Geolocation in a PicoRadio Environment

Project Outline

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1 Overview

The Berkeley Wireless Research Center has been investigating wireless communication issues in various projects [3, 2]. Different radio designs have been implemented to show the feasibility of single chip CMOS radios.

PicoRadios are small, low cost digital radio transceivers that allow flexible communication at a relatively low bitrate and over short distances. Possible applications are to be found among distributed sensor networks, personal communicators, access and remote control. The PicoRadio network is comprised of PicoNodes that form the configuration of the network.

With the extended capability to define a nodes current geographic position, numerous new applications arise.

1.1 Present Developments at BWRC

The Infopad Project [2] has led to the development of a Strong Arm SA1100 based mobile computing platform that supports wireless communication on a 2.4 Ghz ISM band, the Intercom [4]. Along with the development of dedicated low power silicon this platform will be used as a demonstrator for the PicoRadio concept

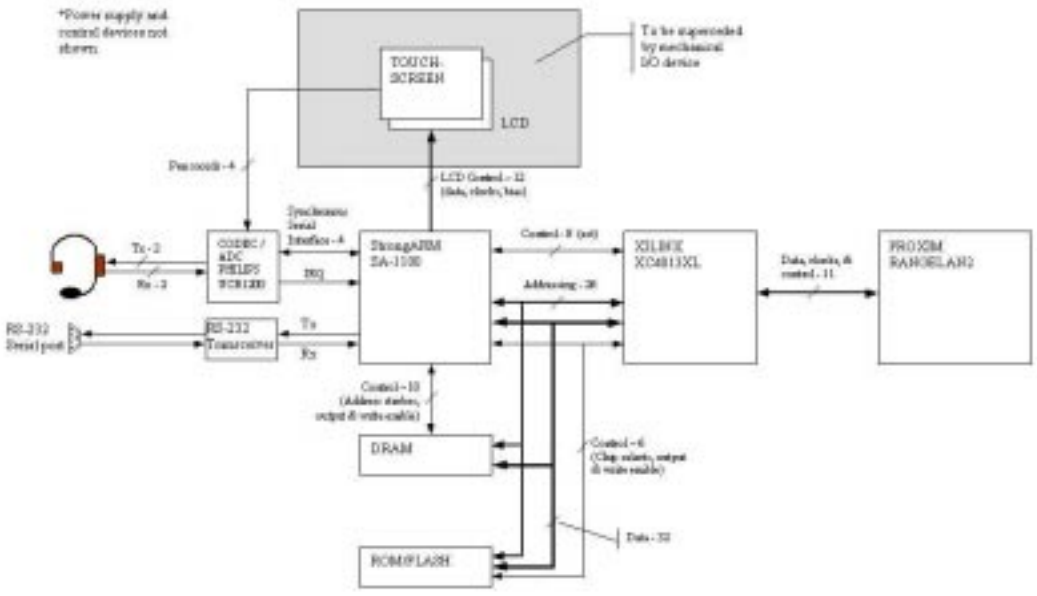

Figure 1: Intercom Block Diagram

1.2 Goals for PicoRadio

A PicoNode is a single-chip implementation of a tiny, very low power, configurable radio.

- Small form factor
- Low system cost
- Energy efficient
- Range 3-10 meters
- In- and outdoor usage
- 16 user per cell
- Low bitrate compared to other networks
- Selfconfiguring, multihop network
- No special infrastructure necessary
- Geolocation capability for every node

Sub-elements of a PicoNode include an embedded microprocessor, a reconfigurable microprocessor, reconfigurable logic e.g. FPGA, a dedicated (custom) digital signal processing block, and an analog block with RF, sensor interfaces, etc (GPS). These blocks will be interconnected in a potentially different way for each type of PicoNode.

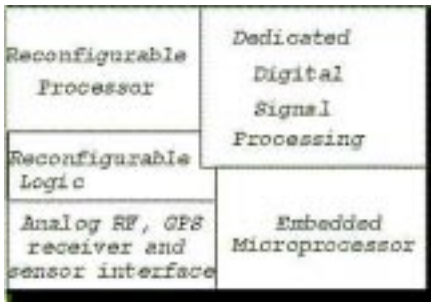

Figure 2: PicoNode System Partitioning

1.3 Application for PicoRadio

Possible applications for PicoRadio range from sensors to communications and remote controls.

Automotive as well as home sensor networks monitoring environmental data, industrial monitoring for status or low datarate process information or even logistics application for generating inventories are basic sensor applications. For simple communication purposes and activators like baby phones, remote controls, (personal) alarm systems etc. these PicoRadio networks would proove very useful.

If a node can explicitly determin it's geographical position an alarm signal would be set off with it's current location, distributed sensor networks would not need to be configured before or during use, acces control systems would engage with the approach to the control station.

2 Workschedule

The research for outlined is to be conducted during August to November 1999.

1. Explore possible navigation scenarios along with PicoRadio communication
    - Narrowband communication (CDMA/TDMA)
    - Impulse radio communication (Spread Spektrum) [5]

2. Adapt a GPS [1] system to be used with the Intercom
    - Hardware integration
    - Selection of antenna
    - Software Driver for Intercom OS
    - Performance measurements
3. Indoor navigation
    - Define possible scenario for indoor position acquisition
    - Set up test environment for indoor position acquisition
    - Verify indoor position acquisition

3 General

The work outlined here will be presented in a talk at the Berkeley Wireless Research Center and at ETH Zürichs Electronic Laboratory and documented in a written report.

References

[1] *µ-blox GPS-MS1, GPS Receiver Module Datasheet*, 1999.

[2] R. Brodersen. A multimedia communication system providing wireless access (infopad). Department of Electrical Engineering and Computer Sience, University of California at Berkeley, 1995.

[3] R. Brodersen. Rf modems for personal communications systems. Department of Electrical Engineering and Computer Sience, University of California at Berkeley, 1995.

[4] Berkeley Wireless Research Center. http://bwrc.eecs.berkeley.edu/research/intercom_group/default.html.

[5] Fleming R. and Kushner C. Low-power, miniature, distributed position location and communication devices using ultra-wideband nonsinusoidal communication technology. Technical report, Aetherwire Location Inc., 1995.