US008312157B2

(12) **United States Patent**
Jakobsson et al.

(10) **Patent No.: US 8,312,157 B2**
(45) **Date of Patent: Nov. 13, 2012**

(54) **IMPLICIT AUTHENTICATION**

(75) Inventors: **Bjorn Markus Jakobsson**, Mountain View, CA (US); **Mark J. Grandcolas**, Burlingame, CA (US); **Philippe J. P. Golle**, San Francisco, CA (US); **Richard Chow**, Sunnyvale, CA (US); **Runting Shi**, Sunnyvale, CA (US)

(73) Assignee: **Palo Alto Research Center Incorporated**, Palo Alto, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 645 days.

(21) Appl. No.: **12/504,159**

(22) Filed: **Jul. 16, 2009**

(65) **Prior Publication Data**

US 2011/0016534 A1 Jan. 20, 2011

(51) **Int. Cl.**
G06F 15/16 (2006.01)

(52) **U.S. Cl.** **709/229**; 709/217; 726/2; 726/3; 726/7; 726/30; 705/51

(58) **Field of Classification Search** 705/64–67; 726/7, 26, 27
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,098,052	A *	8/2000	Kosiba et al.	705/40
6,282,658	B2 *	8/2001	French et al.	726/7
6,496,936	B1 *	12/2002	French et al.	726/7
7,016,809	B1 *	3/2006	Gotwals et al.	702/185
7,086,085	B1 *	8/2006	Brown et al.	726/7
7,284,124	B1 *	10/2007	Ginsberg	713/167
7,305,701	B2 *	12/2007	Brezak et al.	726/5
7,571,472	B2 *	8/2009	Royer	726/19
7,636,853	B2 *	12/2009	Cluts et al.	713/186
7,689,716	B2 *	3/2010	Short et al.	709/246
7,748,029	B2 *	6/2010	Ross	726/6
7,856,384	B1 *	12/2010	Kulasooriya et al.	705/35
7,877,611	B2 *	1/2011	Camacho et al.	713/182
7,890,363	B2 *	2/2011	Gross	705/7.31
7,958,552	B2 *	6/2011	Arnold et al.	726/17
8,065,227	B1 *	11/2011	Beckman	705/39
2003/0208684	A1 *	11/2003	Camacho et al.	713/186
2005/0097320	A1 *	5/2005	Golan et al.	713/166
2006/0273152	A1 *	12/2006	Fields	235/380
2007/0133768	A1 *	6/2007	Singh	379/114.14

(Continued)

OTHER PUBLICATIONS

Weisstein, Eric W. "Quartile" From Mathworld—A Wolfram Web Resource. http://mathworld.wolfram.com/quartile.html. downloaded Jul. 16, 2009.

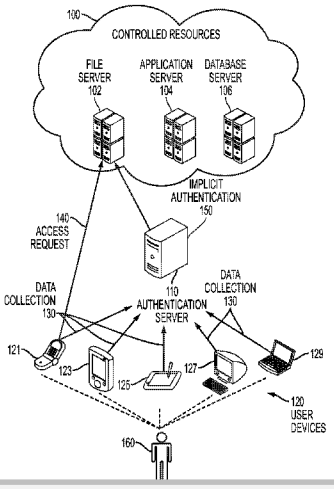
(Continued)

Primary Examiner — Mamon Obeid
(74) *Attorney, Agent, or Firm* — Shun Yao; Park, Vaughan, Fleming & Dowler LLP

(57) **ABSTRACT**

Embodiments of the present disclosure provide a method and system for implicitly authenticating a user to access controlled resources. The system receives a request to access the controlled resources. The system then determines a user behavior score based on a user behavior model, and recent contextual data about the user. The user behavior score facilitates identifying a level of consistency between one or more recent user events and a past user behavior pattern. The recent contextual data, which comprise a plurality of data streams, are collected from one or more user devices without prompting the user to perform an action explicitly associated with authentication. The plurality of data streams provide basis for determining the user behavior score, but a data stream alone provides insufficient basis for the determination of the user behavior score. The system also provides the user behavior score to an access controller of the controlled resource.

23 Claims, 11 Drawing Sheets



U.S. PATENT DOCUMENTS

2007/0177768	A1*	8/2007	Tsantes et al.	382/115
2007/0288319	A1*	12/2007	Robinson et al.	705/14
2008/0103800	A1*	5/2008	Domenikos et al.	705/1
2008/0162383	A1*	7/2008	Kraft	705/500
2008/0189776	A1*	8/2008	Constable	726/7
2009/0006230	A1*	1/2009	Lyda et al.	705/35
2009/0171723	A1*	7/2009	Jenkins	705/7
2009/0198587	A1*	8/2009	Wagner et al.	705/26
2010/0122347	A1*	5/2010	Nadler	726/26
2011/0055373	A1*	3/2011	Bnayahu et al.	709/224
2011/0265162	A1*	10/2011	Alavandar et al.	726/7

OTHER PUBLICATIONS

Nisenson, Mordechai et al., "Towards Behaviometric Security Systems: Learning to Identify a Typist", PKDD 2003, LNAI 2838, pp. 363-374, 2003.

* cited by examiner

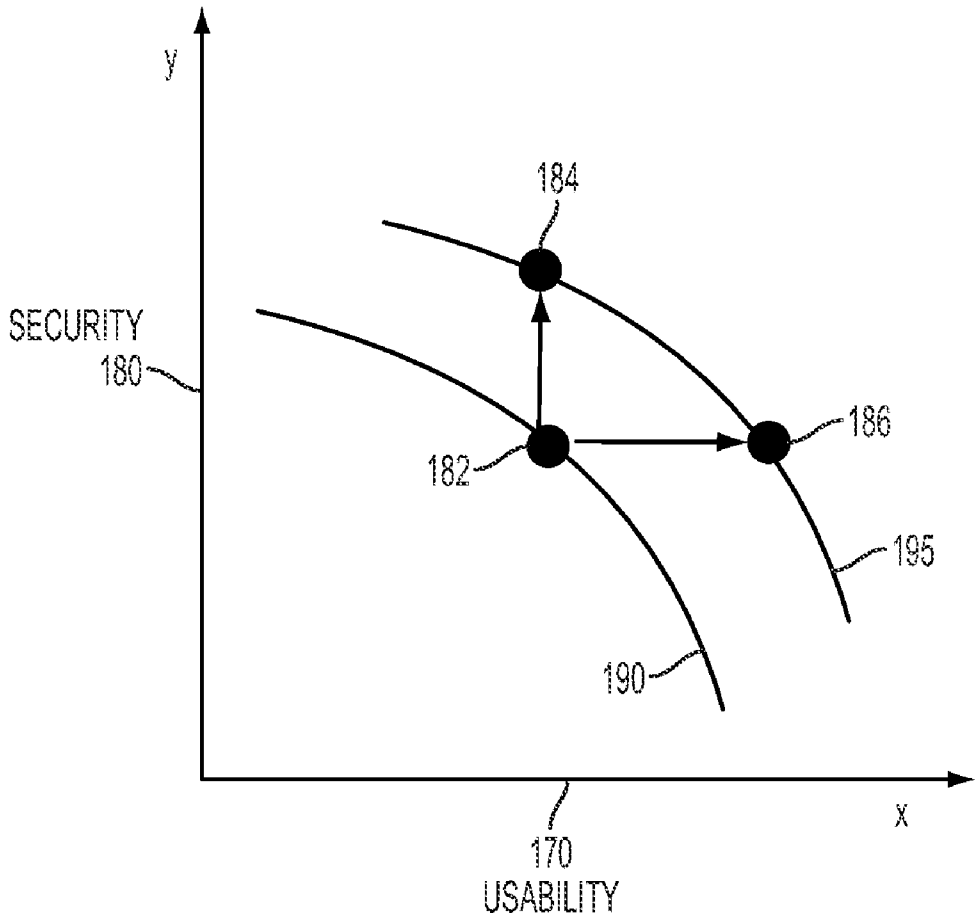


FIG. 1A

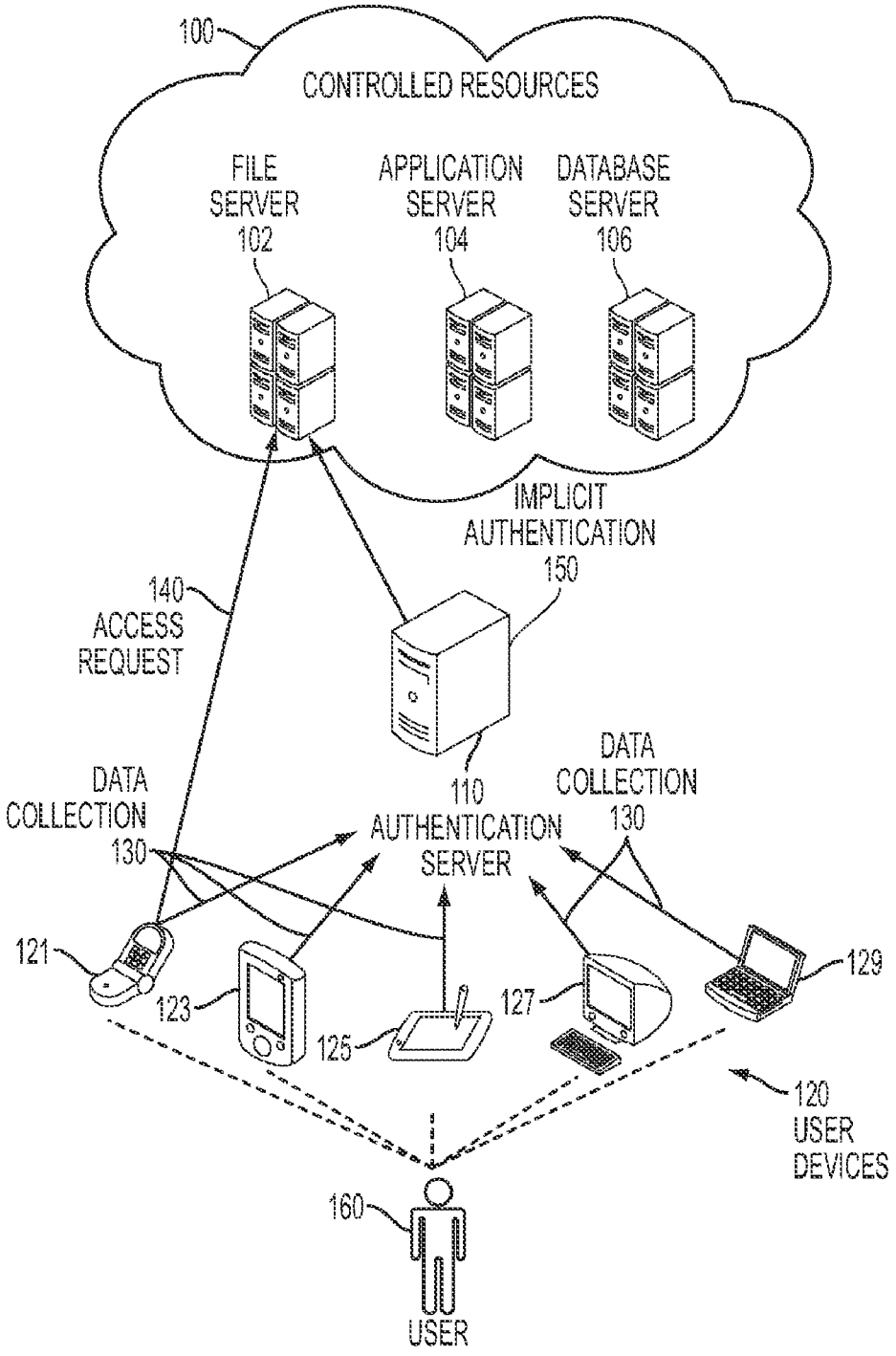


FIG. 1B

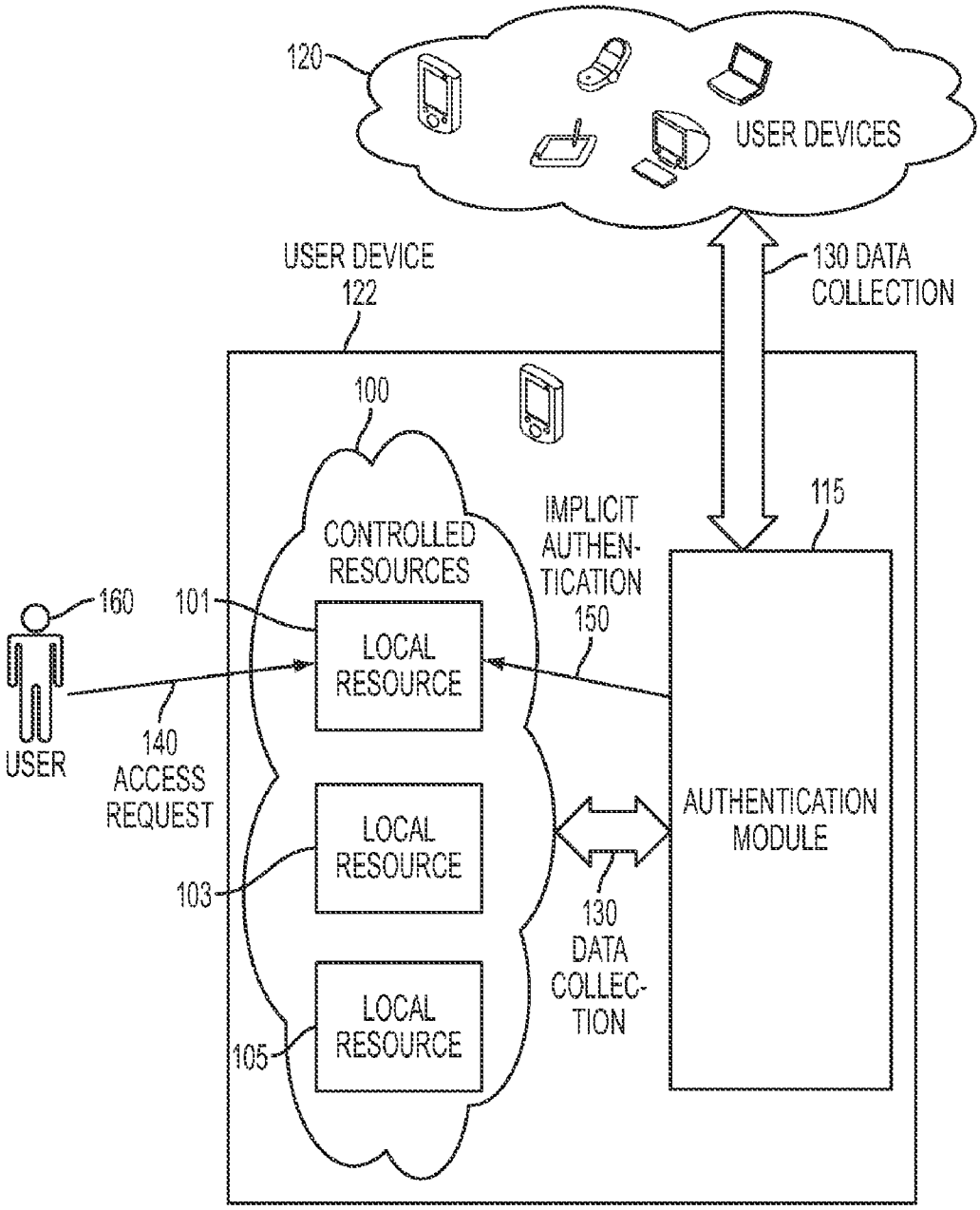


FIG. 1C

DOCKET ALARM

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS
Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS
Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS
Sync your system to PACER to automate legal marketing.