Automatic Door Controller

Members

Mishal Shah- 16CO125

Samyak Jain-16CO254

Aim:
Design and build a simulation of state-of-art door controller (Automatic Door). Represent a finite state machine using a state diagram, truth tables, and logic circuits.

Door moves from Left to Right for Opening and Right to Left for Closing, in addition, there is an electronic eye function. Multi operations have been envisaged which will be designed using a 5 State Machine (State Diagram) with 64 row truth-table. It uses all basic gates and flip-flops for storing the information about previous state.

Synopsis of approach and Working

Inputs:

Right (R)

When the door is at the 'Right', this input is true.

Left (L)

When the door is at the Left, this input is true.

eye (E)

There is a light beam across the doorway with an electric eye. When the electronic eye(sensor) detects the light beam, this input is false. If the light beam is blocked, such as by a small child standing in the doorway, then this input is true.

go (G)

When the button on the remote control is pressed, this input becomes true. When the button on the remote control is released, this input becomes false.

Outputs:

L2R

When this output is true, the motor moves the door 'right' to open it.

R2L

When this output is true, the motor moves the door Left to close it.

If both L2R and R2L are false, then the motor will be stopped. The L2R and R2L outputs should never both be true at the same time to avoid damaging the motor.

Operations

The input from the button on the remote control (G) will be processed by a one-shot circuit which happens to be a finite state machine. This circuit prevents the G input from staying true for more than one clock cycle, even if the button is held down for a long period of time.

1. Assume that the clock rate is 1 Hz so that the controller will respond to changes in the inputs within one tenth of a second, quickly enough to avoid causing injury or damaging the motor.
2. If the door is closed, pressing the button (G = 1) or if a person is standing in front of the door then (E=1) causes the door to begin opening.
3. If the door reaches the right side (R = 1) while opening, the motor will stop.
4. If the door is open, and there is no one standing (E=0) causes the door to begin closing.
5. If the door reaches the left side (L = 1) while closing, the motor will stop.
6. If the electric eye detects that the light beam has been interrupted (E = 1) while the door is closing, the door will reverse direction and begin opening. This is an important safety feature, so the electric eye should take priority over the other inputs in this situation.
7. If the light beam is interrupted (E = 1) while the door is opening then the door continues opening.
8. Pressing the button (G = 1) while the door is opening causes the door to stop (it will open partially). If (E=0) then it will again go to closing mode.
9. Pressing the button (G = 1) while the door is closing causes the door to reverse direction and immediately begin opening.

Applications:

Today automatic doors are a common sight, they are installed in Malls, Hotels, Hospitals, Commercial Establishments, Banks, Office spaces, Post Offices, Garages, Rail Cars, Perimeter fencing – Besides being convenient to use, there are many other advantages as enumerated below:

Advantages

i. Automatic doors provide hands free operations, hence they provide unparalleled access for elderly, divyang(handicapped) and those with small children.
ii. Automatic doors don't necessitate any human effort or force to perform their operation. It helps do away from the struggle and aggravations when it comes to opening a relatively heavier manual door.
iii. They are helpful for people carrying heavy packages, luggage or children.
iv. Automatic doors grant you the option to open the door manually as well.
v. Automatic doors are safe and provide convenient access – they automatically stop closing if someone enters while the door is closing thereby ensuring safety and security of personnel
vi. Automatic doors by virtue of being automatic always close completely and properly, thereby ensuring safety from potential intruders (there are no accidental

opened doors). This also means that one does not need to have additional locks or security systems in place to keep out or deter burglars and thieves from entering premises.

   vii.   The Automatic doors can also be accessed via a remote control from the outside.

  viii.   Automatic doors are easy to operate. They are quite sturdy and require minimal maintenance requirements.

    ix.   Automatic doors also help conserve energy as they open only when passing-by traffic is near, and close spontaneously, automatic doors thus easily conserve temperature inside premises. Thus, saving-up on electricity costs.

    x.   Two automatic doors installed 2-3 feet apart are generally used in High Security regions to prevent tailgating.

   xi.   Automatic doors made using fire-proof material are used in Hospitals, Hotels, Offices to block and prevent fire from spreading.

   xii.   Additionally, using a remote-control device automatic doors can lock, unlock, open, half-open, close i.e. make the door operations very efficient.

  xiii.   In order to further improve security, automatic doors can be fitted with access control functions using biometric devices.

  xiv.   In large establishments like offices, big Malls – multiple automatic doors are installed and managed using centralized security rooms – this reduces the security costs of premises

Disadvantages

    i.   Automatic doors are more costly than manual garage doors.

   ii.   Automatic doors require a one-time installation by trained door technician and regular maintenance and checkup which costs money.

   iii.   Automatic door repairs can be costly especially when some parts need to be replaced.

   iv.   Automatic doors are also more complex to clean since you also need to polish internal parts like springs and bolts to avoid the accumulation of rust.

   v.   In the unlikely scenario that the automatic door becomes faulty, one has to resort to manual operations, hence all automatic doors need to have handles etc. Also, if someone places an obstructive object in the door path – the door will malfunction.

Despite these short comings it is very convenient and is widely used in organizations, office buildings, malls, homes etc.

References

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This is only a proposal and is subject to improvisations.