

ABSTRACT

CONTROL OF APPLIANCE THROUGH INTERNET

“SMART MEDICATION BOX”

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The developments in network technologies provide opportunities to control appliances at homes and offices through the Internet. If these technologies are used appropriately, they can contribute to the welfare of people in many aspects, such as health care. Considering the problems in health care industry and the problems that occur because of medicine noncompliance, we felt that there is a need for a medication dispenser system. By using Internet and home network technologies this system can aid controlling and monitoring patients who are on regular medication. This thesis proposes a solution by introducing a medication dispenser system for the problem based on Internet and a local area wireless network installed at the patient's home.

Keywords: Smart box, Network Technologies, Internet, Health care problems, Health care, Control of appliance

ÖZ

CIHAZLARIN İNTERNET ÜZERİNDEN KONTROLÜ

“AKILLI İLAÇ KUTUSU”

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Ağ teknolojilerindeki gelişmeler evlerde ve ofislerde bulunan cihazların İnternet aracılığıyla kontrolüne imkan sağlamaktadır. Bu teknolojilerin yerinde kullanımı insanların refahını etkileyen bir çok faktörden biri olan sağlık hizmetlerine önemli katkılarda bulunabilecektir. Reçeteye uymadan ilaç almak sağlık hizmetlerinin önemli problemlerden biridir, bu problem ve sağlık hizmetlerindeki diğer problemler ilaç dispensör sistemine olan gereksinimi ortaya çıkarmıştır. Bu sistem İnternet ve yerel ağ teknolojilerindeki gelişmeleri kullanarak düzenli ilaç alan hastaların izlenmesini ve kontrolünü sağlamaktadır. Bu tez, hastaların evine kurulan ve kablosuz ağ aracılığıyla çalışan ilaç dispensör sistemi sayesinde reçeteye uymadan ilaç alma problemine çözüm önerileri getirmektedir.

Anahtar Kelimeler: Ağ teknolojileri, İnternet, Sağlık endüstrisi problemleri, Sağlık hizmetleri, Cihazların uzaktan kontrolü

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REFERENCES

- [1] <http://healthinfo.montana.edu/ruralhealth/WhitePaper/introduction.html>,
last access: 1.01.2004
- [2] <http://www.pharmacyandyou.org/healthinfo/takemedicine.html>,
last access: 1.01.2004
- [3] Lind, L., Sundvall, E., and Ahlfeldt, H., *Experiences from Development of Home Health Care Applications based on Emerging Java Technology*, Journal of Medical Informatics, 830-834, 2001
- [4] Yach D., *Telecommunications for health-new opportunities for action*, Health Promotion International, Vol. 13, No. 4, 1998
- [5] Güler, N. F., and Übey, E. D., *Theory and Application of Telemedicine*, Journal of Medical Systems 26(3), 2002.
- [6] Sing G., O'Donoghue J., Soon C. K., *Telemedicine: Issues and Implications*, Technology and Health Care 10, 1-10, 2002
- [7] Pollack M. E, Colleen E. McCarthy, Tsamardinos I., Ramakrishnan S., Brown L., Carrion S., Colby D., *Autominder: A planning, Monitoring, and Reminding Assistive Agent*, citeseer.ist.psu.edu/496025.html, last access: 1.01.2004
- [8] Zollo S.A., Kienzle M. G., Henshaw Z., Crist L.G., Wakefield D.S., *Tele Education in a Telemedicine Environment: Implications for Rural Health Care and Academic Medical Center*, Journal of Medical Systems, Vol. 23, No.2, 1999
- [9] Lisetti C., Nazsoz F., LeRouge C., Ozyer O., K. Alvarez, *Development multimodel Intelligent affective interface for tele-home health care*, International Journal of Human-Computer Studies, 59, 245-255, 2003
- [10] Cheng E., Rich J. L, *A Home Health Care Routing and Scheduling Problem*, June 26, 1998, citeseer.ist.psu.edu/128516.html, last access: 1.01.2004
- [11] Lehmann C. A., *The Future of Home Testing-Implications for Traditional Laboratories*, Clinical Chimica Acta 323, 31-36, 2002
- [12] The National Board of Health and Welfare, summary Elderly Care in Sweden, <http://www.sos.se/sos/publ/REFERENG/0015004E.htm>, last access: 1.01.2004

- [13] Rhonda G. Vought, R. Grigsby K., Adams L.N., Shevitz S.A., *Tele-psychiatry: Addressing Mental Health Needs in Georgia*, Community Mental Health Journal, Vol. 36, No.5, October 2000
- [14] Angood P.B., *Telemedicine, the Internet, and World Wide Web: Overview, Current Status, and Relevance to Surgeons*, World Journal of Surgery, 25, 1449–1457, 2001
- [15] Bashshur R.L., *Telemedicine effects: cost, quality and access*, J Med Systems 19, 81-91, 1995
- [16] <http://www.m-pill.com/index.php>, last access: 5.04.2004
- [17] <http://www.aafp.org/afp/981101ap/montauk.html>, last access: 1.04.2004
- [18] Herzog A., and Lind L., *Network solutions for home health care applications*, Technology and Health Care 11 (2003), 77-87.
- [19] Haris MI, Flegal KM, Cowie CC, Eberhardt MS, Goldstein DE, Litte RR, et al., *Prevalence of Diabetes, Impaired Fasting Glucose, and impaired Glucose tolerance in US adults*, The Third National Health and Nutrition survey, 1988-1994, Diabetes Care 1998;21:518-24
- [20] Roy N., Baltus G., Fox D., Gemperle F., Goetz J., Hirsch T., Margarities D., Montemerlo M., Pineau J., Schulte J., and Thrun S., *Towards Personal Service Robots for the Elderly*, <http://www-cse.uta.edu/~holder/courses/cse6362/pubs/Roy00.pdf>, last access: 1.01.1-2004
- [21] Schraft R. D., Schaeffer C., and May T., *Care-O-bot : The Concept of a System for Assisting Elderly or Disabled Persons in Home Environments*, <http://citeseer.ist.psu.edu/439608.html>, last access: 1.01.2004
- [22] Finkelstein J., Cabrera M., and Hripesak G., *Internet Based Home Asthma Tele-monitoring*, 117, 2000
- [23] Ziegler J. and Machate J., *Integrated User Interface for the Home Environment*, <http://citeseer.ist.psu.edu/ziegler97integrated.html>, last access: 1.01.2004
- [24] Lusignan S., Wells S., Johnson P., Meredith K., and Leatham E., *Compliance and effectiveness of 1 year's home telemonitoring*, European Journal of Heart Failure 3, 723-730, 2001
- [25] Gillingham W., Holt H., and Gilles J., *Hand-held Computers in Health Care: What Software Programs are Available*, The Information Science Discussion Paper Series, number 2002/05, July 2002, ISSN 117-6024
- [26] Maglavears N., Koutkias V., Chouvarda I., Goulis D.G., Avramides A., Adamidis D., and Louridas G., E.A. Balas, *Home Care Delivery Through the Mobile Telecommunications platform: the Citizen Health System (CHS) perspective*, International Journal of Medical Informatics, 68 (99-111), 2002
- [27] Deitel H. M., *Internet and World Wide Web, How to Program*”, Prentice Hall, 2002
- [28] Samli M., “PHP ile Web Programciligi”, Pusula Yayinlari, 2003

- [29] Patterson L., “Web Publishing and Programming Resource Kit – HTML”, Sams Publishing, 00201997
- [30] MySQL Reference Manual, MySQL AB, 2004
- [31] <http://searchenterpriselinux.techtarget.com>, last access: 1.04.2004
- [32] http://www.phpmyadmin.net/home_page, last access: 1.04.2004
- [33] Microsoft Developer Network (MSDN) Library, “Introduction to Cascading Style Sheets”, (2003)
- [34] Patterson L., “Web Publishing and Programming Resource Kit – HTML”, Sams Publishing, (1997)
- [35] Musciano C., Kennedy B., “HTML and XHTML, The Definitive Guide”, Fifth Edition, O’Reilly & Associates, (2002)
- [36] <http://java.sun.com/docs/overviews/java/java-overview-1.html>, last access: 1.02.2004
- [37] <http://java.sun.com/>, last access: 1.02.2004
- [38] <http://www.geocities.com/Juanga69/parport/>, last access: 1.04.2004
- [39] <http://www.uktech.freemove.co.uk/report/tech.htm>, last access: 1.01.2004
- [40] <http://www.beyondlogic.org/spp/parallel.htm>, last access: 1.01.2004
- [41] Orhan Altinbasak, Mikrodenetleyiciler ve Programlama, 2002,ISBN:975-969-973-7, p11-14
- [42] <http://www.recallrx.com/beptell.html>, last access: 1.01.2004
- [43] <http://www.recallrx.com/medtime.html>, last access: 1.01.2004
- [44] http://www.jandr.com/JRProductPage.process?RestartFlow=t&Merchant_Id=1§ion_Id=1&Product_Id=552399, last access: 1.03.2004
- [45] <http://www.eyesonelders.com/medready/index.html>, last access: 1.01.2004
- [46] <http://www.bindependent.com/cgi-bin/shopper.cgi?preadd=action&key=gcm130>, last access: 1.01.2004
- [47] <http://www.bindependent.com/cgi-bin/shopper.cgi?preadd=action&key=gcm128>, last access: 1.01.2004
- [48] http://www.chitshun.com.hk/Web_Info/PB-01_info.gif, last access: 1.01.2004
- [49] http://www.healthaccessories.com/pill_boxes/pill_box_timers.htm, last access: 1.01.2004
- [50] <http://www.nickellie.com/pocketrx.asp>, last access: 1.01.2004
- [51] <http://www.ontimerx.com/>, last access: 1.01.2004
- [52] Ramez Elmasri & Shamkant B. Navathe, “Fundamentals of Database Systems”, Addison-Wesley, 2000,
- [53] Jan Axelson, “Her Yönüyle Paralel Port”, Bilisim Yayıncılık, 1999

- [54] http://www.hvwtech.com/pages/products_view.asp?ProductID=166, last access:
1.12.2003
- [55] <http://www.informit.com/guides/content.asp?g=java&seqNum=3>, last access:
1.14.2004