Offline and Online Practices for Assembly Language Programming With 8085 Microprocessor

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Abstract: The COVID-19 pandemic has meant that distance teaching and learning at educational institutions since 2020 has become common place. The Ministry of Education in Bhutan has taken the initiative to educate students using learning television and Internet-based online education instead of traditional classes. Thus, the Royal University of Bhutan (RUB) and its ten constituent colleges have been swift in transitioning to online teaching through Moodle and varieties of other applications such as ZOOM, Big Blue Button and Google classroom since March 2020. Since then, offline and online blended teaching began at the College of Science and Technology (CST) under RUB in January 2021. In this paper, we focus on offline and online teaching and learning practices for assembly language programming with the 8085 microprocessor. A Zoom meeting is used for the online practical. Firstly, a tutor gives an 8085 assembly program lesson, which is common to both offline and online teaching practices. In the case of the offline practice, students assemble the assembly program into Hexadecimal code, by looking up a table of the 8085 instruction set. Finally, the Hexadecimal code is input and executed on an 8085 microprocessor trainer, and students confirm the output from the trainer. Here, the trainer is a small computer composed of a microprocessor, peripheral/communication interfaces, timer, memory, input device and output device. In the case of the online practice, on the other hand, students input the assembly program directly on a Web-based 8085 microprocessor simulator. We developed an 8085 microprocessor simulator using JavaScript. Then, students confirm the output from the simulator on a Web browser. The students took 6 offline learning practices and 4 online out of a total of 10. According to a questionnaire survey about the comparison of the offline and online practices from the students, they say offline practices are much better than online ones, because direct communication is important to understand the learning contents. We conclude that there is room for improvement in the online teaching methods.

Keywords: traditional practice, online practice, Zoom, simulator, 8085 microprocessor

1. Introduction

At present, the number of new COVID-19 cases is decreasing each day all over the world. Thus, more countries are relaxing their lockdown measures. In the field of education, many schools and colleges have been shifting from online teaching to offline teaching recently. At CST (College of Science and Technology), RUB (Royal University of Bhutan), classes were taught using both offline and online methods in equal measures in the spring semester of 2022, but will be taught using only offline from the autumn semester of 2022.

However, people found benefits of online teaching during the COVID-19 pandemic. For example, it is easy to record online teaching classes. In the case of the Zoom meeting service, students can record a class video and audio locally to a computer (Zoom Support, n.d.). Also, online teaching is comfortable for both teachers and students, because they can stay at home with casual wear while they are teaching or learning at classes (Ashley, 2020).

In this paper, we focus on teaching methods for assembly language programming with the Intel 8085 microprocessor. Then, we compare online practice using a Web-based 8085 microprocessor simulator with offline practice using the Vinytics VMC-8501 microprocessor trainer, and discuss the advantages and disadvantages of each based on their experience. The methodology is described in section 2. Section 3 is an explanation of the offline teaching practice with the above-mentioned microprocessor trainer. The 8085 microprocessor simulator is described in section 4. In section 5, we describe the online teaching practice with the 8085 microprocessor simulator and the Zoom online meeting service. Section 6 is a comparison between offline and online methods based on the results of a questionnaire completed by students of CST. Advantages and disadvantages of offline and online practices are discussed in section 7. The conclusion is given in section 8.

2. Methodology

The purpose of this research paper is to find advantages and disadvantages of offline and online teaching practices for 8085 assembly language programming, respectively. Then, we propose a better online practice.

In order to find advantages and disadvantages of the offline and online practices, students take both offline and online lessons for 8085 assembly language programming. Next, they answer the questionnaire about the offline

and online methods on a Google online form. We find the advantages and disadvantages from the questionnaire results. Finally, we discuss how the online practices can be improved.

3. Offline practice

Offline lessons are given at a laboratory. Two students form a group, and each group uses the Vinytics VMC-8501 microprocessor trainer, as mentioned above. The tutor provides several assembly language programs, and the students execute the assembly program on the microprocessor. Then, they confirm the output from the trainer. Thus, they understand the assembly instructions. While they are learning, they communicate with the tutor or each other orally. The steps of the offline practice are as follows.

3.1 Explanation of objective and apparatus required

The tutor uploads practice notes on Moodle in advance. Then, he/she explains the objective and apparatus required of today's practice while students are reading them on Moodle with their smartphones. Figure 1 shows an example of them.

Table 1 Example of objective and apparatus required.

Objective:			
	Instructions related to rotating the accumulator bits are introduced. In addition, two types of Compare operations will be introduced. In this practical, firstly we learn the mnemonics of these operations. Next, we input several simple programs including the above operations, and check the results.		
Apparatus Required:			
	8085 Microprocessor Trainer	Vinytics VMC-8501	1
	Manual	Vinytics VMC-850X User's Manual	1

3.2 Explanation of 8085 assembly instruction set

Secondly, the tutor teaches the 8085 assembly instruction set which is used in today's practice on a whiteboard, based on a textbook that he/she refers to in a lecture (Gaonkar, 2013). Figure 1 shows an example of the explanation of an 8085 assembly instruction set.

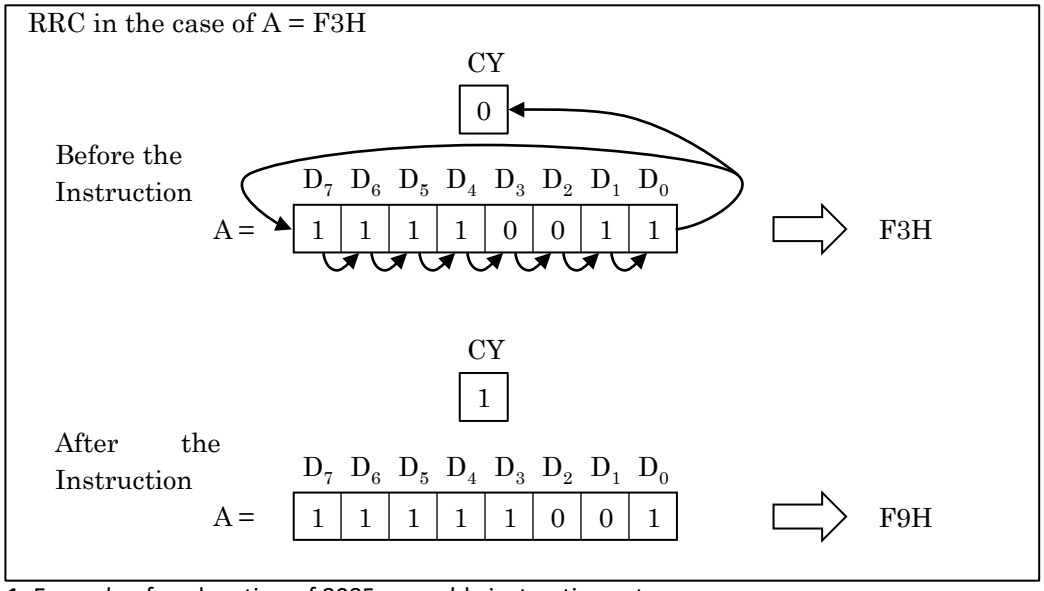

Figure 1: Example of explanation of 8085 assembly instruction set

3.3 8085 assembly language program and its assembling by manual

Thirdly, the tutor gives the 8085 assembly language program as shown in Figure 2. Then, the students translate the assembly program into hexadecimal machine code by the use of the Vinytics VMC-850X user's manual shown in Figure 3. This translation process is called assembling.

A PC S Z AC P CY Initial Contents
MVI A,F3H ORA A RRC HLT

Figure 2: Example of 8085 assembly language program

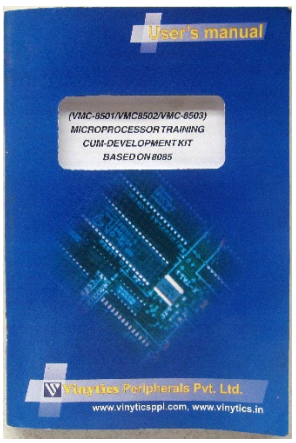

Figure 3: The Vinytics VMC-850X user's manual

Using the user's manual, the students find the hexadecimal machine code as 3E, F3, B7, 0F, 76.

3.4 Input of hexadecimal machine code and its execution on the microprocessor trainer

Fourthly, the students input the hexadecimal code on the trainer, and execute it. The Vinytics VMC-8501 microprocessor trainer is shown in Figure 4 (Vinytics, n.d.).

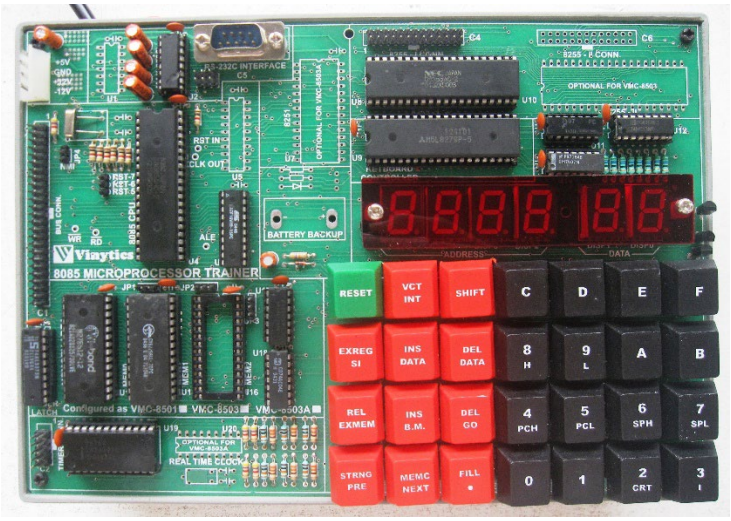

Figure 4: The Vinytics VMC-8501 microprocessor trainer.

3.5 Confirmation of output from the microprocessor trainer

Finally, the output of the hexadecimal code is displayed on six-digit seven-segment LED of the trainer. The students confirm it, and fill in the blanks in Figure 2. The results are given in Figure 5.

	A	PC	S	Z	AC	P	CY	
	00	2000	0	0	0	0	0	Initial Contents
MVI A,F3H	F3	2002	0	0	0	0	0	
ORA A	F3	2003	1	0	0	1	0	
RRC	F9	2004	1	0	0	1	1	
HLT								

Figure 5: Output of 8085 assembly language program

4. Web-based 8085 microprocessor simulator by JavaScript

In the case of offline practices, students use a Web-based 8085 microprocessor simulator. The microprocessor simulator is composed of three modules: GUI (Graphical User Interface) module, Main module, and Execution module. In Muramatsu (2012; 2014), the author developed the Main and Execution modules by PHP (Personal Home page), and the GUI module by JavaScript. Then, the Main and Execution modules run on a Web server, and the GUI module runs on a client PC. If many students use the simulator simultaneously, a heavy load may be applied to the Web server, which is a disadvantage (Mindfire Solutions, 2018).

Therefore, the author rebuilt the 8085 microprocessor simulator as all the three modules run on a client PC for online practices. Namely, the three modules were rebuilt by JavaScript. Figure 6 shows data flow between each module. The details of each module are described as follows.

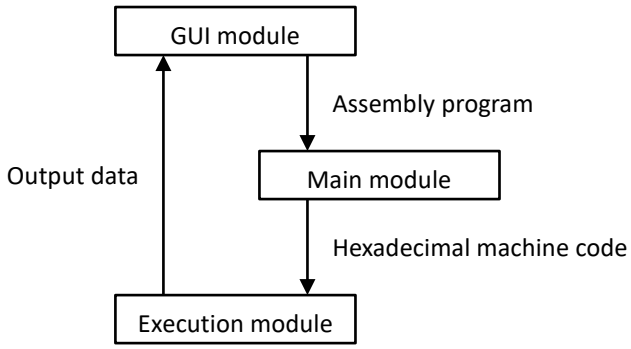

Figure 6: Modules and data flow in the 8085 microprocessor simulator by JavaScript

4.1 GUI module

Students input the assembly program using the GUI module on their PC, and the input program is sent to the Main module. Also, the GUI module displays the results of a Hexadecimal machine program transferred from the Execution module.

4.2 Main module

The Main module translates an assembly language program sent from the GUI module to a Hexadecimal machine code on their PC. The Hexadecimal machine code is sent to the Execution module.

4.3 Execution module

The Execution module executes the Hexadecimal machine code received from the Main module, and transfers its results to the GUI module. These processes are done on the students' PC. Here, the results mean the contents of registers and memory locations on the 8085 microprocessor after the execution.

5. Online practice

In the case of online teaching practices, the students take the lessons at their home individually. If they want to communicate with the tutor or the other students, they can use a personal or group chat on the Zoom online service. Compared with offline practice, online practice is simple. Explanation of objective, apparatus required and 8085 assembly instruction set, is almost the same as for the offline practice. The difference is that the explanation is given using Zoom, not directly (Zoom, n.d.). The tutor also gives the 8085 assembly language program using Zoom. In addition, students do not need to assemble the assembly program, because the Main module of the simulator translates it to the Hexadecimal machine code.

Thus, students launch the 8085 microprocessor simulator shown in Figure 7 on their PC, after the 8085 assembly language program is allocated. Next, they input the 8085 assembly program with a keypad on the simulator as shown in Figure 8. By clicking the 'RUN' button, finally, the program is executed, and its results are displayed on the microprocessor simulator. See Figure 9.

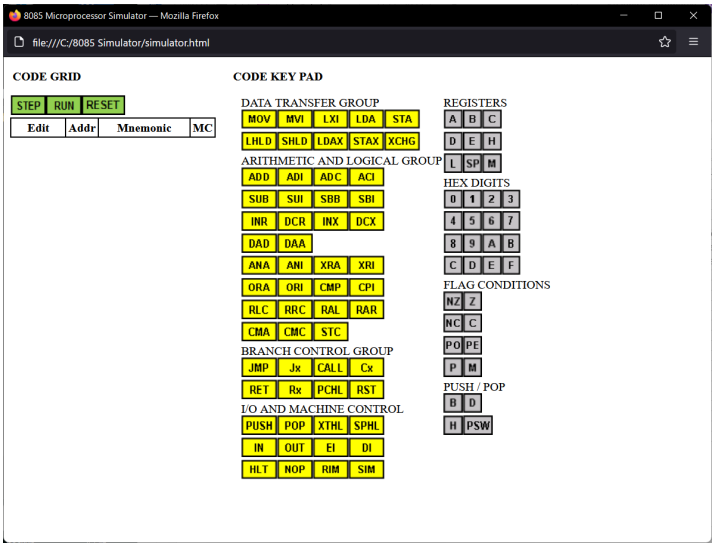

Figure 7: Initial screen of the 8085 microprocessor simulator

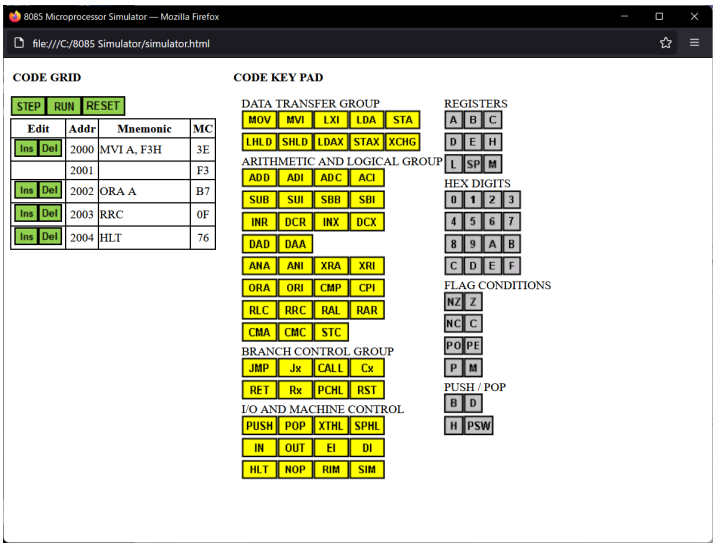

Figure 8: Input of the assembly language program on the 8085 microprocessor simulator

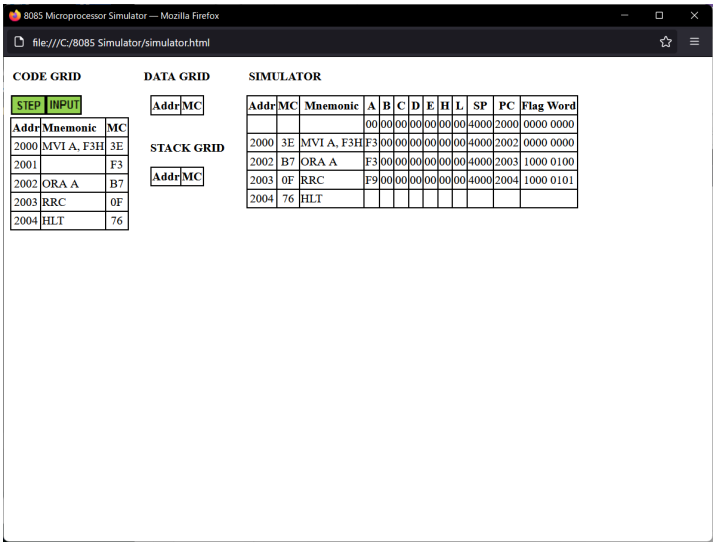

Figure 9: Output of the assembly language program on the 8085 microprocessor simulator

6. Comparison between offline and online practices

In this section, we describe the results of a questionnaire about the comparison between offline and online practices. Twenty two students of the Instrumentation and Control Engineering Course, CST took six offline and four online out of ten practices in the spring semester of 2021. Then, eight students responded to the questionnaire.

Firstly, the author asked which is better, online practices or offline practices in the questionnaire. 75% of the students answered that the offline teaching practice was much better than the online for their learning experience.

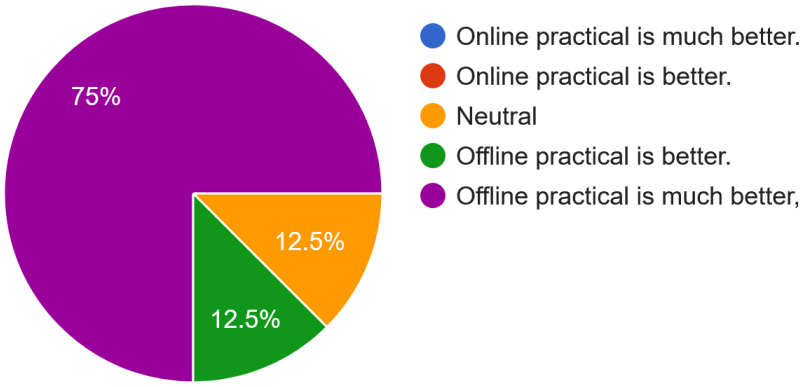

Figure 10: Which is better, online practices or offline practices

The reasons for the above answer are listed as follows.

- Offline practices are much more efficient and easy to understand.
- We get hands-on experience using offline methods.
- We can ask the tutor about doubts face to face.
- Both are good. In online practices, we can do it faster and see the display easily and individually. In offline practices, we are learning with classmates, and the classmates can explain doubts even if we don't understand.

Secondly, the author asked about the advantages of online practices. The response was as follows:-

- We can review the lessons individually if we use a local recording function on Zoom.

Thirdly, the author asked about the advantages of offline practices. The responses were as follows:-

- We can ask classmates or the tutor directly anytime in practice hours if we have doubts.
- We can get knowledge of the I/O interface with the microprocessor by using the microprocessor trainer.
- We can get much more information about the hardware, compared with online practices.

Fourthly, the responses to disadvantages of online practices were as follows:-

- We are unable to focus our mind on the practices properly.
- It is difficult to understand the contents with the microprocessor simulator.

Finally, the response to disadvantages of offline practices was as follows:-

- If the number of the microprocessor trainers is small compared with the number of students, a large group of students uses only one trainer. This situation makes the students not want to join in the lessons.

7. Discussion

According to Figure 10, 75% of the students feel offline practices are much better than online ones. The reason is that offline practices make it easier to communicate with classmates and the tutor even though Zoom online meetings support a group chat function. This means that face-to-face communication is better than one with an online chat. However, Ashley (2020) states that online teaching increases students' access to teachers, because HeyHi's online whiteboard service is effective in communication (HeyHi, n.d.). Thus, methods of communication should be improved in online practices. In offline teaching practices, it is important to handle hardware equipment, because students can understand the hardware aspect of the microprocessor through the microprocessor trainer. In online practices, on the other hand, the Zoom recording function is useful, because students can review the lessons by watching the recorded video anytime (Zoom Support, n.d.). This advantage is mentioned in Ashley (2020).

8. Conclusion

Based on the results of the questionnaire completed by the students of the Instrumentation and Control Engineering Course, CST, in this paper, we compared offline teaching practices and online ones. The results say that 75% of students feel offline practices are much better than online ones, because offline practices make it easier to communicate with each other. Therefore, online practices should be improved by developing user-friendly communication tools.

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