# Lab Week 12: PLC Project (State Tables)

State Diagrams

A system state is a mode of operation. Consider a bank machine that will go through very carefully selected states. The general sequence of states might be idle, scan card, get secret number, select transaction type, ask for amount of cash, count cash, deliver cash/return card, then idle.

A state based system can be described with system states, and the transitions between those states. A state diagram is shown in Figure 1. The diagram has two states, State 1 and State 2. If the system is in State 1 and A happens, the system will then go into State 2, otherwise it will remain in State 1. Likewise if the system is in State 2, and B happens the system will return to State 1. As shown in the figure this state diagram could be used for an automatic light controller. When the power is turned on, the system will go into the "lights off" state. If motion is detected or an "on" push button is pushed, the system will go to the "lights on" state. If the system is in the "lights on" state and 1 hour has passed, or an "off" push button is pushed then the system will go to the "lights off" state. The else statements are omitted on the second diagram, but they are implied.
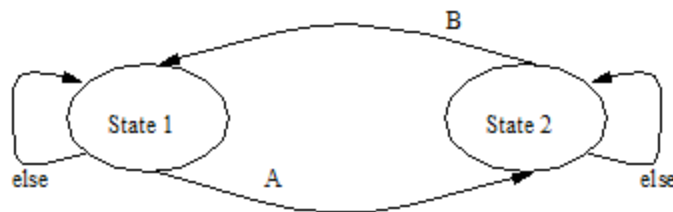
This diagram could describe the operation of energy efficient lights in a room operated by two push buttons. State 1 might be lights off and state 2 might be lights on. The arrows between the states are called transitions and will be followed when the conditions are true. In this case if we were in state 1 and A occurred we would move to state 2. The *else* loop indicate that a state will stay active if a transition are is not followed. These are so obvious they are often omitted from state diagrams.
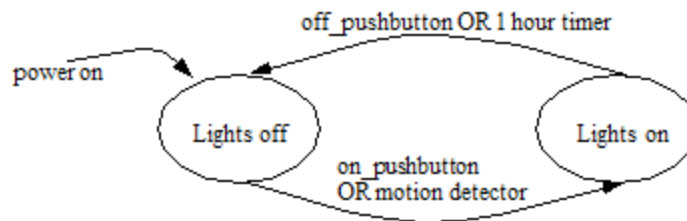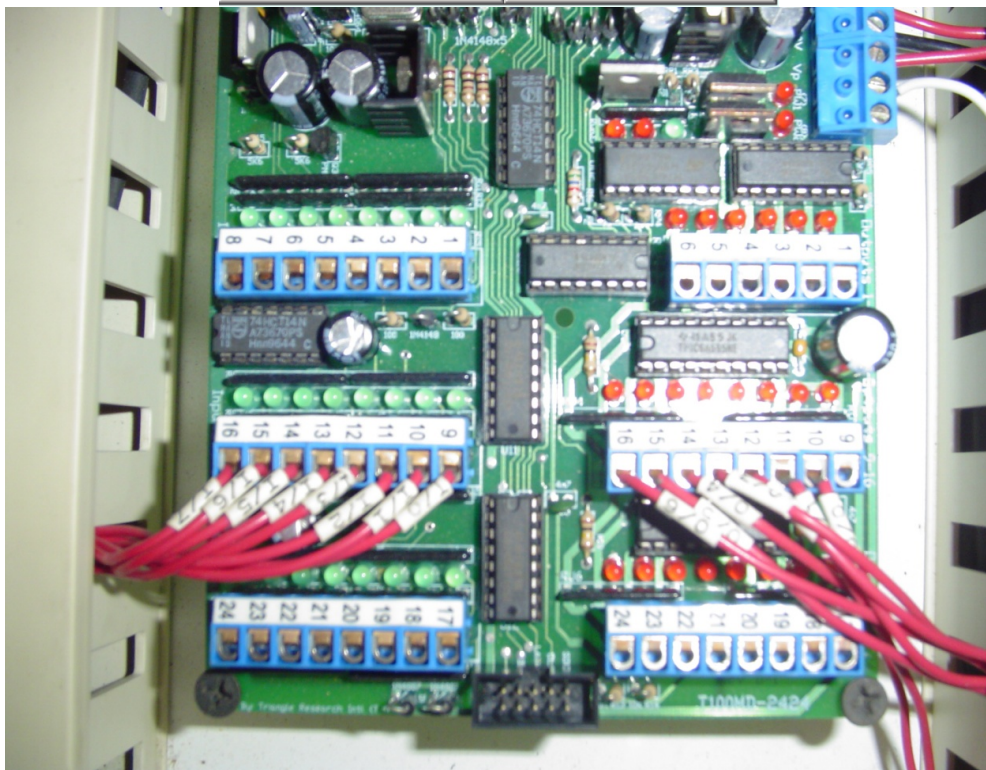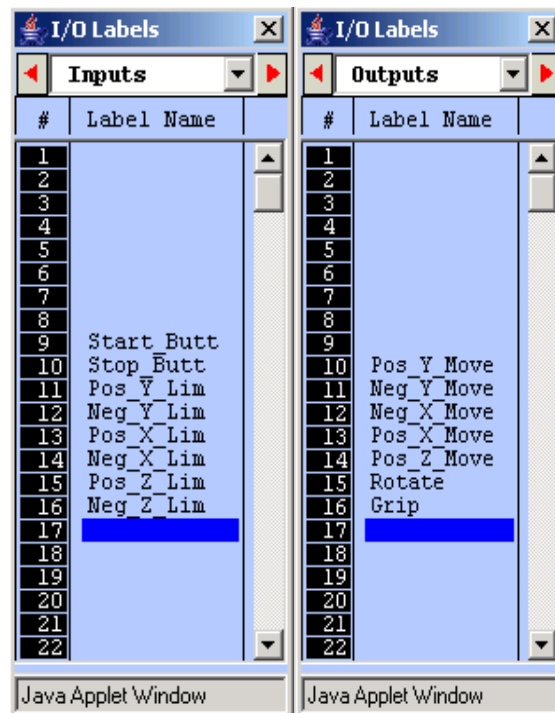

Figure 1 A State Diagram

Create a PLC program

This program will allow you to manually move the toaster arm. Fill in the inputs and outputs to the PLC. The input/output number corresponds to the actual physical wire going into the PLC.
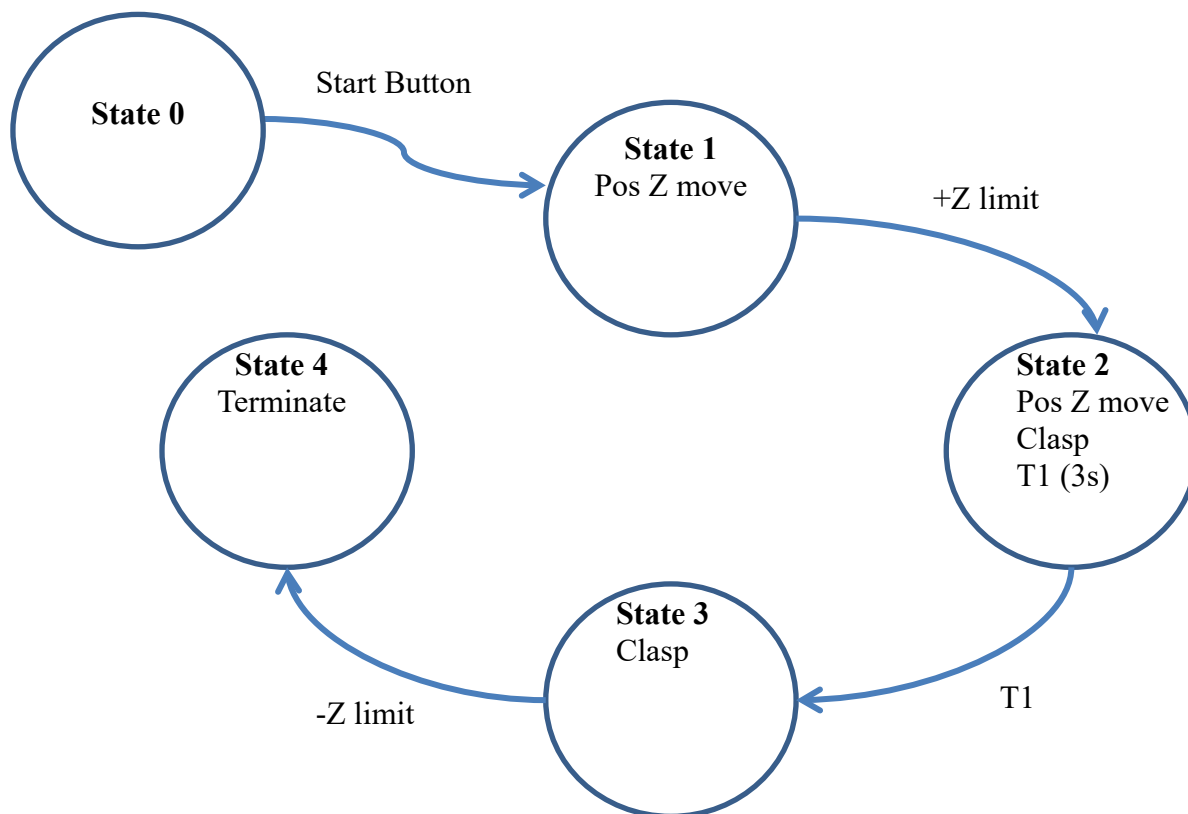
Creating a State Table and State Diagram

An example state table is given.

- When the Start button is pressed the robot arm raises up (+Z)
- When the robot reaches the top it clamps for 3 seconds
- It then lowers, while clamped, and releases when it hits the bottom

State	Trigger (Input)	Outputs/Actions		Other
		Pos_Z_Move	Clasp	
1	Start	X		
2	+Z Limit	X	X	T1 (3s)
3	T1		X	
4	-Z Limit			Program Terminate

State 0 — Start Button → **State 1** Pos Z move

State 1 Pos Z move → +Z limit → **State 2** Pos Z move Clasp T1 (3s)

State 2 → T1 → **State 3** Clasp

State 3 → -Z limit → **State 4** Terminate

Deliverables: Create a state diagram and a state table for the:
- Regular toasting sequence (start button sequence)
- Stop button sequence

Key things to think about when making a state table are:
- What inputs (timer, limit switch, button, etc.) trigger transition to the next state?
- What are the outputs at that state? (Which valves are on? Are the clasps rotated or clamped? Are the toaster coils on?)