DOCUMENTATION

SPIDER_TASK2_EE

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Components List:

SR.NO	COMPONENT(s)	DESCRIPTION
1.	ADC128S102	A 12 bit A/D convertor which converts the analog signals to digital output.
2.	L293D Motor Driver	A dual H Bridge Motor Driver used for controlling the speed and direction of the dual motors attached.
3.	555 Timer IC	A timer circuit used for PWM generation for controlling the motor speed.
4.	D type Positive Cycle triggered Flip Flops	Used as shift registers to produce a parallel output from a serial digital input (SIPO).
5.	AND, OR, NOT Gates	Logic gates designed to output a logical output depending upon the input supplied.
6.	Pulse Generators	Used to produce a pulsed output in a periodic fashion to simulate the IR sensors.
7.	Diodes, Capacitors, Resistors, DC supply source, Potentiometer	Used for general purposes such as for controlling the current , bypassing the excess charge to the ground and to provide power to the different devices for them to work properly.

Steps Followed for the circuit construction:

Step 1: All circuit components were added using the proteus component list.

Step 2: All the components were connected suitably with the sole purpose of controlling the motor speed, rotation angle and the direction of rotation. The task was accomplished using digital circuits and a 555 timer IC which was used as a PWM generator to control the motor speed.

Step 3: All the technical parameters of the circuit including the specifications of the ADC, rating of the motor, power source, threshold voltage etc. were kept in mind during the circuit construction and the datasheet was referred too (for the ADC).

Step 4: The final output of the circuit is demonstrated by controlling the motor speed and direction using different logic inputs and PWM signal which is then fed to the 'input pins' and the 'enable pins' respectively of the motor driver with the help of the ADC that converts the analog signals to digital output.

Working of the Circuit:

The main component of the circuit is the ADC128S102 which is a 12 bit analog to digital convertor. It has got 16 metallic pins designed to perform different functions. To begin with, the pins IN0 and IN7 are connected with the IR sensors (pulse generators) and all the other six input pins are grounded. The CS bar pin is always kept low using a latched gate so as to keep the ADC active and the keep the conversion process on. The following SCLK pin is used to sample the analog input periodically by supplying the pin with a clock signal produced by the clock signal generator of the designated frequency which is 16MHz in this case. The Digital IN pin (D IN) is supplied with the 3.3 volts pulsed input with a duty cycle of 54.8% which is 1.8 volts which sets the threshold value of the circuit and thus makes the robot aware about the white region approaching. The V_D and the V_A pins are the power delivering pins of the ADC board which is thus supplied with a 3.3 volts DC supply which acts as a reference voltage level. The V_{GND} and the D_{GND} pins are grounded. The D_{OUT} pin is used to obtain the serial digital 12bit output corresponding to the analog signal fed by the IR sensors (Pulse generators in this case).

The L293D motor driver is used to control the dual motors attached to the output pins of the driver using the various input values fed to the IN1, IN2, IN3 AND IN4 pins. The enable pins of the driver marked as EN1 and EN2 are used to control the speed of the motor. Also the driver only works when this pin is set to a logical high value. These pins are supplied with the PWM signal output of the 555 timer IC circuit so as to control the motor speed by varying the duty cycle of the PWM signal using a potentiometer. The digital display attached to the motor helps us to keep a track of the direction of motor rotation.

The D_{OUT} pin of the ADC produces a serial digital output which then needs to be converted to the parallel bit output that is achieved using a 12bit shift register composed of D Type Positive Triggered Flip Flops. The D type flip flop is then operated using a clock signal using a clock signal generator. The flip flops become active during the rising edge of the clock pulse and becomes inactive during the falling edge of the signal.

12 such flip flops are connected together and the 12 bits are obtained together in a parallel fashion. The parallel digital output. However, the digital output obtained can't be directly fed into the input pins of the motor driver. We thus pass the 12bits of the output to a 12:1 multiplexer(MUX) which is constructed using six 2:1 MUX each having two input pins and one select pin to convert the digital output into control signals which would further help in controlling the motors' direction. Four such 12:1 MUXs are used in order to get four output bits. A multiplexer selects one among the many inputs fed to it based on the logical state of the select pin. The logical input fed to the motor driver is then used for controlling the motor direction. It's a two-way H bridged motor driver and the truth table for the same is listed below:

Input 1	Input 2	Output
0	0	0(off)
0	1	1(on): Say motor rotates anticlockwise.
1	0	1(on): Motor rotates in a clock wise manner in this case.
1	1	0(Off)

The above truth table is for a single motor. The same applies for the other motor as well.

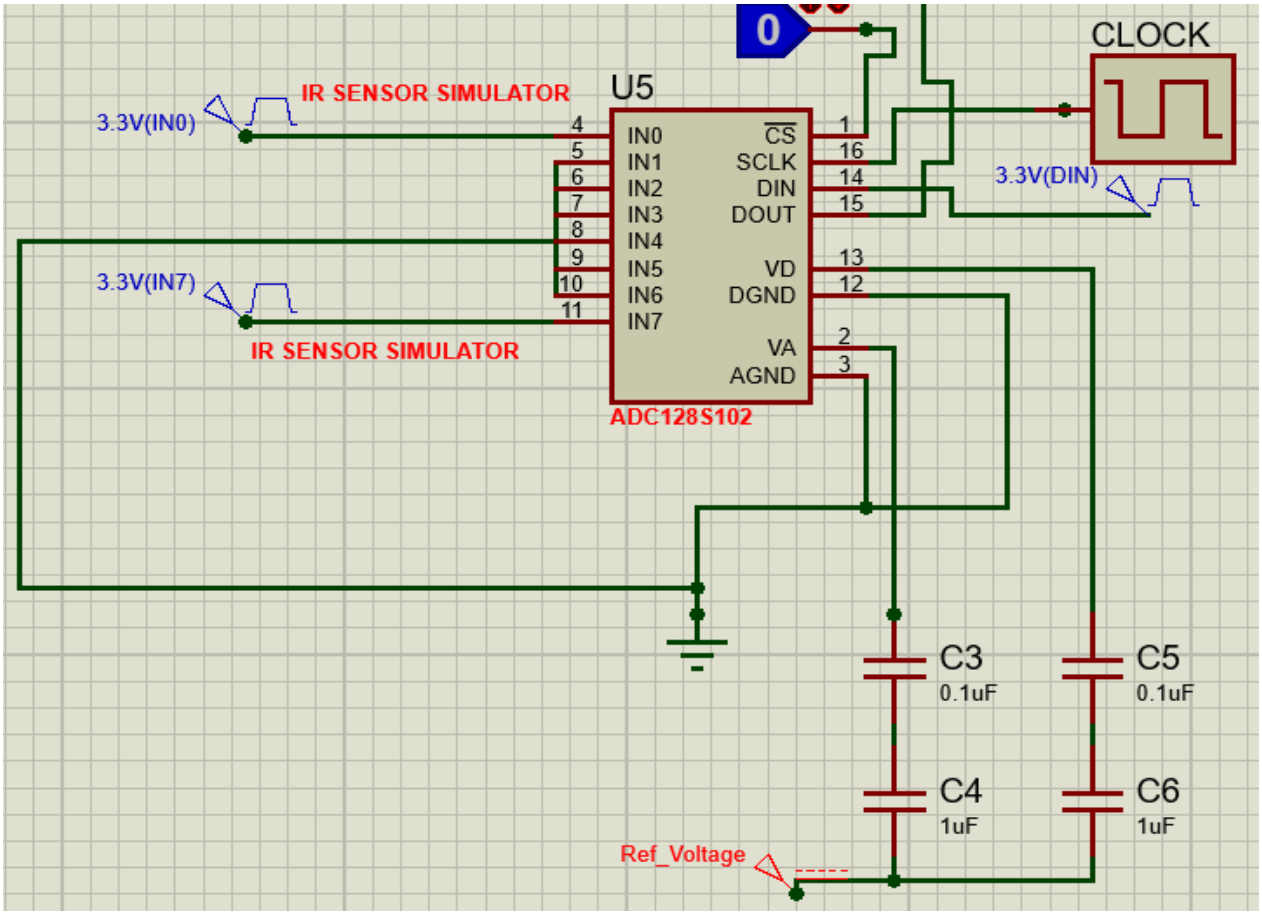
Thus the motor rotates accordingly to the logic state fed into the input with the speed of it being controlled by the PWM signal.

Circuit- Diagram

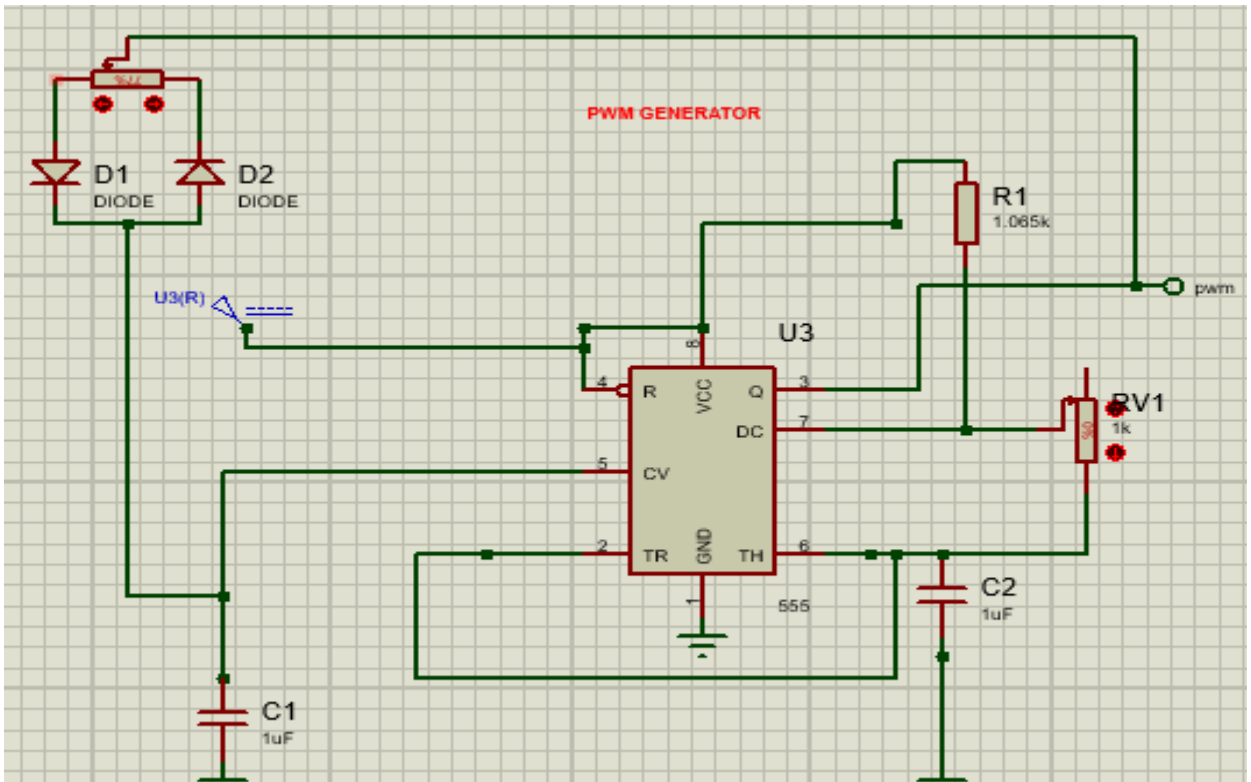
The circuit is divided into several parts to prevent the entire setup from looking messy.

1. ADC circuit
2. PWM circuit
3. Motor driver circuit
4. Flip Flop SIPO shift register circuit
5. Multiplexers Circuit (12:1)

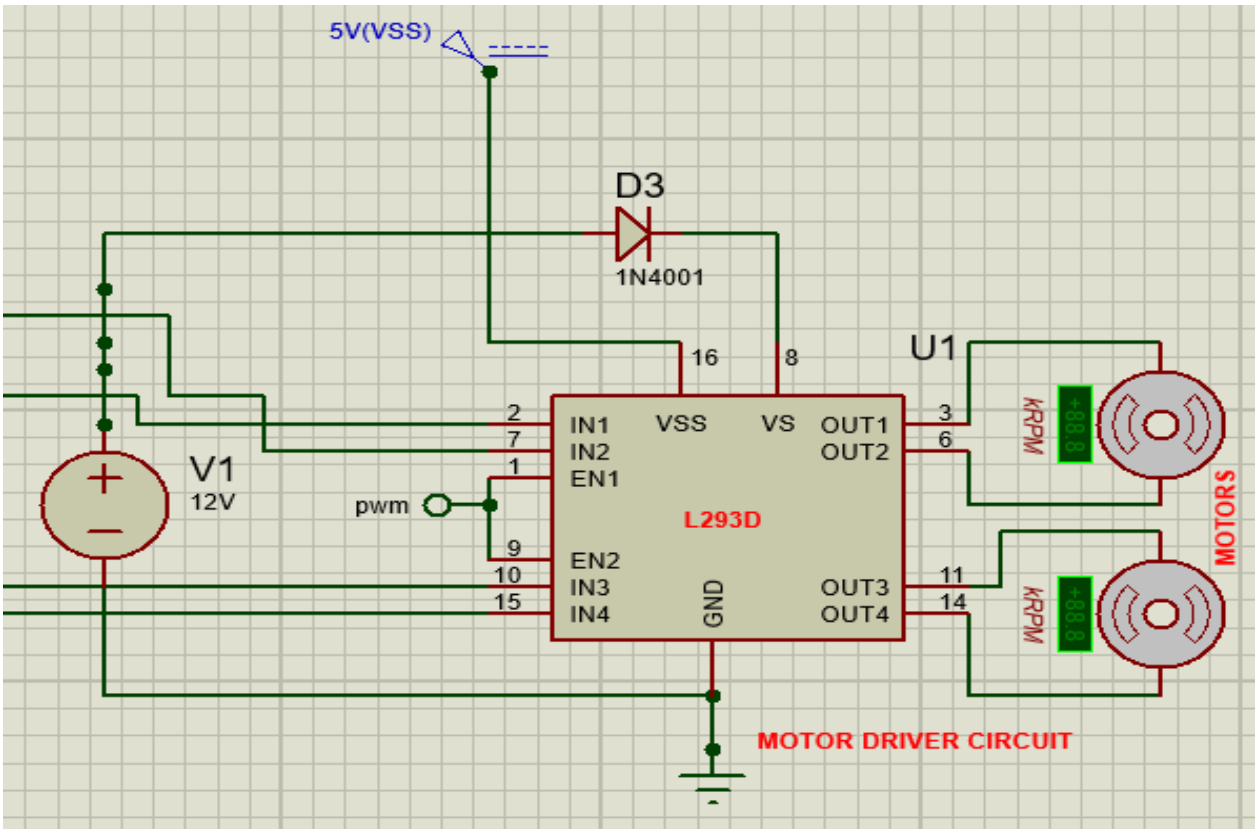
1. ADC circuit



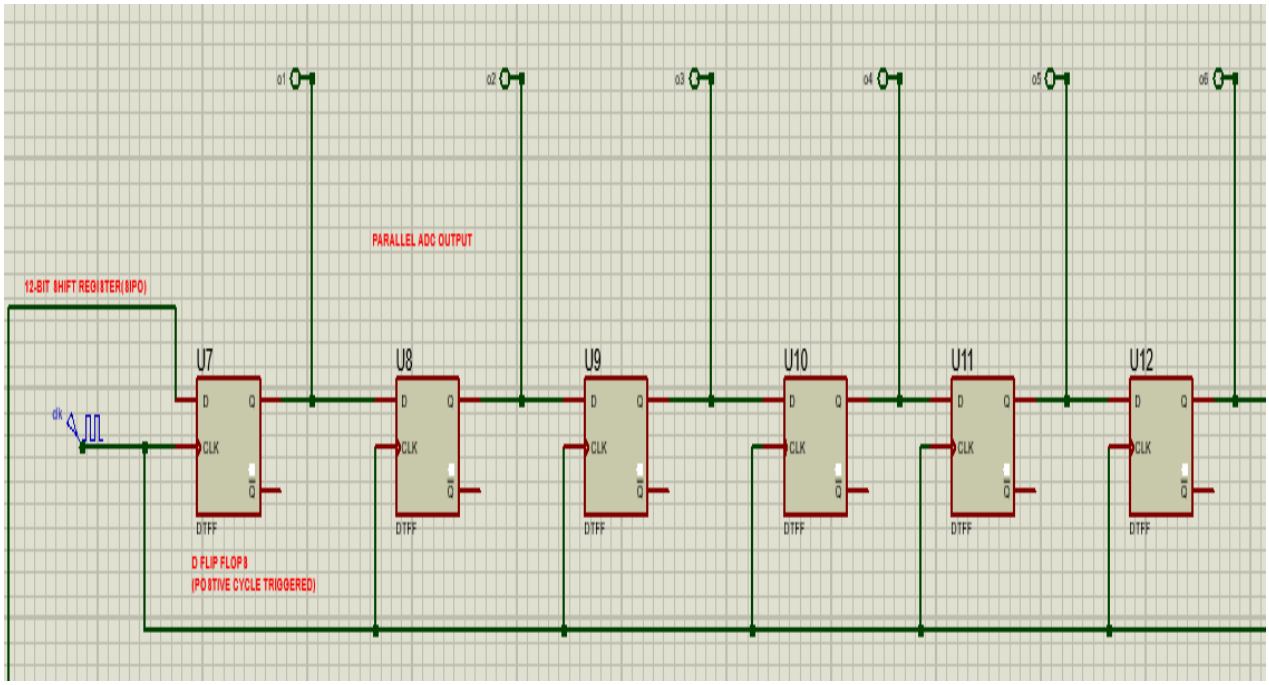
2. PWM Circuit



3. Motor Driver Circuit

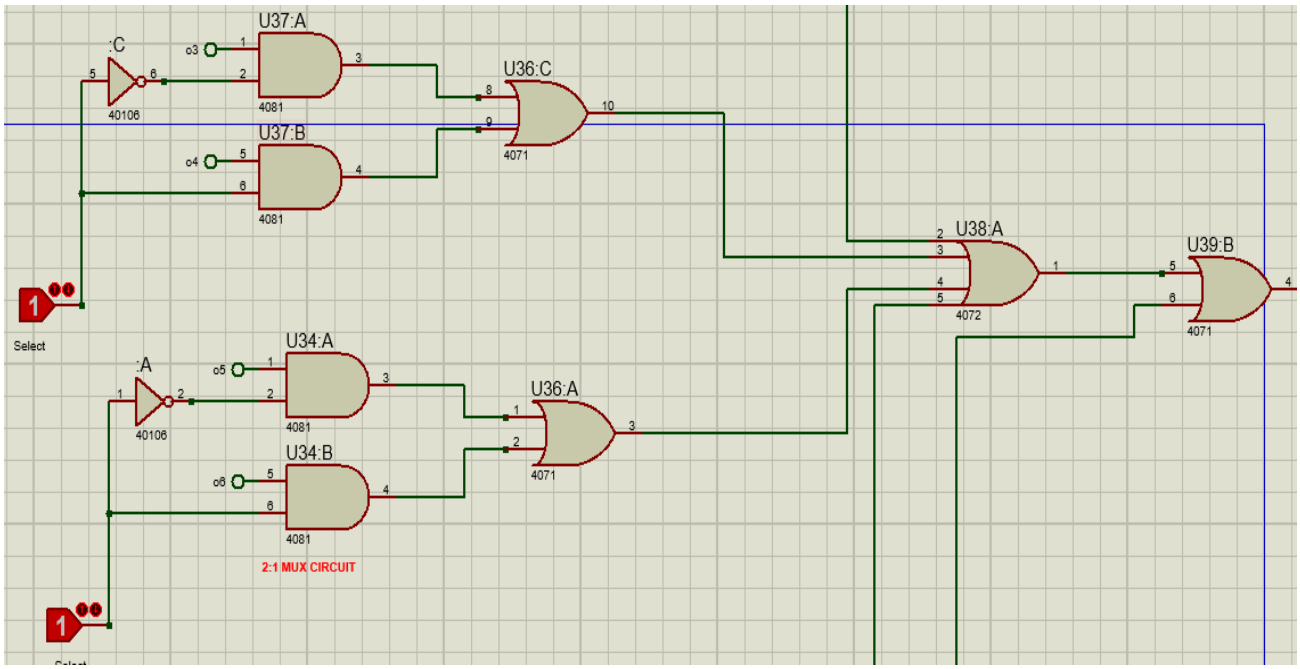


4. Flip Flop SIPO Shift Register Circuit



Note: Only 6 flip flops out of 16 have been shown due to space and visibility constraints.

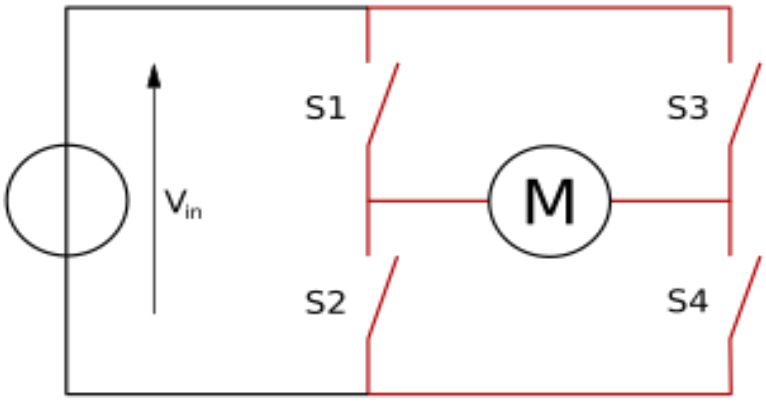
5. Multiplexer Circuit



These Multiplexer circuit units have been repeated so that 12 input channels can be created.

L293D MOTOR DRIVER:

What is a 2-way H Bridge Motor Driver?



The above schematic diagram shows a typical dual way H bridge driver circuit.

In the above figure S1, S2, S3 and S4 shows the four switches which are basically four pnp/npn transistors, and M denotes the motor connected to it.

Now consider if S1 and S2 are closed while the other two switches are open, the motor will not work. The same goes when the switches S3 and S4 are closed simultaneously; the motor doesn't work.

Now consider a situation when the switches S1 and S4 are on while the switches S2 and S3 are open. The motor is now supplied with a voltage V_{in}**,** which makes the motor rotate in a particular direction, say clockwise. In the other case, let us assume switches S3 and S2 are closed while the other two switches are open. In this case too, the motor is supplied with an input voltage of V_{in}**,** but this time with reversed polarity, which makes the motor rotate in the opposite direction, which is anticlockwise.

Thus when logical 0 or logical 1 is supplied to both the inputs, the motor doesn't rotate while when it is supplied with logical 1 at input 1 and logical 0 at input 2 it rotates clockwise while it rotates anticlockwise when the logical 0 is given to input 1 and logical 1 is given to input 2.

The corresponding truth table is tabulated in the above pages.