

# Mobile App for Stock Prediction Using Improved Multiple Linear Regression

Abidatul Izzah

Informatics Engineering  
Polytechnic of Kediri  
Kediri, Indonesia  
abidatul.izzah90@poltek-  
kediri.ac.id

Yuita Arum Sari

Computer Science  
Brawijaya University  
Malang, Indonesia  
yuita@ub.ac.id

Ratna Widyastuti

Informatics Engineering  
Polytechnic of Kediri  
Kediri, Indonesia  
ratna.widya@poltek-  
kediri.ac.id

Toga Aldila Cinderatama

Informatics Engineering  
Polytechnic of Kediri  
Kediri, Indonesia  
togaaldila@poltek-kediri.ac.id

**Abstract**—Stock Prediction is developed in both of two studies, economics, and data mining. Stock predictions got special attention due to its importance for creating a more effective and efficient planning. In this study, Improved Multiple Linear Regression (IMLR) was built into a mobile application based android platform for stock price prediction. IMLR is a hybrid Multiple Linear Regression with Moving Average technique. The app was built in several steps, which are requirement analysis, system design, implementation, and testing. Data were collected from the [finance.yahoo.com](http://finance.yahoo.com) page with category "Jakarta Composite Index (^JKSE)" which were automatically taken by using Yahoo Finance API. In this app, users not only could see daily stock history but also stock price predictions in real time. The mobile app accuracy prediction give the better result than the common algorithm with the value are 15087.465 in MSE, 122.831 in RMSE, and 3.255 in MAPE.

**Keywords**—Android, Mobile App, Moving Average, Prediction, Regression, Stock

## I. INTRODUCTION

Stock price prediction is very important not only for the businessman but also common people [1]. Stock market is affected by economic, political, financial, social factors and noises, meanwhile the stock prices may have different features over different time horizons [2]. Stock markets always aggressive and very difficult to predict the future stock price of the companies since it keeps fluctuating every day. The booming prediction of a stock's future price could give important profit. In data mining, a number of algorithms were designed to overcome this in certitude [3]. However, they have been developed for stock prediction purposes, in reality, it is still required a tool which could give future stock information easily such as mobile app. Millions of apps exist that support user in multiple ways, e.g., for business planning purposes and even for controlling whole business processes [4]. Furthermore, creating mobile apps for stock prediction analysis using robust algorithm could be an innovation and useful apps.

The clustering and regression are the two techniques of data mining [3] to predict stock market. It stated that hybrid K-Means clustering technique and multiple linear regression used for getting the future stock price. Meanwhile, in comparison of

K-Means and Moving Average (MA), MA could perform better than K-Means in regression due to predicting stock market [5]. Based on the advantages of this, the hybrid MA and multiple linear regression, called Improved Multiple Linear Regression (IMLR), have great potential to be developed in such kind of mobile apps for stock prediction. So in this paper, IMLR has been developed into mobile apps android platform for stock prediction analysis. Furthermore, the steps of developing mobile app based on IMLRS were requirement analysis, design system and implement program listing and prototype functional analysis requirement test.

## II. ANDROID APPLICATION DEVELOPMENT

Mobile applications have rapidly caught up in recent times since app stores were made for the mobile phones developers have to be more creative. In this paper, IMLRS has been developed into mobile apps android platform for stock prediction analysis in creating apps for different operating system and platforms [6]. Android is an operating system for linux-based mobile devices including operating systems, middleware, and applications. Android provides an open platform for developers. According to [7], Android is referred to as the first complete, open, and free model platform for the following reasons:

- **Complete (Complete Platform):** The developer can take a comprehensive approach when they are developing the Android platform.
- **Open (Open Source Platform):** The Android platform is provided through an open source license. Developers can freely develop applications.
- **Free (Free Platform):** Android is a free platform in development. No licenses or royalty fees to develop on the Android platform. In addition, there are no membership fees, contracts, and testing fees. Applications for android can be distributed and traded in any form.

In order to develop an android app using the Java programming language, Android Software Development Kit (Android SDK) is required. It provides tools and API for

building android apps. Until this research has been proposed, several android versions have been launched and the most recent version is oreo [8].

Android operating system is a stack of software components which is roughly divided into five sections and four main layers as shown in Figure 1. Each layer of the lower encapsulation provides call interface to the upper layer. At the top layer, we will find all the Android application. All the API framework of the core programs can be easily accessed by developers and can be modified to meet their own needs. Next, the application framework makes easier to understand the reuse of its components. The library is divided into two main elements: Android Runtime and Android Library. Android Runtime is made up of a Core Java Libraries and Dalvik virtual machine. Android system library is reinforced the application framework, it is also a main connection linking between application framework and Linux Kernel. Also, the kernel takes care of all the things that Linux is great at such as networking and a huge array of device drivers, which take the burden out of interfacing to peripheral hardware. The kernel system provides the operations such as internal storage, process management, internet protocol, bottom-drive and other core service are all based on Linux kernel [9].

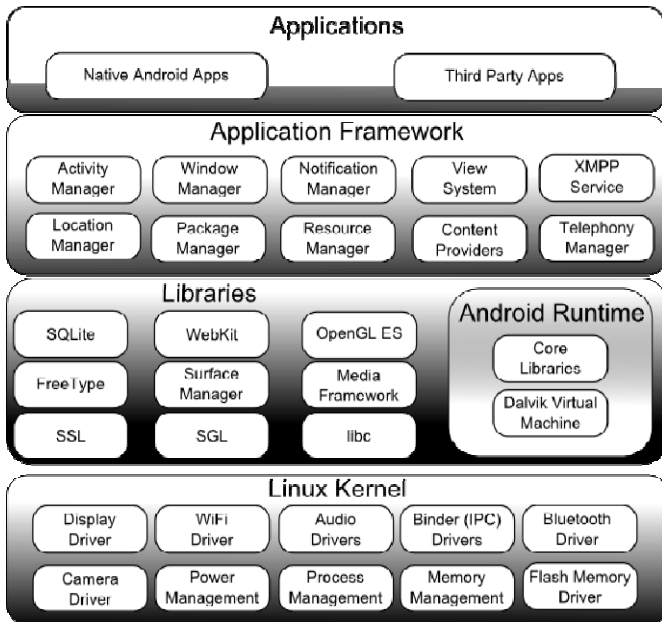


Fig. 1. Android Architecture (Source: www.technopia.com)

### III. IMPROVED MULTIPLE LINEAR REGRESSION

Regression is used for predicting an outcome based on a given input. The simplest regression technique called linear regression and the advanced one called multiple regression. It depends on variable. If a single descriptive variable is being used, it is known as simple linear regression and if more than one descriptive variable is used when the technique is multiple regression. The multiple linear regression predicts the future value of variable ( $\hat{Y}$ ) with respect to other variables ( $X_i$ ) using Eq 1.

$$\hat{Y} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n \quad (1)$$

Where  $\beta_0, \beta_1, \beta_2, \dots, \beta_n$  are co-efficient that can be calculated using Eq 2.

$$\beta = (X^T X)^{-1} X^T Y \quad (2)$$

This multiple linear regression will be hybrid by moving average to avoid data outlier [5]. Moving is an arithmetic moving average calculated by adding the closing price of the security for a number of time periods and then dividing this total by the number of time periods. Moving average is applied based Eq. 3

$$\bar{X}_n = \frac{\sum_{i=1}^n X_i}{n} \quad (3)$$

This improved method can be stated in pseudo code below:

```

Start
input history data as X, n
init N as number of data object X, beta, y';
for i=1:N
    get X(1:n,:)
    Calculate beta using (2)
    Calculate y' using (1)
    Smooth y' using (3)
endfor
end

```

### IV. SYSTEM ANALYSIS AND DESIGN

This research was started by identifying problem. It is a needed to collect information and apps requirement. As shown in Fig. 2, it is seen as flowing steadily downwards (like a waterfall) through the phases of analysis, design, coding, testing, and maintenance.

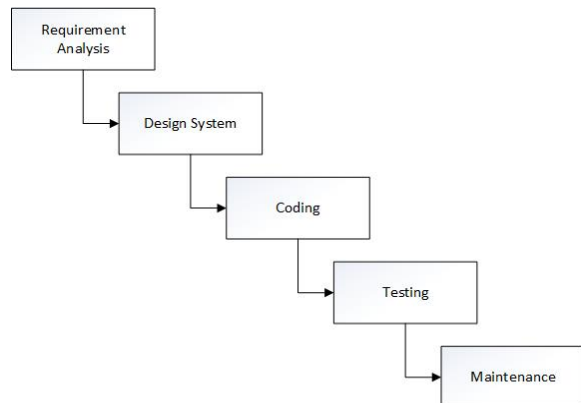


Fig. 2. System Development Method

The system was designed using client-server architecture. The database system performed on the server side, while the forecasting step based on improved multiple linear regression

performed on the client side (mobile app) as depicted in Figure 3.

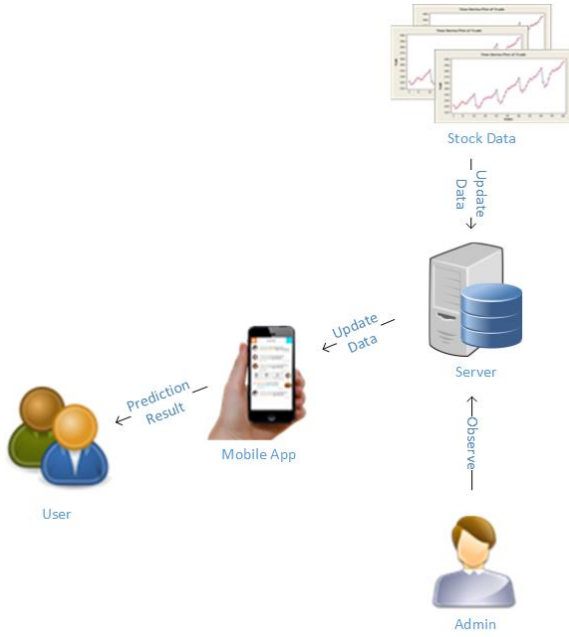


Fig. 3. System Architecture

Furthermore, the system is designed for administrator and user. Administrator not only can login and logout on server to manage master data but also can collect and observe the stock data from yahoo finance page directly. Meanwhile, the user will get stock information about historical data and predictive data. The requirement analysis is depicted in Figure 4. All of historical data will be save in database server. Each historical record will save unique date and several variable i.e. open, high, low, last trade, change, and percent. The design of entity relationship diagram for the recommendation system database is depicted in Fig. 5.

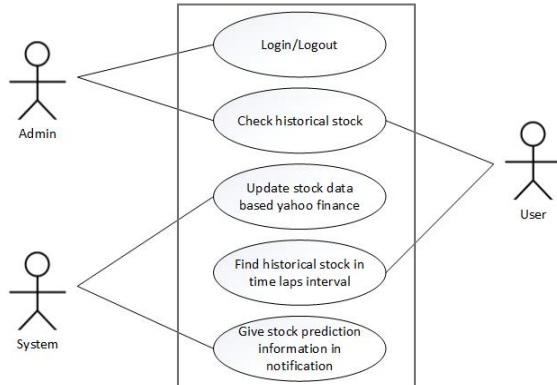


Fig. 4. System Use Case

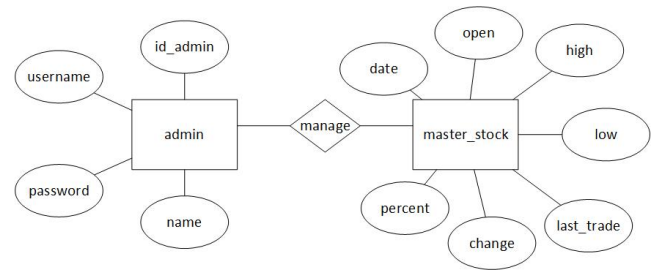


Fig. 5. Entity Relationship Diagram

## V. EXPERIMENT

### A. Data

Data is collected from the finance.yahoo.com page with category "Jakarta Composite Index (^ JCI)". Data was automatically taken by Yahoo Finance API. The IDX Composite, also called Jakarta Composite Index, is an index of all stocks that are traded on the Indonesia Stock Exchange (IDX). In Indonesian, the index is called the *Indeks Harga Saham Gabungan* (IHSG). The historical stock of JCI can access real-time using this source code:

```
$s = file_get_contents("http://finance.yahoo.com/d/quotes.csv?s=^JKSE&f=d1ohg11vc1p2&e=.csv");
```

Historical stock will be saved on server and displayed on mobile apps. Moreover, it will be preprocessed before forecast. Preprocessing data was got from historical data in five days before current time to build a model regression. Thus, the model will be used to predict the stock today. Figure 6 present how to find the model based improved multiple linear regression.

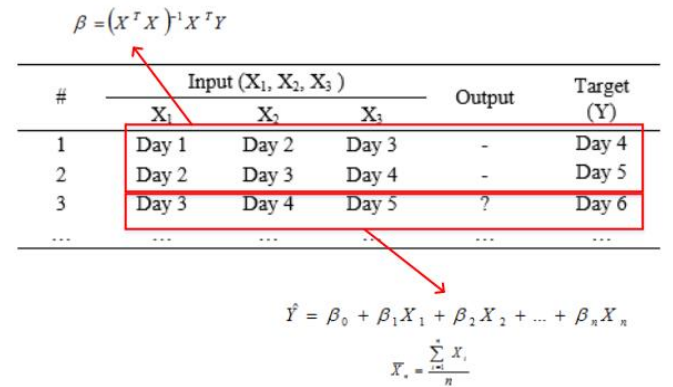


Fig. 6. Data Modelling

### B. Result and Testing

The system was tested using predefined functional requirement. It involves all features for administrator and user. The administrator will manage master data using a web-based system. But, irrelevant testing in administrator side will be ignored in this scene to keep its simplicity. The mobile apps will be elucidated to test and discuss in this paper. First of all, the apps home interface is shown in Fig. 7.



Fig. 7. Home Application

Home application interface contains index stock for today at that current time. There is two buttons for move to any activity. The first button will show all index in time laps interval. How to get all index (not only tommy) in time laps is depicted in Figure 8. The second one will show stock prediction for today. The result prediction will be shown by pressing the button or getting a notification. How to get stock predictive value is depicted in Fig. 9.

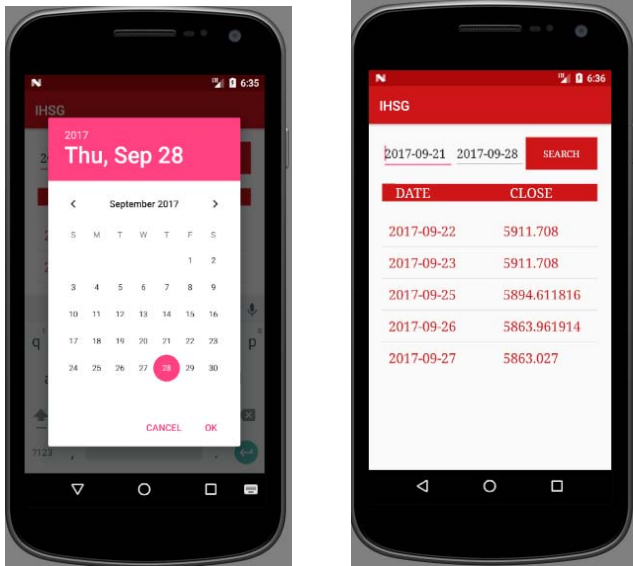


Fig. 8. Getting historical stock in time laps interval

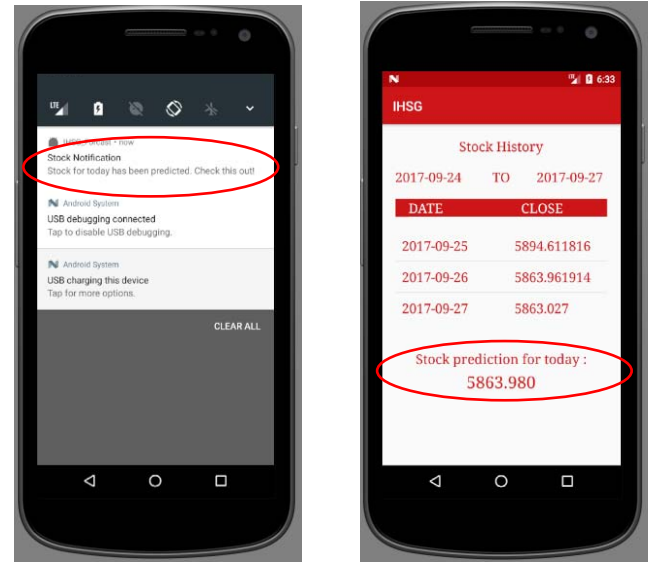


Fig. 9. Stock Prediction Notification

After the user functional requirement has been created, finally the system will be tested using black box system. The result is shown in Table 1

TABLE I. BLACK BOX TESTING

Feature	Available
Administrator can login/logout into server	Yes
Administrator can check historical stock on web-based system	Yes
Users can check historical stock on android-based system	Yes
System can update stock data based yahoo finance	Yes
Users can find historical stock in time laps interval	Yes
System can give stock prediction information in notification	Yes

### C. Discussion

After testing the app, we also discuss the prediction accuracy. To know about that, the apps were test on stock data on January 2, 2013 until December 21, 2015. Data is being used in this experiment were same as the previous one [5] so the result can be compared. In [5], the IMLR algorithm has been simulated and compared with the common MLR using Matlab. And now we will test the algorithm again in mobile app. And the result can be shown in Table II. Based on the result, it can be concluded that the functional algorithm has been successful to be implemented in mobile apps.

TABLE II. RESULT COMPARISON

	Simulation		Mobile Apps
	MLR	IMLR	
MSE	26849.807	15087.465	15087.465
RMSE	163.859	122.831	122.831
MAPE	5.754	3.255	3.255

## VI. CONCLUSIONS

In this paper, a mobile application for stock prediction has been created. The apps are based on improved multiple linear regression as prediction algorithm. An Android-based mobile device can effectively give an information about historical data and predictive data for user. The system is designed for administrator and user. Administrator can login and logout on server to manage master data while collect and observe stock data from yahoo finance page at the same time. While user will get stock information about historical data and predictive data. The result shows that all of user requirements has been provided in apps.

## REFERENCES

- [1] A. Nayak, M.Pai, R. Pai, "Prediction Models for Indian Stock Market". In *Procedia Computer Science*, Vol. 89, pp. 441–449, 2016
- [2] W. Fenghua, X. Jihong, H. Zhifang, G. Xu, "Stock Price Prediction Based on SSA and SVM" in *Procedia Computer Science*, Vol. 31, pp 625-631, 2014
- [3] Bini, T. Mathew, "Clustering And Regression Techniques For Stock Prediction", in *Procedia Technology*, Vol. 24, pp. 1248–1255, 2016
- [4] F. Elberzagher, K. Holl, "Towards Automated Capturing and Processing of User Feedback for Optimizing Mobile Apps", in *Procedia Computer Science*, Vol. 110C, pp. 215–221, 2017
- [5] A. Izzah, R. Widyastuti, "Prediksi Harga Saham Menggunakan Improved Multiple Linear Regression Untuk Pencegahan Data Outlier", *KINETIK*, Vol. 2, No. 3, pp. 141-150, 2017
- [6] A. Khandeparkar, R. Gupta, B. Sindhya, "An Introduction to Hybrid Platform Mobile Application Development", *International Journal of Computer Applications*, Vol. 118, no.15, 2015
- [7] W.M. Lee, "Beginning Android Application Development 1st Edition, Kindle Edition", John Wiley and Sons Inc., 2012
- [8] *Android Open Wonder, Introducing Android 8.0 Oreo*, in page <https://www.android.com/versions/oreo-8-0/>, accessed on Sept 20, 2017
- [9] A. Singh, S. Sharma, S. Singh, "Android Application Development using Android Studio and PHP Framework", *International Journal of Computer Applications*, Vol. xx, no. xx, 2016.
- [9] X. Shu, Z. Du, R. Chen, "Research on Mobile Location Service Design Based on Android", in *Conference: Wireless Communications, Networking and Mobile Computing*, 2009.