UEFI Development Exploration 93–Using the YIE002 Random Number Generator under UEFI

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Using the YIE002 random number generator under UEFI

In UEFI development exploration 72, the development board of YIE002 was planned. The main goal at that time was to use YIE002 as a two-way communication device for USB HID and implement the host computer access program under Windows, Linux and UEFI.

Today, these goals have been achieved, especially the Windows test program UsbHID, which has now become my dedicated test tool.

There was one item in the development plan that has not yet been completed, which is to enable the YIE002 development board to provide the function of generating random numbers so that the generated random numbers can be obtained through the USB channel in various systems, including the UEFI system.

The inspiration for this goal comes from ChaosKey, developed by foreign engineers. I came across it by chance when I was searching for information online while studying UEFI development. It is a small device (the size of a USB flash drive) that generates random numbers. The author spent a lot of time to make it, which I find very interesting. Therefore, when designing YIE002, a mechanism for generating random numbers was reserved.

I spent some time on the weekend and finally made this random number generator . For the specific process, please see my other blog: YIE002 Development Exploration 10-Random Number Generator.

Let's use this small device under UEFI today.

1. Code Writing

The code writing process is actually very simple. We borrowed the HelloHID project from UEFI Development Exploration 88 and slightly modified the functions to achieve the required functions.

Change HelloHID to RngUEFI, including the INF file and source file name. Then in RobinPkg.dsc, add compilation support for the RngUEFI project to complete the framework adjustment.

Since the YIE002 random number generator provides three USB HID communication capabilities, you can use any of them to communicate with it. Therefore, I directly wrote the code using the Feature Report communication method.

Add the function of getting random numbers as follows:

```
//Name: GetRNG_YIE002
//Input: index
//Output:  RNG
UINT16 GetRNG_YIE002(IN INT16 index)
{
  EFI_STATUS Status;
  UINT8   ReportId;
  UINT8 myBuffer[16];
  UINT16 random_value;

  gBS->SetMem(myBuffer,16,0xA0);
  ReportId = 0;
  Status = UsbSetReportRequest(
    gUsbIO[index],
    0,              //interface,
    ReportId,
    HID_FEATURE_REPORT,
    16,
    myBuffer
  );
  if(EFI_ERROR(Status))
  {
    Print(L"UsbSetReportRequest Error!\n");
    return FALSE;
  }
  gBS->SetMem(myBuffer,16,0x00);
  Status = UsbGetReportRequest(
    gUsbIO[index],
    0,              //interface,
    ReportId,
    HID_FEATURE_REPORT,
    16,
    myBuffer
  );
  if(EFI_ERROR(Status))
  {
    Print(L"UsbGetReportRequest Error!\n");
    return FALSE;
  }
  random_value = myBuffer[1];
  random_value = (random_value<<8);
  random_value += myBuffer[0];

  return random_value;
}
```

Add the statement to access the device in the main program:

```
//测试YIE002制作的随机数生成器
  if(retVal)
  {
    for(i=0; i<20; i++)
    {
      wRandomValue = GetRNG_YIE002(myDevice);
      Print(L"------ %02d Get Random number from YIE002:%04x\n",i,wRandomValue);
      Delayms(1000);
    }
  }
```

The code for obtaining random numbers is completed.

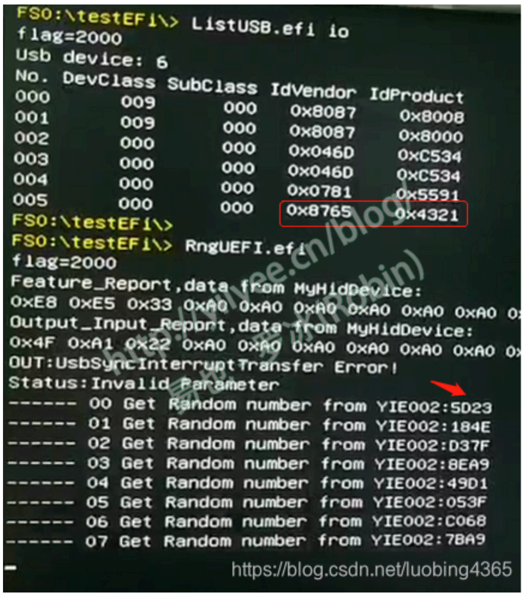
The actual code is at the end of the article as usual, you can read it yourself if you are interested.

2 Testing

Compile the code using the following command:

```
C:\vUDK2018\edk2>build -p RobinPkg\RobinPkg.dsc -m RobinPkg\Applications\RngUEFI\RngUEFI.inf -a X64
```

Copy the generated file RngUEFI.efi to the UEFI boot USB disk for testing, connect YIE002 to the testing machine, and start the UEFI Shell. The test results are shown in Figure 1.



```
FS0:\testEFi\> ListUSB.efi io
flag=2000
Usb device: 6
No. DevClass SubClass IdVendor IdProduct
000       009      000   0x8087     0x8008
001       009      000   0x8087     0x8000
002       000      000   0x046D     0xC534
003       000      000   0x046D     0xC534
004       000      000   0x0781     0x5591
005       000      000   0x8765     0x4321
FS0:\testEFi\>
FS0:\testEFi\> RngUEFI.efi
flag=2000
Feature_Report,data from MyHidDevice:
0xE8 0xE5 0x33 0xA0 0xA0 0xA0 0xA0 0xA0 0xA0 0x
Output_Input_Report,data from MyHidDevice:
0x4F 0xA1 0x22 0xA0 0xA0 0xA0 0xA0 0xA0 0xA0 0x
OUT:UsbSyncInterruptTransfer Error!
Status:Invalid Parameter
------ 00 Get Random number from YIE002:5D23
------ 01 Get Random number from YIE002:184E
------ 02 Get Random number from YIE002:D37F
------ 03 Get Random number from YIE002:8EA9
------ 04 Get Random number from YIE002:49D1
------ 05 Get Random number from YIE002:053F
------ 06 Get Random number from YIE002:C068
------ 07 Get Random number from YIE002:7BA9
_
```

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Figure 1 Testing the random number generator of YIE002

During the test, plug the YIE002 into the USB port of the test machine, and use the previous enumeration tool ListUsb.efi in the UEFI Shell to see whether the device is plugged in (the PID and VID we use are 0x4321 and 0x8765 respectively).

When running RngUEFI.efi, random numbers will continue to be obtained from YIE002. As can be seen in Figure 1, all obtained values are 16-bit random values.

Before testing the random number acquisition, three USB HID communication methods were run. The host computer access method through endpoint 1 (that is, the access method of reading and writing files, YIE002 uses endpoint 1 to read and write to correspond to this method) is not supported on this test machine, so an error is returned.

At this point, the programming of the YIE002 development board that was set at that time was almost completed.

Gitee address: https://gitee.com/luobing4365/uefi-explorer
Project code is located in: /FF RobinPkg/RobinPkg/Applications/RngUEFI