Context Awareness as Resource for Monitoring Elderly Depressed

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1 Extended Abstract: The Context Awareness as Resource for Monitoring Elderly Depressed People

1.1 Context Awareness and Disruptive Technology

This case study was made since the Industrial Design Approach, working interdisciplinary with Psychologist and Geriatrics.

The concept of context awareness (CA) arises from ubiquitous computing [1] and its objective is to acquire and use information that allows identifying the situation in which an entity is located [2], whether an object, a person, or both.

The Internet of Things (IoT) allows us to interconnect different devices capable of sensing environmental, physical environmental situations such as temperature, illumination, movement, sound, etc. [3]. The CA gives escalation to multiple proposals to improve the quality of life of users. One, specifically, is e-health or telemedicine. This concept visualizes distance medical consultation, medical treatment, or monitoring of different patients with different types of diseases or conditions.

The disruptive systems [4] and open hardware like microcontrollers such as the Arduino, Raspberry Pi, Onion, Intel Galileo, among others, coupled with the emergence of various sensors allow to identify situations that occur in the day-to-day of people.

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1.2 Monitoring Elderly Depressed

Several countries are experiencing a process of aging of their population, where the world population is expected to exceed nine billion people by 2050 [5], two billion more than at present. The increase will take place almost entirely in developing countries. In Mexico, an increase of 3–5% for the year 2050 of the population over 85 years old [6].

In Mexico, the INEGI[1] considers older people the population of 60 years or older [7], the current situation and the perception of society, has forced to establish different ranges for the older adults, setting tree levels of older adults: young older adult (65 and 75 years old), older adult (75 and 85 years old) and older advanced adult (+85 years old) [8]. Last ones present a high or total loss of autonomy, more prone to vulnerability and generate greater demands in terms of attention and resources [5]. This condition of disability is reflected in the change in activities of daily living (Activity of Daily Living, ADL) [9], people report one or more severe limitations, defined as a central set of care activities or personal self-care [6], directly affecting the family, since as the disability increases, care work will be assumed and in many cases the State will have to assume treatments, medicines, and even the care [8].

Depression is one of the most common psychiatric conditions in older adults; however, continuously this condition is poorly diagnosed and poorly treated [10]. This leads to many consequences such as the increase in the cost of patient treatment and family problems [11]. It conditions increases cost to society [12], represented by millions in the payment of treatments, medicines, hospitalization, and goes directly to the treasury, to relatives and in some cases the patients lack resources to be able to carry out a treatment [13].

The diagnosis of depression is determined by the application of a questionnaire. In Mexico, the instrument designed by the ENASEM (National Study on Health and Aging in Mexico) is applied, which ensures a reliability of 80.7% [9]. The correct diagnosis gets more difficult when the ailments are accompanied by chronic diseases. The factor of ADL, conditions of loneliness coupled with the symptoms may be masked by other conditions, including the conditions of the natural deterioration of aging [14].

There is no physiological or biological analysis such as a blood test or similar to confirm a diagnosis of depression [15]. Some studies to determine the relationship of biological–physiological markers that help determine a state of depression. Suraki [16] proposes a methodology to make a diagnosis, based on the ADL. However, they do not correlate physiological data or biomarkers for this diagnosis and do not give proof of the reliability of the method.

The case study is presented for the monitoring of elderly people in a depressed state with the objective of assessing the utility and perceived contribution. The sys-

[1]INEGI: (NIIG, National Institute of Information and Statistics in Mexico).

Image 1 Placement of the system for the best visualization of the ADL

tem was tested (initially) with three patients, under the medical protocol established for this purpose, seeking to identify the operation, advantages or disadvantages, and the knowledge of the patient's user experience, the family member, and the treating physician. In other words, the U/X user experience will be evaluated.

The system was applied to "healthy" elderly patients aged +70 years previously diagnosed of depressive state. The patient must wear a bracelet (left arm preferred) and will be monitored in his ADL. Secondary user: family caregiver must install the system (place, connect, put the bracelet), charge and change batteries, check operation on the website. The medical user: not physical contact, monitorize through the website (http://www.cixxi.com.mx/finch/index.php).

The use of the bracelet was for 24 h a day and 2 weeks for a minimum period. In the first week, the system registers and learns the patient's ADL. In the second week, the system has "learned" the ADL and begins the comparison with respect to the record of the previous week, by day and time.

Figure 1 shows the configuration of the system. At first point is a bracelet that acquires biomarkers such as temperature and hear rate. Its information is sent to a second module constructed in a Raspberry Pi configured with Open CV for recognition of human body and track person movement to register the ADL. That information is collected into a server and it presents the information in a Website to the family or caregiver and the medic responsive, via Internet.

The results of the system application are displayed on the website for each patient. Identifying the patient's image, data or observations to it, the temperature and heart rate by date and time, as well as the ADL map with a background image. The system sends a series of alerts by SMS or email, also at the when the system starts.

The system identifies human bodies and records their position at each moment in Cartesian coordinates within a plane, this plane is the image captured by the camera.

Figure 2 presents an example. Superimposed on the background image, the tracking map. The places of incidence of the patient, where the dark pictures (blue) indicate little presence or movement. The yellow boxes indicate the greatest amount of incidence or movement. A grid that facilitates the location of the Cartesian map area.

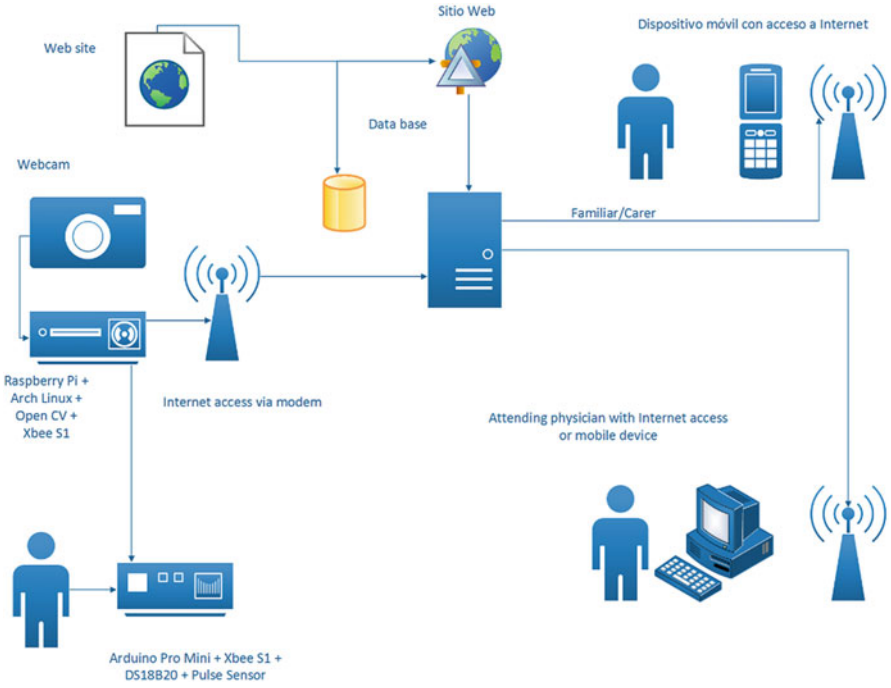

Fig. 1 System proposal, configuration, and system function

User Experience from Patients (U/X)

Once the monitoring process was completed, the survey was applied to the patient, the family member or caregiver, and the doctor or treating person. The intention of this interrogation was to know the UX of the users. It seeks to identify the acceptance of the use of technology for monitoring in older adults.

The responses of the patients allowed us to identify the level of acceptance of the system and the ergonomic appearance of the bracelet and the ease of use of it. Patients willingly accepted the application of this and showed no fear or any doubt about the use of it. There was unanimity in the system's parentage and everyone reports benefit when applying the monitoring in their ADL. In general, it is thought that it is a good idea and that it can help them in their well-being.

In the same way, the idea that the patient warns family members in case of an emergency or readings that are in the alert range (high temperature, HR, or alterations in the ADL) was good. What is interesting is knowing that everyone prefers to be notified to family members and not to the doctor or trader.

The relatives of the patients accepted the proposal well. Seeing that the system is not invasive and there is no need to install special facilities and it can be placed practically anywhere in the house, it improves the acceptance of it and normally

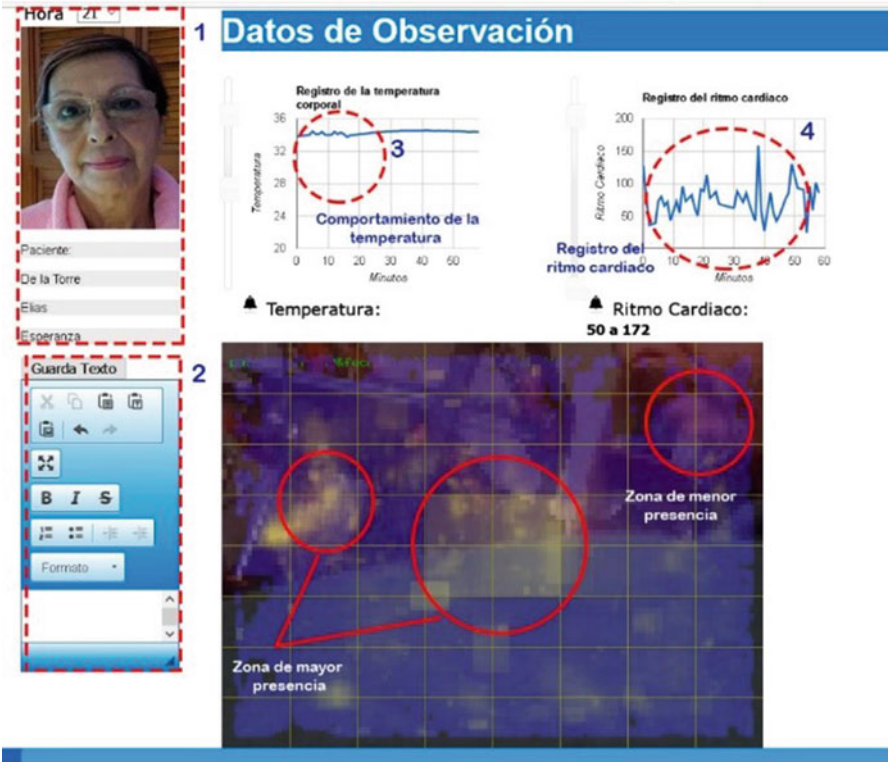

Image 2 View of the website for the doctor or family member. (1) Photograph of the patient; (2) Space to add annotations; (3) Temperature graph per hour; (4) HR chart per hour; (5) Map of ADL

they do not even notice the presence of it, until you tell them where it was placed and how.

The acceptance of the placement and monitoring of their relatives was also as expected. Since, although there was some doubt at the beginning, when seeing that they did not require special knowledge or to be attentive to the functioning of the system, the family members expressed greater taste and acceptance of the proposal.

Regarding security, when seeing the results of the images taken from the ADL, the relatives refer to it as they clearly see that there is no invasion of their privacy and the results can be interpreted, even by them. Relatives.

There is an area of opportunity and that is the duration, recharge, and change of the battery. This is due to the duration of only 12 h, to the "difficulty" of placement and even the visualization of the operation of the bracelet.

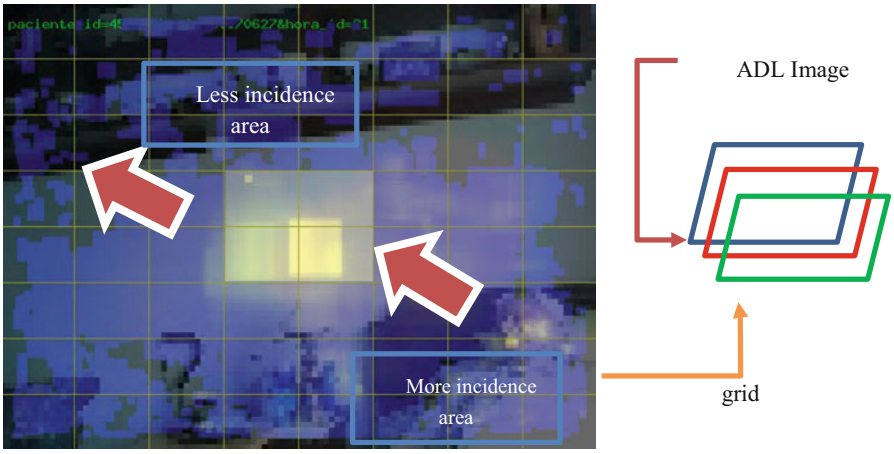

Fig. 2 ADL capture resulting in Cartesian image map in three layers: Background image, ADL map, and reticle

References

1. Bardram, J.E.: Applications of Context-Aware Computing in Hospital Work – Examples and Design Principles. ACM, New York (2004)
2. Anagnostopoulos, C.B., Tsounis, A., Hadjiefthymiades, S.: Context awareness in mobile computing environments. Wirel. Pers. Commun. **42**(3), 445–464 (2006). https://doi.org/10.1007/s11277-006-9187-6
3. Choi, W., Kim, S., Keum, M., Han, D.K., Ko, H., Member, S.: Acoustic and visual signal based context awareness system for mobile application. IEEE Trans. Consum. Electron. **57**(2), 738–746 (2011)
4. Sundmaeker, H., Saint-exupéry, A.D.: Vision and challenges for realising the internet of things. Clust. Eur. Res. Proj. Internet Things Eur. Comm. **3**(3), 34–36 (2010)
5. OECD: Science and technology perspectives on an ageing society. In: OECD Science, Technology and Industry Outlook 2012. OECD, Paris (2012). https://doi.org/10.1787/sti_outlook-2012-en
6. Lafortune, G., Balestat, G.: OECD health working papers no. 26. In: Trends in Severe Disability Among Elderly People, p. 81. OECD, Paris (2007). https://doi.org/10.1787/217072070078
7. INEGI: Los Adultos Mayores en México. Perfil sociodemográfico al Inicio del Siglo XXI, 2005th edn. INEGI, Aguascalientes (2005)
8. Haberkern, K., Schmid, T., Neuberger, F., Grignon, M.: The role of the elderly as providers and recipients of care. In: The Future of Families to 2030. OECD, Paris (2011). https://doi.org/10.1787/9789264168367-en
9. Yáñez-luis, M.M.C.J.A., Fernández-Guzmán, C.M.C.M.P., De Brigada, G., Manuel, M.C.V.: Características clinimétricas en adultos mayores consultados en la. Especialidad de Geriatría de la Unidad de Especialidades Médicas. **63**(4), 156–177 (2009)
10. Crawford, M.J., Prince, M., Menezes, P., Mann, H.: The recognition and treatment of depression in older people. Int. J. Og Geriatr. Psychiatr. **13**(December 1997), 172176 (1998)
11. Cullum, S., Tucker, S., Todd, C., Brayne, C.: Screening for depression in older medical inpatients. Int. J. Geriatr. Psychiatry. **21**(5), 469–476 (2006). https://doi.org/10.1002/gps.1497
12. Mavis, E.: Detection and management of depression in the elderly physically I11 patient. Human Psycopharmacol. **10**, 235–241 (1995). http://doi.org/0885-6222/95/S40235-07

13. Bonin-guillaume, S., Sautel, L., Demattei, C., Jouve, E., Blin, O.: Validation of the retardation rating scale for detecting depression in geriatric inpatients. Int. J. Geriatr. Psychiatry. **22**(1), 68–76 (2007). https://doi.org/10.1002/gps.1657
14. Dorfman, R.A., Lubben, J.E., Mayer-Oakes, A., Atchison, K., Schweitzer, S.O., De Jong, F.J., Matthias, R.E.: Screening for depression among a well elderly population. Soc. Work. **40**(3), 295–304 (1995)
15. Albrecht, A.M., Herrick, C.M.: 100 preguntas y respuestas sobre la depresión, 2nd edn. EDAF, Madrid (2007)
16. Suraki, M.Y., Suraki, M.Y., Nejati, O.: Benefit of internet of things to improve business interaction with depression prevention and treatment. In: 2012 IEEE 14th International Conference on E-Health Networking, Applications and Services (Healthcom), pp. 403–406. IEEE (2012). https://doi.org/10.1109/HealthCom.2012.6379448