



# Runlinc Beginners Project 6: Washing Machine (E32W Version)

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## Introduction

### Problem

Many machines need to perform steps in a specific order to complete their tasks. We want to investigate this by making a washing machine.

### Background

Before the invention of the washing machine, it was necessary to wash all our clothes by hand. Now we can just put the clothes and some washing detergent in, walk away and do other things while the machine does the job for us. However, the machine must do the right steps in the right order. It would be no good if the machine tried to spin the clothes dry first, then added the water! Many other devices around the home need to perform tasks in the right order, such as microwaves, dishwashers, and bread makers. Machines that perform a step-by-step process are also used in industry, such as in bottling plants and car factories. Can you think of any other machines that need to have a step-by-step process?

### Ideas

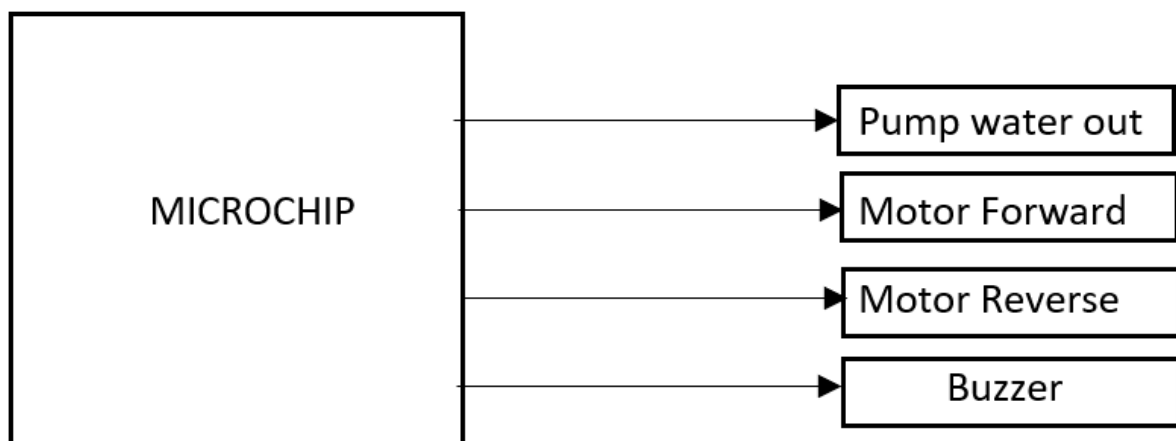
What are the steps we need that our washing machine should perform? How can we show each of these processes by using our kits?

## Plan

The user will need to put the dirty clothes and detergent in, so the first thing we want our washing machine to do is to fill the tub with water, then wash the clothes by spinning the tub back and forth. Once the clothes are washed, the washing machine should pump out the dirty water. We may then want to add a rinse cycle or a spin cycle to our washing machine.

This project uses the E32W controller board, a 4-pin RGB LED, and an electric motor. The washing machine controller will start a wash cycle by pumping water into the washing machine, indicated by the green LED. The motor will then turn in one direction and pause, turn in the opposite direction, pause and repeat five times to “wash” the clothes. After that, the water will be pumped out indicated by the red LED.

### OUTPUTS



**Figure 1:** Block diagram of Microchip outputs

## runlinc Background

runlinc is a web page inside a Wi-Fi chip. The programming is done inside the browsers compare to programming inside a chip. The runlinc web page inside the Wi-Fi chip will command the microchips to do sensing, control, data logging Internet of Things (IoT). It can predict and command.

## Part A: Design the Circuit on runlinc

**Note:** Refer to runlinc Wi-Fi Setup Guide document to connect to runlinc

Use the left side of the runlinc web page to construct an input/output (I/O).

For port D12 name it MotorForward and set it as DIGITAL\_OUT.

For port D13 name it MotorReverse and set it as DIGITAL\_OUT.

For port D14 name it EnableDrivers and set it as DIGITAL\_OUT.

For port D15 name it Buzzer and set it as DIGITAL\_OUT.

For port D19 name it GreenLED and set it as DIGITAL\_OUT.

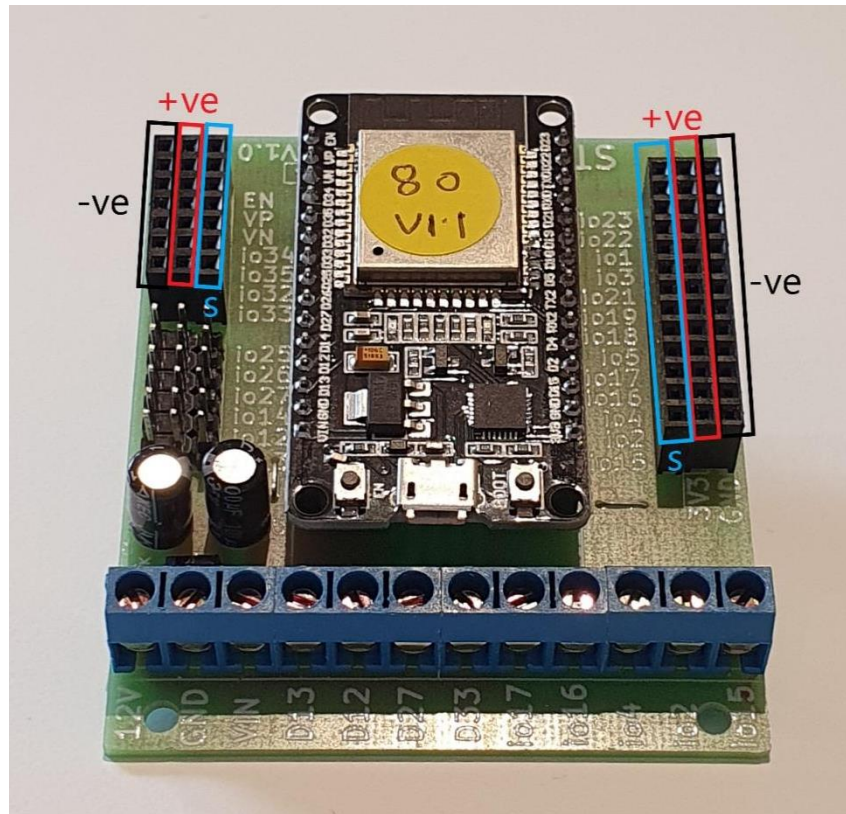
For port D21 name it PumpWaterOut and set it as DIGITAL\_OUT.

D5	DISABLED		
D12	DIGITAL_OUT	MotorForward	OFF
D13	DIGITAL_OUT	MotorReverse	OFF
D14	DIGITAL_OUT	EnableDrivers	OFF
D15	DIGITAL_OUT	Buzzer	OFF
RX2	DISABLED		
TX2	DISABLED		
D18	DIGITAL_OUT	GreenLED	OFF
D19	DIGITAL_OUT	PumpWaterOut	OFF
D21	DISABLED		

**Figure 2:** I/O configurations connections

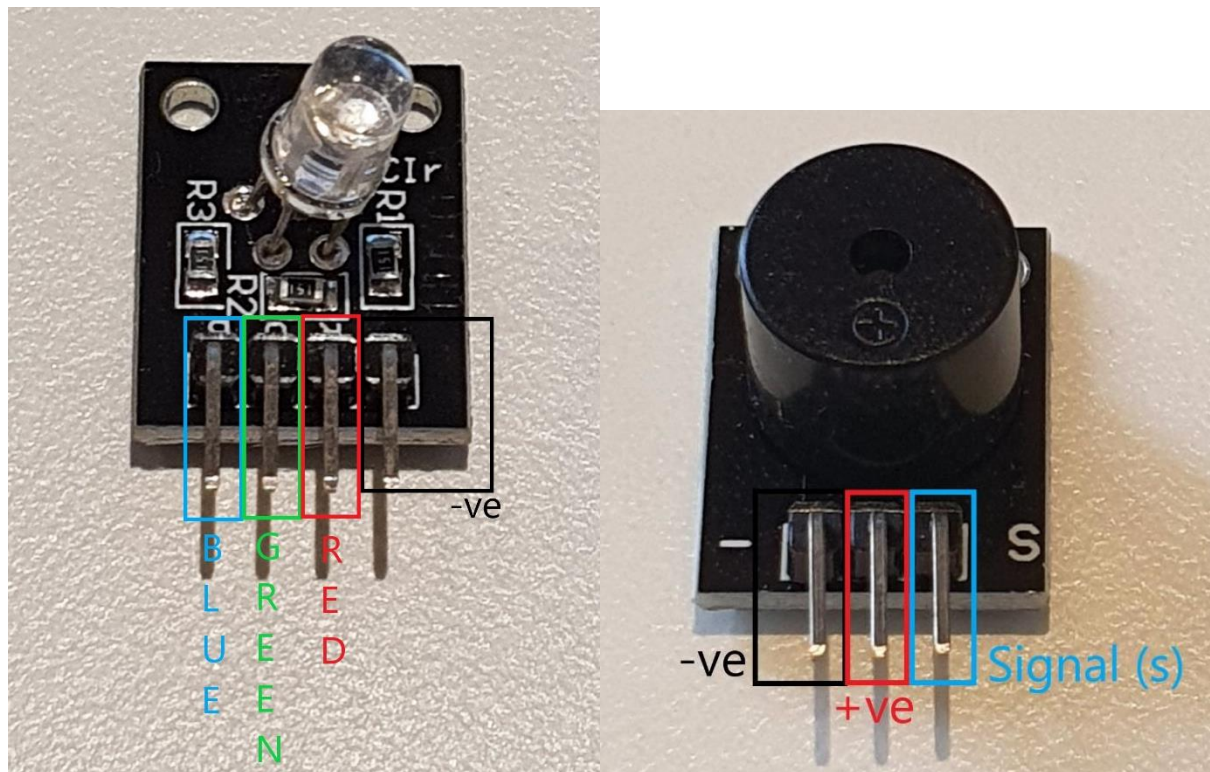
## Part B: Build the Circuit

Use the STEMSEL E32 board to connect the hardware. For this project we are using both the left and right I/O ports, with **negative port (-ve)** on the outer side, **positive port (+ve)** on the middle and **signal port (s)** on the inner side (as shown below).

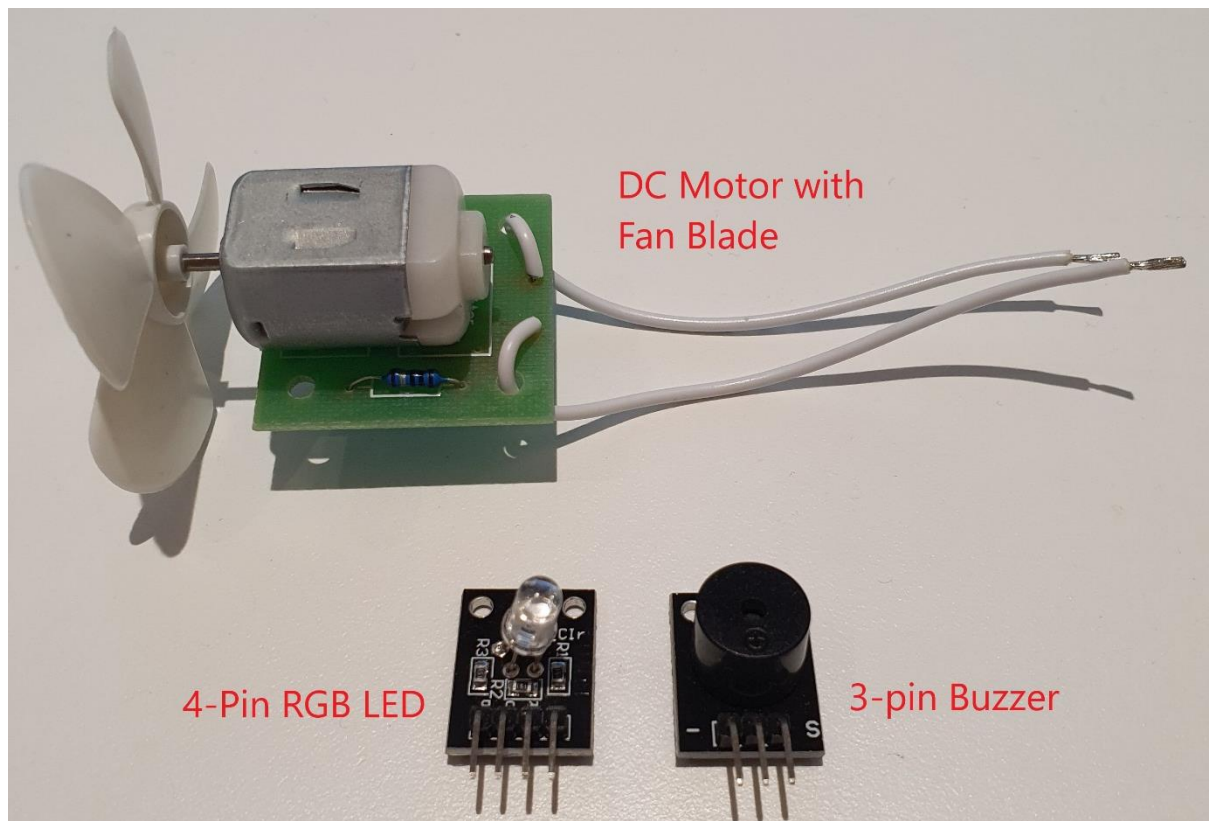


**Figure 3:** Negative, Positive and Signal port on the E32W board

There two I/O parts and one screw pin part we are using for this project, a 4-pin RGB LED, a 3-pin buzzer, and a DC motor with fan blade attached. Their respective pins are shown in the figure below.



**Figure 4:** 4-pin RGB LED (left) and 3-pin Buzzer (right) with their respective pins indicated



**Figure 5:** All 3 I/O parts labeled

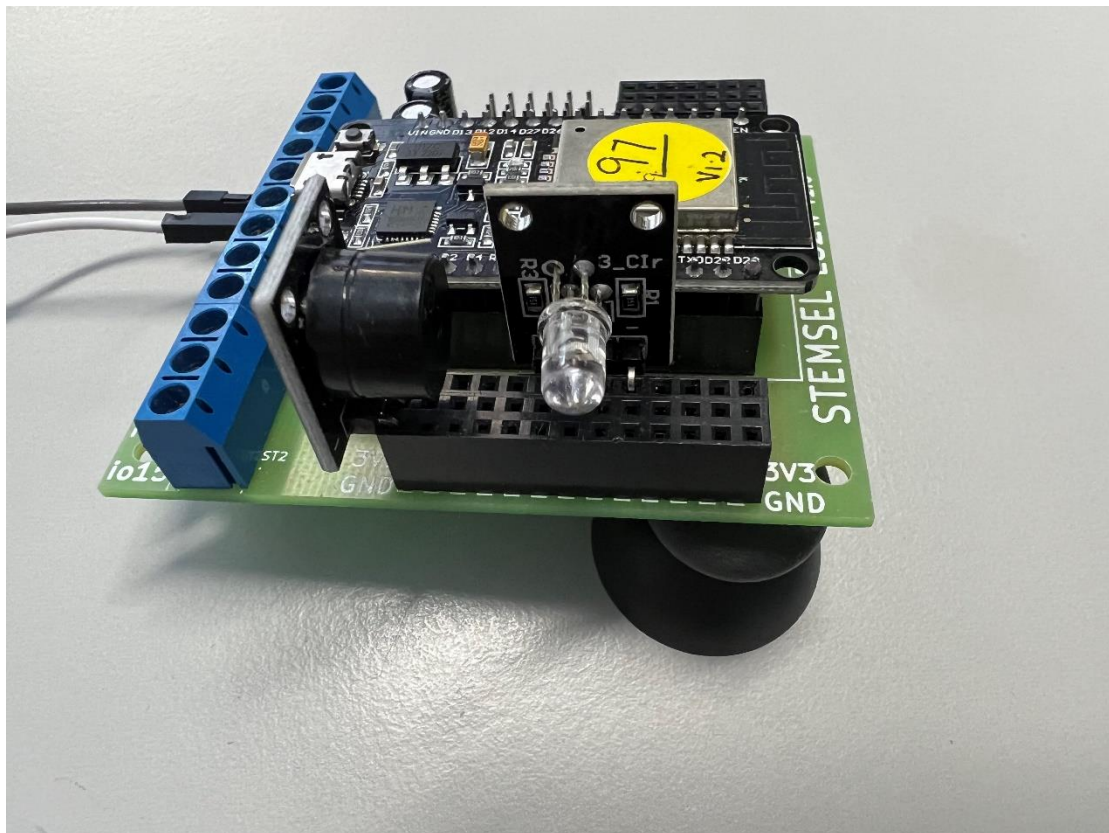
## Wiring instructions



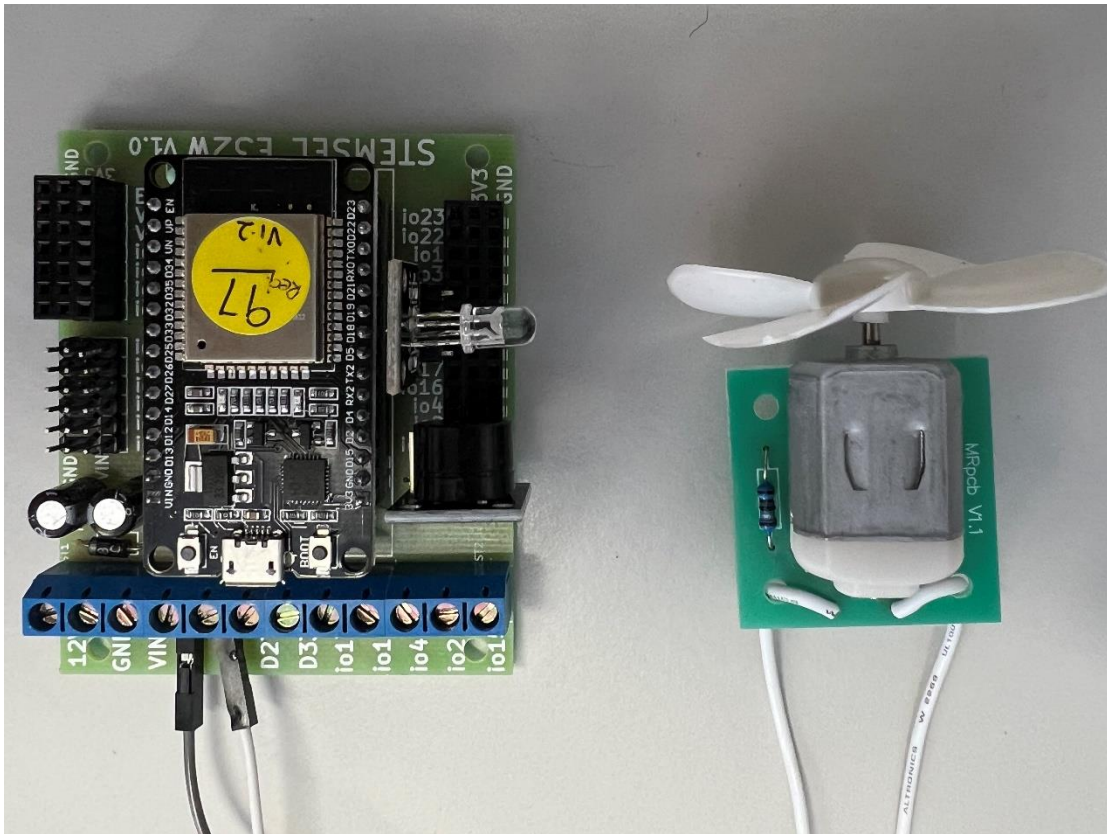
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Similar to Project B5, we only have 3-pins port slots, we need to plug in all 4 pins on the RGB LED into the signal ports.

- Plug in the negative pin on the 4-pins RGB LED into port io21, the rest should be in horizontal order and plug into port io19, io18, io5. Please refer to **Figure 6** for more detail.
- Plug in the 3-pin buzzer to io15 on the E32W board.
- Unscrew D12 and D13 pins, then connect each white wire on the DC motor to D12 and D13 ports. Don't forget to tighten the screws.



**Figure 6:** Circuit board connection with I/O parts (side view)



**Figure 7:** Circuit board connection with I/O parts (top view)

We previously named D14 to EnableDrivers but there isn't any I/O part to connect, this is due to D14 on runlinc page is used to enable the driver output (D12, D13 screw terminals). The screw terminals are set as 'disabled' as the driver chip uses quite a bit of power, even if it's not driving anything, therefore turning it off to save power (especially useful with the power source is batteries).

We need to enable D14 using the turnOn Macro, we will program this feature in Part C in the JavaScript box. If somehow your E32W board works without turning on D14, please also include this line of code.

## Part C: Program the Circuit

Use the blocks on the right side of the runlinc webpage to program the functions of the washing machine. Use the HTML to add content, CSS to add style to your taste and JavaScript to program the microchip.

In this case, JavaScript and JavaScript Loop are needed to program the microchip to act like a Washing Machine. Type the following code.

The lines beginning with a double slash are comments and are not read by the microchip, they're just there to remind yourself of what the code does.

### JavaScript:

```
turnOn(EnableDrivers);  
washingcyclerepeat = 5;
```

### JavaScript Loop:

```
//WASH  
for (Cycle = 0; Cycle < 2; Cycle++ )  
{  
  //FILL WATER  
  turnOn( GreenLED );  
  await mSec( 5000 );  
  turnOff( GreenLED );  
  //WASH  
  for (Count = 0; Count < washingcyclerepeat; Count++ )  
  {  
    turnOn( MotorForward );  
    await mSec( 1000 );  
    turnOff( MotorForward );  
    await mSec( 1000 );  
    turnOn( MotorReverse );  
    await mSec( 1000 );  
    turnOff( MotorReverse );  
    await mSec( 1000 );  
  }  
  //PUMP WATER OUT  
  turnOn( PumpWaterOut );  
  await mSec( 5000 );  
  turnOff( PumpWaterOut );  
}  
turnOn( Buzzer );  
await mSec( 2000 );  
turnOff( Buzzer );  
break;
```



## runlinc Beginners Project 6: Washing Machine (E32W Version)

D5	DISABLED		
D12	DIGITAL_OUT	MotorForward	OFF
D13	DIGITAL_OUT	MotorReverse	OFF
D14	DIGITAL_OUT	EnableDrivers	OFF
D15	DIGITAL_OUT	Buzzer	OFF
RX2	DISABLED		
TX2	DISABLED		
D18	DIGITAL_OUT	GreenLED	OFF
D19	DIGITAL_OUT	PumpWaterOut	OFF
D21	DISABLED		
D22	DISABLED		
D23	DISABLED		
D25	DISABLED		
D26	DISABLED		
D27	DISABLED		
D32	DISABLED		
D33	DISABLED		

**JavaScript**
Select Macro
select a device
Add Macro

```

turnOn(EnableDrivers);
washingcyclerepeat = 5;

```

**JavaScript Loop**
Select Macro
select a device
Add Macro

```

//WASH
for (Cycle = 0; Cycle < 2; Cycle++ )
{
//FILL WATER
turnOn( GreenLED );
await mSec( 5000 );
turnOff( GreenLED );
//WASH
for (Count = 0; Count < washingcyclerepeat; Count++ )
{
turnOn( MotorForward );
await mSec( 1000 );
turnOff( MotorForward );
await mSec( 1000 );
turnOn( MotorReverse );
await mSec( 1000 );
turnOff( MotorReverse );
await mSec( 1000 );
}
//PUMP WATER OUT
turnOn( PumpWaterOut );
await mSec( 5000 );
turnOff( PumpWaterOut );
}
turnOn( Buzzer );
await mSec( 2000 );
turnOff( Buzzer );
break;

```

**Figure 8:** runlinc webpage screenshot (JavaScript and JavaScript Loop)

**Note:** Make sure the fan blades are not touching anything, otherwise you won't see it turning. You can use your hand to hold it up (be careful not to let your fingers touch the fan blades).

## Summary

Washing machines save a lot of time around the house, but they must perform the correct tasks at the correct time. This is also important in the manufacturing industry since a similar step-by-step process is often used. By using runlinc and coding the program on it, it is easy to see these tasks so that we know our washing machine is working correctly.