

INTRO TO CONTROL SYSTEMS

MISSIONS:

DEFINE CONTROLS AND CONTROL SYSTEMS

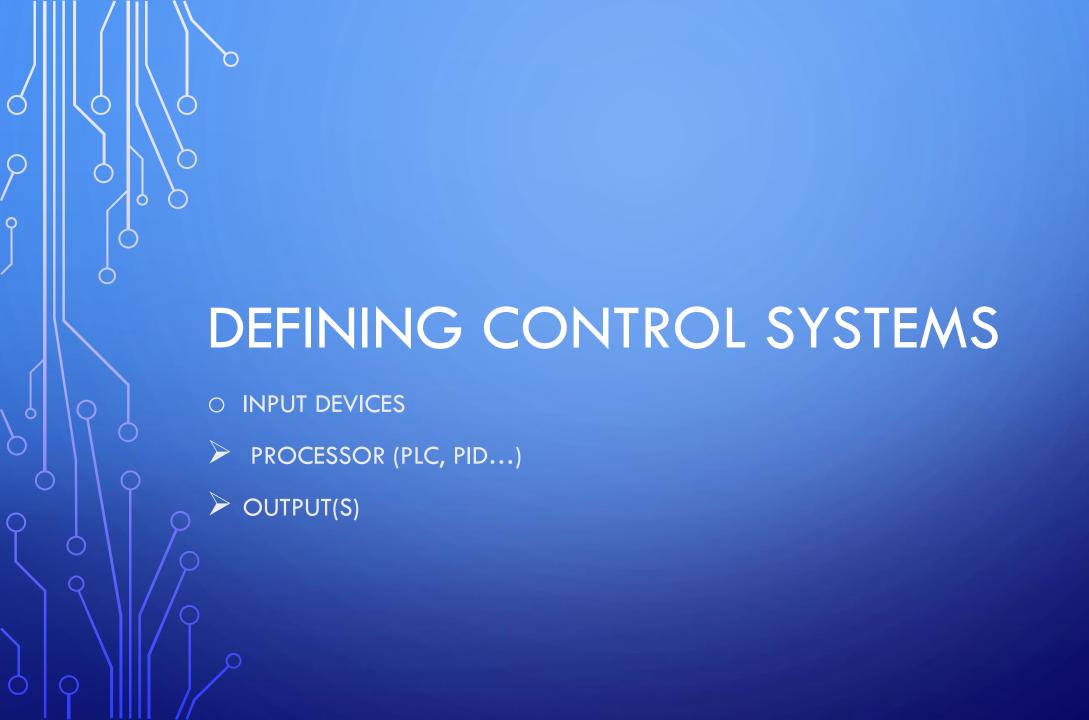
GIVE EXAMPLES AND DISCUSSING CONTROL SYSTEMS

DEFINE COMMON TERMS FROM THE PROCESS CONTROL INDUSTRY

EXAMINE VARIOUS CONTROL SYSTEM TRAINERS









- O MOTOR CONTROL
- > SERVO, STEPPER, DC OR AC MOTOR
- ► ENCODER / POSITION FEEDBACK
- > OUTPUT CONTROLLED TO ACHIEVE POSITION, VELOCITY, AND ACCELERATION TARGETS



- O HVAC SYSTEM
- > HEATERS AND A/C, HUMIDITY CONTROL, AIR DUCTING CONTROLS
- > TEMPERATURE, HUMIDITY AND AIRFLOW / QUALITY SENSORS
- > OUTPUTS CONTROLLED TO MEET ENVIRONMENTAL TARGETS EFFICIENTLY



- O HYDRAULIC POSITIONING
- > ANALOG CONTROL VALVES
- MAGNETIC SENSORS TO DETERMINE CYLINDER POSITION
- > VALVE POSITIONS CAREFULLY CONTROLLED TO REGULATE POSITION AND SPEED



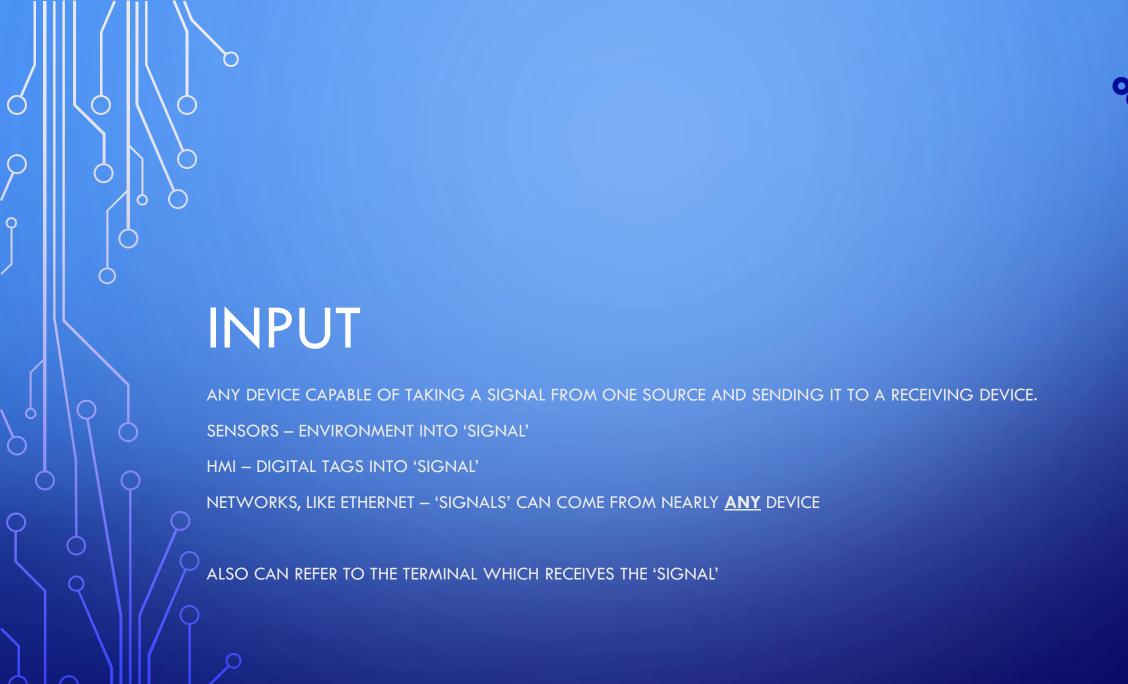
- LIQUID CAPACITY MONITORING
- ANALOG VALVES TO CONTROL FILLING / EMPTYING RATES, TEMP SENSORS
- LEVEL AND TEMPERATURE SENSORS
- > VALVE POSITIONS REGULATE FILL LEVEL, MIXING RATIOS (RECIPES) AND TEMPS



TERMS IN PROCESS CONTROL

CONTEXT IS KEY – SOME DEFINITIONS CHANGE BASED ON INDUSTRY AND APPLICATION.

INTERVIEW TECHS IN VARIOUS INDUSTRIES TO GAIN A BETTER UNDERSTANDING OF THE APPLICATIONS OF THESE CONCEPTS.





OUTPUT

ANY DEVICE WHICH RECEIVES A SIGNAL AND DOES SOMETHING WITH THE SIGNAL LOAD DEVICES – RELAYS, STARTERS, VISUAL AND AUDIBLE INDICATORS

HMI – GRAPHICS CAN BE PROGRAMMED TO SHOW STATUSES AND INFORMATION

OTHER PROCESSORS – ROBOT, MICROCONTROLLER...

ALSO CAN REFER TO THE SIGNAL WHICH IS BEING SENT OUT OF ANY DEVICE.





ANALOG

SIGNALS WHICH CAN TRANSITION FROM OFF TO ON

REQUIRED WHENEVER INFORMATION MUST BE MORE PRECISE THAN ON/OFF

EXAMPLES: DISTANCE, TEMPERATURE OR ORIENTATION INPUTS, VALVES AND HEATER OUTPUTS



DIGITAL

THE FORMAT OF DATA TRANSFER WHICH USES BITS (ON/OFF) TO SEND DATA

ANALOG SIGNALS CAN BE SENT AS DIGITAL STRINGS

DISCRETE SIGNALS CAN BE SENT AS DIGITAL BITS

AC AND DC STATUSES CAN BE SENT AS DIGITAL INFORMATION



ACTUATOR

TECHNICAL TERMS FOR SOMETHING THAT MOVES

OFTEN HYDRAULIC OR PNEUMATIC CYLINDER

LINEAR MOTORS

SOMETIMES TURNING DEVICES ARE CALLED 'ROTARY ACTUATORS'



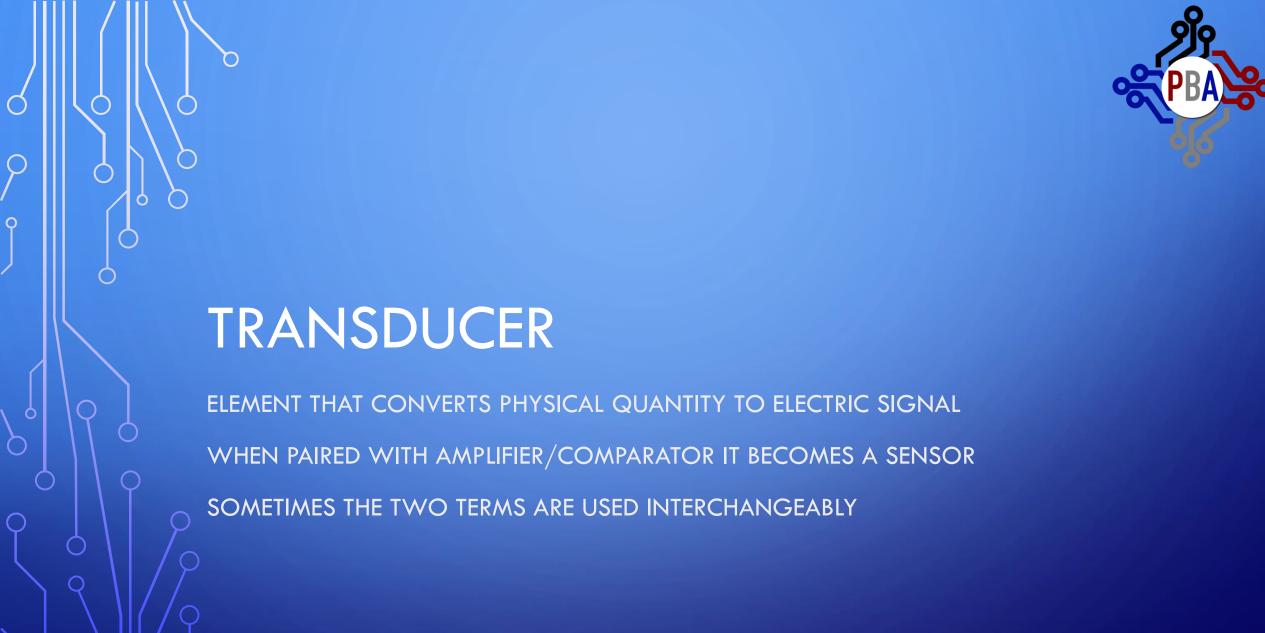
SOLENOID

A COIL WITH A PLUNGER

INDUCTIVE LOAD

MAINLY FOR HYDRAULIC AND PNEUMATIC CONTROL

USUALLY, THE PLUNGER IS THE 'SPOOL' CONTROLLING THE FLUID FLOW





FEEDBACK

ANY SIGNAL THAT REPORTS A 'PARAMETER' WHICH IS THE QUANTITY YOU WANT TO CONTROL

COMMONLY USED IN PID SYSTEMS

ROTATIONAL OR LINEAR POSITION, TEMPERATURE, HUMIDITY, LEVEL, ETC

-- ALSO, THIS INCLUDES FLIGHT INFO FOR UAVS



OPEN LOOP

CONTROL SIGNALS SENT OUT INTO A 'BLACK BOX' - NO FEEDBACK

CORRECTIONS ARE IMPOSSIBLE

IDEAL FOR SYSTEMS WHICH ARE ULTRA CONSISTENT, OR HAVE A WIDE DEGREE OF TOLERANCE, OR ARE VERY LOW RISK OF INJURY/DAMAGE

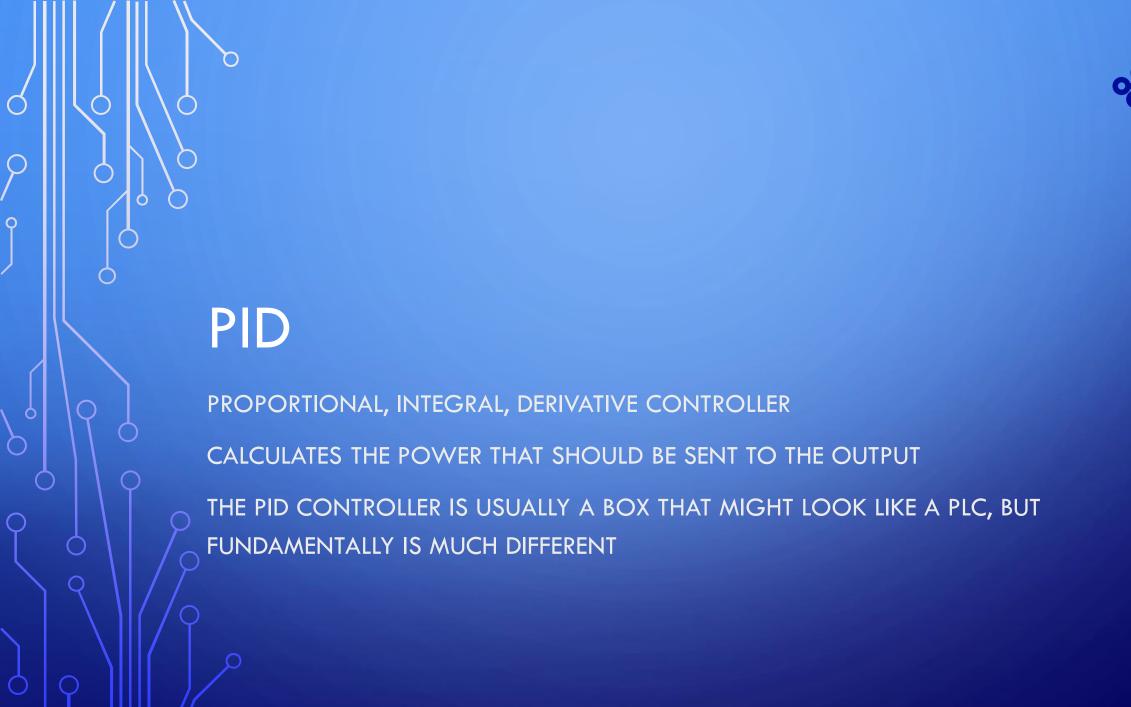


CLOSED LOOP

CURRENT SYSTEM POSITION (OR OTHER KEY VARIABLE) IS KNOWN CONSTANTLY

CURRENT VALUE IS COMPARED WITH TARGET VALUE AND USED TO CALCULATE AND OUTPUT

THE SYSTEM CAN BE MADE RELIABLE, ACCURATE, AND FAST!







PROCESS VARIABLE

IN A PID SYSTEM, YOU NEED PRECISION IN SOME ASPECT

THE PROCESS VARIABLE IS THE KEY INFORMATION TO BE TRACKED

IN MOTION: POSITION, VELOCITY AND ACCELERATION

OTHER SYSTEMS: TEMPERATURE, LIQUID LEVEL

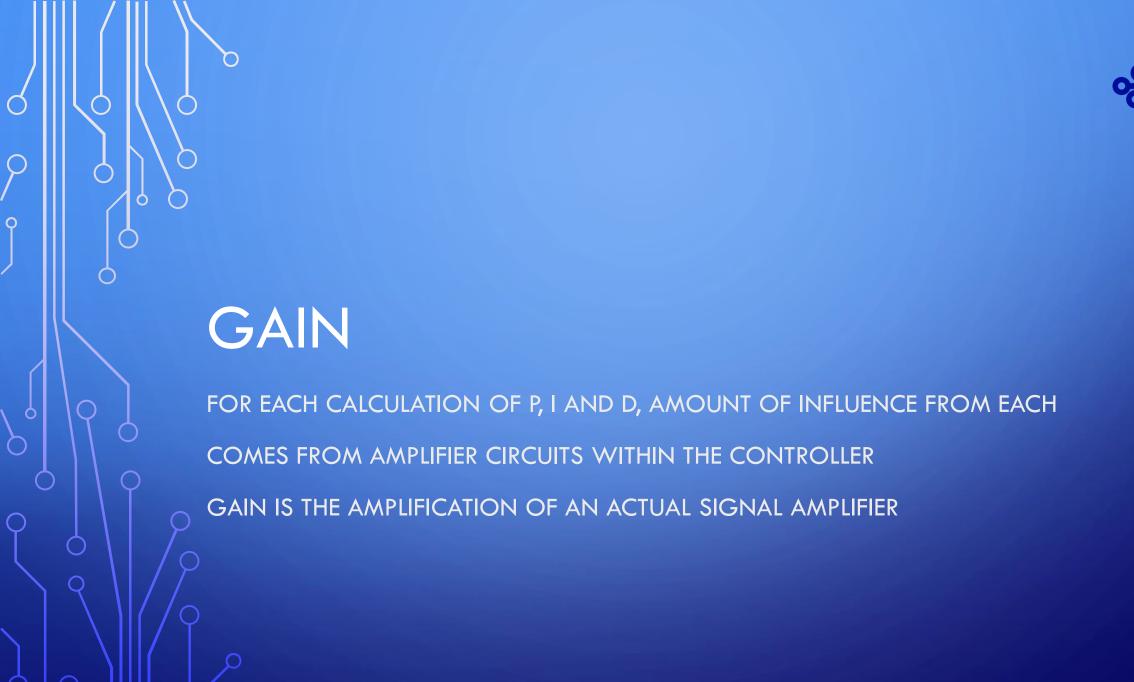


SET POINT

TARGET FOR YOUR PROCESS VARIABLE (SEE BEFORE)

MIGHT BE A SINGLE POINT - "WE NEED TO GET TO 100 DEGREES"

OFTEN IS AN ENTIRE MOTION PROFILE – "WE NEED TO GET TO THIS POSITION AT THIS VELOCITY, THEN MOVE TO A NEW POSITION AT A NEW VELOCITY..."





TUNE

THE PROCESS OF MANUALLY OR AUTOMATICALLY ADJUSTING GAIN LEVELS FOR THE OPTIMUM PROCESS SETTINGS

MODERN CONTROLLERS – TUNED AUTOMATICALLY

OLDER OR SIMPLER SYSTEMS, MANUALLY ADJUST POTENTIOMETERS IN THE AMPLIFIER CIRCUITS



MOTOR CONTROL VS MOTION CONTROL

MOTOR CONTROL INVOLVES THE CIRCUITS NECESSARY TO DRIVE A MOTOR – STARTERS, RELAYS, SERVO AND STEPPER DRIVES.

MOTION CONTROL IS A PID SYSTEM WHICH INCORPORATES FEEDBACK, PID CONTROL, THE MOTOR CONTROL AND THE MOTOR ITSELF

MOTION CONTROL CAN ALSO REFER TO HYDRAULIC MOTION - NO MOTORS!



CONTROL SYSTEM TRAINERS

SIMPLEST:

MORE COMPLEX:

STILL MORE COMPLEX:

MOST COMPLEX:

OPEN LOOP 'MOTOR CONTROL' TRAINERS

PROCESS CONTROL, LIKE HVAC OR MOTION CONTROL

PLC TRAINERS

"INDUSTRY 4.0" WITH NETWORKING AND AUTOMATION