Handout no.4
PLC PROGRAM DEVELOPMENT
FOR CONTROL APPLICATIONS
Interlocking Logic

Conveyor belt control

A conveyor belt is used for transporting loaded boxes. When a box is loaded on the belt, a START push-button is pressed to start the conveyor belt motor. The belt runs until the box reaches the far end where a limit switch becomes ON and the belt motor is deactivated. To avoid continuous operation of the belt motor in case of accidental pressing of the START push-button without having a box loaded on the belt, a STOP push-button can be pressed to deactivate the belt motor. If the belt motor has been continuously active for 5 minutes, it should be automatically deactivated. It is required to develop a PLC program to control the operation of the above system.

Modify the above system so that if the belt motor is deactivated for any reason from the above, it cannot be restarted until a motor protection delay of 15 seconds has passed. During this delay a warning lamp should be turned ON to indicate that pressing the START push-button will not activate the belt motor.

Machine work cell

A machine work cell is bounded by an array of 4 sensors. Each sensor produces a self check functioning signal which is high in normal conditions and becomes low if the sensor self check fails. To avoid injury of persons or damage of equipment each sensor produces an intrusion signal which is normally low and becomes high in case of people or objects trying to enter the work area.

It is required to develop a PLC program which enables/disables the machines of the work cell which include a conveyor belt, a feeding arm and a drilling machine. When a START push-button is pressed, the signals of the sensors are continuously monitored. A system green lamp is turned ON and the machines of the work cell are enabled.

* If a functioning signal becomes low, the system green lamp is turned OFF, all the machines of the work cell are disabled and a Warning lamp is turned ON. This situation should be maintained until a RESET Warning lamp is pressed. Afterwards the system can be restarted by pressing the START pushbutton.

* If an intrusion signal becomes high, the system green lamp is turned OFF, all the machines of the work cell are disabled and an alarm siren is activated. This situation should be maintained until a RESET alarm pushbutton is pressed. Afterwards the system can be restarted by pressing the START pushbutton.

* If all the functioning signals are high and all the intrusion signals are low, pressing a STOP push-button, results in turning OFF the system green lamp and the system is stopped. It can be restarted by pressing the START push-button. While the Warning lamp is ON or the alarm siren is active, pressing the STOP push-button should have no effect.

Engine control

Proper operation of an engine is observed through monitoring the following conditions of operation:

* Temperature of the cooling water should not exceed a certain upper limit. A temperature sensor becomes ON when this happens.

* Lubrication oil level should not go below a minimum level. A level sensor becomes ON when this occurs.

* Oil pressure should be kept above a certain level. A pressure sensor becomes ON if this condition fails.

It is required to develop a PLC program for a driving/protection system having START and STOP push-buttons to drive the oil pump, the cooling fan, the cooling water pump and the engine ignition circuit.

* Upon pressing the START push-button all the above drives should be activated. After a start-up delay of 30 sec. the above conditions of operation are continuously monitored so that if any condition is not met the following actions should be taken:

- All the above drives are deactivated.

- An alarm siren is activated.

- The system should have 3 different warning lamps, which correspond to the 3 conditions of operation. When a condition fails, the corresponding lamp should be turned ON and remain ON even if the corresponding sensor becomes normal.

* Pressing the STOP push-button during alarm should have no effect. If all conditions of operation are normal, pressing the STOP push-button deactivates all the system drives. To restart the system, the START push-button should be pressed.

* During alarm, pressing a RESET alarm push-button deactivates the alarm siren and turns OFF all warning lamps. The system can be restarted by pressing the START push-button.

Electric lift control

An electric lift is used for moving construction workers and material between the ground and an upper level.

- When the lift is at the ground level, a sensor LSD is ON and when it is at the upper level a sensor LSU is ON.

- The control panel of the lift has: UP, DOWN and EMERGENCY STOP pushbuttons.

- For safety, the lift door should be locked causing a DOOR LOCK signal to become ON, which should remain ON so that the lift can be moved upwards or downwards.

It is required to develop a PLC program to control the motion of the lift such that:

* When the UP pushbutton is pressed while the door is locked and LSU is OFF, the lift motor is activated in the UP direction till LSU becomes ON, where the lift motor is deactivated.

* Similarly, when the DOWN pushbutton is pressed while the door is locked and LSD is OFF, the lift motor is activated in the DOWN direction till LSD becomes ON, where the lift motor is deactivated.

* While the lift is moving in a certain direction, pressing the pushbutton of the opposite direction, on the control panel, should have no effect.

* While the lift is moving, if the EMERGENCY STOP pushbutton is pressed or if the DOOR LOCK signal becomes OFF, the lift motor is immediately deactivated.

Modify the above system so that if the lift motor is deactivated when it reaches the upper or the ground level or due to the EMERGENCY STOP pushbutton or the DOOR LOCK signal, it cannot be reactivated again until a motor protection delay of 10 sec. has passed.