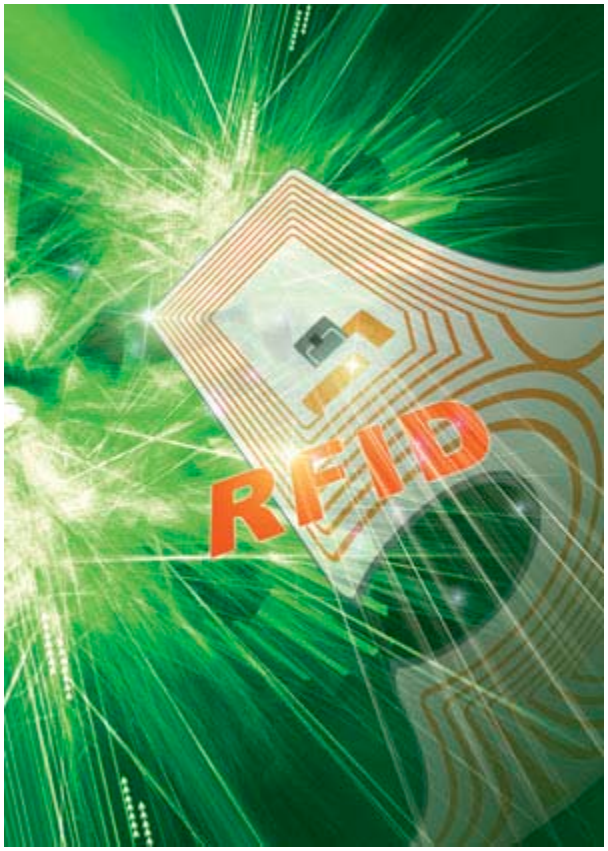

RFID ANTENNA DESIGN AND SIMULATION

EE-Lab Summer 2010
Internship Project

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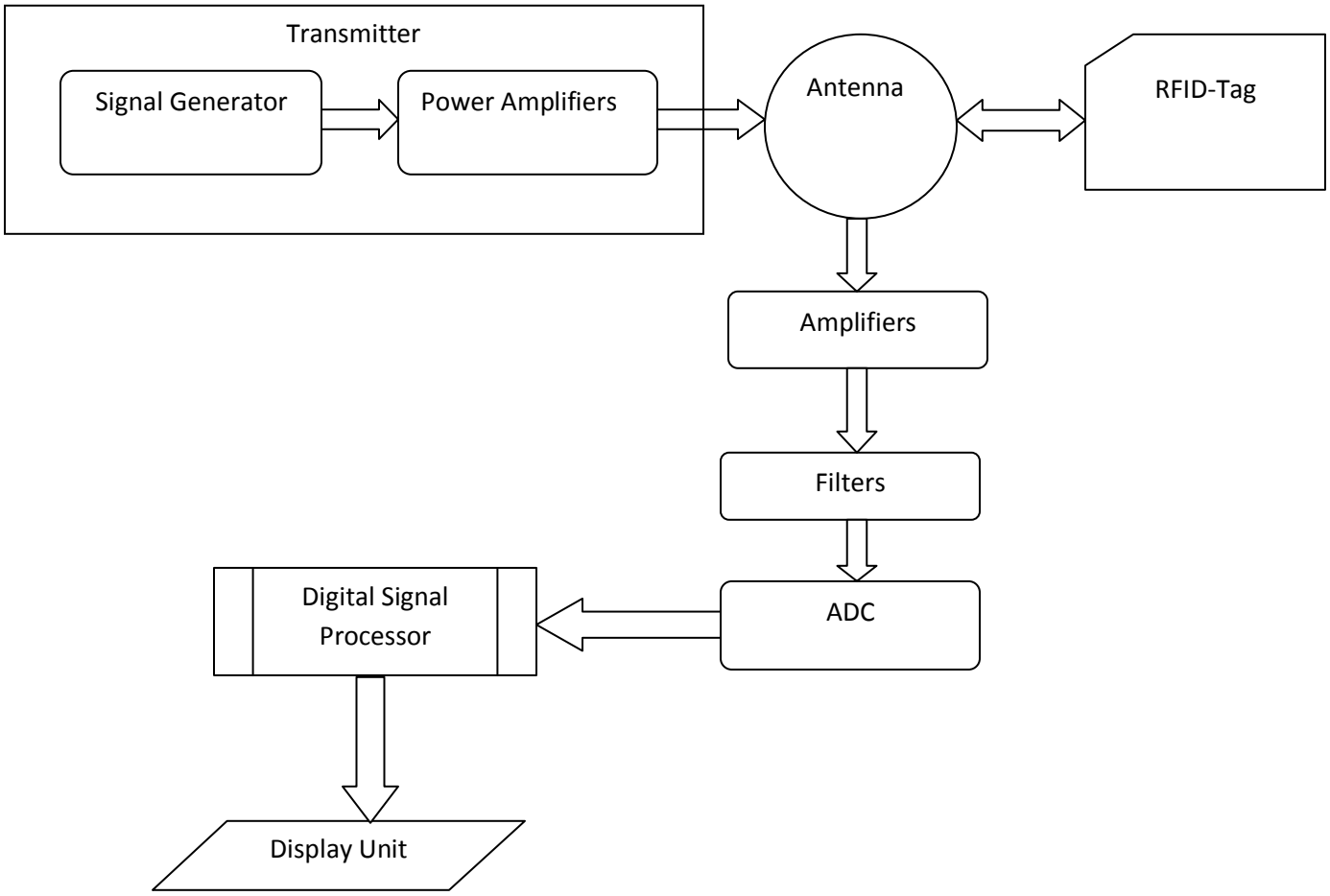
Radio Frequency Identification (RFID) is an automatic identification system. An electronic tag is implanted into an animal or attached to any product for identification purposes. The tag can be read from several meters away and even a direct line of sight is not required. This technology has revolutionized our world from highways to superstores, from stadiums to hospitals.

Block by block description:

An RFID system consists of following main blocks:

- Transmitter
- Antenna
- RFID tag (active or passive)
- Amplifier/Filters
- Digital Signal Processor
- Output Display Unit



Transmitter:

This part includes a signal generator, which generates a sine wave. This carrier wave is amplified, by current amplifiers so that it would have enough power to be transmitted and scattered back from the *Tag*.

Antenna:

The signal generated by Transmitter part is fed to an antenna which propagates it into the air. The design and size of antenna may vary depending on the system parameters, such as the required frequency band and impedance of transmitter.

RFID Tag:

The RFID Tag is implanted on the object to identified, e.g. ID card of a student, a commodity in superstore or a vehicle with e-tag. This tag serves in a similar fashion to a barcode. Tags can be ACTIVE or PASSIVE. An active tag houses its own power supply to send back signals however a passive tag relies on the power of received signal from transmitter for its operation. This signal is modulated and sent back (scattered) to the base in a specific way depending on the data stored on the tag.

Amplifier /Filters:

The signal received from tag is the carrier wave, modulated with tag's data. This part first amplifies the incoming signal. The amplified signal is then passed through a series of Low Pass filters which removes the carrier frequencies, leaving behind the envelope. This envelope contains the information about the tag.

Digital Signal Processor:

Once the envelope is isolated, this information gathered is fed to a DSP unit which interprets it. The interpreted Data is sent to the database for comparison. Based on the database's response the DSP identifies the tag or returns an error message. Further features can be added depending on the exact application.

Output Display Unit:

This is an optional unit. It is operated by DSP which sends the output message depending on the tag recognized. This unit may show the information stored in the database corresponding to the specific e-tag.

Applications:

RFID is currently being used in numerous fields. Some of them are

- TOLL ROAD (E – Tolling in Motorways, Implemented by NADRA.)
- Public Transit
- Product tracking in super stores.

- Animal Identification.
- Planting e-tags in human body for identification.
- Recording racing times

Advantages over barcode:

- Barcode readers require a direct line of sight to the printed barcode; RFID readers do not require a direct line of sight to either active RFID tags or passive RFID tags.
- RFID tags can be read at much greater distances; an RFID reader can pull information from a tag at distances up to 300 feet. The range to read a barcode is much less, typically no more than fifteen feet.
- RFID readers can interrogate, or read, RFID tags much faster; read rates of forty or more tags per second are possible. Reading barcodes is much more time-consuming; due to the fact that a direct line of sight is required, if the items are not properly oriented to the reader it may take seconds to read an individual tag. Barcode readers usually take a half-second or more to successfully complete a read.
- Line of sight requirements also limit the ruggedness of barcodes as well as the reusability of barcodes. (Since line of sight is required for barcodes, the printed barcode must be exposed on the outside of the product, where it is subject to greater wear and tear.) RFID tags are typically more rugged, since the electronic components are better protected in a plastic cover. RFID tags can also be implanted within the product itself, guaranteeing greater ruggedness and reusability.
- Barcodes have no read/write capability; that is, you cannot add to the information written on a printed barcode. RFID tags, however, can be read/write devices; the RFID reader can communicate with the tag, and alter as much of the information as the tag design will allow.
- RFID tags are typically more expensive than barcodes, in some cases, much more so.

Problem Area:

One of the major problems regarding RFID tags is that we need to have a really small antenna size which could fit into the tag. A bigger antenna would not be feasible to be placed in e-tag. Even a larger antenna in base station would make it difficult to be mounted on doors, or making portable units out of it. This constraint on antenna size would greatly cripple its application.

Deliverables:

The size of the base antenna could be reduced in order to make the base station smaller and more portable. We intend to address this problem and investigate different types and shapes of antennas. The designed antennas will be operated on 125kHz frequency(longwave) and are intended to have *25-j395* impedence. Using the information attained as a result of a series of simulations made in HFSS, we would be able to suggest the optimal antenna type to be used for the project.

Thus our minimum deliverables would be:

- Given a particular transmitting frequency and impedance of the RDIF system, suggesting a number of possible antenna shapes which would be compatible with the system.
- By simulating various antenna shapes using *HFSS,* would be able to suggest the optimal antenna available for the particular job.

Timeline:

Week 1-2:

- Understanding the working of RFID system
- Fathoming operation of antennas and their dependence on various factors.

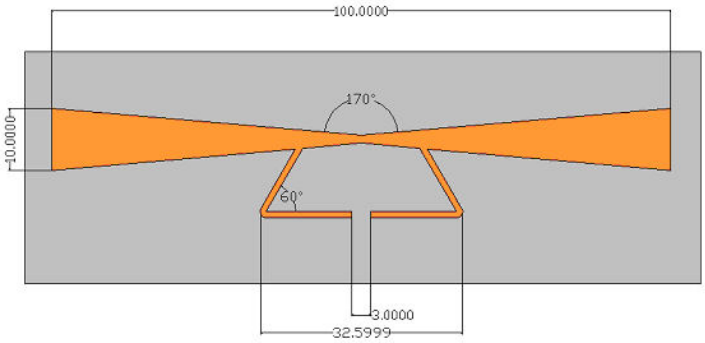
Week 3:

Working with HFSS and becoming comfortable with the GUI.

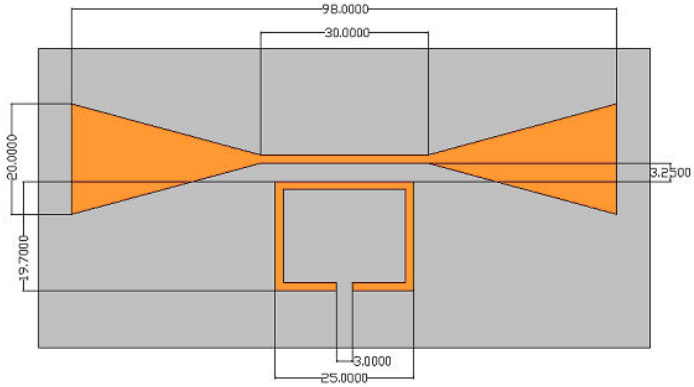
Week 4-6:

Simulating the following antennas: [1]

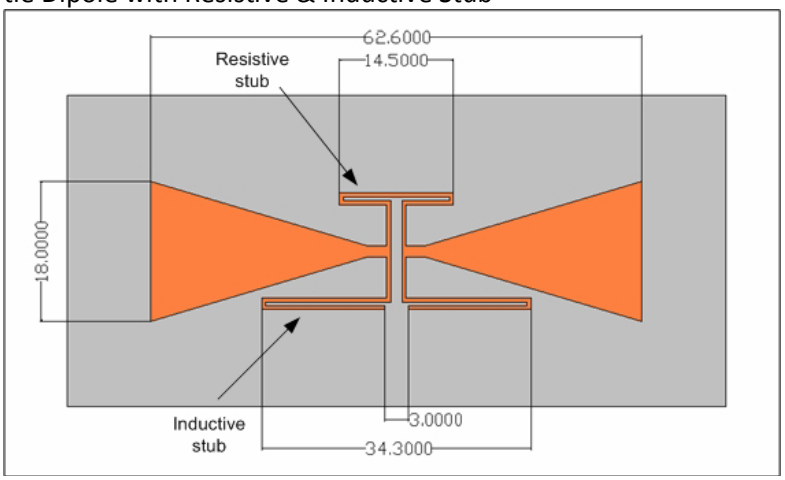
- Bowtie Dipole with L-Matched Feed



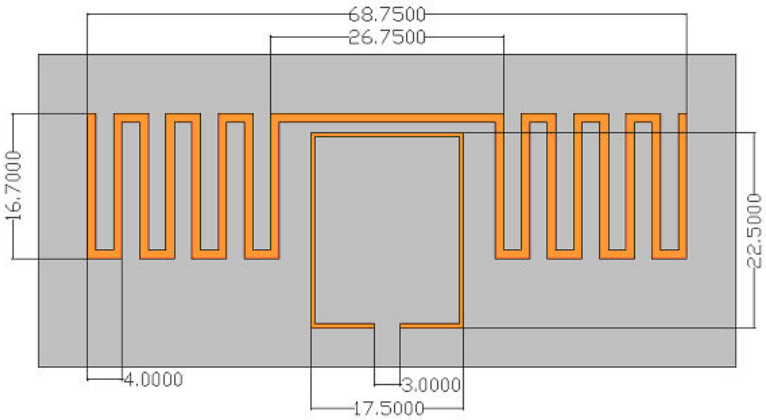
- Bowtie Dipole with Inductively Coupled Feed



- Bowtie Dipole with Resistive & Inductive Stub



- Meander Line Dipole with Inductively Couple Feed



Workload Division:

Muhammad Ahmed Riaz and Ansab Ali:

- Get fimiliar with HFSS
- Simulate various antenna designs in the given software

Ali Raza and Abdul Haseeb:

- Understanding the theory of antenna design
- Suggesting various antenna models appropriate for the project

References:

1. Design of Miniature RFID sensors for Electromagnetic Field Measurements

2. http://www.technovelgy.com/ct/Technology-Article.asp?ArtNum=60

3. Proximity Security System By: Craig Ross and Ricardo Goto