

INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PREVENTION AND CONTROL OF CERVICAL CANCER

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ABSTRACT

This paper presents the development of a system to prevent and control Cervical Cancer. This system runs on a handheld using infrared technology from a service point to make the current process more efficient for the staff responsible for carrying out diagnostic tests, as well as for doctors from health clinics in communities belonging to the city of Tizimín, Yucatan, Mexico.

KEYWORDS

IrDA Technology, WideRay Jack, Cervical Cancer.

1. INTRODUCTION

The development of the technological capabilities of mobile handhelds (phones and PDAs) has taken place over the past few years [1], with the proliferation of those around us.

The digital division between industrial cities and the developing world represents an opportunity for many universities to build sustainable models for the development of their students and their growth.

The sophisticated development of communication has led us to share data between electronic devices (calling it Wireless Communication) using as an intermediary for the exchange of data one of many current technologies: IrDA Transceivers (Infra Red Data Association Transmitter Receiver), Bluetooth or 802.11 Protocol.

In this development, keeping in mind the resources at our disposal, infrared technology was used. These devices have the ability to transmit and receive data without using a serial cable between them, instead they use a wireless data connection using infrared light. The IrDA is inexpensive, capable of exchanging data in both directions and at speeds ranging from 9600 bps to 4 Mbps.

This development is situated in the Universidad Autonoma de Yucatan (UADY), in the Multidisciplinary Unit of Tizimin (UMT) in Mexico, specifically in the Community Development Department (CDD) of the Health Unit (HU) of the nursing department, which, as

part of its functions, has to perform various activities in health promotion in rural communities around Tizimín.

One of the many activities of CDD staff is moving to those communities to test for Cervical Cancer in order to prevent and control it. Each community has a small health clinic, where the CDD staff go to perform this kind of test as support, so that along with the doctor, they may respond better to the welfare of the people in the communities. Due to fact that the health clinics of the communities do not have the equipment to analyze these tests, CDD staff, after obtaining the samples, analyzes them in the HU of the UADY in Tizimín, and at later dates, they go back to the communities for delivery of results.

The current operating procedure for the carrying out of tests and/or delivery of results is as follows: at the beginning of each year, the CDD staff prepare a calendar of activities for testing and delivering the results; leaflets are produced, which include this information as well as the preconditions to be met by the women in the community before it is done; for the delivery of the leaflets, the CDD staff travel to the community. With regard to the analysis of results, after applying the tests, a form is manually filled out for each of the patients. On the day of the delivery of results all this documentation has to be loaded, so the CDD staff or the doctor of the health clinic can provide the results to the patients. This sometimes means records are misplaced amongst the documentation for different communities, or when the CDD staff get to the community, they notice that the documentation is not complete, and consequently some patients do not receive their results on time.

The completion of these tests is of great importance since it has been shown that in the state of Yucatan there are 30.4 deaths caused by Cervical Cancer per 100,000 women aged 25 years or more (statistics from the National Population Council, CONAPO). In addition, women living in rural areas of the state had a 3.07 higher risk of death from this cancer, compared with urban residents.

For all these reasons, the Cervical Cancer prevention program's goal is to reduce the high frequency of this cancer and deaths caused by this disease. It is therefore hoped that the system presented here, might provide technical reports in order to systematize the actions in the prevention and control of this cancer, and to track and control it in rural communities in the eastern region of the state of Yucatan.

Based on the above, a system was developed using infrared wireless technology in an issuer of WideRay Jack content, so the CDD staff or the doctor in the communities can get all the information they need while avoiding printed documentation, making the process more efficient. This will be achieved by placing a Wideray device in the CDD of the HU, in which only the department staff and doctors will have access to all information stored on it.

With the development of this system, patients will wait less time in health clinics to get their results. Also, due to all information is stored on the Wideray device, once it is downloaded to the doctor or CDD staff's PDA, the results will be delivered to patients in a timely manner.

In addition to the above, many studies have been made to evaluate this area; for example [1] presents a case study which shows complementary distribution of static and dynamic multimedia content equipped with WPAN service points, a wireless local area network and mobile phone networks. The paper [2] mentions that Satellife (Center for Health Information and Technology) is using the cell phone network in Uganda to collect field data. The local health care workers collect data on Palm Pilot and then they connect to a server Wideray Jack, which allows data to be sent to and from a central database via cell phone modem. In [3]

software mobile publisher and platform provider Handango Inc. WideRay are joining strength to produce mobile kiosks that will offer Handago's catalog of 20,000 applications for devices such as personal digital assistants (PDAs). On the other hand, the content in [4] shows us a very important point: WLAN hotspots are cool for internet access. The content in [5] explains how in Peru, the project PREVEN conducted a field study in 20 cities of the country in which data on sexual behavior were collected using PDA. There was a good correlation between the responses on paper and PDA responses. The project suggested that the PDA was a viable option to the paper formats for field data collection in a developing country. In [6] we can appreciate the use of WideRay applied to the field of education. In [7] a case study of the use of Wideray, PDA's and MTN Cellular Network is presented. In [8] a mobile catalogue of rules of generation of the CFE (the main electricity company in Mexico) is presented, which was developed with the use of WideRay.

2. IRDA TECHNOLOGY

Infrared Data Association (IrDA) defines a physical standard of transmission and reception of infrared data, established in 1993 by HP, IBM, Sharp and others.

This technology is based on light rays that move in the infrared spectrum. IrDA standards support a broad range of electrical, computer and communication devices, allows bidirectional communication between two peers at speeds ranging from 9600 bps to 4 Mbps. This technology is found in many laptops, PDAs and mobile phones. The FIR (Fast Infrared) is under study, with theoretical speeds of up to 16 Mbps, [9]. IrDA currently exists in millions of devices.

It is based on visible light, being a secure way of communication. The direct infrared connection is point to point, typically one to one communication, is not subject to rules, it requires line of vision and is also a safe way to transmit and receive data, so that it is possible to access a LAN with such confidence like using a cable. The radio frequency is not safe due to the fact that it can penetrate walls, it is subject to uncontrolled interference, and it is typically higher in power than the direct infrared [10]. IrDA defines an organization in layers as shown in figure 1.

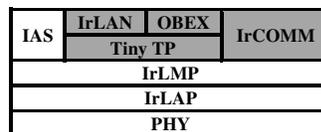


Figure 1. IrDA Layers Organization.

In addition, any device which seeks the agreement of IrDA protocols must meet the requirements (white background in figure 1); however it can skip some or all of the optional protocols (dark background in figure 1). This differentiation allows developers to choose lighter and less expensive designs, which can also accommodate the most demanding requirements without having to exit the IrDA standard

3. WIDERAY JACK

There are already several companies that have successfully tested the Wideray technology called Jack, which is a combination of hardware and software to provide wireless content for people who have mobile devices. People only need to direct the PDA to any Wideray Jack and all the content will be automatically downloaded. This technology has a simple system of

centralized management of all content. In short, it is a system for users with a PDA and other sectors such as education, medicine, among others.

WideRay Jack Service Point is a solution for delivering local content to mobile devices over Bluetooth or IrDA. Jacks have been deployed in real end user environment, such as shopping malls and sports facilities.

WideRay Jacks are portable and can be wall-mounted in high-traffic areas and accessed by multiple PDA users. These jacks can support simultaneous synching of multiple PDA's within a 15 foot range [7].

WideRay is an equipment and integrated platform provider focused on the high-speed free-spectrum on-location wireless data services market. WideRay has developed a single-box architecture for deploying centrally managed, high-speed, low-cost wireless data services in scale, using both infrared and short-range RF for connecting with mobile devices. WideRay's back-end architecture is based on GSM/GPRS for global, always-on support [11].

In the development of this system the WideRay Platform with a Jack Service Point was used. The model that we use supports infrared beaming. Using the jack (figure 2) involves:

- Turning on our handheld device and pointing it at the Jack.
- Downloading the WideRay installer (The installer application allows us to download the WideRay browser and content. The WideRay browser works like a web browser).
- Clicking buttons, links, images, and pulldown menus to navigate through content.
- Selecting the forward and back buttons to review pages. Selecting the home icon to return to the front page.
- Once downloaded, the WideRay browser can be used to access Jack anywhere.
- Selecting the WideRay icon to launch the browser.
- Pointing it at the Jack and downloading new information (We can stand up to 3 feet away from the Jack).



Figure 2. Download the Application.

Some uses for WideRay Jack are: retail, trade show/conference, sports/entertainment venue, education, healthcare and information kiosks among others.

The WideRay Browser application takes up approximately 100 kb of storage space on your handheld. The size of the content can vary; a typical content piece is 80 kb, (it takes approximately 10 seconds to receive the WideRay Browser and approximately 10 seconds to receive content). The Jack will automatically detect that the program is open and will immediately send the content [12].

4. CERVICAL CANCER

Cervical cancer is a malignant neoplasm of the cervical area. It may also appear with vaginal bleeding but these symptoms may be absent until the cancer is in its advanced stages [13].

Treatment consists of surgery (including local excision) in early stages and chemotherapy and radiotherapy in advanced stages of the disease.

Pap smear screening can identify potentially precancerous changes. Treatment of high grade changes can prevent the development of cancer. In developed countries, the widespread use of cervical screening programs has reduced the incidence of invasive cervical cancer by 50% or more. Human papillomavirus (HPV) infection is a necessary factor in the development of nearly 70% of cases of cervical cancer [13, 14]. HPV effective vaccine against the two strains of HPV that cause the most cervical cancer has been licensed in the U.S, Canada, Australia and the EU. These two HPV strains together are currently responsible for approximately 70% [15, 16] of all cervical cancers. Since the vaccine only covers some high-risk types, women should seek regular Pap smear screening, even after vaccination.

The early stages of cervical cancer may be completely asymptomatic [13]. Vaginal bleeding, contact bleeding or (rarely) a vaginal mass may indicate the presence of malignancy. Also, moderate pain during sexual intercourse and vaginal discharge are symptoms of cervical cancer. In advanced disease, metastases may be present in the abdomen, lungs or elsewhere.

Symptoms of advanced cervical cancer may include: loss of appetite, weight loss, fatigue, pelvic pain, back pain, leg pain, single swollen leg, heavy bleeding from the vagina, leaking of urine or feces from the vagina, and bone fractures.

The most important risk factor in the development of cervical cancer is infection with a high-risk strain of human papillomavirus. The virus-cancer link works by triggering alterations in the cells of the cervix, which can lead to the development of cervical intraepithelial neoplasia, which can lead to cancer.

Women who have many sexual partners (or who have sex with men who had many other partners) have a greater risk.

5. SICACE

The UMT of the UADY is aware of the advantages of the use of digital technology; with this in mind, the system called SICACE was developed, which is used by the medical community and the CDD.

The motivation of the development of SICACE was to give CDD and community's doctor the relevant information about Cervical Cancer.

5.1. Design of SICACE

This section defines the design of the system with the help of use cases and the graphical presentation of each of the screens used. As mentioned earlier the system will be used by the CDD staff and the doctor in the community, so these will be the actors to be labelled as "Responsible" (responsible) in the graphs, where the use cases (ovals) can be seen. The use cases are:

- Consultar Informacion CCU (Consult information about Cervical Cancer)
- Consultar Calendario Pruebas (Consult the schedule of tests)
- Consultar Calendario Resultados (Consult the schedule of results)
- Consultar Indicaciones Previas (Consult the previous indications)
- Búsqueda Fecha Comunidad (Search in a community by date)
- Búsqueda Paciente Comunidad (Search a patient in the community)

- Consultar Resultados (Consult results)

Using the methodology of UML (Unified Modeling Language) [17], the use cases diagram used in the development of the system is shown in Figure 3.

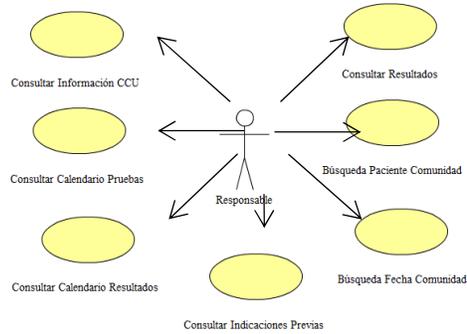


Figure 3. Use-Cases Diagram of the SICACE.

The use cases can be seen defined in the following list: *Consultar Información CCU*, table 1 and figure 4, *Consultar Calendario Pruebas*, table 2 and figure 5, *Consultar Calendario Resultados*, table 3 and figure 6, *Consultar Indicaciones Previas*, table 4 and figure 7, *Búsqueda Fecha Comunidad*, table 5 and figure 8, *Busqueda Paciente Comunidad*, table 6 and figure 9, *Consultar Resultados*, table 7 and figure 10.

Table 1. Use Case: *Consultar Información CCU*.

Use-Case Name	<i>Consultar Información CCU</i> (Consult information about Cervical Cancer)
Description	Used to obtain relevant information of Cervical Cancer, such as its definition, Mexico's current situation about this deadly disease, tips to prevent it and characteristics women should have to be tested.
Stakeholders	<i>Responsable</i> (responsible)
Basic Flow	<ol style="list-style-type: none"> 1. Responsable selects "Que es CCU?" (what is Cervical Cancer?) on the main menu. 2. A list of four options is displayed and Responsable chooses one of them. 3. Responsable uses the navigation buttons to access these options. 4. Once Responsable is in one of the four options, the "Menu CCU" form can be used to return to Consultar Información CCU.

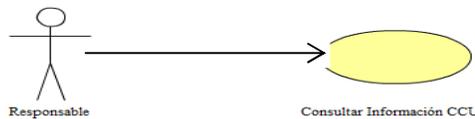


Figure 4. Use-Case Diagram: *Consultar Información CCU*.

Table 2. Use Case: *Consultar Calendario Pruebas*.

Use-Case Name	<i>Consultar Calendario Pruebas</i> (Consult the schedule of tests)
Description	Used to obtain the dates on which testing will take place in each community by month
Stakeholders	<i>Responsable</i> (responsible)
Basic Flow	<ol style="list-style-type: none"> 1. Responsable selects "Calendar" on the main menu. 2. A screen is displayed, on which Responsable selects the option "Calendario para

	<p>pruebas" (schedule of tests).</p> <ol style="list-style-type: none"> 3. A screen is displayed, on which Responsable provides the Community and the month of interest to get the test date. 4. Responsable selects the button "Buscar" (search). It displays a screen that shows the dates on which testing will take place. 5. Responsable can select the option "Agendar" (store) to store in the Date Book. 6. Responsable selects the navigation buttons to get the screen of his/her interest.
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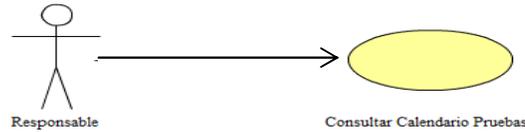


Figure 5. Use-Case Diagram: *Consultar Calendario Pruebas*.

Table 3. Use Case: *Consultar Calendario Resultados*.

Use-Case Name	<i>Consultar Calendario Resultados</i> (Consult the schedule of results)
Description	Used to obtain the dates on which the results will be provided in each community by months.
Stakeholders	<i>Responsable</i> (responsible)
Basic Flow	<ol style="list-style-type: none"> 1. Responsable selects the option "Calendario" (schedule) on the main menu. 2. A screen is displayed, where Responsable select "Calendario para resultados" (schedule of results). 3. A screen is displayed, where Responsable provides the community and the month of interest to get the date of delivery of results. 4. Responsable selects "Buscar" (search). A screen is displayed that shows the dates when results will be provided. 5. Responsable can select the option "Agendar" (store) to store in the Date Book. 6. Responsable selects the navigation buttons to get the screen of his/her interest.

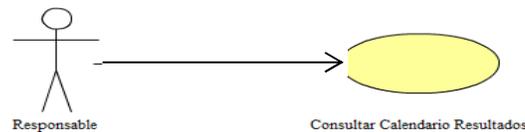


Figure 6. Use-Case Diagram: *Consultar Calendario Resultados*.

Table 4. Use Case: *Consultar Indicaciones Previas*.

Use-Case Name	<i>Consultar Indicaciones Previas</i> (Consult the previous indications)
Description	Used to provide useful information to women who are interested in being tested, to make quicker the process of review of Cervical Cancer.
Stakeholders	<i>Responsable</i> (responsible)
Basic Flow	<ol style="list-style-type: none"> 1. Responsable selects the option "Indicaciones" (indications) from the main menu. 2. A form is displayed, which shows the indications that women must meet before being tested. 3. Responsable selects the button "Menu" to return to the main menu.

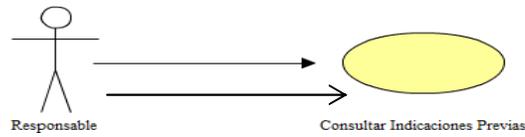


Figure 7. Use-Case Diagram: *Consultar Indicaciones Previas*.

Table 5. Use Case: *Búsqueda Fecha Comunidad*.

Use-Case Name	<i>Búsqueda Fecha Comunidad</i> (Search in a community by date)
Description	Used to make consultations providing the date and the community as parameters. Used to search for dates which will provide the results of the tests and the dates on which these will be performed.
Stakeholders	<i>Responsable</i> (responsible)
Basic Flow	<ol style="list-style-type: none"> 1. Responsable provides the community and the month to get the date of the test, on the screen "Calendario pruebas" (schedule of tests) or "Calendario resultados" (schedule of results). 2. Responsable selects "Buscar" (search). A screen is displayed that shows the dates and times in which tests will take place, or when the results will be provided. 3. Responsable can select the option "Agendar" (store) to store in the Date Book. 4. Responsable selects the navigation buttons to get the screen of his/her interest.

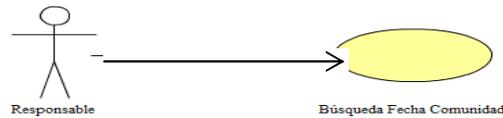


Figure 8. Use-Case Diagram: *Búsqueda Fecha Comunidad*.

Table 6. Use Case: *Búsqueda Paciente Comunidad*.

Use-Case Name	<i>Búsqueda Paciente Comunidad</i> (Search a patient in the community)
Description	Used to make consultations by providing the range of the patient's last name and the community (as input parameters), and then the name of the patient.
Stakeholders	<i>Responsable</i> (responsible)
Basic Flow	<ol style="list-style-type: none"> 1. Responsable provides the community and the range of the last name of the patient who wants to know the result of her test. 2. A screen is displayed with the names of all patients whose last names are on the selected range as long as they belong to the given community. 3. Responsable selects the name of the patient and displays a screen with the results of that patient, such as: the date of the test, cytologic diagnosis, additional findings, if the test will be repeated and why. 4. Responsable can select the "Camara" (camera) button to see a picture of the patient, or use the navigation buttons to get the screen of his/her interest.

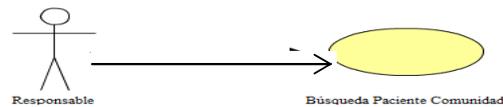


Figure 9. Use-Case Diagram: *Búsqueda Paciente Comunidad*.

Table 7. Use Case: *Consultar Resultados*.

Use-Case Name	<i>Consultar Resultados</i> (Consult results)
Description	Used to know the results of the patients who have been subjected to Pap test.
Stakeholders	<i>Responsable</i> (responsible)
Basic Flow	<ol style="list-style-type: none"> 1. Responsable selects the "Resultados" (results) option from the main menu. 2. A window is displayed in which Responsable must choose the community and the range of the patient's last name. 3. Responsable selects "Buscar" (search) to start the search process, or "Menu" to return to the main menu. 4. If Responsable selects "Buscar" (search), a screen is displayed with the names of the patients in the community and the range of the last names selected. 5. Responsable selects the name of the patient, from the displayed list. 6. A screen is displayed with the results of the patient. Responsable can select the "Camara" (camera) button to see a picture of the patient, or use the navigation buttons to get the screen of his/her interest.



Figure 10. Use-Case Diagram: *Consultar Resultados*.

The next code is an extract of SICACE corresponding to the menu, which is used whenever the option (Que es CCU?) (what is Cervical Cancer?) is selected. It is at the same time a sub-menu which has four functions related to the relevance of Cervical Cancer.

```

<html>
<head>
<title> Menú CCU </title>
</head>
<body>
 <br>
<table border="0" cellpadding="0" cellspacing="0">
<tr>
<td>
<a href="def.htm"></a>
</td>
<td>
<a href="situa.htm"></a>
</tr>
<tr>
<td>
<a href="preven.htm">  </a>
</td>
<td>
<a href="riesgo.htm">  </a>
</td>
</tr>
<tr>
<td align="center">
<a href="menu.htm"> </a>
</td>
</tr>
</table>
</body>
</html>
  
```

Once the programming of the system was ended using html and a text editor, the next step was to upload it to the WideRay Jack, and to access it, a PDA with infrared technology was used to download it and then interact.

5.2. SICACE Software

When the system is started the image in Figure 11 is displayed as a presentation, and to start interacting with it, the main menu is loaded, by selecting the button “Prevencion y Control del CCU” (prevention and control of Cervical Cancer).



Figure 11. Main screen of the system.

Once that is done, it displays a screen that contains the main menu options, as shown in Figure 12.



Figure 12. Main screen of the system.

Next, the screens to each of the main menu options are described:

¿Qué es CCU?:(what is Cervical Cancer): By Selecting this option, the screen shown in Figure 13 is displayed, which contains a submenu with four options, as can be seen.

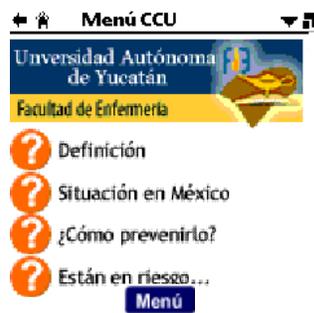


Figure 13. Menu Screen: ¿Qué es CCU? (what is Cervical Cancer?)

As we can see, in this submenu, entitled "Menu CCU", we can select one of the four options, or return to main menu via the "Menu" button. The screens of the options of "Menu CCU" are not included in this document but its contents are defined.

Definición (definition): Contains a description of what Cervical Cancer is.

Situación en México (situation in Mexico): Contains relevant information about the status of the disease in Mexico, with emphasis on the states where the incidence is higher.

¿Cómo prevenirlo? (how to prevent): Contains detailed recommendations to prevent transmission.

Están en riesgo... (You are at risk..): Mentions how a woman can be at risk for that disease, at what age a woman can have this type of tests, and the conditions that a woman can have to affirm she is at risk from this disease.

Calendario (schedule): Selecting this option, the screen shown in Figure 14 is displayed, which is a submenu, entitled "Menu Calendario" (schedule menu). It has two options to be selected, or return to main menu via the button "Menu". In the description, only the first screen is included.



Figure 14. Schedule Menu Screen

Calendario para pruebas (schedule of tests): By selecting this option the screen shown in Figure 15 is displayed. In this screen, the user can select the community name and the month to get the date on which the patients will be tested. Once this data has been given, it is necessary to select the button "Buscar" (search) to initiate the search process. If the user wants to return to "Menu Calendario" (schedule menu) select "Regresar" (back).



Figure 15. Schedule of Tests Screen (1)

By selecting the required community and month the screen shown in figure 16 is displayed.



Figure 16. Schedule of Tests Screen (2).

If the user wants to save some of these dates in the "Date Book" of his/her PDA, he/she must select the icon "Agendar" (store); once done, a confirmation screen is displayed. It is possible to go to the PDA's Date Book to check that the event has been added. For the options "Agendar" (store) and "Calendario para resultados" (results calendar), the handling of dates requires the use of two tables in our database for obtaining information. These tables are "fechas.db", for the dates on which test will be taken in the communities for a given month and "fechasres.db" for the dates the results will be given in the communities.

Calendario para resultados (schedule of results): This is another option whose screens are not included; however, the procedure is similar to the one that we described above whose goal is to get the date in which results are provided to the patients.

Indicaciones (indications): This option displays the screen in Figure 17. It is used so that the doctor may have permanently at his disposal all of the early indications to be considered when women take the Cervical Cancer test and not overlook any of them. This is in order to have a better control to prevent cancer so that women do not have to repeat the test by forgetting any of these indications.

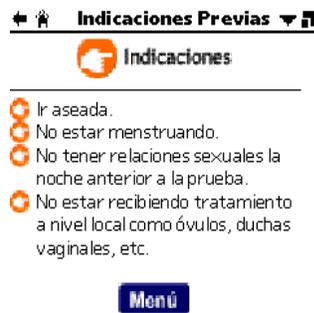


Figure 17. Previous Indications Menu screen.

Resultados (results): This option on the main menu displays the screen in Figure 18. This screen is used when the doctor or CDD supervisor wants to know the results of a patient. For this operation it is necessary to provide the name of the community to which the patient belongs, as well as the range in which the surname of the patient is. Depending on the patient's last name, a range A - E, F - J, K - O, P - T, or U - Z is selected. Then, using the "Buscar" (search) button, this function will display the full names of the patients whose last name is in the range given. This list is sorted alphabetically. When the name of the patient is selected, a list that includes all the information corresponding to the result obtained from the analysis of it is presented.



Figure 18. Results Menu Screen.

As an example, suppose we want to know the results of the patient "Tec Can Marbella" who is in Cabichen community. To get this, we select Cabichen in the community field and the range P - T in last names. By providing this input data and selecting the button "Buscar" (search), the screen shown in Figure 19 is displayed. In this screen the name of the patient is selected and we get the screen with the results of this person (Figure 20). In this figure, the doctor or the CDD supervisor can select the camera icon located on the "Foto" (photo) option to see the image of the patient who is getting the result. This option uses a table in our database called "resultados.db".



Figure 19. Selecting a patient.



Figure 20. Results of a patient.

As mentioned before, this system required the construction of a database with three tables called fechas.db (Table 8 and Figure 21), fechasres.db (Table 9 and Figure 22) and resultados.db (Table 10 and Figure 23).

Table 8. Table: fechas.db

Field	Data type	Description
Comunidad	String	Denotes the community where the patient belonged.
Mes	String	Month when the tests will be conducted.
Mesn	Integer	Month, but in its equivalent integer to use in the Date Book.
Fecha	Integer	Date on which the test will be done for a certain community.
Hini	String	It refers to the time that testing will start.
Hfin	String	It refers to the time that testing will end.
Dife	Integer	Total number of minutes to do the tests, this is indispensable to have to record this time in the Date Book.

```

fechas 7
Comunidad String Mes String Mesn Integer Fecha Integer Hini String Hfin String Dife Integer
Sucopo Enero 1 05 08:00 15:00 540
Sucopo Enero 1 12 10:00 17:00 420
Sucopo Enero 1 19 08:00 15:00 540
Cabichen Febrero 2 16 08:00 14:00 360
Cabichen Febrero 2 23 08:00 15:00 420
xpambina Marzo 3 02 10:00 13:00 180
Sucopo Marzo 3 23 10:00 15:00 300
Sucopo Marzo 3 30 08:00 12:00 240
Xbohom Abril 4 06 10:00 13:00 180
Cabichen Mayo 5 04 10:00 14:00 360
Cabichen Mayo 5 11 08:30 15:00 390
xpambina Mayo 5 18 08:00 12:00 240
Xbohom Junio 6 08 08:00 13:00 300
xpambina Julio 7 06 10:00 13:30 210
Sucopo Julio 7 13 08:30 13:30 420
Sucopo Julio 7 20 10:00 16:00 360
Xbohom Septiembre 9 07 08:00 12:00 240
Cabichen Septiembre 9 14 10:00 13:30 210
    
```

Figure 21 Table: fechas.db

Table 9. Table: fechasres.db

Field	Data type	Description
Comunidad	String	Denotes the community where the patient belongs.
Mes	String	Sets the month when the tests will be conducted.
Fecha	Integer	Date when the test will be done for a certain community.
Hora	String	Time when the tests will start and end.

```

fechas 4
Comunidad String Mes String Fecha Integer Hora String
Sucopo Febrero 09 08:00 a 12:00
Cabichen Marzo 09 10:00 a 14:00
xpambiha Marzo 16 08:00 a 12:00
Sucopo Abril 13 08:00 a 20:00
Xbohoh Abril 20 08:00 a 14:00
Sucopo Abril 27 10:00 a 13:00
xpambiha Mayo 25 10:00 a 14:00
Cabichen Junio 01 09:00 a 15:00
Cabichen Junio 15 10:00 a 13:00
Xbohoh Junio 29 10:00 a 13:00
xpambiha Julio 27 08:30 a 12:00
Sucopo Agosto 24 08:00 a 12:00
Xbohoh Septiembre 28 08:00 a 12:00
Cabichen Octubre 19 10:00 a 13:30
Cabichen Octubre 26 08:30 a 12:00
Sucopo Noviembre 09 10:00 a 16:00
Sucopo Diciembre 07 08:00 a 12:00
xpambiha Diciembre 14 10:00 a 13:00
    
```

Figure 22. Table: fechasres.db

Table 10. Table: resultados.db

Field	Data type	Description
Comunidad	String	Denotes the community where the patient belongs.
Ape	String	It is required to know the range where the name of the patient is.
Nombre	String	Includes the patient's full name who received the result of the test.
Fecpru	String	Date on which the patient was tested.
Carmue	String	Characteristics of the sample. The assigned values can be: Adequate, limited or inadequate. If the value of this field is inadequate, then the patient must again be tested.
Diacit	String	Diagnostic testing, which may take the following values: Negative: When it is not possible to identify cellular alterations related to inflammation, infection with human papilloma virus, dysplasia or cancer. Negative with inflammatory process: when it is possible to identify in the slides inflammatory cell changes, and invasive cancer: This refers to squamous cell carcinoma.
Haladi	String	It may take one or more values such as: HPV image, image of the herpes virus, Chlamydia, Trichomonas, bacteria, fungi, polymorphonuclear and Others.
Repest	String	It only has two values: Yes or No, to retry the test or do not.
Motivo	String	In case you have to perform the test again, it is necessary to indicate in this field the reason why the test will be carried out again. It can take any of the following values: Abscense of metaplasia cells, mucus Absence, Absence of endocervical cells, Foil broken, thick smear, blood sample, wrong sample and others.
Foto	String	Includes a photograph of the patient

Comunidad	String	Nombre	String	Fecpru	string	Carmue	String	Diacit	String	Haladi	String	Repe
Sucopco AE	Camal Uc	Reyna	3/23/2005	Adecuada	Negativo	Bacterias	No	*	*	*	foto1.gif	
Sucopco AE	Ek Castro	Luz	3/23/2005	Adecuada	Negativo	Otros	No	*	*	*	Luz.gif	
Sucopco FJ	Gómez López	Norma	3/23/2005	Inadecuada	*	*	Si	*	*	*	Norma.gif	
Sucopco FJ	González Eúan	Nahielly	3/23/2005	Adecuada	Negativo	Otros	No	*	*	*	Nahielly.gif	
Sucopco KO	May Balam	Victoria	3/30/2005	Limitada	Displasia	leve	Imagen	VPH	No	*	*	Vict
Sucopco KO	Mendoza Caamal	Miriam	3/30/2005	Adecuada	Negativo	Otros	No	*	*	*	Miriam.gif	
Sucopco KO	Nieves Cruz	Citlali	3/30/2005	Adecuada	Negativo	Bacterias	No	*	*	*	Citl	
Sucopco PT	Pech Puc	Jeane	3/30/2005	Adecuada	Negativo	Tricomonas	No	*	*	*	foto1.gif	
Sucopco PT	Perera Góngora	Glendy	3/30/2005	Inadecuada	*	*	Si	*	*	*	foto1.gif	
Cabichén AE	Aké Braga	Alba	2/16/2005	Adecuada	Negativo	Otros	No	*	*	*	foto1.gif	
Cabichén AE	Arjona Marfil	Eva	2/16/2005	Adecuada	Negativo	Negativo	No	*	*	*	Polimorfonucleares	No
Cabichén AE	Chablé uitz	Rosa	2/16/2005	Inadecuada	*	*	Si	*	*	*	foto1.gif	
Cabichén AE	Chan Xuluc	Rita	2/16/2005	Inadecuada	*	*	Si	*	*	*	foto1.gif	
Cabichén AE	Ek Cocom	Norma	2/16/2005	Adecuada	Displasia	leve	Bacterias	No	*	*	foto:	
Cabichén PT	Pomol Tuz	María	23/16/2005	Adecuada	Displasia	leve	Bacterias	No	*	*	foto:	
Cabichén PT	Sánchez Ramírez	Cecilia	23/16/2005	Adecuada	Negativo	Bacterias	No	*	*	*	foto:	
Cabichén PT	Tec Can	Marbella	23/16/2005	Adecuada	Negativo	Tricomonas	No	*	*	*	foto:	
Cabichén UZ	Uc Chan	Rita	23/16/2005	Adecuada	Negativo	Tricomonas	No	*	*	*	foto:	
Cabichén UZ	Yam Ek	Gilda	23/16/2005	Adecuada	Displasia	grave	Imagen	VPH	No	*	*	foto:

Figure 23. Table: resultados.db

5.3. Development and Implementation Tools

For the development of the system SICACE, the following tools were used, both software and hardware: A handheld device (Palm IIIc), a Wideray device, a computer with Palm Desktop Software for Palm OS version 3.0 or higher, an html editor, the Wideray Developer Kit and Macromedia Fireworks MX 2004.

To implement the system SICACE a handheld device (Palm IIIc) and a Wideray device were used.

6. CONCLUSIONS

This paper presents the development of a system which through the use of information and communication technologies based primarily on wireless distribution of rich mobile multimedia content, assists in the prevention and control of Cervical Cancer. Beforehand, generated static content was uploaded to a WideRay Jack service point, from which the content could be downloaded via infrared connection with the use of a handheld.

The service was first tested experimentally in the laboratory and was subsequently implemented and unloaded (in a controlled environment) by users of the CDD and doctors in the community, who reported being comfortable with the use of it and also expressed approval of the information contained. The next step will be to implement the system in a real environment and make an evaluation.

This work will reduce the risk of misplacing information when having to travel to communities carrying it (remember that the current way of working is to bring the printed documents that contain the results of the patients). Now it is only necessary to take the Palm that contains the information that you have downloaded in the WideRay device to be placed in the CDD.

The system presented can be further improved by adding features, such as the implementation of the signature of the person responsible for analyzing the testing of patients. Another function is to include information about the patients who are required to be tested again. It is possible to implement a function to save the name of these patients in a database, so the doctors and medical staff have in mind the month they have to locate the patient to make her test again. This way, doctor and CDD staff will have a better control of Cervical Cancer in the communities in the eastern region of the state of Yucatan, among others.

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