

Code

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x      ,      ,      가      가
.

using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Threading.Tasks;
using System.Diagnostics;
using System.Threading;
using ec = ComiLib.EtherCAT.SafeNativeMethods;

namespace EtherCAT_Examples_CSharp
{
    /// <summary>
    ///
    /// </summary>
    public class Cookbook_Initialize
    {
        // SystemInit()
        // SystemInit(), Init() Task
        .
        ,

#if true // .net 4.5 (async / await)
        public async void SystemInit()
        {
            IsStop = false;
            bool isSuccess = await Init();
            AddLog(string.Format("System Initialize {0}", isSuccess ?
"success" : "false"));
        }

        public async Task<bool> Init()
        {
            // Master Device
            if (!await Task.Run(() => InitMasterDevice()))
                return false;

            // Config Scan .( )
            if (!await Task.Run(() => CheckChannel()))
                return false;

            var taskList = new List<Task<bool>>();

            // , 가
            axisList.ToList().ForEach(axis => taskList.Add(Task.Run(() =>
AxisServo0n(axis))));

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```
        var resultList = (await Task.WhenAll(taskList)).ToList();
        if (resultList.Any(x => !x))
            return false;

        //
        taskList.Clear();
        axisList.ToList().ForEach(axis => taskList.Add(Task.Run(() =>
AxisHomeReturn(axis))));
        resultList = (await Task.WhenAll(taskList)).ToList();
        return resultList.All(x => x);
    }

#else // .net 4.0
    public void SystemInit()
    {
        Task<bool>.Factory.StartNew(() => Init()).ContinueWith(x =>
            AddLog(string.Format("System Initialize {0}", x.Result ?
"success" : "false")));
    }

    public bool Init()
    {
        // Master Device
        if(!Task.Factory.StartNew(() => InitMasterDevice()).Result)
            return false;

        // Config Scan .(
        if (!Task.Factory.StartNew(() => CheckChannel()).Result)
            return false;
        var taskList = new List<Task<bool>>();

        // 가
        axisList.ToList().ForEach(axis =>
taskList.Add(Task.Factory.StartNew(() => AxisServo0n(axis))));
        Task.Factory.ContinueWhenAll(taskList.ToArray(), r => { });
        //Task.WaitAll(taskList.ToArray());
        if (taskList.Exists(x => !x.Result))
            return false;

        //
        taskList.Clear();
        axisList.ToList().ForEach(axis =>
taskList.Add(Task.Factory.StartNew(() => AxisHomeReturn(axis))));
        Task.Factory.ContinueWhenAll(taskList.ToArray(), r => { });
        return (!taskList.Exists(x => !x.Result));
    }

#endif

    public bool IsStop { get; set; }

    int netID = 0;
```

```
uint slaveCount = 0;
int errorCode = 0;
byte[] axisList = new byte[32];
List<string> errorList = new List<string>();
CancellationTokenSource cts;
#region AddLog

private void AddLog(int errorCode)
{
    if (errorCode == 0)
        return;

    Debug.WriteLine(ec.ecUtl_GetErrorString(errorCode));
}

private void AddLog(string errorString)
{
    Debug.WriteLine(errorString);
}

#endregion

void Stop()
{
    IsStop = true;
}

/// <summary>
/// Master Device
/// </summary>
/// <returns></returns>
private bool InitMasterDevice()
{
//
    if (!DeviceLoad())
        return false;

//
    if (!CompareSlaveCount())
        return false;

// SW Version(FW, WDM, SDK)
    if (!GetVersionCompResult())
    {
        AddLog("Version compare fail");
        return false;
    }
    AddLog("Version compare compt");

//
    Input / Output
```

```

        if (!CheckReveseConnection())
        {
            AddLog("                .");
            return false;
        }

        // Network alStatus OP
        if (!SetAlStateToOP())
            return false;

        AddLog("MasterDevice Init Compt");
        return true;
    }

private bool DeviceLoad()
{
    try
    {
        // Device
        if (!ec.ecGn_LoadDevice(ref errorCode))
        {
            AddLog(errorCode);
            switch (errorCode)
            {
                case 5:
                    AddLog("Mater Device 12V
.");
                    break;

                case 8:
                    AddLog("Mater Device가
                    . Windows
FastBoot(
)가
");
                    break;
            }

            return false;
        }

        return true;
    }
    catch (BadImageFormatException)
    {
        AddLog("ecGn_LoadDevice Failed : DLL (x86/x64) OS
.");
        return false;
    }
    catch (DllNotFoundException)
    {
        AddLog("ecGn_LoadDevice Failed : DLL
.");
        return false;
    }
}

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        catch (Exception ex)
        {
            AddLog(string.Format("ecGn_LoadDevice Failed : Exception -
{0}", ex.ToString()));
            return false;
        }
    }

private bool CompareSlaveCount()
{
    // Config slave
    // Configuration

    // Config
https://winoar.com/dokuwiki/platform:ethercat:1\_setup:10\_config:20\_configura
tion

    uint cfgCount = ec.ecNet_GetCfgSlaveCount(netID, ref errorCode);
    if (errorCode != 0)
    {
        AddLog(errorCode);
        return false;
    }

    // slave
    uint slaveCount = ec.ecNet_ScanSlaves(netID, ref errorCode);
    if (errorCode != 0)
    {
        AddLog(errorCode);
        return false;
    }

    //
    if (cfgCount != slaveCount)
    {
        AddLog("
가
.");
        AddLog(string.Format("ScanSlave : {0}. CfgCount : {1}",
slaveCount, cfgCount));
        AddLog("
가
.");
        AddLog("
가 ScanSlave
Configuration
.");
        return false;
    }
    return true;
}

private bool SetAlStateToOP()
{
    // alStatus :
https://winoar.com/dokuwiki/platform:ethercat:2\_info:10\_alstatus
    ec.ecNet_SetAlState(netID, ec.EEcalState.OP, ref errorCode);

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        if (errorCode != 0)
        {
            AddLog(errorCode);
            return false;
        }
        AddLog("Set AlState to OP");

        // Network alStatus가 , Slave alStatus Network
alStatus
        // slave alStatus가 OP가 , slave
        //
https://winoar.com/dokuwiki/platform:ethercat:1\_setup:10\_config:ts:30\_safeop\_failed

        // alStatus가 OP가
        // alStatus가 OP가 slave
        ec.EEcAlState alState = ec.EEcAlState.INITIAL;
        Stopwatch sw = new Stopwatch();
        sw.Start();

        bool isSuccess = false;
        while (sw.ElapsedMilliseconds < 10000 && !isSuccess)
        {
            if (IsStop)
            {
                AddLog("Stop");
                return false;
            }

            isSuccess = true;
            for (int i = 0; i < slaveCount; i++)
            {
                alState = ec.ecSlv_GetAlState_A(netID, i, ref
errorCode);
                if (alState != ec.EEcAlState.OP || errorCode != 0)
                {
                    isSuccess = false;
                    break;
                }
            }
            Thread.Sleep(200);
        }

        if (!isSuccess)
        {
            for (int i = 0; i < slaveCount; i++)
            {
                alState = ec.ecSlv_GetAlState_A(netID, i, ref
errorCode);
                if (alState != ec.EEcAlState.OP || errorCode != 0)
                    AddLog(string.Format(" : {0} AlState OP

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        .", i));
    }

    return false;
}

return true;
}

/// <summary>
/// Config      Scan      (      )
/// </summary>
/// <returns></returns>
public bool CheckChannel()
{
    AddLog("CheckChannel");
    // Scan  Axis  IO
//
    int axisCount = ec.ecmGn_GetAxisList(netID, axisList, 32, ref
errorCode);
    Array.Resize(ref axisList, axisCount);

    if (errorCode != 0)
    {
        AddLog(errorCode);
        return false;
    }

    if (axisCount == 0)
    {
//
        AddLog("      .");
    }

    // config  DI Channel
    int totalDiCount = ec.ecdiGetNumChannels(netID, ref errorCode);
    if (errorCode != 0)
    {
        AddLog(errorCode);
        return false;
    }

    // config  DO Channel
    int totalDoCount = ec.ecdoGetNumChannels(netID, ref errorCode);
    if (errorCode != 0)
    {
        AddLog(errorCode);
        return false;
    }

#if false //
    가
    ,
    .

```



```

        int definedAxisCount = 8; //
        if (definedAxisCount != axisCount)
        {
            // axisCount 가

            //
            //          config
            //          Config 가
            //          .");
            AddLog("
            return false;
        }

        int definedDiCount = 32; //          di channel
        int definedDoCount = 32; //          do channel

        if (definedDiCount != totalDiCount)
        {
            AddLog("          DI Slave가          Config 가          .");
            return false;
        }

        if (definedDoCount != totalDoCount)
        {
            AddLog("          DO Slave가          Config 가          .");
            return false;
        }
#endif
        return true;
    }

    /// <summary>
    /// FW - WDM - DLL
    /// </summary>
    private bool GetVersionCompResult()
    {
        // SW Version(FW, WDM, SDK)
        //
        ec.TEcFileVerInfo_SDK sdkInfo = new ec.TEcFileVerInfo_SDK();
        ec.TEcFileVerInfo_WDM driverInfo = new ec.TEcFileVerInfo_WDM();
        ec.TEcFileVerInfo_FW fwInfo = new ec.TEcFileVerInfo_FW();

        bool isSuccess = ec.ecNet_GetVerInfo(netID, ref sdkInfo, ref
driverInfo, ref fwInfo, ref errorCode);

        if (!isSuccess)
        {
            //FW - SDK
            switch (sdkInfo.nFwCompResult)
            {
                case (int)ec.EEcVerCompatResult.ecVER_MISMATCH_LOWER:
AddLog("Library version is higher than the Firmware"); return false;
                case (int)ec.EEcVerCompatResult.ecVER_MISMATCH_HIGHER:

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AddLog("Library version is lower than the Firmware"); return false;
        case (int)ec.EEcVerCompatResult.ecVER_MATCH: AddLog("FW-
SDK : OK"); break;
        default: AddLog("Firmware Version is invalid"); return
false;
    }

    //FW-WDM
    switch (driverInfo.nFwCompResult)
    {
        case (int)ec.EEcVerCompatResult.ecVER_MISMATCH_LOWER:
AddLog("Driver version is higher than the Firmware"); return false;
        case (int)ec.EEcVerCompatResult.ecVER_MISMATCH_HIGHER:
AddLog("Driver version is lower than the Firmware"); return false;
        case (int)ec.EEcVerCompatResult.ecVER_MATCH: AddLog("FW-
WDM : OK"); break;
        default: AddLog("Firmware Version is invalid"); return
false;
    }

    //SDK-WDM
    switch (sdkInfo.nWdmCompResult)
    {
        case (int)ec.EEcVerCompatResult.ecVER_MISMATCH_LOWER:
AddLog("Driver version is lower than the Library"); return false;
        case (int)ec.EEcVerCompatResult.ecVER_MISMATCH_HIGHER:
AddLog("Library version is lower than the Driver"); return false;
        case (int)ec.EEcVerCompatResult.ecVER_MATCH:
AddLog("SDK-WDM : OK"); break;
        default: AddLog("Driver Version is invalid"); return
false;
    }
}

return isSuccess;
}

/// <summary>
///     Inport / Outport가     가
/// </summary>
private bool CheckReveseConnection()
{
    if (!CanCheckReverseConnection())
        return false;

    //
    int scanSlaveCount = 0;
    int reverseConnectionCount =
ec.ecNet_CheckReverseConnections(netID, ref scanSlaveCount, ref errorCode);

    //     가     ,

```

```
        //if (definedSlaveCount != scanSlaveCount)
        //{
// //          Config
//   AddLog(string.Format("Disconnected Slave Count = {0}",
definedSlaveCount - scanSlaveCount));
//}

// reverseConnectionCount    0    ,

if (reverseConnectionCount == 0)
{
    AddLog(string.Format("ReverseConnection is nothing."));
    return true;
}
else
{
    AddLog(string.Format("ReverseConnectionCount = {0}",
reverseConnectionCount));

    bool isReverseConnected = false;
//
    for (ushort i = 0; i < scanSlaveCount; i++)
    {
        isReverseConnected =
ec.ecSlv_IsReverseConnected_A(netID, i, ref errorCode);

        if (isReverseConnected)
            AddLog(string.Format("Check SlaveIndex {0} :
ReverseConnected", i));
    }
    return false;
}
}

/// <summary>
/// DLL : 1.5.3.2 ( FW : 1.92 / WDM : 1.5.0.6)          가
/// </summary>
private bool CanCheckReverseConnection()
{
    ec.TEcFileVerInfo_SDK sdkInfo = new ec.TEcFileVerInfo_SDK();
    ec.TEcFileVerInfo_WDM driverInfo = new ec.TEcFileVerInfo_WDM();
    ec.TEcFileVerInfo_FW fwInfo = new ec.TEcFileVerInfo_FW();

    //FW / Driver / Library
    bool isSuccess = ec.ecNet_GetVerInfo(netID, ref sdkInfo, ref
driverInfo, ref fwInfo, ref errorCode);
    string sdkVer = string.Format("{0}{1}{2}{3}",
sdkInfo.CurVer.MajorVer, sdkInfo.CurVer.MinorVer, sdkInfo.CurVer.BuildNo,
sdkInfo.CurVer.RevNo);
    int curVer = int.Parse(sdkVer);
```

```
// Library      1.5.3.2
if (curVer < 1532)
{
    AddLog("CheckReverseConnection : Not Supported version");
    return false;
}

return true;
}

/// <summary>
/// Alarm Clear & Servo0n
/// </summary>
/// <param name="axisID"></param>
/// <returns></returns>
private bool AxisServo0n(int axisID)
{
    // state
    int motState = ec.ecmSxSt_GetMotState(netID, axisID, ref
errorCode);
    if (errorCode != 0)
    {
        AddLog(errorCode);
        return false;
    }

    if (motState != 0)
    {
        // State가 Stop
        // Stop
        ec.ecmSxMot_Stop(netID, axisID, 1, 1, ref errorCode);
    }

    Stopwatch sw = new Stopwatch();
    if (motState == -1010) //
    {
        ec.ecmSxCtl_ResetAlm(netID, axisID, ref errorCode); //

        if (errorCode != 0)
        {
            AddLog(errorCode);
            return false;
        }

        sw.Start();
        while (sw.ElapsedMilliseconds < 1000 &&
ec.ecmSxSt_GetMotState(netID, axisID, ref errorCode) == -1010)
            Thread.Sleep(100);
        motState = ec.ecmSxSt_GetMotState(netID, axisID, ref
errorCode);
    }
}
```

```
        if (errorCode != 0)
        {
            AddLog(errorCode);
            return false;
        }

        // 1
        // 1
        if (motState == -1010)
        {
            AddLog(string.Format("Axis {0} :
axisID));
            return false;
        }
    }

    //      가 Operation Enable
    var isOn = ec.ecmSxCtl_GetSvon(netID, axisID, ref errorCode);
    if (errorCode != 0)
    {
        AddLog(errorCode);
        return false;
    }

    if (!isOn)
    {
        // Operation Enable      가      , Enable      (      )

        ec.ecmSxCtl_SetSvon(netID, axisID, 1, ref errorCode);

        sw.Restart();
        while (sw.ElapsedMilliseconds < 2000 &&
!ec.ecmSxCtl_GetSvon(netID, axisID, ref errorCode))
            Thread.Sleep(100);

        // 2      Enable      , Enable

        // 2
        isOn = ec.ecmSxCtl_GetSvon(netID, axisID, ref errorCode);
        if (errorCode != 0)
        {
            AddLog(errorCode);
            return false;
        }

        if (!isOn)
        {
            AddLog(string.Format("Axis {0} : Servo0n fail.",
axisID));

            return false;
        }
    }
}
```

```

    }

    AddLog(string.Format("Axis {0} : ServoOn Success.", axisID));
    return true;
}

/// <summary>
/// Home Return
/// </summary>
/// <param name="axisID"></param>
/// <returns></returns>
private bool AxisHomeReturn(int axisID)
{
    //      Guide
    //
https://winoar.com/dokuwiki/platform:ethercat:70\_users\_guide:10\_homing:start

    int homeMode = 114; //
    ec.ecmHomeCfg_SetMode(netID, axisID, homeMode, ref errorCode);
    if (errorCode != 0)
    {
        AddLog(errorCode);
        return false;
    }

    //      가      가
    // Offset
    double homeOffset = 0;
#if true
    ec.ecmHomeCfg_SetOffsetEx(netID, axisID, homeOffset, false, 1,
ref errorCode);
    if (errorCode != 0)
    {
        AddLog(errorCode);
        return false;
    }
#else
    //      , 가
    ec.ecmHomeCfg_SetOffset(netID, axisID, homeOffset, ref
errorCode);
    if (errorCode != 0)
    {
        AddLog(errorCode);
        return false;
    }
#endif

    //
    //

    int speedMode = 2; // 가      . 0:Constant
1:Trapzoidal 2:S-Curve

```

```

    double workSpeed = 100000;
    double accel = workSpeed * 10;
    double decel = workSpeed * 10;
    double specVel = workSpeed / 10; // 1
    ,
        가
        .

    ec.ecmHomeCfg_SetSpeedPatt(netID, axisID, speedMode, workSpeed,
    accel, decel, specVel, ref errorCode);
    if (errorCode != 0)
    {
        AddLog(errorCode);
        return false;
    }
    int dir = 0; // . 0:(-) 1:(+)
    ec.ecmHomeMot_MoveStart(netID, axisID, dir, ref errorCode);
    if (errorCode != 0)
    {
        AddLog(errorCode);
        return false;
    }

    // TimeOut
    Stopwatch sw = new Stopwatch();
    sw.Start();

    bool isBusy = true;
    while (sw.ElapsedMilliseconds < 10000 && isBusy)
    {
        if (IsStop)
        {
            AddLog("Stop");
            return false;
        }

        isBusy = ec.ecmHomeSt_IsBusy(netID, axisID, ref errorCode);
        Thread.Sleep(100);
    }

    // isBusy가 true , timeout while
    if (isBusy)
    {
        AddLog(string.Format("Axis {0} Homing Timeout", axisID));
        return false;
    }

    // isBusy가 false ,

    // , isBusy false

    ec.TEcmHomeSt_Flags homeFlag = new ec.TEcmHomeSt_Flags();
    homeFlag.word = ec.ecmHomeSt_GetFlags(netID, axisID, ref
    errorCode);

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```
        bool isSuccess = ((homeFlag.word >> 2) & 1) == 1;
        if (!isSuccess)
        {
            // 가 , 가 가 ,
motState 가
            // MotState == 0 , Stop
            int motState = ec.ecmSxSt_GetMotState(netID, axisID, ref
errorCode);
            AddLog(errorCode);
        }

        AddLog(string.Format("Axis {0} : HomeReturn {1}", axisID,
isSuccess ? "success" : "fail"));
        return isSuccess;
    }
}
}
```

From:

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Last update: **2024/07/08 18:23**