence can be easily bent to fit, so a user can sit down on the seat comfortably. Since the sensor sheet is light and thin, it can be carried anywhere and used in various situations in daily life. And the active area is appropriate to get pressure value when person changes his or her posture. FSR-406 specifications are shown in Table 4.

TABLE IV
FSR-406 SPECIFICATIONS

Thickness	0.018” (0.46 mm)
Active area	38.1mm x 38.1mm
Connector	AMP Female connector
Minimum load	0.1N
Maximum load	10N

FSRs are two-wire devices with a resistance that depends on applied force. For specific application needs please contact Interlink Electronics support team. An integration guide is also available. For a simple force-to-voltage conversion, the FSR device is tied to a measuring resistor in a voltage divider configuration. The output is described by the equation:

$$\mathrm{V}_{out} = \frac{R_m V+}{(R_M + R_{FSR})}$$

In the shown configuration, the output voltage increases with increasing force. If R_{FSR} and R_M are swapped, the output swing will decrease with increasing force. These two output forms are mirror images about the line $V_{out} = (V+)/2$. The measuring resistor, $R_{M'}$ is chosen to maximize the desired force sensitivity range and to limit current. Depending on the impedance requirements of the measuring circuit, the voltage divider could be followed by an on-amp. A family of FORCE vs. V_{out} curves is shown on the graph above for a standard FSR in a voltage divider configuration with various R_M resistors. A $(V+)$ of $+5V$ was used for these examples.

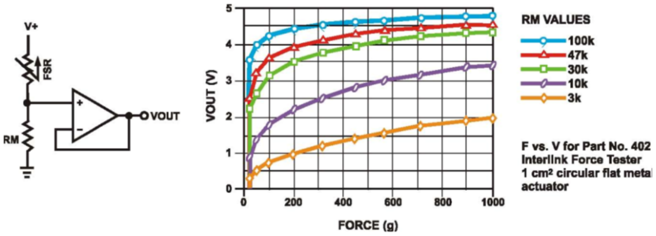


Fig. 6. Typical Schematic and force curve of FSR-406

To recognize difference of sitting posture, we have to make the cushion with proper number of pressure sensors. So, we arranged five pressure sensors to the five points in the cushion. The five points are ’Left-front’, ’Right-front’, ’Center’, ’Left-back’, ’Right-back’ and this classification is shown in Table 5. And the pressure values are transmitted to Arduino board through bread board. The pressure sensors’ spot position is shown in Figure 7.

TABLE V
THE CLASSIFICATION OF PRESSURE SENSOR’S POSITION

(LF)	Left Front
(RF)	Right Front
(C)	Center
(LB)	Left Back
(RB)	Right Back

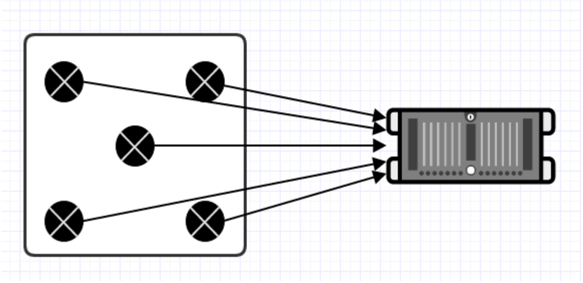


Fig. 7. Pressure sensors' spot position

C. Posture classification

In this part, we describe a way of classifying sitting postures. Posture classification involves three basic issues. One issue is person dependency. Different persons would obviously sit in different ways. Even the same person might sit on different parts of the seating face. One ways to resolve this problem is to normalize pressure distributions by standardizing different postures when workers sit in the chair. The classification of seven postures is shown in Table 6.

TABLE VI
THE CLASSIFICATION OF SEVEN POSTURES

(N)	Left Front
(F)	Leaning Forward
(B)	Leaning Backward
(L)	Leaning Left
(LC)	Left leg crossed
(R)	Leaning Right
(RC)	Right leg crossed

Second issue is the time dependency. We have to push alarm to users when they are doing wrong postures. So, it is needed to decide when we do alarm function. We set time standard from 1 minute to 10 minutes. User could select time when user gets push alarms while user keeps wrong posture. And the last issue is weight dependency. The sensor values would increase linearly or non-linearly with an increase in weight. Therefore, it would be effective to divide the sensor values by the total value. And the each user's pressure value is different when user does 'Normal' posture. So, if user registers in our application, the user's initial pressure values are saved in the database and our algorithm uses each user's data to recognize posture. And we offer the function which initializes user's weight in the application.

D. Specification for Bluetooth communication

We use Arduino board and bluetooth module to get pressure values in the application and do wireless communication. There are many ways doing wireless communication with Arduino such as Wifi, XBee, Bluetooth etc. But Wifi wastes electronic power consuming too much and the connection status is sometimes not stable. And XBee is not widely used because smart phone and pc should have XBee module. On the other hand, Bluetooth module is cheaper than Wifi module and is widely used compared to Xbee because most of the smart phone and pc could recognize bluetooth module. And we use 'Arduino Uno R3' and 'HC-06' because 'Arduino Uno R3' is the basic platform among arduino series and 'HC-06' bluetooth module has excellent performance compared with other bluetooth modules and both of them have very good cost-effectiveness. And bluetooth sets the link with 'Master' and 'Slave' way. If mobile application communicates with arduino bluetooth, the smart phone becomes 'Master' and Arduino becomes 'Slave'. So, we connect HC-06 with Arduino Uno R3, this is shown in Figure 8.

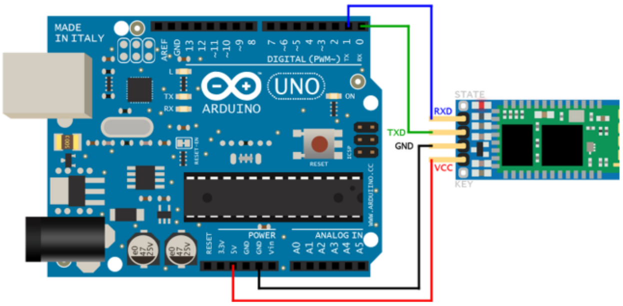


Fig. 8. Connection of arduino with bluetooth module

The 'Blue' line is connection RX pin of HC-06 with digital I/O number 2 of Arduino (RX pin gets some signal from Arduino). The 'Green' line is connection TX pin of HC-06 with digital I/O number 3 of Arduino (TX pin transmits some signal from bluetooth). The 'Black' line is connection GND pin of HC-06 with GND of Arduino (GND is a voltage emitter). The 'Red' line is connection VCC pin of HC-06 with 5V of Arduino (VCC is a votage collector).

And we set HC-06's options to test status of connection with bluetooth and pc. The sample option values of HC-06 are shown in below box.

1. Test Instruction word: AT Return Value: OK

2. Version Checking Instruction word: AT+VERSION Return Value: OKlinvorV1.8

3. Name Change Instruction word: AT+NAME Return Value : OKsetname

4. Baud rate Setting Instruction word: AT+BAUD(Baud rate menu value). Baud rate menu: 1 - 1200, 2 - 2400, 3 - 4800, 4 - 9600 5 - 19200, 6 - 38400, 7 - 57600, 8 - 115200 Return Value : OK Baud rate (ex : OK9600)

5. PIN Setting Instruction word: AT+PIN(4 digits). Return Value : OKsetPIN

E. *Specification for front-end application pages*

– Log-In Page

This page is the first page of the application. To import the posture data, you have to log in first. Your working posture records will be saved in your server with your ID. If you do not have an ID, you can click the Sing Up button. Or, if you forgot your ID or password, you can find it using Find ID button or Find Password button. Once you log in, your ID and password will be automatically saved. Even when you log in via another phone, you can open your records with ease since your posture records are imported from your ID only.

– Sign-Up Page

This page is where a user with no ID can create a new ID. Since ID will be the Primary Key of the User DB that will be saved in the server, it should not be overlapped. So, it is mandatory for you to double-check your ID. There is no limit in the length of the password and the password will be replaced with other letters, such as ****, as soon as you enter your password for the sake of absolute confidentiality.

Name and E-mail will be used for discerning between members and non-members. And, they will also be used for finding ID or Password in case you forgot it.

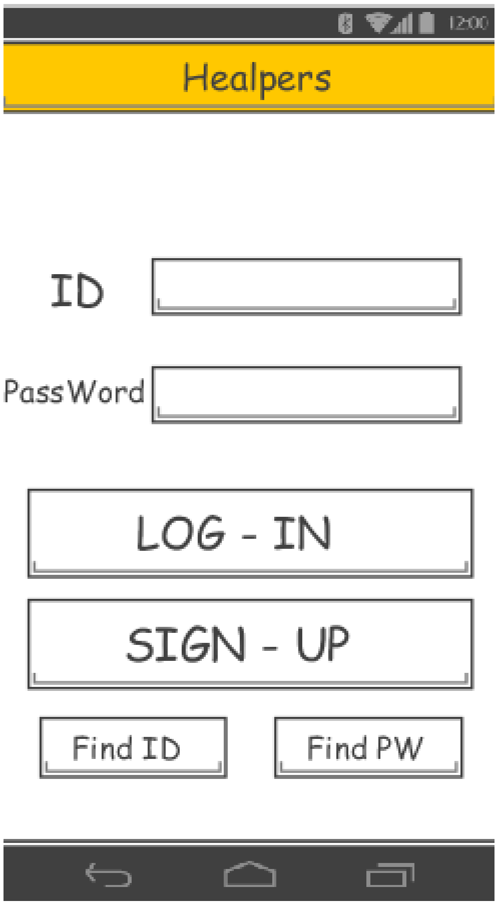


Fig. 9. Log-In Page

– Find ID Page

Once you enter your E-mail that you entered during Sign-up process, it tells your ID on the screen.

–Find Password Page

Once you enter your E-mail that you entered during Sign-up process, it sends your password to your E-mail.

–Now Page

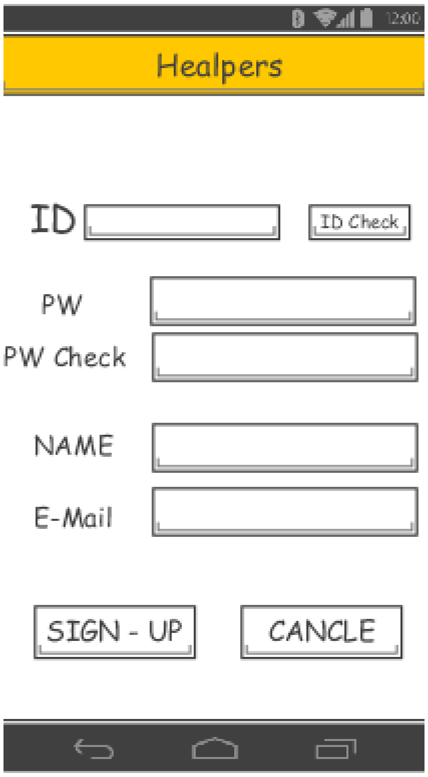


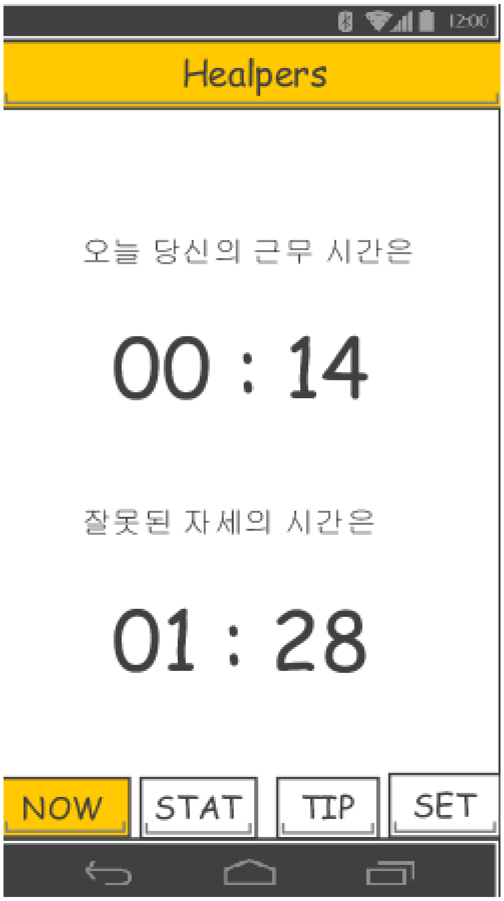
Fig. 10. Sign-Up Page

This page is the first page you see after you log in. There are 4 tabs in the tab bar below. 'Now' tab is the tab of the current page. If you click the 'Stat' tab, you can check your accumulated statistics on daily, weekly, monthly and yearly basis. 'Tip' tab is where you can find images and videos of stretches or exercises useful for correcting posture. The last 'Setting' tab is for setting few functions related to this application.

In this page, the app counts the number of hours you sit on the cushion that is composed of pressure sensor. This data will be exported on the screen in order for you to check your total working hour. (Upper Timer)

In specific, it counts the number of hours of your correct posture and bad posture separately. So, it is possible to check the number of hours of correct posture only. (Lower Timer)

The number of hours exported from this page will be saved in the server as well. Moreover, once the user maintains a bad posture for a long time, the user will receive a push notification that warns his/her long-time bad posture.



오늘 당신의 근무 시간은

00 : 14

잘못된 자세의 시간은

01 : 28

Fig. 11. Now Page

–Stat Page

This page shows up as you click the Stat tab below. It is divided into 3 big graphs and has three tabs at the top of the screen. The graphs of this page are composed of individual time data saved in the server. Each of the three graphs represents total working hour, the number of hours of correct posture and the bad posture. The x-axis of this graph changes according to the upper tab of the screen. The x-axis consists of 7 days in the 'Weekly' tab, 30 days in the 'Monthly' tab and 12 months in the 'Yearly' tab. The y-axis of every tab consists of numbers from 0 to 24, which refer to the number of hours.

The first graph will be presented as a Bar Chart that shows working hour of the days of the week in the 'Weekly' tab, daily working hour in the 'Monthly' tab and monthly average working hour in the 'Yearly' tab. With the same principle, the second graph shows the number of hours of correct

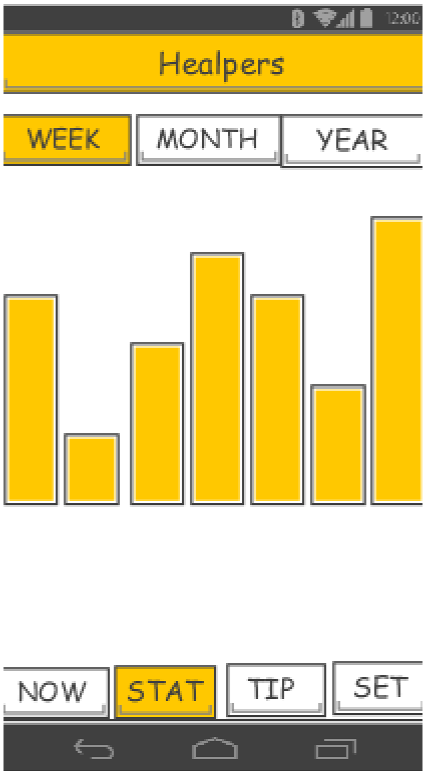
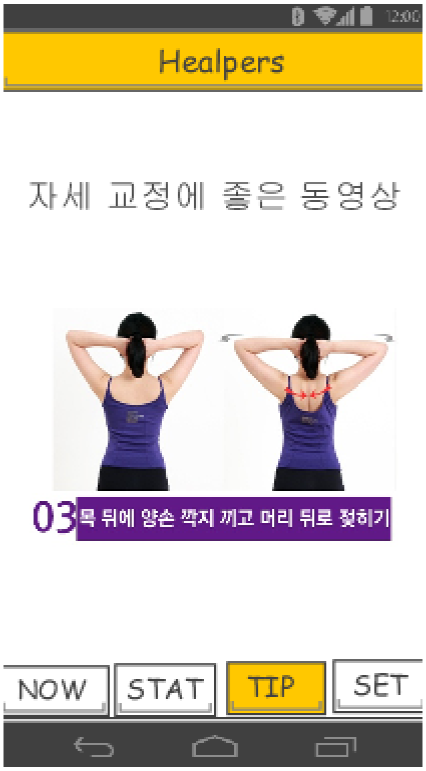


Fig. 12. Stat Page



자세 교정에 좋은 동영상

03 목 뒤에 양손 깍지 끼고 머리 뒤로 젖히기

Fig. 13. Tip Page

posture for each tab whereas the third graph shows the number of hours of the bad posture.

And user could see the score measuring by this program. The score means how well users have sat for today. The score is from 0 to 100 and 100 is the maximum score which means the users posture for today is perfect.

–Tip Page

When clicking the Tip tab below this page, this page will show up. It exports images and videos of stretches or exercises useful for correcting posture as a customized ListView. The function of playing or pausing the video takes the similar format with Youtube. The first click plays the video and the second pauses it.

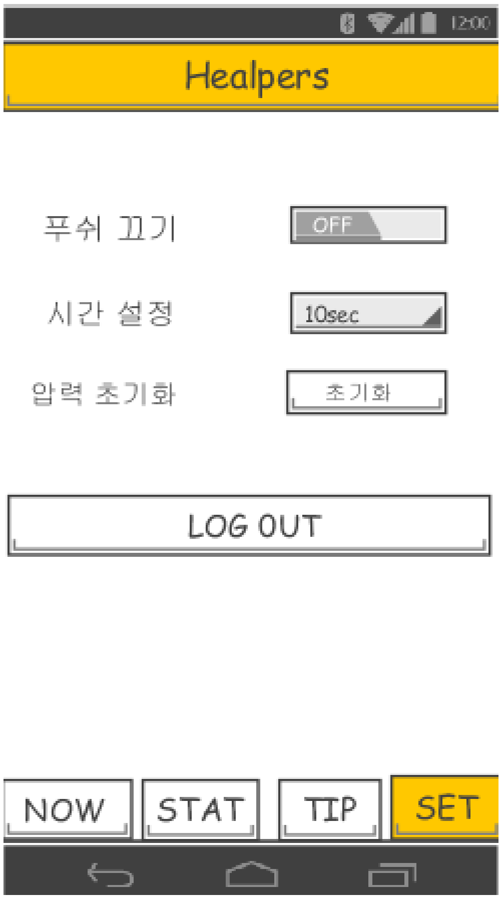
–Setting Page

This page shows up when you click the 'Setting' tab below this page. The first function of this page, comprised of a ListView, is switching on or off the push notification. Essentially, if the user maintains a bad posture for a long time, the user will receive a push notification that warns his/her long-time bad posture. This function can be controlled by the user.

The second function is to set the time when user gets push alarms while user keeps wrong posture. It ranges from minimum 1 minute to maximum 10 minutes. For example, if you set your time to 2 minutes and you maintain a bad posture for 2 minutes, you will directly receive a notification.

The third function resets the pressure value that matches the users' body. According to individuals' weight and environment, the pressure value differs. Hence, it is necessary to save individuals' initial pressure value of the correct posture in the server. The last but not least function is log-out. It allows the user to log out from the app.

– Body Balance Page In this page users could take picture of their upper body sitting on the chair. And the program analyses the users body balance by comparing left and right location of shoulder, chest and waist. Then the program shows how much the users body is twisted using degree. For example if the user's left shoulder is tilted to the left about 30 degrees, the user could see the status of the body balance by green and red line(Green



푸쉬 끄기 OFF

시간 설정 10sec

압력 초기화

Fig. 14. Setting Page

line is criteria line meaning good body balance and the Red line shows how much the body is tilted.)and the message like ”Your left shoulder is tilted to the left about 30 degrees” is shown.

VI. Architecture Design and Implementation

A. Overall architecture

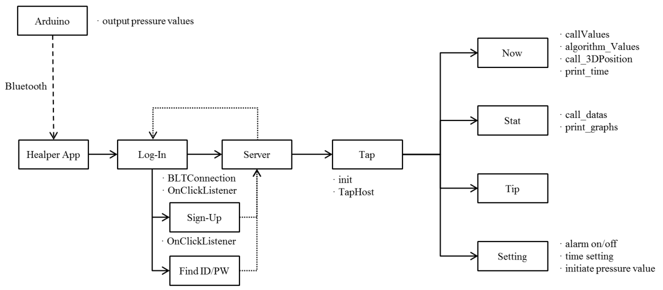


Fig. 15. overall architecture

B. Directory organization

```
Dir1 :
healper_project/Programming/Android/
Healper_Proto/app/src/main/java/com/
example/lg/healper_proto

Dir2 :
healper_project/Programming/Android/
Healper_Proto/app/src/main/res/layout

Dir3 :
healper_project/Programming/Arduino/
ValuesToApp

Dir4 :
healper_project/Programming/Server/
Localhost/WebContent/gateway

Dir5 :
healper_project/Programming/Server/
Localhost/WebContent/gateway/svc

Dir6 :
healper_project/Programming/Server/
Localhost/WebContent/gateway/util
```

TABLE VII
DIRECTORY ORGANIZATION

Directory	File names	Module name in use	Etc
Dir1	MainActivity.java	MainActivity class	
Dir1	NowActivity.java	NowAcivity class	
Dir1	SettingActivity.java	SettingActivity class	
Dir1	SignUpActivity.java	SignUpActivity class	
Dir1	StatActivity.java	StatActivity class	
Dir1	TapActivity.java	StatActivity class	
Dir1	TipActivity.java	TipActivity class	
Dir1	Splash.java	Splash.class	
Dir1	toJSON.java	toJSON.class	
Dir1	toServer.java	toServer.class	
Dir2	Main_sub.xml		
Dir2	Now_sub.xml		
Dir2	Popup.xml		
Dir2	Setting_sub.xml		
Dir2	Splash.xml		
Dir2	stat_sub.xml		
Dir2	tap_sub.xml		
Dir2	tip_sub.xml		
Dir3	ValuesToApp.ino	setup(), loop()	In Arduino
Dir4	Index.jsp		
Dir5	MT0001.jsp		
Dir5	MT0002.jsp		
Dir5	MT0003.jsp		
Dir6	JsonToMap.jsp		

C. Code analysis

1. ValuesToApp.ino

– Purpose:

To send the pressure value that Arduino receive from the pressure sensor to the application through bluetooth,

– Functionality:

This code is embedded in the Arduino. The pressure sensor accepts the pressure value every second, and the pressure value is sent to the application through bluetooth.

– Location of source code:

In Arduino

– Class components:

a. Setup method

Setup method is used firstly when the Arduino is executed. In this program, the speeds of serial communication and bluetooth communication are established in setup method. Variables and Pin value that is connected with the pressure sensors are declared and established.

b. Loop method

Loop method is used constantly while the Arduino is executed. In this program, the functions receiving and sending the pressure value are established in loop method. The pressure values from pressure sensors go through the algorithm and are sent to the application every second.

2. MainActivity

– Purpose:

To show main page and before the program is used in earnest, to set fundamental environment.

– Functionality:

This program uses ID and password functions to save each user's individual data. For this, MainActivity provides log-in function that each users can log-in as their ID, sign-up function for users who start to use, find ID/password function for users who have forgotten theirs and bluetooth function for interworking specific cushion.

– Location of source code:

```
healper_project/Programming/
Android/Healper_Proto/app/src/
main/java/com/example/lg/
healper_proto/MainActivity.java
```

– Class components:

a. OnClickListener

There are four OnClickListner in MainActivity.

1) Log_In

When users enter their ID and password and click Log-in Button, if the account is signed up for server, loading data that are associated with the account from server synchronize with moving to TapActivity. Unless the account is signed up for server, Sign-Up Page appears.

2) Sign_Up

Users who start to use this program use Sign-up button to sign up. When this button is clicked, Sign-Up Page appears.

3) Find ID/ Find Password

When users have forgotten their ID or password, Find ID/Find Password button is used to move to Find ID/Password Page.

3. SignUpActivity

– Purpose:

To show Sign-Up Page to users who start to use this program. Users can sign-up in Sign-Up Page.

– Functionality:

This activity saves new users' accounts information. In this activity, therefore, ID that is going to be the primary key goes through the duplication check and individual account information are saved in server.

– Location of source code:

```
healper_project/Programming/
Android/Healper_Proto/app/src/
main/java/com/example/lg/
healper_proto/SignUpActivity.java
```

– Class components:

a. OnClickListener

There are three OnClickListner in SignUpActivity.

1) Redundancy_Check

Individual account information reported in this page is going to be saved in server. Each user's ID is going to be the primary key in server database. Therefore, the duplication check is necessary to check if an entered ID that tries to sign-up is same as other existing users' ID. There are duplication check button for this.

2) Sign_Up

Account information entered by users is saved in server and moves back to Log-In Page again.

3) Cancel

Cancel Sign-Up process moves back to Log-In Page again.

4. TapActivity

– Purpose:

To show tap page and constitute tap view which consist of Now, Stat, Tip, and Setting for customer.

– Functionality:

TapActivity is the body of this program. We build this program to make users be able to transfer freely using 'tab' from a tap to another tap among four taps; now status, statistics, tips and setting page. TapActivity is used in this part to make Fragment Activity showing each page as fragment.

In each fragment, some methods use users' postures that are sent through bluetooth. So it is convenient to use those values when the fragments receive from TapActivity(basis of those fragments).

And then, bluetooth connection and TapActivity coincide, that receive values every second. Also it declares and initialize values that are shared in four fragments.

– Location of source code:

```
healper_project/Programming/
Android/Healper_Proto/app/
src/main/java/com/example/lg/
healper_proto/TapActivity.java
```

– Class components:

a. Init method

Init method in onCreate method, when this page is created, initialize all of taps to interwork each other.

b. TapHost

when four taps at the bottom of the page are clicked, Fragment is changed to an activity corresponding the tap. Switching page is convenient by using taps.

c. onStart() method

When TapActivity is called and started, this method turns on the bluetooth if bluetooth is turned off.

d. setup() method

This method connect with 'Healper' automatically if bluetooth is turned on or it is run in onStart() method. setup() method runs ThreadConnect BTdevice Thread which finds and connects with 'Healper'

e. ThreadConnectBTdevice Thread

This method creates bluetooth socket and connects the socket to 'Healper'. If the connection is succeeded, it runs startThreadConnected method.

f. startThreadConnected(BluetoothSocket socket) method

This method runs ThreadConnected Thread through the bluetooth socket that this method receives.

g. ThreadConnected Thread

This thread receives the pressure values through the socket every socket, and determines each activity's actions depending on the values.

h. stat_init() method

To insert a graph in StatActivity, we have to save the personal database in resource array. This method initializes the array before save.

i. Right_shoulder, Left_shoulder, Front_hunched, Left_Leg, Right_Leg, Default_Leg, Stand_up method

Depending on the values from Arduino, these methods change ImageView in NowActivity and control Chronometer(timer). These contains callPopup() method which shows pop-up message when a user maintains an wrong posture above schedule time.

j. callPopup() method

This method shows pop-up message on the current activity and differentiates a displayed text from others depending on parameter. Also, it saves the base of nowActivity's timer while a pop-up message is showed.

k. onDestroy() method

When TapActivity is turned off, this method stops ThreaConnectBTdevice Thread and disconnects with the socket.

5. NowActivity

– Purpose:

NowActivity shows users' current posture. It helps users grasp what posture and how long they have adopted.

– Functionality:

NowActivity analyzes the pressure value that comes from Auduino through bluetooth. It also helps users see their current postures in 3D and shows how long the users have adopted the postures and how long they have sat by using chronometer function.

– Location of source code:

```
healper_project/Programming/
Android/Healper_Proto/app/src/
main/java/com/example/lg/
healper_proto/NowActivity.java
```

– Class components:

a. onCreate() method

This method initializes Chronometer, InageView, and Fragment View.

6. StatActivity

–Purpose:

StatActivity makes statistical charts of users' posture data in server and displays three graphs arranged by the week, the month and the year.

– Functionality:

StatActivity loads users' data from server, makes statistical charts and by three graphs, helps users grasp their posture tendencies that they have adopted.

– Location of source code:

```
healper_project/Programming/
Android/Healper_Proto/app/src/
main/java/com/example/lg/
healper_proto/StatActivity.java
```

– Class components:

a. OnClickListener() method

This method changes view of the graph depending on 'year', 'month', 'week' buttons. It deletes the graph which is already shown and displays new graph from new array.

b. getBarChartDataset_year(), getBarChartDataset_month(), getBarChartDataset_week() method

This method is to create 'year', 'month' and 'week' graph. It forms view by displaying cumulative time on X-axis and Y-axis.

7. TipActivity

– Purpose:

To select and recommend orthotherapy videos that users probably need mostly after analyzing their postures.

– Functionality:

StatActivity analyzes today's posture statistics and recommend the orthotherapy exercise for the particularly bad posture in priority. On the basis of data of server, furthermore, it recommends two or three exercises for the steadily bad postures.

– Location of source code:

```
healper_project/Programming/
Android/Healper_Proto/app/src/
main/java/com/example/lg/
healper_proto/TipActivity.java
```

– Class components: None

8. SettingActivity

– Purpose:

To configure software setting and hardware setting to suit users' individual conditions.

– Functionality:

This program basically lets users know that they are maintaining bad posture by push alarm. However, it also has function that turns on/off push alarm function for the case that users do not want to be disturbed by push alarm. Or users can configure schedule time when they want to be alarmed. Because every user has different weights and balances, in addition, we added reset function in Setting Page in case of that basic pressure value of postures might need to be configured newly.

– Location of source code:

```
healper_project/Programming/
Android/Healper_Proto/app/src/
main/java/com/example/lg/
healper_proto/SettingActivity.java
```

–Class components:

a. alarm on/off method

There is a on/off switch for the push alarm in Setting Page. As we established on/off function in onClickListener of this switch, users can choose whether they turn on the push alarm or not.

b. time setting method

There is a list box in Setting Page. In this list box, there are ten options; from 1 minute to 10 minutes. After that time user selects, push alarm informs that users are maintaining the bad postures.

c. initiate pressure value method

Setting up a common pressure value is impossible since every users have different pressure values. Therefore, we made it possible that every users configure their own pressures value. When initialization button in Setting Page is clicked, the average pressure value that has input for five seconds is saved in application and also in server. This program judges whether users' current postures are wrong or not comparing with the saved values.

d. logout method

If users want to logout, this method makes users logout going back to the main activity when users click the log-out button in setting activity.

9. toServer

– Purpose:

We have to do parsing in forms of JSON when we carry out a method which is needed to send a request to servers such as Log_In, Sign_Up, Redudancy_Check. toServer is the class for processing those methods all together assortatively.

– Functionality:

toServer has functions that classify the requests to service code, divide them to request and data, and do parsing to JSON format. Since several activities access to toServer class through other methods, the function that determines which activity is from which method is needed.

– Location of source code:

```
healper_project/Programming/
Android/Healper_Proto/app/src/
main/java/com/example/lg/
healper_proto/toServer.JAVA
```

– Class components:

a. LogIn() method

This method is in static form to be called from other activities. It is used when Log_In request needs to be parsed in JSON form.

b. SignUp() method

This method is in static form to be called from other activities. It is used when Sign_In request needs to be parsed in JSON form.

c. RedudancyCheck() method

This method is in static form to be called from other activities. It is used when Redudancy_Check request needs to be parsed in JSON form.

d. toJson() method

This method creates JSON object which takes string from above three methods as value. toJason is overloaded in the number of parameter. Each toJson method creates JSON object in a proper form and send it as parameter of toURL method.

e. toURL() method

This method sends the JSON form from toJson method to server. It tries to request by accessing to URL which is added the JSON form at the rear of server's domain. When Accessing is succeeded, it reads data from URL in BufferedReader and sends response data to toJSON class.

10. toJSON

– Purpose:

toJSON sends JSON through toURL method of toServer class. It reads JSON replied and makes application work normally. And it also analyzes service code of JSON replied.

– Functionality:

After receiving response data, toJSON sends proper parameters to proper activities depending on service codes.

– Location of source code:

```
healper_project/Programming/
Android/Healper_Proto/app/src/
main/java/com/example/lg/
healper_proto/toJSON.JAVA
```

– Class components:

a. execute() method

This method changes JSON statements(in string form from server) to JSON form of JSON object and then, runs exe_svccd method to analyze service codes.

b. exe_svccd() method

This method classifies analyzed service codes of JSON objects to perform the proper method.

c. login() method

If log_in is succeeded, this method saves cumulative time data of the account to array of TapActivity. At this moment, array of TapActicity has to be declared in static.

d. signup() method

If an account which tried to sign-up is added in database server normally, this method lets users know that. And if an account which tried to sign-up is not added in database server, it lets users be able to try again.

e. re_check() method

This method searches an account which tried to sign-up. If the account is already signed up by another user, it informs the user who is trying to sign-up that the account is unavailable. And if the account is available, lets users know that.

11. Splash

- Purpose :

Splash displays a page that lets know users that it is loading, while the initializing of MainActivity is processing.

- Functionality : None

- Location of Source code:

```
healper_project/Programming/
Android/Healper_Proto/app/src/
main/java/com/example/lg/
healper_proto/Splash.JAVA
```

- Class components : None

12. index.jsp

– purpose :

indes.jsp is a gateway that classifies JSON statements to each values URL and for running a necessary method.

– Functionality :

It has a function to save a log history of users. It runs a proper method after classifies JSON parameter depending on service codes. And then, it parses response data in JSON form again and output the result to send it to application.

– Location of Source code:

```
healper_project/Programming/
Server/Localhost/WebContent/
gateway/index.jsp
```

13. MT0001.jsp

– purpose : It aims to send the fact whether log-in is succeded or not to the application when getting json requiring log-in function from application. - This the class is conducted in server when getting json requiring log-in function from functionality application. And search the proper password in user table in database through id getting by json form. If password getting by json and searched password are same thing, all of data about the ID are created sentence by json form after reentering to the data table of database. If password getting by json and searched password are different, the sentence sending the fact that log-in is failed to the application is passed by index.jsp file.

– Location of Source Code:

```
healper_project/Programming/
Server/Localhost/WebContent/
gateway/svc/MT0001.jsp
```

14. MT0002.jsp

– purpose : This aims to send the fact whether sign-up succeeds or not to the application when getting json form requiring sign-up function from application.

– Functionality : It sends DMS requiring new sign-up having ID, PW, E-mail, Name values. And because ID is primary key, if ID is repeated it makes error sentence sending to the application. But if user succeeds in sign-up, the success sentence will be sending in index.jsp file.

- Location of Source Code:

```
healper_project/Programming/
Server/Localhost/WebContent/
gateway/svc/MT0002.jsp
```

15. MT0003.jsp

– purpose : It aims to send the fact whether the repeatation check succeeds or not to the application when getting json form requiring redudancy_Check function.

– Functionality : It sends the select sentence getting ID requiring repeatation check. After searching ID in database, it makes json form for sending the result. Index.jsp is sended to notify the fact that whether the ID is available or not.

– Location of Source Code:

```
healper_project/Programming/
Server/Localhost/WebContent/
gateway/svc/MT0003.jsp
```

16. JsonToMap.jsp

– purpose: This is class customizing json form exchanged between application and server. This JsonToMap could create json form customized with hashmap base.

– Functionality :

There are tow JSON form that server and application send and receive. The JSON that is sent from application to server is constructed like

```
{ svccd : MT0001, req_data : [{Id : id
```

and JSON that is sent from server to applicationis constructed like

```
{ svccd : MT0001, res_data : [{isOK? :
```

req_data or res_data received only service codes commonly and are saved as Json Array. Since they are in same form, we build a special jsp file to do parsing easily.

– Location of Source Code:

```
healper_project/Programming/
Server/Localhost/WebContent/
gateway/util/JsonToMap.jsp
```

VII. Use Cases

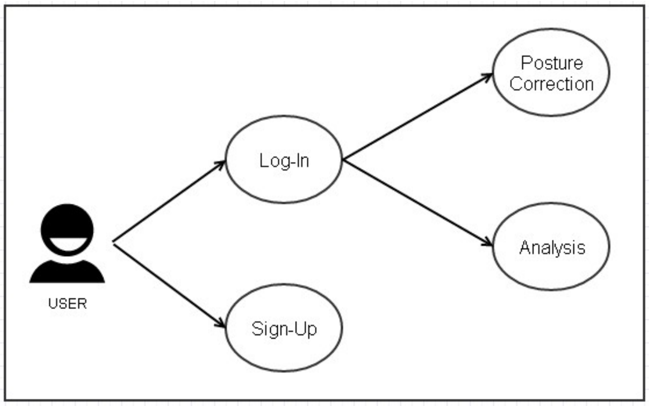


Fig. 16. Overall Usecase

The overall usecase is shown in the Figure 16. Our project's platform is Android-Mobile Application. So, first user should download our application and execute the program to do self-orthotherapy. And if user executed the program, a dialog window to get permission of bluetooth and connect with Arduino would pop up. Then user will find the proper device and connect with the Arduino and finally could see the first page of our application. After that if user has registered already, user could enter into the next functions like 'Posture Correction' or 'Analysis'. If not, user should sign-up and register user's data into the program's database to use this program.

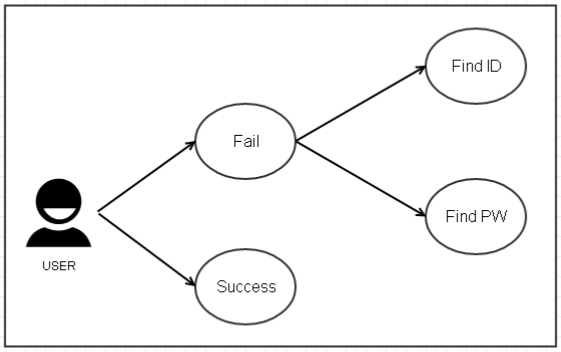


Fig. 17. Log-In Usecase

To use self-orthotherapy program, user should log-in to our system. But if user fails to do log-in, there are two ways of solving this problem. These are 'Find ID' and 'Find PW'. Log-In Usecase is shown in the Figure 17 and the Use Case's descriptions are written in the table 8.

TABLE VIII
The description of Log-In Usecase

Use Case	Description
Find ID	There are two ways to solve log-in problem. The first is 'Find ID'. User could find the own ID by writing the name and E-mail compared to the database's data.
Find PW	And the second is 'Find PW'. User could find the own password by writing the ID, and name compared to the database's data. It could meet the need of 'Log-In' requirement.

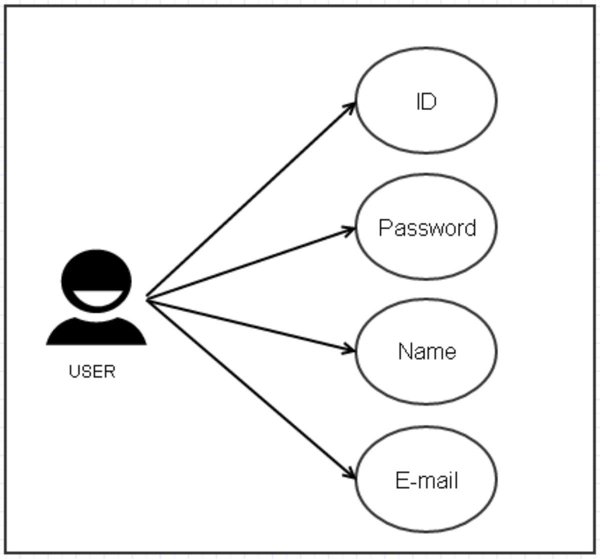


Fig. 18. Sign-up Usecase

If user had not registered in our program, user should do sign-up to use the program. There are four componentes to register user's data into the database. It could meet the need of 'Sign-Up' requirement. Sign-Up Usecase is shown in the Figure 18 and the Use Case's descriptions are written in the table 9.

TABLE IX
THE DESCRIPTION OF SIGN-UP USECASE

Use Case	Description
ID	User should make unique ID to sign-up. It should be made of english and numbers under 10 characters. The special letters can not be used to make ID.And, it is mandatory for you to double-check your ID.
Password	There is no limit in the length of the password and the password will be replaced with other letters, such as ****, as soon as you enter your password for the sake of absolute confidentiality.
Name	User should write own full name(first name + last name). And the english only could be used.
E-mail	User should write one e-mail address. User could select the portal's address like 'gmail.com' or 'naver.com' or write the address in person. After that the permission e-mail will be sent to the written e-mail address. So, it is not possible to do sign-up unless the user do not check the permission e-mail.

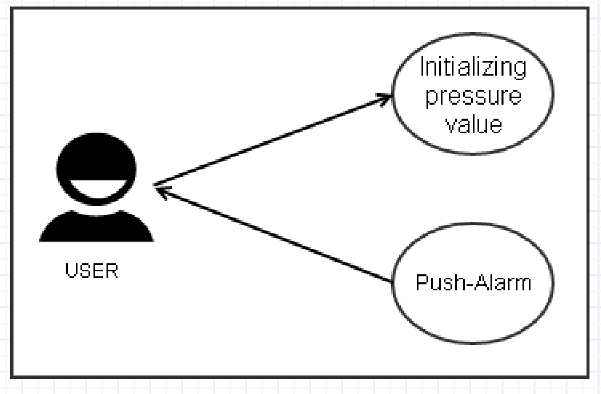


Fig. 19. Posture Correction Usecase

The main function of this program is to correct user's bad posture when user sits down on the chair. So, setting the user's own pressure value is mendatory. Because people have different physical size and weight. Initializing pressure value is the function to meet that requirement. After initializing pressure value, user could get alarm message when they keep bad posture. Posture Correction Usecase is shown in the Figure 19 and the Use Case's descriptions are written in the table 10.

TABLE X
THE DESCRIPTION OF POSTURE CORRECTION USECASE

Use Case	Description
Initializing Pressure Value	To get posture correction alarm, initializing pressure value is needed. Because our algorithm needs the fixed pressure value suited to the user. So, average of 5 times pressure values(when user sit down to the cushion, the pressure values are recognized.)is selected as the initial pressure value of user.
Push-Alarm	If user has wrong posture, program would recognize that status using posture correction algorithm. And the push alarm will be popped up to the user's mobile phone like "Do not make your leg crossed".

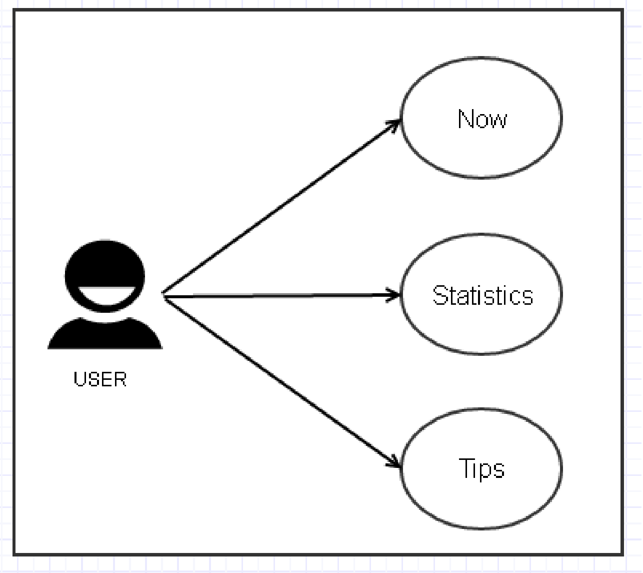


Fig. 20. Analysis Usecase

The another main function of this program is to offer analysis information using user's posture data. And there are three sub functions in analysis part 'Now', 'Statistics' and 'Tips'. Analysis Usecase is shown in the Figure 20 and the Use Case's descriptions are written in the table 11.

TABLE XI
THE DESCRIPTION OF ANALYSIS USECASE

Use Case	Description
Now	User could see the two type of time in the 'Now' part. First is the the time of user's actual working hour. And the second is the time how much user keeps good posture and bad posture. And user could see the 3D feature reflecting user's present posture. So, it could help user recognize their present posture visually.
Statistics	User could see the three type of analysing graphical data such as 'Day', 'Week' and 'Month'. The user's data is saved in the database and the program analyzes that data and shows the graphical graph using that data. So, user could see the data distribution according to the selected period(User could select period by touching the upper tab). It meets the 'Statistics' and 'Visualization' requirements.
Tips	User could see the some videos about stretching good for posture correction. And some of exercises which are good for posture correction are recommended in this page.

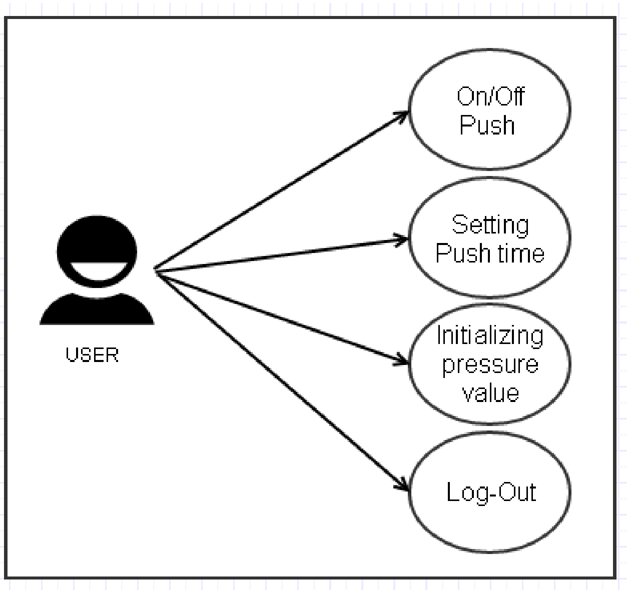


Fig. 21. Setting Usecase

User could do four functions in the Setting page. Those are 'On/Off Push', 'Setting Push time', 'Initializing pressure value' and 'Log-Out'. This functions could help user customize program's functions. Setting Usecase is shown in the Figure 21 and the Use Case's descriptions are written in the table 12.

TABLE XII
THE DESCRIPTION OF SETTING USECASE

Use Case	Description
On/Off Push	User could change the status of push alarm by On/Off. When user has urgent project meetint or needs to keep mobile phone silent, this function would be needed.
Setting Push time	User could set the time when user get the push alarm. The time has range from 1 to 10 minutes. For example, if user selects 2 minutes in this page(Default value is 1 minute)user would get push alarm when user keeps bad posture for 2 minutes.
Initializing pressure value	User could initialize pressure value in this page. The reason why user uses this function is that the actual user could be changed. So, when the actual user is changed the program initializes the pressure value making average value getting five times pressure values.
Log-Out	User could do Log-Out in this page. This function is required when user do not want to use this program or take out his/her own data to the database.

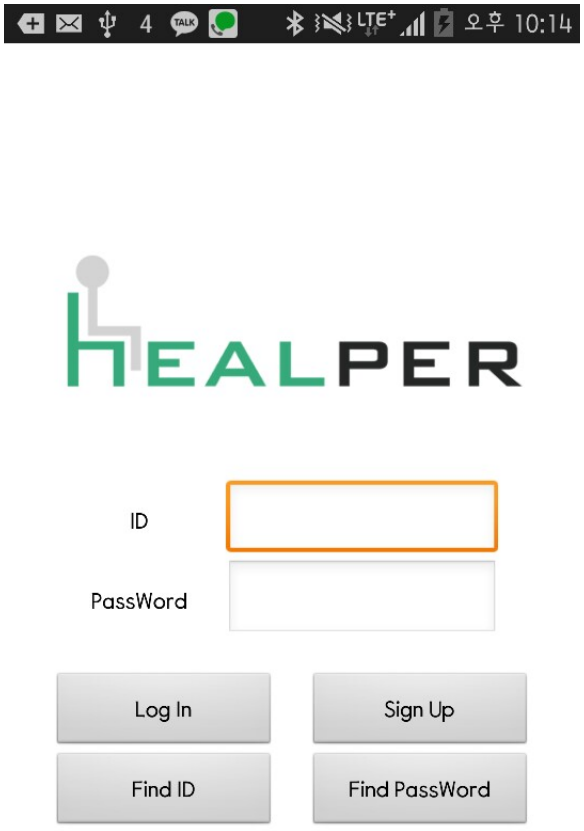


Fig. 22. Log-In Activity

This is log-in page. If user wants to use our program, user should log-in first. Because our one of the project objects is that we make user use our service in any device with only ID and password. And we use database postgreSQL to save personal data and analyze the data concerning user's posture.

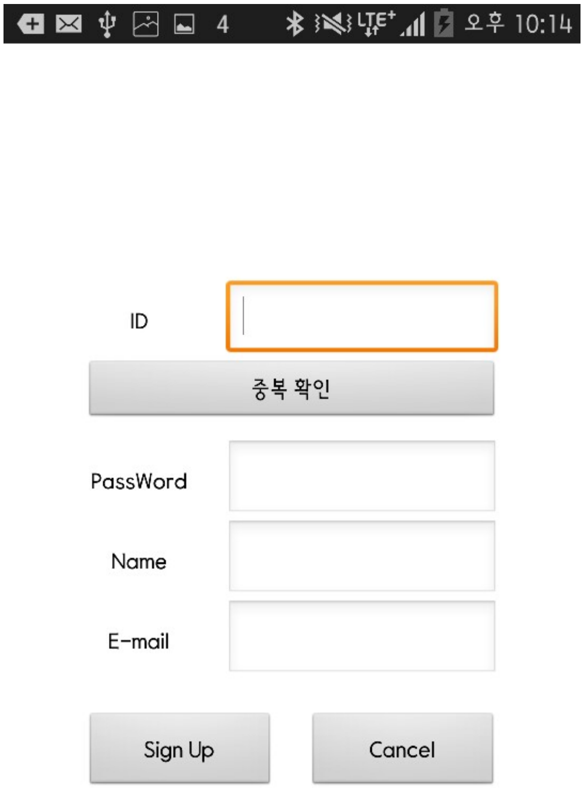
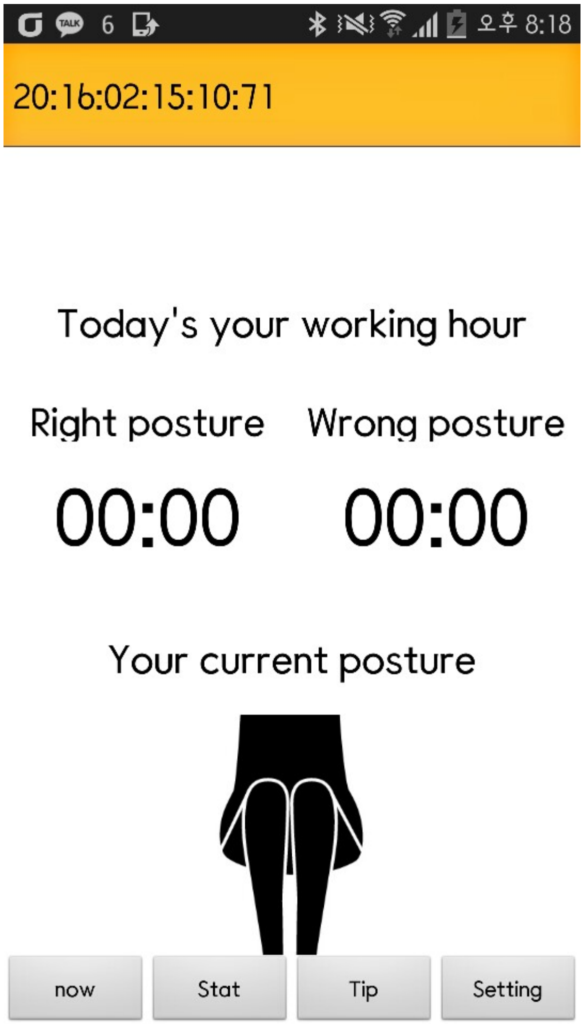


Fig. 23. Sign-Up Activity

So, user should sign-up to use our program and user should write ID, Password, Name and E-mail necessarily. And user should repetition check of ID to avoid overlapping with other user's ID.


20:16:02:15:10:71

Today's your working hour

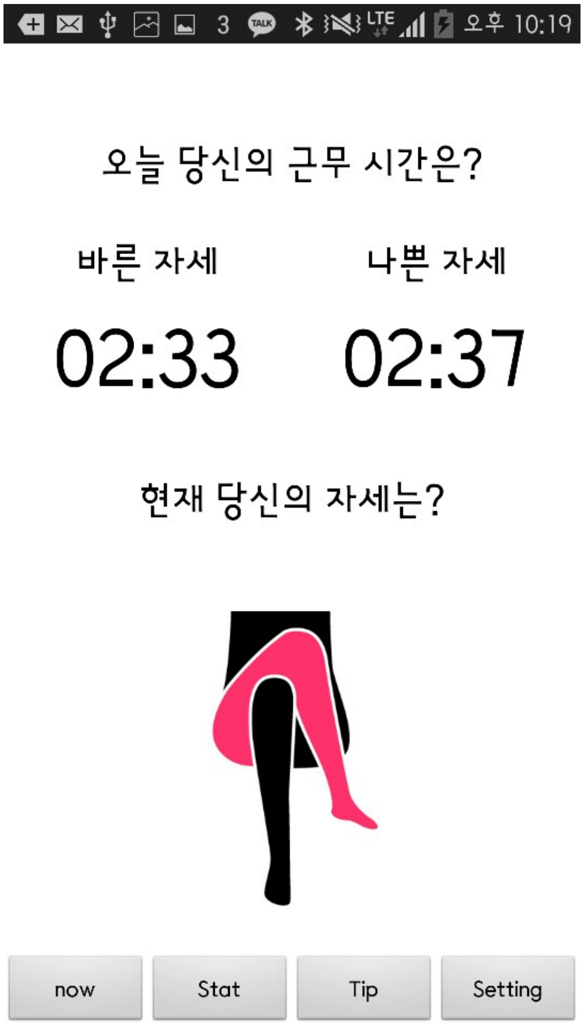
Right posture 00:00

Wrong posture 00:00

Your current posture

Fig. 24. Bluetooth Connection

Our program is based on bluetooth communication. Because we aim to make user use our service only with smart cushion without any mess hardware things and mobile phone, bluetooth communication is needed. So, to connect mobile phone with smart cushion, user should click the top of now activity which makes bluetooth connection.


오늘 당신의 근무 시간은?

바른 자세 02:33

나쁜 자세 02:37

현재 당신의 자세는?

Fig. 25. Now Activity

This is the main part of our program. User could see the current posture status. There are two parts. First, Users could see the time about how much they keep taking right and wrong posture and the second users could see the image of posture users taking now. And we divided the posture type into seven and recognize the each posture by our own algorithm using pressure values. And if specific time is flowed, the warning messge will be poped up.

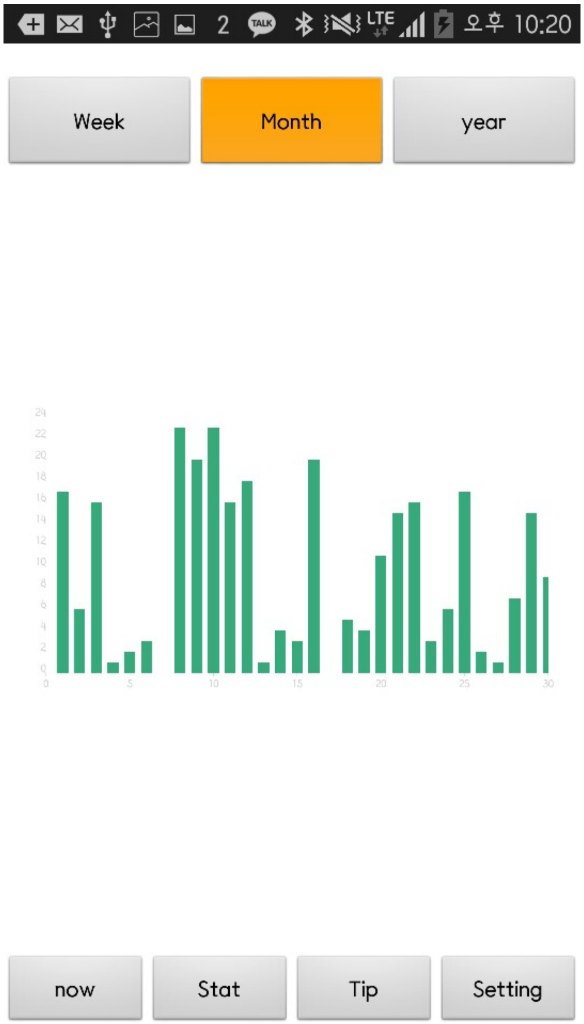
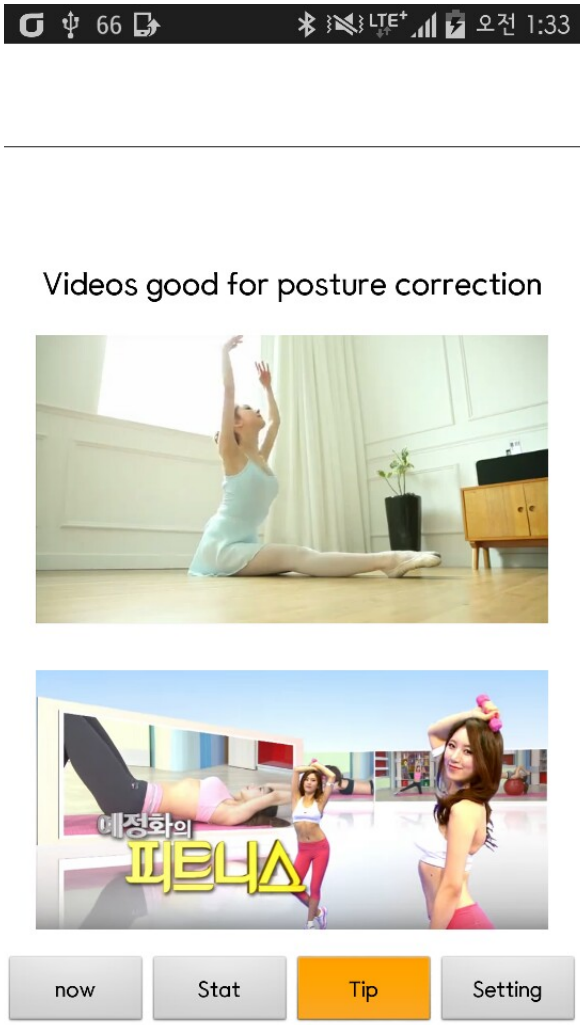


Fig. 26. Statistic Activity

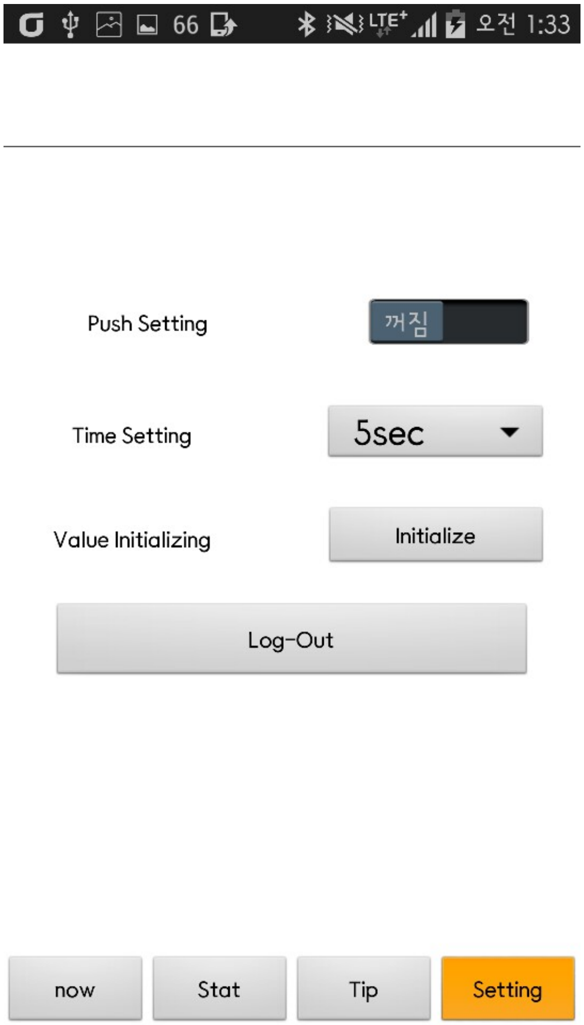
And we also provide the posture statistic data based on specific period (week, month, year) to help user correct their wrong posture habit. So, User could see the personal statistic about how much time user did wrong postures in this page.



Videos good for posture correction

Fig. 27. Tip Activity

This is tip page. In the tip page, user could get additional information for good posture by videos or hospital information such as good for low-back pain or spine.



Push Setting 꺼짐

Time Setting 5sec

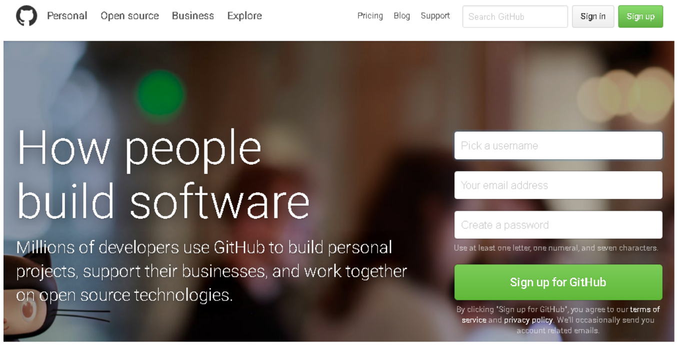
Value Initializing Initialize

Fig. 28. Setting Activity

And in the setting activity, user could set functions suited to the personal style such as push setting (on/off), time setting and value initializing.Value initializing function is important part. Because every chair's shape and depth are different, so to apply our algorithm to recognize different posture types in every environment, initializing pressure value is necessary thing.

VIII. Software Installation Guide

How to install?



How people build software

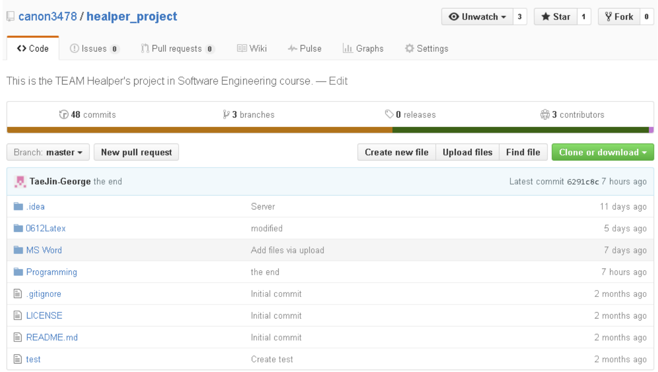
Millions of developers use GitHub to build personal projects, support their businesses, and work together on open source technologies.

Use at least one letter, one numeral, and seven characters.

By clicking "Sign up for GitHub", you agree to our terms of service and privacy policy. We'll occasionally send you account related emails.

Fig. 29. Git Hub

First, you have to sign-up in the 'Git Hub' site because we make our program open-source. The reason why we make our program open-source is that we want that the more people use our program, and people could add some functions if they want. So, you go to the https://github.com/ and should do sign-up first.

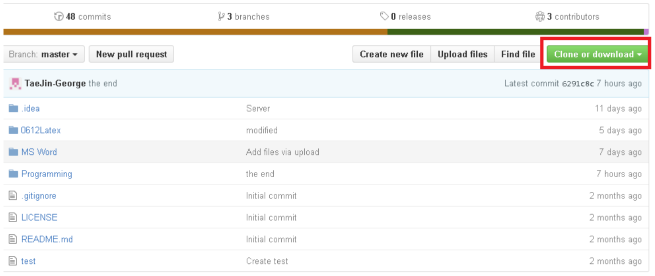


This is the TEAM Healper's project in Software Engineering course. — Edit

TaeJin-George the end		Latest commit 6291c8c 7 hours ago
.idea	Server	11 days ago
0612Latex	modified	5 days ago
MS Word	Add files via upload	7 days ago
Programming	the end	7 hours ago
.gitignore	Initial commit	2 months ago
LICENSE	Initial commit	2 months ago
README.md	Initial commit	2 months ago
test	Create test	2 months ago

Fig. 30. Git Hub

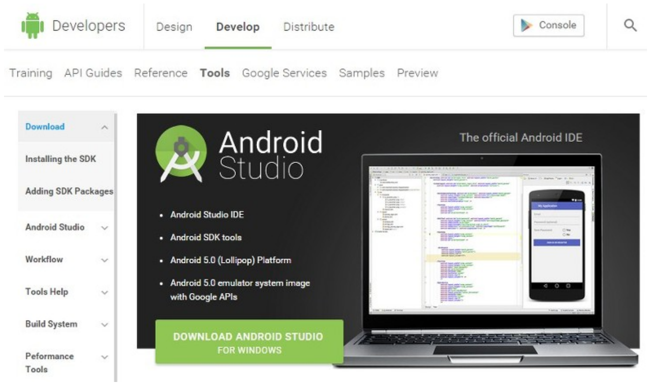
Second, you go to https://github.com/canon3478/healper_project This is our project's URL, so you could see and download all of things including source code.



TaeJin-George the end		Latest commit 6291c8c 7 hours ago
.idea	Server	11 days ago
0612Latex	modified	5 days ago
MS Word	Add files via upload	7 days ago
Programming	the end	7 hours ago
.gitignore	Initial commit	2 months ago
LICENSE	Initial commit	2 months ago
README.md	Initial commit	2 months ago
test	Create test	2 months ago

Fig. 31. Git Hub

And you click the 'Clone or download' button, then you could use and modify the program.



- Android Studio IDE
- Android SDK tools
- Android 5.0 (Lollipop) Platform
- Android 5.0 emulator system image with Google APIs

Fig. 32. Android Studio

Then, you go to http://developer.android.com/sdk/index.html and download the 'Android Studio'.

Fig. 33. Android Studio

Finally, you run the 'Android Studio' and use our 'Healper' program in free of charge.

IX. Discussion

We used many different development tool to develop 'Healper'. We used four tools; Java for developing Android, JavaScript for XML and server, SQL for database and Arduino IDE(C) for algorithm of Arduino. So, sending each value from a tool to other tools was difficult.

When we had to send the value from Arduino to Android using bluetooth, developing bluetooth function was very hard. Also, because it was our first time to develop server, sending the values from Android to server and database.

The electric current was not flowed and when we connect hardware, we tried to do soldering to increase hardware's stability but the soldering is not easy work. So, we bought electric tape and make connection with breadboard and other things.

And our first object is that we want to make soft cushion when user sits, but the some of hardware put into the cushion, it is a little bit not comfortable to user.

And because pressure sensor is too expensive (one unit is about 14,000 won), so we had to change our plan (Our first plan is to buy nine (3x3) or sixteen (4x4) pressure sensors).

Lastly, it was also the first time to write a documentation using LaTex. Since it is unfamiliar to us, we had a very hard time to learn how to use LaTex. Especially, it was the hardest for us to make a table, move the table and set the margin of the table. However, we realized that Latex is very convenient program to write a documentation more cleanly than any other program.

X. issues

1) Our program is based on bluetooth and getting pressure values every second. So, Our program runs out of battery too much now. So. We have to think about how to reduce battery consume next version.

2) We will develop posture recognition function by adding pressure sensors and adjusting algorithm. Now we use just four pressure sensor. But we use more pressure sensors, program could recognize the more wrong postures precisely.

3) We will add new function which checks how much user's body is tilted with photo and numerical value.

4) We will add new function which searches an orthopedic office near users.