WIRELESS CONTEXTUAL INFORMATION ELECTRONIC SYSTEM FOR PEOPLE WITH DISABILITIES

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Abstract In this work we present a prototype of two electronic devices for providing relevant information to people with disabilities, such as the blind, deaf or elderly, in public environments (railway stations, airports, etc). Usually, this kind of collectivities is discriminated in terms of information access. Most of the public information is in text panels, monitors or traffic signals. The rights of these people are easily forgotten. With this work we try to make an effort in this direction facilitating the information access to these groups. In order to avoid them feeling different we try to adapt the transmission to standard portable devices. We based the work on bluetooth technology. Concerned by costs, in order to popularize this technology, our designs use off-the-shelf components. We also propose a new device to avoid the proximity marketing spam so that these people don't suffer its consequences.

1 INTRODUCTION

Lately, there is an increasing interest in ICT for People with disabilities. (Busby, G. Whitehouse, D. 1997), (Busby, G. 1997) (Blanchard, S.M. Rohrbach, R.P. 2000).

Blind, deaf and elderly people are usually discriminated in public environments, such as railway stations or commercial centres, when real time information about transport timetables, commercial advices or security warnings is being emitted (Karim, N.A. Nwagboso, C., 2004). Something similar occurs in signalling for urban purposes. This collectivity can not be informed instantaneously and they are unaware about eventual dangerous situations for them such as holes or wet pavements. Signaletics is a discipline susceptible to be completed with new developments based on wireless beacons. In this work we present a general purpose prototype of sender and receiver to be used as wireless beacons based on an off-the-shelf Bluetooth chipset. In fact, the receiver can be substituted by Bluetooth-equipped commercial mobile phones or *PDA*s.

In this sense, some airports and railway stations have arranged systems based on *sms* mobile technology. People with disabilities have to reach a special information desk to borrow a mobile phone explaining her destination and the rest of the travel information. When the transport is close to departure, one *sms* is sent to the mobile. However, people can read signals, can watch *tv* monitors or, in some cases but less now, can listen to advices and messages.

We propose to incorporate wireless beacons to the information system of monitors or panels for sending relevant information to the portable devices.

In this paper we only present the electronic devices needed for a basic communication. One of our major objectives is the development of low-cost, low-consumption and small devices using off-the-shelf electronic modules.

2 SYSTEM ARCHITECTURE

The system consists of a sender device and a receiver device. Both can exchange information through the Bluetooth protocol. Moreover, the receiver can send the information to the mobile or to the PDA of the disabled user.

Figure 1 shows the basic modules of the architecture. A receiver beacon could suffice, and is

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cheaper than standard portable devices such as mobile phones or PDA's.

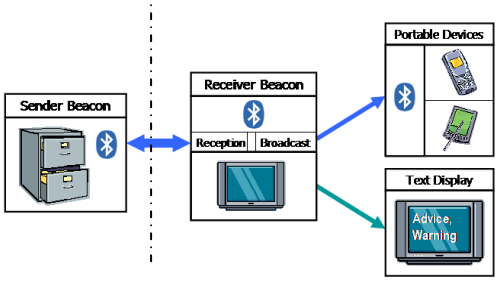

Figure 1: Basic components in the system.

The *sender Beacon* is equivalent to the monitor or panel information system in airports o railway stations. It is also equivalent to a warning advertisement or traffic signal for people in any street or in any commercial centre.

It stores relevant information messages in different data formats (audio, text or image) and transmits them to the receiver beacon.

Receiver beacon consists of a PIC microcontroller, a Bluetooth module and a LCD for showing text messages.

The *receiver beacon* communicates with the sender beacon via the Bluetooth protocol and, optionally, sends complex messages, in audio or image data format, to the portable device when it is present.

Actually, the receiver beacon could be optional whenever a portable device is available. The messages can be sent by the sender beacon to the portable devices directly, but, we have found several advantages to incorporating this small device.

Firstly, as mentioned above, it is cheaper than a mobile phone or PDA. In the case of deaf or elderly users, the receiver beacon is enough for receiving and viewing information. These users don't need to afford an expensive portable device for taking advantage of this technology, something especially interesting in developing countries. In the case of blind users, audio reproduction is currently being added to the beacon.

Secondly, the *receiver beacon,* when used together with a standard portable device, can filter the messages reaching the device. It is particularly interesting for avoiding proximity marketing spam.

3 RESULTS

3.1 Hardware Implementation

Simplicity criteria have been applied in the design of the sender and receiver beacons. Next figure summarizes the hardware subsystems of the sender.

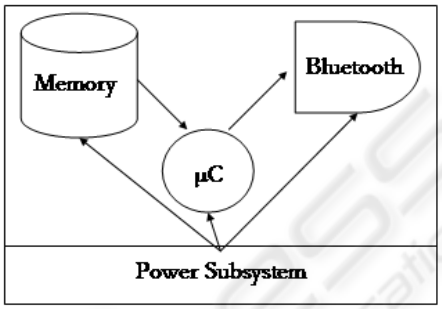

Figure 2: Internal beacon design.

A PIC16F88 (Microchip Inc., Arizona.) is the microcontroller of choice. It responds to a RISC internal architecture and contains a UART (Universal Asynchronous Receiver Transmitter) which is used to connect with the Bluetooth chipset. We highlight the low power consumption, only 0,8 mA at 4MHz and 3,7V. This voltage is the same for the Bluetooth chip so we can simplify the power subsystem.

The EZURIO Bluetooth Chipset (EZURIO Ltd.) is used because it allows a feasible configuration with AT commands, supplied through the UART. Next figure shows the basic connections for this purpose.

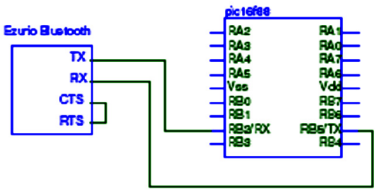

Figure 3: µC – Bluetooth connections through UART pins.

The Memory is a Flash model with a capacity of 512KB divided in 8 sectors and has an access time of 90ns. Its capacity is enough for storing 2 minute messages in mp3 audio format. The addressing mechanism was implemented with three 8-bit cascaded counters using only 19 outputs (the least significant outputs).

The flux control was implemented with an XON/Xoff protocol.

Once the development of the sender was finalized, we redesigned the receiver with a memory subsystem based on EEPROM 24LC512 (64KB and I2C protocol) and adding a LCD Display (Hitachi 44780).

The prototype of the receiver is shown in the next figure.

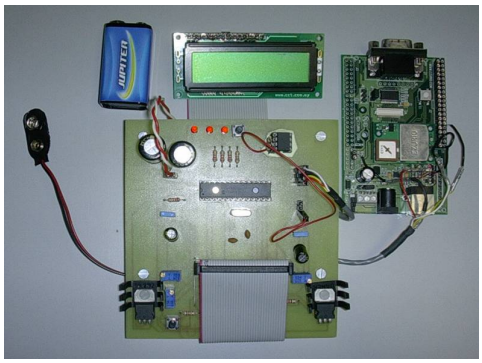

Figure 4: The receiver beacon prototype.

To facilitate the wire connection to the Bluetooth chip, and to test the system, we use the Ezurio Bluetooth development chip. We can see it on Figure 6, on the right. The final prototype has only the Bluetooth chip.

The final result allows the reception of chain characters in the receiver beacon or files in different formats (audio or image) in a PDA or in a mobile phone as shown in the next figure:

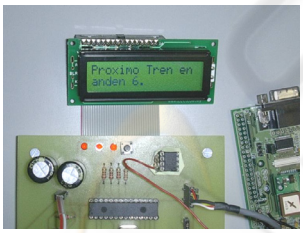

Figure 5: Receiving text and files in the LCD and in the PDA, respectively.

3.2 Software Implementation

The *sender beacon* has to run two main tasks in its PIC microcontroller. Firstly, the PIC must configure a serial communication through its UART. Once the UART is fully operative, the PIC must configure the Bluetooth module by sending AT commands.

In this prototype, the memory was previously loaded using a PC and a Xon/Xoff protocol, as mentioned above. Further developments will allow to load the memory through GSM/GPRS messages.

The files stored are sent to the portable device or the receiver beacon following a simple protocol described below:

- The receiver beacon waits for an external enquiry.
- A Bluetooth connection is established.
- The PIC reads the files from memory and sends them to the receiver beacon.
- When it finishes the connection is released.

The receiver beacon software behaviour is very similar and it is described below:

- The UART and the Bluetooth module are configured in a similar way as in the sender beacon. The receiver beacon is always discoverable. Moreover, the LCD must be configured for files in text data format.
- When the connection between beacons is established, the receiver beacon downloads the file.
- If it is a text file, it is displayed in the LCD. However, if the file data format is for audio or image, the receiver beacon tries to send it to its corresponding PDA or mobile phone.

As can be observed, this second beacon can easily filter spam messages from other devices, in particular, those used in proximity marketing.

All the code was developed with a minimum number of instructions to be stored in the 64KB memory of the PIC.

4 CONCLUSIONS

We have shown the feasibility of a low-cost wireless system for assisting people with disabilities such as blind, deaf or elderly people. A more acute design would allow mass production.

The low cost of the receiver/sender is summarized in the next table:

Table 1: Material Costs.

EZURIO BISMII	22€
Flash Memory/EEPROM Memory	3,45€
8-bit Counters	3,00€
µC PIC16F88	3,13€
LM7805 (Voltage Regulator)	0,60€
Resistors, capacitors, etc	2,50
LCD Display	6€
	≈40€

Further work is in course in order to upload contents to the sender beacon through GPRS. This would allow the contents to be broadcast through a central web-based server.

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