



Clock-Drawing Test Mobile Application

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What Is Clock Drawing Test?

CDT is a screening test used to detect cognitive impairment. Traditionally it is a pen and paper test where the subject is presented with a white paper with the instructions to draw a clock.



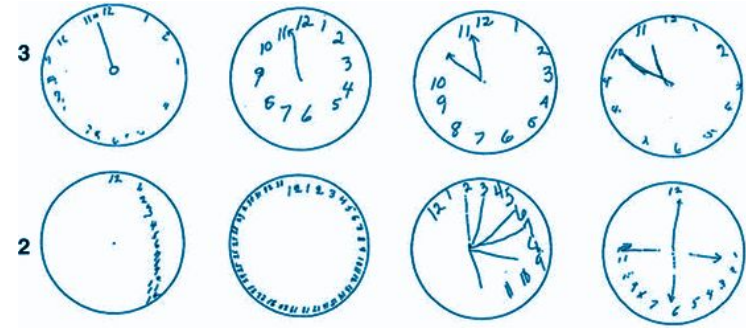
Source: Verywell / Jessica Olah

How is CDT Performed

The doctor will first instruct the patient to draw the numbers on the clock's face.

The person will then be instructed to draw hands to represent a specific time.

Since persons with dementia often have trouble reading standard clocks, the CDT can indicate mental impairment.



Some Example of different CDT results

Source: Mainland B.J., Shulman K.I. (2017) Clock Drawing Test. In: Lerner A.J. (eds) Cognitive Screening Instruments. Springer, Cham.
https://doi.org/10.1007/978-3-319-44775-9_5

Motivation

A standard neurological test for detecting cognitive impairment is the CDT. A computerised version of the test promises to make the test more accessible while also providing more detailed information about the subject's performance. Making a user-friendly mobile application of CDT makes it very accessible to all and also the evaluation of the test from the data collected can be automated.

Project Background

The project consists of a mobile application developed using Godot game engine that will run on leading mobile operating systems Android and iOS. The user will have to set the digits of the clock, and set the hands of the clock on a specified time displayed in the application. The data of the number and the hands position is captured and stored in a file in the mobile. The file obtained is processed separately using program which is written python. The program analyzes the differences in the position of the ideal clock position and the clock inputs received through the generated file.

Related Work

There is work on The pen and paper clock drawing test result assessment utilizing modernized strategies. In any case, the issue of programmed translation of clock drawings, particularly those portrayed by individuals with intellectual hindrance, isn't completely tackled, and in more troublesome cases, the programmed frame-works need to return to the assistance of human assessors in naming the outlined items shaping the clock drawing.

Application Appearance and Usage

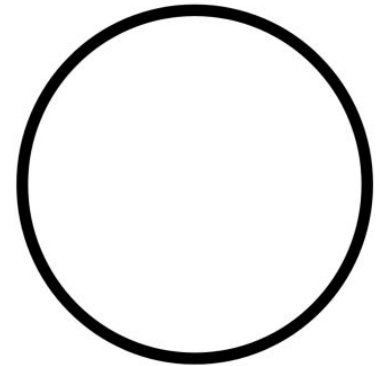
Clock Digits The digits of the clock which are to be arranged in the dial are displayed at the top.

Clock Dial The Clock dial which is given as a reference in the CDT is shown in figure. The digits are arranged in the clock dial.

Set the Time The set time displays the time which the user has to set in the clock by adjusting the clock hands. The set time is shown in figure.18

1	2	3	4	5	6
7	8	9	10	11	12

Set Time: 12:17



Fix Numbers

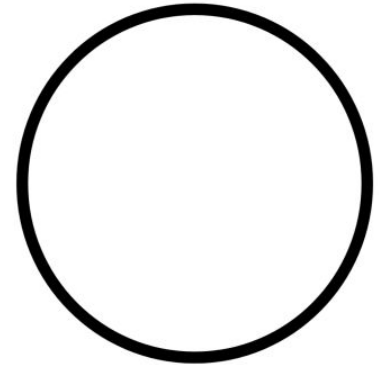
Usage of the Application

There are four tasks that the user has to do in the app for completing the CDT.

1. Set the Clock Digits in the dial.
2. Set the hour hand position corresponding to the time displayed in Set time show in the figure
3. Set the minute hand position corresponding to the time displayed in Set time show in the figure.
4. Once finished, click on the done button.

1	2	3	4	5	6
7	8	9	10	11	12

Set Time: 12:17



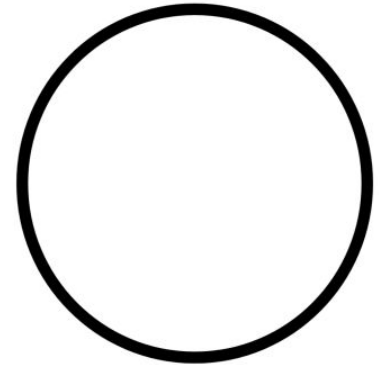
Fix Numbers

Working of the Application

First Screen : The figure shows the first of the four screens which is what the user sees at the beginning. The user here has to drag and drop the digits in to the position in the clock dial.

1	2	3	4	5	6
7	8	9	10	11	12

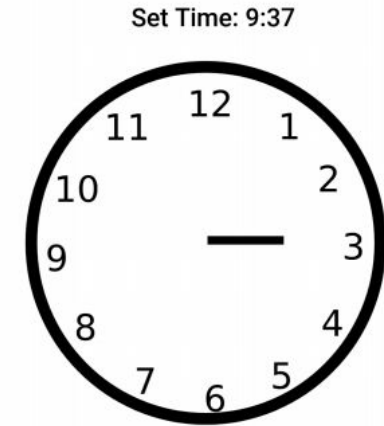
Set Time: 12:17



Fix Numbers

Working of the Application

Second Screen : The figure shows the second of the four screens. Once the user arranges the digits in the clock dial, the user should press the Fix Numbers button. The hour hand appears once the Fix Numbers button is pressed. The user has to rotate the the hours hand and set it according to the Set time displayed.



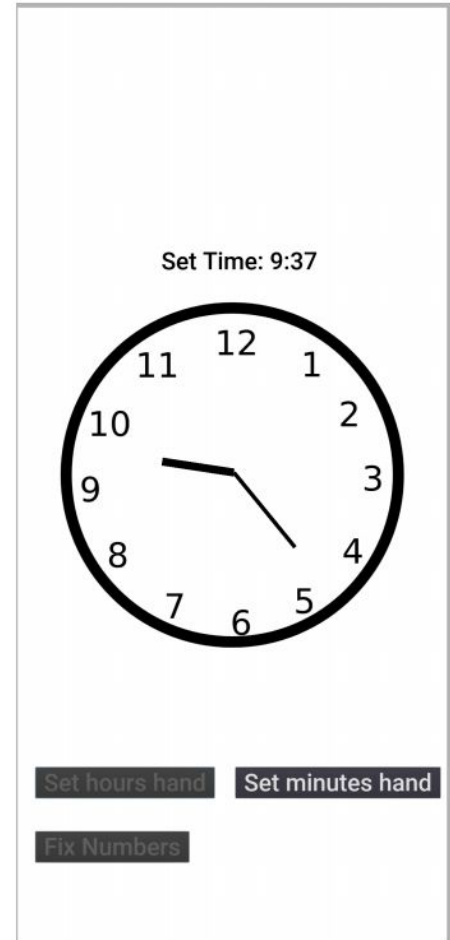
Set hours hand

Fix Numbers

Working of the Application

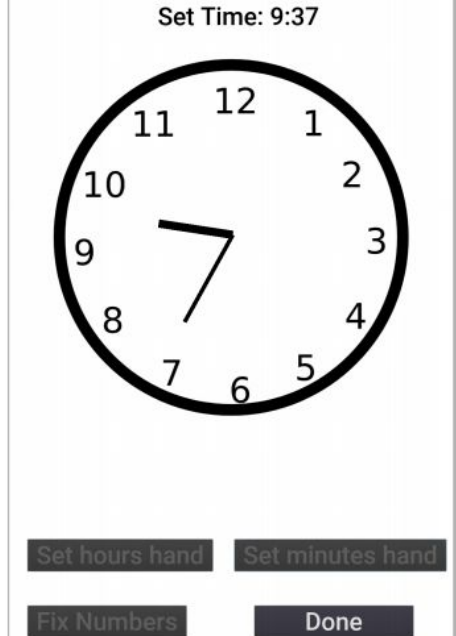
Third Screen : The figure shows the third of the four screens. Once the user sets the hour hand position, the use has to press the Set hours hand button.

Once the Set hours hand button is pressed, the minutes hand appears. The user has to set the minutes hand according to the Set time displayed.



Working of the Application

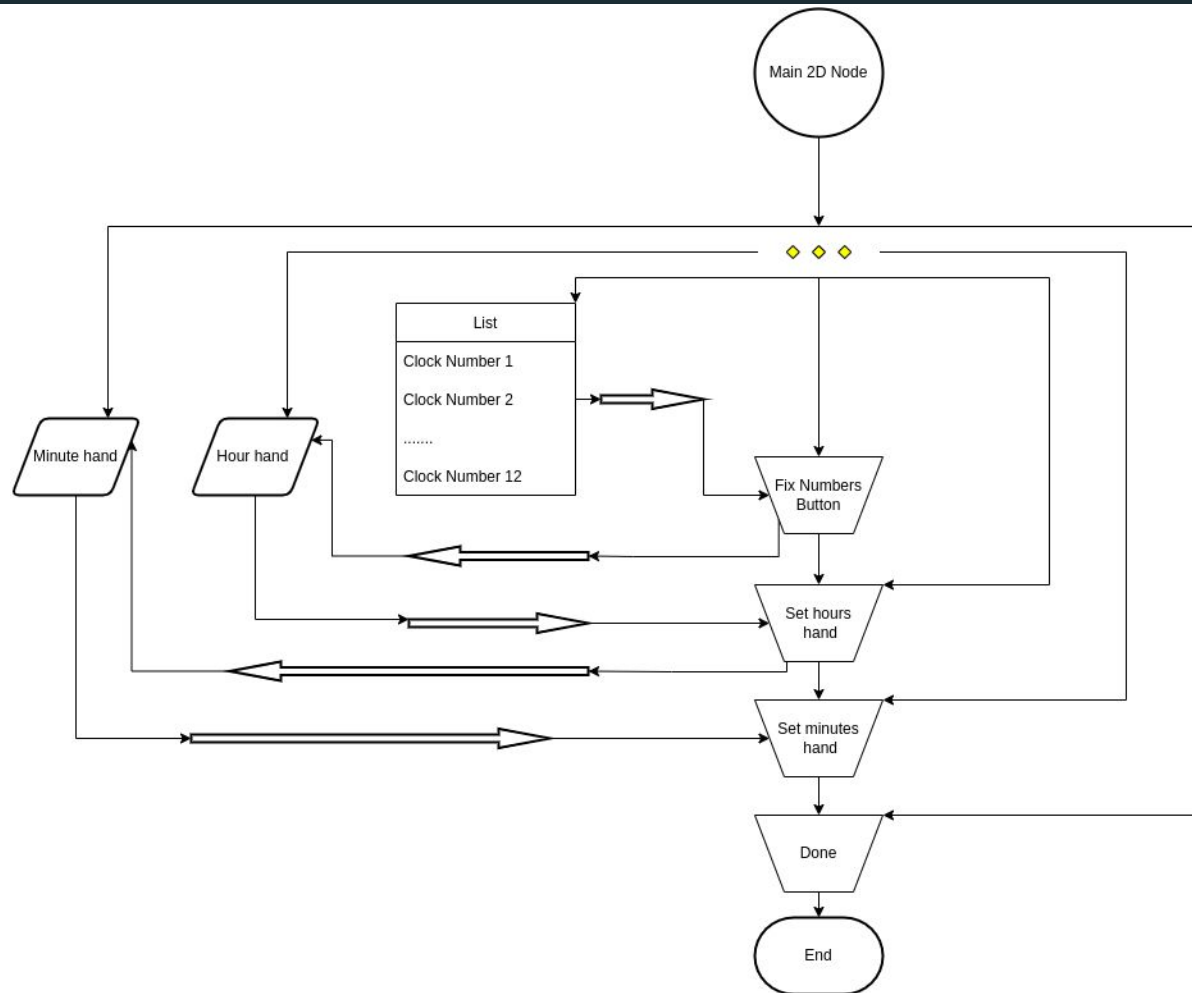
Fourth Screen The figure 3.5(d) shows the fourth of the four screens. Once the user sets the position of the minutes hand, the user has to press the Set minutes hand button. The Done button appears then. Once the user presses the Done button, all of the data from the CDT is stored in a file.



Application design Flow

There is a central parent node of type Node2D. It has 15 child nodes.

1. Background node
2. Digit nodes numbered from 1 to 12
3. Hour hand node
4. minute hand node



Application design Flow

Each child node was a Sprite node. Sprite is a node that displays a 2D texture. The texture displayed can be a region from a larger atlas texture, or a frame from a sprite sheet animation. Each Sprite Node further had a child node, Area2D. It is 2D area that detects CollisionObject2D nodes overlapping, entering, or exiting. CollisionShape2D is the base class for 2D physics objects. It can hold any number of 2D collision Shape2Ds. Each shape must be assigned to a shape owner.

Application design Flow

There were 4 button

1. Fix Numbers
2. Set hours hand
3. Set minutes hand
4. Done

Post Processing the Data

Once the user presses the Done button and finishes the CDT, the app generates a text file containing the following :

1. Pixel coordinates of Clock Digits 1 through 12.
2. Angle of rotation of hour hand
3. Angle of rotation of minute hand
4. Time displayed in set time.

```
(697.412109, 886.640625)
(819.386841, 1003.183594)
(858.569763, 1180.854492)
(819.755859, 1351.098633)
(693.720703, 1436.220703)
(551.865234, 1505.34668)
(373.886719, 1464.213867)
(240.996094, 1301.396484)
(218.079987, 1125.414185)
(254.687363, 1000.073486)
(363.867188, 899.208984)
(522.597656, 865.50293)
-1.991872
1.475402
11:28
```

Post Processing the Data

A Python program is used to generate the following from the text file generated :

1. Difference in the position of the ideal clock number placement and the ones that the user has set.
2. The differences in the angles of the hands in ideal clock time and the one set by user.

Future work

Future work for this project are very high. We can draw several inferences from the data collected from a sarge sample of clock drawing tests. Several important features can be formulated from the input, which can be used as evaluation metrics.

The process of evaluation of the CDT can be completely automatized. This can open several opportunities for the study of cognitive disorder.



Thank You