Gantry Operations

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Useful links:

Github for labview programs: https://github.com/TTUHGCAL/GantryPrograms,
https://github.com/TTUHGCAL/GantryPrograms/tree/MileStone1
TTU gantry slides: googleSlides
CMU github: https://github.com/jparshook/UCSB-Gantry-master-main
CMU programming slides: CMU_Labview

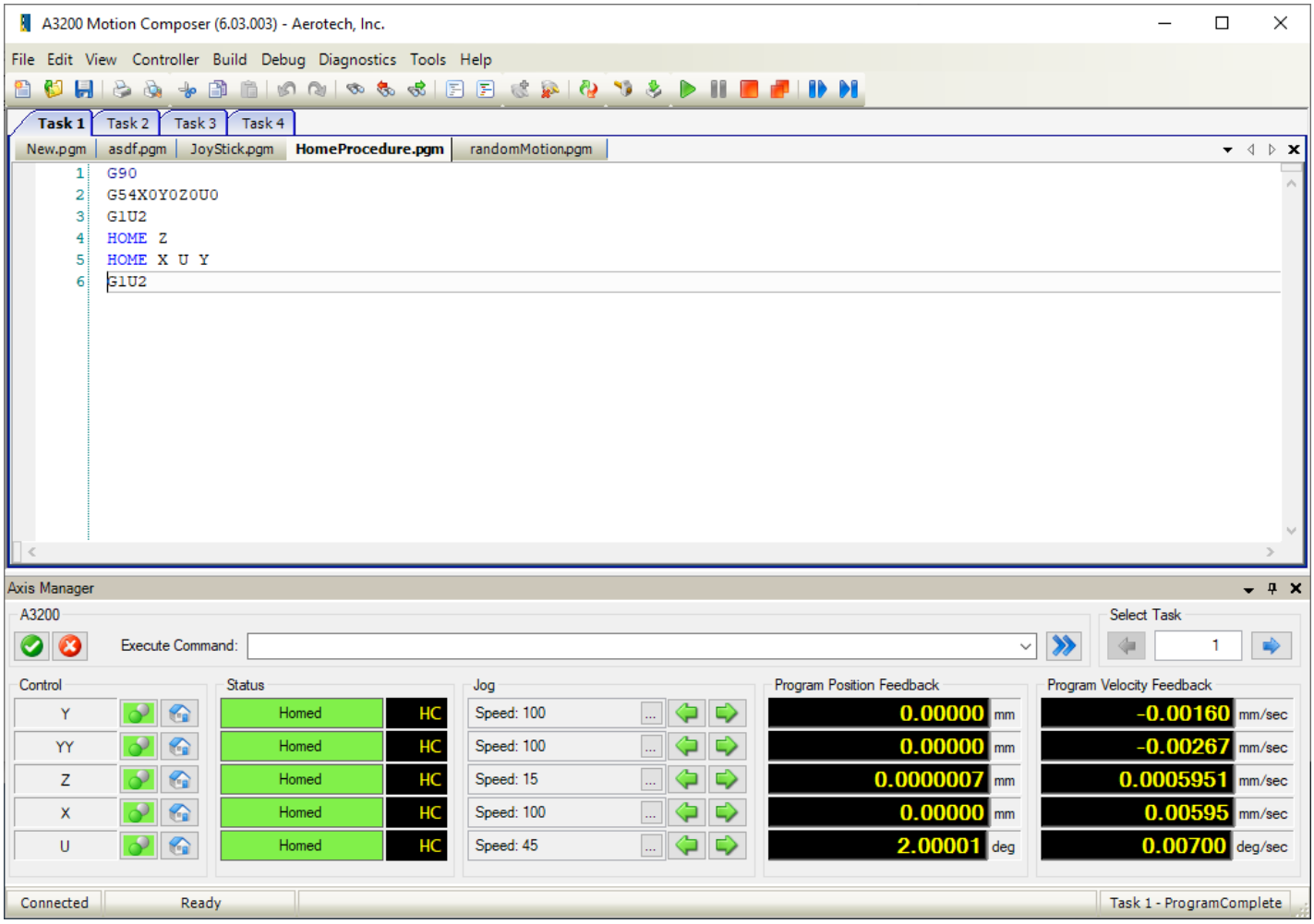
Gantry movement:

Moving the gantry using composer.

Home procedure:

Open A3200 motion composer → Use “HomeProcedure.pgm” and home the gantry. Make sure all controls are enabled.

Never click on home icons, always run “HomeProcedure.pgm”. Always start using the gantry with “HomeProcedure” and home it when you are done.



JoyStick:

Click on “JoyStick.pgm” for joystick program. The contents are:
JOYSTICK 2D RESET
JOYSTICK 2D AXISGROUP 1 Y X
JOYSTICK 2D AXISGROUP 2 Y Z
JOYSTICK 2D ON

Random motion:

Use “randomMotaion.pgm” to move the gantry using Gcode.

Closing:

Home the gantry and disable all the controls and close the A3200 composer program.

Labview programs:

Details about labview programs for assembly are described below. There are two steps in the assembly process:

1. Calibration of components
2. Actual assembly - glue dispensing and P&P (pick and place).

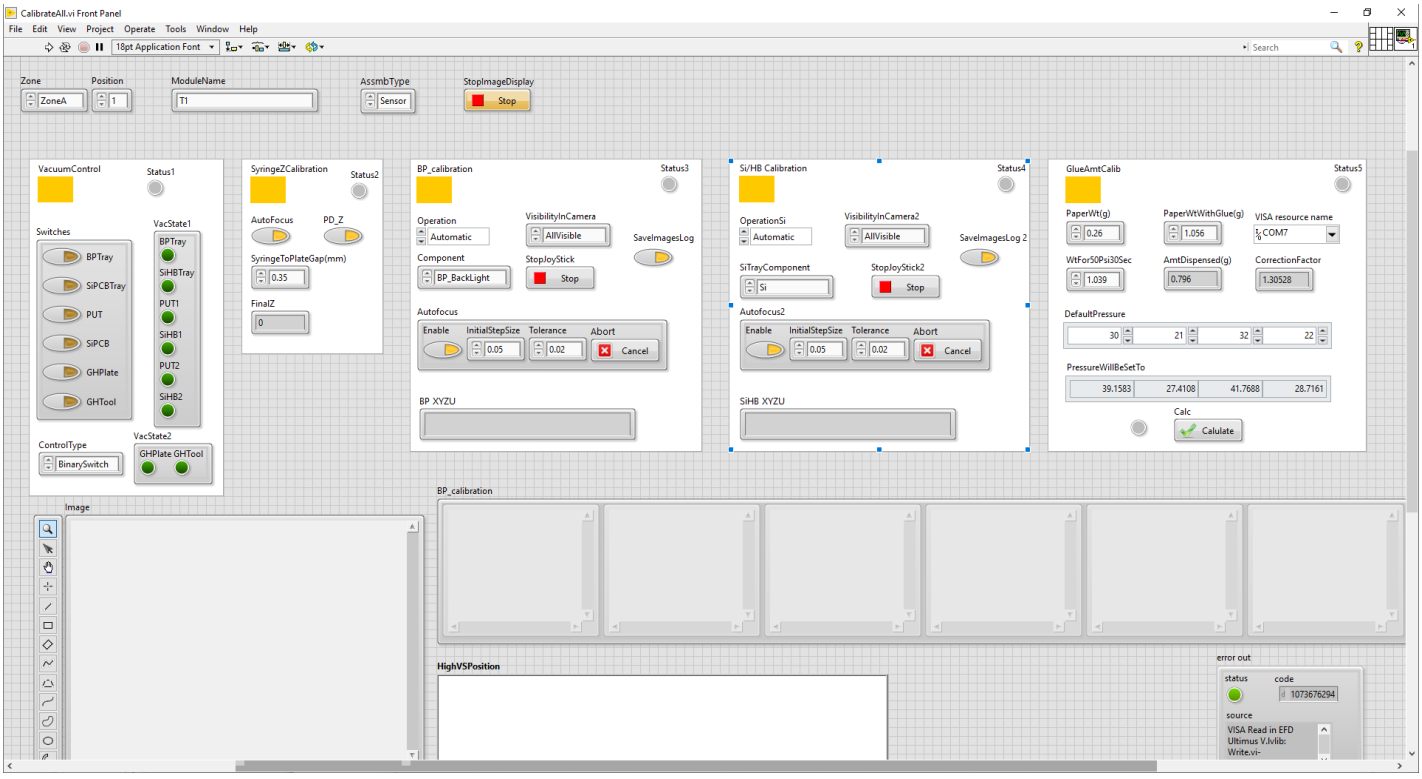
Step 0:

- Make sure that the vacuum pump and compressor are turned on.
- Open vacuum and dry air valves in the gantry room.
- Turn on the dispenser, power to vacuum switches and camera light.

CalibrateAll.vi:

Purpose:

Controls vacuum switches, calibrates the syringe (Z value for dispensing), finds the center and orientation of BP and Si/HB and calibrates glue amount.

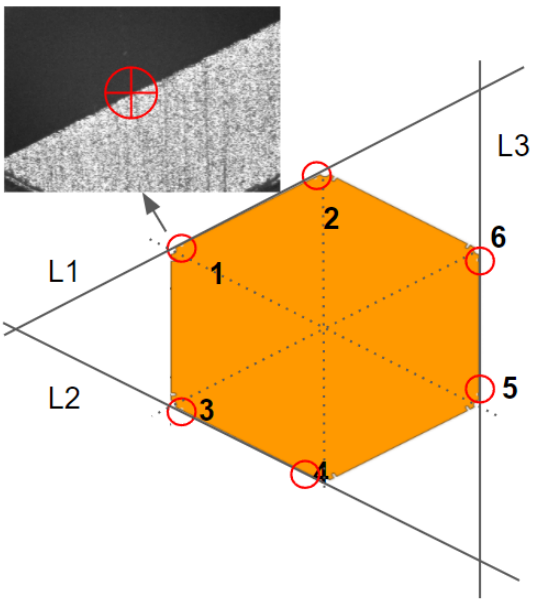


Main Inputs:

ModuleName (Module1, Dummy1 etc)
Zone: A to D
Position: 1 or 2
AssemblyType: Sensor or HB

Procedure:

1. Vacuum control:
    a. Turn on BPTray, SiTray, Si/HB and run VI.
    b. The indicators should light up. If not, try again (sometimes, the indicators do not turn on immediately).
    c. If the indicators do not turn on, check if the vacuum board is on or not.
    d. Make sure that the trays and components are held by vacuum.
2. Syringe Calibration:
    a. Load the syringe to the syringe holder. Mark the front side of the syringe.
    b. Select the “SyringeZCalibration” block and run VI. The camera should start taking images and measure the height of BP. Once this is done, the gantry moves to photo-detector (PD) and evaluates the Z height needed for glue dispensing.
    c. If the flatness variation of the BP is > 65 microns, a warning popup message is shown whether to proceed further or not. It is recommended to reload the BP if this message pops up. A plot of Height vs Position is also displayed.
    d. The Z value is written to a Config file Configs/A1_SyringeZ.txt
3. BP calibration:
    a. Choose the feature to use for BP calibration: BP_BackLight (default), BP_CuEdges etc.
    b. Choose the mode of operation: Automatic or Manual.
        i. Automatic: uses pattern recognition to find the edges.
        ii. Manual: Allows the user to pick a feature from the captured image. If Automatic mode fails to find the pattern, manual mode is activated.
    c. Select BP calibration block and run the VI.
    d. Gantry moves to 6 locations and edges are used to find the center of the BP.
    e. At the end a popup message asks the user to write the position and orientation to a text file. Always choose the “Overwrite” option unless you are debugging.
    f. If Overwrite or Append options are selected in step “e”, the gantry-camera moves to the center of BP and shows the image of center.



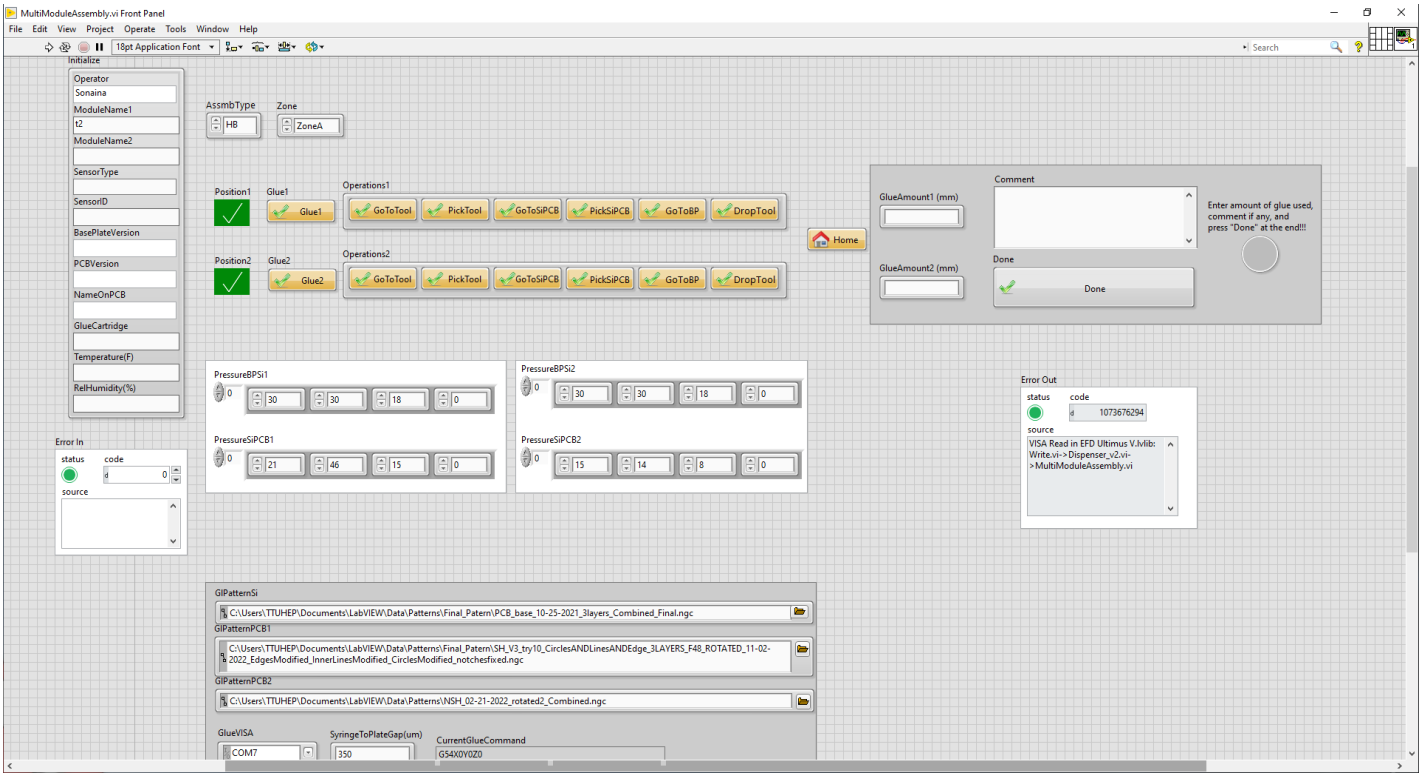
4. Si/HB calibration:
    a. Steps are similar to the BP calibration, except that the features used for calibration might be different.
5. Glue amount calibration:
    a. Please set up MultiModuleAssembly.vi (see next section). DO NOT run it.
    b. Weigh a small piece of paper (~5x5 cm) and enter the weight in grams under “PaperWt”.
    c. Place the paper at (X,Y) = (300,900) on the gantry table.
    d. Fill the syringe with glue and note down the weight of the syringe.
    e. Select “Glue Amount Calib” block and run VI.
    f. The program dispenses glue for 30 s at 50 psi and stops the dispenser.
    g. Weight the paper+glue and enter the amount in “PaperGlueWt”. Press “Calculate”.
    h. A correction factor (= 1.039/Amt) for the pressure is written to the file Configs/DispensePressCorrection.txt.

Repeat steps 1 to 5 for each stage (Position 2, Zone B, C etc).

MultiModuleAssembly.vi

Purpose:

Dispense glue on BP/Si and place Si/HB on BP/Si. Keep log of all the assembly parameters.



Main Inputs:

Initialize: fill all the details. The module name should not be repetitive or already existing. It should be “ModuleX” or “DummyX”, same name as the one used in CalibrateAll.vi and “X” corresponds to a number.
AssmbType: Si ot HB. This will decide what glue pattern to use. NEVER make a mistake here.
Zone: A to D
Glue Amount and Comment: should be entered after finishing the assembly.
Choose which position(s) you want to use for assembly. You can deselect steps if you want to skip those.
Glue Patterns: Choose appropriate gocode files for the pattern.
Pressure: Set nominal values for the pressure. DO NOT adjust them based on your measurements in “Glue Calibration” step. This adjustment is done automatically.

Procedure:

1. Fill all the required details listed in “Main Inputs”. Double check pattern, pressure, Zone and position(s).
2. Run the VI. Avoid stopping the VI while dispensing.
    a. If there is a mistake, turn off the dispenser. This will stop dispensing the glue. Then you can stop the VI. Avoid coming to this step at all costs.
3. After dispensing on Position 1, a few popup messages ask you about the next steps. You should NEVER pick and place with the syringe in its holder. So, take out the syringe once glue dispensing is done and say “Yes” when prompted with “Removed syringe? Proceed to pick and place?”.
4. Once the pick and place is finished, manually turn on PUT vacuum valve(s) (programmed vacuum is already running).
5. Enter the amount of glue. Enter comments, if any. Press “Done”.
6. Log file is written to LogFiles/ModuleX_Assembly_Y_log.txt where Y is Si/HB.

Safety Info:

1. **Do not work or peek on components while the gantry is running**. The gantry can harm you if you are hit.
2. **If you think the gantry is going to crash onto something/someone, press the emergency switch**. This will stop gantry movements.
3. Do not save/delete any of the programs unless you know what you are doing.
4. When finished with the assembly,
    a. Home the gantry by running HomeProcedure. Disconnect the controller.
    b. Turn off all the programming vacuum switches. If curing is needed, use manual vacuum controls. If no vacuum is needed, close the main vacuum valve and the vacuum pump.
    c. Turn off the dispenser, vacuum board and close the dry air line.
    d. If none is using the compressor, turn it off as well.

Following users have read this document

Name of the user	Signature

Labview programs (old SOP):

Details about labview programs for assembly are described below.

VacuumSwitchTest.vi

File location	"C:\Users\TTUHEP\Documents\LabVIEW\GantryPrograms\VacuumSwitchTest.vi"
Operation	ON/OFF vacuum switches and read status of vacuum and gantry microswitches.
SubVIs	None
Main inputs	ControlType, DecimalIn
Main outputs	DecimalExpected, DecimalOut
Other I/Os	ErrorIn, error out
Hardwares	cDAQ1Mod1-NI9476(Spring) → vacuum on/off, cDAQ1Mod5-NI9403 → Read vacuum and gantry micro switches
VI descriptor	file:///C:/Users/TTUHEP/Documents/LabVIEW/GantryPrograms/VI_descriptions/VacuumSwitchTest.html

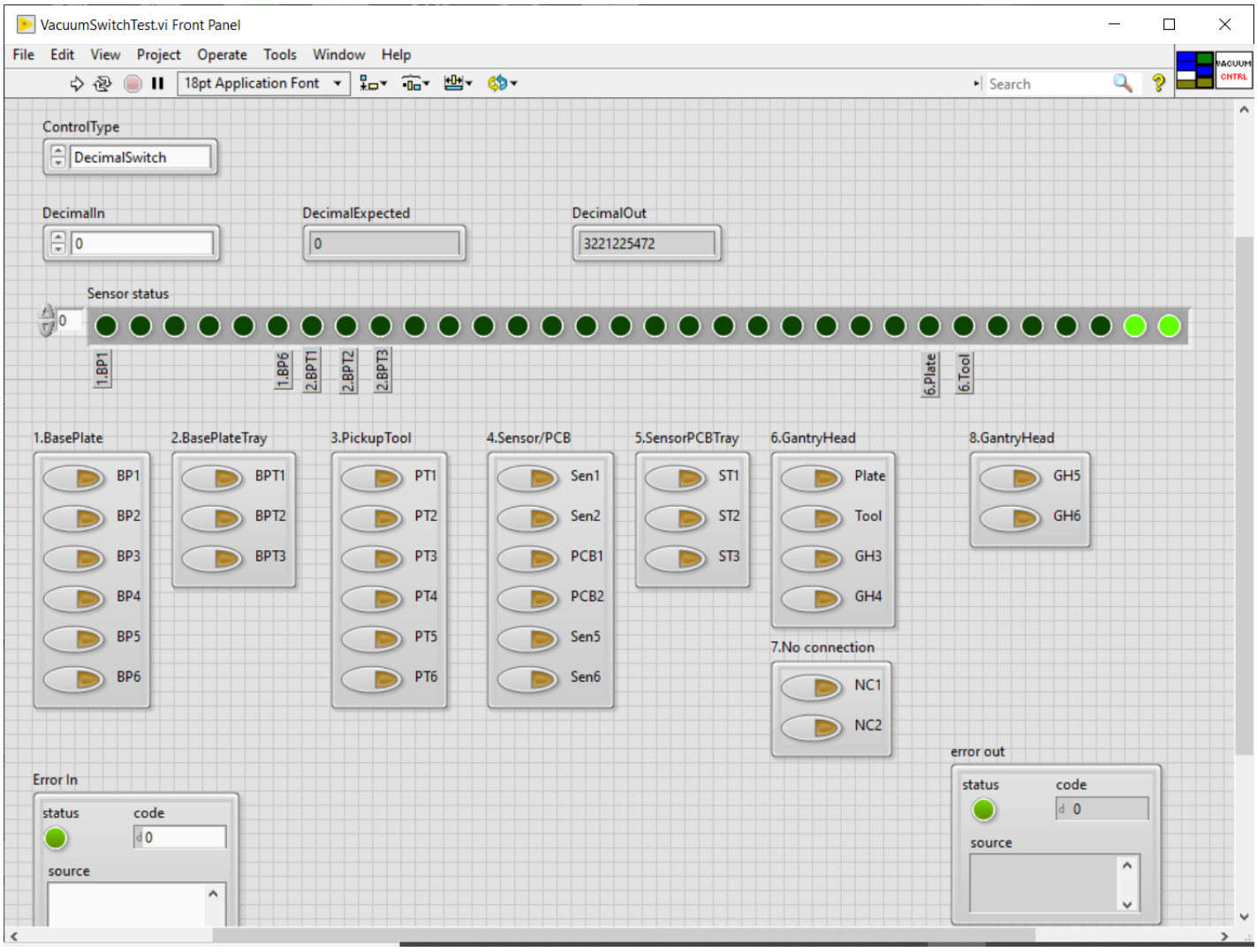
Overview: control the vacuum switches either using toggle buttons or a decimal equivalent of the switch states. Can also be used for reading the state of vacuum and gantry micro switches.

Procedure:

1. Select “ControlType”: DecimalSwitch, BinarySwitch or Conversion.
2. For DecimalSwitch (ignores binary switches):
    a. Enter a value for “DecimalIn”. When you run the program, this number is converted to 30 bit binary and those bit combinations are used to control vacuum switches.
    b. If the vacuum switches are working and no leak, you should get DecimalIn = DecimalExpected
    c. Switch status shows the status of vacuums and gantry microswitch.
3. For BinarySwitch:
    a. Use the 32 binary toggle switches as input. Turn on/off required switches.

b. When the program is run, vacuums are turned on/off and “Switch status” indicates the status of vacuums.
c. “DecimalIn” is ignored. “DecimalExpected” gives the decimal number corresponding to 30 vacuum switches (other 2 switches are for gantry). You can use this number in the other programs with “DecimalSwitch” as the “ControlType”.

4. For Conversion:
   a. Very similar to BinarySwitch, except that the vacuum are not physically turned on/off.
   b. This is useful if you want to only read the status of vacuum or to know the decimal number corresponding to a certain binary switch combination.



Connection details:

NI9476 (Spring)	NI 9403 Mod5		

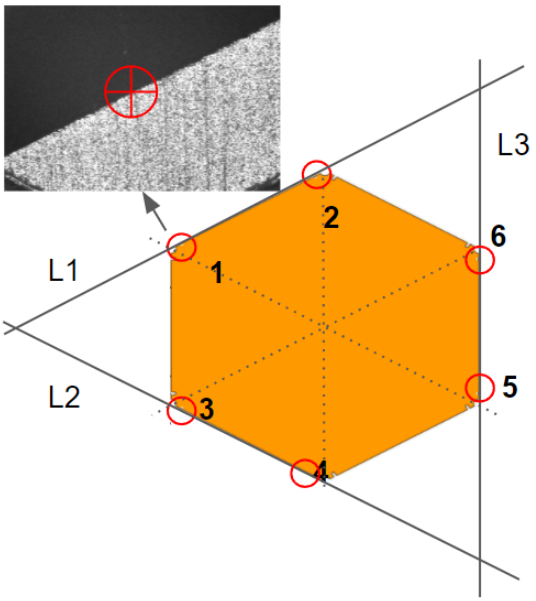
Line no.	Valve no.	Line no. (Sensor)	Vac Tubes Connection	Connected?
0	1	0	Vac Base Plate 1	Yes, direct wall
1	2	1	Vac Base Plate 2	Yes, direct wall
2	3	2	Vac Base Plate 3	
3	4	3	Vac Base Plate 4	
4	5	4	Vac Base Plate 5	
5	6	5	Vac Base Plate 6	
6	7	6	Vac Base Plate Tray 1	Yes
7	8	7	Vac Base Plate Tray 2	
8	11	10	Vac Base Plate Tray 3	
9	12	11	Vac Pickup Tool 1	Yes
10	13	12	Vac Pickup Tool 2	Yes
11	14	13	Vac Pickup Tool 3	
12	15	14	Vac Pickup Tool 4	
13	16	15	Vac Pickup Tool 5	
14	17	16	Vac Pickup Tool 6	
15	18	17	Vac Sensor 1	Yes
16	21	18	Vac Sensor 2	Yes
17	22	19	Vac Sensor 3	Yes as PCB
18	23	20	Vac Sensor 4	Yes as PCB
19	24	21	Vac Sensor 5	
20	25	22	Vac Sensor 6	
21	26	23	Vac Sensor Tray 1	Yes
22	27	24	Vac Sensor Tray 2	Yes as PCB
23	28	25	Vac Sensor Tray 3	
24	9	8	Vac Gantry Head Tool 1	Yes
25	10	9	Vac Gantry Head Tool 2	Yes
26	19		Vac Gantry Head Tool 1	
27	20		Vac Gantry Head Tool 2	
28				
29				
30	31		Vac Gantry Head Tool 1	
31	32		Vac Gantry Head Tool 2	

BaseplateCenterFinder.vi:

File location	"C:\Users\TTUHEP\Documents\LabVIEW\GantryPrograms\BaseplateCenterFinder.vi"
Operation	Find the center of baseplate and its orientation using 6 Cu cutouts
SubVIs	GetArrayFmTxtFile.vi, CaptureImage.vi, GetGantryPosition.vi, GetPixelToGantryRelPosition.vi, CameraXYusingGantryHeadXY.vi
Main inputs	VisibilityInCamera, BaseplateCorners
Main outputs	Output XYZU, CameraGcode, XYZU in "C:\Users\TTUHEP\Documents\LabVIEW\GantryPrograms\Configs\BaseplatePositions.txt"
Other I/Os	AdjustCamera (for ClickMove option of VisibilityCamera), UsedCoordinates, Image, ErrorIn, error out
Hardwares	Camera (cam0), gantry
VI descriptor	file:///C:/Users/TTUHEP/Documents/LabVIEW/GantryPrograms/VI_descriptions/BaseplateCenterFinder.html

Overview:

Find the center of the baseplate and its orientation using 6 Cu cutouts and picking a point on each of them.

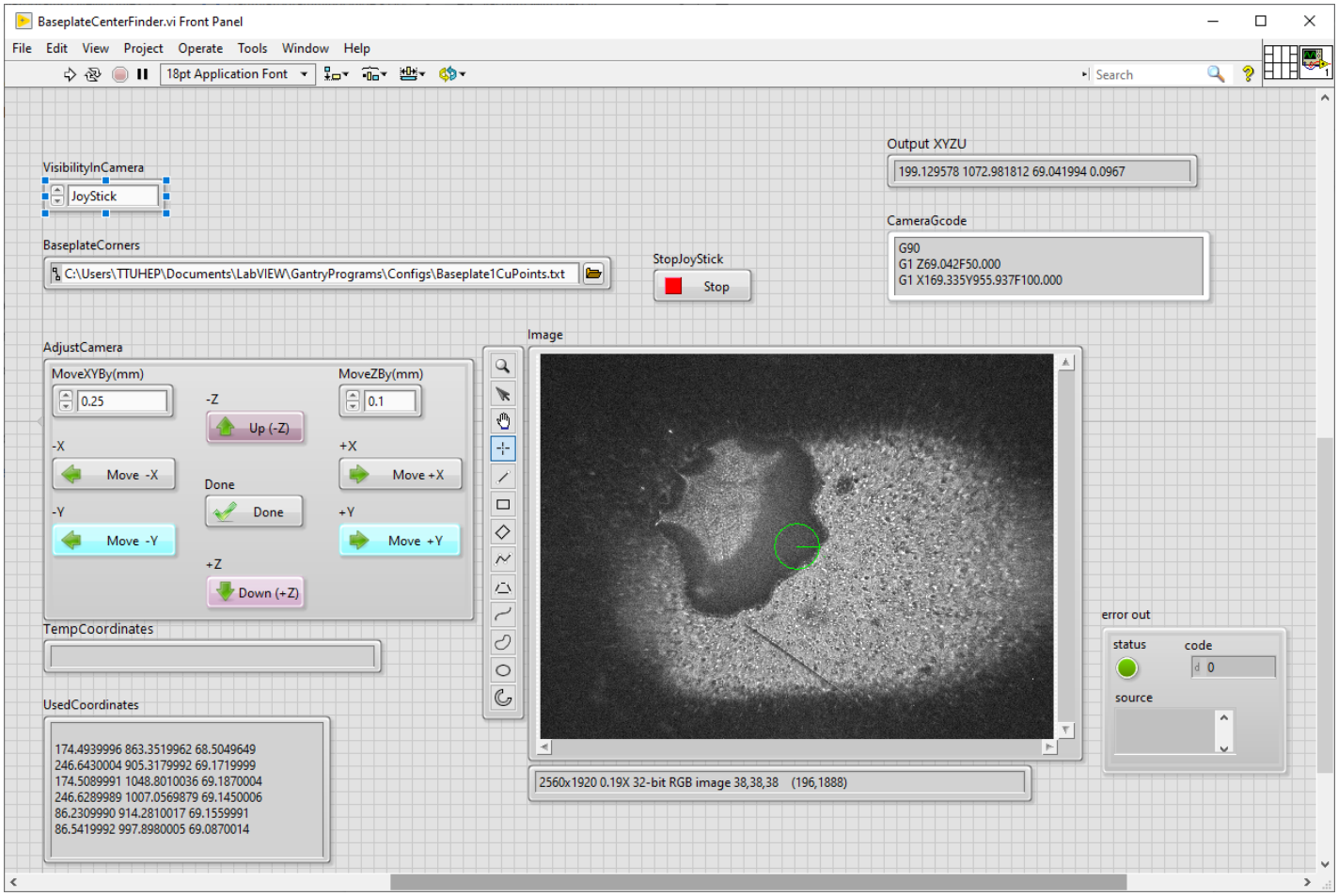


Procedure:

1. Select an option in “VisibilityInCamera”.
    a. JoyStick: you will use the joystick for final adjustments since the camera does not see the fiducials clearly.

b. ClickToMove: Here too, camera cannot see the fiducials clearly. You will use “AdjustCamera” panel to make adjustments instead of joystick.
c. AllVisible: The coordinates specified in “BaseplateCorners” is good and you don’t need any adjustments.

2. Once you run the gantry goes to point 1 and you may/may not adjust the gantry depending on the option you chose in step 1 above. Then you will be asked to pick a point. Pick a point which is on the edge as shown in Figure above.
3. Repeat step 2 for all other 5 points (total 6 points).
4. At the end you will be asked if you want to write XYZU to a text file. If you think the procedure was good click Yes and the program will write (**overwrite**) the coordinates to a text file ““C:\Users\TTUHEP\Documents\LabVIEW\GantryPrograms\Configs\BaseplatePositions.txt”” and the gantry moved so that the camera is looking at the center. A circle at the center of the image is drawn with a 50um radius. If you don’t want to write the XYZU, click No and gantry will not move and nothing is written to the text file. You can see the XYZU in “Output XYZU” and “CameraGcode” can be used to move the gantry to see the center.
5. You can also adjust the input 6 coordinates for future use by looking at “UsedCoordinates”. Note that this is relevant if you have used the joystick or clickToMove option.



SiRealCenterFinder.vi:

File location	"C:\Users\TTUHEP\Documents\LabVIEW\GantryPrograms\SiRealCenterFinder.vi"
Operation	Find the center of sensor and its orientation using 2 circular fiducials
SubVIs	GetArrayFmTxtFile.vi, CaptureImage.vi, CircleFinderAI.vi, GetGantryPosition.vi, GetPixelToGantryRelPosition.vi, CameraXYusingGantryHeadXY.vi
Main inputs	VisibilityInCamera, SiFiducials or SiOnBPFiducials
Main outputs	Output XYZU, CameraGcode, XYZU in "C:\Users\TTUHEP\Documents\LabVIEW\GantryPrograms\Configs\SensorPositions.txt" OR "C:\Users\TTUHEP\Documents\LabVIEW\GantryPrograms\Configs\BaseplatePositions.txt"
Other I/Os	AdjustCamera (for ClickMove option of VisibilityCamera), UsedCoordinates, Image, ErrorIn, error out
Hardwares	Camera (cam0), gantry
VI descriptor	file:///C:/Users/TTUHEP/Documents/LabVIEW/GantryPrograms/VI_descriptions/SiRealCenterFinder.html

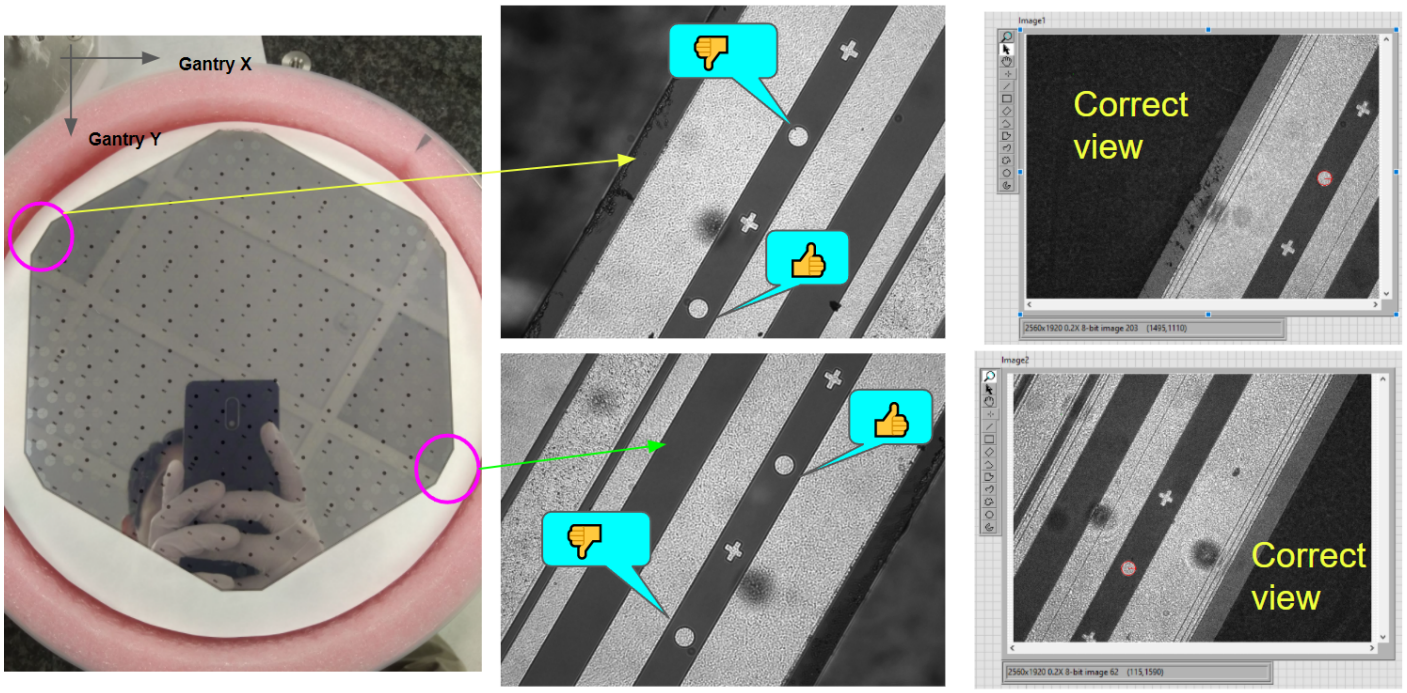
Overview:

The sensor has many fiducials which can be used to accurately find the center. We make use of 2 circles which are at the 2 sides shown in magenta below. Note that you should not make both circles visible. Correct view is shown in the top right and bottom right pictures. Once the fiducials are visible, the program finds the center using circle recognition.

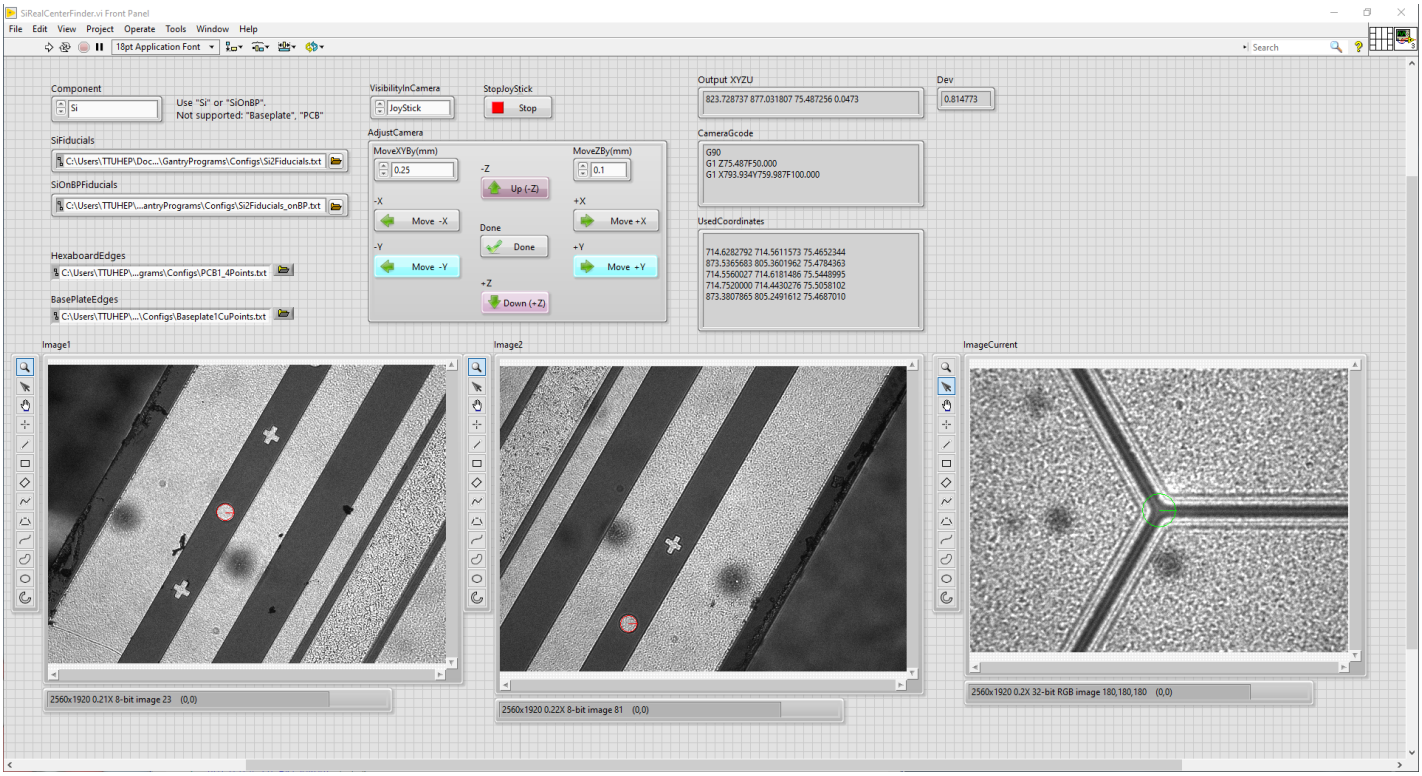
Procedure:

1. Select “Component” Si or SiOnBP depending on the type of assembly.
2. Select “VisibilityInCamera” as “AllVisible” or “ClickToMove” or “JoyStick”. This step is similar to baseplate.
3. Make sure you get a clear and correct picture as shown in the pictures below.

4. The program automatically finds the center and at the end it will ask if you would like to write the center and orientation. If you click yes, then it will write the info and the gantry goes to the center and you can see the center in camera. If you have the center correctly, you will see an intersection of 3 lines at the center as in figure.



5. The cell corresponding to the center is “88” and it is below the number “88”.


SiRealCenterFinder.vi Front Panel
File Edit View Project Operate Tools Window Help
18pt Application Font
Search
Component
Si
Use "Si" or "SiOnBP".
Not supported: "Baseplate", "PCB"
SiFiducials
C:\Users\TTUHEP\Doc...\GantryPrograms\Configs\Si2Fiducials.txt
SiOnBPFiducials
C:\Users\TTUHEP\...antryPrograms\Configs\Si2Fiducials_onBP.txt
HexaboardEdges
C:\Users\TTUHEP\...grams\Configs\PCB1_4Points.txt
BasePlateEdges
C:\Users\TTUHEP\...\Configs\Baseplate1CuPoints.txt
VisibilityInCamera
JoyStick
StopJoyStick
Stop
AdjustCamera
MoveXYBy(mm)
0.25
MoveZBy(mm)
0.1
-Z
Up (-Z)
-X
Move -X
+X
Move +X
Done
Done
-Y
Move -Y
+Y
Move +Y
+Z
Down (+Z)
Output XYZU
823.728737 877.031807 75.487256 0.0473
Dev
0.814773
CameraGcode
G90
G1 Z75.487F50.000
G1 X793.934Y759.987F100.000
UsedCoordinates
714.6282792 714.5611573 75.4652344
873.5365683 805.3601962 75.4784363
714.5560027 714.6181486 75.5448995
714.7520000 714.4430276 75.5058102
873.3807865 805.2491612 75.4687010
Image1
2560x1920 0.21X 8-bit image 23 (0,0)
Image2
2560x1920 0.22X 8-bit image 81 (0,0)
ImageCurrent
2560x1920 0.2X 32-bit RGB image 180,180,180 (0,0)

PCBdummySiCenterFinder.vi:

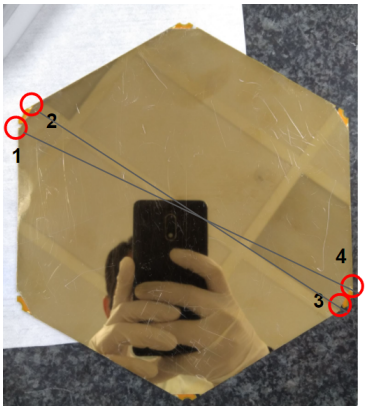
File location	"C:\Users\TTUHEP\Documents\LabVIEW\GantryPrograms\PCBdummySiCenterFinder.vi"
Operation	Find the center and orientation of dummy sensor w/o patterns or PCB hexaboard.
SubVIs	GetArrayFmTxtFile.vi, CaptureImage.vi, GetGantryPosition.vi, GetPixelToGantryRelPosition.vi, CameraXYusingGantryHeadXY.vi
Main inputs	VisibilityInCamera, SiDummy 4 corners or PCB 4 corners
Main outputs	Output XYZU, CameraGcode, XYZU in C:\Users\TTUHEP\Documents\LabVIEW\GantryPrograms\Configs\SensorPositions.txt OR C:\Users\TTUHEP\Documents\LabVIEW\GantryPrograms\Configs\PCBPositions.txt
Other I/Os	AdjustCamera (for ClickMove option of VisibilityCamera), UsedCoordinates, Image, ErrorIn, error out
Hardwares	Camera (cam0), gantry
VI descriptor	file:///C:/Users/TTUHEP/Documents/LabVIEW/GantryPrograms/VI_descriptions/PCBdummySiCenterFinder.html

Overview:

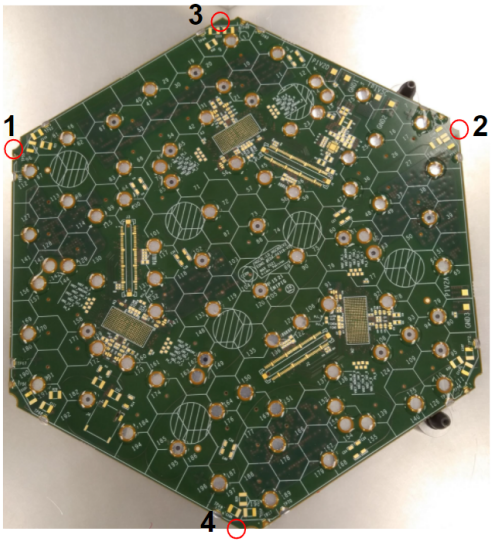
For finding the center of dummy Si w/o patterns, use 4 corners.
For finding the center of PCB, use 4 circular cutouts at the edges.

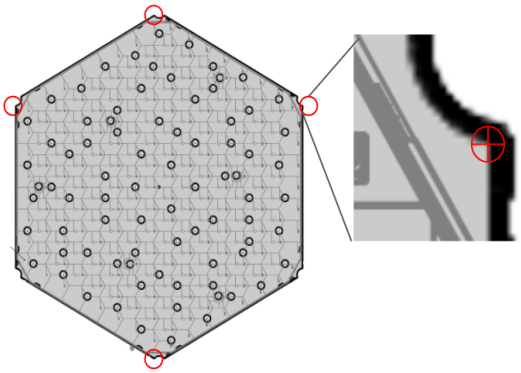
Procedure:

1. The steps to run the program are very similar to baseplate center finder except that we use 4 points instead of 6 points.

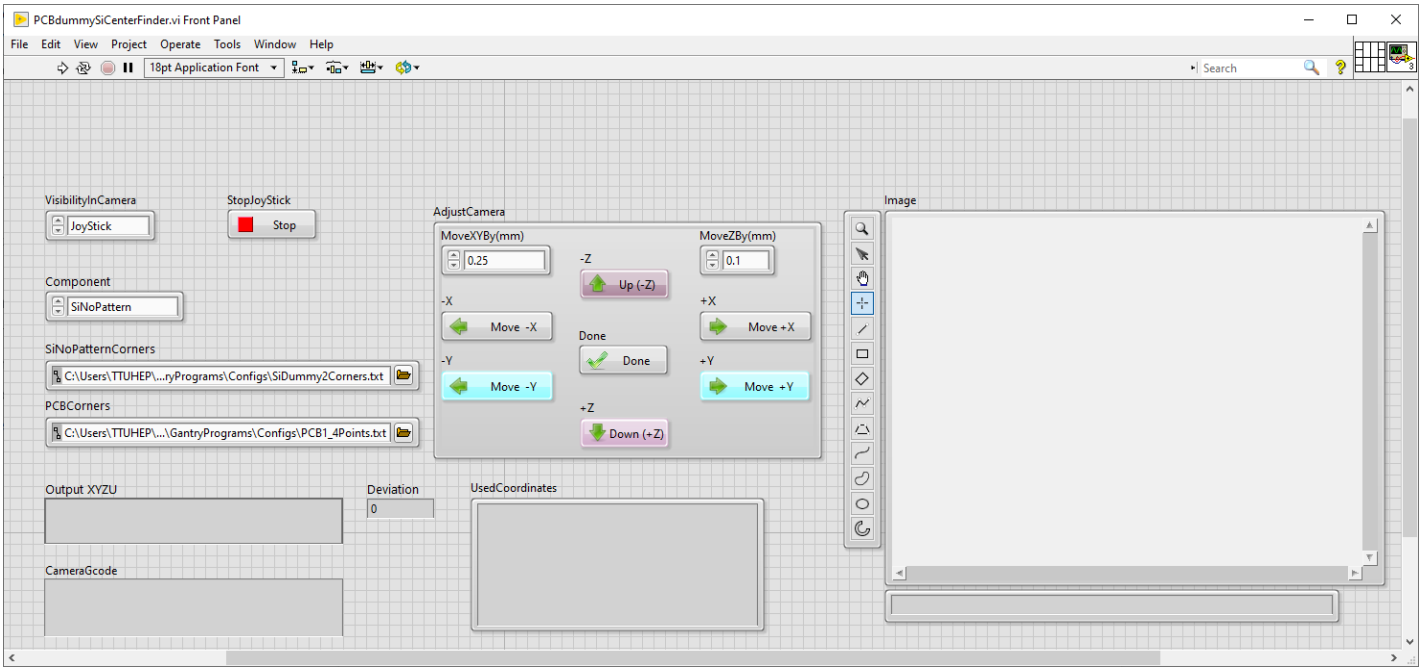


Dummy sensor center finder





PCB center finder



AssembleSiPCB.vi:

File location	"C:\Users\TTUHEP\Documents\LabVIEW\GantryPrograms\AssembleSiPCB.vi"
Operation	Assemble Si or PCB
SubVIs	GetArrayFmTxtFile.vi, Dispenser_v2.vi, RotateGH_U.vi, PickDropVacCtrld.vi
Main inputs	Initialize, AssmbType, Syringe XYZ, Glue pressure settings, Glue pattern and set of operations (Glue, GoToTool, PickTool etc).
Main outputs	Assemble Si/PCB and write log files to "C:\Users\TTUHEP\Documents\LabVIEW\GantryPrograms\LogFiles\"
Other I/Os	Position of baseplate, Si/PCB, PUT position, Vacuum switch states, ErrorIn, error out
Hardwares	Gantry, Vacuum & micro switches, Dispenser
VI descriptor	file:///C:/Users/TTUHEP/Documents/LabVIEW/GantryPrograms/VI_descriptions/AssembleSiPCB.html

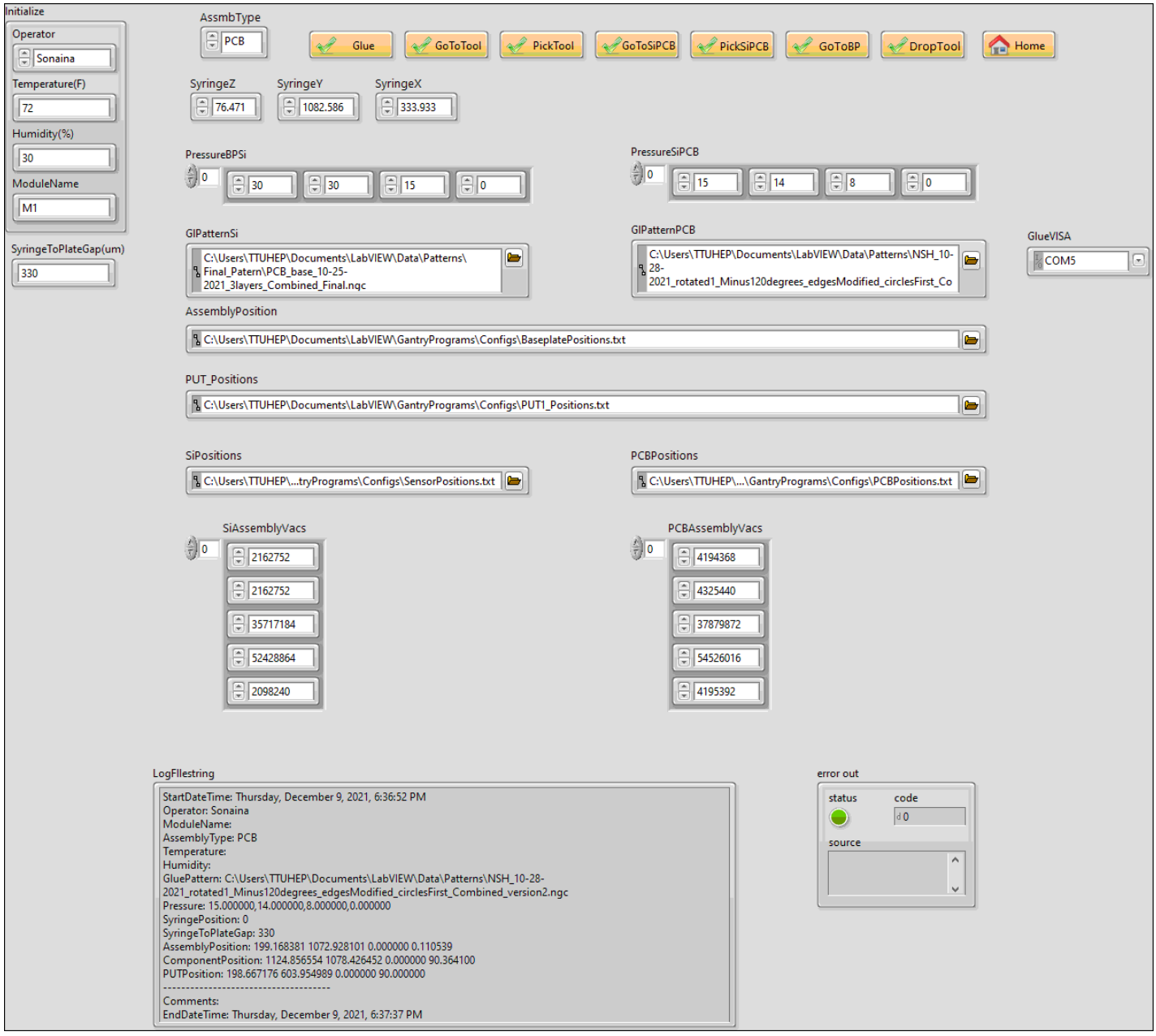
Overview:

Dispense glue using glue pattern, pick and place Si/PCB on baseplate/Si. This is the main program for assembly. It makes use of calibrations values determined from previous steps.
At present we use Position1 for baseplate, position2 for sensor and Position1 for PCB. Position of pickup tool (PUT) is fixed at position1 irrespective of Si or PCB assembly.

Procedure:

1. Do manual calibration of X,Y and Z of syringe and put those values into SyringeX/Y/Z input boxes.
2. Check the pressure and glue patterns as 30,30,15,0 for Si assembly and 15,14,8,0 for PCB assembly.
3. Fill the details in Initialize. For ModuleName, do not use any special characters or space.
4. Choose “AssmbType” as Sensor/PCB.
5. Click on all the steps, Glue, GoToTool….. Home. When they are activated, they are orange, if not they are gray.
6. You don’t need to change anything else if it is a normal assembly.

7. After gluing, the program pauses and waits for your confirmation about the syringe being taken out or not. After removing the syringe, click yes in the popup window.
8. After pick and place, you will be asked if you want to write the log. Click yes. If you don't want to write, click No. Even if the log files are not written, the log is shown in "LogFIlestring" at the bottom of the front panel. You can copy and put the info into a text file. Log files are named as <ModuleName>_Assembly_<Sensor/PCB>_log.txt. For example, LiveModule1_Assembly_PCB_log.txt in "C:\Users\TTUHEP\Documents\LabVIEW\GantryPrograms\LogFiles\" directory.
9. **Never stop glue dispensing in the middle. If it is really needed try to stop when the dispenser is not pumping air. If you stopped glue dispensing in the middle, take out the syringe and *"Home"* the gantry using "Composer", not using the labview program.**


Initialize
Operator
Sonaina
Temperature(F)
72
Humidity(%)
30
ModuleName
M1
SyringeToPlateGap(um)
330
AssmbType
PCB
Glue
GoToTool
PickTool
GoToSiPCB
PickSiPCB
GoToBP
DropTool
Home
SyringeZ
76.471
SyringeY
1082.586
SyringeX
333.933
PressureBPSi
0
30
30
15
0
PressureSiPCB
0
15
14
8
0
GlPatternSi
C:\Users\TTUHEP\Documents\LabVIEW\Data\Patterns\Final_Patern\PCB_base_10-25-2021_3layers_Combined_Final.ngc
GlPatternPCB
C:\Users\TTUHEP\Documents\LabVIEW\Data\Patterns\NSH_10-28-2021_rotated1_Minus120degrees_edgesModified_circlesFirst_Co
GlueVISA
COM5
AssemblyPosition
C:\Users\TTUHEP\Documents\LabVIEW\GantryPrograms\Configs\BaseplatePositions.txt
PUT_Positions
C:\Users\TTUHEP\Documents\LabVIEW\GantryPrograms\Configs\PUT1_Positions.txt
SiPositions
C:\Users\TTUHEP\...tryPrograms\Configs\SensorPositions.txt
PCBPositions
C:\Users\TTUHEP\...\GantryPrograms\Configs\PCBPositions.txt
SiAssemblyVacs
0
2162752
2162752
35717184
52428864
2098240
PCBAssemblyVacs
0
4194368
4325440
37879872
54526016
4195392
LogFIlestring
StartDateTime: Thursday, December 9, 2021, 6:36:52 PM
Operator: Sonaina
ModuleName:
AssemblyType: PCB
Temperature:
Humidity:
GluePattern: C:\Users\TTUHEP\Documents\LabVIEW\Data\Patterns\NSH_10-28-2021_rotated1_Minus120degrees_edgesModified_circlesFirst_Combined_version2.ngc
Pressure: 15.000000,14.000000,8.000000,0.000000
SyringePosition: 0
SyringeToPlateGap: 330
AssemblyPosition: 199.168381 1072.928101 0.000000 0.110539
ComponentPosition: 1124.856554 1078.426452 0.000000 90.364100
PUTPosition: 198.667176 603.954989 0.000000 90.000000

Comments:
EndDateTime: Thursday, December 9, 2021, 6:37:37 PM
error out
status
code
0
source

New Color camera Installation:

https://www.edmundoptics.com/p/u3-3280se-23-color-usb31-camera/43966/

- Download software from https://www.ids-imaging.us/download-details/AB02853.html?os=windows&version=win10&bus=64&floatcalc=#anc-guf-2_9_12769
- Use custom installation (Default installation interferes with NI MAX) without “USB3 Vision Transport layer”:
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