Intelligent Assistants – Conceptual Dimensions, Contextual Model, and Design Trends

Hitesh Dhiman, Christoph Wächter, Michael Fellmann, Carsten Röcker

Business & Information Systems Engineering (2022)

Appendix (available online via http://link.springer.com)

A Complete List of Articles used for Literature Review

List of Articles used for Research Objective 1

Erickson T, Danis CM, Kellogg WA, Helander ME (2008) Assistance: the work practices of human administrative assistants and their implications for it and organizations. In: Proceedings of the ACM 2008 conference on Computer supported cooperative work - CSCW '08, ACM Press, San Diego, CA, USA, p 609, 10.1145/1460563.1460658, http://portal.acm.org/citation.cfm?doid=1460563.1460658

Hall S, Quick J, Hall A, Jones A (2014) Surgical assistance - who can help? The Bulletin of the Royal College of Surgeons of England 96(7):244–246, 10.1308/rcsbull.2014.96.7.244, http://publishing.rcseng.ac.uk/doi/10.1308/rcsbull.2014.96.7.244

Henshall C, Doherty A, Green H, Westcott L, Aveyard H (2019) The role of the assistant practitioner in the clinical setting: a focus group study. part 1. British Journal of Healthcare Assistants 13(2):94–99, 10.12968/bjha.2019.13.2.94, https://doi.org/10.12968/bjha.2019.13.2.94

Kerry T (2005) Towards a typology for conceptualizing the roles of teaching assistants. Educational Review 57(3):373–384, 10.1080/00131910500149515, http://www.tandfonline.com/doi/abs/10.1080/00131910500149515

Minondo S, Meyer LH, Xin JF (2001) The Role and Responsibilities of Teaching Assistants in Inclusive Education: What's Appropriate? Journal of the Association for Persons with Severe Handicaps 26(2):114–119, 10.2511/rpsd.26.2.114, http://journals.sagepub.com/doi/10.2511/rpsd.26.2.114

Perry M, Carpenter I, Challis D, Hope K (2003) Understanding the roles of registered general nurses and care assistants in UK nursing homes. Journal of Advanced Nursing 42(5):497–505, 10.1046/j.1365-2648.2003.02649.x, http://doi.wiley.com/10.1046/j.1365-2648.2003.02649.x

Quick J (2013) The role of the surgical care practitioner within the surgical team. British Journal of Nursing 22(13):759–765, 10.12968/bjon.2013.22.13.759, http://www.magonlinelibrary.com/doi/10.12968/bjon.2013.22.13.759

Taché S, Hill-Sakurai L (2010) Medical assistants: the invisible "glue" of primary health care practices in the United States? Journal of Health Organization and Management 24(3):288–305, 10.1108/14777261011054626, https://www.emerald.com/insight/content/doi/10.1108/14777261011054626/full/html

Takala M (2007) The work of classroom assistants in special and mainstream education in Finland. British Journal of Special Education 34(1):50–57, 10.1111/j.1467-8578.2007.00453.x, http://doi.wiley.com/10.1111/j.1467-8578.2007.00453.x

Whisler TL (1960) The "Assistant-to" in Four Administrative Settings. Administrative Science Quarterly 5(2):181, 10.2307/2390778, https://www.jstor.org/stable/2390778?origin=crossref

List of Articles used for Research Objectives 2 & 3

Aist G, Dowding J, Hockey BA, Rayner M, Hieronymus J, Bohus D, Boven B, Blaylock N, Campana E, Early S, Gorrell G, Phan S (2003) Talking Through Procedures: An Intelligent Space Station Procedure Assistant. In: Proceedings of the Tenth Conference on European Chapter of the Association for Computational Linguistics - Volume 2, Association for Computational Linguistics, Stroudsburg, PA, USA, EACL '03, pp 187–190, 10.3115/1067737.1067781, https://doi.org/10.3115/1067737.1067781, event-place: Budapest, Hungary

Alvarez I, López-de Ipiña MK, Gilbert JE (2012) The Voice User Help, a Smart Vehicle Assistant for the Elderly. In: Hutchison D, Kanade T, Kittler J, Kleinberg JM, Mattern F, Mitchell JC, Naor M, Nierstrasz O, Pandu Rangan C, Steffen B, Sudan M, Terzopoulos D, Tygar D, Vardi MY, Weikum G, Bravo J, López-de Ipiña D, Moya F (eds) Ubiquitous Computing and Ambient Intelligence, vol 7656, Springer Berlin Heidelberg, Berlin, Heidelberg, pp 314–321, 10.1007/978-3-642-35377-2_43, http://link.springer.com/10.1007/978-3-642-35377-2_43

Arai F, Ito M, Fukuda T, Negoro M, Naito T (1995) Intelligent assistance for intravascular tele-surgery and experiments on virtual simulator. In: Proceedings Virtual Reality Annual International Symposium '95, pp 101–107, 10.1109/VRAIS.1995.512485

Armenatzoglou N, Marketakis Y, Kriara L, Apostolopoulos E, Papavasiliou V, Kampas D, Kapravelos A, Kartsonakis E, Linardakis G, Nikitaki S, Bikakis A, Antoniou G (2009) FleXConf: A Flexible Conference Assistant Using Context-Aware Notification Services. In: Hutchison D, Kanade T, Kittler J, Kleinberg JM, Mattern F, Mitchell JC, Naor M, Nierstrasz O, Pandu Rangan C, Steffen B, Sudan M, Terzopoulos D, Tygar D, Vardi MY, Weikum G, Meersman R, Herrero P, Dillon T (eds) On the Move to Meaningful Internet Systems: OTM 2009 Workshops, vol 5872, Springer Berlin Heidelberg, Berlin, Heidelberg, pp 108–117, 10.1007/978-3-642-05290-3_20, http://link.springer.com/10.1007/978-3-642-05290-3_20

Attanayake D, Pfluegel E, Hunter G, Denholm-Price J (2012) SWIMS (Speech-Based Web Interface for Mathematics Using Statistical Language Models): An Intelligent Editing Assistant for Mathematical Text. In: 2012 Eighth International Conference on Intelligent Environments, pp 327–330, 10.1109/IE.2012.41

Babaian T, Grosz BJ, Shieber SM (2002) A Writer's Collaborative Assistant. In: Proceedings of the 7th International Conference on Intelligent User Interfaces, ACM, New York, NY, USA, IUI '02, pp 7–14, 10.1145/502716.502722, http://doi.acm.org/10.1145/502716.502722, event-place: San Francisco, California, USA

Balinsky H, Moore NCA, Simske SJ (2011) Intelligent Assistant for Context-Aware Policies. In: 2011 IEEE 10th International Conference on Trust, Security and Privacy in Computing and Communications, pp 621–630, 10.1109/TrustCom.2011.80

Bench-Capon TJM, Staniford G (1995) PLAID: Proactive Legal Assistance. In: Proceedings of the 5th International Conference on Artificial Intelligence and Law, ACM, New York, NY, USA, ICAIL '95, pp 81–88, 10.1145/222092.222142, http://doi.acm.org/10.1145/222092.222142, event-place: College Park, Maryland, USA

Berry PM, Gervasio M, Peintner B, Yorke-Smith N (2011) PTIME: Personalized Assistance for Calendaring. ACM Trans Intell Syst Technol 2(4):40:1–40:22, 10.1145/1989734.1989744, http://doi.acm.org/10.1145/1989734.1989744

Bhattacharya S, Floréen P, Forsblom A, Hemminki S, Myllymäki P, Nurmi P, Pulkkinen T, Salovaara A (2012) Ma$$iv – An Intelligent Mobile Grocery Assistant. In: 2012 Eighth International Conference on Intelligent Environments, pp 165–172, 10.1109/IE.2012.21

Bolcer GA (1994) User interface design assistance for large-scale software development. In: Proceedings KBSE '94. Ninth Knowledge-Based Software Engineering Conference, pp 142–149, 10.1109/KBSE.1994.342668

Bouloutian S, Kim E (2014) Artificial Intelligence Gaming Assistant for Google Glass. In: Bebis G, Boyle R, Parvin B, Koracin D, McMahan R, Jerald J, Zhang H, Drucker SM, Kambhamettu C, El Choubassi M, Deng Z, Carlson M (eds) Advances in Visual Computing, vol 8888, Springer International Publishing, Cham, pp 770–778, 10.1007/978-3-319-14364-4_74, `http://link.springer.com/10.1007/978-3-319-14364-4_74`

Bradley N, Fritz T, Holmes R (2018) Context-Aware Conversational Developer Assistants. In: 2018 IEEE/ACM 40th International Conference on Software Engineering (ICSE), pp 993–1003, 10.1145/3180155.3180238, iSSN: 1558-1225

Brancaleoni R, Cesta A, D'Aloisi D (1997) MASMA: A personal assistant for meetings management. In: Carbonell JG, Siekmann J, Goos G, Hartmanis J, Leeuwen J, Lenzerini M (eds) AI*IA 97: Advances in Artificial Intelligence, vol 1321, Springer Berlin Heidelberg, Berlin, Heidelberg, pp 455–458, 10.1007/3-540-63576-9_135, `http://link.springer.com/10.1007/3-540-63576-9_135`

Brezillon PJ (1994) Design of an intelligent assistant system from several applications. In: Proceedings of International Conference on Expert Systems for Development, pp 228–233, 10.1109/ICESD.1994.302276

Caine A, Cohen R (2006) MITS: A Mixed-Initiative Intelligent Tutoring System for Sudoku. In: Kanade T, Kittler J, Kleinberg JM, Mattern F, Mitchell JC, Nierstrasz O, Pandu Rangan C, Steffen B, Sudan M, Terzopoulos D, Tygar D, Vardi MY, Weikum G, Tawfik AY, Goodwin SD (eds) Advances in Artificial Intelligence, vol 3060, Springer Berlin Heidelberg, Berlin, Heidelberg, pp 550–561, 10.1007/11766247_47, `http://link.springer.com/10.1007/11766247_47`

Casamayor A, Amandi A, Campo M (2009) Intelligent assistance for teachers in collaborative e-learning environments. Computers & Education 53(4, SI):1147–1154, 10.1016/j.compedu.2009.05.025

Chaari WL, Moisan S, Ghalila SS, Rigault J (2007) Distributed Intelligent Medical Assistant for Osteoporosis Detection. In: 2007 29th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, pp 4347–4350, 10.1109/IEMBS.2007.4353299

Chen L, Cheng S, Birnbaum L, Hammond KJ (2002) The Interactive Chef: A Task-sensitive Assistant. In: Proceedings of the 7th International Conference on Intelligent User Interfaces, ACM, New York, NY, USA, IUI '02, pp 234–234, 10.1145/502716.502773, `http://doi.acm.org/10.1145/502716.502773`, event-place: San Francisco, California, USA

Costello E, Doody J, McGinty L, Smyth B (2006) iCARE: Intelligent Customer Assistance for Recommending Eyewear. In: Proceedings of the 11th International Conference on Intelligent User Interfaces, ACM, New York, NY, USA, IUI '06, pp 282–284, 10.1145/1111449.1111511, `http://doi.acm.org/10.1145/1111449.1111511`, event-place: Sydney, Australia

Coyle L, Cunningham P, Hayes C (2002) A Case-Based Personal Travel Assistant for Elaborating User Requirements and Assessing Offers. In: Goos G, Hartmanis J, van Leeuwen J, Craw S, Preece A (eds) Advances in Case-Based Reasoning, vol 2416, Springer Berlin Heidelberg, Berlin, Heidelberg, pp 505–518, 10.1007/3-540-46119-1_37, `http://link.springer.com/10.1007/3-540-46119-1_37`

Croatti A, Montagna S, Ricci A (2017) A Personal Medical Digital Assistant Agent for Supporting Human Operators in Emergency Scenarios. In: Sukthankar G, Rodriguez-Aguilar JA (eds) Autonomous Agents and Multiagent Systems, vol 10643, Springer International Publishing, Cham, pp 228–244, 10.1007/978-3-319-71679-4_15, `http://link.springer.com/10.1007/978-3-319-71679-4_15`

Crossen A, Budzik J, Warner M, Birnbaum L, Hammond KJ (2001) XLibris: An Automated Library Research Assistant. In: Proceedings of the 6th International Conference on Intelligent User Interfaces, ACM, New York, NY, USA, IUI '01, pp 49–52, 10.1145/359784.360100, `http://doi.acm.org/10.1145/359784.360100`, event-place: Santa Fe, New Mexico, USA

Czibula G, Guran A, Czibula IG, Cojocar GS (2009) IPA - An intelligent personal assistant agent for task performance support. In: 2009 IEEE 5th International Conference on Intelligent Computer Communication and Processing, pp 31–34, 10.1109/ICCP.2009.5284791

De Roeck A, Kruschwitz U, Neal P, Scott P, Steel S, Turner R, Webb N (1998) YPA - an intelligent directory enquiry assistant. BT TECHNOLOGY JOURNAL 16(3):145–155, 10.1023/A:1009650503571

Delgrange C, Dussoux J, Dominey PF (2019) Usage-Based Learning in Human Interaction with an Adaptive Virtual Assistant. IEEE Transactions on Cognitive and Developmental Systems pp 1–1, 10.1109/TCDS.2019.2927399

Dillenburg JF, Wolfson O, Nelson PC (2002) The Intelligent Travel Assistant. In: Proceedings. The IEEE 5th International Conference on Intelligent Transportation Systems, pp 691–696, 10.1109/ITSC.2002.1041302

Djian D (2000) Communication Management: E-Mail and Telephone Assistants. In: Goos G, Hartmanis J, van Leeuwen J, Azvine B, Nauck DD, Azarmi N (eds) Intelligent Systems and Soft Computing, vol 1804, Springer Berlin Heidelberg, Berlin, Heidelberg, pp 284–300, 10.1007/10720181_12, `http://link.springer.com/10.1007/10720181_12`

Dong R, McCarthy K, O'Mahony M, Schaal M, Smyth B (2012) Towards an Intelligent Reviewer's Assistant: Recommending Topics to Help Users to Write Better Product Reviews. In: Proceedings of the 2012 ACM International Conference on Intelligent User Interfaces, ACM, New York, NY, USA, IUI '12, pp 159–168, 10.1145/2166966.2166995, `http://doi.acm.org/10.1145/2166966.2166995`, event-place: Lisbon, Portugal

Elizalde F, Sucar E, deBuen P (2006) An Intelligent Assistant for Training of Power Plant Operators. In: Sixth IEEE International Conference on Advanced Learning Technologies (ICALT'06), pp 205–207, 10.1109/ICALT.2006.1652406

Fahmy HI, Douligeris C (1995) END: an expert network designer. IEEE Network 9(6):18–27, 10.1109/65.475168

Fast E, Chen B, Mendelsohn J, Bassen J, Bernstein MS (2018) Iris: A conversational agent for complex tasks. In: Proceedings of the 2018 chi conference on human factors in computing systems, Association for Computing Machinery, New York, NY, USA, CHI '18, 10.1145/3173574.3174047, `https://doi.org/10.1145/3173574.3174047`

Faulring A, Myers B, Mohnkern K, Schmerl B, Steinfeld A, Zimmerman J, Smailagic A, Hansen J, Siewiorek D (2010) Agent-assisted Task Management That Reduces Email Overload. In: Proceedings of the 15th International Conference on Intelligent User Interfaces, ACM, New York, NY, USA, IUI '10, pp 61–70, 10.1145/1719970.1719980, `http://doi.acm.org/10.1145/1719970.1719980`, event-place: Hong Kong, China

Franke U, Mehring S, Suissa A, Hahn S (1994) The Daimler-Benz steering assistant: a spin-off from autonomous driving. In: Proceedings of the Intelligent Vehicles '94 Symposium, pp 120–124, 10.1109/IVS.1994.639486

Franklin D, Hammond K (2001) The Intelligent Classroom: Providing Competent Assistance. In: Proceedings of the Fifth International Conference on Autonomous Agents, ACM, New York, NY, USA, AGENTS '01, pp 161–168, 10.1145/375735.376037, `http://doi.acm.org/10.1145/375735.376037`, event-place: Montreal, Quebec, Canada

Gavrilis D, Georgoulas G, Vasiloglou N, Nikolakopoulos G (2016) An intelligent assistant for physicians. In: 2016 38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), pp 2586–2589, 10.1109/EMBC.2016.7591259

Gorecky D, Worgan SF, Meixner G (2011) COGNITO: a cognitive assistance and training system for manual tasks in industry. In: Proceedings of the 29th Annual European Conference on Cognitive Ergonomics, Association for Computing Machinery, Rostock, Germany, ECCE '11, pp 53–56, 10.1145/2074712.2074723, `https://doi.org/10.1145/2074712.2074723`

Görtz M, Ackermann R, Steinmetz R (2004) The Digital Call Assistant: Determine Optimal Time Slots for Calls. In: Hutchison D, Kanade T, Kittler J, Kleinberg JM, Mattern F, Mitchell JC, Naor M, Nierstrasz O, Pandu Rangan C, Steffen B, Sudan M, Terzopoulos D, Tygar D, Vardi MY, Weikum G, Roca V, Rousseau F (eds) Interactive Multimedia and Next Generation Networks, vol 3311, Springer Berlin Heidelberg, Berlin, Heidelberg, pp 230–241, 10.1007/978-3-540-30493-7_21, `http://link.springer.com/10.1007/978-3-540-30493-7_21`

Hanke S, Meinedo H, Portugal D, Belk M, Quintas J, Christodoulou E, Sili M, Dias MS, Samaras G (2015) CogniWin – A Virtual Assistance System for Older Adults at Work. In: Zhou J, Salvendy G (eds) Human Aspects of IT for the Aged Population. Design for Everyday Life, vol 9194, Springer International Publishing, Cham, pp 257–268, 10.1007/978-3-319-20913-5_24, `http://link.springer.com/10.1007/978-3-319-20913-5_24`

Hon Wai Chun, Lai EMK (1997) Intelligent critic system for architectural design. IEEE Transactions on Knowledge and Data Engineering 9(4):625–639, 10.1109/69.617054

Hsu JY, Chien-Jung Ting (1998) PHYSIMC: an intelligent assistant for case-based learning. In: Proceedings Tenth IEEE International Conference on Tools with Artificial Intelligence (Cat. No.98CH36294), pp 296–301, 10.1109/TAI.1998.744857

Huang C, Chang S, Chen H, Chen C (2014) Performance evaluation of an intelligent multimedia learning assistant platform. In: 2014 IEEE Frontiers in Education Conference (FIE) Proceedings, pp 1–7, 10.1109/FIE.2014.7044191

Hung CK, Lai EM (1994) An intelligent assistant for the management of telecommunications network services. In: Proceedings of International Conference on Expert Systems for Development, pp 234–237, 10.1109/ICESD.1994.302275

Jain S, Tiwari V, Balasubramanian A, Balasubramanian N, Chakraborty S (2017) PrIA: A Private Intelligent Assistant. In: Proceedings of the 18th International Workshop on Mobile Computing Systems and Applications, ACM, New York, NY, USA, HotMobile '17, pp 91–96, 10.1145/3032970.3032988, `http://doi.acm.org/10.1145/3032970.3032988`, event-place: Sonoma, CA, USA

Jakob M, Moler Z, Pechoucek M, Vaculin R (2011) Intelligent Content-Based Privacy Assistant for Facebook. In: 2011 IEEE/WIC/ACM International Conferences on Web Intelligence and Intelligent Agent Technology, vol 1, pp 499–500, 10.1109/WI-IAT.2011.67

Kebreau S, Pierre S, Probst W (1999) An intelligent information-filtering assistant integrated into a multi-agent architecture. In: Engineering Solutions for the Next Millennium. 1999 IEEE Canadian Conference on Electrical and Computer Engineering (Cat. No.99TH8411), vol 2, pp 996–1001 vol.2, 10.1109/CCECE.1999.808174

Keng Ng, Kramer J, Magee J, Dulay N (1995) The Software Architect's Assistant-a visual environment for distributed programming. In: Proceedings of the Twenty-Eighth Annual Hawaii International Conference on System Sciences, vol 2, pp 254–263 vol.2, 10.1109/HICSS.1995.375454

Kim J, Spraragen M, Gil Y (2004) An Intelligent Assistant for Interactive Workflow Composition. In: Proceedings of the 9th International Conference on Intelligent User Interfaces, ACM, New York, NY, USA, IUI '04, pp 125–131, 10.1145/964442.964466, `http://doi.acm.org/10.1145/964442.964466`, event-place: Funchal, Madeira, Portugal

Kim SY, Kang JK, Oh SY, Ryu YW, Kim K, Park SC, Kim J (2008) An intelligent and integrated driver assistance system for increased safety and convenience based on all-around sensing. Journal of Intelligent & Robotic Systems 51(3):261–287, 10.1007/s10846-007-9187-0

Kincaid R, Pollock G (2017) Nicky: Toward a Virtual Assistant for Test and Measurement Instrument Recommendations. In: 2017 IEEE 11th International Conference on Semantic Computing (ICSC), pp 196–203, 10.1109/ICSC.2017.11

Knoblock CA, Minton S, Ambite JL, Muslea M, Oh J, Frank M (2001) Mixed-initiative, multi-source information assistants. In: Proceedings of the 10th international conference on world wide web, Association for Computing Machinery, New York, NY, USA, WWW '01, p 697–707, 10.1145/371920.372185, `https://doi.org/10.1145/371920.372185`

Kroupa T, Berka P (2002) WISECON: the intelligent support for e-commerce. In: Proceedings First International IEEE Symposium Intelligent Systems, vol 1, pp 210–214 vol.1, 10.1109/IS.2002.1044256

Kurata Y (2010) Interactive Assistance for Tour Planning. In: Hutchison D, Kanade T, Kittler J, Kleinberg JM, Mattern F, Mitchell JC, Naor M, Nierstrasz O, Pandu Rangan C, Steffen B, Sudan M, Terzopoulos D, Tygar D, Vardi MY, Weikum G, Hölscher C, Shipley TF, Olivetti Belardinelli M, Bateman JA, Newcombe NS (eds) Spatial Cognition VII, vol 6222, Springer Berlin Heidelberg, Berlin, Heidelberg, pp 289–302, 10.1007/978-3-642-14749-4_25, `http://link.springer.com/10.1007/978-3-642-14749-4_25`

Kwasnicka H, Szul D, Markowska-Kaczmar U, Myszkowski PB (2008) Learning Assistant - Personalizing Learning Paths in e-Learning Environments. In: 2008 7th Computer Information Systems and Industrial Management Applications, pp 308–314, 10.1109/CISIM.2008.51

Lam MS, Campagna G, Xu S, Fischer M, Moradshahi M (2019) Protecting privacy and open competition with Almond: An open-source virtual assistant. `https://doi.org/10.1145/3355757`

Lam MSW, Chan EYK, Lee VCS, Yu YT (2008) Designing an Automatic Debugging Assistant for Improving the Learning of Computer Programming. In: Fong J, Kwan R, Wang FL (eds) Hybrid Learning and Education, vol 5169, Springer Berlin Heidelberg, Berlin, Heidelberg, pp 359–370, 10.1007/978-3-540-85170-7_32, `http://link.springer.com/10.1007/978-3-540-85170-7_32`

Lesta L, Yacef K (2002) An intelligent teaching assistant system for logic. In: Cerri, SA and Gouarderes, G and Paraguacu, F (ed) Intelligent Tutoring Systems, Assoc Comp Machinery; Int Federat Informat Proc; Artificial Intelligence Educ Soc; IEEE CS Learning Technol Task Force; French Direct Gen Armement; Asociac Espanola Inteligencia Artificial, Lecture Notes in Computer Science, vol 2363, pp 421–431

Li FL, Qiu M, Chen H, Wang X, Gao X, Huang J, Ren J, Zhao Z, Zhao W, Wang L, Jin G, Chu W (2017) AliMe Assist : An Intelligent Assistant for Creating an Innovative E-commerce Experience. In: Proceedings of the 2017 ACM on Conference on Information and Knowledge Management, ACM, New York, NY, USA, CIKM '17, pp 2495–2498, 10.1145/3132847.3133169, `http://doi.acm.org/10.1145/3132847.3133169`, event-place: Singapore, Singapore

Li W, Zhong N, Liu C (2006) ECPIA: An email-centric personal intelligent assistant. In: Wang, G and Peters, JF and Skowron, YY and Yao, YY (ed) Rough Sets and Knowledge Technology, Proceedings, Int Rough Set Soc; Rough Set & Soft Computat Soc; Chinese Assoc Artificial Intelligence; Natl Nat Sci Fdn China; Chongqing Univ Posts & Telecommun; Chongqing Inst Technol; Chongqing Jiaotong Univ; Chongqing Educ Commiss; Chongqing Sci & Technol Commiss; Chongqing Informat Ind Bur; Chongqing Assoc Sci & Technol, Lecture Notes in Artificial Intelligence, vol 4062, pp 502–509

Lino C, Christie M, Ranon R, Bares W (2011) The Director's Lens: An Intelligent Assistant for Virtual Cinematography. In: Proceedings of the 19th ACM International Conference on Multimedia, ACM, New York, NY, USA, MM '11, pp 323–332, 10.1145/2072298.2072341, `http://doi.acm.org/10.1145/2072298.2072341`, event-place: Scottsdale, Arizona, USA

Liu Y, Li S, Wang J, Zeng H, Lu J (2015) A computer vision-based assistant system for the assembly of narrow cabin products. The International Journal of Advanced Manufacturing Technology 76(1-4):281–293, 10.1007/s00170-014-6274-9, http://link.springer.com/10.1007/s00170-014-6274-9

Macias JA (2008) Intelligent assistance in authoring dynamically generated web interfaces. World Wide Web - Internet and Web Information Systems 11(2):253–286, 10.1007/s11280-008-0043-3

Magaña VC, Muñoz-Organero M (2016) Artemisa: A Personal Driving Assistant for Fuel Saving. IEEE Transactions on Mobile Computing 15(10):2437–2451, 10.1109/TMC.2015.2504976

Mandow L, Perez-de-la Cruz J (2004) Sindi: an intelligent assistant for highway design. Expert Systems With Applications 27(4):635–644, 10.1016/j.eswa.2004.06.005

Matthews M, Pharr W, Biswas G, Neelakandan H (2000) USCSH: An active intelligent assistance system. Artificial Intelligence Review 14(1-2):121–141, 10.1023/A:1006508409887

May J, Vargas L (1996) SIMPSON: An intelligent assistant for short-term manufacturing scheduling. European Journal of Operational Research 88(2):269–286, 10.1016/0377-2217(94)00178-2

McCauley L, D'Mello S (2006) MIKI: A Speech Enabled Intelligent Kiosk. In: Hutchison D, Kanade T, Kittler J, Kleinberg JM, Mattern F, Mitchell JC, Naor M, Nierstrasz O, Pandu Rangan C, Steffen B, Sudan M, Terzopoulos D, Tygar D, Vardi MY, Weikum G, Gratch J, Young M, Aylett R, Ballin D, Olivier P (eds) Intelligent Virtual Agents, vol 4133, Springer Berlin Heidelberg, Berlin, Heidelberg, pp 132–144, 10.1007/11821830_11, http://link.springer.com/10.1007/11821830_11

Menczer F, Street WN, Vishwakarma N, Monge AE, Jakobsson M (2002) Intellishopper: A proactive, personal, private shopping assistant. In: Proceedings of the first international joint conference on autonomous agents and multiagent systems: Part 3, Association for Computing Machinery, New York, NY, USA, AAMAS '02, p 1001–1008, 10.1145/545056.545059, https://doi.org/10.1145/545056.545059

Molina M (2001) An Intelligent Sales Assistant for Configurable Products. In: Goos G, Hartmanis J, van Leeuwen J, Zhong N, Yao Y, Liu J, Ohsuga S (eds) Web Intelligence: Research and Development, vol 2198, Springer Berlin Heidelberg, Berlin, Heidelberg, pp 596–600, 10.1007/3-540-45490-X_78, http://link.springer.com/10.1007/3-540-45490-X_78

Molina M (2005) An intelligent assistant for public transport management. In: Huang, DS and Zhang, XP and Huang, GB (ed) Advances in Intelligent Computing, PT 2, Proceedings, Inst Intelligent Machines; Univ Sci Technol; IEEE Computat Intelligence Soc; Hong Kong Computat Intelligence Chapter, Lecture Notes in Computer Science, vol 3645, pp 199–208

Morris JG, Mitchell CM, Potter WJ (1994) A Designer's Associate: support for the design of software for complex dynamic control systems. In: Proceedings of IEEE International Conference on Systems, Man and Cybernetics, vol 2, pp 1745–1750 vol.2, 10.1109/ICSMC.1994.400101

Myers K, Berry P, Blythe J, Conley K, Gervasio M, McGuinness D, Morley D, Pfeffer A, Pollack M, Tambe M (2007) An intelligent personal assistant for task and time management. AI MAGAZINE 28(2):47–61

Oliver N, Czerwinski M, Smith G, Roomp K (2008) RelAltTab: Assisting Users in Switching Windows. In: Proceedings of the 13th International Conference on Intelligent User Interfaces, ACM, New York, NY, USA, IUI '08, pp 385–388, 10.1145/1378773.1378836, http://doi.acm.org/10.1145/1378773.1378836, event-place: Gran Canaria, Spain

Ozeki M, Maeda S, Obata K, Nakamura Y (2008) Virtual assistant: an artificial agent for enhancing content acquisition: how ambient media elicit information from humans. In: Proceedings of the 1st ACM international workshop on Semantic ambient media experiences, Association for Computing Machinery, Vancouver, British Columbia, Canada, SAME '08, pp 75–82, 10.1145/1461912.1461927, https://doi.org/10.1145/1461912.1461927

P D, Bhamidipaty A, Challa S (2008) Intelligent User Assistance for Cost Effective Usage of Mobile Phone. In: Proceedings of the 13th International Conference on Intelligent User Interfaces, ACM, New York, NY, USA, IUI '08, pp 317–320, 10.1145/1378773.1378819, http://doi.acm.org/10.1145/1378773.1378819, event-place: Gran Canaria, Spain

Payne VL, Metzler DP (2005) Hospital care watch (HCW): an ontology and rule-based intelligent patient management assistant. In: 18th IEEE Symposium on Computer-Based Medical Systems (CBMS'05), pp 479–484, 10.1109/CBMS.2005.64

Pedro JS, Burstein F (2003) Intelligent Assistance, Retrieval, Reminder and Advice for Fuzzy Multicriteria Decision-Making. In: Goos G, Hartmanis J, van Leeuwen J, Palade V, Howlett RJ, Jain L (eds) Knowledge-Based Intelligent Information and Engineering Systems, vol 2774, Springer Berlin Heidelberg, Berlin, Heidelberg, pp 37–44, 10.1007/978-3-540-45226-3_6, http://link.springer.com/10.1007/978-3-540-45226-3_6

Quintero MCG, Cuervo PAC (2017) Intelligent driving assistant based on accident risk maps analysis and intelligent driving diagnosis. In: 2017 IEEE Intelligent Vehicles Symposium (IV), pp 914–919, 10.1109/IVS.2017.7995832

Rai S, Raut A, Savaliya A, Shankarmani R (2018) Darwin: Convolutional Neural Network based Intelligent Health Assistant. In: 2018 Second International Conference on Electronics, Communication and Aerospace Technology (ICECA), pp 1367–1371, 10.1109/ICECA.2018.8474861

Reiterer H, Mußler G, Mann TM, Handschuh S (2000) INSYDER &Mdash; an Information Assistant for Business Intelligence. In: Proceedings of the 23rd Annual International ACM SIGIR Conference on Research and Development in Information Retrieval, ACM, New York, NY, USA, SIGIR '00, pp 112–119, 10.1145/345508.345559, http://doi.acm.org/10.1145/345508.345559, event-place: Athens, Greece

Reyes A, Ibarguengoytia PH, Elizalde F, Sánchez L, Nava A (2011) ASISTO: An integrated intelligent assistant system for power plant operation and training. In: 2011 16th International Conference on Intelligent System Applications to Power Systems, pp 1–6, 10.1109/ISAP.2011.6082189

Sanchez J, Priest J, Soto R (1997) Intelligent reasoning assistant for incorporating manufacturability issues into the design process. Expert Systems with Applications 12(1):81–88, 10.1016/S0957-4174(96)00082-6

dos Santos CT, Frozza R, Dhamer A, Gaspary LP (2002) DÓRIS — Pedagogical Agent in Intelligent Tutoring Systems. In: Goos G, Hartmanis J, van Leeuwen J, Cerri SA, Gouardères G, Paraguaçu F (eds) Intelligent Tutoring Systems, vol 2363, Springer Berlin Heidelberg, Berlin, Heidelberg, pp 91–104, 10.1007/3-540-47987-2_14, http://link.springer.com/10.1007/3-540-47987-2_14

Santoso HA, Winarsih NAS, Mulyanto E, saraswati GW, Sukmana SE, Rustad S, Rohman MS, Nugraha A, Firdausillah F (2018) Dinus Intelligent Assistance (DINA) Chatbot for University Admission Services. In: 2018 International Seminar on Application for Technology of Information and Communication, pp 417–423, 10.1109/ISEMANTIC.2018.8549797

Schäfer U, Arnold F, Ostermann S, Reifers S (2013) Ingredients and Recipe for a Robust Mobile Speech-Enabled Cooking Assistant for German. In: Hutchison D, Kanade T, Kittler J, Kleinberg JM, Mattern F, Mitchell JC, Naor M, Nierstrasz O, Pandu Rangan C, Steffen B, Sudan M, Terzopoulos D, Tygar D, Vardi MY, Weikum G, Timm IJ, Thimm M (eds) KI 2013: Advances in Artificial

Intelligence, vol 8077, Springer Berlin Heidelberg, Berlin, Heidelberg, pp 212–223, 10.1007/978-3-642-40942-4_19, `http://link.springer.com/10.1007/978-3-642-40942-4_19`

Schmeil A, Broll W (2007) MARA - A Mobile Augmented Reality-Based Virtual Assistant. In: 2007 IEEE Virtual Reality Conference, pp 267–270, 10.1109/VR.2007.352497, iSSN: 2375-5334

Schmitz M, Baus J, Dörr R (2008) The Digital Sommelier: Interacting with Intelligent Products. In: Floerkemeier C, Langheinrich M, Fleisch E, Mattern F, Sarma SE (eds) The Internet of Things, vol 4952, Springer Berlin Heidelberg, Berlin, Heidelberg, pp 247–262, 10.1007/978-3-540-78731-0_16, `http://link.springer.com/10.1007/978-3-540-78731-0_16`

Segal RB, Kephart JO (1999) MailCat: An Intelligent Assistant for Organizing e-Mail. In: Proceedings of the Third Annual Conference on Autonomous Agents, ACM, New York, NY, USA, AGENTS '99, pp 276–282, 10.1145/301136.301209, `http://doi.acm.org/10.1145/301136.301209`, event-place: Seattle, Washington, USA

Shumin Wu, Ghenniwa H, Weiming Shen, Ma K (2004) Intelligent user assistance in collaborative design environments. In: 8th International Conference on Computer Supported Cooperative Work in Design, vol 2, pp 259–266 Vol.2, 10.1109/CACWD.2004.1349194

Singh-Múgica S, Tovar-Corona B, Silva-Ramírez MA, Jiménez LG (2016) An intelligent system to assist the diagnosis of epilepsy disorder in children: A case of study. In: 2016 IEEE Healthcare Innovation Point-Of-Care Technologies Conference (HI-POCT), pp 142–145, 10.1109/HIC.2016.7797717

Sinha D, Basu A (2012) Gardener: A file browser assistant to help users maintaining semantic folder hierarchy. In: 2012 4th International Conference on Intelligent Human Computer Interaction (IHCI), pp 1–6, 10.1109/IHCI.2012.6481780

St Amant R, Dulberg MS (1998) An Experiment with Navigation and Intelligent Assistance. In: Proceedings of the 3rd International Conference on Intelligent User Interfaces, ACM, New York, NY, USA, IUI '98, pp 171–178, 10.1145/268389.268422, `http://doi.acm.org/10.1145/268389.268422`, event-place: San Francisco, California, USA

Stefanov N, Passenberg C, Peer A, Buss M (2013) Design and Evaluation of a Haptic Computer-Assistant for Telemanipulation Tasks. IEEE Transactions on Human-Machine Systems 43(4):385–397, 10.1109/TSMC.2013.2257743

Strohmann T, Siemon D, Robra-Bissantz S (2017) brAInstorm: Intelligent Assistance in Group Idea Generation. In: Maedche A, vom Brocke J, Hevner A (eds) Designing the Digital Transformation, vol 10243, Springer International Publishing, Cham, pp 457–461, 10.1007/978-3-319-59144-5_31, `http://link.springer.com/10.1007/978-3-319-59144-5_31`

Sumi Y, Etani T, Fels S, Simonet N, Kobayashi K, Mase K (1998) C-MAP: Building a Context-Aware Mobile Assistant for Exhibition Tours. In: Goos G, Hartmanis J, van Leeuwen J, Ishida T (eds) Community Computing and Support Systems, vol 1519, Springer Berlin Heidelberg, Berlin, Heidelberg, pp 137–154, 10.1007/3-540-49247-X_10, `http://link.springer.com/10.1007/3-540-49247-X_10`

Terveen LG, Selfridge PG (1994) Intelligent assistance for software construction: a case study. In: Proceedings KBSE '94. Ninth Knowledge-Based Software Engineering Conference, pp 14–21, 10.1109/KBSE.1994.342682

Todorov J, Stoyanov S, Valkanov V, Daskalov B, Popchev I (2016) Learning Intelligent System for Student Assistance - LISSA. In: 2016 IEEE 8th International Conference on Intelligent Systems (IS), pp 753–757, 10.1109/IS.2016.7737397

Torres M, Pelta DA, Verdegay JL (2018) PRoA: An intelligent multi-criteria Personalized Route Assistant. Engineering Applications of Artificial Intelligence 72:162–169, 10.1016/j.engappai.2018.03.016

Torres VM, Chaves AP, Meech JA (1999) Intelligold-an expert system for gold plant process design. In: Proceedings of the Second International Conference on Intelligent Processing and Manufacturing of Materials. IPMM'99 (Cat. No.99EX296), vol 1, pp 309–316 vol.1, 10.1109/IPMM.1999.792500

Verheij B (1999) Automated Argument Assistance for Lawyers. In: Proceedings of the 7th International Conference on Artificial Intelligence and Law, ACM, New York, NY, USA, ICAIL '99, pp 43–52, 10.1145/323706.323714, `http://doi.acm.org/10.1145/323706.323714`, event-place: Oslo, Norway

Vollebregt A, Hannessen D, Hesselink H, Beetstra J (2002) Modelling Crew Assistants with Multi-Agent Systems in Fighter Aircraft. In: Goos G, Hartmanis J, van Leeuwen J, Hendtlass T, Ali M (eds) Developments in Applied Artificial Intelligence, vol 2358, Springer Berlin Heidelberg, Berlin, Heidelberg, pp 129–135, 10.1007/3-540-48035-8_13, `http://link.springer.com/10.1007/3-540-48035-8_13`

Weerawarna NT, Haththella HMHRB, Ambadeniya ARGKBR, Chandrasiri LHSS, Bandara MSL, Thelijjagoda SS (2011) CyberMate : Artificial Intelligent business help desk assistant with instance messaging services. In: 2011 6th International Conference on Industrial and Information Systems, pp 420–424, 10.1109/ICIINFS.2011.6038105

Winiwarter W (1999) PTA - A Personal Translation Assistant for Accessing the World Wide Web. In: Goos G, Hartmanis J, van Leeuwen J, Bench-Capon TJ, Soda G, Tjoa AM (eds) Database and Expert Systems Applications, vol 1677, Springer Berlin Heidelberg, Berlin, Heidelberg, pp 996–1005, 10.1007/3-540-48309-8_94, `http://link.springer.com/10.1007/3-540-48309-8_94`

Wittig H, Griwodz C (1995) Intelligent media agents in interactive television systems. In: Proceedings of the International Conference on Multimedia Computing and Systems, pp 182–189, 10.1109/MMCS.1995.484923

Yacef K (2002) Intelligent teaching assistant systems. In: International Conference on Computers in Education, 2002. Proceedings., pp 136–140 vol.1, 10.1109/CIE.2002.1185885

Yan H, Selker T (2000) Context-aware Office Assistant. In: Proceedings of the 5th International Conference on Intelligent User Interfaces, ACM, New York, NY, USA, IUI '00, pp 276–279, 10.1145/325737.325872, `http://doi.acm.org/10.1145/325737.325872`, event-place: New Orleans, Louisiana, USA

Yang C (2010) LABTA: An Agent-Based Intelligent Teaching Assistant for Experiment Courses. In: Luo X, Spaniol M, Wang L, Li Q, Nejdl W, Zhang W (eds) Advances in Web-Based Learning – ICWL 2010, vol 6483, Springer Berlin Heidelberg, Berlin, Heidelberg, pp 309–317, 10.1007/978-3-642-17407-0_32, `http://link.springer.com/10.1007/978-3-642-17407-0_32`

Yang D, Garrett JH, Shaw DS, Rendell LA (1994) An intelligent symbol usage assistant for CAD systems. IEEE Expert 9(3):32–41, 10.1109/64.311277

Yau MY, Lai EM, Chun HW (1994) FPDX: a knowledge-based system for architectural floor plan design. In: Proceedings of International Conference on Expert Systems for Development, pp 309–314, 10.1109/ICESD.1994.302261

Zhang S, Abdul Zada V, Balog K (2018) SmartTable: A Spreadsheet Program with Intelligent Assistance. In: The 41st International ACM SIGIR Conference on Research & Development in Information Retrieval, ACM, New York, NY, USA, SIGIR '18, pp 1297–1300, 10.1145/3209978.3210171, `http://doi.acm.org/10.1145/3209978.3210171`, event-place: Ann Arbor, MI, USA

Zhang W, Wu J (2007) A Learning Search Based Intelligent Assistant of Web Browser. In: 2007 International Conference on Wireless Communications, Networking and Mobile Computing, pp 5629–5631, 10.1109/WICOM.2007.1379

B Article Selection Methodology

The article selection methodology is shown in **Table 4**. For research objective 1, we conducted a general search for terms that are used to designate the professional roles of assistants or terms. We used the advanced search feature of Google Scholar to look for 'the exact phrase, anywhere in the article'. Since results are sorted by relevance, for each search we went through the first 10 pages and chose respective articles after reading the abstract.

To consider various terms used in describing intelligent assistants, we conducted an explorative search. We found that articles presenting intelligent assistants use a combination of an adjective as an alias for some sort of intelligent ability (smart, personal, adaptive, cooperative, or intelligent), followed by a verb in some cases which represents an activity (for example driving, writing, teaching, learning etc.), and the word 'assistant' or 'assistance'. These terms were then used to construct a search expression that searches for the adjectives within 5 words of assistan* (which includes assistance, assistants, assistant). We used a full metadata search (including title, abstract and keywords) and excluded commercially available assistants to focus on the research side of the domain.

We filtered the resulting dataset in two rounds, first by reading the title and then the abstract. The articles selected in the final round were distributed among the co-authors and read in depth.

Table 4: Article Selection Methodology

Search Terms	Databanks/Search Engine(s)	Inclusion Criteria	Exclusion Criteria	Initial Hits	Filtered first round	Filtered second round
A clarification of the notion of assistance (RO1)						
'administrative assistants', 'medical assistants', 'nursing assistants', 'healthcare assistants', 'surgical assistants', 'teaching assistants', 'work of assistants', 'role of assistants' (and variations thereof).	Google Scholar	Articles carried out a systematic qualitative or ethnographic study of human assistants at work	Articles that evaluated workplace trends in the respective fields of assistance	18	11	7
A typology for intelligent assistance (RO2)						
("adjective" + "verb" + "assistan*") or ("adjective" + "noun" + "assistan*"), where the adjective is one of the following: smart, intelligent, adaptive, personal, cooperative. Wherever supported, a word distance based search was performed (for example "intelligent" ONEAR/5 "assistan*").	IEEE Explore, ACM Library, Science Direct, SpringerLink and ISI Web of Knowledge	Article was published in the last 25 years (1994-2019), presented a framework or a system that offers some form of assistance, discussed the features of the system	Article did not present a system but used the keywords in a different context, proposed only the design of a system without a description of its functionality, was not available in a full-text form, already existed in the search results or was a review article	2317	356	111
Design and evaluation criteria for intelligent assistance (RO3)						
n.a.	data set filtered after first round in RO1 was used	articles that mention design goals, guidelines or design principles/heuristics etc.	articles that only present a system, do not specify any design goals, guidelines or principles		356	24
n.a.	data set filtered after first round in RO1 was used	articles that evaluate the assistance system presented	articles that do not carry out an evaluation of the presented system		356	60

C Typology Creation

The first stage of the typology creation contains characteristics that were identified from RO1 (Conceptual-to-empirical). Since it concerns the human aspect of assistants, we expected that entries would have to be removed or modified. The 'client' was removed from the cooperating entities list, since intelligent assistants hove been developed for one-to one interaction with the user. The activities performed by human assistants are varied, and were not carried over to the next iteration; the activities of intelligent assistants are primarily digital and interactive. Finally, we did not find any support for contingency response in the design of intelligent assistants, so the dimension was also removed. In the second iteration, we added characteristics of intelligence and intelligent agents, and went through the articles in a chronological manner to refine the typology. The final typology is shown in **Table 1**.

Table 5: Typology Creation Iteration 1 and 2

Meta-Characteristic	Conceptual-to-empirical (Iteration 1)		Empirical-to-conceptual (Iteration 2)	
	Dimension	**Characteristic**	**Dimension**	**Characteristic**
Outcome	outcomes	maintain service provision	outcomes	reduce workload
				learning/skill acquisition
	outcome type	augment	outcome type	augment
		compensate		compensate
Environment	cooperating entities	principal	assistance target	user
		assistant		application
		client		tools
		tools		objects
		objects		
	domain	teaching	domain	software development
		medical		design/verification
		administrative		legal
Assistant	activity	foreground tasks	activity	decision support
		background tasks		answer queries
		problem solving		execute tasks
		maintain situation awareness		
	initiative	self-initiated	invocation mode	autonomous
		delegation		delegated
		mixed		mixed
	contingency-response	intervene	flexibility	adaptive
		adapt		adaptable
				static
			input combination(s)	peripheral
				speech
				language
			output combination(s)	visual
				speech
				haptic
			modality	unimodal
				multimodal
			character	yes
				no
			ubiquity	platform-specific
				web-based
			learning capability	learning
				learned

Table 6: Typology Creation Iteration 3 and 4

Meta-Characteristic	Empirical-to-conceptual (Iteration 3)		Empirical-to-conceptual (Iteration 4)
	Dimension	Characteristic	Characteristic
Outcome	outcomes	improve productivity	improve productivity
		learning/skill acquisition	learning/skill acquisition
		augment experience	augment experience
		improve work quality	improve work quality
	outcome type	augment	augment
		compensate	compensate
		both	both
Environment	assistance target	user	application-interface
		application-interface	objects
		tools	application-interface & object
		objects	
	domain	software development	professional
		design/verification	
		medical work	
		legal	
		administrative	private
		education	education
		e-commerce	
Assistant	activity	providing information	providing information
		executing tasks	executing tasks
	invocation mode	autonomous	autonomous
		delegated	delegated
		mixed	mixed
	flexibility	adaptive	adaptive
		adaptable	adaptable
		static	static
	input combination(s)	peripheral	peripheral
		speech/language	language and peripheral
		language and peripheral	language only
		sensor input	sensor input
			peripheral and sensor input
			language & peripheral & sensor input
	output combination(s)	visual	visual
		speech/language	language and visual feedback
		haptic	language only
			visual and haptic
			haptic
	modality	unimodal	unimodal
		multimodal	multimodal
	embodiment	yes	yes
		no	no
	ubiquity	platform-specific	platform-specific
		mobile	mobile
		web-based	web-based
		multiple devices	multiple devices
	learning capability	learning	learning
		learned	learned

D Qualitative Review of Design Influences, Evaluated Attributes and Evaluation Methods

The summary of design goals in **Table 2** is based off **Table 7**. Similarly, the summary of evaluated attributes in **Table 3** is based off **Table 8**. We gathered the attributes after reading the articles listed in the table(s).

Table 7: Design influences in intelligent assistant research.

Paper Title	Year	Design influence
Intelligent media agents in interactive television systems	1995	personalization
SIMPSON: An intelligent assistant for short-term manufacturing scheduling	1996	task congruency, information congruency,maintainability
MASMA: A personal assistant for meetings management	1997	control of initiative, personalization
YPA – an intelligent directory enquiry assistant	1998	usefulness, user-friendliness
MailCat: An Intelligent Assistant for Organizing e-Mail	1999	simplicity, unobtrusiveness
INSYDER – an Information Assistant for Business Intelligence	2000	agent attributes
Context-aware Office Assistant	2000	context aware computing
USCSH: An active intelligent assistance system	2000	effectiveness, task accomplishment
The Intelligent Classroom: Providing Competent Assistance	2001	competent assistant (bound to specific tasks)
Mixed-initiative, multi-source information assistants	2001	mixed initiative agents
A Writer's Collaborative Assistant	2002	Shared Plans theory of collaboration
IntelliShopper: a proactive, personal, private shopping assistant	2002	autonomy, personalization, privacy
DORIS – Pedagogical Agent in Intelligent Tutoring Systems	2002	environment perception, autonomy, sociability, adaptability, mobility
Balancing Efficiency and Interpretability in an Interactive Statistical Assistant	2003	efficiency, interpretability, granularity, context, explicitness
An intelligent personal assistant for task and time management	2007	directable, personalizable, teachable, transparent
FleXConf: A Flexible Conference Assistant Using Context-Aware Notification Services	2009	context awareness
Agent-assisted Task Management That Reduces Email Overload	2010	usability, performance, predictability, understandability
Ma$$iv? An Intelligent Mobile Grocery Assistant	2012	user centred design
Learning Intelligent System for Student Assistance – LISSA	2016	BDI Agents
Artemisa: A Personal Driving Assistant for Fuel Saving	2016	gamification
PrIA: A Private Intelligent Assistant	2017	personalize privately instead of aggregating collective data
A Personal Medical Digital Assistant Agent for Supporting Human Operators in Emergency Scenarios	2017	context awareness, provide assistance without distraction or interruptions
Designing Out Stereotypes in Artificial Intelligence: Involving Users in the Personality Design of a Digital Assistant	2018	user centred design, participatory design
Protecting privacy and open competition with Almond: An open-source virtual assistant	2019	openness, privacy, control

Table 8: Evaulation of intelligent assistants

Title	Year	Evaluated Attribute	Group	Type
User interface design assistance for large-scale software development	1994	usability	usability	qualitative
The Daimler-Benz steering assistant: a spin-off from autonomous driving	1994	driving attributes	user performance	quantitative
An intelligent symbol usage assistant for CAD systems	1994	predictive accuracy	system performance	quantitative
Intelligent assistance for intravascular tele-surgery and experiments on virtual simulator	1995	collision times	user performance	quantitative
Agents in Their Midst: Evaluating User Adaptation to Agent-assisted Interfaces	1998	usage metrics (sorting time, placement rate), error metrics (user error, agent error, increase in error rate), observations and interviews	user and system performance, user feedback	mixed methods
An Experiment with Navigation and Intelligent Assistance	1998	precision (proportion of retrieved information that is relevant), recall (proportion of relevant information that is retrieved), user actions (selections and duration)	user and system performance	quantitative
C-MAP: Building a Context-Aware Mobile Assistant for Exhibition Tours	1998	usability and user feedback	usability, user feedback	mixed methods
Intelligold-an expert system for gold plant process design	1999	case study	system performance	qualitative
MailCat: An Intelligent Assistant for Organizing e-Mail	1999	predictive accuracy	system performance	quantitative
PTA – A Personal Translation Assistant for Accessing the World Wide Web	1999	user feedback about assistants behavior	user feedback	qualitative
INSYDER – an Information Assistant for Business Intelligence	2000	effectiveness (task completion), efficiency (task completion time), satisfaction (subjective acceptance)	user performance, user feedback	quantitative
Communication Management: E-Mail and Telephone Assistants	2000	technical functionality	system performance	quantitative
Balancing Efficiency and Interpretability in an Interactive Statistical Assistant	2002	Usability (ease of learnability, usefulness)	usability	mixed methods
IntelliShopper: a proactive, personal, private shopping assistant	2002	learning accuracy	system performance	quantitative
An intelligent teaching assistant system for logic	2002	student progress	user performance	quantitative
Balancing Efficiency and Interpretability in an Interactive Statistical Assistant	2003	user operations (navigation, analysis, organization)	user performance	quantitative
Intelligent Assistance, Retrieval, Reminder and Advice for Fuzzy Multicriteria Decision-Making	2003	prediction	system performance	quantitative
An Intelligent Assistant for Training of Power Plant Operators	2006	operator performance	user performance	quantitative
ECPIA: An email-centric personal intelligent assistant	2006	technical performance	system performance	na
MIKI: A Speech Enabled Intelligent Kiosk	2006	user reactions	user feedback	qualitative
Survey Measures for Evaluation of Cognitive Assistants	2007	ease of use, usefulness, collaboration, disorientation, flow	ease of use	quantitative
MARA – A Mobile Augmented Reality-Based Virtual Assistant	2007	user feedback about assistants behavior	user feedback	qualitative
Learning Assistant – Personalizing Learning Paths in e-Learning Environments	2008	learning performance	user performance	quantitative
RelAltTab: Assisting Users in Switching Windows	2008	user effort	user performance	quantitative
Intelligent User Assistance for Cost Effective Usage of Mobile Phone	2008	predictive accuracy	system performance	quantitative
Intelligent assistance in authoring dynamically generated web interfaces	2008	user effort, UI Satisfaction, Perceived Usefulness and Ease of Use	user performance, user feedback	quantitative
Virtual assistant: an artificial agent for enhancing content acquisition: how ambient media elicit information from humans	2008	subjective evaluation	user feedback	quantitative
IPA – An intelligent personal assistant agent for task performance support	2009	learning accuracy	system performance	quantitative
			Continued on next page	

Table 8: Evaulation of intelligent assistants

Title	Year	Evaluated Attribute	Group	Type
Intelligent assistance for teachers in collaborative e-learning environments	2009	system performance	system performance	quantitative
Agent-assisted Task Management That Reduces Email Overload	2010	user performance	user performance	quantitative
LABTA: An Agent-Based Intelligent Teaching Assistant for Experiment Courses	2010	user satisfaction (ease of use, appearance, abilities)	user feedback	quantitative
Intelligent Content-Based Privacy Assistant for Facebook	2011	predictive accuracy	system performance	quantitative
ASISTO: An integrated intelligent assistant system for power plant operation and training	2011	user progress	user performance	quantitative
PTIME: Personalized Assistance for Calendaring	2011	usefulness, usability, performance	system performance, user feedback	mixed methods
The Director's Lens: An Intelligent Assistant for Virtual Cinematography	2011	user effort	user performance	qualitative
SWIMS (Speech-Based Web Interface for Mathematics Using Statistical Language Models): An Intelligent Editing Assistant for Mathematical Text	2012	predictive accuracy	system performance	quantitative
Gardener: A file browser assistant to help users maintaining semantic folder hierarchy	2012	LKM-GOMS	user performance	quantitative
Towards an Intelligent Reviewer's Assistant: Recommending Topics to Help Users to Write Better Product Reviews	2012	learning accuracy, usefulness	system performance, user feedback	mixed methods
The Voice User Help, a Smart Vehicle Assistant for the Elderly	2012	technology acceptance	technology acceptance	quantitative
Design and Evaluation of a Haptic Computer-Assistant for Telemanipulation Tasks	2013	operator performance	user performance	quantitative
Performance evaluation of an intelligent multimedia learning assistant platform	2014	student progress	user performance	quantitative
Artificial Intelligence Gaming Assistant for Google Glass	2014	technical performance	system performance	quantitative
A computer vision-based assistant system for the assembly of narrow cabin products	2015	technical performance	system performance	quantitative
CogniWin-A Virtual Assistance System for Older Adults at Work	2015	helpfulness, improved work efficiency, usefulness, wellness	user performance, user feedback	quantitative
An intelligent assistant for physicians	2016	classification accuracy	system performance	quantitative
An intelligent system to assist the diagnosis of epilepsy disorder in children: A case of study	2016	classification accuracy	system performance	quantitative
Understanding User Satisfaction with Intelligent Assistants	2016	user satisfaction, user effort, task compleness, speech recognition quality	user and system performance	quantitative
Artemisa: A Personal Driving Assistant for Fuel Saving	2016	driving parameters	user performance	quantitative
Intelligent driving assistant based on accident risk maps analysis and intelligent driving diagnosis	2017	Assistant accuracy, driving performance	user and system performance	quantitative
"What Can I Help You with?": Infrequent Users' Experiences of Intelligent Personal Assistants	2017	focus group	user feedback	qualitative
PrIA: A Private Intelligent Assistant	2017	precision comparision with state-of-the art based on user feedback	system performance, user feedback	quantitative
brAInstorm: Intelligent Assistance in Group Idea Generation	2017	Perceived effectiveness, user satisfaction	user feedback	na
A Personal Medical Digital Assistant Agent for Supporting Human Operators in Emergency Scenarios	2017	usability, responsiveness	usability	qualitative
Darwin: Convolutional Neural Network based Intelligent Health Assistant	2018	classification accuracy	system performance	quantitative
Dinus Intelligent Assistance (DINA) Chatbot for University Admission Services	2018	classification accuracy	system performance	quantitative
Iris: A Conversational Agent for Complex Tasks	2018	user effort	user performance	quantitative
PRoA: An intelligent multi-criteria Personalized Route Assistant	2018	comparison with state of the art	system performance	quantitative
Context-Aware Conversational Developer Assistants	2018	subjective evaluation	user feedback	qualitative

Continued on next page

Table 8: Evaulation of intelligent assistants

Title	Year	Evaluated Attribute	Group	Type
Usage-Based Learning in Human Interaction with an Adaptive Virtual Assistant	2019	user effort	user performance	quantitative
From Eliza to XiaoIce: challenges and opportunities with social chatbots	2018	conversations per turn	user and system performance	quantitative