

# **Developing an Android-Based Game Tool with Monitoring Support to Track Stroke Patient Progress During Rehabilitation**

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# Research Goal

- To develop a suite of engaging Android-based tablet games that will treat the fine motor skills of stroke survivors, particularly improving their fine finger dexterity. An assessment and monitoring tool is incorporated to provide an automated tracking of their progress during rehabilitation

# Stroke

- Cerebral Vascular Accident (CVA)
- Occurs when a blockage or rupture in blood vessels disrupts the blood supply to the brain
- Second leading cause of death and primary cause of disability worldwide
- Stroke rehabilitation as means to achieve optimal stroke recovery
- Those whose fine motor skills are affected are subjected to physical and occupational therapies

# Research Questions

- How can Android-based tablet games be designed to enhance fine finger dexterity?
- How does one design an engaging game that motivates the patient to practice physical and functional exercises?
- What objective factors does one need to consider in monitoring the stroke patient's progress in their fine motor skills?
- How does one go about testing the efficacy of the game?

**How does one design an engaging game that motivates the patient to practice physical and functional exercises?**

# Designing an Engaging Game

<b>Basis</b>	<b>How?</b>
Recreational Pursuits	Based on everyday functional tasks
User-friendly interface	Large enough for easy manipulation
Uncomplicated rules	Easily understood game mechanics
Challenging (sense of achievement)	Achievement star rating system
Overall atmosphere of emotional support	Character support, audio rendering

**How can Android-based tablet games  
be designed to enhance fine finger  
dexterity?**

# Fine Finger Dexterity

- **Dexterity** - “speed of coordinated movement”
- Gross versus Fine
- **Fine finger dexterity** - “fine manipulative movements of objects held between the thumb and fingers”
- **Finger control, finger range of motion, and finger isolation and coordination**



# Dragging Task

## Finger control

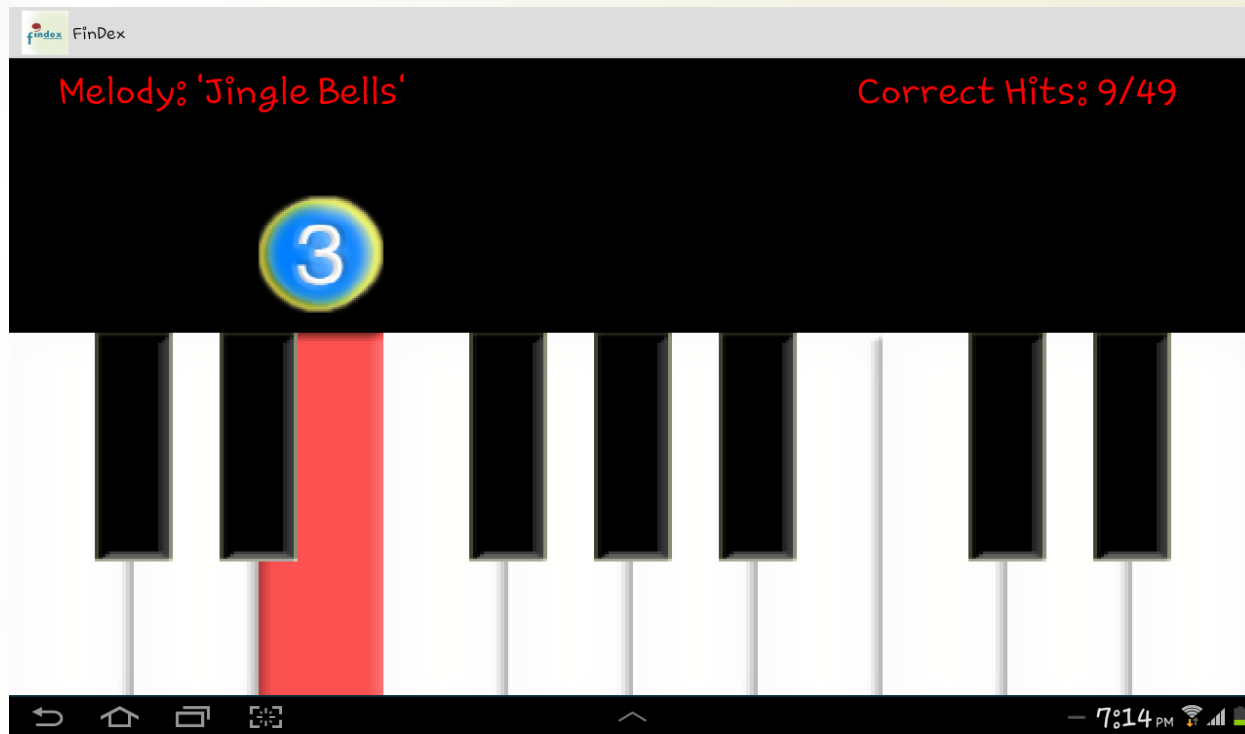
- exercises which involve movement and placement of things in designated areas



# Tapping Task

Finger isolation and coordination

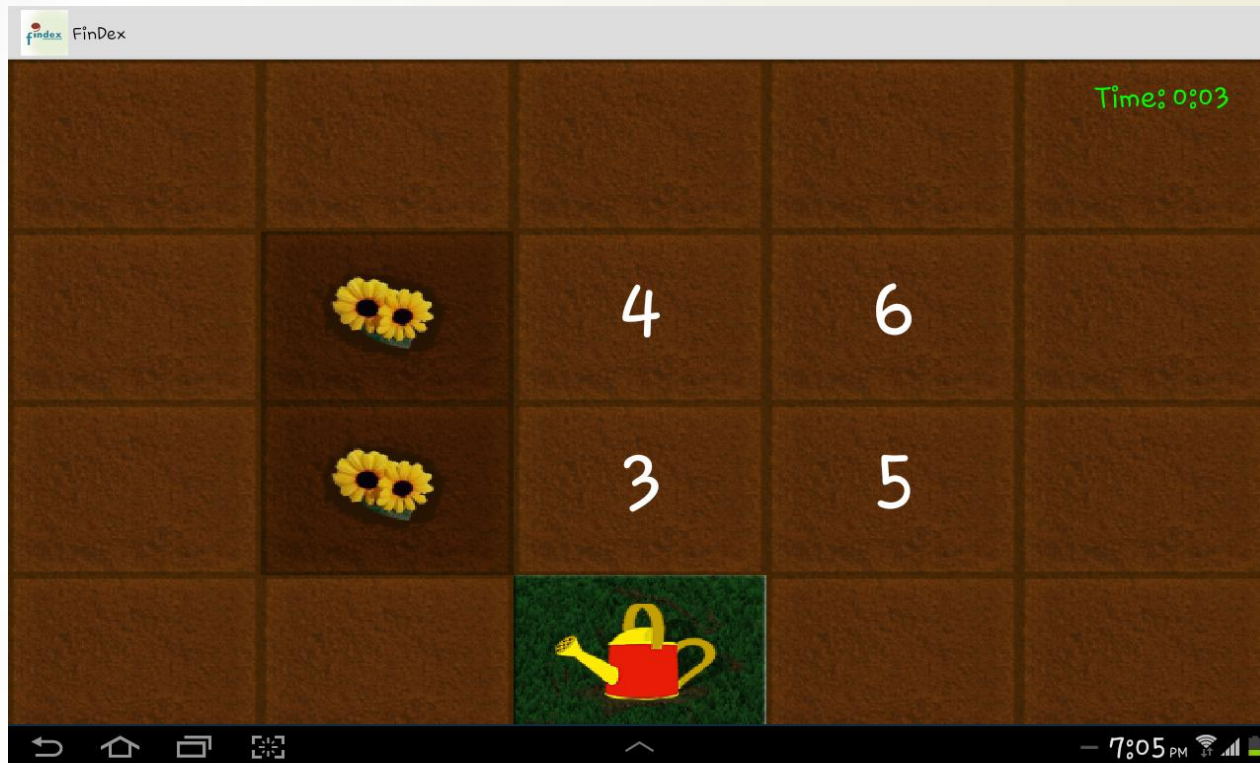
- straight finger lifts



# Stretching Task

## Finger range of motion

- exercise involving the extension of fingers resisted by rubber bands



**What objective factors does one need to consider in monitoring the stroke patient's progress in their fine motor skills?**

# Objective Measures

- Drawn from two reliable and valid finger dexterity assessment tools
- Purdue Pegboard and Rosenbusch Test of Finger Dexterity
- Time and Accuracy

# Assessment Basis

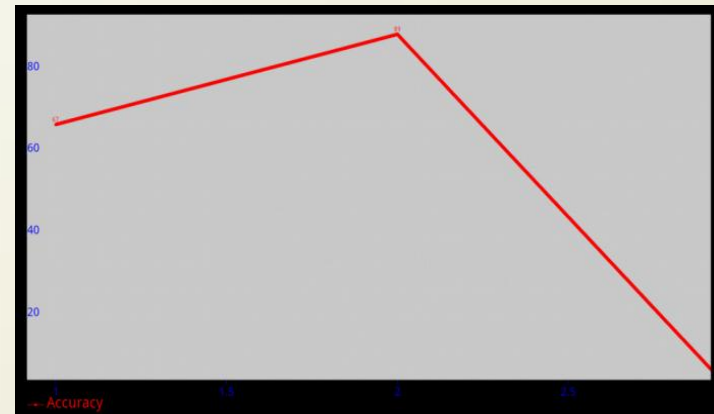
<b>Game Type</b>	<b>Fixed Variable/s</b>	<b>Monitored Data</b>
<b>Dragging</b>	Total no. of toppings Time	Accuracy Time taken
<b>Tapping</b>	Total no. of notes Time	Accuracy
<b>Stretching</b>	Total no. of plant plots Accuracy	Time Taken

# Data Rendering

- Progress tables and charts for easy monitoring

Highest Level Unlocked: 1  
Total No. of Attempts: 2  
Successful Attempts: 2  
Failed Attempts: 0

Attempt No.	Level No.	Date	Accuracy	Time Taken	Successful?
1	1	Fri Sep 28 16:21:33 GMT+08:00 2012	92%	0:25	Yes
2	1	Wed Oct 03 15:07:38 GMT+08:00 2012	93%	0:9	Yes



**How does one go about testing the efficacy of the game?**



# Testing

- Two phases: **Subjects with normal hand function and Stroke survivors**
- Inclusion/exclusion criteria
- First phase - **baseline setting**
- Second phase – adapts **Constraint Induced Movement Therapy or CI therapy**
- Three principles - “constraining the unaffected limb, forced use of the affected limb, and massed practice”
- **8 consecutive testing sessions + 1 final session**

# Inclusion/Exclusion Criteria

## Subjects with Normal Hand Function

- (1) Between 30 to 60 years of age
- (2) With normal hand function
- (3) Did not suffer from any hand impairments during his lifetime

## Stroke Survivors

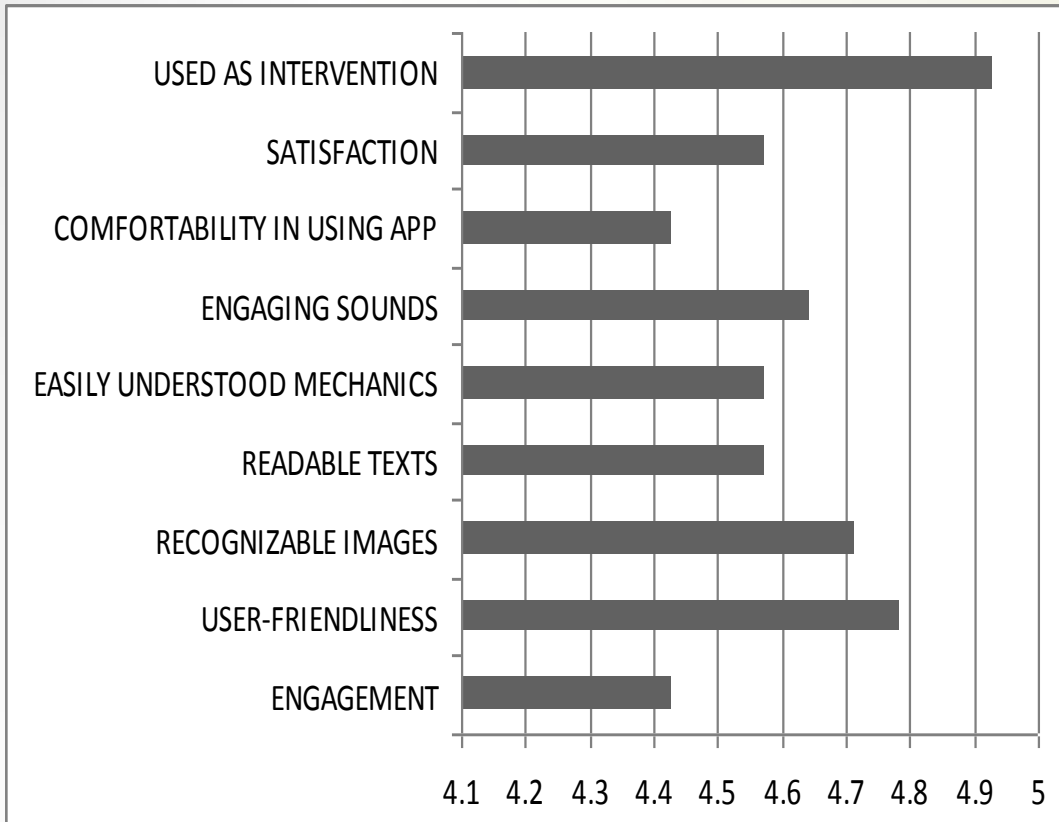
- (1) Able to extend wrist and fingers at least 10 degrees
- (2) Functional hearing and vision
- (3) Undergoes a standard rehabilitation program

## Exclusion criteria

- (1) Severe pain in the impaired arm

# Results: 1<sup>st</sup> Phase

- 15 participants: 9 males and 6 females



**App overall  
rating  
4.78**

# Results: 2<sup>nd</sup> Phase

- 3 stroke survivors

**App overall  
rating  
5**

## Medical Contribution

Subject	Helped Me Improve Fine Motor Performance	Prefer Using Than Standard Finger Dexterity Exercises
Patient A	5	4
Patient B	5	5
Patient C	4	4
<b>Average</b>	<b>4.67</b>	<b>4.33</b>

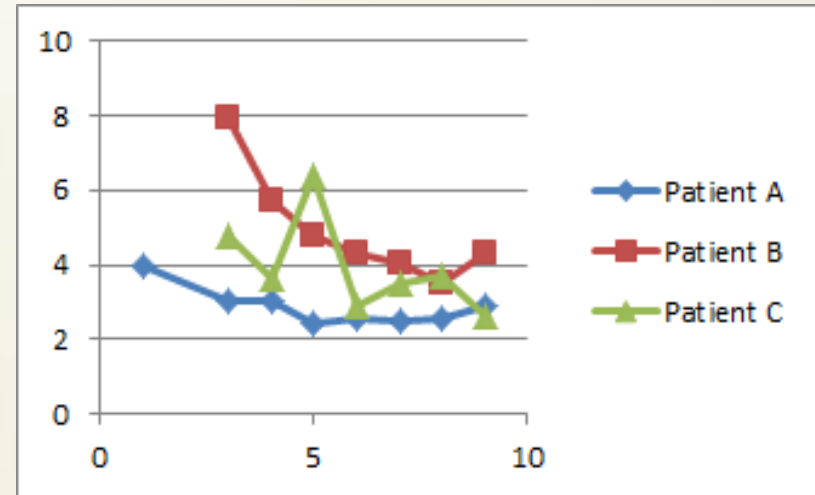
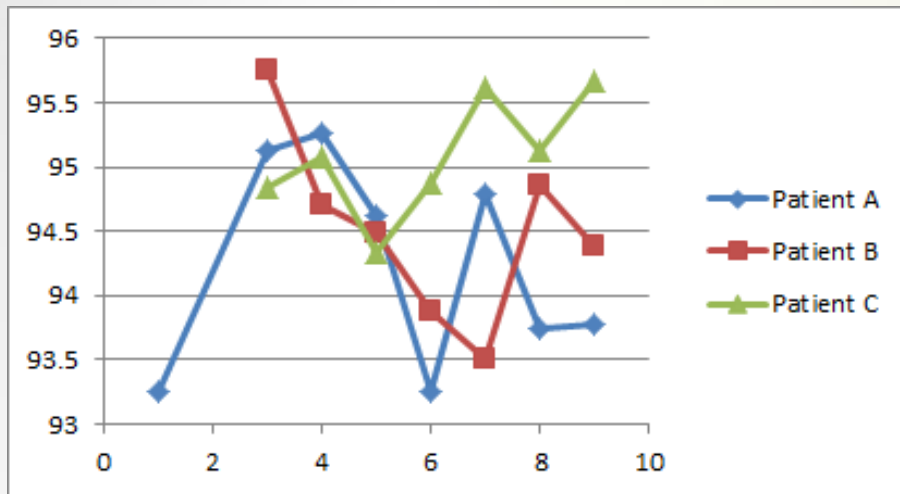
# Results: 2<sup>nd</sup> Phase

Subject	Easily Drag Toppings		Faster in Dragging Toppings		Most Fingers are Able to Respond in Tapping Keys		Respond Faster in Tapping Keys		Able to Expand Fingers in Wider Ranges		Flex Fingers Easily	
Patient A	4	4	4	5	5	4	5	4	4	4	5	4
Patient B	4	3	4	3	4	4	4	5	4	4	5	5
Patient C	3	5	5	5	5	5	5	5	4	5	4	5
Average	<b>3.67</b>	<b>4</b>	<b>4.33</b>	<b>4.33</b>	<b>4.67</b>	<b>4.33</b>	<b>4.67</b>	<b>4.67</b>	<b>4</b>	<b>4.33</b>	<b>4.67</b>	<b>4.67</b>

Subjective Progress

# Results: 2<sup>nd</sup> Phase

## Dragging Task



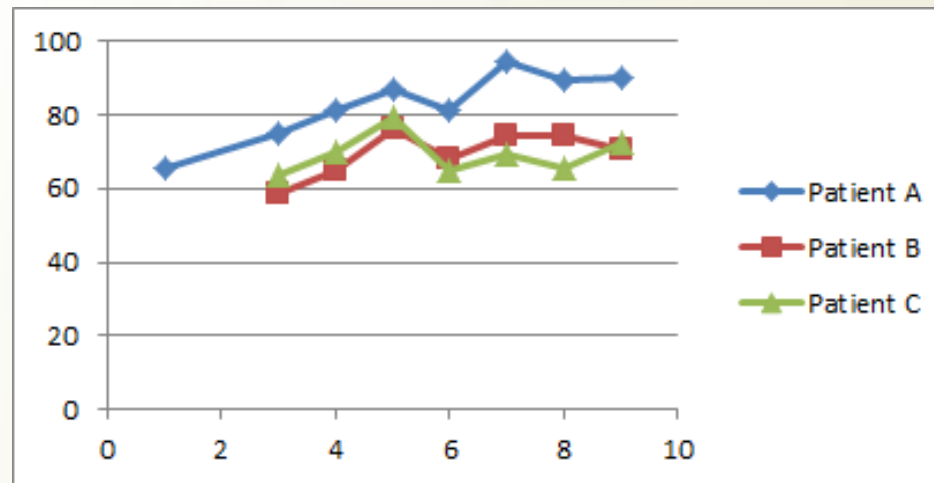
### Average Accuracy Level

- Difference of 3-4%
- Patient A & B: 92-96%
- Patient C: 94-97%

### Average Time Taken per Topping

# Results: 2<sup>nd</sup> Phase

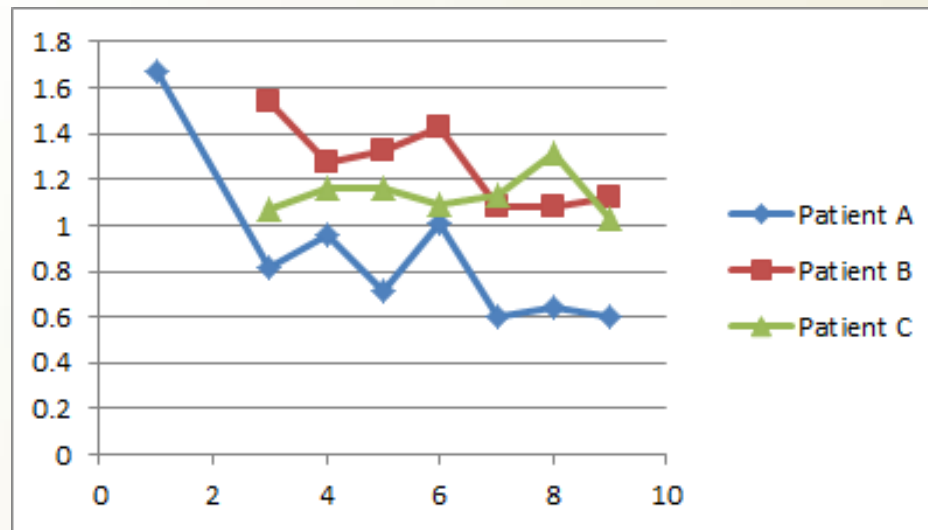
## Tapping Task



Average Accuracy Level

# Results: 2<sup>nd</sup> Phase

## Stretching Task



Average Time Taken per Soil Slot



**Thank you!**