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Developing a CbC Based Agentfor Pre-Oral-Cancer-Analytics - a Case Study

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Abstract: e-Governance process re-engineering in information and technology by government to achieve efficient and effective delivery of government services [4]. The ultimate goal of e-governance is to achieve automated workflow inside the government department. Thus automated workflow can be considerably achieved through CbC and made available in a secured way to the citizen and these automation results in the optimization of resources.The Dashboard Platform serviceis a CbC based platform for configuring the Dashboard needs of an application at the frontend. This paper proposes an idea for implementing a CbC (Construction by Configuration) based agent for the complex data management at the backend. The proposed system enables the services with registration, authorization, authentication, configuration, deployment and testing of web services through the CbC based agent which considerably reducesthe key problem, issues and high effort of writing the web services.

Key words: Construction by configuration · Interoperability · e-SDP (e-Governance Service Delivery Platform) · DPS (Dashboard Platform Service) · Analytics · Agent

INTRODUCTION

In developing countries, cancer isone among the ten most common cause of fatality. Cancer, which is defined as abnormal growth of cell, can affect any tissue or organ of body. Oral cavity is the most common cancer site observed by Indian registries. Oral cancer is usually related to the use of alcohol, smokable tobacco and non smokable tobacco.Pre-oral-cancer-analytics is theproject ofhealth and family welfare department, government of Tamil Nadu and technical consultancy is provided by National Informatics Centre.The main objectives of this analytics includes the screening and follow up of oral cancer patient by collecting the details of oral Cancer Patient which includes Registration Detail, Family Detail, Photograph, Habit details, Symptoms of diseases, Oral Hygiene Practices and Diagnosis and Referral. Thepain area in establishing the whole analytics part of the data, which is required for the dashboard, is the data requirements of the oral cancer Analytics.

Analytics often favors data percepts to communicate insight, discover, interpretation and communication of meaningful patterns in data [1]. Pre-oral-cancer-analytics is developed in dashboard platform service to generate a dynamic visualization system such that it generates various informative (graphical) reports for the senior officials of health and family welfare department so that they will find it simple in analyzing the results based on survey made. Finally, the suspected patients follow up a pathological test. By analyzing the test results, the department will take necessary actions on the treatment.

The analytics on pre oral cancer is to make the complex system to support better decision making.Generally the decision that a manager has to take may range from setting of goals and targets for the entire enterprise to specific decisions regarding day-to-day activities. Some of them may have only short-term implications, while others may have long-term implications on the enterprise [1]. From these points of view, managerial decisions can be broadly classified into two

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categories: First, the operational decision for field level officer where the dentist/dental Assistant at the PHC level reviews all the statistic information of oral cancer patient. Second, the Strategic and tactical decision utilized by state level Nodal officer of health and family department on the survey made over oral cancer patient about the information on how many people suspected, how many people have been screened, how many types of oral cancer sign influence the effect and what is yet to be addressed, those kinds of details are to be followed up at this level.

To perform a faster, improved, effective and efficient pre oral cancer analytics,the paper aims at optimizing the resources both at the frontend and backend by utilizing the present CbC based dashboard platform service and the proposed CbC based agent platform.

Construction by Configuration in E-SDP: e-Governance service delivery platform (e-SDP) [2] is a process of sharing information and delivering effective government services to the citizen and government by ensuring the services cutting across ministries and line department. CbC allows reusability of abstraction, adopting the existing system to the current circumstance of use. Applying Construction by configuration in the DPS platform and Agent platform, would allow services to be designed and developed through reuse [3]. The paper proposes system construction to be reduced by configuration of well-defined components leading to an effective service delivery time with intelligently programmed agents [4].

Information and communication technology enhance the workflow by offering a variety of services with improved government interaction with citizen empowerment. The e-governance services are offered by defining the requirements of the system and then followed by design, development and deployment of the system. As development of the system takes longer time, leading to dissatisfaction with existing business process, it has become a necessity to re-engineer the strategy to 'Construct and Configure' to reduce the timeline for the delivery of services.

Service Discharge by CbC at the Frontend: E-governance services are offered by defining the requirement of the system and then followed by design, development and deployment of the system [5]. Pre-oral-cancer – Analytics uses the frontend as CbC based DPS.The Dashboard Platform Service enables analytics of a complex system to support decision-making. It is easy to read, often single page, real-time user interface, showing a graphical presentation of the current status and historical trends of an organization's or computer appliances key performance indicators to enable instantaneous and informed decisions to be made at a glance which is depicted in various chart (Standard, Dependency and Drill-down) and chart type(single series, multi series,dough nut and combination chart).

Dps allows to design, customize, register, authenticate and to deploy the web services. The Themes, Layouts, labels, legends, header and footer of dashboard are customized and the preview of dashboard is available under preview dashboard. Once the dashboard is customized, xml payload is available to download, using this domain web services is written and registered with authentication details as necessary. Finally the actual dashboard preview with live data using the live web services registered is available to integrate with the domain web services.

Drawbacks of the Existing Model of Service Delivery: The following are the disadvantage of existing service delivery platform

- Web services have to be developed which requires more time [2].
- Skilled people are required to carry out the task.
- Managing the database becomes difficult for novice user.
- More resources are required

Service Discharge by CbC at the Backend: CbC based Agent [4] Platform for data management allows optimizing the resources at the backend in e-governance service delivery platform which provides commonly Shared resources, faster, improved and efficient services [6]. The CbC based agent is constructed with re-usable and customizable components which are more reliable for quick deployment of the dashboard and also optimize the resources to the larger extent. It eliminates the manual work of writing the web services [7]. Agents are defined as being a software program that can perform specific tasks execution and possess a degree of intelligence that permits it to monitor, configure, deploy, test and perform parts of its tasks autonomously and to interact with its environment in a useful manner. The CbC based Agent is programmed with the below requirement

- Agent work with different platforms.
- Bundles DPS service-id.
- Create and monitor Agent database
- Service type (pull, authentication, response token etc.), description, authorization, monitoring the status, filter condition.
- Service specification with chart, chart layout, chart type, dimension and measures.
- User preference to create and to customize views
- Invoke, configure and provide security fixes of tomcat services.
- Test and deploy view for web services.
- Test and deploy final web services.

Need for Agent Services: The current state of service delivery platform be taken to the next level by facilitating the agent service with the following features

- To promote scalability in terms of supported user and to enhance the performance of service delivery platform.
- To facilitate ability of customization.
- To provide flexibility for data movement
- To adopt Construction by Configuration and agility.
- To promote a security audit for web services.

Benefit of Agent: The following benefits can be achieved if agents are programmed intelligently for service delivery:

- Agents can eliminate the manual work reducing human prone errors [6].
- By using agent, the service availability can be made autonomous and accessed from anywhere, anytime.
- Short span of service delivery life cycle.
- No prior knowledge is required for creating web services.
- Managing the database becomes easy for novice user.
- Autonomous action is executed on an event [3].
- Enhanced performance, quality, scalability, interoperability and maintainability.

C.CbC based Agent Model: The e-SDPprovides a variety of services to stakeholder with multiple system components. Fig.1 represents the system interaction for oral cancer analytics. The registered, customized dashboard in DPS creates web services to provide sample data format inXML giventhe dashboard service-id. In order to simplify the data format in XML,the CbC based agent [7] is designed, developed & tested for pre oral cancer analytics case study.

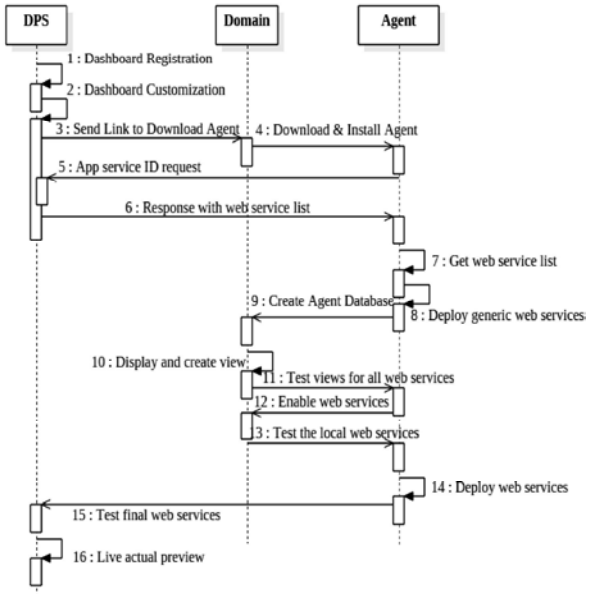

Fig. 1: System Interaction

An agent receives the requirement as service ID, charts Layout, chart type, dimension, measures and levels provided as input and processes the requirement as programmed. The CbC basedagent when invoked with service ID, calls DPS web services list to get the specification for the dashboard and ask domain to create view with the actual view for the requirement of the dashboard and tested for all web services. The output generatedusing the generic web services can be verified for the format and thereby allowing the dashboard to make use of domain data towards live preview.

Key Components of Agent Platform: There are three main component on CbC based agent platform,agent user interface, web service deployment and agent database [9].*Agent user interface*allows monitoring the status of web services completion where the selection of data is done in the database through agent platform. The domain is allowed to build the query by creating the view from the automated quotes of table name and column name;italso offers certain degree of DB abstraction, which simplifies migration to different DB platforms.The testing over the created views is done. Finally the status of the web service is monitored. *Web service deployment* makes use of the list of views specification from the agent database to deploy the tested web services. *Agent Database* contains the data such as service ID, chart ID, Chart types, status needed for views deployment and the details about the domain database.

Implementation on Pre Oral Cancer Analytics: If cancer can be detected early, treatment may be curative. In India, 11% of oral cancer is curable for which radiotherapy and surgery treatment is justified.Analytics provides early detection, ground research on learning the data sets and the risk factors of signs, symptoms and habits of oral cancer patient. Attracting the attention over the nodal officer at PHC level and minister is the core concern about the pre oral cancer analytics from the surveyed data sets of oral cancer patient [10] and how these analytics can be used to filter, suggest, provide awareness and support to the suspected details.

Utilizing the CbC based platform at the frontend and backend,Analysis is providedby considerably optimizing the resources [2]. In this section the implementation of pre oral cancer analytics concentrated on the main dimension of oral cancer patient like oral cancer types, Habits practices, Symptoms details, Oral hygiene practices, Time, Geography, Treatments and measures identified are no of screened cancer patient, no of suspected cancer patient.Table: 1 depicts the dimension name and dimension types of the oral cancer patient.

Table 1: Dimension of Oral Cancer Analytics

Dimensions name	Dimensions type
Oral Cancer Types	•Leukoplakia
	•Lichen planus
	•Erythroplakia
	•Sub mucous fibrosis
Habits practices	•Smoking tobacco
	•Nonsmoking tobacco
	•Consuming alcohol
Symptoms details	•Non healing ulcer
	•Painless swelling
	•Difficulty in swallowing
	•Hoarseness Of voice
	•Inability to mouth
	•Loss of sensation in mouth
Oral hygiene practices	•Cleaning methods
	•Cleaning items
Time	•Yearly
	•Quarterly
	•Monthly
	•Weekly
	•Daily
Geography	•District
	•Block
	•HSC
	•PHC
	•Village
Treatments	•Radiotherapy
	•Chemotherapy
	•Surgery
	•Palliative care

From the dimension and measures of oral cancer patient, the comparative analysis is made and depicted over the dashboard.

Following are the state wise analysis made on the pre-oral-cancer analytics

Analysis Over Screened vs Suspected: Screening program is relatively simple and inexpensive test to classify them as being likely or unlikely to have oral cancer. Screeningmeasures reduces the mortality rate of oral cancer in high-risk individuals and provide the evidence to support screening program for early detection of oral cancers.Dental senior officer should remain vigilant for suspected signs of the oral cavity cancer and helps to increase the awareness and produce the human resources needed for future treatment.

(Fig: 2) represent the number of members screened and the number of members suspected over oral cancer is depicted in both district wise and month wise, is analyzed. The patient is said to be suspected if he/she has any one of the cancer sign of Leukoplakia, Lichen planus, Erythroplakia, Sub mucous fibrosis. White plaques or patches without any associated redness are not listed for suspecting malignancy and should be in the category of prompt referral.Among 8841 people screened, the localized percentage over suspected details of cancer sign is 2.91%, habits practices is 15.86 % and symptom details is 6.33%. From the result habits practices shows the high risk factor over the suspected details.

Fig. 2: Analysis over screened vs suspected

Analysis over Cancer Signs: Early detection of oral cancer needs more than just understanding of the cancer signs. From the fig: 3 it is observed that, among the screened people, 258 people have suspected to cancer sign with a white or red patch in the mouth.20.54% is subjected to be having leukoplakia, itis a white patch

found on the mouth that cannot be rubbed off and cannot be characterized clinically. 27.90% people among the suspected having erythroplakia, It appears as a fiery red, velvety or granular lesion with irregular in outline. Lichen Planus (27.90%) appears as symmetrical white papules, erosive lesions cause pain and discomfort to the patient, especially upon contact with spicy foodstuffs. Submucous Fibrosis is highly prevalent with 47.28%,it presents as a loss of the mucosa, fibrous bands limiting opening of the mouth.

Fig. 3: Analysis over cancer signs

Analysis over habit Practices: Among the total people screened, 1403 people have suspected to be having the habit practices where people consuming alcohol is 44.19%, smokable tobacco is 43.69% and non smokable tobacco is 12.11%. Tobacco use, including smokeless tobacco and excessive alcohol consumption are estimated to account for about 90% of oral cancers.Tobacco-related cancers are controllable for primary prevention (48% in men and 20% in women). At least 30% of the future cancer burden is potentially preventable by tobacco and alcohol control.

Fig. 4: Analysis over habit Practices

Analysis over Symptoms Details: From the fig:4 it is observed that, 560 people have suspected to be having the symptoms of oral cancer like Non Healing Ulcer (11.96%), Painless Swelling (17.67%), Difficulty in Swallowing (17.32%), Hoarness of Voice (16.78%), Inability to open mouth (16.78%), Loss of sensation(19.46%) in mouth is being analyzed. From the results, it is observed that 560 people have suspected to be having the symptoms of oral cancer

Fig. 5: Analysis over habit Practices

Correlation Coefficient over Analysis: Correlation delivers the statistical relationship or dependency over the oral cancer parameters. Mutual information of oral cancer parameters indicates a predictive relationship that can be utilized in practice.The variable x1 is thought to be the linear function of x2, x3, x4 and x5.Where the variable

x1 represent the geography
x2 represent the suspected
x3 represent the cancer sign
x4 represent the habit practices
x5 represent the symptoms details

Table 2: Sample value of the variable

Variable	January	February	March	June	July	November
x1	37	7	122	77	12	3
x2	10	1	64	42	4	1
x3	11	3	19	16	1	3
x4	80	29	177	21	85	23
x5	9	24	17	1	0	2

Table 3: correlation coefficient (r) of oral cancer

Parameter	Geography	Suspected	Cancer sign	Habit	Symptoms
Geography	1	0.99	0.95	0.87	0.38
Suspected	0.99	1	0.92	0.88	0.38
Cancer sign	0.95	0.92	1	0.85	0.42
Habit	0.87	0.88	0.85	1	0.24
Symptoms	0.38	0.38	0.42	0.24	1

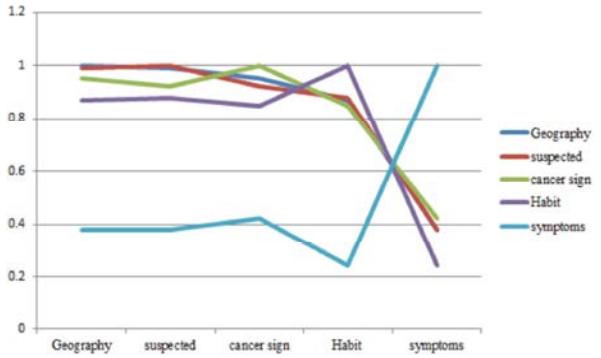

Fig. 6: Correlation Coefficient (r) of oral cancer

Table 2: represents the sample value of the variable over oral cancer parameter. From the sample value, the correlation coefficient (r) of oral cancer is calculated and depicted in Table: 3.

The scattered graph fig:6 depicts the positive relation between the parameter, these results in the evidence that the influence over geography, suspected, cancer sign and habit of oral cancer is highly significantand the symptoms details has less significant.

Table 4: Quantitative Analysis of distribution over habit practices

Habit vs cancer sign	Leukoplakia	Erythroplakia	Lichen planus	sub mucous fibroses
Alcohol	8	9	5	7
Smokable Tobacco	7	10	6	5
Non Smokable tobacco	2	1	4	4

Further analysis over the highly significant parameter of habits practices and cancer sign result in the knowledge of risk factor over smokable tobacco and alcohol consumption.

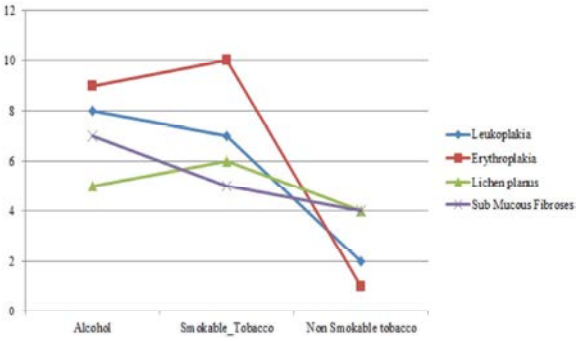

Fig. 7: Distribution over Habits

Performance and Evaluation: NIC has developed many dashboard services and it was noted that the deployment of dashboard are time consuming, due to the high effort of writing the web services towards the pull or push of necessary data from the domain database.

Table 5: Quantitative value over the oral cancer analysis

ANALYSIS	Time Taken for Dashboard without Agent (in hours)	Time Taken for Dashboard with Agent (In hours)
DAMWSS	40	2.1
DAOSS	48	1.8
GWSS	56	1.5
DAMCS	32	1.5
DAOCS	24	2
GWCS	64	1.8
DAMHP	32	1.6
DAOHP	56	1.7
GWHP	64	2
DOH	32	1.3
DAMSD	48	1.6
DOMSD	40	1.5
GWSD	32	1.5
DOS	64	1.8

Table 5 represent the quantitative value of the dashboards developed in DPSsuch as District And Month Wise Screened vs Suspected (DAMWSS), Dependent analysis over screened vs suspected (DAOSS), Geographical wise screened vs suspected (GWSS), District and month wise details over cancer sign (DAMCS), Dependent analysis over cancer sign (DAOCS), Geographical wise details over cancer sign (GWCS), District and month wise details over habit practices (GWCS), Dependent analysis over habit practices (GWCS), Geographical wise details over habit practices (GWCS), Distribution over habits (DOH), District and month wise details over symptom details (DAMSD), Dependent analysis over symptom details(DOMSD), Geographical wise details over symptom details (GWSD), Distribution over symptoms (DOS), are considerablyconsumes more time and the code are not reused. There is also a lack of expertise which causes the delay.

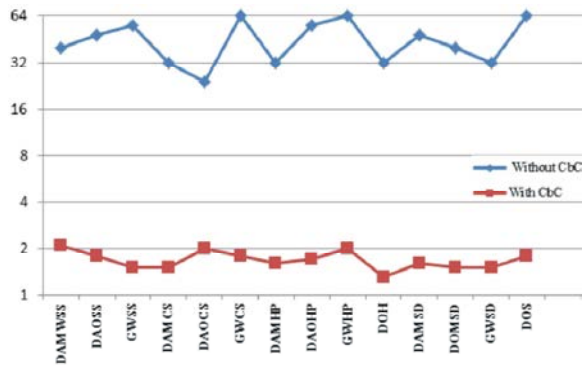

Fig. 8: Time Taken for dashboard without CbC& with CbC

Figure 8 depicts the comparison between the timelines, with and without using CbC. The overall effective time after using agent is drastically reduced.Rework of writing web services and codes are not

required for every new dashboard as re-usability was achieved using the proposed CbC based agent services. This directly optimizes the resources, time and cost associated in the dashboard deployment. Any new requirement on analysis becomes configurable using the agent (Backend CbC), eliminates the design and development of web services to push/pull necessary data using technical experts.

CONCLUSION AND FUTURE WORK

The paper attempts to adopte-SDP platform in analytics and achieving an enhanced performance with CbCbased agents to optimize the resources and allowing interoperability, reusability, flexibility for efficient and effective service to the citizen. CbC based agents also reduces system construction to configuration of well-defined components reducing the time needed to design and develop application services considerably.

The future work may focus on distributed agent modeling and cloud enablement.

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