

# Software Design Document of SSM

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## 1 Introduction

### 1.1 Purpose

In this document we're stating the main (non)functional requirements as well as targeting our main audience. This software design document describes the architecture and system design of SSM. Our audience are the social media platforms e.g. Facebook, Twitter, etc.

### 1.2 Scope

Social Media platforms will benefit from our software as cyberbullying rates will drop. This application will be held by July, 2019 and will cost zero pounds; since its done for academic purposes.

### 1.3 Overview

Our document is organized as follows: System Overview, System Architecture, Data Design, Component Design, Human Interface Design, and Requirements Matrix. Our software will work on reducing the cyberbullying rates and make sure the social media is a safe place for everyone to feel free and express their words freely without humiliating other people.

### 1.4 Reference Material

- 1) Cyberbullying System Detection and Analysis
- 2) Experts and Machines Against Bullies A Hybrid Approach to Detect Cyberbullies
- 3) Cyberbullying Detection using Time Series Modeling
- 4) Machine Learning Approach for Detection of Cyber-Aggressive Comments by Peers on Social Media Network
- 5) SDD-HCI- Professor Doctor Ayman Ezzat

## 1.5 Definitions and Acronyms

Term	Definition
Software Design Document (SDD)	Used as the primary medium for communicating software design information.
SSM	Safe Social Media.
Activity Diagram	is a graphical representation of an executed set of procedural system activities and considered a state chart diagram variation.
Sequence Diagram	represents object collaboration and is used to define event sequences between objects for a certain outcome.
SVM	Support Vector Machine.
Design Entity	An element of a design that is structurally and functionally distinct from other elements.

## 2 System Overview

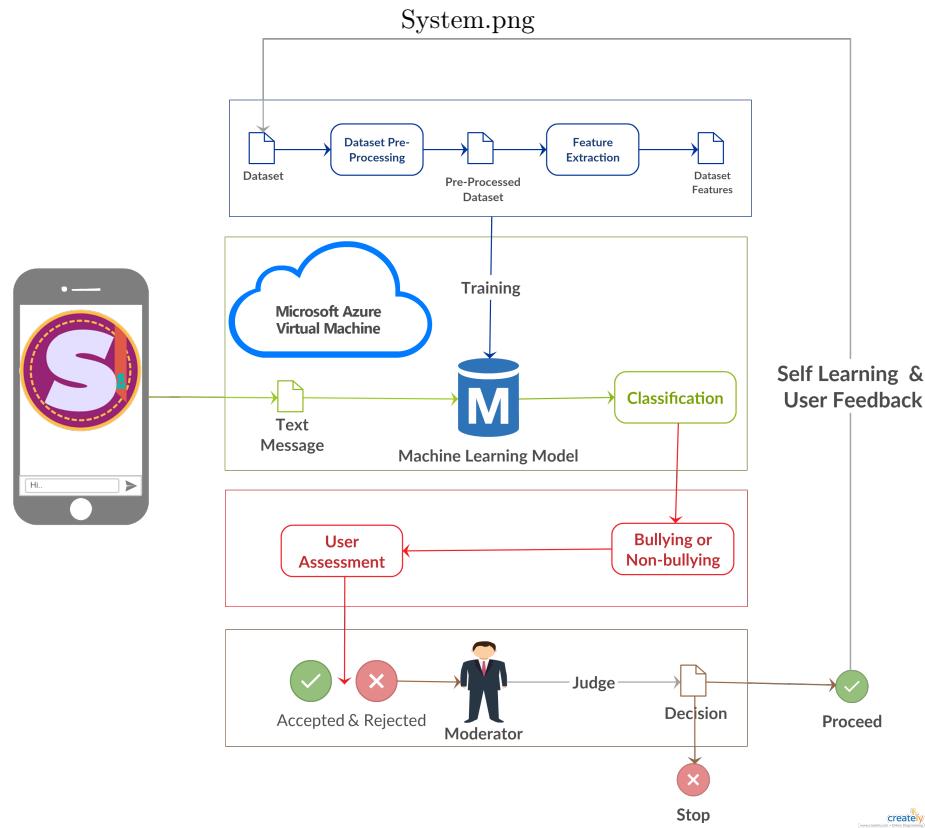


Figure 1: System overview

In order to reach high accuracy in detecting cyberbullying. We developed a system that consists of five stages.

- 1)Pre-processing
- 2)Feature Extraction that consists of three stages
- 3)Training and testing
- 4)Classifying
- 5)Self learning

## **2.1 Pre-processing**

In this stage we have six phases

- 1) Tokenize every word in the text
- 2) Lower the letters
- 3) Correct the words that are incorrect
- 4) Put every word to its root
- 5) Remove any code in the text
- 6) Remove the stop words.

## **2.2 Feature extraction**

We are using TFIDF and sentiment analysis to decrease the false positive instances in the detection of cyberbullying.

## **2.3 Training and testing**

We are using the results of our Feature extraction to train our model and then perform prediction into untested corpus.

## **2.4 Classification**

When the Application sends the text to the SVM classifier, then the classifier will send the result of the classification if it is cyberbullying or not. In addition to the feed forward neural network classification.

## **2.5 Self-learning**

Both accepted and rejected assessments by the user will be taken into consideration but not all of them will be taken once more to our dataset to complete the process of self-learning.

### 3 System Architecture

#### 3.1 Architectural Design

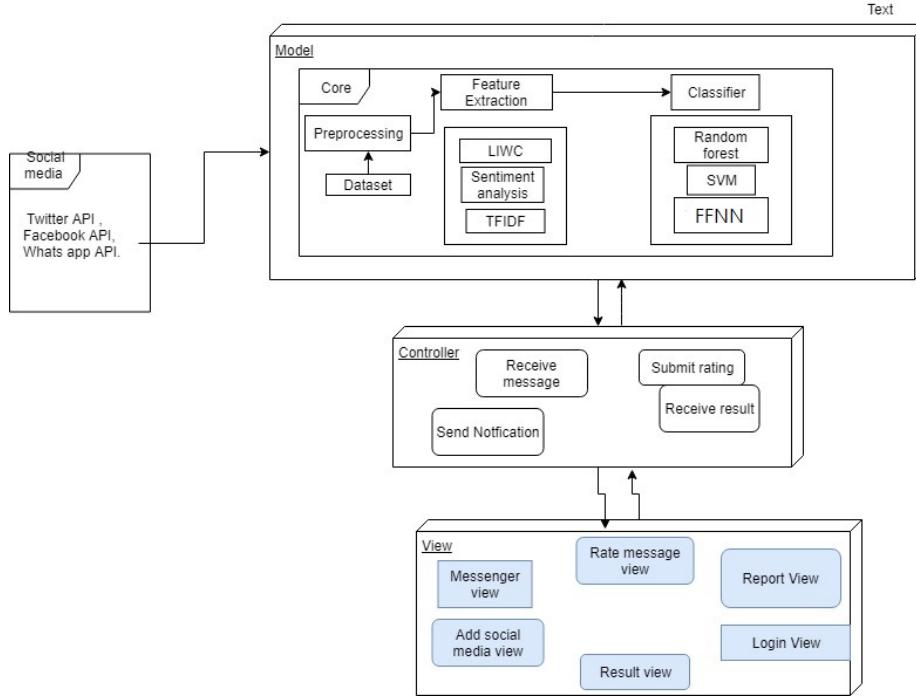


Figure 2: System Architecture

##### 3.1.1 Model

**Pre-Processing:** it is the first module that consists of 4 parts

- 1-Toknization: the first phase that separate each word in the dataset to differentiate between significant words and non-significant words.
- 2-Stop Words Removal: Natural language toolkit to detect and remove the non-significant words like (and, a, an).
- 3-Stemming: a process that return every word to its root word.
- 4-Word Correction :it takes the word and correct the spelling mistakes in it using Bing API.

**Feature Extraction:** features are extracted from the document before feeding in the classifier and it is consists of two parts.

1-TFIDF: Short for term frequency inverse document frequency, is a numerical statistic that is intended to reflect how important a word is to a document.

**2-Sentiment Analysis:** The process of computationally identifying and categorizing opinions expressed in a piece of text, especially in order to determine whether the writer's attitude towards a particular topic, product, etc.: is positive, negative, or neutral.

**Classification:** In this part the extracted features are sent to classifiers for classification. 1-Support-Vector Machines (SVMs, also support-vector networks): are supervised learning models with associated learning algorithms that analyze data used for classification and regression analysis.

**2-FeedForward Neural Network:** feedforward neural network is an artificial neural network wherein connections between the nodes do not form a cycle, also is one of the simplest neural network.

### 3.1.2 Controller

Controller acts on both model and view. It controls all data in the model and updates the view whenever any data change occurs. It is responsible for keeping the model separated from the views section. It handles all the data produced from the Pre-processing, feature extraction, and classification then updating the interfaces takes place.

### 3.1.3 View

This section represents the user mobile interfaces loaded by the system and providing the a chatting application the detect cyberbullying in the chat then it will make the user rate the classification.

**Rating View:** This view will allow the user to assess and send his feedback whether it is acceptance or rejection.

**Login view :** It will allow the user login with his user name and password.

**Add social media view:** Will allow the user to add whatsapp, messenger, or twitter to our app.

**Messenger view:** Will allow to chat in this view.

**Result view:** Will show the user the result of the classification of message.

## 3.2 Decomposition description

### 3.2.1 Class diagram

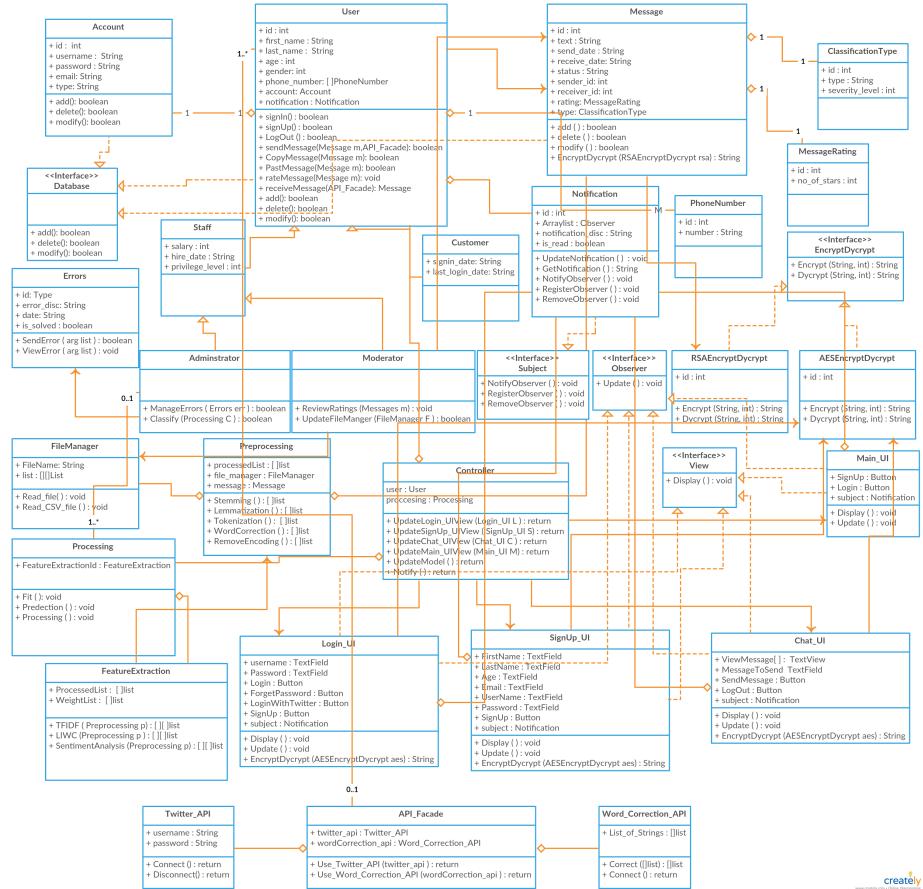


Figure 3: Class diagram

### 3.2.2 MVC Design Pattern

We are using MVC to make every part of the system at its own and that helps for creating many views as we want to make mobile application and desktop application.

### 3.2.3 Facade Design Pattern

Facade Class is associating the classes that contain the twitter API and bing API the user will associate the facade class.

### **3.2.4 Strategy Design Pattern**

We use the strategy design pattern because we are using two Encryption/decryption methods. We have interface class and two concrete classes inherit from the interface class.

### **3.2.5 Observer Design Pattern**

A software design pattern in which an object maintains a list of its dependents and notifies them automatically of any state changes. (Notification Class)

### 3.2.6 Activity Diagram

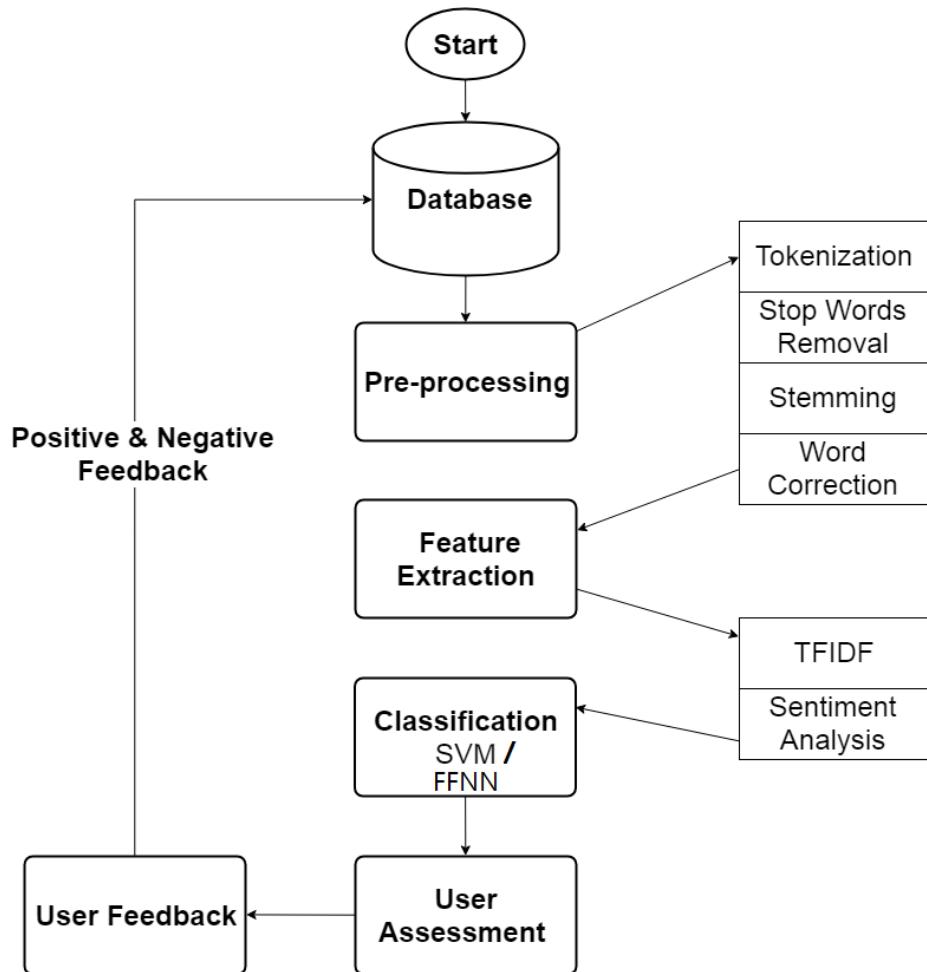


Figure 4: Activity Diagram

### 3.2.7 Sequence Diagram

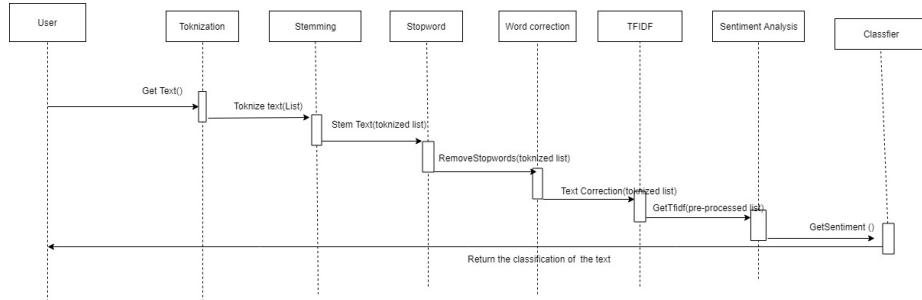


Figure 5: Sequence Diagram

In this diagram we are showing the processes of text classification in the system and how are the stages related in the system.

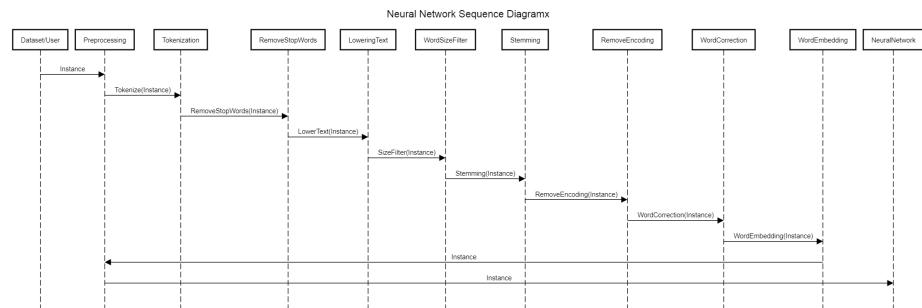


Figure 6: Neural Network Sequence diagram

### 3.3 Design Rationale

The SSM is based in MVC design pattern, where the model (Cloud) handles the back-end processing like feature extraction and classification, the controller takes the information from the model and deliver it to the view for the user interface, the view takes the event from the user using the event listeners and deliver it to the controller, then the controller gives it to the model for further processing. Using the MVC design pattern ensure the re-usability of the SSM for other projects, and the easy maintenance without going deep inside the core.

## 4 Data Design

### 4.1 Data Description

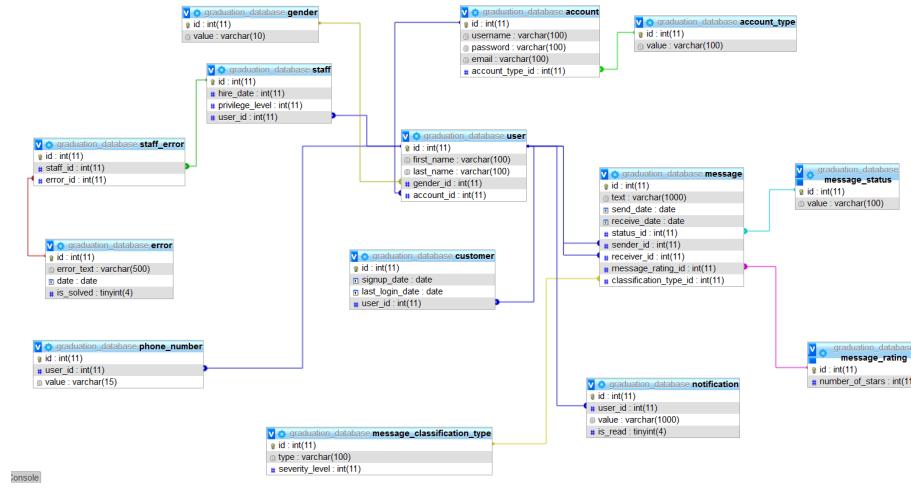


Figure 7: Database design

### 4.2 Data Dictionary

- 1- Account: This entity will hold the account information for every SSM user. It will store information like: username, password and email.
- 2- Account Type: This entity will hold the type of account.
- 3- Customer: This entity will hold the account information of the user like: sign up date, last login date
- 4- Error: This entity will hold information about errors in the application.
- 5- Gender: This entity will hold the type of Gender like: male or female.
- 6- Message: This entity will hold the details of all send and received messages.
- 7- Message Classification Type: This entity will hold the result of classification of the received message.
- 8- Message Rating: This entity will hold the user rating of the received message.
- 9- Message Status: This entity will hold the Status of the message.

10-Notification: This entity will hold the user notification and it's details.

11- Phone Number: This entity will store all the phone number of all users.

12- Staff: This entity will hold the information of all staff like: hire date, privilege level.

13- Staff Error: This entity will hold the information of which error is assigned to which staff

14- User: This entity will hold the information of all users: customers and staff like: first name, last name

## 5 Component Design

### 5.1 Machine learning

#### 5.1.1 TFIDF

TFIDF stands for term frequency inverse document frequency and is used to weight every word in the sentence to measure of how important that term is in the whole corpus.

$$w_{i,j} = tf_{i,j} \times \log\left(\frac{N}{df_i}\right)$$

Figure 8: TFDF equation

#### 5.1.2 Sentiment Analysis

Sentiment analysis is used to know the polarity of the sentence to help in deciding whether it is cyberbullying or not.

#### 5.1.3 SVM

We are using SVM(Support Vector Machine) for classification and we send the result of TFIDF and Sentiment analysis as parameters to the classifier.

$$\mathcal{D} = \left\{ (\mathbf{x}_i, y_i) | \mathbf{x}_i \in \mathbb{R}^p, y_i \in \{-1, 1\} \right\}_{i=1}^n$$

Figure 9: SVM equation

## 5.2 Neural Network

### 5.2.1 ReLU

ReLU stands for Rectified Linear Unit, it is used in the second layer in the feed forward neural network. We use it to eliminate the negative values in the neural network.

$$f(x) = x^+ = \max(0, x)$$

Figure 10: ReLU equation

### 5.2.2 Sigmoid

Sigmoid is used in the third layer in the feed forward neural network, and it's used to get results from 0 to 1.

$$f(x) = \frac{1}{1 + e^{-x}}$$

Figure 11: Sigmoid equation

## 6 Human Interface Design

### 6.1 Overview of User Interface

The User interface is going to be very easy to use. First the user is going to sign up for the application after signing up a screen with adding the social media

platform that the user tends to use with the application. after that the user will see normal screen like the normal social media application. After that the user see normal messages but when a message is classified as bullying it will appear blurred to the user with a note that this message is bullying and have the choice to show it and after showing it the user will be able to rate the classification results.

## 6.2 Screen Images

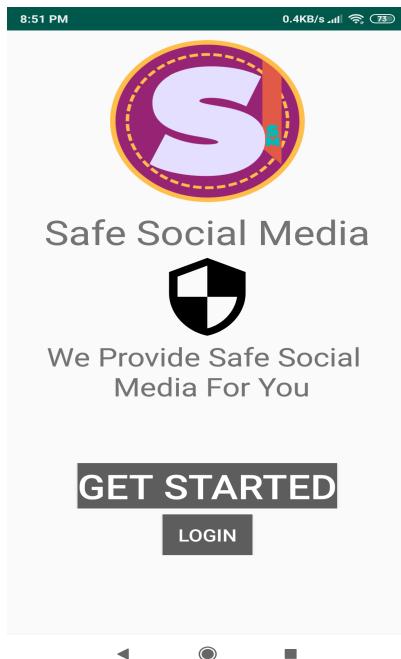


Figure 12: Rating

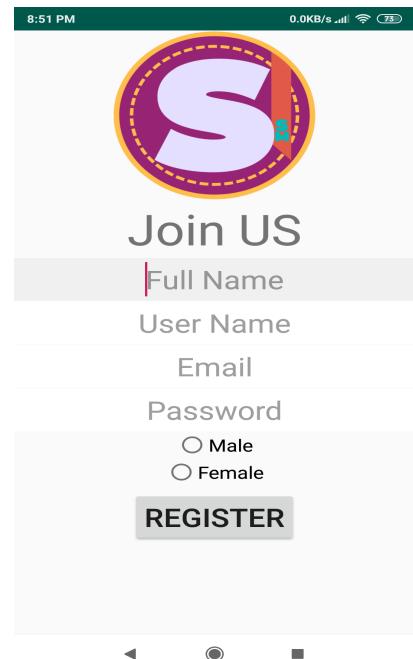


Figure 13: Register

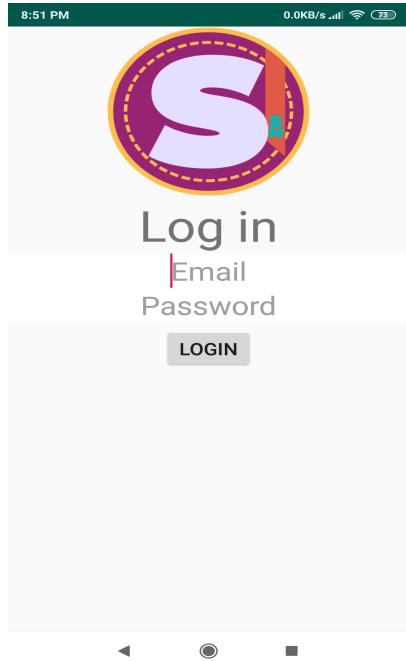


Figure 14: Log in

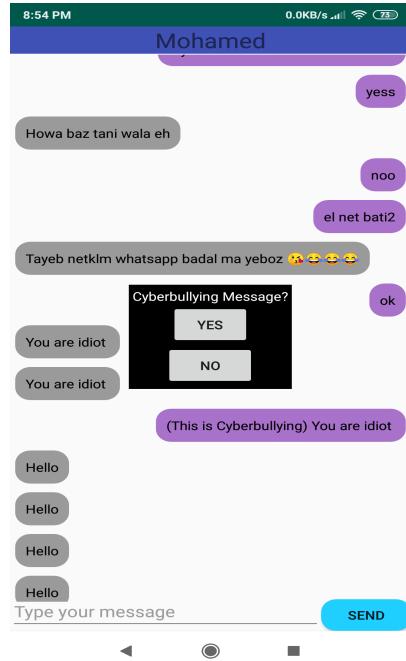


Figure 15: Rating

### 6.3 Screen Objects and Actions

- Figure 12 (Home): This is the main screen when the user open the application
- Figure 13 (Register): In this screen the user Register Account within our service
- Figure 14 (Log in): In this screen the user log in in his account within our service
- Figure 15 (Add Social Media): In this screen the user give our service access to his account on social media in order to monitor the messages
- Figure 16 (Rating): In this screen the user will be able to rate the classification results

## 7 Requirements Matrix

Requirement id	Requirement type	Description	Test strategy
3.1 Login	Required	Allow the user to login into the application	Only accept Entering valid user name and password
3.2 Signup	Required	Allow user to enter his information	Accept only the enters on the fields
3.3 adding social media	Required	Allow user to enter his social media user name and password	Must return acceptance to the user name and password
3.4 chatting menu	Required	Allow the user to see every chat he is doing	Must return all the chats he is doing
3.5 send message	Required	Allow the user to send message to another user	The message must contain at least one character
3.6 Show message	Required	Show all chatting between the users	Must show the messages between the users
3.6 Detect messages	Required	Send the received message to the user and return the result of the detection if yes blur the text	Must blur the detected Text
3.7 Rate the detected text	Required	Allow the user to rate the detection of the cyberbullying	Give the user the ability to rate the detection
3.8 Modulator rating message	Required	Allow the modulator to rate the message that rated as wrong detection	Take the rating from the modulator
3.9 Receive the message	Required	Receive the message from the social media application	Must be sure that message is received
4.0 Logout	Required	Take the user out of the application	End the session of the user