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Transporter Crane

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Abstract: ***The objective of this project is to form a prototype by the students of the industrial maintenance career, of the Technological University of Tlaxcala. The crane is a machine or device whose function is mechanically lifting certain materials or loads. This structure is usually fixed to the ground by means of a mechanism that allows the translation of the entire structure. Generally, the crane moves on rails along the surface to cover a volumetric space, the proposed prototype is to help move an object more easily with the goal of horizing time and money.***

1. Introduction

This project consists of building a crane that is able to lift a kilogram of weight and for which we must design and build a prototype. The first cranes were invented in ancient Greece, driven by men or animals. The modern cranes generally use internal combustion engines or electric motors and hydraulic to provide much greater force. This project is elaborated in order to encourage the design of a crane.

2. Materials

This project aims to build a prototype of crane for educational applications in the career of industrial maintenance. This study is to analyze the main movements of the crane carried out is the elevation of the load and the distribution with the implementation of a robotic hand in the different axes. (X and Z)

Gear motor: For this project a reduction of direct current has been selected because it has great advantages in the use of heavy loads.

Servo Motor: For this project we used a servo motor which is a special type of engine that allows you to control the position of the shaft at a given point in time. The servo motor is designed to place it in the robotic hand and thus sustain some object.

Stepper motor: In this case we have used an engine to steps is a mechanical device used to change the speed of rotation of the robotic hand to move up and down

3. Developing

This project aims to build a prototype of a crane for educational applications in the industrial maintenance career. The study of the main movements of the crane car is carried out, that is: lifting of the load, translation of the car that is destined to raise and distribute the load with the application of a robotic hand on the different axes.(x, y, z). For this project a direct current reduction engine has been selected, since it has great advantages in the use of heavy loads.

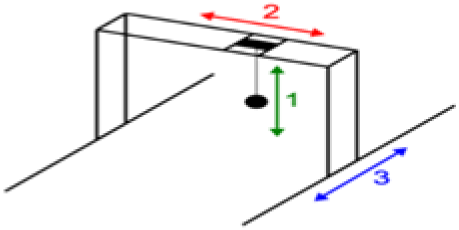

Figure 1: Movement of the crane in its three dimensions

4. Components

This section briefly describes the main components that constitute a conveyor crane.

4.1 Beam

Together with the supports, it forms the basic structural system of the crane. Its mission is to serve as a platform for the movement of the car group, as well as to support the efforts it receives from the robotic hand.

Figure 2: Movable beam

4.2 Supports

They are responsible for receiving the load transmitted by the beam and channeling it to the ground.

4.3 Car

The car serves as a support for the stepper motor. It has an electromechanical group that allows it to move along the beam.

4.4 Movable carriage of the crane

The car serves as a support for the stepper motor. It has an electromechanical group that allows it to move along the beam.

Figure 3: carriage of the crane

5. Translation mechanism

The most common way to transport the conveyor crane is through rails or wheels. Por lo tanto, los soportes soportan bogíes o bastidores equipados con ruedas que son movidas por grupos electromecánicos.

5.1 Lifting height

The lifting height is the vertical distance between the support plane of the device and the point of greatest elevation of the robotic hand. It has been established in 15 centimeters

5.2 Morphology

Due to the exigency in terms of light and load, the crane will have a two-rail configuration, that is, it will have two main beams on which the car will move.

6. Servo Motor Programming

We will use a Raspberry Pi (with its basic accessories such as keyboard and mouse, HDMI cable and USB power) with Python, a prototyping plate, an external power supply, a servo motor and a few cables. The external power supply will be used to power the engine. Although we can power a small device / sensor with the Pi, it is not advisable to use it to directly power the servos and motors in general, since they consume a lot of current and can make our system unstable (and even load some of the pins of our pi). Therefore, the only cable that we will connect from the Raspberry to the servo will be the cable that will carry the control signal.

6.1 Make connections

In the attached image, you can see the connections to the Raspberry Pi and the servo motor. We have connected pin 3 (GPIO2) of the Pi to the servo control signal, while we will use an external power supply to power the servo. In the image you can also see that we have used pin 9 (GND) and have connected it to the negative (GND) of our power supply. This last step is important, otherwise the servo will not interpret the signal we send correctly.

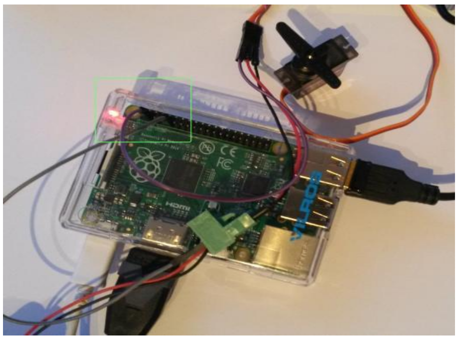

Figure 4: Make connections

6.2 Raspberry

It is a program that will listen to our code requests and execute them, so that we can control the pins using the library.

7. Gear motor Programming

There are 26 pins grouped into two rows of 13, and these as a whole are called the General Purpose Input / Output header or GPIO. They are a mixture of four power pins, five ground pins, and 17 data pins.

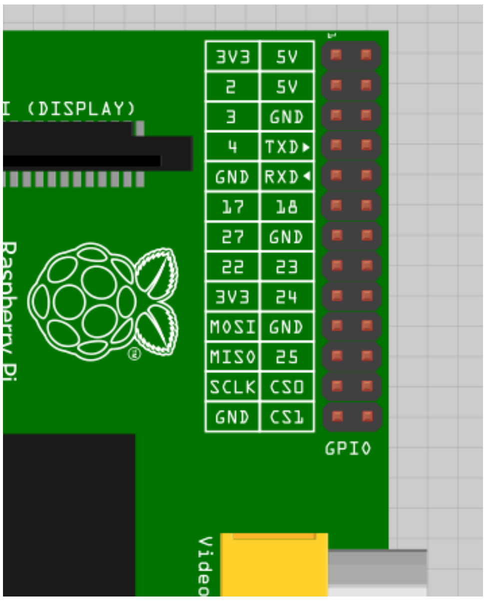

Figure 5: The arrangement of GPIOs with pin numbering. Pin 1 is the one in the upper left corner, labeled 3V3.

8. Assembling the Circuit

The first thing we need to do is connect the power and ground wires. As with most electronic projects, everything connected together will require a common ground. This is indicated with black wires.

Reading pin numbers in an Integrated Circuit (IC) is easily done by positioning the notch or point to the left, then, when starting to count from the bottom left, we get pin 1.

One of the great features of the L293D is that it can drive two engines independently and each engine can run at different speeds or directions. The use of this IC makes it possible to create a two-wheel robot, capable of turning, moving back and forth easily.

It is important to check all the wiring before connecting any power supply to our project. As the wiring can be a bit complicated, it is easy to forget about making a connection and sending 5V to the 3.3V of the Raspberry Pi.

The next job is to tell the Raspberry Pi that an engine, or two, has been connected. For this, I will use a language called Python. It comes installed in Raspberry, which is a bonus.

By using the L293D you can give it an address; An address is represented by the so-called pin A, and the opposite is pin B. To start the engine, we use a pin called Enable, labeled E in the test script - this is pin 22.

Finally, Raspberry Pi is informed that these are all outputs, which is done with GPIO.OUT.

Once the script is configured, in Raspberry Pi you are ready to start the engines. It will light some pins, wait two seconds, and then turn them off, which can be read in the rest of the script.

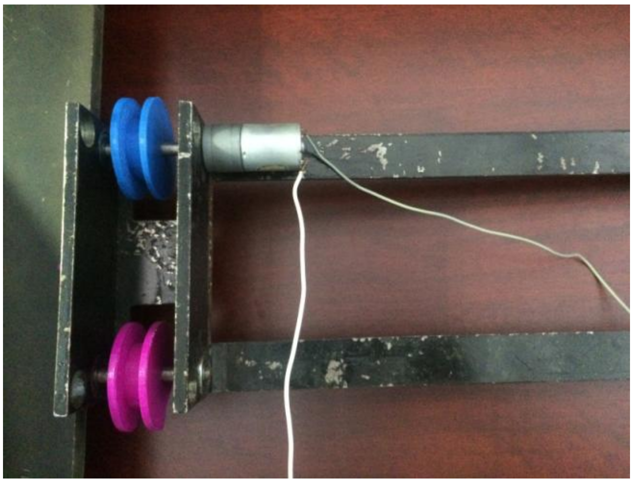

Figure 6: Gear motor Programming

9. Stepper Motor Programming

A stepper motor has four coins that have to be fed correctly to spin them on its axis. In other words, to rotate a stepper motor, you provide a sequence of high and low levels for each of the 4 entries in sequence. Setting the correct sequence at high and low levels, the engine will spin. The direction of rotation can be reversed.

We will use 4 GPIO ports as outputs to control the stepper motor.

The motor is connected to the controller board with its default connector. The controller has 4 + 2 pins that need to be connected to the RPi:

• Food:
(Pin 1) 5V
(Pin 2) GND

• Digital tickets:
IN1 -> GPIO12
IN2 -> GPIO16
IN3 -> GPIO20
IN4 -> GPIO21

We can recreate the code, simplifying it for use with the GPIO Zero library. Also, you can decide if you want "speed" or "force." This is a compromise that you can choose depending on the sequence (4 or 8 steps). We will create a "mode" variable so that we can test both sequences

Figure 7: Stepper motor

10. Conclusions

This project leaves us with a great experience and although it takes us a lot of class time it leaves us with extensive knowledge that we did not have before the project.

It is very important to build devices of this type to develop the intelligence and ability to solve problems since it teaches us to think too much and to look for different alternatives to solve a particular problem.

The systems are immersed in the project that despite being more related to electronics, there are always systems to create to control the device or program.

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Author Profile

Haynet Rivera Flores Graduated in Applied Linguistics graduated from the Autonomous University of Tlaxcala, she has a specialty in teaching and a master's degree in administrative engineering from the Apizaco Institute of Technology. He served as a language assistant in the United Kingdom for a period of one year. Trainer of the method for teaching English Rassias. Author of articles presented at national, international conferences and published in indexed journals. She currently works at the Technological University of Tlaxcala, as a research professor and teacher of the English language.

Oscar Arturo Torres Valderrabano Industrial maintenance technician graduated from the Technological University of Tlaxcala through the articulation of knowledge of various fields, performs activities aimed at industry, production and services, in the maintenance and repair of different equipment, machines and facilities.