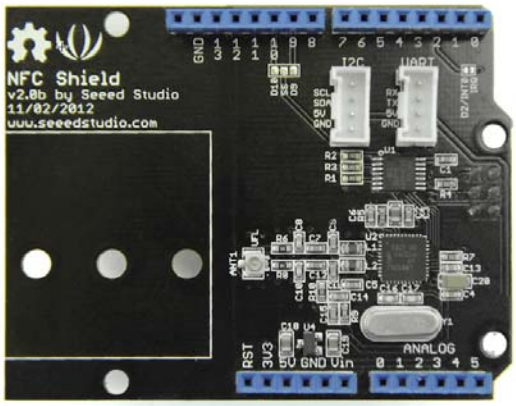
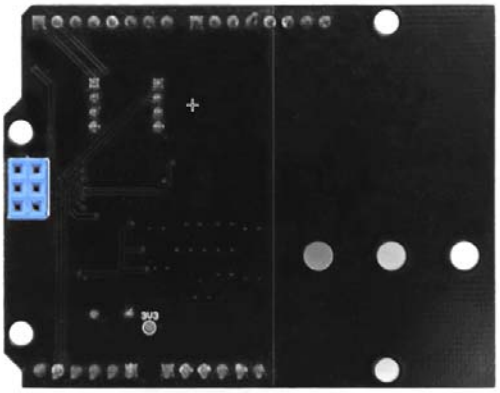
NFC Shield V2.0





NFC (Near Field Communication) is a technology that is widely used. Some of NFC's applications include wireless access control systems (e.g. keyless doors, and locks), and mobile device payments (e.g. store registers that receive payment information via a phone application).

The NFC Shield features a transceiver module, PN532, which handles wireless communication at 13.56MHz, this means that you can read and write a 13.56MHz tag with this shield or implement point to point (P2P) data exchange between the shield and a smart phone.

For this new version of the shield we have created a separate, independent, PCB antenna area which allows you to more easily stretch the NFC interface outside of your main circuit enclosure.

Compatibility

We have produced a lot of extension board that can make your platform board more powerful, however not every extension board is compatible with all the platform board, here we use a table to illustrate how are those boards compatible with platform board.

Note

Please note that "Not recommended" means that it might have chance to work with the platform board however requires extra work such as jump wires or rewriting the code. If you are interested in digging more, welcome to contact with techsupport@seeed.cc.

	Arduino Uno Seeeduino v4.2	Arduino Mega Seeeduino Mega	Zero(m0) LoraWan	Arduino Leonardo Seeeduino Lite	Arduino 101	Arduino Due 3.3v	Intel Edison 5v	Linkit One
2.8'' TFT Touch Shield V2.0	bmp nonsupport	bmp nonsupport	Not recommended	bmp nonsupport	Not recommended	Not recommended	Not recommended	Not recommended
Base Shield V2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Camera Shield	Only Pin234567	Hardware Serial OK	Not recommended	Not recommended	Yes	Hardware Serial OK	No	No
EL Shield	Yes	Yes	No	Yes	No	No	No	No
Energy Shield	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
GPRS Shield	Not recommended	Not recommended	Yes	Yes	Yes	Not recommended	Yes	No need
Motor Shield V2.0	Yes	Stepper motor only	No	Yes	Stepper motor only	Stepper motor only	No	No
Music Shield V2.0	Yes	Yes	Not recommended	Yes	Yes	Yes	Yes	Yes
NFC Shield V2.0	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Protoshield Kit for Arduino	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RS232 Shield	Yes	Yes	No	Yes	No	No	No	No
Relay Shield V3.0	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SD Card Shield V4.0	Yes	Yes	Not recommended	Yes	Yes	Yes	No	No
Seeed BLE Shield V1	Yes	Not recommended	Not recommended	Yes	No need	Not recommended	Not recommended	No need
W5500 Ethernet Shield	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wifi Shield(Fi250) V1.1	Not recommended	Not recommended	Not recommended	Yes	Yes	Not recommended	No need	No need
Wifi Shield V2	Yes	Not recommended	Not recommended	Yes	Yes	Not recommended	No need	No need
XBee Shield V2	Yes	Not recommended	Not recommended	Yes	Yes	Not recommended	Not recommended	Not recommended

Application Ideas

If you want to make some awesome projects by NFC Shield V2.0, here are some projects for reference.

NFC Shield Demo

Paper Man, an interesting object to interact with Android

Make it NOW!

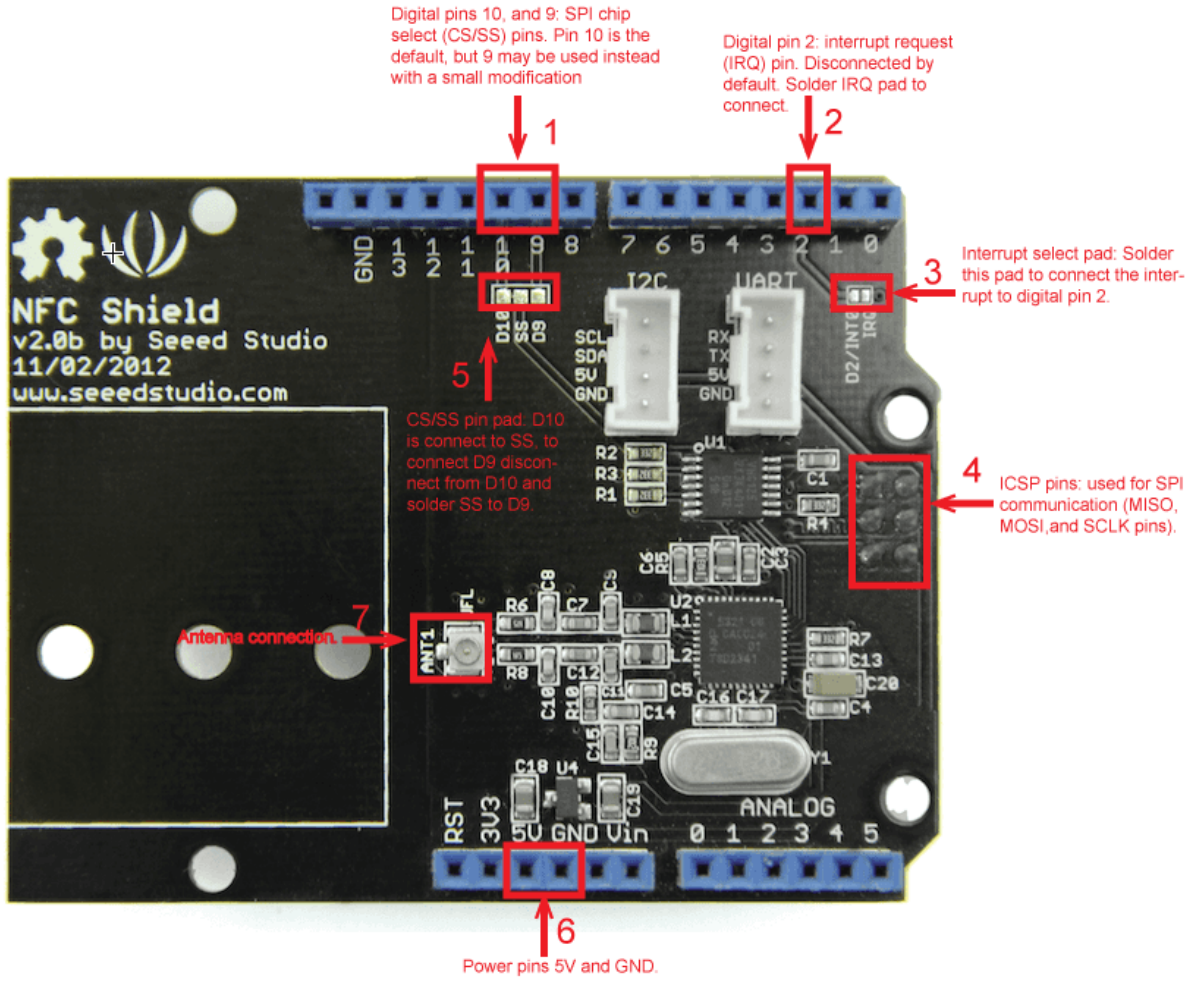
More Awesome Projects by NFC Shield V2.0

Features

- Use of the ICSP header for SPI. This means that the shield works with the following Arduino development boards: Uno, Mega, Leonardo
- Wireless NFC communication at 13.56MHz
- SPI protocol - pin saving interface that requires only 4 pins
- Input Voltage: 5V from the Arduino's 5V pin
- Typical Current: 100mA
- 5cm max effective range
- Supports P2P communication
- Support ISO14443 Type A and Type B protocols

Hardware Overview

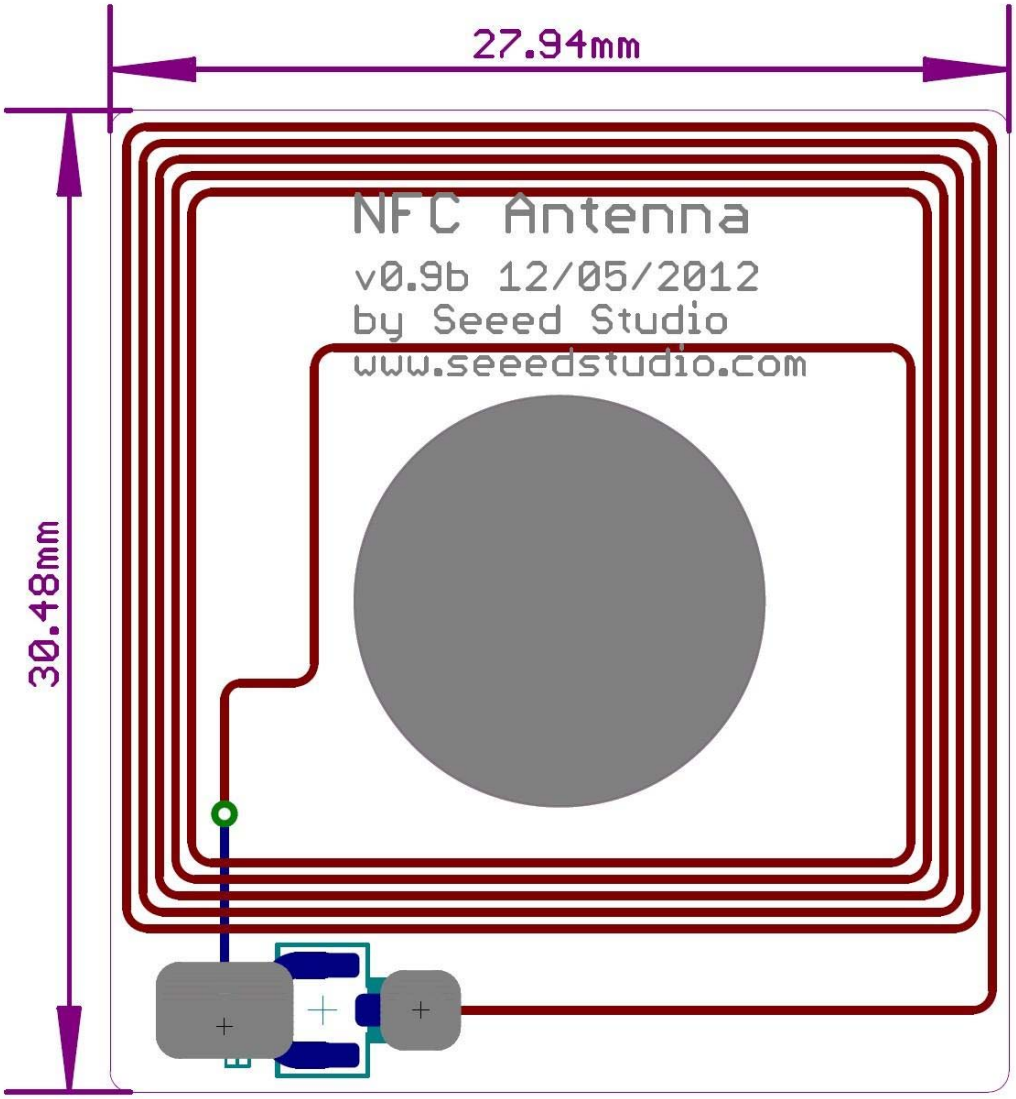
The NFC shield's pins and other terminals are described below.



NFC shield interface

- D10 and D9 are used for SPI chip select (CS/SS). D10 is connected by default, to connect D9 soldering the SS pad to the D9 pad and scraping off the connection between SS and D10 is required.
- D2 can be used to receive the shield's interrupt request (IRQ) pin signal. The interrupt is not connect by default, soldering of the "D2/INT0" and "IRQ" pads is required.
- The shield gets its SPI interface (SPI MOSI, MISO, and SCK pins) from the Arduino's ICSP header directly, this means that the shield works the following Arduinos: Uno, Mega, and Leonardo.
- The ANT1 terminal is where the NFC antenna (included with the shield) is connected to.
- The shield is powered by 5V from the Arduino board.

The NFC shield's antenna, included with the shield, is a separate PCB module that is attached to the shield via a cable. The antenna is the area used to receive and transmit information.



NFC antenna PCB attachment

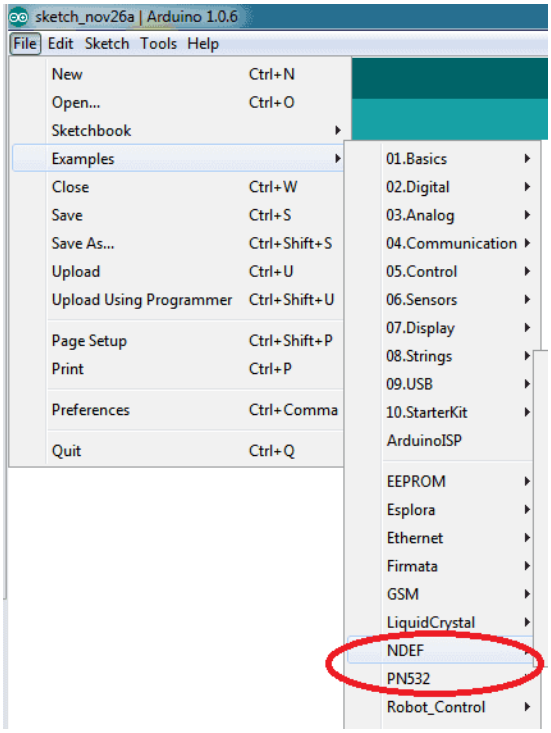
NFC Shield Setup

Hardware Installation

1. Attach the NFC Antenna to the shield.
2. Stack the NFC Shield on your Arduino development board and connect the board to a PC using a USB cable.

Software Libraries Installation

1. Close the Arduino IDE if you have it open.
2. Download the PN532 library ZIP folder and extract the files.
3. Copy the folders PN532, PN532_HSU, PN532_SPI, and PN532_I2C into the Arduino "libraries" folder.
4. Download Don's NDEF library ZIP folder and extract the files.
5. Open the extracted folder and rename the "NDEF-master" folder to "NDEF".
6. Copy the "NDEF" folder to the Arduino "libraries" folder.
7. Restart the Arduino IDE. You should now be able to see "NDEF" and "PN532" as options in the Arduino "Examples" sub-menu (See figure below).



Arduino available libraries menu

NFC Shield Examples/Applications

Example #1: NFC Tag Scan

This example will show you how to use the NFC shield to scan an NFC tag and display its information/data.

In the Arduino IDE copy, paste, then upload the code below to your board.

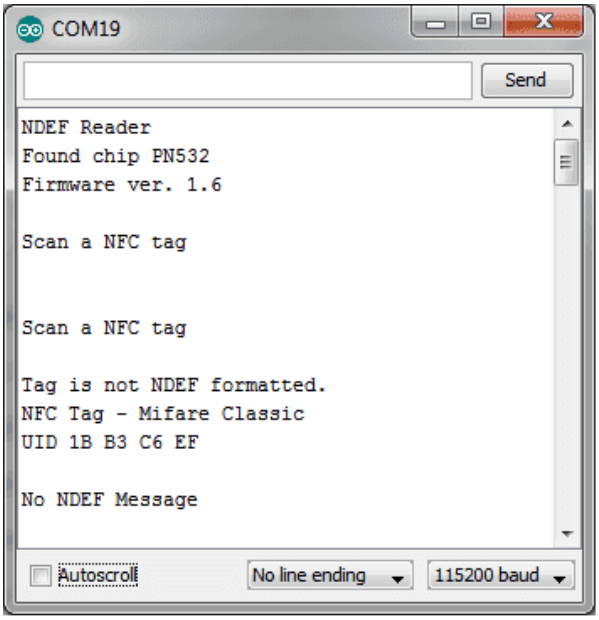
Code

```
#include <SPI.h>
#include "PN532_SPI.h"
#include "PN532.h"
#include "NfcAdapter.h"

PN532_SPI interface(SPI, 10); // create a PN532 SPI interface with the
SPI CS terminal located at digital pin 10
NfcAdapter nfc = NfcAdapter(interface); // create an NFC adapter object

void setup(void) {
    Serial.begin(115200); // begin serial communication
    Serial.println("NDEF Reader");
    nfc.begin(); // begin NFC communication
}

void loop(void) {

    Serial.println("\nScan an NFC tag\n");
    if (nfc.tagPresent()) // Do an NFC scan to see if an NFC tag is
present
```

```
        {
            NfcTag tag = nfc.read(); // read the NFC tag into an object,
nfc.read() returns an NfcTag object.
            tag.print(); // prints the NFC tags type, UID, and NDEF message
  (if available)
        }
        delay(500); // wait half a second (500ms) before scanning again
  (you may increment or decrement the wait time)
    }
```

To test the code:

1. Open the Arduino Serial monitor window
2. Set the baudrate to 115200
3. Hold an NFC tag over the NFC antenna area
4. The NFC shield will scan the tag and you should be able to see the NFC tag's UID, tag type, and message (if available) in the serial monitor window. See the figure below.



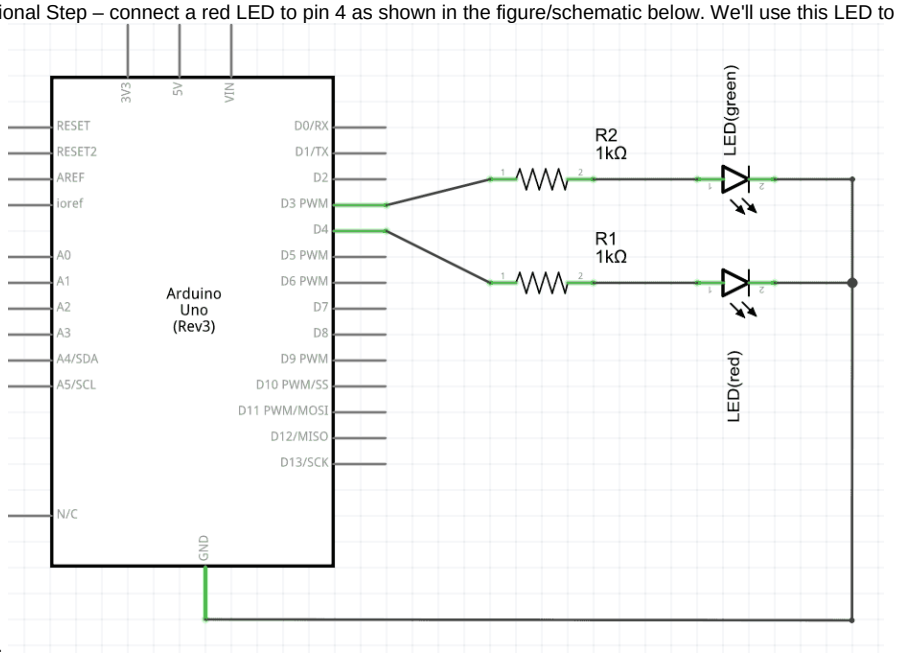
Example #1 serial communication window output when scanning an NFC tag.

Example #2: NFC(keyless) Door Lock

This example will show you how to use an NFC tag as a key to unlock a door or a lock. The door/lock mechanism will be left to your imagination, we'll only cover the NFC part of the code.

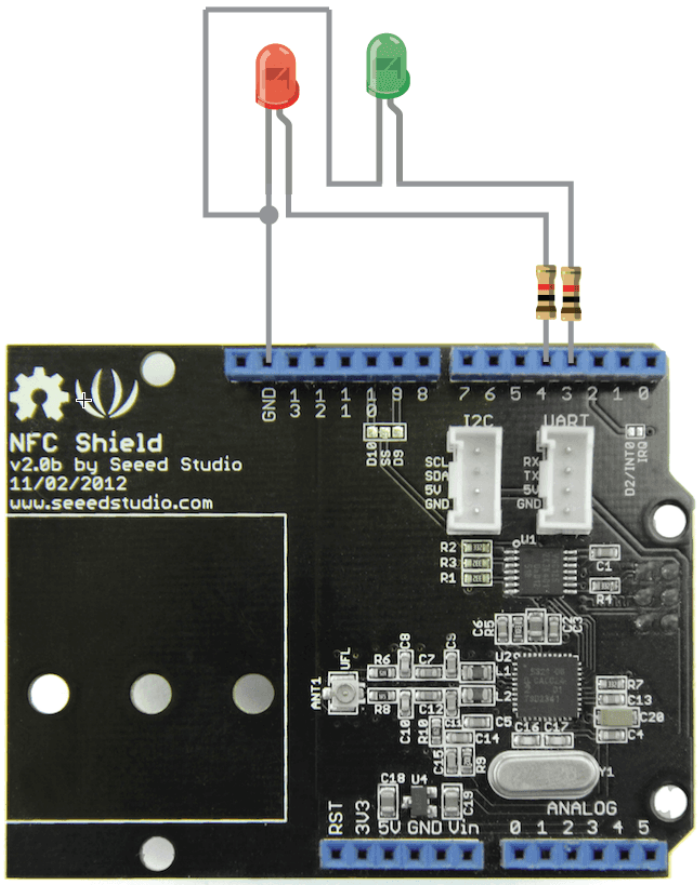
1. Do Example #1: NFC Tag Scan, above, to get your NFC tag's UID.
2. Optional Step - connect a green LED to pin 3 as shown in the figure/schematic below. We'll use this LED to signal a successful match in keys.

3. Optional Step – connect a red LED to pin 4 as shown in the figure/schematic below. We'll use this LED to signal a mismatched



key.

NFC lock circuit



NFC lock circuit

4. In the Arduino IDE create a new sketch and copy, paste, and upload the code below to your Arduino board replacing the myUID string constant with your tag's UID obtained from Example #1.

Code

```
#include <SPI.h>
#include "PN532_SPI.h"
#include "PN532.h"
#include "NfcAdapter.h"

String const myUID = "1B B3 C6 EF"; // replace this UID with your NFC tag's UID
int const greenLedPin = 3; // green led used for correct key notification
int const redLedPin = 4; // red led used for incorrect key notification

PN532_SPI interface(SPI, 10); // create a SPI interface for the shield with the SPI CS terminal at digital pin 10
NfcAdapter nfc = NfcAdapter(interface); // create an NFC adapter object

void setup(void) {
    Serial.begin(115200); // start serial comm
    Serial.println("NDEF Reader");
    nfc.begin(); // begin NFC comm

    // make LED pins outputs
    pinMode(greenLedPin,OUTPUT);
    pinMode(redLedPin,OUTPUT);

    // turn off the LEDs
    digitalWrite(greenLedPin,LOW);
    digitalWrite(redLedPin,LOW);
}

void loop(void) {

    Serial.println("Scanning...");
    if (nfc.tagPresent()) // check if an NFC tag is present on the antenna area
    {
        NfcTag tag = nfc.read(); // read the NFC tag
        String scannedUID = tag.getUidString(); // get the NFC tag's UID

        if( myUID.compareTo(scannedUID) == 0) // compare the NFC tag's UID with the correct tag's UID (a match exists when compareTo returns 0)
        {
          // The correct NFC tag was used
          Serial.println("Correct Key");
          // Blink the green LED and make sure the RED led is off
          digitalWrite(greenLedPin,HIGH);
          digitalWrite(redLedPin,LOW);

          delay(500);
          digitalWrite(greenLedPin,LOW);
          delay(500);
          digitalWrite(greenLedPin,HIGH);
          delay(500);
```

```
54              digitalWrite(greenLedPin,LOW);
55              // put your here to trigger the unlocking mechanism (e.g.
56motor, transducer)
57            }else{
58              // an incorrect NFC tag was used
59              Serial.println("Incorrect key");
60              // blink the red LED and make sure the green LED is off
61              digitalWrite(greenLedPin,LOW);
62              digitalWrite(redLedPin,HIGH);
63
64              delay(500);
65              digitalWrite(redLedPin,LOW);
66              delay(500);
67              digitalWrite(redLedPin,HIGH);
68              delay(500);
                digitalWrite(redLedPin,LOW);
                // DO NOT UNLOCK! an incorrect NFC tag was used.
                // put your code here to trigger an alarm (e.g. buzzard,
  speaker) or do something else
              }
          }
          delay(2000);
      }
```

To test the code/application:

1. Open the Arduino's serial monitor window
2. Hold the NFC tag with the correct key on the antenna area.
3. The green LED should light up and the serial window should print "Correct Key"
4. Now hold a different NFC on the antenna area
5. The red LED should light up and the serial window should print "Incorrect Key"

Example #3: How to use the Interrupt Pin (Example #2: Revisited)

Although the code in Example #2 above does what we need there is a more elegant approach to handling NFC tag detections. In this example we'll show you how to make use of the interrupt pin in the NFC shield so that instead of polling the shield (asking "is there a tag present?") we wait for the shield to tell the Arduino that a tag is available to be read. Why would you want to do this? There are many reasons and interrupts are a whole different topic, but one reason that may convince you is that your project/circuit will save battery since we are not triggering the shield circuit continuously.

Hardware Modification

The NFC shield's interrupt pin (IRQ) is disconnect from the Arduino's digital pin 2 (D2), to connect the IRQ and D2 pin together go ahead and solder the pad on the shield labeled "D2/INT0 IRQ".

Code

Upload the following code to your Arduino board:

```
1    #include <SPI.h>
2    #include "PN532_SPI.h"
3    #include "PN532.h"
4    #include "NfcAdapter.h"
5
```

```
    // FLAG_NONE used to signal nothing needs to be done
    #define FLAG_NONE 0
    // FLAG_IRQ_TRIGGERED used to signal an interrupt trigger
    #define FLAG_IRQ_TRIGGERED 1
    // FLAG_RESET_IRQ used to signal that the interrupt needs to be reset
    #define FLAG_RESET_IRQ 2
    // flags variable used to store the present flag
    volatile int flags = FLAG_NONE;

    String const myUID = "1B B3 C6 EF"; // replace this UID with your NFC tag's UID
    // LED pins
    int const greenLedPin = 3; // green led used for correct key notification
    int const redLedPin = 4; // red led used for incorrect key notification

    // the interrupt we'll be using (interrupt 0) is located at digital pin 2
    int const irqPin = 2; // interrupt pin

    PN532_SPI interface(SPI, 10); // create a SPI interface for the shield with the SPI CS terminal at digital pin 10

    NfcAdapter nfc = NfcAdapter(interface); // create an NFC adapter object

    String scannedUID = ""; // this is where we'll store the scanned tag's UID

    void setup(void) {
        // make LED pins outputs
        pinMode(greenLedPin,OUTPUT);
        pinMode(redLedPin,OUTPUT);

        Serial.begin(115200); // start serial comm
        Serial.println("NDEF Reader");
        nfc.begin(); // begin NFC comm

        // turn off the LEDs
        digitalWrite(greenLedPin,LOW);
        digitalWrite(redLedPin,LOW);
       // attach the function "irq" to interrupt 0 on the falling edges
       attachInterrupt(0,irq,FALLING);// digital pin 2 is interrupt 0, we'll call the irq function (below) on the falling edge of this pin
    }

    void loop(void) {
        int flag = getFlag(); // get the present flag

        switch(flag) // check which flag/signal we are on
        {
           case FLAG_NONE:
             // nothing needs to be done
           break;
           case FLAG_IRQ_TRIGGERED: // the interrupt pin has been triggered
```

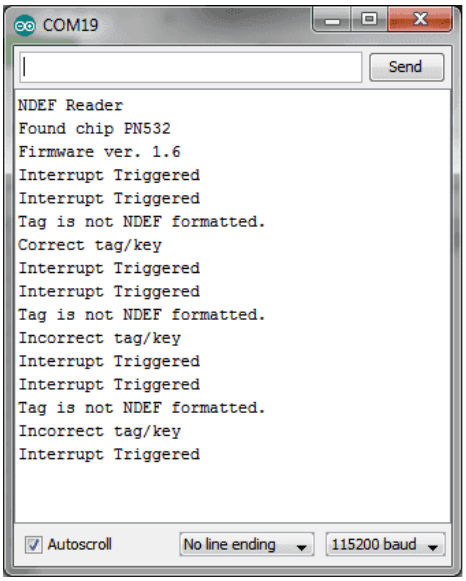
```
                Serial.println("Interrupt Triggered");
                if (nfc.tagPresent())
                {
                  // an NFC tag is present
                   NfcTag tag = nfc.read(); // read the NFC tag
                   scannedUID = tag.getUidString(); // get the NFC tag's
UID
                   if(myUID.compareTo(scannedUID) == 0) // compare the NFC
tag's UID with the correct tag's UID (a match exists when compareTo
returns 0)
                   {
                     // the scanned NFC tag matches the saved myUID value
                     Serial.println("Correct tag/key");
                     blinkLed(greenLedPin,200,4); // blink the green led
                     // put your here to trigger the unlocking mechanism
(e.g. motor, transducer)
                   }else{
                     // the scanned NFC tag's UDI does not match the myUID
value
                     Serial.println("Incorrect tag/key");
                     blinkLed(redLedPin,200,4); // blink the red led
                     // DO NOT UNLOCK! an incorrect NFC tag was used.
                     // put your code here to trigger an alarm (e.g.
buzzard, speaker) or do something else
                   }
                   // return to the original state
                   setFlag(FLAG_NONE);
                   reset_PN532_IRQ_pin();
                }else{
                  // a tag was not present (the IRQ was triggered by some
other action)
                  setFlag(FLAG_NONE);
                }
            break;
            default:
              // do any other stuff for flags not handled above
            break;
        }
    }

    /*
    * Name: setFlat
    * Description: used to set actions/flags to be executed in the
loop(void) function
    * Parameters:
    *        int flag - the action/flag to store
    * Returns: void
    */
    void setFlag(int flag)
    {
      flags = flag;
    }

    /*
    * Name: getFlag
    * Description: used to get the present flag/action
    * Parameters: void
```

```
120     * Returns: int - the flags variable. The action/flag set by setFlag
121     */
122     int getFlag()
123     {
124       return flags;
125     }
126
127     /*
128     * Name: irq
129     * Description: Interrupt service routine (ISR). This function will be
130 executed whenever there is a falling edge on digital pin 2 (the interrupt
131 0 pin)
132     * Parameters: void
133     * Returns: void
134     */
135     void irq()
136     {
137       if(getFlag()==FLAG_NONE){
138         setFlag(FLAG_IRQ_TRIGGERED);
139       }
140     }
141     /*
142     * Name: reset_PN532_IRQ_pin
143     * Description: used to reset the PN532 interrupt request (IRQ) pin
144     * Parameters: void
145     * Returns: void
146     */
147     void reset_PN532_IRQ_pin()
148     {
149       nfc.tagPresent();
150     }

       /*
       * Name: blinkLed
       * Description: used to toggle a pin to blink an LED attached to the
   pin
       * Parameters:
       *      ledPin - the pin where the led is connected to
       *      delayTime - the time in milliseconds between HIGH and LOW
       *      times - the number of times to toggle the pin
       * Returns: void
       */
       void blinkLed(int ledPin,int delayTime,int times)
       {
         for(int i=0;i<times;i++){
           digitalWrite(ledPin,HIGH);
           delay(delayTime);
           digitalWrite(ledPin,LOW);
           delay(delayTime);
         }
       }
```

To test the code/application:

1. If desired, connect the LEDs as shown in Example #2 above.
2. Open the Arduino's serial monitor window
3. Hold the NFC tag with the correct key on the antenna area.
4. The green LED should light up and the serial window should print "Correct Key"
5. Now hold a different NFC on the antenna area
6. The red LED should light up and the serial window should print "Incorrect Key"

The serial window from our test of this code is displayed below, yours should be similar.



Serial comm window output from example 3.

Example #4: Write an NDEF Message to a Tag

NFC tags are capable of storing data, the amount of data is dependent on each tag. In this example we will store two strings/messages on a tag, you will then be able to read this message with the code in *Example #6: Read an NDEF Message From a Tag*.

Upload the following code to your Arduino development board.

Note
If your NFC tag is not properly formatted ("Message write failed" will be displayed in the serial comm window) you'll need to see if you tag can be formatted with the code in *Example #5: Format a Tag as NDEF*

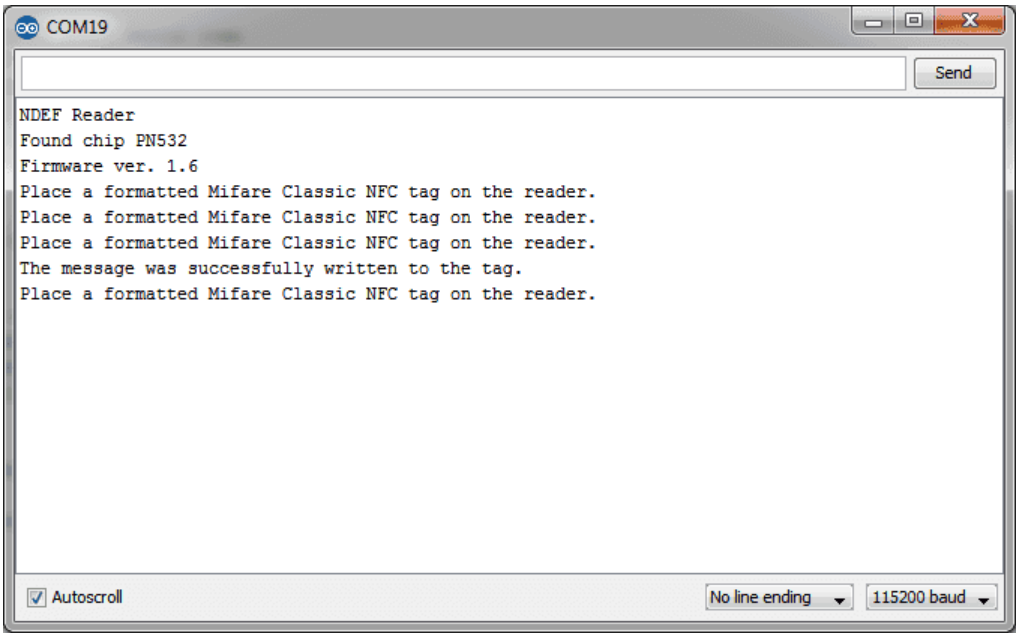
Code

```
#include <SPI.h>
#include "PN532_SPI.h"
#include "PN532.h"
#include "NfcAdapter.h"

PN532_SPI interface(SPI, 10); // create a SPI interface for the shield
with the SPI CS terminal at digital pin 10

NfcAdapter nfc = NfcAdapter(interface); // create an NFC adapter object

void setup(void)
{
    Serial.begin(115200); // start serial comm
```

```
14          Serial.println("NDEF Reader");
15          nfc.begin(); // begin NFC comm
16      }
17
18      void loop(void)
19      {
20        Serial.println("Place a formatted Mifare Classic NFC tag on the
21  reader.");
22        if(nfc.tagPresent())
23        {
24          NdefMessage message = NdefMessage();
25          message.addUriRecord("Hello, world!");
26          message.addUriRecord("How are you today?");
27
28          bool success = nfc.write(message);
29          if(success)
30          {
31            Serial.println("The message was successfully written to the
32  tag.");Ho
33          }else{
34            Serial.println("Message write failed.");
35          }
36        }

          delay(5000);
        }
```

To test the code above:

1. Open an Arduino serial comm window
2. Hold the NFC tag over the NFC shield antenna's area and wait for the success or failure message to appear as shown in the figure below.
3. Remove the NFC tag form the antenna's area as soon as the success message is displayed to prevent a rewrite.



Serial comm window for NDEF message written to card example.

Example #5: Format a Tag as NDEF

Your brand new NFC tag might not be NDEF formatted initially. To format a tag as NDEF upload the following code to your Arduino development board:

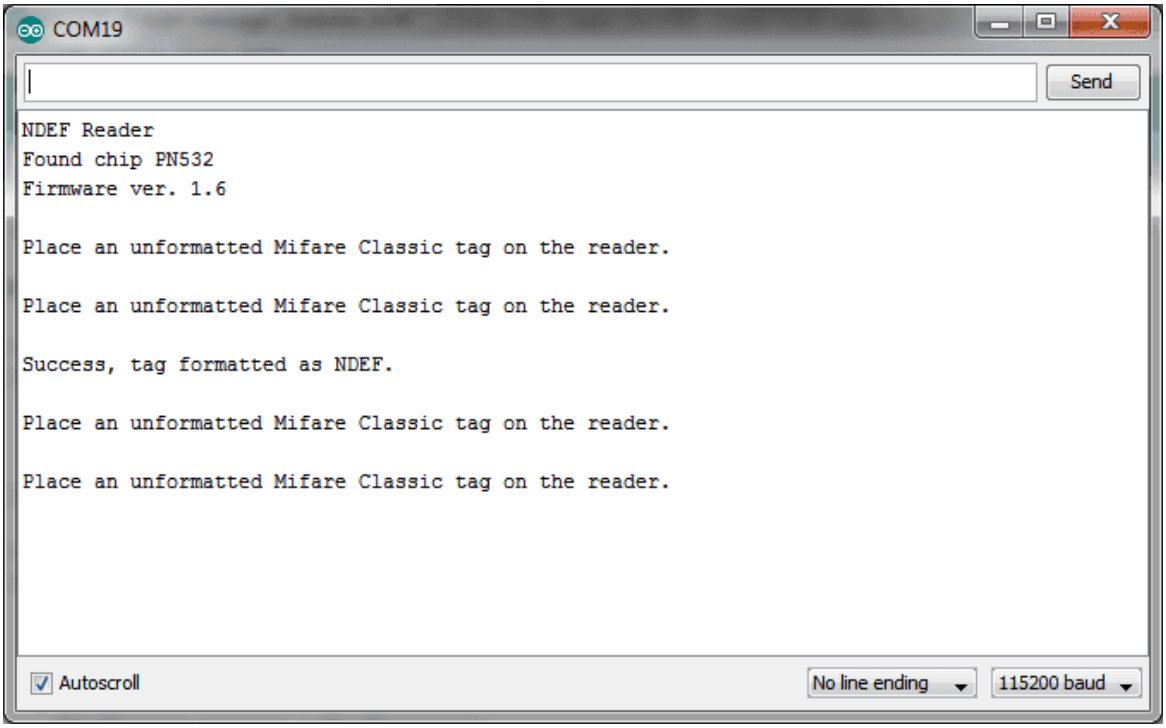
Code

```
#include <SPI.h>
#include "PN532_SPI.h"
#include "PN532.h"
#include "NfcAdapter.h"

PN532_SPI interface(SPI, 10); // create a SPI interface for the shield with the SPI CS terminal at digital pin 10

NfcAdapter nfc = NfcAdapter(interface); // create an NFC adapter object

void setup(void)
{
    Serial.begin(115200); // start serial comm
    Serial.println("NDEF Reader");
    nfc.begin(); // begin NFC comm
}

void loop(void)
{
    Serial.println("Place an unformatted Mifare Classic tag on the reader.");
    if (nfc.tagPresent()) {

        bool success = nfc.format();
        if (success) {
          Serial.println("Success, tag formatted as NDEF.");
        } else {
          Serial.println("Format failed.");
        }

    }
    delay(5000);
}
```

To test/run the code:

1. Open the Arduino serial comm window.
2. Hold the NFC tag you wish to format over the NFC shield antenna's area.
3. Wait for the success or fail message to appear as shown in the figure below.
4. Remove the NFC tag from the antenna's area to prevent a re-format.

Note
If your tag failed to get formatted, try again. If it fails your tag is not capable of getting formatted as NDEF.



Serial comm window output when formatting an NFC tag to NDEF.

Example #6: Read an NDEF Message From a Tag

As you have seen in the example's above, the NFC shield is capable of writing messages to NFC tags. The NFC is also capable of reading NDEF messages from tags, in this example we'll show you how.

Code

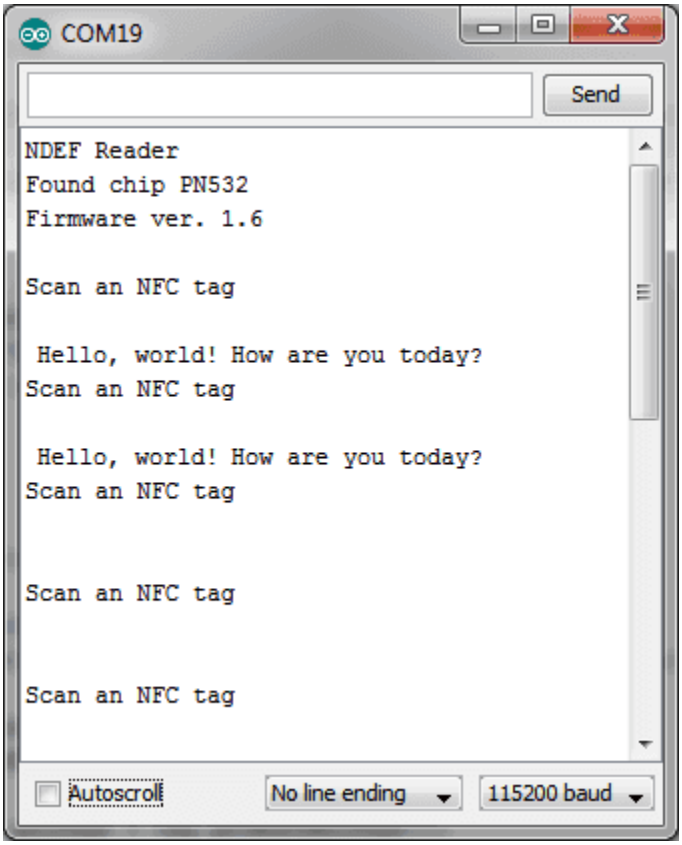
Upload the following code to your Arduino development board.

```
#include <SPI.h>
#include "PN532_SPI.h"
#include "PN532.h"
#include "NfcAdapter.h"

PN532_SPI interface(SPI, 10); // create a SPI interface for the shield
with the SPI CS terminal at digital pin 10

NfcAdapter nfc = NfcAdapter(interface); // create an NFC adapter object

void setup(void)
{
    Serial.begin(115200); // start serial comm
    Serial.println("NDEF Reader");
    nfc.begin(); // begin NFC comm
}

void loop(void)
{
  Serial.println("\nScan an NFC tag\n");
```

```
      if (nfc.tagPresent()) // Do an NFC scan to see if an NFC tag is
present
      {
          NfcTag tag = nfc.read(); // read the NFC tag
          if(tag.hasNdefMessage())
          {
            NdefMessage message = tag.getNdefMessage();
            for(int i=0;i<message.getRecordCount();i++)
            {
              NdefRecord record = message.getRecord(i);
              int payloadLength = record.getPayloadLength();
              byte payload[payloadLength];
              record.getPayload(payload);
              Serial.write(payload,payloadLength);
            }
          }
      }
        delay(500); // wait half a second (500ms) before scanning again (you
  may increment or decrement the wait time)
      }
```

To test code above:

1. Open an Arduino serial comm window
2. Hold the an NFC tag with an NDEF message over the NFC shield antenna's area.
3. The NDEF message written on the tag should be displayed as shown in the figure below.



Serial comm window output for NDEF message read

Example #7: How to Change the Chip Select Pin From D10 to D9

Hardware Modification

1. Scrape off the connection from the pads labeled "SS" and "D10" on the shield
2. Connect/solder pads "SS" and "D9" on the shield.

You can then use the same code in the examples above but with pin 9 instead of 10 for the PN532 interface:

Code

```
PN532_SPI interface(SPI, 9); // create a SPI interface for the shield with
the SPI CS terminal at digital pin 9
```

Example #8: Use Two NFC Shields With One Arduino Board

Hardware Modification

1. Do the hardware modification described in Example #7 on one of the two shields.
2. Stack both shields on the Arduino Board.

You may now create two separate NFC objects, one for each shield, as follows:

Code

```
1    PN532_SPI interface_shield_1(SPI, 10); // create a SPI interface for the
2shield with the SPI CS terminal at digital pin 10
3    PN532_SPI interface_shield_2(SPI, 9); // create a SPI interface for the
4shield with the SPI CS terminal at digital pin 9
5
     NfcAdapter nfc_shield_1 = NfcAdapter(interface_shield_1); // create an
 NFC adapter object for shield one
     NfcAdapter nfc_shield_2 = NfcAdapter(interface_shield_2); // create an
 NFC adapter object for shield two
```

Project

Paper Man An interesting way to communicate with your Android device through the NFC technology.

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Tech Support

Please submit any technical issue into our forum or drop mail to techsupport@seeed.cc.