

ĐẠI HỌC QUỐC GIA TP. HỒ CHÍ MINH
TRƯỜNG ĐẠI HỌC BÁCH KHOA
KHOA ĐIỆN – ĐIỆN TỬ

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BÁO CÁO BÀI TẬP LỚN
Môn: SCADA

THỰC HIỆN MÔ HÌNH LẠI HỆ SCADA
KẾT HỢP GỬI DỮ LIỆU

GVHD: NGUYỄN ĐỨC HOÀNG
SVTH: ĐÀO MINH TRIẾT
MSSV: 1814426

TP. HỒ CHÍ MINH, THÁNG 12 NĂM 2021

LỜI CẢM ƠN

Qua project lần này, em xin gửi lời cảm ơn đến những gì thầy Nguyễn Đức Hoàng đã truyền dạy trong suốt một học kỳ qua. Nhờ những kiến thức đầy đủ đó đã giúp em có thể hiểu và hoàn thành được project này.

Thông qua đó giúp em hiểu được những khái niệm cơ bản nhất của môn học SCADA, để từ đó có những trang bị nhất định cho hành trang công việc trong tương lai.

Tp. Hồ Chí Minh, ngày 28 tháng 12 năm 2021.

Sinh viên

Đào Minh Triết

TÓM TẮT NỘI DUNG

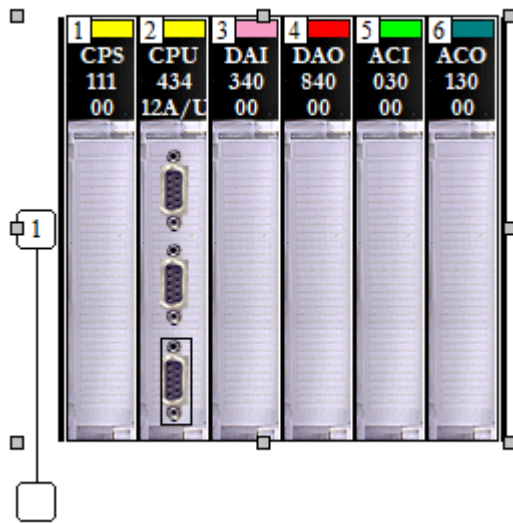
Thực hiện mô phỏng lại được một hệ SCADA. Bao gồm thực hiện mô hình hóa trên Simit, kết nối truyền dữ liệu thông qua KepServerEX, xây dựng giao diện tương tác SCADA, hiện alarm, vẽ trend, đồng thời cũng báo cáo dữ liệu thu thập được lên Database, Excel và Cloud.

Mục lục

I. Lập trình trên Unity Pro XL:	2
1.1 Cấu hình PLC:	2
1.2 Đặt địa chỉ biến:	4
1.3 Các khối khác:	6
II. Đặt địa chỉ KepServerEX:	13
III. Mô hình hóa Motor và Tank trên Simit:	16
IV. Citect:	21
V. Xuất Access và Excel:	27
VI. Cloud:	28
Tài liệu tham khảo:	38

I. Lập trình trên Unity Pro XL:

1.1 Cấu hình PLC:



AC IN 24V 16x1

Overview Configuration I/O objects

I/O variable creation

Prefix for name:

Type:

Comment:

Create

I/O Objects

Channel: ☐ %CH

Configuration: ☐ %KW ☐ %KD ☐ %KF

System: ☐ %MW

Status: ☐ %MW

Parameter: ☐ %MW ☐ %MD ☐ %MF

Command: ☐ %MW ☐ %MD ☐ %MF

Implicits: ☒ %I ☒ %Q ☐ %ID ☐ %IF ☐ %IERR

☒ %QW ☐ %QD ☐ %QF

Update

	Address	Name	Type	State RAM	Comment
1	%I1.1\1.3.1	Motor_2_Start	EB00L	(IX) %I1	
2	%I1.1\1.3.2	Motor_2_Stop	EB00L	(IX) %I2	
3	%I1.1\1.3.3	Motor_3_Start	EB00L	(IX) %I3	
4	%I1.1\1.3.4	Motor_3_Stop	EB00L	(IX) %I4	
5	%I1.1\1.3.5	Tank_2_Open	EB00L	(IX) %I5	
6	%I1.1\1.3.6	Tank_2_Close	EB00L	(IX) %I6	
7	%I1.1\1.3.7	Tank_3_Open	EB00L	(IX) %I7	
8	%I1.1\1.3.8	Tank_3_Close	EB00L	(IX) %I8	
9	%I1.1\1.3.9		EB00L	(IX) %I9	
10	%I1.1\1.3.10		EB00L	(IX) %I10	
11	%I1.1\1.3.11		EB00L	(IX) %I11	
12	%I1.1\1.3.12		EB00L	(IX) %I12	
13	%I1.1\1.3.13		EB00L	(IX) %I13	
14	%I1.1\1.3.14		EB00L	(IX) %I14	
15	%I1.1\1.3.15		EB00L	(IX) %I15	
16	%I1.1\1.3.16		EB00L	(IX) %I16	
17					

AC OUT 24-230V 16x1

Overview Configuration I/O objects

I/O variable creation

Prefix for name:

Type:

Create

Comment:

I/O Objects

Channel: ☐ %CH

Configuration: ☐ %KW ☐ %KD ☐ %KF

System: ☐ %MW

Status: ☐ %MW

Parameter: ☐ %MW ☐ %MD ☐ %MF

Command: ☐ %MW ☐ %MD ☐ %MF

Implicits: ☒ %I ☒ %IW ☐ %ID ☐ %IF ☐ %I ERR

☒ %Q ☒ %QW ☐ %QD ☐ %QF

Update

	Address	Name	Type	State RAM	Comment
1	%QV1.1V1.4.1	Motor_2_Run	EB00L	(0X) %M1	
2	%QV1.1V1.4.2	Motor_3_Run	EB00L	(0X) %M2	
3	%QV1.1V1.4.3	Tank_2_Run	EB00L	(0X) %M3	
4	%QV1.1V1.4.4	Tank_3_Run	EB00L	(0X) %M4	
5	%QV1.1V1.4.5		EB00L	(0X) %M5	
6	%QV1.1V1.4.6		EB00L	(0X) %M6	
7	%QV1.1V1.4.7		EB00L	(0X) %M7	
8	%QV1.1V1.4.8		EB00L	(0X) %M8	
9	%QV1.1V1.4.9		EB00L	(0X) %M9	
10	%QV1.1V1.4.10		EB00L	(0X) %M10	
11	%QV1.1V1.4.11		EB00L	(0X) %M11	
12	%QV1.1V1.4.12		EB00L	(0X) %M12	
13	%QV1.1V1.4.13		EB00L	(0X) %M13	
14	%QV1.1V1.4.14		EB00L	(0X) %M14	
15	%QV1.1V1.4.15		EB00L	(0X) %M15	
16	%QV1.1V1.4.16		EB00L	(0X) %M16	
17					

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Overview Configuration I/O objects

I/O variable creation

Prefix for name:

Type:

Create

Comment:

I/O Objects

Channel: ☐ %CH

Configuration: ☐ %KW ☐ %KD ☐ %KF

System: ☐ %MW

Status: ☐ %MW

Parameter: ☐ %MW ☐ %MD ☐ %MF

Command: ☐ %MW ☐ %MD ☐ %MF

Implicits: ☒ %I ☒ %IW ☐ %ID ☐ %IF ☐ %I ERR

☒ %Q ☒ %QW ☐ %QD ☐ %QF

Update

	Address	Name	Type	State RAM	Comment
1	%IW1.1V1.5.1	Motor_2_SpeedINT	INT	(3X) %IW1	
2	%IW1.1V1.5.1.1		BOOL	(3X) %IW9	
3	%IW1.1V1.5.2	Motor_3_SpeedINT	INT	(3X) %IW2	
4	%IW1.1V1.5.2.1		BOOL	(3X) %IW9	
5	%IW1.1V1.5.3	Tank_2_LevelINT	INT	(3X) %IW3	
6	%IW1.1V1.5.3.1		BOOL	(3X) %IW9	
7	%IW1.1V1.5.4	Tank_2_FlowINT	INT	(3X) %IW4	
8	%IW1.1V1.5.4.1		BOOL	(3X) %IW9	
9	%IW1.1V1.5.5	Tank_3_LevelINT	INT	(3X) %IW5	
10	%IW1.1V1.5.5.1		BOOL	(3X) %IW9	
11	%IW1.1V1.5.6	Tank_3_FlowINT	INT	(3X) %IW6	
12	%IW1.1V1.5.6.1		BOOL	(3X) %IW9	
13	%IW1.1V1.5.7		INT	(3X) %IW7	
14	%IW1.1V1.5.7.1		BOOL	(3X) %IW9	
15	%IW1.1V1.5.8		INT	(3X) %IW8	
16	%IW1.1V1.5.8.1		BOOL	(3X) %IW9	
17	%IW1.1V1.5.9		INT	(3X) %IW9	
18					

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Overview Configuration I/O objects

I/O variable creation

Prefix for name:

Type:

Create

Comment:

I/O Objects

Channel: ☐ %CH

Configuration: ☐ %KW ☐ %KD ☐ %KF

System: ☐ %MW

Status: ☐ %MW

Parameter: ☐ %MW ☐ %MD ☐ %MF

Command: ☐ %MW ☐ %MD ☐ %MF

Implicits: ☒ %I ☒ %IW ☐ %ID ☐ %IF ☐ %I ERR

☒ %Q ☒ %QW ☐ %QD ☐ %QF

Update

	Address	Name	Type	State RAM	Comment
1	%QW1.1V1.6.1	Motor_2_PowerINT	INT	(4X) %MW1	
2	%QW1.1V1.6.2	Motor_3_PowerINT	INT	(4X) %MW2	
3	%QW1.1V1.6.3	Tank_2_PowerINT	INT	(4X) %MW3	
4	%QW1.1V1.6.4	Tank_3_PowerINT	INT	(4X) %MW4	
5	%QW1.1V1.6.5		INT	(4X) %MW5	
6	%QW1.1V1.6.6		INT	(4X) %MW6	
7	%QW1.1V1.6.7		INT	(4X) %MW7	
8	%QW1.1V1.6.8		INT	(4X) %MW8	
9					

1.2 Đặt địa chỉ biến:

Motor_2:

Motor_2_Cmd	EBOOL				%M1
Motor_2_Enable	EBOOL				%M50
Motor_2_PID_2_D	EBOOL				%M203
Motor_2_PID_2_I	EBOOL				%M202
Motor_2_PID_2_Mode	EBOOL				%M200
Motor_2_PID_2_P	EBOOL				%M201
Motor_2_PID_Mode	Mode_PID				
Motor_2_PID_Paras	Para_PID				%MW201
gain	REAL				%MW201
ti	TIME				%MW203
td	TIME				%MW205
td_lag	TIME				%MW207
ymax	REAL				%MW209
ymin	REAL				%MW211
Motor_2_PowerINT	INT				%QW\1.1\1.6.1
Motor_2_PowerINT_W	INT				%IW100
Motor_2_PowerREAL	REAL				%MW51
Motor_2_Run	EBOOL				%Q\1.1\1.4.1
Motor_2_SpeedINT	INT				%IW\1.1\1.5.1
Motor_2_SpeedINT_R	INT				%MW102
Motor_2_SpeedREAL	REAL				%MW53
Motor_2_SpeedSP	REAL				%MW47
Motor_2_Start	EBOOL				%I\1.1\1.3.1
Motor_2_Stop	EBOOL				%I\1.1\1.3.2

Motor_3:

Motor_3_Cmd	EBOOL				%M2
Motor_3_Enable	EBOOL				%M52
Motor_3_PID_2_D	EBOOL				%M213
Motor_3_PID_2_I	EBOOL				%M212
Motor_3_PID_2_Mode	EBOOL				%M210
Motor_3_PID_2_P	EBOOL				%M211
Motor_3_PID_Mode	Mode_PID				
Motor_3_PID_Paras	Para_PID				%MW213
gain	REAL				%MW213
ti	TIME				%MW215
td	TIME				%MW217
td_lag	TIME				%MW219
ymax	REAL				%MW221
ymin	REAL				%MW223
Motor_3_PowerINT	INT				%QW\1.1\1.6.2
Motor_3_PowerINT_W	INT				%IW104
Motor_3_PowerREAL	REAL				%MW55
Motor_3_Run	EBOOL				%Q\1.1\1.4.2
Motor_3_SpeedINT	INT				%IW\1.1\1.5.2
Motor_3_SpeedINT_R	INT				%MW106
Motor_3_SpeedREAL	REAL				%MW57
Motor_3_SpeedSP	REAL				%MW49
Motor_3_Start	EBOOL				%I\1.1\1.3.3
Motor_3_Stop	EBOOL				%I\1.1\1.3.4

Tank_2:

..... Tank_2_Cmd	EBOOL				%M3
..... Tank_2_Enable	EBOOL				%M54
..... Tank_2_FlowINT	INT				%IW\1.1\1.5.4
..... Tank_2_FlowINT_R	INT				%MW112
..... Tank_2_FlowREAL	REAL				%MW63
..... Tank_2_LevelINT	INT				%IW\1.1\1.5.3
..... Tank_2_LevelINT_R	INT				%MW110
..... Tank_2_LevelREAL	REAL				%MW61
..... Tank_2_LevelSP	REAL				%MW71
..... Tank_2_Open	EBOOL				%I\1.1\1.3.5
..... Tank_2_PID_2_D	EBOOL				%M223
..... Tank_2_PID_2_I	EBOOL				%M222
..... Tank_2_PID_2_Mode	EBOOL				%M220
..... Tank_2_PID_2_P	EBOOL				%M221
..... Tank_2_PID_Mode	Mode_PID				
..... Tank_2_PID_Paras	Para_PID				%MW225
..... gain	REAL				%MW225
..... ti	TIME				%MW227
..... td	TIME				%MW229
..... td_lag	TIME				%MW231
..... ymax	REAL				%MW233
..... ymin	REAL				%MW235
..... Tank_2_PowerINT	INT				%QW\1.1\1.6.3
..... Tank_2_PowerINT_W	INT				%IW108
..... Tank_2_PowerREAL	REAL				%MW59
..... Tank_2_Run	EBOOL				%Q\1.1\1.4.3

Tank_3:

Tank_3_Close	EBOOL			%I\1.1\1.3.8
Tank_3_Cmd	EBOOL			%M4
Tank_3_Enable	EBOOL			%M56
Tank_3_FlowINT	INT			%IW\1.1\1.5.6
Tank_3_FlowINT_R	INT			%MW118
Tank_3_FlowREAL	REAL			%MW69
Tank_3_LevelINT	INT			%IW\1.1\1.5.5
Tank_3_LevelINT_R	INT			%MW116
Tank_3_LevelREAL	REAL			%MW67
Tank_3_LevelSP	REAL			%MW73
Tank_3_Open	EBOOL			%I\1.1\1.3.7
Tank_3_PID_2_D	EBOOL			%M233
Tank_3_PID_2_I	EBOOL			%M232
Tank_3_PID_2_Mode	EBOOL			%M230
Tank_3_PID_2_P	EBOOL			%M231
Tank_3_PID_Mode	Mode_PID			
Tank_3_PID_Paras	Para_PID			%MW237
gain	REAL			%MW237
ti	TIME			%MW239
td	TIME			%MW241
td_lag	TIME			%MW243
ymax	REAL			%MW245
ymin	REAL			%MW247
Tank_3_PowerINT	INT			%QW\1.1\1.6.4
Tank_3_PowerINT_W	INT			%IW114
Tank_3_PowerREAL	REAL			%MW65
Tank_3_Run	EBOOL			%Q\1.1\1.4.4

1.3 Các khối khác:

Khối Scale:

```

if Motor_2_Run then
    Motor_2_SpeedREAL := INT_TO_REAL (IN :=
Motor_2_SpeedINT)*1500.0/4095.0;
    Motor_2_PowerINT := REAL_TO_INT (IN :=
(4095.0*Motor_2_PowerREAL/100.0));
else
    Motor_2_SpeedREAL := INT_TO_REAL (IN :=
Motor_2_SpeedINT)*1500.0/4095.0;
    Motor_2_PowerINT := 0;
end_if;

if Motor_3_Run then
    Motor_3_SpeedREAL := INT_TO_REAL (IN :=
Motor_3_SpeedINT)*1500.0/4095.0;
    Motor_3_PowerINT := REAL_TO_INT (IN :=
(4095.0*Motor_3_PowerREAL/100.0));
else
    Motor_3_SpeedREAL := INT_TO_REAL (IN :=
Motor_3_SpeedINT)*1500.0/4095.0;

```

```
Motor_3_PowerINT := 0;
end_if;

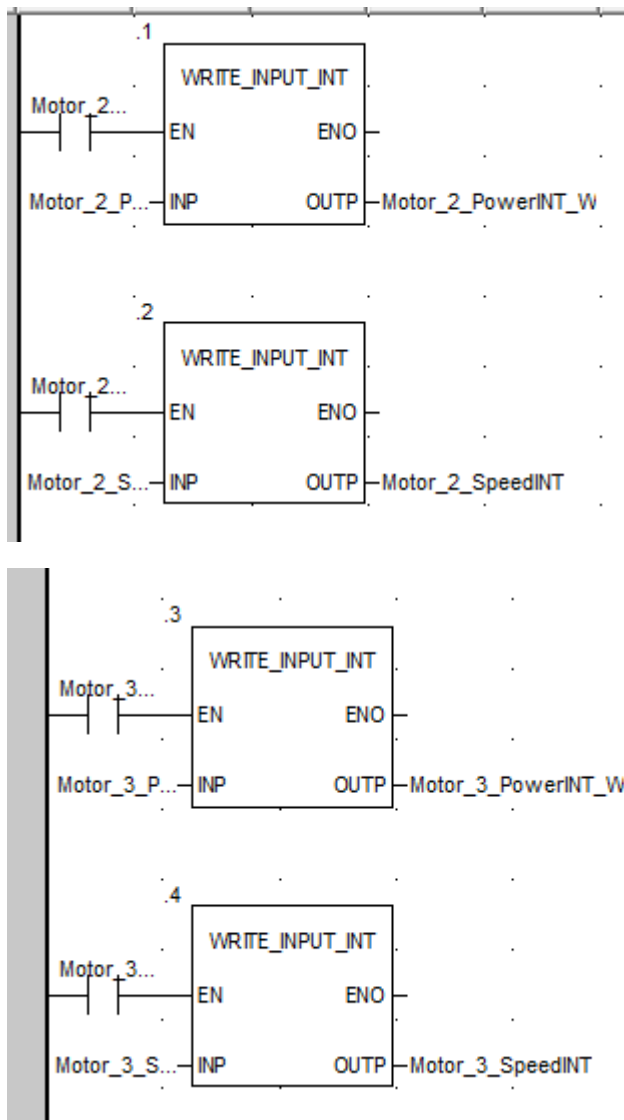
if Tank_2_Run then
    Tank_2_FlowREAL := INT_TO_REAL (IN :=
    Tank_2_FlowINT)*1000.0/4095.0;
    Tank_2_LevelREAL := INT_TO_REAL (IN :=
    Tank_2_LevelINT)*5.0/4095.0;
    Tank_2_PowerINT := REAL_TO_INT (IN :=
    (4095.0*Tank_2_PowerREAL/100.0));
else
    Tank_2_PowerINT := 0;
    Tank_2_LevelREAL := INT_TO_REAL (IN :=
    Tank_2_LevelINT)*5.0/4095.0;
end_if;

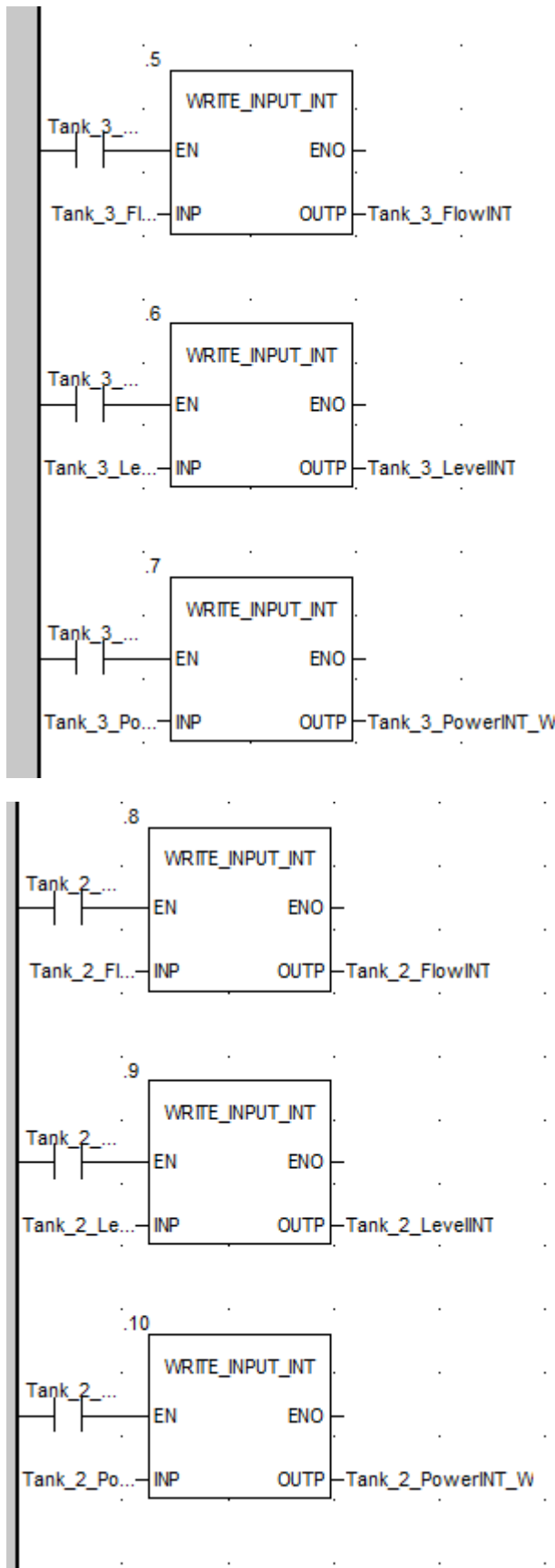
if (Tank_2_LevelREAL <= 0.0) then
    Tank_2_LevelREAL := 0.0;
end_if;

if Tank_3_Run then
    Tank_3_FlowREAL := INT_TO_REAL (IN :=
    Tank_3_FlowINT)*1000.0/4095.0;
    Tank_3_LevelREAL := INT_TO_REAL (IN :=
    Tank_3_LevelINT)*5.0/4095.0;
    Tank_3_PowerINT := REAL_TO_INT (IN :=
    (4095.0*Tank_3_PowerREAL/100.0));
else
    Tank_3_PowerINT := 0;
    Tank_3_LevelREAL := INT_TO_REAL (IN :=
    Tank_3_LevelINT)*5.0/4095.0;
end_if;

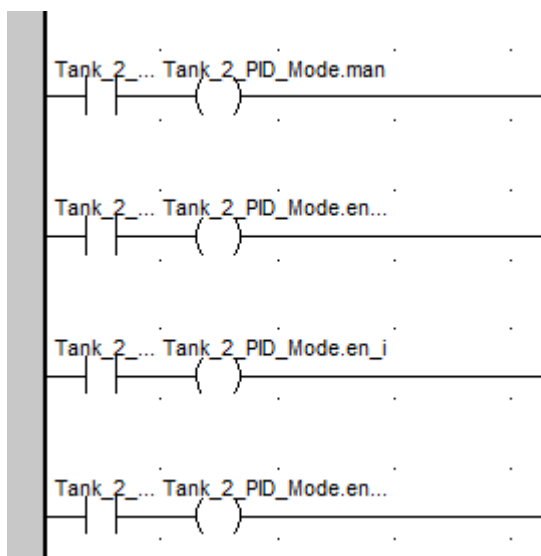
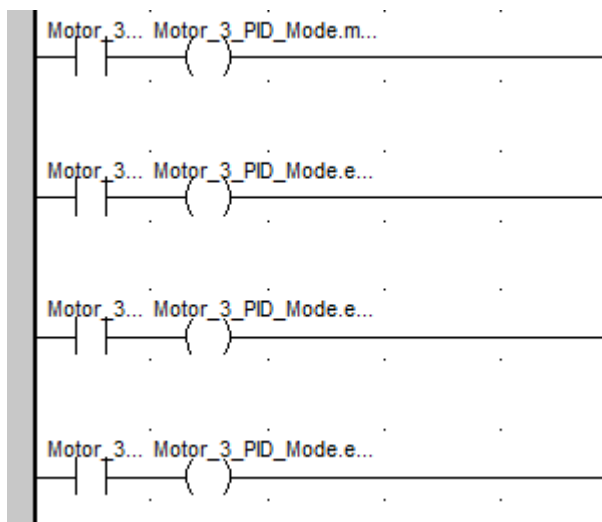
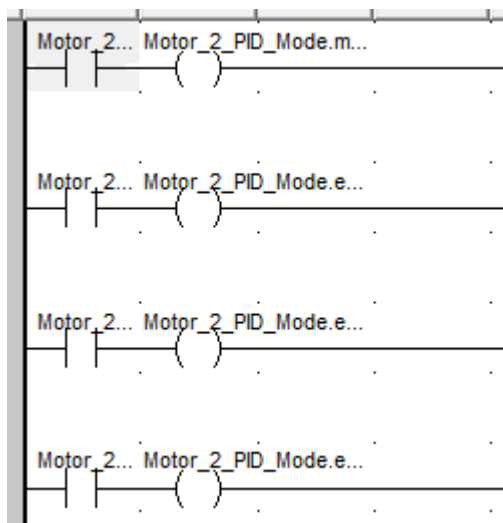
if (Tank_3_LevelREAL <= 0.0) then
    Tank_3_LevelREAL := 0.0;
end_if;
```

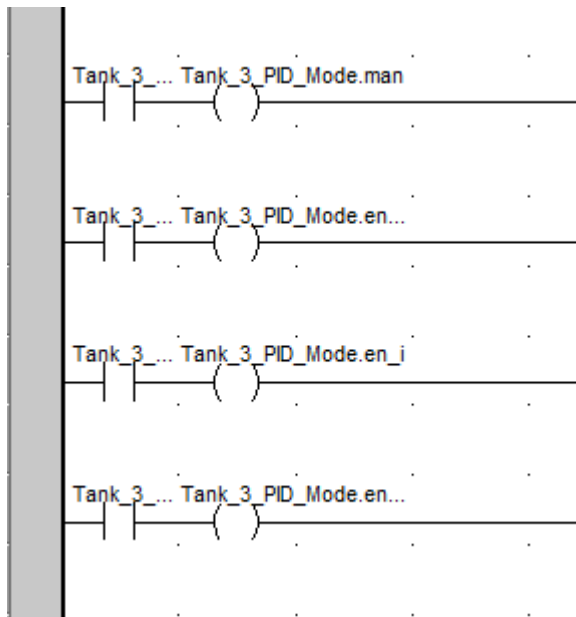
Khối Model:



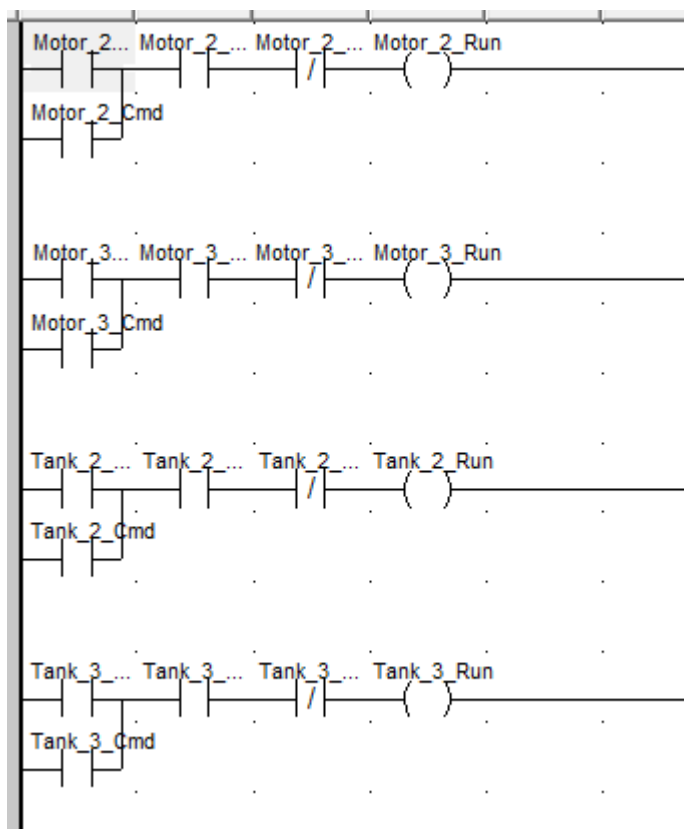


Khởi Control:



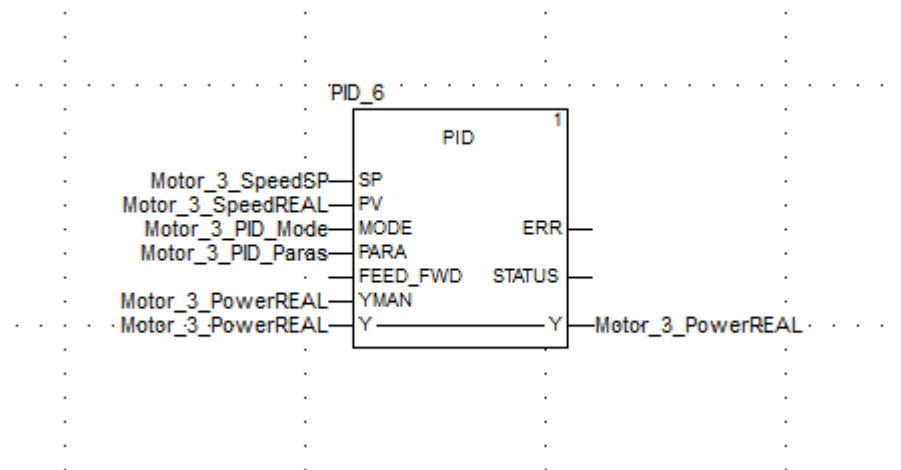


Khởi RUN:

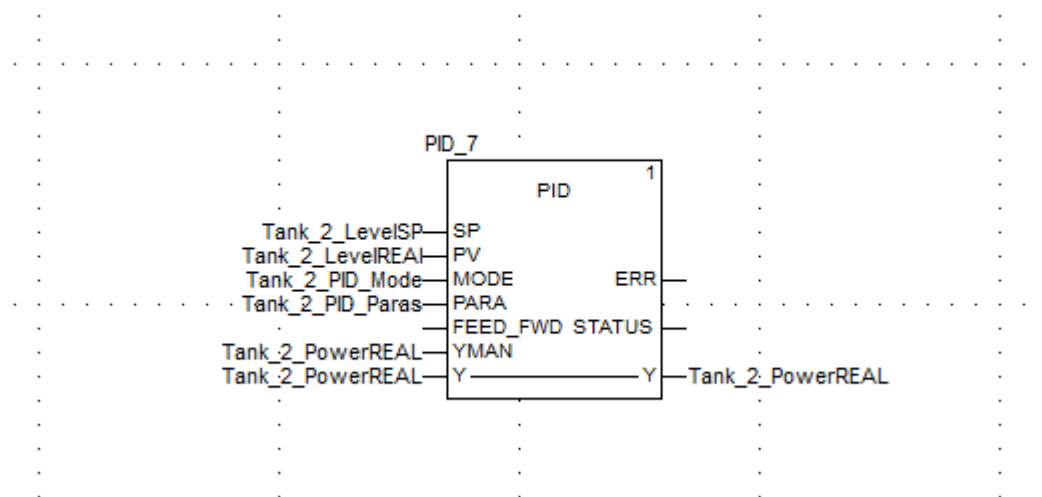


Các khối event: Lần lượt sẽ chạy PID:

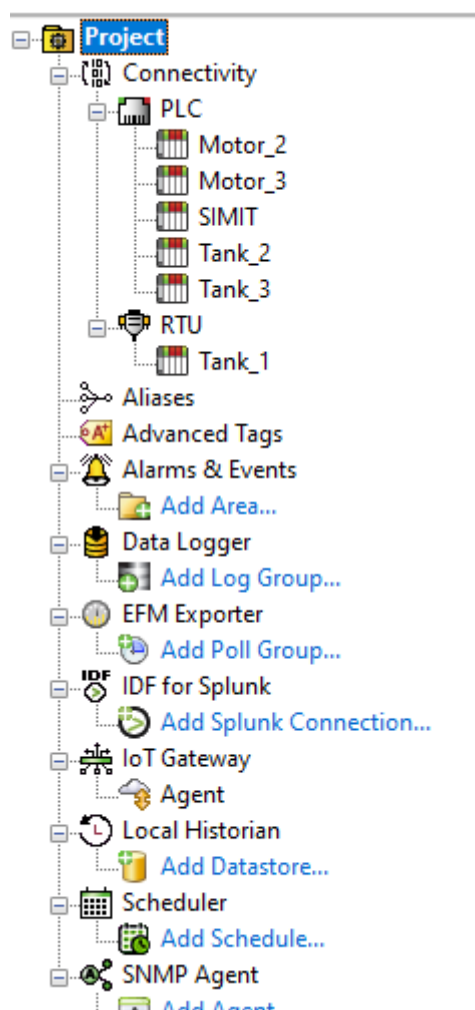
Đại diện cho Motor:



Đại diện cho Tank:



II. Đặt địa chỉ KepServerEX:



Mục Connectivity: Tạo các kết nối đến PLC và RTU.

Trong PLC tiến hành tạo các biến với địa chỉ như sau:

Tag Name	Address	Data Type	Scan Rate	Scaling
Cmd	00001	Boolean	100	None
Enable	00050	Boolean	100	None
enD	00203	Boolean	100	None
enI	00202	Boolean	100	None
enP	00201	Boolean	100	None
Kp	40201	Float	100	None
Mode	00200	Boolean	100	None
PowerMax	40209	Float	100	None
PowerREAL	40051	Float	100	None
SpeedREAL	40053	Float	100	None
SpeedSP	40047	Float	100	None
Start	10001	Boolean	100	None
Stop	10002	Boolean	100	None
Td	40205	DWord	100	None
Ti	40203	DWord	100	None

Project	Tag Name	Address	Data Type	Scan Rate	Scaling
Connectivity					
PLC					
Motor_2	Cmd	00002	Boolean	100	None
Motor_3	Enable	00052	Boolean	100	None
SIMIT	enD	00213	Boolean	100	None
Tank_2	enI	00212	Boolean	100	None
Tank_3	enP	00211	Boolean	100	None
RTU	Kp	40213	Float	100	None
Tank_1	Mode	00210	Boolean	100	None
Aliases	PowerMax	40221	Float	100	None
Advanced Tags	PowerREAL	40055	Float	100	None
Alarms & Events	SpeedREAL	40057	Float	100	None
Add Area...	SpeedSP	40049	Float	100	None
Data Logger	Start	10003	Boolean	100	None
EFM Exporter	Stop	10004	Boolean	100	None
Add Poll Group...	Td	40217	DWord	100	None
IDF for Splunk	Ti	40215	DWord	100	None
Add Splunk Connection					

Project	Tag Name	Address	Data Type	Scan Rate	Scaling
Connectivity					
PLC					
Motor_2	Motor_2_Power	30100	Word	100	None
Motor_3	Motor_2_Speed	40102	Word	100	None
SIMIT	Motor_3_Power	30104	Word	100	None
Tank_2	Motor_3_Speed	40106	Word	100	None
Tank_3	Tank_2_Flow	40112	Word	100	None
RTU	Tank_2_Power	30108	Word	100	None
Tank_1	Tank_2_Speed	40110	Word	100	None
Aliases	Tank_3_Flow	40118	Word	100	None
Advanced Tags	Tank_3_Level	40116	Word	100	None
Alarms & Events	Tank_3_Power	30114	Word	100	None
Add Area...					
Data Logger					
Add Log Group...					

Project	Tag Name	Address	Data Type	Scan Rate	Scaling
Connectivity					
PLC					
Motor_2	Close	10006	Boolean	100	None
Motor_3	Cmd	00003	Boolean	100	None
SIMIT	Enable	00054	Boolean	100	None
Tank_2	enD	00223	Boolean	100	None
Tank_3	enI	00222	Boolean	100	None
RTU	enP	00221	Boolean	100	None
Tank_1	FlowREAL	40063	Float	100	None
Aliases	Kp	40225	Float	100	None
Advanced Tags	LevelREAL	40061	Float	100	None
Alarms & Events	LevelSP	40071	Float	100	None
Add Area...	Mode	00220	Boolean	100	None
Data Logger	Open	10005	Boolean	100	None
EFM Exporter	PowerMax	40233	Float	100	None
Add Poll Group...	PowerREAL	40059	Float	100	None
IDF for Splunk	Td	40229	DWord	100	None
	Ti	40227	DWord	100	None

<div><div>Project</div><div><div>Connectivity</div><div><div>PLC</div><div><div>Motor_2</div><div>Motor_3</div><div>SIMIT</div><div>Tank_2</div><div>Tank_3</div></div></div><div>RTU</div><div><div>Tank_1</div></div></div><div>Aliases</div><div>Advanced Tags</div><div>Alarms & Events</div><div>Add Area...</div><div>Data Logger</div><div>Add Log Group...</div><div>EFM Exporter</div><div>Add Poll Group...</div><div>IDF for Splunk</div><div>Add Splunk Connection</div></div>
--

 | Tag Name | Address | Data Type | Scan Rate | Scaling | |-----------|---------|-----------|-----------|---------| | Close | 10008 | Boolean | 100 | None | | Cmd | 00004 | Boolean | 100 | None | | Enable | 00056 | Boolean | 100 | None | | enD | 00233 | Boolean | 100 | None | | enI | 00232 | Boolean | 100 | None | | enP | 00231 | Boolean | 100 | None | | FlowREAL | 40069 | Float | 100 | None | | Kp | 40237 | Float | 100 | None | | LevelREAL | 40067 | Float | 100 | None | | LevelSP | 40073 | Float | 100 | None | | Mode | 00230 | Boolean | 100 | None | | Open | 10007 | Boolean | 100 | None | | PowerMax | 40245 | Float | 100 | None | | PowerREAL | 40065 | Float | 100 | None | | Td | 40241 | DWord | 100 | None | | Ti | 40239 | DWord | 100 | None | |

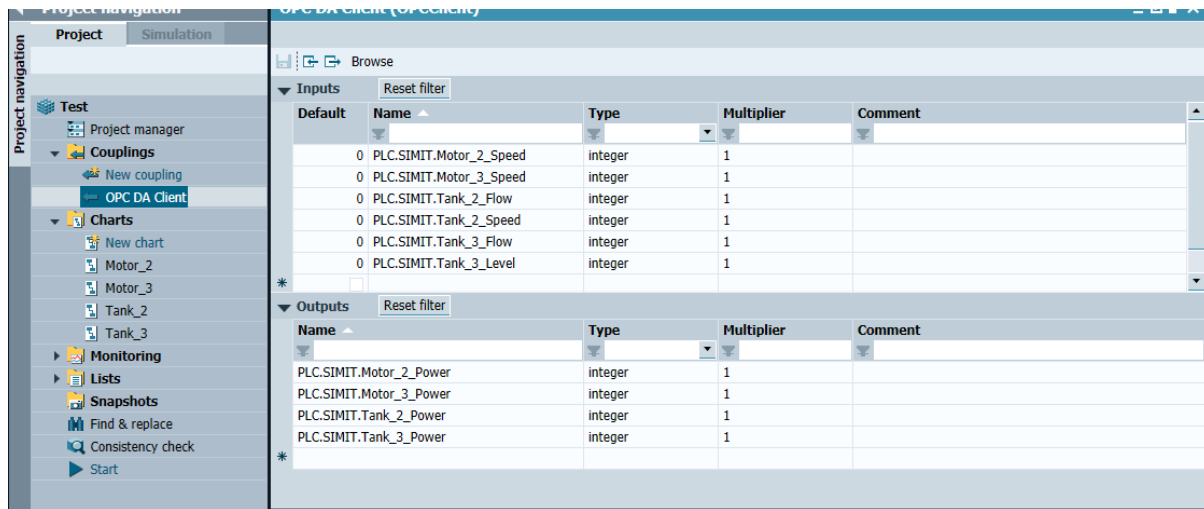
<div><div>Project</div><div><div>Connectivity</div><div><div>PLC</div><div><div>Motor_2</div><div>Motor_3</div><div>SIMIT</div><div>Tank_2</div><div>Tank_3</div></div></div><div>RTU</div><div><div>Tank_1</div></div></div><div>Aliases</div><div>Advanced Tags</div><div>Alarms & Events</div><div>Add Area...</div></div>

 | Tag Name | Address | Data Type | Scan Rate | Scaling | |-----------|---------|-----------|-----------|---------| | Close | 10017 | Boolean | 100 | None | | Cmd | 00001 | Boolean | 100 | None | | Enable | 00017 | Boolean | 100 | None | | FlowREAL | 30011 | Float | 100 | None | | LevelREAL | 30001 | Float | 100 | None | | LevelSP | 40021 | Float | 100 | None | | Open | 10001 | Boolean | 100 | None | | PowerMax | 40001 | Float | 100 | None | | PowerREAL | 40011 | Float | 100 | None | |

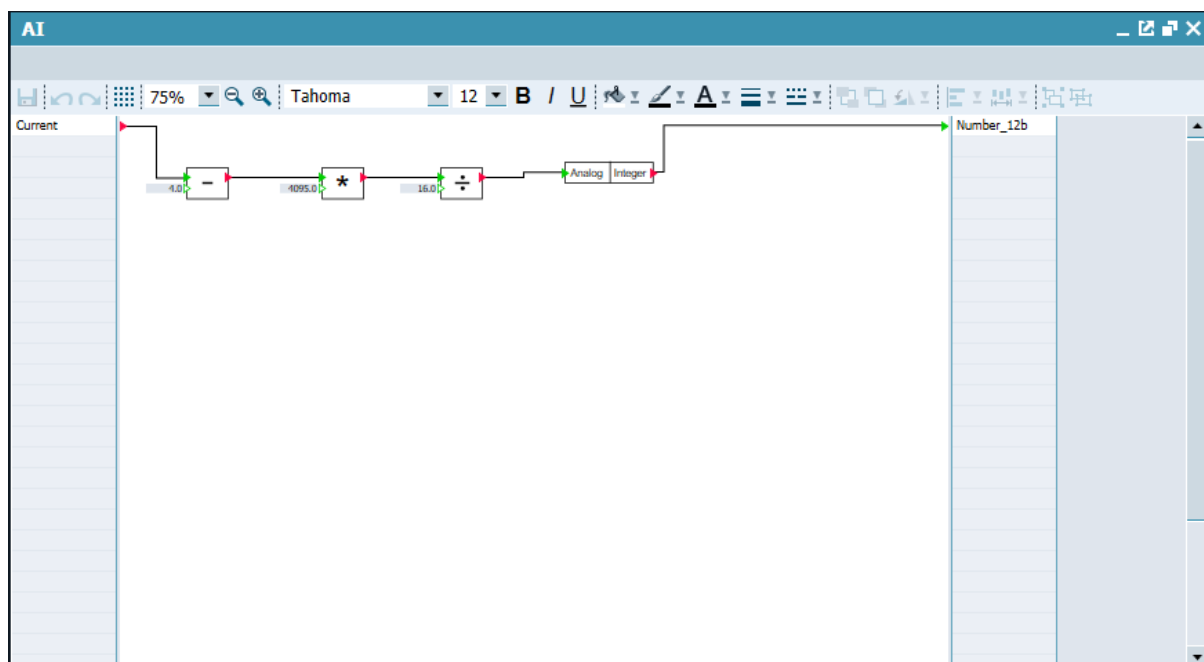
<div><div>Project</div><div><div>Connectivity</div><div><div>PLC</div><div><div>Motor_2</div><div>Motor_3</div><div>SIMIT</div><div>Tank_2</div><div>Tank_3</div></div></div><div>RTU</div><div><div>Tank_1</div></div></div><div>Aliases</div><div>Advanced Tags</div><div>Alarms & Events</div><div>Add Area...</div><div>Data Logger</div><div>Add Log Group...</div><div>EFM Exporter</div><div>Add Poll Group...</div><div>IDF for Splunk</div><div>Add Splunk Connection...</div><div>IoT Gateway</div><div>Agent</div><div>Local Historian</div><div>Add Datastore...</div><div>Scheduler</div><div>Add Schedule...</div><div>SNMP Agent</div><div>Add Agent...</div></div>
--

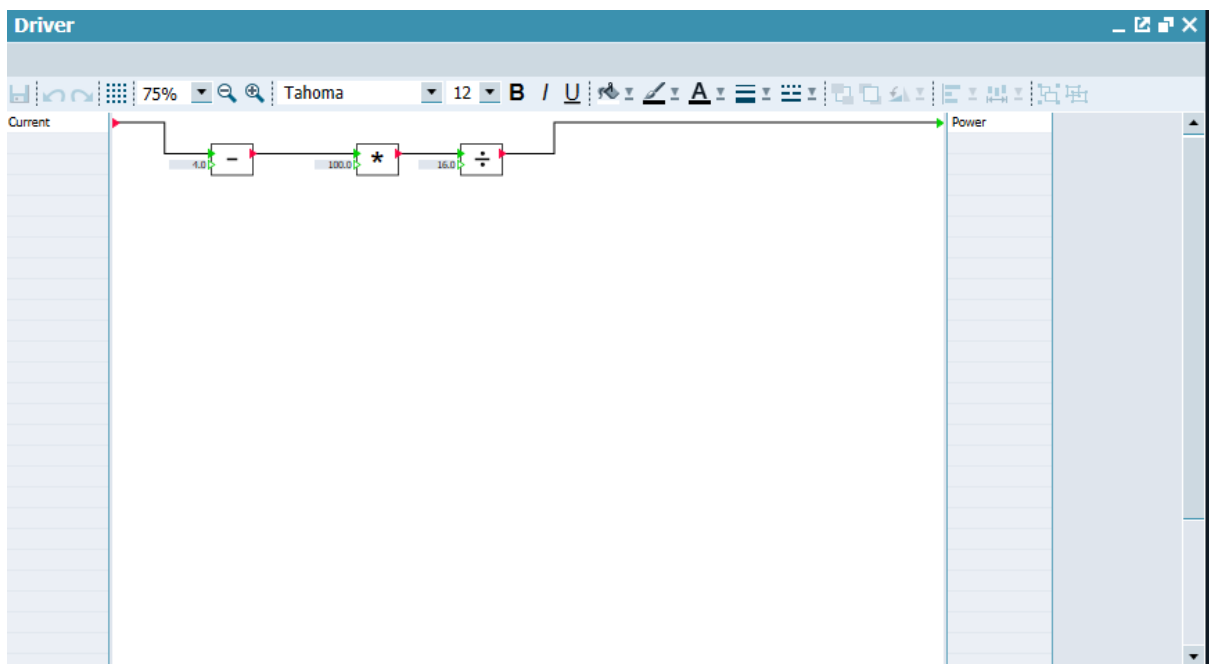
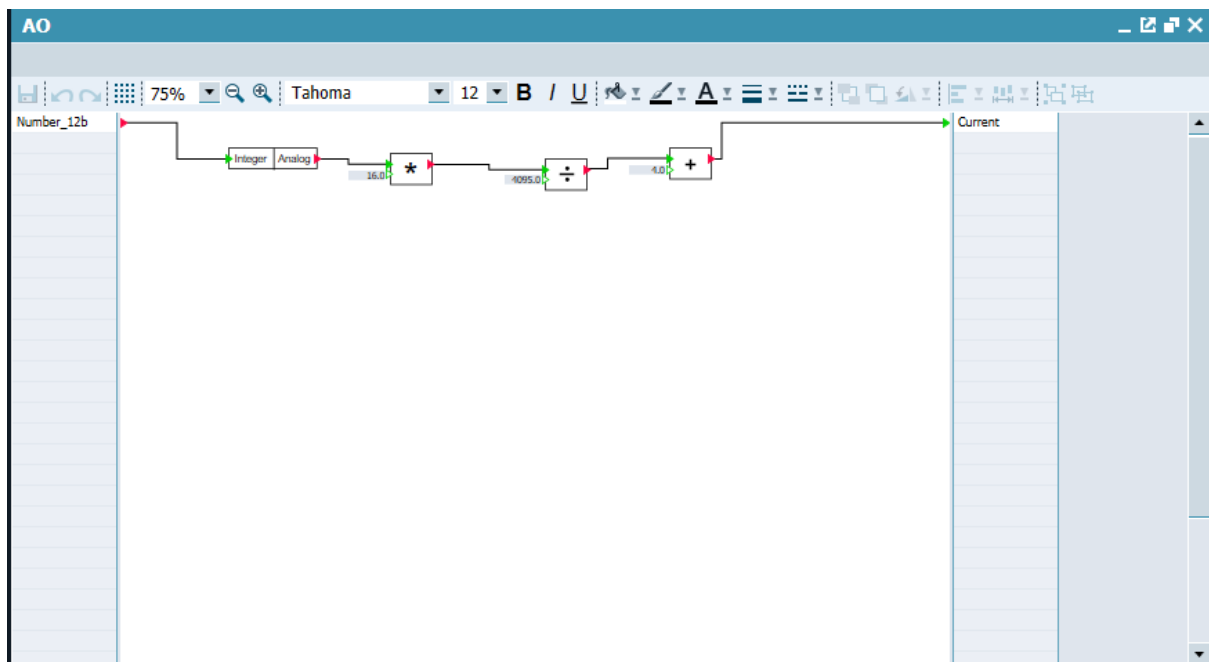
 | Server Tag | State | Data Type | Scan Rate (ms) | |-----------------------|---------|-----------|----------------| | PLC.Motor_2.Cmd | Enabled | Boolean | 1000 | | PLC.Motor_2.Enable | Enabled | Boolean | 1000 | | PLC.Motor_2.enD | Enabled | Boolean | 1000 | | PLC.Motor_2.enI | Enabled | Boolean | 1000 | | PLC.Motor_2.enP | Enabled | Boolean | 1000 | | PLC.Motor_2.Kp | Enabled | Float | 1000 | | PLC.Motor_2.Mode | Enabled | Boolean | 1000 | | PLC.Motor_2.PowerMax | Enabled | Float | 1000 | | PLC.Motor_2.PowerREAL | Enabled | Float | 1000 | | PLC.Motor_2.SpeedREAL | Enabled | Float | 1000 | | PLC.Motor_2.SpeedSP | Enabled | Float | 1000 | | PLC.Motor_2.Start | Enabled | Boolean | 1000 | | PLC.Motor_2.Stop | Enabled | Boolean | 1000 | | PLC.Motor_2.Td | Enabled | DWord | 1000 | | PLC.Motor_2.Ti | Enabled | DWord | 1000 | | PLC.Motor_3.Cmd | Enabled | Boolean | 1000 | | PLC.Motor_3.Enable | Enabled | Boolean | 1000 | | PLC.Motor_3.enD | Enabled | Boolean | 1000 | | PLC.Motor_3.enI | Enabled | Boolean | 1000 | | PLC.Motor_3.enP | Enabled | Boolean | 1000 | | PLC.Motor_3.Kp | Enabled | Float | 1000 | | PLC.Motor_3.Mode | Enabled | Boolean | 1000 | | PLC.Motor_3.PowerMax | Enabled | Float | 1000 | | PLC.Motor_3.PowerREAL | Enabled | Float | 1000 | | PLC.Motor_3.SpeedREAL | Enabled | Float | 1000 | |

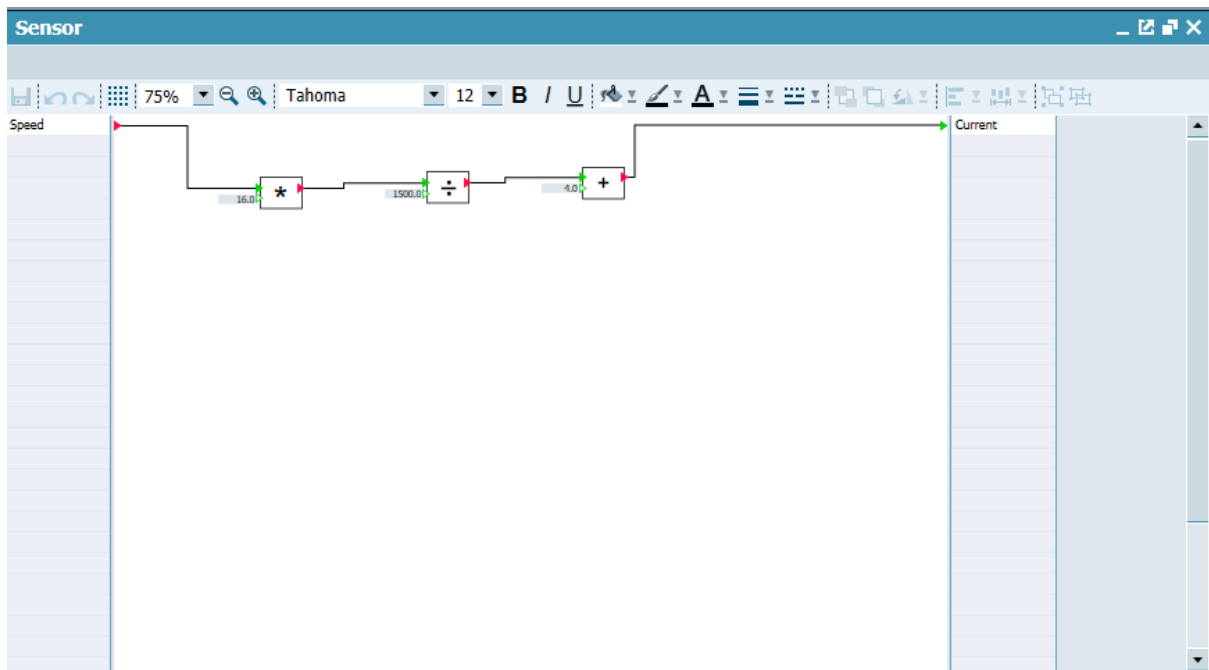
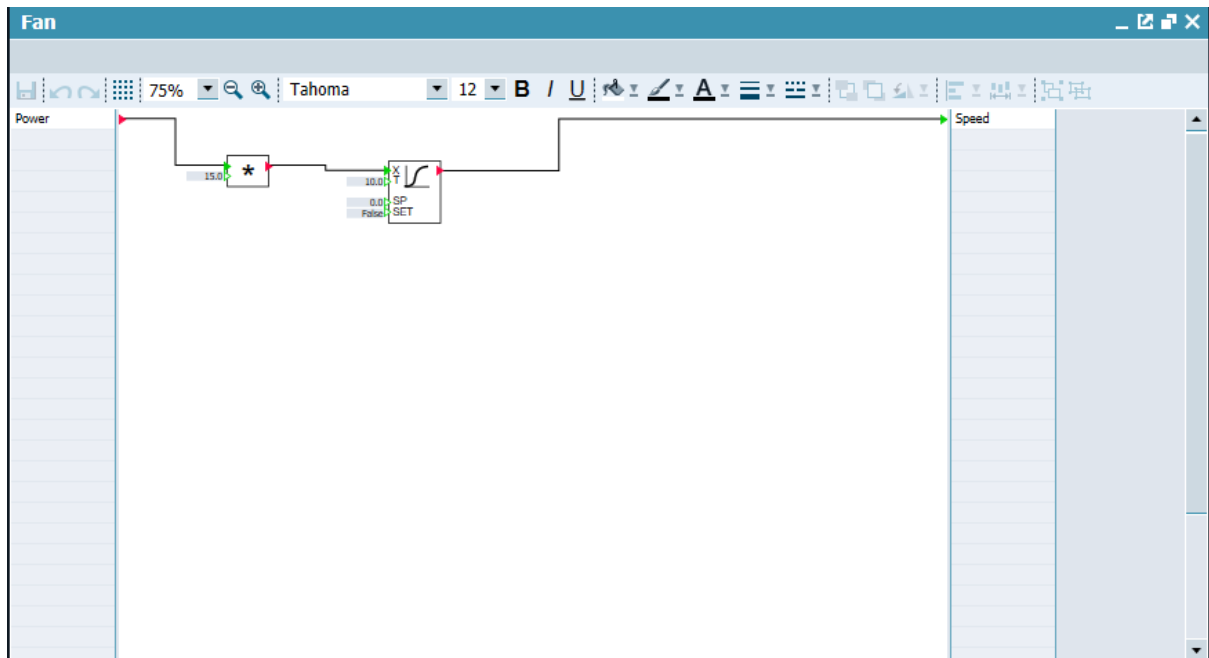
III. Mô hình hóa Motor và Tank trên Simit:

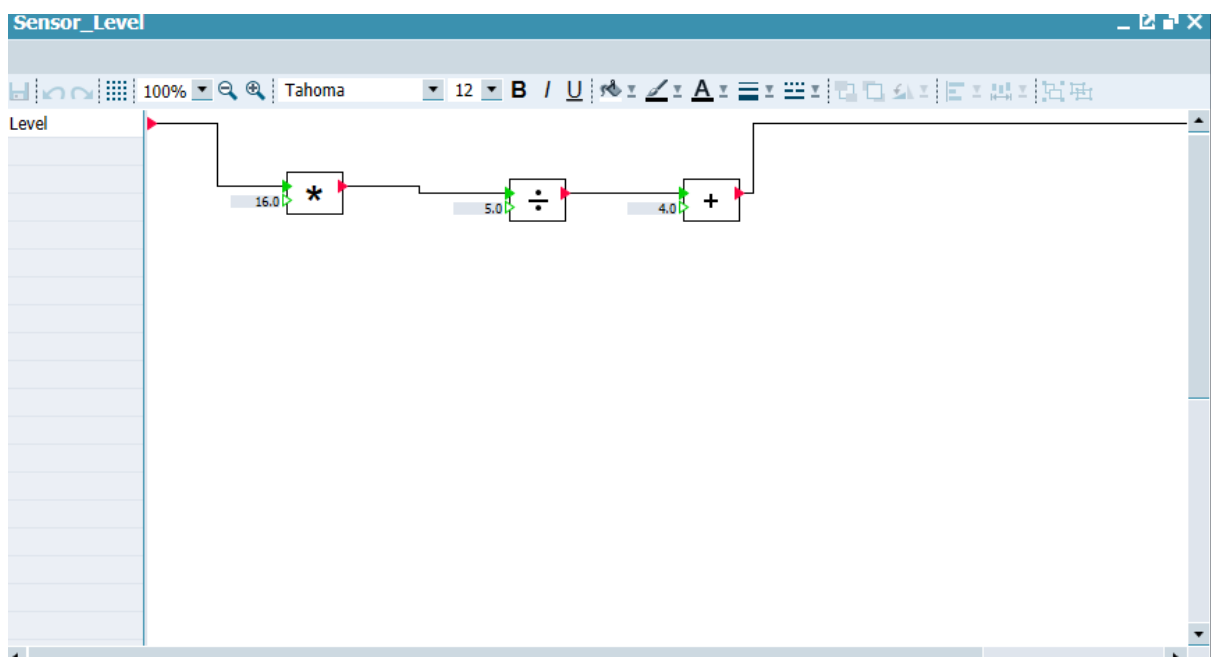
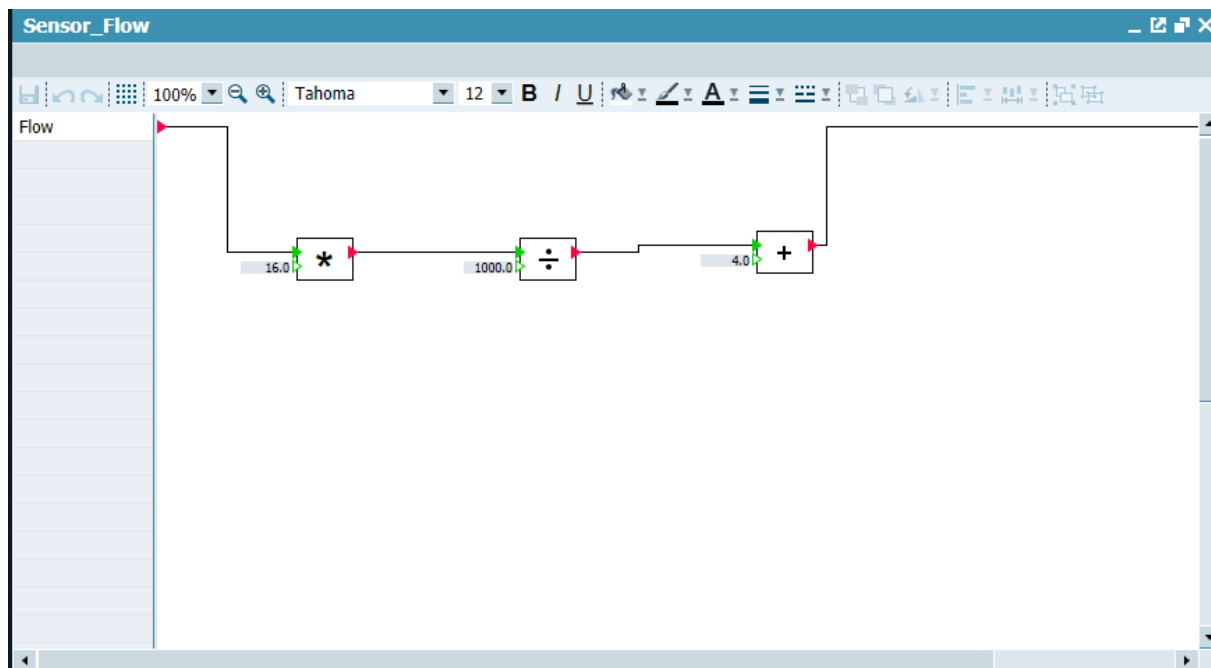


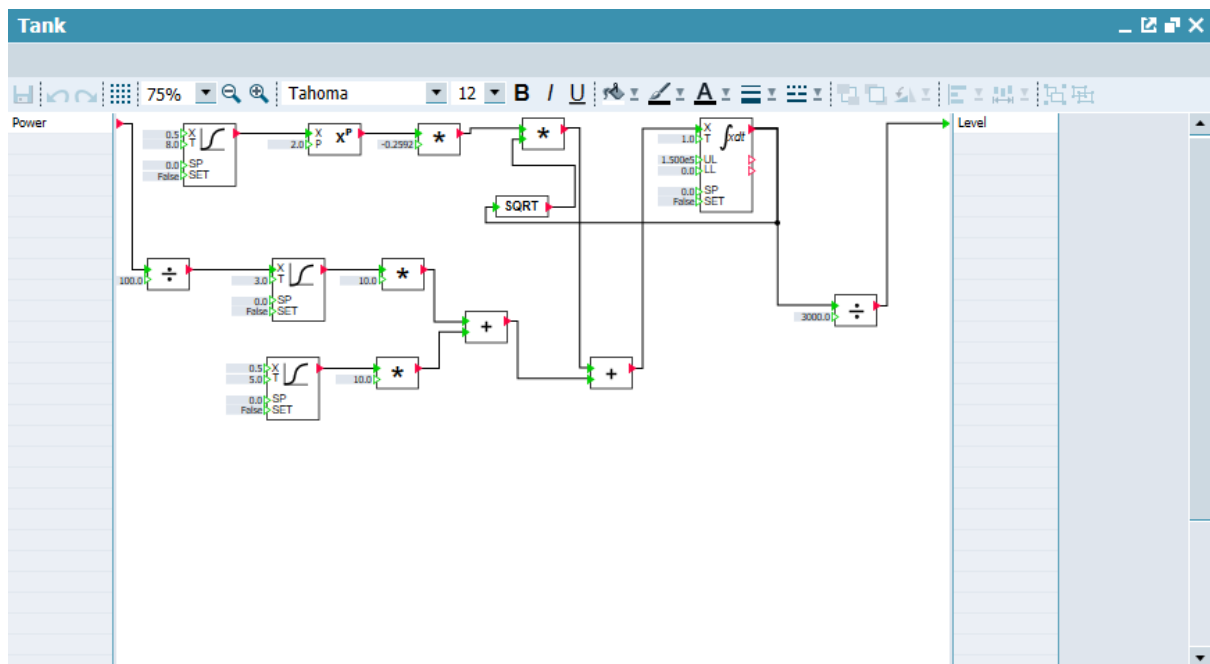
Các khối Marcos





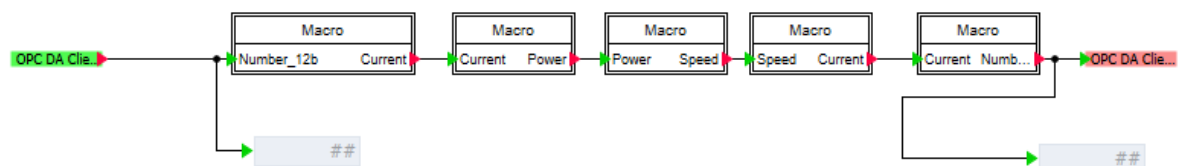




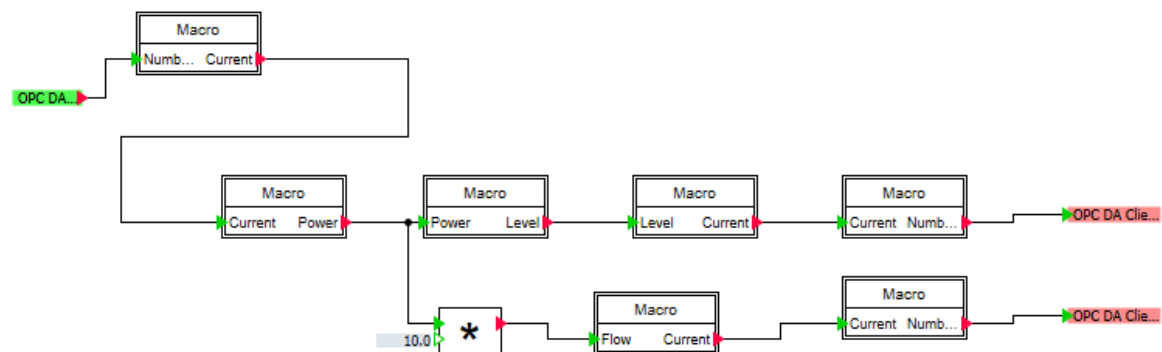


Sau đó tiến hành kết nối như hình:

Với Motor:



Với Tank:



IV. Citect:

I/O Devices

Citect Studio - FinalProject_BTL [Active Project]

Topology Computers Edit Profiles **I/O Devices** Components & Mapping

Save Discard Copy Paste Delete Row(s) Export All Import All Export Tags Import Tags Refresh Tags New Device

Row	Server Name	Name	Number	Address	Protocol	Port Name	Startup Mode	Priori
1	IOServer1	Internal	1		OFSPC		Primary	1
2	IOServer1	Cicode	2		CICODE		Primary	1
3	IOServer1	PLC	3	Kepware:KEPServerEX.V6	OPC	PORT1_BOARD1		
4	IOServer1	TCP	5		MODNET	PORT3_BOARD3		
5	IOServer1	Modbus_TCP	6		MODNET	PORT4_BOARD3		

No objects selected.

Compile Messages

7:07 PM 12/28/2021

Equipments

Citect Studio - FinalProject_BTL [Active Project]

System Model **Equipment** Variables Alarms Trends Accumulators SPC

Save Discard Copy Paste Delete Row(s) Export All Import All Equipment Editor Update Equipment

Row	Name	Cluster Name	Type	Page	Help	Comment	Tag Prefix	I/O Device	Scheduled	Default S
1	Motor_2	Cluster1	Motor				Motor_2	PLC		
2	Motor_3	Cluster1	Motor				Motor_3	PLC		
3	Tank_2	Cluster1	Tank				Tank_2	PLC		
4	Tank_3	Cluster1	Tank				Tank_3	PLC		
5	Motor_1	Cluster1	Motor				Motor_1	Modbus_TCP		
6	Tank_1	Cluster1	Tank				Tank_1	PLC		
7	Motor_2_PID	Cluster1	PID				Motor_2_PID	PLC		
8	Tank_2_PID	Cluster1	PID				Tank_2_PID	PLC		
9	Motor_3_PID	Cluster1	PID				Motor_3_PID	PLC		
10	Tank_3_PID	Cluster1	PID				Tank_3_PID	PLC		

No objects selected.

Compile Messages

7:07 PM 12/28/2021

Variable

Citect Studio - FinalProject_BTL [Active Project]

System Model | Equipment | **Variables** | Alarms | Trends | Accumulators | SPC

Save | Discard | Copy | Paste | Delete Row(s) | Export All | Import All | Refresh All Tags

Row	Equipment	Item Name	Tag Name	Cluster Name	I/O Device	Data Type	Address
1	Motor_2	Start	Motor_2_Start	Cluster1	Internal	DIGITAL	
2	Motor_3	Start	Motor_3_Start	Cluster1	Internal	DIGITAL	
3	Motor_2	Stop	Motor_2_Stop	Cluster1	Internal	DIGITAL	
4	Motor_3	Stop	Motor_3_Stop	Cluster1	Internal	DIGITAL	
5	Motor_2	Startst	Motor_2_Startst	Cluster1	PLC	DIGITAL	PLC.Motor_2_Start
6	Motor_3	Startst	Motor_3_Startst	Cluster1	PLC	DIGITAL	PLC.Motor_3_Start
7	Motor_2	Stopst	Motor_2_Stopst	Cluster1	PLC	DIGITAL	PLC.Motor_2_Stop
8	Motor_3	Stopst	Motor_3_Stopst	Cluster1	PLC	DIGITAL	PLC.Motor_3_Stop
9	Motor_2	Enable	Motor_2_Enable	Cluster1	PLC	DIGITAL	PLC.Motor_2_Enable
10	Motor_3	Enable	Motor_3_Enable	Cluster1	PLC	DIGITAL	PLC.Motor_3_Enable
11	Motor_2	Cmd	Motor_2_Cmd	Cluster1	PLC	DIGITAL	PLC.Motor_2_Cmd
12	Motor_3	Cmd	Motor_3_Cmd	Cluster1	PLC	DIGITAL	PLC.Motor_3_Cmd
13	Motor_2	Power	Motor_2_Power	Cluster1	PLC	REAL	PLC.Motor_2_PowerREAL
14	Motor_3	Power	Motor_3_Power	Cluster1	PLC	REAL	PLC.Motor_3_PowerREAL
15	Motor_2	Speed	Motor_2_Speed	Cluster1	PLC	REAL	PLC.Motor_2_SpeedREAL
16	Motor_3	Speed	Motor_3_Speed	Cluster1	PLC	REAL	PLC.Motor_3_SpeedREAL
17	Tank_2	Open	Tank_2_Open	Cluster1	Internal	DIGITAL	
18	Tank_3	Open	Tank_3_Open	Cluster1	Internal	DIGITAL	
19	Tank_2	Close	Tank_2_Close	Cluster1	Internal	DIGITAL	

Compile Messages

No objects selected.

7:08 PM 12/28/2021

Alarm

Citect Studio - FinalProject_BTL [Active Project]

System Model | Equipment | Variables | **Alarms** | Trends | Accumulators | SPC

Save | Discard | Copy | Paste | Delete Row(s) | Export All | Import All

Row	Equipment	Item Name	Alarm Tag	Alarm Name	Cluster Name	Category	Setpoint	Dev
1	Motor_2	Speed	Motor_2_AlarmSpeed	Motor_2_AlarmSpeed	Cluster1		Motor_2_SpeedSP	100
2	Motor_3	Speed	Motor_3_AlarmSpeed	Motor_3_AlarmSpeed	Cluster1		Motor_3_SpeedSP	100
3	Motor_1	Speed	Motor_1_AlarmSpeed	Motor_1_AlarmSpeed	Cluster1		Motor_1_SpeedSP	100
4	Tank_2	Level	Tank_2_AlarmLevel	Tank_2_AlarmLevel	Cluster1		Tank_2_LevelSP	0.1
5	Tank_3	Level	Tank_3_AlarmLevel	Tank_3_AlarmLevel	Cluster1		Tank_3_LevelSP	0.1
6	Tank_1	Level	Tank_1_AlarmLevel	Tank_1_AlarmLevel	Cluster1		Tank_1_LevelSP	0.1

Compile Messages

No objects selected.

7:08 PM 12/28/2021

Trend

Citect Studio - FinalProject_BTL [Active Project]

System Model | Equipment | Variables | Alarms | **Trends** | Accumulators | SPC

Save | Discard | Copy | Paste | Delete Row(s) | Export All | Import All

Row	Equipment	Item Name	Tag Name	Cluster Name	Type	Expression	Sample Period	Comment	No. Files
1	Motor_2	Speed	Motor_2_TrendSp	Cluster1	TRN_PERIOD	Motor_2_Speed	00:00:01		
2	Motor_3	Speed	Motor_3_TrendSp	Cluster1	TRN_PERIOD	Motor_3_Speed	00:00:01		
3	Motor_1	Speed	Motor_1_TrendSp	Cluster1	TRN_PERIOD	Motor_1_Speed	00:00:01		
4	Motor_2	SpeedSP	Motor_2_TrendSp	Cluster1	TRN_PERIOD	Motor_2_SpeedSP	00:00:01		
5	Motor_3	SpeedSP	Motor_3_TrendSp	Cluster1	TRN_PERIOD	Motor_3_SpeedSP	00:00:01		
6	Motor_1	SpeedSP	Motor_1_TrendSp	Cluster1	TRN_PERIOD	Motor_1_SpeedSP	00:00:01		
7	Motor_2	Power	Motor_2_TrendPo	Cluster1	TRN_PERIOD	Motor_2_Power	00:00:01		
8	Motor_3	Power	Motor_3_TrendPo	Cluster1	TRN_PERIOD	Motor_3_Power	00:00:01		
9	Motor_1	Power	Motor_1_TrendPo	Cluster1	TRN_PERIOD	Motor_1_Power	00:00:01		
10	Tank_2	Power	Tank_2_TrendPow	Cluster1	TRN_PERIOD	Tank_2_Power	00:00:01		
11	Tank_3	Power	Tank_3_TrendPow	Cluster1	TRN_PERIOD	Tank_3_Power	00:00:01		
12	Tank_1	Power	Tank_1_TrendPow	Cluster1	TRN_PERIOD	Tank_1_Power	00:00:01		
13	Tank_2	Level	Tank_2_TrendLev	Cluster1	TRN_PERIOD	Tank_2_Level	00:00:01		
14	Tank_3	Level	Tank_3_TrendLev	Cluster1	TRN_PERIOD	Tank_3_Level	00:00:01		
15	Tank_1	Level	Tank_1_TrendLev	Cluster1	TRN_PERIOD	Tank_1_Level	00:00:01		
16	Tank_2	LevelSP	Tank_2_TrendLev	Cluster1	TRN_EVENT	Tank_2_LevelSP	00:00:01		
17	Tank_3	LevelSP	Tank_3_TrendLev	Cluster1	TRN_EVENT	Tank_3_LevelSP	00:00:01		
18	Tank_1	LevelSP	Tank_1_TrendLev	Cluster1	TRN_EVENT	Tank_1_LevelSP	00:00:01		

Compile Messages

No objects selected.

7:08 PM 12/28/2021

Security

Citect Studio - FinalProject_BTL [Active Project]

Security | Roles | **Users**

Save | Discard | Copy | Paste | Delete Row(s)

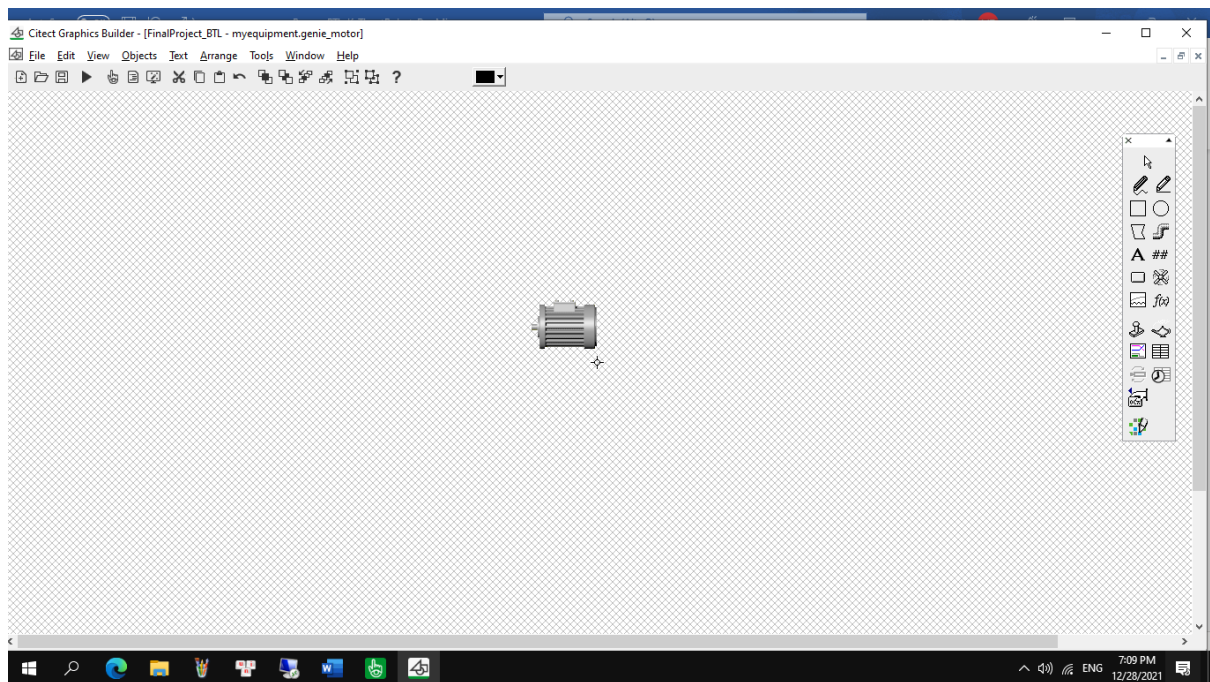
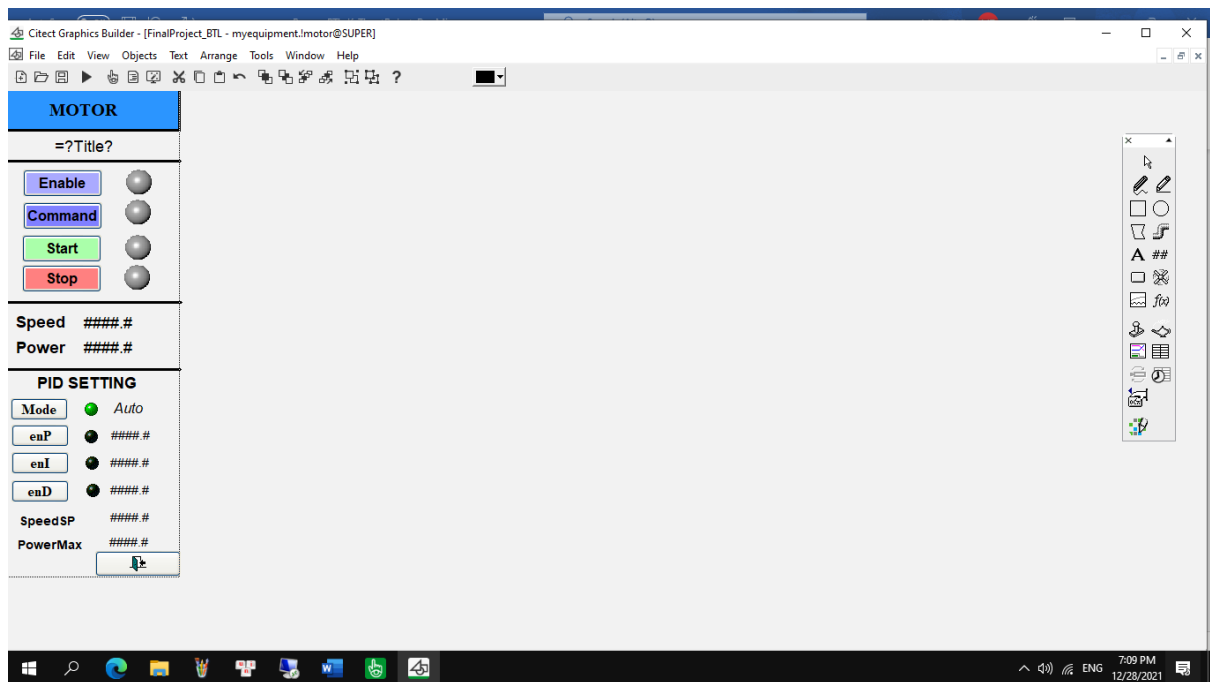
Row	User Name	Full Name	Password	Roles	Type	Comment	Project
1	Admin	Trùm Sò	*****	Administrato			FinalProject_B
2	Eng	Nhân viên	*****	Engineers			FinalProject_B

Compile Messages

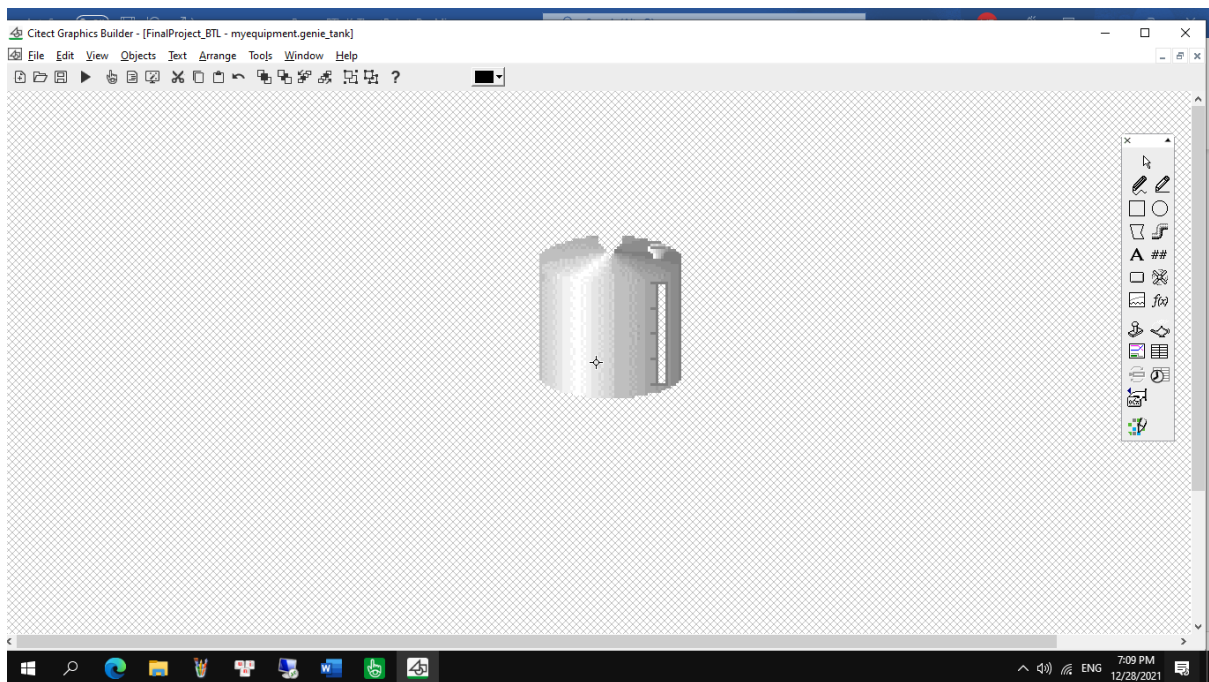
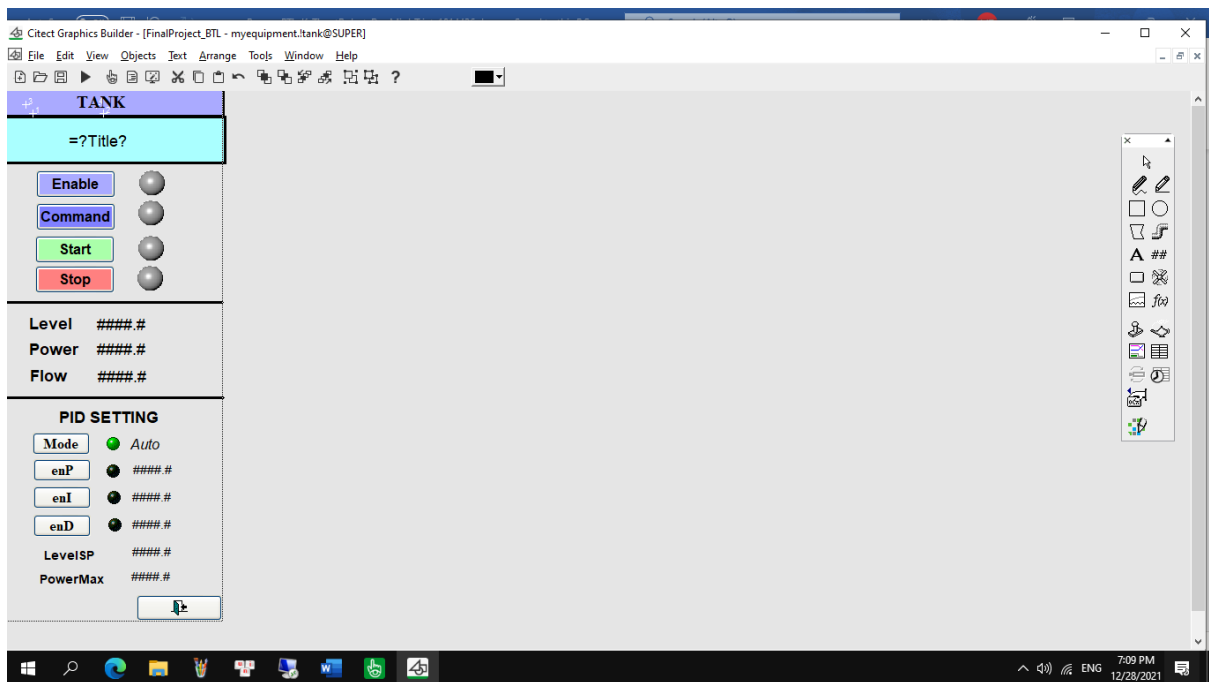
No objects selected.

7:08 PM 12/28/2021

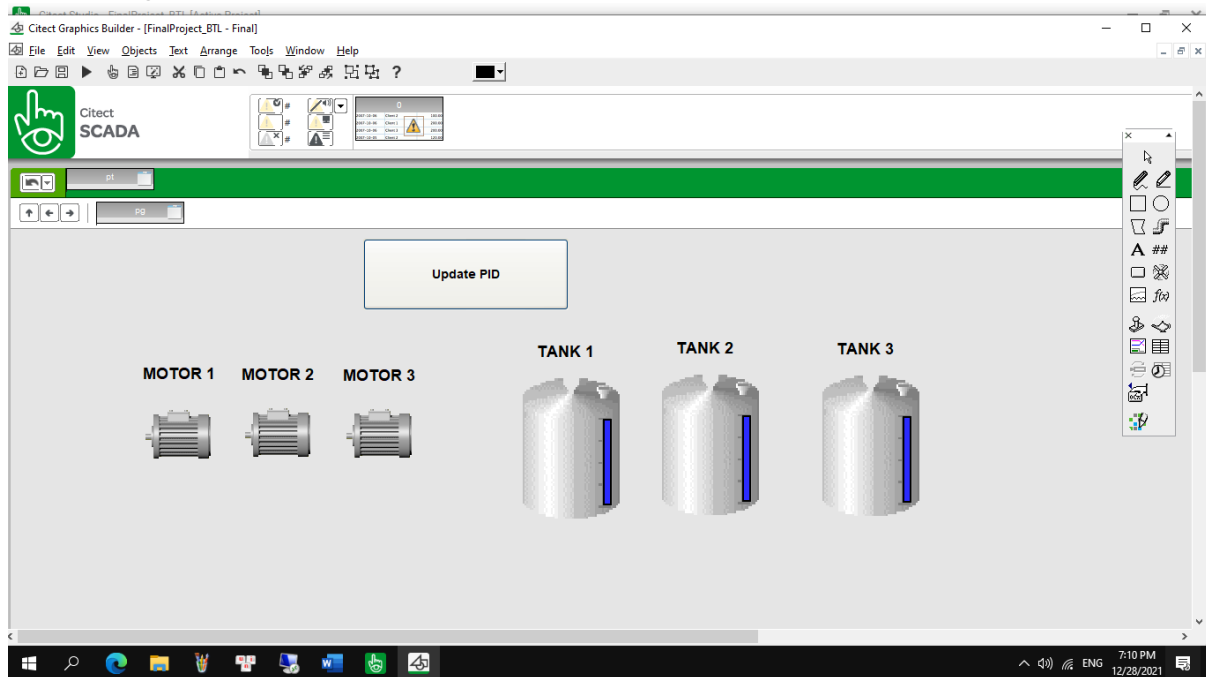
Thiết kế Motor:



Thiết kế Tank:



Thiết kế giao diện chính



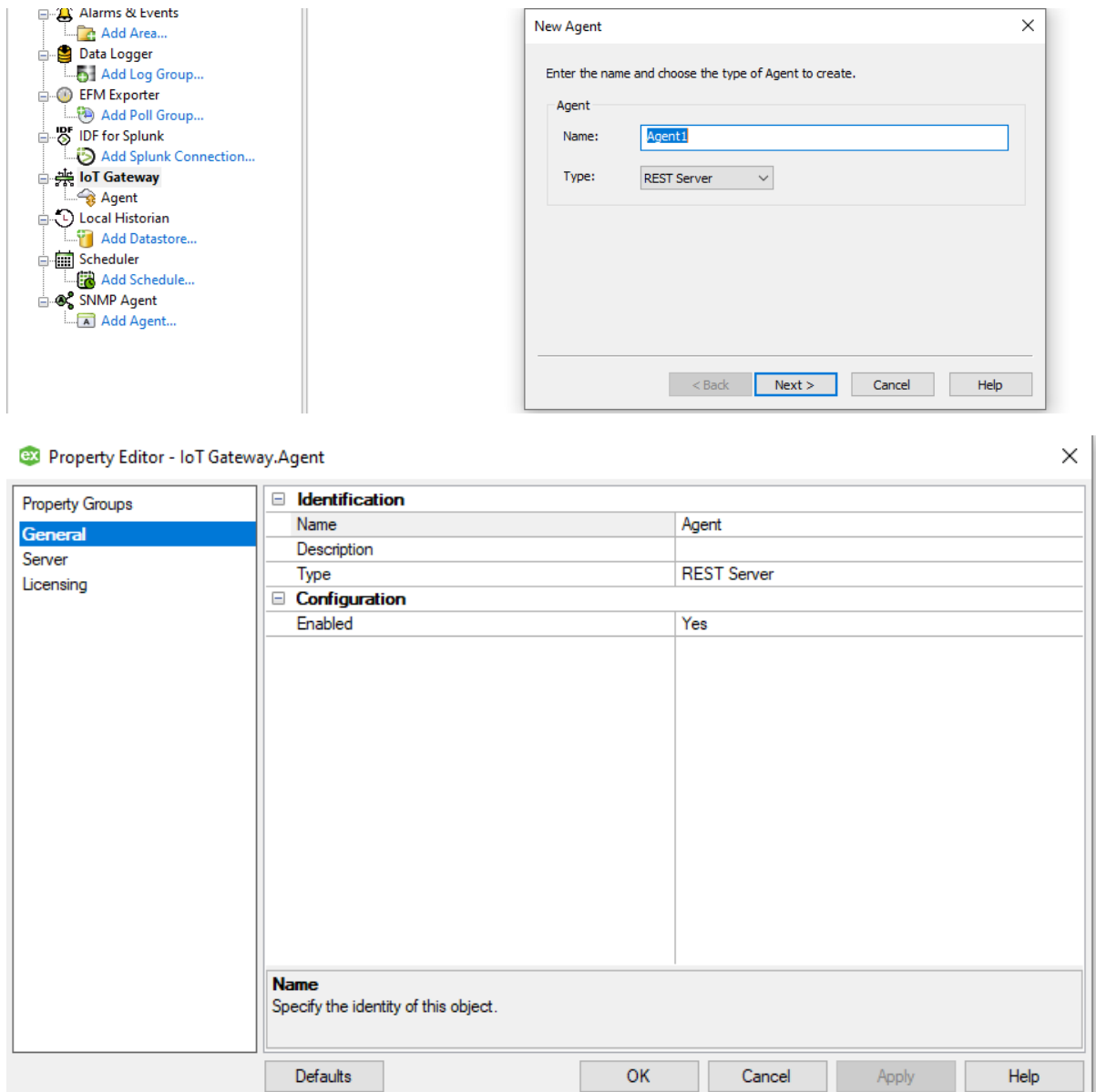
V. Xuất Access và Excel:

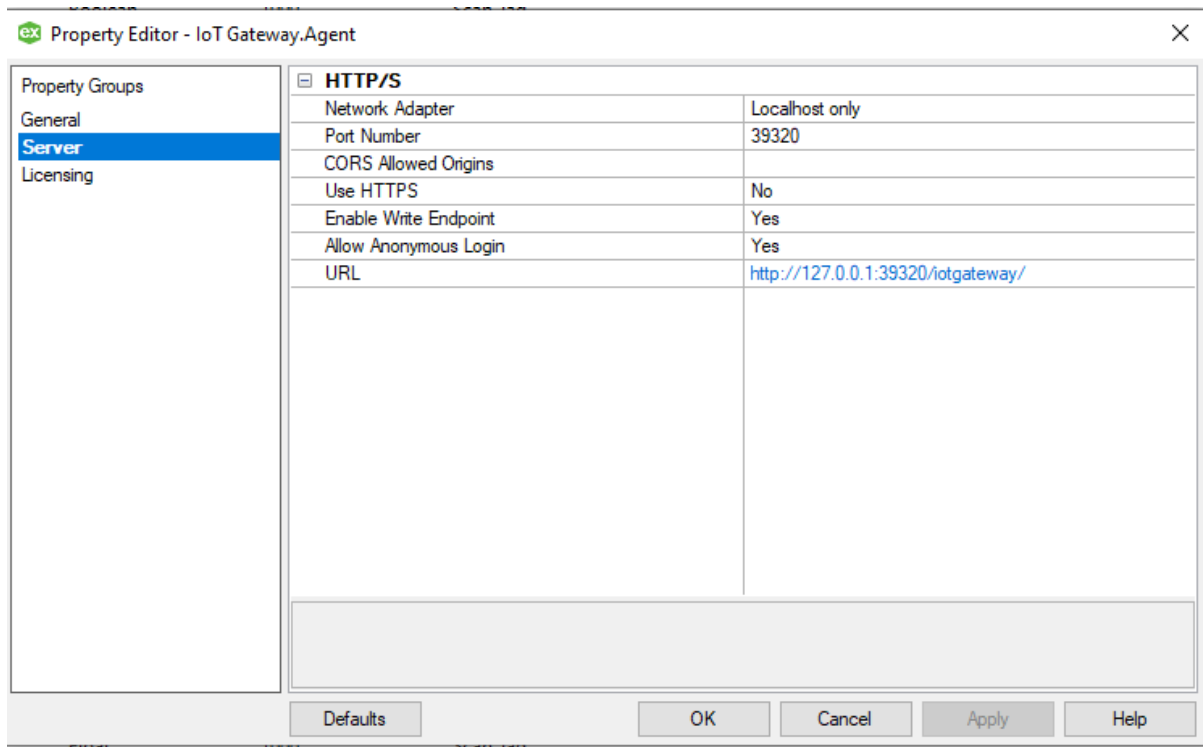
Object	Mode	enP	enI	enD	Gain	TI	Td	PowerMax	Setpoint	Enable
Motor_1	1	1	0	1	7	0	3	70	0	0
Motor_2	0	1	1	1	0.25	6500	40	100	700	0
Motor_3	0	1	1	1	0.25	6000	30	90	1200	0
Tank_1	1	1	0	1	10	3	0	77.77	0	0
Tank_2	0	1	1	0	1	1370	0	99.99	4	0
Tank_3	0	1	1	0	1	1452	0	70	3.3	0

ID	Status	Status_ts	Power	Power_ts	Speed	Speed_ts	Click to Add
14	OFF	12/21/2021 12:30:33 AM	89	12/21/2021 12:31:23 AM	2992	12/21/2021 12:31:40 AM	
15	OFF	12/21/2021 12:30:33 AM	89	12/21/2021 12:31:23 AM	2992	12/21/2021 12:31:40 AM	
16	OFF	12/21/2021 12:30:33 AM	89	12/21/2021 12:31:23 AM	2992	12/21/2021 12:31:40 AM	
17	OFF	12/21/2021 12:30:33 AM	89	12/21/2021 12:31:23 AM	2992	12/21/2021 12:31:40 AM	
18	OFF	12/21/2021 12:30:33 AM	89	12/21/2021 12:31:23 AM	2992	12/21/2021 12:31:40 AM	
20	OFF	12/21/2021 12:30:33 AM	89	12/21/2021 12:31:23 AM	2992	12/21/2021 12:31:40 AM	
21	OFF	12/21/2021 12:30:33 AM	89	12/21/2021 12:31:23 AM	2992	12/21/2021 12:31:40 AM	
22	OFF	12/21/2021 12:30:33 AM	89	12/21/2021 12:31:23 AM	2992	12/21/2021 12:31:40 AM	
23	OFF	12/21/2021 12:30:33 AM	89	12/21/2021 12:31:23 AM	2992	12/21/2021 12:31:40 AM	
24	OFF	12/21/2021 12:30:33 AM	89	12/21/2021 12:31:23 AM	2992	12/21/2021 12:31:40 AM	
25	OFF	12/21/2021 12:30:33 AM	89	12/21/2021 12:31:23 AM	2992	12/21/2021 12:31:40 AM	
26	OFF	12/21/2021 12:30:33 AM	89	12/21/2021 12:31:23 AM	2992	12/21/2021 12:31:40 AM	
27	OFF	12/21/2021 12:30:33 AM	89	12/21/2021 12:31:23 AM	2992	12/21/2021 12:31:40 AM	
28	OFF	12/21/2021 12:30:33 AM	89	12/21/2021 12:31:23 AM	2992	12/21/2021 12:31:40 AM	
30	OFF	12/21/2021 12:55:33 PM	0	12/21/2021 12:55:31 PM	0	12/21/2021 12:55:31 PM	
31	OFF	12/21/2021 12:55:33 PM	0	12/21/2021 12:55:31 PM	0	12/21/2021 12:55:31 PM	
32	OFF	12/21/2021 12:55:33 PM	0	12/21/2021 12:55:31 PM	0	12/21/2021 12:55:31 PM	
33	OFF	12/21/2021 12:55:33 PM	0	12/21/2021 12:55:31 PM	0	12/21/2021 12:55:31 PM	
34	OFF	12/21/2021 12:55:33 PM	0	12/21/2021 12:55:31 PM	0	12/21/2021 12:55:31 PM	
35	OFF	12/21/2021 12:55:33 PM	0	12/21/2021 12:55:31 PM	0	12/21/2021 12:55:31 PM	
36	OFF	12/21/2021 12:55:33 PM	70	12/21/2021 12:58:34 PM	0	12/21/2021 12:55:31 PM	
37	OFF	12/21/2021 12:59:22 PM	70	12/21/2021 12:58:34 PM	0	12/21/2021 12:55:31 PM	
38	OFF	12/21/2021 12:59:22 PM	70	12/21/2021 12:58:34 PM	0	12/21/2021 12:55:31 PM	
39	OFF	12/21/2021 12:59:22 PM	70	12/21/2021 12:58:34 PM	0	12/21/2021 12:55:31 PM	

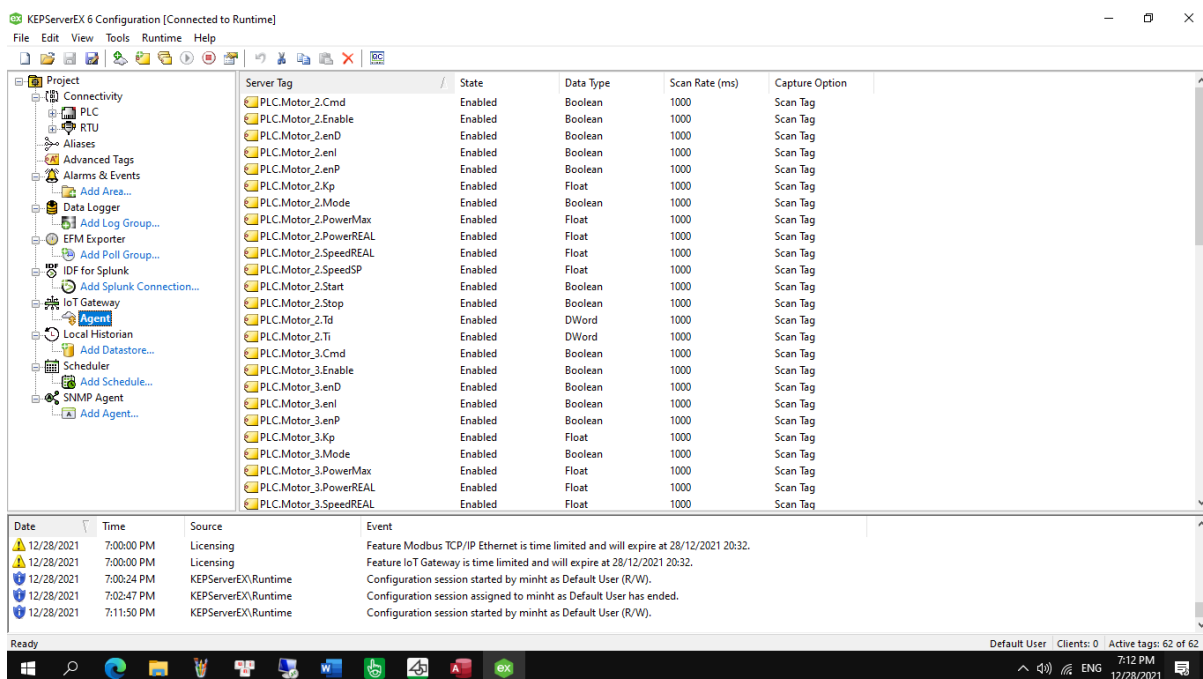
VI. Cloud:

Trước hết cần cài đặt Nodejs và Java. Sử dụng Gateway IOT của Kepware





Sau đó add các biến cần gửi đi vào



Tiếp đó mở cmd của window và vào Node-Red:


```

node-red
=====
28 Dec 19:13:21 - [info] Node-RED version: v2.1.4
28 Dec 19:13:21 - [info] Node.js version: v16.13.1
28 Dec 19:13:21 - [info] Windows_NT 10.0.19042 x64 LE
28 Dec 19:13:23 - [info] Loading palette nodes
28 Dec 19:14:30 - [info] Dashboard version 3.1.3 started at /ui
28 Dec 19:14:30 - [info] Settings file : C:\Users\minht\.node-red\settings.js
28 Dec 19:14:30 - [info] Context store : 'default' [module=memory]
28 Dec 19:14:30 - [info] User directory : \Users\minht\.node-red
28 Dec 19:14:30 - [warn] Projects disabled : editorTheme.projects.enabled=false
28 Dec 19:14:30 - [info] Flows file : \Users\minht\.node-red\flows.json
28 Dec 19:14:30 - [warn]

-----
Your flow credentials file is encrypted using a system-generated key.

If the system-generated key is lost for any reason, your credentials
file will not be recoverable, you will have to delete it and re-enter
your credentials.

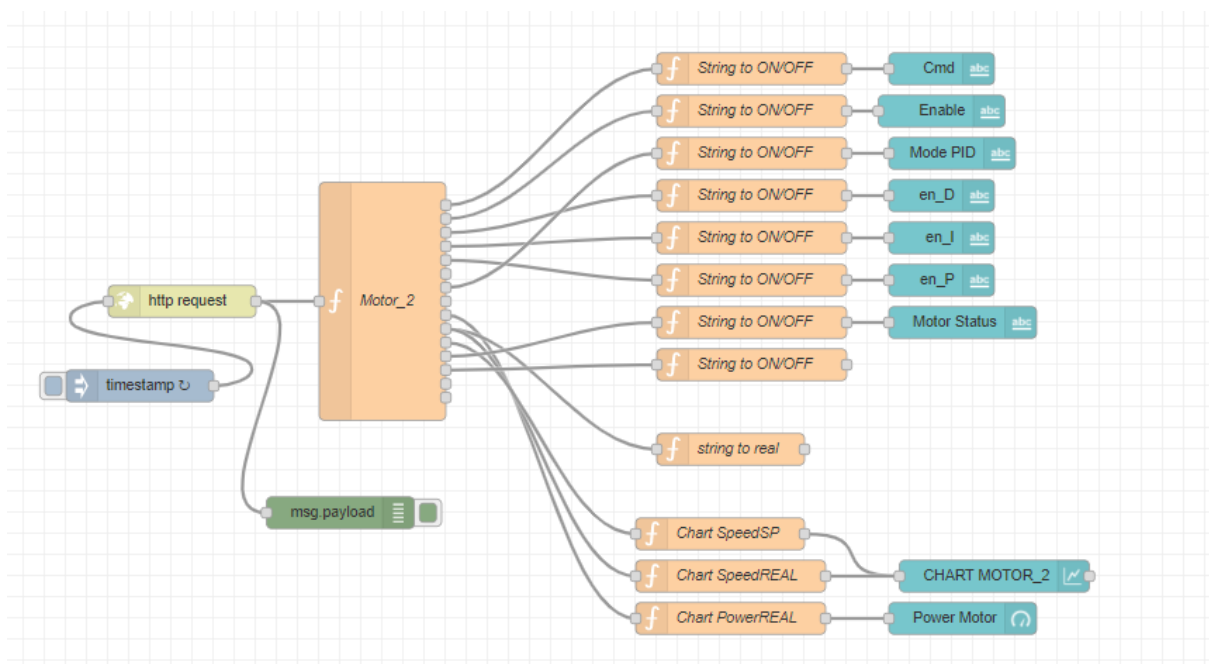
You should set your own key using the 'credentialSecret' option in
your settings file. Node-RED will then re-encrypt your credentials
file using your chosen key the next time you deploy a change.
-----

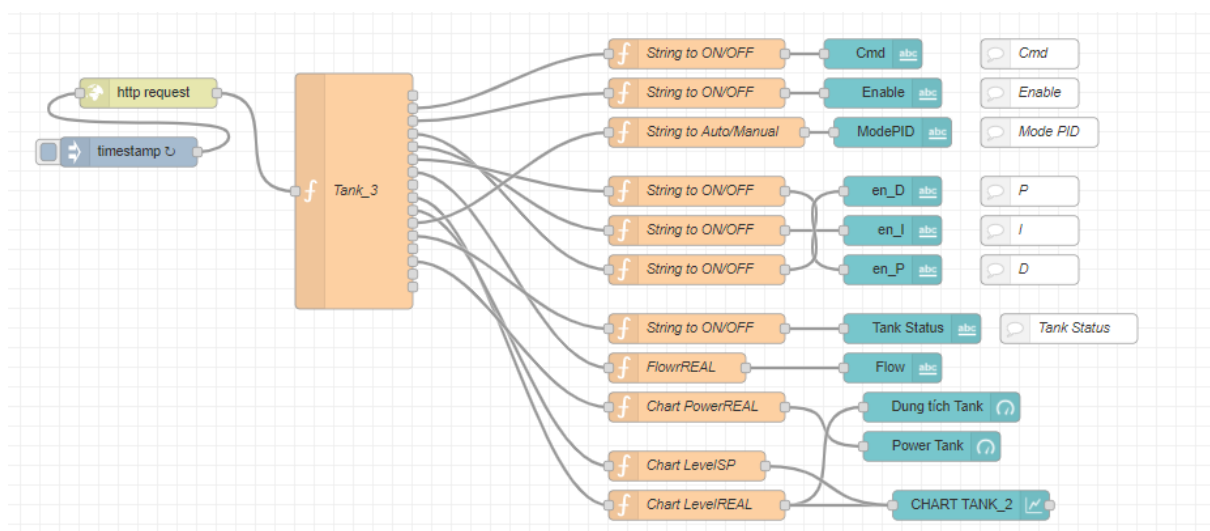
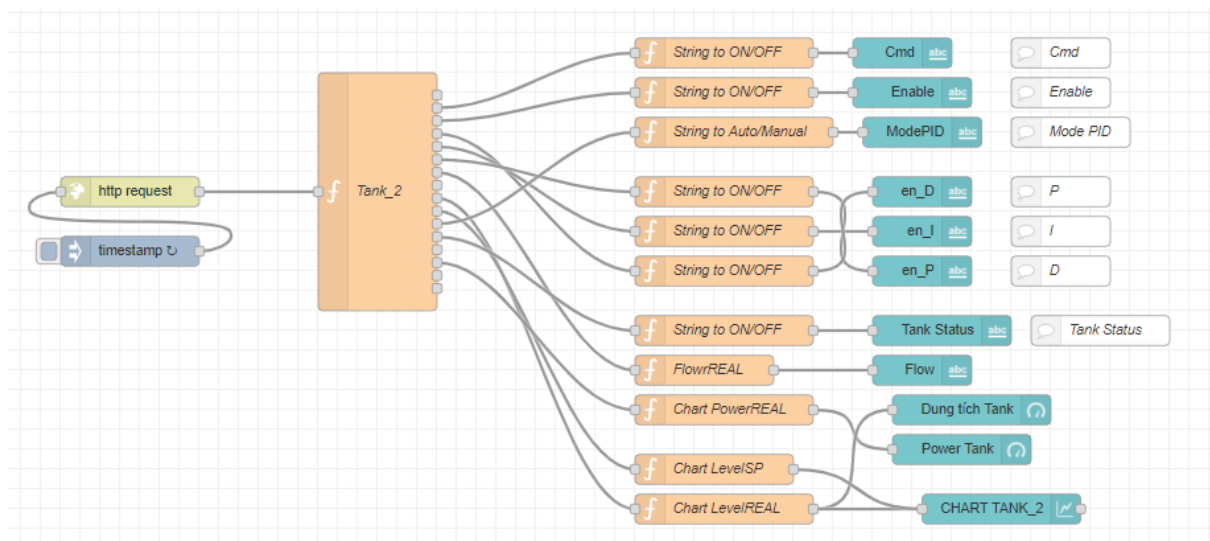
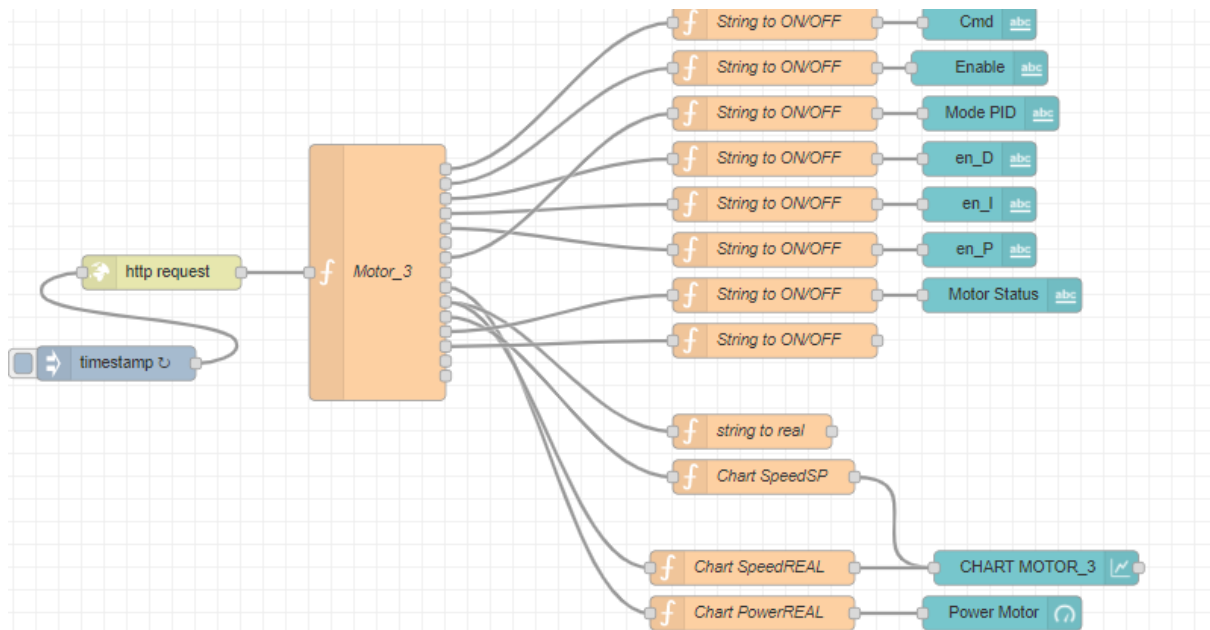
28 Dec 19:14:30 - [info] Server now running at http://127.0.0.1:1880/
28 Dec 19:14:30 - [info] Starting flows
28 Dec 19:14:30 - [info] Started flows

```

Sau đó truy cập vào địa chỉ <http://127.0.0.1:1880/>

Tiến hành lập trình như hình





Trong đó

Khởi http request:

Edit http request node

Delete Cancel Done

Properties

Method: GET

URL: 127.0.0.1:39320/iotgateway/read?ids=PLC.Tank

Payload: Ignore

☐ Enable secure (SSL/TLS) connection

☐ Use authentication

☐ Enable connection keep-alive

☐ Use proxy

☒ Only send non-2xx responses to Catch node

Return: a parsed JSON object

Name: Name

Tip: If the JSON parse fails the fetched string is returned as-is.

☒ Enabled

```
127.0.0.1:39320/iotgateway/read?ids=PLC.Tank_3.Close&ids=PLC.Tank_3.
Cmd&ids=PLC.Tank_3.Enable&ids=PLC.Tank_3.enD&ids=PLC.Tank_3.enI
&ids=PLC.Tank_3.enP&ids=PLC.Tank_3.FlowREAL&ids=PLC.Tank_3.Kp
&ids=PLC.Tank_3.LevelREAL&ids=PLC.Tank_3.LevelSP&ids=PLC.Tank_
3.Mode&ids=PLC.Tank_3.Open&ids=PLC.Tank_3.PowerMax&ids=PLC.Ta
nk_3.PowerREAL&ids=PLC.Tank_3.Td&ids=PLC.Tank_3.Ti
```

Khởi Tank và Motor:

```
var msg0= {payload:[msg.payload.readResults[0].v]}
var msg1= {payload:[msg.payload.readResults[1].v]}
```

```

var msg2= {payload:[msg.payload.readResults[2].v]}
var msg3= {payload:[msg.payload.readResults[3].v]}
var msg4= {payload:[msg.payload.readResults[4].v]}
var msg5= {payload:[msg.payload.readResults[5].v]}
var msg6= {payload:[msg.payload.readResults[6].v]}
var msg7= {payload:[msg.payload.readResults[7].v]}
var msg8= {payload:[msg.payload.readResults[8].v]}
var msg9= {payload:[msg.payload.readResults[9].v]}
var msg10= {payload:[msg.payload.readResults[10].v]}
var msg11= {payload:[msg.payload.readResults[11].v]}
var msg12= {payload:[msg.payload.readResults[12].v]}
var msg13= {payload:[msg.payload.readResults[13].v]}
var msg14= {payload:[msg.payload.readResults[14].v]}
return
[msg0,msg1,msg2,msg3,msg4,msg5,msg6,msg7,msg8,msg9,msg10,msg11,msg12,msg13,msg14];

```

Khởi String to ON/OFF

```

//read payload
var stringValue = msg.payload;
if (stringValue == "true")
{msg.payload = "ON"}
if (stringValue == "false")
{msg.payload = "OFF"}

return msg;

```

Khởi Chart Speed (tương tự với Chart SpeedSP)

```

//read payload
var stringValue = msg.payload;

//convert string to float to 2 decimal places
var floatValue = Number(stringValue)

//set and return payload
msg.payload = floatValue;
msg.topic = "SpeedSP"
return msg;

```

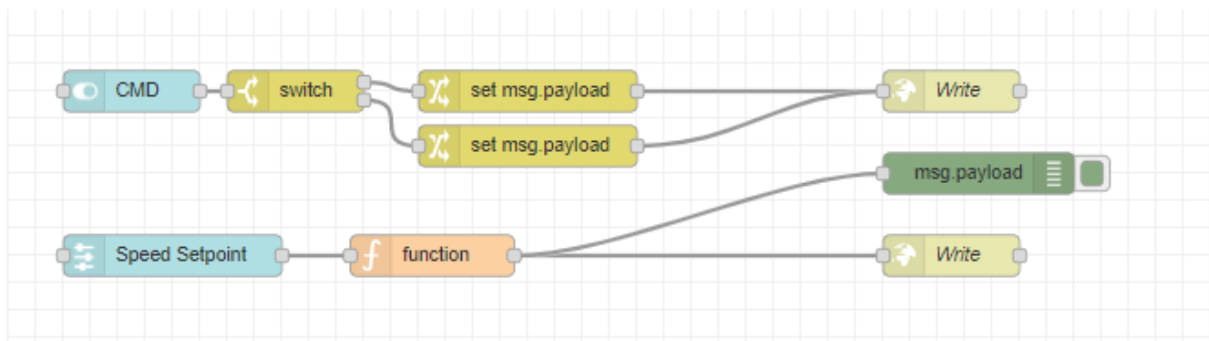
Khởi PowerREAL

```
//read payload
var stringValue = msg.payload;

//convert string to float to 2 decimal places
var floatValue = Number(stringValue)

//set and return payload
msg.payload = floatValue;
msg.topic = "PowerREAL"
return msg;
```

Tương tự sẽ có:



Trong đó khối set msg.payload sẽ:

Edit change node

Delete Cancel Done

Properties

Name

Rules

Set msg.payload

to the value [{"id":"PLC.Motor_2.Cmd","v":true}]

+add

Enabled

```
[{"id":"PLC.Motor_2.Cmd","v":true}]
```

Tương tự với khối còn lại

Khối Write:

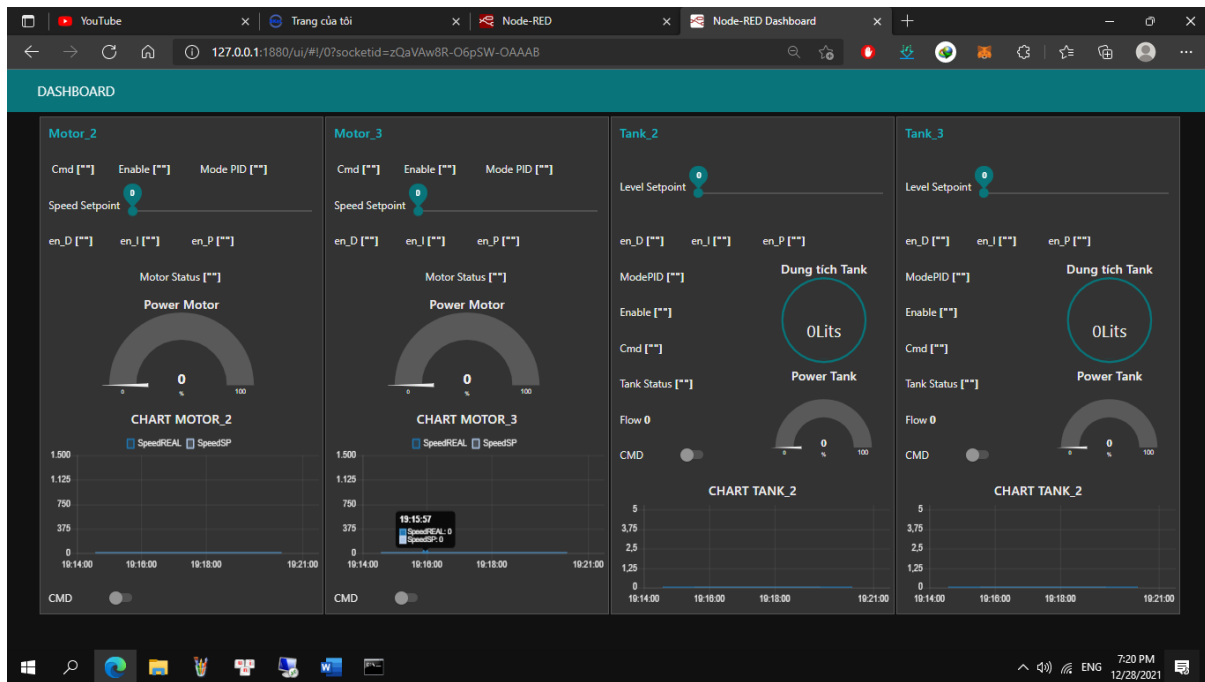
Khởi function của Setpoint:

```
//read payload
var stringValue = msg.payload;

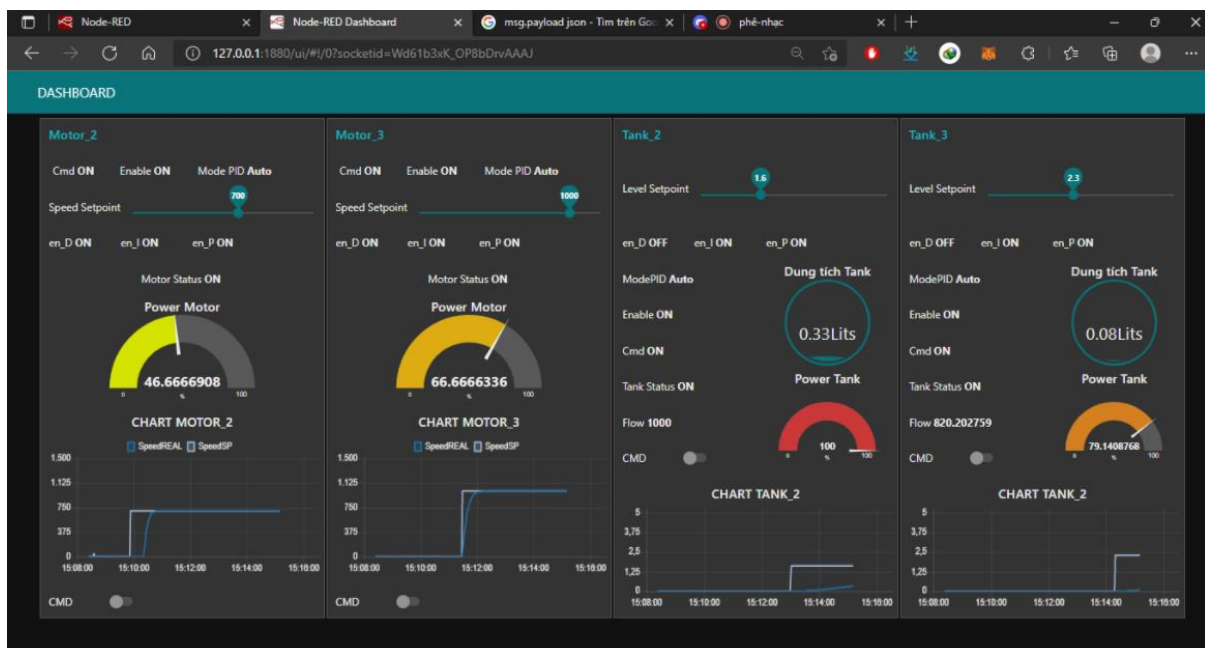
//convert string to float to 2 decimal places
var floatValue = Number(stringValue)
msg.payload=[{"id":"PLC.Motor_2.SpeedSP","v":floatValue}]

return msg;
```

Sau khi thiết kế xong, giao diện sẽ như hình:



Kết quả chạy thực tế:



Tài liệu tham khảo:

- [1] Slide bài giảng môn *SCADA* – Nguyễn Đức Hoàng
- [2] <https://nodered.org/docs/tutorials/>.