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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/398,544	**12/28/2023 12:45:54 PM Z ET**	**10875-10256-US**

Title of Invention

SYSTEM AND METHOD OF CREATING A SHADOW REPRESENTATION OF THE USER INTERFACE FOR FASTER UI ELEMENT RETRIEVAL

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	2614	FILED BY	Edward Van Gieson
PATENT CENTER #	63767020	FILING DATE	-
CUSTOMER #	93219	FIRST NAMED INVENTOR	Muthukrishnan Thukkaram
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Edward Van Gieson

Documents

TOTAL DOCUMENTS: 7

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
10256 US - Application Data Sheet.pdf	9	Application Data Sheet	2174 KB
10256 US - Declaration.pdf	5	Oath or Declaration filed	259 KB
10256 US - Petition to Accept Color Drawings-LET..docx	0	Miscellaneous Incoming Letter	30 KB

Warning: A supported heading was not detected. Please use a valid heading or select a document description from the drop down menu on the upload screen. The automatic document description has been replaced. Document has [Balance SBCS characters and DBCS characters] option enabled and may result in reduction of pages, however, no data or text has been modified.

10256 US - Specification-APP.TEXT.docx	29	Application body structured text document	45 KB

Warning: Bookmarks were found and have been removed. Text decorations have been removed.

10256 US - Power of Attorney.pdf	3	Power of Attorney	280 KB
10256 US - Specification.pdf	29	Auxiliary PDF of Application	156 KB
10256 US - Drawings.pdf	11	Drawings-only black and white line drawings	1227 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
10256 US - Application Data Sheet.pdf	2E99D6C6602DFED8F27DA2058956CFCF0D5E2DC1417F2E0C7255C6D1F2B0ED819992654DA4023C69328AFCAA1905FF6A5DC6FC1367902EC3E816D49F8E4B5546
10256 US - Declaration.pdf	D7D7E8F6315C05744E1C51B718F137243E51D1AD981D3C5E35A427BA923D2315469EF9720F8F8D961E4C1843AE080BC9F8235A323CD51AA35D15C4EA23FF5151
10256 US - Petition to Accept Color Drawings-LET..docx	D8142C0050522287301C7D9809BE52192CB5E930627DE4AAD22AC5E415E3EFB27A351D7E4B3F1A1C8C271BF8DEFCDF6B5C232829B9630960CB125876CC4CD62F
10256 US - Specification-APP.TEXT.docx	2F553D876F7A5E8FF7D516957D4837AC7F29637645129DDE63CA2E893D2B41DBCB6FFE0E172837365B048ABF3DA6C865CD3C0E39C63C5319222D8CDF725050D5
10256 US - Power of Attorney.pdf	5BABBB8B9DA4E560605E27727A0F04DCD97CB82087FBB596052940CFC1E1DCEA10F05D6BE294456A228ADC8D8A721FC895E5813C5993401710F42C189232D8F2

10256 US - Specification.pdf	E7AD706525AD14FA36DA275E31D691B3AA8E41A1E5D8F8F88EDB9B1087B2D0BF2F71B1CB5E08F1F58EDDB13AF21908884D75F373734475A88F1623E5E0D00887
10256 US - Drawings.pdf	0A59CE2242F7D12BBE196D91970ACECB8DC2DD1B2963736A4A47658E8A88D21A3539AA64B7D3D54F80FB3B8FB267D0DD849CC428EFE5F15C4E2AD44FE9551ED8

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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ELECTRONIC PAYMENT RECEIPT

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SYSTEM AND METHOD OF CREATING A SHADOW REPRESENTATION OF THE USER INTERFACE FOR FASTER UI ELEMENT RETRIEVAL

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APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	2614	FILED BY	Edward Van Gieson
PATENT CENTER #	63767020	AUTHORIZED BY	Edward Van Gieson
CUSTOMER #	93219	FILING DATE	-
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Muthukrishnan Thukkaram

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 1002	**E2023BRC49258143**	**Edward Van Gieson**

PRE-AUTHORIZED ACCOUNT	PRE-AUTHORIZED CATEGORY
603148	**37 CFR 1.16 (National application filing, search, and examination fees); 37 CFR 1.17 (Patent application and reexamination processing fees)**

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1111	UTILITY PATENT APPL. SEARCH FEE	700.00	1	700.00
1011	BASIC FILING FEE - UTILITY (PAPER FILING ALSO REQUIRES NON-ELECTRONIC FILING FEE UNDER 1.16(T))	320.00	1	320.00
1311	PATENT APPL. EXAMINATION FEE	800.00	1	800.00
1464	PETITIONS REQUIRING THE PETITION FEE SET FORTH IN 37	140.00	1	140.00

	CFR 1.17(H) (GROUP III)			
1202	EACH CLAIM IN EXCESS OF 20	100.00	1	100.00
			TOTAL AMOUNT:	**$2,060.00**

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	10875-10256-US
	Application Number	
Title of Invention	SYSTEM AND METHOD OF CREATING A SHADOW REPRESENTATION OF THE USER INTERFACE FOR FASTER UI ELEMENT RETRIEVAL	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Muthukrishnan		Thukkaram	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Bangalore	Country of Residence [i]	IN

Mailing Address of Inventor:

Address 1	c/o No.1289/1090E, 18th Cross Road, Sector 3		
Address 2	HSR Layout		
City	Bangalore	**State/Province**	KA
Postal Code	560102	**Country** [i]	IN

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Rahul		Mhambrey	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Bangalore	Country of Residence [i]	IN

Mailing Address of Inventor:

Address 1	c/o No.1289/1090E, 18th Cross Road, Sector 3		
Address 2	HSR Layout		
City	Bangalore	**State/Province**	KA
Postal Code	560102	**Country** [i]	IN

Inventor 3 Remove

Legal Name

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	Application Number	
Title of Invention	SYSTEM AND METHOD OF CREATING A SHADOW REPRESENTATION OF THE USER INTERFACE FOR FASTER UI ELEMENT RETRIEVAL	

Prefix	Given Name	Middle Name	Family Name	Suffix
	.		Anupriya	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Bangalore	Country of Residence [i]	IN

Mailing Address of Inventor:

Address 1	c/o No.1289/1090E, 18th Cross Road, Sector 3		
Address 2	HSR Layout		
City	Bangalore	**State/Province**	KA
Postal Code	560102	**Country** [i]	IN

Inventor 4 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Lalitashree		Ravi Hegde	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Bangalore	Country of Residence [i]	IN

Mailing Address of Inventor:

Address 1	c/o No.1289/1090E, 18th Cross Road, Sector 3		
Address 2	HSR Layout		
City	Bangalore	**State/Province**	KA
Postal Code	560102	**Country** [i]	IN

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	93219		
Email Address	docketing@patentlawworks.net	Add Email	Remove Email

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Application Information:

Title of the Invention	SYSTEM AND METHOD OF CREATING A SHADOW REPRESENTATION OF THE USER INTERFACE FOR FASTER UI ELEMENT RETRIEVAL		
Attorney Docket Number	10875-10256-US	**Small Entity Status Claimed** ☐	
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)		**Suggested Figure for Publication (if any)**	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☒ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	93219		

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Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the “Application Number” field blank.

Prior Application Status			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

			Remove
Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

PTO/AIA/14 (01-22)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	10875-10256-US
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Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

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Title of Invention	SYSTEM AND METHOD OF CREATING A SHADOW REPRESENTATION OF THE USER INTERFACE FOR FASTER UI ELEMENT RETRIEVAL	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

◉ Assignee	○ Legal Representative under 35 U.S.C. 117	○ Joint Inventor
○ Person to whom the inventor is obligated to assign.	○ Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	Whatfix Private Limited

Mailing Address Information For Applicant:

Address 1	No. 1289/1090E, 18th Cross Road, Sector 3		
Address 2	HSR Layout		
City	Bangalore	**State/Province**	KA
Country IN		Postal Code	560102
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button.

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

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Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Edward Van Gieson/			Date (YYYY-MM-DD)	2023-12-28
First Name	Edward	Last Name	Van Gieson	Registration Number	44386

Additional Signature may be generated within this form by selecting the Add button.

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	Application Number	
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This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1 The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

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SYSTEM AND METHOD OF CREATING A SHADOW REPRESENTATION OF THE USER INTERFACE FOR FASTER UI ELEMENT RETRIEVAL

TECHNICAL FIELD

[0001] The present disclosure is related to digital adoption platform technology and the retrieval of UI elements..

BACKGROUND

[0002] A digital adoption platform (DAP) is a type of software that is layered on top of another software, app, or website to help facilitate end user proficiency by helping to guide users through key tasks and provide contextual information as users navigate the user interface of the product. Users are provided with information to help familiarize them and become more proficient. This helps to drive adoption.

[0003] For example, a DAP may generate a help tip. Background information on an example DAP implementation is found in various sources, including U.S. Pat. No. 11,372,661 and U.S. Pat. No. 11,461,090, assigned to Whatfix Private Limited, the contents of each of which are hereby incorporated by reference. A DAP supports content authoring modules and content playback modules to generate, for example, smart tips as a user navigates elements of a user interface of an underlying software application.

[0004] A DAP supports content creators creating new flows or other guided features to enable higher adoption of client applications. Content Creators of the product can create content, record a flow, and the content is played back at the same flow as and when required when end-user clients navigate the client application. This requires the DAP to find the visual UI elements on the application the user is looking at (e.g., finding where the user's cursor is located on a graphical user interface.

[0005] One algorithm used for finding elements employs the UIAutomation library (the officially supported library from Microsoft® for .Net framework), which is primarily designed for automation testing, making it suboptimal for speed. Some example methods used in the industry include using the FindAll and FindFirst, to locate elements on the screen based on provided properties. FindFirst returns the first matching element, while FindAll retrieves all elements that match the given properties. Unfortunately, these approaches lack room for optimization, particularly when there is a large number of elements. For example, if a page contains more than 500 elements, the tree traversal can be quite slow, taking anywhere from 3 to 10 seconds.

[0006] It is possible to create walkthroughs using the standard FindAll API of the UIAutomation library. The desired elements are found using the methods of the UIAutomation library like FindAll and FindFirst which take about 3-10 seconds on most of the standard desktop applications. The time taken is much longer when the machines are low end. This performance is acceptable for applications which are meant for Automation but not for applications built for providing DAP assistance with guided flows that provide an acceptable user experience.

[0007] To mitigate performance issues when there is a large number of elements or a complete hierarchy, one option is to use element selectors. By providing an exact path or precise element matcher, the time it takes to find elements using FindFirst is reduced. This typically brings the finding time to under 5 seconds. However, the challenge lies in identifying the most optimal element selector, which is a complex and technical task. Even with the element selectors, the finding process might still exceed 5 seconds in some cases when trying to

locate elements deep within a tree hierarchy. This is due to the algorithm's internal use of Breadth First Search, which might not be the most efficient approach for such scenarios.

[0008] An unresolved problem in the prior art is that conventional algorithms have problems handling large numbers of elements or complex hierarchies. The automation APIs provided out of the box by major vendors are not optimized for speed as their core use case is process automation. However, for DAP, a delay of even 1 second is not acceptable from a user experience standpoint.

SUMMARY

[0009] A system and method are disclosed for creating a shadow representation of a user interface. In one implementation, the shadow representation may take the form of a shadow User Interface (UI) cache that is updated in response to detected structure change events. An exemplary application of the shadow UI cache and shadow representation is to improve the UI element retrieval for a digital adoption platform.

[0010] In one implementation, a method of finding visual user interface elements of a desktop application for a digital adoption platform (DAP) includes monitoring structure change automation events in a graphical user interface (GUI) of a target desktop application; updating a shadow UI cache representation of the UI screen elements in response to detecting structure change automation events; and in response to a request from a finder for screen element information to provide DAP assistance as a user navigates the target application, accessing the Shadow UI cache to search for screen element information to fulfill the request.

[0011] In one implementation, the method further includes utilizing a structure change event handler for detecting structure change automation events to the target desktop application.

[0012] In one implementation of the method, in response to a cache miss of the shadow UI cache, a traversal path engine is utilized to traverse a UI screen element tree hierarchy to search for one or more screen elements to fulfill the request from the finder.

[0013] In one implementation of the method, the method further includes initially populating the shadow UI cache utilized a FindAll API.

[0014] In one implementation the method further includes updating the shadow UI cache after a cache miss.

[0015] In one implementation, the method further includes removing one or more references to UI elements in the shadow UI cache in response to detecting a remove event.

[0016] In one implementation, the method further includes clearing the shadow UI cache in response to a pre-determined cache clearance condition.

[0017] In one implementation of the method, the structure change events include at least one of a child element added, a child element removed, children bulk added, children bulk removed, and children invalidated.

[0018] In one implementation of the method, the shadow UI cache comprises information associated with a set of IUIAutomation Elements corresponding to the visual screen elements of the UI.

[0019] In another implementation of a method the method is a computer-implemented method of finding visual user interface elements of a desktop application for a digital adoption platform (DAP. The method includes attaching a structure change event handler to a target application for which DAP assistance is to be provided as a user navigates a graphical user interface of the target application; initially populating a shadow UI cache with element information of the graphical user interface of the target application; monitoring structure change automation

events in the GUI of the target desktop application; updating a shadow UI cache representation of the UI screen elements in response to detecting structure change automation events; and in response to a request from a finder for screen element information to provide DAP assistance as a user navigates the target application, accessing the shadow UI cache to search for screen element information to fulfill the request.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] Figure 1 illustrates an embodiment of a DAP system with a shadow cache representation of a UI in accordance with an implementation.

[0021] Fig. 2A illustrates a User interface and associated UI tree.

[0022] Fig. 2B illustrates the user interface of Fig. 2A.

[0023] Fig. 2C illustrates the UI tree of Fig. 2A.

[0024] Fig. 3 illustrates a technical representation of a shadow UI cache in accordance with an implementation.

[0025] Fig. 4 illustrates an example of the use of a structure change event handler to handle the event raised when a UI automation tree structure has changed in accordance with an implementation.

[0026] Fig. 5 illustrates an example of structure change event types in accordance with an implementation.

[0027] Fig. 6 illustrates an example of a traversal path in accordance with an implementation.

[0028] Fig. 7 illustrates a visual representation of the traversal path in accordance with an implementation.

[0029] Fig. 8 illustrates a sequence diagram in accordance with an implementation.

[0030] Figs. 9A and 9B illustrate a general computer system environment for implementing a desktop application in accordance with an implementation.

DETAILED DESCRIPTION

[0031] Fig. 1 is a block diagram of a high-level implementation of an example of system for using a shadow User Interface (UI) cache for a digital adoption platform 103. The digital adoption platform 102 provides guidance for a target client application 101, which may, for example, be displayed on a display screen of a desktop computer 100. As an illustrative example, a target client application 101 running on the desktop of a client computer 100 generates a graphical user interface (GUI) 102 that is displayed on a computer display screen of the computer 100. The target client application may, for example, generate different application display screens (e.g., a calendar screen, a teleconference screen, etc.). The DAP 103 uses a finder 112 to find UI screen elements, which is important to provide the correct DAP guidance, such as help tips for the target client application.

[0032] In one implementation, the DAP 103 includes a DAP player process engine 104 to implement a player process; a Web component 106 to implement a Web process; a native system process engine 108 to implement a native process; and a guided assistance process engine 110 to implement a guided assistance process.

[0033] In one implementation, a shadow UI cache engine 128 caches UI information in a shadow UI cache 120, where the shadow UI cache 120 is a shadow representation of the UI interface tree. The shadow UI cache 120 supports fast element finding to reduce search time, especially when dealing with intricate and deep UI screen element tree hierarchies. Reducing the search time ensures that the DAP overlay elements are shown to the user with minimal

lag enhancing the user experience. Thus, an overall in the performance of the computing system is achieved for supporting DAP.

[0034] In one implementation, this shadow cache representation is created in real time (or near real time) while the user interacts with the target application. For example, a complex graphical user interface may have 500 to 30,000 screen elements. There is a time for a UI screen to be initially loaded. The initial population of the shadow UI cache 120 can occur in parallel while the screen is loading. In terms of user experience, users find a response time for DAP of greater than one second to not be consistent with a pleasant user experience. A finder response time of less than one second is desirable, with less than 500 ms being preferred.

[0035] The shadow UI cache representation is a collection of element references stored in cache memory for faster access. Once the shadow UI cache 120 is created, the find operations for UI elements are executed on this shadow UI cache instead of executing all the find operations on the actual target application. By leveraging this approach, a remarkable speed improvement is achieved while maintaining accuracy in element finding.

[0036] This cache-based method ensures that previously located UI elements are readily available for future queries, eliminating the need to repeatedly traverse the original UI. As a result, the find operations are executed with greatly improved efficiency, providing a seamless user experience even when dealing with complex UI structures.

[0037] The shadow UI cache 120 is temporary and has one or more rules for clearing the cache in response to detecting a cache clearance condition is satisfied. For example, a cache management and maintenance unit 138 may implement one or more rules to clear the cache, such as when the page changes, when the target application is closed, or when some other

condition is satisfied, such as a maximum elapsed time with no activity of the DAP (e.g., a half-hour, but more generally a configurable maximum elapsed time).

[0038] A shadow UI cache population rules module 136 may include rules for initially populating a shadow UI cache 120, such as populating a shadow UI cache 120 for a target application that is launched and for which DAP assistance is to be provided. Additionally, rules may be included for repopulating the shadow UI cache 120. More generally, the shadow UI cache 120 may be optimized in terms of space complexity. In one implementation, the initial population or repopulation of the shadow UI cache 120 is performed for the higher levels of a UI tree but not necessarily initially at all levels of the UI tree. For example, in a complex UI with many screen elements, the cache may be initially filled in at higher levels of the UI tree and then filled in at lower levels of the UI tree. There may be an optional sequence for populating levels of the hierarchy of the shadow UI cache. As an illustrative but non-limiting example, if a UI has 30,000 elements there may be some higher levels of the UI tree that a user is statistically more likely to explore first in terms of needing DAP assistance (e.g., in providing a tool tip) before other deeper levels.

[0039] In some use case scenarios, a single shadow UI cache 120 is used to support DAP assistance for a single target application. But an individual shadow UI cache 120 may be segmented; alternatively, two or more shadow UI caches 120 may be supported. Having a more complex cache structure may, for example, be used to support different cache regions for different target applications. For example, a user may have two or more target applications they interact with on their desktop. Support may be provided to implement a separate shadow UI cache region for each active target application, either as a segmented cache or as two separate caches. As another example, an individual target application may

have different application tags for different aspects of its operation which would have different event handles. For this situation, support may also be provided to implement a separate shadow UI cache region for each active target application, either as a segmented cache or as two separate caches.

[0040] In a preferred implementation, all the screen elements of a user interface screen are cached in a shadow UI cache 120 and updated in response to structural changes to support fast response. There is preferably an initial population of the cache and subsequent updates to the cache to reflect changes to the UI. However more generally, predictive techniques could be used in some situations to predict updates to be made in the cache.

[0041] While a set of defined trigger conditions may be defined for populating the cache, updating the shadow UI cache 120, and removing items from the cache, more generally many variations are possible. For example, the shadow UI cache 120 may be updated as the user navigates a visual UI of a target application.

[0042] A variety of features may be included to optimize performance, including one or more policies to minimize the effects of deleterious shadow UI cache misses 140. This may include fallback rules 144 to define when fallback policies are implemented to provide a more robust solution. Fallback rules may be provided to address the situation where the shadow UI cache 120 lacks an entry and implements an alternate approach to provide requested screen element information.

[0043] In one implementation, a structure change event listener 132 detects structure change automation events to the UI and triggers an update of the shadow UI cache 120. For example, as a user navigates a screen page of a target application, there may be updates to a portion of the UI.

[0044] A traversal path engine 146 may be provided to implement a traversal path algorithm to efficiently traverse a tree hierarchy in the event that cache 129 lacks an entry. A UI automation FindAll API module 150 may be included as an additional fallback technique or to initially populate or repopulate the cache.

[0045] A dictionary 142 may be supported to store mapping definitions. In one implementation, the dictionary includes entries for IUI automation elements and mapping information. In one implementation, the dictionary is of IUIAutomation elements mapped with reliable element properties. For example, a dictionary Dictionary<IntPtr, Dictionary<string, IUIAutomationElement>> may be implemented as a dictionary of IUIAutomation elements mapped with a combination of each elements' reliable properties such as control type, name, automation id and class name. This key value pair is then mapped with the control type and this cache is different for each window handle.{ wnd_handle, { Cache_key , { element }}.

[0046] The information cached in the shadow UI cache 120 provides consistent and rapid element retrieval, regardless of the page size or element depth. This approach doesn't require a reliance on selectors for speed enhancement. Instead, by leveraging structure change automation events, an efficient and responsive shadow caching mechanism is formed. This structure change event-driven approach is implemented to capture and update the shadow UI cache 120 only when necessary, significantly reducing the overhead associated with caching. As a result, the shadow cache representation supports speed improvements over conventional approaches. Dynamic rapid cache updates keep pace with dynamic changes in the user interface. Consequently, the caching mechanism remains highly relevant and responsive, ensuring an enhanced user experience and improved overall performance.

[0047] In one implementation, the shadow UI cache 120 is updated in response to detecting a structure change automation event. As an example, the Microsoft® UI Automation event notification is a key feature for assistive technologies such as screen readers and screen magnifiers. These UI Automation clients track events that are raised by UI Automation providers when something happens in the UI and that use the information to notify end users. Structure change events are one of them.

[0048] Fig. 2A illustrates a representation of an application UI (left, shown in more detail in Fig. 2B) along with the corresponding UI Tree (right, shown in more detail in Fig. 2C). The shadow UI cache tries to replicate the same UI tree but in cache memory. In this example, the UI screen is for a contact wizard with a selection of contact attribute fields, some of which are highlighted.

[0049] Fig. 3 illustrates an example of a representation of a shadow UI cache using UI Automation techniques. The use of UIAutomation provides a way to attach a listener to a window handle for capturing structure changes in the UI called a StructureChangeEvent. This is similar to MutationObservers in Javascript. In the example of Fig. 3, a set of IUIAutomation Elements is illustrated representing a set of panes and buttons corresponding to the screen elements of a UI.

[0050] In one implementation, a shadow UI cache representation is generated of the currently active window the first time the DAP interacts with the target application. Finder calls are then run off of this shadow UI cache, which supports the finder returning results quickly, often within a few milliseconds, depending on implementation details. As discussed below in more detail, various optimizations may be utilized with the StructureChangeEvent approach to make the entire finder process faster for desktop applications.

[0051] An aspect of the operation of a StructureChangedEventHandler (or MutationObserver for Desktop) will now be described with regards to Fig. 4. Fig. 4 illustrates a shadow UI cache 120, a finder request from a finder, and a structure change event handler that is attached to a target application to detect structural changes to a UI such as a child added, a child removed, child bulk added, and child bulk removed. Fig. 5 is a table illustrating in more detail examples of structural changes for examples of different structure change types.

[0052] The structure change event handler represents a method implemented to handle the event raised when the UI Automation tree structure has changed. This is similar to the JavaScript MutationObserver interface which provides the ability to watch for changes being made to the DOM tree. In one implementation, a listener is attached to the target application for listening to structure change events. This listener receives child added and removed events along with the automation elements inside the handler. This event data is used to populate the shadow UI cache. Then finder requests do their first lookup in the shadow UI cache before falling back to default finder techniques to find elements from the application directly using UIAutomation Find* APIs.

[0053] There are a variety of considerations to consider in using a structure change event that may result in a cache miss. For some elements, the structure change event comes even before the element was created so a COM exception is thrown when properties are retrieved. Some elements do not send a structure change event. Also, some elements when added raise an event with ZERO positions, which means that positions are needed for showing the tooltips. This occurs mainly when the element is still rendering on the UI. The shadow UI cache will thus occasionally have some cache misses unless additional steps are used to reduce or

eliminate cache misses. To address the cache miss issues, additional steps may be taken. This includes the use of one or both of a traversal path algorithm and a cache update using FindAll.

[0054] The traversal path engine 146 implements a traversal path algorithm to determine a traversal path for a traversal path finder. The traversal path finder requires the traversal path to be captured during a picking stage. The picker 148 captures the path in a tree format which is easier to deserialize to an exact path. In one implementation, this is based on the principle of best-case time complexity of the tree traversal algorithm when the exact path of the element is clearly known. Then the time to reach the element is at worst the depth of the tree. The picker captures the path in a tree format which is easier to deserialize to an exact path. The traversed element data structure contains properties like name, control type, index, and child element.

[0055] In one implementation, the finder utilizes a Breadth First Search so the traversal time is extremely high when the element to be reached is very deep in the tree. The traversal path finder also requires the traversal path to be captured during the picking stage.

[0056] A sample traversal path captured is illustrated in Fig. 6. A visual representation of the traversal path is shown in Fig. 7. The blue line, B, in the Fig. 7 represents the number of jumps needed to reach the element we are interested in. The red line, R, represents the number of jumps needed in the tree traversal algorithm. The worst-case time complexity is that the depth of the tree is usually not more than 20 in most of the UI applications even with more than 20,000 elements. So, the traversal-based finder would find quickly or also fail quickly if there is a change in the path.

[0057] In one implementation, whenever there is a miss in the cache, there is a fallback to the traversal path and a return of the element. In one implementation, after an element is returned, the algorithm tries to re-populate the cache using the FindAll API to ensure the missing element is back in the cache.

[0058] Fig. 8 is an interaction sequence diagram that illustrates an example of an overall process that may be implemented in a system 180 of Fig. 1. The sequence diagram illustrates interactions between a web component 106 (for the DAP to make requests for element information and receive responses), a finder 112, a shadow UI cache 120, a traversal path 146, and a target application 101 (the application for which help information is to be provided).

[0059] A request 812 is sent from the Web component 106 to the finder 112 and a response 814 is received from the finder. The finder 112 attempts to find the screen element information in the shadow UI cache 120 using a combination of properties, as illustrated by arrow 816. The Web component 106 is the component that contains the main framework for the DAP. The Web component 802 is responsible for creation of requests based on search criteria and processing the response to show the DAP content.

[0060] In one implementation, the finder request is a request to find the target UI elements. The finder request has all necessary properties of the element that is required for the find operation. In one implementation, a native component is the component that is responsible for interacting and finding the elements on the desktop application using the finder functions.

[0061] The shadow UI cache 120 in this implementation is implemented to shadow the tree structure of the target application.

[0062] As illustrated by arrow 810, a structure change event is illustrated. This is supported by accessibility enablement and an event listener. During the process of enabling accessibility features, a structure change event listener is attached to the root element of the target application to monitor for structure change events. This listener is responsible for detecting changes in the UI structure. Accessibility refers to the ability of an application or software system to be programmatically accessed and interacted with by assistive technologies or automated testing frameworks. It involves providing an accessible interface that allows external programs or tools to navigate, query, and interact with the user interface (UI) elements of an application.

[0063] In one implementation, the structure change events 810 are events sent by the element whose structure is changed along with the runtime id. For example, the structure change events in one implementation includes ChildAdded, ChildBulkAdded, ChildRemoved and ChildBulkRemoved, which are all events sent by the element whose structure is changed along with the runtime id. Based on the type of event the cache is modified.

[0064] In one implementation, the shadow UI cache 120 is constructed in response to the event listener initiating the construction of a shadow UI cache, which stores elements for which the structure change event is raised. Elements affected by structural changes are stored within this cache for quick access.

[0065] As an illustrative example, consider initial finder request handling. When a finder request is received from the web component 106 to the native component, the element search is initially attempted within the shadow UI cache 120. The key used for storing elements in the shadow UI cache corresponds to their structural attributes. If the shadow UI cache 120 stores the elements to respond to the find request, the elements are provided 818 to the finder 112.

[0066] As illustrated by arrows 820 and 822, there is support for a fallback approach via Traversal Path 146 Algorithm. If the requested element is not found in the shadow UI cache 120, the traversal path algorithm is invoked to locate the element. This algorithm navigates through the UI hierarchy based on specific criteria to identify the target element. If the traversal path locates the elements for the find request, it sends them 824 to the finder 112.

[0067] A secondary fallback approach can also be provided. An example of a secondary fallback approach is UIAutomation FindAll Method (Conditional). This secondary fallback approach is employed in cases where the traversal path algorithm is unsuccessful, a fallback to the UIAutomation FindAll method is employed. This method retrieves a list of elements from which the final list of found elements is then filtered.

[0068] As illustrated by arrow 826, a shadow UI cache population/repopulation process may be included. An example population process includes the shadow UI cache being repopulated using the FindAll method on the root element. This ensures that all elements in the UI tree are captured in the cache, including those that may have been missed during the structure change event.

[0069] As illustrated by arrow 828, cache management and maintenance rules may be implemented to clear the shadow UI cache 120. The cache management and maintenance rules may include clearing elements of the shadow UI cache 120 in response to a child removed event received from the structure change event. Additionally, a rule may be implemented to clear the shadow UI cache according to other rules, such as clearing the cache periodically according to a schedule (e.g., scheduled every half an hour) to prevent memory leaks in cases where no child removed event is detected. The shadow UI cache is

reconstructed when a structure change child added event is received, ensuring its accuracy for subsequent finder requests.

[0070] It will be understood that the desktop computer may be implemented in a conventional computer architecture to support execution of computer software of the target application and DAP operation and performing the processes previously discussed Fig. 9A illustrates an example desktop computer and Fig. 9B represented configured modules. As illustrated by Fig. 9B, a desktop computing environment may include a processor 908, a memory 910, a communication unit 904, an output device 914, an input device 912, and a data store 920, which may be communicatively coupled by a communication bus 902. The communication unit 904 may support communication over a network such as the Internet. The desktop computing system may support operation of the target application and the DAP. The computing system of Fig. 9A and Fig. 9B is provided by way of example and it should be understood that it may take other forms and include additional or fewer components without departing from the scope of the present disclosure. For instance, various components of the computing device may be coupled for communication using a variety of communication protocols and/or technologies including, for instance, communication buses, software communication mechanisms, computer networks, etc. While not shown, the computing system may include various operating systems, sensors, additional processors, and other physical configurations. The processor 908, memory 910, communication unit 904, etc., are representative of one or more of these components.

[0071] The overall finder process can be implemented to provide efficient and reliable element identification within the UI automation process, considering both real-time structural changes and scenarios where cached data might need updating. One aspect is that building a shadow

UI cache on the structure change event is a reliable trigger source with good performance to build the cache and is observed to be raised in almost all the general accessibility compliant applications. The speed improvement varies from application to application. On average it has become 80% faster over existing solutions and irrespective of the size of the application tree, the find time is less than 200 ms and in the best case with high end machines the time is even less than 50 ms. However, as previously discussed less than a 1 second find time is necessary to have a satisfactory user experience with less than 500 ms being preferred to have a satisfactory user experience.

[0072] Table 1, below, summarizes speed improvements for different applications.

Application	**Speed Improvement**	**Before (in ms)**	**After (in ms)**
Acturis	~88%	1943	232
Exceedra	~81%	1848	383
Teams	~70%	712	210

[0073] Table 1

[0074] The cached properties using the FindAllAndBuildCache method aids the fetching of properties of the element in a shorter time, reducing the number of IPC (Inter Process Communication) calls made to the application in comparison to alternate approaches.

[0075] IPC calls often create performance impact on an application as they continuously interact with the application to fetch required information and hence increase the overall CPU and memory usage. With the help of FindAllAndBuildCache, the required properties are cached in a manner that does require excessive IPC calls to the application. This improves the

performance and reduces the CPU and memory consumption and thus reduces the load on the application put by the finder.

[0076] The use of the shadow UI cache can be performed with high accuracy, because of the element detection which starts with shadow UI cache followed (as necessary as a backup) by the traversal path and FindAll API, making it nearly impossible to not find the element. The system of Fig. 1 implements an innovative cache-based approach that significantly boosts performance without the need for selectors. In one implementation, a shadow UI cache representation of the real user interface of a target application is created using detected structure change events.

[0077] In the above description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the present disclosure. However, it should be understood that the technology described herein can be practiced without these specific details. Further, various systems, devices, and structures are shown in block diagram form in order to avoid obscuring the description. For instance, various implementations are described as having particular hardware, software, and user interfaces. However, the present disclosure applies to any type of computing device that can receive data and commands, and to any peripheral devices providing services.

[0078] In some instances, various implementations may be presented herein in terms of algorithms and symbolic representations of operations on data bits within a computer memory. An algorithm is here, and generally, conceived to be a self-consistent set of operations leading to a desired result. The operations are those requiring physical manipulations of physical quantities. Usually, though not necessarily, these quantities take the form of electrical or magnetic signals capable of being stored, transferred, combined,

compared, and otherwise manipulated. It has proven convenient at times, principally for reasons of common usage, to refer to these signals as bits, values, elements, symbols, characters, terms, numbers, or the like.

[0079] To ease description, some elements of the system and/or the methods are referred to using the labels first, second, third, etc. These labels are intended to help to distinguish the elements but do not necessarily imply any particular order or ranking unless indicated otherwise.

[0080] It should be borne in mind, however, that all of these and similar terms are to be associated with the appropriate physical quantities and are merely convenient labels applied to these quantities. Unless specifically stated otherwise as apparent from the following discussion, it is appreciated that throughout this disclosure, discussions utilizing terms including "processing," "computing," "calculating," "determining," "displaying," or the like, refer to the action and processes of a computer system, or similar electronic computing device, that manipulates and transforms data represented as physical (electronic) quantities within the computer system's registers and memories into other data similarly represented as physical quantities within the computer system memories or registers or other such information storage, transmission or display devices.

[0081] Various implementations described herein may relate to an apparatus for performing the operations herein. This apparatus may be specially constructed for the required purposes, or it may comprise a general-purpose computer selectively activated or reconfigured by a computer program stored in the computer. Such a computer program may be stored in a computer readable storage medium, including, but is not limited to, any type of disk including floppy disks, optical disks, CD ROMs, and magnetic disks, read-only memories

(ROMs), random access memories (RAMs), EPROMs, EEPROMs, magnetic or optical cards, flash memories including USB keys with non-volatile memory or any type of media suitable for storing electronic instructions, each coupled to a computer system bus.

[0082] The technology described herein can take the form of an entirely hardware implementation, an entirely software implementation, or implementations containing both hardware and software elements. For instance, the technology may be implemented in software, which includes, but is not limited to, firmware, resident software, microcode, etc. Furthermore, the technology can take the form of a computer program object accessible from a computer-usable or computer-readable medium providing program code for use by or in connection with a computer or any instruction execution system. For the purposes of this description, a computer-usable or computer readable medium can be any non-transitory storage apparatus that can contain, store, communicate, propagate, or transport the program for use by or in connection with the instruction execution system, apparatus, or device.

[0083] A data processing system suitable for storing and/or executing program code may include at least one processor coupled directly or indirectly to memory elements through a system bus. The memory elements can include local memory employed during actual execution of the program code, bulk storage, and cache memories that provide temporary storage of at least some program code in order to reduce the number of times code must be retrieved from bulk storage during execution. Input or I/O devices (including, but not limited to, keyboards, displays, pointing devices, etc.) can be coupled to the system either directly or through intervening I/O controllers.

[0084] Network adapters may also be coupled to the system to enable the data processing system to become coupled to other data processing systems, storage devices, remote printers, etc.,

through intervening private and/or public networks. Wireless (e.g., Wi-FiTM) transceivers, Ethernet adapters, and Modems, are just a few examples of network adapters. The private and public networks may have any number of configurations and/or topologies. Data may be transmitted between these devices via the networks using a variety of different communication protocols including, for example, various Internet layer, transport layer, or application layer protocols. For example, data may be transmitted via the networks using transmission control protocol / Internet protocol (TCP/IP), user datagram protocol (UDP), transmission control protocol (TCP), hypertext transfer protocol (HTTP), secure hypertext transfer protocol (HTTPS), dynamic adaptive streaming over HTTP (DASH), real-time streaming protocol (RTSP), real-time transport protocol (RTP) and the real-time transport control protocol (RTCP), voice over Internet protocol (VOIP), file transfer protocol (FTP), WebSocket (WS), wireless access protocol (WAP), various messaging protocols (SMS, MMS, XMS, IMAP, SMTP, POP, WebDAV, etc.), or other known protocols.

[0085] Finally, the structure, algorithms, and/or interfaces presented herein are not inherently related to any particular computer or other apparatus. Various general-purpose systems may be used with programs in accordance with the teachings herein, or it may prove convenient to construct more specialized apparatus to perform the required method blocks. The required structure for a variety of these systems will appear from the description above. In addition, the specification is not described with reference to any particular programming language. It will be appreciated that a variety of programming languages may be used to implement the teachings of the specification as described herein.

[0086] The foregoing description has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the specification to the precise

form disclosed. Many modifications and variations are possible in light of the above teaching. As will be understood by those familiar with the art, the specification may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. Likewise, the particular naming and division of the modules, routines, features, attributes, methodologies, and other aspects are not mandatory or significant, and the mechanisms that implement the specification or its features may have different names, divisions and/or formats.

[0087] Furthermore, the modules, routines, features, attributes, methodologies, and other aspects of the disclosure can be implemented as software, hardware, firmware, or any combination of the foregoing. Also, wherever a component, an example of which is a module, of the specification is implemented as software, the component can be implemented as a standalone program, as part of a larger program, as a plurality of separate programs, as a statically or dynamically linked library, as a kernel loadable module, as a device driver, and/or in every and any other way known now or in the future. Additionally, the disclosure is in no way limited to implementation in any specific programming language, or for any specific operating system or environment.

[0088] In the above description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the present disclosure. However, it should be understood that the technology described herein can be practiced without these specific details. Further, various systems, devices, and structures are shown in block diagram form in order to avoid obscuring the description. For instance, various implementations are described as having particular hardware, software, and user interfaces. However, the present

disclosure applies to any type of computing device that can receive data and commands, and to any peripheral devices providing services.

WHAT IS CLAIMED IS:

1. A computer-implemented method of finding visual user interface elements of a desktop application for a digital adoption platform (DAP), comprising:

monitoring structure change automation events in a graphical user interface (GUI) of a target desktop application;

updating a shadow UI cache representation of the UI screen elements in response to detecting structure change automation events; and

in response to a request from a finder for screen element information to provide DAP assistance as a user navigates the target application, accessing the Shadow UI cache to search for screen element information to fulfill the request.

2. The computer-implemented method of claim 1, further comprising utilizing a structure change event handler for detecting structure change automation events to the target desktop application.

3. The computer-implemented method of claim 1, wherein in a response to a cache miss of the shadow UI cache, a traversal path engine is utilized to traverse a UI screen element tree hierarchy to search for one or more screen elements to fulfill the request from the finder.

4. The computer-implemented method of claim 1, further comprising initially populating the shadow UI cache utilized a FindAll API.

5. The computer-implemented method of claim 1, further comprising updating the shadow UI cache after a cache miss.

6. The computer-implemented method of claim 1, further comprising removing one or more references to UI elements in the shadow UI cache in response to detecting a remove event.

7. The computer-implemented method of claim 1, further comprising clearing the shadow UI cache in response to a pre-determined cache clearance condition.

8. The computer-implemented method of claim 1, wherein the structure change events include at least one of a child element added, a child element removed, children bulk added, children bulk removed, and children invalidated.

9. The computer-implemented method of claim 1, wherein the shadow UI cache comprises information associated with a set of IUIAutomation Elements corresponding to the visual screen elements of the UI.

10. A computer-implemented method of finding visual user interface elements of a desktop application for a digital adoption platform (DAP), comprising:

attaching a structure change event handler to a target application for which DAP assistance is to be provided as a user navigates a graphical user interface of the target application;

initially populating a shadow UI cache with element information of the graphical user interface of the target application;

monitoring structure change automation events in the GUI of the target desktop application;

updating a shadow UI cache representation of the UI screen elements in response to detecting structure change automation events; and

in response to a request from a finder for screen element information to provide DAP assistance as a user navigates the target application, accessing the shadow UI cache to search for screen element information to fulfill the request.

11. The computer-implemented method of claim 10, wherein in a response to a cache miss of the Shadow UI cache, a traversal path engine is utilized to traverse a UI screen element tree hierarchy to search for one or more screen elements to fulfill the request from the finder.

12. The computer-implemented method of claim 11, where the shadow UI cache is updated in response to the cache miss.

13. The computer-implemented method of claim 10, further comprising populating the shadow UI cache utilized a FindAll API.

14. The computer-implemented method of claim 10, further comprising removing one or more references to UI elements in the shadow UI cache in response to detecting a remove event.

15. The computer-implemented method of claim 10, further comprising clearing the shadow UI cache in response to a pre-determined cache clearance condition.

16. The computer-implemented method of claim 10, wherein the structure change events include at least one of a child element added, a child element removed, children bulk added, children bulk removed, and children invalidated.

17. The computer-implemented method of claim 10, wherein the shadow UI cache comprises information associated with a set of IUIAutomation Elements corresponding to the visual screen elements of the UI.

18. The computer-implemented method of claim 10, wherein a finder time is less than 1 second.

19. The computer-implemented method of claim 10, wherein a finder time is less than 500 milliseconds.

20. The computer implemented method of claim 10, wherein the shadow UI cache stores screen element reference represents a tree hierarchy of a user interface.

21. The computer implemented method of claim 10, wherein the shadow UI cache is a region of cache memory devoted to caching element information for a particular type of target application.

ABSTRACT

A system and method are disclosed for creating a shadow representation of a user interface. The shadow representation which may take the form of a shadow UI cache is updated in response to detected structure change events. An exemplary application of the shadow representation is to improve the UI element retrieval for a digital adoption platform.

IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE

FIRST INVENTOR:	Muthukrishnan Thukkaram
APPLICATION NO:	Not Yet Known
FILING DATE:	Not Yet Known
TITLE:	SYSTEM AND METHOD OF CREATING A SHADOW REPRESENTATION OF THE USER INTERFACE FOR FASTER UI ELEMENT RETRIEVAL
EXAMINER:	Not Yet Known
GROUP ART UNIT:	Not Yet Known
ATTY. DKT. NO:	10875-10256-US
CONFIRMATION NO:	Not Yet Known

CERTIFICATE OF EFS-WEB TRANSMISSION

Pursuant to 240 OG 45 and the Legal Framework For EFS-Web, I hereby certify that this follow-on correspondence is being officially submitted through the USPTO EFS-Web system from the Pacific Time Zone of the United States on the local date shown below:

Dated: 12/28/2023 By: /Edward Van Gieson/

Edward Van Gieson, Reg. No. 44,386

COMMISSIONER FOR PATENTS
P.O. BOX 1450
ALEXANDRIA, VA 22313-1450

PETITION UNDER 37 CFR 1.84(A)(2) TO ACCEPT COLOR DRAWINGS

Sir/Madam:

Pursuant to 37 CFR 1.84(a)(2), color drawings have been submitted in this application. The color drawings are necessary as the only practical medium by which aspects of the claimed subject matter may be accurately conveyed. In particular, Figures 7 utilizes color to illustrate examples of traversal paths. A visual understanding of the traversal path is enhanced by the use of color drawings.

Copies of this application publication with color drawing(s) will be provided by the Office upon request and payment of the necessary fee.

As the color drawings are being filed electronically via EFS-Web, only one set of the drawings is submitted.

As required by 37 CFR 1.84(a)(2), enclosed are the following documents:

☒ Enclosed are:

☒ one set of color drawings,

☒ petition fee set forth in §1.17(h)in the amount of $140.

The Commissioner is hereby authorized to charge any deficiency in fees (including any excess claim fee or any extension fee required to ensure that this paper is timely filed), or to credit any overpayment, to Deposit Account No. 603148.

Respectfully submitted,
WHATFIX PRIVATE LIMITED

Dated: 12-28-2023 By: /Edward Van Gieson/

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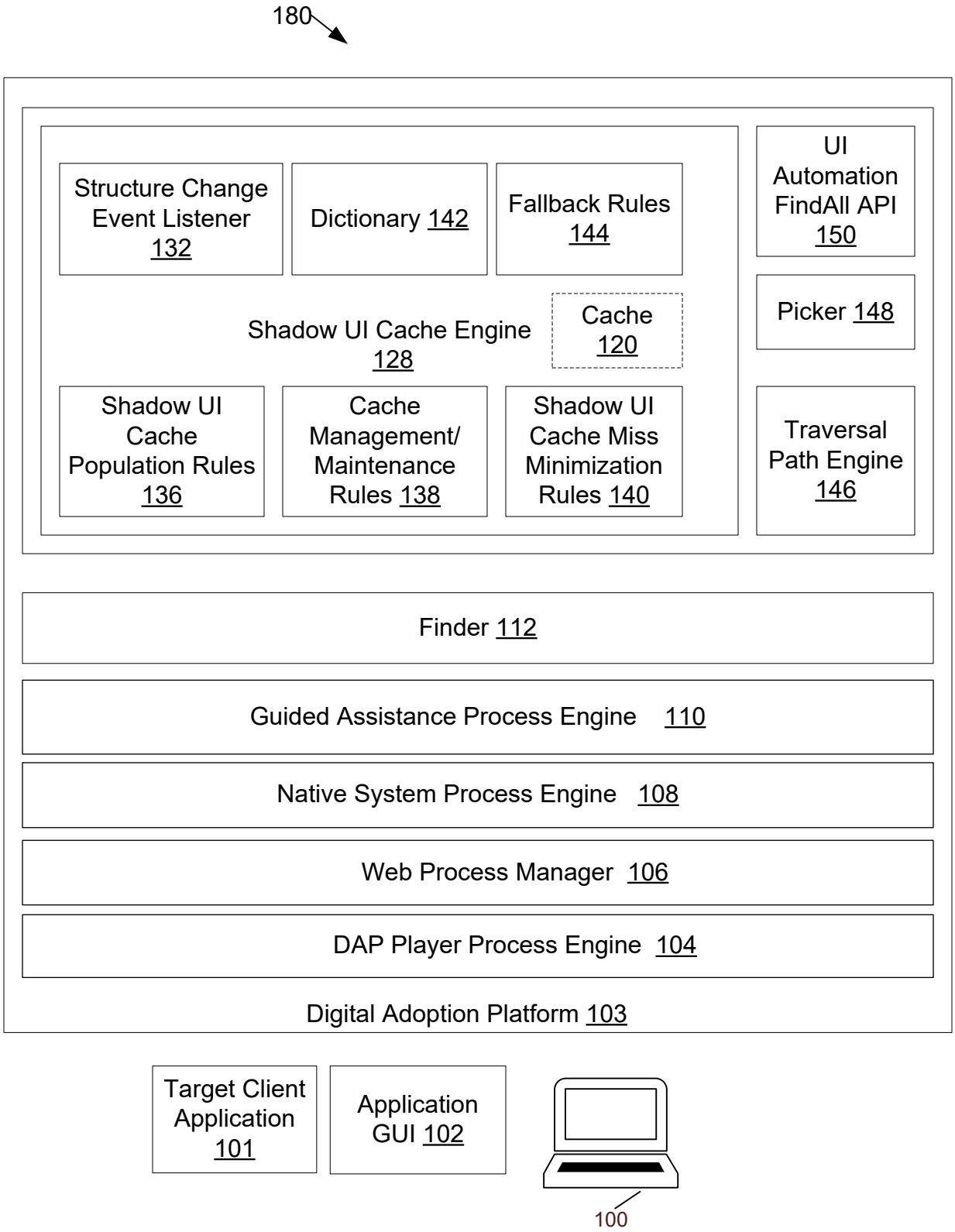
180
Structure Change Event Listener 132
Dictionary 142
Fallback Rules 144
UI Automation FindAll API 150
Shadow UI Cache Engine 128
Cache 120
Picker 148
Shadow UI Cache Population Rules 136
Cache Management/ Maintenance Rules 138
Shadow UI Cache Miss Minimization Rules 140
Traversal Path Engine 146
Finder 112
Guided Assistance Process Engine 110
Native System Process Engine 108
Web Process Manager 106
DAP Player Process Engine 104
Digital Adoption Platform 103
Target Client Application 101
Application GUI 102
100

Fig. 1

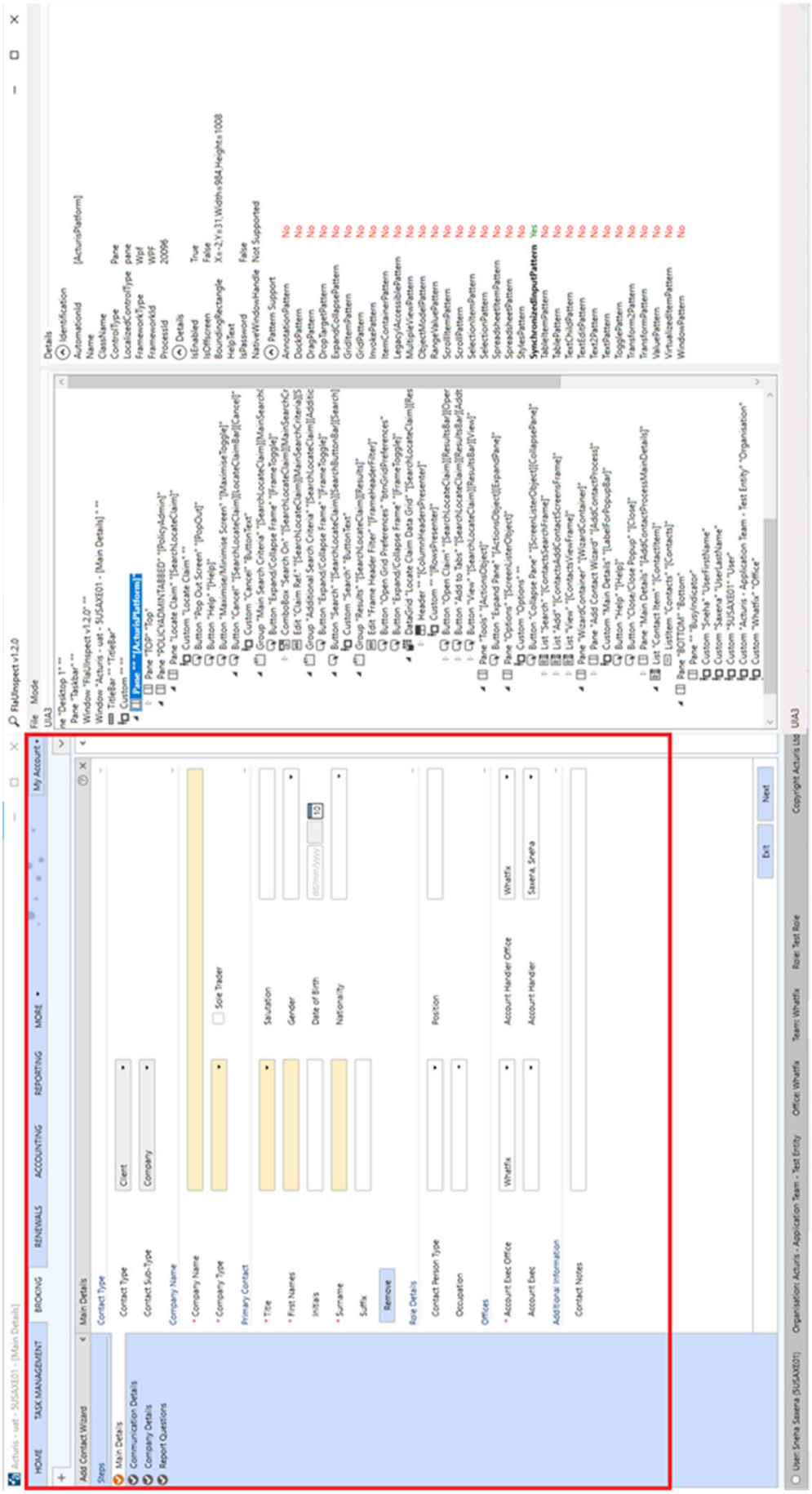

Fig. 2A

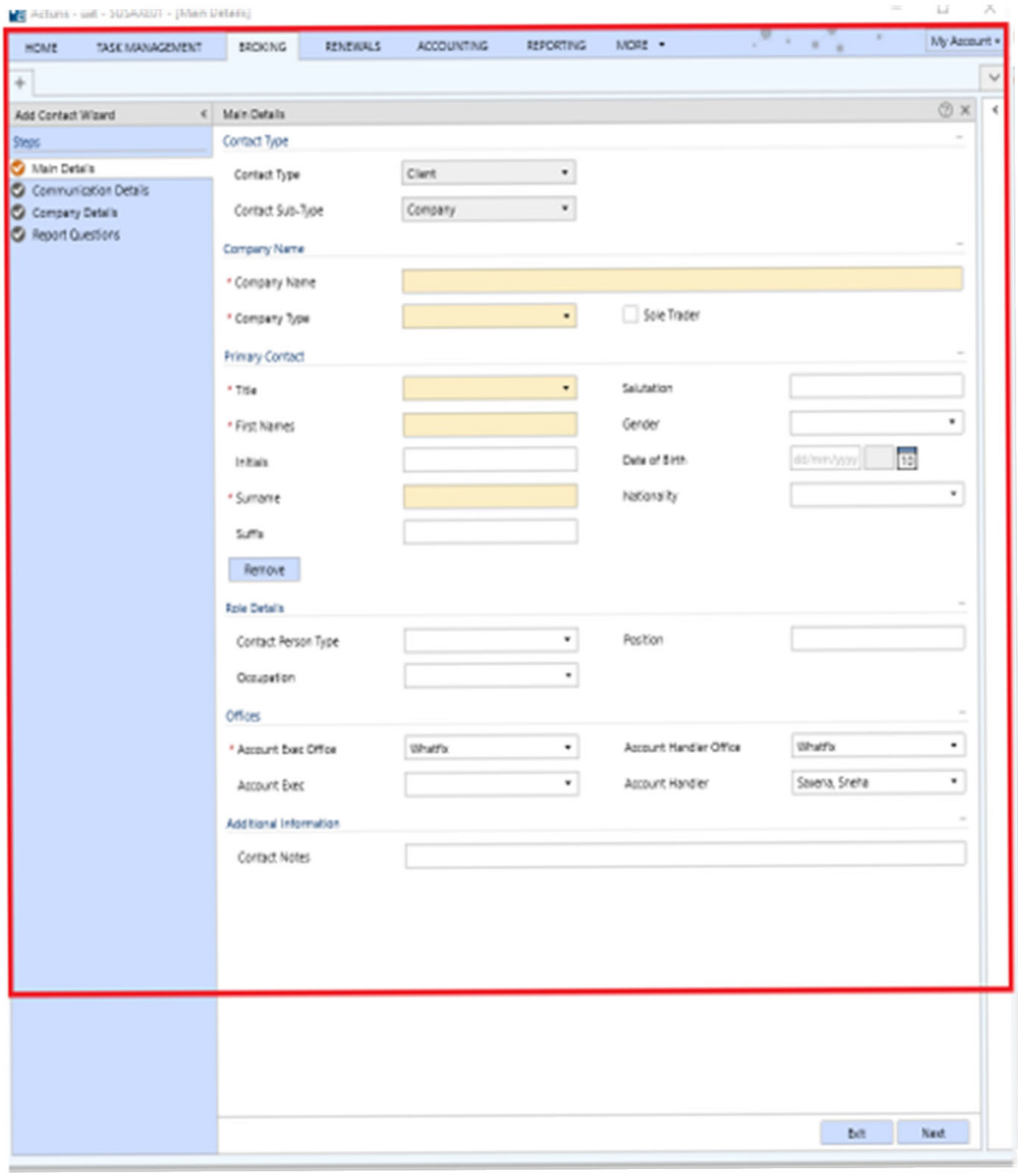
HOME
TASK MANAGEMENT
BROKING
RENEWALS
ACCOUNTING
REPORTING
MORE
My Account
Add Contact Wizard
Steps
Main Details
Communication Details
Company Details
Report Questions
Main Details
Contact Type
Contact Type
Client
Contact Sub-Type
Company
Company Name
* Company Name
* Company Type
Sole Trader
Primary Contact
* Title
Salutation
* First Names
Gender
Initials
Date of Birth
* Surname
Nationality
Suffix
Remove
Role Details
Contact Person Type
Position
Occupation
Offices
* Account Exec Office
Whatfix
Account Handler Office
Whatfix
Account Exec
Account Handler
Saxena, Sneha
Additional Information
Contact Notes
Exit
Next

Fig. 2B

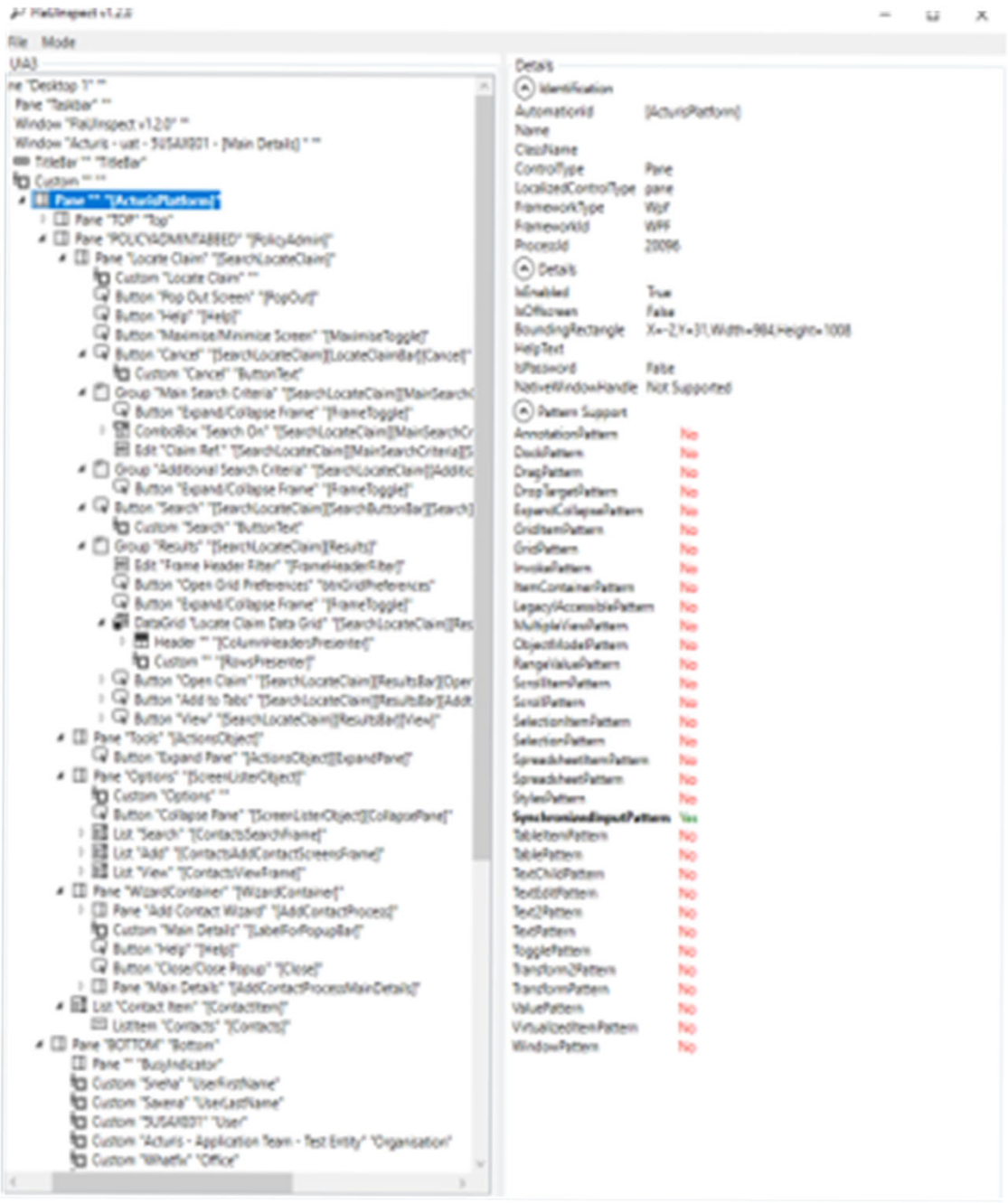

Fig. 2C

```
{
   16248:{
      "pane[Acturis Platform]": <IUIAutomationElement1>,
      "paneTOPtop": <IUIAutomationElement2>,
      "pane[policy Admin]policyAdminTabbed": <IUIAutomationElement3>,
      "ButtonOpen Grid Preferances": <IUIAutomationElement4>,
      "ButtonOpen Collapse Pane": <IUIAutomationElement5>,
      "ButtonOpen Expand Pane": <IUIAutomationElement6>,
      "pane":{
         "1268_2276_20096": <IUIAutomationElement1>,
         "7671_2323_20096": <IUIAutomationElement2>,
         "1345_7890_20096": <IUIAutomationElement3>,
      },
      "button":{
         "1254_2356_20096": <IUIAutomationElement1>,
         "4349_6783_20096": <IUIAutomationElement2>,
         "2537_6351_20096": <IUIAutomationElement3>,
      }
      }
}
```

Fig. 3

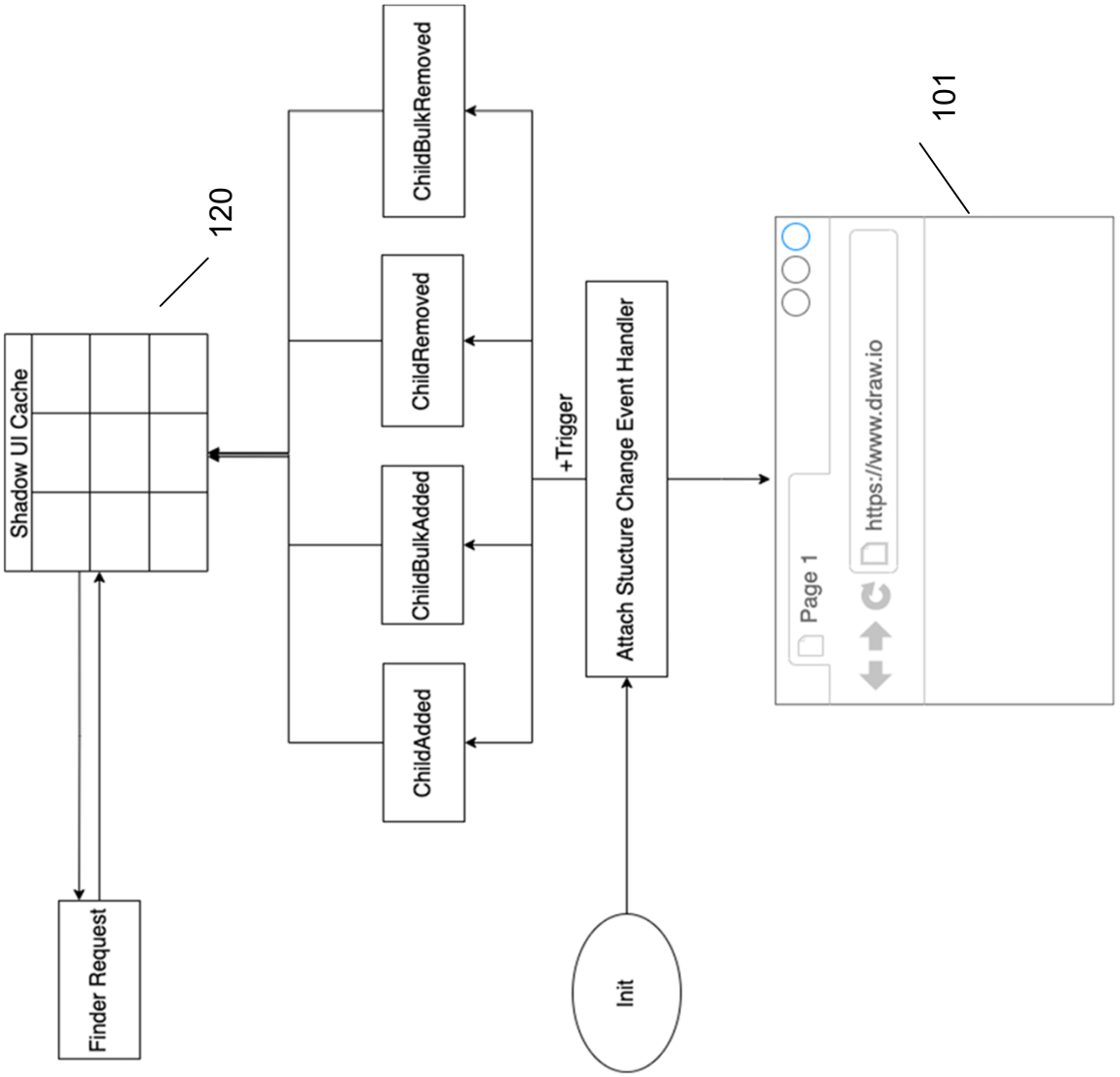
120
Shadow UI Cache
Finder Request
ChildBulkRemoved
ChildRemoved
ChildBulkAdded
ChildAdded
+Trigger
Attach Stucture Change Event Handler
Init
101
Page 1
https://www.draw.io

Fig. 4

event.structureChangeType	event.sender	event.runtimeId
ChildAdded	The child that was added.	The child that was added.
ChildRemoved	The parent of the child that was removed.	The child that was removed.
ChildrenBulkAdded	The parent of the children that were added.	The parent of the children that were added.
ChildrenBulkRemoved	The parent of the children that were removed.	The parent of the children that were removed.
ChildrenInvalidated	The parent of the children that were invalidated.	The parent of the children that were invalidated.

Fig. 5

```
{
  "Name":"Microsoft Teams",
  "ControlType":50030,
  "Index":0,
  "ChildElement":{
     "Name":"Desktop-internal, General channel content",
     "ControlType":50026,
     "Index":14,
     "ChildElement":{
        "Name":"message list",
        "ControlType":50026,
        "Index":0,
        "ChildElement":{
           "Name":"05 July 2022",
           "ControlType":50020,
           "Index":13,
           "ChildElement":null
        }
     }
  }
}
```


Fig. 6

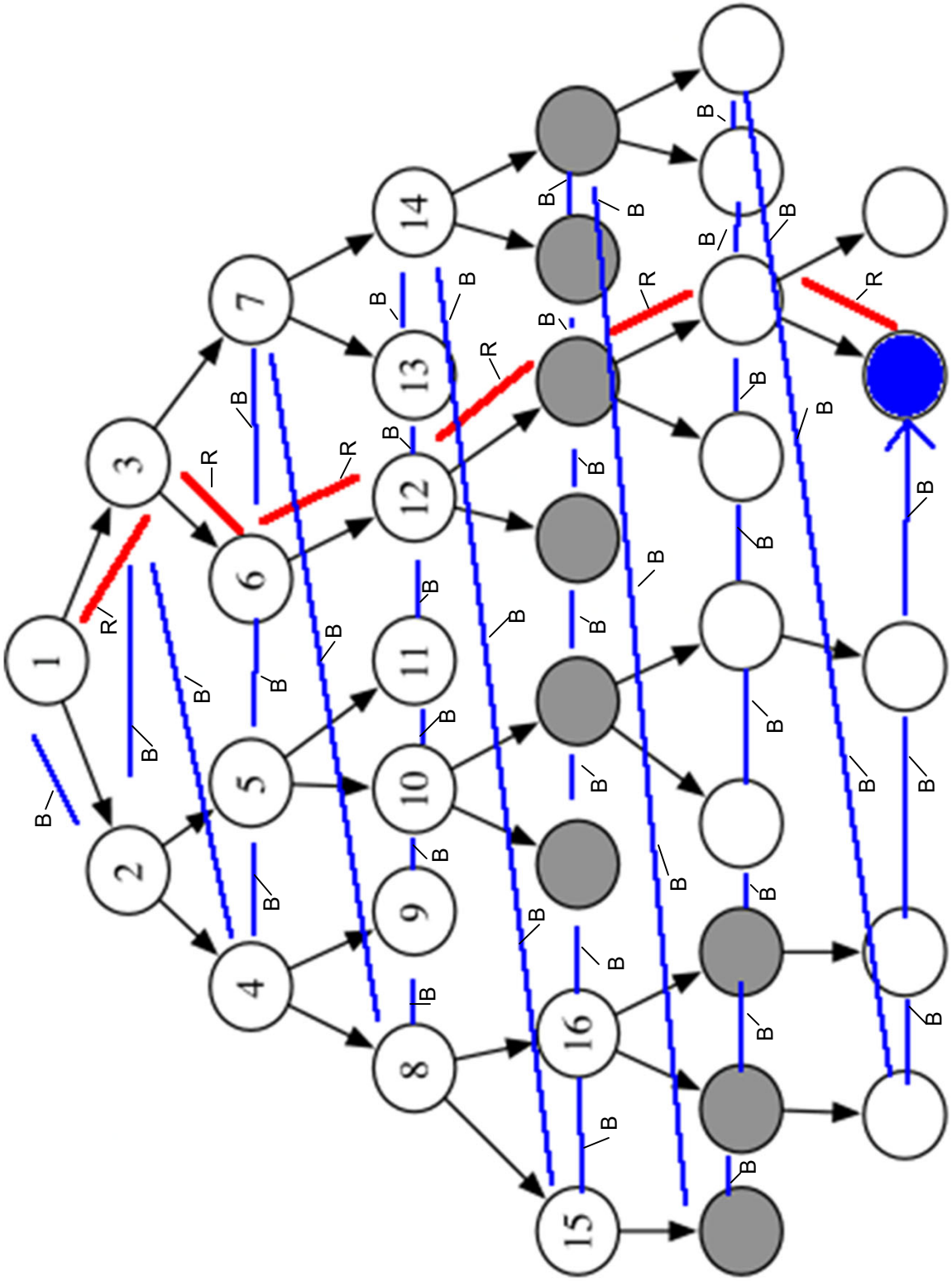

Fig. 7

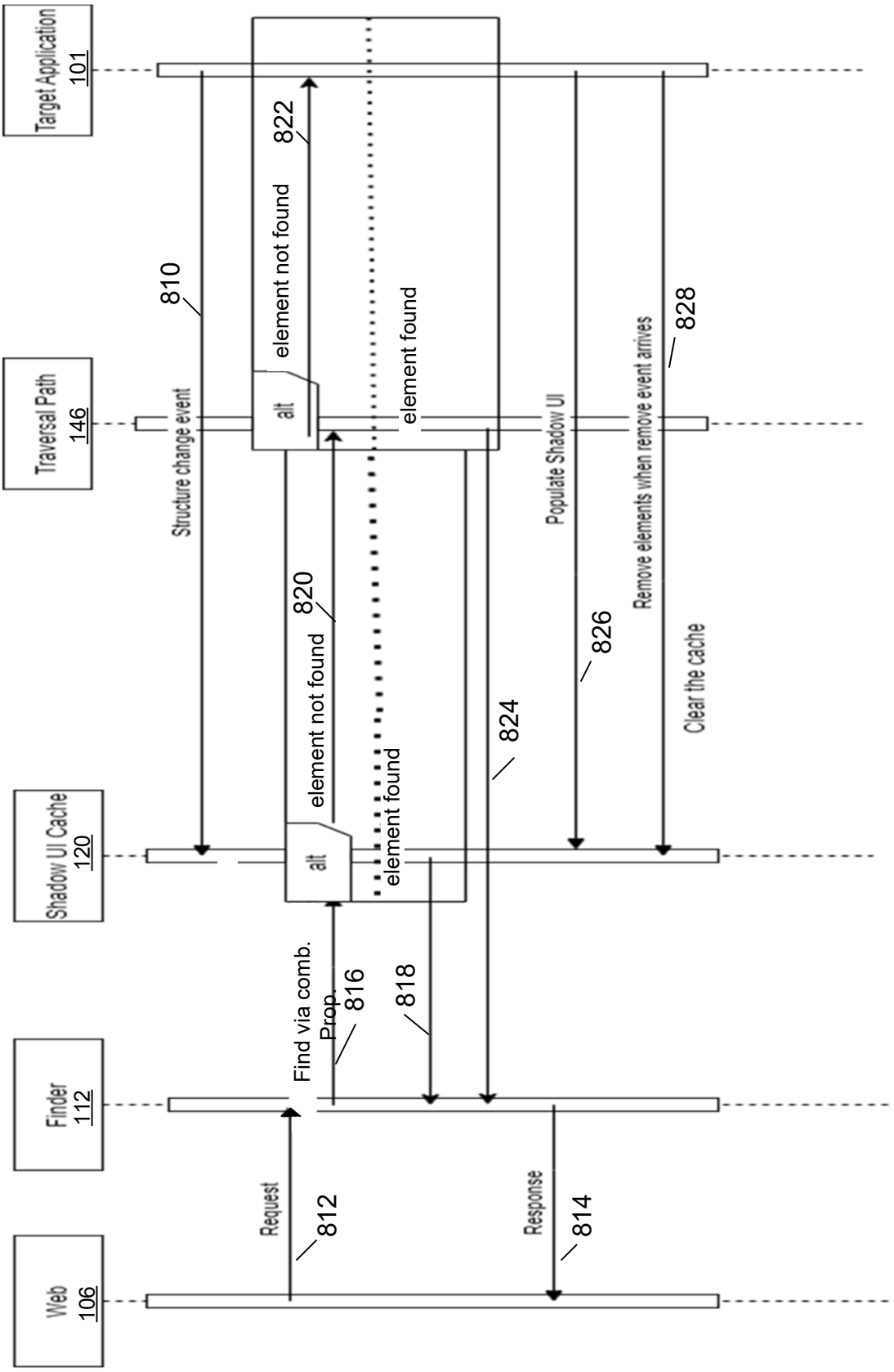
Target Application 101
Traversal Path 146
Shadow UI Cache 120
Finder 112
Web 106
Structure change event
810
alt
element not found
822
element found
Populate Shadow UI
826
Remove elements when remove event arrives
828
Clear the cache
820
element not found
element found
824
Find via comb. Prop.
816
818
Request
812
Response
814

Fig. 8

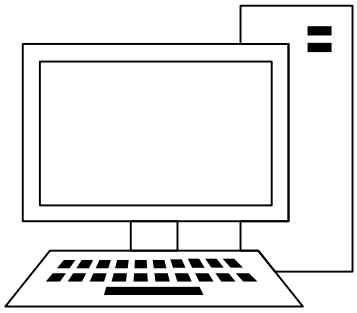

Fig. 9A

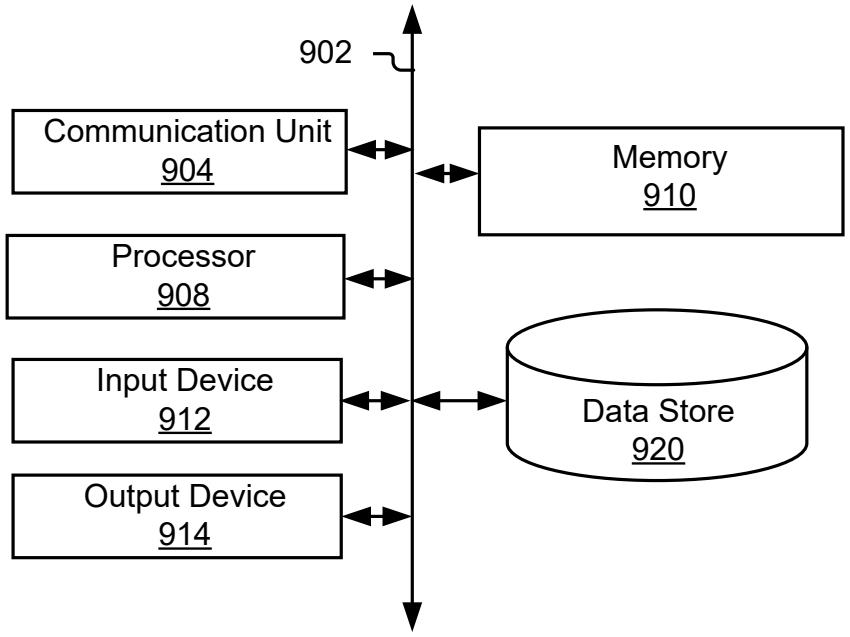
902
Communication Unit
904
Memory
910
Processor
908
Input Device
912
Data Store
920
Output Device
914

Fig. 9B

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	SYSTEM AND METHOD OF CREATING A SHADOW REPRESENTATION OF THE USER INTERFACE FOR FASTER UI ELEMENT RETRIEVAL

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [x] The attached application, or
- [ ] United States application or PCT international application number _____

filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

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LEGAL NAME OF INVENTOR

Inventor: Muthukrishnan Thukkaram Date (Optional) : 12/14/2023

Signature: / DocuSigned by: Muthukrishnan Thukkaram / 81FCE0D724E6437...

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	SYSTEM AND METHOD OF CREATING A SHADOW REPRESENTATION OF THE USER INTERFACE FOR FASTER UI ELEMENT RETRIEVAL

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [■] The attached application, or
- [ ] United States application or PCT international application number _____

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The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

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LEGAL NAME OF INVENTOR

Inventor: Rahul Mhambrey Date (Optional) : 12/14/2023

Signature: / DocuSigned by: RMhambrey 0C00E2A2B74B449... /

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	SYSTEM AND METHOD OF CREATING A SHADOW REPRESENTATION OF THE USER INTERFACE FOR FASTER UI ELEMENT RETRIEVAL

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LEGAL NAME OF INVENTOR

Inventor: Anupriya Date (Optional) : 12/14/2023

Signature: / DocuSigned by: Anupriya 3724DA1908A34F5... /

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

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PTO/AIA/01 (06-12)
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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	SYSTEM AND METHOD OF CREATING A SHADOW REPRESENTATION OF THE USER INTERFACE FOR FASTER UI ELEMENT RETRIEVAL

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [■] The attached application, or
- [ ] United States application or PCT international application number _____

filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Lalitashree Ravi Hegde Date (Optional) : 12/15/2023

Signature: / DocuSigned by: / 6D002A627252443...

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

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If you do not furnish the information requested on this form, the USPTO may not be able to process and/or examine your submission, which may result in termination of proceedings, abandonment of the application, and/or expiration of the patent.

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Additional USPTO uses of the information in this record may include disclosure to: 1) the International Bureau of the World Intellectual Property Organization, if the record is related to an international application filed under the Patent Cooperation Treaty; 2) the public i) after publication of the application pursuant to 35 U.S.C. 122(b), ii) after issuance of a patent pursuant to 35 U.S.C. 151, iii) if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections, or an issued patent, or iv) without publication of the application or patent under the specific circumstances provided for by 37 CFR 1.14(a)(1)(v)-(vii); and/or 3) the National Archives and Records Administration, for inspection of records.

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82A (07-13)
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TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

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Application Number	
Filing Date	
First Named Inventor	Muthukrishnan Thukkaram
Title	SYSTEM AND METHOD OF CREATING A SHADOW REPRESENTATION OF THE USER INTERFACE FOR FASTER UI ELEMENT RETRIEVAL
Art Unit	
Examiner Name	
Attorney Docket Number	10875-10256 US

SIGNATURE of Applicant or Patent Practitioner

Signature	/Edward Van Gieson/	Date (Optional)	
Name	Edward Van Gieson	Registration Number	44,386
Title (if Applicant is a juristic entity)	Attorney of Record		
Applicant Name (if Applicant is a juristic entity)	Whatfix Private Limited		

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☐ *Total of _____ forms are submitted.

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POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 93219

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

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OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

WHATFIX PRIVATE LIMITED

☐ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature	/ DocuSigned by: Khadim Batti F1E6D4F3518942C... /	Date (Optional)	11/29/2022
Name	Khadim Hussain Ismail Batti		
Title	CEO		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

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The information provided by you in this form will be subject to the following routine uses:

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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.