

PAPER • OPEN ACCESS

Study of Usage Behavior on Applying LINE for Fire Safety Works through UTAUT Model

To cite this article: Y C Chen and W J Hu 2020 *IOP Conf. Ser.: Earth Environ. Sci.* **527** 012015

View the [article online](#) for updates and enhancements.

You may also like

- [Analysis of Acceptance of Vocational High School e-Report in Temanggung District Using the UTAUT Model \(Unified Theory of Acceptance and Use of Technology\)](#)
U A Erlita and Priyanto
- [Is the Use of Reference Managers Driven by Necessity or Policy Pressure?](#)
Ahmad Nurkhin, Muhsin, Ade Rustiana et al.
- [Empirical Review of the Challenges of the Cashless Policy Implementation in Nigeria: A Cross-Sectional Research](#)
Chukwuebuka Ejioh, Aderonke A.Oni, Charles K. Ayo et al.



ECS
The
Electrochemical
Society
Advancing solid state &
electrochemical science & technology

DISCOVER
how sustainability
intersects with
electrochemistry & solid
state science research

Study of Usage Behavior on Applying LINE for Fire Safety Works through UTAUT Model

Y C Chen¹ and W J Hu^{1, 2}

1 Department of Environmental Engineering, Da-Yeh University, Changhua 51591, Taiwan

2 New Taipei City Fire Department, New Taipei City 23147, Taiwan

E-mail: yiching@mail.dyu.edu.tw

Abstract. Nowadays, LINE is one of the widely used communication software in Taiwan and fire protection work is also deeply affected through applying LINE. In this study, the Integrated Technology Acceptance Model (UTAUT) is applied to explore the behavior usage of LINE in assistance of fire safety works. A questionnaire survey is designed to explore the three aspects that affect the "behavioral intension", such as "performance expectation", "effort expectation" and "social influence"; and whether "usage behavior" is subject to "behavioral intension" and "facilitating conditions". Moderator variables such as gender, age, experience and voluntary interference with each aspect are also explored. Through the statistical analysis, it is concluded that LINE's assistance to fire safety works is definitely positive. "Performance expectation", "effort expectation" and "social influence" can affect "behavioral intention" to be very significant; "behavioral intension" and "facilitating conditions" can also affect "usage behavior". Among the different moderator variables: gender has no significant difference to each aspect. Age, working seniority and LINE experience have very or extreme significant differences on each aspect. Work unit and grades only have significant differences on some aspect. Voluntary has significant difference only in "social influence."

1. Introduction

When people are not online, they use a variety of communication methods, including phone calls, written letters, and face-to-face conversation. We use these different methods depending on the situation. Nowadays, online communication is very similar: People may use instant messaging, video chat, or social networking depending on the situation. You can choose whichever methods best fit your needs. The online communication definition today, refers to how people communicate with each other through a mobile phone or computer by the internet network. People are resorting to online communication more than the traditional forms due to its many advantages for the person to communicate easily with someone else [1].

The LINE app was launched in Japan in 2011 and now available worldwide, LINE grew to 200 million users within its first two years, spreading well outside of Japan. LINE is more than just a free communication tool. It's a social media site [2]. Like other social online communication tools, Facebook, Twitter, LINE is a freeware app for instant communications on electronic devices such as smartphones, tablet computers, and personal computers. LINE users exchange texts, images, video and audio, and conduct free VoIP conversations and video conferences [3].

The online social communication software on mobile phones or computer today has its convenience, ease of operation and immediateness, which has changed the habits of people's communication and affected people's handling of official duties, too. If firefighters use LINE for handling fire safety works,



Content from this work may be used under the terms of the [Creative Commons Attribution 3.0 licence](https://creativecommons.org/licenses/by/3.0/). Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.

their message expression will be more choices, and the image transmission will be more immediacy. This will help to provide relevant information immediately for the on-site commander to judge the actual situation in time. So, LINE's online communication can really help Taiwan's fire safety works, so it is necessary to conduct a research on the usage behavior for firefighters about application of LINE at work.

2. UTAUT model

Here, the “Unified Theory of Acceptance and Use of Technology (UTAUT)” model was used to investigate the key factors affecting users’ intention and their behaviour through questionnaire survey on LINE at fire safety works.

2.1. Intention-Behavior relationship

A research addressed the ability to predict peoples' computer acceptance from a measure of their intentions, and the ability to explain their intentions in terms of their attitudes. Results showed perceived usefulness strongly influenced peoples' intentions [4]. Also, a number of theoretical models had been proposed to facilitate the understanding of factors impacting the acceptance of IT (information technology). The Technology Acceptance Model (TAM) is one of the most influential and robust in explaining IT adoption behavior. However, the UTAUT model was assumed being able to consolidate previous TAM related studies [5]. Over the last few decades, many models and theories had been developed and tested in order to identify variables affecting the acceptance from end-users. Comparing with TAM and Theory of Reasoned Action (TRA) the UTAUT synthesized 32 constructs from eight well-known models and theories which is most suitable the acceptance of users [6].

TRA assumes that a person's behavior is controlled by his will, that is, personal behavior is determined to take this action or not through conscious and rational thinking. So, intention is the most important key to influence usage behavior [7]. Moreover, Theory of Planned Behavior (TPB) was proposed in which further extended TRA by using the intention as variable for usage behavior [8]. Paul & Olson [9] in 1987 proposed a measurement of intention that can be used to predict whether actual behavior will occur. The definition of use intention is that a person decides whether to take the action after the process of thinking; and the usage behavior is defined as the subjective probability that a person is taking his specific action.

2.2. Model evolution

Venkatesh *et al.* [10] developed the UTAUT model to consolidate TAM based on TRA and TPB for related studies. TAM assumes that beliefs about usefulness and ease of use are always the primary determinants of information technologies adoption in organizations. Perceived usefulness is defined as the extent to which a person believes that using a system would enhance his or her job performance. Perceived ease of use refers to the extent to which a person believes that using a system would be free of mental efforts [11]. According to this rationale, human beings are often rationally and intentionally considering the possible outcomes of various behavioral methods, while intentions are controlled by subjective norm (SN) and attitude together as the framework shown in Figure 1.

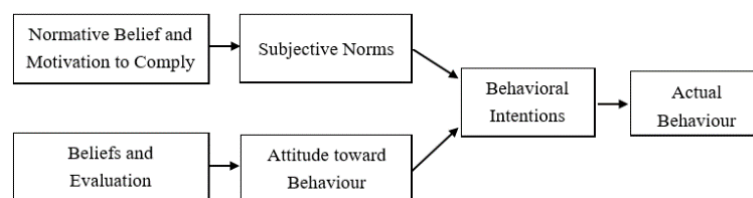


Figure 1. The framework of the TRA model [7].

Moreover, TPB is extended from TRA which assumes that individual behavior is caused by one's own willingness. However, in reality, the individual's willingness to control behavior is actually subject to many restrictions, such as: information, time and ability, and so on, which reduces the explanation to individual's behavior through rational behavior. Therefore, the factors affecting the personal behavioral

intention, in addition to the original attitude toward behavior and subjective norms, must also be added to the individual's own perceived behavioral control such as behavioral ability, opportunity and confidence. The framework of the TPB model is shown in Figure 2.

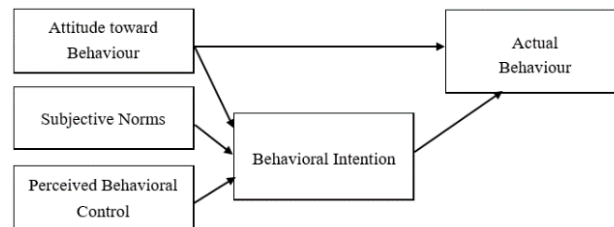


Figure 2. The framework of the TPB model [8].

However, the UTAUT model accounted for 70% of the variance in usage intention, better than any of TAM studies alone [5]. In the UTAUT model, performance expectancy (PE) and effort expectancy (EE) were used to incorporate the constructs of perceived usefulness and ease of use. Also, another two important categories were incorporated, such as social influence (SI) and facilitating conditions (FC). Moreover, the UTAUT model attempts to explain how individual differences influence technology use. More specifically, the relationship between perceived usefulness, ease of use, and intention to use can be moderated by age, gender, experience, and voluntaries of use; and the framework of the TPB model is shown in Figure 3 [10]. About the application of UTUAT model in firefighters, Chen & Chen [12] investigated the influencing factors of the intentions and usage behavior of fire fighters for using live video transmission system in disaster sites, and results show that intention had a positive and direct impact on usage behaviour; Chen & Lin [13] investigated the intention to apply mobile device in emergency medical service sites for fire fighters and most users agree well with good satisfaction about that the usage of mobile device incorporated with ambulance service.

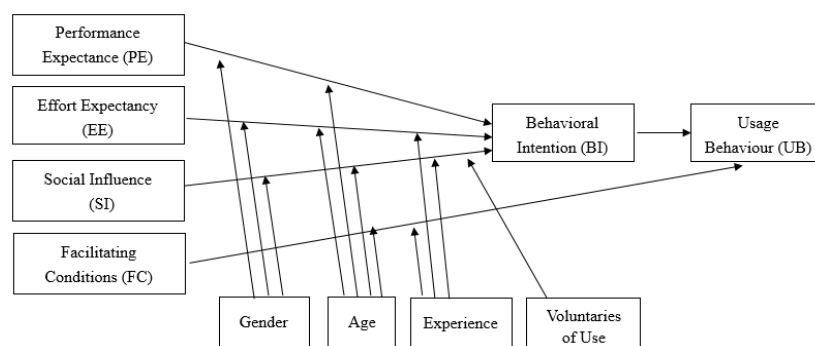


Figure 3. The UTAUT model [10].

3. Methodology

3.1. Research framework

The UTAUT model was applied in this study as the main theoretical basis of the research framework to explore whether PE, EE, SI and FC affect usage behavior for firefighters about application of LINE at work. And, behavioral intention is assumed to be moderated by age, gender, experience, and voluntaries of use. Here, the age includes firefighter's age and working seniority, also experience includes LINE usage experience, working unit and rank.

The operational definition and evaluation for those categories in UTAUT model are described below:

- Performance expectancy (PE): Firefighters subjectively believe that the application of LINE at work can actually help improve their work efficiency and performance.
- Effort expectancy (EE): Firefighters subjectively believe that ease of using LINE can actually help to adapt the mission.

- Social influence (SI): Firefighters can be favorably recognized by the public, the chief executive and colleagues due to application of LINE at work.
- Facilitating conditions (FC): Firefighters personally believe that existing facilities or technology infrastructure (networks, hardware, etc.) can support the application of LINE at work.
- Behavioral intention (BI): The degree of willingness is evaluated for firefighters personally to apply LINE at work.
- Usage behavior (UB): According to previous research on TAM, TRA and TPB, behavioral intentions can actually affect individual behavior. Therefore, the higher the firefighters' intention to recognize the advantages of LINE, the higher his willingness to apply LINE at work.

3.2. Questionnaire design and analyses for validity and confidence

After the questionnaire was reviewed by the experts and revised, a formal questionnaire with expert validity was prepared. According the operational definition for those six categories in UTAUT model there are 31 questions designed as shown in Table 1. The questionnaire is scored by Likter's 5 point scale with range from "very disagree" to "very agree" which is given 1 to 5 points.

Table 1. Questionnaire designing.

item	question
PE1	LINE can improve my efficiency in fire safety works.
PE2	LINE can help me to convey messages in fire safety works.
PE3	LINE can assist me in execution on fire safety service.
PE4	LINE can assist me in fire rescue works.
PE5	LINE can assist me in emergency medical service (EMS) work.
PE6	LINE can assist me in liaising with relevant government departments or civil society.
PE7	LINE can assist me in disaster management.
PE8	LINE can make instant two-way communication.
PE9	LINE can receive and convey diversified information (words, pictures, voice, video, etc.).
PE10	LINE can easily express key points.
PE11	LINE can provide a communication by an accustomed language.
PE12	LINE can communicate the message more effectively.
EE1	LINE is easy to obtain and free.
EE2	LINE is easy to learn.
EE3	Interface operation of LINE is simple.
SI1	My relatives, friends, officers, and colleagues use LINE often.
SI2	My relatives, friends, officers, and colleagues always suggest me to use LINE.
SI3	The public believes that the use of LINE is in needs of society.
SI4	It is a trend to use LINE.
FC1	Line can be easily to use even without applying similar communication software ever.
FC2	It's easy to find someone to ask for help or check the answer on the Internet for LINE.
FC3	LINE can be used on different hardware devices (smart phones, computers, tablets)
BI1	LINE is a good thing to continue to use.
BI2	LINE has very good benefit to use.
BI3	Recommending more colleagues to use LINE in fire safety works.
UB1	A priority to using LINE to convey messages on fire safety works.
UB2	LINE is preferred while using a voice call.
UB3	LINE is preferred while using video and audio calls.
UB4	LINE is preferred while sending text messages.
UB5	LINE is preferred while sending photo messages.
UB6	LINE is preferred while transferring file messages.

For confidence level, Cronbach's α was always measured to assess the reliability, or internal consistency. There were 30 pre-test questionnaires issued to evaluate the Cronbach's α through SPSS which is higher than 0.8 of "good" confidence in Table 2.

Table 2. Cronbach's α for each category.

Category	No. of questions	Cronbach's α
PE	12	0.950
EE	3	0.896
SI	4	0.913
FC	3	0.854
BI	3	0.867
UB	6	0.957
total	31	0.931

4. Results and discussions

4.1. Sample statistics

There are 187 samples needed under 95% confidence level with a 3% margin of error for total 227 staffs in the Fourth Brigade of New Taipei City Fire department. However, only 159 valid questionnaires were collected from 170 returned (93.5%). Most surveyed objects are male (95%), the age is mostly ranged between 31 to 40 years old (61%) and the working seniority of firefighter is mostly about 6 to 10 years (43.4%). More firefighters are basic staffs (91.2%) at local fire squad (89.3%). Also, most are the heavy user experience on LINE (82.4%) and half of them are voluntarily applying LINE to works (54.7%).

4.2. Correlations

The Pearson Product-Moment Correlation is one of the measures of correlation which quantifies the strength as well as the direction of such relationship. The strength of a correlation is measured by the correlation coefficient r . Coefficient $r > 0.7$ indicate variables which can be considered highly correlated.

According to the assumption of UTAUT model results showed high correlation with high significance on BI from categories of PE, EE, and SI in Table 3. It means that users' intention could be highly expected on users' performance expectancy, effort expectancy and social influence. Also, results showed high correlation with high significance on UB from categories of BI and FC, too. It means that users' behavior could be highly expected on users' intention.

Table 3. Pearson correlation between each category according UTAUT model.

	PE	EE	SI	FC	BI	UB
BI	0.782**	0.750**	0.844**	-	-	-
UB	-	-	-	0.751**	0.826**	-

*significant $p < 0.05$ **highly significant $p < 0.01$

4.3. Multiple Regression Analysis

As a predictive analysis, the multiple linear regression is used to explain the relationship between one continuous dependent variable and two or more independent variables. In this study four categories such as PE, EE, SI and FC are assumed to present good relationship with BI, so as BI and UB.

The results shown in Table 4 present that the β coefficients for PE, EE and SI are 0.389, 0.146 and 0.424 respectively with high to very significance. And the regression model is shown in equation (1). In Table 5, another β coefficients for UB and BI is calculated as 0.844 with very high significance, and the regression model is shown in equation (2). For UTAUT model the regression between UB and FC is concerned, too. The β coefficients for UB and FC is calculated as 0.780 with very high significance, and the regression model is shown in equation (3).

Table 4. Regression analysis for BI corresponding to PE, EE, SI, and FC

Category	Standardization coefficient β	T	Collinearity		
			Tolerance	VIF	Cumulative interpretation
PE	0.389	6.410***	0.358	2.793	0.789
EE	0.146	2.291**	0.327	3.062	0.796
SI	0.424	5.751***	0.242	4.131	0.726

*significant $p < 0.05$ **highly significant $p < 0.01$ ***very highly significant $p < 0.001$

Table 5. Regression analysis for UB corresponding to BI and FC

Category	Standardization coefficient β	T	Collinearity	
			Tolerance	VIF
BI	0.844	19.699***	1.000	1.000
R^2	0.712		$Adj R^2$	0.710
F	388.053		Df	(1, 157)
FC	0.780	15.634***	1.000	1.000
R^2	0.607		$Adj R^2$	0.606
F	244.434		Df	(1, 157)

*significant $p < 0.05$ **highly significant $p < 0.01$ ***very highly significant $p < 0.001$

$$BI = 0.389 PE + 0.146 EE + 0.424 SI \quad (1)$$

$$UB = 0.844 BI \quad (2)$$

$$UB = 0.780 FC \quad (3)$$

4.4. Analyses of Moderated Variables

As previous assumption behavioral intention is moderated by those variables, such as gender, age (firefighter's age and working seniority) and experience (LINE usage experience, working unit and rank). In this study the significance of difference was evaluated through independent-sample T-test and ANOVA. The results are shown in Table 6.

Independent-sample T-test was tested for gender, working unit, rank and voluntaries of use. The evaluations show:

- Gender has no significant difference on each categories. i.e. male and female can apply LINE on fire service works without any difference.
- There is significance of difference on working unit for SI, i.e. firefighters in brigade are more concerning favorable recognition by the public than in squad.
- Also, there are significance of differences on rank for SI and FC. It means that basic firefighters are more concerning favorable recognition by the public than supervisors, and basic firefighters can ever trust existing facilities or technology infrastructure in supporting the application of LINE at works than supervisors.
- There is significance of difference on voluntaries of use for SI, i.e. those proactive firefighters are more concerning favorable recognition by the public than those only cooperating in works.

ANOVA was tested for age, working seniority and LINE usage experience. Also, a post-hoc test by scheffé method will be carried out while presenting significance of difference. The evaluations show:

- There are very high significance of differences on age for PE, EE, SI, and FC. It means that those firefighters under 30 years old believe mostly that the application of LINE at work can actually help improve their work efficiency and performance, and they believe mostly that ease of using LINE can actually help to adapt the mission, and they are more concerning favorable

recognition by the public, and they can ever trust existing facilities or technology infrastructure in supporting the application of LINE at works.

- There are very high significance of differences on working seniority for PE, high significance of differences for SI, and FC, and significance of differences for EE. It means that firefighters less than 5 year seniority believe mostly that the application of LINE at work can actually help improve their work efficiency and performance, and they are more concerning favorable recognition by the public, and they can ever trust existing facilities or technology infrastructure in supporting the application of LINE at works. However, firefighters with 11~15 years seniority believe mostly that ease of using LINE can actually help to adapt the mission.
- There are very high significance of differences on LINE usage experience for EE, SI, and FC. It means that those LINE severe user of firefighters believe mostly that ease of using LINE can actually help to adapt the mission, and they are more concerning favorable recognition by the public, and they can ever trust existing facilities or technology infrastructure in supporting the application of LINE at works.

Table 6. The analysis of significance difference on moderated variables for each categories.

moderated variables		N	Category	Significance of difference
gender	(1)male	151	PE	×
	(2)female	8	EE	×
			SI	×
age	(1)under 30	36	PE	*** (1)>(2)(3)(4) (2)>(3)
	(2)31~40	97	EE	*** (1)>(3)(4) (2)>(3)(4)
	(3)41~50	16	SI	*** (1)>(3)(4) (2)>(3)(4)
	(4)above 51	10	FC	*** (1)>(3)(4) (2)>(3)(4)
working seniority	(1)less than 5	19	PE	*** (1)>(2) (1)>(5)
	(2)6~10 yrs.	69	EE	* (3)>(5)
	(3)11~15 yrs.	43	SI	** (1)>(5) (3)>(5)
	(4)16~20 yrs.	15	FC	** (1)>(5) (3)>(5)
	(5)more than 21 yrs.	13		
LINE usage experience	(1)mild user	8	EE	*** (3)>(2)>(1)
	(2)moderate user	20	SI	*** (3)>(2)>(1)
	(3)severe user	131	FC	*** (3)>(2)>(1)
working unit	(1)squad	142	EE	×
	(2)brigade	17	SI	* (2)>(1)
			FC	×
rank	(1)supervisor	14	EE	×
	(2)firefighter	145	SI	* (2)>(1)
			FC	* (2)>(1)
voluntaries of use	(1)yes(proactive)	72	SI	*** (1)>(2)
	(2)no(cooperate in work)	87		

× not significant * significant $p<0.05$ ** highly significant $p<0.01$ *** very highly significant $p<0.001$

5. Conclusions

According the assumed UTAUT model (Figure 3) and examination of regression analysis as well as moderated variables, a new UTAUT model (Figure 4) was accomplished about the applying LINE for fire safety works by firefighters. Two major studies were carried out, i.e. (1) all the main categories of PE, EE, SI can affect the behavioral intention (BI), and categories FC as well as BI can affect usage

behavior (UB); (2) the influence of moderated variables, except gender, such as age (firefighter's age and working seniority) and experience (LINE usage experience, working unit and rank) are confirmed on those categories of PE, EE, SI, and FC individually. Recently, it can be found that many city/county fire departments in of Taiwan are gradually promoting the applying LINE for helping firefighters' fire safety works due to its convenience and efficiency.

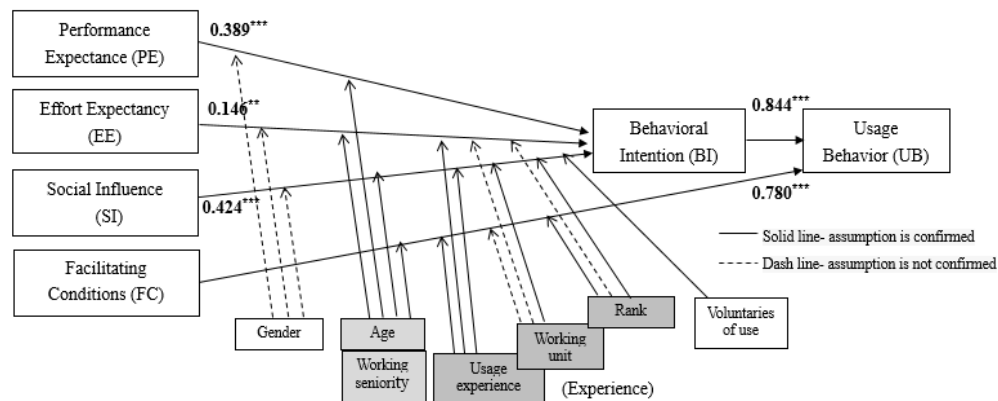


Figure 4. The final UTAUT model about applying LINE for fire safety works by firefighters.

6. References

- [1] Bruce E 2017 What Is Online Communication? *ezTalks* <https://www.eztalks.com/unified-communications/what-is-online-communication.html>
- [2] Scott G 2019 LINE – Japan's free communication app and its plans for world domination *lingualift* <https://www.lingualift.com/blog/line-japan-free-communication-app/>
- [3] Wikipedia 2019 Line (software) [https://en.wikipedia.org/wiki/Line_\(software\)](https://en.wikipedia.org/wiki/Line_(software))
- [4] Davis F D Bagozzi R P and Warshaw P R 1985 User Acceptance of Computer Technology: A Comparison of Two Theoretical Models *Management Science* 35(8) 982-1003
- [5] Marchewka K and Kostiwa K 2007 An application of the UTAUT model for understanding student perceptions using course management software *Communications of the IIMA* 7(2) 93–104
- [6] Maillet É Mathieu L and Sicotte C 2015 Modeling factors explaining the acceptance, actual use and satisfaction of nurses using an Electronic Patient Record in acute care settings: An extension of the UTAUT *International Journal of Medical Informatics* 84(1) 36–47
- [7] Fishbein M and Ajzen I 1975 *Belief, Attitude, Intention, and Behaviour: An Introduction to Theory and Research*. Reading MA: Addison-Wesley
- [8] Ajzen I 1985 *From Intentions to Actions: A Theory of Planned Behaviour* Berlin Heidelberg: Springer
- [9] Paul P J and Olson J C 1987 *Consumer Behavior: Marketing Strategy Perspectives* IL: Richard D. Irwin
- [10] Venkatesh V Morris M G Davis G B and Davis F D 2003 User acceptance of information technology: toward a unified view, *MIS Quarterly* 27(3) 425-478
- [11] Davis F D 1989 Perceived usefulness, perceived ease of use, and user acceptance of information technology, *MIS Quarterly* 13(3) 319–340
- [12] Chen Z Y and Chen Y C 2017 The study of intention to apply live video transmission system in disaster sites for fire fighters in Changhua county *Chinese Conference of Environmental Safety & Health and Fire Engineering* Taiwan: Kaohsiung
- [13] Chen Y C and Lin S K 2018 intention to apply mobile device in emergency medical service sites for fire fighters *Procedia Manufacturing* 30(1) 357-364

Acknowledgments

Authors wish to acknowledge assistance or encouragement from New Taipei City Fire Department and Da-Yeh University for their technical as well as academic support.