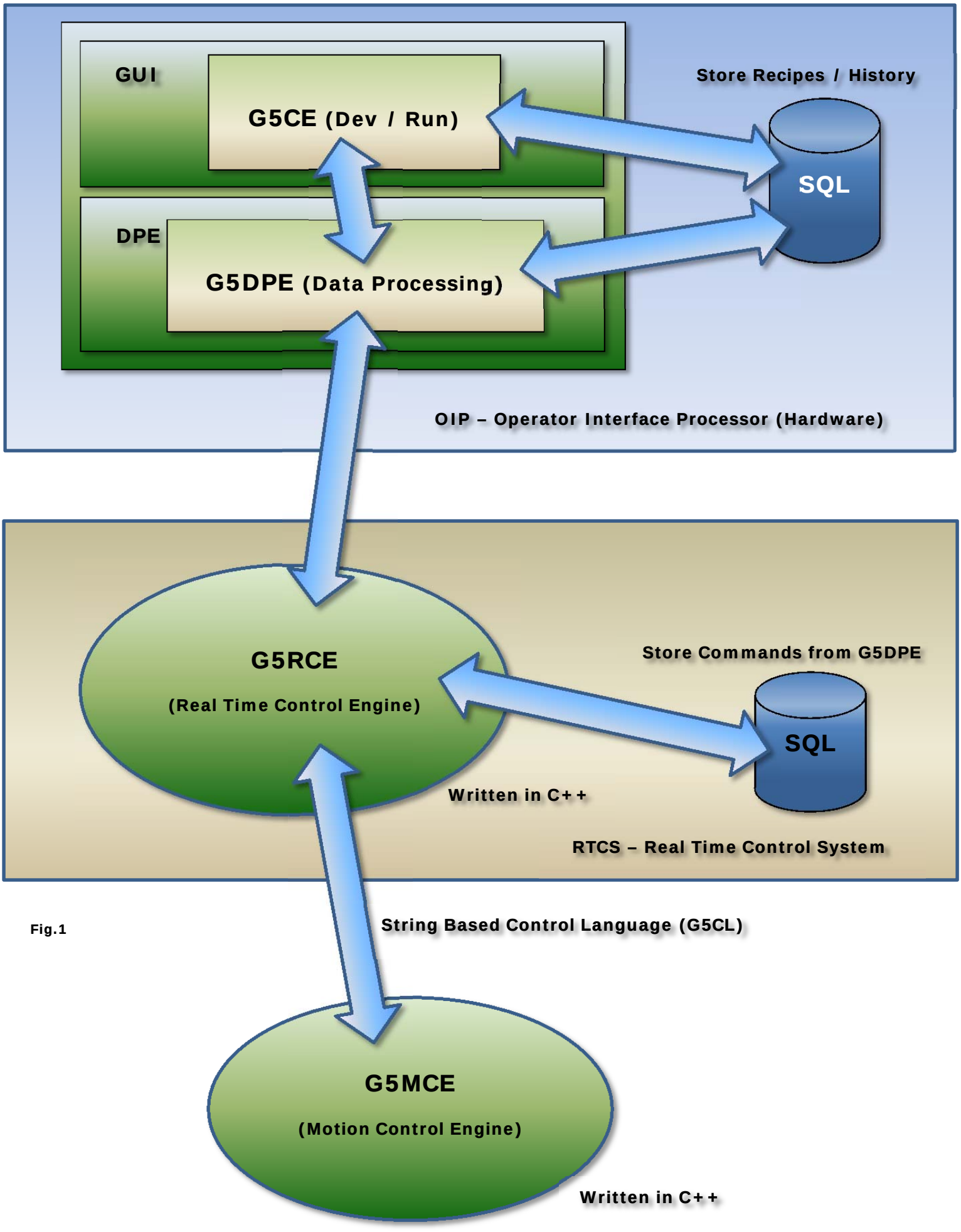
GUI
G5CE (Dev / Run)
Store Recipes / History
SQL
DPE
G5DPE (Data Processing)
OIP – Operator Interface Processor (Hardware)
G5RCE
(Real Time Control Engine)
Store Commands from G5DPE
SQL
Written in C++
RTCS – Real Time Control System
String Based Control Language (G5CL)
G5MCE
(Motion Control Engine)
Written in C++

Fig.1

Basic Requirements of the G5 Control Engine

Development Mode

- All configuration is done through the development GUI (see fig.2)
- Create and develop control programs
- The Recipe for the program consists of control language primitives:
  - Circle
  - Arc
  - Line
  - Dot
  - Square
  - etc …
- Store and read these Recipes in the G5CE SQL database
- The development mode is also used to configure machine parameters:
  - Valve setup
  - Valve calibration
  - Valve cleaning
  - etc …
- Store and read these parameters in the G5CE SQL database

Run Mode

- This GUI screen allows the user to visually monitor the control engine process of the program (see fig.3)

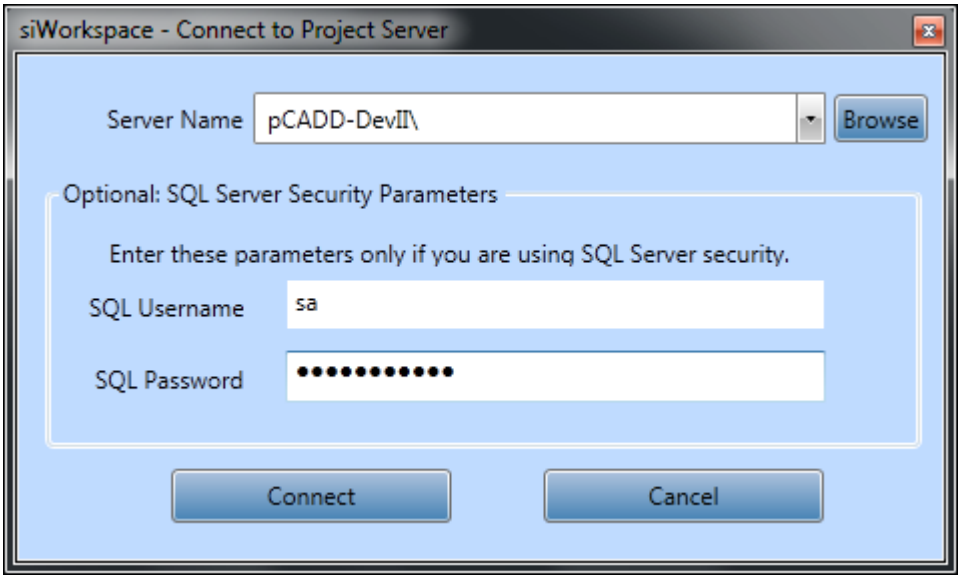

Fig.1 (GUI Login)

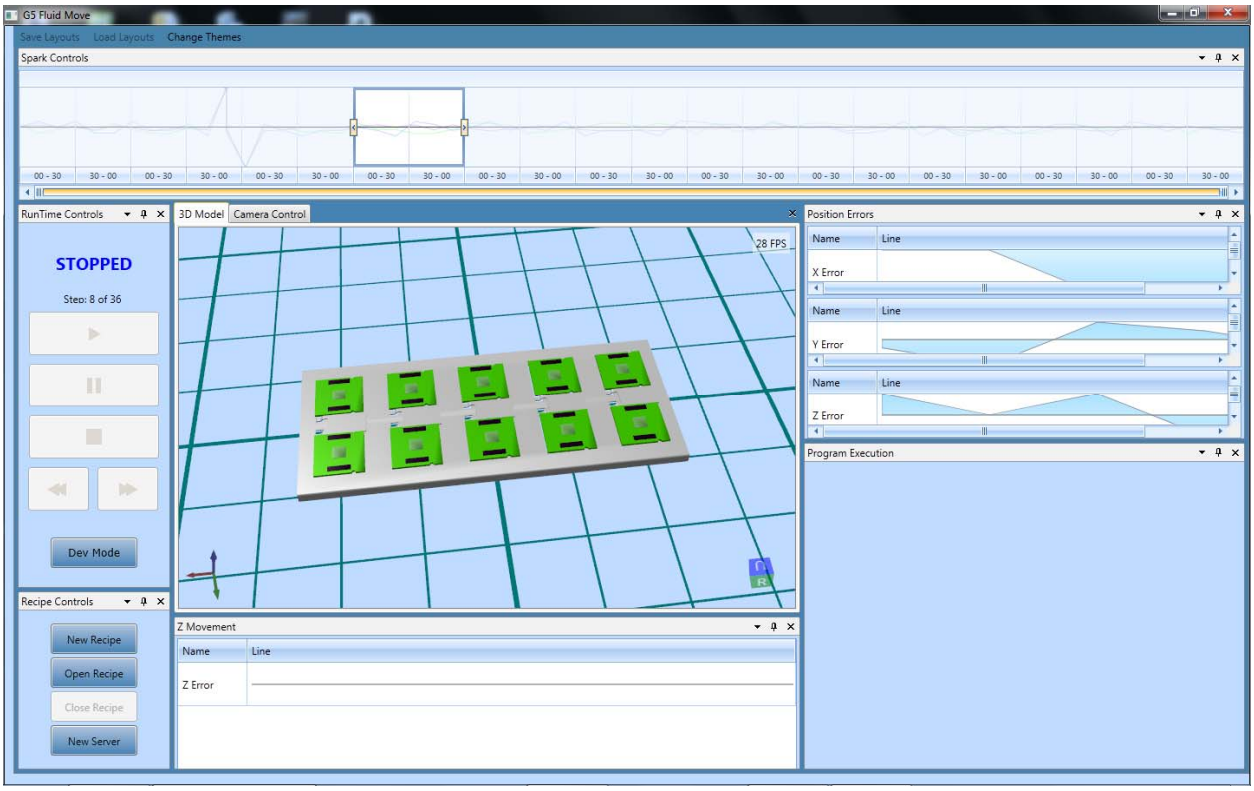

Fig.2 (GUI Development mode)

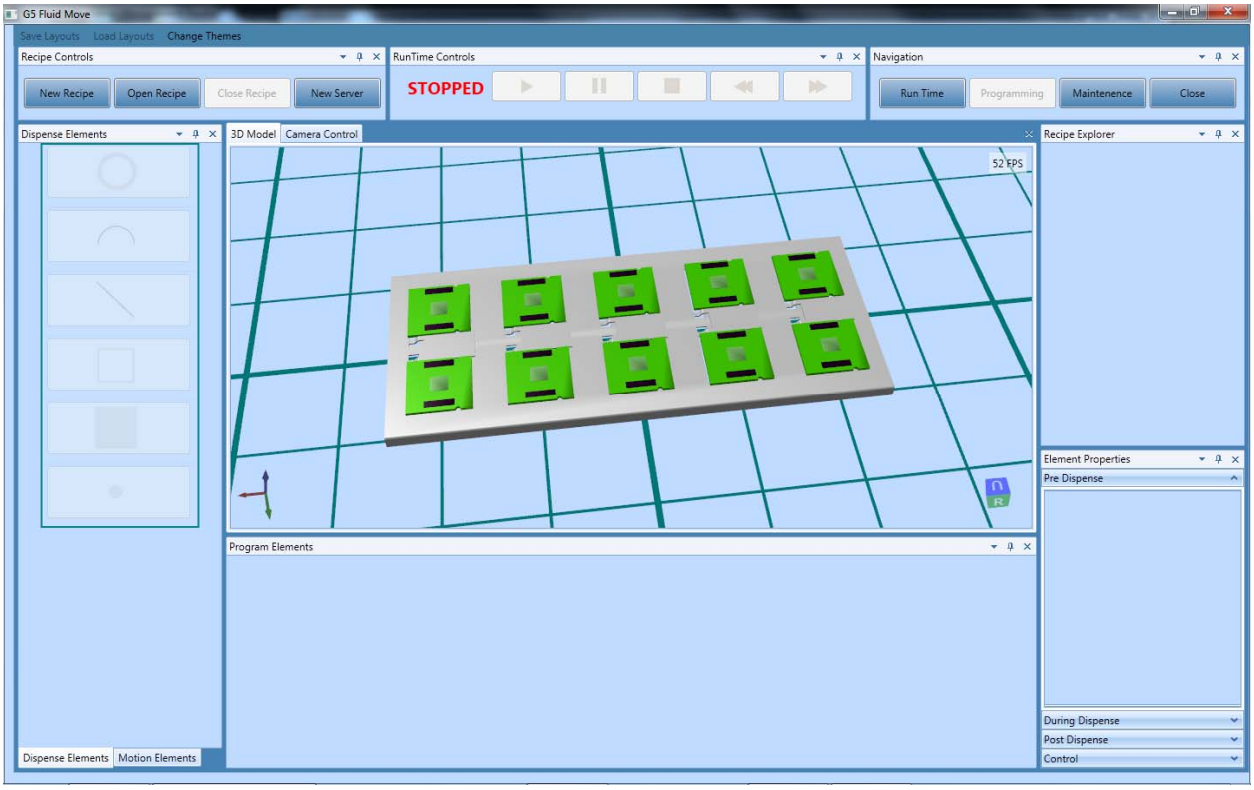

Fig.3 (GUI Run mode)

Fig.3 (GUI Run mode)

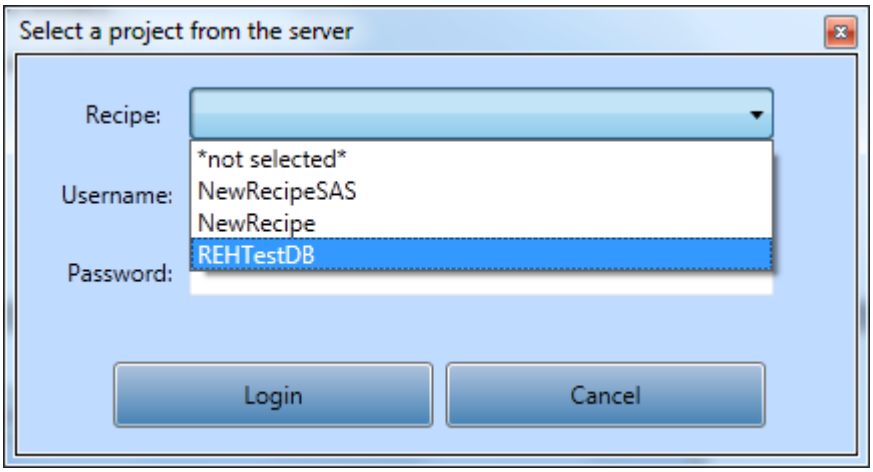

Fig.4 (GUI SetUp Database mode)

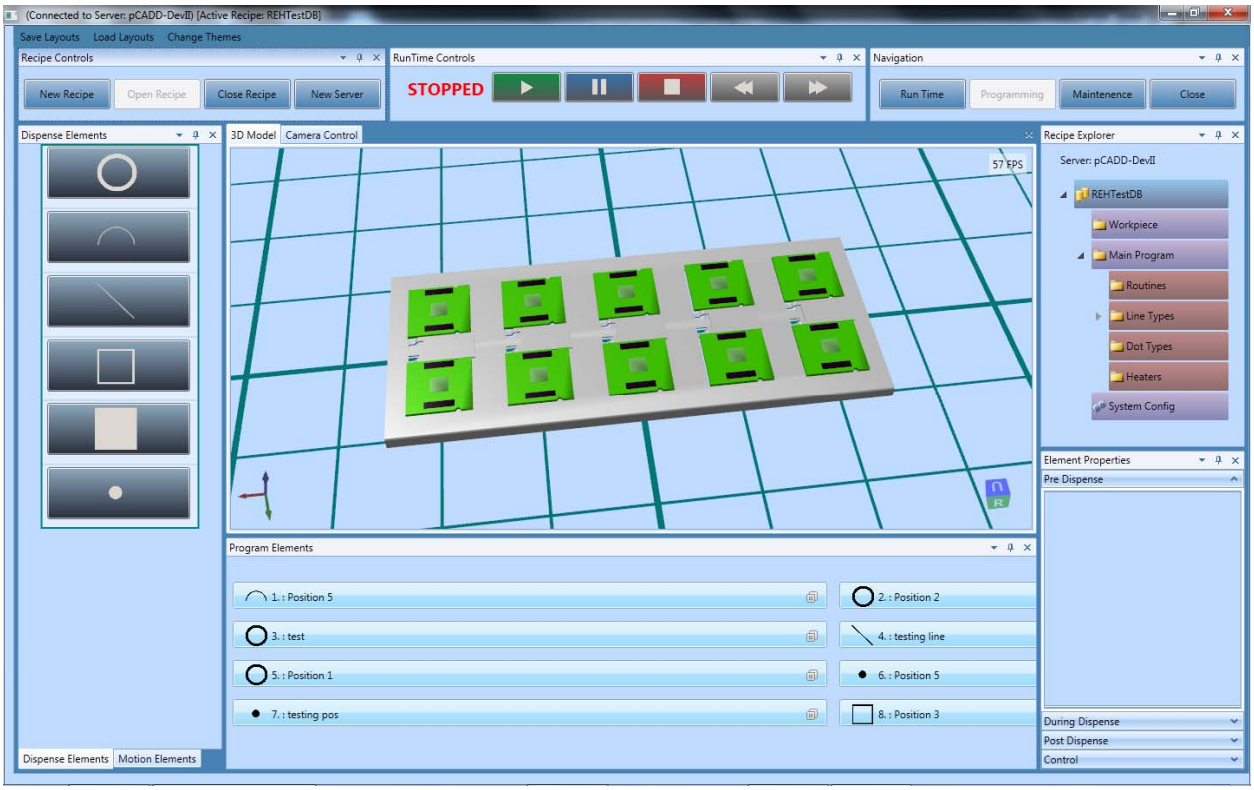

Fig.5 (GUI SetUp Program mode)

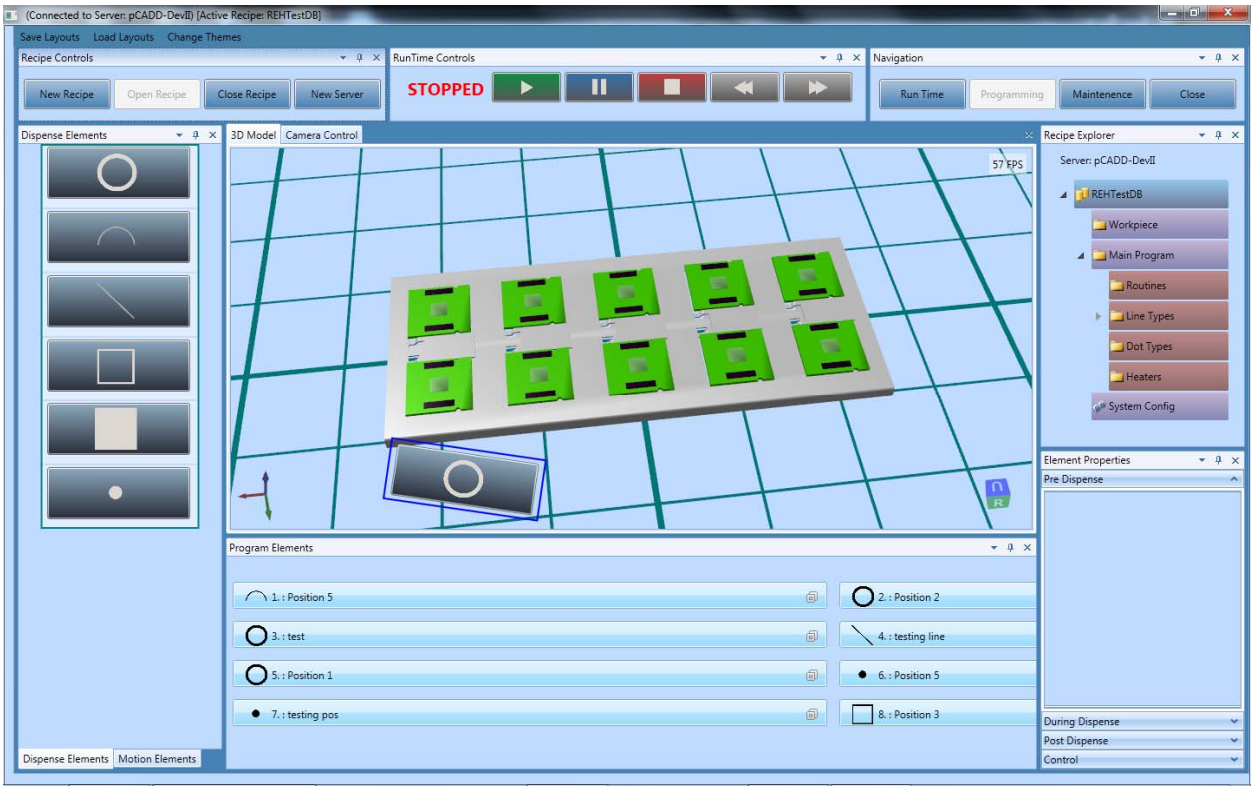

Fig.6 (GUI SetUp Program mode – Drag Element to program execution panel)

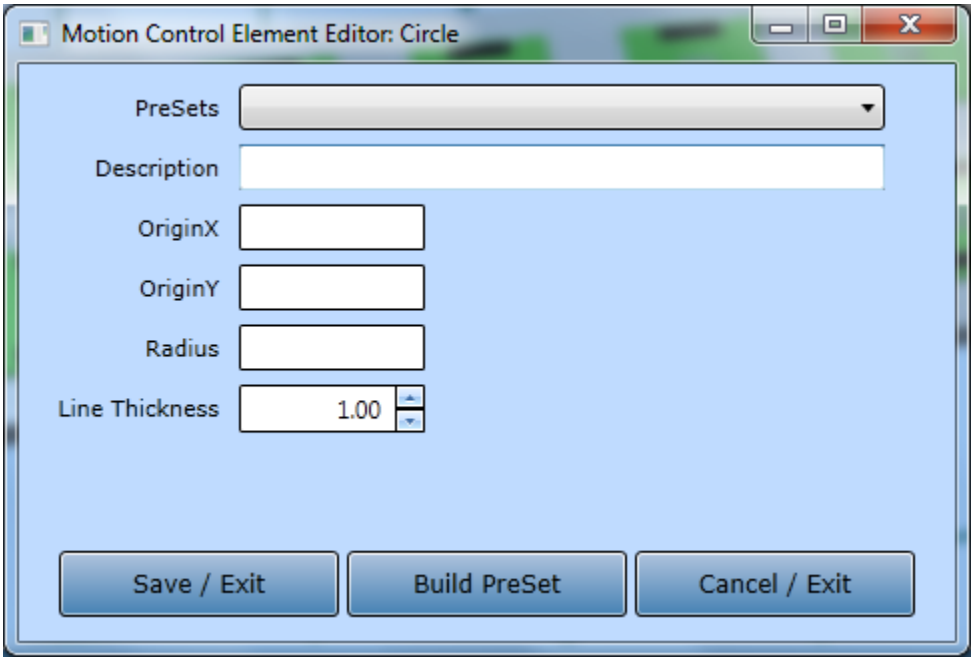

Fig.7 (GUI SetUp Program mode – Dialog to enter positions)

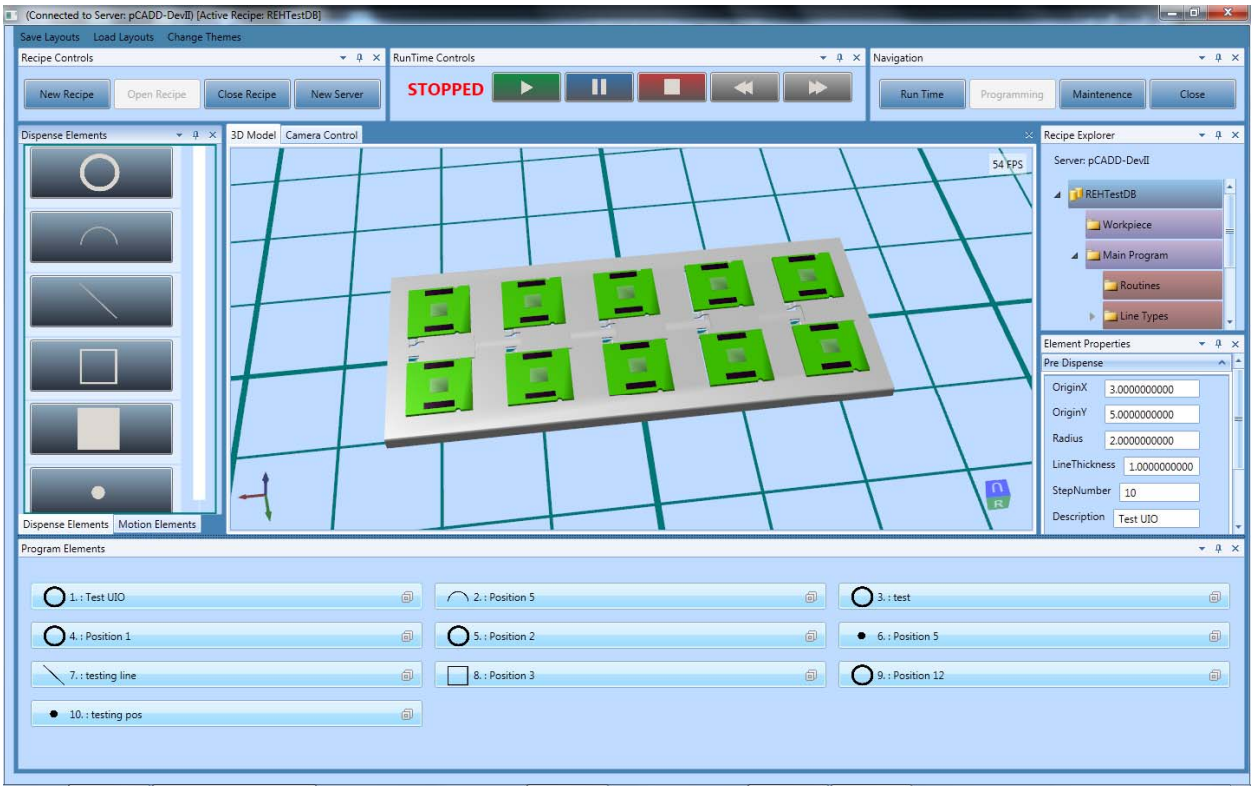

Fig.8 (GUI SetUp Program mode – new execution tile)

Basic Requirements of the G5 Data Processing Engine

- Provide real-time data monitoring and command transmission to the RCE (see RCE in fig.1)
- Logging process history to the local SQL server for post analysis.
- This process data will be stored in wide data format with a time stamp for each row.
    - Data will be stored in decimal value for accuracy.
- Logging event history stored in narrow data format with a time stamp.
    - Data will be stored in decimal value for accuracy.
- The SQL server database is a data repository for recipe definitions, process and event data.

Classes

- DotClass
    - OriginX
    - OriginY
    - Radius
- LineClass
    - LineX1
    - LineX2
    - LineY1
    - LineY2
    - LineThickness
- ArcSegmentClass
    - OriginX
    - OriginY
    - Radius
    - Angle
    - LineThickness
- CircleClass
    - OriginX
    - OriginY
    - Radius
    - LineThickness
- OpenSquareClass
    - OriginX
    - OriginY
    - Width
    - LineThickness
- ClosedSquareClass
    - OriginX
    - OriginY
    - Width

Table 1 (X-Y Commands)

Command	Description	Page No.
AA	Arc Absolute	
AB	Antibacklash Vectors	
AC	Acceleration	
AR	Arc Relative	
BP	Begin Pattern	
CF	Calibration Factors	
CP	Clear Pattern	
CR	Correction	
EP	End Pattern	
FH	Find Home Switches	
MA	Move Absolute	
MR	Move Relative	
MT	Move to Taught Point	
OA	Output Actual Position	
OC	Output Command Position	
OF	Output Calibration Factors	
OG	Output Angle	
OL	Output Travel Limits	
OO	Output Origin	
OR	Output Correction	
OT	Output Taught Point	
PM	Power Level of Motors	
RE	Resolution	
SC	Scale	
SO	Set Origin	
SP	Set Position Counters	
SR	Step Rate	
TL	Travel Limits	
VM	Vector Mode	

Table 2 (3rd Axis Commands)

Command	Description	Page No.
AZ	Absolute Z Move	
CZ	Configure Z Axis	
FZ	Find Z Home	
MZ	Move Z (relative)	
OZ	Output Z Position	
PZ	Set Power Level of Z Motor	
SZ	Set Z Position Counter	

Table 3 (Flow of Execution Commands)

Command	Description	Page No.
XD	Execute Download Sequence	
XI	Execute If (conditionally execute Download Sequence)	
XU	Execute Until (repeat a Download Sequence Until Condition)	
XW	Execute While (repeat a Download Sequence While Condition)	

Table 4 (ACL Variable Commands)

Command	Description	Page No.
OV	Output Variable	
VA	Compare Vector Angle	
VC	Variable Capture	
VL	Vector Length	
VR	Vector Rotate	
VS	Variable Set	
VT	Variable Test	
V<	Variable Less Than	
V=	Variable Equal To	
V>	Variable Greater Than	
V+	Variable Add	
V-	Variable Subtract/Negate	
V*	Variable Multiply	
V/	Variable Divide	
V&	Variable AND	
V|	Variable OR	
V!	Variable NOT/Exclusive-OR	

Table 5 (Digital Outputs Commands)

Command	Description	Page No.
AP	Auxiliary Digital Port Select	
CD	Change Digital Outputs	
GD	Lower Retractable Height Sensor	
GU	Raise Retractable Height Sensor	
MD	Mid-move Digital Outputs Changes	
MM	Multiple Mid-move Digital Outputs Changes	
OD	Output Digital Outputs State	
PD	Pre-move Digital Outputs Changes	
TD	Toggle Digital Outputs	
WD	Wait after Digital Outputs Changes	

Table 6 (Digital Inputs)

Command	Description	Page No.
MN	Mid-move Digital Inputs Response	
ON	Output Digital Inputs State	
WN	Wait For Digital Inputs	

Table 7 (Configuration and Miscellaneous Commands)

Command	Description	Page No.
AD	Abort Download Sequence Execution	
AM	Arrow Mode	
BC	Begin Continuous Path	
BD	Begin Download	
CS	Clear Stop	
EC	End Continuous Path	
ED	End Download	
ES	Execute Escape Sequence	
FP	Front Panel Lockout	
IN	Initialize	
OB	Output Buttons	
OE	Output Error Code	

OI	Output Identification	
OP	Output Personality Parameter	
OQ	Output Qualities	
OS	Output Status	
OU	Output Literal String	

Table 8 (New Commands)

Command	Description	Page No.
BR	Baud Rate	
CP	Clear Patterns	
CT	Configure Theta	
Din	Digital Input from n bit selection	
DOn	Digital Output to nth selected bit state	
DO		
DO-1		
DP	Select Display Position	
DU	Display User Message	
DVn	Display Variable Value	
FD	Find Download	
FM	Flow Monitor	
FT	Find Theta	
GI	GPIO Inputs	
GO	GPIO Outputs	
MS	Move Spline	
PP	PID Parameter	
RA	Read Analog channel	
RD	Request Download	
RC	Read EFD QSPI configuration bits	
RP	Request Program	
RL	Read Laser	
SA	Serial Access	
SD	Set DAC	
SE	Set Error	
SH	Show History	
SS	Set Step response	
TA	Move Theta	
TC	Temperature Control	
TR	Move Theta Relative	
UE	Upload Encoder	
UT	Output Theta	
ZZ	Switch to firmware that re-flashes the external flash memory from a .mot file	