Creating Educational Tutorials using Robotic Process Automation

Goran Savić[1][0000-0002-3917-5487], Jelena Popov[1], Radoslav Dutina[2], Milan Vidaković[1][0000-0002-1008-8662] and Milan Segedinac[1][0000-0003-1743-9522]

[1] University of Novi Sad, Faculty of Technical Sciences, Trg Dositeja Obradovića 6, 21000 Novi Sad, Serbia
[2] Rationale, Zmaj Jovina 26, 21000 Novi Sad, Serbia

Abstract. Digital educational tutorials are an inevitable part of the contemporary learning process, which is today typically organized in an online or blended environment. Creating and maintaining such tutorials classically, using video editors, is error-prone and time-consuming. We propose a more controllable approach for creating and reproducing educational tutorials by using Robotic Process Automation (RPA). Instead of recording videos, as in the classical approach, tutorials are created by specifying a sequence of user operations, which is executed using RPA. A teacher can later easily modify the tutorial just by editing this sequence. As well, since RPA can execute the operations directly on a student's computer, they could get a more interactive tutorial than in the case of prerecorded video files. We have used the UiPath RPA tool for the creation and execution of the tutorials. As a case study, we created 8 educational tutorials for learning Java programming language.

Keywords: education, tutorial, robotic process automation, UiPath, Java.

1   Introduction

The development of information technologies has increased the need for multimedia educational materials, such as video tutorials. Creating this form of learning material classically can be time-consuming and error-prone. In addition, their later modification requires re-recording the video content and re-editing tutorial videos.

We examine an approach that provides more flexibility in editing the tutorial by introducing a formal specification of the tutorial procedure steps using robotic process automation.

Robotic process automation (RPA) is a technology that simulates human actions on the computer [1]. It is used for automating the business process through a predefined set of business logic, rules, and structured data [2]. RPA aims to replace typical and repetitive manual tasks to be executed by software robots. Using software robots for this type of tasks can be faster, more efficient, and more accurate since humans tend to make errors due to a lack of focus and motivation [3].

Although such automation can be implemented by making a program from scratch in an arbitrary programming language, there are specialized, so-called RPA tools,

which allow implementing automation with no writing of programming code. Instead, such tools integrate video recorders for recording a sequence of user actions. This sequence is stored and can be reproduced whenever one needs to perform that set of actions. In addition, the tools typically contain UI editors for specifying a sequence of user actions. Not just the editor provides creating a sequencing formally with no programming code, but it facilitates later editing of the sequence since a user avoids re-recording the whole sequence. Hence, with no professional technical knowledge, RPA allows an organization to automatize its business process.

In this paper, we utilize the RPA approach in making an alternative to educational video tutorials. Video tutorials typically explain a particular procedure by recording the computer screen and displaying particular user actions. In comparison with textual materials, this is a multimedia tutorial and a student can see the set of actions directly, instead of reading its textual explanation. The availability of screen recording and editing software, as well as online video platforms for publishing such videos, video tutorials have become particularly popular. Still, creating and editing such tutorials is much more demanding than textual ones. It requires technical knowledge for using video editing software and re-editing the video any time a teacher notices an error or wants to update the content with some new information. In addition, classic video tutorials do not execute the set of actions on the student's computer, but only display the video of the procedure executed on the teacher's computer.

Instead of directly recording videos, in this paper, we propose an alternative approach - the procedure can be specified using an RPA tool and executed using its software robot. The execution can be made on a teacher's computer where they can record the execution and create a video file. Also, if a student has a similar working environment, the RPA tutorial can be executed directly on a student's computer and provide them with a more interactive learning experience.

The paper is organized as follows. First, we give an overview of the popular RPA tools. Third section explains our solution for creating educational tutorials using UiPath RPA tool. Fourth section presents a case study on creating tutorials for learning Java programming using our approach. In the last section we give concluding remarks.

2   RPA Tools

RPA technology has been applied in various fields so far and different software tools have been being used for this purpose. We present most popular RPA tools below.

Blue Prism is a user-friendly RPA tool providing non-technical users to automatize repetitive tasks using simple drag-and-drop user interface. For more advanced users, it provides automatic execution of scenarios written in a programming language. Automation Anywhere [4] is one of the most popular RPA tools for automatizing business processes. It combines RPA techniques with semantic recognition of natural language and screen content. Furthermore, through its cloud-based Automation 360 platform, it can be used as SaaS. The platform can analyze client's business process and recommend the parts that can be automatized. It supports end-to-end automation with no need of separating front-end and back-end operations. Although it has a modern and intuitive

user interface, its learning curve can be steep for an unexperienced user. One more RPA platform for automating repetitive jobs is Pega [5]. It works solely in cloud and provides a set of tools for building and deploying enterprise applications automatically. Work Fusion [6] RPA tool allows for analysis and automation of business processes. It contains pre-built packages for automatizing typical tasks. In addition, there is support for advanced analytics which shows how automation impacts company business. Desktop applications can be automatized using Jacada [7]. It is being mostly used for call operators and customer support. Nice Systems [8] RPA platform uses software robots installed on company's servers to perform repetitive administrative tasks. It supports completely independent bots, as well as those that interact with employees. The bots are equipped with OCR, chatbot and machine learning features. Kofax [9] is a scalable and flexible RPA platform that can be integrated with other platforms for business process management. Its AI module allows bots to understand data from different data sources and systems and reduce data processing errors in comparison with human processing. UiPath [10] is a very popular tool for automatizing web and desktop applications. It can be hosted on local computers or in cloud environment. Its web scrapping solutions help users to obtain data from web pages and office documents. Furthermore, it supports managing errors and exceptions, delayed process execution, and business process modeling. Since it satisfies all our requirements, in this paper we propose UiPath for creating educational tutorials.

3   Using UiPath for creating educational tutorials

UiPath specifies RPA sequences of actions using diagrams. There is a specialized IDE named UiPath Studio for creating such diagrams. It allows defining simple user actions, such as button clicks or text input, as well as more complicated ones, running user applications or extracting data from user's tables and applications. In addition, Ui Path Studio provides screen recording which records user actions and transforms them into a sequence of activities in a UiPath diagram.

The tool contains three components: UiPath Studio, UiPath Robot and UiPath Orchestrator. UiPath Studio is an IDE that provides visual diagrams for designing automation process. Every diagram specifies the procedure steps for performing specific job. Furthermore, it supports process coding and sequencing. By using UI features, such as buttons and drag&drop techniques, it allows user to specify the automation steps. In addition, predefined templates are supported. UiPath Robot contains software robots that execute tasks previously specified using UiPath Studio. UiPath Orchestrator is a web application for deploying, planning, monitoring and management of robots and processes.
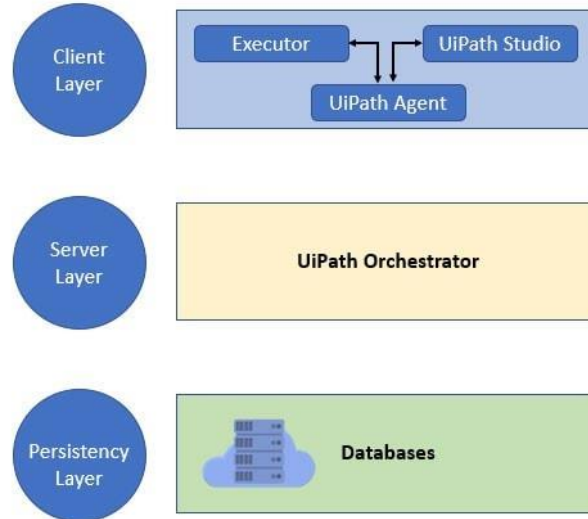
Figure 1 shows the UiPath architecture.

Figure 1. UiPath software architecture

Client layer contains UiPath components accessible to end-users. While UiPath Studio allows designing processes, UiPath Agent provides communication with the backend services. Executor component is responsible for executing the tasks specified in diagrams. Server layer contains UiPath Orchestrator which monitors robots that execute the tasks and generates the reports for end-users. Persistency layer stores data on robot configuration, users and tasks.

UiPath Studio provides creating and editing the process diagrams, and starting the automatic process execution. A user can start from an empty project or reuse some of the built-in templates. Also, custom user projects can be saved as new templates. Within a project, a user specifies process activities which can be executed sequentially or in parallel. Multiple diagrams are supported within a single project. UiPath allows defining simple user actions, such as button clicks or text input, as well as more complicated ones, running user applications or extracting data from user's tables and applications. In addition, Ui Path Studio provides screen recording which records user actions and transforms them into a sequence of activities in a UiPath diagram. Besides features for non-technical users, there are also numerous features for advanced users and developers, such as creating CSV files, running JavaScript code, controlling process flow using conditions and branching, string operations, debugging, etc. A user can control the process execution by running, stopping and pausing it. Also, it can configure the playback speed.

The educational tutorials created in UiPath are interactive. A student runs the tutorial on their computer and they can watch in the real time the whole process execution on real software and data. Furthermore, they can control the execution. Still, running the UiPath project on a local computer requires the similar environment to the teacher's one. This includes all the software tools with compatible versions, as well as software

and data that the robot interacts with during the execution. For this reason, besides the raw UiPath project, a teacher should provide the video of the process execution. This can be done by a screen recording software. Students who find difficult to run the interactive tutorial can watch the video. Later changes in the tutorial must be made by updating the UiPath diagrams and rerecording the automatic process execution. This effort is still much lower than reediting the video itself.

Due to its powerful features, UiPath software has been used in our research for implementing the case study presented in the next section.

4 Case Study

As a case study, using UiPath we have created tutorials for learning programming in Java. 8 tutorials have been created in total:

1. A first Java program
2. Variables and data types
3. Working with strings
4. Operators
5. Arrays
6. Control flow
7. Loops
8. Summary

Every tutorial illustrates how to write particular Java program by executing specific actions in Eclipse IDE. For example, clicking on a New project menu item, typing the text "int" in code editor etc. These actions have been specified using UiPath Studio. They can be easily executed and recorded then, as well as modified.

First tutorial illustrate how to use Eclipse IDE, create a simple project, write HelloWorld program, start it, and monitor its output. Second tutorial introduces variables and primitive data types in Java program. String operations are covered in the next tutorial. Then, we are showing how to use arithmetic and logical operators. Fifth tutorial explain how to organize data into a more complex structure, such as an array. Controling the program flow using if-else statements is presented in tutorial 6. Seventh tutorial explains for, while and do-while loops. Finally, we summarize all the concepts within a single Java program presented in tutorial 8.

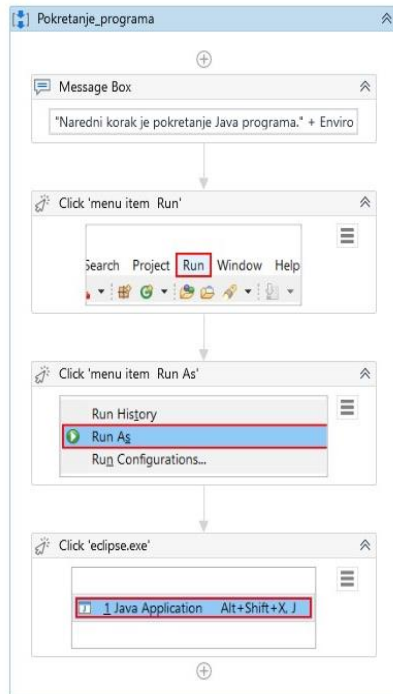Figure 2 presents an example of specifying user actions in UiPath.

Figure 2. Specifying a sequence of user actions in UiPath Studio

The presented diagram specifies the list of activities needed for starting Java program in Eclipse IDE. The following steps are specified:

1. Displaying the Message Box which informs a student that the next step is starting Java program
2. Clicking on the Run button in the Eclipse main menu
3. Clicking on the Run As menu option
4. Clicking on the Java Application menu item which starts Java program

5   Conclusion

Educational video tutorials are typically created through prerecording video files, usually with some screen sharing that shows user actions. Additionally text descriptions, narrator and voice can be presented. Creating and maintaining such tutorials in a classic way, using video editors, is error-prone and time-consuming because editing requires re-recording and re-editing the video. Furthermore, such tutorials are not interactive. Students just watch the video presenting the execution on the author's computer.

The paper proposes a method for creating educational tutorials using RPA. It enables interactive tutorials which are easier for modification. We presented popular RPA tools and explained how the procedure in the educational tutorial can be considered as an

RPA process. Among different RPA tools, we chose UiPath for creating tutorials. We propose using its diagrams for specifying tutorial steps. Once the steps are defined, they can be automatically executed using the UiPath RPA support. Either a student can execute the tutorial directly on their computer or a teacher can execute it on their own while recording the screen, and publish the recorded video as an educational video tutorial. As a case study, we used this approach to create 8 tutorials for learning Java programming. The tutorials explain how to use Eclipse IDE, create Java programs, use variables, and control the program flow.

The case study has shown that this kind of educational tutorials is appropriate for the computer science domain. Although it can be time intensive to create a tutorial using UiPath, once it is created, it is much easier to modify it then using a classic video editing techniques. Furthermore, by saving the diagrams as templates, teachers can save time by reusing the typical tutorial steps.

The main benefits of the proposed approach are as follows: (1) it provides a more formal way in specifying tutorial steps through sequence diagrams, (2) editing is facilitated since it requires changing only particular sequence elements, and (3) tutorials are more interactive because they can be executed directly on student's computer. Still, there are some disadvantages. In the current form, tutorials do not display narrator or voice (only text messages are currently supported). Also, physical objects cannot be presented in tutorials. This implies that the current solution is appropriate for tutorials which illustrate how to perform specific set of actions on the computer.

Our current solution deals only with the visual part of educational tutorials. We currently do not cover the audio part, which is typically present in contemporary video tutorials. Instead, we use UiPath embedded message boxes for communicating additional information with a user. This can be improved by using rich content dialogs instead of current generic ones with plain text. Also, our future work will focus on the possibilities of integrating audio content into this solution. Since we are trying to define tutorials based on the visual or textual input which can be later modified, we are planning to use text-to-speech techniques for integrating audio messages. In this way, a teacher will be expected to modify only the message text, while the audio content will be automatically generated.

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