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THE USE AND ADVANCEMENTS OF ASSISTIVE TECHNOLOGY IN AUTOMATION FOR THE VISUALLY-IMPAIRED WORKFORCE

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ABSTRACT

With the advancements in the world of technology reaching greater heights, the developments in accessibility features for the visually impaired workforce have grown manifold. Resources such as navigational assistance modules, text-to-speech applications, virtual audio displays, etc. have been in the works. There is a lot of enhancement in how technology is being used in the field of automation too. Studies suggest that more than 70% of process-oriented jobs would be automated within the next decade. But there is merely a bridge between the two! Technology has been helping reduce costs, efforts, and time by automating most of the processes.

But there isn't a coalesce in how the visually-impaired workforce can be uplifted with the use of assistive technology for automation tools and services. The world talks about making the workforce of today future-ready, but holistic growth is only suggestive in a scenario where every stratum of society grows.

A look into what the present state of the uses of technology for the visually impaired employees is, how and what can be done today in making this stratum of society future-work ready, and an implementation of one such prospect: An Integration Tool- Development of a Text-to-Speech screen reading tool for Selenium Test Automation *for the visually impaired.*

KEYWORDS: Visually Impaired, Integration, Tools, Development, Assistive Technology, Selenium, Automation, Workforce, Testing, Automation Testing, Etc.

INTRODUCTION

PRESENT DEMOGRAPHIC SCENARIO IN ASSOCIATION WITH THE USE AND AVAILABILITY OF ASSISTIVE TECHNOLOGY

The use and popularity of assistive technology devices, including the adaptations to existing products to support accessibility has been significant in the past several years. Around the globe, there have been several laws, acts, and legislative measures passed to back and enhance accessibility of devices with assistive technology for users with disabilities. The famous Tech Act of 1988, (a.k.a. The Assistive Technology Act) in the United States of America, since its inception has seen numerous amendments and transitions to

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better cater to individuals benefitting from the likes of it. Similar acts have been set in place and passed throughout the world, including the notable Rights of Persons with Disabilities Act 2016, India. Laws such as these enforce funding from States to be spent on direct services for individuals with disabilities. Such acts have allowed in the past and still persist on functioning to increase the awareness and provision of assistive technology in the day-to-day devices, including telephones, smart devices, personal computers, etc.

ASSISTIVE TECHNOLOGY AND ITS USES IN THE PRESENT-DAY WORKPLACE

With the workplaces of today talking about integration and holistic development of each and every employee, creating an environment that is capable of instilling a wholesome culture and empathy towards people with disabilities or challenges is a great step towards achieving an inclusive workplace.

In the past several decades, the usage of assistive technology and accessibility in the workplace has been found to be a major hurdle for individuals with disabilities. (Kaye, 1997) Surveys and reports suggest that more than 10 percent of the adults working still face restrictions in their work due to disabilities. The National Organisation on Disability/ Harris Survey of Americans with Disabilities suggested in its report that more than 26% people surveyed suggested their need for special equipment or technology to perform their jobs. Out of these, more than 10% people reported their need for computers, screen enlargers, voice recognition, screen readers and voice assistants, special keyboards, or speech synthesizers to perform their jobs better. But only a meagre 1.3% of this group of people claimed to own such devices.

Such statistics are testimony to the fact that the following 3 issues are addressable in present-day workplace environments:

a. Need for Assistive Technology: There is a dire need for an immense push towards more assistive technology enabled devices and software that employees with disabilities could use.
b. Lack of Accessibility in the workplaces of today: Even still, there is a huge gap between the requirements and supply of such software/ devices.
c. Dearth of growth perspective and outlook for advancements in this field: Of all the research and development conducted on user technologies today, there is a very small amount of effort and funding put into research for advancements in the field of accessibility.

ADVANCEMENTS IN THE FIELD OF ASSISTIVE TECHNOLOGY

Even with the lack of excessive usage and research devoted towards assistive technology for better accessibility, there have been some interesting innovations in the field. The scope for research is wide, as discussed by some of the latest developments in this domain. From research on the perspective of users of frequency-lowering hearing aids and electric acoustic stimulation cochlear implants (Mathieu, et. Al, 2018), to letter-based head-movement-driven communication through Alternative & Augmented Communication (AAC) (Farago, et al., 2018), to eye-reading technologies such as Dynavox Eyemax System that allows people with disabilities to participate in communication through their eyes, to screen-reading assistants such as JAWS, etc., the advancements in the field of accessibility suggest that these leave some room for better accessibility, the major reasons being:

1. Lack of quality user experience for people with disability.
2. Lack of growth prospects in the innovation for the challenged workforce.

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ASSISTIVE TECHNOLOGY & THE IT INDUSTRY

One of the fastest growing industries in the world, the IT (Information Technology) sector, with a yearly spending of more than USD 150 Billion, has seen one of the fastest growth streaks in the industries. Statistics show that about 19 billion people worldwide software developers today, with more than 8.7 billion developing mobile applications. With the enormity of the software development and testing sector today, a wide range of opportunities come to be alive for the workforce. The possibilities in terms of using better technologies, working on better products, and having a larger learning curve would be much more.

This is where the need for a holistic growth in the workforce comes into play. Empathy towards the visually challenged workforce whilst developing on newer technologies to work on is vital, or there'll be the dreaded gap between the knowledge and capabilities of the workforce with disabilities and otherwise. The knowledge gap between the varied strata of the same workforce could be cause for a massive disparity, if the right steps aren't provided.

THE SHIFT TO NEWER TECHNOLOGIES LEADING TO A GAP

With the advancements in the field of technology taking place by the second, the improvements and the shift to better ways of solving business problems is massive. There is innovation happening in the field every minute. While taking the case of Software Development and Testing; manual v. automation testing as a more specific case, the technology and the way it is solved has seen a tangential shift.

With tens of years working on manually testing products and software systems, the following major issues have been noted:

a. Manual Testing is time consuming and tedious

b. It required huge investment in human resources.

c. It is less reliable and non-programmable.

In comparison, the newer, more enhanced form of testing, i.e. Automation testing allows for the following advantages:

a. Cost Effectiveness.

b. Repeatable & Reusable.

c. Programmable & Comprehensive.

d. More reliable & Better coverage of code.

The advantages of Automation Testing are manifold in comparison to the almost-archaic Manual Testing today. However, the question of growing into and using newer, cutting-edge technologies holistically for every stratum of the workforce. Assistive Technology, however advanced it has become for Manual Testing for the visually challenged workforce, still lags behind (or rather has no solution for) Automation Testing.

With tools such as JAWS (that allow screen reading tools to be integrated with existing software), the visually impaired workforce of today has been actively involved in working on Manual Testing. But there is still no advancement in any of the technologies present today for automation testing that allows for people with visual disabilities to continue working.

Assistive technology lags far behind when it comes to the development and testing of software by and for visually impaired developers working in the field of technology today. In lieu of such limitations to software, the proposition for a tool the helps employees with visual disabilities to work more efficiently on Automation Testing seems extremely viable.

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PROPOSED ACCESSIBILITY FRAMEWORK

The proposition towards an accessible framework for visually impaired employees to be able to use automation testing allows for developing a plug-in addition to an existing IDE (Independent Development Environment).

The following is an elaboration on the proposed framework and the functioning provided for the the plug-in addition to the IDE (As explained in Figure 1). *The user here is referred to as a visually-challenged employee working on Automation Testing:*

a. Software developers create web applications that run on any browser.

b. The testing team generates Selenium test scripts for each of the plausible task scenarios for the web application.

c. The Selenium test scripts developed, will be executed as per the need of the scenarios.

d. The test scripts running on the web application can be accessed through the IDE configured for the scripts.

e. A Text Reader plug-in that is developed as an addition to the existing IDE acts as the accessibility tool for visually impaired users and developers to be able to access the test scripts with the help of simple keyboard-button clicks. This is where the benefit for a visually-challenged user/developer comes into picture.

f. With the screen-reader plug-in, the visually impaired user can access and **run** the test scripts generated for particular applications, and note down the outputs generated on the console screens with minimal effort and maximum efficiency, without the involvement of any help. Moreover, since running test scripts requires minimal coding knowledge, it makes it completely plausible for visually-disabled developers/testers to work on them using the screen-reader plug-in.

g. With the help of the text-reader plug-in, the visually-impaired user can read through the output of the console and perform further actions accordingly.

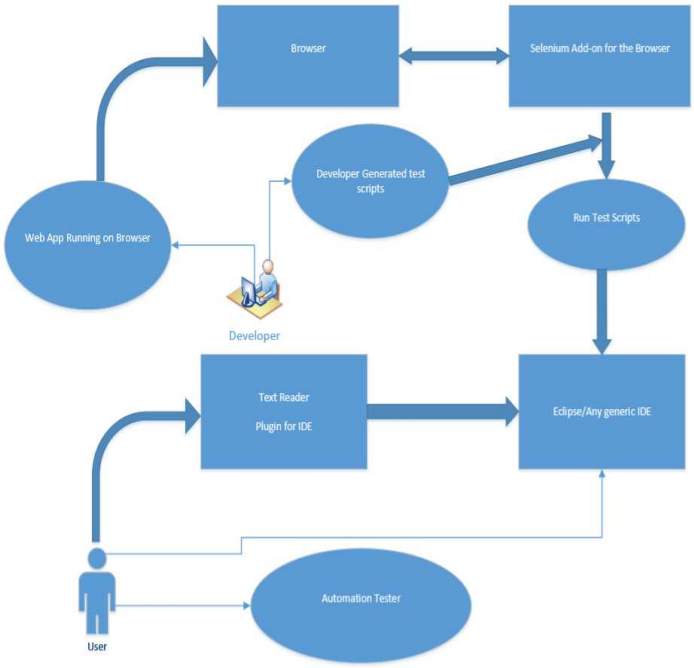

Figure 1.Architecture Diagram: Screen-Reader Plug-in for IDE

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The following defines a detailed outlook towards the components necessary for the framework to function:

a. Text Reader Plug-In: The proposal suggests for the generation of a plug-in for IDE's. The plug-in is created on top of a screen-reading functionality. Screen-reading tools, extremely popular in the world of technology today allow for reading through every element present on the screen, mapping each and then using the text-to-speech converters to transform the text read from the screen and output to the users in the form of audio. The plug-in runs on top of the IDE installed on the user's computer system and reads through every word present on the screen. The plug-in is developed in such a way that it starts reading from pixel (0,0), i.e. the top-left corner of the screen. The user, to continue reading presses a single key (or a set of keys) on their keyboard, to read through the consecutive words of the screen.

Figure 2.Sample Navigation Bar

For a software application with the header menu with the following keywords: *'File', 'Home', 'Insert', 'Design', etc.*

This Plugin will help though the navigation of any IDE where the automated scripts have been coded.

At the start of this application, the screen reader starts reading with the first element, *'File'.* If the user presses a particular button on the keyboard, say, TAB, the screen reader goes to the next element. If the user however presses ENTER, the screen reader enters the contents of *'File'* and reads through the sub-elements of the same.

b. Eclipse or any other generic IDE

With the help of the plug-in installed on top of the IDE (Independent Development Environment), the accessibility features are made possible for a visually impaired user. Any user with access to a keyboard can go through every word written on the screen and perform actions. The text-reader plug-in allows for opening of and running particular test-scripts with minimal effort.

As shown in *Figure 3,* a visually-challenged user can access any project and run any test-script with just the click of a button.

c. Selenium Test Scripts running on top of the IDE and Web Application. As shown in *Figure 3,* with the help of the text-reader, the user can run those test scripts. The scripts can stop their execution on one of the following 3 conditions:

- The test scripts complete execution and return 'completed' output on the console of the IDE.
- The test scripts fail at a particular instance.
- The user manually stops the execution of the test scripts.

Under condition 'i', the text-reader reads through the output, suggesting to the visually-challenged user that the test-scripts have run successfully. In such as case, the user can move on to the next set of scripts to be executed.

Under condition 'ii', the text-reader suggests the occurrence of an *Error* and asks the user to click the *'Enter'* button to go through the detailed stack-trace of the error message being returned on the console window of the IDE.

Under condition 'iii', the user specifically presses the *'Tab' or 'Space'* key on the keyboard to explicitly stop the execution of a specific test-script.

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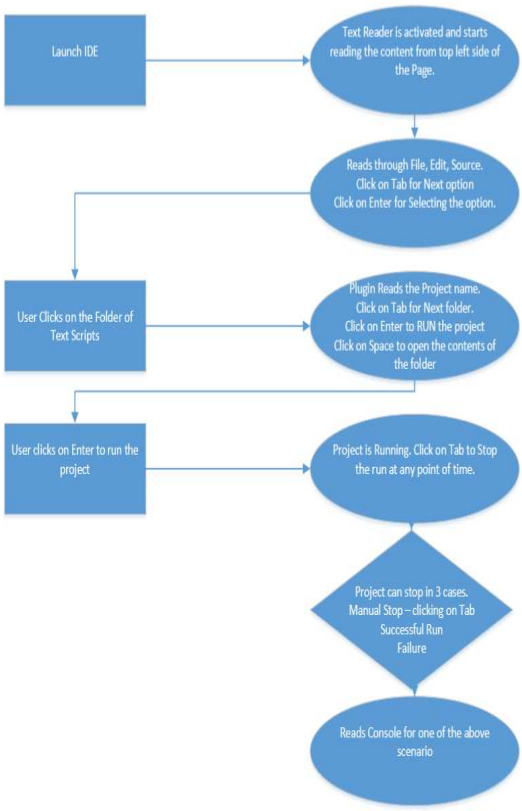

Figure 3.Flow-Chart for Execution using Plug-in

d. Console Output: The output of the console, which is captures by the Text-Reader on the screen is sent as a further output in the form of audio, which is duly noted/recorded by the user running the test-scripts (in our case, the visually-challenged employee/developer).

The scenario proposed above is a single, extremely specific use-case for a much wider gamut of possibilities that the developers can use. With just a few simple additions, the framework can be customized to allow many more features:

a. Creation of Projects/Configurations.
b. Code development and creation.
c. Use of debugger.

There are many such other use cases in relation to how a framework for the visually impaired developers can be useful for a variety of other uses in the near-future in relation to *Development Environments.*

CASE STUDY

While creating a new product or an addition to an existing product, one of the major steps necessary involves understanding what problems that users are facing.

For the same, this research covers a real-life case-study of a visually challenged employee working regularly on testing, who manually tests applications to ensure the guidelines being followed by the development team.

For the purpose of anonymity, the person interviewed in the study has been referenced to as the user.

The work revolves around manual-testing of applications with screen-reading tools. The *user* is responsible for manually testing those applications, generating error reports, detailed issues and bugs faced while testing the applications.

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On discussion with relation to the major challenges being faced while manually testing applications using screen reading tools such as JAWS, it was concluded that the major hurdle faced by the *user* involves dealing with graphics. With proper development practices followed, the images can be access by screen readers with the stipulation on *'alternate text'* being added to the images, so that the screen readers can go through the alt-text and speak out the names of the images to the user. There are many cases however, where alternate text isn't mentioned for a lot of graphics, which leads to slowing down the process of work for testing.

An area of improvement that the *user* feels for the newer web-based applications includes bettering the rich-text for the graphics and more data-oriented approach, to help the scripts running on the screen-reader engines to better grasp every aspect of the application being worked on.

The *user* suggests "focusing on the little attributes of applications while developing with newer technologies such as automation and machine learning would go a long way in making sure that no user lags behind in catching up with the up-and-coming tech." Since automation removes the need for going through each and every item present on the screen manually (with the help of test scripts taking care of graphics, buttons, etc.), the job of a user working on automation testing is simplified dynamically. Thus, the issue that a user with visual disability may face while handling graphics and images is erased. Automation testing, thus, with the help of simple add-on plug-ins to existing development environments, would provide with a simple interface to perform their tasks.

CONCLUSION

The research conducted on understanding the existing developments in the field of Assistive Technology suggests the following key inferences:

a. The developments in the field of Assistive Technology for better accessibility for customers using smart devices are manifold. From smart wearable-devices, to Text-to-Speech converters, to smart systems and implants, the advancements in the field of consumer technology for physically-challenged consumers.

b. Assistive Technology in the field of software development and testing has reached some growth, with credit to tools such as JAWS (Job Access With Speech), etc.

c. There are rarely any developments in the field of assistive technology with the specific outlook of keeping future technologies and automation in mind.

d. With more research and development going into tools and plug-ins such as the *Text-Reader plug-in for IDE's,* the scope of tasks carried out by employees with disabilities would be increased to a much broader level.

e. With the knowledge workforce of today moving towards automation, artificial intelligence and newer technologies by the day, a more holistic approach for growth is highly recommended, keeping in mind every stratum of the workforce in mind.

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