

# Mobile Application for Dysgraphia, Surface Dyslexia, Semantic Dyslexia and Dyscalculia

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**ABSTRACT:** A learning disability is difficulty with day-to-day activities like household task, managing money, socializing and so on, which can affect someone for their whole life. Such people tend to take longer time to learn and may need support to enhance their skills. There are many different types of learning disabilities – for example dysgraphia (affects writing abilities), surface dyslexia (difficulty with whole word recognition), semantic dyslexia (difficulty in attaching words to their meanings) and dyscalculia (difficulty in math). Research articulated here is focused on creating a mobile application using apache cordova and android studio to help children suffering with dysgraphia, dyscalculia, semantic dyslexia and surface dyslexia. The application developed is in English language, using multisensory approach and provides suitable and appropriate learning ecosystem for children.

**Keywords:** Dysgraphia, Dyscalculia, Semantic Dyslexia, Surface Dyslexia, Dyslexia, Assistive Mobile Application, Apache Cordova, Android Studio.

## I. INTRODUCTION

Learning disability (LD) is a neurological disorder affecting the brain's ability to collect, process, stock and respond to an information. A study on Learning Disability conducted at the L.T.M.G. Hospital, Sion, Mumbai, India discloses that of the total number of 2,225 children visiting the hospital for certification of any kind of disability, 640 were diagnosed as having a Specific Learning Disability [1]. Most common language-based learning disabilities are thought to be dyslexia, dysgraphia and dyscalculia. It is said to be the most common reason for writing, reading and spelling issues. Of people suffering with reading difficulties, 70-80% are likely to have some form of dyslexia. It is estimated that between 5-10% of the population has dyslexia, but this number can also be as high as 17% [2].

Reading and writing being a key part of learning, children suffering from LD can have trouble mastering basic skills. This can create problems in succeeding at school. Children suffering from surface dyslexia often have difficulty in converting new words into 'sight words' whereas children suffering from dyscalculia often have problems with addition, subtraction and multiplication. Given all these challenges, children suffering from language-based learning disability usually have trouble with spelling, speaking and writing.

Traditional ways of treating people with language-based learning disability is a cumbersome process and often costly. Treatments are not available in villages and small towns of the world because of which a huge number of children remain untreated. Digital technologies can be utilized in order to assist, train and enable the learning process. Specifically designed applications can stimulate students' interest, but may also help students with disabilities fit into and progress within mainstream school environments [3]. However, much less research has been conducted in the field of mobile learning for children with LD. Mobile phones are widely used but still the potential of these devices in transforming learning and teaching has not yet been fully explored.

The main objective of mobile application proposed here is to help children suffering from dysgraphia, dyscalculia and semantic and surface dyslexia. It also helps to check whether a child has any of the above-mentioned LD or not.

## II. WORKFLOW

### 2.1 OVERVIEW

The objectives of the proposed mobile application (app) are :

- To help children with basic math calculation
- To help them differentiate between letters
- Assist them to predict and imagine objects from words (example of object: book, ticket, ball)
- Try to improve their basic alphabet writing skill.

The app will provide user with a login id, which will either store their individual progress data on their phones or will be linked with their mail/social media account so that if an old user starts the application in a new phone, their individual progress is retained. Each one of the four language- based LD will have game like different levels with few hard tests (levels) in between.

## 2.2 SYSTEM FLOW

The mobile application starts with a login page, after which the user has to select an option from dysgraphia, dyscalculia, semantic dyslexia and surface dyslexia to move forward. If the user completes all the levels without any retry, scores full marks in the test levels and completes particular level in predefined time (time decided by the developer with the help of a psychiatrist), he/she is said to be not suffering from that particular language-based LD. Otherwise, the application will provide an extra help to the user and after all the levels and test are completed, he/she will show improvement in that particularly selected LD.

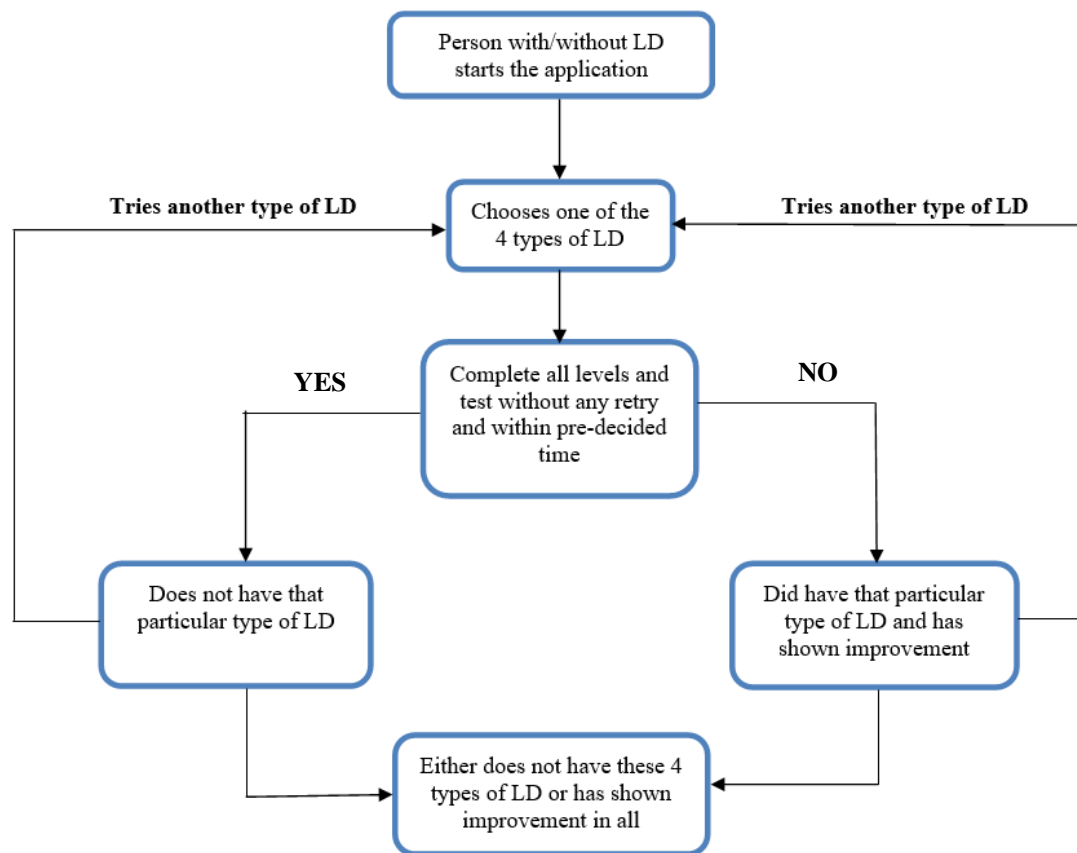


Fig 1. Shows the basic System Flow of the mobile application

## 2.3 APPLICATION DESIGN AND FEATURES

The application is structured around four main language-based Learning Disabilities: 1) Semantic dyslexia (recognize what object is shown on the screen and select the word accordingly) 2) Surface dyslexia (Match the word with appropriate picture gifs) 3) Dysgraphia (one has to glide their finger along the line of the alphabet.) 4) Dyscalculia (do basic math problems like addition, subtraction, multiplication and division). Each LD is comprised of different levels and tests with increasing difficulty which offers the user to play and proceed to the next level according to his or her individual learning capabilities. Attractive cartoon characters are added to enhance children's confidence and encourage them to increase their involvement while simultaneously increasing the possibilities of achieving the said goals. All the levels are carefully designed to offer user friendly interface.

At first an attractive icon displays the application (Fig2(a)), which on clicking directs the user to login page (Fig2(b)) where the individual has to provide login details (Fig2(c)) or in case of new user, has to sign up and then options for four different types of LD are shown (Fig2(d)), from which user can chose any one option. After this the first level of that particular LD is shown (Fig2(e)). If the user successfully completes the level then he/she is directed to next level (Fig2(g)) otherwise a retry is given (Fig.2(f)).

To build the application easily a combination of apache cordova and android studio has been used. Initially the application was created in website form, after which it was converted into an android application APK by using apache cordova. These APK was then tested in an emulator using android studio, which in turn ensures that industry guidelines and standards are followed.

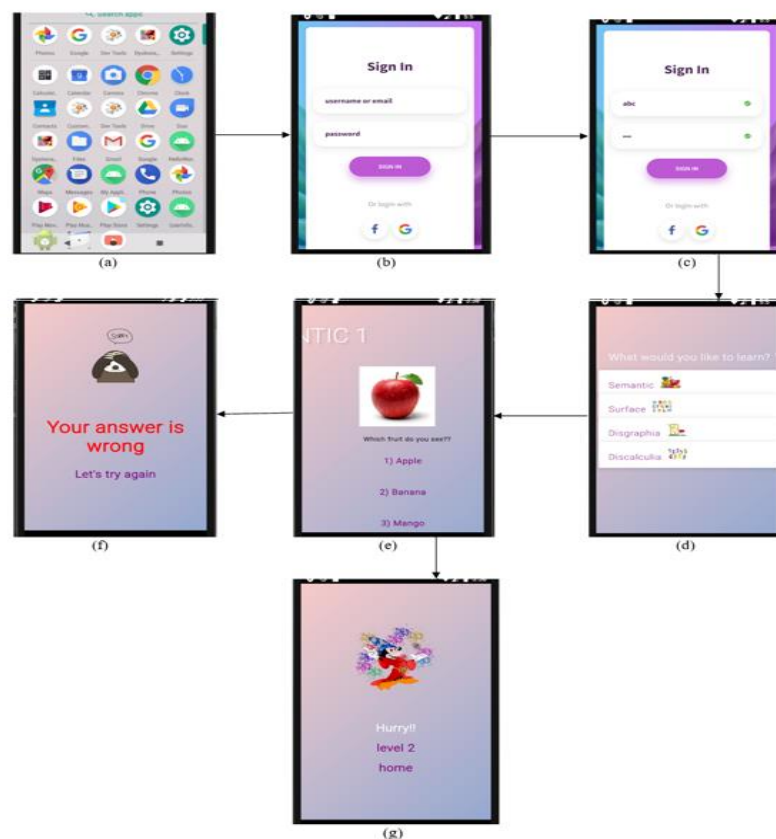


Fig 2. Basic Design of the mobile application

### III. EVALUATION

For the evaluation purpose the beta version of mobile application APK was install in real-time mobile devices and then tested on few students. This beta version had 10 levels and 2 tests. The usability of the application was evaluated by utilizing the well-researched generic usability attributes: efficiency, learnability, effectiveness, memorability, user satisfaction, simplicity, performance and comprehensibility[4][5][6][7][8].

### IV. RESULT

After evaluating the mobile application with few students, it was mainly found that they were focused on completing the levels while avoiding distractions and that students who were suffering from mild language-based LD could complete all the 10 levels and 2 tests without any retry while students with severe language-based LD took few retries to complete hard levels. This application can be effectively helpful in assisting children with above mentioned four language-based LD.

### V. CONCLUSION

The proposed system is helpful to the children suffering from mild or severe language-based learning disabilities: dysgraphia, dyscalculia, semantic dyslexia and surface dyslexia. Even if someone is taking a therapy related with LD from a psychiatrist, the application can provide an extra help. The beta version of the mobile application is successfully working on android devices with android versions equal to or smaller than android 9.0.

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