A Study of Social Graph Analysis for Preschool Education Using Face Authentication

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***Abstract*—Social graph analysis for preschool education is discuss in this paper. The social graph is a figure of human relations. Here, it describes the relation between preschool children, moreover the relation between the children and preschool teachers. The preschool teachers wear eyeglasses equipped with a video camera, and they take a video. The social graph is created by a face recognition and authentication systems that performs an identification for children and preschool teacher from the video. In this paper, we compute some kind of centralities indicators of the social graph nodes – degree centrality, betweenness centrality, closeness centrality, eigenvector centrality, and discuss the important children who is the leader of the members.**

Keywords—Social graph; eyeglasses type video camera; face recognition and authentication system; graph centrality

I. INTRODUCTION

Many kinds of video camera systems for preschools has been studied and provided to practical use. However, almost all systems are surveillance video camera systems for general securities. Some systems take a video for a diary on the daily childcare work, but they are only video recording, we cannot obtain some useful information for the preschool education from the system. Here, we try to extract more intelligent and useful information from the raw video data and analyze the preschool education.

We propose a video system using a face recognition and authentication system and make a social graph which describes the relation between children, moreover the children and teachers in the preschool. The preschool teacher wear eyeglasses equipped with a video camera to take a video of the children, and our system perform personal identification from the video data using a face recognition and authentication engine. When some children appear in the same scene, we draw edges between each child node in the social graph, and we draw edges between the teacher node and the children nodes. After that, we compute some centralities --- degree centrality, betweenness centrality, closeness centrality, and eigenvector centrality in the social graph. We can find some important children of the member using the social graph and analysis the preschool education.

In the next section, we explain in detail how to implement the eyeglass type video camera and take a video, how to recognize faces and authenticate the persons, and how to make the social graph. In Section III, we talk about the four kinds of graph centralities and what meaning of each centrality for our preschool education. We experimented our methods in a classroom of a kindergarten, and show our experimental results in Section IV.

II. AUTHENTICATION AND SOCIAL GRAPH GENERATION

Preschool teacher is wearing the eyeglasses video camera, because it doesn't disturb the preschool teacher's childcare and education. In Fig 1, a preschool teacher is wearing an eyeglasses video camera, and taking a video. The eyeglasses type video camera doesn't seem a video camera; it is possible to care that the children aren't aware of taking video. Moreover, the eyeglasses type video camera has a battery, however it is not heavy to teach for teachers.

Using the face recognition and authentication system, children are identified from appearance in the video. The recognition and authentication system can process for plural persons – not one person, then some children with the deep relationship can be fined in the same scene. Such children may be friends in the classroom. Some children may be alone, or some children don't appear in the video.

Our social graph is made using a face recognition and authentication system from the video data. When two children appear in the same video frames, we draw an edge between the two nodes for the two children in the social graph; we also draw two edge to the two children nodes from the teacher node. Fig. 3 show a social graph of our experiments. Nodes for the children are illustrated using small circles, and nodes for the teachers are illustrated using small rectangles in the figure. The children's names and the teacher names are attached to each nodes. The edges are illustrated using line segments in the figure. We count appearance time for each child in the video, and the number of appearance time for each child is attached to the edge for the child to the teacher. The attached number on each edge between two children means the number of times that the two children appear together in the same video frame.

Our social graph show the relation between children and teachers clearly using a figure image. It is possible to analyze the human relations easily using our social graph.

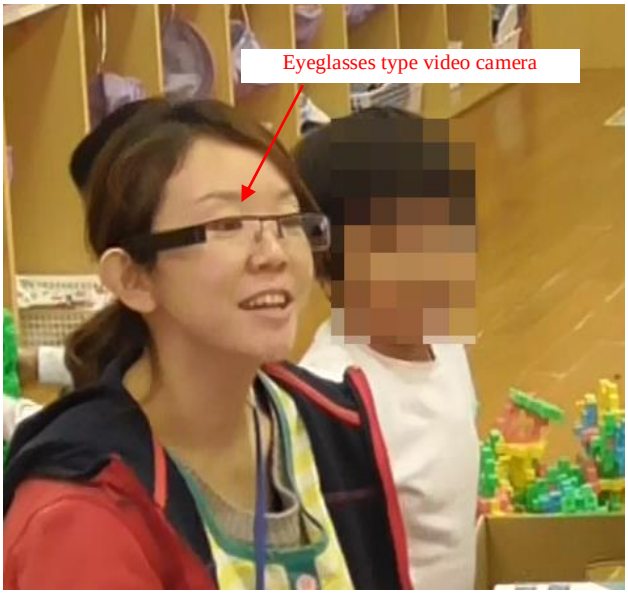

Fig. 1. Taking a video by a kindergarten teacher with eyeglasses type video camera. For the protection of personal information, mosaic is attached in the child face.

Fig. 2. Face recognition and personal authentication in our system. Recognized faces are illustrated using rectangles. For the protection of personal information, mosaic is attached in the faces and these names are temporary.

III. Graph Centrality

We try to analyze our social graph using graph centralities in this paper. Many kinds of graph centralities have been proposed already [1, 2, 3], we focus on the four graph centralities --- degree centrality, betweenness centrality, closeness centrality, eigenvector centrality, and we try to discuss the meaning of each graph centralities in our application. We can find some important children of the member and analysis the preschool education. These centralities are computed on each node in the graph.

Degree centrality: the number of edges on the target node [4, 5]. For our method, the degree centrality means the number of friends whom target child has. In the case that the degree centrality is high and the target child has many friends, we can estimate the target child is important in the member.

TABLE 1. Centrality indicators [1] based on the kindergarten children relationship. For the protection of personal information, these name is temporary.

Name	Degree centrality	Betweenness centrality	Closeness centrality	Eigenvector centrality
Junichi	6	21.40	0.030	0.522
Haru	4	2.633	0.025	0.489
Hana	4	0.000	0.025	0.560
Haruto	1	0.000	0.017	0.068
Honoka	1	0.000	0.019	0.071
Niko	5	9.667	0.026	0.618
Yui	5	9.467	0.026	0.520
Himari	4	3.667	0.024	0.377
Kaito	3	1.167	0.025	0.354
Yuto	2	3.833	0.023	0.224
Riku	5	38.00	0.029	0.378
Sara	7	13.13	0.029	0.778
Akari	1	0.000	0.016	0.058
Toma	4	7.000	0.023	0.322
Asahi	1	0.000	0.019	0.071
Ichika	5	22.17	0.025	0.366
Aoi	3	18.00	0.023	0.311
Sora	3	1.500	0.020	0.199
Reo	11	79.87	0.036	1.000
Hinata	5	4.500	0.026	0.609

TABLE II. Top three children of each centrality. For the protection of personal information, these name is temporary.

Rank	Degree centrality	Betweenness centrality	Closeness centrality	Eigenvector centrality
1	Reo	Reo	Reo	Reo
2	Sara	Riku	Junichi	Sara
3	Junichi	Ichika	Riku and Sara	Niko

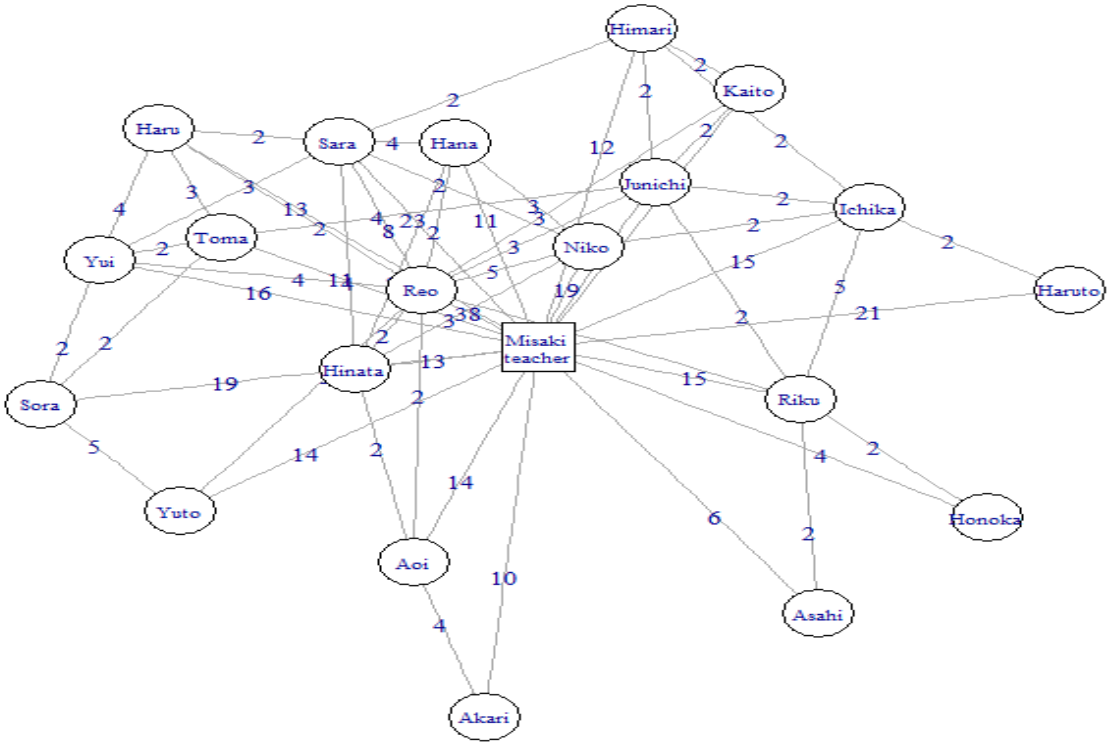

Fig. 3. A social graph for children and a teacher.

Betweenness centrality: when we focus on two node except for the target node, we search the shortest path between two nodes. One case is that the shortest path passes through the target node, the other case that the shortest path doesn't passes through the target node. We count the two case on every combination for the nodes, and then the ratio of the case is the betweenness centrality of the target node. When we want to connect two node, the node with high betweenness centrality is important and in the graph [6, 7]. For our method, the child with high betweenness centrality is required in the member, and he or she is the foundation stone of human resources that connects the members.

Closeness centrality: when we compute the distance between each node and target node in the graph. The distance is define that the number of edge in the shortest path between two nodes [8, 9]. The average of distance is the closeness centrality of the target node [8, 9]. For our method, the child with high closeness centrality is the most familiar person for all member.

Eigenvector centrality: In the case of the target node which is connect to another high degree centrality node, the target node's eigenvector centrality is high [10, 11, 12]. For our method, the child with high eigenvector centrality is connected to a child who has many friends.

IV. Experimental Results

We try to use our system in a classroom in the kindergarten "Jouganji Nakano Takara Youchien in Tokyo Japan" 20 children --- 10 male children and 10 female children --- at 4 or 5 years old, and a teacher joined in our experiments. It should be noted that this experiment is to obtain a review and approval from Tokyo Denki university human bioethics committee.

We take a video, and 90 minutes indoor shoot was used for our analysis. Our eyeglass camera device is a product named "Sanko Mita Mamma glasses H.264." After charging battery for 6 hours, we can take a video for 40 minutes. The video file is AVI format, it is composed of horizontal 1280 pixels and vertical 720 pixels, and the frame rate is 30fps.

For our face recognition and authentication engine, we use a conventional product named "Microsoft project oxford." At first, face registration for each children carried; each child take 5 photo and record them for template images. In the face recognition and authentication, there are 204 video frame which contains at least one or more faces. After that, our authentication is carried out, a list of the frame number and children name is recorded to text file.

We develop our social graph generation engine using the programming language "python." Using the list of the frame

number and children name, we make our social graph, and we count the time of child appearances, and attach them into the graph.

Computing the graph centralities are developed using the programming language "R", and our social graph is described using a package named "igraph" in the programming language "R".

Our total processing time is 2.58 second using a personal computer --- CPU is Core i7, clocks is 3.4GHz, the number of cores is 4 and its logical processors is 8, memory is 4GB.

The social graph is shown in Fig. 3. Teacher "Misaki" is displayed in the center, and children is located around the teacher on the social graph. In this experiment, each child node is always connected to another child node. It can be seen that there no alone child in this classroom. The teacher node is always connected each child node. It can be seen that the teacher care all children. The number on the edge between the teacher and "Reo, Sara, and Haruto" is large, then, It can be seen that the teacher care "Reo, Sara, and Haruto" many times.

The centralities of each child are shown in Table 1, and top three children of each centrality are shown in Table 2. The degree centrality on "Reo, Sara, and Junichi" is high. It can be seen that they have many friends. The betweenness centrality on "Reo, Riku, and Sara" is high. It can be seen that the three children is required to connect each person in the member. The closeness centrality on "Reo, Junichi, Riku, and Sara" is high. It means that the children are familiar for all member. The eigenvector centrality on "Reo, Sara, and Niko" is high. It can be seen that the three children are connected to a child who has many friends. The all centralities on "Reo" are Top, then it means he is the leader in this classroom.

V. Conclusion

We propose a video system using a face recognition and authentication system and make a social graph which describes the relation between children and teachers in the preschool. Our eyeglasses typed video camera doesn't disturb the preschool teacher's childcare and education, so that it is useful to take a video in our method. We explain how to make our social graph and discuss our analysis the relation between children and teachers with the centralities. In this paper, we focus on the four centralities --- degree centrality, betweenness centrality, closeness centrality, and eigenvector centrality in the social graph. We found some important children of the member using the social graph and analysis the preschool education in our experiment.

In our future works, we have to repeat many experiments for our method, and estimate the performance of our method. We have an important task to define the quantitative evaluation method for our performance.

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References

[1] Yutaka Matsuo, Kosuke Shinoda, Hideyuki Nakajima "Network Generation Model by Rational Agent based on Centrality," Transactions of the Japanese Society for Artificial Intelligence, AI 21, pp.122-132, 1 November 2006.

[2] Opsahl, Tore and Agneessens, Filip and Skvoretz, John, "Node centrality in weighted networks: Generalizing degree and shortest paths," Social networks, Vol.32, No.3, pp245-251, July 2010.

[3] Crucitti, Paolo and Latora, Vito and Porta, Sergio, "Centrality measures in spatial networks of urban streets," Physical Review E, Vol.73, No.3, pp.036125, March 2006.

[4] Tsutomu Suzuki, Network analysis, pp.41-60, Kyoritu Shuppan, Tokyo, 2009.

[5] Naoki Masuda, Konno Norio, Complex Network, pp.31-37, Kindaikagakusha, Tokyo, 2010.

[6] Masakazu Kanbe, Shuichiro Yamamoto "Application of Social Network Analysis for Enterprise SNS," Japanese Society for Artificial Intelligence, 3rd Special Interest Group on Knowledge Sharing Network, 2008.

[7] Abbasi, Alireza and Hossain, Liaquat and Leydesdorff, Loet, "Betweenness centrality as a driver of preferential attachment in the evolution of research collaboration networks," Journal of Informetrics, Vol.6, No.3, pp.403-412, July 2012.

[8] Wey, Tina and Blumstein, Daniel T and Shen, Weiwei and Jordan, Ferenc, "Social network analysis of animal behavior: a promising tool for the study of sociality," Animal behavior, Vol.75, No.2, pp.333-344, February 2008.

[9] Daly, Elizabeth M and Haahr, Mads, "Social network analysis for information flow in disconnected delay-tolerant MANETs," IEEE Transactions on Mobile Computing, Vol.8, No.5, pp.606-621, May 2009.

[10] Borgatti, Stephen P, "Centrality and network flow," Social networks, Vol.27, No.1 pp.55-71, January 2005.

[11] Abbasi, Alireza and Altmann, Jorn and Hossain, Liaquat, "Identifying the effects of co-authorship networks on the performance of scholars: A correlation and regression analysis of performance measures and social network analysis measures," Journal of Informetrics, Vol.5, No.4, pp.594-607, October 2011.

[12] Comin, Cesar Henrique and da Fontoura Costa, Luciano, "Identifying the starting point of a spreading process in complex networks," Physical Review E, Vol.84, No.5, pp.056105, November 2011.