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Contouring a User Centered Chatbot for Diabetes Mellitus

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ABSTRACT: Diabetes Mellitus (DM) is a chronic disease. Its management requires continuous adherence to medical care, self-management, and monitoring, to mitigate the risks. During COVID, the difficulties faced in accessing health facilities, created a sense of disconnect between doctors and patients. A Chatbot for Diabetes Mellitus, DBOT, was designed using a set of questions grouped under components- Diabetes History, Medical History, Family History, Medical History (for women only), Eating/Exercising Habits, Tracking Health Status (Lab Test Results), Prescription Status, Knowledge about reducing Risks, Frequently Asked Questions (FAQ), and DBOT Usage. To design the DBOT, JAVA Coding, xml designing language and an Android Studio tool are used. The flow charts and coding sheets for the components were devised. The DBOT was shared with the diabetic patients for their utilization and through a questionnaire survey and the feedback from the respondents about user experience, were collected. The questionnaire data were analyzed using statistical techniques like Two Sample 't" Test, Chi square, One-Way ANOVA, Correlation, and Factor Analysis to determine comparisons, relations, and associations between the components of DBOT. The future steps include incorporating the proposal, recommendations and suggestions of the users and restructure the DBOT with enhanced effectiveness.

KEYWORDS: Systems Software; Mobile Apps; Diabetes Mellitus; DBOT; Questionnaire; Statistical techniques.

Introduction

Health care is the prevention, treatment, complications, management of illness and the preservation of mental and physical well-being through the services offered by the medical, nursing, and allied health professions.[1] The objective of a health care system is to strengthen the health of the people in a society in an effective method. A health care provider, principally a physician, always possesses the potential to elucidate, expound, and supervise the health condition of the patients. A robust interaction and exchange of information between the doctor and patients is a major requisite that develops trust between participants and in succession, reduces the medical risks.

Diabetes Mellitus (DM) is a chronic disease associated with greater rates of cardiovascular problems, kidney disease, vision problems, and non-traumatic amputations.[2] DM cannot be cured, but it can be detected, managed,[3] and its prevention through continuous lifestyle monitoring can delay the further development of the disease.[4] DM management is long, costly, and requires continuous adherence to medical care and in addition, it requires ongoing self-management and monitoring to mitigate the potential risks.[5] The regular and daily decisions made by patients with diabetes (like, eating healthy foods, tracking physical activity, administering insulin and other medications, monitoring blood glucose, undergoing foot and eye care, participating in laboratory studies, making regular clinic visits, maintaining health education) are very important for DM management.[6] Poor adherence to these activities can lead to significant mortality and morbidity, as well as poor quality of life.[7,8]

In general, people with diabetes are more likely to have severe symptoms and complications when infected with any virus.[9] During COVID, the difficulties faced in accessing health facilities, created a sense of disconnect between doctors and the patients.[10] In particular, for diabetes patients, as there is a possibility of disruption to the routine lifestyle management measures like physical activity and psychological stress management due to lockdown, people with diabetes must explore ways to manage their diet, exercise and stress in consultation with the treating physician to prevent worsening of symptoms.[11] Older adults with diabetes, during COVID, are at highest risk of adverse outcomes and mortality caused by the virus and this has greatly affected by their inability to access and receive health care, obtain diabetes medications and supplies, and maintain a healthy lifestyle and social connections.[12]

As a solution, information and communications technologies (ICT) can assist both patients and physicians to improve bonding by introducing them to electronic health (e-Health).[13] According to the World Health Organization (WHO), mobile health (MH) is a component of e-Health and by using mobile phones and smart devices, MH provides promising opportunities to improve diabetes prevention, detection, and self-management with continuous measurements of a patient's bio-signs.[3] In other words, MH supports the transition from clinic-centric to patient-centric healthcare where each agent-hospital, patient, physician, and service are seamlessly connected to each other.[14] The need for a reliable and accurate diagnosis awakens the rise of a new generation of healthcare technology, the Medical Chatbot.[15]

Medical chatbots are a technology that makes interaction between man and machine possible by using natural language processing with the support of dialog flow, because chatbots are reliable, compatible, and provide instant replies.[16] The rapid evolution of Medical Chatbots has opened a niche for Doctor-Patient communication, that minimizes the costs

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and time commitment on routine operations.[17] If a patient rushes in with an emergency, where every second is vital, the doctor can get the patient's information from previous records, related to other diseases, allergies, check-ups, etc., instantly using a medical chatbot.[18]

A medical chatbot paves the way for genetic diagnosis, clinical laboratory screening, and health communication[19] and the main idea of creating the chatbot is to replicate a human discussion.[20] As a tool with high utility among elderly and physically disabled people, a medical chatbot can help patients get solutions to all their health related issue at their fingertips.[21] Patients may also feel that the chatbots are safer interaction partners and hence patients disclose more medical information.[22] The medical chatbot supports sharing of real-time data between healthcare provider, physician, and patient and that provides end to-end comprehensive care and especially for the patients with diabetes, this real-time monitoring can avoid many adverse events.[23] And a chatbot will function as a virtual Diabetes physician to do a basic diagnosis on diabetic patients.[24] This healthcare chatbot system will help hospitals to provide healthcare support online 24 x 7, as it answers deep as well as general questions and serves many people at the same time with the same topic.[25]

My dad is a pioneer, qualified, experienced, and a certified Diabetologist, specialized in the research and treatment of all types of Diabetes, practicing in Tiruchirappalli City, Tamil Nadu state, India. He carries out thorough and complete clinical examinations. His treatment of diabetes includes the regular monitoring of blood pressure, blood glucose levels, insulin therapy, oral anti-diabetic medication, and the careful examination of heart, lungs, abdomen, the nervous system, and the feet. Through conversations with him, I garnered facts regarding the types, signs and symptoms, complications, diagnosis, treatment, and emergency management of diabetes. I was astonished to realize that all types of diabetes are controllable and must be managed for the rest of the person's life, either with insulin or oral anti-diabetic medicines. And those details and statistics have always fascinated me.

In a discussion with my dad, I became acquainted that the COVID pandemic forced the diabetes community to crucially understand the impact of the virus on diabetes patients, in recent days.

Among the diabetic patients, when the sugar level is well maintained and managed, the risk of acquiring illness due to COVID is minimal, even then, the mobility restrictions were an obstacle to access the doctor for check-ups during crisis times. I have noticed that my dad's patients residing in small townships, suburbs, and villages, located in different districts around my city, are unable to visit him to access their monthly or trimonthly follow-up, during the lockdown days.

Diabetic patients who are highly vulnerable/high-risk should be provided an opportunity to communicate with my dad and as a remedy, Whatsapp and Telegram groups were created for receiving the patient's medical and health queries. For some time, the group chats enabled the patients to seek consultation through posting queries. But eventually, maintaining different groups and sending messages resulted in time management and organization difficulties.

At this juncture, the situation inspired me to create a simple chatbot for my dad's patients. A chatbot should provide their users with a simple, valuable, reliable, and pleasing experience.[26] Similarly, I strongly felt that my chatbot should provide a valuable and a pleasing experience to the user and that subsequently will increase its dependability. Right at this point of time, I framed my research question as-

"How to design a user-friendly Medical Chatbot?"

I aimed to initiate a "Diabetic patients- Diabetologist" interlinkage for a finer comprehension of the basic details of the patients, with a simple chatbot. Though chatbots are available readymade, I wish to prepare myself for my dad's patient community. To start with, I referred articles about Diabetes to collect information about the Type1 and Type2 diabetes, classic symptoms, glucose level, blood sugar, Diabetic retinopathy, diabetic nephropathy, diabetic neuropathy, diabetic related foot problems, periodontitis, Diabetes Diagnostic criteria and management. Meanwhile I pursued the Coding skills and prepared a plan of action to design a chatbot, named DBOT, where D stands for Diabetes.

Methods

-A survey questionnaire, with 105 questions, was prepared and circulated to 100 respondents (diabetic patients), those included- Male (65 in number) and Female (35 in number), belonging to various age groups, living locality and educational qualifications. The questionnaire survey was done during September 2021. The questionnaire was sent to the respondents, who are the diabetic patients of my father. The respondents are chosen from the taluks of Tiruchirappalli district, namely- Lalgudi, Musiri, Manapparai, Manachanallur, Tiruchirappalli, Thottiyam, Thuraiyur, Tiruverumbur, and Srirangam.

-Statistical techniques like- Two Sample 't" Test, Chi square test, One Way ANOVA, Correlation and Factor Analysis are used to understand how easy the components are to use.

-Suggestions from the respondents, for contouring DBOT, as a User Friendly chatbot, were received and considered for upgrading the DBOT, in future.

Data Set:

To start with, I framed a set of questions related to Diabetes Mellitus and then grouped those questions under relevant components, namely- Diabetes History, Medical History, Family History, Medical History (for women only), Eating/ Exercising Habits, Tracking Health Status (Lab Test Results), Prescription Status, Knowledge about reducing the Risk, Frequently Asked Questions (FAQ), and DBOT Usage. To design DBOT, I used JAVA Coding language, xml designing language and Android Studio tool. The flow charts and Coding sheets for the components are devised.

After designing the DBOT, I determined to explore the effectiveness of the components included in the chatbot. For the same, I shared the chatbot with some of the active and diligent diabetic patients, to check its usage for a couple of weeks. I perceived that the maximum potential of chatbots will reach the patients, only when their challenges, needs, and expectations are met, because such an investigation determines the

variation in the users' individual perception and experience. To understand the user appropriation, satisfaction, perception, and preferences of DBOT, I preferred receiving the patient's feedback, which would help me to improve the effectiveness of my chatbot. The questionnaire feedback from the user will provide valuable guidance that might assist to mitigate the usability issues and strengthen the conversation effectiveness.[27] Similarly, I wish to scrutinize and examine the user experience, through a questions survey, to examine how convenient, comfortable, and feasible the DBOT is. Questionnaires are an important tool which provides patients the opportunity to voice their experience in a safe fashion and in turn, the health care providers gather information that cannot be picked up in a physical examination.[28] A multi-method approach with Pre- and Post-Test Questionnaire, user tests and short debriefing interviews were able to help me understand the user experience of any chatbot.[29] User feedback through the guided interviews and post-task surveys allow me to collect qualitative and quantitative data and help to discover the positive and negative aspects and develop personalized product experience for target user.[30]

Hence, I formulated a questionnaire related to the components and user experience of DBOT. The questionnaire had 105 questions and accepts answers in the form of the sentences and it has no restriction of the maximum limit of the words that can be entered. The questionnaire was disseminated to 100 diabetic patients. While choosing the respondents the significant factors considered are as follows.

1. Out of 100 respondents, 65 are Male and 35 are Female.
2. Age grouped under <15 (5 Male and 5 Female), 16-40 (20 Male and 10 Female), 41-60 (20 Male and 10 Female), and above 60 years (20 Male and 10 Female).
3. Locality- City, Town or Village.
4. Educational Qualification – Completed School or College Education or Illiterate.

The questionnaire comprises Yes/No questions and questions with 2,3, and 4 options as choices.

Data Processing:

The questionnaire was circulated to the diabetic patients, to record their feedback. Later the questionnaires were collected, and the data were tabled. The data were inspected using SPSS 16.0. The statistical techniques like Two Sample 't" Test, Chi square test, One Way ANOVA, Correlation and Factor Analysis are implemented, and the results are analyzed and interpreted. The results assisted in comparing the relationships between the components, in DBOT.

Results and Discussion

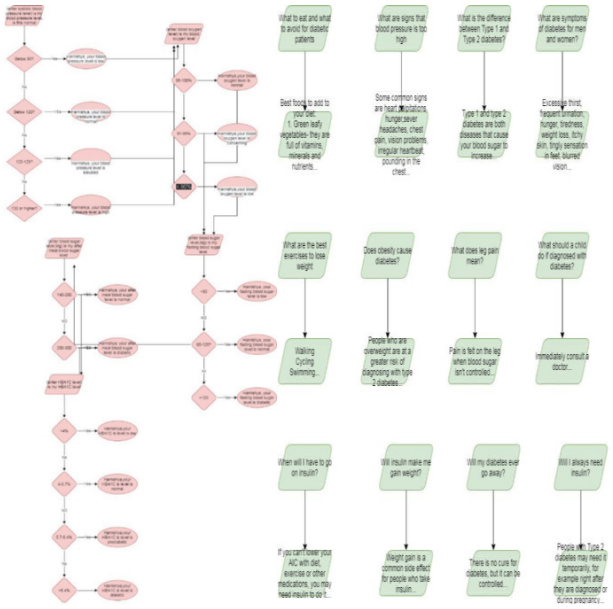
Designing DBOT :

The first step to designing my app was researching and collecting data from my dad, from answers to survey questions. The next step was creating a plan, which I did as a flow chart. The flowchart included all the data details the user could choose from, the answers for each question, and the order in which the questions would be asked. Using this, I created a design for the chatbot in Figma. Here I had to be more specific; I designed buttons, color scheme, font, size, etc. Figma also let me see a visual of how the app would work and the transition between pages when buttons were clicked. Once I was satisfied with the design, I used this as a model and started coding on Android Studio. I used the programming language Java to code my app in Android Studio; where I wrote down the questions and values that patients could select from by looking at my first flowchart model. I then designed the app here by importing my designs in Figma to Android Studio. The app took 2 to 3 weeks to code and edit.

The Flow Charts are prepared for all the components and the sample flow charts for Lab Test Results (Table 1) and Frequently Asked Questions (Table 2) are given below.

Table 1: Flow Chart-Lab Test Results.

Table 2: Flow Chart-Frequently Asked



The Coding Sheets were designed. And sample coding sheets (Tables 3-14) are attached in the Appendix I.

Questionnaire Data Analysis using SPSS:

The Statistical analysis namely-Two Sample 't" Test, Chi square test, One-Way ANOVA, Correlation and Factor Analysis are executed for the data derived from the questionnaire.

1. Comparison - DBOT User based on Gender:

The Two Sample 't" Test is done to compare the DBOT user based on Gender and the results are shown in Table 15.

Research hypothesis (H1): There is a significant difference between Gender of the respondent and the user experience of DBOT. Null hypothesis (H0): There is no significant difference between Gender of the respondent and the user experience of DBOT.

Statistical test: Two Sample 't" Test. Level of Significance (α): 0.05

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Table 15: Two Sample 't' Test, based on Gender.

Components	Male (N = 60)		Female (N =40)		Statistical Inference
	Mean	SD	Mean	SD	
Diabetes History	15.83	3.698	14.91	3.407	T=1.214, Df=98 .228 > 0.05 Not Significant
Medical History	13.29	1.588	13.29	1.545	T=0.020, Df=98 .984 > 0.05 Not Significant
Family History	9.51	1.804	9.34	2.057	T=0.415, Df=98 .679 > 0.05 Not Significant
Medical History (For Women Only)	.00	.000	14.57	1.195	T=-1.722, Df=98 .369 < 0.05 Not Significant
Eating/ Exercising Habits	9.12	.801	9.34	.802	T=-1.308, Df=98 .194 > 0.05 Not Significant
Tracking Health Status (Lab Test Results)	11.45	1.287	11.69	1.157	T=-0.919, Df=98 .361 > 0.05 Not Significant
Medicine Consuming Status	5.43	.558	5.54	.611	T=-0.927, Df=98 .356 > 0.05 Not Significant
Knowledge about reducing the risk	10.37	1.069	10.11	.718	T=1.264, Df=98 .209 > 0.05 Not Significant
Frequently Asked Questions	12.05	3.054	11.97	3.082	T=0.116, Df=98 .908 > 0.05 Not Significant
DBOT Usage	11.06	.768	11.14	.430	T=-0.579, Df=98 .564 > 0.05 Not Significant
All Components	17.4615	2.58044	16.5429	1.91500	T=1.848, Df=98 .068 > 0.05 Not Significant

Findings:

Table 15 reveals that the Probability value of all components is greater than the level of significant value (0.068 > 0.05), and so the research hypothesis is rejected, and the null hypothesis is accepted. The results prove that there is no significant difference between the DBOT user based on Gender, and hence it could be concluded that the user experience about all Components in the DBOT for Male and Female, does not show a greater difference.

2. Comparison - DBOT User based on Locality:

The Two Sample 't' Test is done to compare the DBOT user based on Locality and the results are shown in Table 16.

Research hypothesis (H1): There is a significant difference between Locality of the respondent and the user experience of DBOT. Null hypothesis (H0): There is no significant difference between Locality of the Respondent and the user experience of DBOT.

Statistical test: Two Sample 't" Test. Level of Significance (α): 0.05

Table 16: Two Sample 't' Test, based on Gender.

Components	City/Town (N = 67)		Village (N =33)		Statistical Inference
	Mean	SD	Mean	SD	
Diabetes History	15.28	3.609	15.97	3.618	T=-0.893, Df=98 .374 > 0.05 Not Significant
Medical History	13.43	1.406	13.00	1.837	T=1.305, Df=98 .195 > 0.05 Not Significant
Family History	9.37	1.976	9.61	1.713	T=-0.578, Df=98 .564 > 0.05 Not Significant
Medical History (For Women Only)	5.36	7.246	4.58	6.615	T=0.522, Df=98 .603 < 0.05 Not Significant
Eating/ Exercising Habits	9.24	.676	9.12	1.023	T=0.686, Df=98 .494 > 0.05 Not Significant
Tracking Health Status (Lab Test Results)	11.61	1.114	11.36	1.475	T=0.939, Df=98 .350 > 0.05 Not Significant
Prescription Status	5.48	.612	5.45	.506	T=0.187, Df=98 .852 > 0.05 Not Significant
Knowledge about reducing the risk	10.28	1.012	10.27	.876	T=0.053, Df=98 .958 > 0.05 Not Significant
Frequently Asked Questions	11.69	2.709	12.70	3.592	T=-1.570, Df=98 .120 > 0.05 Not Significant
DBOT Usage	11.13	.672	11.00	.661	T=0.945, Df=98 .347 > 0.05 Not Significant
All Components	17.1045	2.41921	17.2121	2.39475	T=-0.210, Df=98 .834 > 0.05 Not Significant

Findings:

Table 16 reveals that the Probability value of all components is greater than the level of significant value (0.834 > 0.05) and so the research hypothesis is rejected, and the null hypothesis is accepted. The results prove that there is no significant difference between the DBOT user based on Locality, and hence it could be concluded that the user experience about all components in the DBOT for respondents living in City/Town and Village, does not show a greater difference.

3. Association - DBOT User based on Age:

The Chi-square test is done to check the association between the DBOT user based on Age and the results are shown in Table 17.

Research hypothesis (H1): There is a significant difference between Age of the respondent and the user experience of DBOT. Null hypothesis (H0): There is no significant difference between Age of the Respondent and the user experience of DBOT.

Statistical test: Chi-square test. Level of Significance (α): 0.05

Table 17: Chi-square Test based on Age.

		Age of the Respondents					Statistical Inference
		Diabetes History					
		Below 15	15 - 40	41 - 60	Above 60	Total	
Good	F	10	29	29	2	70	χ^2=81.905 Df=3 .000 < 0.05 Significant
	%	100.0%	96.7%	96.7%	6.7%	70.0%	
Bad	F	0	1	1	28	30	
	%	.0%	3.3%	3.3%	93.3%	30.0%	
		Medical History					
Good	F	0	2	8	11	21	χ^2=11.392 Df=3 .010 < 0.05 Significant
	%	.0%	6.7%	26.7%	36.7%	21.0%	
Bad	F	10	28	22	19	79	
	%	100.0%	93.3%	73.3%	63.3%	79.0%	
		Family History					
Good	F	5	21	20	17	63	χ^2=2.045 Df=3 .563 > 0.05 Not Significant
	%	50.0%	70.0%	66.7%	56.7%	63.0%	
Bad	F	5	9	10	13	37	
	%	50.0%	30.0%	33.3%	43.3%	37.0%	
		Medical History (For Women Only)					
Good	F	5	20	20	20	65	χ^2=1.099 Df=3 .777 > 0.05 Not Significant
	%	50.0%	66.7%	66.7%	66.7%	65.0%	
Bad	F	5	10	10	10	35	
	%	50.0%	33.3%	33.3%	33.3%	35.0%	
		Eating/ Exercising Habits					
Good	F	7	19	23	18	67	χ^2=2.156 Df=3 .541 > 0.05 Not Significant
	%	70.0%	63.3%	76.7%	60.0%	67.0%	
Bad	F	3	11	7	12	33	
	%	30.0%	36.7%	23.3%	40.0%	33.0%	
		Tracking Health Status (Lab Test Results)					
Good	F	10	22	28	23	83	χ^2=7.156 Df=3 .067 > 0.05 Not Significant
	%	100.0%	73.3%	93.3%	76.7%	83.0%	
Bad	F	0	8	2	7	17	
	%	.0%	26.7%	6.7%	23.3%	17.0%	
		Prescription Status					
Good	F	0	8	20	29	57	χ^2=44.920 Df=3 .000 < 0.05 Not Significant
	%	.0%	26.7%	66.7%	96.7%	57.0%	
Bad	F	10	22	10	1	43	
	%	100.0%	73.3%	33.3%	3.3%	43.0%	
		Knowledge about reducing the risk					
Good	F	2	6	5	5	18	χ^2=0.181 Df=3 .981 > 0.05 Not Significant
	%	20.0%	20.0%	16.7%	16.7%	18.0%	
Bad	F	8	24	25	25	82	
	%	80.0%	80.0%	83.3%	83.3%	82.0%	
		Frequently Asked Questions					
Good	F	7	20	17	18	62	χ^2=0.962 Df=3 .810 > 0.05 Not Significant
	%	70.0%	66.7%	56.7%	60.0%	62.0%	
Bad	F	3	10	13	12	38	
	%	30.0%	33.3%	43.3%	40.0%	38.0%	
		DBOT Usage					
Good	F	10	24	23	21	78	χ^2=4.040 Df=3 .257 > 0.05 Not Significant
	%	100.0%	80.0%	76.7%	70.0%	78.0%	
Bad	F	0	6	7	9	22	
	%	.0%	20.0%	23.3%	30.0%	22.0%	
		All Components					
Good	F	9	20	18	14	61	χ^2=6.543 Df=3 .088 > 0.05 Not Significant
	%	90.0%	66.7%	60.0%	46.7%	61.0%	
Bad	F	1	10	12	16	39	
	%	10.0%	33.3%	40.0%	53.3%	39.0%	

Findings:

Table 17 reveals that the Probability value of all components is greater than the level of significant value (0.088 > 0.05) and so the research hypothesis is rejected, and the null hypothesis is accepted. The results prove that there is no significant difference between the DBOT user based on Age, and hence it could be concluded that the user experience about all components in the DBOT for respondents of age groups- <15, 16-40, 41-60, and above 60 years, does not show a greater difference.

Comparison - DBOT User based on Educational Qualification:

The One-Way ANOVA was done to check the comparison between the DBOT user based on Educational Qualification and the results are shown in Table 18.

Research hypothesis (H1): There is a significant difference between Age of the respondent and the user experience of DBOT. Null hypothesis (H0): There is no significant difference between Age of the Respondent and the user experience of DBOT.

Table 18: One-Way ANOVA Test based on Educational Qualification.

Educational Qualification	Mean	SD	SS	DF	MS	Statistical inference
Diabetes History						
Between Groups			34.532	2	17.266	
School (n= 43)	15.30	3.461				F=1.335
College (n = 49)	15.37	3.569				.268 > 0.05
Illiterate (n = 8)	17.50	4.472				Not Significant
Within Groups			1254.458	97	12.933	
Medical History						
Between Groups			1.974	2	.987	
School (n= 43)	13.21	1.552				F=0.398
College (n = 49)	13.29	1.633				.673 > 0.05
Illiterate (n = 8)	13.75	1.282				Not Significant
Within Groups			240.616	97	2.481	
Family History						
Between Groups			3.859	2	1.929	
School (n= 43)	9.58	2.038				F=0.536
College (n = 49)	9.27	1.800				.587 > 0.05
Illiterate (n = 8)	9.88	1.642				Not Significant
Within Groups			348.891	97	3.597	
Medical History (For Women Only)						
Between Groups			54.173	2	27.087	
School (n= 43)	5.12	7.122				F=0.545
College (n = 49)	4.69	6.835				.582 > 0.05
Illiterate (n = 8)	7.50	8.036				Not Significant
Within Groups			4824.827	97	49.740	
Eating/ Exercising Habits						
Between Groups			.980	2	.490	
School (n= 43)	9.26	.658				F=0.754
College (n = 49)	9.20	.912				.473 > 0.05
Illiterate (n = 8)	8.88	.835				Not Significant
Within Groups			63.020	97	.650	
Tracking Health Status (Lab Test Results)						
Between Groups			2.305	2	1.153	
School (n= 43)	11.56	1.333				F=0.742
College (n = 49)	11.43	1.173				.479 > 0.05
Illiterate (n = 8)	12.00	1.195				Not Significant
Within Groups			150.605	97	1.553	
Prescription Status						
Between Groups			1.046	2	.523	
School (n= 43)	5.51	.592				F=1.592
College (n = 49)	5.49	.582				.209 > 0.05
Illiterate (n = 8)	5.12	.354				Not Significant
Within Groups			31.864	97	.328	
Knowledge about reducing the risk						
Between Groups			.873	2	.436	
School (n= 43)	10.19	1.006				F=0.464
College (n = 49)	10.33	.944				.630 > 0.05
Illiterate (n = 8)	10.50	.926				Not Significant
Within Groups			91.287	97	.941	
Frequently Asked Questions						
Between Groups			3.478	2	1.739	
School (n= 43)	11.91	3.365				F=0.184
College (n = 49)	12.02	2.825				.832 > 0.05
Illiterate (n = 8)	12.62	2.875				Not Significant
Within Groups			916.482	97	9.448	
DBOT Usage						
Between Groups			.917	2	.458	
School (n= 43)	11.12	.448				F=1.028
College (n = 49)	11.02	.777				.362 > 0.05
Illiterate (n = 8)	11.38	.916				Not Significant
Within Groups			43.273	97	.446	
All Components						
Between Groups			9.249	2	4.625	
School (n= 43)	16.9302	2.50138				F=0.800
College (n = 49)	17.4286	2.38921				.452 > 0.05
Illiterate (n = 8)	16.5000	1.85164				Not Significant
Within Groups			560.791	97	5.781	

Statistical test: One-Way ANOVA test. Level of Significance (α): 0.05

Findings:

Table 18 reveals that the Probability value of all components is greater than the level of significant value (0.452 > 0.05) and so the research hypothesis is rejected, and the null hypothesis is accepted. The results prove that there is no significant difference between the DBOT user based on Educational Qualification, and hence it could be concluded that the user experience about all components in the DBOT for respondents of Educational Qualification- School completed, College completed and Illiterates, does not show a greater difference.

4. Relationship - DBOT User based on All Components:

The Correlation technique is done to check the relation between the DBOT user based on All Components and the results are shown in Table 19.

Table 19: Correlation based on All Components.

All Components	Diabetes History	Medical History	Family History	Medical History (For Women Only)	Eating/ Exercising Habits	Tracking Health Status (Lab Test Results)	Prescription Status	Knowledge about reducing the risk	Frequently Asked Questions	DBOT Usage
Diabetes History	1	.054	-.018	-.126	-.175	.117	-.495**	.037	.073	.123
		.005	**.008**	**.021**	**.002**	**.024**	**.000**	**.015**	**.046**	**.022**
	100	100	100	100	100	100	100	100	100	100
Medical History	.054	1	.010	.009	-.063	-.002	-.018	-.054	-.035	.110
	.005		**.021**	**.027**	**.036**	**.05**	**.007**	**.05**	**.029**	**.027**
	100	100	100	100	100	100	100	100	100	100
Family History	-.018	.010	1	-.037	-.093	-.129	.045	.019	-.049	-.121
	.008	**.021**		**.015**	**.035**	**.020**	**.05**	**.05**	**.028**	**.032**
	100	100	100	100	100	100	100	100	100	100
Medical History (For Women Only)	-.126	.009	-.037	1	.131	.092	.121	-.112	-.036	.061
	.021	**.027**	**.015**		**.019**	**.036**	**.032**	**.026**	**.019**	**.050**
	100	100	100	100	100	100	100	100	100	100
Eating/ Exercising Habits	-.175	-.063	-.093	.131	1	-.148	.100	.187	-.105	-.128
	.002	**.036**	**.035**	**.019**		**.014**	**.021**	**.002**	**.030**	**.020**
	100	100	100	100	100	100	100	100	100	100
Tracking Health Status (Lab Test Results)	.117	-.002	-.129	.092	-.148	1	-.027	-.226*	.112	.185
	.024	**.05**	**.020**	**.036**	**.014**		**.000**	**.024**	**.026**	**.045**
	100	100	100	100	100	100	100	100	100	100
Prescription Status	-.495**	-.018	.045	.121	.100	-.027	1	-.003	-.086	.099
	.000	**.007**	**.05**	**.032**	**.021**	**.000**		**.007**	**.039**	**.028**
	100	100	100	100	100	100	100	100	100	100
Knowledge about reducing the risk	.037	-.054	.019	-.112	.187	-.226*	-.003	1	.063	.023
	.015	**.05**	**.05**	**.026**	**.002**	**.024**	**.007**		**.031**	**.019**
	100	100	100	100	100	100	100	100	100	100
Frequently Asked Questions	.073	-.035	-.049	-.036	-.105	.112	-.086	.063	1	.158
	.046	**.029**	**.028**	**.019**	**.030**	**.026**	**.039**	**.031**		**.017**
	100	100	100	100	100	100	100	100	100	100
DBOT Usage	.123	.110	-.121	.061	-.128	.185	.099	.023	.158	1
	.022	**.027**	**.032**	**.050**	**.020**	**.045**	**.028**	**.019**	**.017**	
	100	100	100	100	100	100	100	100	100	100

Findings:

Table 19 shows that there is a significant correlation between all the Components namely Diabetes History, Medical History, Family History, Medical History (For Women Only), Eating/ Exercising Habits, Tracking Health Status (Lab Test Results), Prescription Status, Knowledge about reducing the risk, Frequently Asked Questions, and DBOT Usage. From the above analysis, it could be concluded that there exists a

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strong relationship between all the components among each other.

5. Factor Analysis - DBOT User based on All Components:

The Factor Analysis is done to check the relation between the DBOT user, based on All Components and the results are shown in Tables 20-22.

Table 20: KMO and Bartlett's Test.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.767
Bartlett's Test of Sphericity	Approx. Chi-Square	84.412
	Df	36
	Significance	.000

From the above analysis (Table 20), the KMO value is 0.767, (which is very high), shows that the factor analysis is beneficial to test the components. Bartlett's test results .000 < 0.05, shows that it is significant for each component.

Table 21: Total Variance Explained.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	%of Variance	Cumulative %	Total	%of Variance	Cumulative %	Total	%of Variance	Cumulative %
1	1.784	19.818	19.818	1.784	19.818	19.818	1.758	19.531	19.531
2	1.250	13.892	33.709	1.250	13.892	33.709	1.211	13.456	32.987
3	1.177	13.074	46.783	1.177	13.074	46.783	1.184	13.158	46.145
4	1.098	12.197	58.980	1.098	12.197	58.980	1.104	12.270	58.414
5	1.067	12.022	62.520	1.047	11.631	70.612	1.098	12.197	70.612
6	1.047	11.631	70.612						
7	.957	10.637	81.249						
8	.761	8.459	89.708						
9	.628	6.974	96.682						
10	.299	3.318	100.00						

From the above analysis (Table 21), each component is grouped under 5 factors, according to their flexibility of usage. The first factor has 19.531 percentage of variance, the second factor shows 13.456 percentage of variance, the third factor with 13.158 percentage of variance, the fourth factor having 12.270 percentage of variance and the fifth factor shows 12.197 percentage of variance.

Table 22: Rotated Component Matrix.

Components	Values	Component
Diabetes History	.882	1
Medical History	.889	1
Family History	.642	5
Medical History (For Women Only)	.779	2
Eating/ Exercising Habits	.785	5
Tracking Health Status (Lab Test Results)	.767	2
Prescription Status	.902	4
Knowledge about Reducing the Risk	-.656	3
Frequently Asked Questions	.797	3
DBOT Usage	.889	1

From the above Table 22, it could be derived that the First factor consists of the components- Diabetes History, Medical History and DBOT Usage and the Second factor includes Medical History (For Women Only) and Tracking Health Status (Lab Test Results). The Third factor comprises components- Knowledge about Reducing the Risk and Frequently Asked Questions, the Fourth factor incorporates the component- Prescription Status and the Fifth factor involves components like- Family History and Eating/ Exercising Habits.

The principal findings of this research paper are as follows. The components-Diabetes History, Medical History and DBOT Usage and Very Easy to use by the respondents. The components-Medical History (For Women Only) and Tracking Health Status (Lab Test Results) are Easy to handle and use by the respondents. The components- Knowledge about reducing the risk and Frequently Asked Questions are Moderate to use. The components- Prescription Status is Hard to use and the components-Family History and Eating/ Exercising Habits are Very Hard to use, by the respondents.

Suggestions from the respondents, for contouring DBOT, a User Friendly chatbot:

From the questionnaire, the following proposals and recommendations are delineated by the respondents, to append in DBOT, to make it as a user friendly chatbot.

- Chatbot Content to be displayed in Local language (Tamil- Official language of Tamil Nadu)
- Add a Diet Chart
- Reducing the number of questions under each component
- Increasing the number of questions under each component
- Simplify the FAQ, as some answers are found hard to understand.
- Avoid personal questions
- Recommend Test Centers
- Add Case studies for diabetic complications
- DBOT is extensive and long-drawn
- Encompass Voice Chat Assistance
- Include the Availability of the physician
- Comprehend illustrations and demonstrations for Diabetic Foot Ulcer
- Enclose latest statistics and instructions about Diabetes
- Mapping the close by location of pharmacy
- Set down an Exercise Chart
- Glossary for Diabetes-terms and meaning
- Space to post patient's queries
- Few Monotonous/irrelevant questions to be expunged
- Save option for patients' information
- Include Components relating emotional health
- Network bandwidth is a major bottleneck to access the chatbot
- Include doctor's appointment schedule
- 1 to 1 Conversation with the physician
- Insert "Drag and Drop" option
- Encompass space for Patient's feedback
- Reminder for Follow-up date
- Append Visuals, Smiley's and GIFs
- Avoid Message chunking
- Evade Conversation delays
- Strengthening security for Personal data

Conclusion

In this research paper, a Chatbot for Diabetes Mellitus, named DBOT, was designed and shared with the diabetic patients for their utilization. Later, a questionnaire survey was conducted to receive the feedback from the respondents about user experience. I enquired the respondents about what they felt while chatting with DBOT and whether they found anything unclear. The filled-in questionnaire was collected, and the data are analyzed using statistical techniques. The principal findings of this research paper were as follows. According to the results, the components namely-Diabetes History, Medical

History, and DBOT Usage are found to be Very Easy to use by the respondents. The components-Medical History (For Women Only) and Tracking Health Status (Lab Test Results) are Easy to use by the respondents. The components- Knowledge about reducing the risk and Frequently Asked Questions are Moderate in difficulty to use. The components- Prescription Status is hard to use and the components-Family History and Eating/ Exercising Habits are Very Hard to use, by the respondents. Through the questionnaire, proposals and recommendations are delineated by the respondents, to improve in DBOT, to make it as a user friendly chatbot. I was surprised while I gathered the feedback, and I realized those facts that went unnoticed during the building phase. The resulting findings guided me further to structure the DBOT more effectively, in the future. My chatbot does not provide the user with the cure for their diabetes problems but gives patient's data to the doctor. DBOT is a tool supporting the diabetic patients and ensures it will not substitute the professional medical advice that a physician gives in person. It will encourage, stimulate, enlighten, instruct, and captivate the diabetic patients in supervising their health with a simple, manageable, uncomplicated cost-effective technology. This DBOT will provide diabetic patients with clinically validated particulars about Diabetes and all that the patients have to do is to commence chatting with DBOT, being quicker, cheaper, and easier and accessible at all times through a few button clicks. And finally, it connects the user to the doctor if necessary. The future step is to incorporate the recommendations and suggestions of the users and restructure the DBOT for enhanced effectiveness.

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Author

Harnishya Palanichamy is in Grade 10 at Hebron School, Ootacamund, Tamil Nadu, India. She's passionate about the field of computer science and is fluent in the coding languages; Java and Java script. She enjoys coding and researching about AI. She started her coding journey by coding games in Java script, and she also has experience with robotics; being in the school robotics club. In the future, she wants to develop her coding knowledge by creating more complex apps.

Appendix I

Table 3: AndriodManifest

AndriodManifest.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<manifest package="com.example.chatbotexample"
xmlns:android="http://schemas.android.com/apk/res/android"><application
android:theme="@style/Theme.ChatbotExample" android:supportsRtl="true"
android:roundIcon="@mipmap/ic_launcher_round" android:label="@string/app_name"
android:icon="@mipmap/ic_launcher" android:allowBackup="true"><activity
android:name=".homepage"/><activity android:name=".MainActivity"><intent-
filter><action android:name="android.intent.action.MAIN"/><category
android:name="android.intent.category.LAUNCHER"/></intent-
filter></activity></application></manifest>
```

Table 4: Activity_main.

Activity_main

```
<?xml version="1.0" encoding="UTF-8"?>
<androidx.constraintlayout.widget.ConstraintLayout tools:context=".MainActivity"
android:layout_height="match_parent" android:layout_width="match_parent"
xmlns:tools="http://schemas.android.com/tools"
xmlns:app="http://schemas.android.com/apk/res-auto"
xmlns:android="http://schemas.android.com/apk/res/android"><ImageView
android:layout_height="150dp" android:layout_width="150dp"
app:srcCompat="@drawable/ic_launcher" app:layout_constraintVertical_bias="0.521"
app:layout_constraintTop_toTopOf="parent"
app:layout_constraintStart_toStartOf="parent"
app:layout_constraintHorizontal_bias="0.563" app:layout_constraintEnd_toEndOf="parent"
app:layout_constraintBottom_toBottomOf="parent"
android:id="@+id/imageView"/><TextView android:layout_height="wrap_content"
android:layout_width="wrap_content" app:layout_constraintVertical_bias="0.636"
app:layout_constraintTop_toTopOf="parent" app:layout_constraintHorizontal_bias="0.496"
app:layout_constraintBottom_toBottomOf="parent" android:id="@+id/textView"
app:layout_constraintRight_toRightOf="parent"
app:layout_constraintLeft_toLeftOf="parent" android:text="Get your questions answered
with DBot"/><Button android:layout_height="wrap_content"
android:layout_width="wrap_content" app:layout_constraintVertical_bias="0.71"
app:layout_constraintTop_toTopOf="parent"
app:layout_constraintStart_toStartOf="parent"
app:layout_constraintEnd_toEndOf="parent"
app:layout_constraintBottom_toBottomOf="parent" android:id="@+id/button"
android:text="Get Started" app:backgroundTint="#3DBFBB"
android:textColorHighlight="#8F1B1B" android:textColor="#F3ECEC"
android:textAllCaps="false"/><ImageView android:layout_height="319dp"
android:layout_width="531dp" app:srcCompat="@drawable/background"
app:layout_constraintVertical_bias="0.0" app:layout_constraintTop_toTopOf="parent"
app:layout_constraintStart_toStartOf="parent"
app:layout_constraintEnd_toEndOf="parent"
app:layout_constraintBottom_toBottomOf="parent" android:id="@+id/imageView2"
android:layout_margin="-10dp"/></androidx.constraintlayout.widget.ConstraintLayout>
```

Table 5: Activity_homepage.

Activity_homepage

```
<?xml version="1.0" encoding="UTF-8"?>
<androidx.constraintlayout.widget.ConstraintLayout tools:context=".homepage"
android:layout_height="match_parent" android:layout_width="match_parent"
xmlns:tools="http://schemas.android.com/tools"
xmlns:app="http://schemas.android.com/apk/res-auto"
xmlns:android="http://schemas.android.com/apk/res/android"><androidx.recyclerview.wi
dget.RecyclerView android:layout_height="match_parent"
android:layout_width="match_parent" tools:listitem="@layout/textin"
android:background="@color/black" android:id="@+id/recycler_view"/> //edit text and
button </androidx.constraintlayout.widget.ConstraintLayout>
```

Table 6: Activity_labtestchat.

Activity_labtestchat

```
<?xml version="1.0" encoding="UTF-8"?>
<androidx.constraintlayout.widget.ConstraintLayout
xmlns:app="http://schemas.android.com/apk/res-auto"
xmlns:tools="http://schemas.android.com/tools" android:background="@color/white"
android:layout_height="match_parent" android:layout_width="match_parent"
xmlns:android="http://schemas.android.com/apk/res/android"><LinearLayout
android:layout_height="match_parent" android:layout_width="match_parent"
app:layout_constraintTop_toTopOf="parent"
app:layout_constraintRight_toRightOf="parent"
app:layout_constraintLeft_toLeftOf="parent"
app:layout_constraintBottom_toTopOf="@id/bottomlayout"
android:id="@+id/linearcompact"><androidx.recyclerview.widget.RecyclerView
android:layout_height="wrap_content" android:layout_width="match_parent"
android:id="@+id/recycler_viewLabTest"
android:layout_marginBottom="100dp"/></LinearLayout><LinearLayout
android:layout_height="wrap_content" android:layout_width="match_parent"
android:id="@+id/bottomlayout" android:layout_weight="0" android:visibility="visible"
android:weightSum="2" app:layout_constraintBottom_toBottomOf="@+id/linearcompact"
android:padding="10dp"><com.google.android.material.textfield.TextInputLayout
android:layout_height="wrap_content" android:layout_width="match_parent"
app:layout_constraintTop_toTopOf="parent" android:id="@+id/ChatextField"
android:layout_weight="2" app:layout_constraintBottom_toBottomOf="parent"
app:layout_constraintVertical_bias="0.269" app:layout_constraintStart_toStartOf="parent"
app:layout_constraintHorizontal_bias="0.535" app:layout_constraintEnd_toEndOf="parent"
android:layout_marginRight="10dp" android:hint="Enter Your Message Here"
style="@style/Widget.MaterialComponents.TextInputLayout.OutlinedBox"><com.googl
e.android.material.textfield.TextInputEditText android:layout_height="match_parent"
android:layout_width="match_parent"
android:id="@+id/chatcontentforsending"/></com.google.android.material.textfield.TextIn
putLayout><com.google.android.material.floatingactionbutton.FloatingActionButton
android:background="@color/chat_view_incoming"
android:layout_height="match_parent" android:layout_width="match_parent"
android:id="@+id/button_submit" app:layout_constraintBottom_toBottomOf="parent"
app:layout_constraintStart_toStartOf="parent"
app:layout_constraintEnd_toEndOf="parent" app:tint="@color/white"
app:backgroundTint="@color/chat_view_incoming"
android:src="@drawable/ic_baseline_send_24"
android:layout_margin="2dp"/></LinearLayout></androidx.constraintlayout.widget.Constrai
ntLayout>
```

Table 5: Activity_faqpage.

Activity_faqpage

```
<?xml version="1.0" encoding="UTF-8"?>
<androidx.constraintlayout.widget.ConstraintLayout
xmlns:tools="http://schemas.android.com/tools" android:background="@color/white"
android:layout_height="match_parent" android:layout_width="match_parent"
xmlns:android="http://schemas.android.com/apk/res/android"><androidx.recyclerview.wi
dget.RecyclerView android:layout_height="match_parent"
android:layout_width="match_parent"
android:id="@+id/recycler_viewFAQ"/></androidx.constraintlayout.widget.ConstraintLayo
ut>
```

Table 8: testin.

Textin

```
<?xml version="1.0" encoding="UTF-8"?>
<RelativeLayout android:id="@+id/main_layout" android:layout_height="wrap_content"
android:layout_width="wrap_content" xmlns:tools="http://schemas.android.com/tools"
xmlns:android="http://schemas.android.com/apk/res/android"><RelativeLayout
android:id="@+id/message_layout" android:layout_height="wrap_content"
android:layout_width="wrap_content" android:background="@android:color/white"
android:padding="10dp" android:layout_margin="8dp"><TextView
android:id="@+id/message_text" android:layout_height="wrap_content"
android:layout_width="wrap_content" android:text="Hi"
android:textColor="@android:color/black" android:textSize="16sp"
android:layout_alignParentLeft="true" android:maxWidth="250dp"
android:minWidth="120dp"/><TextView android:id="@+id/date_text"
android:layout_height="wrap_content" android:layout_width="wrap_content"
tools:text="11:34" android:textColor="#b3b3b3" android:textSize="11sp"
android:visibility="gone" android:layout_below="@+id/message_text"
android:layout_alignRight="@+id/message_text"/><LinearLayout
android:id="@+id/VerticalLinearLayout" android:layout_height="wrap_content"
android:layout_width="match_parent" android:visibility="gone"
android:orientation="vertical"><Button android:id="@+id/LabTestsButton"
android:layout_height="wrap_content" android:layout_width="wrap_content"
android:text="Lab Test Results" android:textAllCaps="false"/><Button
android:id="@+id/FAQsButton" android:layout_height="wrap_content"
android:layout_width="wrap_content" android:text="FAQs"
android:textAllCaps="false"/></LinearLayout></RelativeLayout></RelativeLayout>
```

Table 9: testout.

Textout

```
<?xml version="1.0" encoding="UTF-8"?>
<RelativeLayout android:id="@+id/main_layout" android:layout_height="wrap_conten
android:layout_width="wrap_content" xmlns:tools="http://schemas.android.com/tools'
xmlns:android="http://schemas.android.com/apk/res/android"><RelativeLayout
android:id="@+id/message_layout" android:layout_height="wrap_content"
android:layout_width="wrap_content" android:layout_alignParentRight="true"
android:background="#5089fa" android:padding="10dp"
android:layout_margin="8dp"><TextView android:id="@+id/message_text"
android:layout_height="wrap_content" android:layout_width="wrap_content"
android:text="Hi" android:textColor="@android:color/white" android:textSize="16sp"
android:layout_alignParentLeft="true" android:maxWidth="250dp"
android:minWidth="120dp"/><TextView android:id="@+id/date_text"
android:layout_height="wrap_content" android:layout_width="wrap_content"
tools:text="11:34" android:textColor="@android:color/white" android:textSize="11sp"
android:visibility="gone" android:layout_below="@+id/message_text"
android:layout_alignRight="@+id/message_text"/></RelativeLayout></RelativeLayout>
```

Table 10: CustomAdapter.

CustomAdapter.java

```
package com.example.chatbotexample;
import android.content.Context;
import android.view.LayoutInflater;
import android.view.View;
import android.view.ViewGroup;
import android.widget.LinearLayout;
import android.widget.TextView;
import androidx.recyclerview.widget.RecyclerView;
import java.text.DateFormat;
import java.util.ArrayList;
public class CustomAdapter extends RecyclerView.Adapter<RecyclerView.ViewHolder> {
    private final Context context;
    ArrayList<MessageModel> list;
    public static final int MESSAGE_TYPE_IN = 1;
    public static final int MESSAGE_TYPE_OUT = 2;
    public CustomAdapter(Context context, ArrayList<MessageModel> list) { // you can pass other parameters in constructor
        this.context = context;
        this.list = list;
    }
private class MessageInViewHolder extends RecyclerView.ViewHolder {
TextView messageTV,dateTV;
 LinearLayout linearbuttonLayout;
  MessageInViewHolder(final View itemView) {
            super(itemView);
            messageTV = itemView.findViewById(R.id.message_text);
            dateTV = itemView.findViewById(R.id.date_text);
            linearbuttonLayout= itemView.findViewById(R.id.VerticalLinearLayout);
        }
        void bind(int position) {
            MessageModel messageModel = list.get(position);
            if(messageModel.message.equals("LAYOUTCHANGE"))
            {
                linearbuttonLayout.setVisibility(View.VISIBLE);
                messageTV.setVisibility(View.GONE);
            }
            else{
                linearbuttonLayout.setVisibility(View.GONE);
                messageTV.setVisibility(View.VISIBLE);
            }
messageTV.setText(messageModel.message);
            dateTV.setText(DateFormat.getTimeInstance(DateFormat.SHORT).format(messageModel.messageTime));
        }
    }
    private class MessageOutViewHolder extends RecyclerView.ViewHolder {
        TextView messageTV,dateTV;
        MessageOutViewHolder(final View itemView) {
            super(itemView);
            messageTV = itemView.findViewById(R.id.message_text);
            dateTV = itemView.findViewById(R.id.date_text);
        }
        void bind(int position) {
            MessageModel messageModel = list.get(position);
            messageTV.setText(messageModel.message);
            dateTV.setText(DateFormat.getTimeInstance(DateFormat.SHORT).format(messageModel.messageTime));
        }
    }
    @Override
    public RecyclerView.ViewHolder onCreateViewHolder(ViewGroup parent, int viewType) {
        if (viewType == MESSAGE_TYPE_IN) {
            return new MessageInViewHolder(LayoutInflater.from(context).inflate(R.layout.textin, parent, false));
        }
        return new MessageOutViewHolder(LayoutInflater.from(context).inflate(R.layout.textout, parent, false));
    }
    @Override
    public void onBindViewHolder(RecyclerView.ViewHolder holder, int position) {
        if (list.get(position).messageType == MESSAGE_TYPE_IN) {
            ((MessageInViewHolder) holder).bind(position);
        } else {
            ((MessageOutViewHolder) holder).bind(position);
        }
    }
    @Override
    public int getItemCount() {
```

Table 11: Question And Answer Variable.

QuestionAndAnswerVariable.java

```
package com.example.chatbotexample;
public interface QuestionAndAnswerVariable {
    String Question1 = "Welcome to DBot";
    String Question2 = "Choose from the options below to start the chat";
    String QuestionBloodPressureLevel = "Enter your Blood Pressure Level";
    //HomePage Questions
    String QuestionBasicOne= "Welcome App";
    String QuestionBasicTwo = "Enter your Name";
    //BloodTest Selection Area
    String QuestionForChooseTest = "Please choose the test result you would like to check first";
    String AnswerForChooseTest1 = "Blood Pressure Level";
    String AnswerForChooseTest2 = "Blood Oxygen Level";
    String AnswerForChooseTest3 = "Fasting Blood Sugar Level";
```

Table 12: Message Model.

MessageModel.java

```
package com.example.chatbotexample;
import java.util.Date;
public class MessageModel {
    public String message;
    public int messageType;
    public Date messageTime = new Date();
    // Constructor
    public MessageModel(String message, int messageType) {
        this.message = message;
        this.messageType = messageType;
    }
}
```

Table 13: homepage.

Homepage.java

```
package com.example.chatbotexample;
import androidx.appcompat.app.AppCompatActivity;
import androidx.recyclerview.widget.LinearLayoutManager;
import androidx.recyclerview.widget.RecyclerView;
import android.os.Bundle;
import java.util.ArrayList;
public class homepage extends AppCompatActivity {
  RecyclerView recyclerView;
  @Override
  protected void onCreate(Bundle savedInstanceState) {
      super.onCreate(savedInstanceState);
      setContentView(R.layout.activity_homepage);
      ArrayList<MessageModel> messagesList = new ArrayList<>();
      messagesList.add(new
MessageModel(QuestionAndAnswerVariable.Question1,CustomAdapter.MESSAGE_TYPE_IN));
      messagesList.add(new
MessageModel(QuestionAndAnswerVariable.Question2,CustomAdapter.MESSAGE_TYPE_IN));
      messagesList.add(new MessageModel("LAYOUTCHANGE",CustomAdapter.MESSAGE_TYPE_IN));
      messagesList.add(new MessageModel(" Android",CustomAdapter.MESSAGE_TYPE_IN));
      messagesList.add(new MessageModel("Reply Studio",CustomAdapter.MESSAGE_TYPE_OUT));
//      for (int i=0;i<10;i++) {
//          messagesList.add(new MessageModel("Hi", i % 2 == 0 ?
CustomAdapter.MESSAGE_TYPE_IN : CustomAdapter.MESSAGE_TYPE_OUT));
//      }
      CustomAdapter adapter = new CustomAdapter(this, messagesList);
      recyclerView = findViewById(R.id.recycler_view);
      recyclerView.setLayoutManager(new LinearLayoutManager(this));
      recyclerView.setAdapter(adapter);
  }
}
```

Table 14: MainActivity.

MainActivity.java

```
package com.example.chatbotexample;
import androidx.appcompat.app.AppCompatActivity;
import android.content.Intent;
import android.os.Bundle;
import android.view.View;
import android.widget.Button;
import android.widget.TextView;
public class MainActivity extends AppCompatActivity {
  Button getStarted ;
  TextView questionsAnswered ;
  @Override
  protected void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    setContentView(R.layout.activity_main);
    getStarted = findViewById(R.id.button);
    questionsAnswered= findViewById(R.id.textview);
    getStarted.setOnClickListener(new View.OnClickListener() {
      @Override
      public void onClick(View view) {
        Intent mainToHome = new Intent(MainActivity.this,homepage.class);
        //mainToHome.
        startActivity(mainToHome);
      }
    });
  }
}
```


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