

# IVR Flow Designer and Simulator

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**Abstract**—Interactive Voice Response (IVR) flow in call centre applications is an important component. IVR handles customers automatically, for instance when we call our customer service providers an automatic answer is given to us using an IVR Server. IVR Servers need a script file to manage the customer automatically. Duo IVR Flow Designer and Simulator is developed to produce IVR scripts independent of underlying call server telephony technology. It also supports to simulate IVR flows before deployment. Idea here is that we develop the IVR flow using Windows Workflow with customizable features. Most current IVR Designers support for a single type of technology. They support to create script generation for a single type of call server technology. Duo IVR Flow Designer and Simulator supports to plug different types of IVR nodes into it and different types script generator modules into it. This will ultimately support the underlying call server independency and generation of script for user defined technologies.

## I. INTRODUCTION

The purpose of this research paper is to expose the methodologies and techniques which can be used to design the system. This paper mainly focuses on the importance of a customizable IVR designer and new things that are combined to an IVR Designer system to efficiently create IVR flows.

DuoSoftware is a leading provider of Subscriber Management & Billing, Contact Centre Management and Enterprise Resource Planning solutions to corporations across highly competitive industries worldwide.

One of the main products DuoSoftware currently has is Contact Centre Management System. Majority of our project group members had their internship at Duo Contact Centre Management System. Duo Contact Centre Management System includes Agent console, Supervisor Console, Back Office Console, Automatic Call Distributor, Call Server and IVR Flow Designer.

IVR systems help in automating inbound calls that are repetitive in nature. According to researches, about 50% of the inbound calls of customer service centers are repetitive. Customer calls include password updates, account information retrieval and transaction processing. In customer service call centers call time is money. Every customer service call centers tend to reduce their time of inbound customer calls. The call time for processing such calls can be drastically reduced with a fully automatic IVR solution that serves customers

intelligently based on their queries and inputs, thus enabling faster self-service.

It is clear that a proper IVR system should be there in a customer service centre to handle inbound calls. IVR system automatically answers a customer call without any agent interaction. There is an order in the interaction with the IVR system and the customer. This IVR server and customer interaction order can be defined in a flow. These flows are defined in a script file, XML file or Voice XML files.

Defining this script is a complex and tedious task. To handle customers effectively this flow scripts should be correct and function perfectly. Earlier times these scripts are written manually using text editors. But now these scripts are designed graphically and scripts are generated from tools. Although these graphically designed scripts function well they provide functionalities only to create script files for a certain platform. Current IVR Flow Designers create IVR scripts only for its platform. So providing an IVR Designer which can create IVR flows regardless of the underlying platform is vital. It will help the business users to create call flow script files for any IVR platforms they use.

Simulation is another very important task before deploying an IVR Script in an IVR server. Testing and fixing bugs in an IVR flows help to overcome the customer dissatisfaction. Simulation is a difficult but important task in defining IVR flows. When it comes to platform independency it is more difficult. Different scripts run on different platforms which are specific to them. A proper interfacing should be done to a common simulation model to handle different IVR script simulation for different platform.

During our training period we developed a Contact Centre Management System for a leading mobile service provider in Sri Lanka. Call server and other modules were fixed in the customer service centre of that service provider. Dialogic server was deployed as the call server. As the current IVR Designer lacked the capability of creating IVR scripts for Dialogic, the scripts were written manually. Manually written IVR scripts cause many problems.

- 1) They are not easily understandable
- 2) Modifications are error prone
- 3) Modifications to the scripts need the knowledge of underlying technology
- 4) When the underlying call server technology changes the IVR scripts should be changed

Some modules like Supervisor Console needed frequent changes as the requirements of the customers needed different features time to time. These frequent changes in the requirements needed modifications in the source codes of these applications. Some needed modify large number source code lines. This frequent modification in source code is not a good software development practice. This did not happen in IVR Flow Designer module because the mobile service provider where we deployed the Call Centre application did not use the IVR Designer module. They wanted to use manually written IVR flows although it is a tedious task to write the script manually. This made us to research on developing a customizable IVR Designer.

## II. CUSTOMIZABLE IVR DESIGNER

The current IVR Designer module in DuoSoftware supports the script generation only for Dialogic call server. It does not have any simulation module and that only supports Dialogic platform. Simulation is a very important task which is not currently in Duo IVR Designer.

Duo IVR Designer will have the IVR flow designer module as the main module. IVR Nodes, Script generator module, Simulator module and Plug-in module will be added to it.

In the Duo IVR Flow Designer code blocks as nodes can be drag and dropped, this makes code modifications easy and compatible. Technical customers will be able to create new nodes as they want add to the current designer. Custom nodes created by technical users will be easily imported to the designer by non-technical users and customize the flow easily. This makes them to create and define workflows as they want.

### A. Flow Designer

Flow designer is developed using C#.Net. Flow designer uses Windows Workflow to define the IVR flow. Flow designer is made user friendly using easy access to commands options.

Flow designer is developed by hosting the Windows workflow into a Windows user control. Windows workflow consists of an activity library and a framework, a runtime engine, and a runtime services components that must run within a host application process. Workflows are constructed as a set of activities that are executed by the runtime engine. The runtime engine must run within a host application process. The diagram depicted below shows how workflows, activities, and the workflow runtime engine are all hosted in process with a host application [7].

The execution of the Workflow is important in the simulation of IVR flow before script generation. A runtime engine is provided by Windows Workflow, which is responsible for execution and state management. The WF runtime can be hosted in any .NET process, including ASP.NET, Windows Services, console applications, and Windows Forms applications.

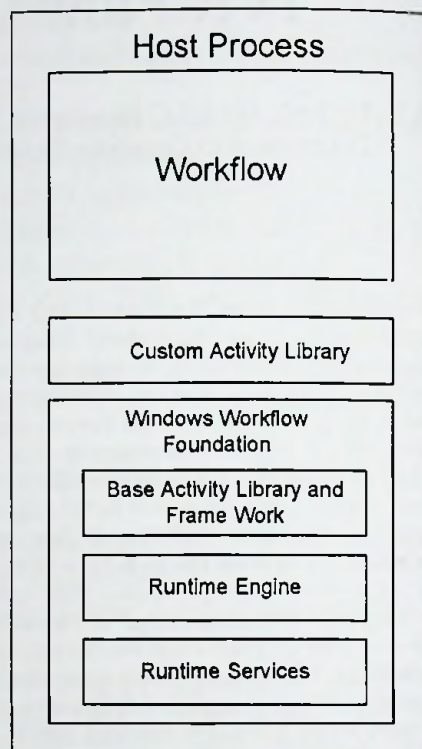


Fig. 1. A process with activities and Workflow runtime engine

### B. Nodes

Nodes are created using workflow activities. Windows workflow provides facilities to create custom activities. Nodes inherit relevant activity classes and implemented using dependency properties and other properties.

### C. Script Generator

The script generator generates scripts of the designed IVR flow according to the selected Computer Telephony Integration (CTI) technology. Since the format of a script varies with the CTI technology, the module should provide facility to generate scripts in various formats. Script generator provides facility to add or modify scripts format easily. The factory design pattern is used to handle multiple IVR script generating function. Technical users can plug different script generating modules to the IVR Designer.

The Script generator parses an XOML file which is generated by the flow designer module and filters necessary node attributes from it. Then it generates a script according to the selected CTI technology.

### C. Simulation

IVR Designer supports to simulate the IVR flow before the generation of IVR scripts. This makes the user more comfortable to test and fix the flaws in the flow. The simulation is a difficult part of the IVR designer. It needs a simulation call server. Through many researches we found

that Asterisks, an open source call server can be used in simulation.

The Asterisk Manager allows a client program to connect to an Asterisk instance and issue commands or read Private Branch Exchange (PBX) events over a TCP/IP stream. Integrators will find this particularly useful when trying to track the state of a telephony client inside Asterisk, and directing that client based on custom (and possibly dynamic) rules. A simple "key: value" line-based protocol is utilized for communication between the connecting client and the Asterisk PBX. Lines are terminated using Carriage Return Line Feed (CRLF). New in Asterisk 1.4: AJAM is a new JavaScript-based technology which allows web browsers or other HTTP enabled applications and web pages to directly access the Asterisk Manager Interface (AMI) via HTTP. Asterisk manager interface is used in debugging process to send commands to the Asterisk server.

The IVR flow designer simulation is based on XOML documents. First the code is compiled and kept in a static variable in order to simulate. Workflow runtime is hosted in simulation application and external data exchange is added for simulation.

#### D. Plug-ability

The system is designed in such a way that it dynamically loads the required plug-in modules to the script generator application and the node set required to the IVR Designer when the technology is changed. All the plug-in modules should be implemented according to the interfaces given for the plug-in modules. Each dynamic link library needed to the applications is stored in a folder structure constructing one folder to each technology. The folder structure is automatically created and the new plug-ins related to the technologies is added to that folder structure according to the programmer preferences at the application installation. The validity of the plug-in modules are also checked when they are added to the folder structure. This Plug-in architecture allows the developers to write new functions to the future technologies as dynamic link libraries and add them to the required applications when delivering a product.

### III. IVR FLOW AND WORKFLOW

Our initial research was to create a flow designer using Microsoft Windows Presentation foundation, which is a graphical subsystem in .NET Framework 3.0. Through our researches we found out that IVR flow can be mapped to workflow.

A workflow is a depiction of a sequence of operations, declared as work of a person, work of a simple or complex mechanism, work of a group of persons, work of an organization of staff, or machines. Workflow may be seen as any abstraction of real work, segregated in work-share, work split or whatever types of ordering. For control purposes, workflow may be a view on real work under a chosen aspect, thus serving as a virtual representation of actual work. The flow being described often refers to a document that is being transferred from one step to

another.

A. Windows Workflow Microsoft's .NET Framework 3.0 supports Windows Workflow. Windows Workflow Foundation is a framework that enables users to create system or human workflows in their applications written for Windows Vista, Windows XP, and the Windows Server 2003 operating systems. It consists of a namespace, an in-process workflow engine, and designers for Visual Studio 2005. Windows Workflow Foundation can be used to solve simple scenarios, such as showing UI controls based on user input, or complex scenarios encountered by large enterprises, such as order processing and inventory control. Windows Workflow Foundation comes with a programming model, a reportable and customizable workflow engine, and tools for quickly building workflow-enabled applications on Windows.

IVR Flow is mapped to Windows Workflow. IVR flow is defined using the nodes created from the custom activities using Microsoft Windows Workflow Foundation.

When mapping IVR flow with Windows workflow there are two types of flows; Sequential workflow and State Machine workflow. State Machine workflow is not user friendly. So the Sequential workflow is mapped to IVR flow. IVR flows should have the ability to go back to a previous node, but in sequential workflow there is no method to go back once it starts execution. A solution to this problem is creating a custom activity that can contain all the nodes that should be visited again. A Do-While custom activity was created to contain different other activities in it and allowed to loop on user preference.

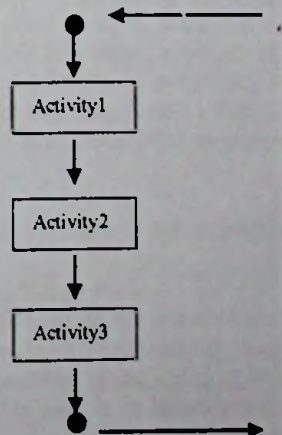


Fig. 2. A Do-While activity which can be executed several times.

IVR designer solution is developed to support the designing of IVR flows part by part in the same solution. A part of a whole solution will have number of Workflows associated with it. Connection of these workflows is done by the Invoke Workflow activity in Windows workflow.

### IV. FUTURE EVOLVEMENT ON THIS AREA OF RESEARCH

Future enhancement will focus on providing personnel

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IVR of customers of a service providing company. For example, a customer of mobile service providing company would like to answer his calls automatically when he is not present in the country. If a person can define his own IVR flow his callers will know what to do, according the automatic answers by the IVR server. This will need to host the IVR Designer in web based application, by giving user accounts to the subscribers. This will be done as a future enhancement to the system.

Showing the debugging process graphically will also be in the future research of the IVR Flow Designer to enhance the user experience. This will include highlighting or changing the colour of the executing node during simulation.

## V. CONCLUSION

Duo IVR Designer and Simulator can provide an easy to use customizable IVR Flow Designer. This IVR Flow Designer helps to create IVR scripts to any platform it is independent of the underlying telephony technology. This feature is done by the plug-in module. IVR simulator helps to simulate the IVR flow while development. IVR Flow is created by mapping windows workflow and generating the IVR script from XOML. The user friendliness and customizability of the IVR Designer we have will help the customers to ease their process of defining IVR call flows, without doubt.

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