Development of an Android Application for Geotechnical Engineers

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ABSTRACT:
With the advancement in technology, many people believe that there must be some involvement of latest technology like the Android platform in our day-to-day practices. Many engineering applications are being developed using this platform. This paper presents the development of Android Application for soil classification system. A simple Android application, that uses input experimental values like percentage passing through different sieves (sieve no. 4, 10, 40 and 200), D_{10} , D_{30}, D_{60}, Liquid Limit and Plastic limit, has been developed.

Keywords: Android, Geotechnical Engineering, Soil Classification

1. INTRODUCTION

Classification is fundamentally important to any science. Not only is it a means to impose order on diversity between and within objects and concepts, but classification also provides the avenue through which research can be addressed in a rigorously systematic manner. Classifications also have more practical applications. Classification of soils, for instance, is indispensible to the soil survey program of mapping the soils of various regions of the world. Soil surveys, in turn, can be used to apply the principle functions of soil science to agriculture, forestry and engineering to predict soil behavior under defined use and management or manipulation. Engineers, typically geotechnical engineers, classify soils according to their engineering properties as they relate to use for foundation support or building material. Modern engineering classification systems are designed to allow an easy transition from field observations to basic predictions of soil engineering properties and behaviors.
There are various soil classification systems used now a days, like USCS (Unified Soils Classification System), AASHTO (American Association of State Highway and Transportation Officials), ISSCS (Indian Standard Soil Classification System), etc.

There are already some applications based on Android and other platforms. Some of them are listed below:

1. Geotechnical Daily Field Report (GFR)[1]: It is an Android app designed for geotechnical engineers and geotechnical engineering technicians to generate daily field reports in the field.
2. Geo Lab Tool Demo[2]: An essential tool for cartography, geotechnical, slope stability, geodynamics, and more.
3. Bearing Capacity FREE[3]: The application gives a preliminary value of the ultimate and design bearing resistance of the spread foundations with different shapes: rectangular, square, circular and strip footings.
4. Portable Geotechnics–Using Android smart phones and tablets for Geotechnical field investigations[4]: With available applications for various Android devices it is possible to use many applications for: geotechnical/geological mapping in real time, collecting strike-dip measurements, borehole logging, augmented photo visualization of investigation site, data storage and geotechnical analysis (such as RMR calculation, soil bearing capacity etc.).

In this paper, we present a simple Android application that classifies soil samples on the basis of their percentage sieve passing values according to various Soil Classification Systems.

2. ABOUT THE CLASSIFICATION SYSTEMS

2.1. USCS: The Unified Soil Classification System (USCS) is a soil classification system used in engineering and geology to describe the texture and grain size of a soil. The classification system can be applied to most unconsolidated materials, and is represented by a two-letter symbol. The flow-chart related to this classification system, according to ASTM D 2487-06[5], used in our application is given in **Fig. 1**.

2.2. ISSCS: In the **Indian Standard Soil Classification System (ISSCS),** soils are classified into groups according to size, and the groups are further divided into coarse, medium and fine sub-groups. The flow-chart related to this classification system, according to IS 1498[6] used in our application is given in **Fig. 2.**

2.3. AASHTO: The AASHTO Soil Classification System was developed by the American Association of State Highway and Transportation Officials, and is used as a guide for the classification of soils and soil-aggregate mixtures for highway construction purposes. The classification system was first developed by Hogentogler and Terzaghi in 1929, but has been revised several times since. The flow-chart related to this classification system, according to AASHTO M-145-91[7] used in our application is given in **Fig. 3.**

3. DESIGN OF THE APPLICATION: This project was made in a Java Integrated Development Environment named Eclipse that contains a base workspace and an extensible plug-in system for customizing the environment. Eclipse is used for development of various applications with the help of various plug-ins that are helpful in writing in other programming languages too, like C, C++, Fortran, JavaScript, etc. Android Development Tools is a plug-in for Eclipse that is designed to provide an integrated environment which is used to build Android applications. ADT extends the capabilities of Eclipse to let developers set up new Android projects, create an application UI (User Interface), add packages based on the Android Framework API, debug their applications using the Android SDK tools, and export signed (or unsigned) *.apk files in order to distribute their applications. It also provides an option to create Android Virtual Devices (AVDs) on a PC. These virtual devices can be used to test Android apps developed in the software and their specifications can be defined by the user.
An android application basically consists of several 'activities' that are loosely bound to each other. Activities are the components of an application that provide a screen with which users can interact in order to do something, such as dialing the phone, taking a photo, etc.

Firstly, a basic design was prepared using XML (Extensible Markup Language).
The internal processing code was written in Java using relevant algorithms shown in figures 1,2, and 3.

3.1. **How various screens and their components look like:**
3.1.1. The main screen that allows the user to choose the classification system is shown in **Fig. 4.**
3.1.2. **USCS** :

The input parameters taken for this classification systems, as shown in **Fig. 5**, were:

i. Percentage passing from sieve no. 10
ii. Percentage passing from sieve no. 200
iii. Liquid Limit
iv. D_{10}
v. D_{30}
vi. D_{60}

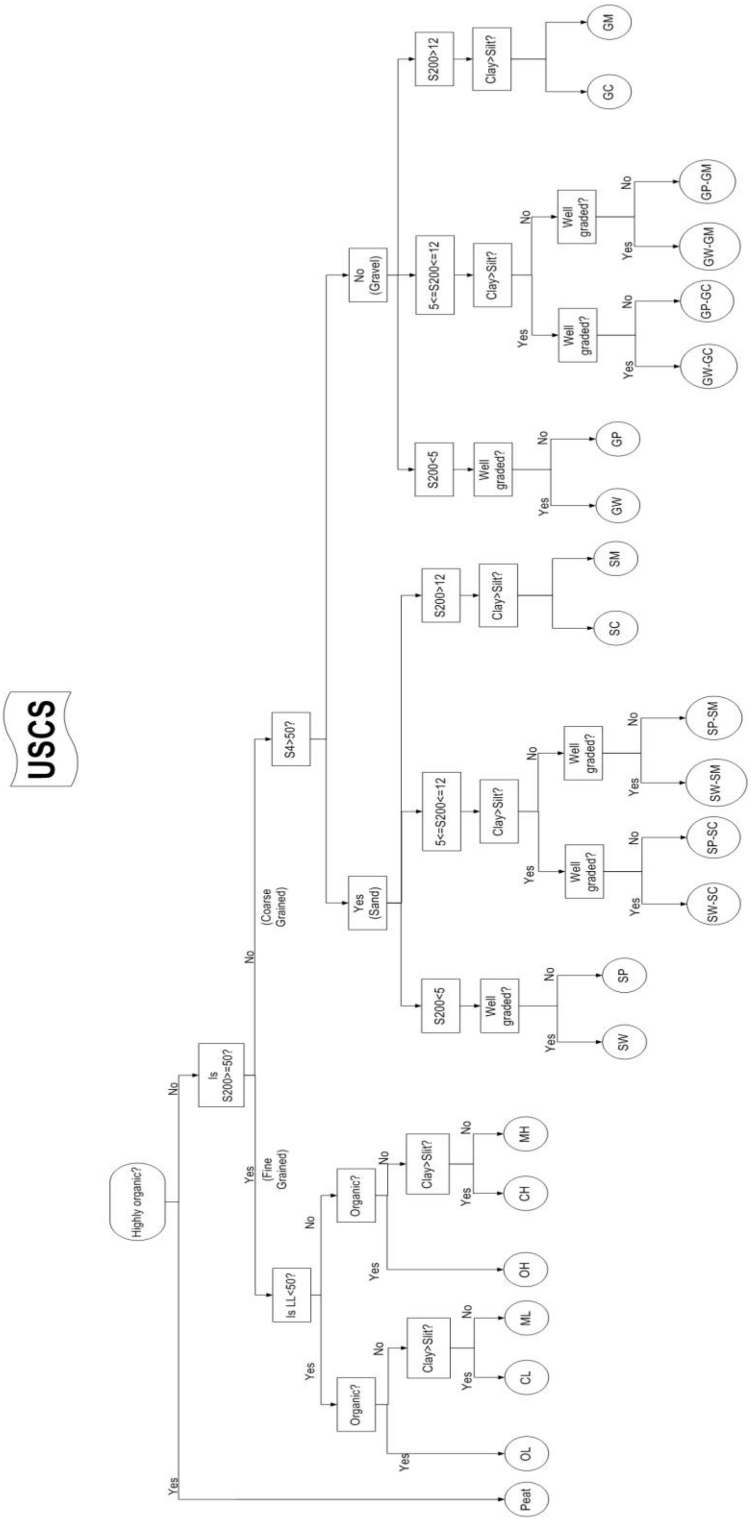

Fig. 1. Flowchart for USCS[5]

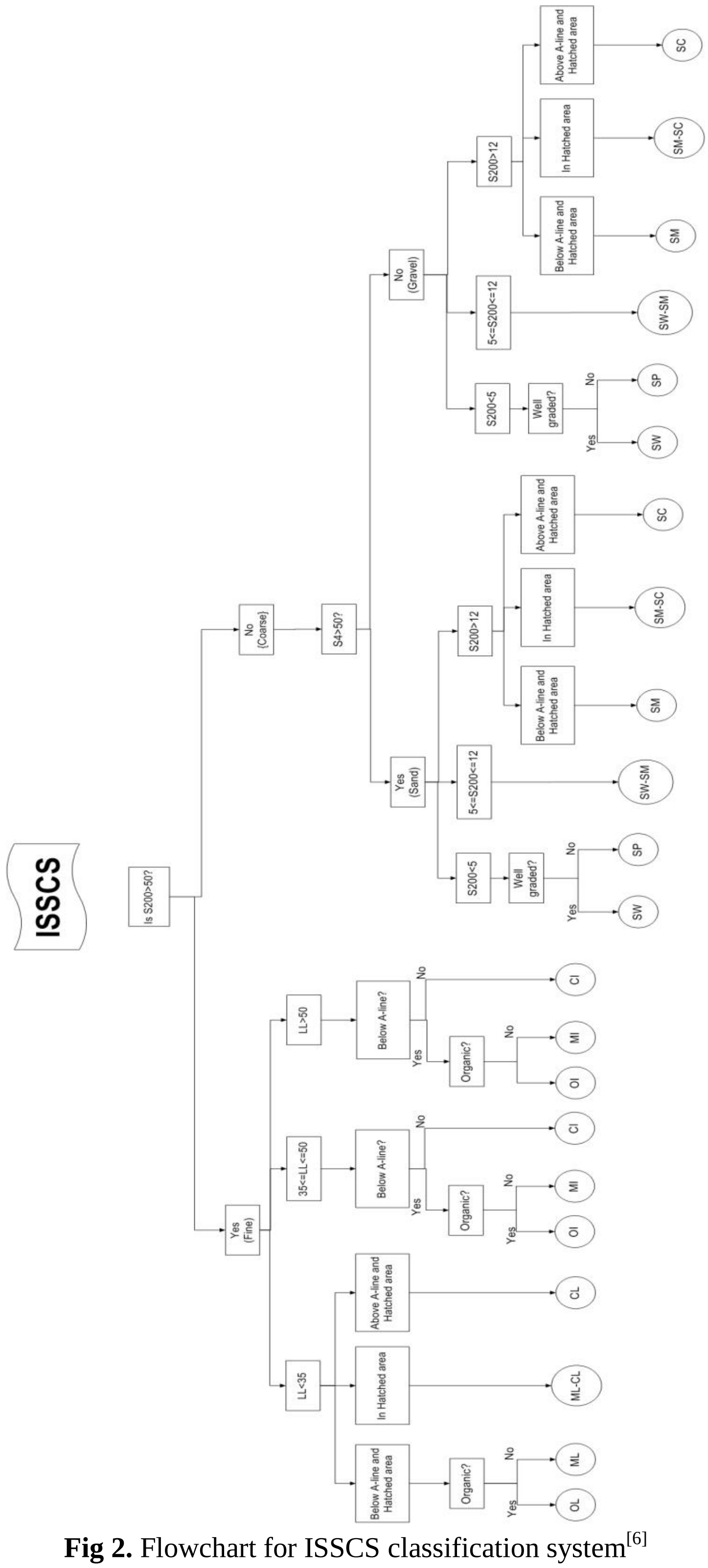

Fig 2. Flowchart for ISSCS classification system[6]

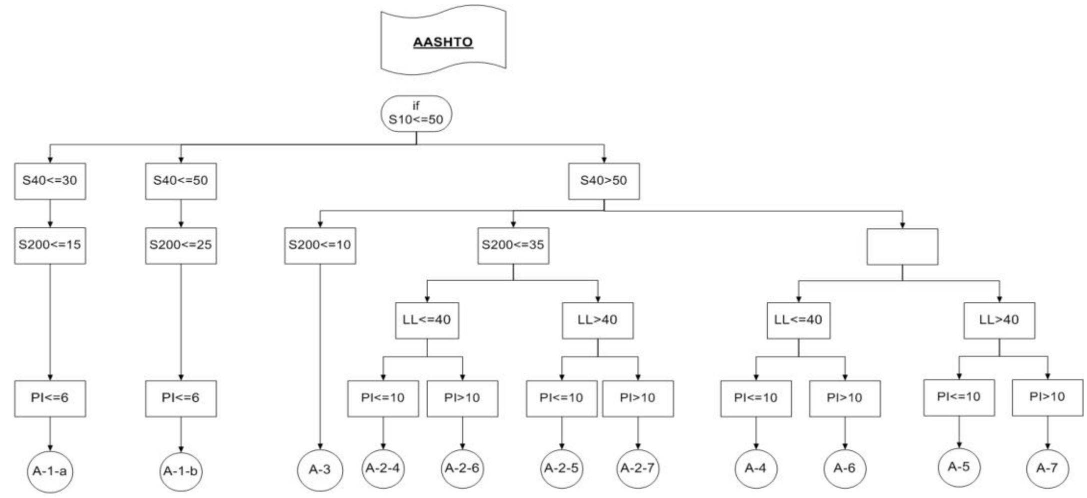

Fig. 3. Flowchart for AASHTO soil classification system[7]

Fig. 4. Main Screen

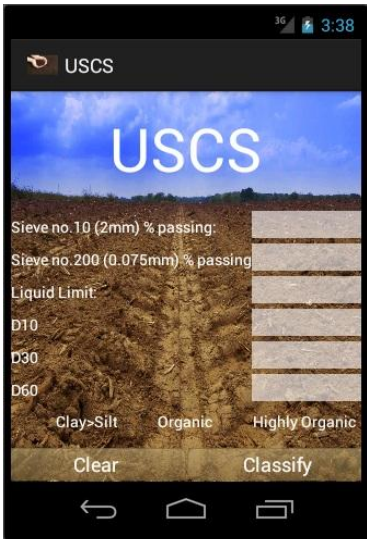

Fig. 5. USCS

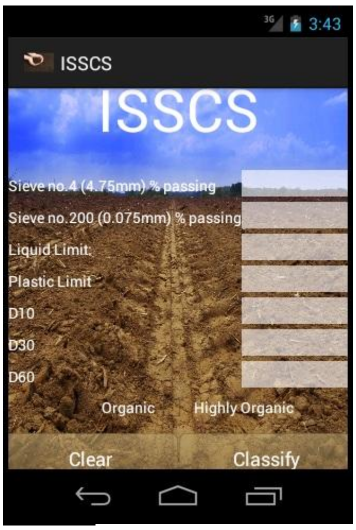

Fig 6. ISSCS

Fig 7. AASHTO

3.1.3. ISSCS:

The input parameters taken for this classification systems, as shown in **Fig. 6**, were:

i. Percentage passing from sieve no. 4
ii. Percentage passing from sieve no. 200
iii. liquid limit
iv. plastic limit
v. D_{10}
vi. D_{30}
vii. D_{60}

3.1.4. AASHTO:

The input parameters taken for this classification systems, as shown in **Fig. 7**, were:

i. Percentage passing from sieve no. 10
ii. Percentage passing from sieve no. 40
iii. sieve no. 200
iv. liquid limit
v. plastic limit

3.2. Examples to demonstrate the working:

3.2.1. USCS: Taking sample values of the following, results are given in **Fig. 8**:

a) Percentage passing from sieve no. 10=34
b) Percentage passing from sieve no. 200=23
c) Liquid Limit=34
d) D_{10}=23
e) D_{30}=43
f) D_{60}=56

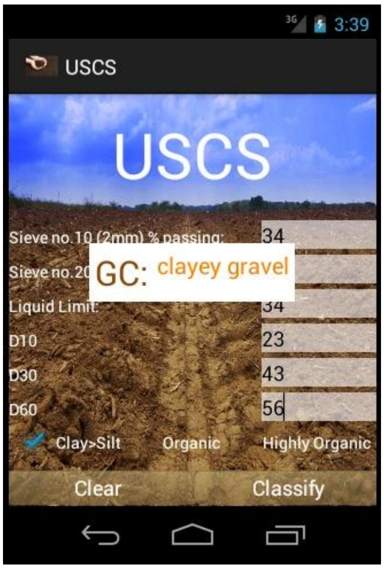

Fig. 8. Results in USCS

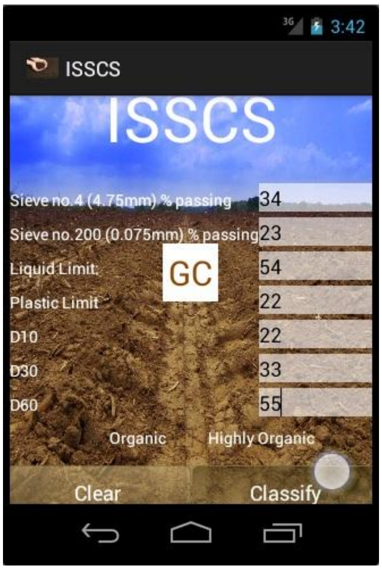

Fig. 9. Results in ISSCS

3.2.2. ISSCS: Taking sample values of the following, results are given in **Fig. 9:**

a) Percentage passing from sieve no. 4=34
b) Percentage passing from sieve no. 200=23
c) Liquid Limit=54
d) Plastic Limit=22
e) D_{10}=22
f) D_{30}=33

g) D60=55

3.2.3. AASHTO: Taking sample values of the following, results are given in **Fig. 10:**

a) Percentage passing from sieve no. 10= 56
b) Percentage passing from sieve no. 40= 22
c) Percentage passing from sieve no. 200= 23
d) Liquid Limit= 34
e) Plastic Limit= 3

Fig 10. Results using AASHTO

4. CONCLUSION

This topic needs to be worked upon, as it will be helpful to most of the geotechnical engineers. There are several tasks that can be accomplished using the technology of Android to decrease the load of our engineers. Many more functions of Android operating system can be utilized for the same purpose.

5. REFERENCES

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