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A Way to Assess Risk Factors in Residential Environment

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Abstract. This paper recognizes life environment risks which variously exist to guarantee safety of users from all kinds of risk factors that do in resident environment and suggests a plan to infer degree of risk. The artificial neural network theory which makes a great contribution to the artificial intelligence and data-mining fields detects risk factors through mechanical learning even in the environment that cannot in advance recognize them and provides clues of good methods to be able to evaluate the degree of risk of real-life situations. The risk factors which exist in each residential environment are not uniform and there are many cases that don't have single factors. It's the plan which can suppose high level of each risk factor and risk environment by handling these various and multiple risk factors. This paper includes the pre-clustering to the risk calculation using the artificial neural network. It was confirmed that the risk calculation using the artificial neural network could be improved through a pre-clustering of the input data.

Keywords : Risk Prediction, Artificial Neural Network, Data clustering

1 Introduction

The large budgets are being used in building the traditional infrastructure for live safety including improvement of roads, installation of lighting, installation of CC cameras, and expansion operation of anticrime checkpoints to solve these problems. On the other hand, the attempts which strengthen the function to guarantee safety of vulnerable residential environments by introducing developed information and communications technology such as ubiquitous computing have been done. The core technologies of ubiquitous computing application technologies such as the system to protect children in front of schools, the system to care senior citizens who live alone remotely, and the system to support activities of disable persons are to recognize different multiple factors related to safety, obtain data about them, and process them effectively and efficiently. Especially, inferring dangerous situations more clearly by

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getting mutually different and various factors and evaluating them properly is the useful and important processing technology.

Therefore, this paper recognizes life environment risks which variously exist to guarantee safety of users from all kinds of risk factors that do in resident environment and suggests a plan to infer degree of risk. The artificial neural network theory which makes a great contribution to the artificial intelligence and data-mining fields detects risk factors through mechanical learning even in the environment that cannot in advance recognize them and provides clues of good methods to be able to evaluate degree of risk of real-life situations. The risk factors which exist in each residential environment are not uniform and there are many cases that don't have single factors. It's the plan which can suppose high level of each risk factor and risk environment by handling these various and multiple risk factors. To this end, risk factors of crime affecting the living condition were identified and weights of each risk factor were determined. The clustering on the status data were performed and applied to the artificial neural network in order to improve the performance of the artificial neural network.

This paper is composed as follow: The chapter 2 arranges the related studies and Chapter 3 suggests the plan to infer the threat factors of life safe. Chapter 4 describes a test and evaluation about the suggested plan and Chapter 5 concludes.

2 The Related Studies

The examples which overcome risk factors by utilizing information and communication technology in all kinds of life environments and improve life security are being variously done.

The system to protect the senior citizens who live alone: This system can take measures by grasping and responding to their physical condition and urgent situations while they lead their lives in real time. The function detects their movement through multiple sensors installed in the flow of human traffic in their residential areas and notifies detection of temperature, humidity, gas, and fire of the general situation center of Gu-offices. It can also forward urgent situations to fire stations and police stations [1][2][3].

U Safe Fire Protection System: This system collects information about all kinds of fire-fighting equipment such as heat sensors, smoke detection equipment, spring coolers, pumps, and tanks through sensors installed in fire receivers and major points in buildings and transmit them to the integrated server of the general situation center in real time. At this moment, the server informs it of the data by analyzing the firefighting standard data values and the transmitted data from the sensor and grasping normality and obstacles of fire-fighting equipment. The system's goal is to be able to extinguish fires early when fires break out through prompt inspection of facilities [4][5][6].

Smart Walk System: This system supports walk of persons who are visually impaired and the old and the infirm. It is divided into RTA and ETA. It has the function to recognize obstacles that pedestrians encounter in pedestrian environments and make them avoid risk factors. It also includes the system to support shopping and

tourism by preparing for equipment to make life easier such as electronic approval systems. RTA has the navigation function to arrive at destinations and make people avoid obstacles located on the routes by recognizing them. For ETA, there are many cases of the small types with less wearability such as the existing white sticks, necklaces, or glasses for disable persons rather than different equipment by considering the point that the persons who are visually impaired prefer white sticks. It usually utilizes ultrasonic sensors, infrared ray sensors, or tri-axial acceleration sensors [7][8][9].

Geographical profiling: A study was done on the grading of risks based on the local incident statistics and the service providing such information. The study had contributed on selecting the risk area by analyzing crime statistics of the past. It, in turn contributed to decreased crimes due to increased patrols, prompt mobilization from the undercover patrol office and roundup of criminals. This study had contributed to suppressing similar crimes and to promptly arresting criminals in a crime ridden area. However, it had not helped to identify dynamic factors involved in crimes. The possibility of a crime might be higher or lower depending on the variable factors such as victim's condition, degree of illumination in the area and foot traffic even in the same area at the same time. This study shall be complemented with considerations in these dynamic factors [10].

3 Inference of risk situations of life safety

It is important to recognize risk factors promptly by evaluating situation information properly even when new risk situations which cannot be in advance modeled occur or there is high probability of their occurrence. Convergence of information detected by various sensors would provide a clue to upcoming circumstance and improve the quality of targeted information. A reasonable way to calculate how the risk changed depending on situations and a measure to converge the multiple factors were needed. This paper suggests the plan to infer the following risk situation to solve this problem. Calculation of risk for dangerous situation was performed using the artificial neural network. Clustering of acquired data was done at this time to enhance the risk computability of the artificial neural network.

3.1 The plan to recognize risk situations

The neural networks are useful for modeling which predicts risks because they have functions to learn something by themselves and compose the relationship between variables. The following procedure is carried out to detect the threat factors in the residential environments, evaluate situations, and infer risk situations.

3.1.1 The procedure to infer risk situations by using the artificial neural network

1) Set a sensor

2) Obtain/save the sensing data
3) Initialize the artificial neural network model.
4) Set the learning pattern of the artificial neural network.
5) Apply the artificial neural network.
6) Draw and evaluate a result.

3.1.2 Set the factors which threat residential environments and sensor

The method to recognize risk situations by using sensors to respond to bodies or CC cameras has the weak point in prevent accidents because it usually recognize the situations on the verge of that accidents occur or the ones that they begin to occur. Therefore, making space of the residential environments smart is required to guarantee safety in advance by recognizing risk situations that the study focuses on beforehand or avoid risk. The study sets the factors which threat safety in the residential environments and the sensor that can detect these threat factors as follow:

1) The distance between space that users use and CC cameras
2) Existence of crime prevention personnels in anticrime checkpoints around users
3) Patrol activities of crime prevention personnels around users
4) The distance between users and anticrime checkpoints
5) Lighting of space that users move(Intensity of illumination)
6) The number of floating persons around space that users move
7) The number of persons who wander around space that users move

1) was set by judging that there is a connection between the distance between the place that CC cameras are located and users and risk factors based on the point that there are less crimes and accidents in the places which are closer to CC cameras. No. 2) was set on the assumption that the factors which threat safety decrease when crime prevention personnel work in anticrime checkpoints in the areas that users move. 3) was set based on the fact that risk situations can be solved when crime prevention personnel patrol the applicable area even though users are far from anticrime checkpoints. 4) was set on the assumption that criminal acts will be avoided around anticrime checkpoints and crime prevention facilities. 5) was set bearing the fact that crimes occur in darker places than brighter ones in mind. 6) was set as the fact that risk of accidents decreases if there are many floating persons in the areas that users move and it increases if there are not many ones in them. 7) was set supposing that infrared ray sensors to sense bodies which were installed in the outdoor activity areas detect persons and the cases that users don't move and there are the persons who wander around them are dangerous situations.

3.2 Build the system to detect risk factors of the artificial neural network

The sensing data related to the variables set in Paragraph 3.2 were utilized to build the system to detect risk factors in the residential environments of users by using the artificial neural network and infers risk situations. And the artificial neural network to

detect the risk factors suggested in the study is composed as follow: The sensing information about the distance between CC cameras and users, existence of crime prevention personnel in anticrime checkpoints, patrol activities of crime prevention personnel, the distance between anticrime checkpoints and users, intensity of illumination of space that users move, the number of floating persons around space that users move, and the number of persons whose activities stop around space that users move are input in the neurons of the input layer. A hidden layer is set in this system and the result about risk is output in the output layer. Now, the nerve network of the system composed like this is actually composed, the result is examined in next Chapter 4, and the result is evaluated.

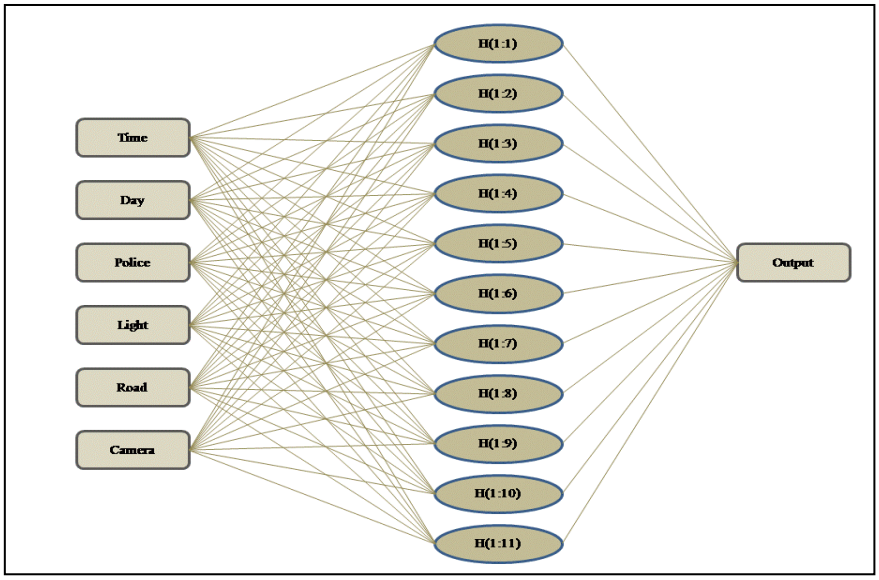

Fig. 1. Artificial neural network to detect risk factors of residential environments

4 Experiment and evaluation

The SPSS is used to test the plan to detect risk factors of residential environments which used the artificial neural network suggested in the study. The 7 risk factors of Paragraph 3.2.2 were used as the input variables. The sensing values were input through SPSS and the details of the nerve network drawn from the result are shown in the Fig. 1.

Table 1. The details of the layers of applied artificial neural network

		Prediction											
		Hidden Layer 1											Output Layer
		H(1:1)	H(1:2)	H(1:3)	H(1:4)	H(1:5)	H(1:6)	H(1:7)	H(1:8)	H(1:9)	H(1:10)	H(1:11)	Output
Input	(Bias)	.004	-.592	.065	-.148	-.167	-3.815	-.944	.130	-.155	.120	.285	
	TIME	-.253	.064	.072	-.102	.162	2.689	-.978	.059	-.028	-.002	-.551	
	WEEK	.324	-.087	-.023	.824	.267	-.011	.045	.637	-.908	-.836	-.251	
	POLICE	-.144	.019	.020	-.285	-.068	-.008	.012	.262	-.217	.253	.092	
	LIGHT	.290	.215	-.756	-.268	-.105	-.003	-.013	.119	-.267	.166	.049	
	LOAD	.381	.080	-.018	-.177	-.142	.005	-.021	.051	-.120	-.042	-.162	
	CCTV	-.400	-.006	-.021	-.177	-.098	-.003	-.002	.040	-.211	.095	.114	
Hidden 1	(Bias)												.444
	H(1:1)												.025
	H(1:2)												.018
	H(1:3)												.449
	H(1:4)												-.829
	H(1:5)												-.761
	H(1:6)												1.503
	H(1:7)												-.827
	H(1:8)												.802
	H(1:9)												-1.115
	H(1:10)												.603
	H(1:11)												.101

The table below summarizes the risk situations of time, day of the week, anti-crime facility, illumination, width of the street and the distance to a CC camera with their weighted values and normalized values which led to a real time risk factors based on the artificial neural network model.
As the result, the Shinchon case and Yongin case had the danger factors of 75% and 96%, respectively.

Table 2. The result of risk degree of Shinchon and Yongin case

TIME	DAY	POLICE	LIGHT	ROAD	surveillance Camera	Predicted Value	risk	Assess	ACC.
1	0	0.25	1	1	0.75	0.75	75 %	Danger	Sinchon
1	0	1	1	1	1	0.96	96 %	Very Danger	Yongin

Detect risk factors

This test calculated how 7 different risk factors affect space that users move through learning of the system. While the intensity of illumination of space around users is low, there is no any patrol activities of crime prevention personnels, degree of risk increased. And it has found that the closer places that CC cameras are installed are, the lower degree of risk is.

The difference between the expected risk level and the one that the artificial nerve network to detect risk factors suggested in the study is shown in the chart of the following figure. As shown in the chart, it has found that there is a little bit of gap between the predicted risk factors and risk level that the artificial nerve network to detect risk factors suggested in the study, but the aspects that degree of risk changes by measured time slot are similar and there are no big differences in its absolute values.

5 Conclusion

This study drew up the artificial neural network-based plan to detect risk factors of residential environments based on the sensing values which detect the 7 risk factors and carried out this. Quantitative evaluation could be done by calculating the effect of mutually different multiple factor values on real life safety through mechanical learning of the risk factors which exist in the residential environments. Based on this study, it is determined that the danger risk factor computations can be improved using the artificial neural network by clustering.

References

1. Lee, S.W., Kim, Y. J., Lee, G. S., Kim, B. J.: Hallym Jikimi: A Remote Monitoring System for Daily Activities of Elders Living Alone. Journal of KIISE, Computing Practices and Letters Vol.15, No. 4, pp. 244--254 (2009)
2. Lee, S.W.: A Circadian Life Pattern Modeling and Anomaly Detection Method for Elders Living Alone. Journal of KIISE, Computing Practices and Letters Vol.17, No. 7, pp. 399--406 (2011)
3. Jang, I.H., Sim, K. B.: Ring-type Heart Rate Sensor and Monitoring system for Sensor Network Application. Journal of KIISS, Vol.17, No. 5, pp. 619--625 (2007)
4. Kang, W. C., Kim, N. O., Min, W. G., Kim, Y. D.: Fire Protection System for Ubiquitous Environment. Journal of Electrical Engineering & Technology, Vol. 54p, No.3, pp. 141--147(2005)
5. Kim, N. O., Min, W. G., Kim, B. C., Shin, S. D., Kang, W. C.: Fire Protection equipment for Ubiquitous System. Journal of KIEE, pp. 139—144(2005)

6. Park, S. H.: A Study on the Development of Integrated Type Fire Alarm Control Panel for Ubiquitous Environment. Journal of KIFSE, Vol. 24, No. 1, pp. 24-30(2010)
7. Lee, J. H., Lim, S. H., Lee, E. S., Shin, B. S.: An Outdoor Navigation System for the Visually Impaired Persons incorporating GPS and Ultrasonic Sensors. Journal of KIISE, Software and Applications, Vol. 36, No. 6, pp. 462--470 (2009)
8. Lee, E. H.: Walking guidance technology for the Blind. The Magazine of the IEEK, Vol. 32, No. 3, pp.40--53(2005)
9. Lim, C. H.: A Study on Design development of Sensor Cane for the Blind. Journal of the Korea Digital Design Council, Vol. 11, No. 1, pp. 1--8(2011)
10. Hong, D. S., Suh, J. S., Han, G. J.: Spatio-Temporal Patterns and Analysis Methods for Supporting the Efficient Investigation on Serial Crimes. Journal of the Korean society for geo-spatial information system, Vol. 21, pp. 477--484 (2008)

