AUTOMATING THE PROCESS OF FILLING GAS-CYLINDERS

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ECT661 ROBOTIC CONTROL SYSTEMS

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INTRODUCTION:

With the increasing population and increasing demand for gas supplies, many industries have been well established to provide the service of filling/refilling the cylinders with liquified petroleum gas (cooking gas), oxygen (hospitals), or CO2 (research labs). Many companies like LPG, Linde Welding Gas, union engineering, etc. have been providing gas supplies.
Manual errors in these hazardous and risky jobs can lead to disasters which can cost huge environmental and social losses.
There have been multiple incidents reported where manual errors cost a huge number of deaths. Introducing robots to work in these companies can increase safety during filling and decrease the risk of having expired cylinders. Detection of defects through manual inspection requires very specialized training and risk acceptance. Hence introducing robots that can sense very precisely and work without tires can drastically decrease the hazards in this process.

OBJECTIVE:

In this project, I am using a 6-axis Articulated Arm robot manufactured by Mitsubishi and the software is MELFA ToolBox V. The robot's primary task is to fill the gas cylinder with a gas nozzle. Cylinders as inputs will be waiting in the conveyor belt, and the robot will take cylinders one by one from the conveyor belt to the box. The box measures the weight of gas in the cylinder and it also works as a carrier of gas cylinders. The carrier is a pallet box of 2 by 2. The robot should complete all the tasks automatically without any interruption. Here interruption means an emergency or defect in a cylinder. If there is any defect in the cylinder the weight sensor can detect it and it will send the signal to the operator.

- Input 8 is on means the conveyor belt is carrying cylinders.
- Input 9 is on means the robot gets commands to carry cylinders from the belt.
- Input 19 is on means the robot will stop doing work after completing the on-going task.
- Input 20 is on means the robot will go to a SAFE ZONE leaving any current work. It is basically an interruption while doing any work by the robot.
- Inputs 10,11,12, and 13 are the options for manually putting a cap on the cylinder based on the input value. 10,11,12, and 13 represents 1,2,3, and 4 number cylinder.

PROCEDURE:

STEP1
- A conveyor belt (input) supplies gas cylinders to the robot one by one.

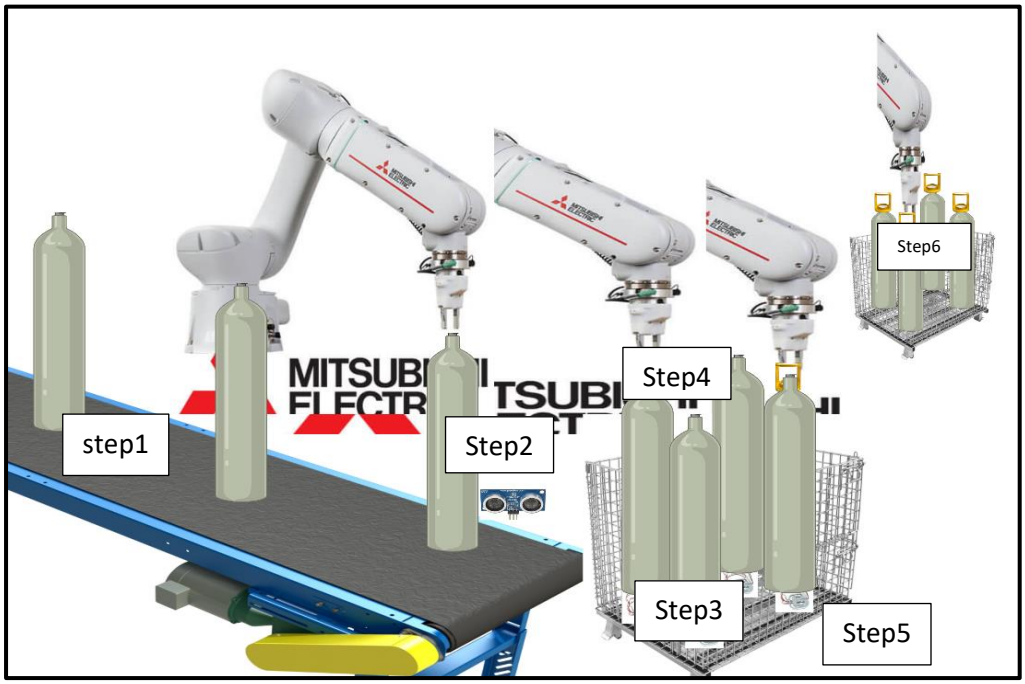
STEP2
- The ultrasonic sensor on the conveyor belt detects the cylinder and the belt stops at the point where the robot gripper holds the cylinder.

STEP3
- The robot completes the box with four gas cylinders.

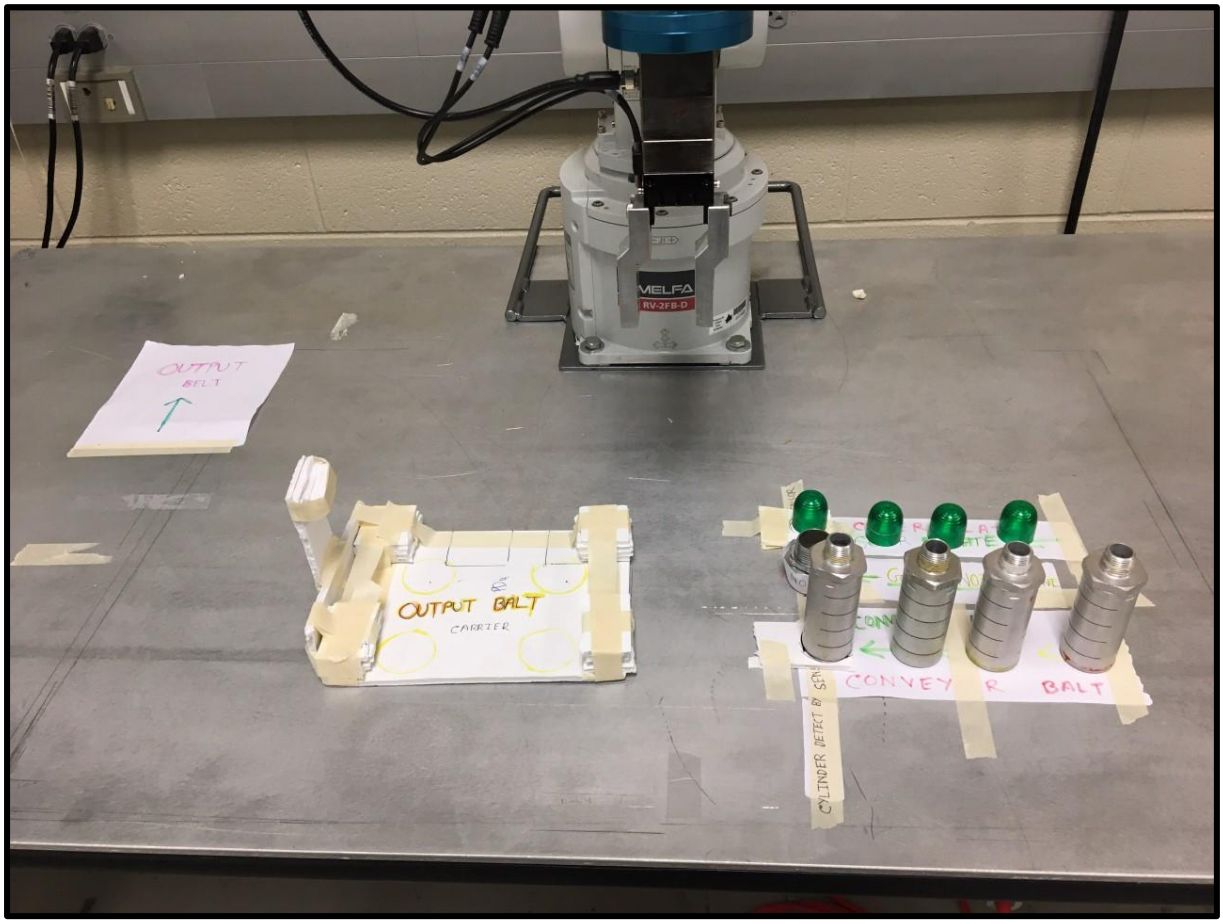
STEP4
- It takes the gas nozzle from the nozzle holder and fills up all the gas cylinders one by one.

STEP5
- The box measures the weight of the cylinders by using a weight sensor and the microcontroller decides how much gas should be filled into a specific cylinder.

STEP6
- After finishing the gas fill-up process, the robot waits for the input from the microcontroller to cap the cylinders. Once the microcontroller approves, the robot will proceed to cap the cylinder. If there is any defective cylinder the robot will not cap it and wait for the manual direction.



PROTOTYPE PICTURE:



FUNCTIONS AND OPERATIONS use in this project:

- Standard Movement
- Linear Motion
- Angular motion
- Comparison expression
- Jump to subroutine
- Interrupt
- If-else statement
- Select-case statement
- Repetition: for-next statement
- Wait statement
- HLT statement
- Palletizing

DESCRIPTION OF ULTRASONIC SENSOR AND WEIGHT SENSOR:

Ultrasonic sensor: Ultrasonic Sensor HC-SR04 is a sensor that can measure distance. It emits ultrasound at 40 000 Hz (40kHz) which travels through the air and if there is an object or obstacle on its path It will bounce back to the module. Considering the travel time and the speed of the sound you can calculate the distance.

Weight Sensor: Weight Sensor manufactured in the U.S. by FUTEK Advanced Sensor Technology (FUTEK), a leading manufacturer producing a huge selection of Weight Transducers, utilizing one of the most advanced technologies in the Sensor Industry: Metal foil strain gauge technology. A Weight Transducer is defined as a transducer that converts an input mechanical load, weight, tension, compression or pressure into an electrical output signal (load cell definition). Weight Sensors are also commonly known as Weight Transducer. There are several types of load cells based on size, geometry and capacity.

CODE OF THE PROJECT:

```
Ovrd 20
Wait M_In(8)=1  ‘ IF THE CONVEIR  BALT IS READY
On M_In(8)=1 GoSub *LOOP1
Wait M_In(9)=1
On M_In(9)=1 GoSub *LOOP2 ‘ WHEN GAS IS READY TO IN
DEF ACT 1, M_IN(20)=1 GOSUB *SAFE_ZONE
If M_In(19)=1 Then Hlt
If M_In(10)=1 Then X1=1
If M_In(11)=1 Then X1=2
If M_In(12)=1 Then X1=3
If M_In(13)=1 Then X1=4

Select X1
Case 1
Mov PHM
MOV PCOLLECTCVR1, -50
```

```
HOPEN 1
MVS PCOLLECTCVR1
HCLOSE 1
MOV PPUTCOVER1, -50
DLY 0.5
MVS PCOLLECTCVR1 DLY 0.5
HOPEN 1
Mov PHM

BREAK
Case 2
Mov PHM
MOV PCOLLECTCVR2, -50
HOPEN 1
MVS PCOLLECTCVR2
HCLOSE 1
MOV PPUTCOVER2, -50
DLY 0.5
MVS PCOLLECTCVR2 DLY 0.5
HOPEN 1
Mov PHM

BREAK
Case 3
Mov PHM
MOV PCOLLECTCVR3, -50
HOPEN 1
MVS PCOLLECTCVR3
```

```
HCLOSE 1
MOV PPUTCOVER3, -50
DLY 0.5
MVS PCOLLECTCVR3 DLY 0.5
HOPEN 1
Mov PHM

BREAK
Case 4
Mov PHM
MOV PCOLLECTCVR4, -50
HOPEN 1
MVS PCOLLECTCVR4
HCLOSE 1
MOV PPUTCOVER4, -50
DLY 0.5
MVS PCOLLECTCVR4 DLY 0.5
HOPEN 1
Mov PHM

BREAK
END SELECT
END

*SAFE_ZONE
HOpen 1
Mov PHM
RETURN
```

```
*LOOP1
Ovrd 20
For M1= 1 To 4
Def Plt 2, PPLACE1, PPLACE2, PPLACE3, PPLACE4, 2 ,2, 1
HOpen 1
Mov PpICK, -55
Mvs PpICK
Dly 1.5
HClose 1
Dly 1.5
Mvs PpICK, -55
Mov PHM
P10 = (Plt 2, M1)
Mov P10, -120
Dly 1.0
Mvs P10
Dly 1.0
HOpen 1
Dly 0.5
Mvs P10, -90
Next M1
Mov PHMRETURN

*LOOP2
OVRD 30
Mov PHM
HOpen 1
MOV PPICKGAS, -70
DLY 1.5
```

```
MVS PPICKGAS
DLY 1.5
HCLOSE 1
DLY 1.5
MOV PHM
For N1= 1 To 4
Def Plt 3, PGASCOVER1, PGASCOVER2, PGASCOVER3, PGASCOVER4, 2 ,2, 1
P11 = (Plt 3, N1)
MOV P11, -90
OVRD 15
DLY 0.5
MVS P11
DLY 2.0
MVS P11, -50
NEXT N1
Mov PHM
MOV PPICKGAS, -90
 DLY 1.0
MVS PPICKGAS
DLY 1.5
HOpen 1
 DLY 1.0
MVS PPICKGAS, -70
Mov PHM
RETURN

*LOOP3
Mov PHM
PPUTCOVER1
```

```
 Mov PPLACE1, -50

'Mvs PPLACE1, -38  IS THE GAS COVER NUGGEL LINE  I HAVE TO ADD 4 PLACE

'Mvs PPLACE1, -16  PUTTING COVER ONE PLACE  IT IS THE COVER OF THE CYLINDER   I
HAVE TO 4 PLACE

DLY 0.5

Mov PPLACE2, -50

Mvs PPLACE2

DLY 0.5

Mov PPLACE3, -50

Mvs PPLACE3

DLY 0.5

Mov PPLACE4, -50

Mvs PPLACE4

DLY 0.5

HOpen 1

MOV PHM

RETURN
```