Boeing NFC Workstation Technology

ECE 445
Project Proposal

James Kim – Shao-Chi Ou Yang – Neil Misak
TA: Kevin Bassett

February 6, 2013

Table of Contents

1. Introduction (Page 3)
    - Statement of Purpose
    - Objectives
        1. Goals
        2. Functions
        3. Benefits
        4. Features
2. Design (Pages 4-5)
    - Block Diagrams/Descriptions
3. Block Level Requirements and Verification (Pages 5-7)
    - Performance Requirements
        1. Verifications
        2. Tolerance Analysis
4. Cost and Schedule (Pages 7-8)
    - Cost Analysis
        1. Labor
        2. Parts
        3. Total Cost
    - Schedule

Project Proposal

I. Introduction

1. Boeing NFC Workstation Technology:

Near Field Communication (NFC) is a short-range wireless technology that operates at 13.56MHz. NFC typically requires a distance of 4cm or less to enable data transfer at rates between 106 to 848 kbit/s. The majority of smartphones in today's market are equipped with NFC, which allows for pairing with NFC tags or stickers. Boeing wants to utilize NFC technology to increase cost effectiveness, accuracy, and speed of its assembly process. The focus of our project will be on utilizing NFC for employees that are collecting parts and assembling them at their respective workstations.

2. Objective

The goal of our project is to satisfy our clients' demands by creating a novel system that aids employees in collecting parts and correctly assembling orders at their respective workstations. The idea is to place NFC tags on all parts and use employee's smartphones as the readers in our system. A work order will be given to an employee on their smartphone with all required parts for assembly. Employees will use their smartphones to scan all parts that they take, and then the tags will store what employee the part was given to. The part will be recognized by the smartphone, which will keep track of which parts have been received and which parts are still needed to complete assembly. Once all parts have been recovered, the employee will be notified that the order has been filled and is ready for assembly. A temperature sensor will also be a feature present in our NFC tag. The maximum and minimum temperature that the part has been exposed to will be stored in the tag. When the employee scans the part, he or she will be able to read this data and ensure that the part has not had exposure to extreme temperatures that could have potentially damaged the part.

Goals

- Ensure that the demands of our client (Boeing) are completely satisfied.
- Add storage capabilities to the existing NFC tags.
- Provide additional modulation such as a temperature sensor to verify the conditions of the storage.

Functions

- Wireless communication between NFC reader (smartphone) and tags on various parts.
- Customized app for workstation scenario.

Benefits

- Electronically monitor parts throughout the assembly process.
- Allows for greater accuracy and faster assembly of orders.
- Allows employees to ensure that they have all required parts at their workstation.
- Temperature history helps ensure that the part is in working condition.

Features

- 13.56 MHz will be the frequency of operation for this system.
- Expected operating distance of 4cm.
- Expected bit rate between 106 to 848 kbit/s.
- No external reader needed besides smartphones.
- Cheaper than RFID.

II. **Design**

1. **Block Diagram:**

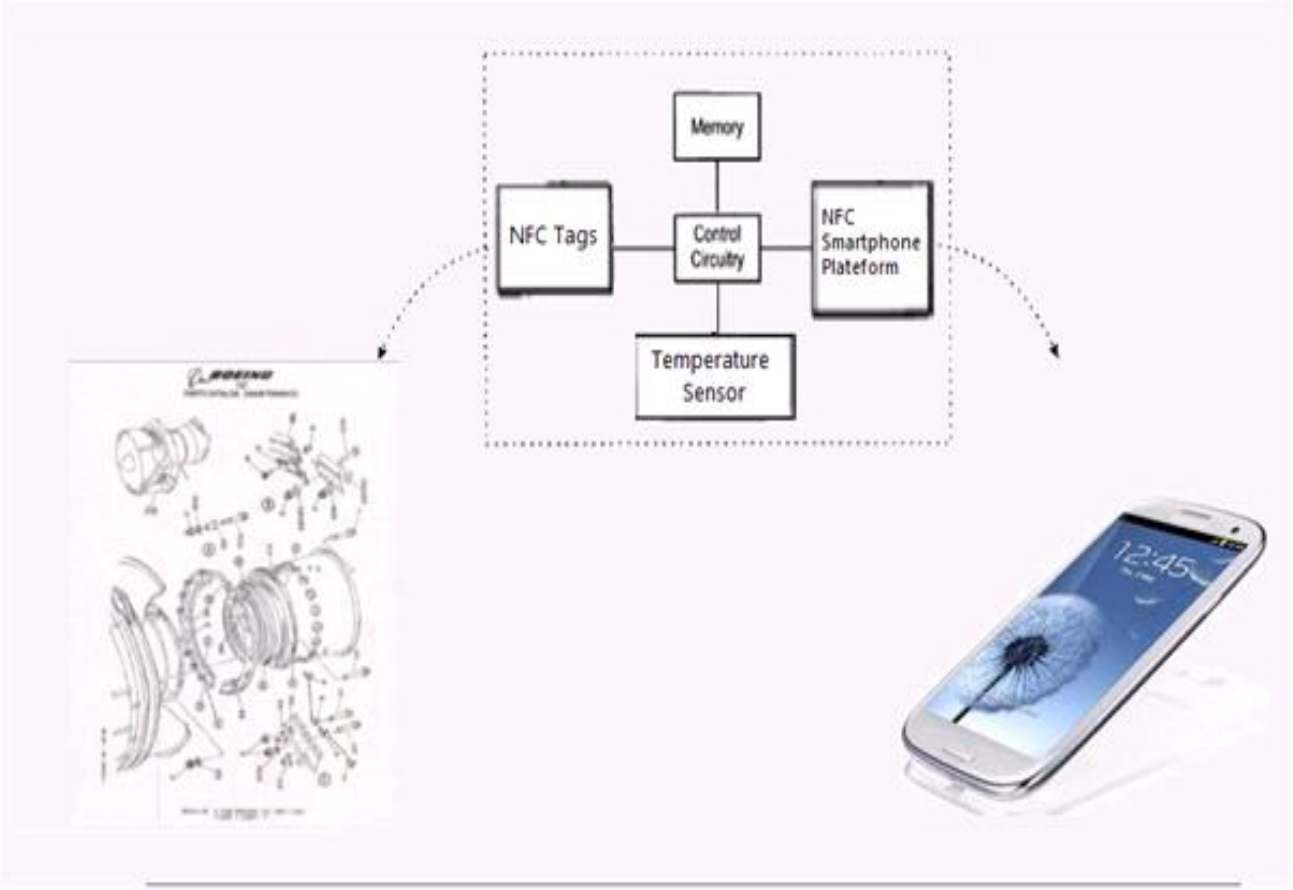

Fig. 1

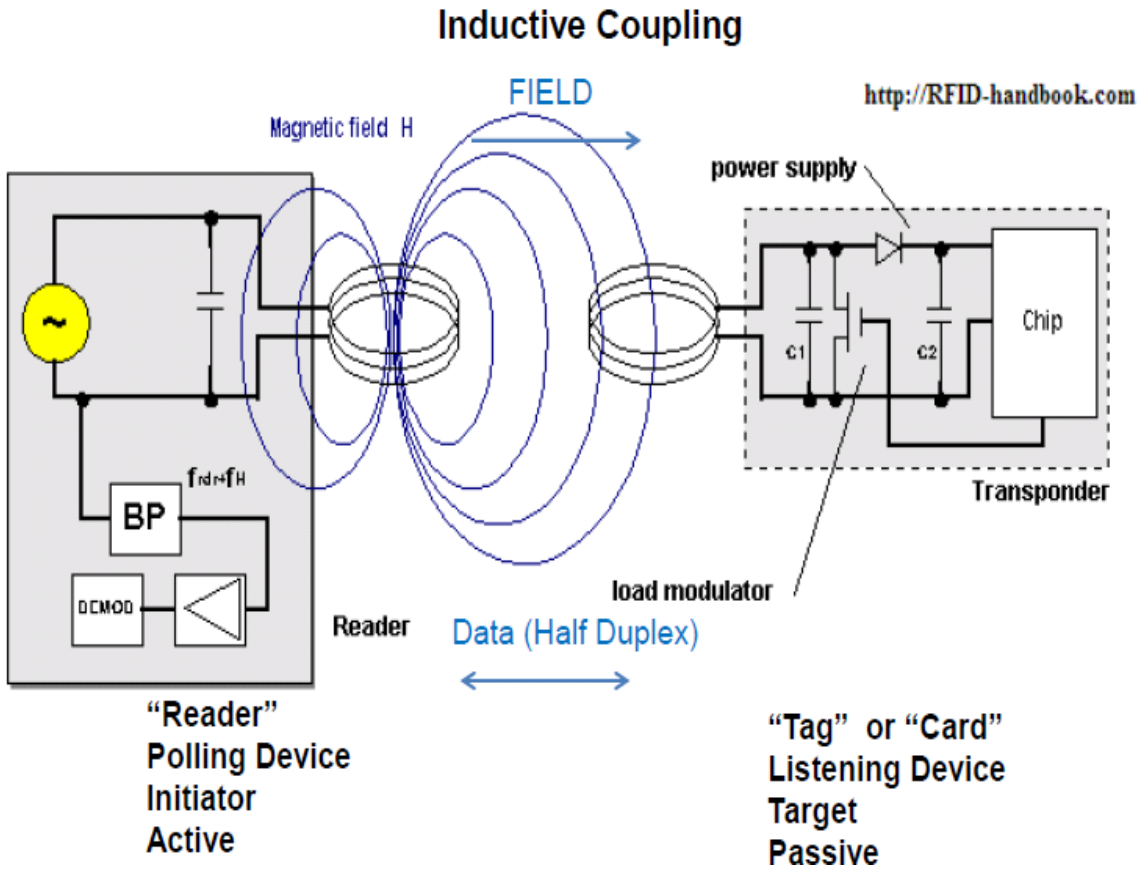

Fig. 2

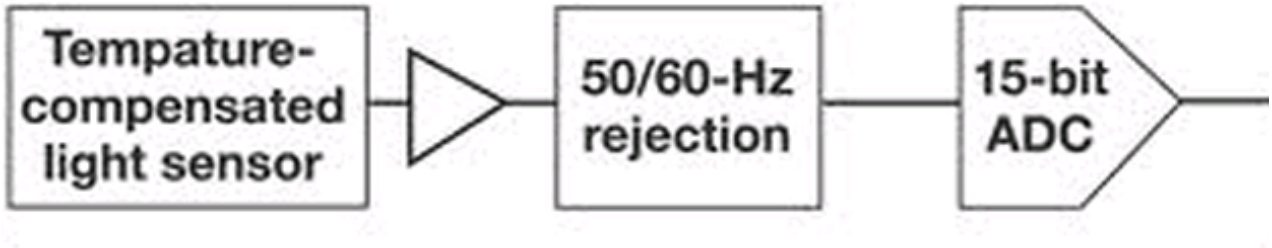

Fig. 3

2. **Block Descriptions:** This design consists of three main components that are tied together by a microcontroller with memory access.

NFC Tags: The design in figure 2 uses inductive coupling to exchange data. The reader component in this case will be our smartphone platform, preferably an android device. These tags are read/writable components that will allow workers to access work instructions and track inventories.

Temperature Sensor: As shown in figure 3, the output of the infrared sensor is fed through a current amplifier and a high pass filter to eliminate 50/60hz noise. The output data goes through a 15 bit analog to digital conversion before it connects with our microcontroller. The function of our temperature sensor is to provide condition checks for potential part replacement and verification.

NFC Smartphone Platform: The data accumulated through both our NFC tag and the temperature sensor is sent to the smartphone platform for a specific application of recognizing parts and listing work instructions. We intend to use Python as the basis of our mobile application programming language and SQL to control data flow.

Control Circuitry: The microcontroller coordinates the NFC tags and the temperature sensor to communicate with the smartphone.

Memory: This system aids all components to store data to be modified by the smartphone platform.

III. Requirements and Verification

1. Requirements

- Smartphone application: Customized application to read/write accurate data to the NFC tag.
- NFC Tags: To test the read and write feature of the tags using our smartphone platform and verify the accuracy of our data. The range of the NFC capability must be within 4 cm.
- Memory: Using the microcontroller to test the memory storing capability and capacity.
- Control Circuit: Check to see if the circuit is taking the signal of 0/1 from the smartphone to enable the memory and temperature sensor.
- Temperature Sensor: Be able to measure extreme temperature changes ranging from -70 to 100 degrees Celsius.
- Custom Antenna: Verify our custom antenna if it will work as wide in area as we intended to.

2. Verification

- Smartphone application: Verify the NFC reader is embedded to the smartphone. Test it by reading and writing via the customized smartphone application.
- NFC Tags: Make sure the condition of the NFC stickers are all intact. Verify its functionality by testing it with an existing android OS application called "NFC task launcher".
- Memory: Try storing actual data into the memory system. Use debugging tools such as the Altera board to check memory storage capabilities. Memory must be read/writable by the smartphone later on.
- Control Circuit: Test the logic of the microcontroller as stated in the embedded design instruction manual. This can be done by using some LEDs with debugging tools.
- Temperature Sensor: Test the range of the temperature sensor with a number display module. Check the extreme ranges using liquid nitrogen and a lighter.
- Custom Antenna: Design a custom PCB board. Test the frequency response of our designed antenna.

3. Tolerance Analysis:

- The smartphone application is a main factor of our project. The software has to be able to read/write and modify the data scanned from the NFC tag. If we get an inaccurate data from our software then our result will be alter dramatically.

- The performance of our project depends greatly on the secure transfer of data between the NFC tag and the smartphone. Even if the circuitry is function 99% of the time, the 1% error can critically alter the outcome of our goal. Signal interference maybe one performance reducing aspect of our project. Test the interference by placing objects between the communication fields. We also need to take in consideration of working with several parts tagged with NFC technology close to each other.

- The custom antenna can have error in some parts of the NFC tag. The copper wire might be chipped or deformed by outside force and environmental factors. This can cause the reading of the smartphone to be inaccurate.

IV. Cost and Schedule

1. Cost Analysis

LABOR:

($35/hour) x (150 hours) x (3 people) x (2.5) =$39,375

PARTS:

Parts	Quantity	Unit Cost	Part Number	Cost
Samsung Galaxy S3 Smartphone	1	$549.00	NXP: PN65 (NFC Chip)	$549.00
NFC Tags	5	$2.99	TecTiles ETC-TT1G6NGSTA	$74.95
Altera DE2 Board	1	$495.00	Altera Cyclone II 2C35 FPGA	$495.00
Temperature Sensor Pack	10	$1.59	DS18B20	$15.90
Total				**$1134.50**

GRAND TOTAL = LABOR ($39,375) + PARTS ($1134.50) = $40,509.85

2. Schedule

Week	Tasks	Responsibility
4-Feb	Finalize and hand in proposal	All
	Research and order NFC tags	Neil
	Finalize selection of temperature sensor/ additional circuit component	Vincent
	Begin experimenting with NFC tags through existing apps	James
11-Feb	Order parts for circuit component	Vincent

	Design additional circuit component	Neil
	Architect design of customized app	James
18-Feb	Begin to develop customized app	All
	Design larger antenna for NFC tag	Neil
25-Feb	Design Reviews	All
	Continue to develop customized app	Vincent
	Continue to work on antenna design	Neil
4-Mar	Continue development of customized app	James
11-Mar	Begin integration of app to hardware component	Neil
	Verify antenna design	Vincent
18-Mar	Spring Break	
25-Mar	Mock-up Demos	All
	Assemble PCB	Vincent
1-Apr	Request First Revision PCB	Neil
	Test antenna	James
8-Apr	Request Final Revision PCB	All
	Fix remaining issues	All
15-Apr	Ensure completion of project	All
	Prepare demo	Neil
	Prepare presentation	James
	Prepare Final Paper	Vincent
22-Apr	Demos	All
29-Apr	Final Presentations	All
	Final Papers Due	All
	Checkout/Awards	All