Microscope Automation Using Labview

B.TECH PROJECT REPORT

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Submitted by

Mr. C Unnikrishnan B Nambiar
Eighth Semester
B.Tech, Instrumentation Technology

Guided by
Mr. Kiran Babu
Assistant Professor
Department of Instrumentation

COCHIN UNIVERSITY OF
SCIENCE AND TECHNOLOGY

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COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY KOCHI-22
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DEPARTMENT OF INSTRUMENTATION

COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

KOCHI-22

CERTIFICATE

This is to certify that this main project report entitled "Microscope Automation using Labview" is a bonafide record of the work done by Mr. C Unnikrishnan B Nambiar, under our guidance towards partial fulfillment of the requirements for the award of B.Tech. Degree in Instrumentation Technology, from the Department of Instrumentation, Cochin University of Science and Technology during the year 2022.

Dr. Johney Issac
Associate Professor & Head
Dept. of Instrumentation
CUSAT

Mr. Kiran Babu

Assistant Professor
Dept. of Instrumentation
CUSAT

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Mr. C Unnikrishnan B Nambiar

Phone : 091-512-2594103

Fax : 091-512-2594010

भारतीय प्रौद्योगिकी संस्थान कानपुर
INDIAN INSTITUTE OF TECHNOLOGY KANPUR

DEPARTMENT OF BIOLOGICAL SCIENCES AND BIO - ENGINEERING

आई०.आई.टी. कानपुर-208016 (उ०प्र०)भारत
I.I.T., KANPUR - 208016 (U.P.) India

Date:22/04/2022

TO WHOMSOVER IT MAY CONCERNS

It is my pleasure to endorse the candidature of **Mr. Bharath K, Mr. C Unnikrishnan B Nambiar, Mr. Salmanul Faris KK, Mr. Sahad Muhammed V** for Non- Degree Student Program at IIT- Kanpur during which they worked in my lab and Online As project trainees for the project **"Microscope Automation Using Labview".**

Sincerely,

Dr. Nitin Mohan
Assistant Professor
Dept. of B.S.B.E.
I.I.T. Kanpur
Kanpur - 208016 (IND)
Tel: +91-0512-2594103

Dr. Nitin Mohan

ABSTRACT

PALM is a super-resolution microscopy technique and PALM is short for Photoactivated Localization Microscopy. The technique was invented by Eric Betzig along with his colleague Harald Hess and this work was recognized internationally with the award of the 2014 Nobel Prize for Chemistry. STORM stands for "Stochastic Optical Reconstruction Microscopy" and it relies on the stochastic activation of individual fluorophores with photoactivatable properties.The device we are going to work on is a very indigenous and rare one where we are going to perform storm imaging, laser controlling , laser cycling and optical modulation.There are only a few locations in the country where we can work on storm imaging and one of them is BSBE,IIT Kanpur.The task we have is to integrate and develop a single VI using Labview software.For that we need to perform basic data acquisition using NI DAQ card,Thorlab motor controlling using Labview and finally EMCCD camera interfacing using labview after which we need to integrate all these into a single Labview program and develop a platform where all these tasks can be done using a single software with much ease,rather than performing each tasks one by one which is really time consuming and cannot be organized.

CONTENTS

1

LIST OF FIGURES

CHAPTER 1

Introduction

1.1 General introduction

Photo-activated localization microscopy(PALM or FPALM)and stochastic optical reconstruction microscopy(STORM)are widefield(as opposed to point scannings such as laser scanning confocal microscopy) that allow fluorescence imaging microscopy to enable the adoption to—images with correction over the distortion limit. The plans were proposed in 2006 after the general emergence of optical super-resolution microscopy methods and were published in the 2008 Annual Methods by the journal Natural Methods. The development of PALM as a targeted biophysical imaging method was mainly due to the discovery of new species and engineering genetics of fluorescent proteins that show controllable photochromism, such as GFP image processing. However, the parallel development of STORM, sharing the same basic principle, was initially used in paired cyanine dyes. One pear molecule(called an activator), when you are happy near its absorption limit , works to regenerate another molecule(called a reporter)in a fluorescent state. A growing amount of dye is used for PALM, STORM and related techniques, organic fluorophores and fluorescent proteins. Some are compatible with live cell capture, while others allow faster detection or over-labelling. The choice of a particular fluorophore ultimately depends on its use and features for photography. Both of these methods have had significant technological advances,mainly to allow multicolour images and three-dimensional expansion, with the best axial of 10 nm in the third dimension obtained using an interferometric approach with two opposing objectives collecting the fluorescence from the sample.

1.2 Graphical Programming and Labview

LabVIEW ties the creation of user interfaces(called front panels)into the development cycle.LabVIEW programs/subroutines are called virtual instruments(VIs).Each VI has three components:a block diagram, a front panel and a connection panel. The latter is used to represent VI in blockchain drawings of others, to call VIs. The front panel is built using controls and pointers. Input controls: allow the user to build a VI. Indicators are given as the output: they show results based on inputs given to VI. Next panel, which is given as a block diagram, contains the program’s source code. All items placed in the front panel will appear in the back panel as terminals. The back panel also contains functions that are to be performed in the specific program . Properties and functions are available in the Tasks palette and can be added to the back panel. Shared controls, pointers, structures, and functions are called nodes. Nodes are connected to each other using cables, e.g., two controls, and the indicator can be wired to add function so that the index reflects the total of two controls. The visual tool can therefore serve as a program, the front panel acting as the user interface, or, when deprecated as a node in a block diagram, the front panel defines the input and output node through the connector window. This means that each VI can be easily tested before being embedded as a sub-system in a larger system. Clicking also allows non-programmers to create programs by dragging and dropping visual presentations of the lab devices they are familiar with. The LabVIEW editing environment, with embedded examples and documents, makes it easy to make small applications. This is an advantage, on the other hand, but there is also a certain risk of undermining the technology required for high-quality G programs. For complex algorithms or high-level code, the editor must have extensive knowledge of LabVIEW's special syntax and its memory management topology. The most advanced LabVIEW development programs offer the ability to build standalone applications. In addition, it is possible to create distributed applications, which communicate via a client-server model, and are thus easier to use due to the natural similarity of G. In this project the microscope was integrated with multiple devices so at first all of them were tried to control using Labview individually and by the end phase all of them were integrated together as a package of virtual instrument softwares.

CHAPTER 2

Data Acquisition Using NI DAQ Card

PCIe-6353 is a high-speed Multifunction I / O device from National Instruments. PCIe-6353 is available under section number 781049-01. PCIe-6353 is a 16-bit X-Series DAQ device. The PCIe-6353 device uses NI-STC3 technology. This technology ensures high performance over time and synchronization. The supported bus connector for PCIe-6353 is PCI Express. The NI PCIe 6353 X Series model offers different types of channels. It includes separate and completed channels only. The device has 32 finished channels. It also covers 16 different terminals for input. These are analog terminals. It also includes flexibility in selecting these terminals with the help of software. This device has a sample rate of 1.25 MS per second. The PCIe-6353 X-Series device does not support simultaneous sampling. This model has a resolution of 10 nanoseconds for analog output time. The PCIe-6353 device comes with FIFO built-in analog input baths. The PCIe-6353 device has 48 editing terminals. These digital terminals are integrated into both input and output devices.

Fig 2.1 : PCle 6353

The PCIe-6353 Multifunction I / O device has four counters or times as well. They have a 32-bit adjustment. These calculators are used for a variety of purposes such as PWM, event counting, coding, and frequency. The PCIe-6353 comes with a built-in generator, equipped with three basic clocks. Its frequencies are limited to the following values: 100 kHz, 10 MHz, and 20 MHz. PCIe-6353 comes with two VHDCI 68-pin connectors for different functions.

2.1 Data Acquisition System

Data Recovery, or DAQ as it is commonly called, is a program for recording data from the world around us so that it can be viewed, analyzed, and stored on a computer. A simple example is the process of measuring room temperature as a digital value using a sensor like a thermocouple. Modern data acquisition systems may include the addition of data analysis and reporting software, network connection, and remote controls and monitoring options. As already discussed, the DAQ or Information Acquisition contains a system size and computer that can measure electrical or physical properties and report them for analysis. The DAQ Vision was introduced in 1963 when it focused exclusively on monitoring or managing a mobile business through a software system. IBM has become a major player in announcing a portable computer switching to fully integrated data acquisition software called the IBM 7700 data acquisition device. The IBM 7700 was replaced by the most effective discovery and exploitation system of IBM 1800 in 1964. With the advancement of generation, computer skills have changed dramatically these days, allowing us to perform faster and maintain records in more ways. The DAQ architecture is an excellent example of this. These devices are able to shoot statistics on a real machine and maintain those records with a flexible structure for advanced engineering or clinical testing. vertical position that requires precision, which includes construction, electrical, manufacturing, and production to name a few. Both DAQ programs are hand-held or can be operated remotely. Portable DAQ systems are useful when you need to read a template that you can physically share. remote DAQ estimates are taken when a person's presence is inconsistent. key add-ons for the DAQ System 1960s IBM machines where computer systems are more than 6 meters. Happily, modern DAQ structures are integrated, yet often more powerful than their predecessors. Years of advances in electronic technology have made it possible for us to have such soft machines that do not have the precision of size. The simple DAQ machine covers 4 parts: Sensors: Sensors or transducers that deal with a measured challenge, immediately or indirectly (touch or not be touched). They hide body values in electric screens. The type of sensors used in the DAQ gadget varies mainly based on the nature of its use.For example, the maximum temperature requires a heat sensor, at the same time as a photovoltaic sensor is useful for small measurements. Their common feature is to hide analog signals like light, temperature, speed, etc. into digital computer indicators. DAQ systems select the best sensors that provide accurate readings with little or no sound. Transmission / signal Conditioning: future electrical signals from sensors .It cannot be used simultaneously, because it needs to be replaced. this change is significant because the indicators are always noisy or they may be at some level that the DAQ gadget cannot measure. For this reason another circuitry is used to make the indicators better, called a sign conditioner. A warning system for improving alerts is known as signal conditioning. The signal conditioner uses clear circuits to separate audio from the actual signal and uses the amplification circuit to amplify the risk alerts. Those are the unusual features they use. There are even additional modes such as balance, line, and tangible pleasure with a suitable signal circuit to create a situation. The choice of signal condition circuit for the most part depends on the sensory characteristics.DAQ Hardware: DAQ Hardware is a hardware component connected between a computer and a sensor. Both DAQ hardware is connected to a portable computer using USB ports or through specific PCI spaces to the motherboard. DAQ Hardware takes in analog signals from the sensors and converts them into computer-readable visual alerts. However, this is just one of the DAQ hardware tools. A few common features of the DAQ device are:ADC: Converts analog signals into digital alerts virtual to analog converter: helps in installing and extracting binary signals RS232, RS485: Interface buses used to talk about different devices singles entry: assist in taking the strings on single strings there may even be a standalone DAQ hardware that can operate on its own without having to be connected to a portable computer. this can be done with a processor and computer unit embedded within the DAQ hardware. DAQ stand-alone computer systems are able to assist customers with the rendering of real-time records. Independent oscilloscopes and mathematical loggers are prime examples of DAQ programs that can paint without a laptop. computer: A fixed piece of the DAQ series is a portable computer that collects all the information that comes with the DAQ hardware for further testing. however, connecting the DAQ hardware to a computer is not enough to create record information. Requires DAQ software that uses the facts from the DAQ hardware to create readable and relevant results. In some clauses, the DAQ software acts as a layer between a person and a DAQ hardware. computer systems are essential for performing high-level calculations with information gathered from the DAQ.

2.2 DAQ Using Labview

LabVIEW-primarily based information acquisition involves writing software on top of suitable hardware to collect information from various sensors (e.g., temperature, strain, modern, …). those statistics are then commonly manipulated and/or filtered earlier than being displayed and/or

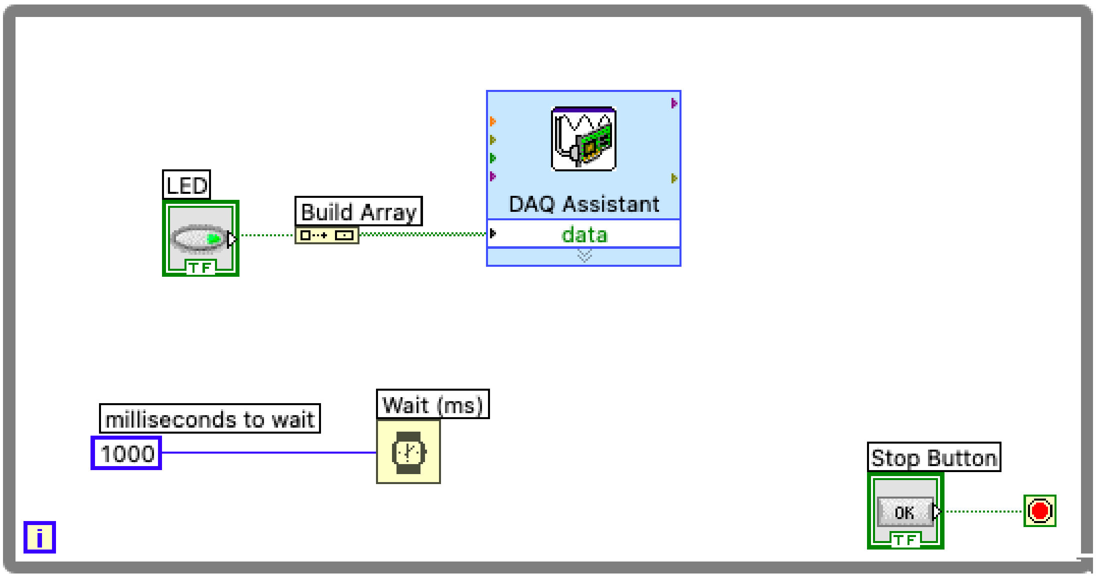


Fig 2.2 : A Simple Code for Turning on LED

recorded for similarly analysis. For learning about this and the concepts this was done using simulation.

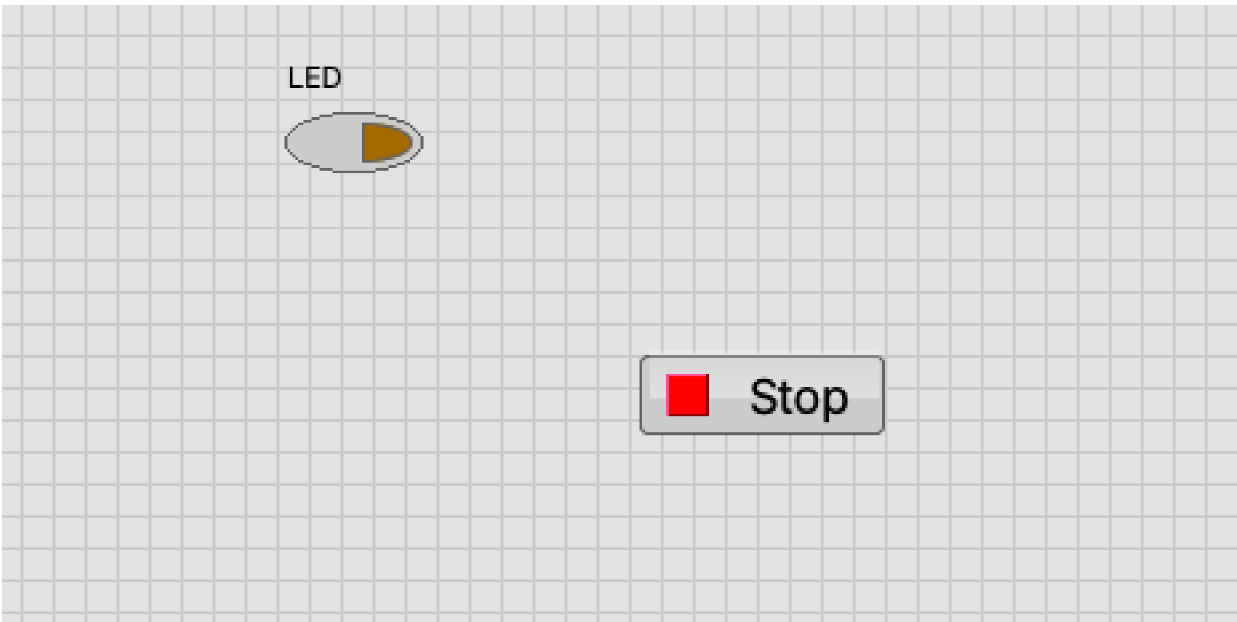


Fig 2.3 :VI for the Code

CHAPTER 3

Motor Controller For The Stage

3.1 KDC101 - K-Cube Brushed DC Servo Motor Controller

The KDC101 K-Cube Brushed DC Servo Motor Controller is part of Thorlabs' new and growing line of advanced motion controls. Designed to provide easy manual and automatic control of DC Servo motors, this single-channel driver can drive a variety of motors with DC brushes (up to 15 V / 2.5 W) encoded with a coding response. It is also designed to work 'out of the box' with Thorlabs' list of optomechanical products fitted with DC servo motors. Extremely flexible software settings and closed-loop tuning also support a wide range of external DC servo motors and compatible components with actuators.

The unit has a very compact foot, 60.0 mm x 60.0 mm x 49.2 mm, which allows it to be placed close to the automotive system for easy adjustment when automatically adjusting the vehicle position using the control panel panels. Tablet performance also allows for smaller cable lengths for easier cable handling. Each unit also contains a pre-installed power switch, which saves all user-adjustable settings when turned off. Please note that this switch should always be used to lower the unit. For convenience, a 1.5 m cable of type A to Micro B USB 3.0 cable is fitted with a KDC101 cube.

3.2 Integrating Kinesis Module With Labview

LabVIEW can be used to connect to any Kinesis- or APT-based controller through .NET controls. In LabVIEW, you create a user interface, known as the front panel, with a set of tools and items and add code using photo presentation functions to control the front panel items. The LabVIEW tutorial, provided below, provides specific information on how to use .NET controls to create Kinesis- and APT control GUIs running within LabVIEW. Includes an overview of all the basic information about using controls in LabVIEW and describes the setup process that needs to be completed before using the LabVIEW GUI to run the device.
LabView provides many standard controls and also has the ability to host third party controls through mechanisms such as .NET. Kinesis software is exposed through .NET to allow users to incorporate hardware control through their own custom applications.

The Steps that helped in opening the dynamic link library (dll) files for the Labview software are given below

Step 1: Expand the Controls palette, then select the .NET & ActiveX palette. If the Controls palette

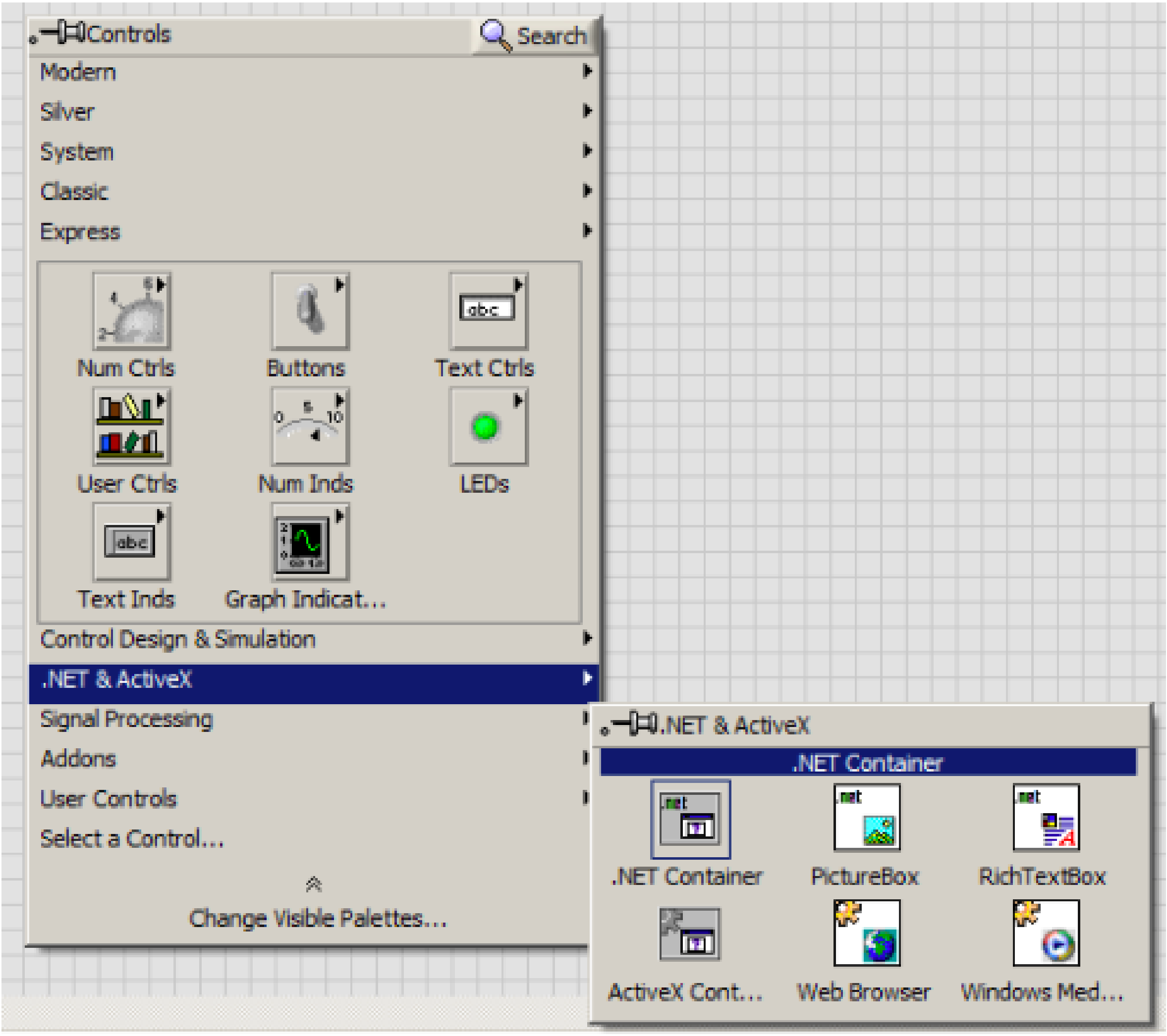


Fig 3.1 : Inserting a .Net Container

is not visible, select View/Controls Palette.

Step 2: Select the .NET Container to attach it to the cursor, and then place the control on the front panel. Notice at this stage the container is empty.

Step 3: Right click on the centre of the .NET Container and select from the shortcut menu “Insert .NET Control”

Step 4: From the dialog window that opens, select Browse… to manually search for the Kinesis .NET control assembly.

Step 5: From the LabView Project folder where the controls and DLLs are copied select the file Thorlabs.MotionControl.Controls.dll

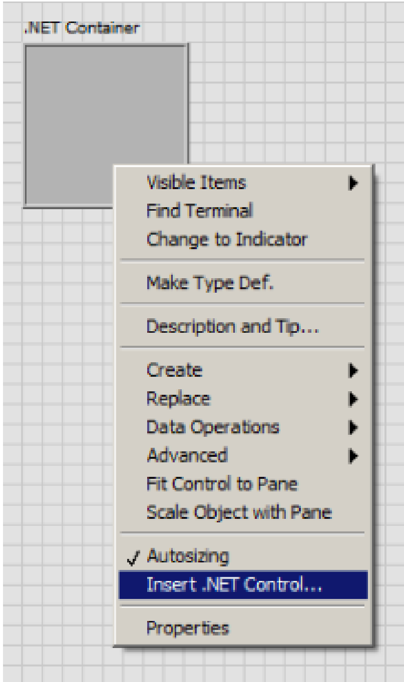


Fig 3.2 : Inserting a .Net Control

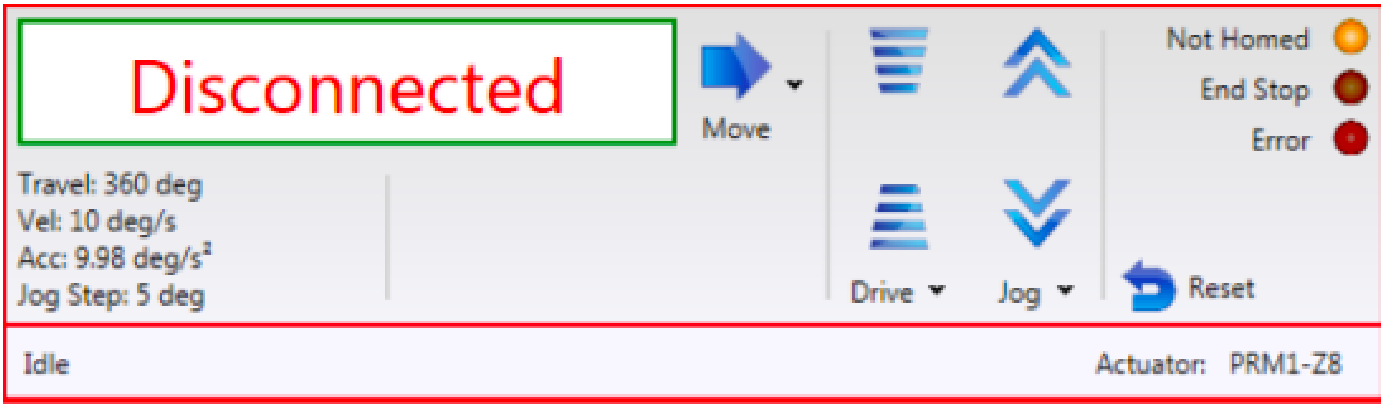
Step 6: From the list displayed, select the control type applicable to the hardware unit you want to load and select KCubeDCServoControl

3.3 Calling a .NET Method

Kinesis control object can be called within the block diagram by using a.NET Invoke Node.In this example we will call the CreateDevice method which starts communication with connected Kinesis hardware.

1) Select the Block Diagram window. If not visible, select Window/Show Block Diagram.
2) .NET palette can be uploaded by right clicking the TCubeDCServoControl object and .NET Palette can be available from the drop down list.
3) Select the Invoke Node icon to attach to the cursor. Then drop the node in the block diagram. Make sure the product number is set before you dial the startup controller in the output area in the previous serialNumber in the CreateDevice enter input log. This guide is the same reference as the first Kinesis control item, however using the output side of the local node ensures that the product number will be set before calling the CreateDevice method.

4) Click the reference output of the location node to start installing cables. Click the invoke node reference input to complete the connection. In the wiring invoke node in the Kinesis control object the invoke node now has available information on which methods are available.
5) Right-click an invoke white node that automatically displays a word path. In the shortcut menu that appears select Options. Available options are introduced in another shortcut menu. Select the CreateDevice method from the list. The invoke node now automatically displays the correct path name. This particular method does not require any other restrictions.



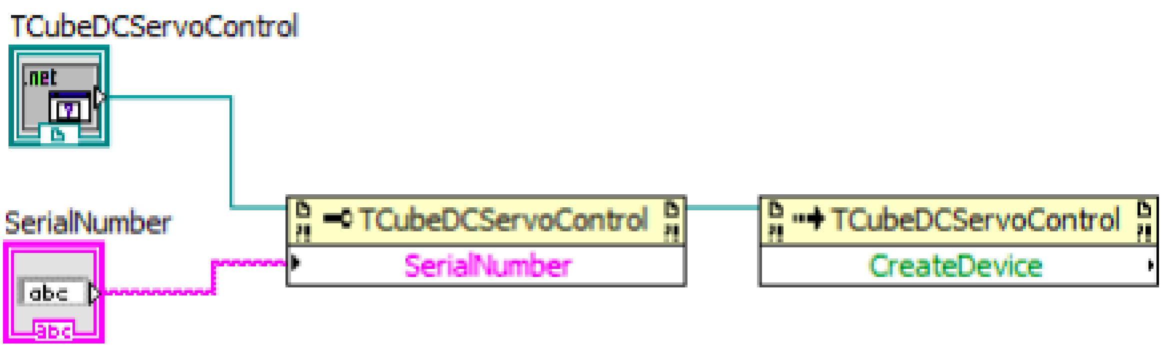


Fig 3.3 :Creating the Motor Control

The program would be able to run in its current state however there would be no way to stop the control. Therefore we need to add a similar method and some execution control to prevent the control stopping prematurely and also to terminate communication to the controller prior to the program finishing. To control the execution control of the VI programming execution structures will

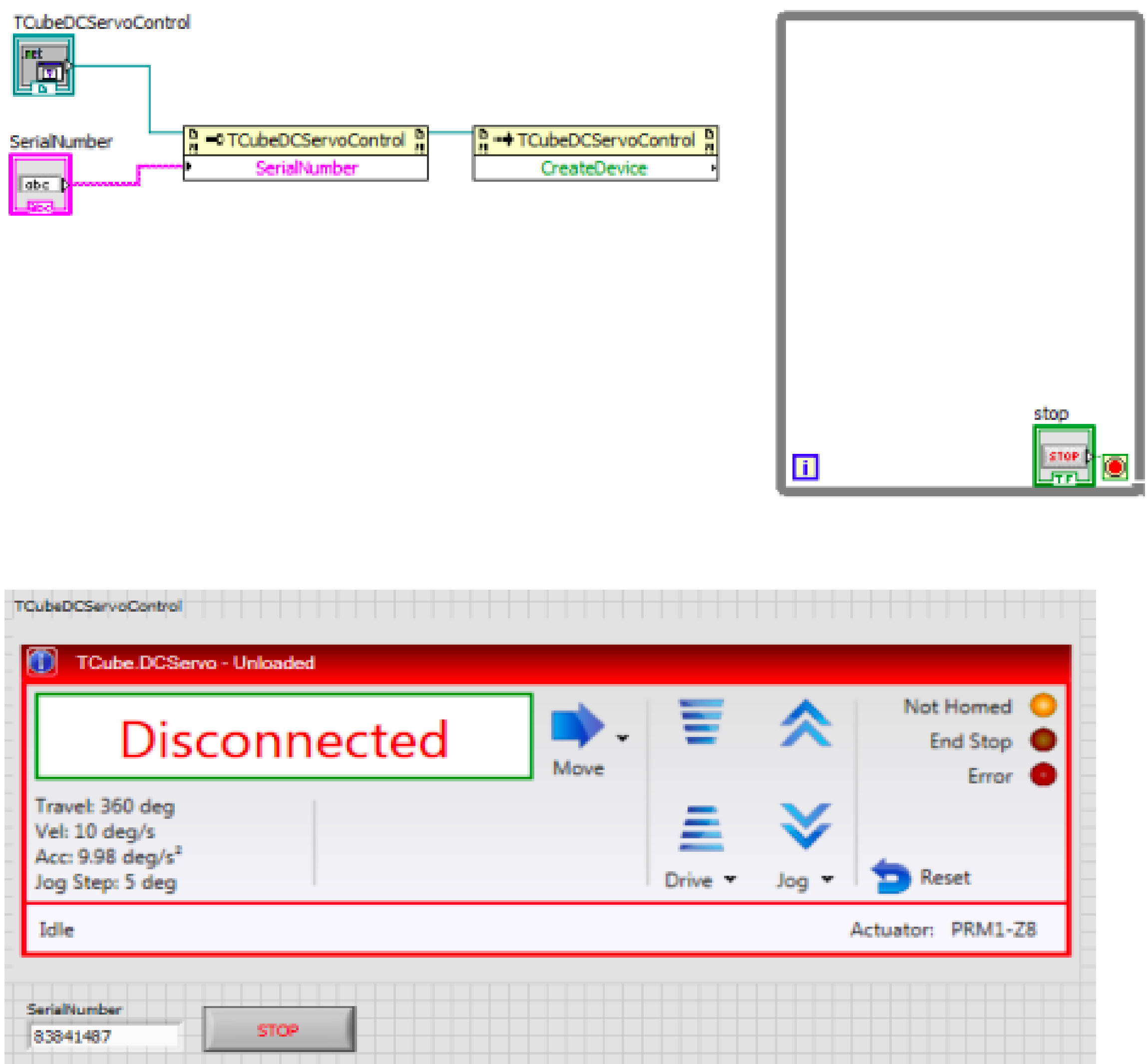


Fig 3.4 : Serial Number Interfacing

need to be added to the block diagram. These help control the order in which LabView function, methods and properties are called, and they can also help prevent the program stopping prematurely. In this case a While Loop should be added to the block diagram. A while loop will repeat any section of code enclosed in the While Loop box until the stop condition is satisfied, at which point the While Loop will complete and the program proceed to the next step.

1) If the block diagram is not visible select from the front panel menu bar Window / Show Block Diagram.
2) Right click the block diagram workspace to view the Functions Palette. To select a While Loop select the Execution Control menu, from the subsequent menu select While Loop.

3) Draw a rectangle onto the block diagram to the right of the CreateDevice method icon, this will create a while loop in the block diagram as shown.
4) A corresponding STOP button to stop the While Loop Will now be displayed on the front panel, which can be repositioned if necessary.

3.4 The Motor

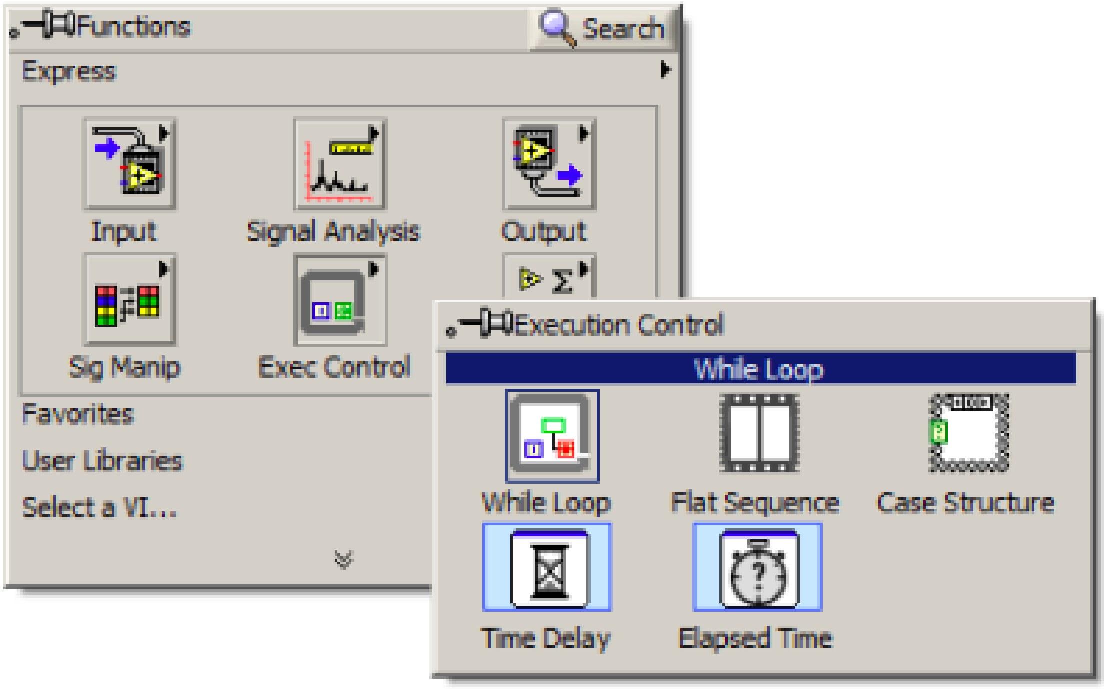


Fig 3.5 : Functions Palette

1) To create a method to call a motor function right click on the output arrow of the Device property node (circled) and select Create / Method for Thorlabs.MotionControl.TCube.DCServoCLI.TCubeDCServo Class
2) From the method drop down menu select the method Home(Int32 waitTimeout). This will create an Invoke node with the selected method. Place this method onto the block diagram.

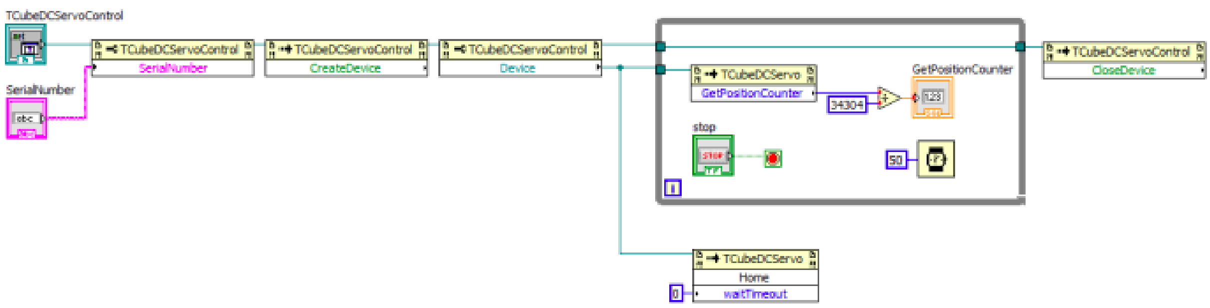


Fig 3.6 : Motor Homing

3) Wire the input reference of the Home method to the wire connecting the Device Property Node to the While loop as shown in the figure below.
4) The method requires a timeout to be entered. If this value is 0 then the function will return immediately. If this value is non zero, then the function will wait until the move completes or the timeout elapses, whichever comes first. To add a wait timeout right click the input connector of the waitTimeout parameter and select from the shortcut menu displayed Create / Constant. A suitable data type constant is created and wired automatically. Enter a suitable timeout. THORLABS 22
5) The completed block diagram should now look similar to the one shown in the figure below.

3.5 Relative Movement of the Motor

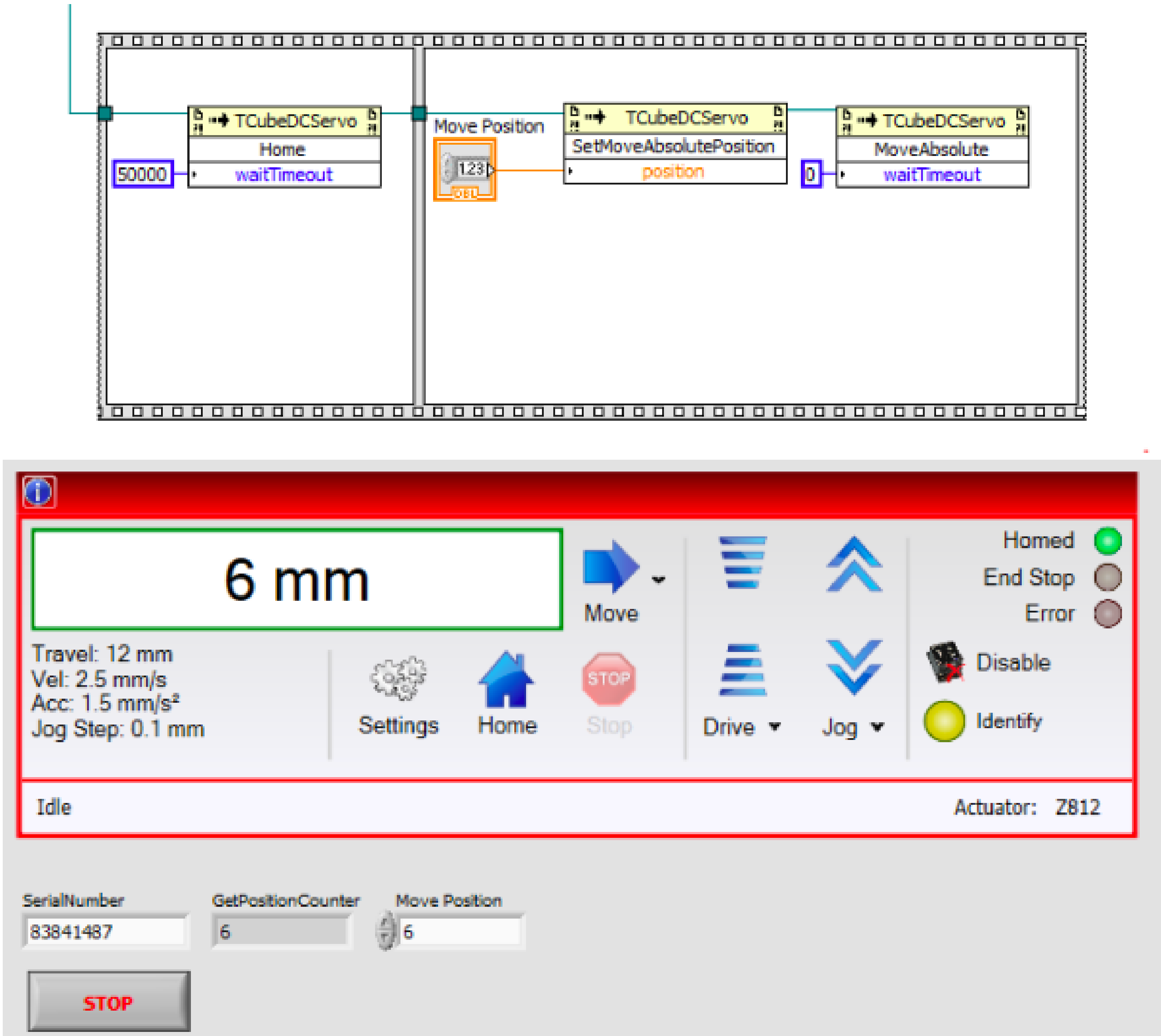


Fig 3.7 : Relative Motion of the Motor

3.6 Position Control

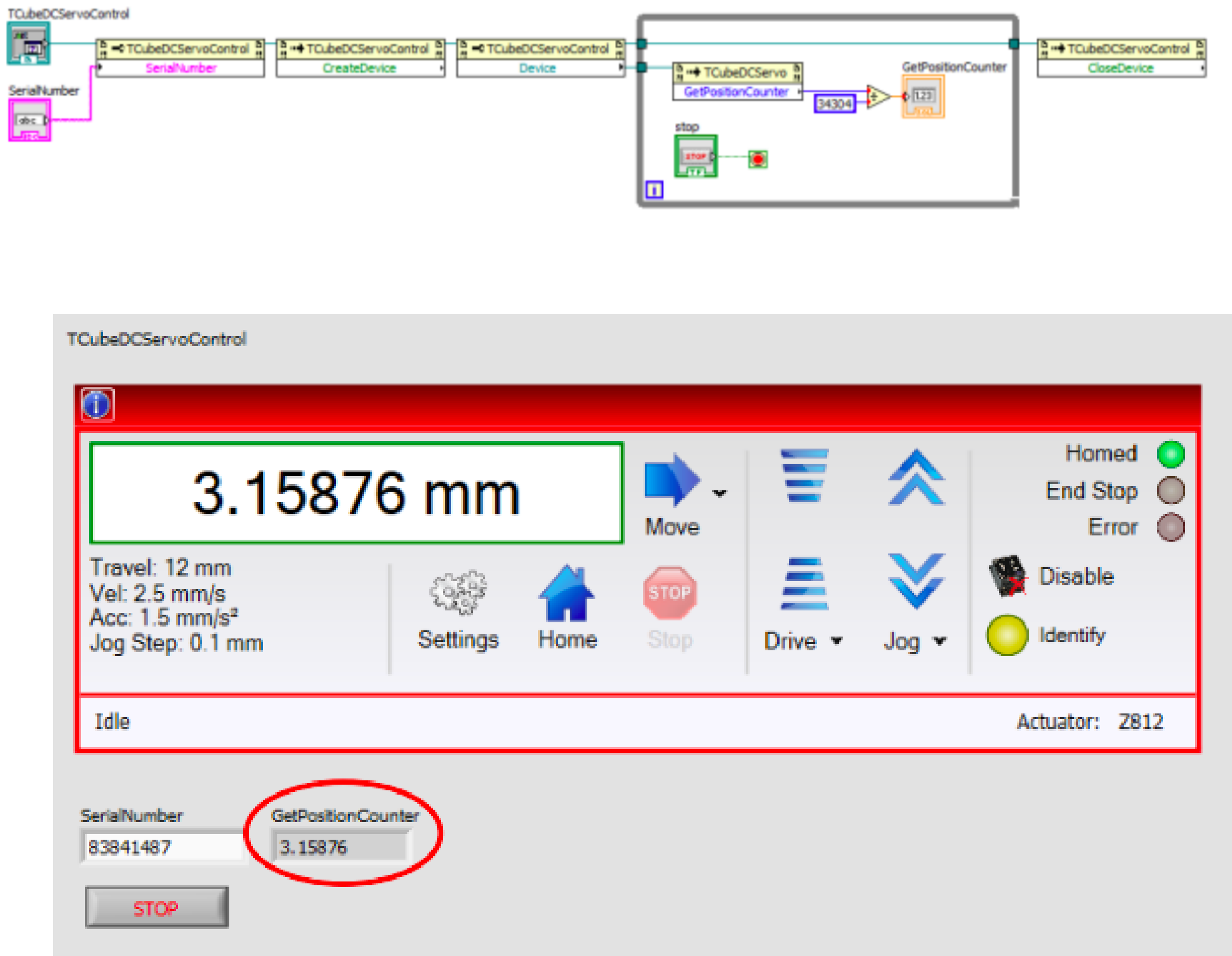


Fig 3.8 : Position Control

3.7 Speed Control

Right click the input connector of the Wait(ms) VI and select Create/Constant from the shortcut menu displayed. A constant, of suitable data type, is created and wired automatically. Edit the default value by double clicking the constant and enter 50. The units are milliseconds.

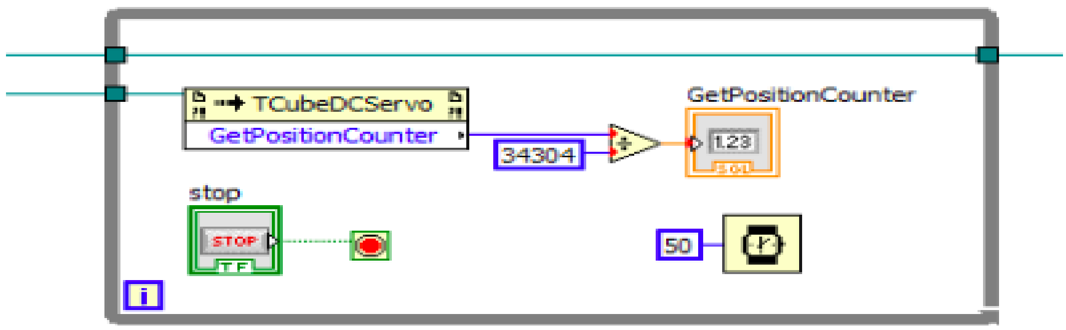


Fig 3.9 : Speed Control

CHAPTER 4

EMCCD Camera Interfacing

Electron Multiplying CCD (EMCCD) works to magnify (EM Gain) for weak signal events to a clear signal level in the learned camera sound at any reading speed, making it feel like a single photon. Despite the latest innovations of high QE, low sCMOS audio technology is definitely adopted for more scientific use, using the “EM advantage”, EMCCD cameras offer more raw sensitivity than the latest CMOS cameras illuminated in the background. EMCCD cameras should be used in the most extreme situations, and open up the obvious benefits of the applications. Charged Coupled Device (CCD) are the basic devices for the Andor devices . The detector is split in two as high as 2-dimensional pixels, each able to detect light. For example, systems based on The EEV 30-11 CCD chip has 1024 X 256 pixels, each of which is 26 mm pixels

In photo mode the CCD is the camera. In this picture taking session we always get a probable value of a pixel in CCD , which actually allows you to 'get a picture’ that falls into a pixel matrix for CCD. To prevent painting the image, light should be prevented from falling on the CCD during the reading process.

A type of EMCCD camera data based on LabVIEW collecting driving mode.

Fig 4.1 Andor iXon Ultra 897

4.1 Technical field

The invention is technically based on the acquisition of a CCD electron duplicating system, specifically a type of EMCCD-based camera data that collects driving modes.

With the rapid development of scientific information technology, the world has entered the photon era, and people are discovering information pathways and moving to broader fields like different wavelengths. Image information, such as the most accurate precision information, has received wide attention. How to get clear image information more accurately, be important research content.

Low-tech imaging technology has become synonymous with this development process, becoming one of the most widely used advanced technologies in the developing world today.

Electron Multiplication CCD (ElectronMultiplicationChargeCoupledDevice, EMCCD) is a high-quality image capture product of the visual field, high sensitivity, like the novel all solid micro-opto image device, with that low volume, longevity, high efficiency quantum is high, power consumption is low, sensitivity benefits are high compared to the traditional low-level image imaging device, there is a great potential for development and the potential for use in low-resolution image field, shown of the electron electron structure. representation. But the presence of an inevitably repetitive CCD electronics camera has the disadvantage that: data read mode is limited, it is impossible to connect applications with other computer platforms, causing the scope of use to be very small. LabVIEW is a kind of programmatic development environment, developed by the American National instrument (NI), similar to the development environment C and BASIC, but the main differences between LabVIEW and other computer languages are this: some computer languages all adopt text-based language. to generate code, and LabVIEW uses the author's language illustrated G, the production process is a kind of block drawing. The LabVIEW development site is integrated with all the necessary tools for the developer and a variety of applications for rapid construction of scientists, intended to help engineers and scientists solve the problem, increase productivity and constantly come up with new ideas. But how to use LabVIEW software is also great. the technical barrier to connecting the EMCCD camera, shooting effectively controls the EMCCD camera and data acquisition. Although the Andor company offers Solis software, it may be connected to the camera and mount, but the scope of its use is limited only to the software itself, it is impossible to integrate with data processing hardware, which can only take pictures, operate one, has no real time. Second, when the camera breaks, it is impossible to know the cause of the failure easily. In addition, it can not just be attached when the test is based on LabVIEW and data is received, and you can not just see the control number of the shooting range and stop the test function, and LabVIEW is a bridge-linking system, hardware image processing hardware, and therefore has significant shortcomings in technology.

4.2 Summary Of The Camera Interface

It is an initiative to provide the type of EMCCD camera data based on LabVIEW and to compile the driving method. The technological solution that recognizes the invention is: the LabVIEW-based EMCCD data type captures drive mode, calls first the internal camera function, the camera is started; Second, the pattern for each camera module is set; Then calculate the correct camera detection parameters, find the pixel size of the camera detector; Open matching photo storage members; Also, In order for the stream to be set, perform an image detection and see the pause function; Finally call the ShutDown command functions that free up memory space.

The current invention is compared to the previous technology, its advantages are:

(1) start-up calls, start and end successfully, perform the task below and, thus simplifying camera start times, response speed, real-time, minimize unnecessary phone work, make the system more accessible.

(2) by arranging the number of the following shooting frame that freely controls the N-value camera For the broadcast to be added to the camera-command command functions and image transfer command function. Detection To broadcast the image command function by rendering, N increment parameter For indoor streaming can be paused when the camera recording can be paused, checking the function of any single image frame information.

(3) Use LabVIEW software interface, each camera part of several duty can be tested at any time, increase controllability, easy to quickly detect error and amendment. (4) is no longer limited to the use of Andor software, and can be equipped with a camera that can drive another LabVIEW can be integrated, to achieve different purposes such as data acquisition, image processing, compensation for Solis and can be connected to the error used by LabVIEW, use more, has a high operating value, freely access to control the camera's independent shooting number at the same time, can stop, when not stopping camera shooting, the purpose of checking the current details of single frame images.

In conjunction, the present invention gathers driving method based on the EMCCD camera data of LabVIEW, first calls camera internal function, camera is initialized; Secondly, the pattern of each module of camera is set; Then calculate the relevant acquisition parameters of camera, obtain camera detector pixel size; Open up image-storage array; Again, For circulation is set, carries out

Fig 4.2 : Block Diagram

image acquisition and realize pause function; Finally call ShutDown command functions releasing memory space. Realize specifically comprising the following steps that of said process

4.3 Algorithm

Step 1, through the USB interface, connects the digicam to the laptop, figuring out the a hit connection of the digital camera through NIMAX.

Step 2, opens LabVIEW, creates a built-in workspace, calls start feature in the atmcd32d.dll library document, the camera is started out.

Step three, we set the features of every of the digicam sample modules, such as lock mode, opening sample, study mode and data acquisition, i.e. in LabVIEW, sequencing employer, every collection is used to paintings mode, sequence of all patterns. , and the concrete overall performance is as follows:

- dial the SetTriggerMode camera cowl sample in the library report atmcd32d.dll inside the SDK, enter zero regularly in the SetTriggerMode characteristic, i.e. use the internal camera blasting pattern;
- dial the SetGateMode camera commencing sample within the library report atmcd32d.dll to the SDK, enter three frequently in the SetGateMode function, even though the digicam establishing is continually open;
- to pressure the SetReadMode undertaking placing learning mode in the library record atmcd32d.dll inside the SDK, enter four frequently inside the SetReadMode function, i.e. the digicam picture of the software;
- name the SetAcquisi-tionMode digicam acquisition mode to the library document atmcd32d.dll in the SDK, enter 1 always within the SetAcquisitionMode feature, i.e. the app digital camera is a SingleScan sample

Step four, setting the precise camera parameter, and along with publicity time and advantage length, the bodily performance is as follows:

to pressure the SetExposure-Time digicam exposure time set to the atmcd32d.dll library record inside the SDK, exposure time values set at zero.02 can get the fine shooting end result;

force the SetEMGainMode digicam set size report to the library report atmcd32d.dll inside the SDK, more than a few 0300 stages, relying at the want for enhancing, obtaining camera pixel statistics.

Step five, placing the statistics transmitted by using the consumer to the digicam, calculates character digital camera photographs and calls for time, i.e., publicity time publicity time, integration time and Kinetic cycle time, and user acquisition time acquisition time. The concrete works are as follows:

name the GetEMCDGain characteristic within the library record atmcd32d.dll inside the SDK, allow the digital camera to get the advantage length of the user setup;

The GetAcquisitionTimings feature within the library file atmcd32d.dll inside the SDK is called, the digicam is designed to locate the publicity time of a consumer, and calculate the whole time required by way of a unmarried frame, whilst the entire time is the sum of AccumulateCycleTime. , KineticcycleTime and publicity time, in addition to AccumulateCycleTime and KineticcycleTime are all set to 0 underneath the SingleScan sample.

Step 6, we get the digicam detector pixel records, i.e. call the GetDetector function within the library report atmcd32d.dll within the SDK, detects the detector pixel horizontally and vertically.

Step 7, we use the LabVIEW launch matrix capabilities to release one piece of internal reminiscence earlier, putting the primary memory cope with to acquire the picture. release matrix capabilities using LabVIEW opens one piece of internal reminiscence earlier, and then the SetImage characteristic within the atmcd32d.dll library report in the SDK is known as, the Horz price set parameter.Binning is 1, the set parameter cost i -Vert.binning says 1, the horizontal setting for Horz.Get started with 1, and the value for putting in Vert.begin is 1. Step 8, enhancing For Distribution, called FOR1, call command functions and image switch feature accrued by means of digital camera picture, to make non-stop detection, and stored in a pre-opened program with FOR1 cyclical photograph series feature. For the published to be set up, called FOR1, FOR1 calls the information switch feature GetAcquiredData begins the StartAcquisition taking pictures manner with the digital camera, the switch-matrix opens early inside the GetAcquiredData characteristic and is exported thru the GetAcquiredData feature and displays an photograph .

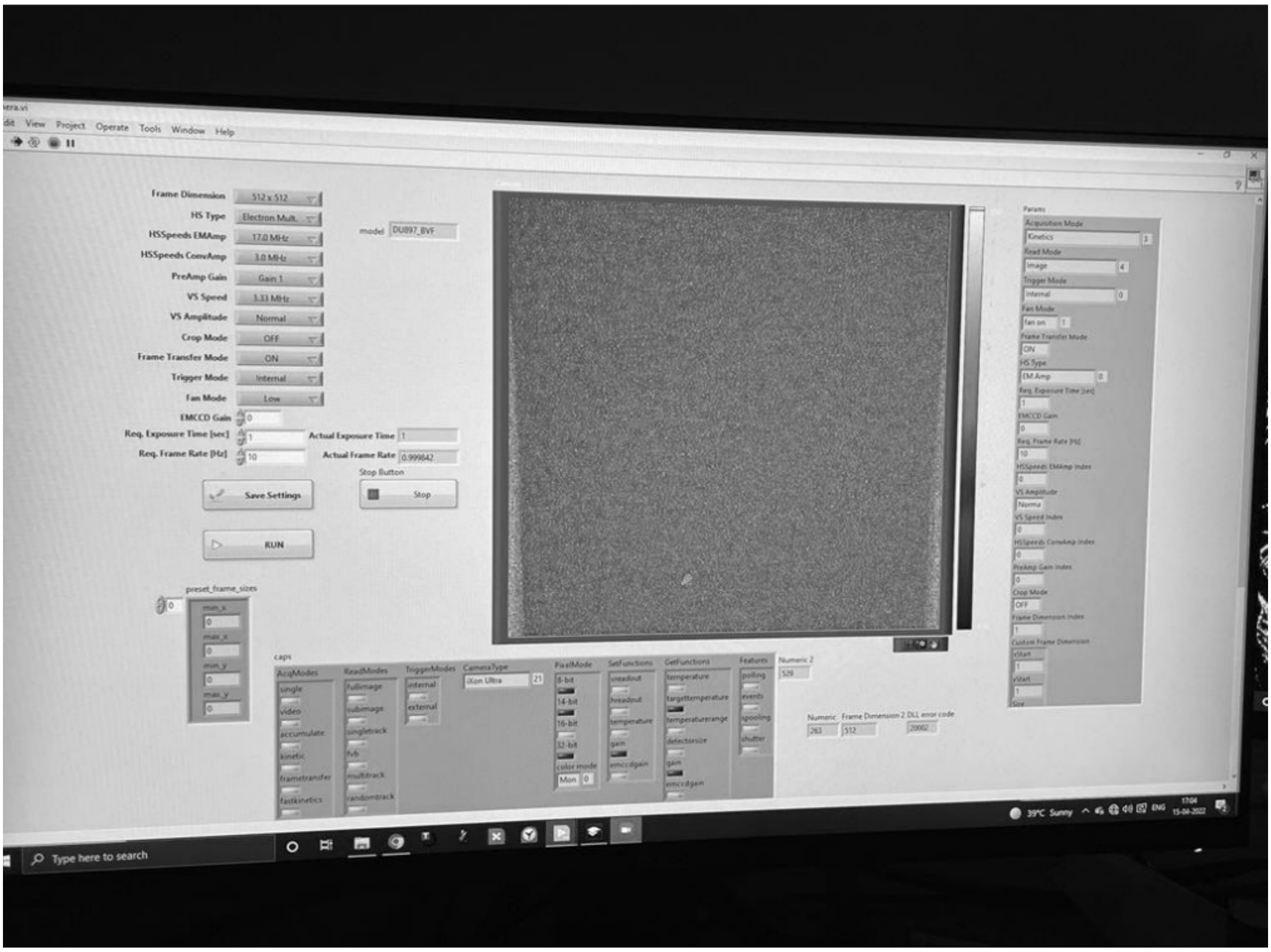


Fig 4.3 : EMCCD Camera VI

Step 9, ascending For the broadcast, the so-called FOR2 explicit function of camera data transfer, detects the shooting process by increasing the N parameter of the FOR2 rotation, check the detailed function of the current images of a single frame. In preparation for distribution, called FOR2, N makes FOR2 1, and is displayed as a constantly changing image; Make N> = 5000, and then display as current images of a single frame, thus playing the time-closing effect. Step 10, all first return values calling functions are exported and show. All first return values calling function are exported and demonstrate the image clapped in the front panel of LabVIEW

Step 11, runs the ShutDown command functions that free up memory space, locking the camera. The so-called innovative work comes from the software development kit provided by the Andor company.

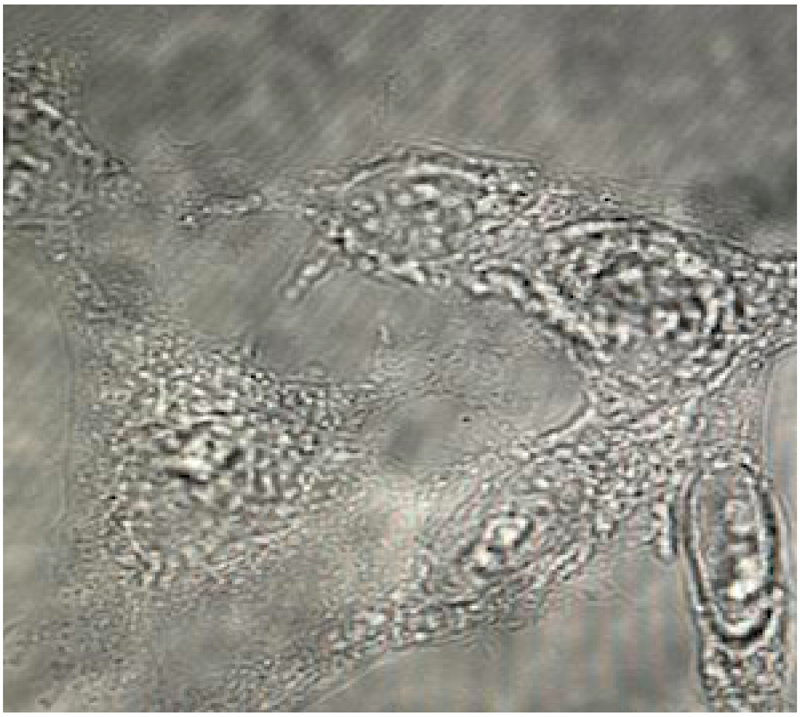
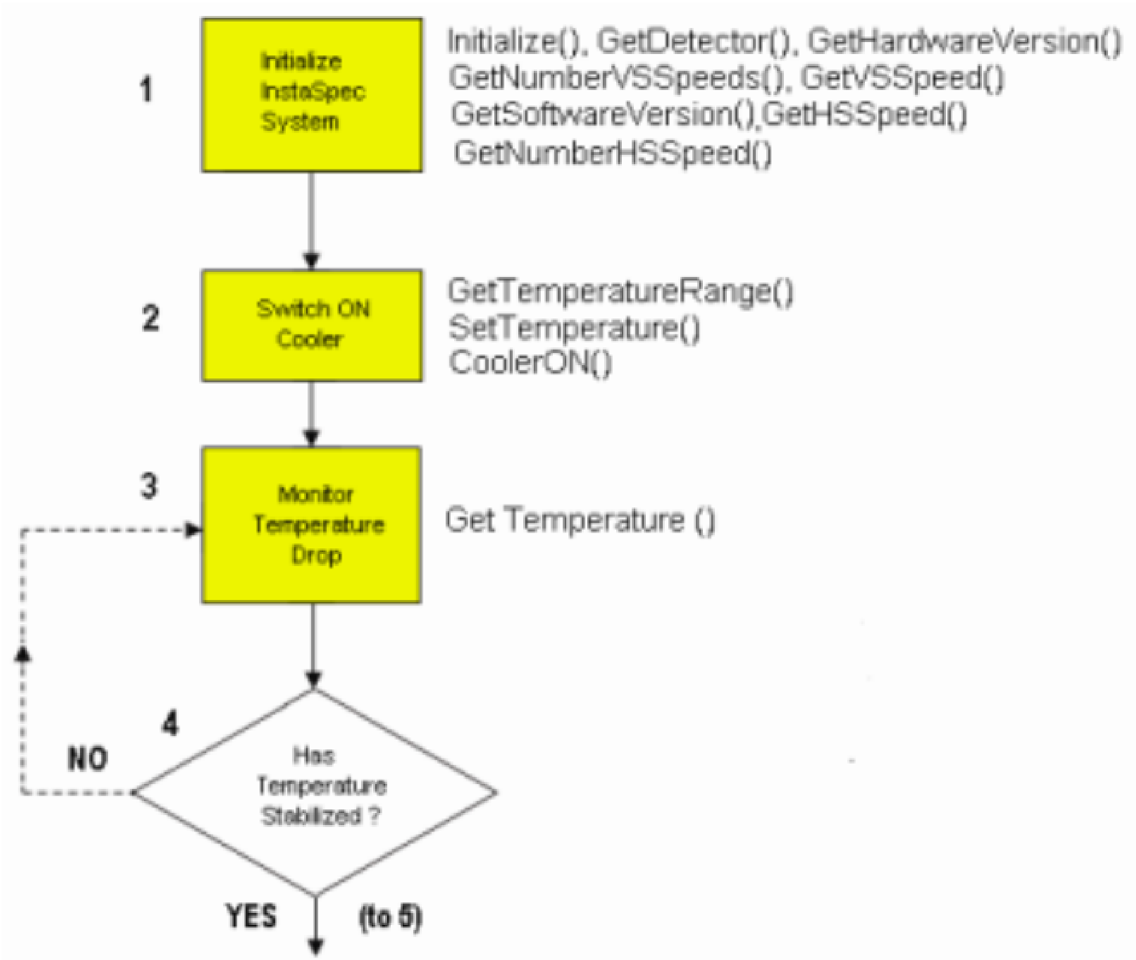


Fig 4.4 Image Captured Using the camera

4.4 Flow Chart of the Function Calls Needed to Control Andor Camera

1. The app launches the camera and receives information related to system power. NOTE: Andor SDK takes a few seconds to automatically adjust the A / D converter on the board whenever a Start function is called.
2. The CCD sensor operating temperature is set to a certain value within the allowable temperature range (e.g. -2 ° C), and the cooler is turned on.
3. The current temperature is monitored periodically to check whether the temperature is stable at the set value. Temperature can take a few minutes to stabilize and with appropriate planning techniques the user should be able to set some tasks, as shown in the C examples. Once the CCD sensor temperature is stable you can start receiving data.



5. Acquisition parameters are configured to match user specifications, e.g. acquisition mode (single scan etc.), read mode (full direct binding etc.) and start mode (Internal etc.).

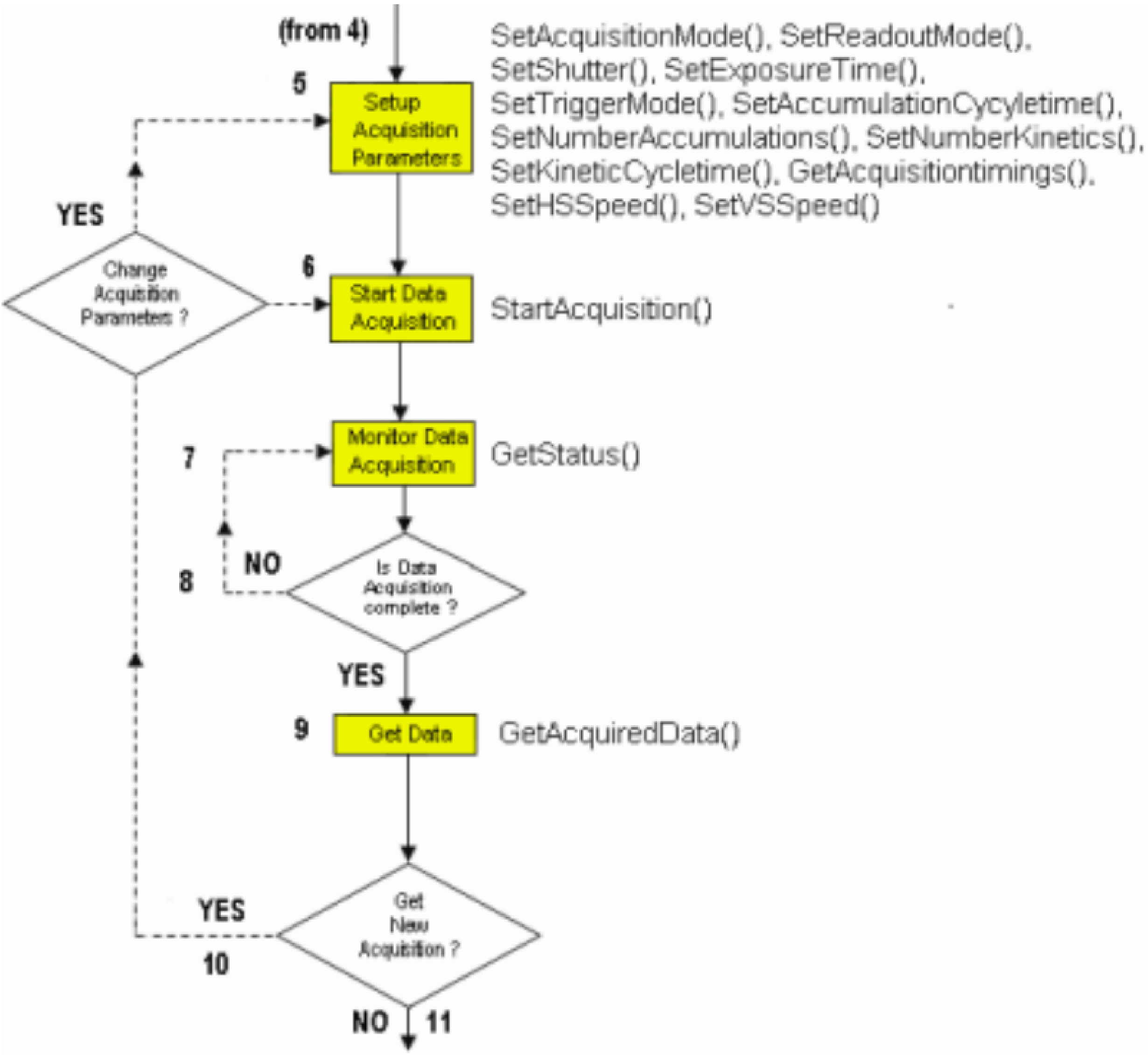
6. You are now ready to begin the discovery.

7 - 8. The current acquisition status is periodically monitored to determine whether the data acquisition is complete.

9. After successful data acquisition the data is transferred from the Andor driver to the application.

10. At this point the user can choose to capture a new acquisition or not.

11. Yes: download the new scanner. The user may decide to change the acquisition setting (e.g. to change exposure time) or use current parameters.

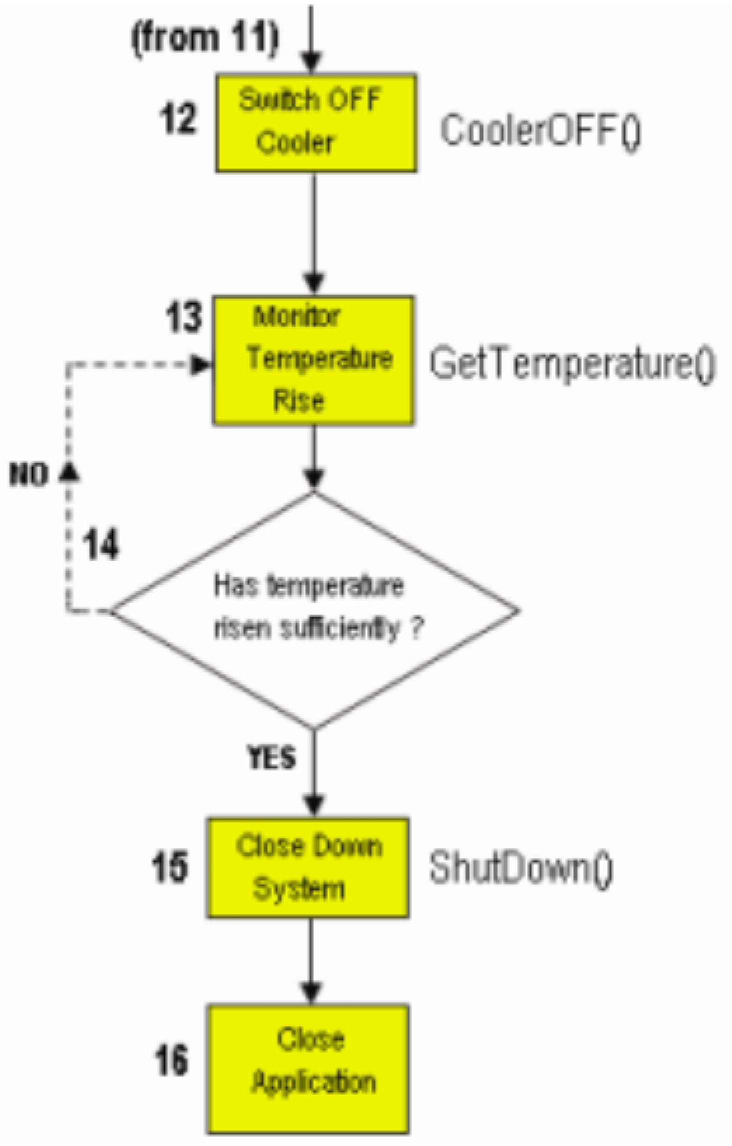


12. When the user has completely finished accessing the data the shutdown process is started. Cooler closed. It is important to control both the temperature and cooling of the CCD sensor otherwise the gradients could damage the sensor. It is therefore highly recommended that the user use the correct exit process rather than, for example, simply shutting down the computer.

13 - 14. Current temperature is monitored from time to time to see if the temperature has risen to a high enough level.

15. For Classic & ICCD systems wait until the temperature rises above -20 ° C. User can now disable Andor SDK system.

16. The program removes any used memory and exits the system.


(from 11)
12
Switch OFF Cooler
CoolerOFF()
13
Monitor Temperature Rise
GetTemperature()
NO
14
Has temperature risen sufficiently ?
YES
15
Close Down System
ShutDown()
16
Close Application

CHAPTER 5

Conclusion

This project emphasize on storm imaging, working in the device enabled a better understanding of the technical side of the device, even though the project focused on the software side of the device. Basic data acquisition using labview, thorlabs motor controlling using labview and EMCCD camera interfacing were performed and successfully developed a single labview program where all these programs are integrated to a single program.This project can be further extended in the near future and the work on laser control and cycling and controlling optical modulators can be carried out.

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