

James Dyson Foundation Undergraduate Bursary

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Outreach Report: Shift Register Circuit

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1 Introduction

Electronics is all around us, and correct timing of the circuit is of utmost importance when designing a PCB circuit. Therefore, the purpose of this outreach activity was to introduce the students to shift-registers and help them understand how basic circuits work. The desired outcomes of the activity were the following:

- Describe what a shift register is using a school bus analogy
- Show how a breadboard works
- Ask them to build a shift register step by step
- State some uses of shift registers

The activity was designed to achieve the aims described above. The next section will outline the chronology of the activity.

2 Outline of activity

This section will describe an outline of the activity. PowerPoint slides were used to provide a framework for the session.

2.1 What is a shift register?

To begin with the students were asked what a shift register is and whether they had seen it before. Then a simple example of a shift register was shown using a bus analogy (see Figure 1). Everyone found it easy to comprehend this analogy and able to explain what happens next.

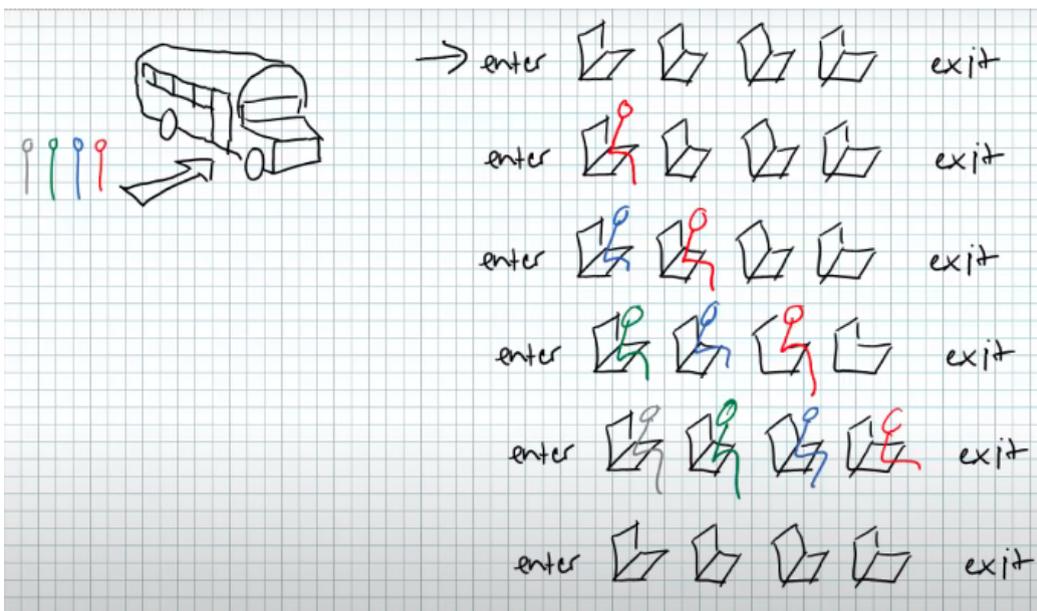


Figure 1: Bus analogy of a shift-register

2.2 Flip-flop

The students were then asked if they knew about logic gates and flip-flop. Although most of them knew what logic gates were, they hadn't heard of flip-flops. I then briefly showed a diagram of D-type flip-flop, explained how it works and how they are used in real-life.

2.3 How to use breadboard?

Learning how to use a breadboard is a very important skill that all engineers should know. It helps for fast prototyping of a circuit diagram. The students were shown a diagram of how a breadboard works. Then they were asked to get into pairs to create a simple circuit to turn on an LED in a series circuit.

2.4 Create a shift-register circuit

Figure 2 shows the circuit of the shift-register. The students are then asked to create the circuit step-by-step aided by the a series of images in the powerpoint slide.

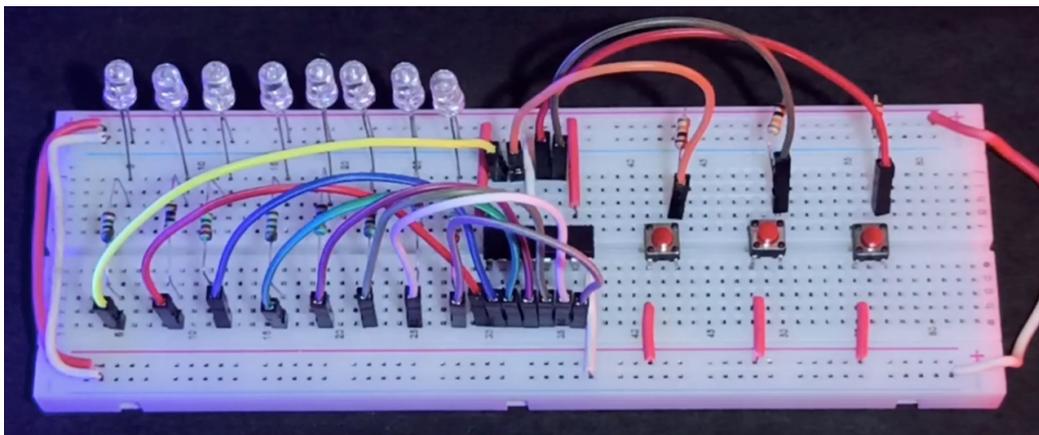


Figure 2: Shift-register breadboard

I waited for a few minutes and ensured that everyone had finished each step before moving on to the next slide. I also managed to go around and help out the groups if any of the instructions were unclear to them when building the circuit.

2.5 Testing the circuit

The students were then asked to test the circuit by connecting the battery. They were asked to do the following and observe what happens to the LEDs:

- Hold DATA and press CLOCK button
- Hold DATA and press LATCH button

To turn off the LED (shifts 1 bit):

- Press CLOCK button
- Press LATCH button

I related this concept back to the D-type flip-flop and how delays/timings are important in electronics.

3 Conclusion

Although the activity was not directly related to the master project due to safety concerns associated with high voltages, the outreach activity proposed in this report was a success. Almost all pairs had a working circuit and were very excited to see the LEDs light up. The 2 pairs who had not managed to get it working had faulty breadboards and were asked to join another group. Despite the time pressure, all the groups got some sort of circuit built, which will have been rewarding. They appreciated the difficulty in electronics engineering comes as much from figuring out how to actually construct the circuit as it does from having a tidy and organised circuit, and will hopefully have taken away an understanding of how the shift-registers can be used as delays in the circuit. I myself had fun delivering the presentation and watching students having a hands-on approach in electronics engineering.