

# Use of Facial Recognition for Data Personalization in Customer Relationship Management (CRM): Case of Great Zimbabwe Hotel.

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**Abstract**— This study was aimed at development of an intelligent facial recognition system for data personalisation in customer relationship management and determine the extend at which the system would enhance customer relationship management at the institution. The research was conducted at Great Zimbabwe Hotel. The increased competition in the hospitality industry now calls for organisations to restructure their operations so as to retain customers. Many organisations are now taking on board the ICTs in order to enhance customer services. This has driven this study to be conducted using a facial recognition in order to increase customer relationship management. The system was developed and implemented at Great Zimbabwe Hotel. A total of 40 questionnaires were distributed and 33 were returned giving a response rate of 82.5%. From both questionnaire and report review conducted, the result show that the customers liked the system. Also on performance measurement, the system proved to be very effective as it managed to match 28 out of the 30 participants. Thus from these results it can be concluded that the system presents opportunity to engage more guests to book for a stay at the hotel.

**Keywords**— Customer Loyalty, Customer Relationship Management, Facial Recognition, Personalisation

## I. INTRODUCTION

Competition is forcing many companies to restructure so that customers rather than business processes become the focus of their organization. Whether customers use telephones, fax, e-mail or websites, each contact point allows the company to capture information that is fed into the system. With the emergence of new technologies and processes, marketers are now beginning to understand each customer better than ever before and are choosing with whom to do business and how to manage customers' behaviours and attitudes. The marketers' goal is to offer a personal approach, to support one-to-one marketing. One of the major developments within today's business practice is the increasing interest in Customer Relationship Management (CRM). Marketers continue to place increased strategic emphasis on building relationships with customers and investing in relational information technology.

## II. BACKGROUND OF THE PROBLEM

In a bid to win customers and encourage them to stay loyal or repurchase the service, most companies have resorted to meeting and satisfying customer needs by not being only reactive but proactive. They are also interested in finding new ways and means to satisfy the customer. Most companies are aiming for good customer relationship which means better service to the customer thereby preventing the customer from being promiscuous. A lot of companies are not just attracting customers, but are working at building long term relationships with customers (both local and foreign customers), suppliers, employees, distributors and the general public. These companies are striving to satisfy the maximized expectations of customers [8].

In the hotel sector, which has increased competition and high customer turnover, competitiveness is significantly dependent on the hotels' ability to effectively satisfy their customers [14]. This sector is ideally suited to implement CRM because it is customer information-intensive and personal service is even more relevant than it is in other industries. In this vein, a recent study showed that CRM was the most used strategic management tool in hotels currently [6], and the topic of customer retention has become an emerging trend in hospitality research, receiving increased attention in the last decade [15]. Successful customer relations will give the company a lead and an edge against its competitors in the market as customer related aspects such as, customer experience, loyalty, satisfaction, and retention are ensured. Core competence on the other hand differentiates the company from its competitors through its competencies, capability and resource and therefore giving it a competitive advantage.

Great Zimbabwe hotel is using different strategies to have a personalized relation with their customers for example it is using e-mails to communicate with customers, using social networks to chat with customers, offering promotions, the aim of these strategies is to have a relationship with customers. These current strategies that are being practised are not very effective in attracting new customers because customers are

receiving the same hospitality when they move from hotel A to hotel B, so there is need for new strategies that will differentiate great Zimbabwe hotel from its competitors.

### III. STATEMENT OF THE PROBLEM

Travellers are becoming more price sensitive, less brand loyal and more sophisticated. To enhance guest loyalty, hotels must focus on developing Customer Relationship Management (CRM) strategies that aim to seek, gather, store and share guest information throughout the entire organization for creating personalized, unique guests experiences.

### IV. AIM

To develop an intelligent facial recognition system for data personalization in customer relationship management.

### V. OBJECTIVES

1. To develop a facial recognition system for data personalization in CRM at Great Zimbabwe Hotel.
2. To assess the acceptance of the facial recognition system by guests.
3. To evaluate the effectiveness of facial recognition system as a strategy to enhance customer relationship management.

### VI. RESEARCH QUESTIONS

1. Does the implementation of facial recognition system at Great Zimbabwe hotel lead to attraction of new customers, retaining of existing customers and keeping of loyal customers?
2. Will the use of facial recognition as a strategy to have personalized relationship with customers have a positive effect to customers and the hotel business?
3. To what extent does the implementation of facial recognition system as a tool to enhance Customer Relationship Management Process influences guest buying behaviour?

### VII. JUSTIFICATION

With the development of the Internet and the continuous improvement of technology, CRM has entered a new era of development. Retaining customer loyalty has been a sales and marketing principle, CRM is actually a tremendous step forward in creating a system that can provide a means of retaining individual loyalty to a business. The use of facial recognition for data personalization in CRM is a strategy for an organization to identify customers who add value to their sales and to have a one-one relationship with these customers because relationships are coming at the forefront of the competitive background.

### VIII. LITERATURE REVIEW

Customer relationship management is designing an organizational structure for mutual communication between the customer and organization [10]; mutual relationship with customers takes place through physical part of behaviors with customers and communications [9]. In today's competitive market, companies need to use modern methods of marketing to achieve and sustain competitive advantage. Relationship marketing is a new marketing strategy which focuses on understanding customer's needs through communication; this can lead to competitive advantage for the organization [1]. Implementing relationship marketing through CRM as an important step in performing relationship marketing methods, brings to the company both the benefits of relational strategy (greater retention and customer loyalty) and customer strategy (greater value and convenience to customers in their interactions with company).

The literature identifies two streams of research to form the theoretical foundation of a CRM concept [5]: a strategic stream (relationship marketing) and a technological stream related to the information systems [2]. Relationship marketing (RM) is more of a strategy designed to foster customer loyalty, interaction, and long-term engagement. It is normally designed to develop strong connections with customers by providing them with information directly suited to their needs and interests and by promoting open communication. This approach often results in increased word-of-mouth activity, repeat business, and a willingness on the customer's part to provide information to the organization. In the case of competition, relationships can serve as the basis for competitive advantage, while technology serves as the enabler of relationship building.

It is important to identify the components of value that are unique to each customer or customer base in order to create unique value propositions to that customer base and manage those relationships appropriately. To create a personalized relationship with customers there is need to create a customer profile which includes name, address, preferences, buying behaviour, and this data is kept in the customer database. Personalization is about building customer loyalty by building meaningful one-to-one relationships, by understanding the needs of each individual and helping satisfies a goal that efficiently and knowledgeably addresses each individual's need in a given context [4]. Personalization is an approach that can aid in bringing, staying and returning customers to a website or a supermarket.

#### A. Forms of CRM

There are three types of CRM as mentioned by [5] which are collaborative, operational and analytical:

- 1) *Operational CRM* - includes the business process and technology that can help to improve the efficiency and accuracy of day to day customer-facing operations within sales, marketing and service automation. It includes areas where direct contact take place, referred to as customer touch points.

- 2) *Analytical CRM* - provides analysis of customer data and behavioral patterns to improve business decisions. This includes customer profiling/segmentations systems and reporting. It focuses on the development and utilization of customer data and is a bottom up perspective focusing on mining of customer data and strategic or tactical purposes.
- 3) *Collaborative CRM*- components and processes that allow an enterprise to collaborate and interact with their customers, including feedback and issue reporting is involved. It includes things like voice technologies, web storefronts, emails, conferencing and face to face interaction. Collaborative CRM sees CRM as a (top down) core customer centric business strategy aiming at winning and keeping profitable customers. The most important goal with this type of CRM is to align the broader business strategy with customer strategy through corporate vision.

Collaborative CRM was used in this research because collaborative CRM can broadly be conceived as collaboration between one or more value chain actors (e.g. suppliers, partners, customers and further external actors such as e-markets) to achieve more customer benefits and to improve customer relationships. In this scenario the aim of CRM is to have a personalized relationship with customers by gathering customer feedback from a technical support session (Facial recognition system) informing marketing staff about products and services that might be of interest to the customer. This will improve the quality of customer service, and as a result, increase customer satisfaction and loyalty, to the hotel it leads to increase in sales, market growth and survival in business.

As a service oriented organization, the delivery of service in a hotel occurs when there is interaction between service providers and the service encounter [3]. Hence in order to enhance service experience, hoteliers need to focus on customer interaction. Customer orientation can be achieved through a positive relationship between customer and service provider. Research has supported that customer orientation leads to increase organizational performance [16]. Furthermore customer orientation is also one of the market beneficial sources, it helps organization to understand customer, and hence it helps in delivering an appropriate plan to satisfy customer needs. As contributed by [19], as competition in the hotel industry intensifies, hoteliers have learnt to shift their strategies from customer acquisition to customer retention and loyalty, which is only possible with effective customer satisfaction.

#### *B. Overview of facial recognition technology*

Facial recognition analyses the characteristics of a person's face images input through a digital video camera. It measures the overall facial structure, including distances between eyes, nose, mouth, and jaw edges. These measurements are retained in a database and used as a comparison when a user stands before the camera.

The importance of technology and its use in CRM is in the increased use of these technologies to establish relationships

and develop loyalty and retention among existing customers. The ability to make inferences about an individual based on his or her unique mix of facial characteristics can have countless uses, many of which are innovative and beneficial to consumers. Facial recognition technology is part of Biometrics, which is the science of recognizing people based on their physical characteristics and personal traits. It offers tremendous potential in lodging applications, particularly in the areas of identity assurance and security. Unlike existing authentication and assurance methods, biometric technology does not require users to carry anything with them to authenticate identity, which means that it cannot be lost, compromised or stolen.

Depending on the face data acquisition methodology, face recognition techniques can be broadly divided into three categories:

- i. Methods that operate on intensity images.
- ii. Methods that deal with video sequences.
- iii. Methods that require other sensory data such as 3D information or infra-red imagery

In the literature, there are many methods for the holistic class, such as, Eigen faces and Fisher faces, which are built on Principal Component Analysis (PCA); the more recent 2D PCA and Linear Discriminant Analysis are examples of holistic approach. Although these methods have been studied widely, local descriptors have gained attention because of their robustness to illumination and pose variations. The local-feature methods compute the descriptor from parts of the face, and then gather the information into one descriptor. Among these methods are Local Features Analysis, Gabor features, Elastic Bunch Graph Matching, and Local Binary Pattern (LBP).

The last one is an extension of the LBP feature that was originally designed for texture description, applied to face recognition. LBP achieved better performance than previous methods, thus it gained popularity, and was studied extensively. Newer methods tried to overcome the shortcomings of LBP, like Local Ternary Pattern (LTP), and Local Directional Pattern (LDiP). The last method encodes the directional information in the neighbourhood, instead of the intensity. Also, [20] explored the use of higher order local derivatives (LDeP) to produce better results than LBP. Both methods use other information, instead of intensity, to overcome noise and illumination variation problems. However, these methods still suffer in non-monotonic illumination variation, random noise, and changes in pose, age, and expression conditions.

Literature identified the major problems with Face recognition technology as illumination and pose problems. Hence below are some of the ways the researcher carried out to overcome these problems. The researcher used special cameras (invisible IR night vision IP WIFI webcam) which capture images of three-dimensional views of the person, and using the special main features of each face that are not changed significantly with time, such as eye hole, the distance between the eyes, nose shape. These features are a source of information for a facial recognition system as the

changes in the lighting or surrounding environmental conditions do not change these measurements. The advantage of 3D facial recognition is that it is not affected by changes in lighting like other techniques. It can also identify a face from a range of viewing angles, including a profile view.

The researcher identified that gradient-based image has been proved to insensitive to illumination. In this research the researcher used gradient-based image. Based on that, [20] proposed an illumination insensitive feature called Gradientfaces for face recognition. Gradientfaces is derived from the image gradient domain such that it can discover underlying inherent structure of face images since the gradient domain explicitly considers the relationships between neighboring pixel points. Therefore, Gradientfaces has more discriminating power than the illumination insensitive measure extracted from the pixel domain. The use of gradient information makes the method robust against illumination changes and noise.

A holistic approach was also used in this study because it has the main advantage of not destroying any of the information in the images by concentrating on only limited regions or points of interest. The researcher used Viola – Jones method which is always a contender for robust face detection. The method computes set of Haar-like features at multiple scales and locations and uses them to classify an image patch as a face or not. A simple, yet efficient, classifier is built by choosing a few effective features out of the complete set of the Haar-like features that can be generated using the AdaBoost method. A number of classifiers, ranging from a very simple 2-features one up to more complex layers containing many features, are combined in a cascade structure to provide both accuracy and real-time processing

**IX. RESEARCH METHODOLOGY**

This section takes an in-depth look into methodologies for the user interface design, ontology design and inference engine design process, and implementation of the suggested theories and strategies and how they were carried out. Further to that the researcher on this section also provides a step by step implementation of the proposed model.

*A. Design Tools*

A PC or Laptop was used in the development work as a workstation for programming and an invisible IR night vision IP WIFI webcam was used to capture customer images. Other development tools used includes Microsoft Visual Studio 2010, Android SDK, SQL Server Management Studio 2008, Internet information services manager (IIS).

*B. System design*

Use case diagrams and entity-relationship diagrams were used for both system analysis and design. The guest first books online for their stay at Great Zimbabwe Hotel, on the booking page they enter their personal information and then

click enrol face. When the face was enrolled it was stored in the facial recognition system database and all the personal information filled. The guest went on to select number of days to stay, room type and room number then he completed the booking step. When the guest came to occupy his booking that is when he will be recognized by invisible IR night vision IP WIFI webcam that were placed at different position around the hotel.

The guest image was taken by invisible IR night vision IP WIFI webcam, the image was compared with the enrolled images that were already stored in the facial recognition database, when a match was found, then the image was accepted or recognized. When the guest’s face was recognized this information was send to the receptionist and the personal details about the guest’s booking, his preferences were shown on the receptionist’s screen. When the guest came to the receptionist’s desk he was greeted by his name. All the information about a customer’s preferences was used to offer guests preferences according to their tastes. When the guests were in their rooms they were texted messages saying for example today we have traditional meals because the waiters know that this person likes it, they were saved according to what they like most and this helped to build customer relationship.

TABLE I: USE CASE OF FACIAL RECOGNITION SYSTEM

Use case name	Facial recognition
Actors	Guests
Description	A guest who made a reservation already
Typical flow of events	Actor action: use case is initiated when the guest come to the hotel. System response: the system recognizes who the guest is and updates all the information in the database.
Precondition	The guest has already made a reservation.

*C. Functional requirements*

- i. The system should perform reliable identification with large database
- ii. The system should compare the given image against images stored in the database
- iii. The system should acquire face images
- iv. The system must pre-process image that is removing background features, more light.
- v. The system must work in real time
- vi. The system must detect features of a face
- vii. The system must respond user verification within few seconds since the system performs in real time.
- viii. The database must store 100 or more images.
- ix. All information regarding user visit, preferences will be saved in the database

#### *D. Usage Scenarios*

- 1) *Admin Module:* The system administrator keeps the system running and therefore should have more access than any other user. Only the administrator can access the administrative site after supplying a unique username and password.

Administrator should be able to form the back end.

- Update user profiles.
- Delete user profiles.
- Add new user.
- Reset passwords - administrator should be able to reset password for users who would have forgotten their passwords.
- Offer access rights to users.
- Should have access to all system components.

- 2) *Guests' module:* Booking - each guest first booked for a stay in the hotel. The guests clicked booking link on the website, they clicked add new book and they were prompted with the page where they were required to fill in their details such as name, sex, residential address, phone number, national identification number, upload pictures, enrol their faces. At enrolment of faces that was where their images were captured and stored in the systems database, when all the information was supplied they saved and exited the booking page.
- 3) *Customer orders page:* The customers specified what they want to eat so that they will be saved according to their preferences.
- 4) *Sales representative module:* The sales representative was responsible for viewing customer history which contains customer orders, how often the customer visits the hotel, room facilities they like and he /she came up with a graph which shows these trends, so that she/he would have the information of what the customers wants or likes. The sales representative was also responsible for alerting customers about their favourite meals, linen, recreational activities that they have and also to alert them on today's special meals. This alert was done via a text message to the customers mobile phone.

#### *E. Database design*

MySQL as a relational database management system was used because it is well known for its reliability and dynamics when it comes to database management. It offers good security for databases as well. It also allows for multiple user interaction with database, at the same time allowing for rapid insertion, deletion and updating of entries into the database. Relational databases are also good in that they can help in implementing measures that will reduce external manipulation. They support diverse data needs and are good in handling data. Hence it was chosen in this study.

#### *F. Population and sample*

The researcher engaged Great Zimbabwe Hotel guests. The sample size used is thirty guests. To come up with this sample size, the researcher chose the guests who booked for the month of April. The researcher collectively and selectively interviewed the guests to evaluate the effectiveness of facial recognition system amongst guests who would have used the system. The researcher put all mechanisms which guaranteed an unbiased result extraction from this sample space. Administrator assessed the system as they undergo the process of maintaining it.

#### *G. Research instruments*

In order to gather information about the acceptance of the facial recognition system by guest, the researcher used observations and questionnaires as primary sources of data whilst agency records were reviewed for secondary data sources.

Observations or visual assessments were carried out as the guests were entering the hotel, all the activities like physical actions, verbal behaviour of participants, express behaviour such as tone of voice, facial expression when they receive a greeting message or a message saying today we have your favourite meal you can book for it if you want it from their mobile phones and this greatly help the researcher in identifying behaviours of guests during their stay at the hotel.

Questionnaires were given as handouts to the guests and they filled them in the comfort of their rooms and submitted them at the reception. The advantage of questionnaires is that the researcher was able to contact large numbers of people quickly, easily and efficiently using a postal questionnaire.

The reports showed the number of new customers who had come at a certain period of time for example a month, the number of those new customers who are coming frequently so that they may be categorized as loyal customers, the number of existing customers who are coming so that management can have a number of loyal customers and those who come at intervals, the rate at which customers returns back to the hotel, number of males, females, local or foreign guests who visit the hotel, their likes and dislikes.

#### *H. Data presentation and analysis*

Quantitative data was presented in tabular and graphical forms. Graphs included pie charts and bar graphs. Data was analysed using percentages and decimals. This measures the proportion that a given category constitutes to every element in the group. SPSS (Statistical Package for the Social Sciences) package was used to do cross-tabulation that was used in the research to compare results basing on different parameters and attributes. This was done using data from questionnaires (closed-ended questions). Results were then compared and conclusions made.

X. RESULTS

A. Analysis of respondent’s questionnaires

The responses that the researcher obtained were eighty three percent which represent a higher portion of the population. The cross-section of respondents is wide enough to warrant reliable findings. The largest numbers of respondents or questionnaires were distributed to guests since they are the final users of the system and are somehow directly affected by the system. The table below show a summary of questionnaire sent-responses received ratio.

TABLE 2: QUESTIONNAIRE RESPONDENTS

TARGET GROUP	QUESTIONNAIRE SENT	RESPONSES RECEIVED	RESPONSE RATE (%)
Guests	37	30	81
Hotel managers	3	3	100
Total	40	33	82.5(1dp)

B. Summary of guest questionnaire responses

Question 1: Did you like the idea of being recognized and texted a message that reminds you about your favourites?

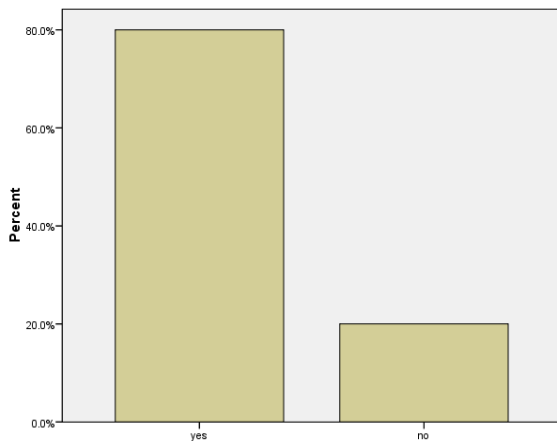


Figure 1: Liked being recognised and texted a message

When asked if they like the being recognized and texted a message that reminds them about their favourites, 80 percent said yes and 20 percent said no. The primary reason why greater percentage liked the idea was that they were happy with the services they were offered and the welcome they received. However, the remaining 20 percent argued that they were did not like being recognized because they thought that their privacy will be disclosed.

Question 2: Did the use of facial recognition system and being offered food according to tastes and preferences motivated you to visit Great Zimbabwe hotel frequently and became loyal to it?

TABLE 3: VISIT HOTEL FREQUENTLY AND BECOME LOYAL

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid yes	27	90.0	90.0	90.0
no	3	10.0	10.0	100.0
Total	30	100.0	100.0	

As depicted in the table above 90 percent of the respondents said the use of facial recognition system and being offered food according to their tastes and preferences motivated them to visit great Zimbabwe hotel frequently and become loyal to it whereas 10 percent said they were not motivated to visit great Zimbabwe hotel frequently and become loyal to it. These responses show great acceptance of the facial recognition system and this contradict the null hypothesis that the implementation of facial recognition system will not influence consumer buying behaviour.

Question 3: What medium would you prefer to use to communicate with the waiters?

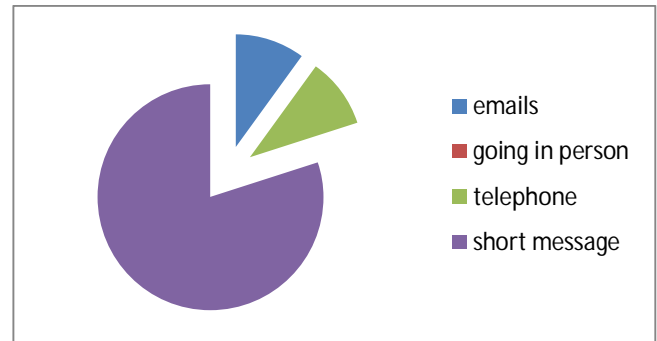


Figure 2: Preferred medium for communication

According to what media of communication guests want, no one said he wants to go in person and say what he wants, ten percent said they want to communicate with waiters using emails, ten percent said they want to communicate with waiters using telephone and eighty percent said they want to communicate with waiters being texted a message.

C. Summary of hotel managers questionnaire

Question 1: Does the implementation of facial recognition system influence guest buying behaviour than the use of loyalty cards?

The results show that all of the respondents agreed that the use of facial recognition system influenced guest buying behaviour than the use of loyalty cards. If the use of facial recognition system did not have an impact on consumer buying behaviour then they would go back to use loyalty cards.

Question 2: Does the use of facial recognition system improve revenue growth and loyalty of guests to the hotel than the use of loyalty cards?

The majority of the respondents concurred that the system improves the loyalty of the guests whilst on revenue growth some had different thoughts.

D. Measuring system effectiveness

The performance was evaluated against two main errors a system can exhibit:

False acceptance rate (FAR) is also known as false match (FM), false positive (FP) or Type I error. The false acceptance rate (FAR) is the measure of the likelihood that the biometric security system will incorrectly accept an access attempt by an unauthorized user. A system's FAR typically is stated as the ratio:

$$\frac{\text{the number of false acceptances}}{\text{the number of identification attempts.}}$$

The table below shows false acceptance rate

TABLE 4: FALSE ACCEPTANCE RATE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	FAR	2	6.7	6.7	6.7
	recognized	28	93.3	93.3	100.0
	Total	30	100.0	100.0	

The facial recognition system was able to recognize correctly 28 people out of 30 people, which shows that the system was 93.3 percent effective. The false acceptance rate was 6.7 percent which is a very small percentage of system failure but overall the facial recognition system was very effective in recognized the correct users.

False rejection rate (FRR) is also known as false non-match (FNM) or false negative (FN) or Type 2 error. The false rejection rate is the instance of a security system failing to verify or identify an authorized person. False rejection rate should be as low as possible. High FRR shows that the system is recognizing wrong people. A system's FRR typically is stated as the ratio of:

$$\frac{\text{the number of false rejections}}{\text{the number of identification attempts}}$$

TABLE 5: FALSE REJECTION RATE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	FRR	1	3.3	3.3	3.3
	recognized	29	96.7	96.7	100.0
	Total	30	100.0	100.0	

From the findings above only 1 person was unable to be identified which is 3.3 percent failure but 29 people were recognized which made 96.7 percent efficiency of the system.

D. Summary of research findings

The research was primarily aimed at designing and implementing a facial recognition system for data personalization in customer relationship management. From the results analysis described in above, the researcher can conclude that the use of facial recognition system lead to attraction of new customers, retaining existing customers, keeping of loyal customers and have a personalized relationship with these customers.

XI. CONCLUSIONS

The aim of the project was to develop an intelligent facial recognition system for data personalization in customer relationship management. To address the research questions, effectiveness of facial recognition system was evaluated against two main errors a system can exhibit which are false rejection rate and false acceptance rate. Effectiveness of facial recognition system evaluated against turnout ratio of two methods of enhancing customer relationship management were compared, one is the use of loyalty cards (reward program) and use of facial recognition system.

It is clear from the data obtained that facial recognition system presents opportunity to engage more guests to book for a stay at great Zimbabwe, thus increasing the hotel sales and build personalized relationship with guests.

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