Project 3.1.7 Machine Control Design (VEX)

Introduction

Every machine that is controlled by a computer bases every operation on data and instructions that were designed by an engineer, technician, or end user. Designers must think through every contingency and all that can go wrong. In addition safeguards must be in place so that people and equipment are not damaged.

Equipment

- PC with ROBOTC software
- POE VEX Kit

Procedure

Your instructor will assign specific problems as described below for you to solve. You will work in teams of two or three. The procedure detailed below must be repeated for each problem solved.

1. As a team read the problem and record the requirements, constraints, components, or programming that must be used in your engineering journal.
2. With your team, discuss and brainstorm possible solutions in your engineering journal.
3. Sketch two potential physical solutions and two potential program solutions. Be sure to include labels, descriptions, signatures, and dates on all sketches.
4. Create a final physical solution as a detailed sketch. Be sure to include labels, descriptions, signatures, and dates.
5. Create and test your design, making necessary modifications. Include descriptions throughout the program for clarification of the process.
6. Prepare the following for documentation:
    - Title, date, class, and team names
    - Image of the final solution
    - Two potential physical sketches
    - Two potential program sketches
    - Final physical sketch
    - Final program sketch
    - Final program with descriptions
    - Answers to the conclusion questions

Problem 1: Start / Finish Line
The Olympic committee would like your team to invent a control system for use with track and field running events. They want this device to automatically record the time and flash an LED for the first 3 runners that cross the start / finish line.

Problem 2: Automated Guided Vehicle
An assembly plant would like for your team to design an Automated Guided Vehicle, AGV, to drive on a marked path back and forth to deliver batches of parts. The vehicle must travel back and forth based on closed loop control. The AGV will not start until a button on the robot is pressed. When the same button is held at the end of a cycle, the robot will stop after completing a trip back and forth.

Problem 3: Cable Winding Mechanism
A telecommunications contractor needs your team to design a device that can accurately wind up a specific length of cable. The device must be able to wind a specific length consistently. The device must also be able to be started and stopped (emergency) by using a switch.

Problem 4: Elevator
A company would like to begin producing residential elevators. Your team must design the control system and a prototype of an elevator that can go between three floors in any combination. The prototype must include a set of three switches to represent each floor of the elevator. Each floor the elevator stops at must have a call button and a set of three lights to indicate where the elevator is currently located. A built-in safety mechanism requires that the elevator normally rest on the ground floor and return to the ground floor after a user-determined period of nonuse.

Problem 5: Surgical Robot Arm
A surgical supplier needs a robotic arm to move equipment within a sterile environment. Your team must design a remotely operated arm with 3 degrees of freedom: Base that pivots, arm that raises and lowers, and pinch mechanism to pick up items.

Problem 6: Chocolate Cookie Topper
A cookie factory needs your team to design a device that will put a chocolate drop on top of their peanut butter cookies. The machine must position a cookie on a separate device that will then move it into position for a dropper to descend and dispense the chocolate drop. The cookie with the chocolate drop should then move to another position where it will be placed with other finished cookies to await inspection and packaging.

Problem 7: Energy Saving Escalator: A mall is looking to save energy costs by installing new energy saving escalators. Design and construct an escalator that will begin when a person walks up, and stop when they exit. Keep in mind the program will need to adjust as more people get on. Ex. One person gets on, then another, then another. The escalator should stop only after all the people have gotten off.

Problem 8: Theme Park gates: You have all seen them, they are the gates that allow people to get on the ride from the line. This new ride will have 3 gates, which should all operate off of 1 motor and should open and close simultaneously. When the ride comes in, the gates should remain closed for 20 seconds to allow the other guest to get off the ride, It should then open for 30 seconds. There should also 2 override buttons that allows the operator to open and close the gates at will.

Problem 9: Moon vehicle
NASA has decided to send a vehicle to scour the surface of the moon. The goal of the vehicle is to study the terrain of the moon and collect samples to bring back. Your task is to design and prototype this vehicle. It will need to:

- Navigate rough terrain with 4 wheel drive (2 drive motors only to save weight)
- Be able to sense large objects in front of it and navigate around them
- Pick up samples and store them on the machine (samples will be a tennis ball, golf ball, or ping pong ball)
- Be able to be controlled wirelessly from a distance.
- Hint: you will need 2 program modes: 1 for autonomous driving and 1 for manual driving.

Problem 10: Vehicle Safety
Safety while driving is of utmost importance. Your company has tasked you with creating some safety features for their new electric vehicle. You are to prototype a functional design that will 1. Turn the vehicle headlights on when it starts to get dark (dash lights should also come on (simulate with LEDs), and 2. An automatic feature that will maintain a safe distance between itself and the vehicle in front of it. If it gets to close, the vehicle should slow down.

Problem11: Binary Safe
Too Many thieves these days know the art of cracking a safe with a standard lock. You are to design a new lock that has 4 buttons. One “set” button and three buttons “1”,”2”,”3” that will be used for the combination lock. The combination will be a 4 digit code utilizing the three buttons. A sample code would be 1111,1323, 2213, etc. The buttons must be pressed in that specific order to open the safe (motor should release the lock). When the lock is opened and the “set” button is pressed, a new code can be entered that will be stored and used to open the safe next time. Some sort of visual aid should tell the user if they have entered a wrong code.

Problem 12: Jeopardy

The Jeopardy game should be programmed to perform the following functions:

1. Alex has 2 buttons at the podium; a button that enables players to ring in once he has read the question or to ring in after someone misses the question(the green LED should light up to indicate the button has been pressed), and the other to reset each program.
2. Each contestant has their own signaling button. When they ring in, their red light flashes with the flashes getting faster as time to answer runs out. (10 seconds)
3. After a contestant rings in, they should not be able to ring in again if they miss the question.
4. If no one answers the question or if someone gets the question right, the reset button should be hit to reset the program.
5. Bonus points for having:1. the green light flash, acting as a timer for any contestant to ring in, and 2: If any player that is holding their button down when Alex enables a question would be locked out.

Problem 12: Traffic Light

The traffic lights should be programmed to perform the following functions:

1. The is a typical intersections of a busy street and a side street. The busy street lights should be programmed to go from green (min 5 sec), to yellow for 2 seconds, then to red - only when a car on the side street drives over a sensor.
2. On the side street, the green light should last for 4 seconds, yellow for 2 seconds and then red allowing cars on the main street to go again.
3. Add turn signal lanes to each street.

Problem 13: Sun Tracker

The light sensor should be programmed to perform the following functions:

1. The tracker should follow the sun(lamp) as it moves across the sky.
2. This system needs to stop seeking the sun when the light level drops to a point where the sensors can no longer function. This might happen when the sun sets at the end of the day, or when the clouds block the sun.
    a. Hint: you will need to compare 2 sensor values to see which way to turn.

Problem 14: Roomba vaccum

Design a robotic vaccum cleaner that will sweep the floors and clean up this room. The robot should work without human interaction and run wirelessly. It should be able to detect obstacles and navigate around them. It should be able to sweep up small vex parts (nuts and bolts) that are on the floor.

Problem 15: Design your own

Submit your idea for teacher approval

Conclusion Questions

1. What was the most difficult part of the problem?

2. List and describe two features that were not part of the design problem that could be added to improve your design.