

Virtual Assistance in any Context – A Taxonomy of Design Elements for Domain-Specific Chatbots

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

Appendix

Perspectives	Iteration 1	Iteration 2	Iteration 3	Iteration 4	Iteration 5	Iteration 6
Approach	Conceptual-to-empirical	Empirical-to-conceptual	Empirical-to-conceptual	Empirical-to-conceptual	Empirical-to-conceptual	Evaluation
Intelligence	Degree of Intelligence					
	Intelligence framework	Intelligence framework	Intelligence framework	Intelligence framework	Intelligence framework	D ₁ Intelligence framework
	Type of AIS					
	Type of expert systems					
	Intelligence	Intelligence				D ₁ Socio-emotional behavior
	Sentiment detection	Sentiment detection	Sentiment detection			D ₂ Service integration
	Emotional quotient			Service provider integration	Service provider integration	D ₃ Personality processing
	Personality processing	Personality processing	Personality processing	Personality processing	Personality processing	D ₂ Intelligence quotient
	Platform integration	Platform integration				
	Intelligence quotient	Intelligence quotient	Intelligence quotient	Intelligence quotient	Intelligence quotient	
Manager type						
Interaction	Communication mode	Communication mode	Communication mode	Communication mode	Communication mode	
	Interaction type					
	Multimodality	M multimodality	Multimodality	M multimodality	Multimodality	D ₄ Multimodality
	Number of humans	Number of humans	Number of participants	Number of participants	Number of participants	D ₁₀ Number of participants
	Locus of control	Locus of control	System architecture - user experience	User assistance design	User assistance design	D ₆ User assistance design
	Socio-emotional behavior	Socio-emotional behavior	Socio-emotional behavior	Socio-emotional behavior	Socio-emotional behavior	D ₁₁ Additional human support
	Additional human support	Additional human support	Additional human support	Additional human support	Additional human support	
	Memory					
	CA presentation	CA presentation	CA presentation	Interface personalization	Interface personalization	D ₉ Interface personalization
	User interface	User interface	User interface	Front-end user interface channel	Front-end user interface channel	D ₇ Front-end user interface channel
Interaction classification	Interaction classification	Interaction classification	Interaction classification	Interaction classification	D ₈ Interaction classification	
Response content type						
Context	Duration of relation	Duration of relation	Duration of relation	Relationship duration	Relationship duration	D ₁₄ Relation duration
	Role of conversational agent	Role of conversational agent	Role of conversational agent	Chatbot role	Chatbot role	D ₁₃ Chatbot role
	Knowledge base	Knowledge base	Knowledge base	Knowledge base	Knowledge base	
	Context aware assistant					
	Application domains	Application domains	Application domains	Application domains	Application domain	D ₁₀ Application domain
	Context	Context	Context	Context	Context	
	Collaboration goal	Collaboration goal	Collaboration goal	Collaboration goal	Collaboration goal	D ₁₆ Collaboration goal
	Sequentiality of process structure					
	Language					
	Number of conversational agents					
Motivation for chatbot use	Motivation for chatbot use	Motivation for chatbot use	Motivation for chatbot use	Motivation for chatbot use	D ₁₇ Motivation for chatbot use	
Networking technology						
Technology						
Type of conversational interfaces	Type of conversational interfaces	Type of conversational interfaces				
Sum	36	23	21	20	19	17

Fig. A.1 Dimensions development for the chatbot taxonomy

Table A.1 Taxonomy dimensions from literature review in Iteration 1

Dimension	Armento et al. (2006)	Bitner et al. (2019)	Brandtzaeg & Følstad (2017)	Chen et al. (2017)	Den Boer (2017)	Di Prospero et al. (2017)	Diederich et al. (2019)	Edwards et al. (1988)	Ehrenbrink et al. (2016)	Følstad et al. (2018)	Gnewuch et al. (2017)	Knote et al. (2018)	Knote et al. (2019)	Maedche et al. (2016)	McTear (2016)	Mittal et al. (2016)	Montenegro et al. (2019)	Ochs et al. (2017)	Pfeuffer et al. (2019)	Sarikaya (2017)	Schuetzler et al. (2019)	Shum et al. (2018)	Sreedevi et al. (2017)	Strohmann et al. (2019)	Thorne (2017)	Wei et al. (2018)	Yalçın et al. (2019)	Zumstein & Hundertmark (2017)		
Application domains																														
CA presentation		•											•						•			•								•
Collaboration goal		•																												
Communication mode		•				•	•				•		•		•		•			•										
Context							•				•																			
Context aware assistant	•													•											•					
Degree of intelligence								•						•																
Dialog manager type																											•			
Duration of relation			•							•																		•		
Emotional quotient																											•			
Intelligence framework							•					•												•			•			
Intelligence quotient																											•			
Interaction classification					•								•																	
Interaction type						•												•												
Knowledge base																														•
Memory																											•			
Motivation for chatbot use		•																												
Multimodality											•							•												
Number of participants		•											•			•														
Personality processing	•					•							•																	
Platform integration							•																							
Response content type					•																									
Role of conversational agent		•																•												
Sentiment detection						•		•												•					•					
Sequentiality of process structure		•																												
Socio-emotional behavior	•																		•		•	•			•			•		
System architecture										•										•					•					
Type of artificial intelligence system							•																	•						
Type of conversational interfaces														•																
Type of expert systems																								•						
User interface					•																									

Table A.2 Definitions and underlying conceptual bases of the taxonomy characteristics

<i>Dimension D_i /Characteristics</i> <i>$C_{i,j}$</i>	<i>Definition</i>
D₁ Intelligence framework	
C _{1,1} Rule-based system	A simple reflex conversational agent (CA) whose capacity to process the user utterances is based on the application of “[...] a set of ‘if-then rules’ to determine suitable actions for the detected situation” (Knote et al. 2018 p. 1087). In a general sense, a CA with this underlying cognitive system design primarily detects the situation implied in the user utterance through a domain-specific keyword search, and subsequently, retrieves the most suitable predefined response or default actions from a knowledge base (Chen et al. 2017). Rule-based CA are recognizable by the fact that they react exclusively to defined input options from which the user can choose. These are either selection options that the user can click on or predefined answer options that the user types into the text field.
C _{1,2} Utility-based system	A CA whose capacity to process the input from the user is based on a retrieval-based response model that enables the CA to “[...] differentia[te] measures on how desirable a goal state is” (Knote et al. 2018 p. 1087), in proportion to the user preferences (utility function) defined through value constraints in the form of, e.g., "inform slots" or "ranking criteria". Characteristically, a CA with this underlying cognitive system design provides as output, utility-based suggestions (e.g. action or item recommendations) within the value constraints provided by the user (Chen et al. 2017; Zheng 2019). Utility-based CA are detected by the characteristic that they ask targeted questions, whose answers the chatbot uses to perform an action. For example, a chatbot in e-commerce asks the user for color and clothing preferences and then suggests a suitable garment.
C _{1,3} Model-based system	A CA whose capacity to process the input from the user is based on an internal model of environmental conditions that enables the CA to “[...] [explain] and [predict] ‘how the world works’”. Although this allows the agent for rudimentary self-reflection, [a model-based CA] chooses an action in the same way as a simple reflex agent.” (Knote et al. 2018 p. 1087)
C _{1,4} Goal-based system	A CA whose capacity to process the user utterances is based on an end-to-end model that enables the CA to choose an action to achieve a specific goal state once that the goal-dependent parameters set by the user had been reached (Chen et al. 2017; Knote et al. 2018). A CA with this underlying cognitive system design can be based on memory networks or a neural architecture to allow the user to track the goal achievement by retrieving information about specific values related to the goal (Sukhbaatar et al. 2015; Li et al. 2016). Goal-based CA can be identified by the fact that they recognize from the textual input the users’ intention and help the user to perform a task within a delimited application area. For example, a goal-based airline chatbot recognizes within the dialogue whether the user, e.g., wants travel advice or to cancel a flight and helps to achieve this goal.

<i>Dimension D_i /Characteristics</i>	<i>Definition</i>
<i>$C_{i,j}$</i>	
C _{1,5} Self-learning system	A CA whose capacity to process the input from the user improves through the incorporation of learning outcomes from previous interactions. Commonly, a CA shows signs of self-learning if it asks the user monitoring questions (e.g. yes-no questions) regarding the quality, correctness or usefulness of the provided response to optimize future responses (Chen et al. 2017). The cognitional design system of this type of CA integrates “a separate learning element which is responsible for behavior adaptation, while the performance element chooses which actions to take” (Knote et al. 2018 p. 1088). Self-learning chatbots can be recognized by the attribute that they continually improve by learning from the information gathered within a dialogue.
D₂ Intelligence quotient	
C _{2,1} Only rule-based knowledge	The chatbot has the capability to operate only on the basis of a set of ‘if-then rules’ (Knote et al. 2018 p. 1087). This is shown by the circumstance that rule-based chatbots only react to specific commands and provide a possible response spectrum. These predefined response options, e.g. "yes" or "no", are then either to be entered by the user or clicked on.
C _{2,2} Text understanding	The chatbot has the capability to rationalize textual input using semantics natural language processing and has sufficient domain-specific linguistic knowledge to provide suitable responses (Nuruzzaman and Hussain 2018). This is shown by the possibility for the user to interact with the chatbot via a free text field without any specifications. Sentences can be formed by the user, from which the chatbot extracts the necessary information and processes it.
C _{2,3} Text understanding and further abilities	The chatbot not only has the capability to understand textual input, but also incorporates additional abilities such as inference, math calculation, photo recognition and interpretation, etc. In this context, chatbots can, e.g., read, interpret and evaluate photos uploaded within the dialogue.
D₃ Personality processing	
C _{3,1} Principal self	The “response [of the chatbot] adheres to a set of standards based on the agent’s role and responsibilities” (Di Prospero et al. 2017 p. 77).
C _{3,2} Adaptive self	The chatbot has the “capacity to recognize the personality of the end-users and adapting” (Di Prospero et al. 2017 p. 77) to the language, choice of words, mood and gender of the counterpart (Yalçın 2019). The real-time identification of personality traits (e.g. extroversion: extroverted or introverted and agreeableness: submissive or dominant) are identified by using interactive genetic algorithms and personality models, e.g., Big Five personality traits model or Myers-Briggs Type Indicator (Lee et al. 2012; Yorita et al. 2019).
D₄ Social-emotional behavior	
C _{4,1} Not present	The chatbot does not possess the capacity to show affection or empathy towards the individual needs and immediate feedback of the user (Bittner et al. 2019).

<i>Dimension D_i /Characteristics</i>	<i>Definition</i>
<i>C_{i,j}</i>	
C _{4,2} Present	The chatbot has the resonance capacity to show affection or empathy towards the individual needs and immediate feedback of the user (Bittner et al. 2019). The chatbot captures the feelings resonating in the dialogue and is emotionally transmitted from the user's point of view by reacting empathically to the specific feelings (Hu et al. 2018).
D₅ Service integration	
C _{5,1} None	The chatbot does not integrate further services. When interacting with the chatbot, no further functionality is provided except communication in defined structures.
C _{5,2} Single integration	The chatbot can integrate one service. A further function besides communication is offered. For example, information can be queried from a database or an image recognition can be performed.
C _{5,3} Multiple integration	The chatbot can integrate two or more services. The definition is similar to C _{5,2} except that several services are offered in one chatbot.
D₆ Multimodality	
C _{6,1} Unidirectional	The chatbot has the capacity to receive input through different communication channels (e.g. text and voice input) but it can only respond through one communication channel (e.g. only text or voice output) (Knote et al. 2018).
C _{6,2} Bidirectional	The chatbot has the capacity to receive input through different communication channels and it is able to respond through a combination of multiple communication channels (Knote et al. 2018).
D₇ Interaction classification	
C _{7,1} Graphical	A chatbot interacting with the user only through graphical elements (e.g. predefined buttons for selection). As soon as the chatbot offers a free input text alternative, the interface is no longer considered as graphical (den Boer 2017).
C _{7,2} Interactive	A chatbot interacting with the user both through graphical elements (e.g. predefined buttons for selection) and plain text input (den Boer 2017).
D₈ Interface personification	
C _{8,1} Disembodied	The chatbot does not incorporate visual or physical anthropomorphic or personification features in the form of static, animated or reactive avatars (Bittner et al. 2019).
C _{8,2} Embodied	The chatbot incorporates visual or physical anthropomorphic or personification features in the form of static, animated or reactive avatars (Bittner et al. 2019).
D₉ User assistance design	
C _{9,1} Reactive assistance	The chatbot does not have the capability to anticipate or actively ask context-relevant questions to the user by “[...] mak[ing] use of inference, user modeling, and ranking to power experiences” (Sarıkaya 2017 p. 70).
C _{9,2} Proactive assistance	Proactive assistance implicates the capability of the chatbot to anticipate or actively ask context-relevant questions to the user by “[...] mak[ing] use of

<i>Dimension D_i /Characteristics</i>	<i>Definition</i>
<i>C_{i,j}</i>	inference, user modeling, and ranking to power experiences” (Sarikaya 2017 p. 70).
D₁₀ Number of participants	
C _{10,1} Individual human participant	The chatbot engages with only one individual human participant per interaction, as it does not have the capacity to simultaneously collaborate with two or more human participants (Bittner et al. 2019).
C _{10,2} Two or more human participants	The chatbot has the capacity to simultaneously collaborate with two or more human participants in a team-focused environment (Bittner et al. 2019).
D₁₁ Additional human support	
C _{11,1} No	The chatbot does not provide the user with the possibility to contact a human agent in case of open questions.
C _{11,2} Yes	The chatbot offers the possibility to contact a human agent in case of open questions (Zumstein and Hundertmark 2017).
D₁₂ Front-end user interface channel	
C _{12,1} App	The chatbot is integrated into mobile applications.
C _{12,2} Collaboration and communication tools	The chatbot is integrated into a communication platform such as Microsoft Teams.
C _{12,3} Social media	The chatbot is integrated into social media platforms such as Facebook, Instagram, etc.
C _{12,4} Website	The chatbot is integrated into a Website.
C _{12,5} Multiple	The chatbot is integrated into a combination of multiple platforms.
D₁₃ Chatbot role	
C _{13,1} Facilitator	The chatbot “[...] guide[s] users to reach a certain goal or execute a task.” (Bittner et al. 2019 p. 287)
C _{13,2} Peer	The chatbot “[...] aim to merge into a human group or become a sparring partner for an individual” (Bittner et al. 2019 p. 287).
C _{13,3} Expert	The chatbot “[...] ha[s] certain skills or fields of expertise that differ from those of their human teammates [...] Expert CA react to, e.g., user’s query, specific key words or a defined action with a single query like in a FAQ database.” (Bittner et al. 2019 p. 287)
D₁₄ Relation duration	
C _{14,1} Short-term relation	The chatbot does not have the capability to remember information from previous conversations to influence future interactions (Wei et al. 2018).
C _{14,2} Long-term relation	The chatbot has the capability to remember information from previous conversations with the intention of influencing future interactions (Wei et al. 2018).
D₁₅ Application domain	
C _{15,1} E-customer service	The chatbot has been designed for supporting the online customer experience.
C _{15,2} Daily life	The chatbot has been designed for supporting day-to-day activities.
C _{15,3} E-commerce	The chatbot has been designed for supporting the online commercialization of products and/or services.
C _{15,4} E-learning	The chatbot has been designed for supporting online learning processes.

<i>Dimension D_i /Characteristics</i>	<i>Definition</i>
<i>C_{i,j}</i>	
C _{15,5} Finance	The chatbot has been designed for supporting financial transactions.
C _{15,6} Work and career	The chatbot has been designed for supporting professional life activities.
D₁₆ Collaboration goal	
C _{16,1} Non goal-oriented	The aim of the chatbot is not to support the user to accomplish a common goal or task but to enable the interaction with the user through question-answer dialogues (Bittner et al. 2019).
C _{16,2} Goal-oriented	The chatbot helps and collaborates with the user to accomplish a common goal or task (Bittner et al. 2019).
D₁₇ Motivation for chatbot use	
C _{17,1} Productivity	The primary extrinsic motivation for chatbot use is embodied in the potential to improve the efficiency in the use of personal resources (e.g. time, money, etc.)
C _{17,2} Entertainment	The primary extrinsic motivation for chatbot use is embodied in the potential to enhance the leisure time or to obtain, e.g., a distraction or relaxation.
C _{17,3} Social/relational	The primary extrinsic motivation for chatbot use is embodied in the expectation to achieve social or interpersonal relationship gains such as peer recognition, etc.
C _{17,4} Utility	The primary extrinsic motivation for chatbot use is linked to a practical use that presents the possibility to attain, e.g., quick or detailed knowledge or a direct or indirect financial reward.

Table A.3 Company sample with name of the chatbot, website, and source

<i>Chatbot</i>	<i>Website</i>	<i>Source</i>
AiRelo	https://www.facebook.com/messages/t/AiReloMe	chatbots.org
Alizia Deixis	http://www.dexilabs.com/alizia.html	chatbots.org
Allerhande Chatbot	https://www.messenger.com/t/205510929509436	chatbots.org
Altai	http://www.dulynx.fr/emergence/	chatbots.org
Amanda	https://www.anglianwater.co.uk/	chatbots.org
Ana Copa Airlines	http://copaair.intelliresponse.com/index.jsp	chatbots.org
Andrew HSBC	https://www.business.hsbc.uk/en-gb	chatbots.org
Annemiek	http://www.spoorwegpensioenfonds.nl/	chatbots.org
Ariane	https://www.cdc.retraites.fr/portail/spip.php?page=rubrique&id_rubrique=121	chatbots.org
Asistente Virtual Fast Food Burger King	http://www.burgerking.com.ar/atencion-al-cliente	chatbots.org
Ask Me	https://www.online.citibank.co.in/customerservice/home.htm	chatbots.org
AufsperrBot Wien	https://www.facebook.com/AufsperrBot/	chatbots.org
AVI	http://marketplace.smart-home.com.co/avi.aspx?projectId=sJ3h--6x1cbgNtNB4t43cKgGXaxM5UOcYsaLx-xTYfItqr7uIQcAOpD0Ut09E2GT	chatbots.org
AXA Chatbot	https://de-de.facebook.com/AXA.de/	chatbots.org
Bahai_QnA	http://peninsulabahai.us/chatbot/	chatbots.org
B-bot TV	https://www.messenger.com/t/bbottv	chatbots.org
Betty	http://www.myfemcare.com.sg	chatbots.org
Bitcoin Buddy	https://www.facebook.com/messages/t/btcadviser	chatbots.org
Bitcoin Price Analytics Bot	https://t.me/BitcoinPriceAnalyticsBot	chatbots.org
BO.T	https://m.me/medicenBOT	chatbots.org
Brain Bot	http://www.botlibre.com/BrowseServlet?browse=Brain+Bot	chatbots.org
BRiN	https://brin.ai/	chatbots.org
Bussense	http://m.me/bussense.org	chatbots.org
Car Dealer Chatbot	https://www.chatbots.systems/?utm_source=botlist	botlist most-popular
Cécile	https://www.pole-emploi.fr/employeur/assistance-technique-@/article.jspz?id=68914	chatbots.org
ChatBot.RO	https://www.messenger.com/t/chatbot.ROU	chatbots.org
Clara	https://www.otto.de/shoppages/service/faq	chatbots.org
Clarizen Bot	https://www.clarizen.com/bot-slack/	chatbots.org
CNN	https://www.messenger.com/t/cnn	chatbots.org
Coin Kolumbus	https://telegram.me/CoinKolumbusBot	chatbots.org
Combot	https://combot.org/	botlist most-popular
CruiseBe	https://www.messenger.com/t/cruisebecom	chatbots.org
Dinner Ideas	https://www.facebook.com/DinnerIdeasBot/	chatbots.org
Drop Shipping	http://m.me/b2b.spycob	chatbots.org
Dropshipping Assistant	https://www.facebook.com/DropshippingAssistant/?utm_source=botlist	botlist most-popular
Else	http://www.cjgkampen.nl/else	chatbots.org
Erwin	http://m.me/erwin.chat	chatbots.org
eShangazi	https://m.me/eshangazibot	chatbots.org
Flower Checker	https://www.flowerchecker.com/	chatbots.org
freshr	https://m.me/hellofreshr?ref=listing_bot	chatbots.org
Gardy	https://www.messenger.com/t/insightbot	chatbots.org
Gero	https://www.messenger.com/t/hellogero	chatbots.org

<i>Chatbot</i>	<i>Website</i>	<i>Source</i>
Haptik Assistant (Finance)	https://play.google.com/store/apps/details?id=co.haptik	chatbots.org
Hazie	https://www.facebook.com/HazieBot/	chatbots.org
Helios	https://www.helioslife.enterprises/	botlist most-popular
HillyYEAH! Bot	http://www.facebook.com/hillyyeah2016	chatbots.org
Horoscoop	https://www.messenger.com/t/metrohoroscoop	chatbots.org
IFRS Rookies	https://www.facebook.com/ifrsrookies/	chatbots.org
InviteMember	https://invitemember.com/	botlist most-popular
James	http://playground.pandorabots.com	chatbots.org
Jaquelina	http://www.spov.nl/	chatbots.org
Jim	http://www.saferwholesale.com/Default.asp	chatbots.org
Joe	http://www.plus.net/help/	chatbots.org
Julia	https://www.kabeldeutschland.de/csc	chatbots.org
Julie (Social)	http://www.botlibre.com/browse?id=667676	chatbots.org
Julie (Travel)	https://www.amtrak.com/about-julie-amtrak-virtual-travel-assistant	chatbots.org
Kim	https://www.nspower.ca/en/home/default.aspx	chatbots.org
Komms.io	http://www.komms.io/index.html	botlist most-popular
Kurna the Klingon	https://mybot.be/chat/-KcnG99buxsyZVPg3ZCS	chatbots.org
Leadza	https://www.facebook.com/leadza/videos/vb.1406517502944972/1971309479799102/?type=2&theater	botlist most-popular
Marina	https://www.facebook.com/100-Regali-per-Lei-1032628263531363/	chatbots.org
Medicare And Social Security Answer	https://www.retirety.com/	chatbots.org
Mega Deals	https://btcdirect.eu/nl-nl	botlist most-popular
mensabot	https://kikmensabot.herokuapp.com/chat	chatbots.org
Millie	https://new.myhermes.co.uk/before-you-get-in-touch.html	chatbots.org
Minty Talk	https://www.facebook.com/mintytoons	chatbots.org
MonCompteFormation	http://www.moncompteformation.gouv.fr	chatbots.org
Name Guru	http://www.babynames.ch/Guru	chatbots.org
National Geographic Trivia Bot	https://chatbotslife.com/how-national-geographic-engaged-its-facebook-audience-with-a-trivia-chatbot-bot-marketing-189507d6c380?gi=ac2df2bf9b71	botlist most-popular
Neomy	http://m.me/yourneomy	chatbots.org
Pathology Lab Chatbot	https://www.lalpathlabs.com/	chatbots.org
Poncho	https://www.chatbots.org/chatbot/poncho/	chatbots.org
Rammas Virtual Agent	https://www.dewa.gov.ae/en/rammas?utm_source=botlist	botlist most-popular
Rembo	https://haptik.ai/rembo?ref=direct&_branch_match_id=673898596276084244	chatbots.org
Rewardy	https://m.me/rewardy.co?ref=landing	chatbots.org
Simbibot	https://simbibot.com/	chatbots.org
Singapore Weather Bot	https://www.facebook.com/messages/t/wbotbyrth	chatbots.org
SkinvisionBot	https://www.facebook.com/skinabot/	chatbots.org
Smarty	https://apps.apple.com/us/app/smarty-answers-to-all-questions/id1211970601	chatbots.org
Soa Seks Check	https://soasekscheck.nl	chatbots.org
Soccer.bot	https://bots.kik.com/#/soccer.bot	chatbots.org
Sofia (Finance)	http://microlending.com.ar/contacto	chatbots.org
Sofia (Travel)	http://www.flytap.com/Portugal/en/Homepage	chatbots.org
Sophie	http://www.congstar.de/hilfe-service/?zxid=1579825254208189440&zuserid=134386	chatbots.org

<i>Chatbot</i>	<i>Website</i>	<i>Source</i>
Stina (stena Line)	https://itunes.apple.com/gb/app/travelmate-stena-line/id503869301?mt=8	chatbots.org
TalkToTheWord	https://www.talktotheword.com/?utm_source=botlist	botlist most-popular
T-Bot	http://www.infotbc.com/	chatbots.org
Terry Tablet	https://help89.creativevirtual.com/gsol/bot.htm?isJSEnabled=1	chatbots.org
The Best Constructor	https://www.facebook.com/chatfuel/?fref=ts	chatbots.org
The Durian Chatbot	http://thedurianchatbot.strikingly.com/	chatbots.org
Toni, the Football Chatbot	https://toni.football/	chatbots.org
uInterview	https://m.me/Uinterview	chatbots.org
Vet Fit Health Coach	https://www.facebook.com/vetfitnl/	chatbots.org
Virtuele Assistent	https://www.centraalbeheer.nl/contact/paginas/contactpagina.aspx	chatbots.org
Virtuele medewerker	https://www.ditzo.nl/service	chatbots.org
Virtueller Bürger-Service-Assistent	https://service.berlin.de/virtueller-assistent/virtueller-assistent-606279.php	chatbots.org
Vouchee	https://www.messenger.com/t/1494754200567989	chatbots.org
Weps	http://www.getweps.com/chatbot	chatbots.org
Widdy	https://www.widiba.it/banca/online/it/home	chatbots.org
Woobot.io	https://woobot.io/	botlist most-popular
Yar	https://www.yourhosting.nl/support/contact/	chatbots.org
Yoko	http://www.toshiba.fr/innovation/generic/SUPPORT_PORTAL/	chatbots.org
Ziman	https://play.google.com/store/apps/details?id=com.mociz.zimanpro&hl=en	chatbots.org

Table A.4 Recommended number of clusters of 103 domain-specific chatbots surveyed

<i>Measure by</i>	<i>Recommended amount of clusters (kMeans)</i>
Ball and Hall (1965)	3
Caliński and Harabasz (1974)	2
Davies and Bouldin (1979)	7
Dunn (1974)	7
Frey and Van Groenewoud (1972)	NA
Halkidi et al. (2000)	6
Hartigan (1975)	4
Hubert and Levin (1976)	6
Krzanowski and Lai (1988)	4
McClain and Rao (1975)	2
Milligan (1980, 1981)	8
Rousseeuw (1987)	2
Tibshirani et al. (2001)	2

Table A.5 Compliance with the adopted ending conditions

<i>Iteration 1</i>	<i>Iteration 2</i>	<i>Iteration 3</i>	<i>Iteration 4</i>	<i>Iteration 5</i>	<i>Evaluation phase</i>
Conceptual	Empirical	Empirical	Empirical	Empirical	Focus groups
	•	•	•	•	• Subjective ending conditions (Nickerson et al. 2013)
	•	•	•	•	• Mutually exclusive: no object has two different characteristics in a dimension
					• Collectively exhaustive: each chatbot has at least one characteristic in each dimension
					• Concise: dimensions and characteristics are limited
•	•	•	•	•	• Robust: sufficient number of dimensions and characteristics
				•	• Comprehensive: identification of all (relevant) dimensions of an object
•	•	•	•	•	• Extendable: possibility to easily add dimensions and characteristics in the future
					• Explanatory: dimensions and characteristics sufficiently explain the object
					Objective ending conditions (Nickerson et al. 2013)
	• (12)	• (78)	• (91)	• (all)	• All chatbots (or a representative sample) were analyzed
				•	• No object was merged or split
		•	•	•	• At least one object assigned to each characteristic
				•	• No new dimensions or characteristics were added
				•	• No dimensions or characteristics were merged or split
		•	•	•	• Every dimension is unique
			•	•	• Every characteristic within the dimension is unique
			•	•	• Every combination of characteristics is unique

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