An Online Identity & Smart Contract Management System.

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***Abstract*—In today's online environment, people attend various kinds of activities, exhibit different digital presence, build personal digital reputations, issuing and receiving feedbacks from online communities being involved with. These diverse information sources once aggregated can provide a valuable future reference for personal online digital identity and credits check. The primary objective of this paper is to propose a systematic framework for aggregating online identity and reputation information, to provide a holistic approach to personal online behavioral ratings. Major contributions include: An identity aggregation mechanism based on social dependency network is proposed, a smart contract management framework referring to personal online ratings based on the aggregated digital identity, an experiment implementation based on blockchain technology, with illustrative examples and theoretical evaluations to the proposed approach.**

Keywords— Digital Identity; Online Reputation; Blockchain; Smart Contract Utility.

I. INTRODUCTION

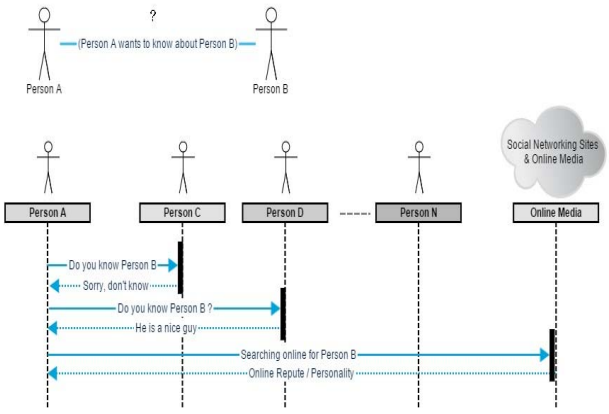
The primary goal of this study is to provide a mechanism by which we can get to know regarding the personality of a person in detail, Such as, how the person is in his Online & professional life? How a person behaves online?
If we are successful in proposing a system that gives us the detail information regarding an individual; that system can be used around the globe. For Example, Whether a person is an industrialist & he is searching for a client around the world or a supervisor short listing research student for higher studies from another country, in every phase of life one has to interact with another person. This system will be helpful in finalizing the decision with building trust between the two parties.

Social media is a term used to describe collectively a set of tools that foster interaction, discussion, and community; thus allowing people to build relationships and share information. It is not just a broadcast channel or a sales and a marketing tool.[1] For the last so many years, marketing people are using presentations, video chatting, face to face meetings, print media, advertisements & television for their product marketing. Many researchers from various fields are researching on how we can use social media /social networking channels to convey our positive repute across the globe.[2] Apart from the aspects mentioned in [2], we also have to understand the role of social media channels to solve future business challenges to be successful. Nowadays it is easy to contact the customer who is living across the globe, but the real issue is to build trust between the client and company. Trust factor is not only necessary for client and company but also within the company[3], [4]. Many researchers have studied the fact that online reputation of a person or group shows different than his real personality or status.[5]– [7]

Research Question: What kind of recommendation method can be applied in the social network / online media to propose user reputation system?

Below image explains the process of collecting feedback in real life. Suppose person A living in China and person B living in Canada. Both are ready to do business by using smart contract, but there is a trust deficit on both sides. To get the repute of the partner the person will ask his friend(s) / relative(s) for feedback and after getting initial feedback from various sources, a person will search for the business partner on online media. The main issue is that the information extracted from this process in the majority of the cases will not be correct. In many studies, it is proved that online personality of a person is not the same as the real life personality of an individual [5]–[7].

Also, nowadays there are various companies online that help the business or individual to push negative remarks and comments down to the search result by a search engine(s). Few of the companies are reputation.com, brandyourself.com, and rankur.com. In this scenario client and company will never be able to get the real feedback online quickly.



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II. Privacy Concerns From Literature

In a study [8]–[10], researchers argue that individuals were disclosing information that may be inappropriate for certain audiences such as prospective employers, and there is fear of identity theft or other negative outcomes from the excessive use and sharing of SNS's.

In a study[11], the researcher believes that the primary way to be aware of the risks and threats of Social Networking site (Facebook), is to be a careful by changing the default settings or simply by not having a Facebook account.

In a study [12], researchers first draw the attention of the user by asking the questions, Are you on Social Networking Site (Facebook)? Do you post personal information online to other sites or programs? If so, have you read the privacy policy and realized how information can be used by others? The author also mentions in the paper that an article in The New York Times noted that Facebook's privacy policy was 5830 words long, where the United States Constitution, without any of the updates, is a brief 4,543 words long.

In a study [13], researchers focus on the news of security breaches and state supervision that have made Internet users more concerned about their privacy, showing to greater control of the privacy policies of social media and web applications providers.

In all the above literature we can easily see that there is a valid concern for privacy among the researchers. Fear of information misuse, identity theft is few of the most critical areas Etc.

III. Five Rules of Respect Trust Network [18]

A. Rule 1: Promise

According to rule number 1 of respect trust network, every member must promise that they will respect the digital boundary of another network user. The users will respect the presence of other network users and the information they share within the network. This is more like a moral binding for the user. This rule of promise is very similar to "*Signing Contract*" in real life.

B. Rule 2: Permission

As part of promise rule, all the users must take permission from the user before using his/her information that may be personal or shared one on the network. The user will negotiate with each other in good faith. If the user wants to use any other user's information he has to take permission before using. This step of Permission in respect trust network is more like a procedure of getting information in real life. A user request to another network user to grant access to his / her information for the purpose explained. The user grants access or can decline the request. In the case of decline, the other user is morally bound not to use or share the information.

C. Rule 3: Protection

As part of promise rule, the network user must protect the information shared by other network users. Every member must provide enough security to the information shared by other users. The user must protect the identity and data entrusted to his / her. In we map this in real life this step is "Execution level protection".

D. Rule 4: Portability

As part of the promised rule, the network user has the right to move their information to another network. The host member is the real owner of the information whether other users have the shared information from the host users. The user will support other member's freedom of movement. If he wants to move the data from one system to other systems, they are allowed to move. In real life, this step shows "*the ownership*", explained as the information belongs to the user whether he/she switched off the other network.

E. Rule 5: Proof

As part of promise rule, each network user will participate and share the correct information with other network users that will help in the positive growth of the network. Moreover, also, the user must not involve in any negative practices or must not be a part of any plan to target another user(s). The user will reasonably co-operate for the benefit of all members. They will cooperate and share the valuable information about the health of the system. In real life, this step is more like "*Community Rules*". Every user participates his or her share for the betterment of the network.

As referred in the article by Respect Trust Network Version 2, the concept of respect trust framework is legally supported by countries around the globe under Fair Information Practices law. For detail we have summarized and aggregate that information, see the table below. In below table Canada is represented as CA, Sweden is represented as SE, Great Britain is represented as GB, European Union is represented as EU, National Strategy for Trusted Identities in Cyberspace is represented as USNSTIC and Council of Europe as COE.

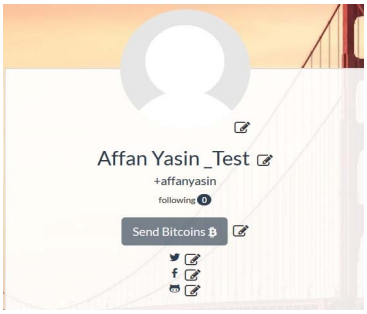
The obligation on Network User. 5 P's Principle	*Right w.r.t to "Fair Information Practices"*	*CA*	*SE*	*GB*	*EU*	*US NSTIC*	*COE*
Promise: Respect other members input or output controls.	Identity Integrity.	✓	✓	✓	✓	✓	✓
Permission: Ask permission before using or sending data/identity; Honest Dealing.	Negotiation.	✓	✓	✓	✓	✓	✓
Protection: Protect data / identity in possession from the third party.	Safety from third party access.	✓	✓	✓	✓	✓	✓
Portability: Allow data subject access and use of data / identity held about them.	Freedom of movement.	✓					✓
Proof: Information sharing & cooperation.	Fair systems information access, knowledge.	✓	✓	✓		✓	

IV. Related Work

Many studies have been done on an online rating of products and their issues. List of papers focusing on product ratings can be seen as [1], [2]. Another aspect of which papers have been published is social media usage and its impact on personality [14], [15]. Besides these topics, recently there are two related work(s) worth mentioning in this regard which are in their initial phases. Which are explained below:-

A. OneName

OneName is a company makes it easy to register and manage a blockchain ID. Users can create a personal or company profile and share their blockchain ID on their website, social media profiles, and business cards so others can easily find them online. They have a stance that with a blockchain ID, users are in control of their online identity. The following image shows their tool. [16]



Our work is one step further to this work as we not only give identity by using blockchain id but also trying to calculate the online reputation, personality rating, and professional rating.

B. OMS (Open Mustard Seed)

ID3 an educational and non-profit organization working on a platform OMS (Open Mustard Seed) for developing and deploying secure and trusted cloud-based and mobile applications. [17]

- ✓ *The framework provides a stack of core technologies that provide a high level of authentication and security when sharing and collecting personal data.*
- ✓ *Individuals and groups should have control of their personal digital identities and personal data.*

Our work is different from them is that their platform can be used to build the application, and we are developing the application to calculate user reputation. Also, we have to see that OMS framework is available for mobile development only or support the web-based application.

V. Research Method

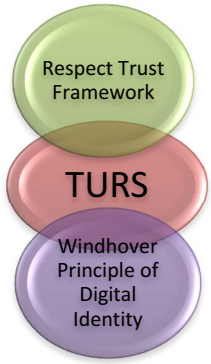
The research method used for this is a **literature review** and **Action based research**. First, we searched Inspec and Google Scholar for a possible solution to this problem. After analyzing the research gap, we proposed a new system named as TURS (Tsinghua University User Reputation System).

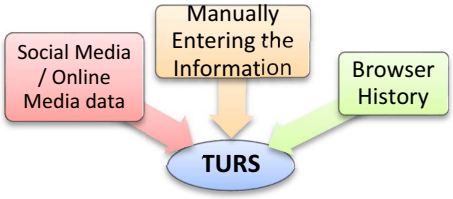
VI. TURS (User Reputation system)

TURS stands for Tsinghua University User Reputation System. The goal is to collect all the valuable information from various online sources and use that information in the calculation of user online, professional and personality rating.

Following are the important points on our TURS system.

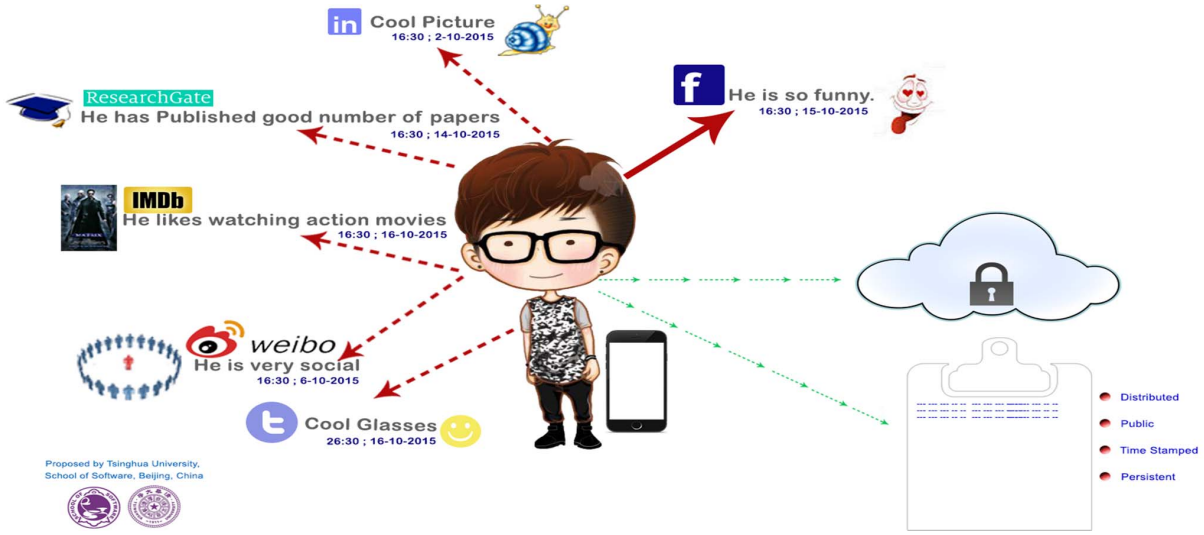
- The user(s) who will not obey the rules of Respect Trust Framework will get a major adverse effect on reputation points. If they continue to do the same (not obeying the rules of Respect Trust Framework), all such users will be blocked from the TURS system.
- In real life, there is all type of users. This is why we have to build rules and regulations to ensure that the information of the users may not be misused. If in real life all the people do positive things then there will not be any need to make rules, and there will not be any need to give punishments. We believe that for respect trust network, there must be some process by which network user can get a membership. Some of the possible solutions are:-
  - ➢ Solution 1: One way is to refer the user. The members of the network refer other known people/friends for the network thus making the network robust and more trustworthy. This may be a slow process initially but in the longer run make a network trustworthy.
  - ➢ Solution 2: There must be a minimum age limit for joining the network. Age must be verified by some process. e.g. by uploading some identity certificate Etc.
  - ➢ Solution 3: As we are expecting maturity level of the user for TURS, user's maturity level must be ensured before giving access to the information of the network. (Can be done by giving maturity test proved by psychologist).
- By implementing Respect Trust Framework with the addition to reference method for TURS, we are trying to ensure that the user cooperates with each other in the benefit of humanity and by this; we can minimize the negativity or negative elements in the network. Once the user joined the TURS network all the responsibility goes into the hands of the users, how seriously and honestly they care for TURS Network.





VII. Management of Evidence for Trust

If we analyze the situation of a person, he is using various online media for communication, social networking, and enjoyment. If we see the below image, we can see that the same person at the same time may be famous on Facebook for his weird behavior and on researchgate.com famous as a researcher. As shown in below diagram the evidence calculated from various online websites will be saved in the private cloud which can only be assessed by the user. No other user, company or government will access. If any user wants to see the detail of the profile, he has to request the user for grant of full access. The user when to give the access this transaction will be recorded on blockchain so that it must not be replaced or deleted. In the case of bitcoin, currency is transferred but in the case of giving access to profile, the time duration will be moved for which access will be granted to another user.



VIII. TURS System Proposed

- The proposed system ranks the personal, professional and online repute separately. The weighted formula will do this calculation. (Weighted formula is shown below).
- Beside this whenever a person will log in this system there will be a question asked regarding his personality, the answer will be saved and will use to analyze his/ her behavior and personality. This process will help to gather answers from the user and from that we can conclude the type of personality by *the proven* personality test. All the answers will be saved and will be used in calculating TURS point (which will be calculated by dealing personal, professional, and online and personality test points.
- Every person having an account on TURS must have real information so that no one will be able to make any fake account. By making user login by Blockchain ID, this thing can be ensured.
- The friends, colleagues, family members, and relative can rate the skill(s), Qualities and can have detail remarks and comments regarding his / her personality.

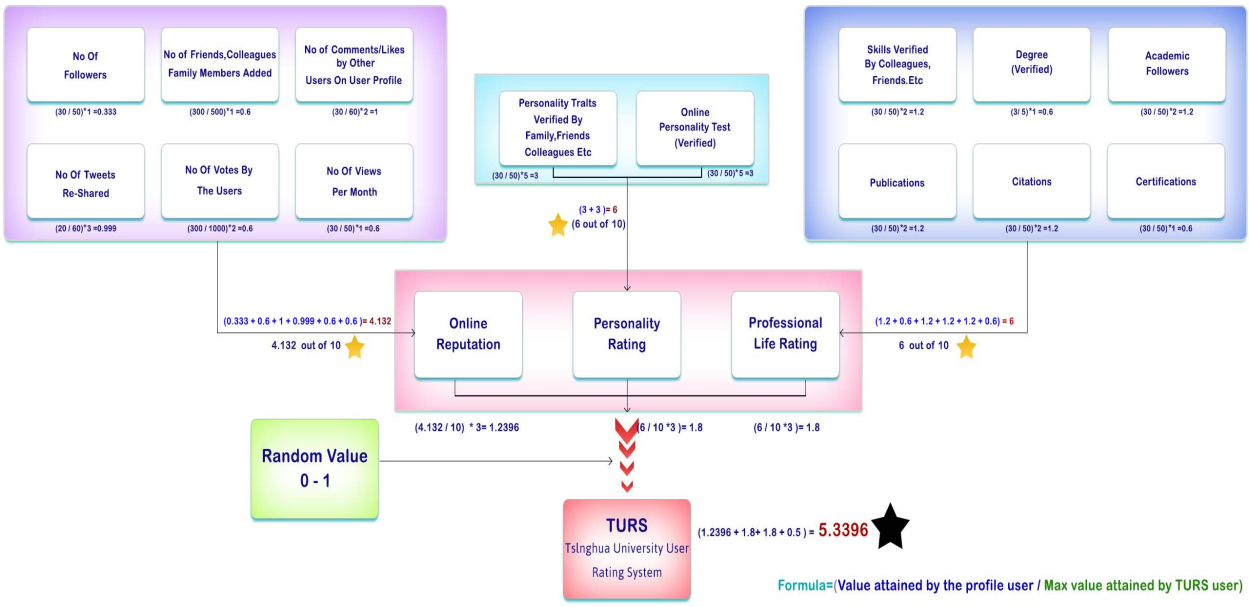
It will be more helpful for the TURS system to judge the personality if the user gives us access to the following data & information: -

- Access to his browser history; that history will be used to analyze the most visited websites, trends, Likes, Dislikes Etc.
- If the user provides the access to Social Media account; from his messages, Facebook Likes, movies, books Etc we can predict the likes, dislikes and personality of a person.
    - If the user gives access to Email ids; Inbox, sent, draft, subscription emails Etc this information can be used to see the trend of websites or individuals in contact. Conceptual Model of TURS

Below is the conceptual model of TURS. In the below model, we have categorized the information coming from various sources into three broad categories Online Reputation, Personality rating, and Professional rating. For example, No of followers, no of votes, no of profile views are some of the information used to calculate the reputation. We have used the below formula for calculation. Below mentioned is the early form of formula that can be changed or updated as per requirement(s).

Online Reputation *= (No of followers for profile User X / Maximum number of followers by TURS user)* ******* *weight.*

Same is the formula for personality and professional rating. Weight-age can vary from 1 star to three stars at maximum. This is explained below in detail in the given tables.



In the below table, we focus on calculating online reputation. For X and Y values, *X shows value attained by the profile user Mr. Lee and Y shows max value achieved by TURS user.*

In the below table if we observe "calculation" column, numerator value represent **X** and denominator value is of **Y**. Values of X & Y are assumed in the below table just to give an idea, how can we calculate the online reputation:-

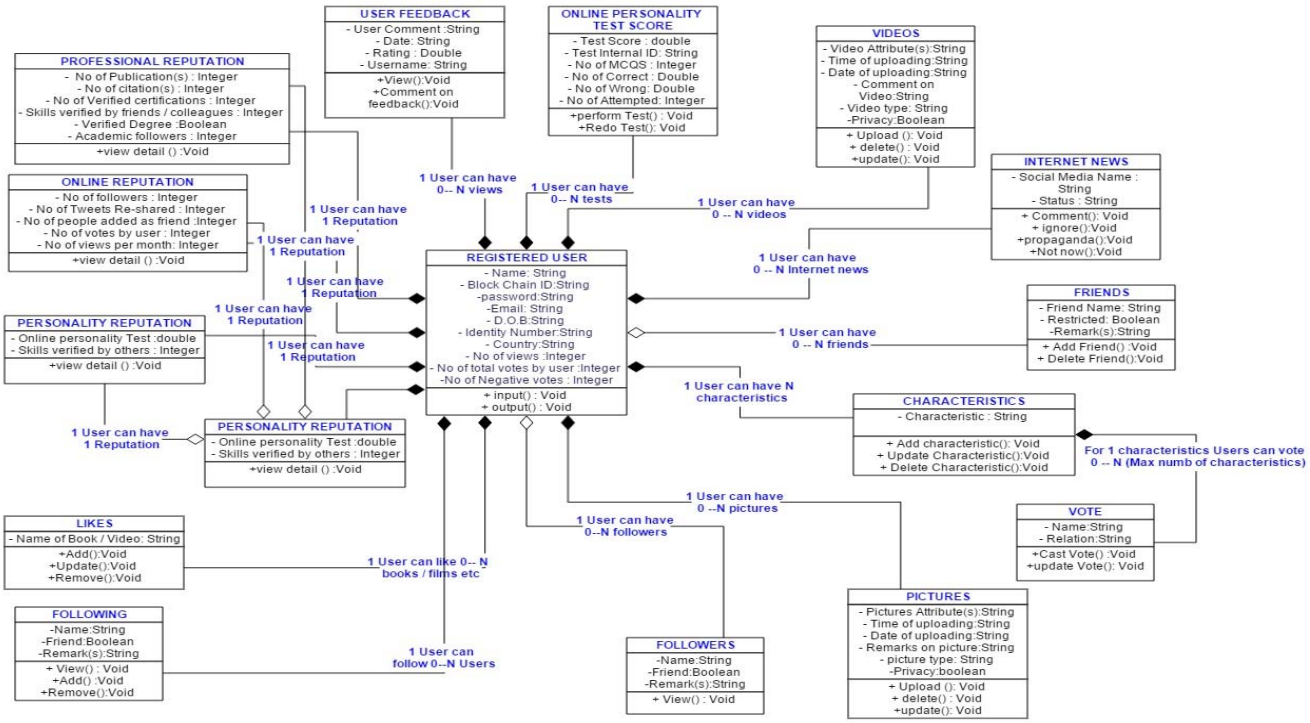
Serial No	Table Online Reputation | Formula=(X/Y)*weight		
	Attributes	***Weight***	***calculation***
1	No of views per month.	1 Star	(30/50)*1 = **0.6**
2	No of friends & colleagues added.	1 Star	(300/500)*1=**0.6**
3	No of votes by the users.	2 Stars	(300/1000)*2= **0.6**
4	No of tweets re-shared.	1 Star	(10/50)*1= **0.2**
5	No of comments /likes/tagging on the user profile. (Involvement of others).	2 Stars	(30/60)*2= **1**
6	No of followers.	3 Stars	(20/60)*3= **1**
	Online Reputation Value out of 10	**10 Stars**	**4 out of 10**

As explained in the above table we will calculate for personality rating and professional ratings with the similar method.

S. No	Table TURS points | Formula=(X / 10) * weight			
	Attributes	***Value (X)***	***Weight***	***calculation***
1	Online Reputation	4 out of 10	3 Stars	(4/10)*3 = **1.2**
2	Personality Rating	5 out of 10	3 Stars	(5/10)*3= **1.5**
3	Professional Rating	6 out of 10	3 Stars	(6/10)*3= 1.8
4	Random Value	0.4	1 Star	0.4
	TURS points out of 10		**10 Stars**	**4.9 out of 10**

A. Object-Oriented Model of TURS

Object oriented model for the proposed system TURS is shown below. Below is an initial OO model. In future, this model can be used to suggest a new system.



B. Comply with Windhover Principle of Digital ID

Our system will conform the Windhover principle of digital identity [17]. Detail of that is given below.

- **Individuals must have control of their digital data and identity.**

  ***TURS Comply*:** No fake profiles as sign up is from blockchain ID & digital data control by the user on a private cloud.

- **Ensuring innovation in Trust & Privacy.**

  ***TURS Comply*:** By autonomous identity system, we will enhance the trust and privacy. Along with this by following Respect Trust Framework by the network users, we will ensure Trust and Privacy.

- **Improving personal privacy & accommodating regular auditing**

  ***TURS Comply*:** Through R & D new options will be explored, and proper auditing will be in policy.

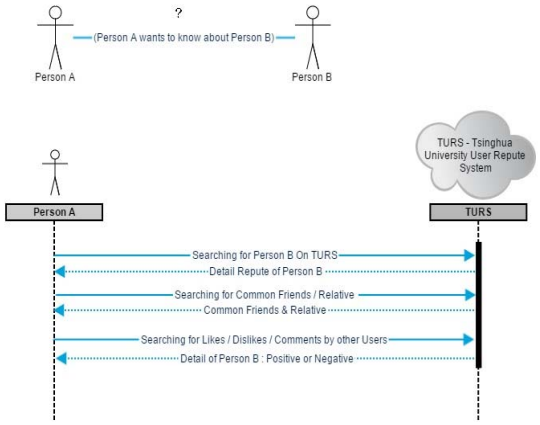
- **An open source collaboration to build a system that follows above.**

  ***TURS Comply*:** For this particular Identity system, we are open for cooperation and innovation.

Our research group is exploring various options. For adopting Windhover principle, we have to see that OMS framework is for mobile. If we are only targeting mobile users, then this platform can be a choice.

C. Feedback after TURS system introduced

Above image shows that now if anybody wants the detail of any other person. The User only has to connect to TURS system. From TURS system, he/she can get the ample amount of information.



IX. Conclusion & Future Work

With the emergence of social media and online websites used for communication, it is now very important to secure the identity of individual from hijacking, from online character assassination and provide the real repute of the individual. In social media web sites we can sign up the

account by using fake information. By getting a system like TURS we may protect the users from identity theft and provide a trustworthy network with authentic repute regarding the user.

- For future research, researchers can work on the optimized list for calculating online reputation, Personality rating, and professional ratings.
- As we are catering all kind of professions, we can provide the options at the start to select as a Researcher, Developer, doctor or any combination. Alternatively, we can provide the list the user to select the attributes that fit most for his/her profile (Concept using Software Product Line).
- Researchers can suggest a mechanism for which User A, who wants to know about User B, can select the attributes and weight-age to attributes according to his / her choice and the result will be shown depending on the choices of the users. This can be due to reason that some Company or User weight more to one attribute than other and similar is the case for a client for XYZ Company.

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