

# **Graphical User Interface Controller**

## **for**

# **Baxter Research Robot**

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## 1. Introduction

Baxter is an industrial robot predecessor to Sawyer (robot) built by Rethink Robotics, a start-up company founded by Rodney Brooks. It was introduced in September 2012. Baxter is a 3-foot tall (without pedestal; 5'10" – 6'3" with pedestal), two-armed robot with a 1024 x 600 display. It weighs 165 lbs without the pedestal and 306 lbs with the pedestal. It is used for simple industrial jobs such as loading, unloading, sorting, and handling of materials. Brooks stated that Baxter was designed to perform the dull tasks on a production line. It is intended to be sold to small and medium-sized companies.

## 2. Aim

In previous studies, we created a face system which can represent the Baxter's feelings and interact with the user to enable Baxter to work more interactively with the user. If the user wants, s/he can control the face situation on the display of Baxter with "rostopic". All of the face actions and situations can be controlled publishing a message as String to 'display\_chatter' topic.

In this project we tried to develop a system which can help the controlling the face actions and situations with an external program on any platform with or without Graphical User Interface.

Also we tried to make a sample program which has Graphical User Interface to control the Baxter's face actions and situations using Java.



Figure 1

## 3. Technical Content

We tried to make system that can communicate the Baxter and any external program using "Socket Programming" technology. In addition user can control the Baxter with an external program.

### 3.1.Communication

Face system (Face Program) of the Baxter Research Robot can be controlled publishing a message as a String to “display\_chatter” topic. By using this feature of the program we have written a “node” named “control\_server.py” to communicate the external program which is written in any programming language. “control\_server.py” is the server side of the “Socket” that we used for a communication with TCP protocol.

This node publishes the incoming messages, via determined ip address and port number by client side of the socket, as a String to a determined topic.

```
[baxter - http://011607P0027.local:11311] digammart@ubuntu:~/ros_ws$ rosrun baxter_face control_server.py  
ip: 192.168.0.103  
port: 8080  
topic: display_chatter
```

Figure 2

## 4. Sample Program with Graphical User Interface for Desktop

We created a sample program ,which is the client side of the Socket, that can connect with “control\_server.py”(Server side of the socket) and has a Graphical user interface. Aim of the program is showing the Baxter Face System can be controlled with an any program with or without Graphical User Interface. We can control the face situations and face, head actions of Baxter Research Robot with a Graphical User Interface using this program which is written in Java, but the machine which will control the Baxter should be connected the same network with Baxter.

### 4.1.Connection

The Java Program has to connect with the “control\_server.py” to control the Face situations and

actions of the  
Baxter Research  
Robot. User has to

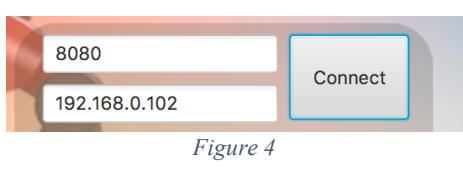


Figure 4

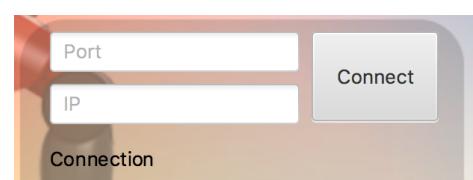
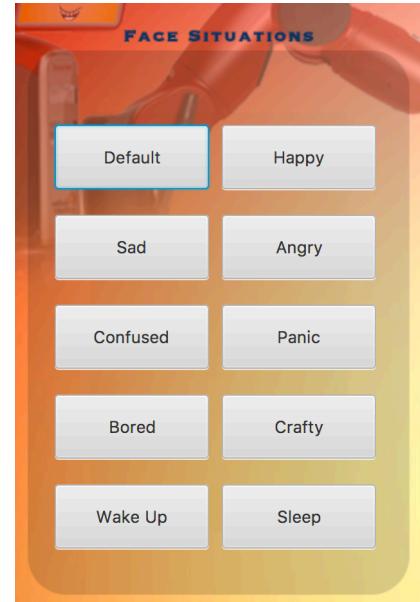


Figure 3

enter right IP address and Port Number to connect the server part of the Socket. User can learn the right IP address and Port number from the server program on terminal screen. If the connection is successful user can see the notification as “Connection Successful”.

#### 4.2.Face Situations

In the left side of the program, there are 10 different buttons to control the face situations of the Baxter. (8 different emotions and waking up and sleeping animations).



#### 4.3.Actions

Baxter Face System has two types of action. Auto action and Manual action,

Auto Action: Baxter decides where to look by itself.

Manual Action: Baxter looks at the given coordinates.

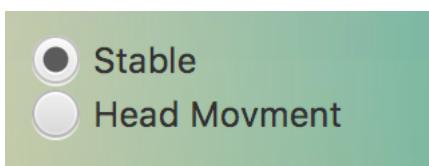


Figure 6

There are two radio buttons in the bottom of the Graphical User Interface. User can set the availability of the head movement properties using these radio buttons.

Figure 5

##### 4.3.1. Auto Actions

User can control only one type of Auto action using the sample program. User can provide with the Baxter follows the right and left hands with three buttons.



Figure 7

##### 4.3.2. Manual Actions

User can set the eyes and head position manually (giving coordinate.)



Figure 8

There is a slider in the middle of the program. User can control the head position of the Baxter using this slider as a radian degree. After pressing the “Wobble” button, head movement will be applied. If a user want to set the Baxter’s head to the default position, s/he can press

“Wobble -> 0” button.

In the right side of the program, there is a control panel, and the user can control the eyes and eyes with head movement. There are two sliders to set the coordinate of the eyes, and also user can enter the coordinates manually using text fields.

After pressing the “Look” button, Baxter will look at that determined coordinates.

## 5. Sample Program with Graphical User Interface for Android

We also created a sample program, which is the client side of the Socket, that can connect with “control\_server.py”(Server side of the socket) for operating system of Android. Aim of the program is the same with the program written in Java for Desktop. (Because of this reason, most of the properties of this program is nearly same with the other program.) Difference of this program is, user can control the face system of Baxter Research Robot using his/her own android smartphone or tablet.

### 5.1.Connection

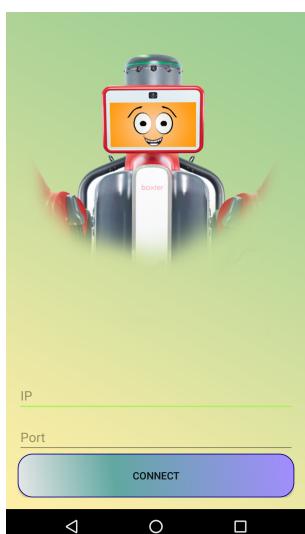


Figure 9

When we run the Android application, user has to enter right IP address and port number to reach the control buttons of Baxter’s face. If the connection is successful, program will change the screen automatically, but when you enter wrong information, program shows a warning on the screen.

### 5.2. Face Situations

There are 10 different buttons to control the face situations (8 emotions and wake up, sleep), also there are extra 5 buttons to set the colour of the skin.

(0-4) User can set the skin as 5 different colours.

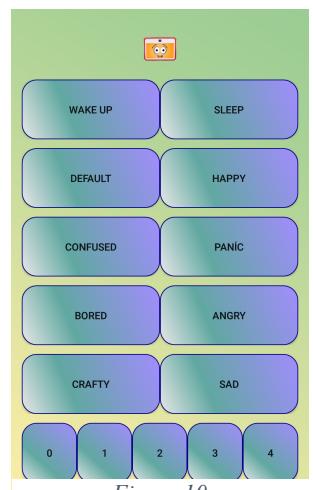


Figure 10

### 5.3.Actions

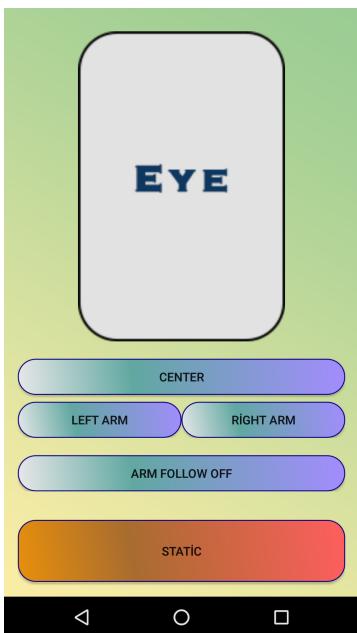


Figure 11

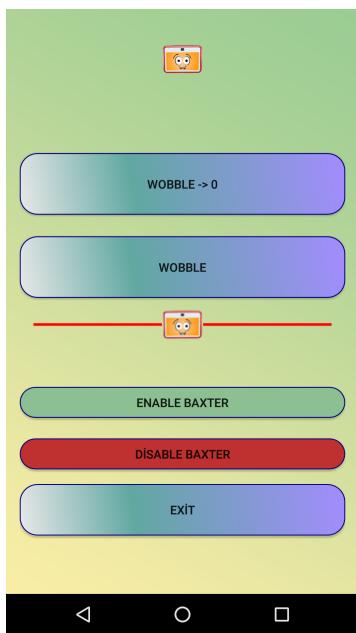


Figure 12

The android app has two pages had action controlling buttons. In first screen, user can control the robot's current situation (enable - disable) and position of the head. In second screen, user can control the looking of the Baxter's eyes. Unlike the desktop program, the exact position of the eyes can be controlled using determined eye control panel.

### 5.4.Control with Speech

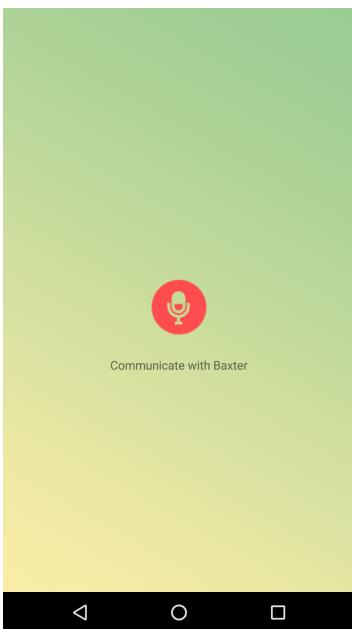


Figure 13

User can also control the face system of the Baxter Research Robot with speech recognition technologies on android. People can communicate with Baxter pressing the button (Figure 13). The program which is run on android sends the text version of the speech to server program of the Socket as "data\*<text version of speech>". Server side of the program processes the <text version of speech> and convert to Baxter's face command. After all procession, server side of the Socket publishes the data as the other datas.

## 6. Result

In this project we tried to build a groundwork for helping the controlling the Baxter's face system with external programs. In addition we created a program with Graphical User Interface using this groundwork to control the Baxter's face system.

User can control the Baxter's face situations and actions using this program if the machine and the Baxter are at the same network. Also a programmer can make another controller for Baxter.



Figure 14



Figure 15

## 7. Source Materials

[1] <http://www.rethinkrobotics.com/baxter/>

[2] [https://en.wikipedia.org/wiki/Baxter\\_\(robot\)](https://en.wikipedia.org/wiki/Baxter_(robot))