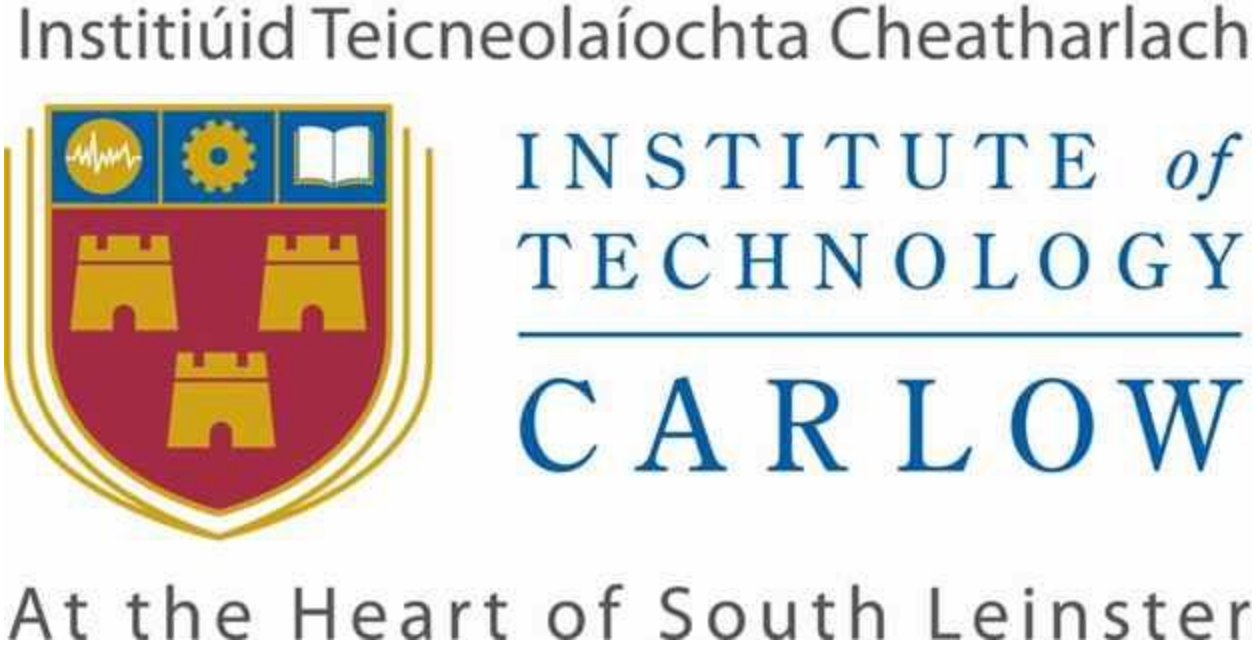
# Find The Word Mobile Application
# Final Report

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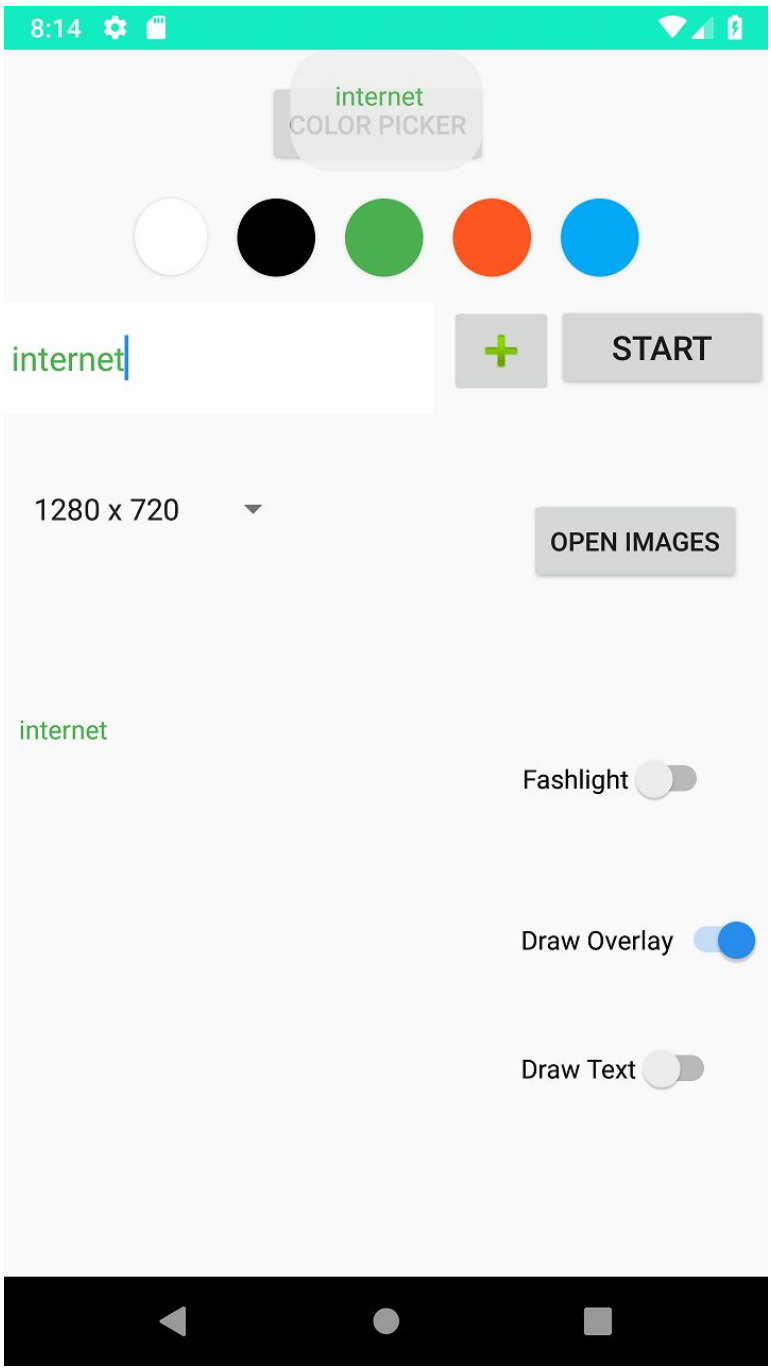
# Introduction

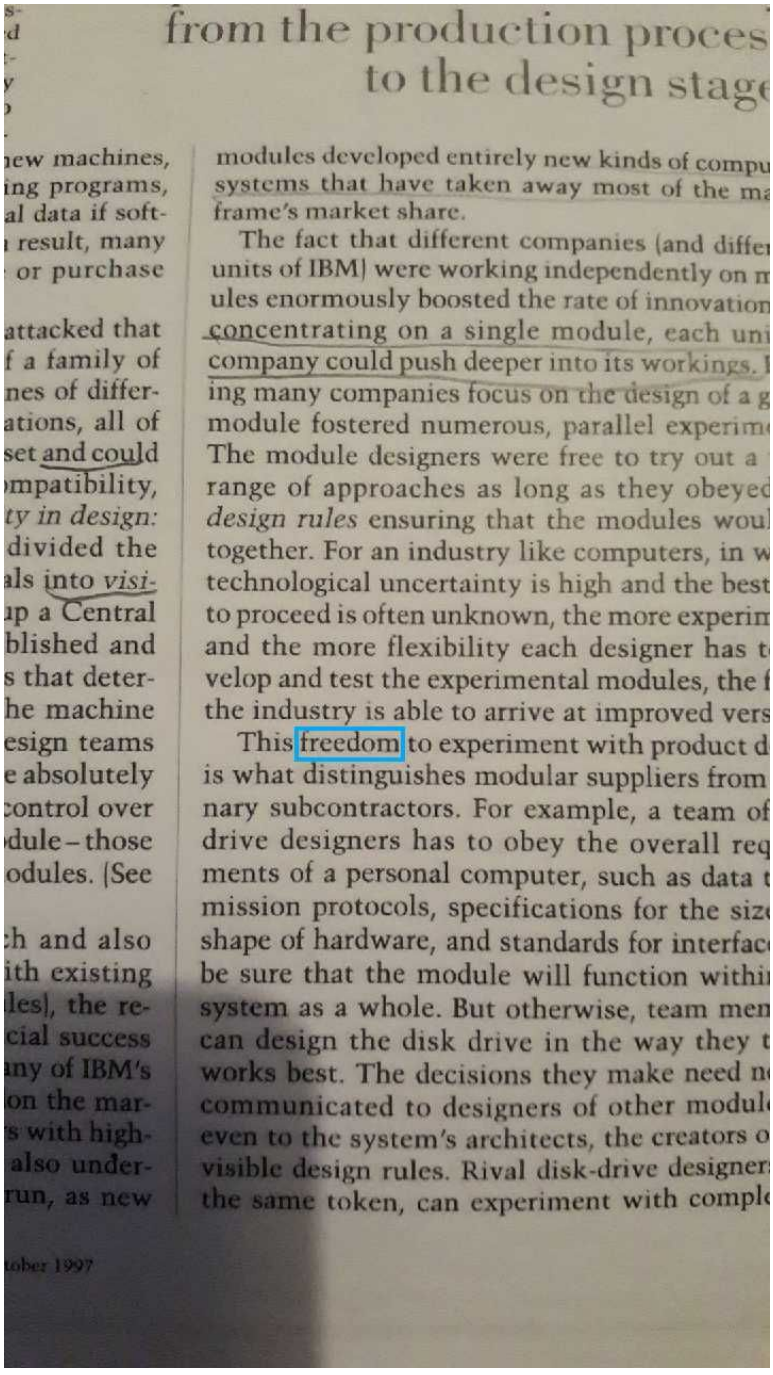
The purpose of this document is to outline the project description, conformance to specifications, learning outcomes and  the review of the  Find Word Application project.

# Description of Submitted Project

This project was created in Android Studio using java programming language, and google firebase ml kit for text recognition. This application allows users to find particular word on a physical page with printed text the book page for example. The user input the word into input field choose colour for the word and stars word search.



After user added  all words he wish, user can click start button and camera preview with text search starts. Once the word/words is found, it is highlighted with rectangle overlay, the text coloured or both.



The overall idea of the application is to aid user who is looking for particular word on page with printed text. Main idea comes to project author mind during long study session with many tabs opened in internet browser, many books opened and pages with printed tutorials lying on the table. When looking for something on the website one just need to press control + f type word and find highlighted word on the screen. When it comes to find something on the physical  book page it is not that easy,  the time must be spend  to scan text  and especially when eyes are tired after many hours of study the task to find test on the page is cumbersome. By using this application user can save time and find the searched word without frustration.

# Description of  Conformance to Specifications and Design

## Changed functionalities

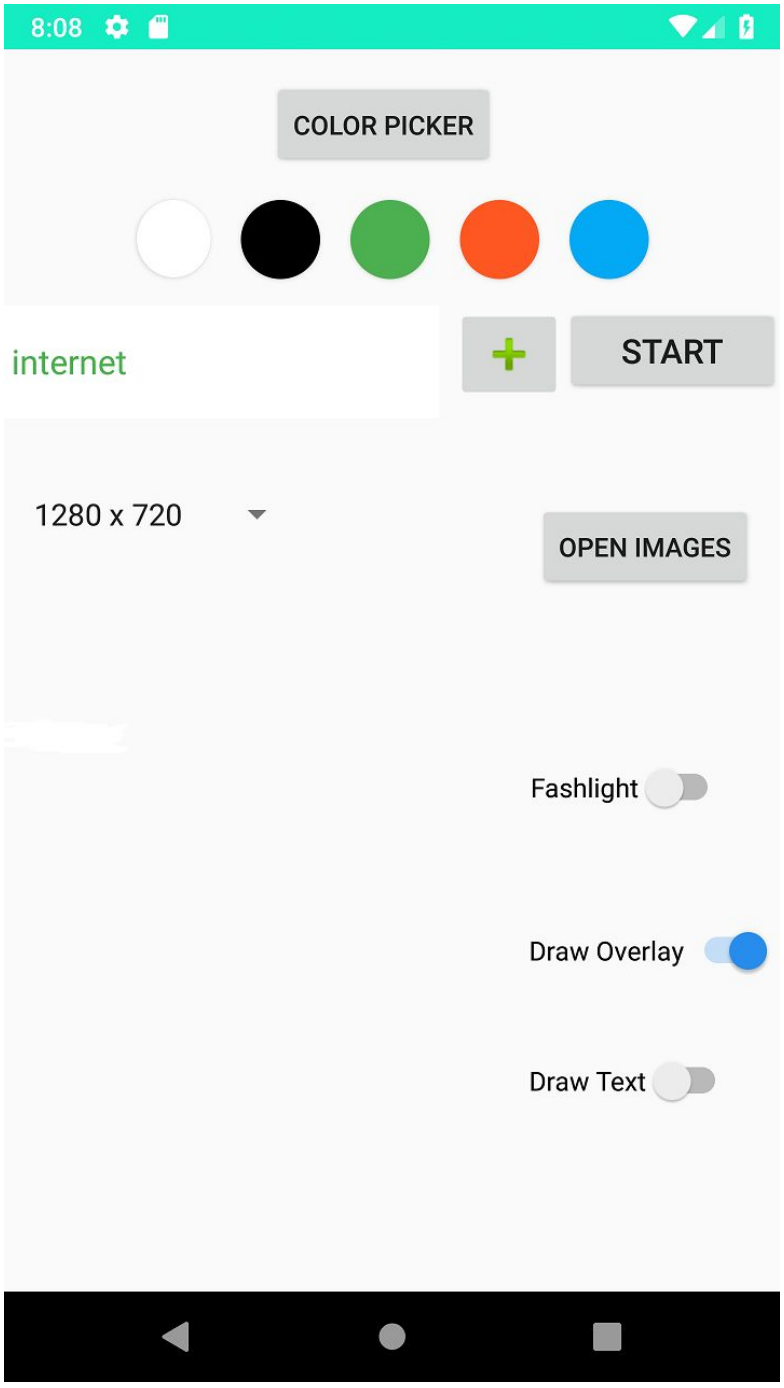
Instead of taking picture and perform text recognition on picture taken the application perform text recognition on live camera preview, this functionality was changed after testing google firebase ml kit which showed good results for text recognition with live camera preview. By taking advantage of modern mobile technology and using high resolution camera preview starting from resolution 1280x720 and higher the text could been found from distance 30 cm so the whole A4 page fits the screen. The phones used for testing:

- Samsung Galaxy S6
- Samsung Galaxy Core Prime
- Sony Ericsson F3311
- Sony Ericsson D2303
- Huawei MYA-L11

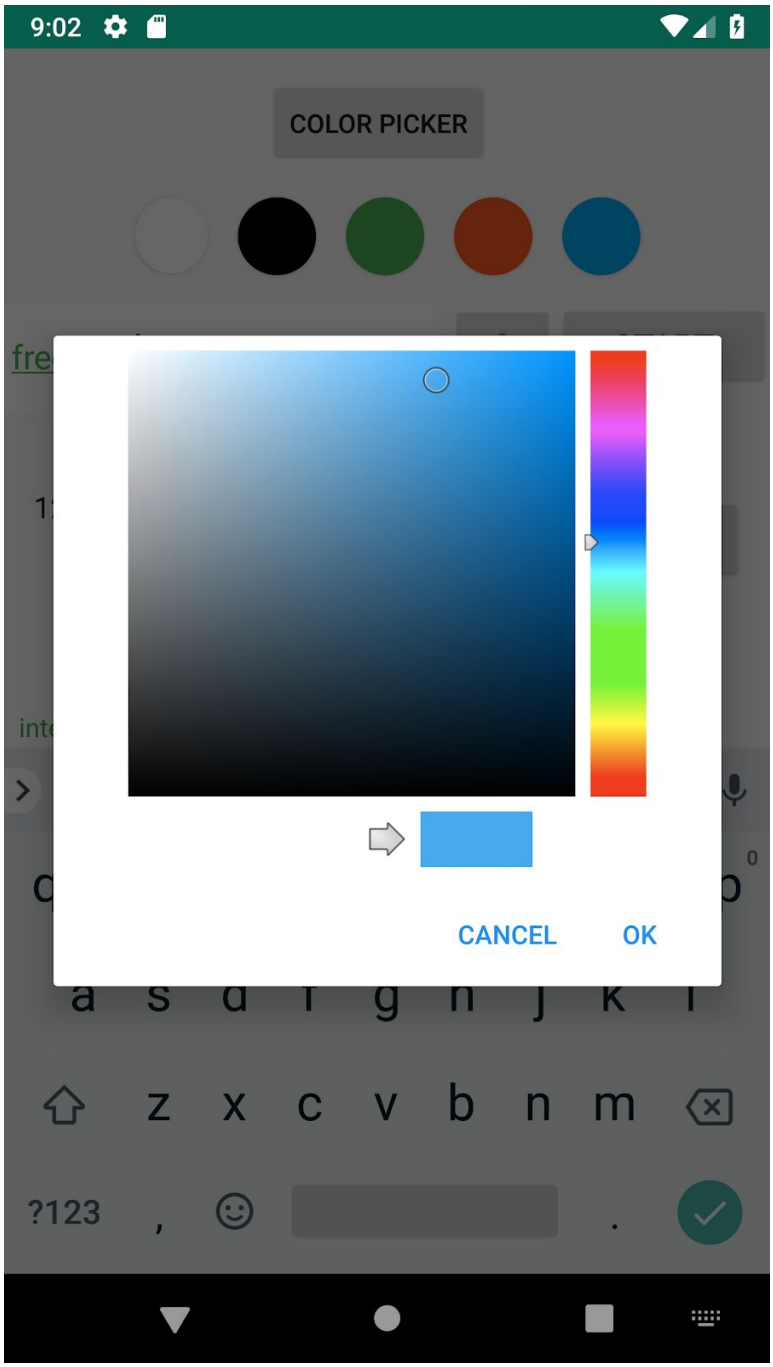
As the text recognition is performed on live camera preview the phones with better hardware performed better. The best results were achieved on the Samsung Galaxy S6 phone this phone have the best hardware among five phones tested and higher resolutions could been set without application become laggy. For example on the Samsung Ericsson D2303 with resolution 1280x720  the text recognition was good but the screen lag  took 5 and  sometimes more seconds.

## New Functionalities

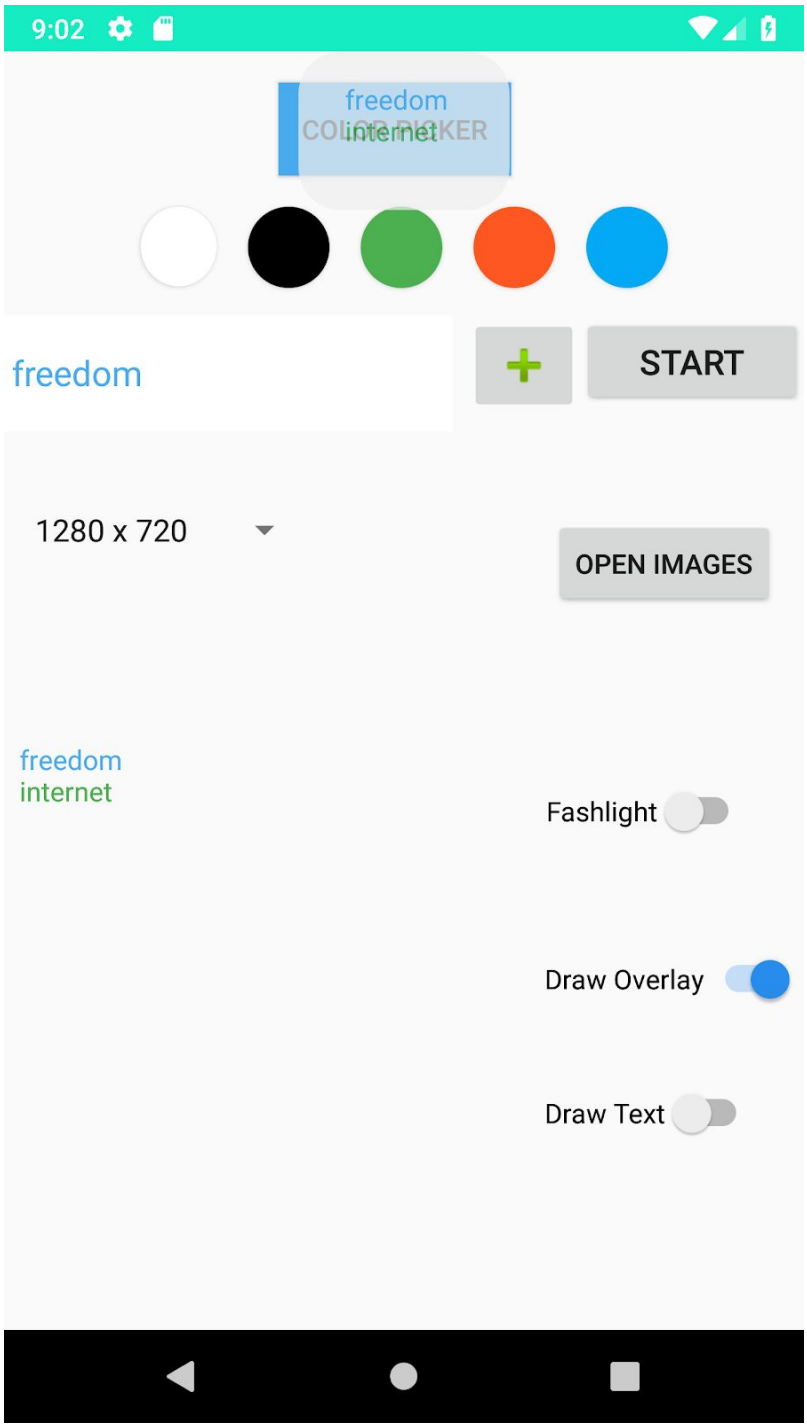
- User can quick pick colour from five round buttons above input text



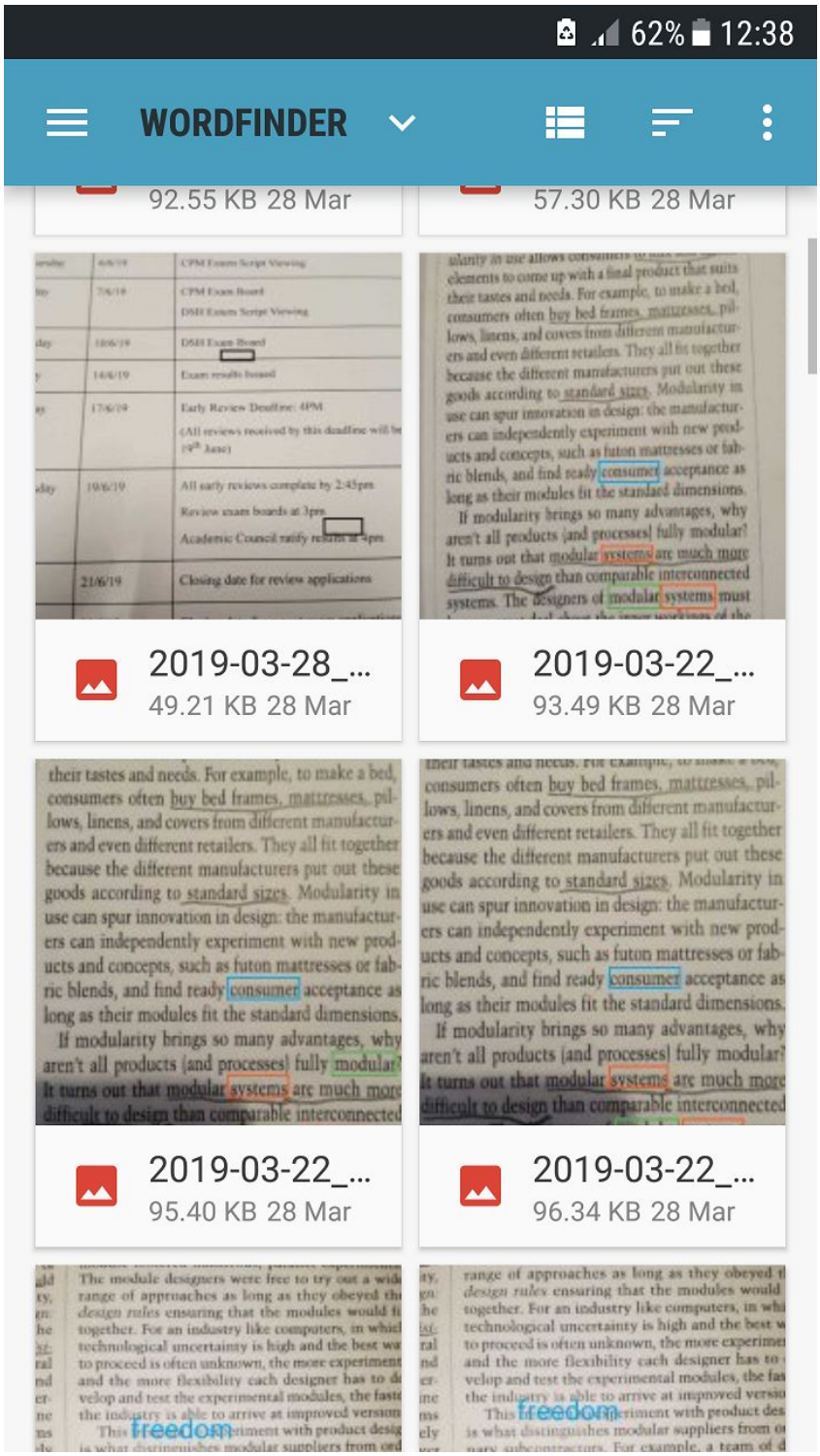
- The user can choose custom color from color picker after clicking color picker button.
  https://github.com/yukuku/ambilwarna



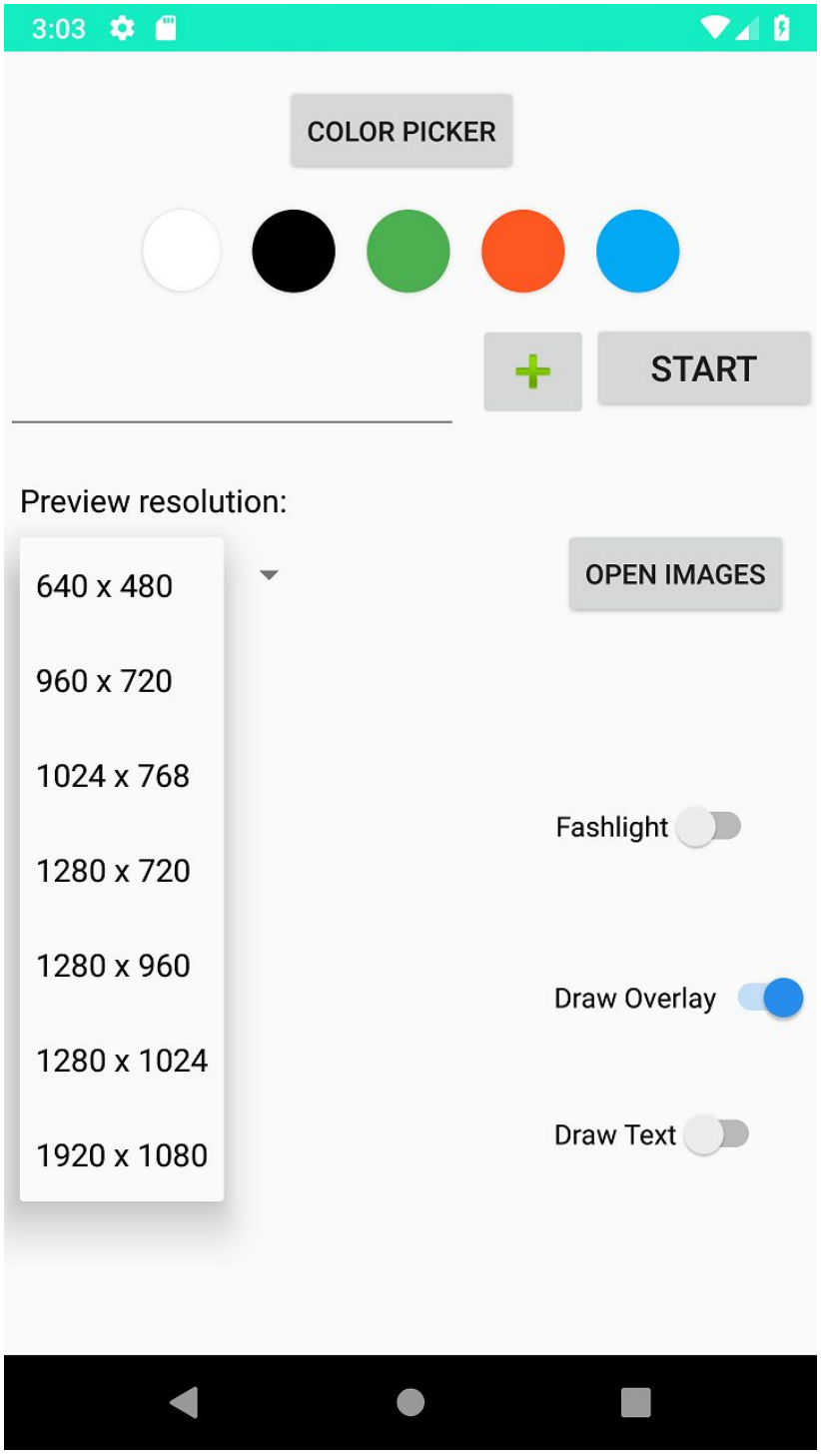
- The user can click plus button and this will add the word to the word list. The popup message will display  the added word along with previously added words if any, each word is  displayed in colour that is assigned to this word. The word is added to the list in the bottom left corner.



- User can save the word search result by double tapping the screen while in camera preview mode
- User can open images folder the saved images are saved in Pictures/Wordfinder directory



- User can select camera preview resolution size

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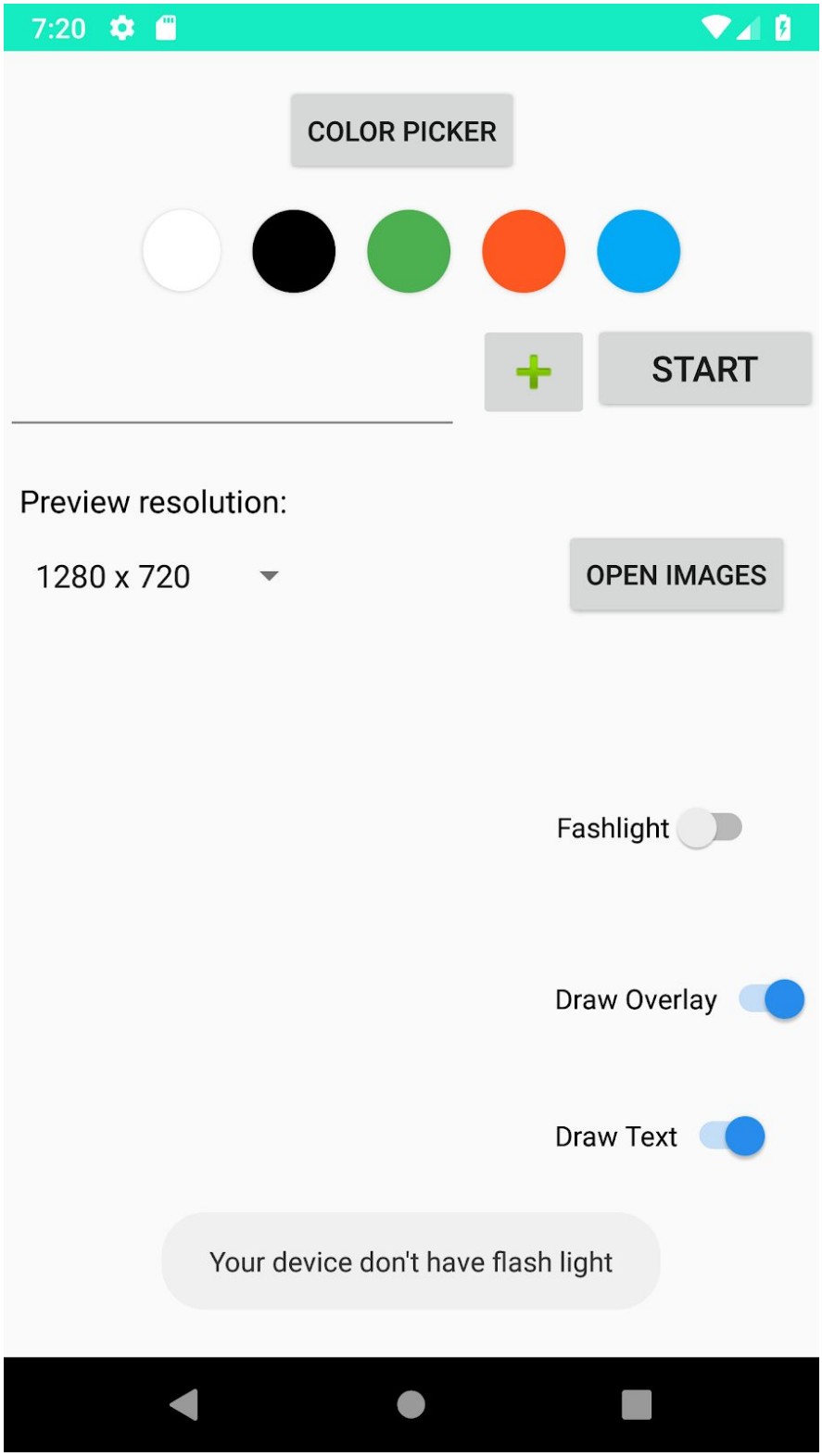
- User can choose to draw overlay around found text and/or to draw text, user can use flashlight if device support it by using the switches on right bottom corner



# Description of learning

## Technical

- Learned how text recognition works.
- Learned what is artificial neuron and neural network.
- Learned what is convolutional neural network.
- I already had experience with android and I learned more about android development.
- Learned that research is important task during project development, and that documenting research is important too. For example in future if I will be working on another project which will use similar technologies going back to own research is always easier than doing whole research again.
- Learned how important and time taking is to test the application, When regarding to android development there are many devices with different screen resolutions and with different android versions. Some features work on one android version and don't work on another android version. Usually first tests run on virtual phone and tested functionality behaves differently on real device.
- Learned how important is to maintain good code quality from start as the application grow and more code is added as it is without proper formatting from start. Later on is much more difficult to maintain the big chunks of the code for example it is even to find out which code is needed for application to work and which code was just  used as example.

## Personal

- Learned that being pragmatic when it comes to assigning time for new functionalities is crucial if the project has time constraints. For example tried to use camera2 api for the preview but learning android camera2 api on its own require time and although after one week partially succeeded i.e. had camera preview working and text recognition working on the preview it was very inefficient and would require another week or more to implement camera2 properly in this project. Had to resignate from camera2 because of time constraints, as there were other subject during school year to work on.
- I have improved my research and presentation skills.
- I learned that I can trust myself as a developer as this project was my own idea and I had no experience with AI technologies before. Overall I see this project as a big success in my software development journey.

# Review of Project

## What went right

The text recognition works surprisingly well on mobile devices. Before first tests of text recognition libraries I was not sure how text recognition will perform on the mobile device because of mobile devices hardware limitations. And  my requirement regarding to text recognition library was to perform text recognition quickly on the device without need to send image to the cloud and wait for the output. The google firebase ml kit fulfilled that requirement very good. Overall process of development for android went right as well.

## What went wrong

Attempt to use camera2 api did not work. The time constraints did not let me to finish implementing android camera2 api. Estimating roughly I would need around two full weeks to work only on implementing camera2 properly in this project thus could not finish it.

## What is still left to do

If I could have more time I would add to the project:

- Ability for the user to input the word by voice
- Functionality that will allow user to “teach” application the user handwriting style so the handwriting recognition could perform much better
- Functionality that will recognize math symbols/formulas

## If starting again

If starting again I would spend more time on research and in particular on research how camera api works in android from the start of the project.

## Advice for someone approaching similar project

Take your time during research. Don’t be afraid of using AI (machine learning) technologies on mobile devices.

## Technology choices

I believe my technology choices were right. The text recognition need pictures with good quality and by using android native development developer have control over the device camera which in turn give developer control over pictures/camera stream quality. The google firebase ml kit is performing very well on the device text recognition.

# Acknowledgements

I would like to thank to my supervisor Paul Barry. Paul helped me to go through each project phase without unnecessary stress and gave me advices which helped me to finish this project.
And I would like to thanks all the tutors over the four years I spend In the college for their time and knowledge they shared with us.