

FIREBASE AS A BACKEND SERVICE IN MOBILE AND WEB APPLICATION DEVELOPMENT*

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Abstract

Nowadays, mobile applications are widely used in organizations. Moreover, mobile applications have become more and more reliant upon large amount of database and unorganized data such as videos, images, audio, text, files and other arbitrary types. It is difficult for Relational Database Management System (RDBMS) to handle the unstructured data. Firebase is a powerful web and mobile application platform to solve the key challenges of app development. This platform is a Backend-as-a-Service (BaaS) solution both for mobile and web-based applications. Moreover, firebase is a relatively new technology for handling large amount of unstructured data. It is very fast when compared to RDBMS. This paper develops a university student attendance system using Firebase and intend its concepts, related terminologies, advantages and limitations. Student attendance systems rely on large amount of database, require prompt system responses and the number of user access to the applications is unpredictable. Therefore, student attendance system was developed to demonstrate the real-time affordances of Firebase and its features.

Keywords: Firebase, Mobile app, Cloud storage, NoSQL, Student Attendance System

Introduction

In today society, everyone uses mobile phones and daily operations of organizations can be expanded by implementing a number of businesses as a mobile application. In this paper, we look to create an application and determine how useful Firebase is, in the case of development of student attendance system. This paper implements an application with which teachers can easily record student attendance using their mobile phones. In addition to collecting a class attendance, the application also allows teachers to record their personal information, check their daily class schedule, review the attendance list at any time, submit daily attendance to department head and send/read department notifications. There are about 1,000 teachers who are in charge of teaching at a university, and the number of times they can access information from the app is unpredictable. Therefore, every time data is read/ written into a database, the cost may increase. To solve these problems, we tried to develop a mobile app with Firebase.

Firebase is a toolset to “build, improve, and grow app”, and the tools cover a large portion of the services that developers would normally have to build themselves, because they had rather be focusing on the app experience itself. This includes application analytics, authentication, databases, configuration, file storage, push messaging, and the list goes on. The services are hosted in the cloud, and scale with little to no effort on the part of the developer.

Therefore, this paper aims to implement a Student Attendance System for all universities. The system will be implemented using the services provided by Firebase. This paper will show the use of Firebase services. In addition, the implemented student attendance system will be available at all universities.

The paper is structured as follows. Section 2 briefly presents the basic concepts and services of Firebase. Section 3 presents the related work. Section 4 describes the application

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development: the implementation stage is depicted in detail. Section 5 is result and discussion. Finally, section 6 concludes the paper.

Firebase

Firebase was established by Andrew Lee and James Tamplin in 2011 and launched formally in April 2012. Started as a realtime database, now Firebase has 18 services (4 of them currently in beta), and dedicated APIs.

The Firebase platform is a Backend-as-a-Service (BaaS) solution both for mobile and web-based applications. Firebase services include features building, testing, and managing apps. With easy development, Firebase developers can focus more on crafting fantastic user experiences. Developers do not have to manage servers and write APIs. Firebase serves as a server for API and data store. The most important feature of Firebase is its generality that allows developers to modify it to suit their needs. Additionally, developers will occasionally need to use other bits of the Google Cloud for their advanced applications.

Firebase is suitable for developing student attendance systems because it is a useful framework for building portable and web applications for businesses which require real-time database which means when one user updates a record in the database, the update should be conveyed to every single user instantly. A host of other Google features packed- in with the service gives a basic and unified platform to many applications along with. Firebase handles most of the server-side work when it comes to the development of applications. Firebase has several elements that helps maintain a state of harmony between the developer and the client by causing minimal delay of work. Firebase has several features that make this platform essential as shown in Figure 1. These features include unlimited analytics and reporting, cloud messaging, authentication and hosting.

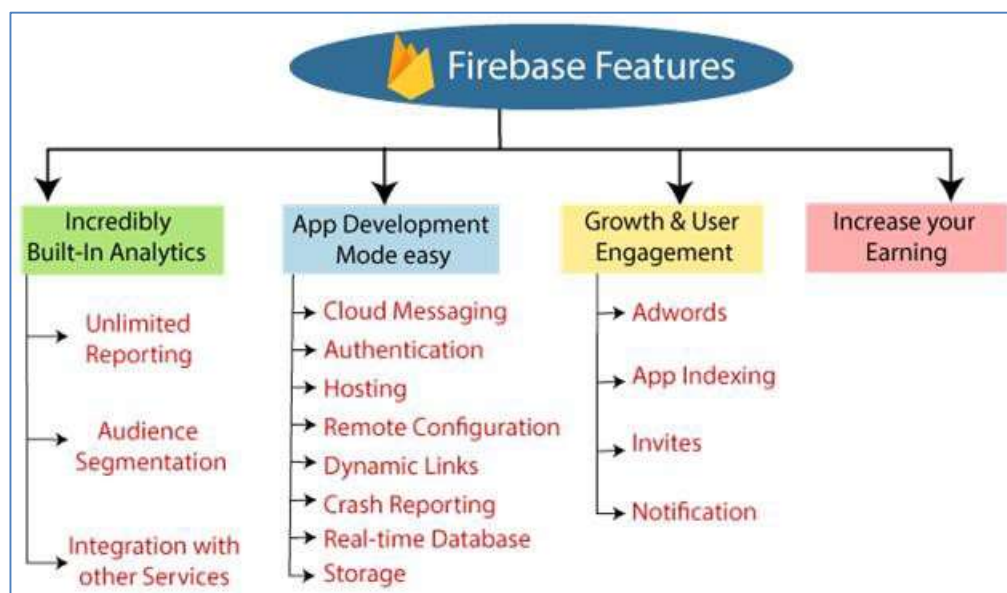


Figure 1 Available Firebase Features

There are many services that can be integrated to our application to enable the features, some of the services. Services such as (1) Authentication, (2) Hosting (3) Crash Reporting (4) Real-time Database (5) Analytics, and (6) Cloud messaging are used in implementing our proposed work.

Table 1 Firebase services

No.	Service	Description
1.	Authentication	Firestore has little friction with acclaimed authentication.
2.	Hosting	Firestore has little friction with acclaimed authentication.
3.	Crash Reporting	Prioritize and fix issues with powerful, real-time crash reporting.
4.	Real-time Database	It can store and sync app data in real-time.
5.	Analytics	Get free and unlimited app analytics.
6.	Cloud messaging	Firestore allows us to deliver and receive messages in a more reliable way across different platforms

Proposed Work

The system was implemented into two sides: Admin side and Teacher side. At admin side, professor or staff can set up all required information to use the system such as student information, teachers, courses, modules and timetables. Professors can also see daily, monthly and semester-based reports on student. At teacher side, a teacher can sign up for an account, check their weekly timetables and check student attendance. Admin side is a web-based application and teacher side is a mobile application with which teachers can easily check student attendance on their phone during the class. This is the part where Firestore is especially suitable for the system because data from the webapp needs to be effectively synchronized on the mobile app and Firestore supports it best. Details will be discussed along with the users interfaces shown below.

Professor or staff can login to their account and this user authentication can be easily done. Most tasks that can be done in professor and staff account are nearly the same but staffs cannot see attendance reports or cannot approve re-submission of attendance requests from teachers as professors can do. User can login to the system by the following firestore authentication code.

```

FirestoreAuth authentic=FirestoreAuth.getInstance();
authentic.signInWithEmailAndPassword(email, password)
.addOnCompleteListener(new OnCompleteListener())
{
  @Override
  public void onComplete (Task task)
  {
    if(task.isSuccessful())
    {
      FirestoreUser user=task.getResult().getUser();

      String email=user.getEmail();
      //...
    }
  }
});

```

Figure 2 is where professor can assign and view teacher to courses. If an assignment for a teacher is redundant for the same lecture time, the system will notify it to the professor and thus the professor can avoid redundant schedule assignment for the teachers.

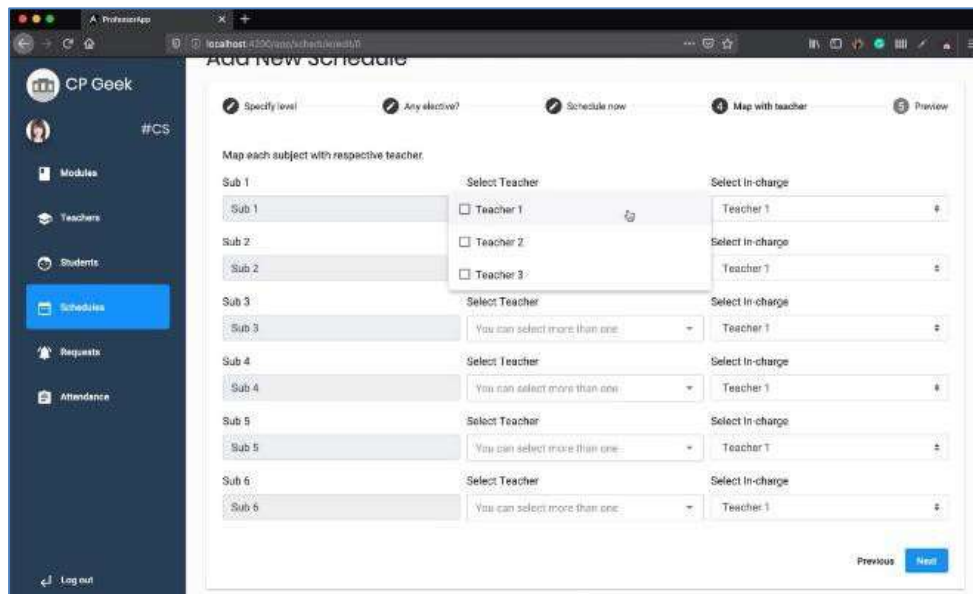


Figure 2 Assign Teacher to Course

Professor can approve or reject requests from staffs and teachers as shown in Figure 3. Requests from staffs can be made when they have submitted student data for use but need to edit student information due to their errors. Requests from teachers can happen when teachers want to modify student attendance for some reasons. After teachers have submitted daily student attendance to the professor, they cannot modify without professor permission. In that case professors can approve or reject those requests in the following form.

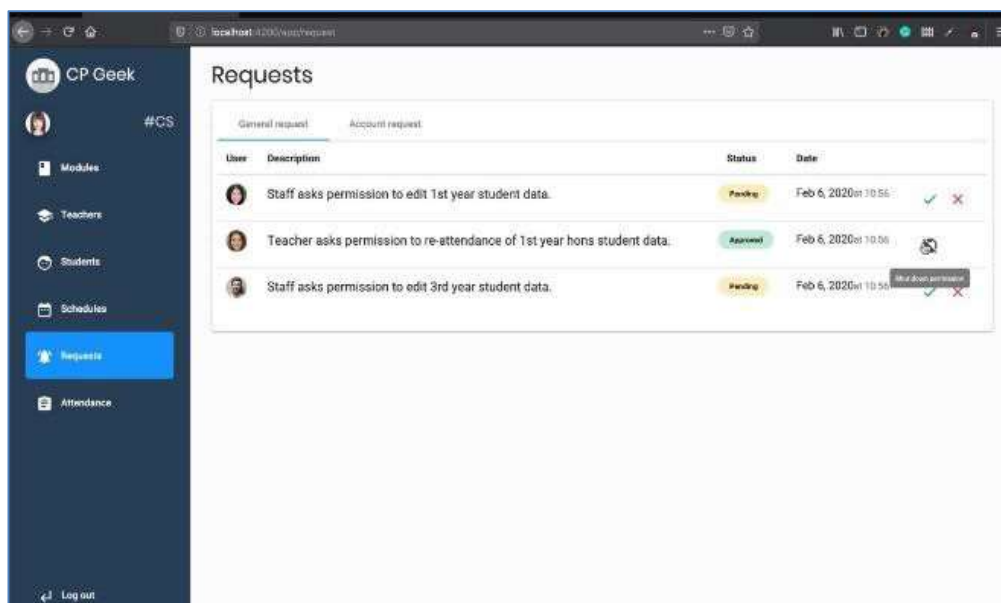


Figure 3 Approve/Reject Requests by Professor

In Figure 4, professor can select a class (second year, third year) and modules to see the attendance of the students.

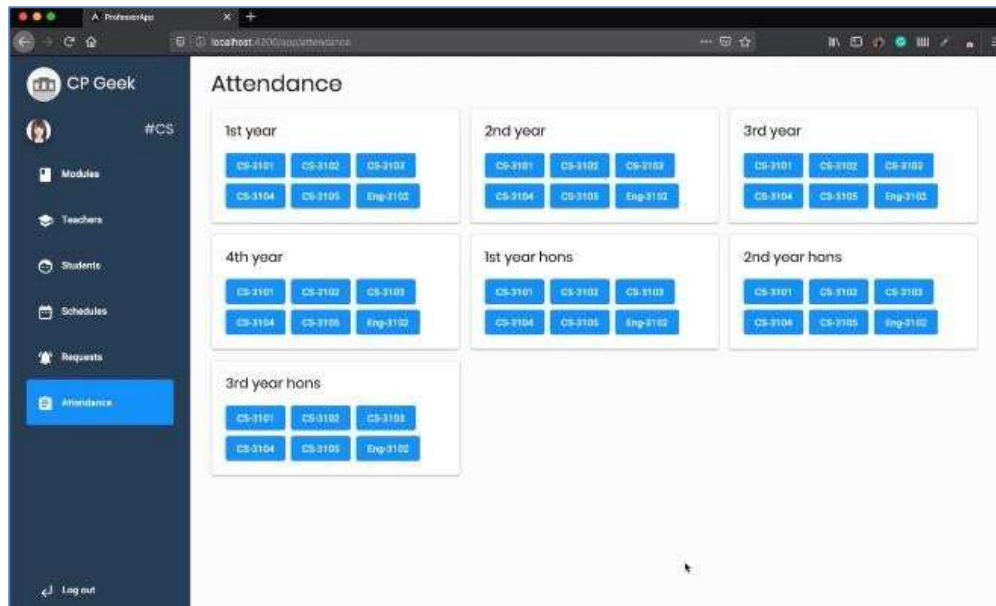


Figure 4 Select Class and Module to check student attendance

Professors can check student attendance by means of day, month and semester. They can also filter students with attendance under 75% or above. This attendance report (Figure 5) can be printed or exported to an excel file format.

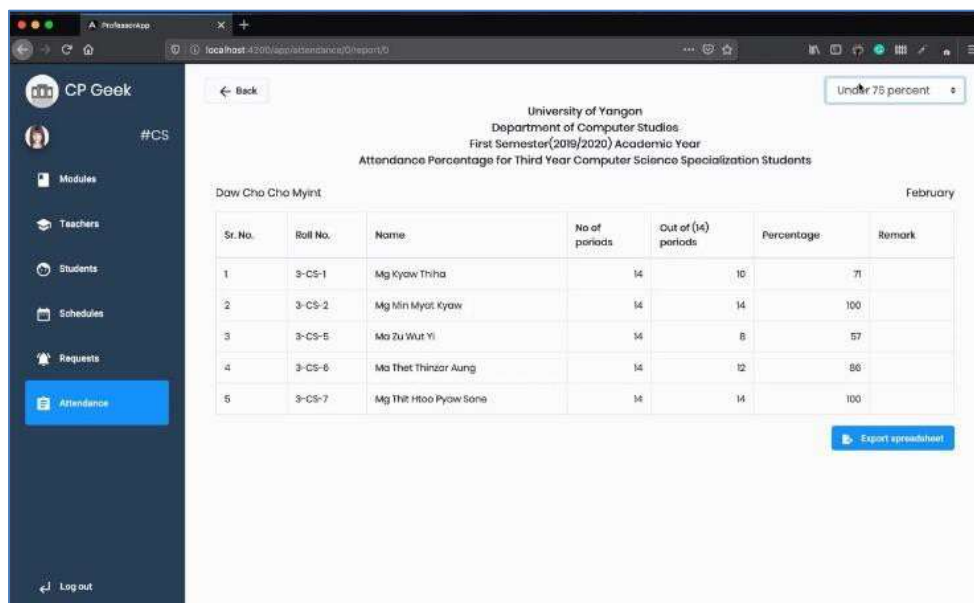


Figure 5 Attendance report

A teacher can sign up for an account on their mobile app. The following code can be used to add Firebase as a dependency to android project:

```
{ compile 'com.google.firebase:firebase-client-android:2.5.0+'
}
```

Once the Firebase and storage dependency are added to the application, Firebase storage and hosting tasks can be easily done with the following built in codes:

```

FirestoreStorage storageObj =FirestoreStorage.getInstance();
StorageReference fileRef = storageRef.child("filePath");

```

All departments have their staff data filled up before teachers use the mobile application. When a teacher signs up, the sign up information such as staff number and NRC number match with teacher information in the department staff database, the teacher account is approved and created. Teachers will be able to retrieve as the Figure 6.



Figure 6 Teacher profile page after signing up

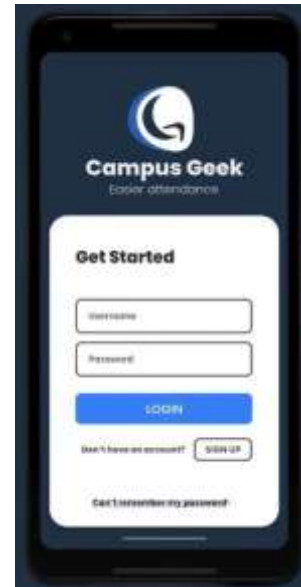


Figure 7 Teacher log in page.

A teacher can log in Figure 7 after signing up to the application. Data entry in signing up can be readily performed using the following code in Firebase:

Call: ref.push().setValue(object) or ref.setValue(object)

A teacher can check their weekly schedule (Figure 8 a) and daily schedule (Figure 8 b). Teachers can check and pay student attendance as in Figure 9. Each teacher can also view monthly report of student attendance as the Figure 10. Because of Firebase's auto synchronization web services, teachers can concurrently check their daily schedules and attendance report with almost no concurrency error. Teachers can also check notifications and announcement within the department as shown in Figure 11.

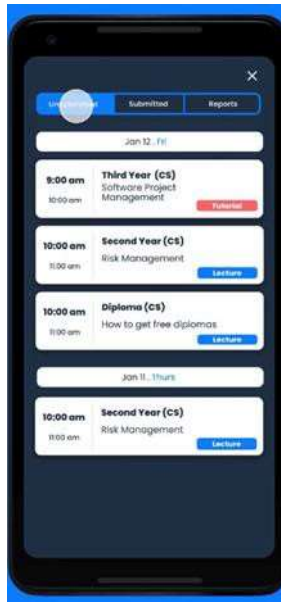


Figure 8 (a) Teacher weekly Schedule



Figure 8 (b) Teacher daily schedule

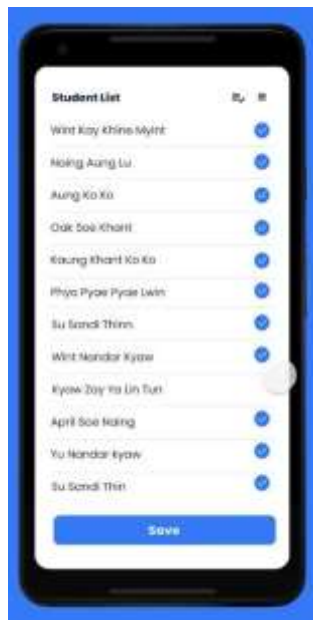


Figure 9 Check student attendance



Figure 10 Monthly student attendance percentage

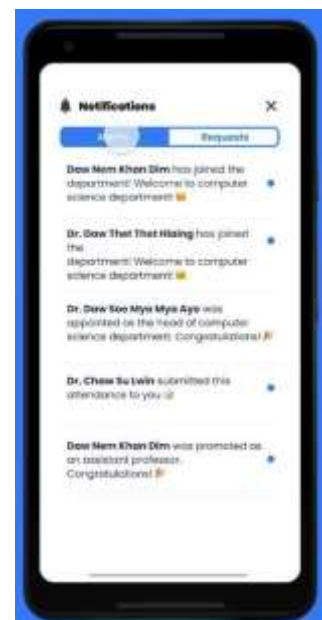


Figure 11 Notificaiton page

In Figure 12, admin can see detail app analytics; how many users are using, current quota period and how many transactions occur over time. The analytics show the number of database read/write transanctions on which database costs can be estimated.

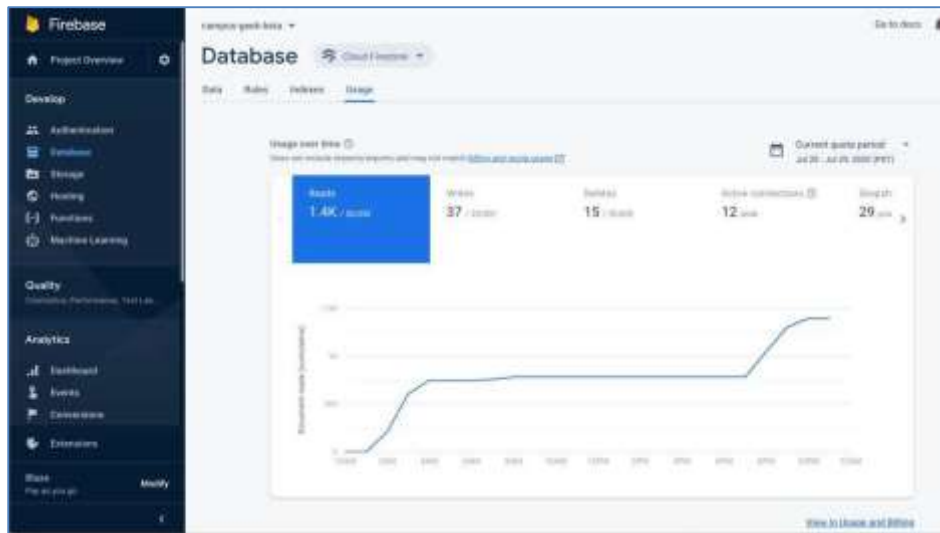


Figure 12 User feedback analytics on the proposed work

Results and Discussion

A pilot study was conducted at Department of Computer Studies, University of Yangon (YUCS). During the study, professor, Department staff and teachers from YUCS use the system performing their respective tasks, and record their feedbacks regarding their experiences in using the system and answer some follow up questions. The pilot study took one month.

The proposed system receive positive comments from users. The efficiency in doing tasks and user experiences are greatly appreciated by the users. Users found it easy to learn and use the system. User satisfaction, fatigue, ease of learn, ease of use of the system are recorded using a seven-point Likert scale after the pilot study (for example, 1 for not satisfied at all and 7 for very satisfied).

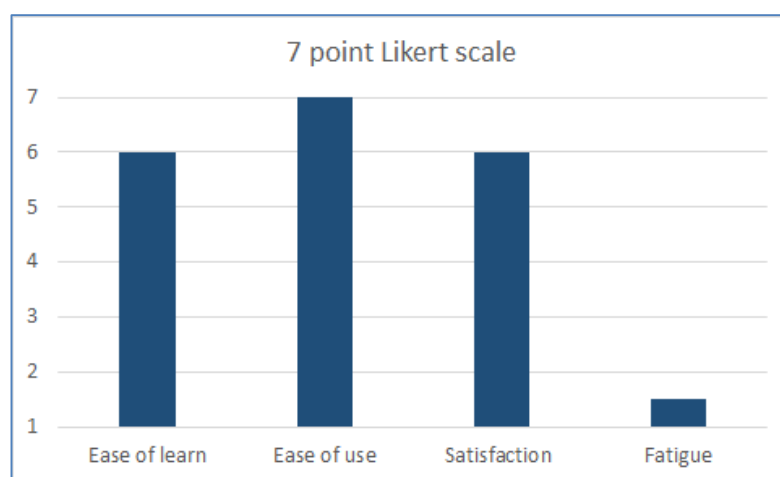


Figure 13 User feedback on the system

In Figure 13, users gave high rating for all items: ease to learn, ease to use and user satisfaction. Less score in fatigue means that the system offered good users experience that users feel less stressed and tired using the system.

Subjective comments from users were also analyzed to find opportunities for improvements of the system. Some users suggest to add export function for attendance report at

teacher side too. Some other users suggest to link the system to other school software such as HR management and student registration system so that some tasks for data entry can be reduced at the current system. Some other users also suggest to consider about teachers transfer so that the system can be used for any University in Myanmar. Those comments and suggestions will be considered for further improvement of the system in the future. Firebase framework is oriented toward real-time and synchronization and there is a few limitation in data migration because there can be restriction in exporting data from servers that users do not own.

Conclusion

This paper demonstrates the use of Firebase framework to develop a student attendance system that is a portable web application which require real-time database transactions. Affordable services in Firebase eases the development processes. Also, the proposed system receives positive feedback and receptivity from its potential users. The contributions of this paper are the demonstrations of implementation of a mobile web application using Firebase services and a student attendance system that can be used in all universities. The present study was conducted and the proposed system was pilot tested in Yangon University. In the future, current work will be extended to test the system in other universities to better understand the affordances and limitations of Firebase.

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