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IPRO 344: Improving Audio Efficiency in Mobile Devices and Intercoms

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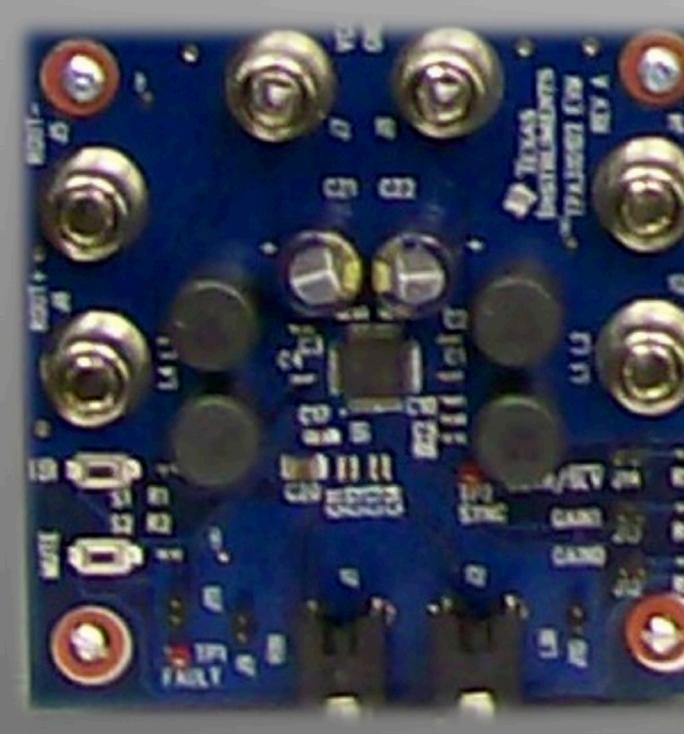Woochan Kim   Roozbeh Shegarfi
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Objective: The fall 2009 IPRO 344 team had set forth the following goals throughout the course of the semester:
- Reconstruct Server Side Module (SSM) to be more user friendly
- Improve testing methodology
- Evaluate performance by determining the speech transmission index (STI) through the system
- Collect comparative real-world sample from local fast food chain
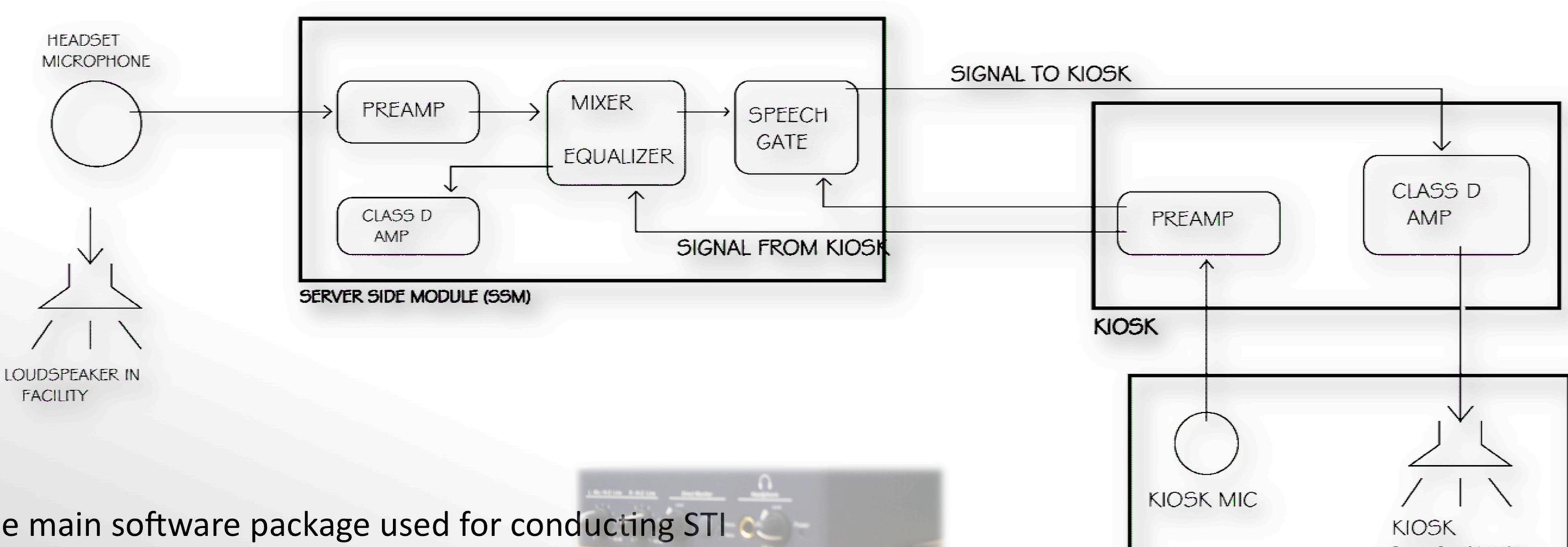- Conduct several ambient noise tests using ANAA

Class D Amplifier
Class D audio amplifiers are highly efficient due to their rapidly changing states. At any given moment, a class D amp is either switched fully on or off, in which the amp does no drain energy from the source. Energy is used during the transition period between states, thus reducing the overall power consumption. This has allowed high-power amps to be constructed without the need for a heat sink. This also allows for a reduction in size of the amplifier. Class D amplifiers are desirable for use in our application since they are low cost, produce excellent sound quality, and are energy efficient.
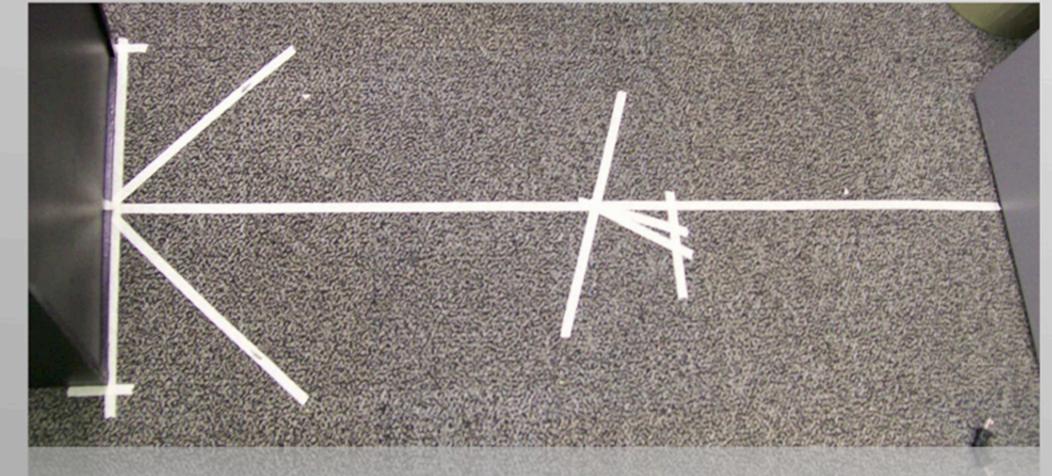
Testing
LexSTI was the main software package used for conducting STI measurement tests. LexSTI allows for a signal to be played through the system, in which then the program calculates the return signal's STI value, a number ranging from zero to one, one being perfect transmission. Several parameters were tested this way, such as, microphone depth and type, and angle of the kiosk.
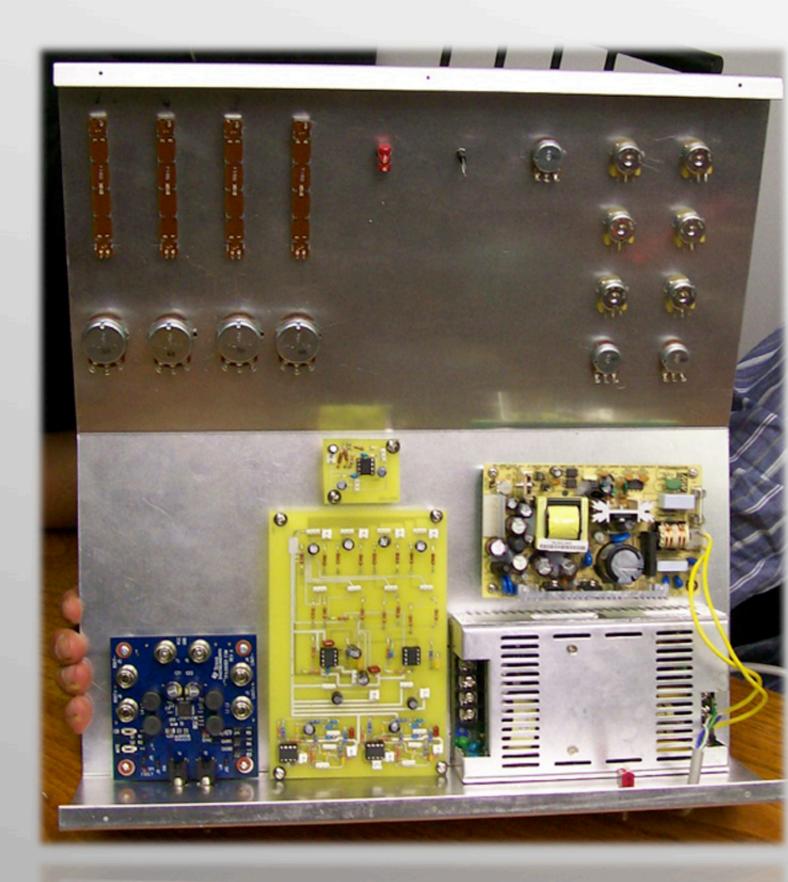
Ambient noise tests were conducted using ANAA techniques. Several parameters were also tested such as the angle of the kiosk, distance of the kiosk with respect to the noise source, and the type of ambient noise.

Circuits and Signal Processing
Another main goal of the team this semester was to redesign and rebuild the SSM. The goals were to make the module more clean looking, user friendly, and most importantly, easier to use.
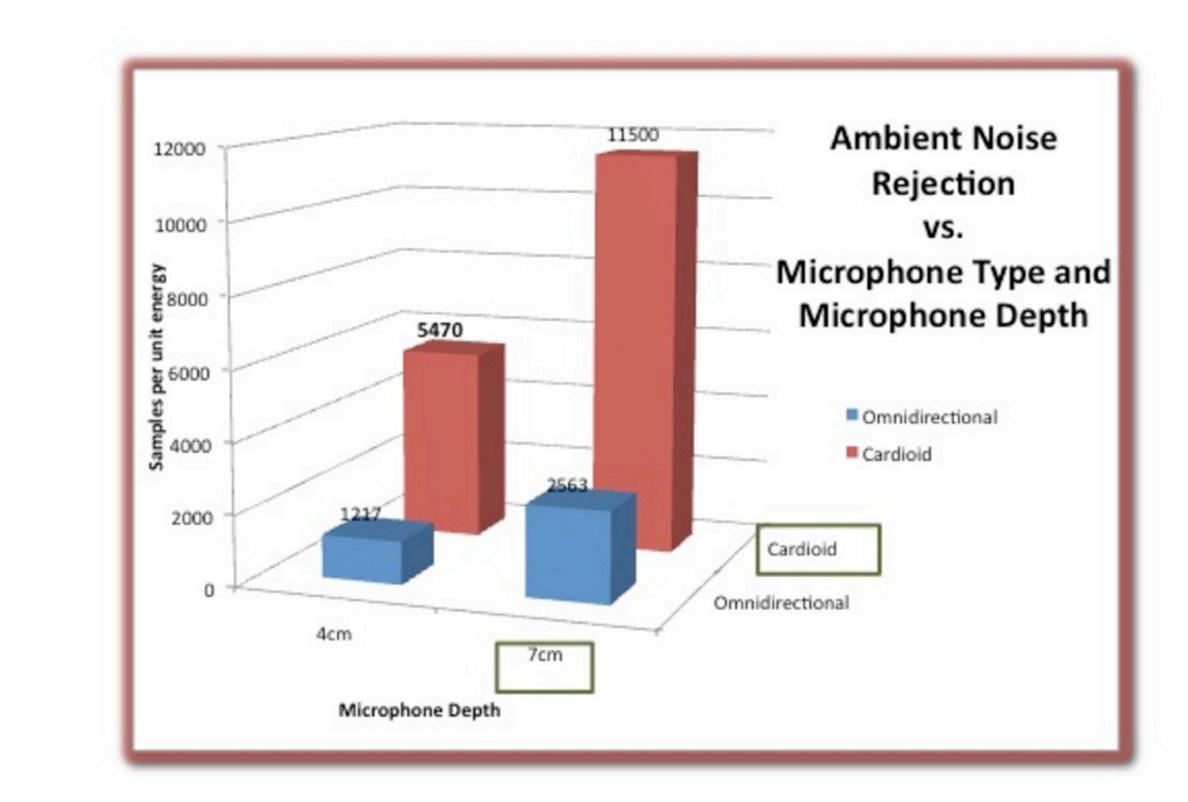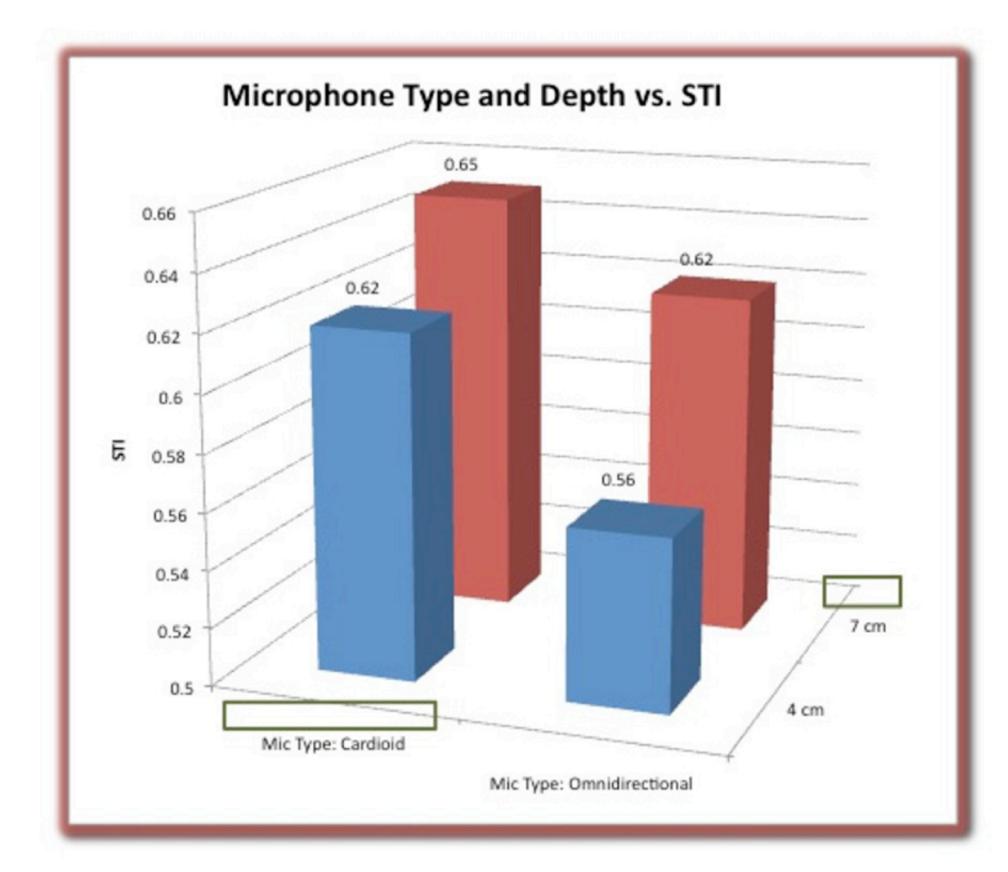
The rebuilt SSM allows workers on the inside of the restaurant to adjust the levels of the signal to achieve maximum quality assurance. The module allows for ease of volume, gain, and frequency adjustments whenever necessary.
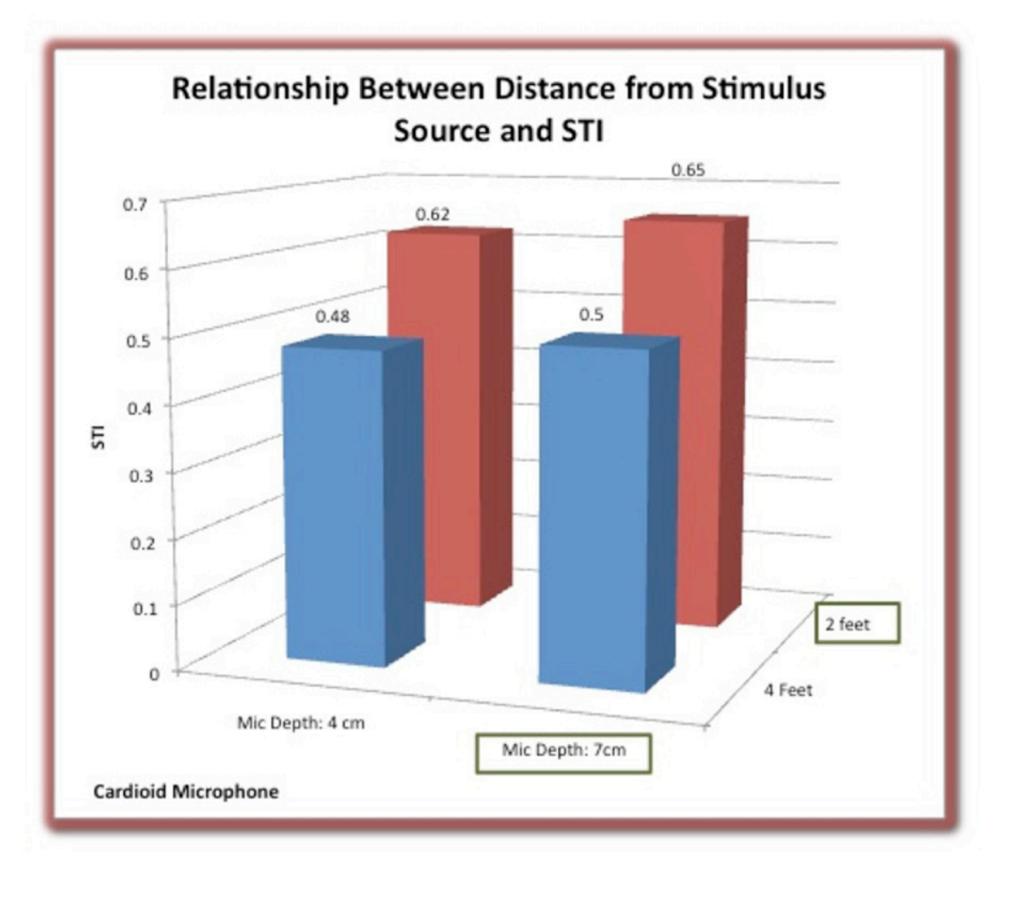
Results
After analyzing the STI and ANAA tests, there are specific relations between the sound quality and variables tested. Some of the more interesting results are represented in the following graphs. The graph to the right shows how ambient noise rejection is affected by microphone type and depth. It is easily seen that the cardioid microphone at a depth of seven centimeters rejected the most ambient noise.
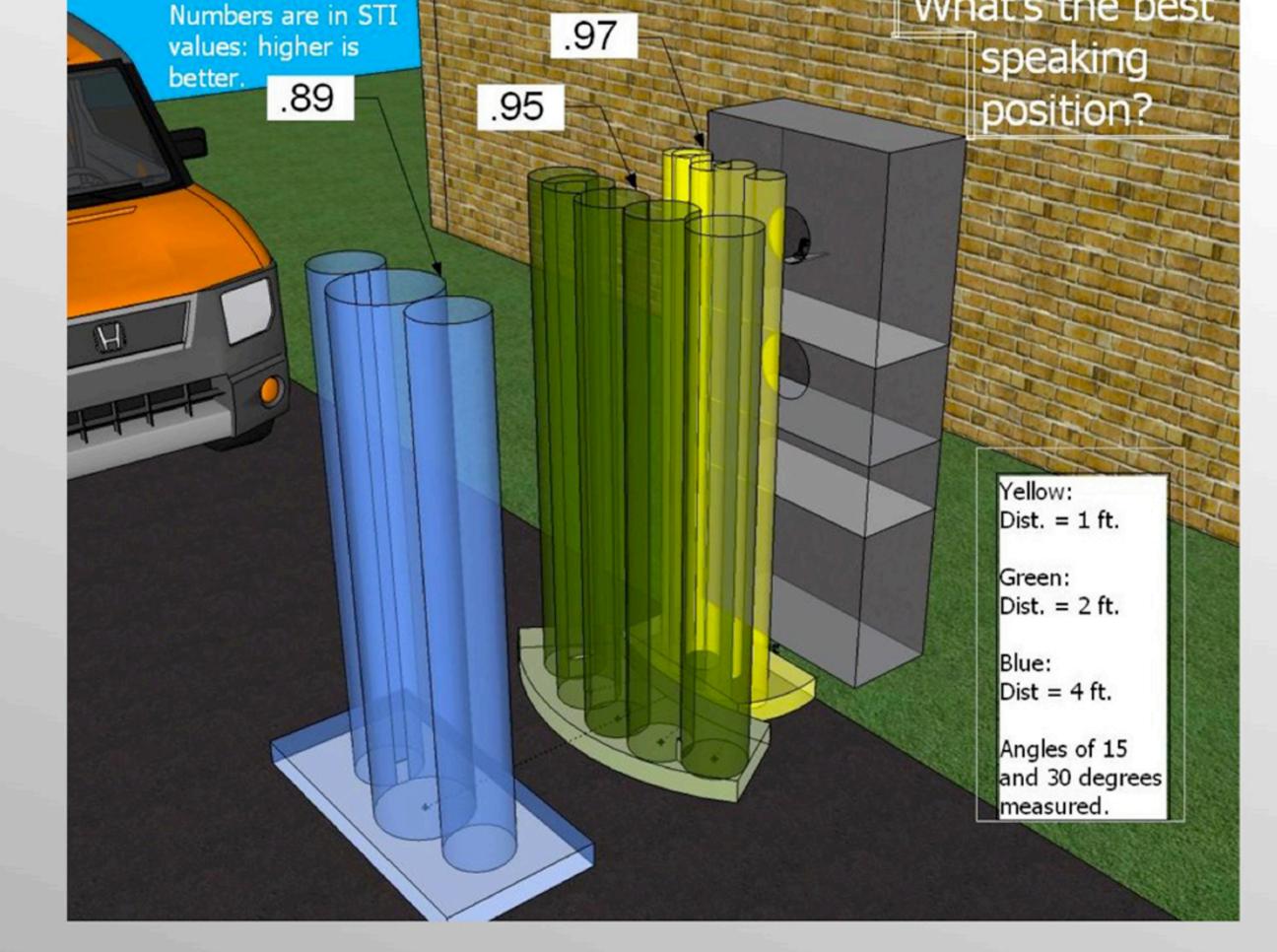
The graph to the left shows how microphone type and depth affect the STI value of the incoming signal. From the results obtained, the cardioid microphone at a depth of seven centimeters had the highest STI value, while the omnidirectional microphone at a depth of four centimeters had the lowest.

To the right, this graph represents the relationship between the distance of the microphone and kiosk with respect to the sound source. The highest STI value is obtained at a microphone depth of seven centimeters and at a kiosk distance of two feet.

The image on the left shows how the distance from, and angle with respect to the kiosk affect STI.