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B) JURNAL PENYELIDIKAN mukasurat

Kata-Kata Aluan

PENGARAH KAMPUS UITM PERLIS

Syukur ke hadrat Allah S.W.T. kerana UiTM Perlis telah berjaya menerbitkan Jurnal Intelek yang merupakan dokumentasi hasil kerja-kerja penyelidikan yang telah dijalankan di kampus ini. Tidak syak lagi berdasarkan penulisan yang dihasilkan, UiTM Perlis mampu menjalankan banyak kerja-kerja penyelidikan untuk manfaat bersama.

Penerbitan jurnal ini juga diharapkan dapat menyemarakkan lagi budaya penyelidikan dan penulisan di kalangan kakitangan akademik UiTM Perlis.

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Sekian, terima kasih.

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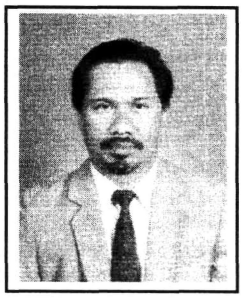

Kata-Kata Aluan

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Assalamualaikum Warahmatullahi Wabarakatuh

Terlebih dahulu saya ingin mengucapkan kesyukuran ke hadrat Allah S.W.T. kerana dengan limpah kurnia-Nya dapatlah saya mencatatkan sepatah dua kata di dalam Jurnal Intelek, UiTM Perlis.

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Maka dengan adanya Jurnal Intelek ini akan dapat membekal, menyediakan pengetahuan, kemahiran, nilai dan sikap yang sesuai dengan kehendak perkembangan dunia ICT dan negara.

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KERTAS
KONSEP

AN EMPIRICAL STUDY OF INPUT METHODS DEPLOYED DURING TREATMENT SESSION IN A CLINICAL SYSTEM

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Norlis bt Othman
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ABSTRACT

This paper study the effect of using various input methods such as keyboard, Personal Digital Assistant and touchscreen to input patient information during patient-doctor treatment or consultation session. This input interface integrates into a clinical information system that consists of modules such as patient registration, databases and prescription management. The system will accumulate patients' data and produce reports as required by any of the user in the network. It will assimilate the conventional method used by the users, in this case, doctors for data entry and menu navigation into the project. This will make the clinic daily operation more efficient and automatically increase the productivity in the workplace. This can be gain through lessening the time for patient registration and the waiting time between patients. Theoretically it will also reduce the patient-doctor consultation time. Hence, a viable solution is identified for a user friendly, ergonomic input device to reduce the psychological barrier between patients and doctors that exists while the doctor is keying the patient's diagnosis during consultation and also the phobia that users usually develop in the computerization stage.

INTRODUCTION

Human-Computer Interaction (HCI) is about designing computer systems that support people so that they can carry their activities productively and safely. The definition taken from *ACM SIGCHI(1992)* stated ... *"a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use..."*. According to *Preece (1994)* one of the key aims in selecting an input device and deciding how it will be used to control events in a system is to help users to carry out their work safely, effectively, efficiently and if possible, enjoyable. The choice of input device should contribute as positively as possible to the usability of the system.

Realizing the importance of computerization in the medical world, **CLINISYS – Clinical System** is developed to automate the transaction process during medical consultation where retrieving and updating patient records can be done efficiently. The doctors can directly insert data into the computers during consultation without having to fill paper forms and send to a clerk or nurse to key in the computers. This project utilizes conventional input device, keyboard as well as alternative devices such as **PDA (Personal Digital Assistant)** and **touchscreen** as the input device to automate the transaction process during medical consultation. This gives the doctor in the examining room mobility and doesn't interfere physically and psychologically with the doctor-patient interaction. The PDA is integrated with the clinical information system database that consists of modules such as patient registration, databases and prescription management.

The idea behind HCI-based system is to retain the conventional elements used by doctors while conducting treatment or consultation with a patient. With the use of PDA, it will somewhat reduce the psychological barrier between doctor and patient that exists while the doctor is typing the patient's diagnosis on the keyboard during the consultation time. The patient feel they can interact freely with the doctor without feeling annoyed that the doctor's attention is on the keyboard. By allowing doctors to write reports as their norm during consultation, this may also reduce the resistance on the doctors'

part in adopting IT in the clinic or specifically in the treatment room. It will make the clinic daily operation more efficient and automatically increase their productivity in the workplace. The **turnaround time** of a patient in the clinic is reduced considerably as the time spend on registration and waiting between patients is lessen. Thus, the number of patients consulted per day is increased.

Since most areas are not exposed to such a system before, a pilot study was conducted at the campus onsite clinic to determine how users' respond to such a system and the kind of problems encounter in using the system. Results from the study may help the medical practitioners in this country to improvise the current system. The inefficiencies and frustration associated with the use of paper-based medical records have become increasingly clear especially when dealing with inadequate access to clinical information. According to *M. Johnsen(1996),* it is one of the principal barriers encounter by medical practitioners when trying to increase the efficiency in order to meet the productivity goal of their practices.

LITERATURE REVIEW

John Hopkins Hospital has developed an information system for its hospital named *Wireless OrderNet* (1997). This project enables nurses to insert charts data patient directly into database using portable computers that are brought from one patient room into another. This system utilizes laptops as portable device to enter data, The advantage of this system is nurses can directly insert data into the computers without having to fill forms and send to another nurse for her to input it into the computer. The usage of portable devices enables nurses to carry around with ease much information needed by the patients. This is far better than having to fetch patient record from a file center. However the nurses need to haul the trolley that accommodate the laptop from one patient to another. This requires a lot of energy considering the amount of patients the need to be served per day.

In addition, laptops, although it is relatively small, it requires a stable platform when data need to be keyed in. As such the nurses not only have to concern about attending the patients, they also have to look after trivia issues such as the location to park the laptop, keying in the information and hauling the laptops from one place to another. Our research project on the other hand will consider even lighter device such as palm top, PDA and pen computing which could be better substitutes for the laptops.

Starter Kit for Community Health Information Networks (CHIN) is a project researched by *University of Michigan (1997).* Health System technology division. The purpose of the project is, to identify all the components required to put CHIN on the Internet. The project utilizes the standard network protocols to integrate CHIN with the Internet. By having this system, patients/customers can use CHIN to get medical services. This project concentrate on building the applications (software) rather than developing system that consists of hardware and software. The advantage of the system is everybody can access the CHIN as long as they have Internet connection. People can use personal computers, personal digital assistants, laptops or even Internet enabled hand phones to connect with the CHIN system. Although this research focus on satisfying the need for portable users, it focus more on underlying networking technology then inquiring the best device to be used for the portable connection.

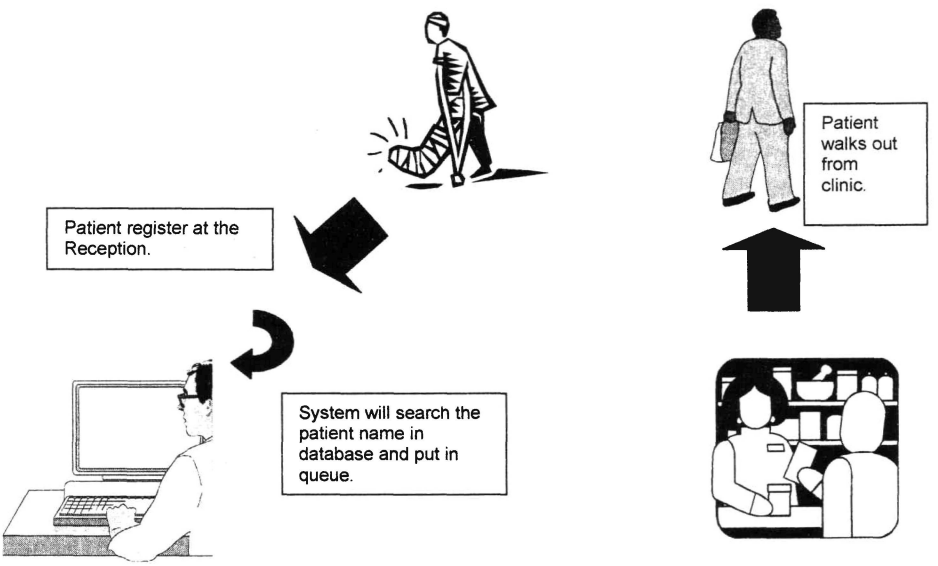
Another research project by University of Michigan Medical School in medical information system is named *Wireless Project (Kokabus, 1997).* This project utilizes handheld devices such as Personal Digital Assistant (PDA), tablet and digitizer for the medical information system. The project focused on the wireless implementation of the device. The advantage of this project is, the users (doctors and nurses) can now move around with ease while carrying the handheld devices). They do not have to concern about the wires or socket to attach their devices into. They can concentrate on the patient treatment rather than attending the system needs. Although the project seems to be similar with what

we are doing, the information system will be based on American Hospital System. Ours is aimed for small-scale Malaysian clinical system environment

A research conducted by *Mr. Charlyn D. Black (1995) titled "The population Health Information System: Data Analysis and Software"* discussed about the development of a medical system. The project accumulated patients' data and produced information whenever required. This project is aimed more towards gathering aggregate information. This means that the data is more likely to be use by middle to senior management in Decision Support System (DSS). Our project is based on **Transaction Processing System (TPS).** The system is meant for daily transaction that involves the clinic and its customers.

Kaiser Permanente of Ohio has also developed an information system that incorporates hand held computing devices into the systems. In the *paper "The Transition from Paper Charts to Electronic Medical Record: A Case Study of Kaiser Permanente of Ohio"* by *Amber Boglin (1998)*, Kaiser Permanente has developed their own computerized information system to be used for internal system. The system includes extensive amount of transactions from patient records to insurance system to billing system. The system is of a large scale and expensive, our focus of project is a small scale system in which it will be build around Malaysian clinical environment.

PROCESS THAT A PATIENT HAS TO GO THROUGH IN THIS SYSTEM



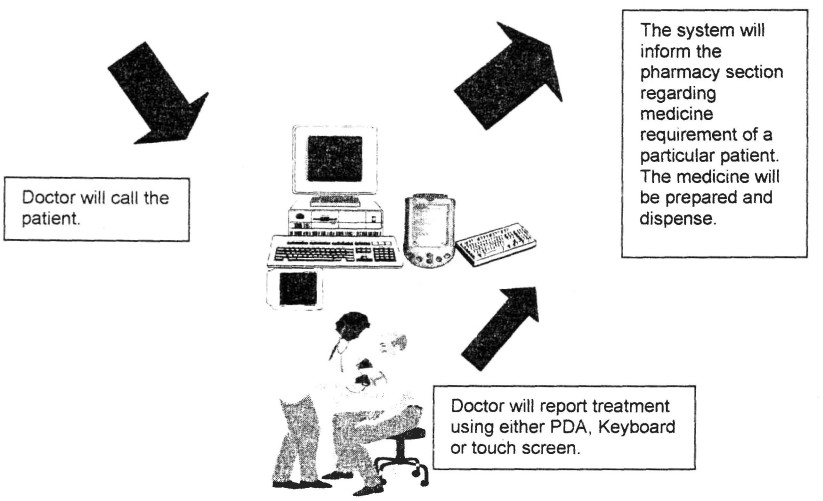


Figure 1: The Patient-Treatment Cycle

Currently there are many software that utilize hand held devices such as light pen, PDA and tablet for the clinical information system. Among the software are Adult Residential Care (ARS) by HealthCom, Clinisys by Compass System Corp, PureMD by Development Purkinje Inc. and wireless Hospital. However, these software are meant for large organizations and incorporate western hospital system namely American hospital system. Our research project will focus on small-scale (clinic) Malaysian oriented clinical information system.

The issue of electronic medical records (EMRs) is gaining more attention as shown in St. Vincent Hospital & Health Services Weekly *(1998)*. The inefficiencies and frustration associated with the use of paper-based medical records have become increasingly clear especially when inadequate access to clinical information is one of the principal barriers the clinicians encounter when trying to increase their efficiency in order to meet the productivity goal of their practices.

Practitioners clamor for more reliable system that provides facile, intuitive access to the information they need at the time they are seeing the patients. The EMR offers the hope from such improved access, to patient-specific information and should provide a major benefit both for the quality of care and the quality of life for clinical practices.

Pen-based computer used in Electronic Clinical Information System (ECIS) at St. Vincent's Indiana Heart Institute practices allow user to pint and write. This gives the physician mobility in the examining room and does not interfere physically or psychologically with the physician-patient relationship. A survey done on patients showed that 98% said they were comfortable with having the records and treatment information stored on computer. They thought it is more accurate than paper documentation and would increase the quality of medical care.

ECIS also increases medical practices productivity and better relationship with the pharmacist. Several steps for the typical manual prescription refill can be reduced.

Martin Briscae (1996), Exeter in his paper *"Encouraging Clinicians to use Computers"* has identified several problems associated with IT and its solutions. He summarized that clinicians should demand better and more clinically more relevant systems and they are not prepared to cooperate with systems that do not provide clinically useful material. This view was further supported by *Johnsen*

(1996), in his paper "*The Big IT and US: Clinicians View*" . "The ability to adopt a system to meet the needs of users while delivering the essential management information must be one of the most fundamental aspects of IT. No matter how good a system is, if users are not trained in its use, it will fail."

SCOPE OF THE PROJECT

This project is meant for:

Automating the transaction process during medical consultation where retrieving and updating patient records can be done efficiently.

Identifying an effective data source automation from several input devices such as pointing device, touching device and keyboard that is user friendly, ergonomic and did not act as psychological barrier during patient-doctor consultation.

A small scale and inexpensive clinical information system to be used in small Malaysian clinic but can be expand to a large scale application in TeleMedicine.

DESCRIPTION OF THE SYSTEM - CLINISYS

The variable of primary interest in this study is duration of the treatment/consultation time. The variance in the dependent variable can be explained by the independent variable that is the types of input device used from manual to computerization with the use of conventional keyboard and the alternatives PDA and touchscreen.

Data is also tested on the manual system because it provide the basis for improvement in implementing computerization, be it using keyboard or HCI-based devices (PDA, touchscreen). Keyboard is also an essential data element in comparing between the traditional method and HCI devices that is user friendly, ergonomic and did not act as psychological barrier during the patient-doctor consultation. Of the two HCI input devices, PDA is chosen for this study because of its portability, mobility and convenience. The handheld device is used in many medical information system such as University of Michigan Medical School, Wireless Hospital , ARS Resident Care by Health Com, Clinisys by Compass System Corp., PureMD by Development Purkinje Inc. and others.

Touchscreen is also used as an alternative to keyboard because it resembled the keyboard interface but without the mechanics of typing. Instead the user simply tapped his finger on the buttons displayed on the screen interface to select command or to type in data.

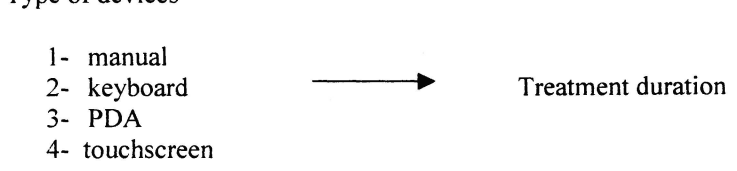


Figure 2: Schematic Diagram of the Theoretical Framework

System Specifications

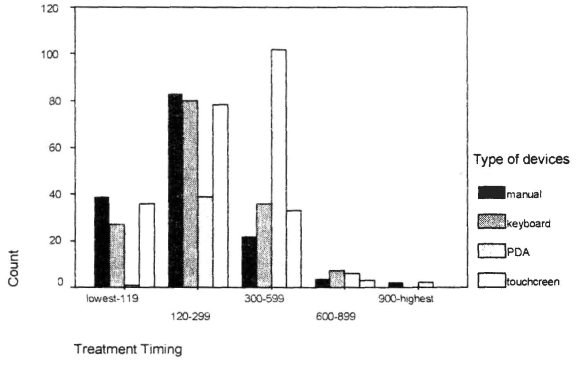
Hereby are the system requirements (minimum) to run the Clinical Management System application.

Hardware – IBM compatible PC with Intel Pentium 100Mhz or equivalent.
Hard Disk – 10 Gigabyte.
RAM – 64Mb MB RAM.
IrDA device – to transmit/receive from PDA to PC.
Software – MS Access for the database system. OS – Win 9x.
Input Device – 1) Keyboard
2) Personal Digital Assistant (PDA) – running on Palm OS. Utilizing infra red (IrDA) device. Use memo pad application in the PDA to display the data extracted from database, manipulate it and beam back to the database. Refer to the Appendix for illustration of the devices.
3) Touchscreen

Relationship Between Type Of Input Devices And The Treatment Time

The duration of timing if less than 2 minutes is considered irrelevant and if more than 15 minutes is considered as extraordinary. From the chart in Figure 3, PDA is shown to have a higher frequency in treatment time between 5 to 10 minutes.

Figure 3: A Comparison of Frequency Timing in grouping Among the Different Input Method.



compared to other input methods. PDA also has the highest mean with the lowest standard deviation. This indicate that the duration of PDA falls heavily around the mean of 5.9 minutes (357.33 seconds) with a dispersion of 2.19 minutes (131.962 seconds). Even with the use of keyboard, the mean is high at 4.13 minutes and standard deviation of 2.6 minutes. While the mean of manual is at 3.66 minutes (219.87 seconds) with a high standard deviation of 3 minutes (180.7 seconds) is lower than touchscreen 's mean of 3.7 minutes.

As can be seen from the statistics, the user mostly spend a shorter time for treatment or consultation with the patient when there is no computerization. This may be because the user need some time to adjust to using computer during treatment . The treatment time is then increased. But towards the end of the testing phase after a period of 7 months adjustments, it seems from the touchscreen time that the user has become slightly comfortable with the system and the various input devices.

Type of devices	Mean	N	Std. Deviation
manual	219.87	150	180.715
keyboard	247.68	150	160.515
PDA	357.33	150	131.962
touchcreen	222.00	150	133.222

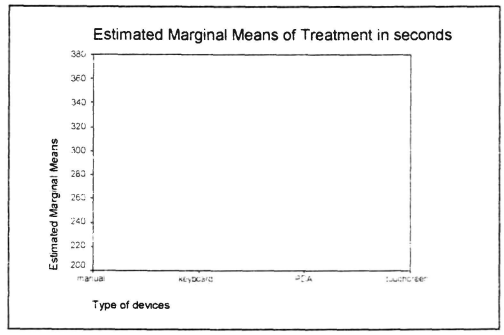


Figure 4: Descriptive Statistics :Treatment in seconds

Hypothesis Testing

Post Hoc Test is done to determine which input methods contribute to the treatment timing. From the various test done (Bonferoni, Tukey HSD, LSD), it shows similar results where there is a significant different in treatment timing between PDA and the other input methods. (The significant value for PDA versus manual, keyboard and touchscreen is 0.000, less than α value.)

Dependent Variable: Treatment in seconds

			Mean Difference (I-J)	**Std. Error**	**Sig.**	**95% Confidence Interval**	
	(I) Type of devices	(J) Type of devices				Lower Bound	Upper Bound
Bonferroni	manual	keyboard	-27.81	17.662	.695	-74.57	18.94
		PDA	-137.47	17.662	.000	-184.22	-90.71
		touchcreen	-2.13	17.662	1.000	-48.89	44.62
	keyboard	manual	27.81	17.662	.695	-18.94	74.57
		PDA	-109.65	17.662	.000	-156.41	-62.90
		touchcreen	25.68	17.662	.879	-21.07	72.43
	PDA	**manual**	**137.47**	**17.662**	**.000**	**90.71**	**184.22**
		keyboard	**109.65**	**17.662**	**.000**	**62.90**	**156.41**
		touchcreen	**135.33**	**17.662**	**.000**	**88.58**	**182.09**
	touchcreen	manual	2.13	17.662	1.000	-44.62	48.89
		keyboard	-25.68	17.662	.879	-72.43	21.07
		PDA	-135.33	17.662	.000	-182.09	-88.58

Based on observed means.

* The mean difference is significant at the .05 level.

Figure 5: Multiple Comparisons

CONCLUSION

This study shows that PDA as an input device plays an integral role in influencing the treatment time. From the findings we discovered that the mean for PDA is the highest among other input methods with heavy dispersion in the higher range of the treatment time (between 5 – 10 minutes). This reflect that the influence is negative, hindering the user rather than fasten the process of keying the data during treatment or consultation time. This opposes out initial assumption that the PDA is better than other input devices because it is a direct input device where data is entered directly through the doctor's writing on the PDA screen.

The rationale for the finding is simple. This is because to use the PDA, the user needs to be comfortable with writing in the character format as specified by the specified device. Handwriting recognition device has its own set of calligraphy that a user needs to follow in order to write data or instructions on the PDA screen (refer to figure 6) .This takes some considerable time to practice even for an advanced computer user. As well as achieving a certain level of computer competency, the user must possess a positive attitude towards trying out a new technology.

The handwritten technology embedded inside the PDA is not matured enough in capturing the human writing as fast as keyboard. When using PDA, we have to write the character one by one whereas this is not so when using the keyboard. Hence typing report will be relatively faster. This setback however cannot be made as an excuse for totally abandoning the handwriting technology. The setback is believed to be temporary only. As new innovation emerged, the handwriting technology will hopefully evolved into a more efficient device to be used by the users. The practicality of the PDA cannot be totally dismissed considering that using PDA enable the doctor to move around. A feat that is important if the system is applied in ward environment where doctor have to move around to visit the patient. Moreover, using the PDA simulates the manual environment in which the doctors are comfortable with.

Study by Rogers, Tanke, Hawker, Lorenzi has demonstrated a number of challengers that exists during the adoption of their system at both the clinic and the organization level such training , education and planning. We believe these factors greatly influenced our result. It is suggested that the user must use the PDA regularly in a personal capacity first before use it in a professional capacity. Then only can the transition from the manual system to the computerized system be made with minimum resistance and smoothness since writing on the PDA resembles writing report on the paper.

Usage of touch screens as the input device seems to be at par with the usage of keyboard in terms of time taken during treatment sessions. This can be attributed to the fact that the doctor has a low typing speed rate. Assuming that the doctor has a faster typing speed rate, then the keyboard-based system will see a significance difference if compared with the touch screens' timing.

Although the manual system does not varies from the keyboard-based systems or touch-screens based systems, we have to remember that that the scope of the project is only focused on the time during the treatment session, the capability of the computerized system as a whole should ideally far outweigh the manual system if we consider the seek time of patient record, report preparation functions, records management and so on. Thus, it is advisable for any small clinic to use the computerized system for an efficient clinic operation.

In the future, this study can be expanded to include samples from many users with varying degree of computer competency.

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