SE3910 – REAL TIME SYSTEMS

## Real Time Systems Fundamentals

OBJECTIVES

- Define the concept of a system
- Define response time
- Define real time system
- Compare and contrast soft, firm, and hard real time systems
- Define punctuality
- Define event
- Define release time
- Classify events as either being synchronous or asynchronous, periodic, aperiodic, or sporadic
- Define deterministic system

taxonomy

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Something that takes inputs and makes outputs.

=) Components change system.

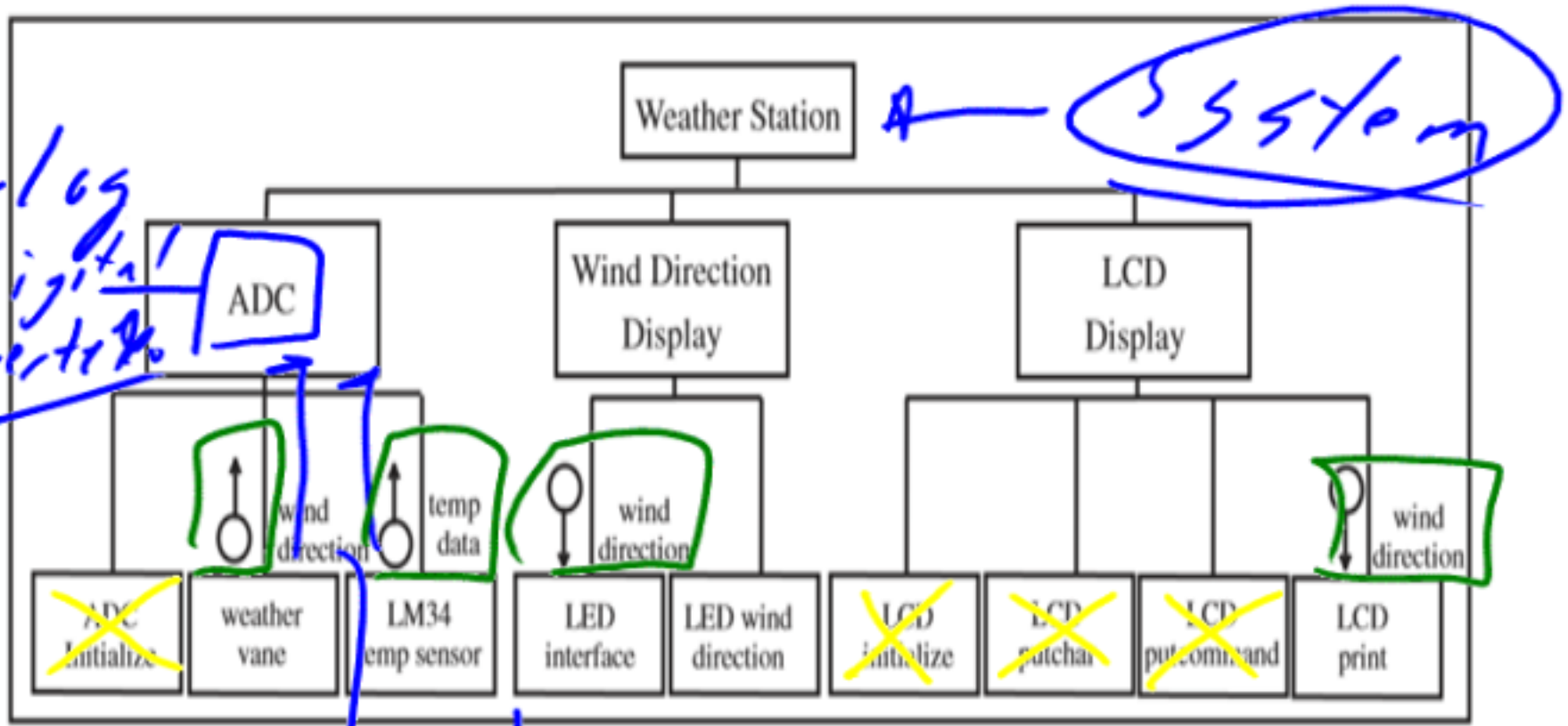- A system is a mapping of a set of inputs into a set of outputs

Inputs

Outputs

Input Space

System

Mapping Function

Output Space
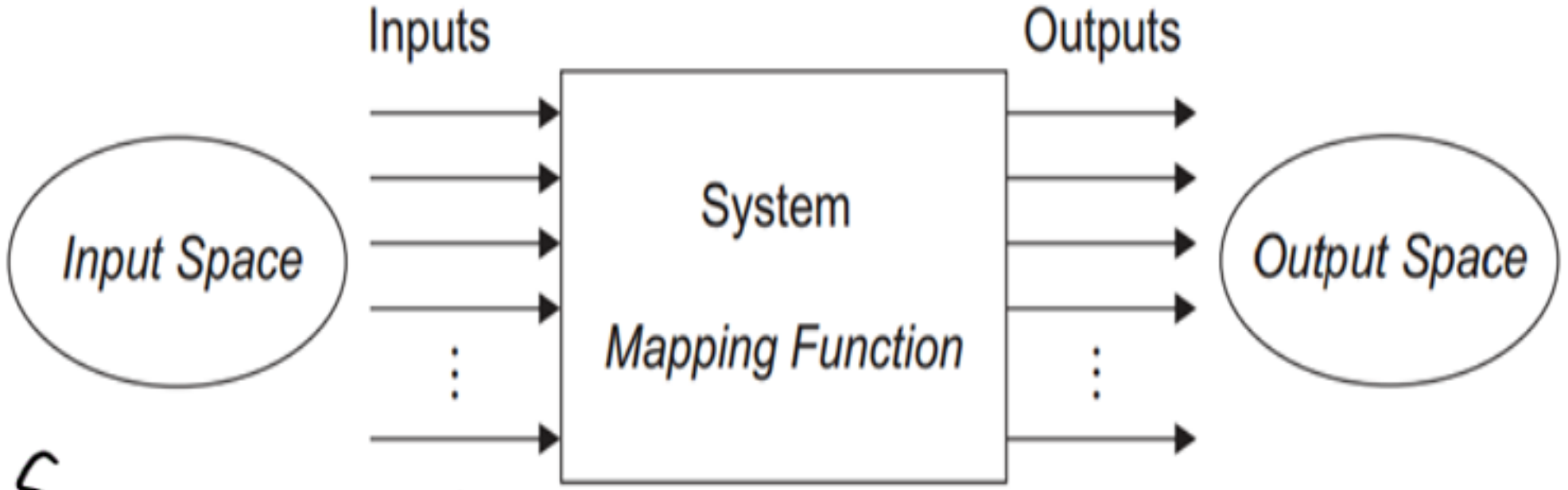
5 properties:
1. Connected in unorganized way
2. System is modified if a component joins or leaves the the system.
3. Has a purpose.
4. A degree of performance.
5. Defined as being of interest.

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Something specific that must occur on a routine basis.

REAL TIME TASKING

Job 1

Job 2

Job 3

Job 4

⋮

Job n

Real-Time System

Schedule

[Job 3, Job 1, Job n, ...]

when
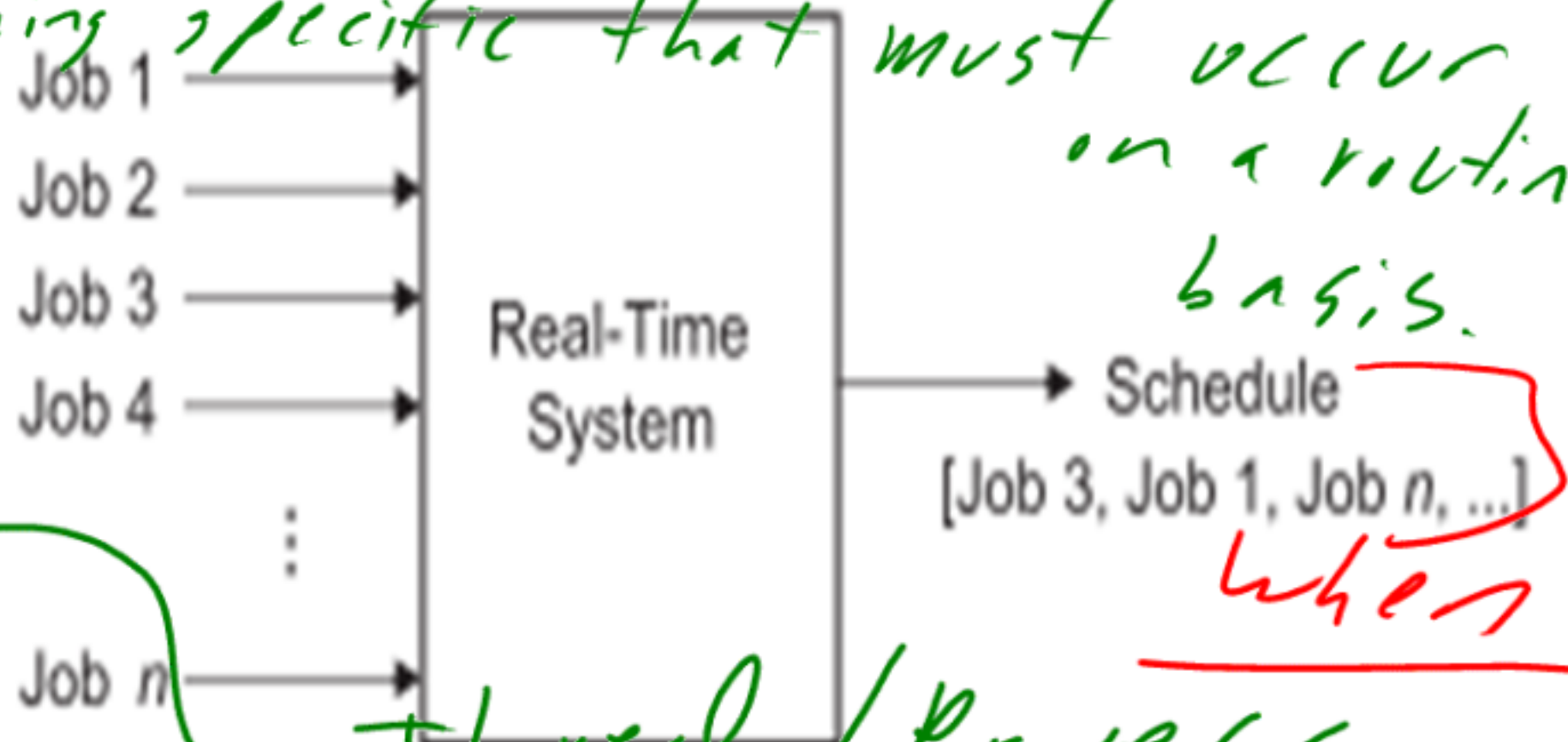
Thread/Process

Job 1 ⇒ Measure wind speed

Job 2 ⇒ Wind direction

Job 3 ⇒ Measure temperature

Job 4 ⇒ Drive LEDS

Job 5 ⇒ Drive LCD

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- Response time

  - The time between the presentation of a set of inputs to a system and the realization of the required behavior, including the ability of all associated outputs → Delay

- We're going to talk more about this next lecture...

  - And we'll do some "experimentation"

- Soft Real Time System — "Doesn't matter too much"

  - A system in which performance is degraded but not destroyed by failure to meet real time response constraints

- Hard Real Time System — "Really matters a lot"

  - A hard real time system in which failure to meet even a single deadline may lead to complete or catastrophic system failure

- Firm Real Time System) — In between

  - A firm real-time system is one in which a few missed deadlines will not lead to total failure of the system, but missing more than a few may lead to complete or catastrophic failure of the system.

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YOUTUBE VIDEO EXAMPLE

- http://www.youtube.com/watch?v=bYCc3toOHdc

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- Discuss with the person sitting next to you: What type of real time system is each of the following systems

System	Classification	Explanation
Video Surveillance System for Car Dealership	Firm	
Laser welding robot to construct car frames	Hard	
2 player air hockey game on game console	Soft Firm	

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TABLE 1.1. A Sampling of Hard, Firm, and Soft Real-Time Systems

System	Real-Time Classification	Explanation
Avionics weapons delivery system in which pressing a button launches an air-to-air missile	Hard	Missing the deadline to launch the missile within a specified time after pressing the button may cause the target to be missed, which will result in catastrophe
Navigation controller for an autonomous weed-killer robot	Firm	Missing a few navigation deadlines causes the robot to veer out from a planned path and damage some crops
Console hockey game	Soft	Missing even several deadlines will only degrade performance

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- Every response time has an average value T_R with an upper and lower bounds of $T_R + \varepsilon_U$ and $T_R - \varepsilon_L$ with $\varepsilon_U, \varepsilon_L \rightarrow 0^+$

  - Jitter -> a variance in how fast the response occurs.

- Example

  - How fast do your assignments get returned?

1 Day ± 2 weeks

- In real time systems

  - Any occurrence that causes the program counter to change non-sequentially is considered a change of control flow, and thus an event

- The time at which an instance of a scheduled task is ready to run, generally associated with an interrupt.

RELEASE TIME

- Synchronous Event —

  - An event which occurs at a predictable time of flow in the program

- Asynchronous Events

  - Events which occur at unpredictable points of flow in the control flow

  - Usually caused by external entities → *Interrupts.*

- Aperiodic Events

  - Events that do not occur at regular intervals

- Sporadic Events

  - Aperiodic events which occur *extremely infrequently*

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- A system is deterministic if, for each possible state and each set of inputs, a unique set of outputs and next state of the system can be determined.

DIGIBOTS

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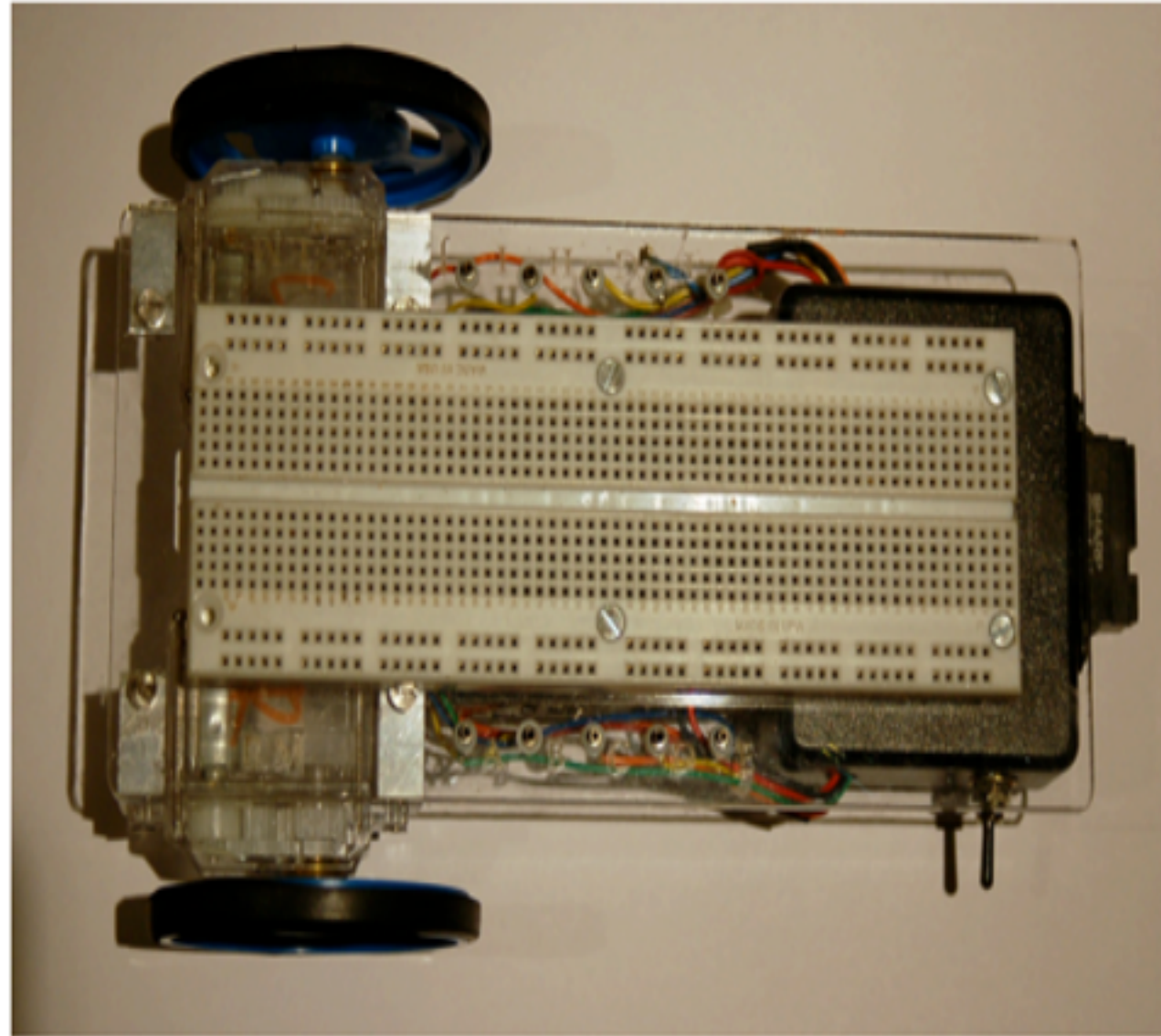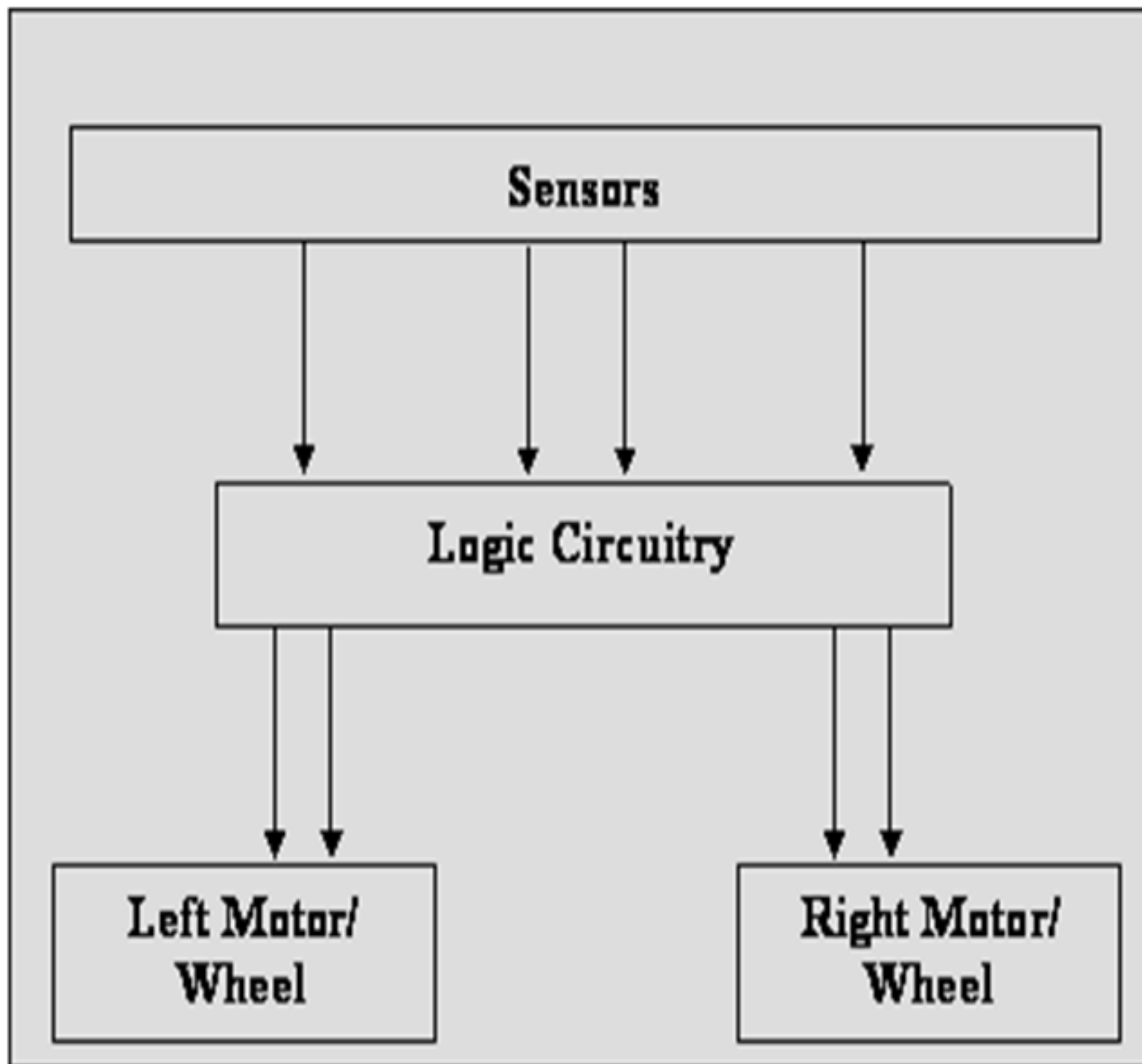
- How can we make our vehicle follow a path using the line tracker?

Sensor States	Action
O O O	
O O O	
O O O	
O O O	
O O O	
O O O	
O O O	
O O O	

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