TRUST EVALUATION OF USER IN SOCIAL MEDIA

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Abstract: This paper proposes a model to overcome with problem of cyber harassment as this has become a challenging problem in today's cyberspace. The proposed model may behave as an antidote for cyber harassment. The model helps either to accept or reject friendship request based on mainly three components namely, *i)* profile similarity analysis, *ii)* mutual friends analysis and *iii)* sentiment and emoticon analysis. The purpose is to safeguard users from after effect of friendship over social media. User(s) if wants to expand their social circle by accomplishing the friendship relation, this model may assist them in making a judgment about other person based on different components. Components will analyze the friend requester on parameters like profile data, based on mutual friends and how that person shares relation with others in the social circle. Individual can compare his own perception with other person to take a final decision.

Key Words: Cyberspace, cyber-harassment, Social Media, trust, profile similarity, mutual friends, sentiments and emoticons analysis.

I. INTRODUCTION

The extensive practice and rapid advancement of the World Wide Web (WWW) has certainly improved human being's day-to-day activity over social media. It improvises the way to conduct an act, to fulfil the work, and to gain or learn from such environment. Communication through Internet, requires devices like PC, mobile, laptops etc., but nowadays these devices are not merely a simple tool for accessing the Internet. They are becoming a medium through which users interact to other user in cyberspace. Ample users' use online social media to stay in touch with acquaintance, to reunite with friends, meet new persons and to discuss about themselves and others [1]. Online Social Medias' such as Twitter, Facebook, Google+, LinkedIn etc., have significantly gained popularity in the last decade because it incorporates impersonal transmission of messages (e.g. regulating gatherings, conferences, agendas and other business related activities), mass related information (songs, news, advertisements, cinema clips and websites) and, most compellingly, social interactions (direct personal conversations, sharing of knowledge, thoughts, ideas, sentiments, perceptions and pictures on daily basis) among individuals, businesses, and news agencies. Along with the Online Social Media users, distinct organized groups comprised of hacktivists, terrorists and activists have also been utilizing this platform to disseminate their plans and messages. Attackers exploit it to disseminate their notion, ideas or brag about crimes in the environment and hamper the innocent user(s) in the social environment [2]. According to the criminology field professionals, the presence of organized cyber-criminals in the internet world is growing swiftly [3]. Most common problem among cybercrimes is cyber-harassment or cyberbullying. Cyberbullying, Cyber-Harassment, Cyber stalking and Internet Trolling are generally used analogously to portray cyber-criminal activities that include an attacker(s) aiming victim(s) by using intrusive intelligent technology moves.

It can be defined as persistent and repetitive violence applied [4] towards someone by using the Information and Communication Technology (ICT). It uses communication technology as the medium through which one can blackmail, hassle, agitate, or psychologically prohibit the other person from society [5-6]. The Online Social Media provides different platform and services, these classified groups use them

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to raise their views and voice for communication in the society or to an individual. The main concern is that online interaction may endorse a climate promotive to cyber-harassment. Author of [7] states that online communications are build up emotionally and Finn [8] explored that Internet can create fake sense of relational intimacy and misunderstanding among the users. The individuals at time of communication create an abstract image of other person in lack of awareness, nonverbal, historical, and circumstantial information available to them. The idealize perception of user misguide them and sometimes they miscompute the intentions of the messages they receive [8]. Different ways of committing cyber-harassment on online social platform includes comment that are negative, mean, harassing and hurtful, posting of images or videos on social sites or on mobile phones, or spreading the threats or rumors by using technology as a medium. Maybe, initially cyber-harassment may not cause any physical hamper to the user, but it has potentially catastrophic psychological effects in future like low self-esteem, dejection, suicide ideation, depression, and even suicide [9-10]. The Online Social Network's also implements law imposition and gives research society with a breach into their world to better distinguish the objective of these groups. Previous work on cyber-harassment addresses the psychological effects on victims. They are generally focused on extensive surveys exhibiting the problem scope.

Several social media networks have an "Online Safety Page" that heads to resources such as the government anti-harassing sites or other such organizations. They handle the harassing disputes mainly related to user's recompensing to clearly people grievances. Although, in several Social Media Networks, the amount of grievances collected on day-to-day basis, quickly astonishes the talent of small groups' of grievance handlers to deal with them. The few automatic finding facilities used to identify harassment are very simple, straightforward and inefficient, often using regular-statements to capture the abusive word list. The spam filtering was originated to detect harassment issues and bullying problem [11] with little accuracy and abundant of false positives.

While most of the research have focused on the predominance and effect of cyberbullying and harassment in psychology and education [12-14]. Users join the network with different intensions. Social media helps the user to expand their social-network by joining other users in their friend-list. For this one can send the friend request to other. The recipient (trustor) in social media if being able to judge the request sender (trustee) then s/he may be able to avoid the situation of cyber-harassment in future. As simply recommending a user to get isolated from the Internet, is not a solution to stop harassment in cyberspace. Since then, they may become disconnected from their companion group. Moreover, harassment that arises in online network can follow the user and can happen to them face-to-face. So, escaping from the use of cyberspace communication will not constrain other's harassing actions. Thus, actions should be taken to avoid cyber-harassment within a broader area of creating a positive environment in social media.

This paper shows interest in understanding how cyber-harasser uses social media as a platform and how harassment can be detected by calculating the trust value of any individual prior of forming the relation. The harassment can't be stop over social media but proposed model will help user to stay away from such harassments by not joining such groups or individual.

This paper is organized as follows, the following Section 2 presents literature review about cyber-harassment and bullying. It also describes how it is increasing in social media and the drawbacks of them in the society. Section 3 proposes a model for cyber harassment detection. The proposed model calculates trust of a user from individual's perspective. It also describes different components that will be used to calculate final trust value. It will help in knowing a person and may prevent cyber-harassment to users. And finally Section 4 concludes the paper and gives future direction.

II.   LITERATURE REVIEW

Internet technology has contributed to the cyberspace in form of Social Networking Medias like Facebook, MySpace, LinkedIn, Google+ and others that provide facility of instant messages and online chat platform as means to connect with relatives, colleagues, acquaintances and fraternize over the cyberspace. Social Media have become gradually popular between social users [15] and are also potential channels for them to

get engaged in annoying and deleterious behaviors [16]. The use of Information and Communication Technology (ICT) to hassle, dominate, betray or commonly defame a teenager, grown-up, organization without an explicit or hidden risk of physical damage. In contrast to physical harassment that involves face-to-face communication, cyber-harassment requisites the ICT usage and is lingual, vulgar, sentimental or communal exploitation of an individual, organization or group. The cyber harasser's elementary objective is to apply power and restriction over the intended target(s) [17]. In cyberspace, to safeguards users (especially teenagers) from being tortured and exploited, there have been commands that restrict the user from accessing of the cyberspace with the belief that such constraints may be capable of scaling down the effect of hazardous behaviors. In few cases, severe after-effects have been imported to discourage harassment and bullying of users by associates and outsiders [18].

Social media have been notably cursed as an origin of molestation for cyberspace users and for the recent increase in youth exploitation [19] making a case for inhibiting youth from accessing social media networking sites. Although, there is no consent that social media aids to increase in harassment or exploitation of users. The research that have specifically conducted in regards to this correlation are also not been capable to find out whether Social Media Sites are actually the only reason to be cursed exclusively, or there is some other factors and behaviors also that leads to these situations [20].

But if an individual becomes aware about other person intensions and psychological attitude in advance then there is a scope to avoid harassment situation in Social Media. This is what completely lacking in our cyberspace environment. If an individual is able to build a trust factor on other person prior creating a link to them; then they can decide whether to establish relationship or not. Trust is a general term with diversified interpretations among researchers. Trust is a subjective matter related to series of changes framed after inspecting several factors about a person. Author in [21] describes `Trust' as the outcome of chain of various observations taken over time about an individual. As time passes trust is built and cultivated in an environment through sharing of information or communication about another entity [22]. Trust can be built on others based on different parameters namely like profile similarity based, mutual friends based and sentiments based.

Trust is important for cyberspace because the presence of workable rules creates reliance on the socially acceptable behavior of others to be essential for the continuity of the community [23]. Distinct components proposed in model to calculate trust give different factors to judge on.

Profile similarity gives a correlation between two individuals. In [24], authors specify that there exists a relation between profile similarity and trust. Through an analysis, authors' shows that there is a significant and strong correlation between similarity of users and trust. The more similar two people are, more chances that there exists trust between them.

Mutual friends or acquaintance overlap measures closeness to being a local bridge and represents another important measure called edge embeddedness. Both of these measures are considered as an indication of the level of trust in the relation between two users [22]. Moreover, the field of sociology states that if two users are having an embedded link then they will likely to place a trust on each other and which results in increased confidence in their relations to some extent [25].

Sentiment is defined as a feeling that has a target associated with it. Sentiment analysis is used to express sentiments about a target and give a judgment it. Sentiment analysis helps to identify the psychological attitude of an individual in the society. It gives a polarity score as either positive or negative which helps in judging the acceptability of target in the society from an individual's perspective [26]. Sentiments enclosed in cyber world exchanged within a user's individual ego-network have significant impact on the polarization of a following message to another node [27]. Emoticons and sentiment analysis give a polarity score as a recommendation value to other which will help individuals' to predict the reliability to that person in Social Media.

III.   PROPOSED MODEL

Much of the existing work aims to identify key person within organized criminal associations that rely on a specific analysis such as social network analysis metrics, or content mining. Relying on only one method may not be able to identify the actual dominant people as well as it may astonish to a result as dominant while they are not (false positives). Therefore, an amalgam approach that incorporates several analysis techniques to identify key dominant individuals may give more authentic and decisive results. Therefore, this paper proposes a model that incorporates different components or techniques useful at time of calculating trust of an individual.

It has been seen that when a person joins the cyber world s/he tries to expand the network by adding more people in their cyber-world. What if one adds a person whose intentions or the psychological attitude is not good towards the individual/society? Adding these person's in friendship network means giving them opportunity to exploit and harass the user(s). This paper focuses for solution that may help one to avoid such kind of situations in the cyber network by calculating a trust value on that person and to some extent assure cyber security for them at primary level. The proposed solution consists of:

i)   Exploring the profile of person who has sent the friend request i.e. PROFILE SIMILARITY ANALYSIS,
ii)   Judging them on basis of common friends i.e. MUTUAL FRIENDS ANALYSIS and
iii)   How other's react to his/her uploads in Cyber networks i.e. EMOTICON AND SENTIMENT ANALYSIS.

The following subsections will explore each component in detail.

The proposed model includes above mentioned components which can assist a user at time of accepting a friend request. Since, once a user accepts friend request of a person then that request sender can access or post any information to the acceptor's account. It may sometime leads to a situation in which the acceptor feels harassed and bullied. So, to avoid these circumstances a user can calculate a trust factor on the trustee before committing the friendship with him. Figure 1 depicts the model for the same.
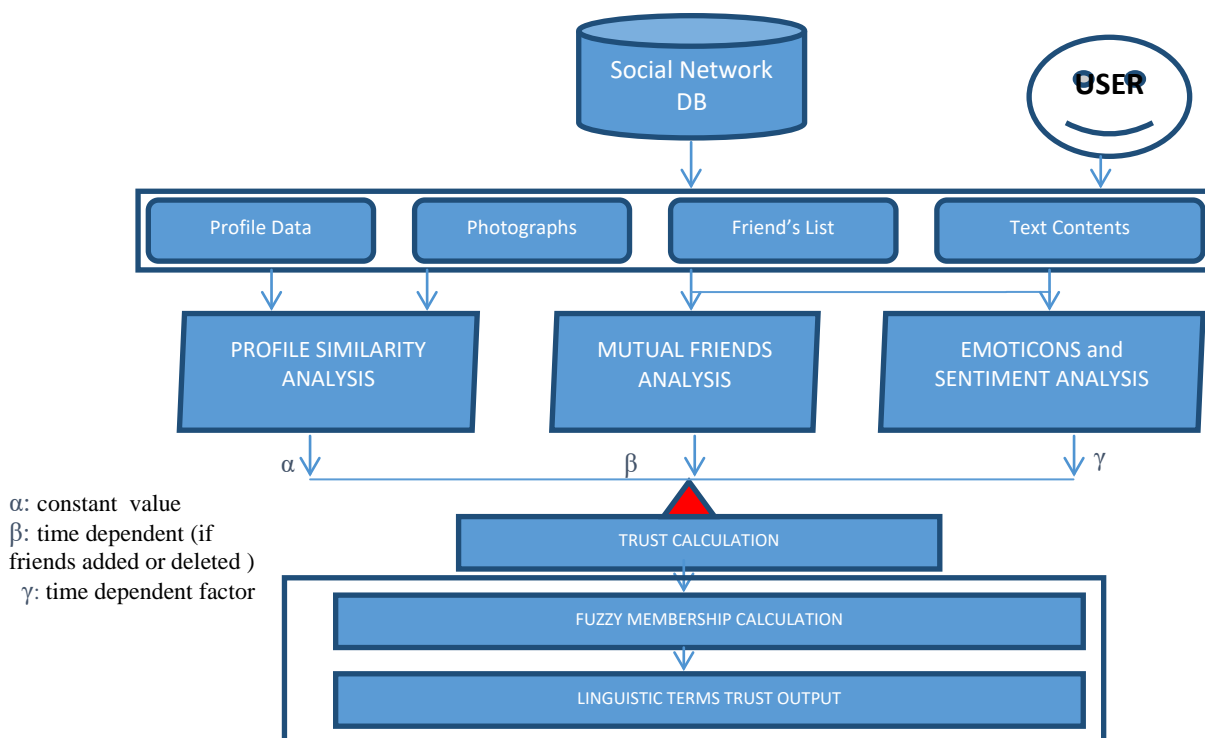

α: constant value
β: time dependent (if friends added or deleted)
 γ: time dependent factor

Figure 1.   Proposed Model for Trust Calculation

The final aggregated trust can be calculated in two ways:

i)   *Overall Aggregation Method*

All scores from different attributes combined to give a final trust (FT) value. Equation (1) represents the final trust calculation formula where P, M and S represents dynamic weightage assigned to each component; Profile Similarity Analysis, Mutual Friends Analysis and Emoticon and Sentiment Analysis respectively in complete model set.

$$FT = P* \alpha + M * \beta + S * \gamma \tag{1}$$

Since the final calculated trust will be a numeric value. Due to the equivocality and inexactness of trust concept, it is preferred to symbolize the trust by linguistic expression which can enhance the understanding of users' interaction. The fuzzy membership concept will be used to avoid the ambiguous situation and generate a linguistic terminology for it as shown in Figure 1.

ii)   *Individual Threshold Setting Method*

Another trust computation method can be assign a threshold value for each component. For eg. Let ε, δ and η be threshold values for components; Profile Similarity Analysis, Mutual Friends Analysis and Emoticon and Sentiment Analysis respectively. Then if the final score of each component greater than respective thresholds (rules with assumptions described below) then only the person is considered to be trustworthy otherwise not.
It can be represented as:

• When a user is new comer to social media and have no conversation and friends then
                                    if $(\alpha \geq \varepsilon)$
                                         then s/he is Trustworthy
                              Otherwise: Untrustworthy

• When user have no mutual friends with friendship-requester then
                              if $(\alpha \geq \varepsilon$ and $\gamma \geq \eta)$
                                    then s/he is Trustworthy
                              Otherwise: Untrustworthy

• When all information is with model then
                              if $(\alpha \geq \varepsilon$ and $\beta \geq \delta$ and $\gamma \geq \eta)$
                                    then s/he is Trustworthy
                              Otherwise: Untrustworthy

Both proposed methods can help in finding the trustworthiness of a user in social media. The calculation is based on different components and gives will output with respect to other person's preference.
The following subsections will discuss each component used in proposed model in detail.

3.1 Profile Similarity Analysis –

Profile Similarity Analysis includes different attributes (*eg.* Location, Education, Interest, Language etc.) of profiles (requester and receiver). The similarity analysis on basis of these attributes will help one to judge how much the requester is similar to him. Profile Analysis will include dynamic assigning of

weights to attributes by using Ordered Average Weighting (OWA). The user will be asked to give a preferred attribute on whose basis he wants to calculate trust. Since in trust calculation all attributes will be considered but more weightage will be given to the preferred attribute.

In general OWA operator of elements m is a mapping $S: R^m \rightarrow R$ that has a correlated weighting vector such that [29]:

$$W = (w_1,\ldots\ldots\ldots, w_m)^t \tag{2}$$

of having the following properties

$$w_1 +\ldots\ldots + w_m = 1, \quad 0 \leq w_i \leq 1, \, i = 1,\ldots, m \tag{3}$$

and such that

$$S(a_1,\ldots\ldots, a_m) = \sum_{i=1}^{m} w_i\, a_i \tag{4}$$

where a_i is the *ith* largest element of the aggregated objects $(a_1, \ldots\ldots, a_m)$. OWA operator has two properties namely, *i)* measure of *orness* of aggregation and *ii)* measure of *dispersion* of aggregation.

With slight modification in OWA operator i.e. giving preference to attribute selected by user and making it as first attribute of list and then arranging rest as specified in [28], the final aggregated trust value on basis of profile similarity will be calculated as equation (4). According to model requirement, in equation (4) a_i represents similarity score for *ith* attribute of profile between two users' profile and w_i represents the dynamic weight assigned to each attributes. This final score benefits the user by letting them know that whether the requester is similar to their nature or not and whether they are correlated to each other or not.

Another way of performing Profile Analysis can be asking both the parties to fill the questionnaire to check how much they are similar in attitude and nature to each other. This questionnaire can help in finding the distinguish features between them based on Profile Similarity Analysis proposed above.

The Profile Similarity Analysis all in alone cannot judge the psychological mind of the person but can restrict one from joining such kind of person who actually are very different in nature from them.

3.2 Mutual Friend Analysis –

It's not always true but in many situation one come to know other person through some other friend, they are referred as Mutual or Common acquaintances. In cyber network, when one sends a friend request to other person then there is a probability that they both have some friends in common. The second component of model proposed in this paper includes analysis on basis of these common friends.
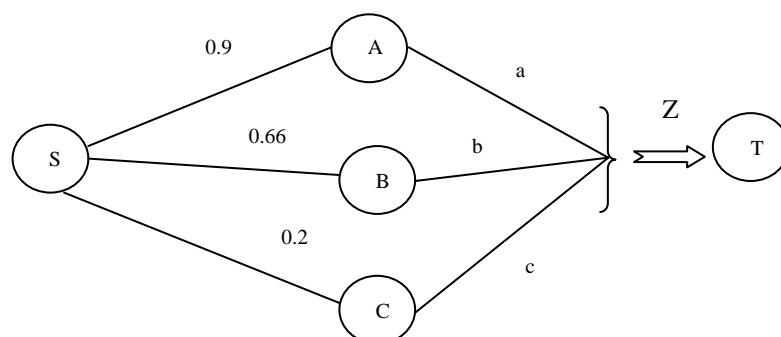

Figure 2.   **Example of trust development based on Common (Mutual) friends**

The acquaintance classification can be done as following: family, close friend, acquaintance, colleague etc. Each class has different importance in user's network. So, when no. of common friends is identified between the trustor and trustee, they can be further divided on basis of these classes. Trustors' different classes of friends have different trust value according to them. So, trust calculation based on mutual friends should give different weightage to these classes according to trustor's requirement. This weight should also be assigned dynamically to them. OWA operator can be used to assign weights to distinct classes to give more realistic results.

This trust value will be calculated on factor that how much trustor gives importance to their current friends and how much s/he trust them.

Figure 2 shows an example of trust development based on mutual friends where S represents the trustor who got the friend request from user T. In the network A, B and C represent the different classes of friends and edges represents link between them and S, and values on edge (eg. 0.9, 0.66 and 0.2) shows different trust value given to them by S manually (static assignment of trust based on direct experience) or dynamically (calculate using direct or indirect experience of user and user's associated person). Further, a, b and c will be the outcome of trust calculation process by giving different weightage to classes A, B and C. Z will be the aggregated weight assigned to T by using OWA operator [28].

It is being said that friends' recommendation can also be given weightage at time of giving judgment about someone. Hence the outcome of this component will give a trust score that can assist the trustor to give the final response about the requester [29].

3.3 Emoticon and Sentiment Analysis –

Another component that may assist the user from being getting harassed from other person is Emoticon and Sentiment Analysis. It describes the psychological state of mind of a person. It is defined as looking for the opinions in content and trying to pick sentiments within those opinions. It is the process of obtaining the knowledge from people's opinions, emotions and appraisals towards entities, events and their attributes. These statements can greatly impact other person's to make their choice and opinion about the target person. This component will track the record of the requester; analyze the content s/he has uploaded and how friends of him reacted to it.

This analysis will be done on sentence level to find polarity of the expression. The text data image will be captured from the user's post and relative comments on it. The analysis of comments on the updated post will derive a fact that how much that person is socially acceptable in the friend's circle.

The analysis includes the following process:

1) A dictionary to be prepared with list of positive and negative words along with the respective score assigned to them or can use SentiwordNet dictionary [30].
2) The sentence will be divided into Bag of Words.
3) A conditional probability will be calculated to handle the situation when list of positive and negative words represent either a positive or a negative situation.
4) Along with this, local effect of words such as an intensifier or a negation word will also be included while calculating the polarity of sentence.
5) The final polarity of sentence will yield a knowledge that can be used at time of final judgment about the trustee.
At time of doing the emoticon and sentiment analysis, time factor will also play a role in trust calculation. As time passes trust among the user increases or decreases depending upon the situation. Analysis including history data can be represented as shown in equation (5), (6) and (7):

$$K = [x(1), x(2),...., x(t),..., x(h-1), x(h)] \tag{5}$$

where t = time stamp,

$$t \in [1,h] \qquad\qquad 0 \leqslant x(t) \leqslant 1,$$

$x(t)$ = Aggregated polarity score at time t,
h = history experience and adjustable factor,

$$F = \begin{cases} \sum_{t=1}^{h} [x(t) * \varphi(t)] / h & h \neq 0 \\ 0 & h = 0 \end{cases} \qquad (6)$$

where $\varphi(t)$ = Attenuation factor such that

$$\varphi(t) = \begin{cases} 1 & t = h \\ \varphi(t-1) - (1-\mu)^h & t \neq h \end{cases} \qquad (7)$$

μ = decay factor.

The Attenuation factor and decay factor will play a vital role in calculating the Final Sentiment Score (F) in equation (6).

Another way to analyze emoticon and sentiments may be questionnaire method. Questionnaire based on sentiment and personality related traits can be forwarded to both the friendship requester (trustee) as well as to the person who got the request for friendship (trustor). On receiving the result the trustor can compare both the results and may come to a conclusion that how much the trustee is correlated to him on basis of sentiment and emotional traits.

IV.   CONCLUSION

In this paper, a model is proposed to calculate trust of an individual using preference of another person, before formation of relation between them in social media. It may assist the user to predict the harassing behavior of the trustee (who sent the friend request) with respect to their own in prior of doing friendship with him/her. Hence, this proposed model may work as a countermeasure for cyber harassment. As in Social Media, once a person is added in social circle, then s\he can post any type of information to others account. This service, if misused may exploit and harass a target user. The trust calculated with model will depicts the similarity between both users based upon profile, friends and sentiments. This score may aid user to distinguish the requester from themselves. Hence, may shield user(s) from repercussion of counterfeit friendship relation. Furthermore if a user wants to determine trust on their existing friends, this proposed model will help to calculate it. This calculated value will aid the user to frame the decision in regards to remain friend of that individual or not.

Future work is to implement and analyze results of the proposed model *i.e.* overall aggregation method and individual threshold setting method. Analysis will conclude that which method is appropriate for which type of social environment.

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