

## INTELLEAGENT MOBILE VOICE INFORMATION CENTER SYSTEM : TAKING THE EMERGENCY TRIAGE SUPPORT SYSTEM AS AN EXAMPLE

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**Abstract:** According to International Telecommunication Union (ITU) research, people hold the rate of mobile phone is the first of the world in Taiwan and every one has two cell phones. We usually use mobile phone to make contact with hospital or 119 in emergency.

We develop new call flow style and combine traditional passive call flow. The system is designed by voice menu and users can command services actively. The telephone connect computer server to enter call flow module with ASR and TTS. Then the recognition term come from voice term database. Voice management center is an ER triage decision system.

We has tested three scenarios which are DOA, a large number of patients and critical trauma. We measure the completion time and recognition rate for all the scenarios. The recognition rate of all three cases are above 90%.The average completion time for DOA is 38.6 seconds, for the large number of patients is 20 seconds and for the critical trauma case average is 252.7 seconds It is too slow to input one patient's data but the part of communication transfer message fast and convenient, the DOA notice only takes 38 seconds to inform medical staffs, it is certainly efficiency and medical staffs believe that can help them communication.

We will continue to extend our system and further apply it to other domains. Future studies may combine the internet platform with the WiFi phone and soft phone (skype) and broaden the scope of application scope in Taiwan.

### Introduction

According to the International Telecommunication Union (ITU) research, people hold the rate of mobile phone is the first of the world in Taiwan and every one has one or two cell phones, So if occur unfortunately events we usually use mobile phone to make contact with hospital or 119.

In fact, new businesses are rapidly forming about these technologies [1]. Recent advances in automatic speech recognition and related technologies allow computers to carry on conversations by telephone[2].

Automatic speech recognition and text-to-speech synthesis will provide users with more freedom on when, where, and how they access information [3]. The telephony provides an easy-to-use, reliable and cheap computer interface. The telephony is not only just a communication tool but is sample, quick and cheap interface [4].

Many unexpected events occur outside hospital such as mass gatherings, traffic accident, etc. The first response is to call to emergency or EMT. Therefore, we have ideas which setup an emergent call center. The first-aid personnel call center and via voice input the patient's data and medical care at the same time. During emergency treatment must need triage at first. If medical staffs can acquire patient's data, maybe they will ready in early time.

### Materials and Methods

When a call starts, user's voice will be recorded for recognition .If successfully recognized, the system would repeat the recognized term, and wait for comment; otherwise if it recognized fail, the system would return to record voice. below as Figure1.

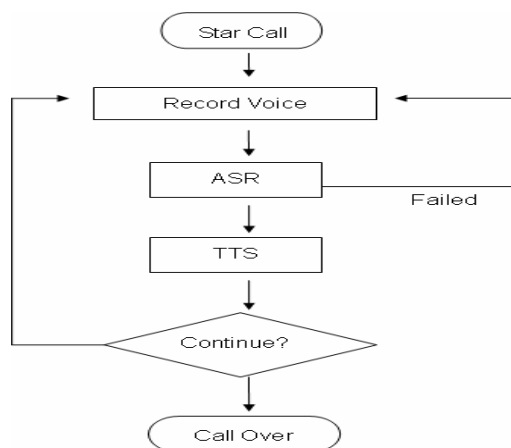


Figure 1: The call flow design conception

The hardware Architecture of System needed one phone voice card and one line voice card, the phone voice care was connected extension and the line voice card was connected PSTN. They were interconnected

with RJ45 port. In part of VoIP(Voice over Internet Protocol) we install Skype AP than user could via soft phone to dial in this system. Below as Figure2

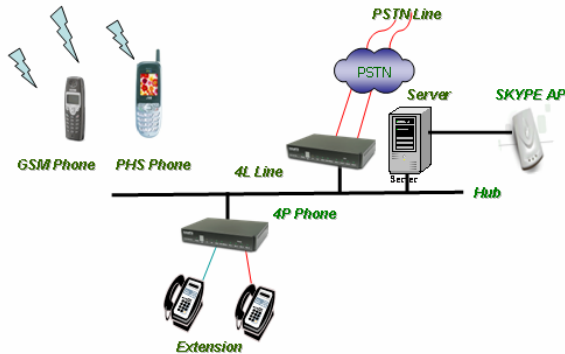


Figure 2: The hardware Architecture of System

The telephony module had three devices that include PSTN, cell phone and Skype soft phone.

The telephone connected computer server to enter call flow module with ASR and TTS. Then the recognition term come from voice term database. Voice management center is an ER triage decision system. The out bound module was function of urgent notice. If there was critical situation the system could automatic dial medical staffs to transfer voice message. The Voice Management Center is displayed by GUI.

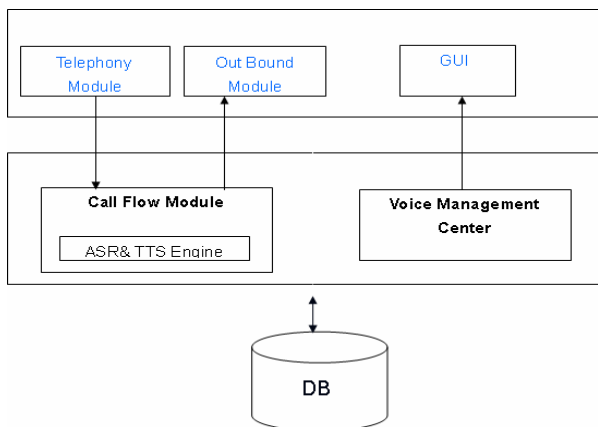


Figure 3: The system design conception

In order to comprehend system's easy of use and usefulness, we used simulated cases for ER's nurses to operate this system. We selected ten nurses that come from emergency room of region teaching hospital as our subjects. we demonstrated and illustrated how to use the system. Users could understand design conception and know this system. The situations as below :

Table1: Three written scenarios for subjects to test system with different interface mode

Scenario	
1	A DOA female patient, suicide by hanging  A large number of patient 10 people, one man strangulation of right arm; it resulted in traumatic amputation of right arm. His symptom is pale, cold sweating, coma and vital sign BP : 80/50, PR : 122, RR : 24, BT : 35.9
2	An old man comes with rest home staff. His symptom is conscious unclear somnolence ,
3	medical history is DM and vital sign BP : 100/60, PR : 68, RR : 17, BT : 34.2°C

users tested the system then input recognition terms that include inputting ER patient's situation and testing all kind of system function. We calculate recognition rate and time and they will fill in technology acceptance model (TAM) based questionnaire and provide the suggestion. The questionnaire is confirmed by two ER triage specialists and a medicine informatics expert.

### Results

At this study, we visit ten clinical ER nurses to test our voice system, Among the 10 subjects in the intervention group.

We has tested three situation of patients that include DOA, a large number of patients and critical trauma. We calculate three situations needing time and recognition rate. The evaluation of results is shown in

Table 2, the case 1 average need 38.6 seconds, the case 2 average need 252.7 seconds and the case 3 average need 267.2 seconds. The parts of recognition rate, all of case are upward 90%.

Table 2: The result of recognition rate and time

No	Case 1 time(s)	Case 1 recognition rate (%)	Case 2 time(s)	Case 2 recognition rate (%)	Case 3 time(s)	Case 3 recognition rate (%)
1	40	66.67	276	88.24	288	88.89
2	42	100.00	270	94.12	280	94.44
3	50	66.67	267	94.12	289	88.89
4	45	100.00	250	94.12	262	94.44
5	38	100.00	230	94.12	240	94.44
6	35	100.00	280	88.24	299	83.33
7	30	100.00	250	94.12	267	94.44
8	36	100.00	219	100.0	235	94.44
9	38	100.00	240	94.12	254	94.44
10	32	100.00	244	94.12	258	94.44
average	38.6	93.20	252.7	93.53	267.2	92.22

The easy of use of result shows that interaction clear over 60% is agree; the 20% deem that operating flow is smooth; the 50% deem that inputting voice is easy; the 60% deem that teaching is learning easy; the 40% deem that voice recognition is quickly; the 50% deem that prompt is clear; the 50% deem that broadcasting sound is

suitable; the 80% deem that recognition correct rate is precise; the 20% deem that changing input item is convenient; the 30% deem that corrections is easy. There are 30% that deem the whole of the system is friendly; there are 40% that accept the whole of the system design; there are 70% that the whole of the system use easy. The detail results as follows

Table 3: The result of recognition rate and time

	Very Strongly Agree	Agree	Neutral	Disagree	Very Strongly Disagree
1. Interaction is clear	10%	50%	10%	30%	0%
2. Operating flow is smooth	0%	20%	20%	60%	0%
3. Inputting voice is easy	10%	40%	20%	30%	0%
4. Teaching is learning easy	30%	30%	30%	10%	0%
5. Voice recognition is quickly	20%	20%	40%	20%	0%
6. Prompt is clear	10%	40%	40%	10%	0%
7. Broadcasting sound is suitable	20%	30%	20%	30%	0%
8. Recognition correct rate is precise	50%	30%	10%	10%	0%
9. Changing input item is convenient	10%	10%	40%	40%	0%
10. Corrections is easy	10%	20%	30%	40%	0%
11. The whole of the system, it is friendly	0%	30%	40%	30%	0%
12. The whole of the system, you accept this design	10%	30%	30%	20%	10%
13. The whole of the system, it is use easy	20%	50%	30%	0%	0%

The usefulness of result shows that the 20% deem handling ER triage faster; the 50% deem that reduce paper work time; the 50% deem decision ER triage quickly; the 40% deem that input data and take care patient at the same time; the 80% deem that reduce notice time; the 70% deem that an early announcement of emergent patient that can strive golden time; the 90% deem that an early announcement of emergent patient that can help ER ready; the 100% deem that an prompt announcement of the patients of large number can help ER work smooth; the 80% deem that the telephone notify family that can promote patient and Dr. relationship; the 60% deem that the whole of the system, the voice is usefulness for ER triage. The detail results follow as Table4

Table 4: The easy of use evaluation results

	Very Strongly Agree	Agree	Neutral	Disagree	Very Strongly Disagree
1. Handling ER triage faster	0%	20%	20%	60%	0%
2. Reducing paper work time	10%	40%	20%	30%	0%
3. Decision ER triage quickly	0%	50%	10%	40%	0%
4. Input data and take care patient at the same time	0%	40%	50%	10%	0%
5. Reducing notice time	10%	70%	0%	20%	0%
6. An early announcement of emergent patient that can strive golden time	20%	50%	20%	10%	0%
7. An early announcement of emergent patient that can help ER ready.	10%	80%	10%	0%	0%
8. An prompt announcement of the patients of large number can help ER work smooth	20%	80%	0%	0%	0%
9. The telephone notify family that can promote patient and Dr. relationship	20%	60%	0%	20%	0%
10. The whole of the system, the voice is usefulness for ER triage	0%	60%	10%	30%	0%

There are 60% deem that calamity care suit to use voice and 50% deem that can apply in telemedicine. There are 40% deem DOA, 40% deem critical trauma

and 50% deem patient of large number. There are 90% deem that add emergent notice function. The detail result as follows Table5

Table 5: The usefulness evaluation results

Items	Agree
1. Which field suit use this voice system	
Chronic patient service	10%
Cancer patient service	10%
Patient room service	10%
Calamity care	60%
Telemedicine.	50%
2. Which situation suit to use this voice system	
Health education information	0%
Physiology report	10%
An urgent call	90%
3. Could the voice system add other function	
DOA	40%
Critical trauma	40%
Patient of large number.	50%
An old folks' home	10%

## Discussion

We studied the ability of the voice system using ER triage and notice to application. The voice system mainly has good performance but some issues still worthy to discuss. We may discuss the subject under the following heads: (1) technology; (2) Application ;( 3) Economy.

### (1)Technology

The voice system is designed use voice modem the initial stage of the study; we tried using easy and cheap tools complete the sound input in PC, but the problem of listen still can not solve because computer voice channel format is 16bit stereo and then telephony voice channel format is 8bit mono. For this reason, we can input sound in computer but we can not listen computer's voice.

The voice card is PCI interface hardware equipment, when we set up on motherboard the PC can not take the driver and efficacy will turn down, even PC would be hardware collision and shutdown. Many problems of installation voice card included hardware and software; it was not easy for end user. It must be experience of operation then set up successfully.

User interface friendly is most of important. My design conception use this ideal that according to users habits to say keyword and insert the data into system. Although, according IVR design theory include prompts 、 grammar、 dialog logic but in our system is designed that prompts is very terse and dialog logic use voice menu style. Users will be more elasticity to control the voice system.

### (2)Application

In part of easy of use, there 60% were dissatisfied with operating flow smooth, user were not familiar with the voice system structure because they only trained

10~20 minutes. If they can add training time, it could be more satisfied.

User forgot how to correct voice term, if the voice system recognized failure. They forgot to touch keypad“#” or response was not fast enough that miss the correction time .They could not see the screen display error therefore there 40% were dissatisfied with correction voice item.

In part of usefulness, there over 70% were satisfied with reducing notice time, an early announcement of emergent patient that can help ER ready and a prompt announcement of the patients of large number can help ER work smooth. Because those functions would help them work faster better than now. For this reason, they accepted this design to use in clinical practice. But they deem that system is slower then people triage therefore they didn't agree that system decision is quickly.

In emergency ward, ER triage staff usually decides a patient's triage only needing 120~150 seconds. The most problem of this system is too slow, completely ER triage must need 200~240 seconds, .therefore we consider that voice system dose not suit to apply in ER. But the voice system transfer message fast and convenient, it is certainly efficiency and medical staffs believe that can help them communication.

The telephone service has several major advantages : Ubiquity (universal telephone was a public policy goal set over 60 years age), relatively low cost for installation, minimal training . Thus we apply other field that will be smoother.

### (3)Economy

In the study we try to install different devices, the one is installed using modem connection PC and the other is installed using voice card. The two systems cost different price. Evidently the voice system is expensive than the modem system but the voice system support many functions such as outbound call and multitask (dial in the center at the same time).These functions is necessary in voice system.

### Conclusions

We will continue to extend our system and further apply it to other domains.The performance may increase when applying it to other fields for instance, chronic disease patient service, and the process can help us extensibility of the voice system.

Future studies may combine the internet platform with the WiFi phone and soft phone (skype) and broaden the application scope in Taiwan. It is possible to implement it in a hospital voice information system. It may improve the management of patients and enhance the quality of medical care.

### Acknowledgments

The study hardware is sponsored by CALLURL Inc.

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