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(54) **ROUTE RISK MITIGATION**

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None
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(56) **References Cited**

U.S. PATENT DOCUMENTS

4,119,166 A 10/1978 Ayotte et al.
4,622,636 A 11/1986 Tachibana
(Continued)

FOREIGN PATENT DOCUMENTS

CN 101131588 A 2/2008
DE 102010001006 A1 7/2011
(Continued)

OTHER PUBLICATIONS

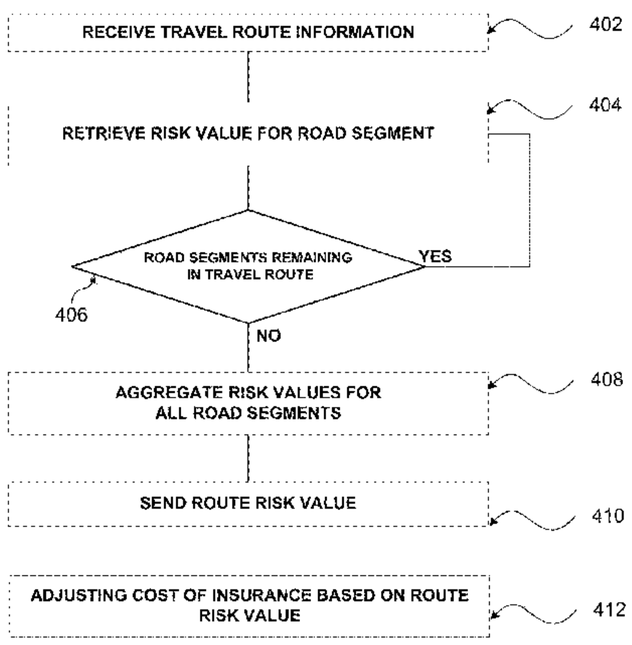
VentureBeat.com webpage; "Cisco and NXP encourage car communication to make driving safer" www.venturebeat.com/2013/01/04/cisco-and-nxp-encourage-car-communication-to-make-driving-safer/, Rebecca Grant dated Jan. 4, 2013.
(Continued)

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(57) **ABSTRACT**

A method is disclosed for mitigating the risks associated with driving by assigning risk values to road segments and using those risk values to select less risky travel routes. Various approaches to helping users mitigate risk are presented. A computing device is configured to generate a database of risk values. That device may receive accident information, geographic information, vehicle information, and other information from one or more data sources and calculate a risk value for the associated road segment. Subsequently, the computing device may provide the associated risk value to other devices. Furthermore, a personal navigation device may receive travel route information and use that information to retrieve risk values for the road segments in the travel route. An insurance company may use this information to determine whether to adjust a quote or premium of an insurance policy. This and other aspects relating to using geographically encoded information to promote and reward risk mitigation are disclosed.

20 Claims, 5 Drawing Sheets



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(56) **References Cited**

U.S. PATENT DOCUMENTS

4,926,336	A	5/1990	Yamada	
5,053,964	A	10/1991	Mister et al.	
5,270,708	A *	12/1993	Kamishima	G01C 21/3697 340/905
5,295,551	A	3/1994	Sukonick	
5,430,432	A	7/1995	Camhi et al.	
5,465,079	A	11/1995	Bouchard et al.	
5,475,387	A	12/1995	Matsumoto	
5,572,449	A	11/1996	Tang et al.	
5,680,122	A	10/1997	Mio	
5,710,565	A	1/1998	Shirai et al.	
5,797,134	A *	8/1998	McMillan	G06Q 30/0283 705/4
5,848,373	A	12/1998	DeLorme et al.	
6,026,345	A	2/2000	Shah et al.	
6,064,970	A	5/2000	McMillan et al.	
6,116,369	A	9/2000	King et al.	
6,128,559	A	10/2000	Saitou et al.	
6,186,793	B1	2/2001	Brubaker	
6,188,950	B1	2/2001	Tsutsumi et al.	
6,301,530	B1	10/2001	Tamura	
6,366,207	B1	4/2002	Murphy	
6,389,351	B1	5/2002	Egawa et al.	
6,415,226	B1 *	7/2002	Kozak	G01C 21/3461 340/988
6,502,020	B2	12/2002	Lang	
6,502,035	B2	12/2002	Levine	
6,647,328	B2	11/2003	Walker	
6,675,094	B2	1/2004	Russell et al.	
6,707,378	B2	3/2004	MacNeille et al.	
6,732,024	B2	5/2004	Wilhelm Rekow et al.	
6,780,077	B2	8/2004	Baumgartner et al.	
6,868,386	B1	3/2005	Henderson et al.	
6,931,309	B2 *	8/2005	Phelan	G01M 17/00 340/439
6,982,635	B2	1/2006	Obradovich	
7,116,248	B2	10/2006	Lu et al.	
7,186,199	B1	3/2007	Baxter, Jr.	
7,286,825	B2	10/2007	Shishido et al.	
7,304,589	B2	12/2007	Kagawa	
7,315,239	B2	1/2008	Cheng et al.	
7,339,483	B1	3/2008	Farmer	
7,353,111	B2	4/2008	Takahashi et al.	
7,356,516	B2	4/2008	Richey et al.	
7,366,892	B2	4/2008	Spaur et al.	
7,546,206	B1 *	6/2009	Miller	G01C 21/00 701/120
7,610,210	B2	10/2009	Helitzer et al.	
7,650,211	B2	1/2010	Wang et al.	
7,657,370	B2 *	2/2010	Nagase	G01C 21/3492 340/995.13
7,657,441	B2	2/2010	Richey et al.	
7,660,725	B2	2/2010	Wahlbin et al.	
7,664,589	B2	2/2010	Etori et al.	
7,739,087	B2	6/2010	Qiu	
7,805,321	B2	9/2010	Wahlbin et al.	
7,821,421	B2	10/2010	Tamir et al.	
7,966,118	B2	6/2011	Kade	
7,991,629	B2	8/2011	Gay et al.	
8,031,062	B2	10/2011	Smith	
8,065,169	B1	11/2011	Oldham et al.	
8,078,349	B1	12/2011	Prada Gomez et al.	
8,078,382	B2	12/2011	Sugano et al.	
8,086,523	B1	12/2011	Palmer	
8,090,598	B2	1/2012	Bauer et al.	
8,139,109	B2	3/2012	Schmiedel et al.	
8,145,393	B2	3/2012	Foster et al.	
8,152,589	B2	4/2012	Bowen et al.	
8,160,809	B2	4/2012	Farwell et al.	
8,180,655	B1	5/2012	Hopkins, III	
8,195,394	B1	6/2012	Zhu et al.	
8,229,618	B2	7/2012	Tolstedt et al.	
8,280,308	B2	10/2012	Anschutz et al.	
8,290,701	B2	10/2012	Mason et al.	
8,314,718	B2	11/2012	Muthaiah et al.	
8,326,473	B2	12/2012	Simpson et al.	
8,335,607	B2	12/2012	Gatten et al.	
8,352,112	B2	1/2013	Mudalige	
8,407,139	B1	3/2013	Palmer	
8,457,827	B1	6/2013	Ferguson et al.	
8,457,892	B2	6/2013	Aso et al.	
8,538,785	B2	9/2013	Coleman et al.	
8,566,126	B1	10/2013	Hopkins, III	
8,577,703	B2	11/2013	McClellan et al.	
8,595,037	B1	11/2013	Hyde et al.	
8,620,693	B1	12/2013	Schumann, Jr.	
8,639,535	B1	1/2014	Kazenas	
8,686,844	B1	4/2014	Wine	
8,718,861	B1	5/2014	Montemerlo et al.	
8,750,306	B2	6/2014	Youseti et al.	
8,757,309	B2	6/2014	Schmitt et al.	
8,781,669	B1	7/2014	Teller et al.	
8,799,036	B1	8/2014	Christensen et al.	
8,949,016	B1	2/2015	Ferguson et al.	
8,954,226	B1	2/2015	Binion et al.	
9,046,374	B2	6/2015	Ricci	
9,063,543	B2	6/2015	An et al.	
9,079,587	B1	7/2015	Rupp et al.	
9,141,582	B1 *	9/2015	Brinkmann	G06F 17/00
9,188,985	B1	11/2015	Hobbs et al.	
9,216,737	B1	12/2015	Zhu et al.	
9,262,787	B2	2/2016	Binion et al.	
9,330,571	B2	5/2016	Ferguson et al.	
9,355,423	B1	5/2016	Slusar	
9,384,148	B2	7/2016	Muttik et al.	
9,495,874	B1	11/2016	Zhu et al.	
2001/0020902	A1 *	9/2001	Tamura	G01C 21/3697 340/905
2001/0039509	A1	11/2001	Dar et al.	
2002/0022920	A1	2/2002	Straub	
2002/0024464	A1	2/2002	Kovell et al.	
2002/0095249	A1	7/2002	Lang	
2002/0111725	A1	8/2002	Burge	
2002/0120396	A1 *	8/2002	Boies	G06Q 10/047 701/424
2002/0178033	A1	11/2002	Yoshioka et al.	
2003/0128107	A1	7/2003	Wilkerson	
2003/0187704	A1	10/2003	Hashiguchi et al.	
2004/0054452	A1	3/2004	Bjorkman	
2004/0068555	A1 *	4/2004	Satou	G07C 5/008 709/219
2004/0098464	A1	5/2004	Koch et al.	
2004/0103006	A1	5/2004	Wahlbin et al.	
2004/0103010	A1	5/2004	Wahlbin et al.	
2004/0128613	A1 *	7/2004	Sinisi	G06Q 10/00 715/203

(56) **References Cited**

U.S. PATENT DOCUMENTS

2004/0142678	A1*	7/2004	Krasner	G08B 25/016 455/404.2
2004/0153362	A1	8/2004	Bauer et al.	
2004/0236476	A1	11/2004	Chowdhary	
2004/0254698	A1	12/2004	Hubbard et al.	
2004/0260579	A1*	12/2004	Tremiti	G06Q 40/08 705/4
2005/0091175	A9	4/2005	Farmer	
2005/0107951	A1*	5/2005	Brulle-Drews	G01C 21/3461 701/533
2005/0174217	A1	8/2005	Basir et al.	
2005/0228622	A1	10/2005	Jacobi	
2005/0256638	A1*	11/2005	Takahashi	G01C 21/3484 701/431
2005/0264404	A1	12/2005	Franczyk et al.	
2005/0283503	A1	12/2005	Hancock et al.	
2005/0288046	A1	12/2005	Zhao et al.	
2006/0006990	A1	1/2006	Obradovich	
2006/0053038	A1	3/2006	Warren et al.	
2006/0055565	A1	3/2006	Kawamata et al.	
2006/0095301	A1	5/2006	Gay	
2006/0129313	A1*	6/2006	Becker	G01C 21/3484 701/533
2006/0129445	A1*	6/2006	McCallum, Jr.	G06Q 10/10 705/7.18
2006/0161341	A1	7/2006	Haegebarth et al.	
2006/0206623	A1	9/2006	Gipps et al.	
2006/0221328	A1	10/2006	Rouly	
2006/0247852	A1*	11/2006	Kortge	G01C 22/00 701/533
2006/0253307	A1	11/2006	Warren et al.	
2007/0021910	A1	1/2007	Iwami et al.	
2007/0027583	A1	2/2007	Tamir et al.	
2007/0136107	A1	6/2007	Maguire et al.	
2007/0167147	A1*	7/2007	Krasner	G08B 25/009 455/404.2
2007/0182532	A1	8/2007	Lengning et al.	
2007/0216521	A1*	9/2007	Guensler	G08G 1/0104 340/439
2007/0256499	A1	11/2007	Pelecanos et al.	
2007/0257815	A1*	11/2007	Gunderson	G08G 1/16 340/903
2008/0004802	A1*	1/2008	Horvitz	G01C 21/3415 701/533
2008/0013789	A1	1/2008	Shima et al.	
2008/0033637	A1*	2/2008	Kuhlman	H04L 63/10 701/533
2008/0059007	A1	3/2008	Whittaker et al.	
2008/0059351	A1	3/2008	Richey et al.	
2008/0091309	A1	4/2008	Walker	
2008/0091490	A1	4/2008	Abrahams et al.	
2008/0114542	A1*	5/2008	Nambata	G08G 1/096827 701/533
2008/0148409	A1	6/2008	Ampunan et al.	
2008/0161987	A1	7/2008	Breed	
2008/0243558	A1	10/2008	Gupte	
2008/0258890	A1	10/2008	Follmer et al.	
2008/0319602	A1	12/2008	McClellan et al.	
2009/0024419	A1	1/2009	McClellan et al.	
2009/0063201	A1	3/2009	Nowotarski et al.	
2009/0079839	A1	3/2009	Fischer et al.	
2009/0115638	A1*	5/2009	Shankwitz	G01C 21/26 340/988
2009/0140887	A1	6/2009	Breed et al.	
2009/0312945	A1	12/2009	Sakamoto et al.	
2010/0023183	A1	1/2010	Huang et al.	
2010/0030586	A1	2/2010	Taylor et al.	
2010/0131300	A1	5/2010	Collopy et al.	
2010/0131304	A1	5/2010	Collopy et al.	
2010/0138244	A1	6/2010	Basir	
2010/0211270	A1	8/2010	Chin et al.	
2010/0250087	A1	9/2010	Sauter	
2010/0256852	A1	10/2010	Mudalige	
2010/0280751	A1	11/2010	Breed	
2010/0302371	A1	12/2010	Abrams	
2010/0324775	A1	12/2010	Kermani et al.	
2010/0332131	A1*	12/2010	Horvitz	G01C 21/3697 701/414
2011/0029170	A1	2/2011	Hyde et al.	
2011/0071718	A1	3/2011	Norris et al.	
2011/0077028	A1	3/2011	Wilkes, III et al.	
2011/0161119	A1	6/2011	Collins	
2011/0173015	A1	7/2011	Chapman et al.	
2011/0202305	A1	8/2011	Willis et al.	
2011/0210867	A1	9/2011	Benedikt	
2012/0034876	A1	2/2012	Nakamura et al.	
2012/0053808	A1	3/2012	Arai et al.	
2012/0072243	A1	3/2012	Collins et al.	
2012/0083960	A1	4/2012	Zhu et al.	
2012/0101660	A1	4/2012	Hattori	
2012/0109418	A1	5/2012	Lorber	
2012/0123641	A1	5/2012	Ferrin et al.	
2012/0123806	A1	5/2012	Schumann, Jr. et al.	
2012/0173290	A1	7/2012	Collins et al.	
2012/0197669	A1	8/2012	Kote et al.	
2012/0209505	A1	8/2012	Breed et al.	
2012/0290146	A1	11/2012	Dedes et al.	
2012/0295592	A1	11/2012	Peirce	
2013/0006469	A1	1/2013	Green et al.	
2013/0006674	A1	1/2013	Bowne et al.	
2013/0006675	A1	1/2013	Bowne et al.	
2013/0013179	A1	1/2013	Lection et al.	
2013/0030606	A1	1/2013	Mudalige et al.	
2013/0037650	A1	2/2013	Heppe	
2013/0052614	A1	2/2013	Mollicone et al.	
2013/0066511	A1	3/2013	Switkes et al.	
2013/0073321	A1	3/2013	Hofmann et al.	
2013/0131906	A1	5/2013	Green et al.	
2013/0144657	A1	6/2013	Ricci	
2013/0147638	A1	6/2013	Ricci	
2013/0166325	A1	6/2013	Ganapathy et al.	
2013/0179198	A1	7/2013	Bowne et al.	
2013/0198737	A1	8/2013	Ricci	
2013/0198802	A1	8/2013	Ricci	
2013/0200991	A1	8/2013	Ricci et al.	
2013/0203400	A1	8/2013	Ricci	
2013/0204645	A1	8/2013	Lehman et al.	
2013/0212659	A1	8/2013	Maher et al.	
2013/0218603	A1	8/2013	Hagelstein et al.	
2013/0218604	A1	8/2013	Hagelstein et al.	
2013/0226441	A1	8/2013	Horita	
2013/0250933	A1	9/2013	Yousefi et al.	
2013/0253809	A1	9/2013	Jones et al.	
2013/0261944	A1	10/2013	Koshizen	
2013/0304513	A1	11/2013	Hyde et al.	
2013/0304514	A1	11/2013	Hyde et al.	
2013/0311002	A1	11/2013	Isaac	
2014/0074512	A1	3/2014	Hare et al.	
2014/0080098	A1	3/2014	Price	
2014/0088855	A1	3/2014	Ferguson	
2014/0108058	A1	4/2014	Bourne et al.	
2014/0113619	A1	4/2014	Tibbitts et al.	
2014/0139341	A1	5/2014	Green et al.	
2014/0156133	A1	6/2014	Cullinane et al.	
2014/0156134	A1	6/2014	Cullinane et al.	
2014/0210644	A1	7/2014	Breed	
2014/0257871	A1	9/2014	Christensen et al.	
2014/0257873	A1	9/2014	Hayward et al.	
2014/0266795	A1	9/2014	Tseng et al.	
2014/0272810	A1	9/2014	Fields et al.	
2014/0300494	A1	10/2014	Tseng et al.	
2014/0303827	A1	10/2014	Dolgov et al.	
2014/0333468	A1	11/2014	Zhu et al.	
2014/0350970	A1	11/2014	Schumann, Jr. et al.	
2014/0358413	A1	12/2014	Trombley et al.	
2014/0379384	A1	12/2014	Duncan et al.	
2014/0379385	A1	12/2014	Duncan et al.	
2014/0380264	A1	12/2014	Misra et al.	
2015/0025917	A1	1/2015	Stempora	
2015/0081404	A1	3/2015	Basir	
2015/0088334	A1	3/2015	Bowers et al.	
2015/0088550	A1	3/2015	Bowers et al.	
2015/0112543	A1	4/2015	Binion et al.	

(56) **References Cited**

U.S. PATENT DOCUMENTS

2015/0112730	A1	4/2015	Binion et al.
2015/0112731	A1	4/2015	Binion et al.
2015/0112733	A1	4/2015	Baker et al.
2015/0134181	A1	5/2015	Ollis
2015/0142244	A1	5/2015	You et al.
2015/0149017	A1	5/2015	Allard et al.
2015/0149019	A1	5/2015	Pilutti et al.
2015/0158486	A1	6/2015	Healey et al.
2015/0166059	A1	6/2015	Ko
2015/0166069	A1	6/2015	Engelman et al.
2015/0170287	A1	6/2015	Tirone et al.
2015/0175168	A1	6/2015	Hoye et al.
2015/0179062	A1	6/2015	Ralston et al.
2015/0187013	A1	7/2015	Adams et al.
2015/0187014	A1	7/2015	Adams et al.
2015/0187015	A1	7/2015	Adams et al.
2015/0187019	A1	7/2015	Fernandes et al.
2015/0194055	A1	7/2015	Maass
2015/0217763	A1	8/2015	Reichel et al.
2015/0242953	A1	8/2015	Suiter
2015/0248131	A1	9/2015	Fairfield et al.
2015/0266455	A1	9/2015	Wilson
2016/0009291	A1	1/2016	Pallett et al.
2016/0036558	A1	2/2016	Ibrahim et al.
2016/0086285	A1	3/2016	Jordan Peters et al.
2016/0189303	A1	6/2016	Fuchs

FOREIGN PATENT DOCUMENTS

EP	1296305	A1	3/2003
EP	2293255	A1	3/2011
EP	2471694	A2	7/2012
WO	2001039090	A1	5/2001
WO	2005108928	A1	11/2005
WO	2008067872	A1	6/2008
WO	2008096376	A1	8/2008
WO	2012014042	A2	2/2012
WO	2012150591	A2	11/2012
WO	2013012926	A1	1/2013
WO	2013126582	A1	8/2013
WO	2013160908	A2	10/2013
WO	2014148975	A1	9/2014

OTHER PUBLICATIONS

Yang et al., "A vehicle-to-vehicle communication protocol for cooperative collision warning"; Aug. 2004.
Festag et al., "Vehicle-to-vehicle and road-side sensor communication for enhanced road safety"; Nov. 2008.
Zalstein, David, Car Advice. com webpage, "First large-scale vehicle-to-vehicle communication technology test unveiled" dated Aug. 22, 2012, www.caradvice.com.au/187379/first-large-scale-vehicle-to-vehicle-communication-technology-test-unveiled/basic-rgb-4/, 3 pages.
BMW.com webpage; "BMW Technology Guide: Car-to-car communication" www.bmw.com/com/en/insights/technology/technology_guide/articles/cartocar_communication.html; downloaded Apr. 5, 2013.
NEC.com webpage; "Car2Car Communication" www/nec.com/en/global.onlinetv/en/society/car_commu_l:html; downloaded Apr. 5, 2013.
Xu, Qing et al., "Vehicle-to-Vehicle Safety Messaging in DSRC"; 2004.
EE Herald webpage, "DSRC Packet Sniffer, a vehicle-to-vehicle communication technology is under demo"; www.eeherald.com/section/news/nw10000198.html; dated Nov. 22, 2008.
Bai, Fan et al., "Reliability Analysis of DSRC Wireless Communication for Vehicle Safety"; Sep. 2006.
Kotani, Kazuya et al., "Inter-Vehicle Communication Protocol for Cooperatively Capturing and Sharing Intersection Video"; date unkown but believed to be before 2011.
BC Technology Webpage; "CarCom Intercom System"; www.bctechnologyltd.co.uk/clarson-intercom-system-brochure.htm; downloaded May 29, 2013.
Wolf Intercom webpage; "Wolf Intercom Systems"; http://wolfintercom.com/; downloaded May 29, 2013.
Telephonics Webpage; "Integrated Communication Systems Wired & Wireless Secure Intercommunications"; www.telephonics.com/netcom.asp; downloaded May 29, 2013.
Car-to-Car webpage; "Car-2-Car Communication"; www.car-to-car.org/index.php?id=8; downloaded May 29, 2013.
Cohda Wireless webpage; www.cohdawireless.com/default.html; downloaded May 29, 2013.
Eichler, Stephen et al., "Car-to-Car Communication" dated Oct. 2006.
Oki Webpage "OKI Develops World's First DSRC Inter-vehicle Communication Attachment for Mobile Phones to Help Pedestrian Safety" dated Jan. 8, 2009.
Light, Donald, "A Scenario: The End of Auto Insurance," May 8, 2012, downloaded Nov. 11, 2013 from ww.celent.com/reports/scenario-end-auto-insurance, 2 pages.
"Driver Assistance Systems," Robert Bosch GmbH, downloaded Oct. 27, 2013 from www.bosch-automotivetechnology.us/en_us/us/driving_comfort_1/driving_comfort_systems_for_passenger_cars_2/driver_assistance_systems_5/driver_assistan . . . 12 pages.
"Autonomous Car," Wikipedia, the free encyclopedia, downloaded Nov. 11, 2013 from en.wikipedia.org/wiki/Autonomous_car#cite_ref-28, 20 pages.
"Schlaue Autos von A bis Z." Encyclopedia, downloaded Oct. 27, 2013 from www.bester-beifahrer.de/startseite/exikon/, 15 pages.
"Chassis Systems Control, Adaptive Cruise Control: More comfortable driving," Robert Bosch GmbH, Brochure downloaded Oct. 26, 2013, 4 pages.
"Get Ready for Automated Cars," Houston Chronicle, Sep. 11, 2012, downloaded Nov. 11, 2013, 1 page.
Levy, Steven, Salmon, Felix, Stokes, Jon, "Artificial Intelligence is Here. In Fact, It's All Around Us. But It's Nothing Like We Expected," Jan. 2011, 14 pages.
"Driverless cars study: 1 in 5 would let computers do the driving," Nov. 4, 2013, downloaded Dec. 19, 2013 from http://www.carinsurance.com/press/driverless-cars-survey-results.aspx, 2 pages.
Shladover, Steven E. "What if Cars Could Drive Themselves," ACCESS Magazine, University of California Transportation Center, UC Berkeley, Apr. 1, 2000, downloaded Dec. 19, 2013, 7 pages.
Kim, Mun Hyun, Dickerson, Julie, Kosko, Bart, "Fuzzy throttle and brake control for platoons of smart cars," University of Southern California, Received May 1995, revised Aug. 1995, downloaded Dec. 19, 2013, 26 pages.
"A velocity control strategy for vehicular collision avoidance system," Abstract downloaded on May 9, 2013 from ieeexplore.ieee.org/xpl/articleDetails.jsp?tp=arnumber=1626838 &contentType=Conference+Publications &queryText%3DA+velocity+control+strategy+for . . . , 1 page.
"Fuzzy system representation of car-following phenomena," Abstract downloaded on May 9, 2013 from ieeexplore.ieee.org/xpl/articleDetails.jsp?tp=&amumber=527798 &contentType=Conference+Publications& queryText%3DFuzzy+system+representation+of . . . , 1 page.
"Direct adaptive longitudinal control of vehicle platoons," Abstract downloaded on May 9, 2013 from ieeexplore.ieee.org/xpl/articleDetails.jsp?tp=&arnumber=917908 &contentType=Joumals+%26+Magazines &queryText%3DDirect+adaptive+longitudinal+c . . . , 1 page.
Sharma, Devansh, "Development of Leader-Follower Robot in IIT Bombay," 4 pages.
Noguchi, Noboru, Will, Jeff, Reid, Joh, and Zhang, Qin, "Development of a master-slave robot system for farm operations," Computers and Electronics in Agriculture 44 (2004), 19 pages.
"Project SARTRE (Safe Road Trains for the Environment)," Road Traffic Technology, downloaded on May 9, 2013 from www.roadtraffic-technology.com/projects/the-sartre-project/, 3 pages.

(56) **References Cited**

OTHER PUBLICATIONS

"A semi-autonomous tractor in an intelligent master-slave vehicle system," Oct. 2010, vol. 3, Issue 4, pp. 263-269, downloaded Dec. 19, 2013 from http://link.springer.com/article/10.1007%2Fs11370-010-0071-6, 4 pages.
"Development of an intelligent master-slave system between agricultural vehicles," Abstract downloaded on Dec. 19, 2013 from http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=5548056&url=http%3A%2F%2Fi . . . , 1 page.
"A leader-follower formation flight control scheme for UAV helicopters," Abstract downloaded on Dec. 19, 2013 from http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=4636116&url=http%3A%2F%2Fi . . . , 1 page.
Kurian, Bonny, "Auto-Insurance—Driving into the sunset?", Tala Consultancy Services, 2013.
O'Brien, Christine, "Autonomous Vehicle Technology: Consideration for the Auto Insurance Industry", University Transportation Resource Center (The 2nd Connected Vehicles Symposium, Rutgers University), Jun. 17, 2013.
Anderson, James M. et al., "Autonomous Vehicle Program: A Guide for Policymakers", Rand Corporation: Transportation, Space, and Technology Program, 2014.
Marchant, Gary E. et al., "The Corning Collision Between Autonomous Vehicles and the Liability System", Santa Clara Law Review (vol. 52: No. 4 (Article 6)), Dec. 17, 2012.
"The Munix Advantage", AUMA, retrieved Apr. 8, 2014, <http://www.auma.ca/live/digitalAssets/71/71248_MUNIX_onepager.pdf>.
"The Use of Occupation and Education Factors in Automobile Insurance", State of New Jersey: Department of Banking and Insurance, Apr. 2008.
"Preliminary Statement of Policy Concerning Automated Vehicles", National Highway Traffic Safety Administration, retrieved Jun. 9, 2014.
Walker Smith, Bryant, "Summary of levels of Driving Automation for On-Road Vehicles", Stanford Law School: The Center for Internet and Society, Dec. 18, 2013, <http://cyberlaw.stanford.edu/blog/2013/12/sae-levels-driving-automation>.
Auto Insurance Discounts, Liberty Mutual Insurance, downloaded from http://www.libertymutual.com/auto-insurance/auto-insurance-coverage/auto-insurance-discounts, Jan. 8, 2014, 2 pages.
Autonomous Vehicles Regulations, California Department of Motor Vehicles, 2011, downloaded from www.dmv.ca.gov/vr/autonomous/auto.htm, Jan. 2, 2014, 3 pages.
Sharma, Aroma, Autonomous Vehicle Conf Recap 2012: "Driving the Future: The Legal Implications of Autonomous Vehicles," High Tech Law Institute, downloaded from law.scu.edu/hightech/autonomousvehicleconfrecap2012/, Jan. 2, 2014, 7 pages.
Strumpf, Dan, "Corporate News: Driverless Cars Face Issues of Liability", Strumpf Dan, The Wall Street Journal Asia [Hong Kong] Jan. 29, 2013: 19, downloaded from http://search.proquest.com.ezproxy, Jan. 8, 2014, 2 pages.
Lienert, Anita, Drivers Would Opt for Autonomous Cars to Save on Insurance, Study Finds: Published: Nov. 7, 2013, downloaded from www.edmunds.com/car-news/drivers-would-opt-for-autonomous-cars-to-save-on-insurance-study-finds.html on Jan. 2, 2014, 6 pages.
Neumann, Peter G. and Contributors, "Risks to the Public," ACM SIGSOFT Software Engineering Notes, Jul. 2012 vol. 37 No. 4, pp. 20-29.
Quad City Intersection Traffic Accident Study, Davenport-Rock Island-Moline Urbanized Area 1993 data, Bi-State Regional Commission, Mar. 1996; http://ntl.bts.gov/lib/000/300/338/00338.pdf; 78 pages; downloaded Apr. 8, 2008.
Geographic Information Systems Using CODES Linked Data (Crash Outcome Data Evaluation System), U.S. Department of Transportation National Highway Traffic Safety Administration, Apr. 2001; http://ntl.bts.gov/lib/11000/11100/11149/809-201.pdf; 44 pages; downloaded Apr. 8, 2008.
Final Report: What Value May Geographic Information Systems Add to the Art of Identifying Crash Countermeasures? John S. Miller, Senior Research Scientist, Virginia Transportation Research Council, Charlottesville, Virginia, Apr. 1999; http://www.virginiadot.org/vtrc/main/online_reports/pdf/99-r13.pdf; 44 pages; downloaded Apr. 8, 2008.
Mapping the Streets of the World, Hilmar Schmundt, Speigel Online, May 12, 2006 03:37 PM, High Technology; http://www.spiegel.de/international/spiegel/0,1518,druck-415848,00.html; 2 pages; downloaded Jun. 25, 2008.
Patents: At the forefront of technological innovation, Printed from the Teleatlas.com website, 2007; http://www.teleatlas.com/WhyTeleAtlas/Innovation/Patents/index.htm; 1 page; downloaded Jun. 25, 2008.
Digital Collection—Metadata View; Quad City Intersection Traffic Accident Study: 1993 Data; http://ntlsearch.bts.gov/tris/record/ntl/338.html; 2 pages; downloaded Jun. 25, 2008.
Advanced Tracking Technologies, Inc., Shadow Tracker Prov5 Track Detail Map, http://www.advantrack.com/map_pro_3.htm; 1 page; downloaded Jun. 25, 2008.
Advanced Tracking Technologies, Inc.; Track Playback; http://www.advantrack.com/Animated-Track-Playback.htm; 1 page; downloaded Jun. 25, 2008.
What is Geocoding?, http://www.trpc.org/programs/gis/geocode.htm; 5 pages; downloaded Jun. 25, 2008.
Logistics, Not Consumers, Best Early Market for Premium Traffic Information, Sep. 25, 2006; http://auto.ihs.com/news/2006/abi-premium-traffic.htm; 2 pages; downloaded Jun. 25, 2008.
Property/Casualty Insurance Gaining Position With Technology; Telematics, the use of Wireless communications and Global Positioning System (GPS) tracking, may soon change the way automobile insurance, both personal and commercial, is priced. Individual rating of a driver, to supplement class rating, now appears to be feasible.; http;//www.towersperrin.com/TILLINGHAST/publications/publications/emphasis/Emphasis_2005_3/Holderedge.pdf; 4 pages; downloaded Apr. 8, 2008.
IVOX's Driver Score; Personal Lines; Benefits to using IVOX DriverScore; http://www.ivosdata.com/personal_lines.html; 1 page; downloaded Jul. 25, 2008.
Group1 Software; Point-Level Geocoding Option Geocoding Enrichment Solution; http://www.g1.com/PDF/Product/PointLevelGeocode.pdf; 2 pages; downloaded Apr. 8, 2008.
Integrated Enterprise Geo-Spatial Technology—Insurance Risk Examples by Brady Foust, Ph.D., Howard Botts, Ph.D. and Margaret Miller, Ph.D., Jan. 27, 20076; http://www.directionsmag.com/printer.php?artcicle_id-2081; 2 pages; downloaded Jun. 25, 2008.
How the Discounts Work; www.SaveAsYouDrive.com; http://www.saveasyouddrive.com/page.asp?pageid=34&print=true; 2 pages; downloaded Jun. 25, 2008.
Kirkpatrick, Keith, "Legal issues with Robots," Communications of the ACM, Nov. 2013, vol. 56 No. 11, pp. 17-19.
Ingolfo, Silvia, and Silva Souza, Vitor E., "Law and Adaptivity in Requirements Engineering," SEAMS 2013, pp. 163-168.
O'Donnell, Anthony, "Prepare for Deep Auto Insurance Premium Drop Scenario, Celent Report Advises," Insurance & Technology, May 8, 2012, downloaded from http://www.insurancetech.com/claims/prepare-for-deep-auto-insurance-premium/232901645?printer_friendly=this-page, Jan. 9, 2014, 3 pages.
Top issues: An annual report "The insurance industry in 2013; Strategy: Reshaping auto insurance", vol. 5, 2013, 6 pages.
O'Donnell, Anthony, "Rapid Emergence of Driverless Cars Demands Creation of Legal Infrastructure, Stanford Scholar Says," Insurance & Technology—Online, Jan. 3, 2013, downloaded from http: I I search.proquest.com . ezproxy.apollolibrary.com/ docview / 12 66 314 720 /fulltext/ 142 DA8916CC2 E861A14/ 11 ?accountid=3 5812, Jan. 8, 2014, 2 pages.
"Self-driving cars: The next revolution" (kpmg.com | cargroup.org), 2012, 36 pages.
The autonomous car: The road to driverless driving, May 30, 2013, downloaded from analysis.telematicsupdate.com/v2x-safety/autonomous-car-road-driverless-driving on Jan. 2, 2014, 6 pages.
Ruquet, Mark E., "Who Insures a Driverless Car"? Property & Casualty 360, Oct. 1, 2012, downloaded from http:/ / search.proquest.com on Jan. 8, 2014, 2 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Neil, Dan, "Who's Behind the Wheel? Nobody. The driverless car is coming. And we all should be glad it is," Wall Street Journal (Online) [New York, N.Y] Sep. 24, 2012, downloaded from http://search.proquest.com on Jan. 8, 2014, 4 pages.
Bylund, Anders, "Would You Buy a Self-Driving Car to Save 80% on Auto Insurance?" The Motley Fool, Nov. 27, 2013, http://www.dailyfinance.com/2013/11/27/would-you-buy-a-self-driving-car-to-save-80-on-car/, 2 pages.
Litman, Todd, "Autonomous Vehicle Implementation Predictions Implications for Transport Planning," Victoria Transport Policy Institute, Dec. 23, 2013, 19 pages.
Zeng, X., Yin, K., and Ge, H., "Hazardous Driving Prediction System," Submission to The Connected Vehicle Technology Challenge,Sep. 24, 2014, 20 pages.
Wardzinski, Dynamic risk assessment in autonomous vehicles motion planning, IEEE, 1st International Conference on Information Technology, Gdansk, May 18-21, 2008 [retrieved on Jul. 25, 2016], Retrieved from the Internet, <URL:http://kio.pg.gda.pl/lag/download/2008-1EEE%20ICIS-Dynamic%20Risk%20Assessment.pdf>, 4 pages.
Jan. 13, 2016—(US) Non-Final Office Action—U.S. Appl. No. 14/458,744.
Mar. 18, 2016—(WO) International Search Report—App PCT/US2016/013204.
Mar. 18, 2016—(WO) Search Report and Written Opinion—App PCT/US2016/013204.
Aug. 31, 2016—(WO)—International Search Report—App PCT/US2016/036136.
Apr. 28, 2017—(WO) International Search Report—PCT/US17/16176.
Feb. 10, 2017—(US) Final Office Action—U.S. Appl. No. 14/733,576.
Mar. 27, 2017—(US) Non-Final Office Action—U.S. Appl. No. 15/015,623.
Apr. 5, 2017—(US) Final Office Action—U.S. Appl. No. 14/184,272.
Apr. 6, 2017—(US) Non-Final Office Action—U.S. Appl. No. 14/697,153.
Apr. 6, 2017—(US) Non-Final Office Action—U.S. Appl. No. 14/816,336.
Apr. 7, 2017—(US) Non-Final Office Action—U.S. Appl. No. 14/816,299.
Apr. 21, 2017—(US) Non-Final Office Action—U.S. Appl. No. 14/862,266.
Apr. 21, 2017—(US) Non-Final Office Action—U.S. Appl. No. 15/206,521.
May 19, 2017—(US) Notice of Allowance—U.S. Appl. No. 14/163,719.
Jun. 1, 2017—(US) Final Office Action—U.S. Appl. No. 14/458,796.
Jun. 2, 2017—(US) Non-Final Office Action—U.S. Appl. No. 14/607,433.
Jun. 13, 2017—(US) Final Office Action—U.S. Appl. No. 14/458,764.
Jun. 16, 2017—(US) Final Office Action—U.S. Appl. No. 14/697,131.
Jul. 13, 2017—(US) Non-Final Office Action—U.S. Appl. No. 14/735,576.
Jul. 27, 2017—(US) Final Office Action—U.S. Appl. No. 14/458,826.
Aug. 8, 2017—(US) Final Office Action—U.S. Appl. No. 15/015,623.
Aug. 15, 2017—(US) Final Office Action—U.S. Appl. No. 14/458,744.
Aug. 22, 2017—(US) Non-Final Office Action—U.S. Appl. No. 14/673,150.
Aug. 30, 2017—(US) Notice of Allowance—U.S. Appl. No. 14/862,266.
Sep. 7, 2017—(US) Non-Final Office Action—U.S. Appl. No. 14/458,764.
Jun. 22, 2016 (US) Non-Final Office Action—U.S. Appl. No. 14/607,433.
Sep. 21, 2017—(US) Final Office Action—U.S. Appl. No. 14/816,299.
Oct. 3, 2017—(US) Non-Final Office Action—U.S. Appl. No. 14/458,796.
U.S. Appl. No. 61/391,271, filed Oct. 8, 2010, Appendix to the Specification, "Appendix B", (incorporated by reference in US 20120083960, Zhu, J. et al)) (Year: 2010).
U.S. Appl. No. 61/391,271, filed Oct. 8, 2010, Specification, "Google 3.8-292" (incorporated by reference in US 2012-0083960 (Zhu, J. et al)) (Year: 2010).
Oct. 5, 2017—(US) Final Office Action—U.S. Appl. No. 14/607,433.
Oct. 6, 2017—(US) Final Office Action—U.S. Appl. No. 14/697,153.
Oct. 26, 2017—(US) Notice of Allowance—U.S. Appl. No. 15/206,521.
Dec. 5, 2017—(US) Final Office Action—U.S. Appl. No. 14/816,336.
Jan. 8, 2018 (US) Non-Final Office Action—U.S. Appl. No. 15/015,623.
Feb. 7, 2018—(US) Non-Final Office Action—U.S. Appl. No. 15/166,638.
Feb. 12, 2018—(US) Notice of Allowance—U.S. Appl. No. 14/673,150.
Jan. 15, 2015—(US) Non-Final Office Action—U.S. Appl. No. 14/163,761.
Jan. 21, 2015—(US) Non-Final Office Action—U.S. Appl. No. 14/163,719.
Jan. 29, 2016—(US) Notice of Allowance and Fee(s) Due—U.S. Appl. No. 14/163,741.
Mar. 17, 2016—(US) Notice of Allowance and Fee(s) Due—U.S. Appl. No. 14/163,761.
Apr. 7, 2016—(US) Non-Final Office Action—U.S. Appl. No. 14/163,719.
Sep. 9, 2016—(US) Notice of Allowance—U.S. Appl. No. 14/163,719.
Sep. 9, 2016—(US) Non-Final Office Action—U.S. Appl. No. 14/697,131.
Sep. 9, 2016—(US) Non-Final Office Action—U.S. Appl. No. 14/697,153.
Oct. 6, 2016—(US) Non-Final Office Action—U.S. Appl. No. 14/184,272.
Oct. 3, 2016—(US) Non-Final Office Action—U.S. Appl. No. 14/733,576.
Oct. 20, 2016—(US) Non-Final Office Action—U.S. Appl. No. 14/816,336.
Oct. 21, 2016—(US) Non-Final Office Action—U.S. Appl. No. 14/862,266.
Oct. 24, 2016—(US) Non-Final Office Action—U.S. Appl. No. 14/816,299.
Oct. 17, 2016—(US) Office Action—U.S. Appl. No. 13/892,598.
Nov. 29, 2016—(US) Non-Final Office—U.S. Appl. No. 14/458,796.
Dec. 12, 2016—(US) Notice of Allowance—U.S. Appl. No. 14/832,197.
Dec. 19, 2016—(US) Final Office Action—U.S. Appl. No. 14/607,433.
Dec. 29, 2016—(US) Non-Final Office Action—U.S. Appl. No. 14/458,764.
Jan. 4, 2017—(US) Non-Final Office Action—U.S. Appl. No. 14/697,131.
Jan. 12, 2017—(US) Non-Final Office Action—U.S. Appl. No. 14/458,826.
Jan. 13, 2017—(US) Non-Final Office Action—U.S. Appl. No. 14/458,744.
Jan. 19, 2017—(US) Final Office Action—U.S. Appl. No. 14/673,150.
Dec. 26, 2017—(US) Notice of Allowance—U.S. Appl. No. 14/163,719.

(56) **References Cited**

OTHER PUBLICATIONS

Dec. 27, 2017—(US) Non-Final Office Action—U.S. Appl. No. 14/697,131.
Dec. 20, 2017—(US) Notice of Allowance—U.S. Appl. No. 14/184,272.
Dec. 22, 2017—(US) Notice of Allowance—U.S. Appl. No. 14/733,576.

* cited by examiner

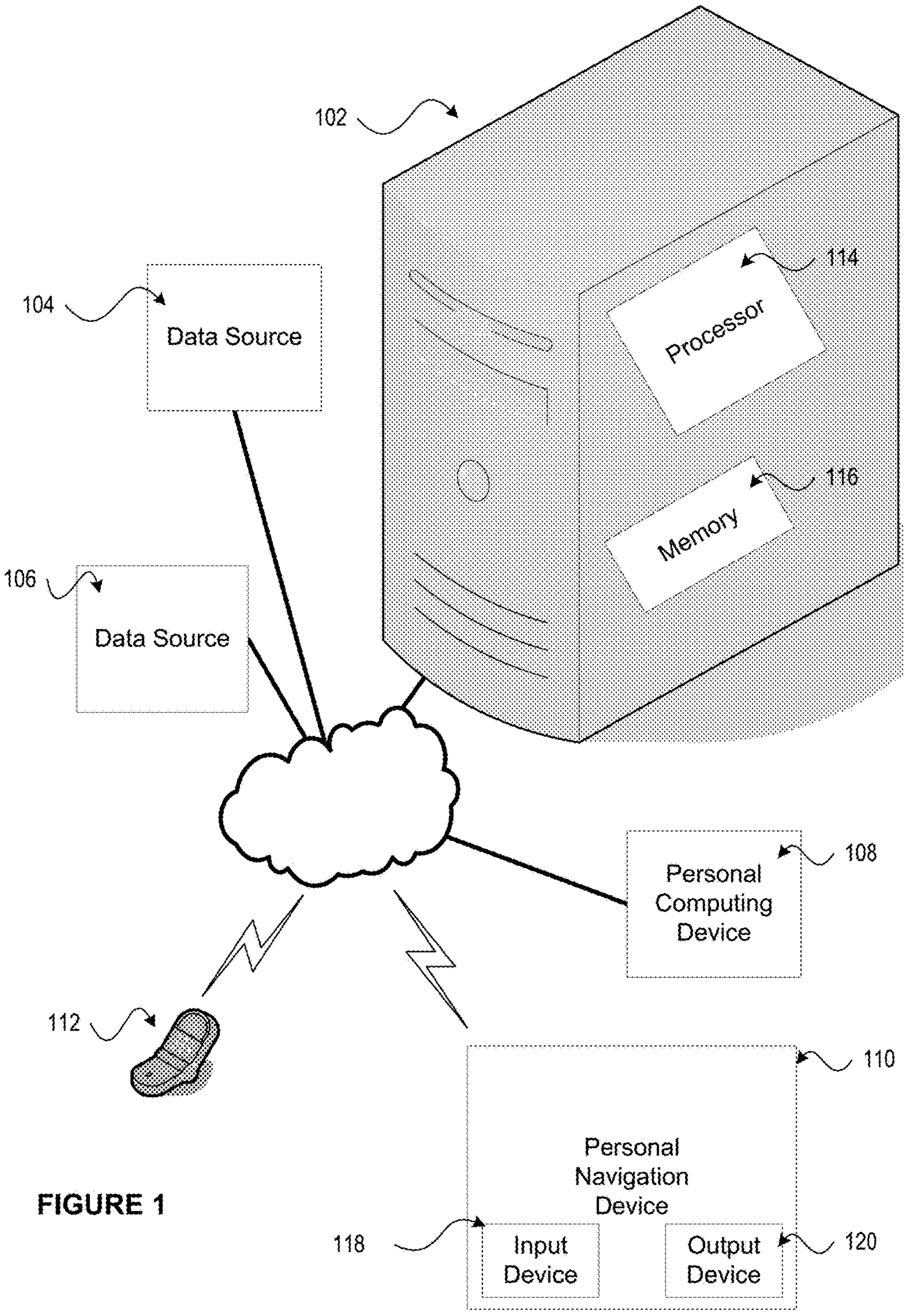

102
104
Data Source
106
Data Source
114
Processor
116
Memory
108
Personal Computing Device
112
110
Personal Navigation Device
118
Input Device
Output Device
120

FIGURE 1

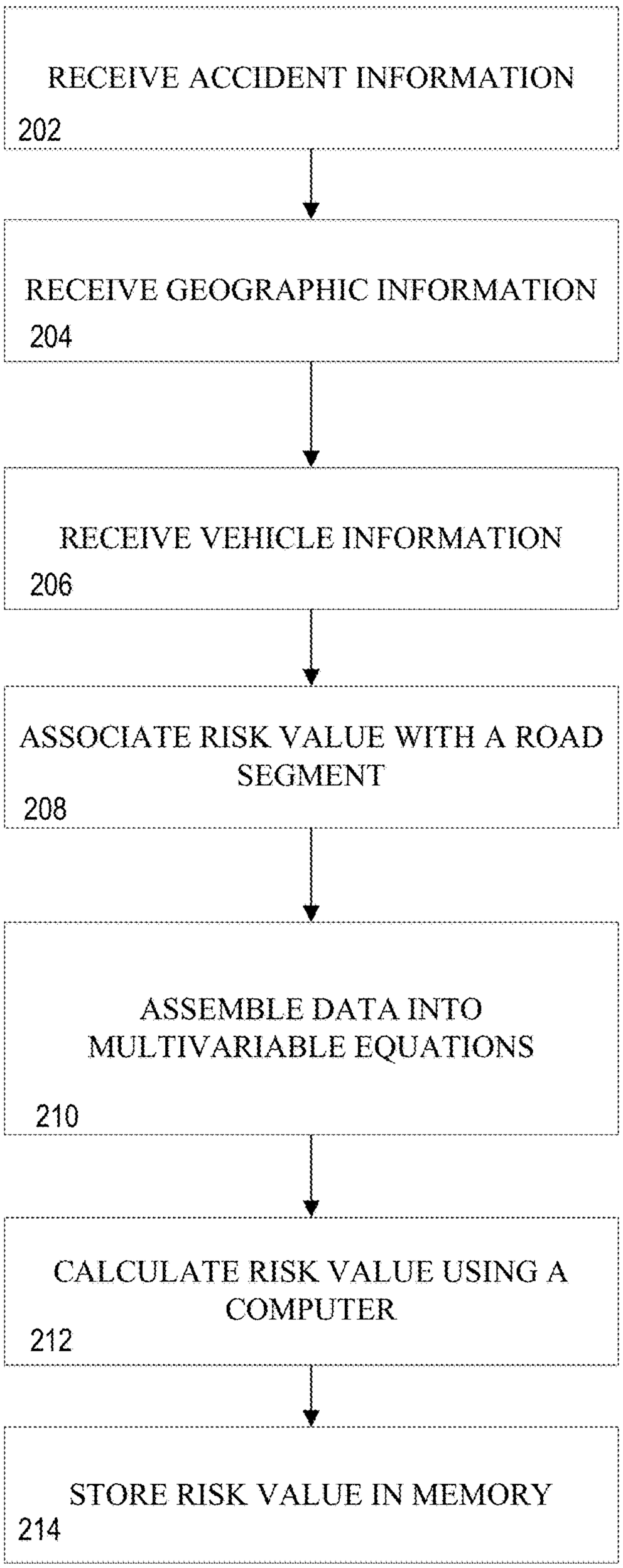

RECEIVE ACCIDENT INFORMATION
202
RECEIVE GEOGRAPHIC INFORMATION
204
RECEIVE VEHICLE INFORMATION
206
ASSOCIATE RISK VALUE WITH A ROAD SEGMENT
208
ASSEMBLE DATA INTO MULTIVARIABLE EQUATIONS
210
CALCULATE RISK VALUE USING A COMPUTER
212
STORE RISK VALUE IN MEMORY
214

FIGURE 2

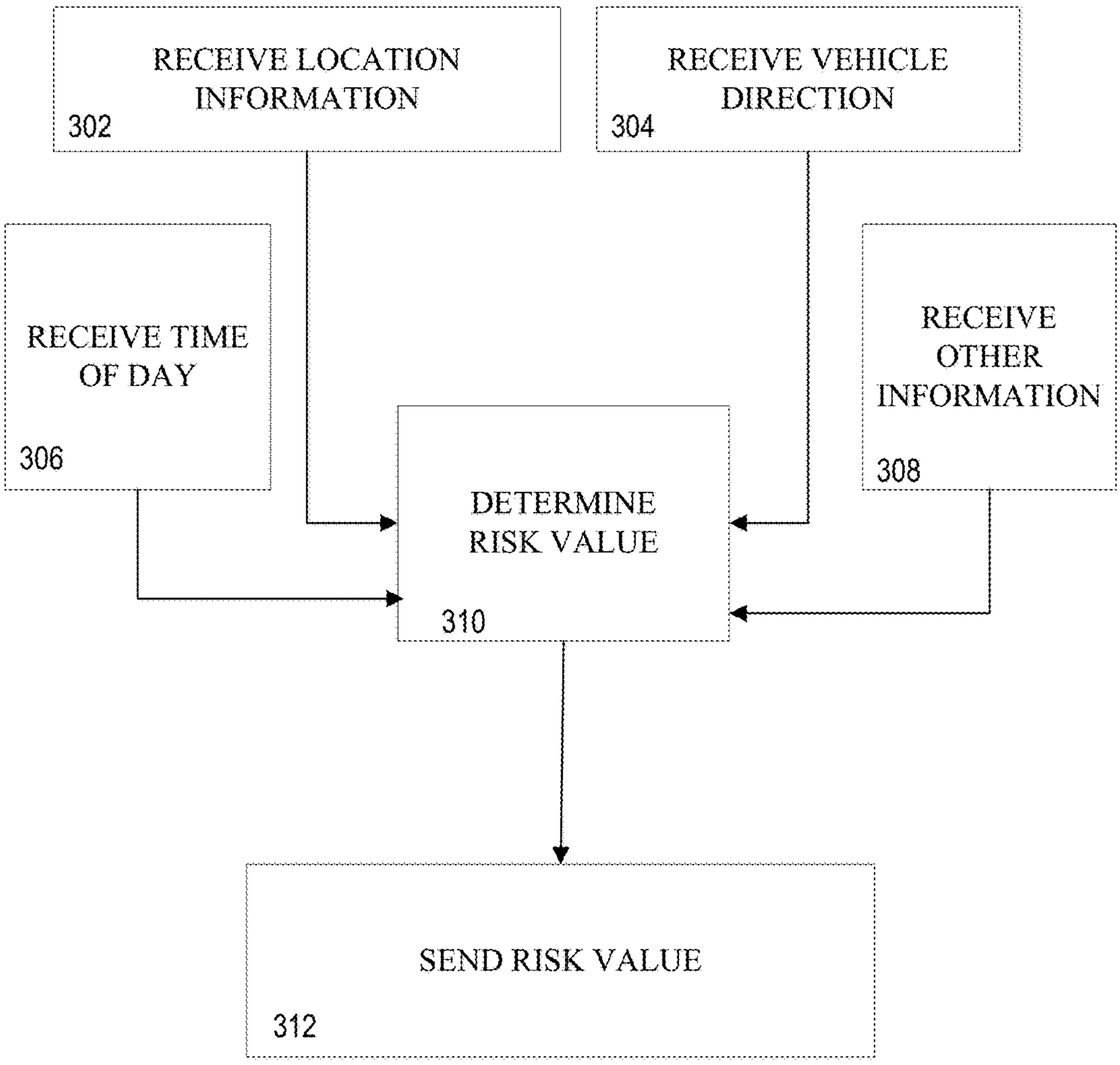

RECEIVE LOCATION INFORMATION
302
RECEIVE VEHICLE DIRECTION
304
RECEIVE TIME OF DAY
306
RECEIVE OTHER INFORMATION
308
DETERMINE RISK VALUE
310
SEND RISK VALUE
312

FIGURE 3

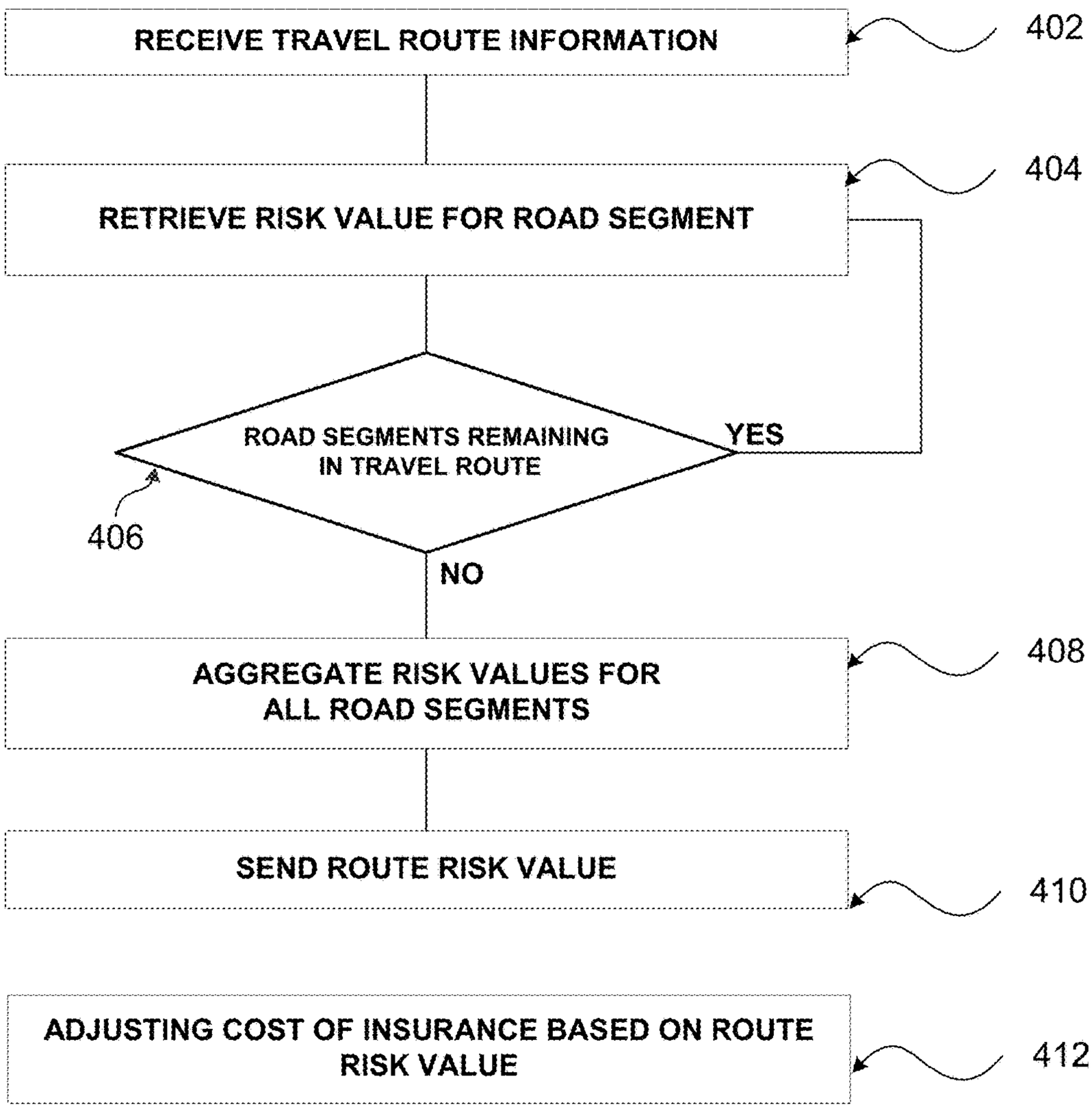

RECEIVE TRAVEL ROUTE INFORMATION
402
RETRIEVE RISK VALUE FOR ROAD SEGMENT
404
ROAD SEGMENTS REMAINING IN TRAVEL ROUTE
YES
406
NO
AGGREGATE RISK VALUES FOR ALL ROAD SEGMENTS
408
SEND ROUTE RISK VALUE
410
ADJUSTING COST OF INSURANCE BASED ON ROUTE RISK VALUE
412

FIGURE 4

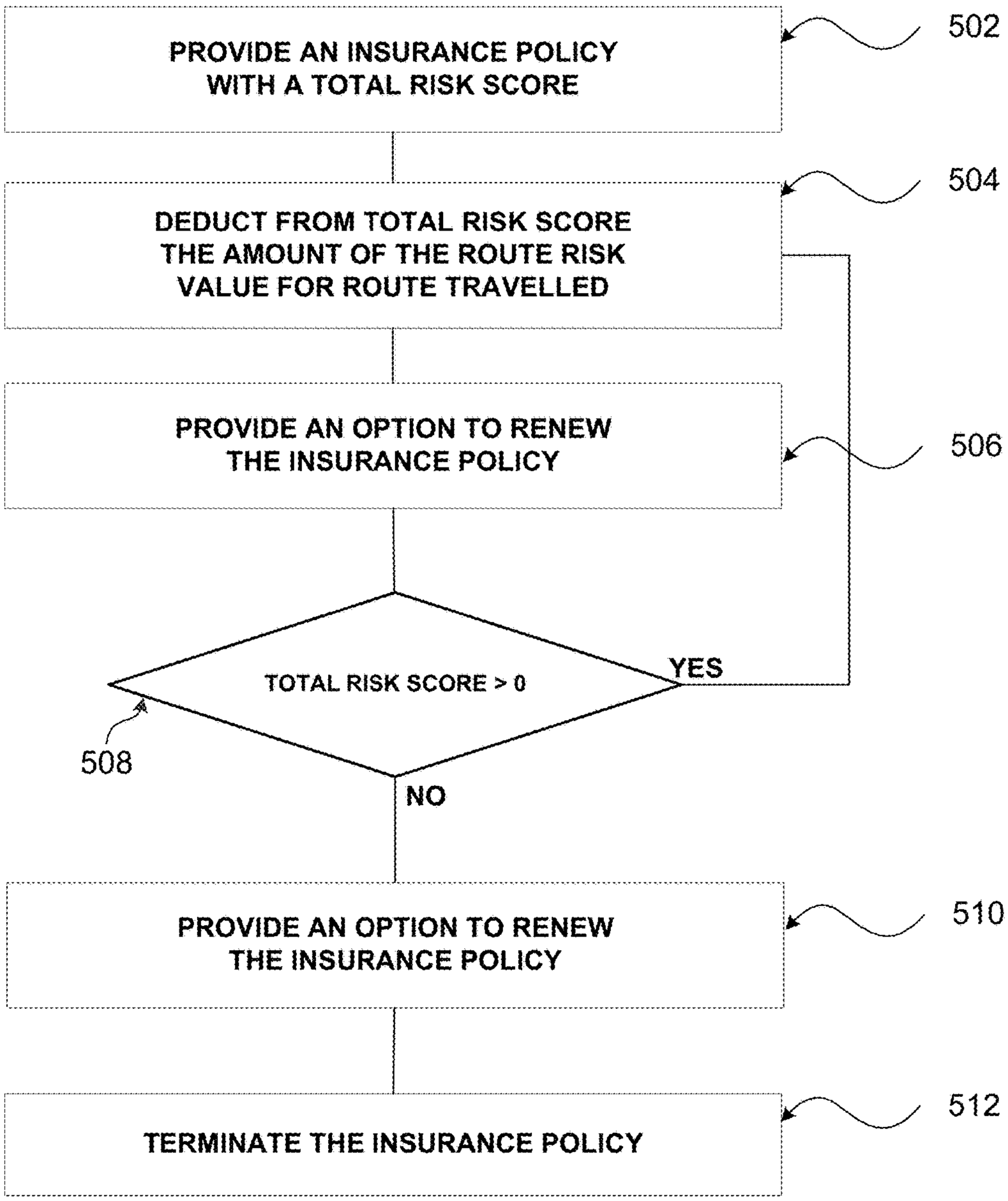

PROVIDE AN INSURANCE POLICY WITH A TOTAL RISK SCORE
502
DEDUCT FROM TOTAL RISK SCORE THE AMOUNT OF THE ROUTE RISK VALUE FOR ROUTE TRAVELLED
504
PROVIDE AN OPTION TO RENEW THE INSURANCE POLICY
506
TOTAL RISK SCORE > 0
YES
508
NO
PROVIDE AN OPTION TO RENEW THE INSURANCE POLICY
510
TERMINATE THE INSURANCE POLICY
512

FIGURE 5

ROUTE RISK MITIGATION

RELATED APPLICATION

This application is a divisional of U.S. patent application Ser. No. 14/100,754, filed Dec. 9, 2013 (and will grant on Apr. 28, 2015 as U.S. Pat. No. 9,020,751), which is a divisional of U.S. patent application Ser. No. 12/118,021, filed May 9, 2008, issued Dec. 10, 2013 as U.S. Pat. No. 8,606,512, which claims priority to U.S. Provisional Patent Application No. 60/917,169 filed May 10, 2007. All of the aforementioned are incorporated by reference in their entirety herein.

TECHNICAL FIELD

Aspects of the invention relate generally to risk mitigation. More particularly, aspects of the invention relate to using geographically encoded information to promote and/or reward risk mitigation.

DESCRIPTION OF THE RELATED ART

Although insurers may vary insurance premiums based on garaging location (by state, county, etc.), there is a need in the art for enhanced systems and methods to better account for variations in a location-based risk to vehicles and subsequently acting accordingly. For example, some insurers use location-based technology such as GPS (global positioning satellites) to monitor the location of vehicles. Nevertheless, there is a need in the art for a technique for estimating the risk associated with a route using the various aspects disclosed by the present invention. Therefore, there is a benefit in the art for an enhanced method and device for calculating a risk for a road segment and using it to, among other things, mitigate risk.

SUMMARY

Aspects of the invention overcome problems and limitations of the prior art by providing a method for mitigating the risks associated with driving by assigning risk values to road segments and using those risk values to select less risky travel routes.

Various approaches to helping users mitigate risk are presented. In accordance with aspects of the invention, a computing system is disclosed for generating a data store (e.g., database) of risk values. The system may receive various types of information, including but not limited to, accident information, geographic information, and vehicle information, from one or more data sources. The system calculates a risk value for an associated road segment. Subsequently, the computing system may provide the associated risk value when provided with location information (and/or other information) for the road segment.

In an alternate embodiment in accordance with aspects of the invention, a personal navigation device, mobile device, and/or personal computing device may communicate, directly or indirectly, with the system's database of risk values. The system may receive travel route information and use that information to retrieve risk values for the associated road segments in the travel route. The system may send a compilation of the risk values to the device for display on a screen of the device or for recording in memory. The system may also aggregate risk values and form a score that is then sent for display on the screen of the device or sent for recording in a memory. The contents of memory may also be uploaded to a data store for use by, e.g., insurance companies, to determine whether to adjust a quote or premium of an insurance policy.

In an alternate embodiment in accordance with aspects of the invention, a personal navigation device, mobile device, and/or personal computing device may communicate, directly or indirectly, with the system's database of risk values. The system may receive regional location information and retrieve the risk values for road segments within the associated region and send the associated information to the device for recording into memory. The device may receive travel route information and query the memory for the associated risk values. The risk values may be sent for display on the device or for recording in memory. The contents of memory may also be uploaded to a system data store for use by, e.g., insurance companies, to determine whether to adjust a quote or premium of an insurance policy.

In yet another embodiment, in accordance with aspects of the invention, a personal navigation device, mobile device, and/or personal computing device may access the database of risk values to assist in identifying and presenting alternate lower-risk travel routes. The driver may select among the various travel routes presented, taking into account one or more factors such as a driver's tolerance for risk and/or desire to lower the cost of insurance. These factors may be saved in memory designating the driver's preferences. Depending on the driver's selection/preferences, the cost or other aspects of the vehicle's insurance coverage may be adjusted accordingly for either the current insurance policy period or a future insurance policy period.

The details of these and other embodiments of the invention are set forth in the accompanying drawings and description below. Other features and advantages of aspects of the invention will be apparent from the description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Aspects of the invention may take physical form in certain parts and steps, embodiments of which will be described in detail in the following description and illustrated in the accompanying drawings that form a part hereof, wherein:

FIG. **1** depicts an illustrative operating environment in accordance with aspects of the invention;

FIG. **2** depicts illustrative steps for calculating the risk value of a route segment by applying actuarial and/or statistical methods in accordance with aspects of the invention;

FIG. **3** depicts illustrative steps for determining and providing risk values to a computing device in accordance with aspects of the invention;

FIG. **4** depicts illustrative steps for calculating the risk value of a travel route in accordance with aspects of the invention; and

FIG. **5** depicts illustrative steps for providing an insurance policy based on risk consumption in accordance with aspects of the invention.

It will be apparent to one skilled in the art after review of the entirety disclosed that the steps illustrated in the figures listed above may be performed in other than the recited order, and that one or more steps illustrated in these figures may be optional.

DETAILED DESCRIPTION

In accordance with aspects of the invention, a new set of pricing tiers are disclosed herein for enabling safe driving

and lower rates for insurance policy customers. In addition, various approaches to helping users mitigate risk are presented. In accordance with aspects of the invention, a computing device is disclosed for generating risk values in a data store. The system may receive various types of information, including but not limited to, accident information, geographic information, and vehicle information, from one or more data sources and calculate a risk value for associated road segments. Subsequently, the computing device may provide the associated risk value when provided with location information for a road segment such as regional location information and/or other information.

In an alternate embodiment in accordance with aspects of the invention, a personal navigation device, mobile device, and/or personal computing device may communicate with the database of risk values. The devices may receive information about a travel route and use that information to retrieve risk values for road segments in the travel route. The aggregate of the risk values is sent for display on a screen of the device or for recording in memory of the device. The contents of memory may also be uploaded to a data store for use by, e.g., insurance companies, to determine whether to adjust a quote for insurance coverage or one or more aspects of current insurance coverage such as premium, specific coverages, specific exclusions, rewards, special terms, etc.

In yet another embodiment, in accordance with aspects of the invention, a personal navigation device, mobile device, and/or personal computing device may access the database of risk values to assist in identifying and presenting alternate low-risk travel routes. The driver may select among the various travel routes presented, taking into account his/her tolerance for risk. Depending on the driver's selection, the vehicle's insurance policy may be adjusted accordingly, for either the current insurance policy or a future insurance policy.

Referring to FIG. **1**, an example of a suitable operating environment in which various aspects of the invention may be implemented is shown in the architectural diagram of FIG. **1**. The operating environment is only one example of a suitable operating environment and is not intended to suggest any limitation as to the scope of use or functionality of the invention. The operating environment may be comprised of one or more data sources **104**, **106** in communication with a computing device **102**. The computing device **102** may use information communicated from the data sources **104**, **106** to generate values that may be stored in a conventional database format. In one embodiment, the computing device **102** may be a high-end server computer with one or more processors **114** and memory **116** for storing and maintaining the values generated. The memory **116** storing and maintaining the values generated need not be physically located in the computing device **102**. Rather, the memory (e.g., ROM, flash memory, hard drive memory, RAID memory, etc.) may be located in a remote data store (e.g., memory storage area) physically located outside the computing device **102**, but in communication with the computing device **102**.

A personal computing device **108** (e.g., a personal computer, tablet PC, handheld computing device, personal digital assistant, mobile device, etc.) may communicate with the computing device **102**. Similarly, a personal navigation device **110** (e.g., a global positioning system (GPS), geographic information system (GIS), satellite navigation system, mobile device, other location tracking device, etc.) may communicate with the computing device **102**. The communication between the computing device **102** and the other devices **108**, **110** may be through wired or wireless communication networks and/or direct links. One or more networks may be in the form of a local area network (LAN) that has one or more of the well-known LAN topologies and may use a variety of different protocols, such as Ethernet. One or more of the networks may be in the form of a wide area network (WAN), such as the Internet. The computing device **102** and other devices (e.g., devices **108**, **110**) may be connected to one or more of the networks via twisted pair wires, coaxial cable, fiber optics, radio waves or other media. The term "network" as used herein and depicted in the drawings should be broadly interpreted to include not only systems in which devices and/or data sources are coupled together via one or more communication paths, but also stand-alone devices that may be coupled, from time to time, to such systems that have storage capability.

In another embodiment in accordance with aspects of the invention, a personal navigation device **110** may operate in a stand-alone manner by locally storing some of the database of values stored in the memory **116** of the computing device **102**. For example, a personal navigation device **110** (e.g., a GPS in an automobile) may be comprised of a processor, memory, and/or input devices **118**/output devices **120** (e.g., keypad, display screen, speaker, etc.). The memory may be comprised of a non-volatile memory that stores a database of values used in calculating an estimated route risk for identified routes. Therefore, the personal navigation device **110** need not communicate with a computing device **102** located at, for example, a remote location in order to calculate identified routes. Rather, the personal navigation device **110** may behave in a stand-alone manner and use its processor to calculate route risk values of identified routes. If desired, the personal navigation device **110** may be updated with an updated database of values after a period of time (e.g., an annual patch with new risk values determined over the prior year).

In yet another embodiment in accordance with aspects of the invention, a personal computing device **108** may operate in a stand-alone manner by locally storing some of the database of values stored in the memory **116** of the computing device **102**. For example, a personal computing device **108** may be comprised of a processor, memory, input device (e.g., keypad, CD-ROM drive, DVD drive, etc.), and output device (e.g., display screen, printer, speaker, etc.). The memory may be comprised of CD-ROM media that stores values used in calculating an estimated route risk for an identified route. Therefore, the personal computing device **108** may use the input device to read the contents of the CD-ROM media in order to calculate a value for the identified route. Rather, the personal computing device **108** may behave in a stand-alone manner and use its processor to calculate a route risk value. If desired, the personal computing device **108** may be provided with an updated database of values (e.g., in the form of updated CD-ROM media) after a period of time. One skilled in the art will appreciate that personal computing device **108**, **110**, **112** need not be personal to a single user; rather, they may be shared among members of a family, company, etc.

The data sources **104**, **106** may provide information to the computing device **102**. In one embodiment in accordance with aspects of the invention, a data source may be a computer which contains memory storing data and is configured to provide information to the computing device **102**. Some examples of providers of data sources in accordance with aspects of the invention include, but are not limited to, insurance companies, third-party insurance data providers, government entities, state highway patrol departments, local law enforcement agencies, state departments of transporta-

tion, federal transportation agencies, traffic information services, road hazard information sources, construction information sources, weather information services, geographic information services, vehicle manufacturers, vehicle safety organizations, and environmental information services. For privacy protection reasons, in some embodiments of the invention, access to the information in the data sources **104**, **106** may be restricted to only authorized computing devices **102** and for only permissible purposes. For example, access to the data sources **104**, **106** may be restricted to only those persons/entities that have signed an agreement (e.g., an electronic agreement) acknowledging their responsibilities with regard to the use and security to be accorded this information.

The computing device **102** uses the information from the data sources **104**, **106** to generate values that may be used to calculate an estimated route risk. Some examples of the information that the data sources **104**, **106** may provide to the computing device **102** include, but are not limited to, accident information, geographic information, and other types of information useful in generating a database of values for calculating an estimated route risk.

Some examples of accident information include, but are not limited to, loss type, applicable insurance coverage(s) (e.g., bodily injury, property damage, medical/personal injury protection, collision, comprehensive, rental reimbursement, towing), loss cost, number of distinct accidents for the segment, time relevancy validation, cause of loss (e.g., turned left into oncoming traffic, ran through red light, rear-ended while attempting to stop, rear-ended while changing lanes, sideswiped during normal driving, sideswiped while changing lanes, accident caused by tire failure (e.g., blow-out), accident caused by other malfunction of car, rolled over, caught on fire or exploded, immersed into a body of water or liquid, unknown, etc.), impact type (e.g., collision with another automobile, collision with cyclist, collision with pedestrian, collision with animal, collision with parked car, etc.), drugs or alcohol involved, pedestrian involved, wildlife involved, type of wildlife involved, speed of vehicle at time of incident, direction the vehicle is traveling immediately before the incident occurred, date of incident, time of day, night/day indicator (i.e., whether it was night or day at the time of the incident), temperature at time of incident, weather conditions at time of incident (e.g., sunny, downpour rain, light rain, snow, fog, ice, sleet, hail, wind, hurricane, etc.), road conditions at time of incident (e.g., wet pavement, dry pavement, etc.), and location (e.g., geographic coordinates, closest address, zip code, etc.) of vehicle at time of incident.

Accident information associated with vehicle accidents may be stored in a database format and may be compiled per segment. One skilled in the art will understand that the term segment may be interchangeably used to describe a road segment, intersection, round about, bridge, tunnel, ramp, parking lot, railroad crossing, or other feature that a vehicle may encounter along a route.

Time relevancy validation relates to the relevancy of historical accident information associated with a particular location. Time relevancy validation information may be dynamically created by comparing the time frames of accident information to the current date. For example, if a location or route had many collisions prior to five years ago but few since, perhaps a road improvement reduced the risk (such as adding a traffic light). Time relevancy information may be generated remotely and transmitted by a data source **104**, **106** to the computing device **102** like other information. Alternatively, time relevancy information may be calculated at the computing device **102** using other information transmitted by a data source **104**, **106**. For example, the appropriateness of historical information may be related to the time frame into which the information belongs. Examples of time frames may include, but are not limited to, less than 1 year ago, 1 year ago, 2 years ago, 3 years ago, 4 years ago, 5 to 10 years ago, and greater than 10 years ago. In one embodiment, the more recent the historical information, the greater weight is attributed to the information.

Some examples of geographic information include, but are not limited to, location information and attribute information. Examples of attribute information include, but are not limited to, information about characteristics of a corresponding location described by some location information: posted speed limit, construction area indicator (i.e., whether location has construction), topography type (e.g., flat, rolling hills, steep hills, etc.), road type (e.g., residential, interstate, 4-lane separated highway, city street, country road, parking lot, etc.), road feature (e.g., intersection, gentle curve, blind curve, bridge, tunnel), number of intersections, whether a roundabout is present, number of railroad crossings, whether a passing zone is present, whether a merge is present, number of lanes, width of road/lanes, population density, condition of road (e.g., new, worn, severely damaged with sink-holes, severely damaged with erosion, gravel, dirt, paved, etc.), wildlife area, state, county, and/or municipality. Geographic information may also include other attribute information about road segments, intersections, bridges, tunnels, railroad crossings, and other roadway features.

Location information for an intersection may include the latitude and longitude (e.g., geographic coordinates) of the geometric center of the intersection. The location may be described in other embodiments using a closest address to the actual desired location or intersection. The intersection (i.e., location information) may also include information that describes the geographic boundaries, for example, of the intersection which includes all information that is associated within a circular area defined by the coordinates of the center of the intersection and points within a specified radius of the center. In another example of location information, a road segment may be defined by the latitude and longitude of its endpoints and/or an area defined by the road shape and a predetermined offset that forms a polygon. Segments may comprise intersections, bridges, tunnels, rail road crossings or other roadway types and features. Those skilled in the art will recognize that segments can be defined in many ways without departing from the spirit of this disclosed invention.

Some examples of vehicle information include, but are not limited to, information that describes vehicles that are associated with incidents (e.g., vehicle accidents, etc.) at a particular location (e.g., a location corresponding to location information describing a segment, intersection, etc.) Vehicle information may include vehicle make, vehicle model, vehicle year, and age. Vehicle information may also include information collected through one or more in-vehicle devices or systems such as an event data recorder (EDR), onboard diagnostic system, or global positioning satellite (GPS) device; examples of this information include speed at impact, brakes applied, throttle position, direction at impact. As is clear from the preceding examples, vehicle information may also include information about the driver of a vehicle being driven at the time of an incident. Other examples of driver information may include age, gender, marital status, occupation, alcohol level in blood, credit score, distance from home, cell phone usage (i.e., whether the driver was using a cell phone at the time of the incident), number of occupants.

In one embodiment in accordance with aspects of the invention, a data source **104** may provide the computing device **102** with accident information that is used to generate values (e.g., create new values and/or update existing values). The computing device **102** may use at least part of the received accident information to calculate a value, associate the value with a road segment (or other location information), and store the value in a database format. One skilled in the art will appreciate, after thorough review of the entirety disclosed herein, that there may be other types of information that may be useful in generating a database of values for use in, among other things, calculating an estimated route risk.

For example, in accordance with aspects of the invention, a data source **104** may provide the computing device **102** with geographic information that is used to generate new roadway feature risk values in a database of risk values and/or update existing risk values; where the roadway feature may comprise intersections, road segments, tunnels, bridges, or railroad crossings. Attributes associated with roadways may also be used in part to generate risk values. The computing device **102** may use at least part of the received geographic information to calculate a value, associate the value with a road segment (or other location information), and store the value in a database format. Numerous examples of geographic information were provided above. For example, a computing device **102** may receive geographic information corresponding to a road segment comprising accident information and roadway feature information and then calculate a risk value. Therefore, when calculating a risk value, the system may use, in one example, the geographic information and the accident information (if any accident information is provided). In alternative embodiments in accordance with aspects of the invention, the computing device may use accident information, geographic information, vehicle information, and/or other information, either alone or in combination, in calculating risk values in a database format.

The values generated by the computing device **102** may be associated with a road segment containing the accident location and stored in a data store. Similar to a point of interest (POI) stored in GPS systems, a point of risk (POR) is a road segment or point on a map that has risk information associated with it. Points of risk may arise because incidents (e.g., accidents) have occurred at these points before. In accordance with aspects of the invention, the road segment may be a predetermined length (e.g., ¼ mile) on a stretch of road. Alternatively, road segments may be points (i.e., where the predetermined length is minimal) on a road. Furthermore, in some embodiments, road segment may include one or more different roads that are no farther than a predetermined radius from a road segment identifier. Such an embodiment may be beneficial in a location, for example, where an unusually large number of streets intersect, and it may be impractical to designate a single road for a road segment.

Referring to FIG. **2**, in accordance with aspects of the invention, a computing device **102** may receive accident information (in step **202**), geographic information (in step **204**), and/or vehicle information (in step **206**). The computing device **102** may calculate (in step **212**) the risk value for a road segment (or point of risk) by applying actuarial techniques to the information that may be received from data sources **104**, **106**. In one embodiment, the computing device **102** receives and stores the accident information in a data store with the latitude/longitude and time of the incident. The accident data is associated with a location and combined with other accident data associated with the same location (in step **210**). Applying actuarial and/or statistical modeling techniques involving multiple predictors, such as generalized linear models and non-linear models, a risk value may be calculated (**212**), and the calculated risk value may be recorded in memory (**116**) (in step **214**). The multiple predictors involved in the statistical model used to calculate a risk value may include accident information, geographic information, and vehicle information. Associating the risk value (in step **208**) with a line segment and/or point which best pinpoints the area of the road in which the incident(s) occurred may be accomplished by using established GIS locating technology (e.g., GPS ascertaining a geographically determinable address, and assigning the data file to a segment's or intersection's formal address determined by the system). For example, two or more accidents located in an intersection or road segment may have slightly different addresses depending on where within the intersection or segment the accident location was determined to be. Therefore, the system may identify a location based on business rules. In another example business rules may identify an incident location using the address of the nearest intersection. In yet another example the system may identify the location of an incident on a highway using segments based on mileage markers or the lengths may be dynamically determined by creating segment lengths based on relatively equal normalized risk values. Therefore, roadways that have stretches with higher numbers of accidents may have shorter segments than stretches that have fewer accidents. In another example, if the incident occurred in a parking lot, the entire parking lot may be associated with a formal address that includes all accidents located within a determined area. One skilled in the art will appreciate after review of the entirety disclosed that road segment includes a segment of road, a point on a road, and other designations of a location (e.g., an entire parking lot).

For example, an insurance claim-handling processor may collect data about numerous incidents such as collision, theft, weather damage, and other events that cause any one of (or combination of) personal injury, vehicle damage, and damage to other vehicles or property. Information about the accident may be collected through artifacts such as first notice of loss (FNOL) reports and claim adjuster reports and may be stored in one or more data stores used by the insurer. Other data may also be collected at the point and time when the incident occurred, and this information (e.g., weather conditions, traffic conditions, vehicle speed, etc.) may be stored with the other accident information. The information in these data stores may be distributed by data sources **104**, **106** in accordance with aspects of the invention. In addition, some information may also be recorded in third-party data sources that may be accessible to one or more insurance companies. For example, traffic information (e.g., traffic volume) and weather information may be retrieved in real-time (or near real-time) from their respective data sources.

Referring to FIG. **3**, in accordance with aspects of the invention, the computing device **102** may send (in step **312**) the risk value corresponding to a road segment when it receives location information (in step **302**) requesting the risk associated with a particular location. The particular location information may be in the form of longitude/latitude coordinates, street address, intersection, closest address, or other form of information. Furthermore, in an alternative embodiment the accuracy of the risk value may be improved by submitting the direction that a vehicle travels (or may travel) through a road segment. The computing device **102** may receive (in step **304**) the vehicle

direction and use it to determine the risk value associated with the vehicle route. For example, a dangerous intersection demonstrates high risk to a vehicle/driver that passes through it. However, actuarial analysis (e.g., of data showing many recorded accidents at the location) may show that it is more dangerous if the driver is traveling northbound on the road segment and turns left. Therefore, the vehicle direction may also be considered when retrieving the appropriate risk value (in step **310**).

Likewise, the computing device **102** may also receive (in step **308**) other information to enhance the accuracy of the risk value associated with a travel route. For example, the computing device **102** may receive (in step **306**) the time of day when the driver is driving (or plans to drive) through a particular travel route. This information may improve the accuracy of the risk value retrieved (in step **310**) for the travel route. For example, a particular segment of road through a wilderness area may have a higher rate of accidents involving deer during the night hours, but no accidents during the daylight hours. Therefore, the time of day may also be considered when retrieving the appropriate risk value (in step **310**). In addition, the computing device may receive (in step **308**) other information to improve the accuracy of the risk value retrieved (in step **310**) for a travel route. Some examples of this other information include, but are not limited to, the vehicle's speed (e.g., a vehicle without a sport suspension attempting to take a dangerous curve at a high speed), vehicle's speed compared to the posted speed limit, etc.

In accordance with aspects of the invention, a computer-readable medium storing computer-executable instructions for performing the steps depicted in FIGS. **2** and **3** and/or described in the present disclosure is contemplated. The computer-executable instructions may be configured for execution by a processor (e.g., processor **114** in computing device **102**) and stored in a memory (e.g., memory **116** in computing device **102**). Furthermore, as explained earlier, the computer-readable medium may be embodied in a non-volatile memory (e.g., in a memory in personal navigation device **110**) or portable media (e.g., CD-ROM, DVD-ROM, USB flash, etc. connected to personal computing device **108**).

In accordance with aspects of the invention, a personal navigation device **110** may calculate a route risk value for a travel route of a vehicle. The personal navigation device **110** may be located, for example, in a driver's vehicle or in a mobile device **112** with location tracking capabilities. Alternatively, a personal computing device **108** may be used to calculate the route risk value for a travel route of a vehicle.

For example, referring to FIG. **4**, a personal navigation device **110** may receive (in step **402**) travel route information. The travel route information may include, but is not limited to, a start location, end location, road-by-road directions, and/or turn-by-turn directions. The personal navigation device **110** may use the travel route information and mapping software to determine the road segment upon which the vehicle will travel, and retrieve (in step **404**) the risk value for that road segment. For each subsequent road segment remaining in the travel route (see step **406**), the personal navigation device **110** may access the database of risk values to retrieve (in step **404**) the risk value for that road segment. As explained earlier, the database of risk values may be stored locally to the personal navigation device **110**, or may be stored remotely and accessed through a wired/wireless link to the data store.

The risk values retrieved (in step **404**) for the travel route may be aggregated (in step **408**) and a total risk value for the travel route may be sent (in step **410**). In an alternate embodiment, the computing device **102** may count the number of each type of road risk along the travel route based on the values stored in the database. This number may then be multiplied by a risk-rating factor for the respective risk type. A risk type may comprise intersections, locations of past accidents along a route, railroad crossings, merges, roadway class (residential, local, commercial, rural, highways, limited access highways). Other risk types may include proximity to businesses that sell alcohol, churches or bingo parlors.

The sum of this product over all risk types may, in this alternate embodiment, equal the total route risk value. The total route risk value may be divided by the distance traveled to determine the route risk category for the travel route. For example, a route risk category may be assigned based on a set of route risk value ranges for low, medium, and high risk routes.

After being aggregated, the total risk value may be sent (in step **410**) to a viewable display on the personal navigation device **110**. Alternatively, the total risk value may be sent (in step **410**) to a local/remote memory where it may be recorded and/or monitored. For example, it may be desirable for a safe driver to have her total risk value for all travel routes traveled over a time period to be uploaded to an insurance company's data store. The insurance company may then identify the driver as a lower-risk driver (e.g., a driver that travels on statistically lower-risk routes during lower-risk times) and provide the driver/vehicle with a discount and/or credit (in step **412**) on an existing insurance policy (or towards a future insurance policy). At least one benefit of the aforementioned is that safe drivers are rewarded appropriately, while high-risk drivers are treated accordingly.

In some embodiments in accordance with aspects of the invention, the route risk value sent (in step **410**) may be in the form of a number rating the risk of the travel route (e.g., a rating of 1 to 100 where 1 is very low risk and 100 is very high risk). Alternatively, the route risk value may be in the form of a predetermined category (e.g., low risk, medium risk, and high risk). At least one benefit of displaying the route risk value in this form is the simplicity of the resulting display for the driver. For example, an enhanced GPS unit may display a route (or segment of a route) in a red color to designate a high risk route, and a route may be displayed in a green color to designate a lower risk route. At least one benefit of a predetermined category for the route risk value is that it may be used as the means for comparing the amount of risk associated with each travel route when providing alternate routes. In addition, the enhanced GPS unit may alert the driver of a high risk road segment and offer the driver an incentive (e.g., monetary incentive, points, etc.) for avoiding that segment.

In accordance with aspects of the invention, a computer-readable medium storing computer-executable instructions for performing the steps depicted in FIG. **4** and/or described in the present disclosure is contemplated. The computer-executable instructions may be configured for execution by a processor (e.g., a processor in personal navigation device **110**) and stored in a memory (e.g., flash memory in device **110**).

When retrieving risk values, in accordance with aspects of the invention, one or more techniques, either alone or in combination, may be used for identifying and calculating the appropriate risk value for road segments. For example, under an accident cost severity rating (ACSR) approach, each point of risk has a value which measures how severe

the average accident is for each point of risk. The value may be normalized and/or scaled by adjusting the range of the values. For example, under an ACSR approach using a range of values from 1 to 10: considering all accidents that occur in a predetermined area (e.g., road segment, state, zip code, municipality, etc.), the accidents in the top ten percentile of expensive accidents in that territory would get a 10 value and the lowest 10 percentile of costly accidents in that region would get a 1 value. The actual loss cost may be calculated by summing the various itemized loss costs (e.g., bodily injury, property damage, medical/personal injury protection, collision, comprehensive, uninsured/underinsured motorist, rental reimbursement, towing, etc.).

In an alternate embodiment, the ACSR approach may attribute varying weights to the different types of loss costs summed to calculate the actual loss cost. For example, after analyzing the information, certain portions of a loss cost (e.g., medical cost) may indicate risk more accurately than others. The importance of these portions may be weighted more heavily in the final loss cost calculation. Actuarial methods may be used to adjust loss cost data for a segment where a fluke accident may cause the calculated risk value to far exceed the risk value based on all the other data.

Under the accidents per year (APYR) approach, in accordance with aspects of the invention, each point of risk has a risk value that may reflect the average number of accidents a year for that individual point of risk. Under a modified APYR approach, the risk value for a point of risk continues to reflect the average number of accidents a year, but attributes a lesser weight to accidents that occurred a longer time ago, similar to time relevancy validation (e.g., it gives emphasis to recent accident occurrences over older occurrences).

Under the risk severity (RSR) approach, in accordance with aspects of the invention, each point of risk has a risk value that may reflect the severity of risk for that individual point of risk. For example, an intersection that is a frequent site of vehicle accident related deaths may warrant a very high risk value under the RSR approach. In one embodiment, risk severity rating may be based on accident frequency at intersections or in segments over a determined period of time. In another embodiment, the rating may be based on loss costs associated to intersections and segments. Yet another embodiment may combine accident frequency and severity to form a rating for a segment or intersection. One skilled in the art can recognize that risk severity ratings may be based on one or a combination of factors associated with intersections or segments.

Under the Environmental Risk Variable (ERV) approach, in accordance with aspects of the invention, each point of risk has a risk value that may reflect any or all information that is not derived from recorded accidents and/or claims, but that may be the (direct or indirect) cause of an accident. In one embodiment, the risk value under the ERV approach may be derived from vehicle information transmitted by a data source **104**, **106**. In an alternate embodiment, the EVR approach may use compound variables based on the presence or absence of multiple risk considerations which are known to frequently, or severely, cause accidents. A compound variable is one that accounts for the interactions of multiple risk considerations, whether environmental or derived from recorded accidents and/or claims. For example, driving through a wildlife crossing zone at dusk would generate a greater risk value than driving through this same area at noon. The interaction of time of day and location would be the compound variable. Another example may consider current weather conditions, time of day, day of the year, and topography of the road. A compound variable may be the type of infrequent situation which warrants presenting a verbal warning to a driver (e.g., using a speaker system in a personal navigation device **110** mounted in a vehicle) of a high risk route (e.g., a high risk road segments).

Another possible approach may be to calculate the route risk value using one or more of the approaches described above divided by the length of the route traveled. This may provide an average route risk value for use in conjunction with a mileage rating plan. In one embodiment, the system combines route risk and conventional mileage data to calculate risk per mile rating.

In one embodiment, a device in a vehicle (e.g., personal navigation device **110**, mobile device **112**, etc.) may record and locally store the route and/or the route and time during which a route was traveled. This travel route information may be uploaded via wireless/wired means (e.g., cell phones, manually using a computer port, etc.). This travel route information may be used to automatically query a data source **104**, **106** for route rating information and calculate a total risk value.

Some accident data may be recorded and locally stored on a device (e.g., personal navigation device **110**, mobile device **112**, etc.) that provides incident location and a timestamp that can be used to synchronize other data located in data sources **104** and **106**. The captured information may be periodically uploaded to computing device **102** for further processing of accident data for updating the road segment database in memory **116**. In some embodiments, the other data may include local weather conditions, vehicle density on the roadway, and traffic signal status. Additional information comprising data from an in-vehicle monitoring system (e.g., event data recorder or onboard diagnostic system) may record operational status of the vehicle at the time of the incident. Alternatively, if the vehicle did not have a location tracking device, an insurance claims reporter may enter the address and other information into the data source manually. If the vehicle was configured with an in-vehicle monitoring system that has IEEE 802.11 Wi-Fi capabilities (or any other wireless communication capabilities), the travel route information may be periodically uploaded or uploaded in real-time (or near real-time) via a computer and/or router. The in-vehicle monitoring system may be configured to automatically upload travel route information (and other information) through a home wireless router to a computer. In some advanced monitoring systems, weather and traffic data (and other useful information) may be downloaded (in real-time or near real-time) to the vehicle. In some embodiments, it may be desirable to use mobile devices **112** (with the requisite capabilities) to transmit the information, provide GPS coordinates, and stream in data from other sources.

The risk types described above may be variables in a multivariate model of insurance losses, frequencies, severities, and/or pure premiums. Interactions of the variables would also be considered. The coefficient the model produces for each variable (along with the coefficient for any interaction terms) would be the value to apply to each risk type. The personal navigation device **110** may initially provide the quickest/shortest route from a start location A to an end location B, and then determine the route risk value by determining either the sum product of the number of each risk type and the value for that risk type or the overall product of the number of each risk type and the value for that risk type. (Traffic and weather conditions could either be included or excluded from the determination of the route risk value for comparison of routes. If not included, an

adjustment may be made to the route risk value once the route has been traveled). The driver may be presented with an alternate route which is less risky than the initial route calculated. The personal navigation device **110** may display the difference in risk between the alternate routes and permit the driver to select the preferred route. In some embodiments in accordance with the invention, a driver/vehicle may be provided a monetary benefit (e.g., a credit towards a future insurance policy) for selecting a less risky route.

In one example in accordance with aspects of the invention, a driver may enter a starting location and an end location into a personal navigation device **110**. The personal navigation device **110** may present the driver with an illustrative 2-mile route that travels on a residential road near the following risks: 5 intersections, 3 past accident sites, 1 railroad crossing, and 1 lane merging site. Assuming for illustrative purposes that the following risk values apply to the following risk types:

Risk Type	Risk-rating Factor
Intersections	55
Past Accidents	30
Railroad Crossing	5
Merge	60
Residential Road	2 per mile

Then, the route risk value for the entire 2-mile route may be calculated, in one embodiment of the invention, as follows:

Risk Type	Risk-rating Factor	Count	Product
Intersections	55	5	55 * 5 = 275
Past Accidents	30	3	30 * 3 = 90
Railroad Crossing	5	1	5 * 1 = 5
Merge	60	1	60 * 1 = 60
Residential Road	2 per mile	2	2 * 2 = 4
Sum Total			434

Assuming a route risk value between 0 and 350 (per mile) is categorized as a low-risk route, then the aforementioned 2-mile route's risk value of 217 (i.e., 434 divided by 2) classifies it a low-risk route.

In some embodiments, for rating purposes the route risk value may consider the driving information of the driver/vehicle. For example, the personal navigation device **110** (or other device) may record the route taken, as well as the time of day/month/year, weather conditions, traffic conditions, and the actual speed driven compared to the posted speed limit. The current weather and traffic conditions may be recorded from a data source **104**, **106**. Weather conditions and traffic conditions may be categorized to determine the risk type to apply. The posted speed limits may be included in the geographic information. For each segment of road with a different posted speed limit, the actual speed driven may be compared to the posted speed limit. The difference may be averaged over the entire distance of the route. In addition, various techniques may be used to handle the amount of time stopped in traffic, at traffic lights, etc. One illustrative technique may be to only count the amount of time spent driving over the speed limit and determine the average speed over the speed limit during that time. Another illustrative method may be to exclude from the total amount of time the portion where the vehicle is not moving. Then, upon completion of the trip, the route risk value may be calculated and stored in memory along with the other information related to the route risk score and mileage traveled. This information may later be transmitted to an insurance company's data store, as was described above.

In another embodiment in accordance with aspects of the invention, real time data may be used to dynamically assign risk values to each point of risk. For example, some road segments may have a higher risk value when a vehicle travels through at a time when, e.g., snowfall is heavy. In such situations, a dynamic risk value may be applied to the road segment to determine the appropriate route risk value to assign to the route.

Referring to FIG. **5**, in accordance with aspects of the invention, a method of selling a vehicular insurance policy is illustrated. A vehicle owner or driver may be provided (in step **502**) with an insurance policy with a total risk score. The total risk score (e.g., **500**) indicates the quantity of risk the vehicle is permitted to travel through before the insurance policy must be renewed or becomes terminated. For example, as the vehicle is driven over various travel routes, the route risk values for the road segments traveled are deducted (in step **504**) from the total risk score of the insurance policy. The vehicle owner and/or driver may be provided (in step **506**) an option to renew the insurance policy (e.g., to purchase additional risk points to apply towards the total risk score of the insurance policy). Once the total risk score falls to zero or under (see step **508**), the vehicle owner and/or driver (or any other person/entity authorized to renew the policy) is provided (in step **510**) with a final option to renew the insurance policy before the insurance policy terminates (in step **512**). It will be apparent to one skilled in the art after review of the entirety disclosed that the embodiment illustrated above may benefit from a personal navigation device **110** (or similar device) to monitor and record the route traveled by a vehicle. At least one benefit of the insurance policy illustrated by FIG. **5** is the ability to pay per quantity of risk consumed instead of paying only a fixed premium.

In another embodiment in accordance with aspects of the invention, route-dependent pricing uses route risk values to adjust insurance pricing based on where a vehicle is driven. Contrary to the embodiment above where the vehicle's insurance policy terminated dependent on the quantity of risk consumed by the vehicle's travel route, in this embodiment, an insurance company (or its representatives, e.g., agent) may adjust the price quoted/charged for an insurance policy based on risk consumed. In this embodiment, a vehicle/driver may be categorized into a risk class (e.g., low-risk, medium-risk, high risk, etc.) and charged for insurance accordingly. For example, the vehicle/driver may be provided with notification of a credit/debit if the vehicle consumed less/more, respectively, of risk at the end of a policy term than was initially purchased.

In another embodiment: the insurance policy is sold and priced in part based on where a customer falls within a three sigma distribution of risk units consumed by all insured per a typical policy period. The policy pricing may be based on an initial assumption of risk to be consumed in the prospective policy period or may be based on risk consumed in a preceding policy period. In a case where the number of risk units consumed is greater than estimated, the customer may be billed for the overage at the end of (or during) the policy period. In yet another embodiment, the system may be provided as a pay-as-you-drive coverage where the customer is charged in part based on the actual risk units consumed in the billing cycle. The system may include a telematics device that monitors, records, and periodically transmits the

consumption of risk units to processor **114** that may automatically bill or deduct the cost from an account.

While the invention has been described with respect to specific examples including presently exemplary modes of carrying out the invention, those skilled in the art will appreciate that there are numerous variations and permutations of the above-described systems and techniques that fall within the spirit and scope of the invention.

We claim:

1. A method, comprising:

at a computing device comprising at least one processor and at least one memory:

receiving, by the at least one processor, from a location detection unit, information identifying a travel route being traveled by a vehicle in which the computing device is located, wherein the travel route being traveled by the vehicle comprises a first location and a second location detected by the location detection unit as the vehicle travels along the travel route, and wherein the travel route being traveled by the vehicle comprises a plurality of route segments associated with the travel route being traveled by the vehicle;

retrieving, by the at least one processor, a segment value for each route segment of the plurality of route segments associated with the travel route being traveled by the vehicle, wherein each segment value is determined based on accident information associated with the corresponding route segment, and wherein the accident information associated with the corresponding route segment comprises accident loss information and information identifying a direction of travel at an accident location;

aggregating, by the at least one processor, the segment values retrieved for each route segment of the plurality of route segments associated with the travel route being traveled by the vehicle to calculate a total route risk value for the travel route being traveled by the vehicle;

adjusting, by the at least one processor, a cost of a vehicle insurance policy for the vehicle based on a balance of risk points corresponding to a difference between a total risk score associated with the vehicle insurance policy for the vehicle and the total route risk value for the travel route being traveled by the vehicle; and

based on adjusting the cost of the vehicle insurance policy for the vehicle based on the balance of risk points, sending, by the at least one processor, information identifying the cost of the vehicle insurance policy for the vehicle to a navigation device located in the vehicle while the travel route is being traveled by the vehicle, wherein sending the information identifying the cost of the vehicle insurance policy for the vehicle to the navigation device located in the vehicle causes the navigation device located in the vehicle to display the cost of the vehicle insurance policy for the vehicle while the travel route is being traveled by the vehicle.

2. The method of claim **1**, comprising:

designating, by the at least one processor, the vehicle into a predetermined class based on the total risk score associated with the vehicle insurance policy for the vehicle, wherein adjusting the cost of the vehicle insurance policy for the vehicle comprises adjusting the cost of the vehicle insurance policy for the vehicle based on the predetermined class into which the vehicle is designated.

3. The method of claim **1**, comprising:

causing, by the at least one processor, an output device to provide a notification of a credit if the cost of the vehicle insurance policy for the vehicle is reduced as a result of adjusting the cost of the vehicle insurance policy for the vehicle based on the balance of risk points.

4. The method of claim **1**, comprising:

causing, by the at least one processor, an output device to provide a notification of a debit if the cost of the vehicle insurance policy for the vehicle is increased as a result of adjusting the cost of the vehicle insurance policy for the vehicle based on the balance of risk points.

5. The method of claim **1**, comprising:

causing, by the at least one processor, an insurance provider computer system to deduct the cost of the vehicle insurance policy for the vehicle from an account associated with the vehicle.

6. The method of claim **1**,

wherein each segment value for each route segment of the plurality of route segments associated with the travel route being traveled by the vehicle is further determined based on road topology information associated with the corresponding route segment and weather condition information associated with the corresponding route segment, and

wherein the total route risk value for the travel route being traveled by the vehicle indicates safety risk of the travel route being traveled by the vehicle independent of a specific driver of the vehicle.

7. The method of claim **6**, wherein the first location corresponds to a start location of the travel route being traveled by the vehicle and the second location corresponds to an end location of the travel route being traveled by the vehicle.

8. The method of claim **1**, wherein the location detection unit is a mobile location tracking device or a global positioning satellite unit.

9. A computing device, comprising:

at least one processor; and

at least one memory storing instructions that, when executed by the at least one processor, cause the computing device to:

receive, from a location detection unit, information identifying a travel route being traveled by a vehicle in which the computing device is located, wherein the travel route being traveled by the vehicle comprises a first location and a second location detected by the location detection unit as the vehicle travels along the travel route, and wherein the travel route being traveled by the vehicle comprises a plurality of route segments associated with the travel route being traveled by the vehicle;

retrieve a segment value for each route segment of the plurality of route segments associated with the travel route being traveled by the vehicle, wherein each segment value is determined based on accident information associated with the corresponding route segment, and wherein the accident information associated with the corresponding route segment comprises accident loss information and information identifying a direction of travel at an accident location;

aggregate the segment values retrieved for each route segment of the plurality of route segments associated with the travel route being traveled by the vehicle to

calculate a total route risk value for the travel route being traveled by the vehicle;

adjust a cost of a vehicle insurance policy for the vehicle based on a balance of risk points corresponding to a difference between a total risk score associated with the vehicle insurance policy for the vehicle and the total route risk value for the travel route being traveled by the vehicle; and

based on adjusting the cost of the vehicle insurance policy for the vehicle based on the balance of risk points, send information identifying the cost of the vehicle insurance policy for the vehicle to a navigation device located in the vehicle while the travel route is being traveled by the vehicle, wherein sending the information identifying the cost of the vehicle insurance policy for the vehicle to the navigation device located in the vehicle causes the navigation device located in the vehicle to display the cost of the vehicle insurance policy for the vehicle while the travel route is being traveled by the vehicle.

10. The computing device of claim **9**, wherein the at least one memory stores additional instructions that, when executed by the at least one processor, cause the computing device to:

designate the vehicle into a predetermined class based on the total risk score associated with the vehicle insurance policy for the vehicle, wherein adjusting the cost of the vehicle insurance policy for the vehicle comprises adjusting the cost of the vehicle insurance policy for the vehicle based on the predetermined class into which the vehicle is designated.

11. The computing device of claim **9**, wherein the at least one memory stores additional instructions that, when executed by the at least one processor, cause the computing device to:

cause an output device to provide a notification of a credit if the cost of the vehicle insurance policy for the vehicle is reduced as a result of adjusting the cost of the vehicle insurance policy for the vehicle based on the balance of risk points.

12. The computing device of claim **9**, wherein the at least one memory stores additional instructions that, when executed by the at least one processor, cause the computing device to:

cause an output device to provide a notification of a debit if the cost of the vehicle insurance policy for the vehicle is increased as a result of adjusting the cost of the vehicle insurance policy for the vehicle based on the balance of risk points.

13. The computing device of claim **9**, wherein the at least one memory stores additional instructions that, when executed by the at least one processor, cause the computing device to:

cause an insurance provider computer system to deduct the cost of the vehicle insurance policy for the vehicle from an account associated with the vehicle.

14. The computing device of claim **9**,

wherein each segment value for each route segment of the plurality of route segments associated with the travel route being traveled by the vehicle is further determined based on road topology information associated with the corresponding route segment and weather condition information associated with the corresponding route segment, and

wherein the total route risk value for the travel route being traveled by the vehicle indicates safety risk of the travel route being traveled by the vehicle independent of a specific driver of the vehicle.

15. The computing device of claim **14**, wherein the first location corresponds to a start location of the travel route being traveled by the vehicle and the second location corresponds to an end location of the travel route being traveled by the vehicle.

16. The computing device of claim **9**, wherein the location detection unit is a mobile location tracking device or a global positioning satellite unit.

17. One or more non-transitory computer-readable media storing instructions that, when executed by a computing device comprising at least one processor and at least one memory, cause the computing device to:

receive, from a location detection unit, information identifying a travel route being traveled by a vehicle in which the computing device is located, wherein the travel route being traveled by the vehicle comprises a first location and a second location detected by the location detection unit as the vehicle travels along the travel route, and wherein the travel route being traveled by the vehicle comprises a plurality of route segments associated with the travel route being traveled by the vehicle;

retrieve a segment value for each route segment of the plurality of route segments associated with the travel route being traveled by the vehicle, wherein each segment value is determined based on accident information associated with the corresponding route segment, and wherein the accident information associated with the corresponding route segment comprises accident loss information and information identifying a direction of travel at an accident location;

aggregate the segment values retrieved for each route segment of the plurality of route segments associated with the travel route being traveled by the vehicle to calculate a total route risk value for the travel route being traveled by the vehicle;

adjust a cost of a vehicle insurance policy for the vehicle based on a balance of risk points corresponding to a difference between a total risk score associated with the vehicle insurance policy for the vehicle and the total route risk value for the travel route being traveled by the vehicle; and

based on adjusting the cost of the vehicle insurance policy for the vehicle based on the balance of risk points, send information identifying the cost of the vehicle insurance policy for the vehicle to a navigation device located in the vehicle while the travel route is being traveled by the vehicle, wherein sending the information identifying the cost of the vehicle insurance policy for the vehicle to the navigation device located in the vehicle causes the navigation device located in the vehicle to display the cost of the vehicle insurance policy for the vehicle while the travel route is being traveled by the vehicle.

18. The one or more non-transitory computer-readable media of claim **17**, storing additional instructions that, when executed by the computing device, cause the computing device to:

designate the vehicle into a predetermined class based on the total risk score associated with the vehicle insurance policy for the vehicle, wherein adjusting the cost of the vehicle insurance policy for the vehicle comprises adjusting the cost of the vehicle insurance policy for the vehicle based on the predetermined class into which the vehicle is designated.

19. The one or more non-transitory computer-readable media of claim **17**, storing additional instructions that, when executed by the computing device, cause the computing device to:

cause an output device to provide a notification of a credit if the cost of the vehicle insurance policy for the vehicle is reduced as a result of adjusting the cost of the vehicle insurance policy for the vehicle based on the balance of risk points.

20. The one or more non-transitory computer-readable media of claim **17**, storing additional instructions that, when executed by the computing device, cause the computing device to:

cause an output device to provide a notification of a debit if the cost of the vehicle insurance policy for the vehicle is increased as a result of adjusting the cost of the vehicle insurance policy for the vehicle based on the balance of risk points.

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