.:: Cell Phone Tracking ::.

Purpose:

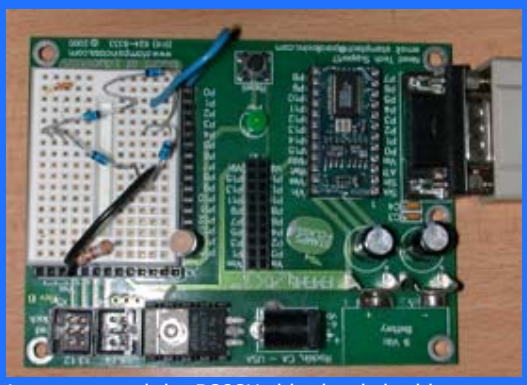
The purpose of this experiment is to demonstrate the ability to track a cell phone's location electronically. Cell phones are being used all the time now by people of all ages and almost all average income American carries around a cell phone with them at all times. We even occasionally hear them ringing at theaters and in classrooms. Cell phones are two way radio transmitters that work by connecting to a nearby tower and exchanging data. Despite the FCC's limitation on maximum power output of a cell phone, they are still able to connect with towers miles away at UHF frequencies and produce enough RF power to supply those fancy replacement flashing antennas with energy. Because cell phones put out a constant RF output (sometimes pulsed) they can be tracked using the tower triangulation method where the network administrators can find your precise location with their administrative network access. Unfortunately most of us don't have access to the network's administrative features. This experiment will demonstrate an alternative method for tracking a cell phone.

Materials:

- Cell Phone
- BASIC Stamp 2 SX BOE
- UHF RF Diodes
- 330 Ohm Resistor
- LED

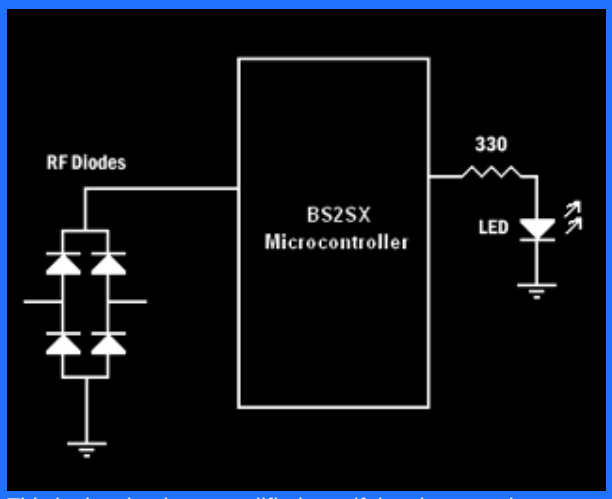
Data:

I used this Nokia cell phone (with internal antenna) for the experiment. This phone has a feature that initially transmits lots of power and then cuts down slowly until it cant anymore without losing reception. This helps save power in the phone but makes detection more difficult without signal amplification.

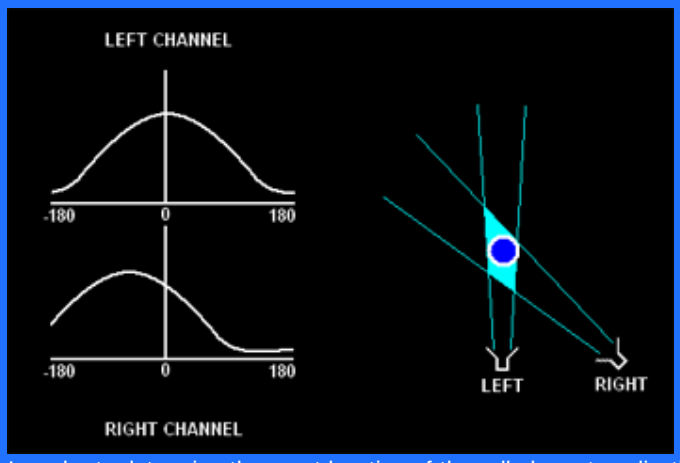


I programmed the BS2SX chip that is in this prototyping board. It determined if the pin that was connected to the RF bridge rectifier was TTL high. If the pin was high then an LED would be toggled from green to red. I used the following source code to do the trick.

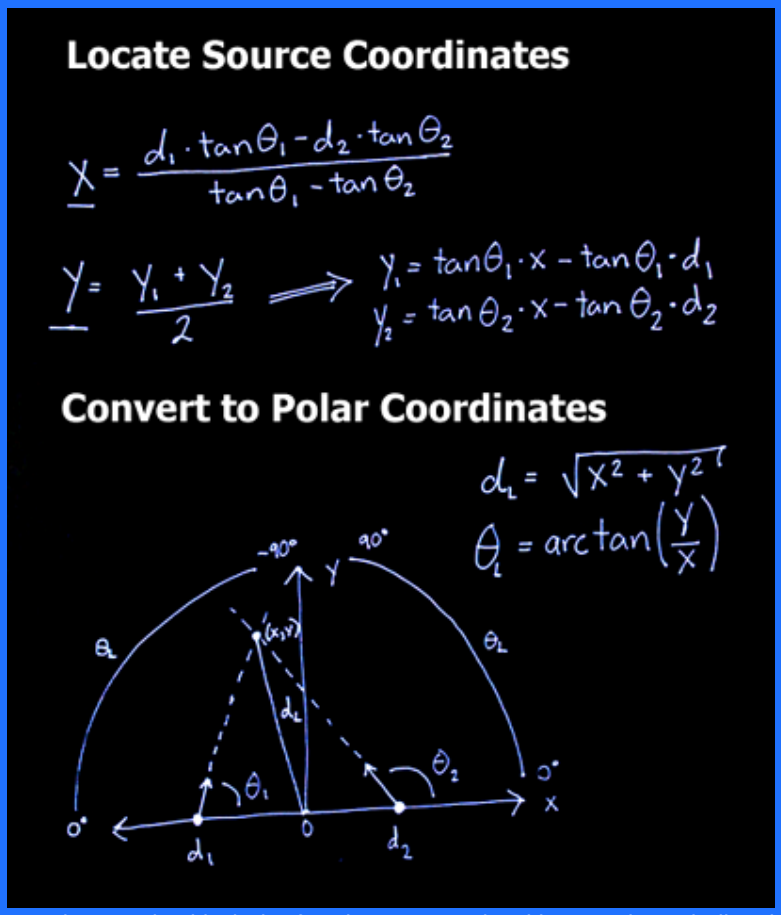
```
'{$STAMP BS2sx}
input 0
loop:
if IN0 = 1 then yes
if IN0 = 0 then no
cont:
goto loop
yes:
low 15
high 14
pause 100
goto cont
no:
low 14
high 15
goto cont
```



This is the simple unamplified true/false detector that senses the cell phone when the RF bridge rectifier sets the microcontroller input to high.

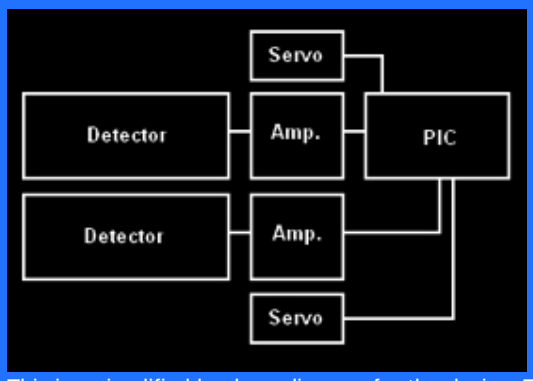


In order to determine the exact location of the cell phone two diectional scanning detectors must be used with signal amplification for long range detection. An A/D converter should also be used with the microcontroler. The two detectors rotate and graph reletive power detected over rotation angle. If only one cell phone is close by, then both detectors will sense the signal and will each provide a direction. The two direction angles can be converted to polar coordinates which will provide one direction and a distance from the detectors to the cell phone. Knowing the detector gain one can estimate the uncertainty of the result vector.



In order to make this device function one must be able to mathematically calculate the signal source location from the collected data. Both sensors will be at peak at a certian angle theta-1 and theta-2. The formulas I dirived in the above graphic allows you to plug in the x coordinate location of each sensor and their angles at which they peak. The formula then tells you the x and y coordinate where the two rays intersect, which is where the source is. If you proceed to the next formula you can then convert the coordinates into a polar coordinate or vector. Notice that the angles in the polar coordinate are not the same as the angles used in theta-1 and theta-2.

Going from right to left the angle starts at 0 degrees then becomes 90 degrees at the top then suddenly becomes -90 (actually 90 or -90 degrees is undefined) then goes back down to 0 degrees as it reaches the left side. In the first formulas theta-1 and theta-2 start with 0 degrees at the right, go up to 90 degrees, and then becomes 180 degrees all the way on the left.



This is a simplified hook up diagram for the device. The A/D converter isn't shown.

Conclusion:

The experiment shows that stand-alone devices for cell phone tracking are not difficult to construct by someone with programming and electronics background. These devices may infringe upon our privacy as the entire world becomes connected via cell phones. Though this tracking technology can be used for evil it can also be quite useful for hostage situations when there is no visibility but the bad guy is using a cell phone. The snipers can then easily pin point the location of his cell phone and fire a few rounds to the right and left of the phone.