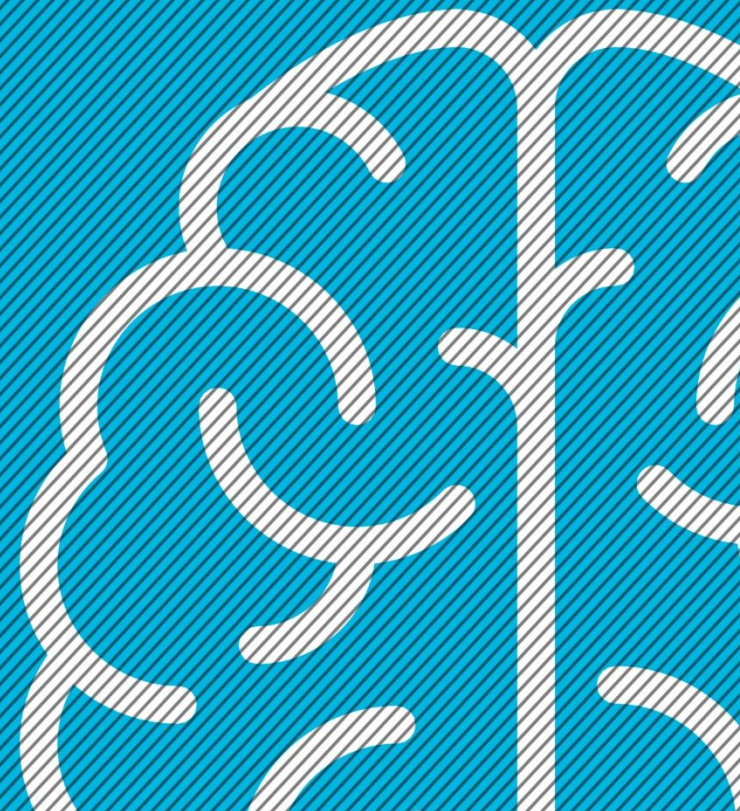
DESIGN A PERSONALIZED BRAIN COMPUTER INTERFACE BY USER-CENTERED DESIGN METHOD AND USABILITY TEST

Design for X Perspectives
Project II

WAN-JUN LIN
CHI-XUIAN TSAI
PENG WU
XIAO-HAN ZHU



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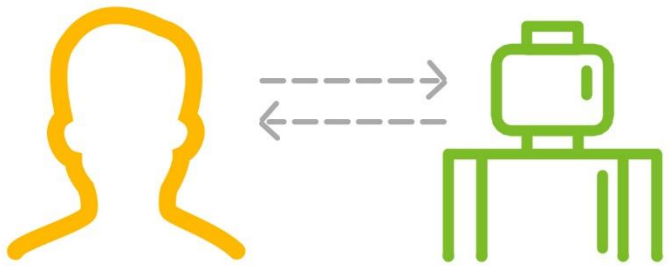
01. Introduction

INTRODUCTION

INTRODUCTION

- UCLA BCI laboratory team use EEG signals to communicate with the machine, make use of visual stimulation, and control to the cursor by BCI. (Vidal, 1970)
- The word of BCI was published first in 1973.(Vidal, 1970)



- Brain-Computer Interface (BCI)

Brain-computer interface is defined as follows:
"One does not need via the peripheral nerves and muscles can make the brain's communications system."

——Wolpaw (2002)

RESEARCH QUESTION

01 No previous literature discussed about designing the personalized BCIs.

02 Lots of BCIs maybe suitable for specific groups but not for all.

02. Literature review

LITERATURE REVIEW

2.1

Method and applications of brain computer inter-face

2.2

Usability test

2.3

User-Centered Design

2.1 Method and applications of brain computer interface

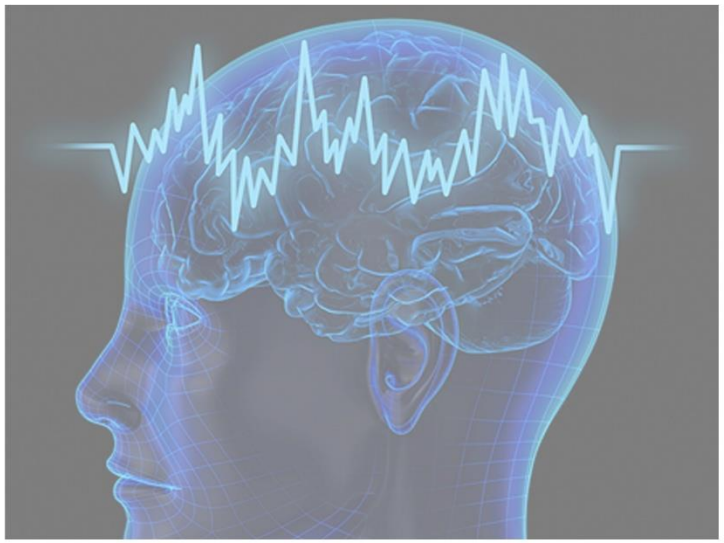
Liu and Huang (2012) proposed the use of the letter to the EEG-based brainwave interface system with FPFA the system with via Bluetooth wireless interface to control an electric wheelchair to move, thereby propose ways to help paralyzed patients.

2.2 Usability test

Nielson(1994) and Shneiderman(1998) also defined to the usability that it could be the significant element of computer interface and electronic products.

2.3 User-Centered Design

Garrett(2011) also considered that the user-centered design is a simple and effect method to design interfaces, so that he developed an evaluative method of virtual environment which based on UCD(1999).

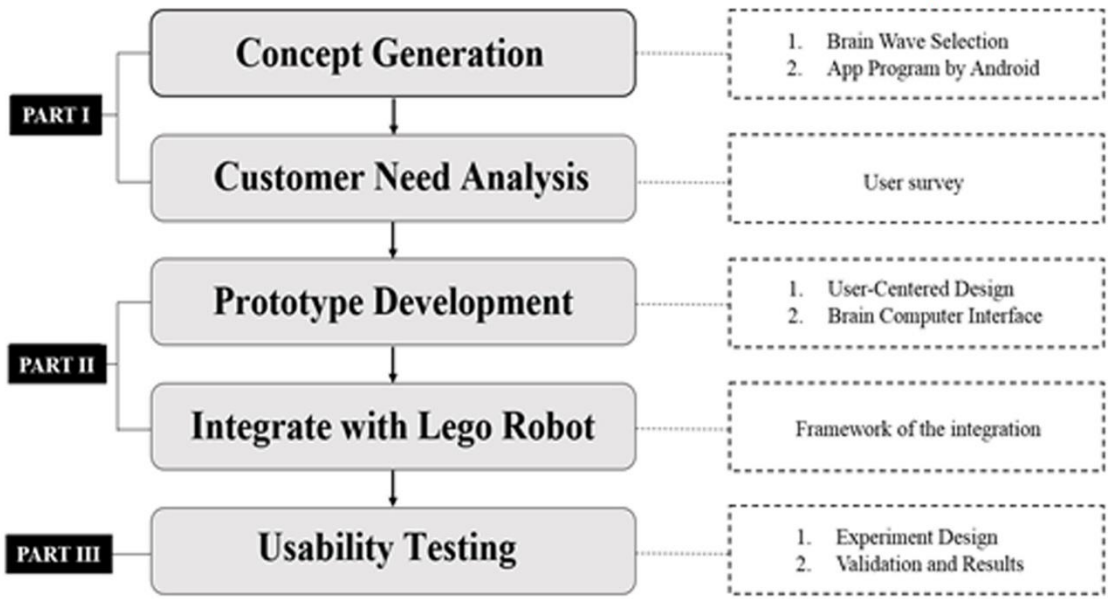


2.4 Summary

The goal of our research is to give the brain-computer interface to achieve individual differences in the design, and let everyone can control the part of EEG easier.

03. Method

Method



The purpose of this research is to design and verify the personalized brain computer interface.

This study is divided into three parts shown in Figure 1, the first part is the framework of the personalized brain computer interface.

Figure 1

Method

The second part demonstrated the design process of is the interface design of personalized brain-computer interface which based on the user-centered design method, mainly focused mainly on the design of interface, as well as improved the user interface, allowing everyone in accordance with their active brainwave and personalized preferences to choose the control mechanism to solve the electroencephalogram wearable pan with the problem of insufficient.

The third part of this personalized brain-computer interface used in Lego robot motion control is the usability test, the details will present clearly in Chapter 4.

Method

The framework of Personalized Brain Computer Interface Establishment

The brain computer interface includes three steps: brainwave EEG signal acquisition, signal processing and choreography controlled device in signal acquisition and signal processing stage. We used NeuroSky Mind-wave Mobile shown in Figure 2 to collect and analyze signals

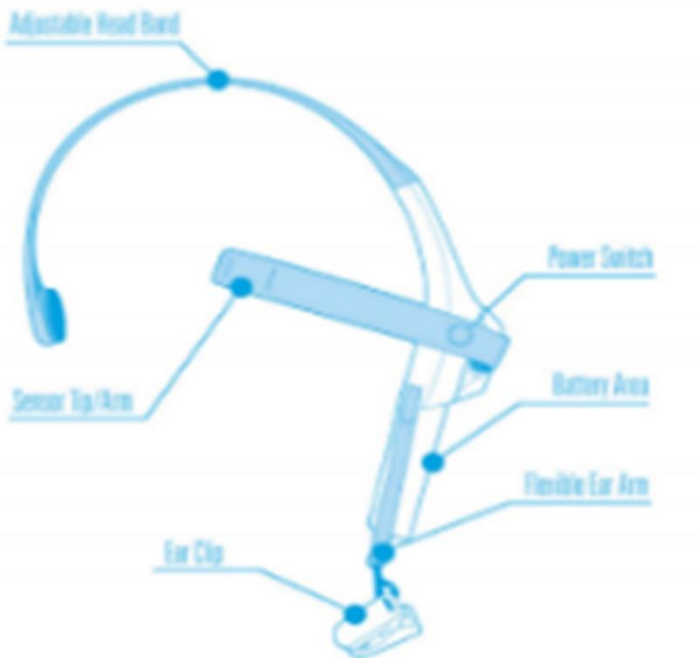


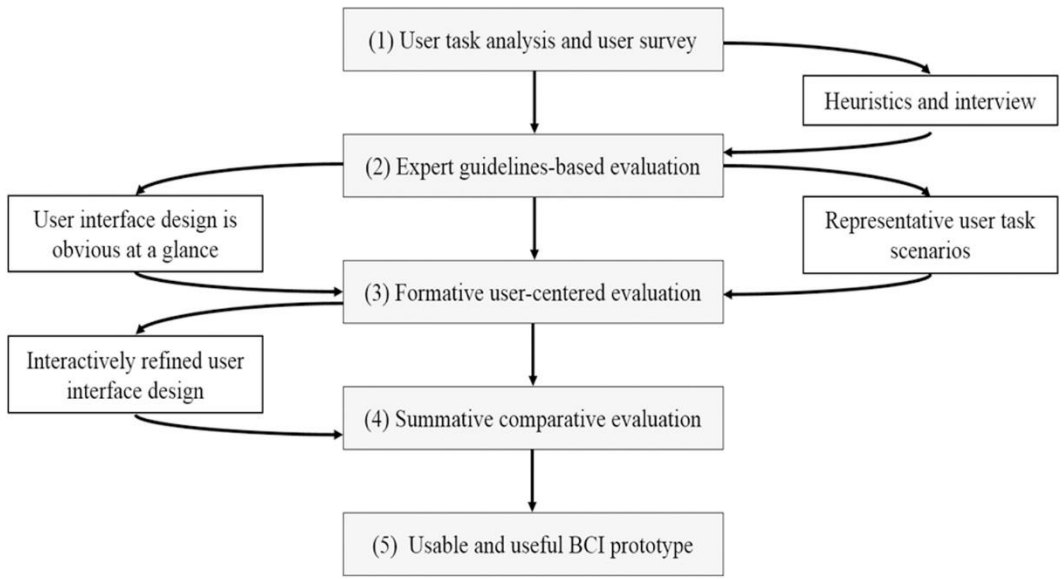
Figure 2

Method

User-Centered Design

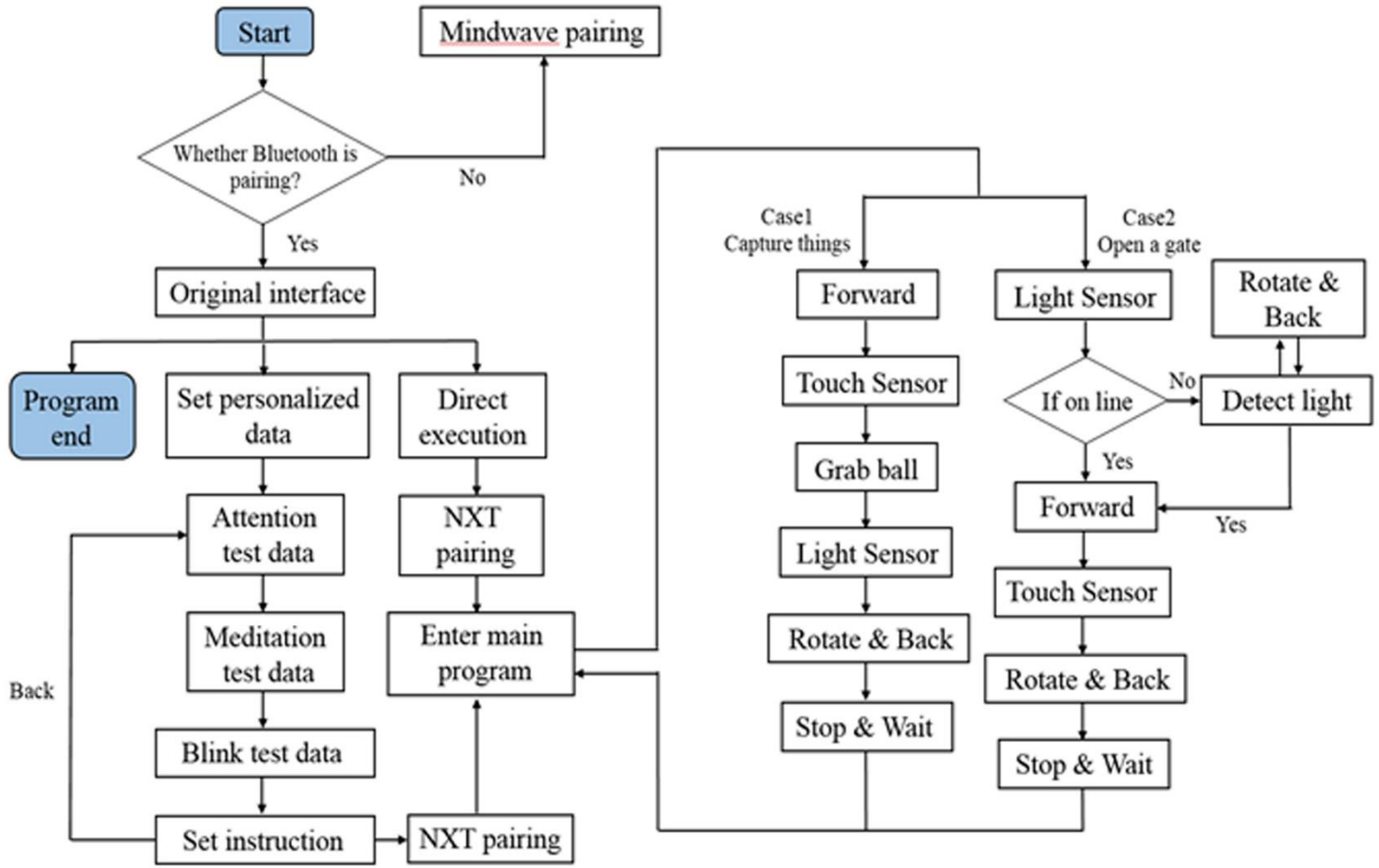
This study aimed to establish a useful and efficient BCI to assess the usability of the Lego robot so that we based on the user-centered design method to develop our BCI. To support rich and dynamic user-centered design and evaluation of it, we forged the well-established techniques for evaluation and design of human activity.

1. User task analysis and user survey
2. Expert guidelines-based evaluation
3. Formative user-centered evaluation
4. Summative comparative evaluations



Method

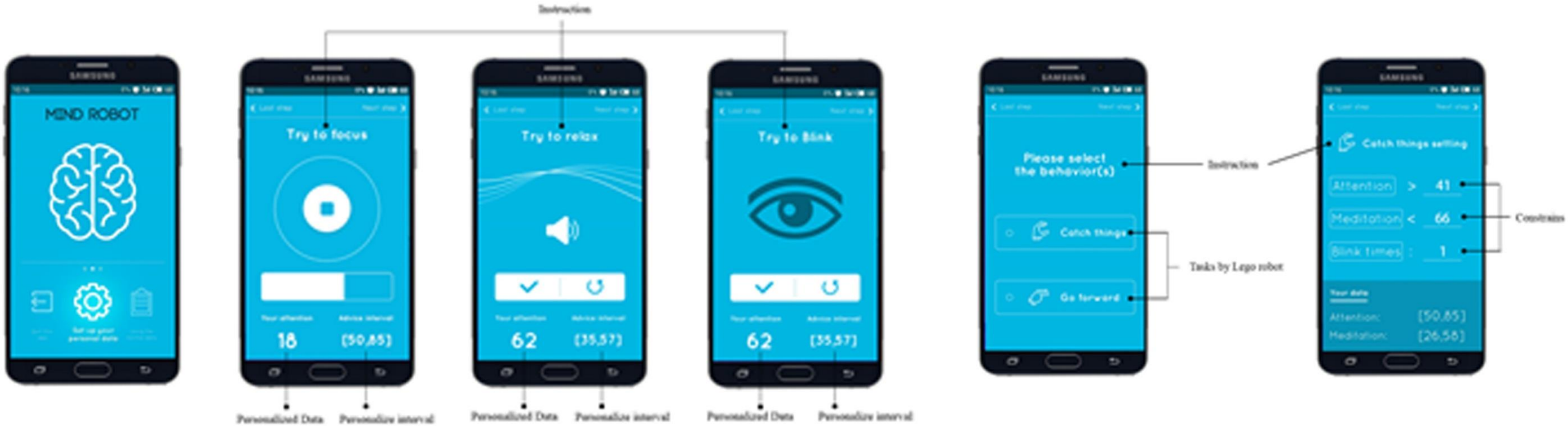
Integrate the Personalized Brain Computer Interface and Lego Robot



04. Usability test of the personalized brain computer interface with mind robot

4.1 Prototype of Personalized Brain Computer Interface

Base on the mentioned user-centered design method, we conduct this personalized brain computer interface as our prototype demonstrate.



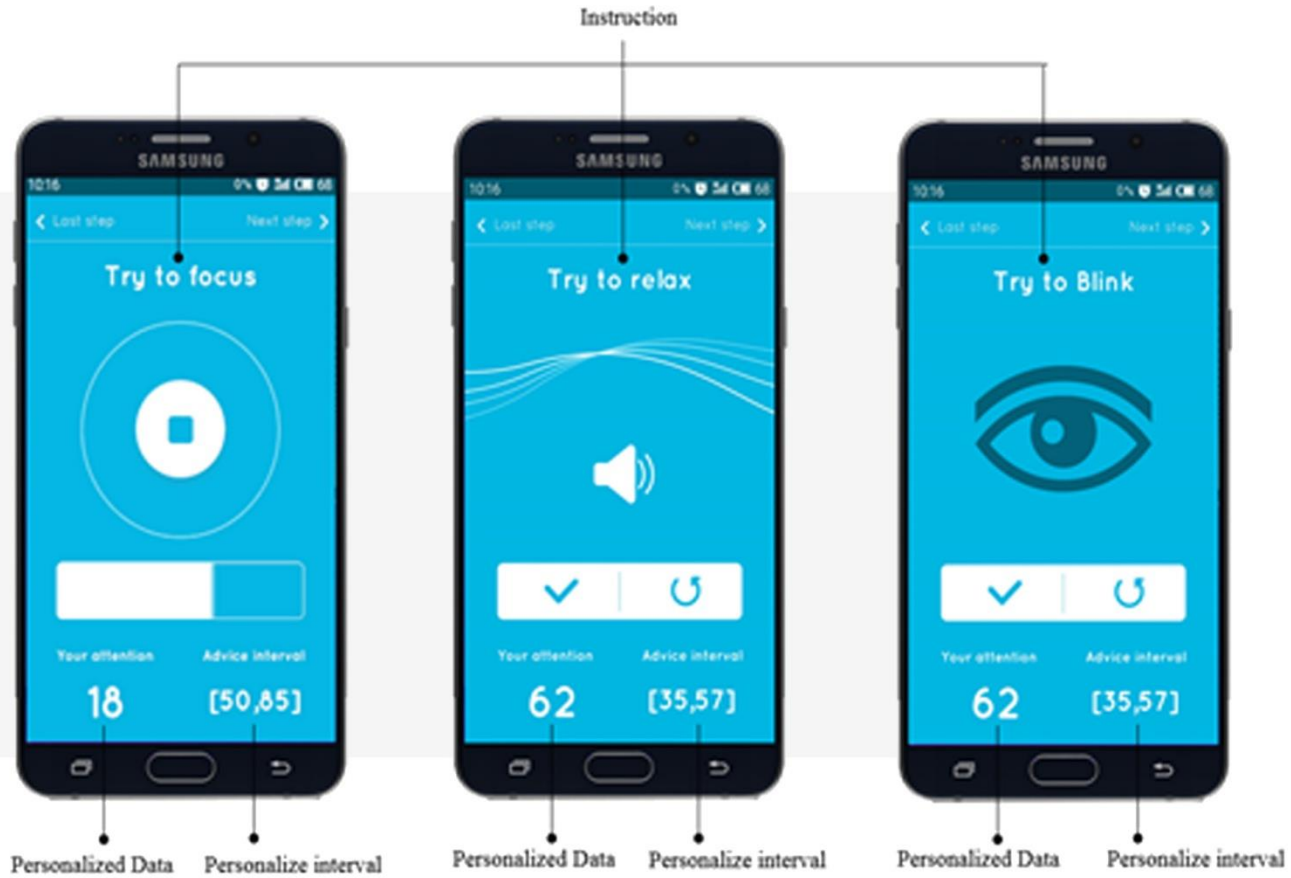
4.1 Prototype of Personalized Brain Computer Interface

The main page showed three buttons include start, setting personalized data and leave.

Users can press the "setting personalized data" button to set individual data.

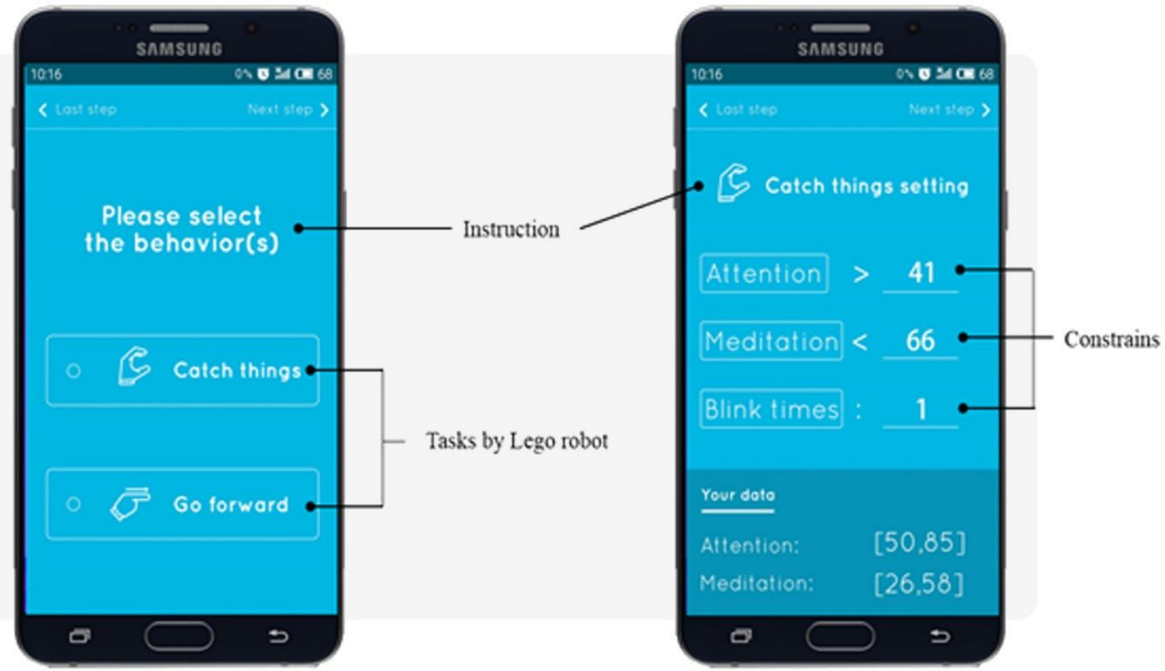
4.1 Prototype of Personalized Brain Computer Interface

Via a Bluetooth connection, the three values include attention data, meditation data and blink data which collected and transferred to the APP by the BCI, this APP calculated these three values assuming the parent is normal distribution. After that, there is a personalized interval for the users.



4.1 Prototype of Personalized Brain Computer Interface

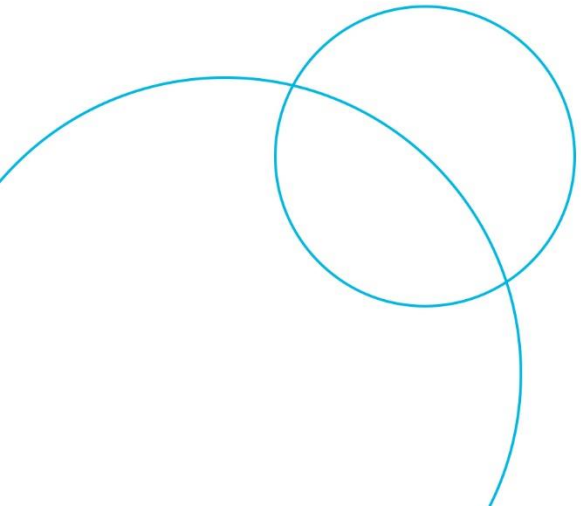
After users set the personalized data, the page of all the data are shown in Figure 6. We design two tasks in this APP so that users can choose the situations to control the Lego robot. Every user can keep or change their own constrains. Final, press the "enter" button then you can start to control the Lego Robot with personalized brain waves.



4.2 Designs in Questionnaire

The questionnaire design for this study referred to the Hart and Staveland (1988), who proposed NA-SA-TLX, a method for subjectively measuring the workload of a task based on six attributes.

Second, we used SERVQUAL questionnaire to measure the different satisfactions between before and after process.

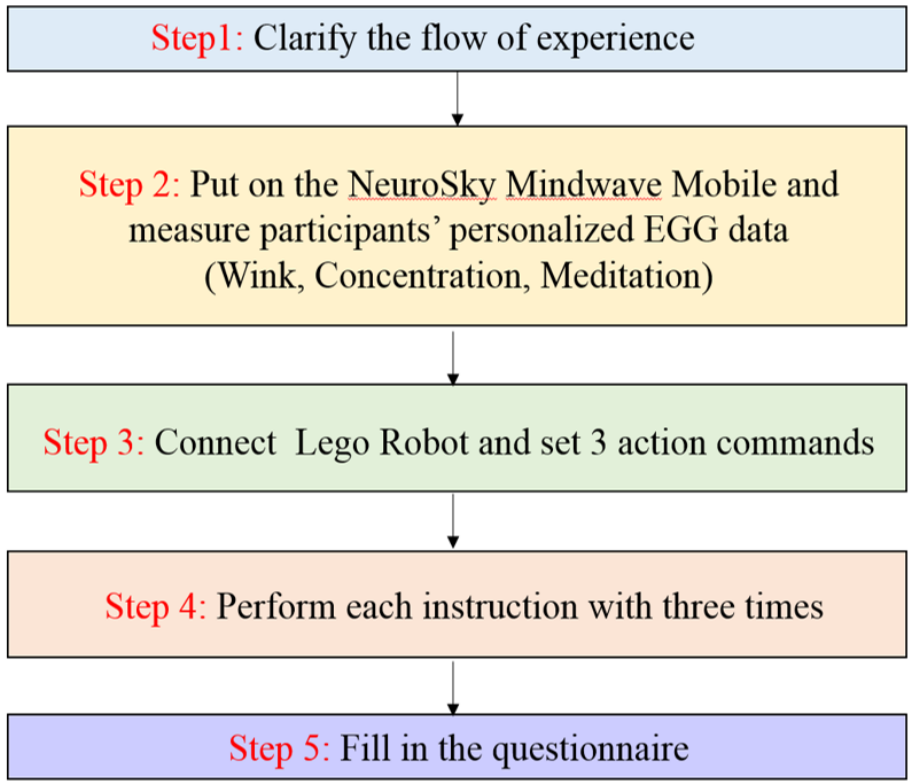


Both NASA-TLX questionnaires and SERVQUAL questionnaires were based on the Likert seven points scale for agreement/disagreement (e.g. strongly disagree for 1 point, little disagree for 2 points, disagree for 3 points, neutral for 4 points, agree for 5 points, little agree for 6 points and strongly agree for 5 points)

4.3 Designs in Experiment

In order to reveal and evaluate the usability of the prototype, this study conducted the experiment and designed two tasks to analyze the BCI with Lego robot. Participants were invited to join this experiment and the statistical approach adopted to analyze the data included descriptive statistics such as mean and standard deviation. ANOVA was also used to evaluate the results and eight aspects were included in the questionnaire to analyze presence: effectiveness, efficiency, satisfaction, error, learnability, flexibility, memorability, and sociability.

4.3 Designs in Experiment



05. Conclusion

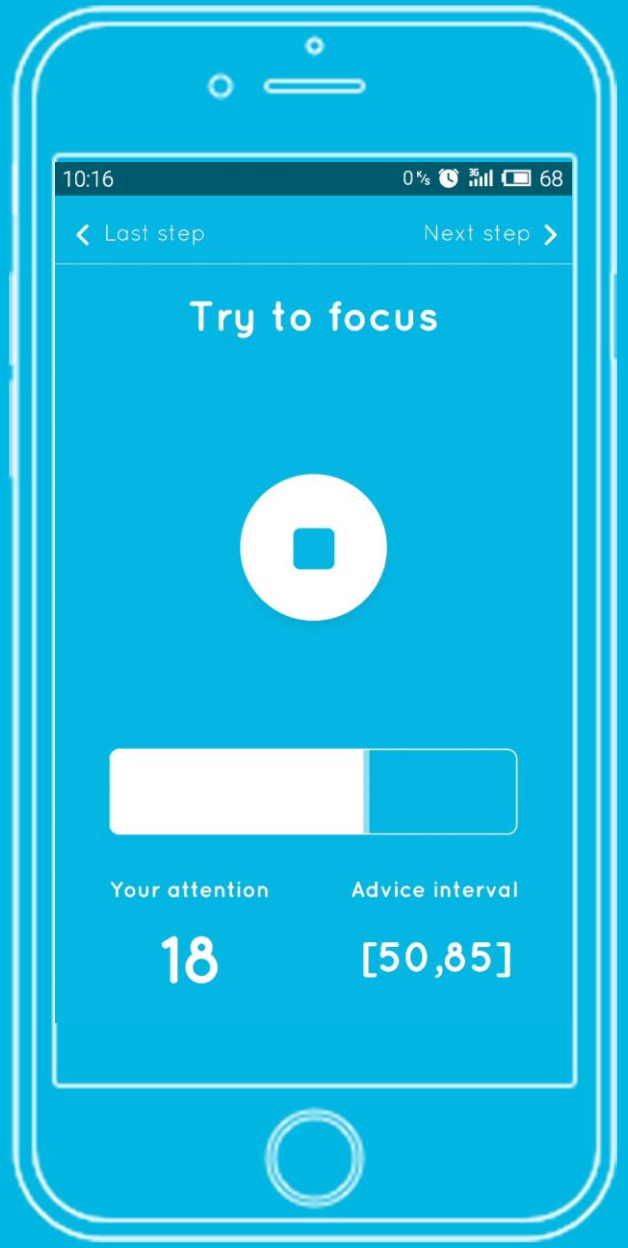
Conclusion

This is the first paper that integrates the application of personalized brain computer interface and robot to conduct instructions. In addition, this is the first study discuss on personalized BCI to adapt individual person. So that everyone can accord own EGG data to control the device. Moreover, this study integrates the hardware and software to develop a new personalized BCI APP. According to our prototype and usability test, this brain computer interface, which is in keeping with human's habits, is simple and easy to learn. Final, we hope that this personalized BCI will be applied in medical treatment, business and livelihood, promoting.

Others

— 界面要對比鮮明讓人容易區分

— 將操作的狀態或者進度呈現出來



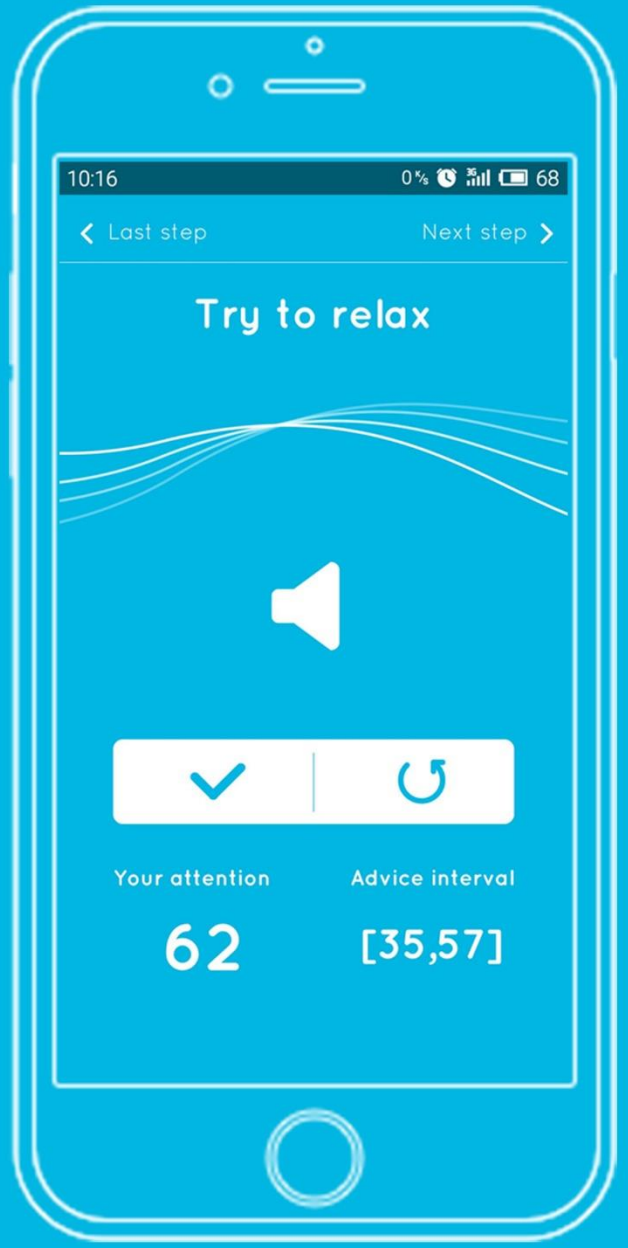
— 使用逐步的引導代替突兀的註冊

— 保持界面一致性
不增加用戶的學習成本

— 讓進度條預設已經走了一部分

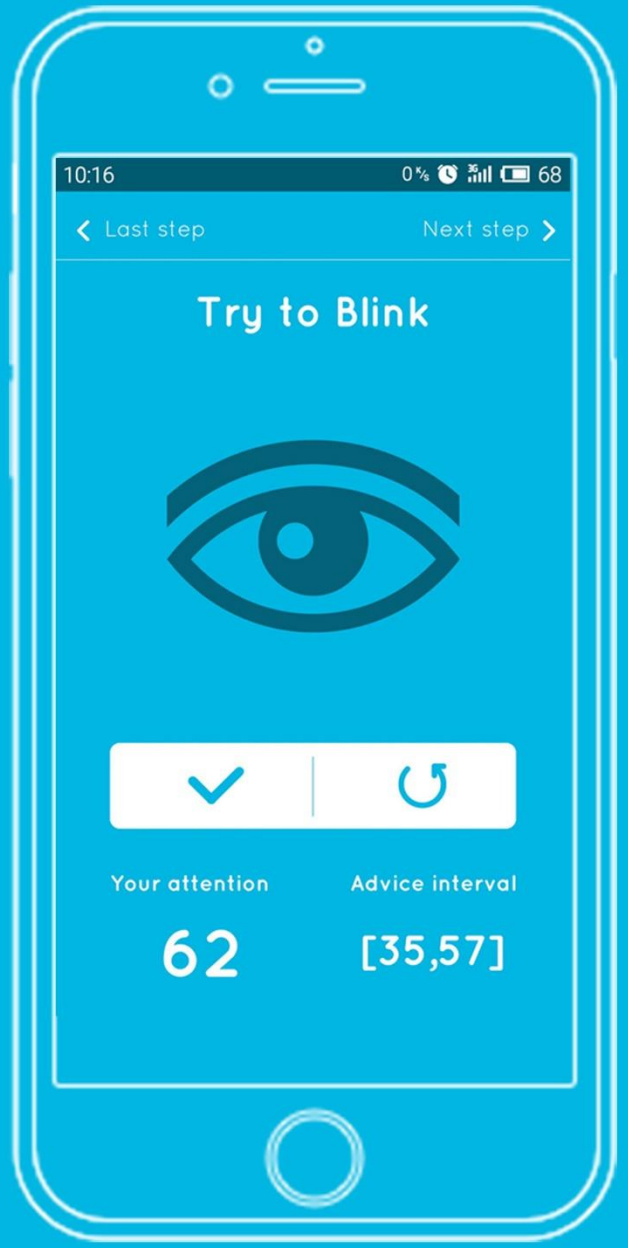
— 使用直觀的操作
而不是缺乏上下文關聯的菜單

— 具有層次的圖形化
展示優於直白的文字描述



— 將頁面中重要的信息進行突出

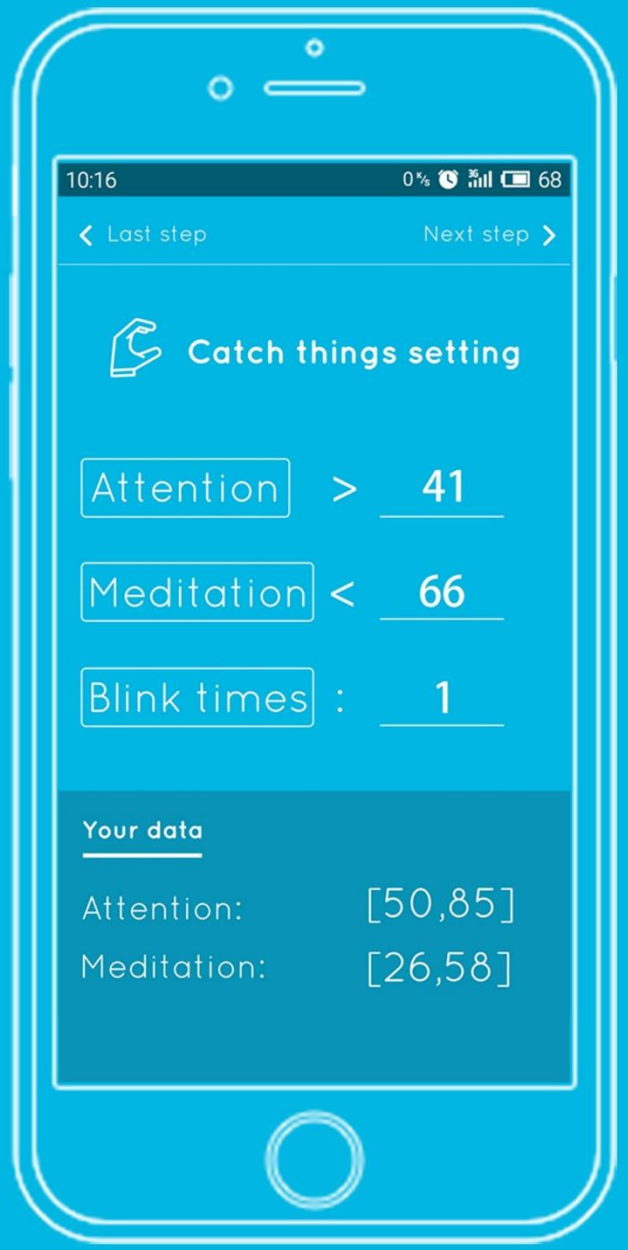
— 個性鮮明勝過普通



— 圖形暗示增強認知

— 暴露選項而不是隱藏

— 讓界面平滑顯示而不要死板地呈現

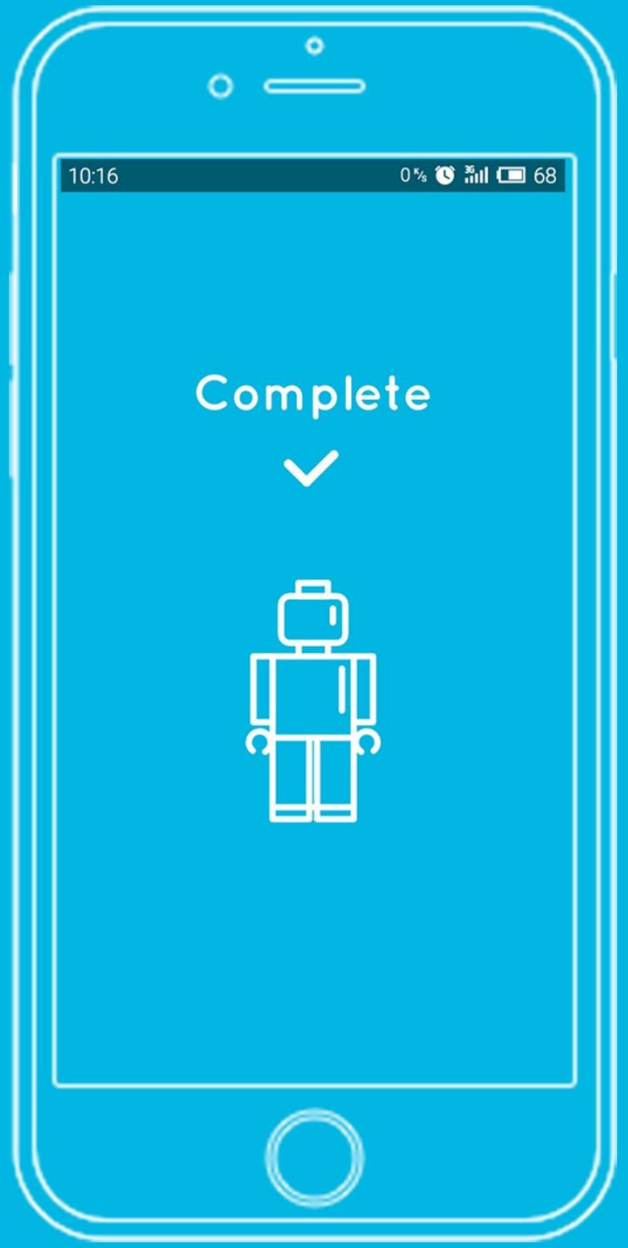


— 給予用戶再次確認選擇的自由

— 增加重試和重做的功能

— 把界面做得環環相扣
要好過直白的排版

— 嘗試增加圖標文本



— 使用寬鬆的間隔避免元素擠在一起

THE END

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