

Answer to the Q.No 1@

For this water filling system designed ^{a close} ~~open~~ loop control system' is using . Because in the question it's mentioned that the water tank has also a water level controller system in which input water is controlled by the water level of the reservoir.

In close loop system we know the input is ~~not~~ controlled by the output system. Here in the scenario water level controller is dependent on the reservoir. Here is reservoir is our output which have to design. So, as the definition suggests, the control system in which input or controlling action depends on the output and as our water level controller is dependent on our reservoir (output), so the control system used is close-loop' control system.

(b)

For tuning PID controllers using Ziegler-Nichols rules:-

Using only Proportional control, turn up the gain until the system oscillates without dying down i.e. is marginally stable. Assuming that K and P are the resulting gain and oscillation period respectively.

For P control:

$$K_p = 0.5K$$

For PI control:

$$K_p = 0.45K$$

$$K_i = 1.2/P$$

For PID control:

$$K_p = 0.6K$$

$$K_i = 2.0/P$$

$$K_d = P/8.0$$

Ziegler-Nichols tuning is for second or higher order system.

Answer to the Q. No 2

(a)

Sensor model: A sensor measures raw values in an environment. We have to map them into a Grid Cell Value. Robots can have different sensors and configurations.

⑥

For this path planning 'Bug - based' ~~algo~~ planning can be used. Because always have goal direction and/or distance which is known as global. But no map because only local knowledge of environment.

For example, outdoor robot knows GPS location of goal, but building in the way same as indoor robot ~~need~~ see goal location but furniture and motor. in the way. Using it's camera, it can follow a certain path to reach the goal, it doesn't need any map. Bug based path planning are simple computation which are visual homing + wall-following also odometry purpose this ~~path~~ path planning is used. This ~~algo~~ planning is very intuitive class of algorithms but surprisingly powerful.

Answer to the Q. No 3

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Convolutional Layer:-

First layer to extract features from the input image. Performs a mathematical operation called 'convolution' that takes two input such as image matrix and a filter or Kernel. The objective of the convolution operation is to extract the low-level features such as edges from the input image.

~~Convolution~~ The first convolution layer is responsible for capturing these features e.g. edges, colors, gradient orientation etc. Moreover, convolution of an image with different filters can perform operations such as edge detection, blurring etc.

Down Sampling :-

It is also known as 'pooling layer' or 'subsampling'. It used for reducing the number of parameters in case of large images. It retains major information. Max pooling and average pooling are two types of pooling that are used here.

b

For an autonomous car to detect pedestrians and other vehicles it can use first 'classification' technique that whether ~~inf~~ the infront thing is pedestrian 93%, or it could be a cycle 7%, then it can use 'Tagging', by which ^{it} can classify more like the percentage of pedestrian 60%, by cycle 30% and bus 10%. Then the car can use 'detection' technique by which it can capture the image in front of it like of pedestrian or car and pointing them. The last technique is 'segmentation'. In segmentation autonomous car make a border of finding objects for detecting. In those way, autonomous car can detect pedestrian and other vehicles.

For real-time usage detection algorithm can be used 'YOLO-V3' which stands for 'You Only Look Once - Version - 3'. This algorithm is very fast. For example, while auto car driving it need to detect pedestrian or other vehicles very fast to

avoid any kind of accident. Also it's a real usage algorithm.

Answer to the Q. No 4

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Pros of UART:-

- ① Only two wires needed.
- ② Parity bit for error checking.
- ③ No clock signal is required.
- ④ Well documented and widely used.

whereas in SPI:-

- ① Higher data transmission
- ② No start and stop bits, so data can be transferred without interruption.

So, those are the pros of UART protocol over SPI protocol.

(b)

For building an automated kitchen where we want to control and monitor the kitchen, cook favourite dishes by passing command from smartphones, we can use RF Module. Because, the communication is done through optical communication or radio frequency. Several ranges of frequencies are used in RF such as 433.92 MHz, 915 MHz. Moreover, RF modules are most often used in medium and low volume products for consumer application. For a simple wireless communication to transmit information within a short range, RF pair could be the right choice where the transmission distance is 3 meters (without antenna) to 100 meter (maximum). Furthermore, data transmission speed is 100 kbp.

So, for those reasons, I use RF module as to control command of kitchen short distance

is is required.