



Argus
Thesis

용광 | ↑↑

SD Card

■ SD card uses 3.3V voltage level. Arduino Mega is 5V system.

Therefore, we need a **level shifter**.

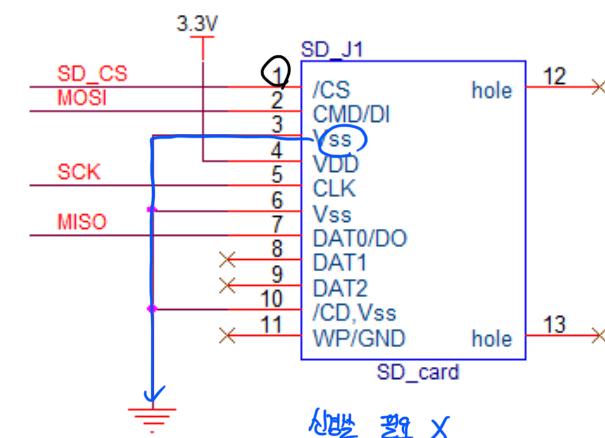
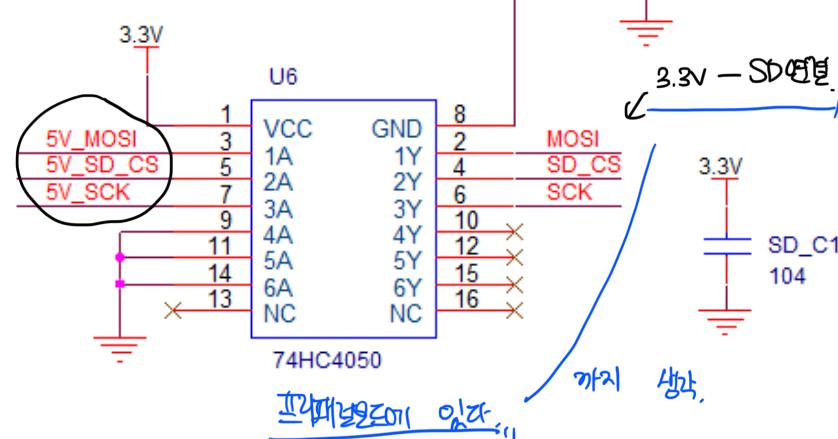
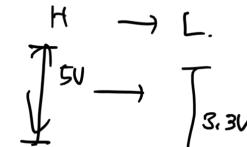
■ 74HC4050

- Hex non-inverting HIGH-to-LOW level shifter

- Inputs are voltage tolerant to 15 V

■ Connection : SPI Communication

- MOSI (3.3V) – DI
- MISO (3.3V) – DO
- SCK (3.3V) – CLK
- SS(3.3V) - /CS



SPI Communication

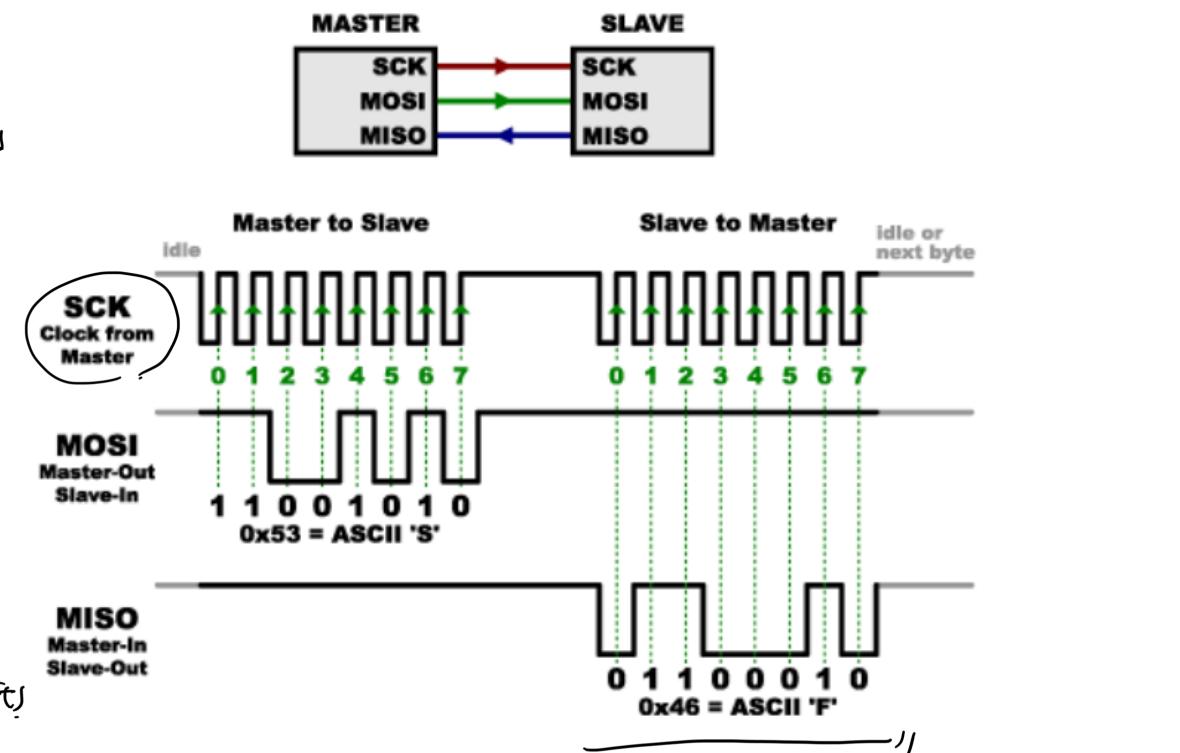
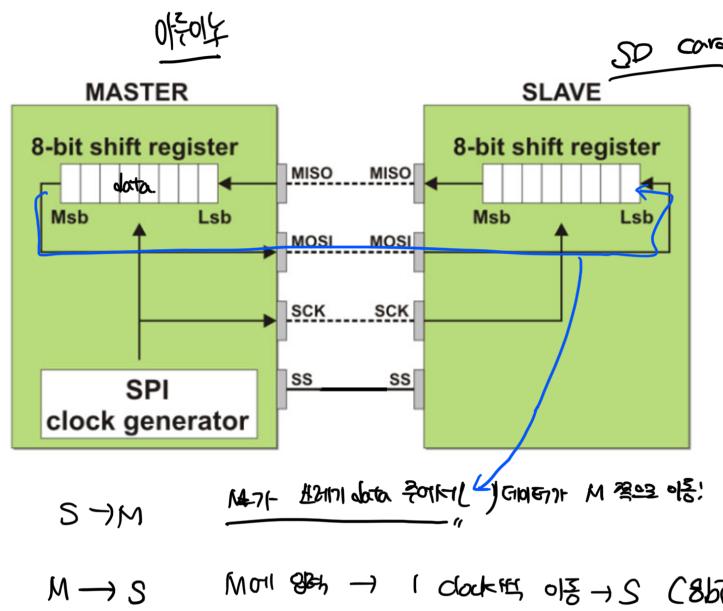
Set&R
직렬
peripheral
작동
주변
인터페이스
작동
주변
인터페이스

SPI

- Synchronous serial communication interface specification used for short distance communication // (단거리).
- Developed by Motorola in the mid 1980s.

$\frac{L}{16}$ 비트

[MOSI → Master out slave input]
[MISO → Master input slave output]

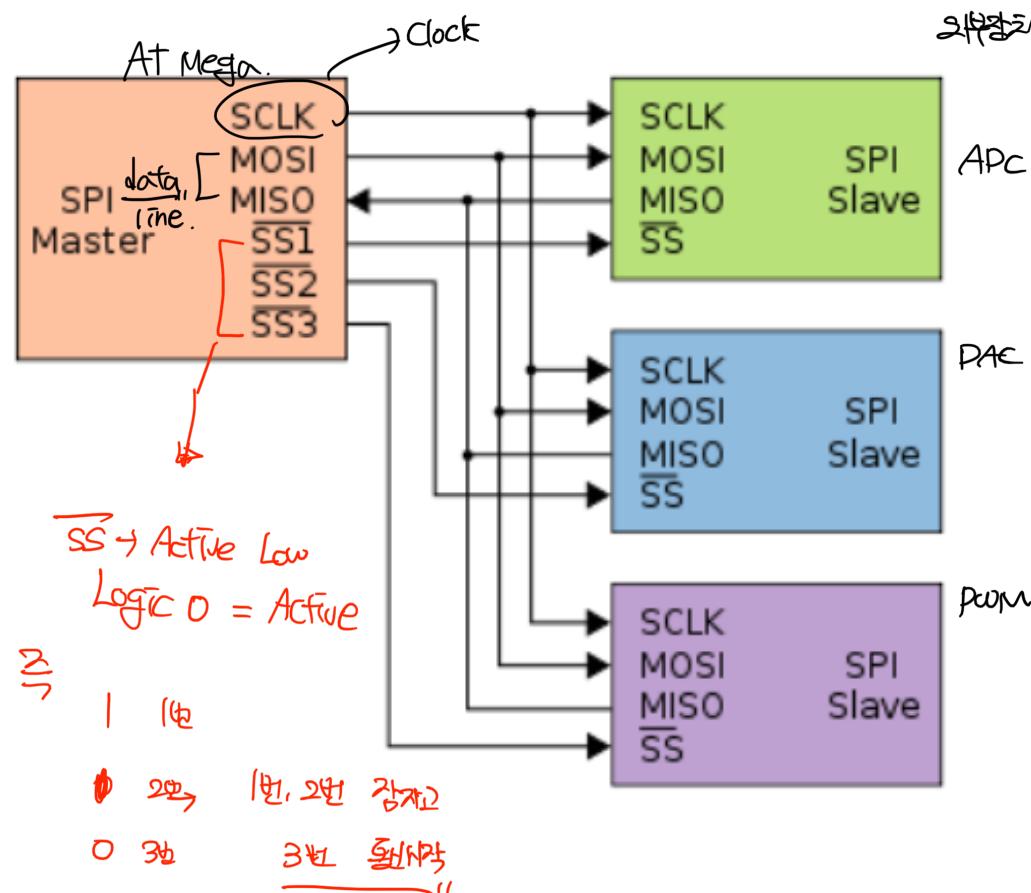


∴ M01 clock 발생은 공통, Master가 관리한다.

SPI Communication

■ Single master, multiple slaves

- Many peripherals support SPI interface
- You can interface those peripherals with your u-controller as follows:
[Note] You can use GPIO pins for generation of /SS signals.

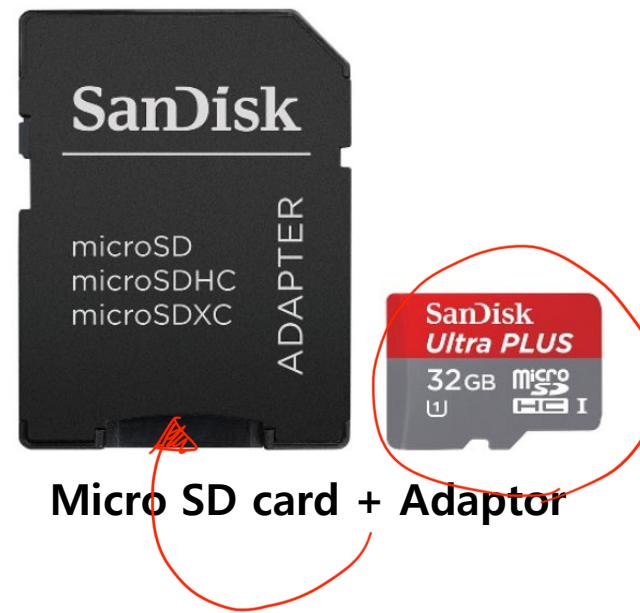


SanDisk SD Card

- There exist many manufacturers of SD cards. However, be sure to get one from San Disk. SD cards from other companies may not work with the SD library



SD card



Micro SD card + Adaptor

SD Card

■ SD (Secure Digital) : Flash memory card

- SDHC : 2GB ~32GB

- SDXC : ~ 2 TB

■ Speed

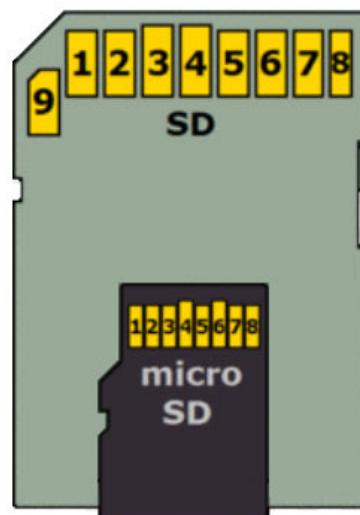
- Class 2 : 2 MB/s

- Class 4 : 4 MB/s

- Class 6 : 6 MB/s

- Class 10 : 10 MB/s

☆ 추가할 것



Pin	SD	uSD	SPI
1	CD/DAT3	DAT2	CS
2	CMD	CD/DAT3	DI (MOSI)
3	VSS1	CMD	VSS1
4	VDD	VDD	VDD
5	CLK	CLK	SCLK
6	VSS2	VSS	VSS2
7	DAT0	DAT0	DO (MISO)
8	DAT1	DAT1	X
9	DAT2		X

SD Library

+

SPI Library

■ <https://www.arduino.cc/en/Reference/SD> //

SD library

- Reading from and writing to SD cards
- It supports FAT16 and **FAT32 file systems** on standard SD cards and **SDHC cards.**

- It uses **8.3 names for files**

(Ex: rainy.txt (O), rainy_window.txt (x))

- The communication between the **SD cards** and the microcontroller uses **SPI.**

(Ex: **Pins 50, 51, 52, 53 in Arduino Mega**)

MOSI
MISO
CLK
SS
CS

- Internal SPI clock setting = 4 MHz (verified through oscilloscope)

○ 배→여기서 미리

SD Library

SD class

The SD class provides functions for accessing the SD card and manipulating its files and directories.

- begin()
- exists()
- mkdir()
- open()
- remove()
- rmdir()

To use this library

```
#include <SPI.h>  
#include <SD.h>
```

File class

The File class allows for reading from and writing to individual files on the SD card.

- name()
- available()
- close()
- flush()
- peek()
- position()
- print()
- println()
- seek()
- size()
- read()
- write()
- isDirectory()
- openNextFile()
- rewindDirectory()

SD Library

■ Examples

- **Card Info** : Get info about your **SD card**
- **Dump File** : Read a file from the **SD card** 어떤 파일의 내용을 봄다
- **List Files** : Print out the files in a **directory** on a SD card
- **Files** : Create and destroy an SD card file
- **Read Write** : Read and write data to and from an SD card
- **Datalogger** : Log data from three analog sensors to an SD card

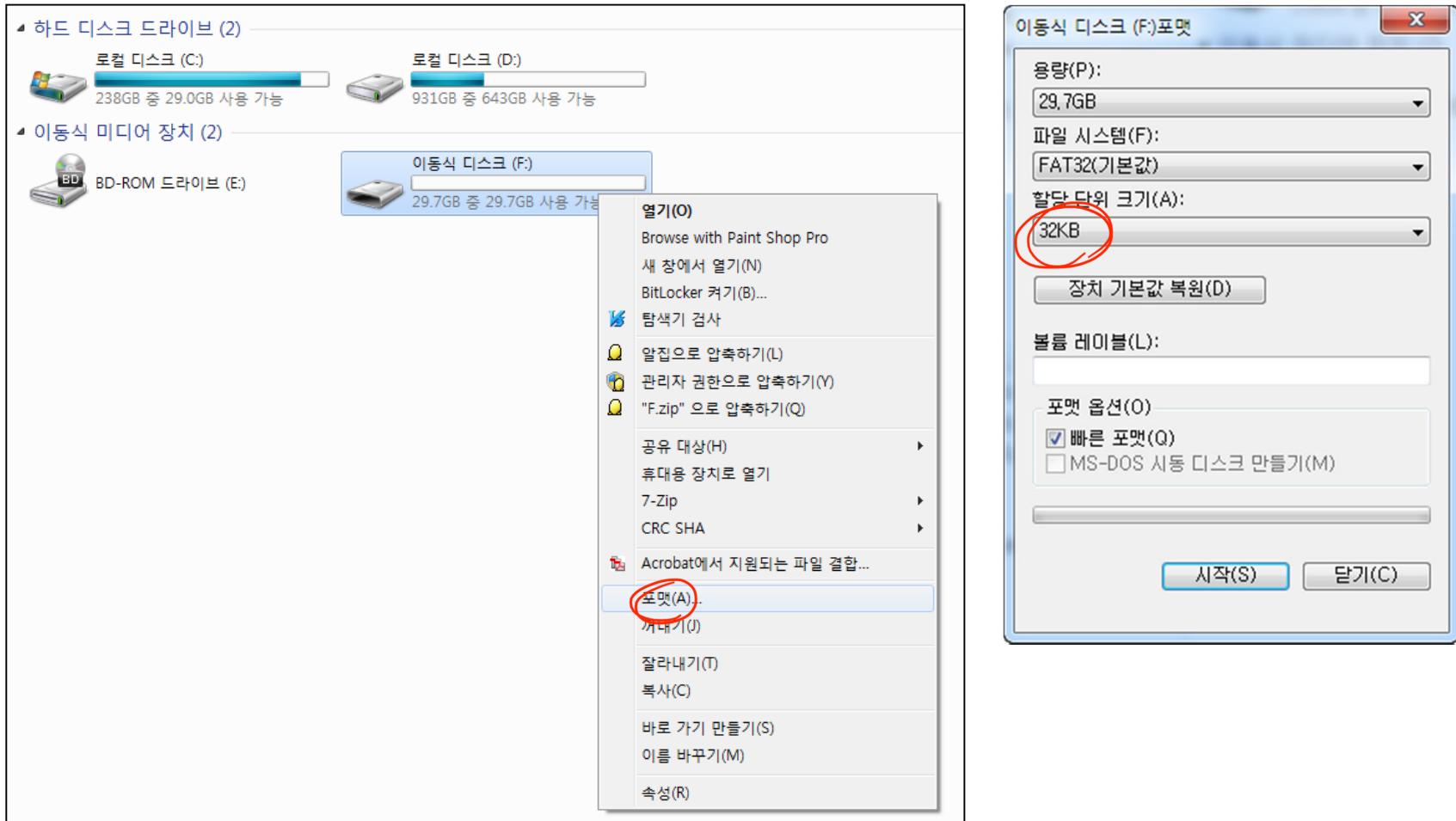
6개의 예제

어떤 파일의 내용을 봄다

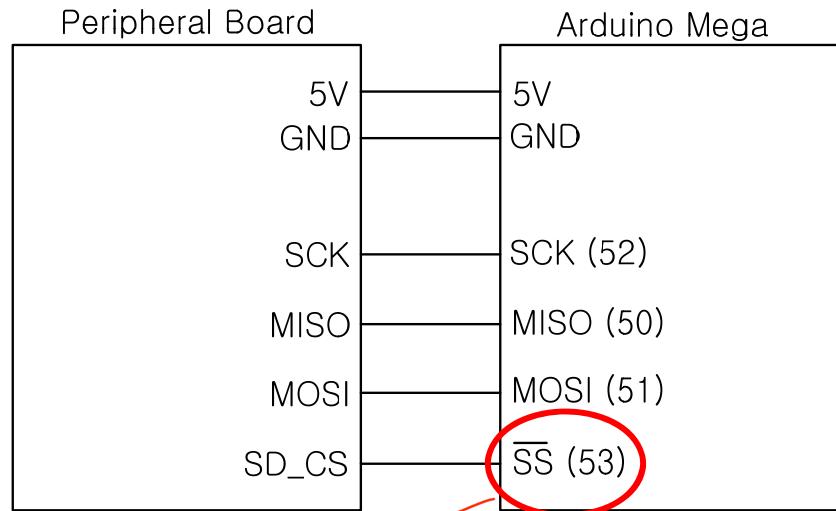
특정 텍스트 내용을 봄다

Formatting SD

Formatting SD card to FAT32



Connection Info



```
if (!SD.begin(53)) {  
    Serial.println("initialization failed!");  
    return;  
}
```

When you call `SD.begin()`, be sure to use **53** as a parameter.
53 is the pin number of hardware SS in ATMega2560.

Files in the SD card

Let's assume that the following files are in the SD card to test the SD card libray

파일명	↑확장자	크기
[..]		<폴더>
speech	txt	1.501
WAV Bette	wav	40,167,980
WAV Cavatina	wav	38,458,412
WAV Every_br	wav	44,665,388
WAV Gabriel	wav	23,864,876
WAV Lady	wav	10,911,788
WAV Lady_16	wav	21,823,532
WAV Lonely	wav	39,034,412
WAV Only_if	wav	34,629,164
WAV Rainy	wav	19,330,604
WAV Wanna_be	wav	30,859,820

listfiles.ino (1)

```
//-----  
// File name : listfiles  
//  
// <Abstract>  
// This example shows how print out the files in a directory on a SD card  
//  
// <Wire connection>  
// Arduino Mega2560 Peripheral Board  
//-----  
// Pin52(SCK)      --  SCK  
// Pin50(MISO)     --  MISO  
// Pin51(MOSI)     --  MOSI  
// Pin53 (/SS)     --  SD_CS  
//  
// This example code is in the public domain.  
//-----  
[ #include <SPI.h>  
#include <SD.h> ]  
  
File root;  
  
void setup()  
{  
    // Open serial communications and wait for port to open:  
    Serial.begin(115200);  
  
    Serial.print("Initializing SD card...");  
  
    if (!SD.begin(53)) // SD.begin은 성공하면 1 return, 실패면 0 return  
    {  
        Serial.println("initialization failed!");  
        return;  
    }  
    Serial.println("initialization done.");  
  
    root = SD.open("/"); // open(filepath) : 즉 file 경로를 입력인자로.  
    printDirectory(root, 0);  
  
    Serial.println("done!");  
}
```

listfiles.ino (2)

```
void loop()
{
    // nothing happens after setup finishes.
}

void printDirectory(File dir, int numTabs)
{
    while (true)
    {
        File entry = dir.openNextFile(); // 다음 file 또는 directory를 report 한다.
        if (!entry)
        {
            break; // no more files
        }
        for (uint8_t i = 0; i < numTabs; i++) // numTabs의 수만큼 \t를 출력한다.
        {
            Serial.print('\t');
        }
        Serial.print(entry.name()); // file 또는 directory 이름의 출력
        if (entry.isDirectory()) // directory인 경우
        {
            Serial.println("/");
            printDirectory(entry, numTabs + 1);
        }
        else
        {
            // files have sizes, directories do not
            Serial.print("\t\t");
            Serial.println(entry.size(), DEC);
        }
        entry.close();
    }
}
```

DumpFile.ino (1)

```
//-----  
// File name : DumpFile.ino  
//  
// <Abstract>  
// This example shows how to read a file from the SD card using the  
// SD library and send it over the serial port.  
//  
// <Wire connection>  
// Arduino Mega2560 Peripheral Board  
//-----  
// Pin52(SCK)    --    SCK  
// Pin50(MISO)   --    MISO  
// Pin51(MOSI)   --    MOSI  
// Pin53 (/SS)   --    SD_CS  
//  
// This example code is in the public domain.  
//-----  
#include <SPI.h>  
#include <SD.h>  
  
const int chipSelect = 53; // Arduino Mega의 경우 Pin 53
```

DumpFile.ino (2)

```
void setup()
{
    // Open serial communications and wait for port to open:
    Serial.begin(115200);
    while (!Serial) {
        ; // wait for serial port to connect. Needed for native USB port only
    }

    Serial.print("Initializing SD card...");

    // see if the card is present and can be initialized:
    if (!SD.begin(chipSelect))
    {
        Serial.println("Card failed, or not present");
        // don't do anything more:
        return;
    }
    Serial.println("card initialized.");

    // open the file. note that only one file can be open at a time,
    // so you have to close this one before opening another.
    File dataFile = SD.open("speech.txt"); // file 이름을 인자로 넘겨준다.

    // if the file is available, write to it:
    if (dataFile)
    {
        while (dataFile.available())
        {
            Serial.write(dataFile.read());
        }
        dataFile.close();
    }
    // if the file isn't open, pop up an error:
    else
    {
        Serial.println("error opening speech.txt");
    }
}

void loop()
{
```