

# Intelligent User Interfaces for Contact Centres

B. A. Jason and A. P. Calitz

Department of Computer Science and Information Systems  
Nelson Mandela Metropolitan University, PO Box 77000, Port Elizabeth, 6031

Tel: 041-504-2247 Fax: 041-504-2831

Email: {Bronwin.Jason, Andre.Calitz}@nmmu.ac.za

**Abstract—** Contact centres have had a major impact on the way business is conducted today and have become an important component in the service industry. Researchers initially believed that contact centres represented the first wave of electronic commerce i.e. conducting business online. Companies are expecting higher productivity from their contact centre personnel to remain competitive and reduce costs. Contact centres must take advantage of the latest technological advancements such as improved computer-user interfaces. Intelligent User Interfaces can be considered the next wave of computer-user interfaces. They aim to amplify the rate of information flow by delivering interaction between the user and the computer that is efficient, effective and natural. The focus of this research is to develop and evaluate an intelligent user interface for a service desk at the NMMU in order to determine if the interface could possibly be extended to provide more efficient and effective contact centre customer support.

**Index Terms—** Intelligent User Interfaces, Adaptive User Interfaces, Intelligent Agents and Contact Centres

## I. INTRODUCTION

“If the customer experience is at the centre of how companies compete, then customer contact is at the centre of that experience” [2].

Every customer contact is an important moment for companies, because the company’s customer interaction is a valuable asset for building lasting and profitable customer relationships. Call Centres or their successors, contact centres (help desks and service desks), are the primary interaction point between a company and its customers. It is rapidly expanding in terms of both workforce and economic scope. The trend towards contact centres has been inspired by the Internet, by customer demand for channel variety and by acknowledged potential for efficiency gains [6].

The Merchants Global Contact Centre Benchmarking Report revealed that 48% of contact centres serve customer bases with over 1 million customers. The average size of the customer base served was found to be 9.7 million. It was also found that the size of the contact centres participating in the survey has increased every year [4]. Companies are expecting more from their contact centres in order to remain

competitive and cut costs while providing premium customer service. In order to remain efficient, contact centres must take advantage of the latest technological advancements.

Intelligent User Interfaces (IUIs) can be considered the next wave of computer-user interfaces [9]. They are considered important especially when the aim of contact centres is supporting heterogeneous user groups with variable and diverse needs, abilities and preferences since they facilitate a more ‘natural’ interaction, i.e. effective and efficient user-computer interaction [15].

It is therefore envisioned that by applying IUIs to the domain of computer-user interfaces for contact centres, an improved customer experience could be achieved. The problem statement of this research is thus to develop an IUI for the current ICT contact centre, that operates in the capacity of a service desk, at the Nelson Mandela Metropolitan University (NMMU) that will assist ICT staff at NMMU with their day-to-day work tasks and provide more efficient and effective customer support. The IUI for the NMMU is a proof of concept that would be extended to focus on Adaptive User Interfaces (AUI) for contact centre personnel.

Section II of this paper discusses the problem domain and related work, as well as IUIs in greater detail. The implementation of the IUI for the domain of NMMU ICT service desk is discussed in Section III as well as an evaluation of the IUI prototype. Section VI focuses on current and future research related to AUI.

## II. RELATED WORK

### A. Call Centres and Contact Centres

A call centre can be defined as an operation that uses telephone, personnel or contact centre agents (CCAs) and computer technology in sophisticated ways to deliver a variety of services to customers [1, 19]. The working environment of a typical large call centre can be envisioned as a room with numerous open-space cubicles in which CCAs sit in front of computer terminals using computer-user interfaces in order to provide services to customers [6].

Contact centres are the contemporary successors of call centres. Contact centres are defined as call centres, however in addition to the traditional telephone services, they interface with customers via some additional multi-media customer-contact channels such as Interactive Voice Response (IVR) units, email, fax, Internet and chat facilities [6, 14].

The various areas of operations for contact centres are either a help desk or a service desk. A help desk (centralised or decentralised) can be defined as a single point of contact for customer problem resolution [5]. A centralised help desk acts as a single location within an organisation to provide support to all its users and decentralised help desks are distributed throughout multiple sites within a single organisation [22].

Service desks are defined as a central point of contact between the customer and all IT related areas whereby customers can use multiple channels for requesting services [5, 18]. They can either have a local, central or virtual structure. Local service desks are situated at each location or department within an organisation. Central service desks are responsible for support to an entire organisation unit. A virtual service desk is a combination of both the local and central service desk allowing for information to be centrally stored and accessed globally [7, 18].

The main difference thus between a help desk and service desk is that a service desks enables the usage of multiple channels to service customers. A central characteristic of contact centres is whether they handle inbound or outbound traffic [6]. An inbound contact centre is primarily responsible for receiving incoming calls from customers whereas an outbound contact centre is responsible for placing calls. Inbound contact centres handle either queries or transactions. Query based inbound contact centres are dependent on a knowledge base / database that contains the necessary information which can provide possible solutions to the customers' queries. Transactional inbound contact centres are dependent on a set of procedures that could be used to assist the customer with a transactional process [20].

Even though contact centres utilise state-of-the-art technology, all contact centres rely on people to act as the intermediaries between the information in the database and the servicing of the customers [19]. Contact centres employ CCA whose responsibility it is to receive the calls placed by customers and either redirect those calls or personally assist the customer. These CCA are trained and skilled in customer service [1].

### B. Intelligent User Interfaces

IUIs currently constitute a major direction of Human Computer Interaction (HCI) research, towards the provision of high-quality user-computer interaction. IUIs are human-computer interfaces that aim to improve the efficiency, effectiveness, and naturalness of human-machine interaction by representing, reasoning, and acting on models of the user, domain, task, discourse, and media (e.g. graphics, natural language, gesture) [15]. Efficient interaction means the ability to complete tasks with less work. Effective interaction means doing the right thing at the right time such as tailoring content according to context. A more natural interaction means support for natural language [9]. Intelligence in computer systems was found to be evident in its ability to adapt and its ability to communicate [17].

IUIs have been proposed as a means to overcome some of the problems that direct manipulation interfaces cannot handle [8], for example:

- Information overflow problems;
- Providing help on how to use complex systems or real-time cognitive overload problems; and
- Making systems individualised or personalised, thereby increasing the system's flexibility and appeal.

Any interface that is called intelligent should at least be able to answer the six types of questions from users shown in Figure 1.

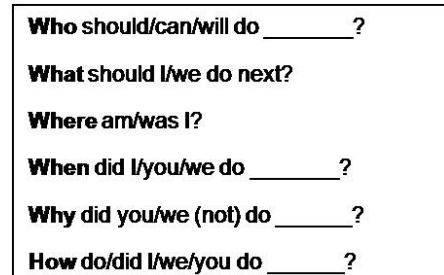


Figure 1: Six Questions for an Intelligent Interface.

An ability to ask and answer these kinds of questions implies a flexible and adaptable division of labor between the human and the computer in the interaction process. Unlike most current interfaces, an IUI should be able to guide and support a user when he/she makes a mistake or if user(s) don't know how to use the system well [13].

There are different ways of how user interfaces can become intelligent [11], for example:

- In IUI, the intelligence might be in predicting what the user wants do next and then presenting information to the user using this prediction;
- The user might find a helpful and information-using interface more intelligent. An example of this would be if the system detects that a user needs help doing a particular task. The system might then provide the user with help; and
- The interface might have some knowledge of how to navigate the system, or tasks that a user would want to accomplish. Using this information, the system can present its interface in an intelligent manner, making navigation and operation more intuitive to the user.

Intelligence in this context therefore doesn't necessarily mean cognition. It means using information in an appropriate manner. A system which has an IUI thus uses intelligent techniques in working with the user. These techniques could be using user models, being knowledgeable about system functionality or helping the user [11].

A suitable IUI architecture depicting the main functions of an IUI can be seen in Figure 2. This specific architecture was proposed by Tyler *et al*[23]. The main components of this architecture are the *Input/Output Manager*, *Plan Manager*, *Presentation Manager*, *Adaptor* and *Knowledge Base* [23].

The *Input/Output* provides the user with multimodal means of input. The *Knowledge Base* is the key component of the IUI as it is a repository that is used to adapt the user interface (UI) to the user's needs. The *Plan Manager* assists the user with achieving high-level goals by using

knowledge of the user's current goals and plans. The *Plan Manager* has the ability of detecting errors and correcting them, interpreting ambiguous requests and the ability to help users map high-level goals into low-level application commands. The *Adaptor* ensures that the UI is modified to best fulfill the user's needs and thereby assists the user with task completion. The *Presentation Manager* determines the most suitable modality and modality techniques to display to the user [23].

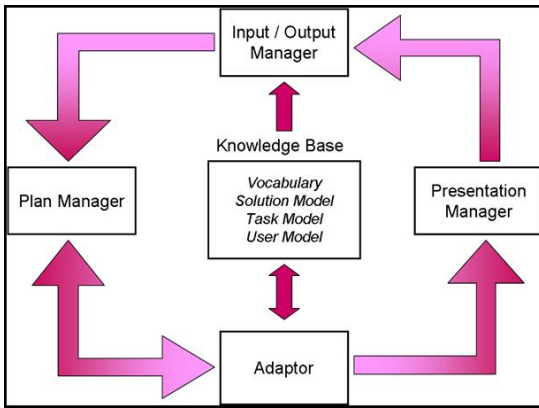


Figure 2: Tyler et al.'s Intelligent Interface Architecture (Extract).

The following section discusses the implementation of the proposed IUI at the NMMU ICT service desk, by employing certain components of the IUI architecture, as well as the evaluation of the system.

### III. IMPLEMENTATION

The NMMU ICT service desk is currently understaffed and this has led to unmotivated and dissatisfied customers. The main purpose of the NMMU service desk is to provide solutions to computer related problems and to log problems for the users (staff and students) on all campuses. Calls are tracked using the user's username. The NMMU ICT service desk can be accessed via three ways namely: telephonically, electronically and physically.

Usage of the online service desk has been minimal in the past and a need was expressed to encourage more customers to log calls online instead of telephonically. Consequently developing an IUI for the NMMU ICT service desk was suggested to improve user satisfaction and to improve the performance of NMMU ICT call takers. This IUI was intended to be developed for use by the NMMU staff members logging calls (i.e. the callers).

The main tasks of the online NMMU ICT service desk were identified as:

- Logging a call;
- Checking the call status;
- Searching FAQ;
- Browsing the call history; and
- Updating and Searching contact details.

Problems were found in the existing user interfaces of the NMMU ICT service desk, HEAT system. The service desk contained some redundant screens and displayed no signs of an IUI. For example, Figure 3 contains a screenshot of the Home Page for the Intranet service desk system. After

clicking on the link *Report a Fault*, Figure 4 appears. This screen is unnecessary as it only provides a link to *Log a Call* and therefore does not provide any additional functionality.

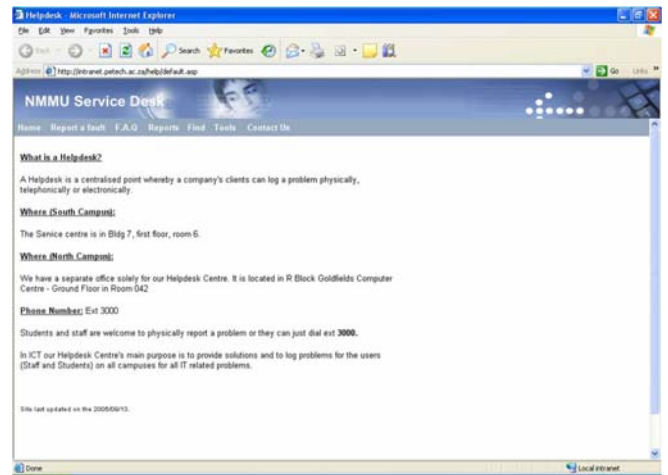


Figure 3: NMMU ICT service desk Home Page Interface.

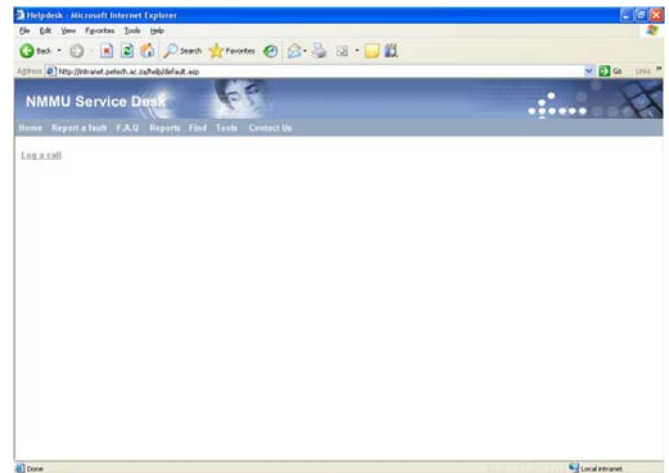


Figure 4: NMMU ICT service desk Fault Logging Interface.

An IUI for the NMMU ICT service desk was thus developed to improve user satisfaction and to improve the performance of NMMU ICT call takers. Figure 5 contains a screenshot of the Home Page for the implemented IUI.

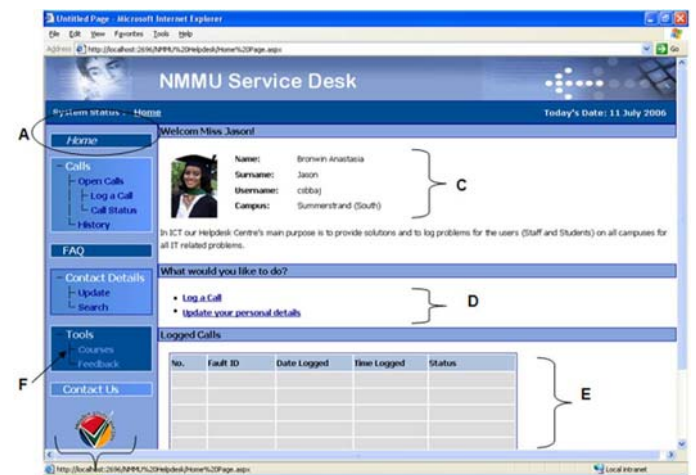


Figure 5: Improved Home Page for the NMMU ICT service desk.

In Figure 5, intelligence is provided in the interface in the

following ways:

- By providing feedback. The system displays the system status and displays more information about the user and his / her current calls (See A, C, E).
- By offering the user assistance. The system asks the user what he / she would like to do and displays these options based on what the user most frequently does (See D).
- By providing the user with more detail as requested. When the user clicks the cell containing the fault ID he / she is transferred to the Call Status page where he / she can view more detailed information about current call logged (See E).
- By providing a dynamic menu. If the user is not found in the database, then the Log a Call and Update option on the left hand pane will not be available. This dynamic menu structure is used consistently throughout the rest of the UI design (See B).
- By suggesting the specific courses that the user can take based on the user's call history (See F).

Various other IUI screens were implemented to support the main tasks of the online NMMU ICT service desk. On completion of the pilot study, a number of research findings were accomplished. The most significant research findings will be discussed next.

A user model was created to keep track of the user's activities, the most viewed FAQ, the most recent search values and to allow for courses to be recommended based on the number of times a user logs a call in a specific category. This is one of the key elements in creating an IUI and by creating this user model, the system could be considered to have some intelligence at the interface level.

Users were able to perform all tasks in a quick and easy manner. When logging a call, help was provided when selecting call categories, thereby encouraging the user to make use of the self help facility provided (viewing past and current calls and searching FAQ). Users were able to view information on demand when viewing the solutions and problems of past and current calls and the system's status was always clearly available. All these factors provide some intelligence at the interface level.

This research thus only utilised the *Input/Output Manager*, *Knowledge Base* and *Adaptor* components of the IUI architecture. The *Knowledge Base* contained the user model and was implemented using SQL Server 2005. The components of the *Adaptor* were implemented in C#. The *Adaptor* performed all the validations as required and maintained the user model.

#### A. Evaluation and Results

The system was evaluated by seven users. The users chosen comprised of NMMU staff members and primary users of the NMMU service desk. The user testing was conducted during the final phases of the system's development. A workstation which ran on Windows XP was selected and configured to operate as a web server. The users were given a test plan instructing them to carry out a series of tasks that may be typically performed with the system. In addition to these tasks, users were encouraged to explore the system and to expand their interaction beyond

that suggested by the test plan. Users were left to complete the test plan and use the system at their own discretion. During the evaluation, users were passively observed and their comments were noted. Questions and further comments were solicited after the evaluation by means of a user satisfaction questionnaire. The questionnaires were intended to determine the user's general impressions of the system and its functionality.

The questionnaire administered to the participants was divided into eight sections. The first section (A) was used to obtain biographical information and to determine their level of previous computer experience. The remaining seven sections were used to assess their experience obtained with the system by following the test plan provided. Of these remaining seven sections, six (B-G) were used to obtain quantitative ordinal data and the remaining section (H) was used to obtain some form of qualitative data.

Participants were required to respond to questions or statements within these seven sections by providing an appropriate rating on a 5-point Likert scale (1=Unsatisfactory to 5=Excellent). Results were captured in Microsoft Excel and statistical functions were applied in order to determine the mean and the standard deviation for each section.

Initially all sections, besides the UI intelligence section (G), were tested by all seven users. At a later date the UI intelligence section (G) was tested as it was identified that the original questionnaire did not have specific questions on the UI intelligence aspects of the system. Only five out of the seven users were available for the testing of this last section (G) and this can be seen in Table 1 where N/A indicates that that particular user was unavailable for testing for the UI intelligence section (G) at the time of testing.

The results of these responses are summarised in Figure 6 and Table 1 below and the analysis thereof will be discussed.

Category	Participants							Mean	Std Dev
	1	2	3	4	5	6	7		
Overall User Reactions	3.83	3.50	4.00	3.83	4.17	3.33	4.00	3.81	0.27
Interface Design	4.00	4.00	4.71	3.70	4.14	3.28	4.14	4.00	0.41
Terminology and System Information	4.00	4.80	3.80	3.40	3.60	3.40	4.80	3.97	0.58
Navigation and Functionality	4.17	4.80	5.00	4.17	4.50	3.50	5.00	4.45	0.51
Learning	4.00	4.75	4.25	4.50	4.50	3.50	5.00	4.36	0.46
System Capabilities	4.50	3.50	4.00	3.00	4.25	3.75	5.00	4.00	0.61
User Interface Intelligence	4.00	4.00	4.00	N/A	3.50	N/A	4.63	4.03	0.36

Table 1: Quantitative Results from User Satisfaction Questionnaire (means for all participants).

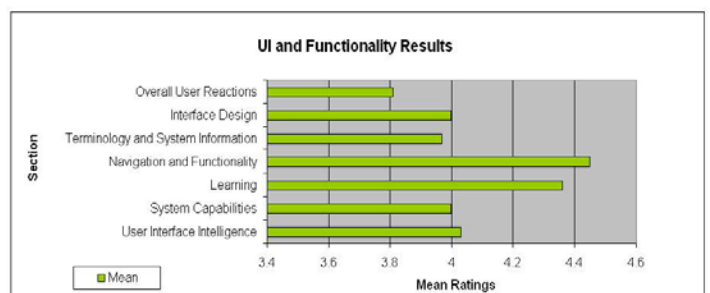


Figure 6: Bar Graph of Data in Table 1.

As can be seen from the results presented in Figure 6 above, the overall reaction to the system was good (mean ratings above 3.8 out of 5). Results indicate that participants felt that the system was generally well designed, provided consistent feedback and terminology, was reliable and easy to learn and most importantly, they were generally happy with the level of UI intelligence.

In particular, users were most pleased with the Navigation and Functionality section of the system since this section has a mean greater than 4.4 (out of 5) as indicated in Figure 6. The users' overall reactions to the system appear to have the lowest mean but is still greater than 3.8 (out of 5) indicating that users were still generally pleased with the system.

The low values for the standard deviation as seen in Table 1, suggest that, in general, there was consensus amongst users with regard to their answers to the statements in the questionnaire. In particular, the System Capabilities section of the system appears to have the lowest consensus amongst users as it has the highest standard deviation of 0.61 (Table 1). The Overall User Reaction section appears to have the most consensus amongst users as it has the lowest standard deviation of 0.27 (Table 1).

The final results indicate an improvement in the productivity of service desk personnel at NMMU and increased computer-user interface satisfaction. The proposed IUI was found to be more efficient as it is easier to use and more effective as users found it to be faster to use than the existing interface. An improvement was thus seen in users' performance levels. Users thus preferred the IUI and therefore the concept of IUIs can now be extended to a more detailed focus on a subset of IUIs, namely AUIs. Many IUIs can be viewed as AUIs, since they change their behavior to adapt to a user or a task. According to research, AUIs will play a major role in the next generation of computer interfaces [21], thus it appears more natural to focus future research on AUIs. It is also intended to extend the contact centre domain to a more national contact centre so that more accurate and useful results could be obtained.

#### IV. CURRENT AND FUTURE RESEARCH

Extensive research was done to understand IUIs and how to apply them to the scope of this research. This project merely scratches the surface on what could be done by providing IUI's for contact centre personnel. There are still several problems that prevent developers from creating good IUIs. The most important research that still needs to be done is to develop usability and design principles for IUIs as these do not currently exist.

A small test sample was used to obtain initial results and future research would utilise a larger sample. According to the user test results however, the UI intelligence aspect of the system did not have as high mean rating as was expected. This indicates that there is a need for further research on making the UI of contact centres more intelligent and more importantly, further research is needed on the topic of IUIs and adaptive user interface (AUIs).

IUI include adaptive characteristics as a major source of their intelligent behaviour [10]. Current research is thus being done on adaptive user interface (AUIs). The next

section provides a brief overview on AUIs and how they can be applied to contact centres.

##### A. Adaptive User Interfaces

CCA differ in their ability to respond to customer queries. Not all CCA do their job the same manner and sequence. They have different levels of competency such as knowledge in different languages or technical information. Besides the CCA differences in experience levels, they also have differences in learning and work styles and cognitive abilities. The current user interfaces for contact centre agents appear to be static in nature, i.e. they appear the same for each CCA. Thus the traditional contact centre user interfaces often seem too complex for a novice CCA, while appearing too simplistic to an expert CCA. Studies have provided empirical support that user performance can be increased when the interface characteristics match the user skill level. This emphasises the importance of AUI research [10]. Adaptive strategies are becoming a trend in current interface design.

An AUI is a software artifact that improves its ability to interact with a user and thus assists a user by constructing a user model based on partial experience with that user. Thus an adaptive interface doesn't exist in isolation and is designed to interact with human users. Moreover it is only adaptive if it improves its interaction with that user and simple memorisation of such interactions does not suffice. Improvements should also rather result from generalisation over past experiences and carry over to new interactions [12].

The basic concept of an AUI thus involves changing the user interface based on some user characteristics. There are some cases whereby AUI are composed of one or more Intelligent Agents (IAs), that are usually simple processes which runs in the background, to decompose the task of implementing the interface [16].

IAs can be defined as Personalized Assistants that "looks over the user's shoulder" and learns the user's characteristics in order to act for that user's interest. The user's characteristics therefore form the core element of the individualisation. This information of the user's characteristics is called the user's model. The user model in combination with the relevant IA knowledge base, will be used by the IA to predict the human responses, needs and suggest to the user things to do [3].

It is envisaged that by developing AUI for CCAs using IA, operational and time costs will be decreased and thus an improvement will be made in the productivity of CCAs.

#### V. CONCLUSION

This paper has identified the need to apply IUIs to the contact centre domain to achieve more efficient and effective customer support.

A proof of concept IUI for the NMMU ICT service desk was implemented and evaluated against the existing NMMU ICT service desk software. Although evaluation yielded good results, it was found that IUIs are such a broad area of research that the implementation done constitutes a small possible solution from a multitude of possibilities. It was

also found that because IUIs are such a broad research area that future research would be more beneficial to focus on AUIs. Literature suggests that AUIs will play a major role in the next generation of computer interfaces [21], thus it appears more natural to focus future research rather on AUIs than IUIs.

Future research is thus currently being done whereby only an aspect of IUIs, AUIs, is being investigated in the domain of a national contact centre employing a large number of CCAs. Due to the research focus area being limited to only an aspect of IUIs in a more realistic domain, it is envisaged that the implemented solution will yield improved results and higher productivity for CCAs.

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**Bronwin Anastasia Jason** received her BSc Computer Science degree (*Cum laude*) in 2005 and her BSc (Hons) degree in 2006 from the Nelson Mandela Metropolitan University. She is currently pursuing a Masters degree in the field of Computer Science and Information Systems at the Nelson Mandela Metropolitan University.