Title: Cell Phone Audio Controlled Point of Sale
Students: ECE, ECE, ECE
Topics: Mechanical Design, Communication Protocols, Microcontroller Coding, Wireless, PC Application Programming

Description
The world of wireless connectivity is getting complex (Wi-Fi, Bluetooth, 3G, etc.). This project steps back to the simple world of audio interfaces to bypass the myriad of phone models and wireless technologies on the market to accomplish a very simple transaction. The idea is to use a tone-generator application to send a sequence of tones over the phone network to your cell phone speaker. When the speaker is held close to a point of sale application (such as a parking meter, a DVD point of sale, a pay-n-park location, etc.) the sound is transmitted to the point of sale device. A microphone picks up the sound and a microcontroller with DSP algorithms decodes the signal. A successful decoding of the signal results in minutes added to the parking meter, or a credit to the DVD dispenser, or a ticket from the pay-n-park machine.

A typical application begins with a user approaching a parking meter dial an 800 number from a cell phone. An Interactive Voice Response (IVR) system would use caller-id to authenticate the account. If this were to fail, the user is prompted for a phone number and a password. After this, they would enter in (using the phone keypad) a numerical identifier or serial number for the parking meter. The IVR system would determine the type of device as a ‘meter’ and the user is prompted for the amount of money to add to the meter. The user is instructed to hold the phone speaker up to the meter, and the cell phone uses audio tones to communicate with the parking meter. The parking meter confirms the transaction with an audio tone, and the call would terminate.

Absolute Minimum Requirements
- Demonstrate tone decoding at a distance of 3 inches from Cell Phone speaker with a 99% success rate
- Research and prototype various command tone encoding and decoding algorithms (DTMF, FSK, OOK)
- Research and prototype confirmation tone encoding and decoding algorithm
- Research ways to address security concerns that would apply to this medium. For example, how to protect against replay attacks, spoofing the call source or other things the Black Hats could exploit
- Determine and demonstrate optimal baud rate in clean environments and noisy environments including roadside, cafeteria, fire-station siren, music, and senior expo hall.
- Working prototype for senior expo where anyone not on the project team can use their own cell phone, place a call, hold their speaker next to the prototype, send a tone that contains at least 100bits of information, and see the resulting decoded information on the Display and/or an actuator responding to the information.
- System must be cost effective and usable by technologically challenged

Desired Features
- “Point of Sale” device
- Microcontroller with DSP algorithms for audio filtering, tone decoding, audio noise rejection
- Display (and optionally an actuator to add credit to an imaginary meter, strike a relay, turn on an LED, etc.)
- Real time clock time (i.e. meter runs out of credits, LED turns off)
- Speaker for confirmation tone or tones
- Microphone to record sounds from cell phone speaker
- Battery
- Energy harvesting (i.e. solar, RF energy, audio, etc.)
- Environmentally rugged (dust, water)
- IVR application
- Tone generation in same range as voice. The idea is that the different cell phone technologies compress signals and their algorithms are all optimized to allow clear transmission of human speech
- Receives confirmation tone
- Simple application to receive incoming call, generate tones, and then hang up