

# **Designing an Appointment Management System for the Mother and Child Health Department of the Klinik Kesihatan Changlun**

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# **Designing an Appointment Management System for the Mother and Child Health Department of the Klinik Kesihatan Changlun**

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Universiti Utara Malaysia

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## **Abstract**

Information and Communication Technology has been changing the way things have been carried out. Traditionally many work required people to visit the location where the work has been carried out. ICT has been making these services available at their fingertips by hosting these applications online. *Klinik Kesihatan Changlun* is a public general clinic in the state of Kedah. The appointment management which is one of the most important services of a clinic is presently carried out manually here. Both patients and the staff have to face a lot of problems due to the inefficiency of the manual system. If the system can be automated and made available on the internet, it will solve a lot of problems currently faced by them. This project proposes to design an appointment management system for the Mother and Child Health Department of the *Klinik Kesihatan Changlun*. The project has been proposed to follow the formal research methodology proposed by Kuchler and Vaishnavi due to its suitability for small to medium sized development projects. Finally it has been proposed conduct a usability test on the prototype developed for ease of use and user friendliness with the aid of the questionnaire.

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**ALGHAMEDI, AHMAD ALI**

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# CHAPTER 1

## INTRODUCTION

### 1.1 Introduction

With the development of Information and Communication Technologies (ICT), more and more online services are becoming popular. These online services provide the users with the flexibility of getting their work done without leaving the comfort of their living rooms. Traditionally these services required the people to travel to the place where the services were provided.

*Klinik Kesehatan Changlunis* a community health clinic under the Ministry of Health that serves the people in the area around the city of Changlun. The clinic is of moderate size with two departments namely the Outpatient Department and the Mother and Child Health Department. The Outpatient Department provides general clinical services and the Mother and Child Health Department is a specialized unit providing antenatal and postnatal care for mothers and pediatric care to children up to the age of six years. The Mother and Child Health Department is staffed by 15 healthcare professionals comprising one specialist, one general physician, seven staff nurses and six community nurses. All the services are of outpatient type as the clinic does not have facilities to admit patients for inpatient care. The clinic is equipped with basic laboratory facilities to carry out urine test, blood pressure, weight and height measurements and physical examination of pregnant mothers

The contents of  
the thesis is for  
internal user  
only

## References

- Ackermann, E., & Hartman, K. (2000). *Internet and web essentials*. Wilsonville, OR, USA: Franklin, Beedle and Associates.
- Alamgir, M., & Shamsuddoha, M. (2004). Service quality dimensions: a conceptual analysis. *The Chittagong University Journal of Business Administration*, 19(3), 42-57.
- Atle, K.S. (2008). *Extending UML sequence diagrams to model trust-dependent behavior with the aim to support risk analysis*. *Electronic Notes in theoretical computer science*, 197(2): 15-29.
- Avgerou, C. (2000). Recognizing alternative rationalities in the deployment of information systems. *Electronic Journal of Information System in Developing Countries*, 3(7), 1-15.
- Barclay, K., & Savage, J. (2004). *Object-Oriented Design with UML and Java*. Burlington, USA: Elsevier Butterworth-Heinemann.
- Belardi, F. G., Weir, S., & Craig F. W. (2004). A controlled trial of an advanced access appointment system in a residency family medicine center, 36(5), 341-345.

- Bennett, S., McRobb, S., & Farmer, R. (2002). *Object-oriented system analysis and design (2<sup>nd</sup> ed.)*. London: McGraw Hill.
- Chatrath, V., Attri, J. P., & Chatrath, R. (2010). Telemedicine and anesthesia. *Indian Journal of Anesthesia*, 54(3), 199–204.
- Dennis, A., Wixom, B.H., & Tegarden, D. (2005). *System analysis and design with UML version 2.0: an object-oriented approach with UML (2<sup>nd</sup> ed.)*. Hoboken, NJ, USA: John Wiley and Sons, Inc.
- Dynacrates.(2011). Dynacrates clinic management system. Retrieved February 15, 2011, from <http://www.advanceddatasystems.com/clinicpro.htm>
- Elkhuizen, S., Das, S., Bakker, P., & Hontelez, J. (2007). Using computer simulation to reduce access time for outpatient departments. *Journal of Quality and Safety in Health Care*, 16(5), 382-386.
- Firdhous, M. F. M., & Karunaratne, P. M. (2011). An ICT enhanced life quality for the elderly in developing countries: analysis study applied to Sri Lanka. *Journal of Health Informatics in Developing Countries*, 5(1), 1-14.
- FreshLogics. (2011). FreshLogics clinic management system. Retrieved April 16, 2011, from [http://www.freshlogics.com/clinic\\_management.php](http://www.freshlogics.com/clinic_management.php)

Giachetti, R., Centeno, E., Centeno, M., & Sundaram, R. (2005). Assessing the viability of an open access policy in an outpatient clinic: a discrete event and continuous simulation modeling approach. *In proceedings of the 2005 Winter Simulation Conference, WSC2005*, Orlando FL, USA, December 4-7, 2005. Orlando FL, USA: ACM. 2246-2255.

Gladwin, J., Dixon, R. A., & Wilson, T. D. (2003). Implementing a new health management information system in Uganda. *Health Policy and Planning*, 18(2), 214-224.

Goldschmidt, P. G., & Liao, J. (1998). Quality of health information on the Internet—enabling consumers to tell fact from fraud. Health Improvement Institute. Bethesda, MD, USA. Retrieved March 15, 2011, from <http://www.ahrq.gov/qual/hiipt.htm>

Grubor, A., Salai, S., & Leković, B. (2008). Service quality as a factor of marketing competitiveness. *4<sup>th</sup> International Conference of the Association of Economic Universities of South and Eastern Europe and the Black Sea Region*, Bucharest, Romania, May 22-24, 2008. 273-281.

Gubb, J. (2007). Waiting times in the NHS. CIVITAS Institute for the study of civil society. London, UK. Retrieved February 15, 2011, from [http://www.civitas.org.uk/nhs/download/waitingtimes\\_jan\\_08.pdf](http://www.civitas.org.uk/nhs/download/waitingtimes_jan_08.pdf)



- Harper, P. R., & Gamlin, H. M. (2003). Reduced outpatient waiting times with improved appointment scheduling: a simulation modeling approach. *Spectrum*, 25(2), 207-222.
- Ho, C.J., Lau, H.S., & Li, J. (1995). Introducing variable-interval appointment scheduling rules in service systems. *International Journal of Operations & Production Management*, 15(6), 59-68.
- Ho, C. J., & Lau, H. S. (1999). Evaluating the impact of operating conditions on the performance of appointment scheduling rules in service systems. *European Journal of Operational Research*, 112(3), 542-553.
- HoC.(2011). Health on click hospital management system. Retrieved April 15, 2011, from <http://www.healthonclick.com/>
- Holzinger, A. (2005). Usability engineering methods for software developers. *Communications of the ACM*, 48(1), 71-74.
- Houston, T. K., Sands, D.Z., Jenckes, M. W., & Ford, D. E. (2004). Experiences of patients who were early adopters of electronic communication with their physician: satisfaction, benefits, and concerns. *American Journal of Managed Care*, 10 (9), 601-608.

- Jayaweera, P., Jayasinghe, J., Malawaraarachchi, L. W. V., & Liyanage, S. (2006). Clinics management system (CMS) based on patient centered process ontology. *Ruhuna Journal of Science*, 1(1), 40-47.
- Johan, K. (2004). Information system analysis and design. Retrieved March 1, 2011, from <http://www.cs.toronto.edu/~jm/3405/slides2/sequence D.pdf>
- Kuechler, W., & Vaishnavi, V. (2008). The emergence of design research in information systems in North America. *Journal of Design Research*, 7 (1), 1-16.
- Kumar, A., & Shim, S. J. (2007). Maximizing utilization of consultation rooms at the hospital clinics. *International Conference on Industrial Engineering and Systems Management*, Beijing, China, May 30-June 2, 2007. 1-10.
- Krueger, K. P., Felkey, B. G., & Berger, B. A. (2003). Improving adherences and persistence: a review and assessment of interventions and description of steps toward a national adherence initiative. *Journal of the American Pharmacists Association*, 43(6), 668-679.
- Laudon, K. C., & Laudon, J. P. (2001). *Management Information Systems: Organization and Technology in the Networked Enterprise (7th ed.)*. Upper Saddle River, NJ, USA: Prentice Hall.

- Lian, J., DiStefano, K., Shields, S. D., Heinich, C., Giampietri, M., & Wang, L. (2010). Clinical appointment process: improvement through schedule defragmentation. *IEEE Engineering in Medicine and Biology Magazine*, 29(2), 127-134.
- Ma, G., Liu, J., & Wei, Z. (2010). The portable personal health records: storage on SD card and network, only for one's childhood. *International Conference on Electrical and Control Engineering*, Wuhan, China, June 25-27, 2010. 4829-4833.
- Martin, F., & Kendall, S. (2000). *UML Distilled: brief guide to the standard object modeling language (2nd ed.)*. Boston, USA: Addison-Wesley Longman Publishing Co.
- Martin, R. M., Sterne J. A. C., Gunnell, D., Ebrahim, S., Davey S. G. , Frankel, S. (2003). NHS waiting list and evidence of national or local failure: analysis of health service data. *British Medical Journal, BMJ*, 326, 188-192.
- McManus, M. L., Long M. C., Cooper, A., Mandell, J., Berwick, D. M., Pagano, M., & Litvak, E. (2003). Variability in surgical caseload and access to intensive care services, *Anesthesiology*, 98(6), 1491-1496.
- MediNous. (2011). MediNous hospital management system. Retrieved February 15, 2011, from [Rehttp://www.medinous.com/](http://www.medinous.com/)

- MemDB. (2011). MemDB clinic management system. Retrieved April 16, 2011, from <http://www.memdb.com/MemClinicE/MemClinic.htm>
- Menon, J., & Melendez-Nakamura, A. (2009). *Aging in Asia: trends, impacts and responses* (Working Paper Series on Regional Economic Integration No. 25). Metro Manila, the Philippines: Asian Development Bank.
- Meyer, M., & Müller, I. (2006). Networked healthcare: a practical guide to understanding influence networks in the health-care industry. *Journal of Medical Marketing*, 6(4), 250-259.
- Moore, C. G., Wilson-Witherspoon, P., & Probst, J. C. (2001). Time and money: effects of no shows at a family practice residency clinic. *Family Medicine*, 33(7), 522-527.
- Murdock, A., Rodgers, C., Lindsay, H., & Tham, T. C. K. (2002). Why do patients not keep their appointments? prospective study in a gastroenterology outpatient clinic. *Journal of the Royal Society of Medicine*, 95(6), 284-286.
- Najmuddin, A. F., Ibrahim, I. M., & Ismail, S. R. (2010). A simulation approach: improving patient waiting time for multiphase patient flow of obstetrics and gynecology department (O&G department) in local specialist centre. *WSEAS Transactions on Mathematics*, 9 (10), 778-790.

Najmuddin, A. F., Ibrahim, I. M., & Ismail, S. R. (2010). Simulation modeling and analysis of multiphase patient flow in obstetrics and gynecology department (O&G department) in specialist centre. *4<sup>th</sup> International Conference on Applied Mathematics, Simulation, Modeling, ASM '10*, Corfu Island, Greece, July 22-25, 2010. 125-130.

Nielson, J. (2006). Quantitative studies: how many users to test Alertbox. Retrieved May 03, 2011, from [http://www.useit.com/alertbox/quantitative\\_testing.html](http://www.useit.com/alertbox/quantitative_testing.html)

Profmax. (2011). Profmax healthcare ERP. Retrieved February 15, 2011, from <http://www.profmax.com/pbs/solutions/erp/healthcare/healthcare.aspx>

Rajasekar, S., Philominathan, P., & Chinnathambi, V. (2006). Research Methodology. Retrieved April 15, 2011, from <http://www.scribd.com/doc/6949151/Research-Methodology>

Revere, D., & Dunbar, P. J. (2001). Review of computer-generated outpatient health behavior interventions: clinical encounters “in absentia”. *Journal of the American Medical Informatics Association*, 8(1), 62-79.

T-CAS. (2011). T-CAS: Total Clinic Automation Solution. Retrieved February 15, 2011, from <http://m2india.com/our-products/t-cas-total-clinic-automation-solution/>

- Tang, W. T., Hu, C. M., & Hsu, C. Y. (2010). A mobile phone based homecare management system on the cloud. *3<sup>rd</sup> International Conference on Biomedical Engineering and Informatics, BMEI 2010*, Yantai, China October 16, 2010. 2442-2445.
- Tuso, P. J., Murtishaw, K., & Tadros, W. (1999). The easy access program: A way to reduce patient no show rate, decrease add-ons to primary care schedules, and improve patient satisfaction. *The Permanente Journal*, 3(3). Retrieved April 15, 2011, from <http://xnet.kp.org/permanentejournal/fall99pj/ea.html>
- Virji, A., Yarnall, K. S., Krause, K. M., Pollak, K. I., Scannell, M. A., Gradison, M. (2006). Use of email in a family practice setting: opportunities and challenges in patient- and physician-initiated communication. *BMC Medicine Journal*, 4 (1). Retrieved April 15, 2011, from <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1563473/>
- Wijewickrama, A., & Takakuwa, S. (2005). Simulation analysis of appointment scheduling in an outpatient department of internal medicine. *In proceedings of the 2005 Winter Simulation Conference, WSC2005*, Orlando FL, USA, December 4-7, 2005. Orlando FL, USA: ACM. 2264-2273.
- Wijewickrama, A. A., & Takakuwa, S. (2006). Simulation analysis of an outpatient department of internal medicine in a university hospital. *In proceedings of the 2006 Winter Simulation Conference, WSC2006*, Monterey, CA, USA, December 3-6, 2006. Monterey, CA, USA: ACM. 425-432.

Wijewickrama, A., & Takakuwa, S. (2008). Outpatient appointment scheduling in a multi facility system. *In proceedings of the 2008 Winter Simulation Conference, WSC2008*, Miami, FL, USA, December 7-10, 2008. Miami, FL, USA: ACM. 1563-1571

Zheng, Y. (2005). Information culture and development: Chinese experience of e-health. *38<sup>th</sup> Hawaii International Conference on System Sciences, HICSS'05*, Big Island, HI, USA, January 3-6, 2005. 153-163.

Zhu, Z., Heng, B.H., & Teow, K.L. (2010). Analysis of factors causing long patient waiting time and clinic overtime in outpatient clinics. *Journal of Medical Systems*, 6(2), 1-7.

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