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Attention aware virtual assistant dismissal

Abstract

Systems and processes for operating an intelligent automated assistant are provided. An example process includes initiating a virtual assistant session responsive to receiving user input. In accordance with initiating the virtual assistant session, the process includes determining, based on data obtained using one or more sensors of the electronic device, whether one or more criteria representing expressed user disinterest are satisfied. In accordance with determining that the one or more criteria representing expressed user disinterest are satisfied prior to a first time, the process includes automatically deactivating the virtual assistant session prior to the first time. The first time is defined by a setting of the electronic device. In accordance with determining that the one or more criteria representing expressed user disinterest are not satisfied prior to the first time, the process includes automatically deactivating the virtual assistant session at the first time.

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9569549	12/2016	Jenkins et al.	N/A	N/A
9571645	12/2016	Quast et al.	N/A	N/A
9571995	12/2016	Scheer et al.	N/A	N/A
9574894	12/2016	Karakotsios et al.	N/A	N/A
9575964	12/2016	Yadgar et al.	N/A	N/A
9576196	12/2016	Natarajan	N/A	N/A
9576575	12/2016	Heide	N/A	N/A
9578173	12/2016	Sanghavi et al.	N/A	N/A
9584946	12/2016	Lyren et al.	N/A	N/A
9586318	12/2016	Djugash et al.	N/A	N/A
9602946	12/2016	Karkkainen et al.	N/A	N/A
9606986	12/2016	Bellegarda	N/A	N/A
9607612	12/2016	Deleeuw	N/A	N/A
9612999	12/2016	Prakah-Asante et al.	N/A	N/A
9619200	12/2016	Chakladar et al.	N/A	N/A
9619459	12/2016	Hebert et al.	N/A	N/A
9620113	12/2016	Kennewick et al.	N/A	N/A
9620126	12/2016	Chiba	N/A	N/A
9626695	12/2016	Balasubramanian et al.	N/A	N/A
9626799	12/2016	McArdle et al.	N/A	N/A
9626955	12/2016	Fleizach et al.	N/A	N/A
9633004	12/2016	Giuli et al.	N/A	N/A
9633191	12/2016	Fleizach et al.	N/A	N/A
9633660	12/2016	Haughay	N/A	N/A
9633674	12/2016	Sinha	N/A	N/A
9646313	12/2016	Kim et al.	N/A	N/A
9648107	12/2016	Penilla et al.	N/A	N/A
9652453	12/2016	Mathur et al.	N/A	N/A
9658746	12/2016	Cohn et al.	N/A	N/A
9659002	12/2016	Medlock et al.	N/A	N/A
9659298	12/2016	Lynch et al.	N/A	N/A
9665567	12/2016	Li et al.	N/A	N/A
9665662	12/2016	Gautam et al.	N/A	N/A
9668121	12/2016	Naik et al.	N/A	N/A
9672725	12/2016	Dotan-Cohen et al.	N/A	N/A
9672822	12/2016	Brown et al.	N/A	N/A
9678664	12/2016	Zhai et al.	N/A	N/A
9679570	12/2016	Edara	N/A	N/A
9690542	12/2016	Reddy et al.	N/A	N/A
9691161	12/2016	Yalniz et al.	N/A	N/A
9691378	12/2016	Meyers et al.	N/A	N/A
9691384	12/2016	Wang et al.	N/A	N/A
9696963	12/2016	Son et al.	N/A	N/A
9697016	12/2016	Jacob	N/A	N/A
9697822	12/2016	Naik et al.	N/A	N/A
9697827	12/2016	Lilly et al.	N/A	N/A
9697828	12/2016	Prasad et al.	N/A	N/A
9697829	12/2016	Tickner et al.	N/A	N/A
9698999	12/2016	Mutagi	N/A	N/A
9711148	12/2016	Sharifi et al.	N/A	N/A
9715875	12/2016	Piernot et al.	N/A	N/A

9720907	12/2016	Bangalore et al.	N/A	N/A
9721566	12/2016	Newendorp et al.	N/A	N/A
9721570	12/2016	Beal et al.	N/A	N/A
9723130	12/2016	Rand	N/A	N/A
9734817	12/2016	Putrycz	N/A	N/A
9734839	12/2016	Adams	N/A	N/A
9741343	12/2016	Miles et al.	N/A	N/A
9747083	12/2016	Roman et al.	N/A	N/A
9747093	12/2016	Latino et al.	N/A	N/A
9754591	12/2016	Kumar et al.	N/A	N/A
9755605	12/2016	Li et al.	N/A	N/A
9760566	12/2016	Heck et al.	N/A	N/A
9767710	12/2016	Lee et al.	N/A	N/A
9772994	12/2016	Karov et al.	N/A	N/A
9786271	12/2016	Combs et al.	N/A	N/A
9792907	12/2016	Bocklet et al.	N/A	N/A
9798719	12/2016	Karov et al.	N/A	N/A
9812128	12/2016	Mixter et al.	N/A	N/A
9813882	12/2016	Masterman	N/A	N/A
9818400	12/2016	Paulik et al.	N/A	N/A
9823811	12/2016	Brown et al.	N/A	N/A
9823828	12/2016	Zambetti et al.	N/A	N/A
9824379	12/2016	Khandelwal et al.	N/A	N/A
9824691	12/2016	Montero et al.	N/A	N/A
9824692	12/2016	Khoury et al.	N/A	N/A
9830044	12/2016	Brown et al.	N/A	N/A
9830449	12/2016	Wagner	N/A	N/A
9842168	12/2016	Heck et al.	N/A	N/A
9842584	12/2016	Hart et al.	N/A	N/A
9846685	12/2016	Li	N/A	N/A
9846836	12/2016	Gao et al.	N/A	N/A
9858925	12/2017	Gruber et al.	N/A	N/A
9858927	12/2017	Williams et al.	N/A	N/A
9886953	12/2017	Lemay et al.	N/A	N/A
9887949	12/2017	Shepherd et al.	N/A	N/A
9891811	12/2017	Federighi et al.	N/A	N/A
9892732	12/2017	Tian et al.	N/A	N/A
9911415	12/2017	Vanblon et al.	N/A	N/A
9916839	12/2017	Scalise et al.	N/A	N/A
9922642	12/2017	Pitschel et al.	N/A	N/A
9928835	12/2017	Tang	N/A	N/A
9934777	12/2017	Joseph et al.	N/A	N/A
9934785	12/2017	Hulaud	N/A	N/A
9940616	12/2017	Morgan et al.	N/A	N/A
9946862	12/2017	Yun et al.	N/A	N/A
9948728	12/2017	Linn et al.	N/A	N/A
9953634	12/2017	Pearce et al.	N/A	N/A
9959129	12/2017	Kannan et al.	N/A	N/A
9959506	12/2017	Karppanen	N/A	N/A
9959867	12/2017	Lindahl	N/A	N/A
9966065	12/2017	Gruber et al.	N/A	N/A
9966068	12/2017	Cash et al.	N/A	N/A
9967381	12/2017	Kashimba et al.	N/A	N/A
9971495	12/2017	Shetty et al.	N/A	N/A
9972304	12/2017	Paulik et al.	N/A	N/A
9972318	12/2017	Kelly et al.	N/A	N/A
9983785	12/2017	Wong et al.	N/A	N/A
9984686	12/2017	Mutagi et al.	N/A	N/A
9986419	12/2017	Naik et al.	N/A	N/A
9990129	12/2017	Yang et al.	N/A	N/A
9990176	12/2017	Gray	N/A	N/A
9990921	12/2017	Vanblon et al.	N/A	N/A
9990926	12/2017	Pearce	N/A	N/A

9996626	12/2017	Bailey et al.	N/A	N/A
9998552	12/2017	Ledet	N/A	N/A
10001817	12/2017	Zambetti et al.	N/A	N/A
10009666	12/2017	Van Scheltinga et al.	N/A	N/A
10013416	12/2017	Bhardwaj et al.	N/A	N/A
10013654	12/2017	Levy et al.	N/A	N/A
10013979	12/2017	Roma et al.	N/A	N/A
10019436	12/2017	Huang	N/A	N/A
10025378	12/2017	Venable et al.	N/A	N/A
10026209	12/2017	Dagley et al.	N/A	N/A
10026401	12/2017	Mutagi et al.	N/A	N/A
10027662	12/2017	Mutagi et al.	N/A	N/A
10032451	12/2017	Mamkina et al.	N/A	N/A
10032455	12/2017	Newman et al.	N/A	N/A
10037758	12/2017	Jing et al.	N/A	N/A
10043516	12/2017	Saddler et al.	N/A	N/A
10048748	12/2017	Sridharan et al.	N/A	N/A
10049161	12/2017	Kaneko	N/A	N/A
10049663	12/2017	Orr et al.	N/A	N/A
10049668	12/2017	Huang et al.	N/A	N/A
10055390	12/2017	Sharifi et al.	N/A	N/A
10055681	12/2017	Brown et al.	N/A	N/A
10068570	12/2017	Dai et al.	N/A	N/A
10074360	12/2017	Kim	N/A	N/A
10074371	12/2017	Wang et al.	N/A	N/A
10078487	12/2017	Gruber et al.	N/A	N/A
10083213	12/2017	Podgorny et al.	N/A	N/A
10083688	12/2017	Piernot et al.	N/A	N/A
10083690	12/2017	Giuli et al.	N/A	N/A
10088972	12/2017	Brown et al.	N/A	N/A
10089072	12/2017	Piersol et al.	N/A	N/A
10089393	12/2017	Agarwal et al.	N/A	N/A
10089983	12/2017	Gella et al.	N/A	N/A
10096319	12/2017	Jin et al.	N/A	N/A
10101887	12/2017	Bernstein et al.	N/A	N/A
10102359	12/2017	Cheyer	N/A	N/A
10102851	12/2017	Kiss et al.	N/A	N/A
10115055	12/2017	Weiss et al.	N/A	N/A
10127901	12/2017	Zhao et al.	N/A	N/A
10127908	12/2017	Deller et al.	N/A	N/A
10127926	12/2017	James	N/A	N/A
10134425	12/2017	Johnson, Jr.	N/A	N/A
10135965	12/2017	Woolsey et al.	N/A	N/A
10140845	12/2017	Knas	N/A	N/A
10142222	12/2017	Zhang	N/A	N/A
10146923	12/2017	Pitkanen et al.	N/A	N/A
10147421	12/2017	Liddell et al.	N/A	N/A
10147441	12/2017	Pogue et al.	N/A	N/A
10149156	12/2017	Tiku et al.	N/A	N/A
10158728	12/2017	Vanblon et al.	N/A	N/A
10162512	12/2017	Seo et al.	N/A	N/A
10162817	12/2017	Schlesinger et al.	N/A	N/A
10169329	12/2018	Futrell et al.	N/A	N/A
10170123	12/2018	Orr et al.	N/A	N/A
10170135	12/2018	Pearce et al.	N/A	N/A
10175879	12/2018	Missig et al.	N/A	N/A
10176167	12/2018	Evermann	N/A	N/A
10176802	12/2018	Ladhak et al.	N/A	N/A
10176808	12/2018	Lovitt et al.	N/A	N/A
10178301	12/2018	Welbourne et al.	N/A	N/A
10185542	12/2018	Carson et al.	N/A	N/A
10186254	12/2018	Williams et al.	N/A	N/A
10186266	12/2018	Devaraj et al.	N/A	N/A

10191627	12/2018	Cieplinski et al.	N/A	N/A
10191646	12/2018	Zambetti et al.	N/A	N/A
10191718	12/2018	Rhee et al.	N/A	N/A
10192546	12/2018	Piersol et al.	N/A	N/A
10192552	12/2018	Raitio et al.	N/A	N/A
10192557	12/2018	Lee et al.	N/A	N/A
10193840	12/2018	Dar	N/A	N/A
10198877	12/2018	Maltsev et al.	N/A	N/A
10199051	12/2018	Binder et al.	N/A	N/A
10200824	12/2018	Gross et al.	N/A	N/A
10204627	12/2018	Nitz et al.	N/A	N/A
10210860	12/2018	Ward et al.	N/A	N/A
10216351	12/2018	Yang	N/A	N/A
10216832	12/2018	Bangalore et al.	N/A	N/A
10223066	12/2018	Martel et al.	N/A	N/A
10224030	12/2018	Kiss et al.	N/A	N/A
10225711	12/2018	Parks et al.	N/A	N/A
10228904	12/2018	Raux	N/A	N/A
10229109	12/2018	Cherepanov et al.	N/A	N/A
10229356	12/2018	Liu et al.	N/A	N/A
10229680	12/2018	Gillespie et al.	N/A	N/A
10236016	12/2018	Li et al.	N/A	N/A
10237711	12/2018	Linn et al.	N/A	N/A
10241644	12/2018	Gruber et al.	N/A	N/A
10242501	12/2018	Pusch et al.	N/A	N/A
10248308	12/2018	Karunamuni et al.	N/A	N/A
10248771	12/2018	Ziraknejad et al.	N/A	N/A
10249300	12/2018	Booker et al.	N/A	N/A
10249305	12/2018	Yu	N/A	N/A
10255922	12/2018	Sharifi et al.	N/A	N/A
10257314	12/2018	Agrawal et al.	N/A	N/A
10261672	12/2018	Dolbakian et al.	N/A	N/A
10261830	12/2018	Gupta et al.	N/A	N/A
10269345	12/2018	Sanchez et al.	N/A	N/A
10271093	12/2018	Jobanputra et al.	N/A	N/A
10275513	12/2018	Cowan et al.	N/A	N/A
10276170	12/2018	Gruber et al.	N/A	N/A
10282737	12/2018	Clark et al.	N/A	N/A
10283111	12/2018	Mairesse et al.	N/A	N/A
10289205	12/2018	Sumter et al.	N/A	N/A
10291066	12/2018	Leabman et al.	N/A	N/A
10296160	12/2018	Shah et al.	N/A	N/A
10297253	12/2018	Walker, II et al.	N/A	N/A
10303715	12/2018	Graham et al.	N/A	N/A
10303772	12/2018	Hosn et al.	N/A	N/A
10304463	12/2018	Mixter et al.	N/A	N/A
10311482	12/2018	Baldwin	N/A	N/A
10311871	12/2018	Newendorp et al.	N/A	N/A
10317992	12/2018	Prokofieva et al.	N/A	N/A
10325598	12/2018	Basye et al.	N/A	N/A
10331312	12/2018	Napolitano et al.	N/A	N/A
10332509	12/2018	Catanzaro et al.	N/A	N/A
10332513	12/2018	D'Souza et al.	N/A	N/A
10332518	12/2018	Garg et al.	N/A	N/A
10339224	12/2018	Fukuoka	N/A	N/A
10339714	12/2018	Corso et al.	N/A	N/A
10339721	12/2018	Dascola et al.	N/A	N/A
10339925	12/2018	Rastrow et al.	N/A	N/A
10346540	12/2018	Karov et al.	N/A	N/A
10346541	12/2018	Phillips et al.	N/A	N/A
10346753	12/2018	Soon-Shiong et al.	N/A	N/A
10346878	12/2018	Ostermann et al.	N/A	N/A
10353975	12/2018	Oh et al.	N/A	N/A

10354168	12/2018	Bluche	N/A	N/A
10354677	12/2018	Mohamed et al.	N/A	N/A
10356243	12/2018	Sanghavi et al.	N/A	N/A
10360305	12/2018	Larcheveque et al.	N/A	N/A
10360716	12/2018	Van Der Meulen et al.	N/A	N/A
10365887	12/2018	Mulherkar	N/A	N/A
10366160	12/2018	Castelli et al.	N/A	N/A
10366692	12/2018	Adams et al.	N/A	N/A
10372814	12/2018	Gliozzo et al.	N/A	N/A
10372881	12/2018	Ingrassia, Jr. et al.	N/A	N/A
10373381	12/2018	Nuernberger et al.	N/A	N/A
10382799	12/2018	Walters et al.	N/A	N/A
10387461	12/2018	Sharifi et al.	N/A	N/A
10389876	12/2018	Engelke et al.	N/A	N/A
10402066	12/2018	Kawana	N/A	N/A
10403272	12/2018	Fanty et al.	N/A	N/A
10403283	12/2018	Schramm et al.	N/A	N/A
10409454	12/2018	Kagan et al.	N/A	N/A
10410637	12/2018	Paulik et al.	N/A	N/A
10416760	12/2018	Burns et al.	N/A	N/A
10417037	12/2018	Gruber et al.	N/A	N/A
10417344	12/2018	Futrell et al.	N/A	N/A
10417554	12/2018	Scheffler	N/A	N/A
10418032	12/2018	Mohajer et al.	N/A	N/A
10431210	12/2018	Huang et al.	N/A	N/A
10437928	12/2018	Bhaya et al.	N/A	N/A
10446142	12/2018	Lim et al.	N/A	N/A
10453117	12/2018	Reavely et al.	N/A	N/A
10469665	12/2018	Bell et al.	N/A	N/A
10474961	12/2018	Brigham et al.	N/A	N/A
10475446	12/2018	Gruber et al.	N/A	N/A
10482875	12/2018	Henry	N/A	N/A
10482904	12/2018	Hardie et al.	N/A	N/A
10490195	12/2018	Krishnamoorthy et al.	N/A	N/A
10496364	12/2018	Yao	N/A	N/A
10496705	12/2018	Irani et al.	N/A	N/A
10497250	12/2018	Hayward et al.	N/A	N/A
10497365	12/2018	Gruber et al.	N/A	N/A
10497366	12/2018	Sapugay et al.	N/A	N/A
10499146	12/2018	Lang et al.	N/A	N/A
10504513	12/2018	Gray et al.	N/A	N/A
10504518	12/2018	Irani et al.	N/A	N/A
10512750	12/2018	Lewin et al.	N/A	N/A
10515133	12/2018	Sharifi	N/A	N/A
10515623	12/2018	Grizzel	N/A	N/A
10521946	12/2018	Roche et al.	N/A	N/A
10528386	12/2019	Yu	N/A	N/A
10540976	12/2019	Van Os et al.	N/A	N/A
10558893	12/2019	Bluche	N/A	N/A
10559225	12/2019	Tao et al.	N/A	N/A
10559299	12/2019	Arel et al.	N/A	N/A
10566007	12/2019	Fawaz et al.	N/A	N/A
10568032	12/2019	Freeman et al.	N/A	N/A
10572885	12/2019	Guo et al.	N/A	N/A
10579401	12/2019	Dawes	N/A	N/A
10580409	12/2019	Walker, II et al.	N/A	N/A
10582355	12/2019	Lebeau et al.	N/A	N/A
10585957	12/2019	Heck et al.	N/A	N/A
10586369	12/2019	Roche et al.	N/A	N/A
10599449	12/2019	Chatzipanagiotis et al.	N/A	N/A
10599758	12/2019	Yu et al.	N/A	N/A
10628483	12/2019	Rao et al.	N/A	N/A
10629186	12/2019	Slifka	N/A	N/A

10630795	12/2019	Aoki et al.	N/A	N/A
10642934	12/2019	Heck et al.	N/A	N/A
10643611	12/2019	Lindahl	N/A	N/A
10649652	12/2019	Sun	N/A	N/A
10652392	12/2019	Eades	N/A	N/A
10652394	12/2019	Van Os et al.	N/A	N/A
10659851	12/2019	Lister et al.	N/A	N/A
10671428	12/2019	Zeitlin	N/A	N/A
10679007	12/2019	Jia et al.	N/A	N/A
10679608	12/2019	Mixter et al.	N/A	N/A
10684099	12/2019	Zaetterqvist	N/A	N/A
10684703	12/2019	Hindi et al.	N/A	N/A
10685187	12/2019	Badr et al.	N/A	N/A
10691473	12/2019	Karashchuk et al.	N/A	N/A
10699697	12/2019	Qian et al.	N/A	N/A
10706841	12/2019	Gruber et al.	N/A	N/A
10706848	12/2019	Greene et al.	N/A	N/A
10721190	12/2019	Zhao et al.	N/A	N/A
10732708	12/2019	Roche et al.	N/A	N/A
10743107	12/2019	Yoshioka et al.	N/A	N/A
10747498	12/2019	Stasior et al.	N/A	N/A
10748529	12/2019	Milden	N/A	N/A
10748546	12/2019	Kim et al.	N/A	N/A
10754658	12/2019	Tamiya	N/A	N/A
10755032	12/2019	Douglas et al.	N/A	N/A
10757499	12/2019	Vautrin et al.	N/A	N/A
10757552	12/2019	Gross et al.	N/A	N/A
10769385	12/2019	Evermann	N/A	N/A
10776933	12/2019	Faulkner	N/A	N/A
10778839	12/2019	Newstadt et al.	N/A	N/A
10783151	12/2019	Bushkin et al.	N/A	N/A
10783166	12/2019	Hurley et al.	N/A	N/A
10783883	12/2019	Mixter et al.	N/A	N/A
10789945	12/2019	Acero et al.	N/A	N/A
10791176	12/2019	Phipps et al.	N/A	N/A
10791215	12/2019	Ly et al.	N/A	N/A
10795944	12/2019	Brown et al.	N/A	N/A
10796100	12/2019	Bangalore et al.	N/A	N/A
10803255	12/2019	Dubyak et al.	N/A	N/A
10811013	12/2019	Secker-Walker et al.	N/A	N/A
10818288	12/2019	Garcia et al.	N/A	N/A
10831494	12/2019	Grocutt et al.	N/A	N/A
10832031	12/2019	Kienzle et al.	N/A	N/A
10832684	12/2019	Sarikaya	N/A	N/A
10842968	12/2019	Kahn et al.	N/A	N/A
10846618	12/2019	Ravi et al.	N/A	N/A
10847142	12/2019	Newendorp et al.	N/A	N/A
10860629	12/2019	Gangadharalah et al.	N/A	N/A
10861483	12/2019	Feinauer et al.	N/A	N/A
10877637	12/2019	Antos et al.	N/A	N/A
10878047	12/2019	Mutagi et al.	N/A	N/A
10880668	12/2019	Robinson et al.	N/A	N/A
10885277	12/2020	Ravi et al.	N/A	N/A
10891968	12/2020	Chung et al.	N/A	N/A
10892996	12/2020	Piersol	N/A	N/A
10904488	12/2020	Weisz et al.	N/A	N/A
10909171	12/2020	Graham et al.	N/A	N/A
10909459	12/2020	Tsatsin et al.	N/A	N/A
10931999	12/2020	Jobanputra et al.	N/A	N/A
10937263	12/2020	Tout et al.	N/A	N/A
10937410	12/2020	Rule	N/A	N/A
10942702	12/2020	Piersol et al.	N/A	N/A
10942703	12/2020	Martel et al.	N/A	N/A

10944859	12/2020	Weinstein et al.	N/A	N/A
10957310	12/2020	Mohajer et al.	N/A	N/A
10957311	12/2020	Solomon et al.	N/A	N/A
10957337	12/2020	Chen et al.	N/A	N/A
10970660	12/2020	Harris et al.	N/A	N/A
10974139	12/2020	Feder et al.	N/A	N/A
10978056	12/2020	Challa et al.	N/A	N/A
10978090	12/2020	Binder et al.	N/A	N/A
10983971	12/2020	Carvalho et al.	N/A	N/A
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11010127	12/2020	Orr et al.	N/A	N/A
11010763	12/2020	Fillinger	N/A	N/A
11012942	12/2020	Freeman et al.	N/A	N/A
11017766	12/2020	Chao et al.	N/A	N/A
11037565	12/2020	Kudurshian et al.	N/A	N/A
11038934	12/2020	Hansen et al.	N/A	N/A
11043086	12/2020	Daoura et al.	N/A	N/A
11043220	12/2020	Hansen et al.	N/A	N/A
11048473	12/2020	Carson et al.	N/A	N/A
11061543	12/2020	Blatz et al.	N/A	N/A
11062696	12/2020	Tadpatrikar et al.	N/A	N/A
11072344	12/2020	Provost et al.	N/A	N/A
11076039	12/2020	Weinstein et al.	N/A	N/A
11080336	12/2020	Van Dusen	N/A	N/A
11086858	12/2020	Koukoumidis et al.	N/A	N/A
11087759	12/2020	Lemay et al.	N/A	N/A
11093306	12/2020	Libin	N/A	N/A
11094311	12/2020	Candelore et al.	N/A	N/A
11112875	12/2020	Zhou et al.	N/A	N/A
11113598	12/2020	Socher et al.	N/A	N/A
11126331	12/2020	Lo et al.	N/A	N/A
11126400	12/2020	Stasior et al.	N/A	N/A
11132172	12/2020	Naik et al.	N/A	N/A
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11169660	12/2020	Gupta et al.	N/A	N/A
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11183193	12/2020	Hansen et al.	N/A	N/A
11183205	12/2020	Ebenezer et al.	N/A	N/A
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11204787	12/2020	Radebaugh et al.	N/A	N/A
11205192	12/2020	Rivera et al.	N/A	N/A
11210062	12/2020	Heikinheimo et al.	N/A	N/A
11210477	12/2020	Srinivasan et al.	N/A	N/A
11211048	12/2020	Kim et al.	N/A	N/A
11211058	12/2020	Eakin et al.	N/A	N/A
11217255	12/2021	Kim et al.	N/A	N/A
11223699	12/2021	Niewczas	N/A	N/A
11235248	12/2021	Orrino et al.	N/A	N/A
11269426	12/2021	Jorasch et al.	N/A	N/A
11269678	12/2021	Gruber et al.	N/A	N/A
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11301766	12/2021	Muramoto et al.	N/A	N/A
11302310	12/2021	Gandhe et al.	N/A	N/A
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11348582	12/2021	Lindahl	N/A	N/A
11361863	12/2021	Gass et al.	N/A	N/A
11373645	12/2021	Mathew et al.	N/A	N/A
11380310	12/2021	Acero et al.	N/A	N/A
11380323	12/2021	Shin et al.	N/A	N/A
11388291	12/2021	Van Os et al.	N/A	N/A

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11423866	12/2021	Park et al.	N/A	N/A
11449802	12/2021	Maalouf et al.	N/A	N/A
11481552	12/2021	Krause et al.	N/A	N/A
11481559	12/2021	Asefi et al.	N/A	N/A
11487932	12/2021	Kramer	N/A	N/A
11495218	12/2021	Newendorp et al.	N/A	N/A
11507183	12/2021	Manjunath et al.	N/A	N/A
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11537352	12/2021	Clements	N/A	N/A
11538469	12/2021	Acero et al.	N/A	N/A
11580990	12/2022	Paulik et al.	N/A	N/A
11669788	12/2022	Balasubramanian et al.	N/A	N/A
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11756574	12/2022	Maddika et al.	N/A	N/A
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11769497	12/2022	Manjunath et al.	N/A	N/A
11783805	12/2022	Nadig et al.	N/A	N/A
11784893	12/2022	Chang	N/A	N/A
11809783	12/2022	Piersol et al.	N/A	N/A
11818111	12/2022	Debolt	N/A	N/A
11837232	12/2022	Manjunath et al.	N/A	N/A
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2014/0180697	12/2013	Torok et al.	N/A	N/A
2014/0181123	12/2013	Blaise et al.	N/A	N/A
2014/0181703	12/2013	Sullivan et al.	N/A	N/A
2014/0181715	12/2013	Axelrod et al.	N/A	N/A
2014/0181741	12/2013	Apacible et al.	N/A	N/A
2014/0181865	12/2013	Koganei	N/A	N/A
2014/0184542	12/2013	Mao et al.	N/A	N/A
2014/0188335	12/2013	Madhok et al.	N/A	N/A
2014/0188460	12/2013	Ouyang et al.	N/A	N/A
2014/0188477	12/2013	Zhang	N/A	N/A
2014/0188478	12/2013	Zhang	N/A	N/A
2014/0188485	12/2013	Kim et al.	N/A	N/A
2014/0188835	12/2013	Zhang et al.	N/A	N/A
2014/0195226	12/2013	Yun et al.	N/A	N/A
2014/0195230	12/2013	Han et al.	N/A	N/A
2014/0195233	12/2013	Bapat et al.	N/A	N/A
2014/0195244	12/2013	Cha et al.	N/A	N/A
2014/0195251	12/2013	Zeinstra et al.	N/A	N/A
2014/0195252	12/2013	Gruber et al.	N/A	N/A
2014/0198048	12/2013	Unruh et al.	N/A	N/A
2014/0200891	12/2013	Larcheveque et al.	N/A	N/A
2014/0201655	12/2013	Mahaffey et al.	N/A	N/A
2014/0203939	12/2013	Harrington et al.	N/A	N/A
2014/0205076	12/2013	Kumar et al.	N/A	N/A
2014/0207439	12/2013	Venkatapathy et al.	N/A	N/A
2014/0207446	12/2013	Klein et al.	N/A	N/A
2014/0207447	12/2013	Jiang et al.	N/A	N/A
2014/0207466	12/2013	Smadi	N/A	N/A
2014/0207468	12/2013	Bartnik	N/A	N/A
2014/0207582	12/2013	Flinn et al.	N/A	N/A
2014/0211944	12/2013	Hayward et al.	N/A	N/A
2014/0214429	12/2013	Pantel	N/A	N/A
2014/0214537	12/2013	Yoo et al.	N/A	N/A
2014/0215367	12/2013	Kim et al.	N/A	N/A
2014/0215513	12/2013	Ramer et al.	N/A	N/A
2014/0218372	12/2013	Missig et al.	N/A	N/A
2014/0222422	12/2013	Sarikaya et al.	N/A	N/A
2014/0222435	12/2013	Li et al.	N/A	N/A
2014/0222436	12/2013	Binder et al.	N/A	N/A
2014/0222678	12/2013	Sheets et al.	N/A	N/A
2014/0222967	12/2013	Harrang et al.	N/A	N/A
2014/0223377	12/2013	Shaw et al.	N/A	N/A
2014/0223481	12/2013	Fundament	N/A	N/A
2014/0223586	12/2013	Berger et al.	N/A	N/A
2014/0226503	12/2013	Cooper et al.	N/A	N/A
2014/0229158	12/2013	Zweig et al.	N/A	N/A
2014/0229184	12/2013	Shires	N/A	N/A
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2014/0230055	12/2013	Boehl	N/A	N/A
2014/0232570	12/2013	Skinder et al.	N/A	N/A
2014/0232656	12/2013	Pasquero et al.	N/A	N/A
2014/0236595	12/2013	Gray	N/A	N/A
2014/0236986	12/2013	Guzman	N/A	N/A
2014/0237042	12/2013	Ahmed et al.	N/A	N/A
2014/0237366	12/2013	Poulos et al.	N/A	N/A
2014/0244248	12/2013	Arisoy et al.	N/A	N/A
2014/0244249	12/2013	Mohamed et al.	N/A	N/A
2014/0244254	12/2013	Ju et al.	N/A	N/A
2014/0244257	12/2013	Colibro et al.	N/A	N/A
2014/0244258	12/2013	Song et al.	N/A	N/A
2014/0244263	12/2013	Pontual et al.	N/A	N/A

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2014/0244268	12/2013	Abdelsamie et al.	N/A	N/A
2014/0244270	12/2013	Han et al.	N/A	N/A
2014/0244271	12/2013	Lindahl	N/A	N/A
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2014/0247383	12/2013	Dave et al.	N/A	N/A
2014/0247926	12/2013	Gainsboro et al.	N/A	N/A
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2014/0249816	12/2013	Pickering et al.	N/A	N/A
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2014/0258357	12/2013	Singh et al.	N/A	N/A
2014/0258857	12/2013	Dykstra-Erickson et al.	N/A	N/A
2014/0258905	12/2013	Lee et al.	N/A	N/A
2014/0267022	12/2013	Kim	N/A	N/A
2014/0267599	12/2013	Drouin et al.	N/A	N/A
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2014/0272821	12/2013	Pitschel et al.	N/A	N/A
2014/0273974	12/2013	Varghese et al.	N/A	N/A
2014/0273979	12/2013	Van Os et al.	N/A	N/A
2014/0274005	12/2013	Luna et al.	N/A	N/A
2014/0274203	12/2013	Ganong, III et al.	N/A	N/A
2014/0274211	12/2013	Sejnoha et al.	N/A	N/A
2014/0278051	12/2013	McGavran et al.	N/A	N/A
2014/0278343	12/2013	Tran	N/A	N/A
2014/0278349	12/2013	Grieves et al.	N/A	N/A
2014/0278379	12/2013	Coccaro et al.	N/A	N/A
2014/0278390	12/2013	Kingsbury et al.	N/A	N/A
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2014/0278436	12/2013	Khanna et al.	N/A	N/A
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2014/0278513	12/2013	Prakash et al.	N/A	N/A
2014/0279622	12/2013	Lamoureux et al.	N/A	N/A
2014/0279739	12/2013	Elkington et al.	N/A	N/A
2014/0279787	12/2013	Cheng et al.	N/A	N/A
2014/0280072	12/2013	Coleman	N/A	N/A
2014/0280107	12/2013	Heymans et al.	N/A	N/A
2014/0280138	12/2013	Li et al.	N/A	N/A
2014/0280292	12/2013	Skinder	N/A	N/A
2014/0280353	12/2013	Delaney et al.	N/A	N/A
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2014/0281983	12/2013	Xian et al.	N/A	N/A
2014/0281997	12/2013	Fleizach et al.	N/A	N/A
2014/0282003	12/2013	Gruber et al.	N/A	N/A

2014/0282007	12/2013	Fleizach	N/A	N/A
2014/0282016	12/2013	Hosier, Jr.	N/A	N/A
2014/0282045	12/2013	Ayanam et al.	N/A	N/A
2014/0282178	12/2013	Borzello et al.	N/A	N/A
2014/0282201	12/2013	Pasquero et al.	N/A	N/A
2014/0282203	12/2013	Pasquero et al.	N/A	N/A
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2014/0282586	12/2013	Shear et al.	N/A	N/A
2014/0282743	12/2013	Howard et al.	N/A	N/A
2014/0283111	12/2013	Dolph et al.	N/A	N/A
2014/0288990	12/2013	Moore et al.	N/A	N/A
2014/0289508	12/2013	Wang	N/A	N/A
2014/0297267	12/2013	Spencer et al.	N/A	N/A
2014/0297281	12/2013	Togawa et al.	N/A	N/A
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2014/0304086	12/2013	Dasdan et al.	N/A	N/A
2014/0304605	12/2013	Ohmura et al.	N/A	N/A
2014/0309990	12/2013	Gandrabur et al.	N/A	N/A
2014/0309996	12/2013	Zhang	N/A	N/A
2014/0310001	12/2013	Kalns et al.	N/A	N/A
2014/0310002	12/2013	Nitz et al.	N/A	N/A
2014/0310348	12/2013	Keskitalo et al.	N/A	N/A
2014/0310365	12/2013	Sample et al.	N/A	N/A
2014/0310595	12/2013	Acharya et al.	N/A	N/A
2014/0313007	12/2013	Harding	N/A	N/A
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2014/0316585	12/2013	Boesveld et al.	N/A	N/A
2014/0316764	12/2013	Ayan et al.	N/A	N/A
2014/0317030	12/2013	Shen et al.	N/A	N/A
2014/0317502	12/2013	Brown et al.	N/A	N/A
2014/0317578	12/2013	Chaudhri	N/A	N/A
2014/0320398	12/2013	Papstein	N/A	N/A
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2014/0324884	12/2013	Lindahl et al.	N/A	N/A
2014/0330560	12/2013	Venkatesha et al.	N/A	N/A
2014/0330569	12/2013	Kolavennu et al.	N/A	N/A
2014/0330951	12/2013	Sukoff et al.	N/A	N/A
2014/0335823	12/2013	Heredia et al.	N/A	N/A
2014/0337037	12/2013	Chi	N/A	N/A
2014/0337048	12/2013	Brown et al.	N/A	N/A
2014/0337266	12/2013	Wolverton et al.	N/A	N/A
2014/0337370	12/2013	Aravamudan et al.	N/A	N/A
2014/0337371	12/2013	Li	N/A	N/A
2014/0337438	12/2013	Govande et al.	N/A	N/A
2014/0337621	12/2013	Nakhimov	N/A	N/A
2014/0337751	12/2013	Lim et al.	N/A	N/A
2014/0337814	12/2013	Kalns et al.	N/A	N/A
2014/0341217	12/2013	Eisner et al.	N/A	N/A
2014/0342762	12/2013	Hajdu et al.	N/A	N/A
2014/0343834	12/2013	Demerchant et al.	N/A	N/A
2014/0343943	12/2013	Al-Telmissani	N/A	N/A
2014/0343946	12/2013	Torok et al.	N/A	N/A
2014/0343950	12/2013	Simpson et al.	N/A	N/A
2014/0344205	12/2013	Luna et al.	N/A	N/A
2014/0344627	12/2013	Schaub et al.	N/A	N/A
2014/0344687	12/2013	Durham et al.	N/A	N/A
2014/0344727	12/2013	Chaudhry	N/A	N/A
2014/0347181	12/2013	Luna et al.	N/A	N/A

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2014/0350924	12/2013	Zurek et al.	N/A	N/A
2014/0350933	12/2013	Bak et al.	N/A	N/A
2014/0351268	12/2013	Weskamp et al.	N/A	N/A
2014/0351741	12/2013	Medlock et al.	N/A	N/A
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2014/0358549	12/2013	O'Connor et al.	N/A	N/A
2014/0359456	12/2013	Thiele et al.	N/A	N/A
2014/0359637	12/2013	Yan	N/A	N/A
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2014/0361973	12/2013	Raux et al.	N/A	N/A
2014/0363074	12/2013	Dolfing et al.	N/A	N/A
2014/0364149	12/2013	Marti et al.	N/A	N/A
2014/0364171	12/2013	Heiman et al.	N/A	N/A
2014/0365209	12/2013	Evermann	N/A	N/A
2014/0365214	12/2013	Bayley	N/A	N/A
2014/0365216	12/2013	Gruber et al.	N/A	N/A
2014/0365218	12/2013	Chang et al.	N/A	N/A
2014/0365226	12/2013	Sinha	N/A	N/A
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2014/0365407	12/2013	Brown et al.	N/A	N/A
2014/0365505	12/2013	Clark et al.	N/A	N/A
2014/0365878	12/2013	Dai et al.	N/A	N/A
2014/0365880	12/2013	Bellegarda	N/A	N/A
2014/0365885	12/2013	Carson et al.	N/A	N/A
2014/0365895	12/2013	Magahern et al.	N/A	N/A
2014/0365912	12/2013	Karunamuni et al.	N/A	N/A
2014/0365922	12/2013	Yang	N/A	N/A
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2014/0370817	12/2013	Luna	N/A	N/A
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2014/0372468	12/2013	Collins et al.	N/A	N/A
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2014/0379326	12/2013	Sarikaya et al.	N/A	N/A
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2014/0379798	12/2013	Bunner et al.	N/A	N/A
2014/0380214	12/2013	Huang et al.	N/A	N/A
2014/0380285	12/2013	Gabel et al.	N/A	N/A
2015/0001850	12/2014	Jaw et al.	N/A	N/A
2015/0003797	12/2014	Schmidt	N/A	N/A
2015/0004958	12/2014	Wang et al.	N/A	N/A
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2015/0006167	12/2014	Kato et al.	N/A	N/A
2015/0006176	12/2014	Pogue et al.	N/A	N/A
2015/0006178	12/2014	Peng et al.	N/A	N/A
2015/0006182	12/2014	Schmidt	N/A	N/A
2015/0006184	12/2014	Marti et al.	N/A	N/A
2015/0006199	12/2014	Snider et al.	N/A	N/A
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2015/0012260	12/2014	Chakladar	N/A	N/A
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2015/0012862	12/2014	Ikeda et al.	N/A	N/A

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2015/0019954	12/2014	Dalal et al.	N/A	N/A
2015/0019974	12/2014	Doi et al.	N/A	N/A
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2015/0025890	12/2014	Jagatheesan et al.	N/A	N/A
2015/0026620	12/2014	Kwon et al.	N/A	N/A
2015/0027178	12/2014	Scalisi	N/A	N/A
2015/0031416	12/2014	Labowicz et al.	N/A	N/A
2015/0032443	12/2014	Karov et al.	N/A	N/A
2015/0032457	12/2014	Koo et al.	N/A	N/A
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2015/0033219	12/2014	Breiner et al.	N/A	N/A
2015/0033275	12/2014	Natani et al.	N/A	N/A
2015/0034855	12/2014	Shen	N/A	N/A
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2015/0039292	12/2014	Suleman et al.	N/A	N/A
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2015/0040012	12/2014	Faaborg et al.	N/A	N/A
2015/0042640	12/2014	Algreatly	N/A	N/A
2015/0045003	12/2014	Vora et al.	N/A	N/A
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2015/0045068	12/2014	Soffer et al.	N/A	N/A
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2015/0049884	12/2014	Ye	N/A	N/A
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2015/0050923	12/2014	Tu et al.	N/A	N/A
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2015/0051901	12/2014	Stonehouse et al.	N/A	N/A
2015/0052128	12/2014	Sharifi	N/A	N/A
2015/0053779	12/2014	Adamek et al.	N/A	N/A
2015/0053781	12/2014	Nelson et al.	N/A	N/A
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2015/0065149	12/2014	Russell et al.	N/A	N/A
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2015/0066473	12/2014	Jeong et al.	N/A	N/A
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2015/0067521	12/2014	Heo et al.	N/A	N/A
2015/0067819	12/2014	Shribman et al.	N/A	N/A
2015/0067822	12/2014	Randall	N/A	N/A
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2015/0074615	12/2014	Han et al.	N/A	N/A
2015/0081295	12/2014	Yun et al.	N/A	N/A
2015/0082180	12/2014	Ames et al.	N/A	N/A
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2015/0106096	12/2014	Toopran et al.	N/A	N/A
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2015/0112684	12/2014	Scheffer et al.	N/A	N/A
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2015/0113454	12/2014	McLaughlin	N/A	N/A
2015/0120296	12/2014	Stern et al.	N/A	N/A
2015/0120641	12/2014	Soon-Shiong et al.	N/A	N/A
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2015/0121305	12/2014	Saund et al.	N/A	N/A
2015/0123898	12/2014	Kim et al.	N/A	N/A
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2015/0127337	12/2014	Heigold et al.	N/A	N/A
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2015/0134334	12/2014	Sachidanandam et al.	N/A	N/A
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2015/0135123	12/2014	Carr et al.	N/A	N/A
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2015/0163558	12/2014	Wheatley	N/A	N/A
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2015/0169284	12/2014	Quast et al.	N/A	N/A
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2017/0025124	12/2016	Mixter et al.	N/A	N/A
2017/0026318	12/2016	Daniel et al.	N/A	N/A
2017/0026509	12/2016	Rand	N/A	N/A
2017/0026705	12/2016	Yeh et al.	N/A	N/A
2017/0027522	12/2016	Van Hasselt et al.	N/A	N/A
2017/0031576	12/2016	Saoji et al.	N/A	N/A
2017/0031711	12/2016	Wu et al.	N/A	N/A
2017/0032022	12/2016	Srinivasan et al.	N/A	N/A
2017/0032440	12/2016	Paton	N/A	N/A
2017/0032783	12/2016	Lord et al.	N/A	N/A
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2017/0034087	12/2016	Borenstein et al.	N/A	N/A
2017/0039283	12/2016	Bennett et al.	N/A	N/A
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2017/0041388	12/2016	Tal et al.	N/A	N/A
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2017/0060853	12/2016	Lee et al.	N/A	N/A
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2017/0068423	12/2016	Napolitano et al.	N/A	N/A
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2017/0068550	12/2016	Zeitlin	N/A	N/A
2017/0068670	12/2016	Orr et al.	N/A	N/A
2017/0069308	12/2016	Aleksic et al.	N/A	N/A
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2017/0075879	12/2016	Sakamoto et al.	N/A	N/A
2017/0076518	12/2016	Patterson et al.	N/A	N/A
2017/0076720	12/2016	Gopalan et al.	N/A	N/A
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2017/0311005	12/2016	Lin	N/A	N/A
2017/0316775	12/2016	Le et al.	N/A	N/A
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2018/0081886	12/2017	Tomkins et al.	N/A	N/A
2018/0082692	12/2017	Khoury et al.	N/A	N/A
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2018/0088902	12/2017	Mese et al.	N/A	N/A
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2018/0089588	12/2017	Ravi et al.	N/A	N/A
2018/0090143	12/2017	Saddler et al.	N/A	N/A

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2018/0091732	12/2017	Wilson et al.	N/A	N/A
2018/0091847	12/2017	Wu et al.	N/A	N/A
2018/0096683	12/2017	James et al.	N/A	N/A
2018/0096690	12/2017	Mixter et al.	N/A	N/A
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2018/0103209	12/2017	Fischler et al.	N/A	N/A
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2018/0107945	12/2017	Gao et al.	N/A	N/A
2018/0108346	12/2017	Paulik et al.	N/A	N/A
2018/0108351	12/2017	Beckhardt et al.	N/A	N/A
2018/0108356	12/2017	Mizumoto et al.	N/A	N/A
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2018/0114591	12/2017	Pribanic et al.	N/A	N/A
2018/0314362	12/2017	Kim et al.	N/A	N/A
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2018/0130471	12/2017	Trufinescu et al.	N/A	N/A
2018/0137097	12/2017	Lim et al.	N/A	N/A
2018/0137404	12/2017	Fauceglia et al.	N/A	N/A
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2021/0044870	12/2020	Li et al.	N/A	N/A
2021/0049237	12/2020	Demme et al.	N/A	N/A
2021/0065698	12/2020	Topcu et al.	N/A	N/A
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2021/0067631	12/2020	Van Os et al.	N/A	N/A
2021/0072953	12/2020	Amarilio et al.	N/A	N/A
2021/0073254	12/2020	Ghafourifar et al.	N/A	N/A
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2021/0074264	12/2020	Liang et al.	N/A	N/A
2021/0074295	12/2020	Moreno et al.	N/A	N/A
2021/0081749	12/2020	Claire	N/A	N/A
2021/0082400	12/2020	Vishnoi et al.	N/A	N/A
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2021/0090314	12/2020	Hussen et al.	N/A	N/A
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2021/0092128	12/2020	Leblang	N/A	N/A
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2021/0105528	12/2020	Van Os et al.	N/A	N/A
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Background/Summary

(1) This application is a continuation of U.S. patent application Ser. No. 18/130,346, entitled “ATTENTION AWARE VIRTUAL ASSISTANT DISMISSAL,” filed on Apr. 3, 2023, which is a continuation of U.S. patent application Ser. No. 17/836,907 entitled “ATTENTION AWARE VIRTUAL ASSISTANT DISMISSAL,” filed on Jun. 9, 2022 which is a continuation of U.S. patent application Ser. No. 17/322,115 entitled “ATTENTION AWARE VIRTUAL ASSISTANT DISMISSAL,” filed on May 17, 2021, which is a continuation of U.S. patent application Ser. No. 16/885,027, entitled “ATTENTION AWARE VIRTUAL ASSISTANT DISMISSAL,” filed on May 27, 2020, which is a continuation of U.S. patent application Ser. No. 16/039,099, entitled “ATTENTION AWARE VIRTUAL ASSISTANT DISMISSAL,” filed on Jul. 18, 2018, which claims priority to U.S. Patent Application No. 62/679,332, entitled “ATTENTION AWARE VIRTUAL ASSISTANT DISMISSAL, filed on Jun. 1, 2018. The contents of each of these applications are hereby incorporated by reference in their entireties.

FIELD
(1) This relates generally to intelligent automated assistants and, more specifically, to efficient dismissal of intelligent automated assistant sessions.
BACKGROUND
(2) Intelligent automated assistants (or digital assistants) can provide a beneficial interface between human users and electronic devices. Such assistants can allow users to interact with devices or systems using natural language in spoken and/or text forms. For example, a user can provide a speech input containing a user request to a digital assistant operating on an electronic device. The digital assistant can interpret the user's intent from the speech input and operationalize the user's intent into tasks. The tasks can then be performed by executing one or more services of the electronic device, and a relevant output responsive to the user request can be returned to the user.
(3) Operating a digital assistant requires electric power, which is a limited resource on handheld or portable devices that rely on batteries and on which digital assistants often run. Accordingly, it can be desirable to operate a digital assistant in an energy efficient manner.
SUMMARY
(4) Example methods are disclosed herein. An example method includes, at an electronic device having one or more processors, initiating a virtual assistant session responsive to receiving user input. In accordance with initiating the virtual assistant session, the method includes determining, based on data obtained using one or more sensors of the electronic device, whether one or more criteria representing expressed user disinterest are satisfied. In accordance with determining that the one or more criteria representing expressed user disinterest are satisfied prior to a first time, the method includes automatically deactivating the virtual assistant session prior to the first time. The first time is defined by a setting of the electronic device. In accordance with determining that the one or more criteria representing expressed user disinterest are not satisfied prior to the first time, the method includes automatically deactivating the virtual assistant session at the first time.
(5) Example non-transitory computer-readable media are disclosed herein. An example non-transitory computer-readable storage medium stores one or more programs. The one or more programs comprise instructions, which when executed by one or more processors of an electronic device, cause the electronic device to: initiate a virtual assistant session responsive to receiving user input; in accordance with initiating the virtual assistant session, determine, based on data obtained using one or more sensors of the electronic device, whether one or more criteria representing expressed user disinterest are satisfied; and in accordance with determining that the one or more criteria representing expressed user disinterest are satisfied prior to a first time, automatically deactivate the virtual assistant session prior to the first time, wherein the first time is defined by a setting of the electronic device; and in accordance with determining that the one or more criteria representing expressed user disinterest are not satisfied prior to the first time, automatically deactivate the virtual assistant session at the first time.
(6) Example electronic devices are disclosed herein. An example electronic device comprises one or more processors; a memory; and one or more programs, where the one or more programs are stored in the memory and configured to be executed by the one or more processors, the one or more programs including instructions for: initiating a virtual assistant

session responsive to receiving user input; in accordance with initiating the virtual assistant session, determining, based on data obtained using one or more sensors of the electronic device, whether one or more criteria representing expressed user disinterest are satisfied; and in accordance with determining that the one or more criteria representing expressed user disinterest are satisfied prior to a first time, automatically deactivating the virtual assistant session prior to the first time, wherein the first time is defined by a setting of the electronic device; and in accordance with determining that the one or more criteria representing expressed user disinterest are not satisfied prior to the first time, automatically deactivating the virtual assistant session at the first time.

(7) An example electronic device comprises means for: initiating a virtual assistant session responsive to receiving user input; in accordance with initiating the virtual assistant session, determining, based on data obtained using one or more sensors of the electronic device, whether one or more criteria representing expressed user disinterest are satisfied; and in accordance with determining that the one or more criteria representing expressed user disinterest are satisfied prior to a first time, automatically deactivating the virtual assistant session prior to the first time, wherein the first time is defined by a setting of the electronic device; and in accordance with determining that the one or more criteria representing expressed user disinterest are not satisfied prior to the first time, automatically deactivating the virtual assistant session at the first time.

(8) Example methods are disclosed herein. An example method includes, at an electronic device having one or more processors: initiating a virtual assistant session responsive to receiving user input; in accordance with initiating the virtual assistant session, determining, based on data obtained using one or more sensors of the electronic device, whether one or more criteria representing expressed user engagement are satisfied; in accordance with determining that the one or more criteria representing expressed user engagement are satisfied prior to a first time, forgoing deactivating the virtual assistant session at the first time, wherein the first time is a predetermined duration after a second time at which a final result for the virtual assistant session is presented; and in accordance with determining that the one or more criteria representing expressed user engagement are not satisfied prior to the first time, deactivating the virtual assistant session at the first time.

(9) Example non-transitory computer-readable media are disclosed herein. An example non-transitory computer-readable storage medium stores one or more programs. The one or more programs comprise instructions, which when executed by one or more processors of an electronic device, cause the electronic device to: initiate a virtual assistant session responsive to receiving user input; in accordance with initiating the virtual assistant session, determine, based on data obtained using one or more sensors of the electronic device, whether one or more criteria representing expressed user engagement are satisfied; in accordance with determining that the one or more criteria representing expressed user engagement are satisfied prior to a first time, forgo deactivating the virtual assistant session at the first time, wherein the first time is a predetermined duration after a second time at which a final result for the virtual assistant session is presented; and in accordance with determining that the one or more criteria representing expressed user engagement are not satisfied prior to the first time, deactivate the virtual assistant session at the first time.

(10) Example electronic devices are disclosed herein. An example electronic device comprises one or more processors; a memory; and one or more programs, where the one or more programs are stored in the memory and configured to be executed by the one or more processors, the one or more programs including instructions for: initiating a virtual assistant session responsive to receiving user input; in accordance with initiating the virtual assistant session, determining, based on data obtained using one or more sensors of the electronic device, whether one or more criteria representing expressed user engagement are satisfied; in accordance with determining that the one or more criteria representing expressed user engagement are satisfied prior to a first time, forgoing deactivating the virtual assistant session at the first time, wherein the first time is a predetermined duration after a second time at which a final result for the virtual assistant session is presented; and in accordance with determining that the one or more criteria representing expressed user engagement are not satisfied prior to the first time, deactivating the virtual assistant session at the first time.

(11) An example electronic device comprises means for: initiating a virtual assistant session responsive to receiving user input; in accordance with initiating the virtual assistant session, determining, based on data obtained using one or more sensors of the electronic device, whether one or more criteria representing expressed user engagement are satisfied; in accordance with determining that the one or more criteria representing expressed user engagement are satisfied prior to a first time, forgoing deactivating the virtual assistant session at the first time, wherein the first time is a predetermined duration after a second time at which a final result for the virtual assistant session is presented; and in accordance with determining that the one or more criteria representing expressed user engagement are not satisfied prior to the first time, deactivating the virtual assistant session at the first time.

(12) Determining, based on data obtained using one or more sensors of the electronic device, whether one or more criteria representing expressed user disinterest are satisfied (and/or whether one or more criteria representing expressed user engagement are satisfied) allows determination of whether a user is engaged with a virtual assistant session. Knowing whether a user is engaged allows intelligent decision making about whether to deactivate the virtual assistant session. For example, if the user is not engaged, a device can deactivate the virtual assistant session to save battery and processing power. As another example, if the user is engaged, the device can forgo deactivating the virtual assistant session so the user can continue interacting with the virtual assistant session (and so the virtual assistant session does not deactivate while the user is still interacting with it). In this manner, the user-device interface is made more efficient (e.g., by deactivating a virtual assistant session when a user is not engaged with it, by preventing deactivation of a virtual assistant session while the user is actively engaged with it, or by reducing user input to re-initiate an incorrectly deactivated virtual assistant session) which additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) FIG. **1** is a block diagram illustrating a system and environment for implementing a digital assistant, according to various examples.
(2) FIG. **2**A is a block diagram illustrating a portable multifunction device implementing the client-side portion of a digital assistant, according to various examples.
(3) FIG. **2**B is a block diagram illustrating exemplary components for event handling, according to various examples.
(4) FIG. **3** illustrates a portable multifunction device implementing the client-side portion of a digital assistant, according to various examples.
(5) FIG. **4** is a block diagram of an exemplary multifunction device with a display and a touch-sensitive surface, according to various examples.
(6) FIG. **5**A illustrates an exemplary user interface for a menu of applications on a portable multifunction device, according to various examples.
(7) FIG. **5**B illustrates an exemplary user interface for a multifunction device with a touch-sensitive surface that is separate from the display, according to various examples.
(8) FIG. **6**A illustrates a personal electronic device, according to various examples.
(9) FIG. **6**B is a block diagram illustrating a personal electronic device, according to various examples.
(10) FIG. **7**A is a block diagram illustrating a digital assistant system or a server portion thereof, according to various examples.
(11) FIG. **7**B illustrates the functions of the digital assistant shown in FIG. **7**A, according to various examples.
(12) FIG. **7**C illustrates a portion of an ontology, according to various examples.
(13) FIGS. **8**A-**8**D depict exemplary techniques for operating a digital assistant at an electronic device.
(14) FIG. **9** illustrates a block diagram of a system configured to operate a digital assistant session according to various examples.
(15) FIGS. **10**A-**10**B illustrate a process for operating a digital assistant according to various examples.
DETAILED DESCRIPTION
(16) In the following description of examples, reference is made to the accompanying drawings in which are shown by way of illustration specific examples that can be practiced. It is to be understood that other examples can be used and structural changes can be made without departing from the scope of the various examples.
(17) The present disclosure generally relates to determining whether to deactivate a virtual assistant session based on determining whether a user is engaged with the virtual assistant session. For example, if a user is not engaged with a virtual assistant session, the virtual assistant session may be automatically deactivated to conserve battery and processing power. If a user is engaged with the virtual assistant session, automatic deactivation of the virtual assistant may be forgone or delayed so the virtual assistant session does not deactivate while the user is engaged. In this manner, user experience operating virtual assistants is improved.
(18) Although the following description uses terms “first,” “second,” etc. to describe various elements, these elements should not be limited by the terms. These terms are only used to distinguish one element from another. For example, a first input could be termed a second input, and, similarly, a second input could be termed a first input, without departing from the scope of the various described examples. The first input and the second input are both inputs and, in some cases, are separate and different inputs.
(19) The terminology used in the description of the various described examples herein is for the purpose of describing particular examples only and is not intended to be limiting. As used in the description of the various described examples and the appended claims, the singular forms “a,” “an,” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will also be understood that the term “and/or” as used herein refers to and encompasses any and all possible combinations of one or more of the associated listed items. It will be further understood that the terms “includes,” “including,” “comprises,” and/or “comprising,” when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.
(20) The term “if” may be construed to mean “when” or “upon” or “in response to determining” or “in response to detecting,” depending on the context. Similarly, the phrase “if it is determined” or “if [a stated condition or event] is detected” may be construed to mean “upon determining” or “in response to determining” or “upon detecting [the stated condition or event]” or “in response to detecting [the stated condition or event],” depending on the context.
(21) 1. System and Environment
(22) FIG. **1** illustrates a block diagram of system **100** according to various examples. In some examples, system **100** implements a digital assistant. The terms “digital assistant,” “virtual assistant,” “intelligent automated assistant,” or “automatic digital assistant” refer to any information processing system that interprets natural language input in spoken and/or textual form to infer user intent, and performs actions based on the inferred user intent. For example, to act on an inferred user intent, the system performs one or more of the following: identifying a task flow with steps and parameters designed to accomplish the inferred user intent, inputting specific requirements from the inferred user intent into the task flow; executing the task flow by invoking programs, methods, services, APIs, or the like; and generating output responses to the user in an audible (e.g., speech) and/or visual form.

(23) Specifically, a digital assistant is capable of accepting a user request at least partially in the form of a natural language command, request, statement, narrative, and/or inquiry. Typically, the user request seeks either an informational answer or performance of a task by the digital assistant. A satisfactory response to the user request includes a provision of the requested informational answer, a performance of the requested task, or a combination of the two. For example, a user asks the digital assistant a question, such as “Where am I right now?” Based on the user's current location, the digital assistant answers, “You are in Central Park near the west gate.” The user also requests the performance of a task, for example, “Please invite my friends to my girlfriend's birthday party next week.” In response, the digital assistant can acknowledge the request by saying “Yes, right away,” and then send a suitable calendar invite on behalf of the user to each of the user's friends listed in the user's electronic address book. During performance of a requested task, the digital assistant sometimes interacts with the user in a continuous dialogue involving multiple exchanges of information over an extended period of time. There are numerous other ways of interacting with a digital assistant to request information or performance of various tasks. In addition to providing verbal responses and taking programmed actions, the digital assistant also provides responses in other visual or audio forms, e.g., as text, alerts, music, videos, animations, etc.
(24) As shown in FIG. **1**, in some examples, a digital assistant is implemented according to a client-server model. The digital assistant includes client-side portion **102** (hereafter “DA client **102**”) executed on user device **104** and server-side portion **106** (hereafter “DA server **106**”) executed on server system **108**. DA client **102** communicates with DA server **106** through one or more networks **110**. DA client **102** provides client-side functionalities such as user-facing input and output processing and communication with DA server **106**. DA server **106** provides server-side functionalities for any number of DA clients **102** each residing on a respective user device **104**.
(25) In some examples, DA server **106** includes client-facing I/O interface **112**, one or more processing modules **114**, data and models **116**, and I/O interface to external services **118**. The client-facing I/O interface **112** facilitates the client-facing input and output processing for DA server **106**. One or more processing modules **114** utilize data and models **116** to process speech input and determine the user's intent based on natural language input. Further, one or more processing modules **114** perform task execution based on inferred user intent. In some examples, DA server **106** communicates with external services **120** through network(s) **110** for task completion or information acquisition. I/O interface to external services **118** facilitates such communications.
(26) User device **104** can be any suitable electronic device. In some examples, user device **104** is a portable multifunctional device (e.g., device **200**, described below with reference to FIG. **2**A), a multifunctional device (e.g., device **400**, described below with reference to FIG. **4**), or a personal electronic device (e.g., device **600**, described below with reference to FIG. **6**A-B.) A portable multifunctional device is, for example, a mobile telephone that also contains other functions, such as PDA and/or music player functions. Specific examples of portable multifunction devices include the Apple Watch®, iPhone®, iPod Touch®, and iPad® devices from Apple Inc. of Cupertino, California. Other examples of portable multifunction devices include, without limitation, earphones/headphones, speakers, and laptop or tablet computers. Further, in some examples, user device **104** is a non-portable multifunctional device. In particular, user device **104** is a desktop computer, a game console, a speaker, a television, or a television set-top box. In some examples, user device **104** includes a touch-sensitive surface (e.g., touch screen displays and/or touchpads). Further, user device **104** optionally includes one or more other physical user-interface devices, such as a physical keyboard, a mouse, and/or a joystick. Various examples of electronic devices, such as multifunctional devices, are described below in greater detail.
(27) Examples of communication network(s) **110** include local area networks (LAN) and wide area networks (WAN), e.g., the Internet. Communication network(s) **110** is implemented using any known network protocol, including various wired or wireless protocols, such as, for example, Ethernet, Universal Serial Bus (USB), FIREWIRE, Global System for Mobile Communications (GSM), Enhanced Data GSM Environment (EDGE), code division multiple access (CDMA), time division multiple access (TDMA), Bluetooth, Wi-Fi, voice over Internet Protocol (VOIP), Wi-MAX, or any other suitable communication protocol.
(28) Server system **108** is implemented on one or more standalone data processing apparatus or a distributed network of computers. In some examples, server system **108** also employs various virtual devices and/or services of third-party service providers (e.g., third-party cloud service providers) to provide the underlying computing resources and/or infrastructure resources of server system **108**.
(29) In some examples, user device **104** communicates with DA server **106** via second user device **122**. Second user device **122** is similar or identical to user device **104**. For example, second user device **122** is similar to devices **200**, **400**, or **600** described below with reference to FIGS. **2**A, **4**, and **6**A-B. User device **104** is configured to communicatively couple to second user device **122** via a direct communication connection, such as Bluetooth, NFC, BTLE, or the like, or via a wired or wireless network, such as a local Wi-Fi network. In some examples, second user device **122** is configured to act as a proxy between user device **104** and DA server **106**. For example, DA client **102** of user device **104** is configured to transmit information (e.g., a user request received at user device **104**) to DA server **106** via second user device **122**. DA server **106** processes the information and returns relevant data (e.g., data content responsive to the user request) to user device **104** via second user device **122**.
(30) In some examples, user device **104** is configured to communicate abbreviated requests for data to second user device **122** to reduce the amount of information transmitted from user device **104**. Second user device **122** is configured to determine supplemental information to add to the abbreviated request to generate a complete request to transmit to DA server **106**. This system architecture can advantageously allow user device **104** having limited communication capabilities and/or limited battery power (e.g., a watch or a similar compact electronic device) to access services provided by DA server **106** by using second user device **122**, having greater communication capabilities and/or battery power (e.g., a mobile phone, laptop

computer, tablet computer, or the like), as a proxy to DA server **106**. While only two user devices **104** and **122** are shown in FIG. **1**, it should be appreciated that system **100**, in some examples, includes any number and type of user devices configured in this proxy configuration to communicate with DA server system **106**.
(31) Although the digital assistant shown in FIG. **1** includes both a client-side portion (e.g., DA client **102**) and a server-side portion (e.g., DA server **106**), in some examples, the functions of a digital assistant are implemented as a standalone application installed on a user device. In addition, the divisions of functionalities between the client and server portions of the digital assistant can vary in different implementations. For instance, in some examples, the DA client is a thin-client that provides only user-facing input and output processing functions, and delegates all other functionalities of the digital assistant to a backend server.
(32) 2. Electronic Devices
(33) Attention is now directed toward embodiments of electronic devices for implementing the client-side portion of a digital assistant. FIG. **2**A is a block diagram illustrating portable multifunction device **200** with touch-sensitive display system **212** in accordance with some embodiments. Touch-sensitive display **212** is sometimes called a "touch screen" for convenience and is sometimes known as or called a "touch-sensitive display system." Device **200** includes memory **202** (which optionally includes one or more computer-readable storage mediums), memory controller **222**, one or more processing units (CPUs) **220**, peripherals interface **218**, RF circuitry **208**, audio circuitry **210**, speaker **211**, microphone **213**, input/output (I/O) subsystem **206**, other input control devices **216**, and external port **224**. Device **200** optionally includes one or more optical sensors **264**. Device **200** optionally includes one or more contact intensity sensors **265** for detecting intensity of contacts on device **200** (e.g., a touch-sensitive surface such as touch-sensitive display system **212** of device **200**). Device **200** optionally includes one or more tactile output generators **267** for generating tactile outputs on device **200** (e.g., generating tactile outputs on a touch-sensitive surface such as touch-sensitive display system **212** of device **200** or touchpad **455** of device **400**). These components optionally communicate over one or more communication buses or signal lines **203**.
(34) As used in the specification and claims, the term "intensity" of a contact on a touch-sensitive surface refers to the force or pressure (force per unit area) of a contact (e.g., a finger contact) on the touch-sensitive surface, or to a substitute (proxy) for the force or pressure of a contact on the touch-sensitive surface. The intensity of a contact has a range of values that includes at least four distinct values and more typically includes hundreds of distinct values (e.g., at least 256). Intensity of a contact is, optionally, determined (or measured) using various approaches and various sensors or combinations of sensors. For example, one or more force sensors underneath or adjacent to the touch-sensitive surface are, optionally, used to measure force at various points on the touch-sensitive surface. In some implementations, force measurements from multiple force sensors are combined (e.g., a weighted average) to determine an estimated force of a contact. Similarly, a pressure-sensitive tip of a stylus is, optionally, used to determine a pressure of the stylus on the touch-sensitive surface. Alternatively, the size of the contact area detected on the touch-sensitive surface and/or changes thereto, the capacitance of the touch-sensitive surface proximate to the contact and/or changes thereto, and/or the resistance of the touch-sensitive surface proximate to the contact and/or changes thereto are, optionally, used as a substitute for the force or pressure of the contact on the touch-sensitive surface. In some implementations, the substitute measurements for contact force or pressure are used directly to determine whether an intensity threshold has been exceeded (e.g., the intensity threshold is described in units corresponding to the substitute measurements). In some implementations, the substitute measurements for contact force or pressure are converted to an estimated force or pressure, and the estimated force or pressure is used to determine whether an intensity threshold has been exceeded (e.g., the intensity threshold is a pressure threshold measured in units of pressure). Using the intensity of a contact as an attribute of a user input allows for user access to additional device functionality that may otherwise not be accessible by the user on a reduced-size device with limited real estate for displaying affordances (e.g., on a touch-sensitive display) and/or receiving user input (e.g., via a touch-sensitive display, a touch-sensitive surface, or a physical/mechanical control such as a knob or a button).
(35) As used in the specification and claims, the term "tactile output" refers to physical displacement of a device relative to a previous position of the device, physical displacement of a component (e.g., a touch-sensitive surface) of a device relative to another component (e.g., housing) of the device, or displacement of the component relative to a center of mass of the device that will be detected by a user with the user's sense of touch. For example, in situations where the device or the component of the device is in contact with a surface of a user that is sensitive to touch (e.g., a finger, palm, or other part of a user's hand), the tactile output generated by the physical displacement will be interpreted by the user as a tactile sensation corresponding to a perceived change in physical characteristics of the device or the component of the device. For example, movement of a touch-sensitive surface (e.g., a touch-sensitive display or trackpad) is, optionally, interpreted by the user as a "down click" or "up click" of a physical actuator button. In some cases, a user will feel a tactile sensation such as an "down click" or "up click" even when there is no movement of a physical actuator button associated with the touch-sensitive surface that is physically pressed (e.g., displaced) by the user's movements. As another example, movement of the touch-sensitive surface is, optionally, interpreted or sensed by the user as "roughness" of the touch-sensitive surface, even when there is no change in smoothness of the touch-sensitive surface. While such interpretations of touch by a user will be subject to the individualized sensory perceptions of the user, there are many sensory perceptions of touch that are common to a large majority of users. Thus, when a tactile output is described as corresponding to a particular sensory perception of a user (e.g., an "up click," a "down click," "roughness"), unless otherwise stated, the generated tactile output corresponds to physical displacement of the device or a component thereof that will generate the described sensory perception for a typical (or average) user.
(36) It should be appreciated that device **200** is only one example of a portable multifunction device, and that device **200** optionally has more or fewer components than shown, optionally combines two or more components, or optionally has a

different configuration or arrangement of the components. The various components shown in FIG. 2A are implemented in hardware, software, or a combination of both hardware and software, including one or more signal processing and/or application-specific integrated circuits.

(37) Memory **202** includes one or more computer-readable storage mediums. The computer-readable storage mediums are, for example, tangible and non-transitory. Memory **202** includes high-speed random access memory and also includes non-volatile memory, such as one or more magnetic disk storage devices, flash memory devices, or other non-volatile solid-state memory devices. Memory controller **222** controls access to memory **202** by other components of device **200**.

(38) In some examples, a non-transitory computer-readable storage medium of memory **202** is used to store instructions (e.g., for performing aspects of processes described below) for use by or in connection with an instruction execution system, apparatus, or device, such as a computer-based system, processor-containing system, or other system that can fetch the instructions from the instruction execution system, apparatus, or device and execute the instructions. In other examples, the instructions (e.g., for performing aspects of the processes described below) are stored on a non-transitory computer-readable storage medium (not shown) of the server system **108** or are divided between the non-transitory computer-readable storage medium of memory **202** and the non-transitory computer-readable storage medium of server system **108**.

(39) Peripherals interface **218** is used to couple input and output peripherals of the device to CPU **220** and memory **202**. The one or more processors **220** run or execute various software programs and/or sets of instructions stored in memory **202** to perform various functions for device **200** and to process data. In some embodiments, peripherals interface **218**, CPU **220**, and memory controller **222** are implemented on a single chip, such as chip **204**. In some other embodiments, they are implemented on separate chips.

(40) RF (radio frequency) circuitry **208** receives and sends RF signals, also called electromagnetic signals. RF circuitry **208** converts electrical signals to/from electromagnetic signals and communicates with communications networks and other communications devices via the electromagnetic signals. RF circuitry **208** optionally includes well-known circuitry for performing these functions, including but not limited to an antenna system, an RF transceiver, one or more amplifiers, a tuner, one or more oscillators, a digital signal processor, a CODEC chipset, a subscriber identity module (SIM) card, memory, and so forth. RF circuitry **208** optionally communicates with networks, such as the Internet, also referred to as the World Wide Web (WWW), an intranet and/or a wireless network, such as a cellular telephone network, a wireless local area network (LAN) and/or a metropolitan area network (MAN), and other devices by wireless communication. The RF circuitry **208** optionally includes well-known circuitry for detecting near field communication (NFC) fields, such as by a short-range communication radio. The wireless communication optionally uses any of a plurality of communications standards, protocols, and technologies, including but not limited to Global System for Mobile Communications (GSM), Enhanced Data GSM Environment (EDGE), high-speed downlink packet access (HSDPA), high-speed uplink packet access (HSUPA), Evolution, Data-Only (EV-DO), HSPA, HSPA+, Dual-Cell HSPA (DC-HSPDA), long term evolution (LTE), near field communication (NFC), wideband code division multiple access (W-CDMA), code division multiple access (CDMA), time division multiple access (TDMA), Bluetooth, Bluetooth Low Energy (BTLE), Wireless Fidelity (Wi-Fi) (e.g., IEEE 802.11a, IEEE 802.11b, IEEE 802.11g, IEEE 802.11n, and/or IEEE 802.11ac), voice over Internet Protocol (VOIP), Wi-MAX, a protocol for e mail (e.g., Internet message access protocol (IMAP) and/or post office protocol (POP)), instant messaging (e.g., extensible messaging and presence protocol (XMPP), Session Initiation Protocol for Instant Messaging and Presence Leveraging Extensions (SIMPLE), Instant Messaging and Presence Service (IMPS)), and/or Short Message Service (SMS), or any other suitable communication protocol, including communication protocols not yet developed as of the filing date of this document.

(41) Audio circuitry **210**, speaker **211**, and microphone **213** provide an audio interface between a user and device **200**. Audio circuitry **210** receives audio data from peripherals interface **218**, converts the audio data to an electrical signal, and transmits the electrical signal to speaker **211**. Speaker **211** converts the electrical signal to human-audible sound waves. Audio circuitry **210** also receives electrical signals converted by microphone **213** from sound waves. Audio circuitry **210** converts the electrical signal to audio data and transmits the audio data to peripherals interface **218** for processing. Audio data are retrieved from and/or transmitted to memory **202** and/or RF circuitry **208** by peripherals interface **218**. In some embodiments, audio circuitry **210** also includes a headset jack (e.g., **312**, FIG. **3**). The headset jack provides an interface between audio circuitry **210** and removable audio input/output peripherals, such as output-only headphones or a headset with both output (e.g., a headphone for one or both cars) and input (e.g., a microphone).

(42) I/O subsystem **206** couples input/output peripherals on device **200**, such as touch screen **212** and other input control devices **216**, to peripherals interface **218**. I/O subsystem **206** optionally includes display controller **256**, optical sensor controller **258**, intensity sensor controller **259**, haptic feedback controller **261**, and one or more input controllers **260** for other input or control devices. The one or more input controllers **260** receive/send electrical signals from/to other input control devices **216**. The other input control devices **216** optionally include physical buttons (e.g., push buttons, rocker buttons, etc.), dials, slider switches, joysticks, click wheels, and so forth. In some alternate embodiments, input controller(s) **260** are, optionally, coupled to any (or none) of the following: a keyboard, an infrared port, a USB port, and a pointer device such as a mouse. The one or more buttons (e.g., **308**, FIG. **3**) optionally include an up/down button for volume control of speaker **211** and/or microphone **213**. The one or more buttons optionally include a push button (e.g., **306**, FIG. **3**).

(43) A quick press of the push button disengages a lock of touch screen **212** or begin a process that uses gestures on the touch screen to unlock the device, as described in U.S. patent application Ser. No. 11/322,549, “Unlocking a Device by Performing Gestures on an Unlock Image,” filed Dec. 23, 2005, U.S. Pat. No. 7,657,849, which is hereby incorporated by reference in its entirety. A longer press of the push button (e.g., **306**) turns power to device **200** on or off. The user is able to customize a functionality of one or more of the buttons. Touch screen **212** is used to implement virtual or soft buttons and one or more

soft keyboards.
(44) Touch-sensitive display **212** provides an input interface and an output interface between the device and a user. Display controller **256** receives and/or sends electrical signals from/to touch screen **212**. Touch screen **212** displays visual output to the user. The visual output includes graphics, text, icons, video, and any combination thereof (collectively termed “graphics”). In some embodiments, some or all of the visual output correspond to user-interface objects.
(45) Touch screen **212** has a touch-sensitive surface, sensor, or set of sensors that accepts input from the user based on haptic and/or tactile contact. Touch screen **212** and display controller **256** (along with any associated modules and/or sets of instructions in memory **202**) detect contact (and any movement or breaking of the contact) on touch screen **212** and convert the detected contact into interaction with user-interface objects (e.g., one or more soft keys, icons, web pages, or images) that are displayed on touch screen **212**. In an exemplary embodiment, a point of contact between touch screen **212** and the user corresponds to a finger of the user.
(46) Touch screen **212** uses LCD (liquid crystal display) technology, LPD (light emitting polymer display) technology, or LED (light emitting diode) technology, although other display technologies may be used in other embodiments. Touch screen **212** and display controller **256** detect contact and any movement or breaking thereof using any of a plurality of touch sensing technologies now known or later developed, including but not limited to capacitive, resistive, infrared, and surface acoustic wave technologies, as well as other proximity sensor arrays or other elements for determining one or more points of contact with touch screen **212**. In an exemplary embodiment, projected mutual capacitance sensing technology is used, such as that found in the iPhone® and iPod Touch® from Apple Inc. of Cupertino, California.
(47) A touch-sensitive display in some embodiments of touch screen **212** is analogous to the multi-touch sensitive touchpads described in the following U.S. Pat. No. 6,323,846 (Westerman et al.), U.S. Pat. No. 6,570,557 (Westerman et al.), and/or U.S. Pat. No. 6,677,932 (Westerman), and/or U.S. Patent Publication 2002/0015024A1, each of which is hereby incorporated by reference in its entirety. However, touch screen **212** displays visual output from device **200**, whereas touch-sensitive touchpads do not provide visual output.
(48) A touch-sensitive display in some embodiments of touch screen **212** is as described in the following applications: (1) U.S. patent application Ser. No. 11/381,313, “Multipoint Touch Surface Controller,” filed May 2, 2006; (2) U.S. patent application Ser. No. 10/840,862, “Multipoint Touchscreen,” filed May 6, 2004; (3) U.S. patent application Ser. No. 10/903,964, “Gestures For Touch Sensitive Input Devices,” filed Jul. 30, 2004; (4) U.S. patent application Ser. No. 11/048,264, “Gestures For Touch Sensitive Input Devices,” filed Jan. 31, 2005; (5) U.S. patent application Ser. No. 11/038,590, “Mode-Based Graphical User Interfaces For Touch Sensitive Input Devices,” filed Jan. 18, 2005; (6) U.S. patent application Ser. No. 11/228,758, “Virtual Input Device Placement On A Touch Screen User Interface,” filed Sep. 16, 2005; (7) U.S. patent application Ser. No. 11/228,700, “Operation Of A Computer With A Touch Screen Interface,” filed Sep. 16, 2005; (8) U.S. patent application Ser. No. 11/228,737, “Activating Virtual Keys Of A Touch-Screen Virtual Keyboard,” filed Sep. 16, 2005; and (9) U.S. patent application Ser. No. 11/367,749, “Multi-Functional Hand-Held Device,” filed Mar. 3, 2006. All of these applications are incorporated by reference herein in their entirety.
(49) Touch screen **212** has, for example, a video resolution in excess of 100 dpi. In some embodiments, the touch screen has a video resolution of approximately 160 dpi. The user makes contact with touch screen **212** using any suitable object or appendage, such as a stylus, a finger, and so forth. In some embodiments, the user interface is designed to work primarily with finger-based contacts and gestures, which can be less precise than stylus-based input due to the larger area of contact of a finger on the touch screen. In some embodiments, the device translates the rough finger-based input into a precise pointer/cursor position or command for performing the actions desired by the user.
(50) In some embodiments, in addition to the touch screen, device **200** includes a touchpad (not shown) for activating or deactivating particular functions. In some embodiments, the touchpad is a touch-sensitive area of the device that, unlike the touch screen, does not display visual output. The touchpad is a touch-sensitive surface that is separate from touch screen **212** or an extension of the touch-sensitive surface formed by the touch screen.
(51) Device **200** also includes power system **262** for powering the various components. Power system **262** includes a power management system, one or more power sources (e.g., battery, alternating current (AC)), a recharging system, a power failure detection circuit, a power converter or inverter, a power status indicator (e.g., a light-emitting diode (LED)) and any other components associated with the generation, management and distribution of power in portable devices.
(52) Device **200** also includes one or more optical sensors **264**. FIG. **2**A shows an optical sensor coupled to optical sensor controller **258** in I/O subsystem **206**. Optical sensor **264** includes charge-coupled device (CCD) or complementary metal-oxide semiconductor (CMOS) phototransistors. Optical sensor **264** receives light from the environment, projected through one or more lenses, and converts the light to data representing an image. In conjunction with imaging module **243** (also called a camera module), optical sensor **264** captures still images or video. In some embodiments, an optical sensor is located on the back of device **200**, opposite touch screen display **212** on the front of the device so that the touch screen display is used as a viewfinder for still and/or video image acquisition. In some embodiments, an optical sensor is located on the front of the device so that the user's image is obtained for video conferencing while the user views the other video conference participants on the touch screen display. In some embodiments, the position of optical sensor **264** can be changed by the user (e.g., by rotating the lens and the sensor in the device housing) so that a single optical sensor **264** is used along with the touch screen display for both video conferencing and still and/or video image acquisition.
(53) Device **200** optionally also includes one or more contact intensity sensors **265**. FIG. **2**A shows a contact intensity sensor coupled to intensity sensor controller **259** in I/O subsystem **206**. Contact intensity sensor **265** optionally includes one or more piezoresistive strain gauges, capacitive force sensors, electric force sensors, piezoelectric force sensors, optical force sensors, capacitive touch-sensitive surfaces, or other intensity sensors (e.g., sensors used to measure the force (or pressure) of a

contact on a touch-sensitive surface). Contact intensity sensor **265** receives contact intensity information (e.g., pressure information or a proxy for pressure information) from the environment. In some embodiments, at least one contact intensity sensor is collocated with, or proximate to, a touch-sensitive surface (e.g., touch-sensitive display system **212**). In some embodiments, at least one contact intensity sensor is located on the back of device **200**, opposite touch screen display **212**, which is located on the front of device **200**.
(54) Device **200** also includes one or more proximity sensors **266**. FIG. **2**A shows proximity sensor **266** coupled to peripherals interface **218**. Alternately, proximity sensor **266** is coupled to input controller **260** in I/O subsystem **206**. Proximity sensor **266** is performed as described in U.S. patent application Ser. No. 11/241,839, "Proximity Detector In Handheld Device"; Ser. No. 11/240,788, "Proximity Detector In Handheld Device"; Ser. No. 11/620,702, "Using Ambient Light Sensor To Augment Proximity Sensor Output"; Ser. No. 11/586,862, "Automated Response To And Sensing Of User Activity In Portable Devices"; and Ser. No. 11/638,251, "Methods And Systems For Automatic Configuration Of Peripherals," which are hereby incorporated by reference in their entirety. In some embodiments, the proximity sensor turns off and disables touch screen **212** when the multifunction device is placed near the user's ear (e.g., when the user is making a phone call).
(55) Device **200** optionally also includes one or more tactile output generators **267**. FIG. **2**A shows a tactile output generator coupled to haptic feedback controller **261** in I/O subsystem **206**. Tactile output generator **267** optionally includes one or more electroacoustic devices such as speakers or other audio components and/or electromechanical devices that convert energy into linear motion such as a motor, solenoid, electroactive polymer, piezoelectric actuator, electrostatic actuator, or other tactile output generating component (e.g., a component that converts electrical signals into tactile outputs on the device). Contact intensity sensor **265** receives tactile feedback generation instructions from haptic feedback module **233** and generates tactile outputs on device **200** that are capable of being sensed by a user of device **200**. In some embodiments, at least one tactile output generator is collocated with, or proximate to, a touch-sensitive surface (e.g., touch-sensitive display system **212**) and, optionally, generates a tactile output by moving the touch-sensitive surface vertically (e.g., in/out of a surface of device **200**) or laterally (e.g., back and forth in the same plane as a surface of device **200**). In some embodiments, at least one tactile output generator sensor is located on the back of device **200**, opposite touch screen display **212**, which is located on the front of device **200**.
(56) Device **200** also includes one or more accelerometers **268**. FIG. **2**A shows accelerometer **268** coupled to peripherals interface **218**. Alternately, accelerometer **268** is coupled to an input controller **260** in I/O subsystem **206**. Accelerometer **268** performs, for example, as described in U.S. Patent Publication No. 20050190059, "Acceleration-based Theft Detection System for Portable Electronic Devices," and U.S. Patent Publication No. 20060017692, "Methods And Apparatuses For Operating A Portable Device Based On An Accelerometer," both of which are incorporated by reference herein in their entirety. In some embodiments, information is displayed on the touch screen display in a portrait view or a landscape view based on an analysis of data received from the one or more accelerometers. Device **200** optionally includes, in addition to accelerometer(s) **268**, a magnetometer (not shown) and a GPS (or GLONASS or other global navigation system) receiver (not shown) for obtaining information concerning the location and orientation (e.g., portrait or landscape) of device **200**.
(57) In some embodiments, the software components stored in memory **202** include operating system **226**, communication module (or set of instructions) **228**, contact/motion module (or set of instructions) **230**, graphics module (or set of instructions) **232**, text input module (or set of instructions) **234**, Global Positioning System (GPS) module (or set of instructions) **235**, Digital Assistant Client Module **229**, and applications (or sets of instructions) **236**. Further, memory **202** stores data and models, such as user data and models **231**. Furthermore, in some embodiments, memory **202** (FIG. **2**A) or **470** (FIG. **4**) stores device/global internal state **257**, as shown in FIGS. **2**A and **4**. Device/global internal state **257** includes one or more of: active application state, indicating which applications, if any, are currently active; display state, indicating what applications, views or other information occupy various regions of touch screen display **212**; sensor state, including information obtained from the device's various sensors and input control devices **216**; and location information concerning the device's location and/or attitude.
(58) Operating system **226** (e.g., Darwin, RTXC, LINUX, UNIX, OS X, IOS, WINDOWS, or an embedded operating system such as VxWorks) includes various software components and/or drivers for controlling and managing general system tasks (e.g., memory management, storage device control, power management, etc.) and facilitates communication between various hardware and software components.
(59) Communication module **228** facilitates communication with other devices over one or more external ports **224** and also includes various software components for handling data received by RF circuitry **208** and/or external port **224**. External port **224** (e.g., Universal Serial Bus (USB), FIREWIRE, etc.) is adapted for coupling directly to other devices or indirectly over a network (e.g., the Internet, wireless LAN, etc.). In some embodiments, the external port is a multi-pin (e.g., 30-pin) connector that is the same as, or similar to and/or compatible with, the 30-pin connector used on iPod® (trademark of Apple Inc.) devices.
(60) Contact/motion module **230** optionally detects contact with touch screen **212** (in conjunction with display controller **256**) and other touch-sensitive devices (e.g., a touchpad or physical click wheel). Contact/motion module **230** includes various software components for performing various operations related to detection of contact, such as determining if contact has occurred (e.g., detecting a finger-down event), determining an intensity of the contact (e.g., the force or pressure of the contact or a substitute for the force or pressure of the contact), determining if there is movement of the contact and tracking the movement across the touch-sensitive surface (e.g., detecting one or more finger-dragging events), and determining if the contact has ceased (e.g., detecting a finger-up event or a break in contact). Contact/motion module **230** receives contact data from the touch-sensitive surface. Determining movement of the point of contact, which is represented by a series of contact

data, optionally includes determining speed (magnitude), velocity (magnitude and direction), and/or an acceleration (a change in magnitude and/or direction) of the point of contact. These operations are, optionally, applied to single contacts (e.g., one finger contacts) or to multiple simultaneous contacts (e.g., “multitouch”/multiple finger contacts). In some embodiments, contact/motion module **230** and display controller **256** detect contact on a touchpad.

(61) In some embodiments, contact/motion module **230** uses a set of one or more intensity thresholds to determine whether an operation has been performed by a user (e.g., to determine whether a user has “clicked” on an icon). In some embodiments, at least a subset of the intensity thresholds are determined in accordance with software parameters (e.g., the intensity thresholds are not determined by the activation thresholds of particular physical actuators and can be adjusted without changing the physical hardware of device **200**). For example, a mouse “click” threshold of a trackpad or touch screen display can be set to any of a large range of predefined threshold values without changing the trackpad or touch screen display hardware. Additionally, in some implementations, a user of the device is provided with software settings for adjusting one or more of the set of intensity thresholds (e.g., by adjusting individual intensity thresholds and/or by adjusting a plurality of intensity thresholds at once with a system-level click “intensity” parameter).

(62) Contact/motion module **230** optionally detects a gesture input by a user. Different gestures on the touch-sensitive surface have different contact patterns (e.g., different motions, timings, and/or intensities of detected contacts). Thus, a gesture is, optionally, detected by detecting a particular contact pattern. For example, detecting a finger tap gesture includes detecting a finger-down event followed by detecting a finger-up (liftoff) event at the same position (or substantially the same position) as the finger-down event (e.g., at the position of an icon). As another example, detecting a finger swipe gesture on the touch-sensitive surface includes detecting a finger-down event followed by detecting one or more finger-dragging events, and subsequently followed by detecting a finger-up (liftoff) event.

(63) Graphics module **232** includes various known software components for rendering and displaying graphics on touch screen **212** or other display, including components for changing the visual impact (e.g., brightness, transparency, saturation, contrast, or other visual property) of graphics that are displayed. As used herein, the term “graphics” includes any object that can be displayed to a user, including, without limitation, text, web pages, icons (such as user-interface objects including soft keys), digital images, videos, animations, and the like.

(64) In some embodiments, graphics module **232** stores data representing graphics to be used. Each graphic is, optionally, assigned a corresponding code. Graphics module **232** receives, from applications etc., one or more codes specifying graphics to be displayed along with, if necessary, coordinate data and other graphic property data, and then generates screen image data to output to display controller **256**.

(65) Haptic feedback module **233** includes various software components for generating instructions used by tactile output generator(s) **267** to produce tactile outputs at one or more locations on device **200** in response to user interactions with device **200**.

(66) Text input module **234**, which is, in some examples, a component of graphics module **232**, provides soft keyboards for entering text in various applications (e.g., contacts module **237**, email client module **240**, IM module **241**, browser module **247**, and any other application that needs text input).

(67) GPS module **235** determines the location of the device and provides this information for use in various applications (e.g., to telephone module **238** for use in location-based dialing; to camera module **243** as picture/video metadata; and to applications that provide location-based services such as weather widgets, local yellow page widgets, and map/navigation widgets).

(68) Digital assistant client module **229** includes various client-side digital assistant instructions to provide the client-side functionalities of the digital assistant. For example, digital assistant client module **229** is capable of accepting voice input (e.g., speech input), text input, touch input, and/or gestural input through various user interfaces (e.g., microphone **213**, accelerometer(s) **268**, touch-sensitive display system **212**, optical sensor(s) **264**, other input control devices **216**, etc.) of portable multifunction device **200**. Digital assistant client module **229** is also capable of providing output in audio (e.g., speech output), visual, and/or tactile forms through various output interfaces (e.g., speaker **211**, touch-sensitive display system **212**, tactile output generator(s) **267**, etc.) of portable multifunction device **200**. For example, output is provided as voice, sound, alerts, text messages, menus, graphics, videos, animations, vibrations, and/or combinations of two or more of the above. During operation, digital assistant client module **229** communicates with DA server **106** using RF circuitry **208**.

(69) User data and models **231** include various data associated with the user (e.g., user-specific vocabulary data, user preference data, user-specified name pronunciations, data from the user's electronic address book, to-do lists, shopping lists, etc.) to provide the client-side functionalities of the digital assistant. Further, user data and models **231** include various models (e.g., speech recognition models, statistical language models, natural language processing models, ontology, task flow models, service models, etc.) for processing user input and determining user intent.

(70) In some examples, digital assistant client module **229** utilizes the various sensors, subsystems, and peripheral devices of portable multifunction device **200** to gather additional information from the surrounding environment of the portable multifunction device **200** to establish a context associated with a user, the current user interaction, and/or the current user input. In some examples, digital assistant client module **229** provides the contextual information or a subset thereof with the user input to DA server **106** to help infer the user's intent. In some examples, the digital assistant also uses the contextual information to determine how to prepare and deliver outputs to the user. Contextual information is referred to as context data.

(71) In some examples, the contextual information that accompanies the user input includes sensor information, e.g., lighting, ambient noise, ambient temperature, images or videos of the surrounding environment, etc. In some examples, the contextual information can also include the physical state of the device, e.g., device orientation, device location, device temperature, power level, speed, acceleration, motion patterns, cellular signals strength, etc. In some examples, information

related to the software state of DA server **106**, e.g., running processes, installed programs, past and present network activities, background services, error logs, resources usage, etc., and of portable multifunction device **200** is provided to DA server **106** as contextual information associated with a user input.

(72) In some examples, the digital assistant client module **229** selectively provides information (e.g., user data **231**) stored on the portable multifunction device **200** in response to requests from DA server **106**. In some examples, digital assistant client module **229** also elicits additional input from the user via a natural language dialogue or other user interfaces upon request by DA server **106**. Digital assistant client module **229** passes the additional input to DA server **106** to help DA server **106** in intent deduction and/or fulfillment of the user's intent expressed in the user request.

(73) A more detailed description of a digital assistant is described below with reference to FIGS. **7**A-C. It should be recognized that digital assistant client module **229** can include any number of the sub-modules of digital assistant module **726** described below.

(74) Applications **236** include the following modules (or sets of instructions), or a subset or superset thereof: Contacts module **237** (sometimes called an address book or contact list); Telephone module **238**; Video conference module **239**; E-mail client module **240**; Instant messaging (IM) module **241**; Workout support module **242**; Camera module **243** for still and/or video images; Image management module **244**; Video player module; Music player module; Browser module **247**; Calendar module **248**; Widget modules **249**, which includes, in some examples, one or more of: weather widget **249-1**, stocks widget **249-2**, calculator widget **249-3**, alarm clock widget **249-4**, dictionary widget **249-5**, and other widgets obtained by the user, as well as user-created widgets **249-6**; Widget creator module **250** for making user-created widgets **249-6**; Search module **251**; Video and music player module **252**, which merges video player module and music player module; Notes module **253**; Map module **254**; and/or Online video module **255**.

(75) Examples of other applications **236** that are stored in memory **202** include other word processing applications, other image editing applications, drawing applications, presentation applications, JAVA-enabled applications, encryption, digital rights management, voice recognition, and voice replication.

(76) In conjunction with touch screen **212**, display controller **256**, contact/motion module **230**, graphics module **232**, and text input module **234**, contacts module **237** are used to manage an address book or contact list (e.g., stored in application internal state **292** of contacts module **237** in memory **202** or memory **470**), including: adding name(s) to the address book; deleting name(s) from the address book; associating telephone number(s), e-mail address(es), physical address(es) or other information with a name; associating an image with a name; categorizing and sorting names; providing telephone numbers or e-mail addresses to initiate and/or facilitate communications by telephone module **238**, video conference module **239**, e-mail client module **240**, or IM module **241**; and so forth.

(77) In conjunction with RF circuitry **208**, audio circuitry **210**, speaker **211**, microphone **213**, touch screen **212**, display controller **256**, contact/motion module **230**, graphics module **232**, and text input module **234**, telephone module **238** are used to enter a sequence of characters corresponding to a telephone number, access one or more telephone numbers in contacts module **237**, modify a telephone number that has been entered, dial a respective telephone number, conduct a conversation, and disconnect or hang up when the conversation is completed. As noted above, the wireless communication uses any of a plurality of communications standards, protocols, and technologies.

(78) In conjunction with RF circuitry **208**, audio circuitry **210**, speaker **211**, microphone **213**, touch screen **212**, display controller **256**, optical sensor **264**, optical sensor controller **258**, contact/motion module **230**, graphics module **232**, text input module **234**, contacts module **237**, and telephone module **238**, video conference module **239** includes executable instructions to initiate, conduct, and terminate a video conference between a user and one or more other participants in accordance with user instructions.

(79) In conjunction with RF circuitry **208**, touch screen **212**, display controller **256**, contact/motion module **230**, graphics module **232**, and text input module **234**, e-mail client module **240** includes executable instructions to create, send, receive, and manage e-mail in response to user instructions. In conjunction with image management module **244**, e-mail client module **240** makes it very easy to create and send e-mails with still or video images taken with camera module **243**.

(80) In conjunction with RF circuitry **208**, touch screen **212**, display controller **256**, contact/motion module **230**, graphics module **232**, and text input module **234**, the instant messaging module **241** includes executable instructions to enter a sequence of characters corresponding to an instant message, to modify previously entered characters, to transmit a respective instant message (for example, using a Short Message Service (SMS) or Multimedia Message Service (MMS) protocol for telephony-based instant messages or using XMPP, SIMPLE, or IMPS for Internet-based instant messages), to receive instant messages, and to view received instant messages. In some embodiments, transmitted and/or received instant messages include graphics, photos, audio files, video files and/or other attachments as are supported in an MMS and/or an Enhanced Messaging Service (EMS). As used herein, “instant messaging” refers to both telephony-based messages (e.g., messages sent using SMS or MMS) and Internet-based messages (e.g., messages sent using XMPP, SIMPLE, or IMPS).

(81) In conjunction with RF circuitry **208**, touch screen **212**, display controller **256**, contact/motion module **230**, graphics module **232**, text input module **234**, GPS module **235**, map module **254**, and music player module, workout support module **242** includes executable instructions to create workouts (e.g., with time, distance, and/or calorie burning goals); communicate with workout sensors (sports devices); receive workout sensor data; calibrate sensors used to monitor a workout; select and play music for a workout; and display, store, and transmit workout data.

(82) In conjunction with touch screen **212**, display controller **256**, optical sensor(s) **264**, optical sensor controller **258**, contact/motion module **230**, graphics module **232**, and image management module **244**, camera module **243** includes executable instructions to capture still images or video (including a video stream) and store them into memory **202**, modify characteristics of a still image or video, or delete a still image or video from memory **202**.

(83) In conjunction with touch screen **212**, display controller **256**, contact/motion module **230**, graphics module **232**, text input module **234**, and camera module **243**, image management module **244** includes executable instructions to arrange, modify (e.g., edit), or otherwise manipulate, label, delete, present (e.g., in a digital slide show or album), and store still and/or video images.
(84) In conjunction with RF circuitry **208**, touch screen **212**, display controller **256**, contact/motion module **230**, graphics module **232**, and text input module **234**, browser module **247** includes executable instructions to browse the Internet in accordance with user instructions, including searching, linking to, receiving, and displaying web pages or portions thereof, as well as attachments and other files linked to web pages.
(85) In conjunction with RF circuitry **208**, touch screen **212**, display controller **256**, contact/motion module **230**, graphics module **232**, text input module **234**, e-mail client module **240**, and browser module **247**, calendar module **248** includes executable instructions to create, display, modify, and store calendars and data associated with calendars (e.g., calendar entries, to-do lists, etc.) in accordance with user instructions.
(86) In conjunction with RF circuitry **208**, touch screen **212**, display controller **256**, contact/motion module **230**, graphics module **232**, text input module **234**, and browser module **247**, widget modules **249** are mini-applications that can be downloaded and used by a user (e.g., weather widget **249-1**, stocks widget **249-2**, calculator widget **249-3**, alarm clock widget **249-4**, and dictionary widget **249-5**) or created by the user (e.g., user-created widget **249-6**). In some embodiments, a widget includes an HTML (Hypertext Markup Language) file, a CSS (Cascading Style Sheets) file, and a JavaScript file. In some embodiments, a widget includes an XML (Extensible Markup Language) file and a JavaScript file (e.g., Yahoo! Widgets).
(87) In conjunction with RF circuitry **208**, touch screen **212**, display controller **256**, contact/motion module **230**, graphics module **232**, text input module **234**, and browser module **247**, the widget creator module **250** are used by a user to create widgets (e.g., turning a user-specified portion of a web page into a widget).
(88) In conjunction with touch screen **212**, display controller **256**, contact/motion module **230**, graphics module **232**, and text input module **234**, search module **251** includes executable instructions to search for text, music, sound, image, video, and/or other files in memory **202** that match one or more search criteria (e.g., one or more user-specified search terms) in accordance with user instructions.
(89) In conjunction with touch screen **212**, display controller **256**, contact/motion module **230**, graphics module **232**, audio circuitry **210**, speaker **211**, RF circuitry **208**, and browser module **247**, video and music player module **252** includes executable instructions that allow the user to download and play back recorded music and other sound files stored in one or more file formats, such as MP3 or AAC files, and executable instructions to display, present, or otherwise play back videos (e.g., on touch screen **212** or on an external, connected display via external port **224**). In some embodiments, device **200** optionally includes the functionality of an MP3 player, such as an iPod (trademark of Apple Inc.).
(90) In conjunction with touch screen **212**, display controller **256**, contact/motion module **230**, graphics module **232**, and text input module **234**, notes module **253** includes executable instructions to create and manage notes, to-do lists, and the like in accordance with user instructions.
(91) In conjunction with RF circuitry **208**, touch screen **212**, display controller **256**, contact/motion module **230**, graphics module **232**, text input module **234**, GPS module **235**, and browser module **247**, map module **254** are used to receive, display, modify, and store maps and data associated with maps (e.g., driving directions, data on stores and other points of interest at or near a particular location, and other location-based data) in accordance with user instructions.
(92) In conjunction with touch screen **212**, display controller **256**, contact/motion module **230**, graphics module **232**, audio circuitry **210**, speaker **211**, RF circuitry **208**, text input module **234**, e-mail client module **240**, and browser module **247**, online video module **255** includes instructions that allow the user to access, browse, receive (e.g., by streaming and/or download), play back (e.g., on the touch screen or on an external, connected display via external port **224**), send an e-mail with a link to a particular online video, and otherwise manage online videos in one or more file formats, such as H.264. In some embodiments, instant messaging module **241**, rather than e-mail client module **240**, is used to send a link to a particular online video. Additional description of the online video application can be found in U.S. Provisional Patent Application No. 60/936,562, “Portable Multifunction Device, Method, and Graphical User Interface for Playing Online Videos,” filed Jun. 20, 2007, and U.S. patent application Ser. No. 11/968,067, “Portable Multifunction Device, Method, and Graphical User Interface for Playing Online Videos,” filed Dec. 31, 2007, the contents of which are hereby incorporated by reference in their entirety.
(93) Each of the above-identified modules and applications corresponds to a set of executable instructions for performing one or more functions described above and the methods described in this application (e.g., the computer-implemented methods and other information processing methods described herein). These modules (e.g., sets of instructions) need not be implemented as separate software programs, procedures, or modules, and thus various subsets of these modules can be combined or otherwise rearranged in various embodiments. For example, video player module can be combined with music player module into a single module (e.g., video and music player module **252**, FIG. **2**A). In some embodiments, memory **202** stores a subset of the modules and data structures identified above. Furthermore, memory **202** stores additional modules and data structures not described above.
(94) In some embodiments, device **200** is a device where operation of a predefined set of functions on the device is performed exclusively through a touch screen and/or a touchpad. By using a touch screen and/or a touchpad as the primary input control device for operation of device **200**, the number of physical input control devices (such as push buttons, dials, and the like) on device **200** is reduced.
(95) The predefined set of functions that are performed exclusively through a touch screen and/or a touchpad optionally

include navigation between user interfaces. In some embodiments, the touchpad, when touched by the user, navigates device **200** to a main, home, or root menu from any user interface that is displayed on device **200**. In such embodiments, a “menu button” is implemented using a touchpad. In some other embodiments, the menu button is a physical push button or other physical input control device instead of a touchpad.

(96) FIG. **2**B is a block diagram illustrating exemplary components for event handling in accordance with some embodiments. In some embodiments, memory **202** (FIG. **2**A) or **470** (FIG. **4**) includes event sorter **270** (e.g., in operating system **226**) and a respective application **236-1** (e.g., any of the aforementioned applications **237-251**, **255**, **480-490**).

(97) Event sorter **270** receives event information and determines the application **236-1** and application view **291** of application **236-1** to which to deliver the event information. Event sorter **270** includes event monitor **271** and event dispatcher module **274**. In some embodiments, application **236-1** includes application internal state **292**, which indicates the current application view(s) displayed on touch-sensitive display **212** when the application is active or executing. In some embodiments, device/global internal state **257** is used by event sorter **270** to determine which application(s) is (are) currently active, and application internal state **292** is used by event sorter **270** to determine application views **291** to which to deliver event information.

(98) In some embodiments, application internal state **292** includes additional information, such as one or more of: resume information to be used when application **236-1** resumes execution, user interface state information that indicates information being displayed or that is ready for display by application **236-1**, a state queue for enabling the user to go back to a prior state or view of application **236-1**, and a redo/undo queue of previous actions taken by the user.

(99) Event monitor **271** receives event information from peripherals interface **218**. Event information includes information about a sub-event (e.g., a user touch on touch-sensitive display **212**, as part of a multi-touch gesture). Peripherals interface **218** transmits information it receives from I/O subsystem **206** or a sensor, such as proximity sensor **266**, accelerometer(s) **268**, and/or microphone **213** (through audio circuitry **210**). Information that peripherals interface **218** receives from I/O subsystem **206** includes information from touch-sensitive display **212** or a touch-sensitive surface.

(100) In some embodiments, event monitor **271** sends requests to the peripherals interface **218** at predetermined intervals. In response, peripherals interface **218** transmits event information. In other embodiments, peripherals interface **218** transmits event information only when there is a significant event (e.g., receiving an input above a predetermined noise threshold and/or for more than a predetermined duration).

(101) In some embodiments, event sorter **270** also includes a hit view determination module **272** and/or an active event recognizer determination module **273**.

(102) Hit view determination module **272** provides software procedures for determining where a sub-event has taken place within one or more views when touch-sensitive display **212** displays more than one view. Views are made up of controls and other elements that a user can see on the display.

(103) Another aspect of the user interface associated with an application is a set of views, sometimes herein called application views or user interface windows, in which information is displayed and touch-based gestures occur. The application views (of a respective application) in which a touch is detected correspond to programmatic levels within a programmatic or view hierarchy of the application. For example, the lowest level view in which a touch is detected is called the hit view, and the set of events that are recognized as proper inputs is determined based, at least in part, on the hit view of the initial touch that begins a touch-based gesture.

(104) Hit view determination module **272** receives information related to sub events of a touch-based gesture. When an application has multiple views organized in a hierarchy, hit view determination module **272** identifies a hit view as the lowest view in the hierarchy which should handle the sub-event. In most circumstances, the hit view is the lowest level view in which an initiating sub-event occurs (e.g., the first sub-event in the sequence of sub-events that form an event or potential event). Once the hit view is identified by the hit view determination module **272**, the hit view typically receives all sub-events related to the same touch or input source for which it was identified as the hit view.

(105) Active event recognizer determination module **273** determines which view or views within a view hierarchy should receive a particular sequence of sub-events. In some embodiments, active event recognizer determination module **273** determines that only the hit view should receive a particular sequence of sub-events. In other embodiments, active event recognizer determination module **273** determines that all views that include the physical location of a sub-event are actively involved views, and therefore determines that all actively involved views should receive a particular sequence of sub-events. In other embodiments, even if touch sub-events were entirely confined to the area associated with one particular view, views higher in the hierarchy would still remain as actively involved views.

(106) Event dispatcher module **274** dispatches the event information to an event recognizer (e.g., event recognizer **280**). In embodiments including active event recognizer determination module **273**, event dispatcher module **274** delivers the event information to an event recognizer determined by active event recognizer determination module **273**. In some embodiments, event dispatcher module **274** stores in an event queue the event information, which is retrieved by a respective event receiver **282**.

(107) In some embodiments, operating system **226** includes event sorter **270**. Alternatively, application **236-1** includes event sorter **270**. In yet other embodiments, event sorter **270** is a stand-alone module, or a part of another module stored in memory **202**, such as contact/motion module **230**.

(108) In some embodiments, application **236-1** includes a plurality of event handlers **290** and one or more application views **291**, each of which includes instructions for handling touch events that occur within a respective view of the application's user interface. Each application view **291** of the application **236-1** includes one or more event recognizers **280**. Typically, a respective application view **291** includes a plurality of event recognizers **280**. In other embodiments, one or more of event

recognizers **280** are part of a separate module, such as a user interface kit (not shown) or a higher level object from which application **236-1** inherits methods and other properties. In some embodiments, a respective event handler **290** includes one or more of: data updater **276**, object updater **277**, GUI updater **278**, and/or event data **279** received from event sorter **270**. Event handler **290** utilizes or calls data updater **276**, object updater **277**, or GUI updater **278** to update the application internal state **292**. Alternatively, one or more of the application views **291** include one or more respective event handlers **290**. Also, in some embodiments, one or more of data updater **276**, object updater **277**, and GUI updater **278** are included in a respective application view **291**.
(109) A respective event recognizer **280** receives event information (e.g., event data **279**) from event sorter **270** and identifies an event from the event information. Event recognizer **280** includes event receiver **282** and event comparator **284**. In some embodiments, event recognizer **280** also includes at least a subset of: metadata **283**, and event delivery instructions **288** (which include sub-event delivery instructions).
(110) Event receiver **282** receives event information from event sorter **270**. The event information includes information about a sub-event, for example, a touch or a touch movement. Depending on the sub-event, the event information also includes additional information, such as location of the sub-event. When the sub-event concerns motion of a touch, the event information also includes speed and direction of the sub-event. In some embodiments, events include rotation of the device from one orientation to another (e.g., from a portrait orientation to a landscape orientation, or vice versa), and the event information includes corresponding information about the current orientation (also called device attitude) of the device.
(111) Event comparator **284** compares the event information to predefined event or sub-event definitions and, based on the comparison, determines an event or sub event, or determines or updates the state of an event or sub-event. In some embodiments, event comparator **284** includes event definitions **286**. Event definitions **286** contain definitions of events (e.g., predefined sequences of sub-events), for example, event **1** (**287-1**), event **2** (**287-2**), and others. In some embodiments, sub-events in an event (**287**) include, for example, touch begin, touch end, touch movement, touch cancellation, and multiple touching. In one example, the definition for event **1** (**287-1**) is a double tap on a displayed object. The double tap, for example, comprises a first touch (touch begin) on the displayed object for a predetermined phase, a first liftoff (touch end) for a predetermined phase, a second touch (touch begin) on the displayed object for a predetermined phase, and a second liftoff (touch end) for a predetermined phase. In another example, the definition for event **2** (**287-2**) is a dragging on a displayed object. The dragging, for example, comprises a touch (or contact) on the displayed object for a predetermined phase, a movement of the touch across touch-sensitive display **212**, and liftoff of the touch (touch end). In some embodiments, the event also includes information for one or more associated event handlers **290**.
(112) In some embodiments, event definition **287** includes a definition of an event for a respective user-interface object. In some embodiments, event comparator **284** performs a hit test to determine which user-interface object is associated with a sub-event. For example, in an application view in which three user-interface objects are displayed on touch-sensitive display **212**, when a touch is detected on touch-sensitive display **212**, event comparator **284** performs a hit test to determine which of the three user-interface objects is associated with the touch (sub-event). If each displayed object is associated with a respective event handler **290**, the event comparator uses the result of the hit test to determine which event handler **290** should be activated. For example, event comparator **284** selects an event handler associated with the sub-event and the object triggering the hit test.
(113) In some embodiments, the definition for a respective event (**287**) also includes delayed actions that delay delivery of the event information until after it has been determined whether the sequence of sub-events does or does not correspond to the event recognizer's event type.
(114) When a respective event recognizer **280** determines that the series of sub-events do not match any of the events in event definitions **286**, the respective event recognizer **280** enters an event impossible, event failed, or event ended state, after which it disregards subsequent sub-events of the touch-based gesture. In this situation, other event recognizers, if any, that remain active for the hit view continue to track and process sub-events of an ongoing touch-based gesture.
(115) In some embodiments, a respective event recognizer **280** includes metadata **283** with configurable properties, flags, and/or lists that indicate how the event delivery system should perform sub-event delivery to actively involved event recognizers. In some embodiments, metadata **283** includes configurable properties, flags, and/or lists that indicate how event recognizers interact, or are enabled to interact, with one another. In some embodiments, metadata **283** includes configurable properties, flags, and/or lists that indicate whether sub-events are delivered to varying levels in the view or programmatic hierarchy.
(116) In some embodiments, a respective event recognizer **280** activates event handler **290** associated with an event when one or more particular sub-events of an event are recognized. In some embodiments, a respective event recognizer **280** delivers event information associated with the event to event handler **290**. Activating an event handler **290** is distinct from sending (and deferred sending) sub-events to a respective hit view. In some embodiments, event recognizer **280** throws a flag associated with the recognized event, and event handler **290** associated with the flag catches the flag and performs a predefined process.
(117) In some embodiments, event delivery instructions **288** include sub-event delivery instructions that deliver event information about a sub-event without activating an event handler. Instead, the sub-event delivery instructions deliver event information to event handlers associated with the series of sub-events or to actively involved views. Event handlers associated with the series of sub-events or with actively involved views receive the event information and perform a predetermined process.
(118) In some embodiments, data updater **276** creates and updates data used in application **236-1**. For example, data updater **276** updates the telephone number used in contacts module **237**, or stores a video file used in video player module. In some

embodiments, object updater **277** creates and updates objects used in application **236-1**. For example, object updater **277** creates a new user-interface object or updates the position of a user-interface object. GUI updater **278** updates the GUI. For example, GUI updater **278** prepares display information and sends it to graphics module **232** for display on a touch-sensitive display.

(119) In some embodiments, event handler(s) **290** includes or has access to data updater **276**, object updater **277**, and GUI updater **278**. In some embodiments, data updater **276**, object updater **277**, and GUI updater **278** are included in a single module of a respective application **236-1** or application view **291**. In other embodiments, they are included in two or more software modules.

(120) It shall be understood that the foregoing discussion regarding event handling of user touches on touch-sensitive displays also applies to other forms of user inputs to operate multifunction devices **200** with input devices, not all of which are initiated on touch screens. For example, mouse movement and mouse button presses, optionally coordinated with single or multiple keyboard presses or holds; contact movements such as taps, drags, scrolls, etc. on touchpads; pen stylus inputs; movement of the device; oral instructions; detected eye movements; biometric inputs; and/or any combination thereof are optionally utilized as inputs corresponding to sub-events which define an event to be recognized.

(121) FIG. **3** illustrates a portable multifunction device **200** having a touch screen **212** in accordance with some embodiments. The touch screen optionally displays one or more graphics within user interface (UI) **300**. In this embodiment, as well as others described below, a user is enabled to select one or more of the graphics by making a gesture on the graphics, for example, with one or more fingers **302** (not drawn to scale in the figure) or one or more styluses **303** (not drawn to scale in the figure). In some embodiments, selection of one or more graphics occurs when the user breaks contact with the one or more graphics. In some embodiments, the gesture optionally includes one or more taps, one or more swipes (from left to right, right to left, upward and/or downward), and/or a rolling of a finger (from right to left, left to right, upward and/or downward) that has made contact with device **200**. In some implementations or circumstances, inadvertent contact with a graphic does not select the graphic. For example, a swipe gesture that sweeps over an application icon optionally does not select the corresponding application when the gesture corresponding to selection is a tap.

(122) Device **200** also includes one or more physical buttons, such as “home” or menu button **304**. As described previously, menu button **304** is used to navigate to any application **236** in a set of applications that is executed on device **200**. Alternatively, in some embodiments, the menu button is implemented as a soft key in a GUI displayed on touch screen **212**.

(123) In one embodiment, device **200** includes touch screen **212**, menu button **304**, push button **306** for powering the device on/off and locking the device, volume adjustment button(s) **308**, subscriber identity module (SIM) card slot **310**, headset jack **312**, and docking/charging external port **224**. Push button **306** is, optionally, used to turn the power on/off on the device by depressing the button and holding the button in the depressed state for a predefined time interval; to lock the device by depressing the button and releasing the button before the predefined time interval has elapsed; and/or to unlock the device or initiate an unlock process. In an alternative embodiment, device **200** also accepts verbal input for activation or deactivation of some functions through microphone **213**. Device **200** also, optionally, includes one or more contact intensity sensors **265** for detecting intensity of contacts on touch screen **212** and/or one or more tactile output generators **267** for generating tactile outputs for a user of device **200**.

(124) FIG. **4** is a block diagram of an exemplary multifunction device with a display and a touch-sensitive surface in accordance with some embodiments. Device **400** need not be portable. In some embodiments, device **400** is a laptop computer, a desktop computer, a tablet computer, a multimedia player device, a navigation device, an educational device (such as a child's learning toy), a gaming system, or a control device (e.g., a home or industrial controller). Device **400** typically includes one or more processing units (CPUs) **410**, one or more network or other communications interfaces **460**, memory **470**, and one or more communication buses **420** for interconnecting these components. Communication buses **420** optionally include circuitry (sometimes called a chipset) that interconnects and controls communications between system components. Device **400** includes input/output (I/O) interface **430** comprising display **440**, which is typically a touch screen display. I/O interface **430** also optionally includes a keyboard and/or mouse (or other pointing device) **450** and touchpad **455**, tactile output generator **457** for generating tactile outputs on device **400** (e.g., similar to tactile output generator(s) **267** described above with reference to FIG. **2**A), sensors **459** (e.g., optical, acceleration, proximity, touch-sensitive, and/or contact intensity sensors similar to contact intensity sensor(s) **265** described above with reference to FIG. **2**A). Memory **470** includes high-speed random access memory, such as DRAM, SRAM, DDR RAM, or other random access solid state memory devices; and optionally includes non-volatile memory, such as one or more magnetic disk storage devices, optical disk storage devices, flash memory devices, or other non-volatile solid state storage devices. Memory **470** optionally includes one or more storage devices remotely located from CPU(s) **410**. In some embodiments, memory **470** stores programs, modules, and data structures analogous to the programs, modules, and data structures stored in memory **202** of portable multifunction device **200** (FIG. **2**A), or a subset thereof. Furthermore, memory **470** optionally stores additional programs, modules, and data structures not present in memory **202** of portable multifunction device **200**. For example, memory **470** of device **400** optionally stores drawing module **480**, presentation module **482**, word processing module **484**, website creation module **486**, disk authoring module **488**, and/or spreadsheet module **490**, while memory **202** of portable multifunction device **200** (FIG. **2**A) optionally does not store these modules.

(125) Each of the above-identified elements in FIG. **4** is, in some examples, stored in one or more of the previously mentioned memory devices. Each of the above-identified modules corresponds to a set of instructions for performing a function described above. The above-identified modules or programs (e.g., sets of instructions) need not be implemented as separate software programs, procedures, or modules, and thus various subsets of these modules are combined or otherwise rearranged in various embodiments. In some embodiments, memory **470** stores a subset of the modules and data structures

identified above. Furthermore, memory **470** stores additional modules and data structures not described above.
(126) Attention is now directed towards embodiments of user interfaces that can be implemented on, for example, portable multifunction device **200**.
(127) FIG. **5**A illustrates an exemplary user interface for a menu of applications on portable multifunction device **200** in accordance with some embodiments. Similar user interfaces are implemented on device **400**. In some embodiments, user interface **500** includes the following elements, or a subset or superset thereof:
(128) Signal strength indicator(s) **502** for wireless communication(s), such as cellular and Wi-Fi signals; Time **504**; Bluetooth indicator **505**; Battery status indicator **506**; Tray **508** with icons for frequently used applications, such as: Icon **516** for telephone module **238**, labeled “Phone,” which optionally includes an indicator **514** of the number of missed calls or voicemail messages; Icon **518** for e-mail client module **240**, labeled “Mail,” which optionally includes an indicator **510** of the number of unread e-mails; Icon **520** for browser module **247**, labeled “Browser;” and Icon **522** for video and music player module **252**, also referred to as iPod (trademark of Apple Inc.) module **252**, labeled “iPod;” and Icons for other applications, such as: Icon **524** for IM module **241**, labeled “Messages;” Icon **526** for calendar module **248**, labeled “Calendar;” Icon **528** for image management module **244**, labeled “Photos;” Icon **530** for camera module **243**, labeled “Camera;” Icon **532** for online video module **255**, labeled “Online Video;” Icon **534** for stocks widget **249-2**, labeled “Stocks;” Icon **536** for map module **254**, labeled “Maps;” Icon **538** for weather widget **249-1**, labeled “Weather;” Icon **540** for alarm clock widget **249-4**, labeled “Clock;” Icon **542** for workout support module **242**, labeled “Workout Support;” Icon **544** for notes module **253**, labeled “Notes;” and Icon **546** for a settings application or module, labeled “Settings,” which provides access to settings for device **200** and its various applications **236**.
(129) It should be noted that the icon labels illustrated in FIG. **5**A are merely exemplary. For example, icon **522** for video and music player module **252** is optionally labeled “Music” or “Music Player.” Other labels are, optionally, used for various application icons. In some embodiments, a label for a respective application icon includes a name of an application corresponding to the respective application icon. In some embodiments, a label for a particular application icon is distinct from a name of an application corresponding to the particular application icon.
(130) FIG. **5**B illustrates an exemplary user interface on a device (e.g., device **400**, FIG. **4**) with a touch-sensitive surface **551** (e.g., a tablet or touchpad **455**, FIG. **4**) that is separate from the display **550** (e.g., touch screen display **212**). Device **400** also, optionally, includes one or more contact intensity sensors (e.g., one or more of sensors **457**) for detecting intensity of contacts on touch-sensitive surface **551** and/or one or more tactile output generators **459** for generating tactile outputs for a user of device **400**.
(131) Although some of the examples which follow will be given with reference to inputs on touch screen display **212** (where the touch-sensitive surface and the display are combined), in some embodiments, the device detects inputs on a touch-sensitive surface that is separate from the display, as shown in FIG. **5**B. In some embodiments, the touch-sensitive surface (e.g., **551** in FIG. **5**B) has a primary axis (e.g., **552** in FIG. **5**B) that corresponds to a primary axis (e.g., **553** in FIG. **5**B) on the display (e.g., **550**). In accordance with these embodiments, the device detects contacts (e.g., **560** and **562** in FIG. **5**B) with the touch-sensitive surface **551** at locations that correspond to respective locations on the display (e.g., in FIG. **5**B, contact **560** corresponds to **568** and contact **562** corresponds to **570**). In this way, user inputs (e.g., contacts **560** and **562**, and movements thereof) detected by the device on the touch-sensitive surface (e.g., **551** in FIG. **5**B) are used by the device to manipulate the user interface on the display (e.g., **550** in FIG. **5**B) of the multifunction device when the touch-sensitive surface is separate from the display. It should be understood that similar methods are, optionally, used for other user interfaces described herein.
(132) Additionally, while the following examples are given primarily with reference to finger inputs (e.g., finger contacts, finger tap gestures, finger swipe gestures), it should be understood that, in some embodiments, one or more of the finger inputs are replaced with input from another input device (e.g., a mouse-based input or stylus input). For example, a swipe gesture is, optionally, replaced with a mouse click (e.g., instead of a contact) followed by movement of the cursor along the path of the swipe (e.g., instead of movement of the contact). As another example, a tap gesture is, optionally, replaced with a mouse click while the cursor is located over the location of the tap gesture (e.g., instead of detection of the contact followed by ceasing to detect the contact). Similarly, when multiple user inputs are simultaneously detected, it should be understood that multiple computer mice are, optionally, used simultaneously, or a mouse and finger contacts are, optionally, used simultaneously.
(133) FIG. **6**A illustrates exemplary personal electronic device **600**. Device **600** includes body **602**. In some embodiments, device **600** includes some or all of the features described with respect to devices **200** and **400** (e.g., FIGS. **2**A-**4**). In some embodiments, device **600** has touch-sensitive display screen **604**, hereafter touch screen **604**. Alternatively, or in addition to touch screen **604**, device **600** has a display and a touch-sensitive surface. As with devices **200** and **400**, in some embodiments, touch screen **604** (or the touch-sensitive surface) has one or more intensity sensors for detecting intensity of contacts (e.g., touches) being applied. The one or more intensity sensors of touch screen **604** (or the touch-sensitive surface) provide output data that represents the intensity of touches. The user interface of device **600** responds to touches based on their intensity, meaning that touches of different intensities can invoke different user interface operations on device **600**.
(134) Techniques for detecting and processing touch intensity are found, for example, in related applications: International Patent Application Serial No. PCT/US2013/040061, titled “Device, Method, and Graphical User Interface for Displaying User Interface Objects Corresponding to an Application,” filed May 8, 2013, and International Patent Application Serial No. PCT/US2013/069483, titled “Device, Method, and Graphical User Interface for Transitioning Between Touch Input to Display Output Relationships,” filed Nov. 11, 2013, each of which is hereby incorporated by reference in their entirety.
(135) In some embodiments, device **600** has one or more input mechanisms **606** and **608**. Input mechanisms **606** and **608**, if

included, are physical. Examples of physical input mechanisms include push buttons and rotatable mechanisms. In some embodiments, device **600** has one or more attachment mechanisms. Such attachment mechanisms, if included, can permit attachment of device **600** with, for example, hats, eyewear, earrings, necklaces, shirts, jackets, bracelets, watch straps, chains, trousers, belts, shoes, purses, backpacks, and so forth. These attachment mechanisms permit device **600** to be worn by a user.
(136) FIG. **6**B depicts exemplary personal electronic device **600**. In some embodiments, device **600** includes some or all of the components described with respect to FIGS. **2**A, **2**B, and **4**. Device **600** has bus **612** that operatively couples I/O section **614** with one or more computer processors **616** and memory **618**. I/O section **614** is connected to display **604**, which can have touch-sensitive component **622** and, optionally, touch-intensity sensitive component **624**. In addition, I/O section **614** is connected with communication unit **630** for receiving application and operating system data, using Wi-Fi, Bluetooth, near field communication (NFC), cellular, and/or other wireless communication techniques. Device **600** includes input mechanisms **606** and/or **608**. Input mechanism **606** is a rotatable input device or a depressible and rotatable input device, for example. Input mechanism **608** is a button, in some examples.
(137) Input mechanism **608** is a microphone, in some examples. Personal electronic device **600** includes, for example, various sensors, such as GPS sensor **632**, accelerometer **634**, directional sensor **640** (e.g., compass), gyroscope **636**, motion sensor **638**, and/or a combination thereof, all of which are operatively connected to I/O section **614**.
(138) Memory **618** of personal electronic device **600** is a non-transitory computer-readable storage medium, for storing computer-executable instructions, which, when executed by one or more computer processors **616**, for example, cause the computer processors to perform the techniques and processes described below. The computer-executable instructions, for example, are also stored and/or transported within any non-transitory computer-readable storage medium for use by or in connection with an instruction execution system, apparatus, or device, such as a computer-based system, processor-containing system, or other system that can fetch the instructions from the instruction execution system, apparatus, or device and execute the instructions. Personal electronic device **600** is not limited to the components and configuration of FIG. **6**B, but can include other or additional components in multiple configurations.
(139) As used here, the term “affordance” refers to a user-interactive graphical user interface object that is, for example, displayed on the display screen of devices **200**, **400**, **600**, and/or **800** (FIGS. **2**A, **4**, **6**A-B, and **8**A-D). For example, an image (e.g., icon), a button, and text (e.g., hyperlink) each constitutes an affordance.
(140) As used herein, the term “focus selector” refers to an input element that indicates a current part of a user interface with which a user is interacting. In some implementations that include a cursor or other location marker, the cursor acts as a “focus selector” so that when an input (e.g., a press input) is detected on a touch-sensitive surface (e.g., touchpad **455** in FIG. **4** or touch-sensitive surface **551** in FIG. **5**B) while the cursor is over a particular user interface element (e.g., a button, window, slider or other user interface element), the particular user interface element is adjusted in accordance with the detected input. In some implementations that include a touch screen display (e.g., touch-sensitive display system **212** in FIG. **2**A or touch screen **212** in FIG. **5**A) that enables direct interaction with user interface elements on the touch screen display, a detected contact on the touch screen acts as a “focus selector” so that when an input (e.g., a press input by the contact) is detected on the touch screen display at a location of a particular user interface element (e.g., a button, window, slider, or other user interface element), the particular user interface element is adjusted in accordance with the detected input. In some implementations, focus is moved from one region of a user interface to another region of the user interface without corresponding movement of a cursor or movement of a contact on a touch screen display (e.g., by using a tab key or arrow keys to move focus from one button to another button); in these implementations, the focus selector moves in accordance with movement of focus between different regions of the user interface. Without regard to the specific form taken by the focus selector, the focus selector is generally the user interface element (or contact on a touch screen display) that is controlled by the user so as to communicate the user's intended interaction with the user interface (e.g., by indicating, to the device, the element of the user interface with which the user is intending to interact). For example, the location of a focus selector (e.g., a cursor, a contact, or a selection box) over a respective button while a press input is detected on the touch-sensitive surface (e.g., a touchpad or touch screen) will indicate that the user is intending to activate the respective button (as opposed to other user interface elements shown on a display of the device).
(141) As used in the specification and claims, the term “characteristic intensity” of a contact refers to a characteristic of the contact based on one or more intensities of the contact. In some embodiments, the characteristic intensity is based on multiple intensity samples. The characteristic intensity is, optionally, based on a predefined number of intensity samples, or a set of intensity samples collected during a predetermined time period (e.g., 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10 seconds) relative to a predefined event (e.g., after detecting the contact, prior to detecting liftoff of the contact, before or after detecting a start of movement of the contact, prior to detecting an end of the contact, before or after detecting an increase in intensity of the contact, and/or before or after detecting a decrease in intensity of the contact). A characteristic intensity of a contact is, optionally based on one or more of: a maximum value of the intensities of the contact, a mean value of the intensities of the contact, an average value of the intensities of the contact, a top 10 percentile value of the intensities of the contact, a value at the half maximum of the intensities of the contact, a value at the 90 percent maximum of the intensities of the contact, or the like. In some embodiments, the duration of the contact is used in determining the characteristic intensity (e.g., when the characteristic intensity is an average of the intensity of the contact over time). In some embodiments, the characteristic intensity is compared to a set of one or more intensity thresholds to determine whether an operation has been performed by a user. For example, the set of one or more intensity thresholds includes a first intensity threshold and a second intensity threshold. In this example, a contact with a characteristic intensity that does not exceed the first threshold results in a first operation, a contact with a characteristic intensity that exceeds the first intensity threshold and does not exceed the second intensity threshold results in a second operation, and a contact with a characteristic intensity that exceeds the second

threshold results in a third operation. In some embodiments, a comparison between the characteristic intensity and one or more thresholds is used to determine whether or not to perform one or more operations (e.g., whether to perform a respective operation or forgo performing the respective operation) rather than being used to determine whether to perform a first operation or a second operation.

(142) In some embodiments, a portion of a gesture is identified for purposes of determining a characteristic intensity. For example, a touch-sensitive surface receives a continuous swipe contact transitioning from a start location and reaching an end location, at which point the intensity of the contact increases. In this example, the characteristic intensity of the contact at the end location is based on only a portion of the continuous swipe contact, and not the entire swipe contact (e.g., only the portion of the swipe contact at the end location). In some embodiments, a smoothing algorithm is applied to the intensities of the swipe contact prior to determining the characteristic intensity of the contact. For example, the smoothing algorithm optionally includes one or more of: an unweighted sliding-average smoothing algorithm, a triangular smoothing algorithm, a median filter smoothing algorithm, and/or an exponential smoothing algorithm. In some circumstances, these smoothing algorithms eliminate narrow spikes or dips in the intensities of the swipe contact for purposes of determining a characteristic intensity.

(143) The intensity of a contact on the touch-sensitive surface is characterized relative to one or more intensity thresholds, such as a contact-detection intensity threshold, a light press intensity threshold, a deep press intensity threshold, and/or one or more other intensity thresholds. In some embodiments, the light press intensity threshold corresponds to an intensity at which the device will perform operations typically associated with clicking a button of a physical mouse or a trackpad. In some embodiments, the deep press intensity threshold corresponds to an intensity at which the device will perform operations that are different from operations typically associated with clicking a button of a physical mouse or a trackpad. In some embodiments, when a contact is detected with a characteristic intensity below the light press intensity threshold (e.g., and above a nominal contact-detection intensity threshold below which the contact is no longer detected), the device will move a focus selector in accordance with movement of the contact on the touch-sensitive surface without performing an operation associated with the light press intensity threshold or the deep press intensity threshold. Generally, unless otherwise stated, these intensity thresholds are consistent between different sets of user interface figures.

(144) An increase of characteristic intensity of the contact from an intensity below the light press intensity threshold to an intensity between the light press intensity threshold and the deep press intensity threshold is sometimes referred to as a “light press” input. An increase of characteristic intensity of the contact from an intensity below the deep press intensity threshold to an intensity above the deep press intensity threshold is sometimes referred to as a “deep press” input. An increase of characteristic intensity of the contact from an intensity below the contact-detection intensity threshold to an intensity between the contact-detection intensity threshold and the light press intensity threshold is sometimes referred to as detecting the contact on the touch-surface. A decrease of characteristic intensity of the contact from an intensity above the contact-detection intensity threshold to an intensity below the contact-detection intensity threshold is sometimes referred to as detecting liftoff of the contact from the touch-surface. In some embodiments, the contact-detection intensity threshold is zero. In some embodiments, the contact-detection intensity threshold is greater than zero.

(145) In some embodiments described herein, one or more operations are performed in response to detecting a gesture that includes a respective press input or in response to detecting the respective press input performed with a respective contact (or a plurality of contacts), where the respective press input is detected based at least in part on detecting an increase in intensity of the contact (or plurality of contacts) above a press-input intensity threshold. In some embodiments, the respective operation is performed in response to detecting the increase in intensity of the respective contact above the press-input intensity threshold (e.g., a “down stroke” of the respective press input). In some embodiments, the press input includes an increase in intensity of the respective contact above the press-input intensity threshold and a subsequent decrease in intensity of the contact below the press-input intensity threshold, and the respective operation is performed in response to detecting the subsequent decrease in intensity of the respective contact below the press-input threshold (e.g., an “up stroke” of the respective press input).

(146) In some embodiments, the device employs intensity hysteresis to avoid accidental inputs sometimes termed “jitter,” where the device defines or selects a hysteresis intensity threshold with a predefined relationship to the press-input intensity threshold (e.g., the hysteresis intensity threshold is X intensity units lower than the press-input intensity threshold or the hysteresis intensity threshold is 75%, 90%, or some reasonable proportion of the press-input intensity threshold). Thus, in some embodiments, the press input includes an increase in intensity of the respective contact above the press-input intensity threshold and a subsequent decrease in intensity of the contact below the hysteresis intensity threshold that corresponds to the press-input intensity threshold, and the respective operation is performed in response to detecting the subsequent decrease in intensity of the respective contact below the hysteresis intensity threshold (e.g., an “up stroke” of the respective press input). Similarly, in some embodiments, the press input is detected only when the device detects an increase in intensity of the contact from an intensity at or below the hysteresis intensity threshold to an intensity at or above the press-input intensity threshold and, optionally, a subsequent decrease in intensity of the contact to an intensity at or below the hysteresis intensity, and the respective operation is performed in response to detecting the press input (e.g., the increase in intensity of the contact or the decrease in intensity of the contact, depending on the circumstances).

(147) For ease of explanation, the descriptions of operations performed in response to a press input associated with a press-input intensity threshold or in response to a gesture including the press input are, optionally, triggered in response to detecting either: an increase in intensity of a contact above the press-input intensity threshold, an increase in intensity of a contact from an intensity below the hysteresis intensity threshold to an intensity above the press-input intensity threshold, a decrease in intensity of the contact below the press-input intensity threshold, and/or a decrease in intensity of the contact

below the hysteresis intensity threshold corresponding to the press-input intensity threshold. Additionally, in examples where an operation is described as being performed in response to detecting a decrease in intensity of a contact below the press-input intensity threshold, the operation is, optionally, performed in response to detecting a decrease in intensity of the contact below a hysteresis intensity threshold corresponding to, and lower than, the press-input intensity threshold.
(148) 3. Digital Assistant System
(149) FIG. **7**A illustrates a block diagram of digital assistant system **700** in accordance with various examples. In some examples, digital assistant system **700** is implemented on a standalone computer system. In some examples, digital assistant system **700** is distributed across multiple computers. In some examples, some of the modules and functions of the digital assistant are divided into a server portion and a client portion, where the client portion resides on one or more user devices (e.g., devices **104**, **122**, **200**, **400**, **600**, or **800**) and communicates with the server portion (e.g., server system **108**) through one or more networks, e.g., as shown in FIG. **1**. In some examples, digital assistant system **700** is an implementation of server system **108** (and/or DA server **106**) shown in FIG. **1**. It should be noted that digital assistant system **700** is only one example of a digital assistant system, and that digital assistant system **700** can have more or fewer components than shown, can combine two or more components, or can have a different configuration or arrangement of the components. The various components shown in FIG. **7**A are implemented in hardware, software instructions for execution by one or more processors, firmware, including one or more signal processing and/or application specific integrated circuits, or a combination thereof.
(150) Digital assistant system **700** includes memory **702**, one or more processors **704**, input/output (I/O) interface **706**, and network communications interface **708**. These components can communicate with one another over one or more communication buses or signal lines **710**.
(151) In some examples, memory **702** includes a non-transitory computer-readable medium, such as high-speed random access memory and/or a non-volatile computer-readable storage medium (e.g., one or more magnetic disk storage devices, flash memory devices, or other non-volatile solid-state memory devices).
(152) In some examples, I/O interface **706** couples input/output devices **716** of digital assistant system **700**, such as displays, keyboards, touch screens, and microphones, to user interface module **722**. I/O interface **706**, in conjunction with user interface module **722**, receives user inputs (e.g., voice input, keyboard inputs, touch inputs, etc.) and processes them accordingly. In some examples, e.g., when the digital assistant is implemented on a standalone user device, digital assistant system **700** includes any of the components and I/O communication interfaces described with respect to devices **200**, **400**, **600**, or **800** in FIGS. **2**A, **4**, **6**A-B, and **8**A-D respectively. In some examples, digital assistant system **700** represents the server portion of a digital assistant implementation, and can interact with the user through a client-side portion residing on a user device (e.g., devices **104**, **200**, **400**, **600**, or **800**).
(153) In some examples, the network communications interface **708** includes wired communication port(s) **712** and/or wireless transmission and reception circuitry **714**. The wired communication port(s) receives and send communication signals via one or more wired interfaces, e.g., Ethernet, Universal Serial Bus (USB), FIREWIRE, etc. The wireless circuitry **714** receives and sends RF signals and/or optical signals from/to communications networks and other communications devices. The wireless communications use any of a plurality of communications standards, protocols, and technologies, such as GSM, EDGE, CDMA, TDMA, Bluetooth, Wi-Fi, VOIP, Wi-MAX, or any other suitable communication protocol. Network communications interface **708** enables communication between digital assistant system **700** with networks, such as the Internet, an intranet, and/or a wireless network, such as a cellular telephone network, a wireless local area network (LAN), and/or a metropolitan area network (MAN), and other devices.
(154) In some examples, memory **702**, or the computer-readable storage media of memory **702**, stores programs, modules, instructions, and data structures including all or a subset of: operating system **718**, communications module **720**, user interface module **722**, one or more applications **724**, and digital assistant module **726**. In particular, memory **702**, or the computer-readable storage media of memory **702**, stores instructions for performing the processes described below. One or more processors **704** execute these programs, modules, and instructions, and reads/writes from/to the data structures.
(155) Operating system **718** (e.g., Darwin, RTXC, LINUX, UNIX, iOS, OS X, WINDOWS, or an embedded operating system such as VxWorks) includes various software components and/or drivers for controlling and managing general system tasks (e.g., memory management, storage device control, power management, etc.) and facilitates communications between various hardware, firmware, and software components.
(156) Communications module **720** facilitates communications between digital assistant system **700** with other devices over network communications interface **708**. For example, communications module **720** communicates with RF circuitry **208** of electronic devices such as devices **200**, **400**, and **600** shown in FIGS. **2**A, **4**, **6**A-B, respectively. Communications module **720** also includes various components for handling data received by wireless circuitry **714** and/or wired communications port **712**.
(157) User interface module **722** receives commands and/or inputs from a user via I/O interface **706** (e.g., from a keyboard, touch screen, pointing device, controller, and/or microphone), and generate user interface objects on a display. User interface module **722** also prepares and delivers outputs (e.g., speech, sound, animation, text, icons, vibrations, haptic feedback, light, etc.) to the user via the I/O interface **706** (e.g., through displays, audio channels, speakers, touch-pads, etc.).
(158) Applications **724** include programs and/or modules that are configured to be executed by one or more processors **704**. For example, if the digital assistant system is implemented on a standalone user device, applications **724** include user applications, such as games, a calendar application, a navigation application, or an email application. If digital assistant system **700** is implemented on a server, applications **724** include resource management applications, diagnostic applications, or scheduling applications, for example.
(159) Memory **702** also stores digital assistant module **726** (or the server portion of a digital assistant). In some examples,

digital assistant module **726** includes the following sub-modules, or a subset or superset thereof: input/output processing module **728**, speech-to-text (STT) processing module **730**, natural language processing module **732**, dialogue flow processing module **734**, task flow processing module **736**, service processing module **738**, and speech synthesis processing module **740**. Each of these modules has access to one or more of the following systems or data and models of the digital assistant module **726**, or a subset or superset thereof: ontology **760**, vocabulary index **744**, user data **748**, task flow models **754**, service models **756**, and ASR systems **758**.

(160) In some examples, using the processing modules, data, and models implemented in digital assistant module **726**, the digital assistant can perform at least some of the following: converting speech input into text; identifying a user's intent expressed in a natural language input received from the user; actively eliciting and obtaining information needed to fully infer the user's intent (e.g., by disambiguating words, games, intentions, etc.); determining the task flow for fulfilling the inferred intent; and executing the task flow to fulfill the inferred intent.

(161) In some examples, as shown in FIG. **7**B, I/O processing module **728** interacts with the user through I/O devices **716** in FIG. **7**A or with a user device (e.g., devices **104**, **200**, **400**, or **600**) through network communications interface **708** in FIG. **7**A to obtain user input (e.g., a speech input) and to provide responses (e.g., as speech outputs) to the user input. I/O processing module **728** optionally obtains contextual information associated with the user input from the user device, along with or shortly after the receipt of the user input. The contextual information includes user-specific data, vocabulary, and/or preferences relevant to the user input. In some examples, the contextual information also includes software and hardware states of the user device at the time the user request is received, and/or information related to the surrounding environment of the user at the time that the user request was received. In some examples, I/O processing module **728** also sends follow-up questions to, and receive answers from, the user regarding the user request. When a user request is received by I/O processing module **728** and the user request includes speech input, I/O processing module **728** forwards the speech input to STT processing module **730** (or speech recognizer) for speech-to-text conversions.

(162) STT processing module **730** includes one or more ASR systems **758**. The one or more ASR systems **758** can process the speech input that is received through I/O processing module **728** to produce a recognition result. Each ASR system **758** includes a front-end speech pre-processor. The front-end speech pre-processor extracts representative features from the speech input. For example, the front-end speech pre-processor performs a Fourier transform on the speech input to extract spectral features that characterize the speech input as a sequence of representative multi-dimensional vectors. Further, each ASR system **758** includes one or more speech recognition models (e.g., acoustic models and/or language models) and implements one or more speech recognition engines. Examples of speech recognition models include Hidden Markov Models, Gaussian-Mixture Models, Deep Neural Network Models, n-gram language models, and other statistical models. Examples of speech recognition engines include the dynamic time warping based engines and weighted finite-state transducers (WFST) based engines. The one or more speech recognition models and the one or more speech recognition engines are used to process the extracted representative features of the front-end speech pre-processor to produce intermediate recognitions results (e.g., phonemes, phonemic strings, and sub-words), and ultimately, text recognition results (e.g., words, word strings, or sequence of tokens). In some examples, the speech input is processed at least partially by a third-party service or on the user's device (e.g., device **104**, **200**, **400**, **600**, or **800**) to produce the recognition result. Once STT processing module **730** produces recognition results containing a text string (e.g., words, or sequence of words, or sequence of tokens), the recognition result is passed to natural language processing module **732** for intent deduction. In some examples, STT processing module **730** produces multiple candidate text representations of the speech input. Each candidate text representation is a sequence of words or tokens corresponding to the speech input. In some examples, each candidate text representation is associated with a speech recognition confidence score. Based on the speech recognition confidence scores, STT processing module **730** ranks the candidate text representations and provides the n-best (e.g., n highest ranked) candidate text representation(s) to natural language processing module **732** for intent deduction, where n is a predetermined integer greater than zero. For example, in one example, only the highest ranked (n=1) candidate text representation is passed to natural language processing module **732** for intent deduction. In another example, the five highest ranked (n=5) candidate text representations are passed to natural language processing module **732** for intent deduction.

(163) More details on the speech-to-text processing are described in U.S. Utility application Ser. No. 13/236,942 for “Consolidating Speech Recognition Results,” filed on Sep. 20, 2011, the entire disclosure of which is incorporated herein by reference.

(164) In some examples, STT processing module **730** includes and/or accesses a vocabulary of recognizable words via phonetic alphabet conversion module **731**. Each vocabulary word is associated with one or more candidate pronunciations of the word represented in a speech recognition phonetic alphabet. In particular, the vocabulary of recognizable words includes a word that is associated with a plurality of candidate pronunciations. For example, the vocabulary includes the word “tomato” that is associated with the candidate pronunciations of custom character and custom character. Further, vocabulary words are associated with custom candidate pronunciations that are based on previous speech inputs from the user. Such custom candidate pronunciations are stored in STT processing module **730** and are associated with a particular user via the user's profile on the device. In some examples, the candidate pronunciations for words are determined based on the spelling of the word and one or more linguistic and/or phonetic rules. In some examples, the candidate pronunciations are manually generated, e.g., based on known canonical pronunciations.

(165) In some examples, the candidate pronunciations are ranked based on the commonness of the candidate pronunciation. For example, the candidate pronunciation custom character is ranked higher than custom character because the former is a more commonly used pronunciation (e.g., among all users, for users in a particular geographical region, or for any other appropriate subset of users). In some examples, candidate pronunciations are ranked based on whether the candidate

pronunciation is a custom candidate pronunciation associated with the user. For example, custom candidate pronunciations are ranked higher than canonical candidate pronunciations. This can be useful for recognizing proper nouns having a unique pronunciation that deviates from canonical pronunciation. In some examples, candidate pronunciations are associated with one or more speech characteristics, such as geographic origin, nationality, or ethnicity. For example, the candidate pronunciation custom character is associated with the United States, whereas the candidate pronunciation custom character is associated with Great Britain. Further, the rank of the candidate pronunciation is based on one or more characteristics (e.g., geographic origin, nationality, ethnicity, etc.) of the user stored in the user's profile on the device. For example, it can be determined from the user's profile that the user is associated with the United States. Based on the user being associated with the United States, the candidate pronunciation custom character (associated with the United States) is ranked higher than the candidate pronunciation custom character (associated with Great Britain). In some examples, one of the ranked candidate pronunciations is selected as a predicted pronunciation (e.g., the most likely pronunciation).

(166) When a speech input is received, STT processing module **730** is used to determine the phonemes corresponding to the speech input (e.g., using an acoustic model), and then attempt to determine words that match the phonemes (e.g., using a language model). For example, if STT processing module **730** first identifies the sequence of phonemes custom character corresponding to a portion of the speech input, it can then determine, based on vocabulary index **744**, that this sequence corresponds to the word "tomato."

(167) In some examples, STT processing module **730** uses approximate matching techniques to determine words in an utterance. Thus, for example, the STT processing module **730** determines that the sequence of phonemes custom character corresponds to the word "tomato," even if that particular sequence of phonemes is not one of the candidate sequence of phonemes for that word.

(168) Natural language processing module **732** ("natural language processor") of the digital assistant takes the n-best candidate text representation(s) ("word sequence(s)" or "token sequence(s)") generated by STT processing module **730**, and attempts to associate each of the candidate text representations with one or more "actionable intents" recognized by the digital assistant. An "actionable intent" (or "user intent") represents a task that can be performed by the digital assistant, and can have an associated task flow implemented in task flow models **754**. The associated task flow is a series of programmed actions and steps that the digital assistant takes in order to perform the task. The scope of a digital assistant's capabilities is dependent on the number and variety of task flows that have been implemented and stored in task flow models **754**, or in other words, on the number and variety of "actionable intents" that the digital assistant recognizes. The effectiveness of the digital assistant, however, also dependents on the assistant's ability to infer the correct "actionable intent(s)" from the user request expressed in natural language.

(169) In some examples, in addition to the sequence of words or tokens obtained from STT processing module **730**, natural language processing module **732** also receives contextual information associated with the user request, e.g., from I/O processing module **728**. The natural language processing module **732** optionally uses the contextual information to clarify, supplement, and/or further define the information contained in the candidate text representations received from STT processing module **730**. The contextual information includes, for example, user preferences, hardware, and/or software states of the user device, sensor information collected before, during, or shortly after the user request, prior interactions (e.g., dialogue) between the digital assistant and the user, and the like. As described herein, contextual information is, in some examples, dynamic, and changes with time, location, content of the dialogue, and other factors.

(170) In some examples, the natural language processing is based on, e.g., ontology **760**. Ontology **760** is a hierarchical structure containing many nodes, each node representing either an "actionable intent" or a "property" relevant to one or more of the "actionable intents" or other "properties." As noted above, an "actionable intent" represents a task that the digital assistant is capable of performing, i.e., it is "actionable" or can be acted on. A "property" represents a parameter associated with an actionable intent or a sub-aspect of another property. A linkage between an actionable intent node and a property node in ontology **760** defines how a parameter represented by the property node pertains to the task represented by the actionable intent node.

(171) In some examples, ontology **760** is made up of actionable intent nodes and property nodes. Within ontology **760**, each actionable intent node is linked to one or more property nodes either directly or through one or more intermediate property nodes. Similarly, each property node is linked to one or more actionable intent nodes either directly or through one or more intermediate property nodes. For example, as shown in FIG. **7**C, ontology **760** includes a "restaurant reservation" node (i.e., an actionable intent node). Property nodes "restaurant," "date/time" (for the reservation), and "party size" are each directly linked to the actionable intent node (i.e., the "restaurant reservation" node).

(172) In addition, property nodes "cuisine," "price range," "phone number," and "location" are sub-nodes of the property node "restaurant," and are each linked to the "restaurant reservation" node (i.e., the actionable intent node) through the intermediate property node "restaurant." For another example, as shown in FIG. **7**C, ontology **760** also includes a "set reminder" node (i.e., another actionable intent node). Property nodes "date/time" (for setting the reminder) and "subject" (for the reminder) are each linked to the "set reminder" node. Since the property "date/time" is relevant to both the task of making a restaurant reservation and the task of setting a reminder, the property node "date/time" is linked to both the "restaurant reservation" node and the "set reminder" node in ontology **760**.

(173) An actionable intent node, along with its linked property nodes, is described as a "domain." In the present discussion, each domain is associated with a respective actionable intent, and refers to the group of nodes (and the relationships there between) associated with the particular actionable intent. For example, ontology **760** shown in FIG. **7**C includes an example of restaurant reservation domain **762** and an example of reminder domain **764** within ontology **760**. The restaurant reservation domain includes the actionable intent node "restaurant reservation," property nodes "restaurant," "date/time," and

"party size," and sub-property nodes "cuisine," "price range," "phone number," and "location." Reminder domain **764** includes the actionable intent node "set reminder," and property nodes "subject" and "date/time." In some examples, ontology **760** is made up of many domains. Each domain shares one or more property nodes with one or more other domains. For example, the "date/time" property node is associated with many different domains (e.g., a scheduling domain, a travel reservation domain, a movie ticket domain, etc.), in addition to restaurant reservation domain **762** and reminder domain **764**.

(174) While FIG. **7**C illustrates two example domains within ontology **760**, other domains include, for example, "find a movie," "initiate a phone call," "find directions," "schedule a meeting," "send a message," and "provide an answer to a question," "read a list," "providing navigation instructions," "provide instructions for a task" and so on. A "send a message" domain is associated with a "send a message" actionable intent node, and further includes property nodes such as "recipient(s)," "message type," and "message body." The property node "recipient" is further defined, for example, by the sub-property nodes such as "recipient name" and "message address."

(175) In some examples, ontology **760** includes all the domains (and hence actionable intents) that the digital assistant is capable of understanding and acting upon. In some examples, ontology **760** is modified, such as by adding or removing entire domains or nodes, or by modifying relationships between the nodes within the ontology **760**.

(176) In some examples, nodes associated with multiple related actionable intents are clustered under a "super domain" in ontology **760**. For example, a "travel" super-domain includes a cluster of property nodes and actionable intent nodes related to travel. The actionable intent nodes related to travel includes "airline reservation," "hotel reservation," "car rental," "get directions," "find points of interest," and so on. The actionable intent nodes under the same super domain (e.g., the "travel" super domain) have many property nodes in common. For example, the actionable intent nodes for "airline reservation," "hotel reservation," "car rental," "get directions," and "find points of interest" share one or more of the property nodes "start location," "destination," "departure date/time," "arrival date/time," and "party size."

(177) In some examples, each node in ontology **760** is associated with a set of words and/or phrases that are relevant to the property or actionable intent represented by the node. The respective set of words and/or phrases associated with each node are the so-called "vocabulary" associated with the node. The respective set of words and/or phrases associated with each node are stored in vocabulary index **744** in association with the property or actionable intent represented by the node. For example, returning to FIG. **7**B, the vocabulary associated with the node for the property of "restaurant" includes words such as "food," "drinks," "cuisine," "hungry," "eat," "pizza," "fast food," "meal," and so on. For another example, the vocabulary associated with the node for the actionable intent of "initiate a phone call" includes words and phrases such as "call," "phone," "dial," "ring," "call this number," "make a call to," and so on. The vocabulary index **744** optionally includes words and phrases in different languages.

(178) Natural language processing module **732** receives the candidate text representations (e.g., text string(s) or token sequence(s)) from STT processing module **730**, and for each candidate representation, determines what nodes are implicated by the words in the candidate text representation. In some examples, if a word or phrase in the candidate text representation is found to be associated with one or more nodes in ontology **760** (via vocabulary index **744**), the word or phrase "triggers" or "activates" those nodes. Based on the quantity and/or relative importance of the activated nodes, natural language processing module **732** selects one of the actionable intents as the task that the user intended the digital assistant to perform. In some examples, the domain that has the most "triggered" nodes is selected. In some examples, the domain having the highest confidence value (e.g., based on the relative importance of its various triggered nodes) is selected. In some examples, the domain is selected based on a combination of the number and the importance of the triggered nodes. In some examples, additional factors are considered in selecting the node as well, such as whether the digital assistant has previously correctly interpreted a similar request from a user.

(179) User data **748** includes user-specific information, such as user-specific vocabulary, user preferences, user address, user's default and secondary languages, user's contact list, and other short-term or long-term information for each user. In some examples, natural language processing module **732** uses the user-specific information to supplement the information contained in the user input to further define the user intent. For example, for a user request "invite my friends to my birthday party," natural language processing module **732** is able to access user data **748** to determine who the "friends" are and when and where the "birthday party" would be held, rather than requiring the user to provide such information explicitly in his/her request.

(180) It should be recognized that in some examples, natural language processing module **732** is implemented using one or more machine learning mechanisms (e.g., neural networks). In particular, the one or more machine learning mechanisms are configured to receive a candidate text representation and contextual information associated with the candidate text representation. Based on the candidate text representation and the associated contextual information, the one or more machine learning mechanisms are configured to determine intent confidence scores over a set of candidate actionable intents. Natural language processing module **732** can select one or more candidate actionable intents from the set of candidate actionable intents based on the determined intent confidence scores. In some examples, an ontology (e.g., ontology **760**) is also used to select the one or more candidate actionable intents from the set of candidate actionable intents.

(181) Other details of searching an ontology based on a token string are described in U.S. Utility application Ser. No. 12/341,743 for "Method and Apparatus for Searching Using An Active Ontology," filed Dec. 22, 2008, the entire disclosure of which is incorporated herein by reference.

(182) In some examples, once natural language processing module **732** identifies an actionable intent (or domain) based on the user request, natural language processing module **732** generates a structured query to represent the identified actionable intent. In some examples, the structured query includes parameters for one or more nodes within the domain for the actionable intent, and at least some of the parameters are populated with the specific information and requirements specified

in the user request. For example, the user says "Make me a dinner reservation at a sushi place at **7**." In this case, natural language processing module **732** is able to correctly identify the actionable intent to be "restaurant reservation" based on the user input. According to the ontology, a structured query for a "restaurant reservation" domain includes parameters such as {Cuisine}, {Time}, {Date}, {Party Size}, and the like. In some examples, based on the speech input and the text derived from the speech input using STT processing module **730**, natural language processing module **732** generates a partial structured query for the restaurant reservation domain, where the partial structured query includes the parameters {Cuisine="Sushi"} and {Time="7 pm"}. However, in this example, the user's utterance contains insufficient information to complete the structured query associated with the domain. Therefore, other necessary parameters such as {Party Size} and {Date} are not specified in the structured query based on the information currently available. In some examples, natural language processing module **732** populates some parameters of the structured query with received contextual information. For example, in some examples, if the user requested a sushi restaurant "near me," natural language processing module **732** populates a {location} parameter in the structured query with GPS coordinates from the user device.
(183) In some examples, natural language processing module **732** identifies multiple candidate actionable intents for each candidate text representation received from STT processing module **730**. Further, in some examples, a respective structured query (partial or complete) is generated for each identified candidate actionable intent. Natural language processing module **732** determines an intent confidence score for each candidate actionable intent and ranks the candidate actionable intents based on the intent confidence scores. In some examples, natural language processing module **732** passes the generated structured query (or queries), including any completed parameters, to task flow processing module **736** ("task flow processor"). In some examples, the structured query (or queries) for the m-best (e.g., m highest ranked) candidate actionable intents are provided to task flow processing module **736**, where m is a predetermined integer greater than zero. In some examples, the structured query (or queries) for the m-best candidate actionable intents are provided to task flow processing module **736** with the corresponding candidate text representation(s).
(184) Other details of inferring a user intent based on multiple candidate actionable intents determined from multiple candidate text representations of a speech input are described in U.S. Utility application Ser. No. 14/298,725 for "System and Method for Inferring User Intent From Speech Inputs," filed Jun. 6, 2014, the entire disclosure of which is incorporated herein by reference.
(185) Task flow processing module **736** is configured to receive the structured query (or queries) from natural language processing module **732**, complete the structured query, if necessary, and perform the actions required to "complete" the user's ultimate request. In some examples, the various procedures necessary to complete these tasks are provided in task flow models **754**. In some examples, task flow models **754** include procedures for obtaining additional information from the user and task flows for performing actions associated with the actionable intent.
(186) As described above, in order to complete a structured query, task flow processing module **736** needs to initiate additional dialogue with the user in order to obtain additional information, and/or disambiguate potentially ambiguous utterances. When such interactions are necessary, task flow processing module **736** invokes dialogue flow processing module **734** to engage in a dialogue with the user. In some examples, dialogue flow processing module **734** determines how (and/or when) to ask the user for the additional information and receives and processes the user responses. The questions are provided to and answers are received from the users through I/O processing module **728**. In some examples, dialogue flow processing module **734** presents dialogue output to the user via audio and/or visual output, and receives input from the user via spoken or physical (e.g., clicking) responses. Continuing with the example above, when task flow processing module **736** invokes dialogue flow processing module **734** to determine the "party size" and "date" information for the structured query associated with the domain "restaurant reservation," dialogue flow processing module **734** generates questions such as "For how many people?" and "On which day?" to pass to the user. Once answers are received from the user, dialogue flow processing module **734** then populates the structured query with the missing information, or pass the information to task flow processing module **736** to complete the missing information from the structured query.
(187) Once task flow processing module **736** has completed the structured query for an actionable intent, task flow processing module **736** proceeds to perform the ultimate task associated with the actionable intent. Accordingly, task flow processing module **736** executes the steps and instructions in the task flow model according to the specific parameters contained in the structured query. For example, the task flow model for the actionable intent of "restaurant reservation" includes steps and instructions for contacting a restaurant and actually requesting a reservation for a particular party size at a particular time. For example, using a structured query such as: {restaurant reservation, restaurant=ABC Café, date=3/12/2012, time=7 pm, party size=5}, task flow processing module **736** performs the steps of: (1) logging onto a server of the ABC Café or a restaurant reservation system such as OPENTABLE®, (2) entering the date, time, and party size information in a form on the website, (3) submitting the form, and (4) making a calendar entry for the reservation in the user's calendar.
(188) In some examples, task flow processing module **736** employs the assistance of service processing module **738** ("service processing module") to complete a task requested in the user input or to provide an informational answer requested in the user input. For example, service processing module **738** acts on behalf of task flow processing module **736** to make a phone call, set a calendar entry, invoke a map search, invoke or interact with other user applications installed on the user device, and invoke or interact with third-party services (e.g., a restaurant reservation portal, a social networking website, a banking portal, etc.). In some examples, the protocols and application programming interfaces (API) required by each service are specified by a respective service model among service models **756**. Service processing module **738** accesses the appropriate service model for a service and generates requests for the service in accordance with the protocols and APIs required by the service according to the service model.

(189) For example, if a restaurant has enabled an online reservation service, the restaurant submits a service model specifying the necessary parameters for making a reservation and the APIs for communicating the values of the necessary parameter to the online reservation service. When requested by task flow processing module **736**, service processing module **738** establishes a network connection with the online reservation service using the web address stored in the service model, and sends the necessary parameters of the reservation (e.g., time, date, party size) to the online reservation interface in a format according to the API of the online reservation service.
(190) In some examples, natural language processing module **732**, dialogue flow processing module **734**, and task flow processing module **736** are used collectively and iteratively to infer and define the user's intent, obtain information to further clarify and refine the user intent, and finally generate a response (i.e., an output to the user, or the completion of a task) to fulfill the user's intent. The generated response is a dialogue response to the speech input that at least partially fulfills the user's intent. Further, in some examples, the generated response is output as a speech output. In these examples, the generated response is sent to speech synthesis processing module **740** (e.g., speech synthesizer) where it can be processed to synthesize the dialogue response in speech form. In yet other examples, the generated response is data content relevant to satisfying a user request in the speech input.
(191) In examples where task flow processing module **736** receives multiple structured queries from natural language processing module **732**, task flow processing module **736** initially processes the first structured query of the received structured queries to attempt to complete the first structured query and/or execute one or more tasks or actions represented by the first structured query. In some examples, the first structured query corresponds to the highest ranked actionable intent. In other examples, the first structured query is selected from the received structured queries based on a combination of the corresponding speech recognition confidence scores and the corresponding intent confidence scores. In some examples, if task flow processing module **736** encounters an error during processing of the first structured query (e.g., due to an inability to determine a necessary parameter), the task flow processing module **736** can proceed to select and process a second structured query of the received structured queries that corresponds to a lower ranked actionable intent. The second structured query is selected, for example, based on the speech recognition confidence score of the corresponding candidate text representation, the intent confidence score of the corresponding candidate actionable intent, a missing necessary parameter in the first structured query, or any combination thereof.
(192) Speech synthesis processing module **740** is configured to synthesize speech outputs for presentation to the user. Speech synthesis processing module **740** synthesizes speech outputs based on text provided by the digital assistant. For example, the generated dialogue response is in the form of a text string. Speech synthesis processing module **740** converts the text string to an audible speech output. Speech synthesis processing module **740** uses any appropriate speech synthesis technique in order to generate speech outputs from text, including, but not limited, to concatenative synthesis, unit selection synthesis, diphone synthesis, domain-specific synthesis, formant synthesis, articulatory synthesis, hidden Markov model (HMM) based synthesis, and sinewave synthesis. In some examples, speech synthesis processing module **740** is configured to synthesize individual words based on phonemic strings corresponding to the words. For example, a phonemic string is associated with a word in the generated dialogue response. The phonemic string is stored in metadata associated with the word. Speech synthesis processing module **740** is configured to directly process the phonemic string in the metadata to synthesize the word in speech form.
(193) In some examples, instead of (or in addition to) using speech synthesis processing module **740**, speech synthesis is performed on a remote device (e.g., the server system **108**), and the synthesized speech is sent to the user device for output to the user. For example, this can occur in some implementations where outputs for a digital assistant are generated at a server system. And because server systems generally have more processing power or resources than a user device, it is possible to obtain higher quality speech outputs than would be practical with client-side synthesis.
(194) Additional details on digital assistants can be found in the U.S. Utility application Ser. No. 12/987,982, entitled "Intelligent Automated Assistant," filed Jan. 10, 2011, and U.S. Utility application Ser. No. 13/251,088, entitled "Generating and Processing Task Items That Represent Tasks to Perform," filed Sep. 30, 2011, the entire disclosures of which are incorporated herein by reference.
(195) 4. Exemplary Techniques for Operating a Virtual Assistant
(196) FIGS. **8**A-**8**D depict exemplary techniques for operating a virtual assistant at an electronic device **800**. Device **800** is, for example, similar or the same as device **200** or **400**, described above. In some examples, device **800** includes the modules and functions of a digital assistant described above in FIGS. **7**A-**7**C. In some examples, device **800** includes the components and functions of system **900** (FIG. **9**), described below.
(197) As described below, in some examples, depending on how a virtual assistant session is initiated, different default behaviors for deactivating the virtual assistant session are employed. For example, if user input received via a button of the electronic device initiates the virtual assistant session, it may be likely that the user is holding the device and thus wishes to interact with the virtual assistant session for an extended duration. Accordingly, as shown in FIG. **8**A, the default behavior for such manner of initiation is not to deactivate the virtual assistant session (e.g., until a display screen of the electronic device is powered off). As another example, if user input at an external electronic device (e.g., a wired or wireless headset) initiates the virtual assistant session, it may be likely that the user initiates the virtual assistant session for a quick request (e.g., to check the weather, to check stock prices, etc.). Accordingly, as shown in FIG. **8**C, the default behavior for such manner of initiation is to deactivate the virtual assistant session shortly after the request is completed (e.g., after the virtual assistant provides a response).
(198) However, in some examples, the default behavior associated with each manner of initiating a virtual assistant may be undesirable. For example, if the default behavior is not to deactivate the virtual assistant session, and the user is not engaged

with the virtual assistant session, it can be undesirable to continue execution of the virtual assistant session (e.g., because executing the virtual assistant session consumes battery power and/or because the user is not interested in interacting with the virtual assistant session). As another example, if the default behavior is to deactivate a virtual assistant session shortly after request completion, and a user is still engaged with the virtual assistant session after request completion, it can be undesirable to deactivate the virtual assistant session (e.g., because the user is still reading a presented result and/or wishes to issue another request to the virtual assistant session).
(199) Accordingly, in some examples, it may be desirable to override a default behavior for deactivating a virtual assistant session based on whether the user is engaged with the virtual assistant session. For example, if the default behavior is not to deactivate the virtual assistant session (e.g., until a display screen of the electronic device is powered off), it is determined whether the user is not engaged with the virtual assistant session. As shown in FIG. **8**B, if the user is not engaged, the default behavior is overridden, and the virtual assistant deactivates (e.g., before the time a display is powered off). As another example, if the default behavior is to deactivate the virtual assistant session shortly after request completion, it is determined whether the user is engaged with the virtual assistant session after request completion. As shown in FIG. **8**D, if the user is engaged, the default behavior of deactivating the virtual assistant session shortly after request completion is overridden, and the virtual assistant session continues to execute.
(200) FIG. **8**A depicts an exemplary timeline of operating a virtual assistant session on device **800** according to a default behavior of not deactivating the virtual assistant session until a time defined by a device setting (e.g., a time a display is powered off). As discussed, in some examples, the default behavior may be undesirable, resulting in a virtual assistant continuing to execute despite a user not being engaged with it.
(201) As shown, at time T**1**, device **800** initiates a virtual assistant session responsive to receiving user input corresponding to one or more predetermined types. For example, user **802** interacts with a button (e.g., a physical or a virtual button) on device **800** to cause device **800** to initiate a virtual assistant session. In some examples, initiating a virtual assistant session includes providing audio output. In some examples, initiating a virtual assistant session includes displaying a user interface associated with the virtual assistant session (e.g., in the foreground of a user interface displayed on display **804**). In some examples, initiating a virtual assistant session includes powering on processor circuitry configured to operate a virtual assistant. In some examples, initiating a virtual assistant includes initiating one or more programs or modules (e.g., digital assistant module **726**).
(202) In some examples, device **800** determines a type of the user input for initiating the virtual assistant session. For example, device **800** determines whether the type of the user input is a first type or a second type. In some examples, the first type of user input includes gesture input (e.g., a swipe) received via a touch sensitive display of an electronic device, input received via a physical button (e.g., a “home” button) of the electronic device, and/or via a virtual button (e.g., a button displayed on a display) of the electronic device. In some examples, the second type of user input includes input received from an external electronic device (e.g., input from wired or wireless headsets), voice input (e.g., voice input for initiating a virtual assistant such as “Hey Siri”), and/or motion input (e.g., a motion of an electronic device that initiates a virtual assistant).
(203) In some examples, each type of the user input is associated with different default behaviors for deactivating the virtual assistant session. For example, device **800** infers from the first type of input that the user wishes to interact with the virtual assistant session for an extended duration. Accordingly, if device **800** determines that the type of user input is the first type, the default behavior is not to deactivate the virtual assistant session (e.g., until a time a display of the electronic device is powered off (e.g., not displaying)). As another example, device **800** infers from the second type of input that the user does not wish to interact with the virtual assistant session for an extended duration. Accordingly, if device **800** determines that the type of user input is the second type, the default behavior is to deactivate the virtual assistant session a predetermined duration (e.g., a short duration) after the completion of the user request.
(204) In the present example of FIG. **8**A, the input for initiating the virtual assistant session is the first type of input (e.g., a swipe or virtual button). Accordingly, as shown, the default behavior is not to deactivate the virtual assistant session (e.g., until a time defined by a device setting).
(205) After initiating the virtual assistant session, at time T**2**, user **802** provides input to the virtual assistant session (e.g., “Set a timer for ten minutes”). The virtual assistant of device **800** receives the input and performs a task based on the input (e.g., according to the techniques discussed above with respect to FIGS. **7**A-C). For example, the virtual assistant session performs the task of setting a timer and presents the result “Setting the timer for 10 minutes” (e.g., on display **804**).
(206) In some examples, a result presented during the virtual assistant session is a final result (e.g., “Setting the timer for 10 minutes”). However, in some examples, some results presented during the virtual assistant session are not final results. For example, if the virtual assistant session is engaged in a multi-turn interaction (e.g., an interaction where input is provided to the virtual assistant and the virtual assistant responds by eliciting further input), the result eliciting further input is not a final result. For example, if the user provides the input “send a message,” and the virtual assistant session responds by outputting “send a message to who?”, “send a message to who?” is not a final result. Accordingly, in some examples, a final result is a presented result for which no further user response is expected and/or for which no further result is expected to be presented by the virtual assistant.
(207) Device **800** presents a final result for the virtual assistant session at a time (e.g., at time T**3** in FIG. **8**A). For example, if the virtual assistant provides audio output of the final result (e.g., the virtual assistant performs text-to-speech of “Setting the timer for 10 minutes”) the final result time is when the virtual assistant finishes providing the audio output (e.g., finishes audio output of “10 minutes”). In some examples, a virtual assistant session displays the final result (e.g., displays “Setting the timer for 10 minutes” on display **804**). Accordingly, in some examples, the final result time is when the final result is

displayed. In some examples, the final result time is a predetermined duration (e.g., 0.5 seconds, 1 second, 2 seconds, etc.) after the time the final result is displayed.
(208) In the present example, after device **800** presents the final result, user **802** is no longer engaged with the virtual assistant session. For example, as shown, user **802** at time T**4** is not looking at device **800** and has dropped device **800** to be near his side. However, because user **802** initiated the virtual assistant session using the first type of input (e.g., a button press), device **800** operates according to the default behavior of not deactivating the virtual assistant session until a time defined by a device setting (e.g., a screen lock time). As shown, this may undesirably result in a virtual assistant continuing to execute (e.g., between times T**4** and T**5**) even though a user is not engaged with it.
(209) In some examples, the device setting is a user configurable setting associated with a screen lock time or a screen dimming time. For example, a user specifies a screen lock time and/or a screen dimming time of 30 seconds, 1, 2, 3, 4, or 5 minutes. A screen lock time of 2 minutes specifies, for instance, that the device powers off a display screen after 2 minutes of not detecting user input at the device (e.g., tactile input, motion input, audio input, gaze input, and/or detection of a user's face, etc.). In some examples, the device setting specifies to not automatically power off the screen and/or to not automatically dim the screen. In such examples, a virtual assistant session operating according to a default behavior of not deactivating the virtual assistant session would not deactivate (e.g., until the electronic device runs out of battery).
(210) In some examples, the device setting is a user configurable setting associated with the virtual assistant. For example, a device setting specifies to automatically deactivate the virtual assistant session a predetermined duration (e.g., 30 seconds, 1 minute, 2 minutes) after the time at which the virtual assistant session was initiated. As another example, a device setting specifies to automatically deactivate the virtual assistant session a predetermined duration after the time at which a final result for the virtual assistant session is presented.
(211) In some examples, device **800** automatically deactivates the virtual assistant session at the time defined by the device setting (e.g., at time T**5** in FIG. **8**A). For example, a screen lock setting specifies to power off display **804** five minutes after not detecting user input. When display **804** powers off at time T**5**, device **800** deactivates the virtual assistant session at time T**5**. As another example, a screen dimming setting specifies to dim display **804** five minutes after not detecting user input. When display **804** dims, device **800** deactivates the virtual assistant session. In some examples, automatically deactivating the virtual assistant session includes deactivating the virtual assistant session without receiving explicit user input to deactivate the virtual assistant session. Explicit user input to deactivate a virtual assistant session includes, for instance, a touch or a press of a physical or a virtual button, a swipe gesture on a display, and/or audio and/or textual input (e.g., explicit audio and/or textual input for deactivating a virtual assistant session such as “Shut off,” “Go away,” “turn off,” and the like).
(212) In some examples, deactivating a virtual assistant session includes ceasing the display of a user interface associated with the virtual assistant session (e.g., the display of a virtual assistant user interface is replaced with the display of a home screen user interface or a user interface associated with another application). In some examples, deactivating a virtual assistant session includes powering off a display. In some examples, deactivating a virtual assistant session includes powering off processor circuitry (e.g., circuitry of a main processor) configured to operate a virtual assistant. In some examples, deactivating a virtual assistant includes deactivating one or more programs or modules (e.g., digital assistant module **726**).
(213) As demonstrated by FIG. **8**A, the default behavior of not deactivating a virtual assistant session until a time defined by a device setting may be undesirable. In particular, there is a period (e.g., between T**4** and T**5**) during which the virtual assistant continues to execute (e.g., a virtual assistant user interface is displayed in the foreground of the user interface), despite the user not being engaged with the virtual assistant session. This may be a significant battery power and processing power drain for the device (e.g., especially if the screen lock time is long or the device setting specifies to not power off the screen). Accordingly, in some examples, it may be desirable to override a default behavior by automatically deactivating the virtual assistant when (or shortly after) it is determined that the user is not engaged with the virtual assistant session.
(214) FIG. **8**B illustrates an exemplary timeline for automatically deactivating a virtual assistant session. In FIG. **8**B, a default behavior of not deactivating a virtual assistant session (e.g., until a screen lock time) is overridden. In particular, as discussed below, a device determines that the user is disinterested in (e.g., not engaged with) the virtual assistant session, and the device deactivates the virtual assistant session prior to the time associated with the device setting (e.g., the screen lock time).
(215) In FIG. **8**B, at time T**1**, user **802** initiates a virtual assistant session by providing user input (e.g., by interacting with a button of device **800**). In response, device **800** initiates a virtual assistant session. For example, device **800** displays a virtual assistant user interface on display **804**.
(216) In some examples, device **800** determines a type of the user input. In the present example, because the user input was received via a button of device **800**, device **800** determines that the type of the user input is the first type. Accordingly, the default behavior is to not deactivate the virtual assistant session until a time defined by a device setting (recall that in some examples, different types of input are respectively associated with different default behaviors).
(217) At time T**2**, user **802** provides input requesting a task (e.g., “Set a timer for 10 minutes”) to the virtual assistant session. Device **800** determines a task based on the input, performs the task, and presents a final result for the virtual assistant session at time T**3**. For example, device **800** presents the audio output “Setting the timer for 10 minutes” at time T**3**.
(218) In some examples, after a time at which a final result for the virtual assistant session is presented, device **800** determines whether the user is disinterested in the virtual assistant session. For example, device **800** determines whether the user is disinterested in the virtual assistant session a predetermined duration (e.g., 1, 2, 3, 4, 5, 6 seconds) after a time at which a final result for the virtual assistant session is presented. In some examples, device **800** determines whether the user is disinterested in the virtual assistant session as soon as the final result is presented. In some examples, device **800** determines

whether the user is disinterested in the virtual assistant session as soon as the virtual assistant session is initiated.
(219) In some examples, device **800** determines whether the user is disinterested in the virtual assistant session in accordance with determining that the type of the user input for initiating the virtual assistant session is the first type. For example, as discussed, the first type of input is associated with the default behavior of not deactivating the virtual assistant session. Accordingly, device **800** determines whether the user is disinterested with the virtual assistant session to determine whether to override the default behavior (e.g., by automatically deactivating the virtual assistant session before a screen lock time).
(220) In some examples, determining whether the user is disinterested in the virtual assistant session includes, determining based on data obtained using one or more sensors of an electronic device, whether one or more criteria representing expressed user disinterest are satisfied. In some examples, determining whether the user is disinterested in the virtual assistant session includes determining a probability of disinterest in the virtual assistant session. For example, if one or more criteria representing expressed user disinterest are satisfied, a probability of disinterest in the virtual assistant session is increased. If one or more criteria representing expressed user disinterest are not satisfied, the probability of disinterest in the virtual assistant session is decreased. In some examples, the user is determined to be disinterested in the virtual assistant session if the probability of disinterest is greater than a predetermined threshold and/or if one or more criteria representing expressed user disinterest are satisfied.
(221) Exemplary criteria representing expressed user disinterest are discussed below.
(222) An exemplary criterion includes a direction of a user gaze. For example, device **800** includes one or more front and/or rear facing cameras. Device **800** analyzes data collected by the one or more cameras to determine a direction of a user gaze. If device **800** determines that the direction of the user gaze is directed to the device, a criterion representing expressed user disinterest is not satisfied. If device **800** determines that the direction of the user gaze is not directed to the device, a criterion representing expressed user disinterest is satisfied. In some examples, if device **800** cannot determine a user gaze direction from camera data, the data is not considered in determining whether a user is disinterested in the virtual assistant session. In some examples, if device **800** cannot determine a user gaze direction from camera data (e.g., a user's face and/or gaze is not detected by one or more cameras), the data is considered to indicate that the user gaze is not directed to the device.
(223) An exemplary criterion includes a duration for which a user gaze is determined not to be directed to the device. For example, device **800** collects data from one or more cameras and determines whether a user gaze is directed to the electronic device for a predetermined duration (e.g., 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, etc. seconds). If device **800** determines that the user gaze is not directed to the device during the predetermined duration (e.g., camera data indicates that a user gaze is not directed to the device for any portion of the predetermined duration), a criterion representing expressed user disinterest is satisfied. In some examples, if device **800** determines that the user gaze is directed to the electronic device during the predetermined duration (e.g., camera data indicates that a user gaze is directed to the device for at least a portion of the predetermined duration), a criterion representing expressed user disinterest is not satisfied.
(224) In some examples, determining whether a user gaze is directed to the electronic device for a predetermined duration includes collecting one or more samples of the user gaze during the predetermined duration. For example, during an exemplary predetermined duration of 6 seconds, device **800** collects four samples of camera data. By way of example, a first sample is collected at 0 seconds (e.g., a predetermined duration after which a final result is presented), a second sample is collected at 2 seconds, a third sample is collected at 4 seconds, and a fourth sample is collected at 6 seconds. In some examples, if each of the samples of camera data indicates that a user gaze is not directed to the device, a criterion representing expressed user disinterest is satisfied. In some examples, if at least one of the samples of camera data indicates that a user gaze is directed to the device, a criterion representing expressed user disinterest is not satisfied. In some examples, if only the first sample indicates that a user gaze is directed to the device, a criterion representing expressed user disinterest is satisfied.
(225) An exemplary criterion includes a determination that user gaze towards the electronic device has discontinued. In some examples, determining that user gaze towards the electronic device has discontinued includes determining that the user gaze is directed to the device at a first time, and then determining that the user gaze is no longer directed to the device (e.g., for a predetermination duration) at a second time after the first time. In some examples, if device **800** determines that user gaze towards the electronic device has discontinued, a criterion representing expressed user disinterest is satisfied. In some examples, if device **800** does not determine that user gaze towards the electronic device has discontinued, a criterion representing expressed user disinterest is not satisfied.
(226) An exemplary criterion includes whether a user face (or a portion thereof) is detected. For example, device **800** includes one or more cameras and device **800** analyzes data collected from the one or more cameras to determine whether a user face is detected (e.g., a particular user's face, a human face not particular to any user). In some examples, if device **800** does not detect a user face, a criterion representing expressed user disinterest is satisfied. In some examples, if device **800** detects a user face, a criterion representing expressed user disinterest is not satisfied.
(227) An exemplary criterion includes a duration for which a user face is not detected. In some examples, determining a duration for which a user face is not detected is performed analogously to the above described techniques for determining a duration for which a user gaze is not directed to an electronic device.
(228) An exemplary criterion includes that a user face is no longer detected by the electronic device. In some examples, determining that the user face is no longer detected by the electronic device is performed analogously to the above described techniques for determining that user gaze towards the electronic device has discontinued.
(229) In some examples, a user chooses how he or she would like to deactivate the virtual assistant session based on face detection and/or gaze detection. For example, device **800** includes a user configurable setting that specifies either (1) to deactivate the virtual assistant session when a direction of a gaze is determined to not be directed to the device (e.g., for a

predetermined duration) (e.g., even if a face is detected) or (2) to deactivate the virtual assistant session when a face is not detected (e.g., for a predetermined duration).

(230) An exemplary criterion includes a lowering of the electronic device. For example, device **800** includes one or more sensors configured to detect motion of the electronic device (e.g., accelerometer(s), gyroscope(s), magnetometer(s), etc.). Device **800** analyzes data collected using the one or more sensors to determine a lowering of the device (e.g., a lowering of a device from near a user's face to near the user's waist, a lowering motion placing the device on a table, etc.). If device **800** determines the lowering, a criterion representing expressed user disinterest is satisfied. If device **800** does not determine a lowering, a criterion representing expressed user disinterest is not satisfied.

(231) An exemplary criterion includes an orientation of the electronic device. For example, device **800** includes one or more sensors configured to detect an orientation of the device (e.g., gyroscopes(s), camera(s), proximity sensors(s), light sensor(s), etc.). Device **800** analyzes data collected using the one or more sensors to determine whether the electronic device is facing down (e.g., horizontal and a display facing down). If device **800** determines it is facing down, a criterion representing expressed user disinterest is satisfied. If device **800** determines it is not facing down, a criterion representing expressed user disinterest is not satisfied.

(232) An exemplary criterion includes whether an electronic device is in an enclosed space. Exemplary enclosed spaces include a pocket, a bag, a drawer, a purse, etc. For example, device **800** includes one or more sensors configured to determine whether the electronic device is in an enclosed space (e.g., camera(s), light sensors(s), microphone(s), proximity sensor(s), etc.). Device **800** analyzes data collected from the one or more sensors to determine whether it is in an enclosed space. Any technique, currently known or later developed, for determining whether an electronic device is in an enclosed space may be employed. For example, device **800** uses proximity sensor data indicating the presence of an object very close to the device (e.g., touching the device, less than 2 cm away from the device, etc.) in conjunction with light sensor data indicating a low level of light to determine that the device is in an enclosed space. If device **800** determines that it is in an enclosed space, a criterion representing expressed user disinterest is satisfied. If device **800** determines that it is not in an enclosed space, a criterion representing expressed user disinterest is not satisfied.

(233) An exemplary criterion includes whether a display of an electronic device is covered (e.g., by a user hand). For example, device **800** includes one or more sensors configured to determine whether a display of the device is covered (e.g., camera(s), light sensors(s), microphone(s), proximity sensor(s), etc.). Device **800** analyzes data collected from the one or more sensors to determine whether its display is covered. For example, device **800** uses front-facing light sensor data indicating that a low level of light (or no light) is detected and/or front facing proximity sensor data indicating that an object is touching the display of the device to determine that the display is covered. If device **800** determines that its display is covered, a criterion representing expressed user disinterest is satisfied. If device **800** determines that its display is not covered, a criterion representing expressed user disinterest is not satisfied.

(234) In some examples, device **800** determines whether the user is disinterested in the virtual assistant session for a first predetermined duration (e.g., 15 seconds, 30 seconds, 45 seconds, 1 minute, etc.). For example, device **800** determines whether the user is disinterested in the virtual assistant session for a first predetermined duration after the time at which a final result for the virtual assistant session is presented (e.g., time T**3**). In some examples, if device **800** determines that the user is disinterested in the virtual assistant session during the first predetermined duration, device **800** automatically deactivates the virtual assistant session (e.g., when user disinterest is determined). In some examples, if device **800** does not determine that the user is disinterested in the virtual assistant session during the first predetermined duration (e.g., none of the above criteria representing expressed user disinterest is determined to be satisfied), device **800** forgoes automatically deactivating the virtual assistant session (e.g., until the time defined by a device setting) and device **800** ceases determining whether the user is disinterested in the virtual assistant session (e.g., ceases sampling camera data).

(235) Accordingly, in some examples, if device **800** does not determine user disinterest in a virtual assistant session during the first predetermined duration, device **800** resorts to a default behavior of not automatically deactivating the virtual assistant session (e.g., until the time defined by a device setting). This may provide the advantage of saving battery power and processing power otherwise consumed by determining whether the user is disinterested in the virtual assistant session (e.g., for longer than the first predetermined duration). This may also improve device usability by continuing execution of a virtual assistant session when the user is engaged with it (e.g., because if user disinterest is not determined during the first predetermined duration, the user may likely be engaged with the virtual assistant session).

(236) In some examples, determining that a user is engaged with the virtual assistant session prevents automatic deactivation of the virtual assistant session (e.g., until a time defined by a device setting). For example, if device **800** determines that the user is engaged with the virtual assistant session during the first predetermined duration (and before time T**4** at which the virtual assistant deactivates due to determining user disinterest), device **800** resorts to the default behavior of not automatically deactivating the virtual assistant session.

(237) In some examples, if device **800** determines that the user is engaged with the virtual assistant session during the first predetermined duration, device **800** continues to determine whether the user is disinterested in the virtual assistant session for a second predetermined duration (e.g., 15 seconds, 30 seconds, 45 seconds, etc.). For example, device **800** determines whether the user is disinterested in the virtual assistant session (e.g., according to the examples discussed above) for a second predetermined duration starting from a time at which user engagement was determined.

(238) In some examples, determining whether the user is engaged with the virtual assistant session includes, determining based on data obtained using one or more sensors of an electronic device, whether one or more criteria representing expressed user engagement are satisfied. In some examples, determining whether the user is engaged with the virtual assistant session includes determining a probability of engagement with the virtual assistant session. For example, if one or

more criteria representing expressed user engagement are satisfied, a probability of engagement with the virtual assistant session is increased. If one or more criteria representing expressed user engagement are not satisfied, the probability of engagement with the virtual assistant session is decreased. In some examples, the user is determined to be engaged with the virtual assistant session if the probability of engagement is greater than a predetermined threshold and/or if one or more criteria representing expressed user engagement are satisfied.
(239) Exemplary criteria representing expressed user engagement are discussed below.
(240) An exemplary criterion includes a direction of a user gaze. For example, analogous to the above discussed techniques, device **800** determines a direction of a user gaze. If device **800** determines that the direction of the user gaze is directed to the device (e.g., for a predetermined duration), a criterion representing expressed user engagement is satisfied. If device **800** determines that the direction of the user gaze is not directed to the device, a criterion representing expressed user engagement is not satisfied.
(241) An exemplary criterion includes whether a user face (or a portion thereof) is detected. For example, analogous to the above discussed techniques, device **800** analyzes obtained camera data to determine whether a user's face is detected. If device **800** detects a user face, a criterion representing expressed user engagement is satisfied. If device **800** does not detect a user face, a criterion representing expressed user engagement is not satisfied.
(242) An exemplary criterion includes whether a touch on the electronic device is detected. For example, device **800** determines whether a touch is detected on a touch sensitive display and/or on a touch sensitive button of the device. If device **800** detects a user touch, a criterion representing expressed user engagement is satisfied. If device **800** does not detect a user touch, a criterion representing expressed user engagement is not satisfied.
(243) An exemplary criterion includes a raising of an electronic device (e.g., a raising motion lifting an electronic device to eye level). For example, device **800** determines whether data obtained using one or more motion sensors indicate a raising of the device. If the data indicate a raising, a criterion representing expressed user engagement is satisfied. If the data does not indicate a raising, a criterion representing expressed user engagement is not satisfied.
(244) In the example depicted in FIG. **8**B, device **800** determines that user **802** is disinterested in the virtual assistant session. For example, device **800** determines that user **802**'s gaze is not directed to device **800**. Further, device **800** does not detect any indication that the user is engaged with the virtual assistant session, for instance.
(245) In some examples, in accordance with determining that the user is disinterested in a virtual assistant session (e.g., prior to time T**5** defined by a device setting), device **800** automatically deactivates the virtual assistant session at time T**4** (e.g., prior to time T**5**). For example, at time T**4**, a home screen user interface replaces a virtual assistant user interface. In some examples, operating and displaying a home screen user interface requires less battery and processing power than operating a virtual assistant (e.g., displaying a virtual assistant user interface). Accordingly, as shown in FIG. **8**B, battery and processing power are conserved by not operating the virtual assistant session between deactivation time and the deactivation time defined by the device setting (e.g., between T**4** and T**5**).
(246) In some examples, in accordance with determining that the user is disinterested in a virtual assistant session (e.g., prior to a time defined by a device setting), device **800** displays an affordance indicating that the virtual assistant session will be deactivated. For example, device **800** displays an affordance on display **804** for a predetermined duration (e.g., 1, 2, 3, 4, 5, 6, etc. seconds). During the predetermined duration, if a user interacts with the affordance (e.g., touches it and/or clicks it with a mouse cursor), deactivation of the virtual assistant session is forgone. For example, device **800** resorts to a default behavior of not deactivating the virtual assistant session (e.g., until time T**5** defined by a device setting). If a user does not interact with the affordance, device **800** automatically deactivates the virtual assistant session at the end of the predetermined duration. Accordingly, in some examples, a displayed affordance provides a visual indication that deactivation is imminent and a user interacts with the affordance to prevent deactivation.
(247) In some examples, in accordance with not determining that the user is disinterested in the virtual assistant session, device **800** automatically deactivates the virtual assistant session at the time defined by the device setting (e.g., at time T**5**).
(248) In some examples, the context of an electronic device affects whether and/or how a virtual assistant session is deactivated. For example, if a navigation application was executing when the virtual assistant was initiated, it may be undesirable for a virtual assistant user interface to replace a user interface associated with the navigation application for an extended duration. This may be because the user wishes to see navigation instructions while driving. Accordingly, in some examples, if the navigation application was executing when the virtual assistant session was initiated, the virtual assistant session automatically deactivates a short duration after a final result is presented.
(249) Exemplary device contexts and how the device contexts affect virtual assistant deactivation are discussed below.
(250) As discussed, an exemplary device context includes an application context. For example, device **800** determines whether a predetermined application is executing on device **800** when the virtual assistant session is initiated. If the predetermined application is executing, a virtual assistant session is automatically deactivated a short duration (e.g., 1, 2, 3, 4, 5, or 6 seconds) after a final result is presented. If the predetermined application is not executing, in some examples, the device determines whether to deactivate the virtual assistant session according to any of the techniques discussed herein. In some examples, the predetermined application is an application configured to provide navigation services (e.g., a maps application).
(251) An exemplary device context includes whether the device is paired to an external electronic device. For example, device **800** determines whether it is paired to an external electronic device through a wired or wireless communication medium (e.g., Bluetooth®, Wi-Fi, etc.). If device **800** is paired to an external electronic device, a virtual assistant session is automatically deactivated a short duration (e.g., 1, 2, 3, 4, 5, or 6 seconds) after a final result is presented. In some examples, an electronic device being paired to an external electronic device (e.g., a Bluetooth® enabled vehicle console) indicates that

the user is in a vehicle, and may not wish to be disturbed by an initiated virtual assistant session. Accordingly, in some examples, if device **800** is paired to an external electronic device, device **800** automatically deactivates the virtual assistant session shortly after a final result is presented.
(252) An exemplary device context includes a device mode and/or setting. For example, device **800** determines whether it is in a “do not disturb mode” (e.g., a device mode where audio and/or haptic output notifying a user about incoming communications is limited). If device **800** is in the “do not disturb” mode, device **800** automatically deactivates a virtual assistant session a short duration (e.g., 1, 2, 3, 4, 5, or 6 seconds) after a final result is presented.
(253) As another example, device **800** determines whether it is in a “low power mode” (e.g., a mode configured to save battery power). In some examples, device **800** enters a low power mode (e.g., by user request) if the battery level of device **800** falls below a predefined level (e.g., below 20%, 10%, 5%, etc.). If device **800** determines that it is in a low power mode, device **800** automatically deactivates a virtual assistant session a short duration (e.g., 1, 2, 3, 4, 5, or 6 seconds) after a final result is presented. In this manner, if battery level is low, device **800** automatically deactivates an initiated virtual assistant session shortly after request completion to save battery power.
(254) It is to be understood that the above described contexts are merely exemplary, and in some examples, other device contexts are considered in determining whether and/or how to deactivate a virtual assistant sessions. For example, device **800** may consider its location, a current time, its speed of movement, its device type (e.g., phone, watch, speaker, vehicle console, etc.), whether it was locked (e.g., via a passcode) when the virtual assistant session was initiated, whether it was outputting audio when the virtual assistant session was initiated, a domain of a result presented by the virtual assistant session, and/or a type of an external electronic device paired with it in determining whether and/or how to deactivate a virtual assistant session.
(255) In some examples, device **800** determines whether one or more of the above described contexts satisfy a predetermined condition (e.g., a predetermined location, a predetermined time, a predetermined device type, a predetermined domain, etc.). If the context satisfies the predetermined condition, the virtual assistant session operates according to a first default behavior (e.g., automatically deactivating a short duration (e.g., 1, 2, 3, 4, 5, or 6 seconds) after a final result is presented). In some examples, device **800** determines whether to override the first default behavior according to the techniques discussed herein. If the context does not satisfy the predetermined condition, the virtual assistant session operates according to a second default behavior (e.g., not automatically deactivating until a time defined by a device setting). In some examples, device **800** determines whether to override the second default behavior according to the techniques discussed herein.
(256) FIG. **8**C depicts an exemplary timeline of operating a virtual assistant session according to a default behavior of automatically deactivating a virtual assistant session a predetermined duration (e.g., a short duration) after a time at which a final result is presented. As discussed, deactivating the virtual assistant session according to the predetermined duration may be undesirable if the user is still engaging with the virtual assistant session.
(257) In FIG. **8**C, at time T**1** user **802** initiates a virtual assistant session by providing input via an external electronic device (e.g., a press of a button on wireless headset **806**). Device **800** determines that the input is a second type of input, and operates the virtual assistant session according to a default behavior of automatically deactivating a virtual assistant session a predetermined duration after a time at which a final result is presented.
(258) At time T**2**, user **802** provides a request to the virtual assistant session (e.g., “What's the news today?”). The virtual assistant performs a task based on the user request and presents a final result at time T**3**. For example, the virtual assistant session provides audio output “Here's some news” and displays one or more news articles (e.g., on display **804**) at time T**3**.
(259) User **802** is engaged with the virtual assistant session after the final result is presented. For example, as shown, a direction of user **802**'s gaze is directed to device **800** (e.g., because user **802** is reading news articles). However, due to the default behavior, device **800** automatically deactivates the virtual assistant session at time T**4**. Time T**4** is predetermined duration (e.g., 3, 4, 5, 6, etc. seconds) after time T**3** associated with the presentation of the final result. For example, device **800** replaces a virtual assistant user interface (containing news articles) with a home screen user interface at time T**4**.
(260) As shown, such default behavior may be undesirable, as the virtual assistant session deactivates despite the user being engaged with the virtual assistant session. Accordingly, in some examples, it can be desirable to forgo automatically deactivating the virtual assistant session.
(261) FIG. **8**D illustrates an exemplary timeline for forgoing automatically deactivating a virtual assistant session. In FIG. **8**D, a default behavior of automatically deactivating a virtual assistant session a predetermined duration after a final result is presented is overridden based on determining that the user is engaged with the virtual assistant session.
(262) In FIG. **8**D, at time T**1**, user **802** initiates a virtual assistant session by providing input via an external electronic device (e.g., a press of a button on wireless headset **806**). The input is the second type of input. Accordingly, the default behavior is to deactivate the virtual assistant session a predetermined duration after which a final result is presented (e.g., at time T**4**).
(263) At time T**2**, user **802** provides a request to the virtual assistant session (e.g., “What's the news today?”). The virtual assistant performs a task based on the user request and presents a final result at time T**3**. For example, the virtual assistant session provides audio output “Here's some news” and displays one or more news articles. As discussed below, device **800** then determines whether the user is engaged with the virtual assistant session to determine whether to override the default behavior of automatically deactivating the virtual assistant session shortly after request completion.
(264) In some examples, device **800** determines whether the user is engaged with the virtual assistant session as soon as a final result is presented. In some examples, device **800** determines whether the user is engaged with the virtual assistant session a predetermined duration (e.g., 1, 2, 3, 4, 5, 6 seconds) after a time when a final result is presented.
(265) In some examples, device **800** determines whether the user is engaged with the virtual assistant session in accordance with determining that the type of the user input for initiating the virtual assistant session is the second type. For example, as

discussed, the second type of input is associated with the default behavior of automatically deactivating the virtual assistant session shortly after request completion. Accordingly, device **800** determines whether the user is engaged with the virtual assistant session to determine whether to override the default behavior (e.g., by forgoing automatically deactivating the virtual assistant session shortly after request completion).
(266) In the present example, device **800** determines that user **802** is engaged with the virtual assistant session (e.g., prior to time T**4** at which the virtual assistant session would automatically deactivate).
(267) Determining whether a user is engaged with the virtual assistant session is performed according to any of the above discussed techniques. For example, device **800** determines that the user is engaged with the virtual assistant session if one or more criteria representing expressed user engagement are satisfied. For example, as shown in FIG. **8**D, device **800** determines that user **802** is engaged with the virtual assistant session because user **802**'s gaze is directed to device **800** (e.g., because user **802** is reading news articles).
(268) In some examples, in accordance with determining that a user is engaged with a virtual assistant session (e.g., prior to time T**4**), device **800** forgoes automatically deactivating the virtual assistant session at time T**4**. For example, as shown, a virtual assistant user interface remains displayed on display **804** at time T**4**. In this manner, device usability is improved by forgoing automatically deactivating a virtual assistant session when a user is engaged with it.
(269) In some examples, in accordance with forgoing automatically deactivating the virtual assistant session at time T**4**, device **800** determines whether a user is disinterested in the virtual assistant session (e.g., according to any of the above discussed techniques). For example, if after time T**4**, user **802** becomes disinterested in the virtual assistant session (e.g., user **802** looks away from device **800**), device **800** automatically deactivates the virtual assistant session when the user disinterest is detected (e.g., when or shortly after user **802** looks away).
(270) In some examples, in accordance with forgoing automatically deactivating the virtual assistant session at time T**4**, device **800** forgoes automatically deactivating the virtual assistant session (e.g., until a time defined by a device setting).
(271) In some examples, in accordance with not determining that a user is engaged with the virtual assistant session prior to time T**4**, device **800** automatically deactivates the virtual assistant session at time T**4**. For example, if device **800** determines that none of the above described criteria representing expressed user engagement is satisfied prior to time T**4**, device **800** automatically deactivates the virtual assistant session at time T**4**.
(272) FIG. **9** illustrates a block diagram of a system configured to operate a virtual assistant session according to various examples. In some examples, system **900** is implemented on a standalone computer system (e.g., any of devices **104**, **106**, **200**, **400**, **600**, or **800**). In some examples, system **900** is distributed across multiple devices. For example, some of the components and functions of system **900** are divided into a server portion and a client portion, where the client portion resides on one or more user devices (e.g., devices **104**, **106**, **200**, **400**, **600**, or **800**) and communicates with the server portion (e.g., server system **108**) through one or more networks, e.g., as shown in FIG. **1**.
(273) The respective functions of each of the blocks of FIG. **9** discussed below are, optionally implemented by hardware, software, or a combination of hardware and software to carry out the principles of the examples described herein. Further, it should be noted that system **900** is only one example of a system for deactivating a virtual assistant session and system **900** can have more or fewer components than shown, can combine two or more components, or can have a different configuration or arrangement of the components. Further, although the below discussion describes functions being performed at a single component of system **900**, it is to be understood that such functions can be performed at other components of system **900** and that such functions can be performed at more than one component of system **900**.
(274) System **900** includes input unit **902**, virtual assistant unit **918**, user engagement unit **920**, settings unit **922**, type determining unit **924**, and context unit **926**. In some examples, the components of system **900** include instructions for automatically deactivating a virtual assistant session and for foregoing automatically deactivating a virtual assistant session described in FIGS. **8**B and **8**D above. In some examples, the components of system **900** include instructions for performing the operations of process **1000** (FIGS. **10**A-B), described below.
(275) Input unit **902** includes various input devices, such as one or more cameras **904**, one or more accelerometers **906**, one or more microphones **908**, one or more gyroscopes **910**, one or more light sensors **912**, one or more proximity sensors **914**, and/or one or more touch sensors **916** (e.g., a touch sensitive button, a touch sensitive display screen, etc.). The depicted input devices are merely exemplary, and many other types of input devices can be included in input unit **902**.
(276) Inputs respectively collected by the various input devices are provided to, for instance, user engagement unit **920** and virtual assistant unit **918**. As discussed below, based on input from input unit **902**, user engagement unit **920** and/or virtual assistant unit **918** determine whether to deactivate a virtual assistant session according to the techniques discussed herein.
(277) Virtual assistant unit **918** is configured to operate a virtual assistant session according to any of the techniques discussed herein. For example, virtual assistant unit **918** provides the functionalities discussed above with respect to FIGS. **7**A-C. In some examples, virtual assistant unit **918** initiates a virtual assistant session responsive to receiving user input. In some examples, virtual assistant unit **918** automatically deactivates a virtual assistant session (e.g., based on a determination from user engagement unit **920** to automatically deactivate a virtual assistant session).
(278) User engagement unit **920** determines whether a user is engaged with a virtual assistant session according to any of the techniques discussed herein. For example, user engagement unit **920** determines whether one or more criteria representing expressed user engagement are satisfied and determines whether one or more criteria representing expressed user disinterest are satisfied. In some examples, user engagement unit **920** determines to automatically deactivate a virtual assistant session (e.g., at a time) according to any of the examples discussed herein. In some examples, user engagement unit **920** determines to forgo automatically deactivating a virtual assistant session (e.g., at a time) according to any of the examples discussed herein.

(279) In some examples, user engagement unit **920** includes a neural network and/or is implemented using any suitable machine learning technique. For example, based on inputs respectively provided by input unit **902**, settings unit **922**, type determining unit **924**, and/or context unit **926**, a machine learning model determines whether and/or when to deactivate a virtual assistant session according to the examples herein. In some examples, the machine learning model is trained (e.g., over time) to determine whether and/or when to deactivate a virtual assistant session based on the respective inputs.
(280) Settings unit **922** is configured to operate an electronic device according to device settings. For example, settings unit **922** is configured to accept user input specifying a device setting (e.g., a screen lock time) and to operate an electronic device according to the device setting. In some examples, settings unit **922** provides one or more device settings to user engagement unit **920** and user engagement unit **920** considers the one or more device settings in determining whether and/or when to deactivate a virtual assistant session according to the techniques discussed herein.
(281) Type determining unit **924** is configured to determine a type of user input for initiating a virtual assistant session. For example, type determining unit **924** determines whether user input is a first type or a second type according to the examples herein. In some examples, type determining unit **924** provides a determined user input type to user engagement unit **920**. User engagement unit **920** determines whether and/or when to deactivate the virtual assistant session based on the determined user input type according to the examples herein.
(282) Context unit **926** is configured to determine a context of the electronic device according to the examples herein. For example, context unit **926** determines whether a predetermined application is executing when a virtual assistant is initiated. In some examples, context unit **926** provides one or more determined contexts to user engagement unit **920**. User engagement unit **920** determines whether and/or when to deactivate the virtual assistant session based on the one or more determined contexts according to the examples herein.
(283) 5. Process for Automatically Deactivating a Virtual Assistant Session
(284) FIGS. **10**A-**10**B illustrate process **1000** for operating a digital assistant according to various examples. Process **1000** is performed, for example, using one or more electronic devices implementing a digital assistant (e.g., device **800**). In some examples, process **1000** is performed using a client-server system (e.g., system **100**), and the blocks of process **1000** are divided up in any manner between the server (e.g., DA server **106**) and a client device. In other examples, the blocks of process **1000** are divided up between the server and multiple client devices (e.g., a mobile phone and a smart watch). Thus, while portions of process **1000** are described herein as being performed by particular devices of a client-server system, it will be appreciated that process **1000** is not so limited. In other examples, process **1000** is performed using only a client device (e.g., user device **104**) or only multiple client devices. In process **1000**, some blocks are, optionally, combined, the order of some blocks is, optionally, changed, and some blocks are, optionally, omitted. In some examples, additional steps may be performed in combination with process **1000**.
(285) As described below, process **1000** includes initiating a virtual assistant session responsive to receiving user input (e.g., a button press or audio input such as “Hey Siri”). In some examples, as discussed, a type of the user input is determined and different strategies for deactivating the virtual assistant session are employed depending on the determined input type. For example, in accordance with determining that the input is a first type (e.g., a button press), it is determined whether one or more criteria representing expressed user disinterest are satisfied (e.g., whether a user gaze is not directed to an electronic device). In accordance with determining that the one or more criteria representing expressed user disinterest are satisfied prior to a first time defined by a setting of an electronic device (e.g., prior to a time specified by a screen lock setting), the virtual assistant session is automatically deactivated prior to the first time. In accordance with determining that the one or more criteria representing expressed user disinterest are not satisfied prior to the first time, the virtual assistant session is automatically deactivated at the first time (e.g., when a display screen powers off).
(286) In some examples, in accordance with determining that the input is a second type (e.g., an audio input such as “Hey Siri”), it is determined whether one or more criteria representing expressed user engagement are satisfied (e.g., whether a user gaze is directed to the device). In accordance with determining that the one or more criteria representing expressed user engagement are satisfied prior to a second time a predetermined duration after a third time at which a final result for the virtual session is presented (e.g., prior to when the virtual assistant session would automatically deactivate), deactivation of the virtual assistant session at the second time is forgone. In accordance with determining that the one or more criteria representing expressed user engagement are not satisfied prior to the second time, the virtual assistant session is deactivated at the second time.
(287) Determining, based on data obtained using one or more sensors of the electronic device, whether one or more criteria representing expressed user disinterest are satisfied (and/or whether one or more criteria representing expressed user engagement are satisfied) allows determination of whether a user is engaged with a virtual assistant session. Knowing whether a user is engaged allows intelligent decision making about whether to deactivate the virtual assistant session. For example, if the user is not engaged, a device can deactivate the virtual assistant session to save battery and processing power. As another example, if the user is engaged, the device can forgo deactivating the virtual assistant session so the user can continue interacting with the virtual assistant session (and so the virtual assistant session does not deactivate while the user is still interacting with it). In this manner, the user-device interface is made more efficient (e.g., by deactivating a virtual assistant session when a user is not engaged with it, by preventing deactivation of a virtual assistant session while the user is actively engaged with it, or by reducing user input to re-initiate an incorrectly deactivated virtual assistant session) which additionally, reduces power usage and improves battery life of the device by enabling the user to use the device more quickly and efficiently.
(288) At block **1002** a virtual assistant session is initiated (e.g., by virtual assistant unit **918**) responsive to receiving user input (e.g., from input unit **902**). For example, as shown in FIG. **8**B, a virtual assistant user interface including “How can I

help you?" is displayed on display **804**.
(289) In some examples, initiating the virtual assistant session includes providing audio output. In some examples, initiating the virtual assistant session includes displaying a user interface associated with the virtual assistant session (e.g., on display **804**).
(290) At block **1004**, a type of the user input is determined (e.g., by unit **924**). As discussed, in some examples, different types of user input are associated with different default behaviors for deactivating the virtual assistant session which may be overridden. Accordingly, determining the type of the user input allows correct determination of a default behavior for deactivating the virtual assistant session, which in turn, allows correct determination of the strategy used to override the default behavior. In this manner, a virtual assistant session may be deactivated when a user is not engaged with it and may not be deactivated when the user is engaged with it, making the user-device interface more efficient as discussed above.
(291) At block **1006**, in accordance with initiating the virtual assistant session, it is determined, based on data obtained using one or more sensors of the electronic device (e.g., data from input unit **902**), whether one or more criteria representing expressed user disinterest are satisfied (e.g., by unit **920**).
(292) In some examples, determining whether the one or more criteria representing expressed user disinterest are satisfied is performed in accordance with determining that the type of the user input is a first type (block **1004** FIRST TYPE). In some examples, the first type of user input includes input received via a physical button on the electronic device or via a virtual button on the electronic device.
(293) In some examples, a first final result for the virtual assistant session is presented at a second time and determining whether the one or more criteria representing expressed user disinterest are satisfied is performed after the second time. For example, determining whether the one or more criteria representing expressed user disinterest is performed after time T**3** in FIG. **8**B.
(294) Determining whether the one or more criteria representing expressed user disinterest are satisfied after the second time allows user disinterest to be determined at an appropriate time. For example, the user is likely interested in the virtual assistant session before the second time (e.g., when the virtual assistant session is presenting a result), so it may be unnecessary to determine whether the user is disinterested in the virtual assistant session before the second time. In this manner, consumption of battery and processing power to determine user disinterest at inappropriate times is prevented.
(295) The below described techniques for determining whether one or more criteria representing expressed user disinterest are satisfied may allow for accurate determination that a user is disinterested in a virtual assistant session. In this manner, an electronic device can accurately determine to deactivate a virtual assistant session when a user is disinterested in it.
(296) In some examples, the one or more criteria representing expressed user disinterest are satisfied in accordance with determining that a direction of a user gaze is not directed to the electronic device (e.g., by unit **920**), as shown in block **1008**.
(297) In some examples, the one or more criteria representing expressed user disinterest are satisfied in accordance with determining a lowering of the electronic device (e.g., by unit **920**), as shown in block **1010**.
(298) In some examples, the one or more criteria representing expressed user disinterest are satisfied in accordance with determining that the electronic device is facing down (e.g., by unit **920**), as shown in block **1012**.
(299) In some examples, the one or more criteria representing expressed user disinterest are satisfied in accordance with determining that the electronic device is in an enclosed space (e.g., by unit **920**), as shown in block **1014**.
(300) In some examples, the one or more criteria representing expressed user disinterest are determined to be satisfied if one or more of the respective determinations of blocks **1008**, **1010**, **1012**, and **1014** are made.
(301) At block **1016**, in accordance with determining that the one or more criteria representing expressed user disinterest are satisfied prior to a first time (e.g., time T**5** in FIG. **8**B), the virtual assistant session is automatically deactivated prior to the first time (e.g., by unit **918** at time T**4** in FIG. **8**B).
(302) In some examples, the first time is defined by a setting of the electronic device. In some examples, the setting of the electronic device is a user configurable setting associated with a screen lock time or a screen dimming time.
(303) In some examples, deactivating the virtual assistant session includes ceasing the display of the user interface associated with the virtual assistant session. For example as shown in FIG. **8**B, a virtual assistant user interface displaying a result is replaced with a home screen user interface.
(304) In some examples, automatically deactivating the virtual assistant session prior to the first time is performed at a fifth time (e.g., time T**4** in FIG. **8**B), and automatically deactivating the virtual assistant session at the fifth time is performed further in accordance with not detecting a touch on a screen or on a button of the electronic device between a third time associated with a second presentation of a second final result for the virtual assistant session and the fifth time (e.g., between times T**3** and T**4** in FIG. **8**B). In some examples, this advantageously prevents deactivation of a virtual assistant session if the user is determined to be engaged with the virtual assistant session (e.g., a user touch likely indicates engagement with the virtual assistant session).
(305) At block **1018**, in accordance with determining that the one or more criteria representing expressed user disinterest are not satisfied prior to the first time (e.g., by unit **920**), the virtual assistant session is automatically deactivated at the first time (e.g., time T**5** in FIG. **8**B).
(306) In some examples, it is determined (e.g., by unit **926**) whether a predetermined application (e.g., a maps application) is executing when the user input was received, as shown in block **1020**.
(307) In some examples, in accordance with a determination that the predetermined application is executing when the user input was received, the virtual assistant session is deactivated a predetermined duration after a fourth time associated with a third presentation of a third final result for the virtual assistant session, as shown in block **1022**.
(308) In some examples, it can be undesirable for a virtual assistant user interface to disrupt the display of a user interface

associated with certain applications (e.g., especially in examples where display of a virtual assistant user interface replaces display of a user interface associated with the application). For example, if the application is configured to provide navigation services (e.g., a maps application), it can be undesirable to replace such application's user interface with a virtual assistant user interface for an extended duration (e.g., because a user wishes to see navigation directions while driving, biking, running, etc.). Accordingly, deactivating a virtual assistant session in this manner improves user experience by allowing a device to quickly return to a desired application's user interface. User experience is further improved because the initiated virtual assistant can perform a user requested task and the effect of the initiated virtual assistant on displayed application user interfaces is minimized.
(309) Returning to FIG. **10**A, at block **1024**, in accordance with initiating the virtual assistant session, it is determined (e.g., by unit **920**), based on data obtained using one or more sensors of the electronic device, whether one or more criteria representing expressed user engagement are satisfied.
(310) In some examples, determining whether the one or more criteria representing expressed user engagement are satisfied is performed in accordance with determining that the type of the user input is a second type (block **1004** SECOND TYPE). In some examples, the second type of user input includes input received from an external electronic device (e.g., headset **806**) or audio input.
(311) The below described techniques for determining whether one or more criteria representing expressed user engagement are satisfied may allow for accurate determination that a user is engaged with a virtual assistant session. In this manner, an electronic device can accurately determine to forgo deactivating the virtual assistant session when a user is engaged with it.
(312) In some examples, the one or more criteria representing expressed user engagement are satisfied in accordance with determining that a direction of a user gaze is directed to the electronic device (e.g., by unit **920**), as shown in block **1026**.
(313) In some examples, the one or more criteria representing expressed user engagement are satisfied in accordance with detecting a touch on a button or on a screen of the electronic device (e.g., by unit **920**), as shown in block **1028**.
(314) In some examples, the one or more criteria representing expressed user engagement are satisfied in accordance with determining a raising of the electronic device (e.g., by unit **920**), as shown in block **1030**.
(315) In some examples, the one or more criteria representing expressed user engagement are determined to be satisfied if one or more of the respective determinations of blocks **1026**, **1028**, and **1030** are made.
(316) At block **1032**, in accordance with determining that the one or more criteria representing expressed user engagement are satisfied prior to a first time (e.g., time T**4** in FIG. **8**D), deactivating the virtual assistant at the first time is forgone. The first time is a predetermined duration after a second time at which a final result for the virtual assistant session is presented (e.g., time T**3** in FIG. **8**D). For example, as shown in FIG. **8**D, at time T**4**, a virtual assistant user interface displaying a result remains displayed.
(317) At block **1034**, in accordance with determining that the one or more criteria representing expressed user engagement are not satisfied prior to the first time, the virtual assistant session is deactivated at the first time (e.g., by unit **918**). In some examples, deactivating the virtual assistant session includes ceasing the display of the user interface associated with the virtual assistant session.
(318) In some examples, it is determined (e.g., by unit **926**) whether a predetermined application is executing when the user input was received, as shown in block **1036**.
(319) In some examples, in accordance with a determination that the predetermined application is executing when the user input was received, the virtual assistant session is deactivated (e.g., by unit **918**) a second predetermined duration after the second time, as shown in block **1038**.
(320) The operations described above with reference to FIGS. **10**A-**10**B are optionally implemented by components depicted in FIGS. **1**-**4**, **6**A-**6**B, **7**A-**7**C, **8**A-**8**D, and **9**. For example, the operations of process **1000** may be implemented by, inter alia, virtual assistant unit **918** and user engagement unit **920**. It would be clear to a person having ordinary skill in the art how other processes are implemented based on the components depicted in FIGS. **1**-**4**, **6**A-**6**B, and **7**A-**7**C, **8**A-**8**D, and **9**.
(321) In accordance with some implementations, a computer-readable storage medium (e.g., a non-transitory computer readable storage medium) is provided, the computer-readable storage medium storing one or more programs for execution by one or more processors of an electronic device, the one or more programs including instructions for performing any of the methods or processes described herein.
(322) In accordance with some implementations, an electronic device (e.g., a portable electronic device) is provided that comprises means for performing any of the methods or processes described herein.
(323) In accordance with some implementations, an electronic device (e.g., a portable electronic device) is provided that comprises a processing unit configured to perform any of the methods or processes described herein.
(324) In accordance with some implementations, an electronic device (e.g., a portable electronic device) is provided that comprises one or more processors and memory storing one or more programs for execution by the one or more processors, the one or more programs including instructions for performing any of the methods or processes described herein.
(325) The foregoing description, for purpose of explanation, has been described with reference to specific embodiments. However, the illustrative discussions above are not intended to be exhaustive or to limit the invention to the precise forms disclosed. Many modifications and variations are possible in view of the above teachings. The embodiments were chosen and described in order to best explain the principles of the techniques and their practical applications. Others skilled in the art are thereby enabled to best utilize the techniques and various embodiments with various modifications as are suited to the particular use contemplated.
(326) Although the disclosure and examples have been fully described with reference to the accompanying drawings, it is to be noted that various changes and modifications will become apparent to those skilled in the art. Such changes and

modifications are to be understood as being included within the scope of the disclosure and examples as defined by the claims.
(327) As described above, one aspect of the present technology is the gathering and use of data available from various sources to improve decision making about whether and/or when to deactivate a virtual assistant session. The present disclosure contemplates that in some instances, this gathered data may include personal information data that uniquely identifies or can be used to contact or locate a specific person. Such personal information data can include demographic data, location-based data, telephone numbers, email addresses, twitter IDs, home addresses, data or records relating to a user's health or level of fitness (e.g., vital signs measurements, medication information, exercise information), date of birth, or any other identifying or personal information.
(328) The present disclosure recognizes that the use of such personal information data, in the present technology, can be used to the benefit of users. For example, the personal information data can be used to determine that a user is engaged with a virtual assistant session (e.g., through detection of the user's face). Accordingly, use of such personal information enables accurate determination of whether to deactivate a virtual assistant session based on determined user engagement. Further, other uses for personal information data that benefit the user are also contemplated by the present disclosure. For instance, health and fitness data may be used to provide insights into a user's general wellness, or may be used as positive feedback to individuals using technology to pursue wellness goals.
(329) The present disclosure contemplates that the entities responsible for the collection, analysis, disclosure, transfer, storage, or other use of such personal information data will comply with well-established privacy policies and/or privacy practices. In particular, such entities should implement and consistently use privacy policies and practices that are generally recognized as meeting or exceeding industry or governmental requirements for maintaining personal information data private and secure. Such policies should be easily accessible by users, and should be updated as the collection and/or use of data changes. Personal information from users should be collected for legitimate and reasonable uses of the entity and not shared or sold outside of those legitimate uses. Further, such collection/sharing should occur after receiving the informed consent of the users. Additionally, such entities should consider taking any needed steps for safeguarding and securing access to such personal information data and ensuring that others with access to the personal information data adhere to their privacy policies and procedures. Further, such entities can subject themselves to evaluation by third parties to certify their adherence to widely accepted privacy policies and practices. In addition, policies and practices should be adapted for the particular types of personal information data being collected and/or accessed and adapted to applicable laws and standards, including jurisdiction-specific considerations. For instance, in the US, collection of or access to certain health data may be governed by federal and/or state laws, such as the Health Insurance Portability and Accountability Act (HIPAA); whereas health data in other countries may be subject to other regulations and policies and should be handled accordingly. Hence different privacy practices should be maintained for different personal data types in each country.
(330) Despite the foregoing, the present disclosure also contemplates embodiments in which users selectively block the use of, or access to, personal information data. That is, the present disclosure contemplates that hardware and/or software elements can be provided to prevent or block access to such personal information data. For example, in the case of collecting and storing the user's facial characteristics, the present technology can be configured to allow users to select to “opt in” or “opt out” of participation in the collection of personal information data during registration for services or anytime thereafter. In another example, users can select not to provide data representing facial characteristics to an electronic device. In yet another example, users can select to limit the length of time data representing facial characteristics is maintained or entirely prohibit the collection and usage of data representing facial characteristics. In addition to providing “opt in” and “opt out” options, the present disclosure contemplates providing notifications relating to the access or use of personal information. For instance, a user may be notified upon downloading an app that their personal information data will be accessed and then reminded again just before personal information data is accessed by the app.
(331) Moreover, it is the intent of the present disclosure that personal information data should be managed and handled in a way to minimize risks of unintentional or unauthorized access or use. Risk can be minimized by limiting the collection of data and deleting data once it is no longer needed. In addition, and when applicable, including in certain health related applications, data de-identification can be used to protect a user's privacy. De-identification may be facilitated, when appropriate, by removing specific identifiers (e.g., date of birth, etc.), controlling the amount or specificity of data stored (e.g., collecting location data at a city level rather than at an address level), controlling how data is stored (e.g., aggregating data across users), and/or other methods.
(332) Therefore, although the present disclosure broadly covers use of personal information data to implement one or more various disclosed embodiments, the present disclosure also contemplates that the various embodiments can also be implemented without the need for accessing such personal information data. That is, the various embodiments of the present technology are not rendered inoperable due to the lack of all or a portion of such personal information data. For example, it can be determined whether a user is engaged with a virtual assistant session based on non-personal information data or a bare minimum amount of personal information, such as the content being requested by the device associated with a user, other non-personal information such as an orientation and/or a raising or lowering of the device, or publicly available information.

Claims

1. A non-transitory computer-readable storage medium storing one or more programs, the one or more programs comprising instructions, which when executed by one or more processors of an electronic device that includes a camera, cause the

electronic device to: initiate a virtual assistant session responsive to receiving user input; in accordance with initiating the virtual assistant session, determine whether one or more criteria representing expressed user engagement are satisfied, wherein determining that the one or more criteria representing expressed user engagement are satisfied includes: obtaining data from the camera; and determining, based on the data obtained from the camera, that a user face is detected; in accordance with determining that the one or more criteria representing expressed user engagement are satisfied prior to a first time, forgo deactivating the virtual assistant session at the first time, wherein the first time is a predetermined duration after a second time at which a final result for the virtual assistant session is presented; and in accordance with determining that the one or more criteria representing expressed user engagement are not satisfied prior to the first time, deactivate the virtual assistant session at the first time.

2. The non-transitory computer-readable storage medium of claim 1, wherein the one or more programs further comprise instructions, which when executed by the one or more processors, cause the electronic device to: present the final result for the virtual assistant session, wherein the data is obtained from the camera a second predetermined duration after the final result is presented.

3. The non-transitory computer-readable storage medium of claim 1, wherein the one or more programs further comprise instructions, which when executed by the one or more processors, cause the electronic device to: present the final result for the virtual assistant session, wherein the data is obtained from the camera in response to the final result being presented.

4. The non-transitory computer-readable storage medium of claim 1, wherein determining that the one or more criteria representing expressed user engagement are satisfied further includes determining, based on the data obtained from the camera, that a user gaze is directed to the electronic device.

5. The non-transitory computer-readable storage medium of claim 1, wherein determining that the one or more criteria representing expressed user engagement are satisfied further includes detecting a touch on a button or on a screen of the electronic device.

6. The non-transitory computer-readable storage medium of claim 1, wherein determining that the one or more criteria representing expressed user engagement are satisfied further includes determining a raising motion of the electronic device.

7. The non-transitory computer-readable storage medium of claim 1, wherein initiating the virtual assistant session includes displaying a user interface associated with the virtual assistant session.

8. The non-transitory computer-readable storage medium of claim 7, wherein deactivating the virtual assistant session includes ceasing the display of the user interface associated with the virtual assistant session.

9. The non-transitory computer-readable storage medium of claim 1, wherein the one or more programs further comprise instructions, which when executed by the one or more processors, cause the electronic device to: after forgoing deactivating the virtual assistant session at the first time: determine whether one or more criteria representing expressed user disinterest are satisfied; and in accordance with a determination that the one or more criteria representing expressed user disinterest are satisfied, deactivate the virtual assistant session.

10. The non-transitory computer-readable storage medium of claim 9, wherein determining that the one or more criteria representing expressed user disinterest are satisfied includes: obtaining second data from the camera; and determining, based on the second data obtained from the camera, that a user gaze is not directed to the electronic device.

11. The non-transitory computer-readable storage medium of claim 9, wherein determining that the one or more criteria representing expressed user disinterest are satisfied includes: obtaining second data from the camera; and determining, based on the second data obtained from the camera, that a second user face is not detected.

12. The non-transitory computer-readable storage medium of claim 1, wherein the one or more programs further comprise instructions, which when executed by the one or more processors, cause the electronic device to: after forgoing deactivating the virtual assistant session at the first time, continue continuing to forgo deactivating the virtual assistant session until a time defined by a setting of the electronic device.

13. An electronic device, comprising: a camera; one or more processors; a memory; and one or more programs, wherein the one or more programs are stored in the memory and configured to be executed by the one or more processors, the one or more programs including instructions for: initiating a virtual assistant session responsive to receiving user input; in accordance with initiating the virtual assistant session, determining whether one or more criteria representing expressed user engagement are satisfied, wherein determining that the one or more criteria representing expressed user engagement are satisfied includes: obtaining data from the camera; and determining, based on the data obtained from the camera, that a user face is detected; in accordance with determining that the one or more criteria representing expressed user engagement are satisfied prior to a first time, forgoing deactivating the virtual assistant session at the first time, wherein the first time is a predetermined duration after a second time at which a final result for the virtual assistant session is presented; and in accordance with determining that the one or more criteria representing expressed user engagement are not satisfied prior to the first time, deactivating the virtual assistant session at the first time.

14. The electronic device of claim 13, wherein the one or more programs further include instructions for: presenting the final result for the virtual assistant session, wherein the data is obtained from the camera a second predetermined duration after the final result is presented.

15. The electronic device of claim 13, wherein the one or more programs further include instructions for: presenting the final result for the virtual assistant session, wherein the data is obtained from the camera in response to the final result being presented.

16. The electronic device of claim 13, wherein determining that the one or more criteria representing expressed user engagement are satisfied further includes determining, based on the data obtained from the camera, that a user gaze is directed to the electronic device.

17. The electronic device of claim 13, wherein determining that the one or more criteria representing expressed user engagement are satisfied further includes detecting a touch on a button or on a screen of the electronic device.
18. The electronic device of claim 13, wherein determining that the one or more criteria representing expressed user engagement are satisfied further includes determining a raising motion of the electronic device.
19. The electronic device of claim 13, wherein initiating the virtual assistant session includes displaying a user interface associated with the virtual assistant session.
20. The electronic device of claim 19, wherein deactivating the virtual assistant session includes ceasing the display of the user interface associated with the virtual assistant session.
21. The electronic device of claim 13, wherein the one or more programs further include instructions for: after forgoing deactivating the virtual assistant session at the first time: determining whether one or more criteria representing expressed user disinterest are satisfied; and in accordance with a determination that the one or more criteria representing expressed user disinterest are satisfied, deactivating the virtual assistant session.
22. The electronic device of claim 21, wherein determining that the one or more criteria representing expressed user disinterest are satisfied includes: obtaining second data from the camera; and determining, based on the second data obtained from the camera, that a user gaze is not directed to the electronic device.
23. The electronic device of claim 21, wherein determining that the one or more criteria representing expressed user disinterest are satisfied includes: obtaining second data from the camera; and determining, based on the second data obtained from the camera, that a second user face is not detected.
24. The electronic device of claim 13, wherein the one or more programs further include instructions for: after forgoing deactivating the virtual assistant session at the first time, continuing to forgo deactivating the virtual assistant session until a time defined by a setting of the electronic device.
25. A method, comprising: at an electronic device with a camera: initiating a virtual assistant session responsive to receiving user input; in accordance with initiating the virtual assistant session, determining whether one or more criteria representing expressed user engagement are satisfied, wherein determining that the one or more criteria representing expressed user engagement are satisfied includes: obtaining data from the camera; and determining, based on the data obtained from the camera, that a user face is detected; in accordance with determining that the one or more criteria representing expressed user engagement are satisfied prior to a first time, forgoing deactivating the virtual assistant session at the first time, wherein the first time is a predetermined duration after a second time at which a final result for the virtual assistant session is presented; and in accordance with determining that the one or more criteria representing expressed user engagement are not satisfied prior to the first time, deactivating the virtual assistant session at the first time.
26. The method of claim 25, further comprising: presenting the final result for the virtual assistant session, wherein the data is obtained from the camera a second predetermined duration after the final result is presented.
27. The method of claim 25, further comprising: presenting the final result for the virtual assistant session, wherein the data is obtained from the camera in response to the final result being presented.
28. The method of claim 25, wherein determining that the one or more criteria representing expressed user engagement are satisfied further includes determining, based on the data obtained from the camera, that a user gaze is directed to the electronic device.
29. The method of claim 25, wherein determining that the one or more criteria representing expressed user engagement are satisfied further includes detecting a touch on a button or on a screen of the electronic device.
30. The method of claim 25, wherein determining that the one or more criteria representing expressed user engagement are satisfied further includes determining a raising motion of the electronic device.
31. The method of claim 25, wherein initiating the virtual assistant session includes displaying a user interface associated with the virtual assistant session.
32. The method of claim 31, wherein deactivating the virtual assistant session includes ceasing the display of the user interface associated with the virtual assistant session.
33. The method of claim 25, further comprising: after forgoing deactivating the virtual assistant session at the first time: determining whether one or more criteria representing expressed user disinterest are satisfied; and in accordance with a determination that the one or more criteria representing expressed user disinterest are satisfied, deactivating the virtual assistant session.
34. The method of claim 33, wherein determining that the one or more criteria representing expressed user disinterest are satisfied includes: obtaining second data from the camera; and determining, based on the second data obtained from the camera, that a user gaze is not directed to the electronic device.
35. The method of claim 33, wherein determining that the one or more criteria representing expressed user disinterest are satisfied includes: obtaining second data from the camera; and determining, based on the second data obtained from the camera, that a second user face is not detected.
36. The method of claim 25, further comprising: after forgoing deactivating the virtual assistant session at the first time, continuing to forgo deactivating the virtual assistant session until a time defined by a setting of the electronic device.