Super Sudoku

Cloud19

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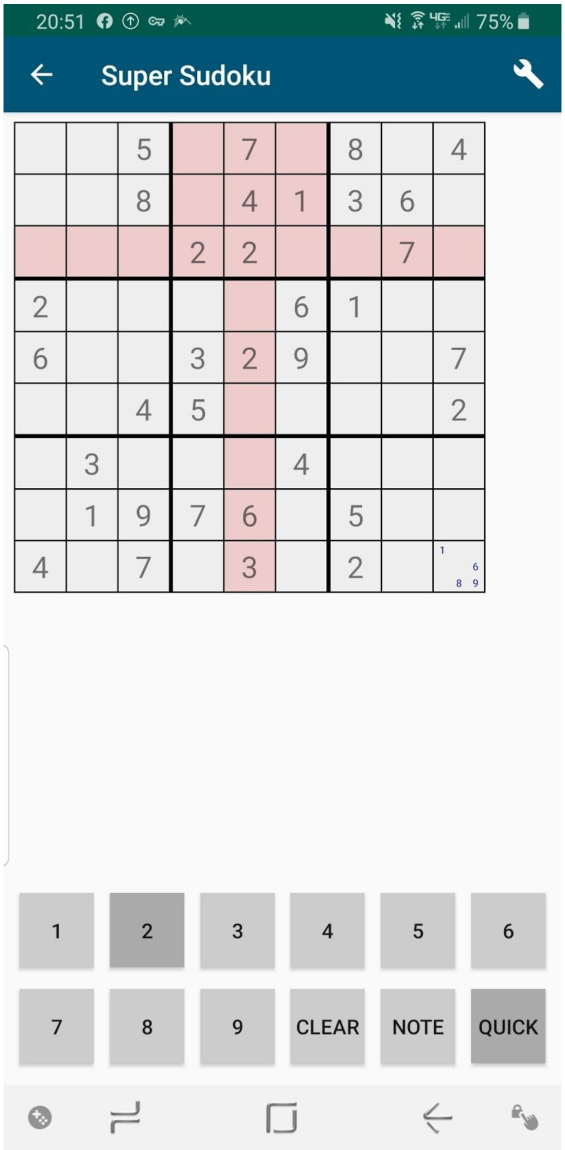
Introduction

Several of the members of team 19 are experienced Sudoku players, and they have found that few Android apps exist which support classical Sudoku. The apps the team tested had few or no features which supported many of the popular strategies for completing traditional sudoku puzzles. While these approaches are often as simple as writing notes concerning the possible numbers for a cell, few apps supported any features aside from entering numbers into cells. Team 19 set out to develop a simple application which would facilitate these strategies and to find out what features the modern sudoku player would like to see implemented. The team also wanted to make sure that any added functionality did not overload the screen and did not make the game too easy. Through research, testing, and polling, team 19 has developed an application which will cater to the needs of any sudoku player - Super Sudoku.

Example Scenario



		5		7		8		4
		8		4	1	3	6	
			2	2			7	
2					6	1		
6			3	2	9			7
		4	5					2
	3				4			
	1	9	7	6		5		
4		7		3		2		1 6 8 9

The above image is an example of several key game board features present in the Super Sudoku app. Using the quick add feature, the user was able to input several 2's into cells they chose without having to reselect the desired number for every cell. After entering these numbers, the conflict highlight hint alerted the player that the number they most recently input did not fit. The row, column, and section have all been highlighted red to indicate the problem. The user has also input some potential correct numbers for the bottom right cell through use of the notes feature. This is a popular strategy among traditional sudoku players and can be used to help manage difficult puzzle decisions.

Development Process

To most efficiently build the app, the team placed each members' assigned roles into either the front or back end of development. These two sides of the process ran concurrently. Planning for both, including new feature and design choices, occurred before and during each step in development. Each development step followed this process:

1. Identify Need
2. Brainstorm Solutions
3. Choose Direction
4. Prototype Ideas
5. Choose Final Direction from Prototypes
6. Trial and Implementation
7. Testing and Feedback

An early example of this process was the puzzle selection menu layout. The team recognized the need to create a puzzle selection menu, brainstormed ideas, chose general direction and essential elements, prototyped several designs, selected a single design, created the matching menu in Android Studio, paired the menu with the back end via Github, and recorded team and user feedback on the effectiveness of the menu. Following is a table of the planned and executed steps for each aspect of development.

Task	Planned Start Date	Planned Finish Date	Team Member(s)	Start	Completion
Project Proposal	1/27/20	1/31/20	All	1/27/20	1/31/20
Project Plan	1/31/20	2/14/20	All	1/31/20	2/14/20
Research Sudoku Strategies	1/31/20	2/5/20	Gabe	2/7/20	2/14/20
Choose several mockup designs	1/31/20	2/16/20	Stephen, David	2/7/20	2/21/20
Feedback on UI design gathered	2/16/20	2/21/20	Stephen, David	3/7/20	4/23/20
Github Repo Working	1/31/20	2/1/20	Jon	1/31/20	2/8/20
Continuous Testing of everyone’s area	1/31/20	4/23/20	All	1/31/20	ongoing
Front end built	2/14/20	4/10/20	Stephen, David	2/14/20	4/21/20
Create several backend optional features	1/31/20	3/30/20	Jon, Gabe	1/31/20	4/19/20
Feedback on features (back end)	3/30/20	4/2/20	Luke, Jon, Gabe	tbd	tbd
Backend features implemented	4/2/20	4/10/20	Jon	tbd	tbd
Wire action listeners to backend	4/10/20	4/16/20	Stephen, David	4/10/20	4/16/20
Documentation up to date	1/31/20	4/16/20	Luke	1/31/20	ongoing
Final Testing	4/16/20	4/23/20	All	tbd	tbd
Begin Project	3/12/20	4/23/20	All	4/17/20	4/24/20

Digest					

The team had originally planned to incorporate more user feedback earlier in the process. However, due to the nature of design and the number of decisions to be made, user feedback was more concentrated in the latter half of development. The team felt it would be unnecessary to obtain user feedback in the early stages of every design step. The process of choosing, designing, and implementing new elements also took on a slightly different look than originally planned. While more significant aspects of design such as the menus and board layout received the multiple prototypes intended before final implementation, a few of the smaller elements such as the quick add or notes features saw more initial planning and less prototyping before introduction to the final app.

Results

When first opening the Super Sudoku app, the user is greeted with a welcome screen that displays the game title, and two columns of color coded difficulty levels on the left and right side of the screen that range from easy to extreme. The columns differentiate the premade puzzle boards from the uniquely generated puzzles. From there, a user can select a difficulty level and proceed to choose a premade board from the given selection or wait while a unique puzzle is generated. This puzzle selection menu is color coded according to this difficulty.

Color	**Difficulty**
Green	Easy
Yellow	Medium
Red	Hard

Purple	Extreme

The game board design features a 9 by 9 grid of cells that can be edited using the UI buttons. This was done by putting a grid of identically sized squares onto a black background. The space between cells shows the black background behind them giving the illusion of borders for the cells. The cells are edited using a keypad at the bottom of the screen. The position of the keypad is in the best spot to allow the easiest access to the user. There are 9 buttons that represent the 9 digit entries for a sudoku board, a clear cell button, an annotation button, and a quick entry mode button. The use of these buttons has been described and displayed previously in relation to the usage example.

In order to play Super Sudoku, one would need an Android Device, or a way to emulate an Android device such as Android Studio’s built in emulator or BlueStacks. The team has taken special consideration to maximize app readability. The limited implementation of a colorblind corrective feature is one such approach to expand access to more users. The pinch to zoom feature allows users to zoom in and out and pan across the board, increasing visibility for the vision impaired or anyone with a particularly small screen.

To store and manage each game board we created a Board class which includes two arrays of size 81. The first array is the solvedboard where we can store the given cells so the user can not change the givens, we can also store the complete solution to the board here if given to the constructor for board. The second array is the workingboard where we store the values input by the user, this includes both the actual value for the cell as well as annotations, given cells are initialized to -1 on the workingboard to indicate that the value is on the solvedboard. For the development of the game board interface we made extensive use of Android api, this includes linking Android activities to its associated fxml file, as well as using built in gesture/on-click event handlers to implement the interactive components. For the design portion of the project we made use of AdobeXD, Balsamic, as well as hand drawn designs. For the development of the app we used Android Studio with built in Android emulators for testing, and we used Android Studio's github integration for version control and file sharing.

Future Direction

The Super Sudoku project has the potential to host a variety of additional features. One planned but yet unimplemented feature is the sudoku board generator. Currently the selection consists only of premade sudoku boards. However, the team at Cloud19 intended to prioritize the completion of an in-app unique puzzle generator. This board generator will greatly expand the scale of the Super Sudoku app by allowing for an endless amount of possible puzzles. The board generator is also not intended to replace the selection of premade boards. These pregenerated boards are useful for user tutorial and continued practice. Rules such as the number of filled cells and the distance between numbers will also be built into the puzzle generator to maintain the distinct levels of difficulty present in the premade selection.

Other planned but yet incomplete features are the sound effects and background music options. The options to enable these features are currently present in the options menu. However, the sounds have not been added to the app. Location and selection of freely available sounds and music is currently being made by the team. The team is also working to redesign the implemented notes feature. While this feature is technically fully implemented and serving its intended purpose, feedback suggests that the displayed note is too small. This causes some difficulty of use.

From recent user feedback, the team has elected to provide users with the option to visually distinguish prefilled puzzle numbers from user entered numbers. This distinction will become more helpful as the player progresses through a puzzle. Although the game does not allow users to clear prefilled numbers, at first glance it can be difficult to determine which numbers a player can change on a mostly completed board. Although general user feedback indicated the effectiveness of Super Sudoku's simple design, the team desires to implement increased options for user style choices such as color and background selection.

Conclusion

The Cloud19 team set out to bring classical sudoku into the modern age by pairing traditional player strategies with today's smartphone technology. Anyone with an android device can now take sudoku on the go without sacrificing the use of their prefered strategies. The team has found that the simple approach to application layout appeals most to the average user. This approach has allowed more team resources to be channeled into the implementation of new user strategies. The simple framework of Super Sudoku also has the potential to host a variety of other features and design and style options.

Team Summary

During this project Mr. Barnes led the documentation and general project management logistics. Mr. Burris and Mr. Devore headed up the UI design and measuring user feedback. Mr. LeMaster has spearheaded the back-end game development and functionality. Mr. Scott took charge of researching sudoku strategies and incorporating them into the UI, as well as video production. All of these roles were intended to overlap, and each members' respective tasks have been done in collaboration with all other team members.