

Dopa: A Generalized Android App for Memory Enhancement

K. Linganesan

Department of Computer Science and Engineering, University of Moratuwa, Sri Lanka
linganesan.12@cse.mrt.ac.lk

Abstract— This research mainly focused on finding the ways to adopt visual learning among Autodidacts to assess learning progress, predict performance, use memory techniques and track potential issues. In order to promote self-motivated and self-taught students in the future, this APP, 'Dopa' (derived from the hormone 'Dopamine', which is responsible for the reward-learning) introduces/reminds the user to utilize and ingrain visualized learning as their second nature. Method of Loci (also known as Roman Room | Mind Palace | The Journey Method) is the widely used methodology for visual based learning. While there exists similar software, 'Dopa' specifically targets the Sri Lankan users as the pedagogy and other education mechanisms are considerably different in our settings. The ultimate vision is to produce as many autodidacts as possible. Thus 'Dopa' deals with a special case, where the teachers are being the students, the autodidacts.

Keywords—Dopa; Method of Loci; Learning analytics; autodidact

I. INTRODUCTION

Learning is a complex process. Advancements in Information Technology (IT) has unwrapped fresh tools, techniques and even newer pedagogical perspectives to improve the learning process. One such area is Learning Analytics. Learning Analytics is all about improving the learning and its environment via the traces those are left behind by the teachers and learners, during the teaching/learning process [2].

Learning is ubiquitous. Paradigm shifts in the learning process had caused each and every significant leap in the human history. Education incorporates learning and thus the Education systems determine the betterment of any society. Here, I define Education as the process of transferring and facilitating the knowledge, skills and the habits. The emerging research area of learning analytics looks for ways to improve learning outcomes with the assistance of Information Technology. It tends to use model of analytics to enrich the education process and the education systems. Learning analytics applies the model of analytics to improve learning. It collects the digital 'breadcrumbs' left by the student who has interacted with IT (computer) systems and then analyzes the records to find correlations between these interactions and learning outcomes. Such correlations (either associations) are presented back to the

relevant user hence they could interact with the system in a better way in the future to produce better learning outcomes. The results could be presented to the 'teacher' as well as learning analytics focus on pedagogy, the art & science of teaching. In a special case the 'Teacher' and the 'Student' would be the same person, Autodidact-ism. Autodidact-ism is the next paradigm shift in the education domain. That is self-motivated and self-taught students are the future. With all these ever increasing knowledge sharing mechanisms and fluent access to this incredible amount of data, what else it takes to be an autodidact? Well, there should be something.

At present, particularly in Sri Lanka, the widely used mechanism for associating is the 'Repetition'. This is proven to be one of the most inefficient, tedious and boring mechanism for learning. Repetition inherently performs asymmetric association. For instance if we used repetition (mainly the auditory sense) to remember an event – year pair, then on some other day the event might remind the year, but the year might not remind the event due to the inherent mapping order. In a programming analogy, we are using the event as a pointer to the year. There is technically no way from the year to trace the event. But our brain is complicated and uses several loops to perform this reverse order in some instances. The point is that the asymmetric approach is not the best way to go for. It has also been proved very inefficient compared to some other methods.

Dopa is mainly focused on Autodidacts. Dopa tends to access powerful methods for significantly improving the power of user's memory. A powerful memory will help user to succeed in school, in career, and in life. This application will ask the users to build their own mind palace (Loci). Users can practice with their mind palace and able to view their improvements through a specific profiling. For example a student needs to memorize the order of Periodic Table Elements, Plants etc. She/he could enter the Keywords (in this case the Element name, Planet name etc.) and then use the system to associate with their already input Loci. User can use this app for his/her general purpose needs such as remember notes for exams, speech, presentation, phone numbers, lists, etc. In further developments this application will contain some

interesting memory games like strategies that to enrich indirect/passive learning.

II. LITERATURE REVIEW

Method of Loci is a method of memory enhancement which uses visualization to organize and recall information. In this technique the subject memorizes the layout of some building, or the arrangement of shops on a street, or any geographical entity which is composed of a number of discrete loci. When desiring to remember a set of items the subject 'walks' through these loci in their imagination and commits an item to each one by forming an image between the item and any feature of that locus. Retrieval of items is achieved by 'walking' through the loci, allowing the latter to activate the desired item [4].

DOPA is not only a research project on educational memory training based on data mining, but also a development effort on bringing down the learning analytics concepts to the real word learning context. This research identified the limitations and the development part tries to solve some of those. The future of this research is expected to find more on visual learning as more data will be available with the successful use of this tool. The user data source will grow with more detailed information with user management in the future. Also a desktop version will be developed with better interactive intuitive designs [5]. This research is more self-learning centered for the initiation purpose, but even the performance of teachers, school students, university academics can be modelled in the same way.

III. SYSTEM MODELS

A. System Requirement

With this android application, users are allowed to create their own mind palace and build personalized profiles of each user. Users can practice various disciplines with the help of their mind palaces. Also users can keep their important notes according their mind palace.

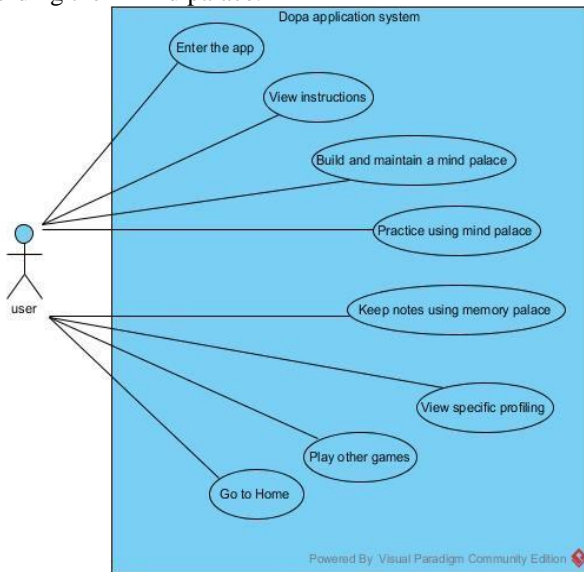


Fig. 1. Use case diagram

Nonfunctional requirements will be similar to any other typical mobile application. Such as performance, security and availability are crucial to make a better mobile application. For a mobile app maximizing battery life by reducing computation and optimizing for responsiveness are essential ones.

B. System Design

The project Dopa is consisted of four well-separated modules. Such are, Theory pages, Training Area, Mind Palace and Intelligent Feedbacks and Profiling. The class diagram shown in Fig. 2, represents the important classes implemented for the application with their operations and return types. The diagram also shows how each class is associated with other classes in the system. Each activity is represented as a class and the functions associated with the class are represented within.

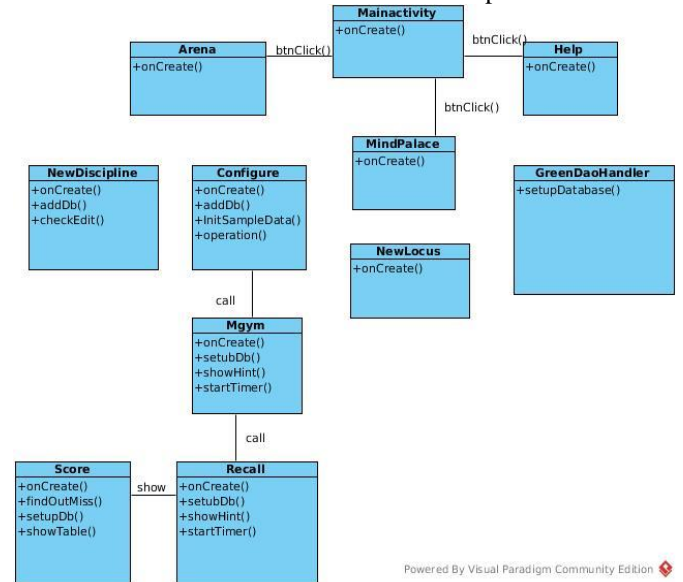


Fig. 2. Class diagram

The sequence diagram given in Fig. 3, shows the interaction between the various classes and processes and the interaction order necessary to perform the functionality of the scenario. It showcases the classes involved in an interaction and the function calls and sequence of messages exchanged in that interaction. Each module can be access through main activity class.

C. Database Design

The major information saved in this application is mind palace (Locus) and discipline details. During the start-up of the application user is required to build a memory palace and details are saved. Initially this data is saved in the MindPalaceDAO object of the application and subsequently these details are saved in the database, which is hosted inside the application.

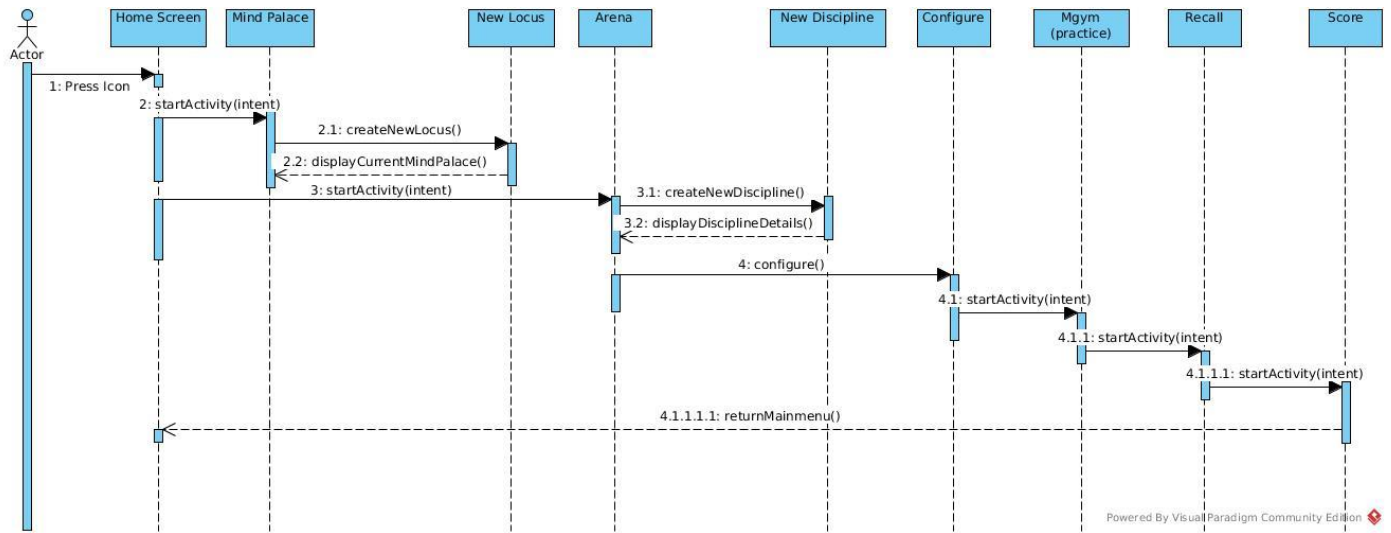


Fig. 3. Sequence diagram

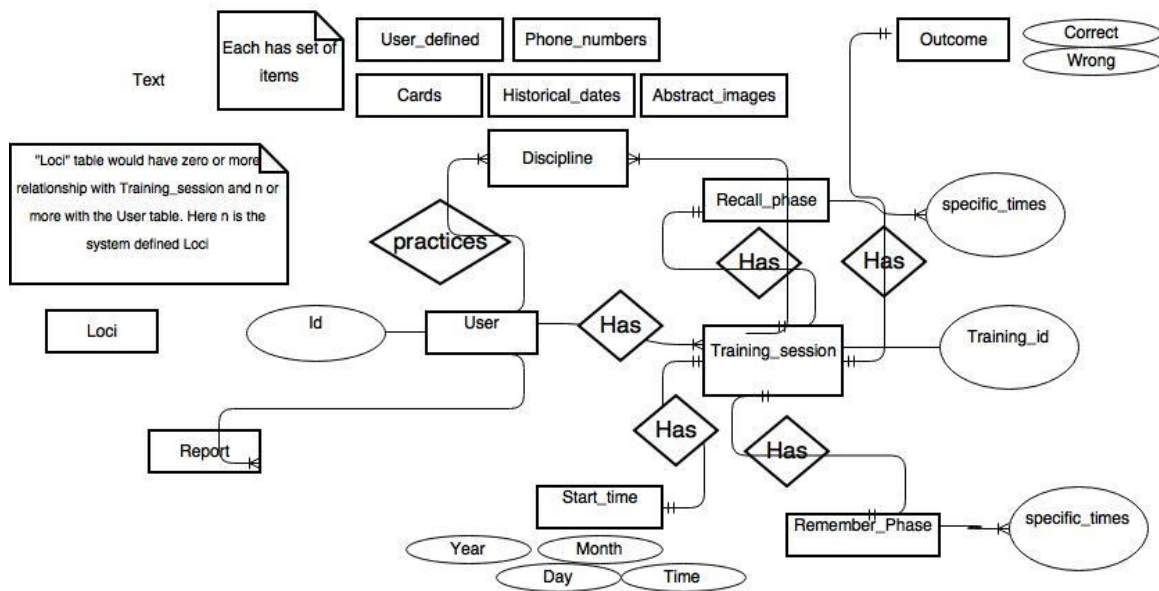


Fig. 4. ER diagram

During a practice session user can be requested to view his/her memory palace, in order to memorize the words given in the session. GreenORM, an object-relational mapping (ORM) framework for Android is used for storing the database map objects into the database [8]. It provides better performance. GreenORM takes over the responsibility of a Content Provider and offers methods to persist objects directly. The Entity Relationship diagram is shown in Fig. 4.

IV. SYSTEM IMPLEMENTATION

A. Implementation Procedure

This application is implemented using Android and Java is used as the main implementation language. The implementation in Android starts with creating a new Android project in Android Studio which creates separate folders for source code, resource files like images, xml files representing user interface

layouts, gen folder that transforms each individual element names in resource file to unique identifiers that would be referred by the android system and other folders.

Google's Android Studio makes creating native Android apps very easy. Also provide better UI in designing and coding. Dopa is designed from a user point of view. The user friendly design helps the users in accomplishing their task with ease. Attempts have been made to keep the design simple and understandable. The screens were designed in XML and the application logic was written in Java. An Activity is an application component in Android providing a screen with which users can interact in order to do something. The activity with some of the resource files represents the user interface in Android [10]. The Dopa contains several activities to show different screens within our application as follows: MainActivity, Arena, MindPalace, Help, NewLocus,

NewDiscipline, ConFig. , Recall, Arena and Score. Android has a built in database engine SQLite which helps applications to do database operations. Any database created by an Android application is accessible by name to any class within the application but not outside the application. The database used is SQLite where all the information related to dopa is stored. In database design an Android ORM framework tool called GreenORM is used. It is a complete code generation which allows to generate data model without creating each table and managing the column names and indexes.

B. Materials

In the practice session, user has to practice mind palace with limited number of random words. To create a list of random words a list of words file in a text file format (.txt) was used. It contains 1000 words and 53KB in size and is stored in asset folder of the android project directory. This file is called by program when user wants to practice with random words.

C. Main interfaces

The user interface is made simple and as intuitive as possible. “Keep it Simple” was the motive behind the UI design. The project involved analyzing the design of few applications so as to make the application more user friendly. To do so, it was really important to keep the navigations from one screen to the other well-ordered and at the same time reducing the amount of typing the user needs to do. Hints are given to help the user in giving the correct input. Screenshots of the user interface design are as follows. They are designed carefully, in order to build an application with the improved usability. In order to make the application more accessible, the Android version had to be chosen so that it is compatible with most of the Android devices. Hence Android 4.1.2 Jelly Beans version was chosen.



Fig. 5. Dopa homepage

In the start-up of the application users are asked to create their own mind palace. Also user can create multiple mind palaces according to their needs. To create a mind palace user clicks on “Mind Palace” button in the home page given in Fig. 5. It will redirects to the Mind palace page shown in Fig. 6. In that page, user can create a new mind palace or edit/delete an existing one.

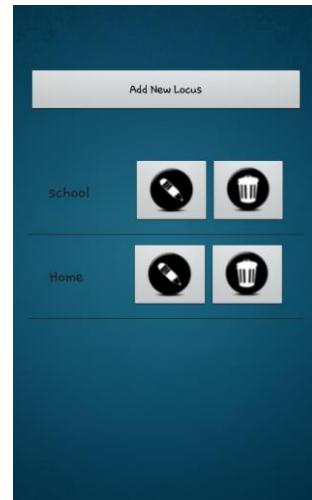


Fig. 6. Mind palace page



Fig. 7. Arena page



Fig. 8. ConFig. page

Discipline is the list, what user wants to memorize by using Method of Loci (Mind palace). In the Arena page given in Fig. 7, user can add his/her disciplines. Also duplicate entries in

Locus name and Discipline name are not allowed in each set. To practice the discipline, user has to click on Key image. User will redirect to the conFig. page shown in Fig. 8, which contains three major parts such as, selected discipline, practice time and recall time. User can edit all these three options. User can minimize or maximize practicing time by typing manually in the given space, and recall time.

If the user wants to change the loci in practice session, there is an option called “Construct New Locus”. Here user can construct new locus instead of using existing one. Before pressing the “Start” button, user has to make sure about her/his Loci. User must press on selected Loci “key image” and then press “Start” button will take the user to practicing page as shown in Fig. 9.

Practicing page is the place, which connect user’s loci with the user’s discipline. Here user can test the correlations between selected discipline and mind palace (Loci), if user presses the correlation button (on the top image), he/she will get a pop-up message identifying the discipline with the correlated locus. Practicing page contains navigation bars, where user can navigate (previous and next) and practice each discipline. Practicing page also runs a timer. This is used to calculate the practicing and recalling time in the feedback.

After pressing “Done” button, user will be redirected to the recall page shown in Fig. 10. This page is same as the practicing page. This page also contains navigation buttons and the correlation image button. Here user types memorized list of discipline in proper order. When user clicks on the correlation (hint) button, he/she will see the locus correlation, which is connected to the discipline.

After typing the correct answers using the correlation hint button or typing without any hints, user will get into the “Review report” page shown in Fig. 11. Review will calculate Missed Items and Succeed Items. Also the report will correlate each **locus** with each discipline.



Fig. 9. Practice page

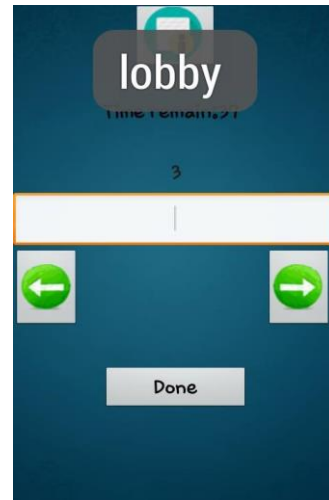


Fig. 10. Recall page

V. SYSTEM TESTING AND ANALYSIS

The Android SDK consists of a virtual mobile device emulator that helps to test the application without having a physical device as it provides all the functionalities of a typical physical mobile device. Logging and debugging in Android is done with the tool Android Device Bridge (ADB) [3]. ADB is one of the useful tools that come with the Android SDK. The system level logs and user defined logs are shown when ‘adb logcat’ command is executed while the application is running in emulator or in the device. Also, the Dalvik Debug Monitor Server [DDMS] which comes integrated with Android plugin for Android Studio helps to read the log messages for a specific emulator instance running our application. ADB tool also provides the shell access to the Android system of the device connected to system via USB cable. This tool provides access to SQLite database and the tables created and can be used to display the entries in the table.



Fig. 11. Review report page

This application is tested among several users and received their feedback as part of user testing. Some of the feedback they gave was on about the navigation of the application and they requested to enhance the usability. In unit testing each independent unit is tested separately, by isolating it from the remainder of the code to ensure parts of the code are working properly. JUnit provides several assertion-based testing, such as `assertNull()`, `assertEquals()`, `assertTrue()`, and `assertSame()`. If any of these returns false, then the test case is considered as failure. Also Integration testing is done by giving the input details programmatically and checking the activities. Some of the test results for the Unit testing is given in Table 1.

TABLE I. RESULTS OF UNIT TESTING

Test Case	Expected Result	Result
Check the locations on the Locus(MindPalace)	No duplicates are allowed	Pass
Check the locus name	Locus name should not be null	Pass
Check Number of locations in Locus	Size of Locus should be equal or greater than size of Discipline	Pass
Check practice time	Not to be null	Pass
Check each Locus's location with loop	Each location should properly assign to each item in discipline	Pass
Check Timer time	Timer should be end to practice time.	Pass
Check each Locus's location with loop	Each location should properly assign to each item in discipline	Pass
Check Timer time	Timer should be end to practice time.	Pass
Check review list	User missed items should be shown.	Pass

VI. CONCLUSION AND FUTURE WORK

The application has been successfully designed, implemented and tested with real devices and users. The project helped in understanding the challenges involved in developing an android application for android phones and tablets, the ways to overcome those and in better understanding the complexities of mobile application development. The project also helped in understanding the value of designing the components of overall application before implementing them. The project has also taught me programming skills and refining the design and implementation logic of the software at every phase of the development life cycle to improve the overall performance of the application. The vision is to help as many people to become autodidacts. One major channel is to introduce/remind the users the visual based learning methodologies. At present the Dopa

APP is only concerned of the Journey method (Mind Palace/Roman Room/Method of Loci), which is the mostly used visual based learning method. Dopa is a generic tool that anyone can use to memorize any set of things, as long as they could be entered as Texts/Keywords.

This system can be extended in many ways. The input types can be generalized to images, sound etc. User interfaces can be improved with high interactivity and attractiveness. User expectations can be enhanced using built in disciplines, such as cards. Another main extension is incorporating learning analytics. This can be achieved using many ways; Collect granular data such as number of attempts/time per item, correlations, `isHintUsed` etc.; Use Association Rule Mining to find out patterns, for instance which Locus is handy, which Disciplines are related, which set of Discipline-Locus is performing well in tandem; Use Classification to rate user (after collecting results from various users); Use clustering to identify 'unsupervised' outcomes (for a criteria which gender, demographic, which discipline etc.).

REFERENCES

- [1] G. Eason, B. Noble, and I.N. Sneddon, "On certain integrals of Lipschitz-Hankel type involving products of Bessel functions," *Phil. Trans. Roy. Soc. London*, vol. A247, pp. 529-551, April 1955. (references)
- [2] 1st International Conference on Learning Analytics and Knowledge 2011. [Online]. <https://tekri.athabascau.ca/analytics/>
- [3] W.W Palagolla and Nisha Curl Kumari, "Use of ICT among secondary schools in the North Central Province of Sri Lanka," Faculty of IT, UOM, SriLanka, 2009.
- [4] Fassbender, E., and W. Heiden. "The virtual memory palace." *Journal of Computational Information Systems* 2.1 (2006): 457-464.
- [5] Harman, Joshua. "Creating a memory palace using a computer." CHI'01 Extended Abstracts on Human Factors in Computing Systems. ACM, 2001.
- [6] Vogel, L. (2009). Android Development Tutorial. Retrieved August 2, 2011, from [vogella:http://www.vogella.de/articles/Android/article.html](http://www.vogella.de/articles/Android/article.html)<http://developer.android.com/index.html>
- [7] Samy, M. (2010). Android. Retrieved August 5, 2011, from CodeProject: <http://www.codeproject.com/KB/android/AndroidSQLite.aspx>
- [8] Vivien Dollinger, Markus Jungiger. GreenORM – Android ORM for SQLite, 2013. From : <http://greendao-orm.com/features/>
- [9] widgetguide. (2010). Retrieved October 27, 2011, from Droiddraw: <http://www.droiddraw.org/widgetguide.html> A basic game architecture. (2010, July 26).
- [10] Android Architecture Description <http://www.android-app-market.com/android-architecture.html>
- [11] Wikipedia. Retrieved June 2nd, 2015 from the Wikipedia Wiki: http://en.wikipedia.org/wiki/Method_of_loci
- [12] Art of Memory. Retrieved June 2nd, 2015 from the ArtOfMemory.com: <http://artofmemory.com/>
- [13] Yates, F. A. (1966). *The art of memory*. United Kingdom: Routledge and Kegan Paul
- [14] Mustafizur Rahman, Md. Rafiul Hassan, Rajkumar Buyya, "Jaccard Index based Availability Prediction in Enterprise Grids", Department of Computer Science and Software Engineering The University of Melbourne, Victoria 3010, Australia, 2010.