

Psychology Software Tool (PST) for Specific Language Impairment Person

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Introduction



- Specific Language Impairment (SLI)
- SLI diagnosis and Music therapy
- Collaboration project
 - School of Computer Sciences
 - School of Humanities
 - School of Medicine
- Research Papers submitted
 - AiIC2020- [*'Psychology Software Tool for SLI Person'*]
 - MJMS- [*'An Innovation-Driven Approach to SLI Diagnosis'*]
 - IEEE- [*'Pushdown Automata Versioning Framework for Web-Based Developmental Surveillance Systems'*]





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2020

Best Paper Award **AiIC2020**

PSYCHOLOGY SOFTWARE TOOL (PST) FOR SPECIFIC
LANGUAGE IMPAIRMENT PERSON

by

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Universiti Sains Malaysia

2nd Applied Informatics International Conference (**AiIC2020**)

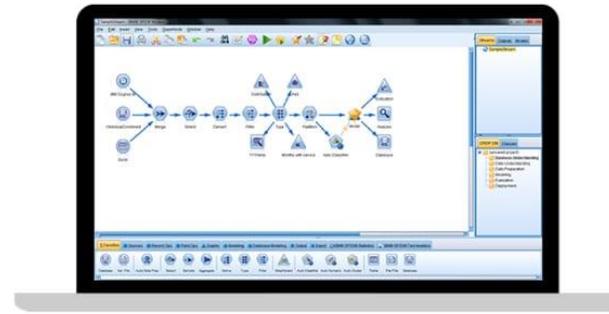
*"Empowering Applied Informatics Research for Contemporary
Technology trends"*

12th & 13th August 2020

Problem Statement



- Diagnosing and treating SLI is “manual labour” for therapists.
- Complex diagnosis and treatment methods.
- Too many different (and expensive) tools!

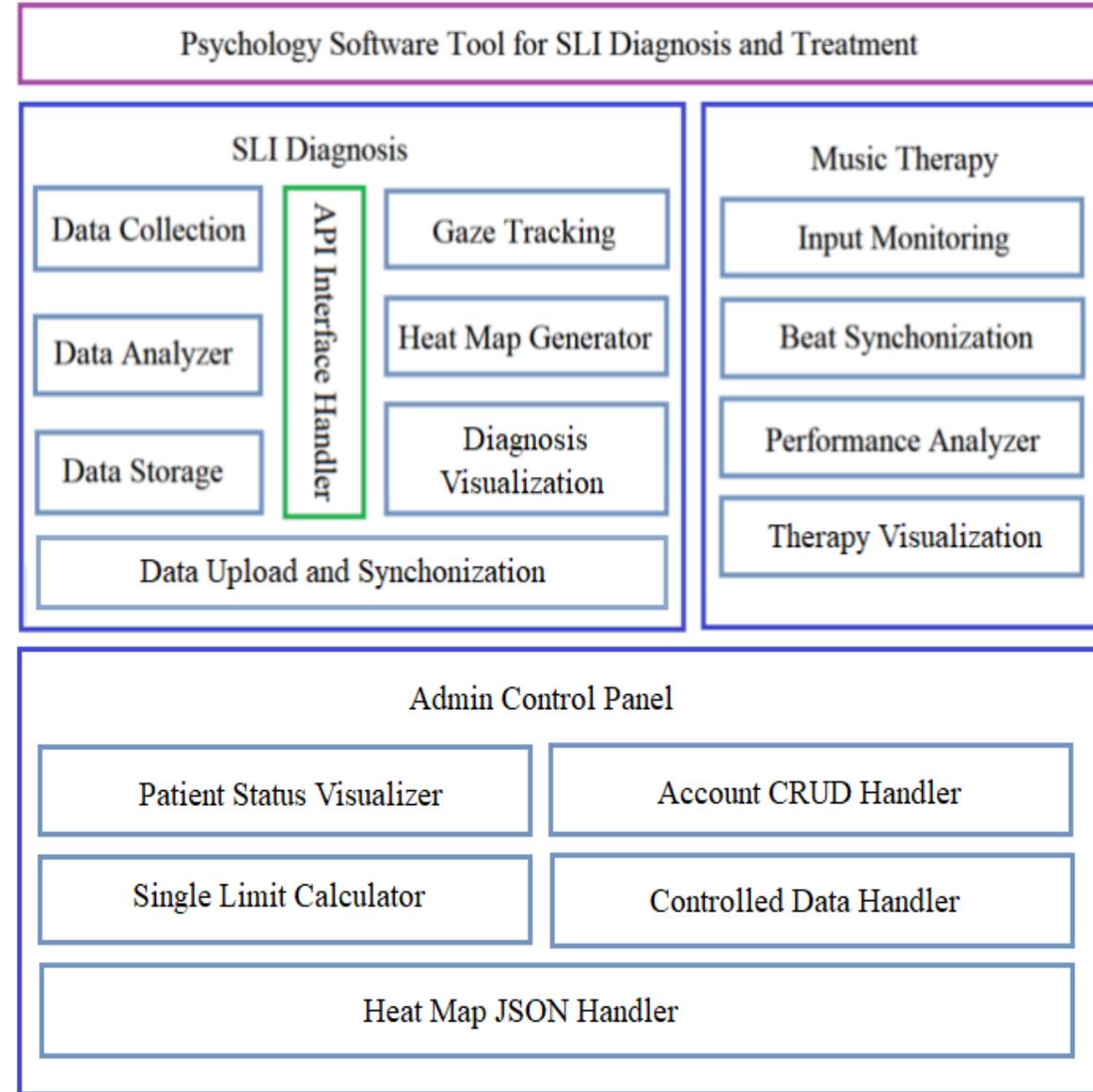
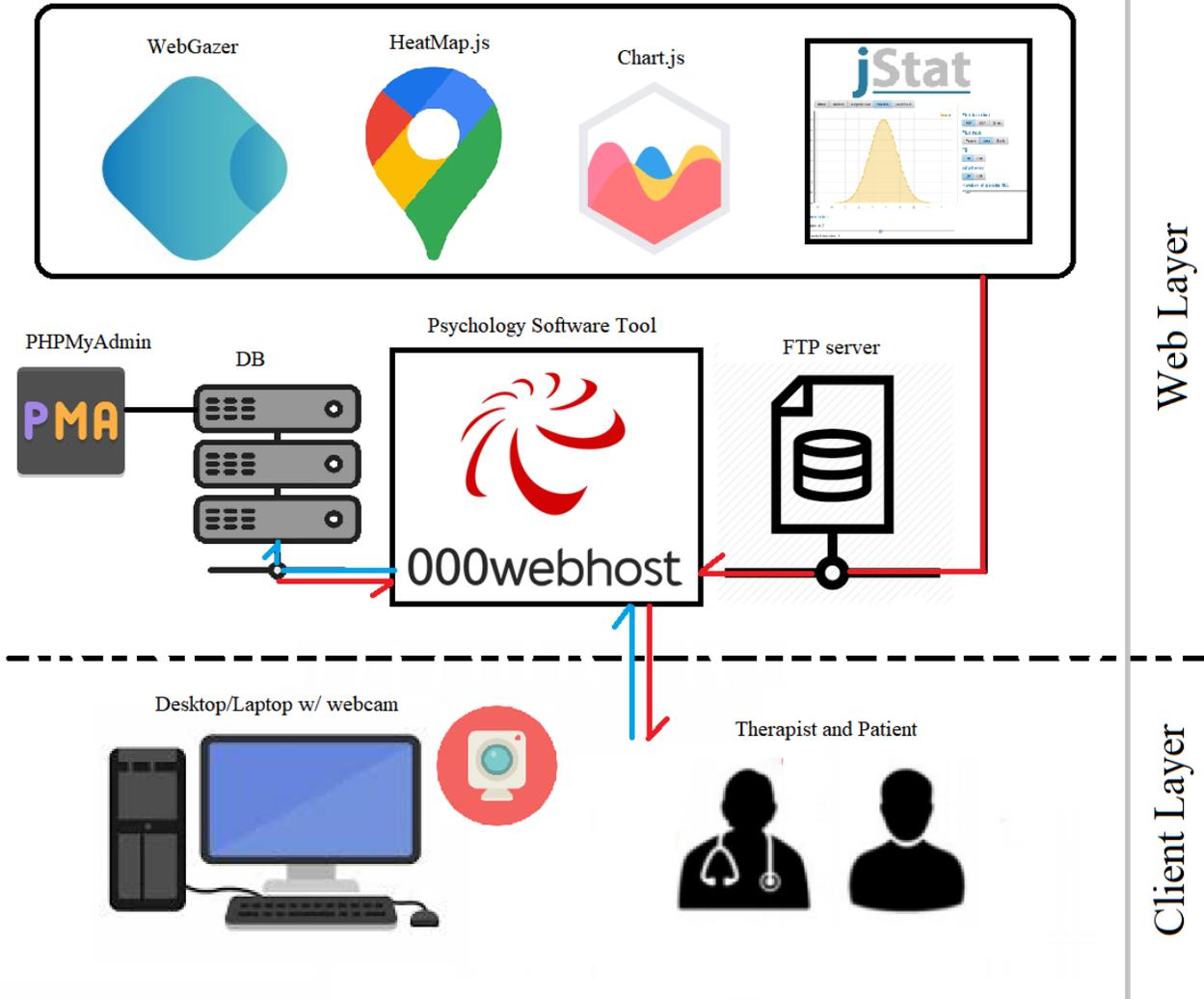


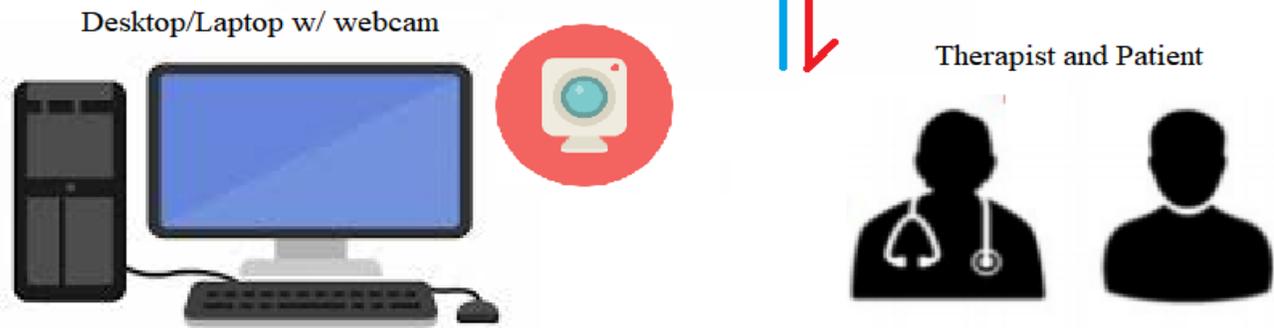
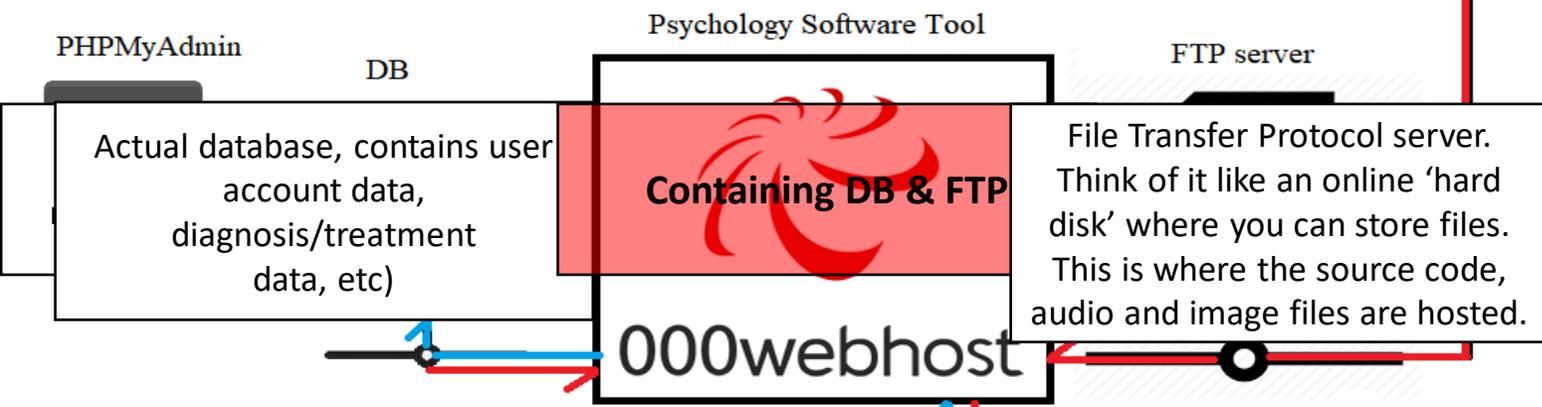
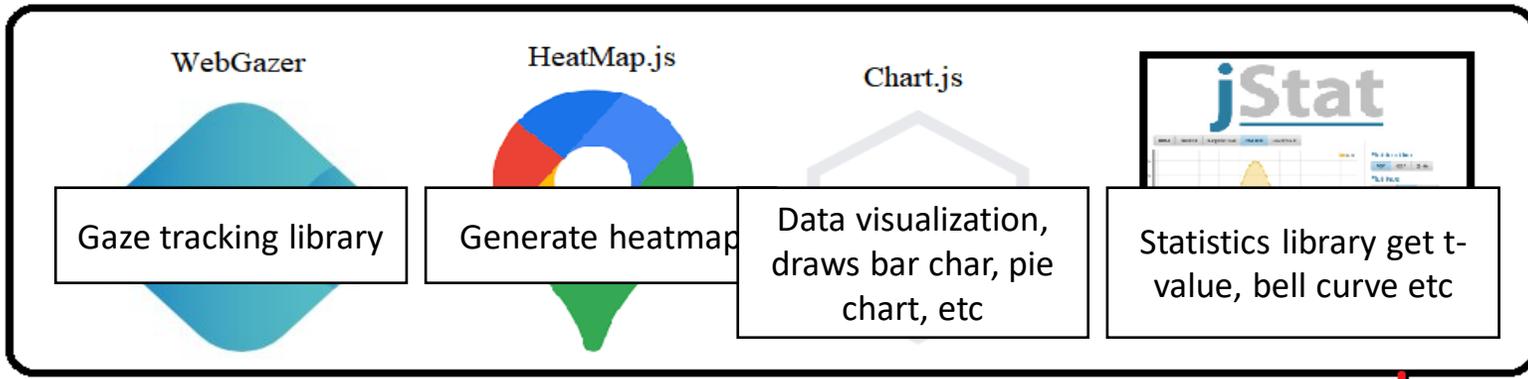
Psychology Software Tool (PST)



- An **integrated system** to diagnose and treat SLI.
 - Web application which offers SLI **diagnosis** and **treatment**.
 - **Gaze tracking** libraries to replace eye tracker hardware.
 - Provides **music therapy**.
- PST Objectives
 - ↪ Develop web application which offers SLI diagnosis and music therapy.
 - ↪ Provide integrated package - Automation, gaze tracking, mathematical inferencing capabilities
 - ↪ • Eliminate diagnosis and treatment dependencies on costly equipment

PST Architecture and Modules





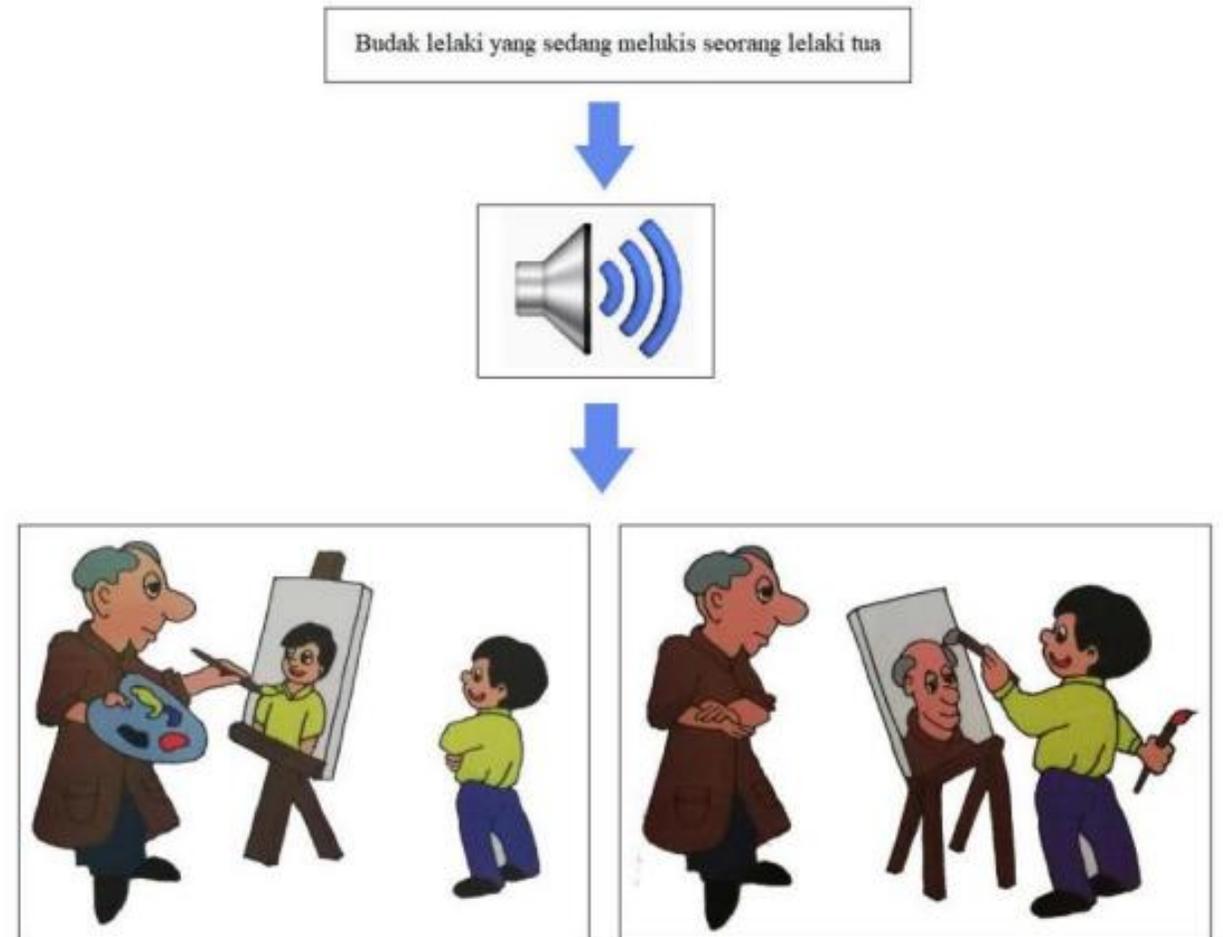
Web Layer

Client Layer

Two-Tier Client-Server Architecture

PST Components and Workflow

- Sentence-picture matching task
- Gaze tracking
 - WebGazer.js
 - Heatmap.js
- PST inference engine
 - Crawford, Howell (1998)
- Music Therapy
- Data Visualization
 - Chart.js
 - jstat.js





Psychology
Software
Tool

Sign In



Guest Login





Psychology
Software
Tool



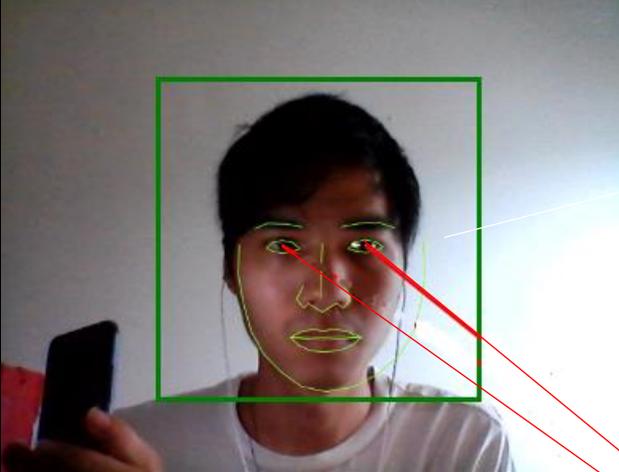
SLI Diagnosis



Music Therapy



PART 1: Diagnosis



Gaze deduced based on
webcam data (WebGazer.js)

After 1000ms blank screen,
display for 5000ms

Budak lelaki yang sedang melukis seorang lelaki tua.



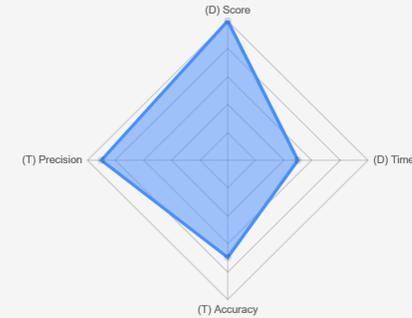
Audio provided within 7000ms,
then blank screen for 500ms

PST Results

- Data visualization for relevant information
- Track diagnosis/treatment result changes against time

User Report

Radar chart with scale of 0 (poor) to 10 (excellent)



Diagnosis history

date	score	OTP	meantime
2020-05-31	100	0.00184	2693
2020-06-01	100	0.00184	6568
2020-06-15	100	0.13977	3237
2020-06-15	100	0.13977	4299
2020-06-15	100	0.13977	7118

Treatment history

date	precision	accuracy
2020-05-31	0.91	0.93
2020-06-15	0.93	0.9
2020-06-15	0.88	0.88
2020-06-15	1.2	0.46
2020-06-25	0.67	0.8

Session Overview



JSON for Heatmap Generator

```

{"pic":0,"coord":
{"885.7090265272848":1608.8843941113623,"888.8967538373365":487.2435485560983,"879.9678754469509":382
.789300834565,"926.8411715616985":386.2837648755339,"930.4389992297173":411.9778197448062,"953.19108
5027929":471.79825405652326,"838.0773922338279":357.81934554950817,"828.4420863791789":242.492939740
40137,"821.5488731674125":146.51109029846,"741.5760558474834":255.48757687199102,"718.4912430936274":
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632718956859":255.6782032713644,"612.5518850656722":272.99689973158263,"442.88206526163526":266.8728
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42048371":367.9320205786868,"474.14909906427886":446.87444707933207,"449.1797349147344":482.10848438
8277,"519.8602261274384":369.3768594499242,"631.1610388420219":292.35034954163103,"480.5236654341025
    
```

Results

Total answered: 10
 Total correct: 7
 Mean time: 955
 Score: 70.00
 One-tailed P: 0.27712

Q1: B | t: 2979

Q2: A | t: 700

Q3: A | t: 869

Q4: B | t: 1291

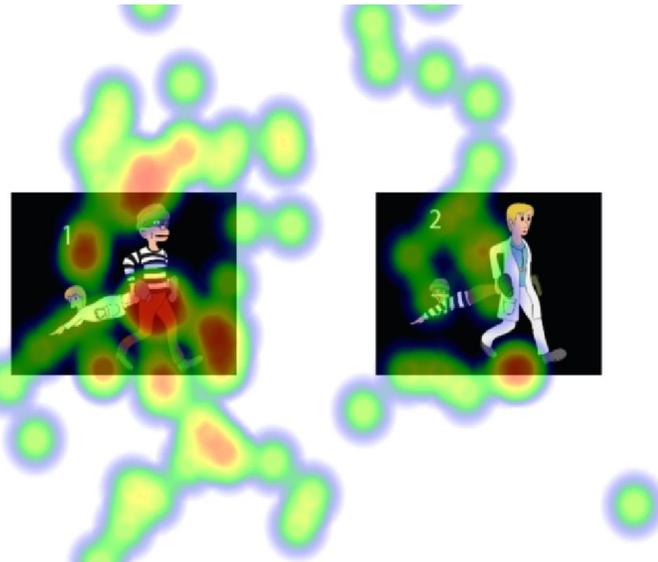
Q5: A | t: 788

Q6: B | t: 743

Q7: B | t: 659

Q8: B | t: 667

Q9: B | t: 578



1

User Report

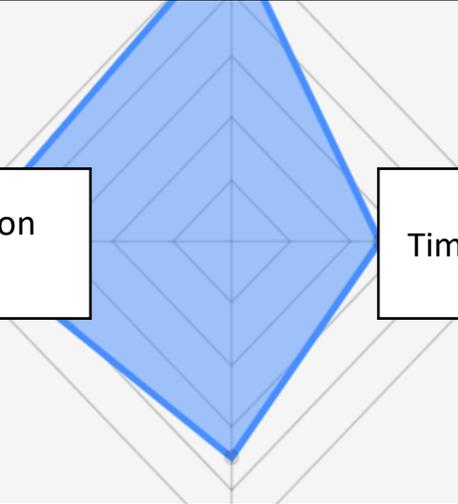
Radar chart with scale of 0 (poor) to 10 (excellent)

Diagnosis score. Max score 100, normalized scale max= 10 (i.e. score/10)

Precision: Music therapy clap precision (correct claps/total claps)

Time: Average time taken to answer one question

Accuracy: Music therapy clap accuracy (correct claps/total bars)



Diagnosis history

date	score	OTP	meantime
2020-05-31	100	0.00184	2693
2020-06-01	100	0.00184	6568
2020-06-15	100	0.13977	3237
2020-06-15	100	0.13977	4299
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Treatment history

date	precision	accuracy
2020-05-31	0.91	0.93
2020-06-15	0.93	0.9
2020-06-15	0.88	0.88
2020-06-15	1.2	0.46
2020-06-25	0.67	0.8

Results

Total answered: 15

Total correct: 13

Mean time: 5306

Score: 86.67

One-tailed P: 0.06821

■ Q1: A | t: 12901

■ Q2: A | t: 5387

■ Q3: B | t: 5741

■ Q4: A | t: 4568

■ Q5: A | t: 3555

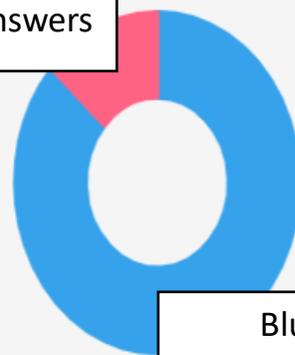
■ Q6: A | t: 4724

■ Q7: B | t: 12433

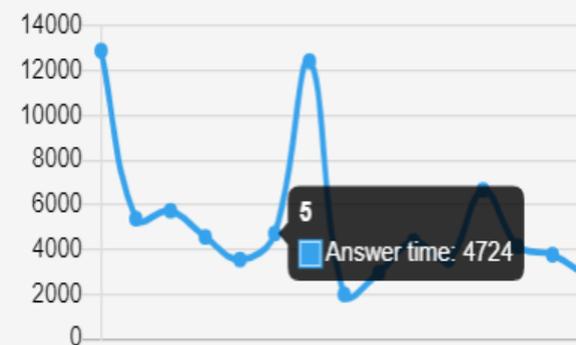
■ Q8: B | t: 1997

Session Overview

Red:
Wrong answers



Blue:
Correct
answers



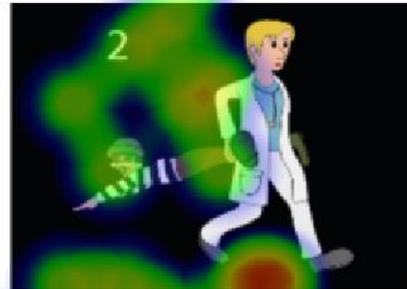
JSON for Heatmap Generator

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{  
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5466925244211":679.8542081010476,"1132.2835212507593":683.504408350956,"1173.1338  
786626425":651.2432593111449,"1193.252748563004":652.7189839421463,"1131.16408927  
7188":621.3101899892861,"1073.7447914653794":523.5197795643277,"1106.451512158557  
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98.19505598758485,"1154.4015233078976":594.1070584928228,"1125.1822407772831":610  
.965918651778,"1225.4196150375658":659.0474160782333,"1341.1331127726364":684.784
```



Results

Total answered
Total correct:
Mean time: 53
Score: 86.67
One-tailed P: 0



```
233686,"1074.  
56,"1173.1338  
1131.16408927  
.451512158557  
4507507215":4  
07772831":610
```



PART 2: Music Therapy

Music Therapy Settings

Track

Shinkukan Dolls - CLCT ▾

Shinkukan Dolls - CLCT

Twinkle Twinkle Little Star

Bar Frequency x1

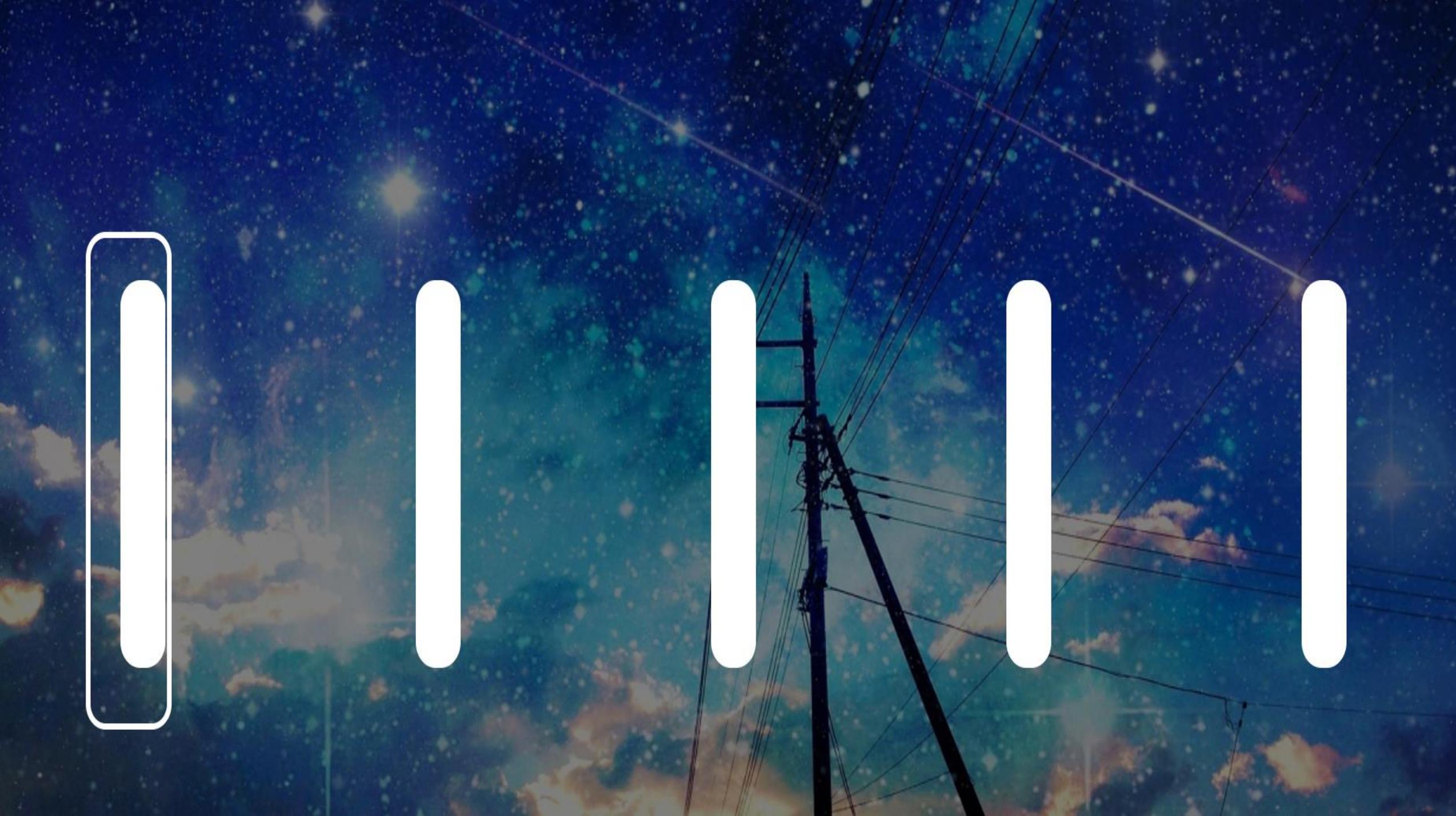
Difficulty Easy

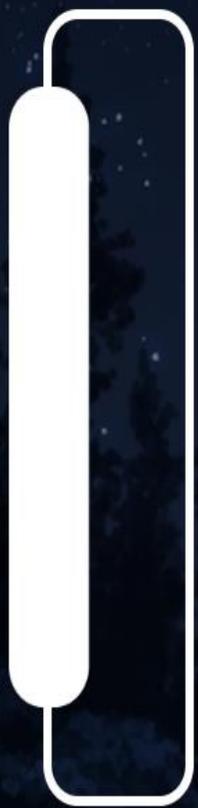
Show Background

Tutorial Mode

Confirm







Results

Shinkukan Dolls - CLCT

Duration: 0:22

Difficulty: Easy

Overall Rating:

A

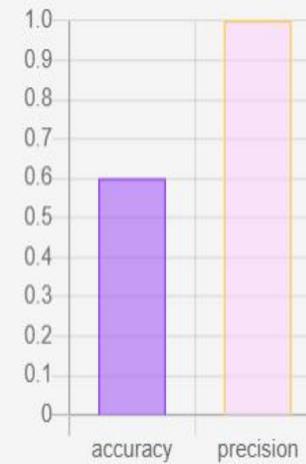
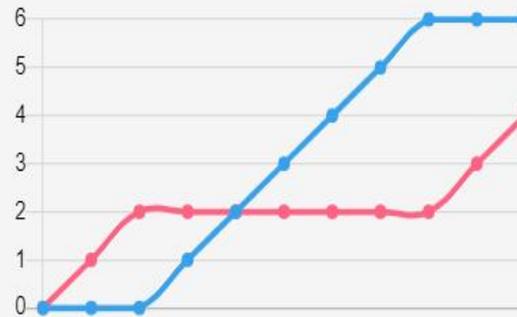
Session Overview

Claps: 6

Bar Spawned: 10

Hits: 6

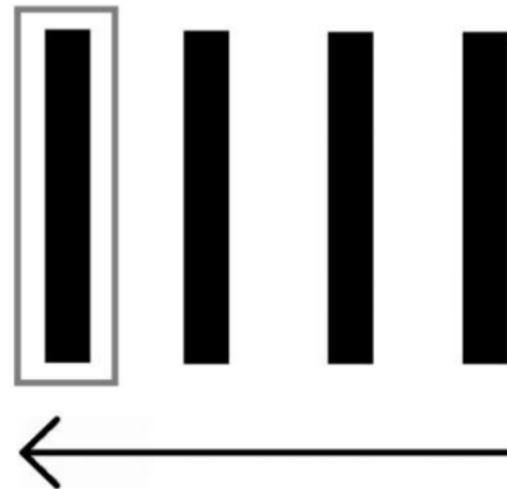
Misses: 4



Music Therapy - Base Concept

When bar is in hitbox, user press a designated key/button/device, hence "clapping" to the rhythm correctly

Intended to be used with hardware to detect clapping, currently implemented as JS keydown event.



As music is being played, bars representing the rhythm of music will move towards the hitbox at constant speed predefined to arrive at the hitbox according to beat of music.

Novelty and Inventiveness



- Automation is common, but existing systems lack integration
 - Questionnaires, eye trackers, music therapy, SPSS, etc used separately
 - All-in-one, standalone web app for SLI diagnosis and treatment is rare
- New ideas are made out of old ideas
 - Most required components already exist
 - PST's core is an interface which allow libraries to talk to each other
 - The result is a new product to confront an old problem



Intellectual Property (IP) Status

- | | |
|---------------------------|----------------|
| (1) PSS-SDT Main System | (LY2020002320) |
| (2) PSS-SDT Music Therapy | (LY2020002317) |
| (3) BPMT_sentences.js | (LY2020002319) |
| (4) musicBeatInfo.js | (LY2020002318) |
| (5) PSS-SDT Admin Panel | (LY2020002315) |
| (6) PSS-SDT SLI Diagnosis | (LY2020002316) |

Usefulness and Application



- Analysis indicates fulfillment of intended use cases and objectives
 - Cost reduction in terms of SLI diagnosis and treatment
 - Reduced ties of SLI diagnosis to costly equipment
 - Web application model guarantees wide availability and far reach
- Ease of use
 - Intended for use under supervision of speech-language pathologist
 - Relatively simple, straightforward use cases
 - Therapists no longer need to switch between different tools to diagnosis and treat SLI

Status of Invention - TRL 6



TRL 0	Ideation	Unproven concept, no testing has been performed
TRL 2	Technology formulation	Concept and application have been formulated
TRL 3	Applied research	Laboratory tests completed; proof of concept
TRL 4	Small scale prototype	Built in a laboratory environment ("ugly prototype")
TRL 5	Large scale prototype	Tested in an intended environment
TRL 6	Prototype system	Tested in intended environment close to expected performance
TRL 7	Demonstration system	Operating in operational environment at pre-commercialisation scale
TRL 8	First of a kind commercial system	Upscaling; manufacturing issues solved
TRL 9	Full commercial application	Technology available for mass production, available for consumers

Commercial Potential



- Web-based application introduces new potential business models
 - Subscription based? One time purchase? Free w/ premium features?
 - Many existing models as example
 - PST initially conceived without intent for profit due to ethical reasons
- Clear potential market and customer base
- Lacks competition
 - No well-known web service which offers SLI diagnosis and treatment in Malaysia

Potential Partners



- PST initially intended to be used internally
 - Several aspects affect scale of deployment and further development
 - Effectiveness in operational environment
 - Perceived popularity
 - Open for partnership
- Businesses related to education or medical industry
 - Schools supporting special education needs
 - Private clinics

Knowledge Management



Impact of the Product



- With respect to PST goals
 - Increase community awareness about SLI
 - Promote use of technology for benefit of PWD/OKU
 - Reduce economic burden of SLI patients through reduced cost and increased diagnosis and treatment effectiveness
- Negligible impact towards environment