Impact of Smart design in UAE's Fine Dining: A Four Season's Design Concept

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Abstract

In an era of rapidly evolving sustainable technology and smart solutions, it is vital that smart solutions of interior design are integrated in this era. Smart design plays a major role in the evolvement of sustainable interior design. It is becoming significantly important to involve smart solutions when it comes to designing interior spaces. In contrast to traditional design, smart design reduces waste production, promotes a healthy environment and is time efficient and cost effective. In fine dining, the overall experience of customers is heavily reliant on the interior design of the restaurant. This paper attempts to implement smart design in the fine dining industry in the United Arab Emirates through the use of smart design elements: smart soft material, smart liquid, smart lighting fixtures and smart technologies, in creating a four season's themed restaurant and assess its impact on creating healthy environments, reducing design time and cost, and ultimately enhancing customer experience.

Keywords: Smart design, Smart material, Sustainable, Fine dining, Cost effective

Introduction and Background

A restaurant is a business that prepares and serves food and beverages to customers. Savoring tasty food with family or friends in a nice environment is one of life's pleasures and eating outside of home has recently become a way of life for most families. Nowadays, a lot of people prefer to eat their meals outside of their homes (Walker J. R., 2021).

Developing atmospheric eating venues is gaining a lot of interest among restaurant owners to attract customers looking for special places for leisure, also many restaurants offer take-out and food delivery services as well. Restaurants differ greatly in offerings and appearance, which means that cuisines range from cheap fast-food restaurants and cafeterias to mid-priced family restaurants, to high-priced luxury establishments.

The Four Seasons' restaurant is a restaurant which takes four different appearances at four different times of the year, by applying Smart Design; Spring lasts from 1st March to 31st May, Summer lasts from 1st June to 31st August, Fall (autumn) lasts from 1st September to 30th November, and Winter lasts from 1st December to 28th February.

Existing fine dining restaurants in the UAE use traditional approaches in design. They have a single theme in each restaurant that does not change because of the use of conventional design elements. Traditional restaurants are characterized with having a single theme, which means, they offer a specific, non-changing experience to people who visit them every time. This

may discourage most people from visiting the same restaurant multiple times because people are usually looking for new experiences all the time.

Till date, smart design has not been introduced to restaurants in the UAE. However, it is currently employed in hotels. They use smart automation technology that allows guests to control HVAC, lighting, curtains, and shades etc. This control over guest room amenities can increase the comfort of the guest and optimize energy consumption that will bring major reduction in energy bills.

Based on the efficiency of smart design and in line with the UAE vision of 2020, smart design should be incorporated in restaurants to create a more dynamic design that can easily change into different themes for a unique experience. Creating any interior design that can change themes can be costly and time consuming in the absence of the right technology or smart design that can drive the transition between themes.

Smart design can be defined as the use of techniques that increase the flexibility of building compartments to reduce the number of constructed areas while maintaining the necessary requirements. Such techniques include movable partitions, color changing fabrics and other smart materials (Barbosa, Araújo, Mateus, & Bragança, 2015). Abu Dhabi does not have a four seasons restaurant that changes themes throughout the year. Usually, restaurants have only one theme with which they are recognized. This means they offer a specific, non-changing

Figure 1 The Four Seasons theme applied in the interior of restaurants

experience to people who visit them each time, leading to the boredom of regular customers and who would them to explore new restaurants seeking a different experience.

Research Gap

Extensive research and studies have been carried out explaining smart design and outlining different elements of smart design, various factors associated with and impacted by it, suggestions on methods to implement it and expected outcome of the process. The research has not been extended to cover implementation of smart design in the fine dining sector in the UAE through a four seasons' themed restaurant. The aim of this research is to propose smart design elements in the design four season's themed restaurant in the UAE and suggest their role in creating healthy environments, reducing design time and cost, and ultimately enhancing customer experience.

Literature Review

Classifications of Restaurants

The factors that differently classify restaurants vary from, but not limited to, the style of the menu, the cuisine, the service quality, the ingredient, the target customer…etc.

According to Canziani et al. (2016), restaurants can be broadly classified as quick service restaurants, family dining restaurants, casual dinng restaurants and fine dining restaurants as

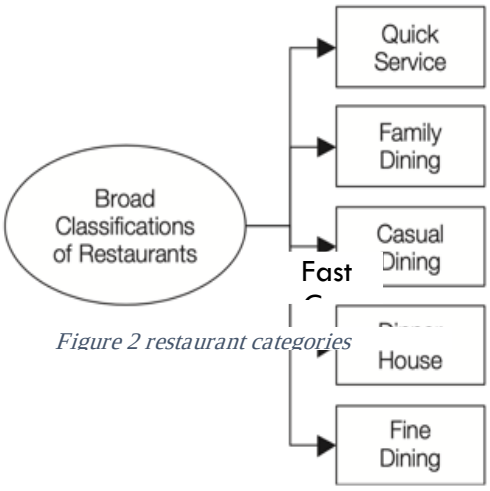

Figure 2 restaurant categories

outlined in figure 3 below.

Quick service restaurant

People in a hurry have often chosen quick-service restaurants. The reason fast food is loved by many is because of its speed and cheap prices. The first known quick-service restaurant goes back to the 1870s; Plate House, which was a New York City food service establishment that served a quick meal in almost 10 minutes. Such kinds of restaurants usually use bright colors to stimulate the appetite. The furniture of the seating is designed to be uncomfortable to make customers spend the least possible time. Customers could serve themselves seasonings and drinks from a nearby counter, then pick up their food on trays (Walker J. , 2011).


Figure 3 Quick service restaurant use the least comfortable chairs to make customers leave as soon as they finish eating

Fast casual restaurant

Filling the gap between quick service and casual dining, fast casual restaurants serve carry-out meals that are upscale in comparison with quick service restaurants. Fast casual restaurants are increasing with new concepts frequently coming out. They do not offer full table

service, but their food has a higher quality, and their atmosphere is better than quick service restaurants. Usually, in this type of restaurant, the kitchen is visible to the customers. (Walker J. , 2011).

Figure 4: Fast Casual restaurants is a transition between quick service restaurants and casual restaurants

Casual dining

Casual dining is preferred by many because it suits the societal trend of a relaxed lifestyle. Factors that define this type of restaurant include comfortable, relaxing, friendly atmosphere, homey décor, signature food items, moderate prices, and creative bar menus.

This type of restaurant is between fast casual and fine dining restaurants. It is usually characterized by having large alcohol menus with a sidebar and bar staff. Portion size is

Figure 5: Casual restaurants is where non-disposable cutlery is used, and the waiters go to the customers while they are seated to take their orders.

frequently large, and disposable cutlery is not used like quick service and fast casual restaurants (Samygina, 2017).

Family dining

Family style restaurant is very similar to casual dining with some simple variations. First, the food is served in wider dishes on tables so that customers can serve the food for themselves and pass it to the other people at the table.

Another variation is that the family restaurant includes a relaxed, comfortable atmosphere where customers have control over what they eat. This type of restaurant is suitable for families with children or groups of friends. Usually, in family restaurants you can find a circular rotating 'plate' in the middle of the table, so people can reach to any dish they want (Samygina, 2017).

Figure 6: Family dining restaurant include a relaxed atmosphere that is appropriate to families and large groups.

Fine dining restaurant

This is a more formal restaurant that has better quality of furniture, materials, and more luxurious design. Lighting is designed with high quality and is slightly dimmed to create a luxurious, romantic atmosphere (Malekshahi, 2013).

Fine dining is basically the dining experience offered by luxurious restaurants where food, beverages and service are expensive. Customer service staff are much more attentive in this type of restaurants. In addition to taking customers' orders and serving them, they escort

customers to their tables, hold the chairs for the ladies, and replace the linen when customers leave the tables.

Therefore, the staff must be well trained for working in such restaurants and be prepared to answer any queries about the menu and make recommendations if required.

The music being played in fine dining restaurants must be inspired by the restaurants' theme.

As for the customers, they need to follow a certain dress code and reserve a table before coming. Usually, the customers of such restaurants are loyal customers that the restaurant should be trying to maintain (Samygina, 2017).

Turnover on each table is mostly less than one on each evening. A majority of the customers go there for a special occasion, such as a birthday. Glassware, silverware, tables, chinaware, and linen are usually expensive, and the restaurant often includes paintings and interesting architectural features (Walker J. R., 2021).

Figure 7: a Fine dining restaurant is the most luxurious type because it gives a very unique experience.

Smart material in Smart design

Nowadays, Smart design is accessible, seamless and favorable. Smart design can be integrated in any interior space, and the technologies and tools involved in smart design vary greatly, including staging and 3D printing tools. In addition to technologies and tools in smart design, it is important to recognize the smart material involved in smart design and how it gained huge

popularity among designers. Smart design includes smart material, smart light fixtures and smart technologies. Smart material can be divided into two categories, smart soft material and smart hard material.

Smart soft material discussed in this paper include the following (Breedon, 2013):

- color changing fabric,
- Fiber optic fabric:
- Fabric with Electroluminescent Ink,
- appearing pattern wall,
- Mixed fabric with phosphorescent threads,
- Color changing upholstery.

Smart hard material include discussed in this paper include the following (Han, Zhang, & Ou, 2017):

- Glass tabletop incorporating phosphorescent glaze
- Concrete with phosphorescent inorganic pigments

Smart light fixtures discussed in this paper include:

- Optical fibers
- Light emitting diode (LED lights):
- Lumi splash

Smart technologies discussed in this paper include (Smart Technologies for Interior Design, 2020):

- wall turning triangles
- proposed control system

Smart Soft Material

Color Changing Fabric. The College of Optics & Photonics at The University of Central Florida (UCF), has announced active user-controlled color-changing fabrics. These fabrics allow the user to change the fabric color through their smartphone. The ChroMorphous technology used, enables the user to control the change in color and pattern in any textile product.

The threads of these fabrics contain a thin metal micro wire in which electric current flows, resulting in a slight increase in the threads' temperature. Special pigments embedded in the threads then respond to this change in temperature by changing color. It is important to mention that the only patterns that can be created by this fabric are striped patterns of different widths or a gradient color. According to the University, these fabrics can be used in clothing, accessories, and furniture (Fabric has user-controlled color and pattern function, 2018).

Figure 8: color changing Fabric

Fiber optic fabric. Optical fibers are used in many interior components such as curtains, table covers, and upholstery. These materials can change colors through a control device.

Fiber optic fabric is made of conventional threads in addition to fiber optic threads that can be illuminated in different colors. These threads are connected from one end to an artificial source of light that is usually very small which enables it to be hidden in the fabric.

Figure 12: Fiber optic table cover

Figure 12: Fiber optic curtain

Figure 12: Fiber optic upholstery

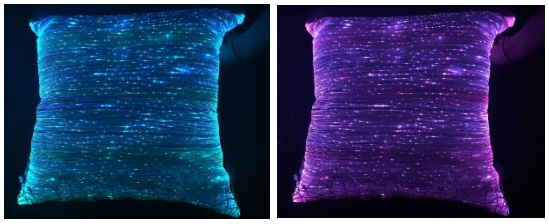

Figure 12: Fiber optic pillows

Fabric with Electroluminescent Ink. These room dividers consist of textile louvres suspended from the ceiling. The patterns on the louvre were made to luminesce by an electroluminescent ink, which can be applied to the textile using a special inkjet printer. Thin electrical wires behind the patterns allow each area of the pattern to be illuminated and controlled individually. A special software can be developed for the room dividers to enable the creation of special different patterns when different areas of the louvre are illuminated (Ritter, 2007).

Appearing pattern wallpaper. This wallpaper is dyed with a UV-sensitive ink that can change it from a monochromic to a bio chromic red when it is influenced by light (Ritter, 2007).

Figure 35 Appearing pattern wallpaper

Mixed fabric with phosphorescent threads. The phosphorescent threads emit light in the dark

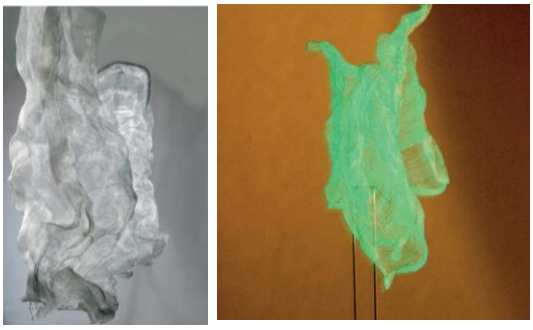

Figure 14 Mixed fabric with phosphorescent threads

which is reflected by the metallic threads that increases the luminous effect (Ritter, 2007).

Color changing upholstery. This kind of fabric uses cotton fabric that is printed using conventional pigments and thermochromic ink. At 27^{o}C the fabric changes from opaque to transparent which reveals the colors under it. This fabric interacts to the human body temperature when someone sits on it or touches it for a certain amount of time. The disadvantage of this fabric is that it needs a lot of space under the upholstery for the electronic components (Ferrara & Bengisu, 2014).

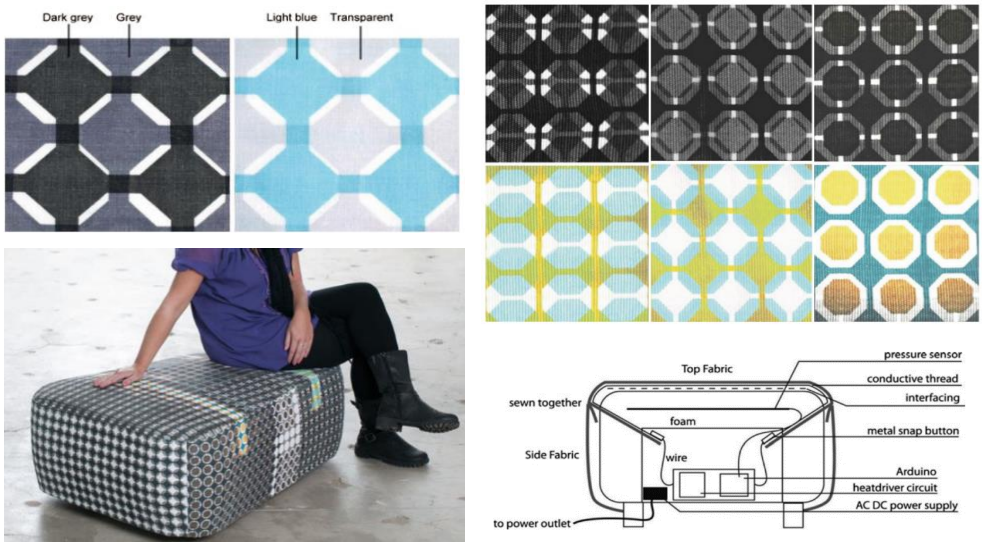

Figure 37 Color changing upholstery

Smart Liquid

Phosphorescent wall surface. Phosphorescent pigments are added to the paint on the wall; they include a solution made of egg white mixed with royal icing sugar and hot water. These are applied to a sheet of glass that has the intended wallpaper pattern.

Figure 38 Phosphorescent wall paint

Smart hard material

Glass tabletop incorporating phosphorescent glaze. Glass tables that luminesce in the dark have a topcoat of phosphorescent glass-ceramic paint that stores daylight and artificial light

Figure 39: Glass table with phosphorescent glaze39

and releases it in the dark. The topcoat can be applied by several various processes including screen printing. It is then baked to create an strong bond between the glass surface and the glaze.

Concrete with phosphorescent inorganic pigments. As mentioned earlier, a phosphorescent coat can release light in the dark after it stores it throughout the day from the daylight, which is exactly how it works when incorporated with concrete as well (Han, Zhang, & Ou, 2017).

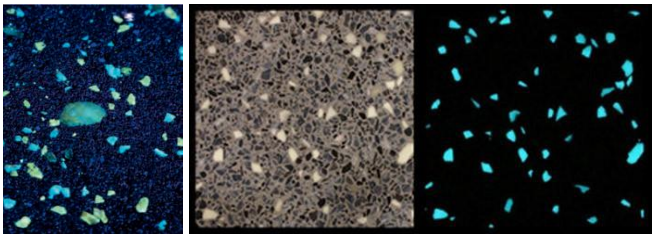

Figure 40: concrete with phosphorescent pigments

Smart lighting fixtures

Optical fibers. Optical fibers illuminate in different colors and have the ability to change the color of illumination by controlling it. They are used in many forms and shapes to create beautiful chandeliers that give a luxurious effect.

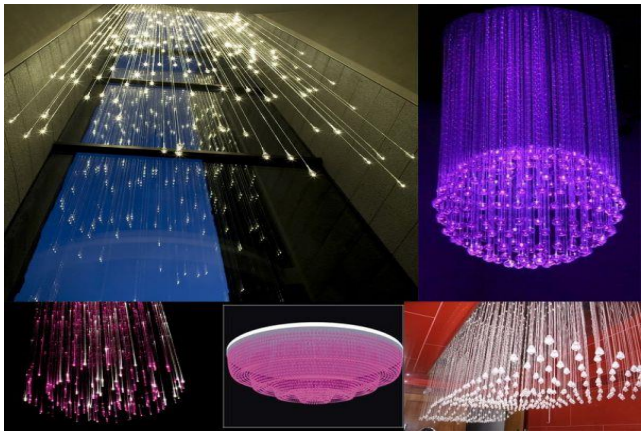

Figure 41: Fiber optic chandeliers

Light emitting diode (LED lights). The general lighting of any space influences the overall appearance of colors, so having different lighting temperatures is essential. Tunable LED strips allow users to adjust the correlated color temperature (CCT) of the light source through a controller or computerized lighting automation system. LED lights can also be incorporated in tables tops for decorative purposes. They can change between several colors to match the desired mood.

Figure 42: Tunable LED lights

Lumi splash. Lumi Splash is a patented, multilayered, ultra-thin 1/4″ (6mm) decorative laminate that emits light evenly across its surface and has impressive impact, scratch, chemical, and abrasion resistant properties. This system uses a Light Bar and Light Guide Panel to produce luminance across a translucent surface. Unique as they are beautiful, these laminates provide soft light that may be dimmed to serve as either task or ambient light.

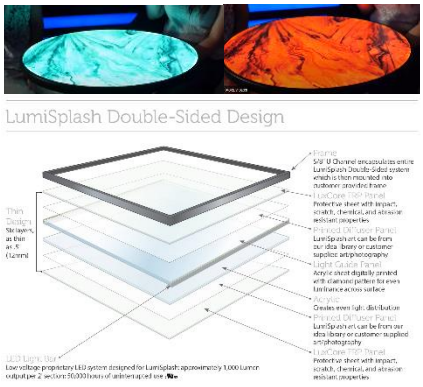

Figure 43 Lumi splash is a material that can illuminate in different colors

Smart technologies

A wall of turning-triangles. The tiles of this wall are actually several prisms capable of showing different faces on demand in varying colors. The tiles can be controlled through a device which allows the user to select which tiles they want to turn. The faces of the tiles can be painted with plain colors, or pieces of wallpaper can be applied to create a single pattern.

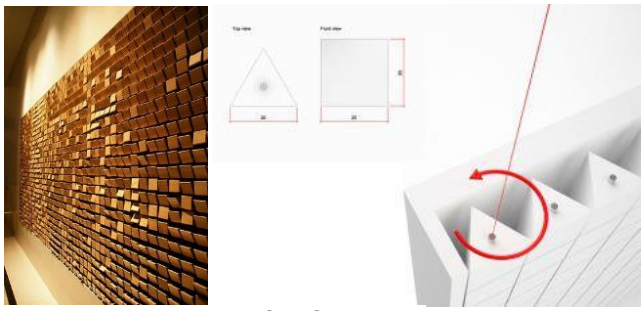

Figure 44: turning Triangular tiles

Proposed control system. Because of the existence of smart interior components in restaurants, there should be an efficient control system over these components. The "Internet of

Things" (IoT) system has been used in smart homes for so long to control all kinds of equipment, lighting, TV, and curtains etc. The IoT system works on connecting all the smart components in the space to one single device instead of having to control each smart object on its own. This can be summarized in a simple equation: IoT= Physical object + Control devices/sensors + Internet. It is important to use this system in the restaurant to be able to control and change the theme easily (Kilic & Bayir, 2017).

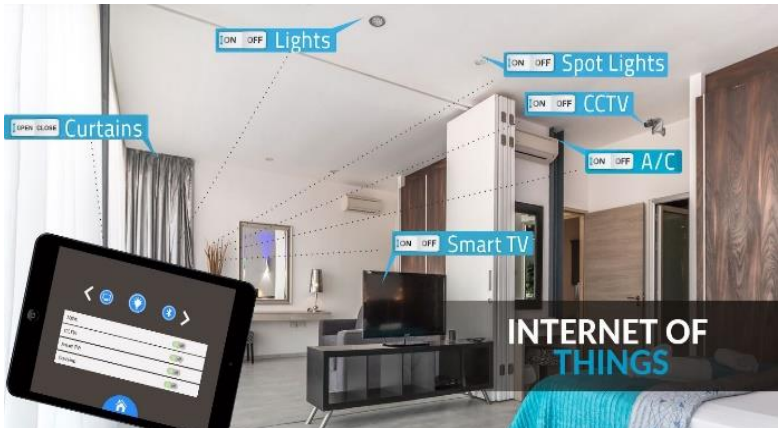

Figure 45 the internet of things allows us to control everything within the room

About Abu Dhabi

Abu Dhabi is the largest emirate in the United Arab Emirates, occupying 84 per cent of the national landmass territory. It has 200 islands and a long coastline stretching 700km. Its total area is 67,340 sq. km (U.AE, 2020).

Location. The emirate of Abu Dhabi lies on the coast of the Arabian Gulf and is bordered by Sultanate of Oman to the east, the Kingdom of Saudi Arabia to the south and the west and the emirate of Dubai to the northeast. The three main regions of the emirate are the city of Abu Dhabi, Al Ain in the east, and Al Dhafrah in the west.

Figure 46 Emirates Palace, Abu Dhabi, UAE

Figure 47 Sheikh Zayed mosque, Abu Dhabi, UAE

Types of fine dining restaurants in Abu Dhabi

According to the author of this paper, fine dining restaurants in Abu Dhabi are characterized by having very luxurious and unique designs. However, they only utilize conventional materials and lighting, and they only have one fixed theme. This is due to the inflexible design components being used.

Applying smart design to such restaurants would be a great opportunity to allow guests to experience multiple themes at different times of the year whilst maintaining a healthy environment and reducing overall design execution costs.

Hakkassan Restaurant

Hakassan restaurant in Emirates palace, Abu Dhabi is one of the fine dining restaurants in Abu Dhabi with the following specifications (Hakkasan Emirates palace Abu Dhabi, 2016):

- Clients: Hakkassan Ltd. UK.
- Designer: decovision
- Location: Emirates Palace Hotel, Abu Dhabi
- Size: 1500 sq-ft
- Theme: modern Chinese restaurant

Figure 15: Hakkasan, Emirates Palace, Abu Dhabi

Graphic analysis. Space includes a dining area, a bar, a lounge and four private dining rooms. All sections are separated by carved wooden lattice screens made of American red oak, adding luster to the luxurious interior of the high-class restaurant. The designer wanted to reproduce the same ambience of the restaurant's London branch in the UAE and complement it with Arabian touches.

The designer maintained the modern-ethnic Hakkasan elements and accentuated the facility with embroidered finished furniture and marbled Chinese forms to add body to key spaces. The main dining area was crafted into a wooden cage-like structure surrounded by blue glass nested in a stainless-steel frame (Hakkasan Emirates palace Abu Dhabi, 2016).

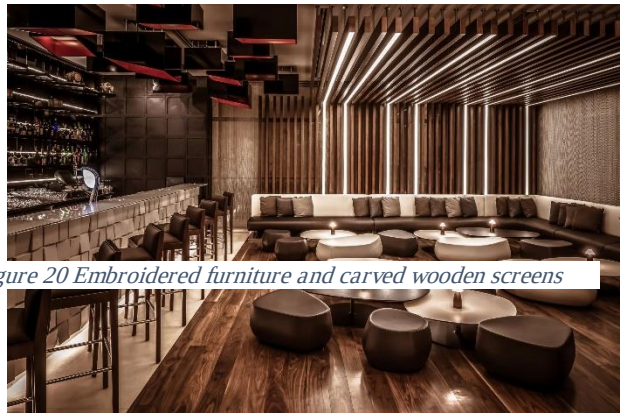

Figure 16: BOA Steakhouse, Abu Dhabi

Figure 17 Outdoor seating with similar atmosphere

Figure 18 Bar area

Figure 19 High level of privacy by using screens

Figure 20 Embroidered furniture and carved wooden screens





BOA Steakhouse

Another fine dining restaurant in Abu Dhabi is BOA Steakhouse, with the following specifications:

- Client: Tourism Development and investment company
- Location: Eastern Mangroves Promenade, Abu Dhabi
- Size: 6,975 sq-ft.
- Theme: theatrical atmosphere

Graphic analysis. The venue is conveniently placed to attract elite individuals and a clientele searching for an enhanced nightlife experience. The overall design features the use of dynamic and high-end materials such as Senso flooring which breaks up into different patterns,

intriguing lighting and full LED walls create optical illusions, Swarovski studded crystal carpets, dynamic furniture laid out organically in its shapes and forms and three-dimensional reflective ceilings that transport you to new world of performance and entertainment with an elite sense of exclusivity (BOA Steakhouse - Eastern Mangroves Promenade, Abu Dhabi, n.d.).

Figure 21 Luxurious themed restaurant using LED lights

Global examples of Smart Fine Dining restaurants

According to the author of this paper, there are world leading smart fine dining restaurants that seem to be implementing smart design in interior spaces.

Worlds Unleashed and then Connecting Tokyo, Japan. 2017 Designer: teamLab

Project background. When a dish is placed on the table, the drawings within the dish are unleashed onto the table and into the surrounding space. The drawings unleashed from each dish connect in the external space creating a new larger world. They are affected by the other dishes on the table.

For example, a bird released from one dish can perch on the branch of a tree unleashed from another. The trees that grow from each dish are not identical; their sizes and shapes are affected by "the worlds unleashed" by the other dishes on the table. These unleashed worlds are also affected by your behavior. If you stand still, a tiny bird might alight on your hand; if you move suddenly, it might fly away.

The worlds unleashed from the dishes on the table influence each other, react to the actions of visitors, and combine to create one single continuous world. The world is constantly changing from moment to moment and no two moments are alike. What is on the table is observed by artificial intelligence. Therefore, the plates can be arranged on the table however visitors wish (TeamLab, 2015).

Figure 22 The restaurant uses artificial intelligence to create the seasons of Japan.

Graphic and Information Analysis. The ceiling is the main artificial intelligence here since it reads the patterns and drawings on the plates then it starts casting similar patterns on the table and around the plates and sometimes on the hands of the guests. The restaurant uses advanced smart design that interacts with the guests and the theme presented in the plates with walls

designed with artificial intelligence to match the patterns, and drawings detected on the dishes that the guests are eating in change appearances monthly. Dishes are changed every month because they are the main element that influence the entire surrounding. The restaurant has a different theme every month to show how Japanese nature is changing. The use of the same smart design on walls and tabletops is a bit too much which makes the place feel too artificial. One downside to this design is the lack no of natural light source, and the general lighting of the room is too dark. Only one group of people can experience this place in one day because the capacity is only 8 people.

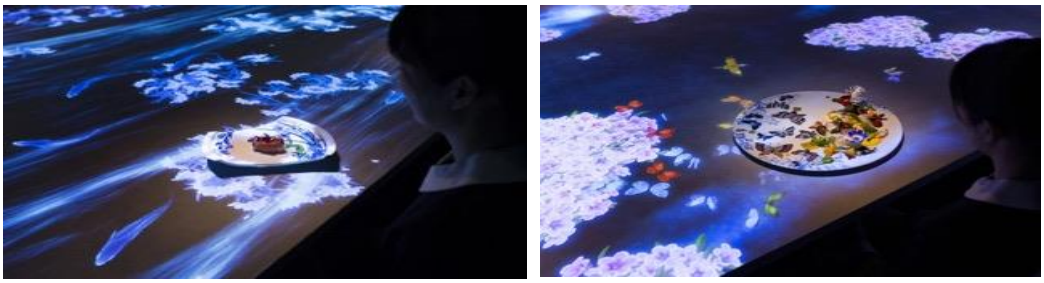

Figure 26 The sensors in the ceiling read the drawings on the plate then starts projecting similar drawings

Figure 26 the artificial intelligence detects that a plate has been placed on the table and then starts showing a blooming flower inside the transparent

Figure 26 the artificial intelligence makes the flying birds interact with the movement of the

Inamo Restaurant London, UK Designer: Blacksheep 2008

Project background. In the main dining area, a projector and computer are suspended above each table; customers can use a touch panel to order food, access the kitchen webcam, play games, change the pattern projected onto the Corian tabletop and source local information.

The 'cocoon' projectors are set at the same height throughout the suspended high gloss black ceiling and come in three sizes to light 2-cover, 4-cover, or 6-cover tables.

When customers sit down, there are white spots for plates and an individual 'e-cloth' for each table. Customers use a touch panel to order food and drink or change their tabletop to one of the seven other patterns available.

Walls are in a white vinyl wallpaper with mirrored graphic panels, which work effectively like lightboxes with an etched pattern and a cut pattern, with light allowing the cut pattern to shine through.

Seats are either a silver vinyl banquette with feature red stitching or else 2-tone flip chairs with black backs and white frontage (from Protocol). The tables themselves have a black base and a white Corian top (Krzykowski, 2008).

Figure 27 Inamo restaurant uses interactive table tops that lets people play games on it or order

Graphic and Information analysis. The restaurant uses smart design in the tables that helps customers choose and order their food easily. It provides games that can entertain guests while waiting for their food, which is not a conventional feature in restaurants. Although the main lighting source is coming from the table, the material of the surrounding interior elements is used properly in a way that increases the lighting to desirable levels. Due to the tabletop technology, there are no table accessories at all. The restaurant does not have a strong character when it comes to the design elements; it is only depending on the technology featured in the table. Records can easily be kept of the sales of the restaurant through the data base. The tabletop with the projector above are used to allow the customers to:

- Have a look at the menu through seeing the dishes on the tabletop as if they were real.
- Order the food digitally
- Play games to pass time until the food is served.
- Change the patterns or colors of the tabletop as per their preference.
- Answer a customer satisfaction questionnaire about the restaurant or place any comments.

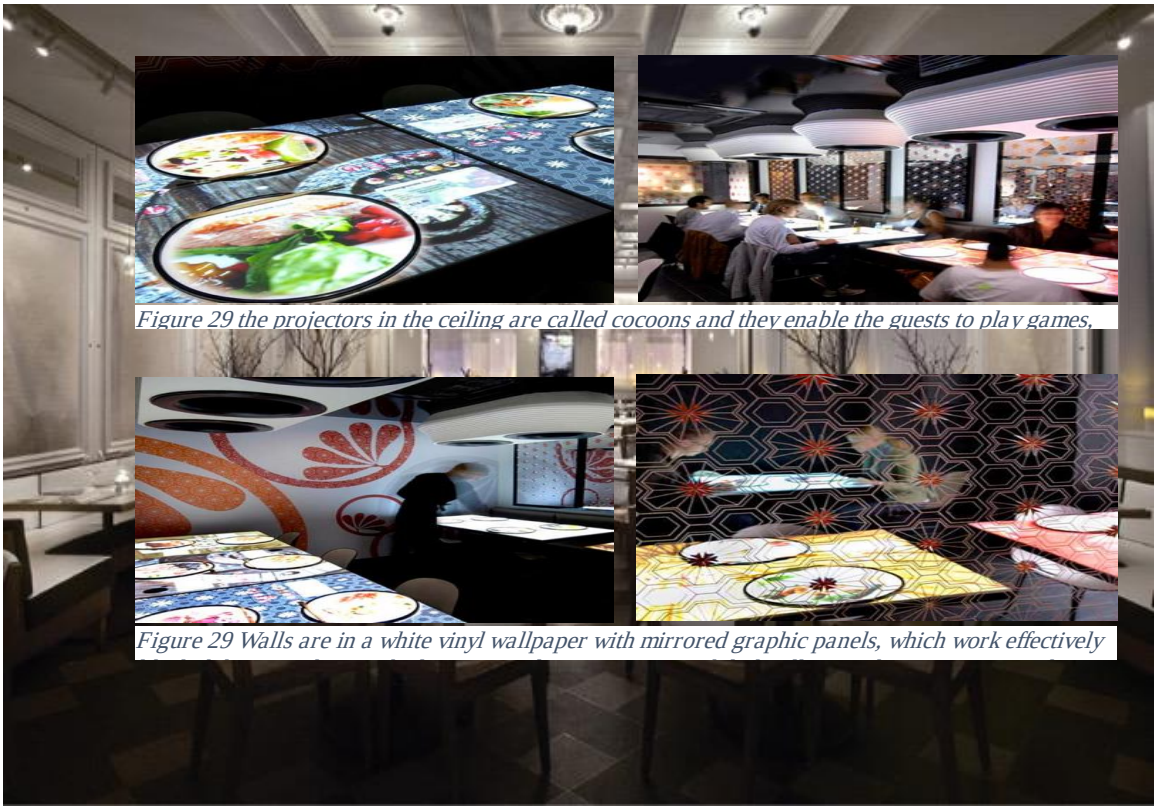

Figure 29 the projectors in the ceiling are called cocoons and they enable the guests to play games,

Figure 29 Walls are in a white vinyl wallpaper with mirrored graphic panels, which work effectively

Figure 30 Park avenue restaurant (winter theme)

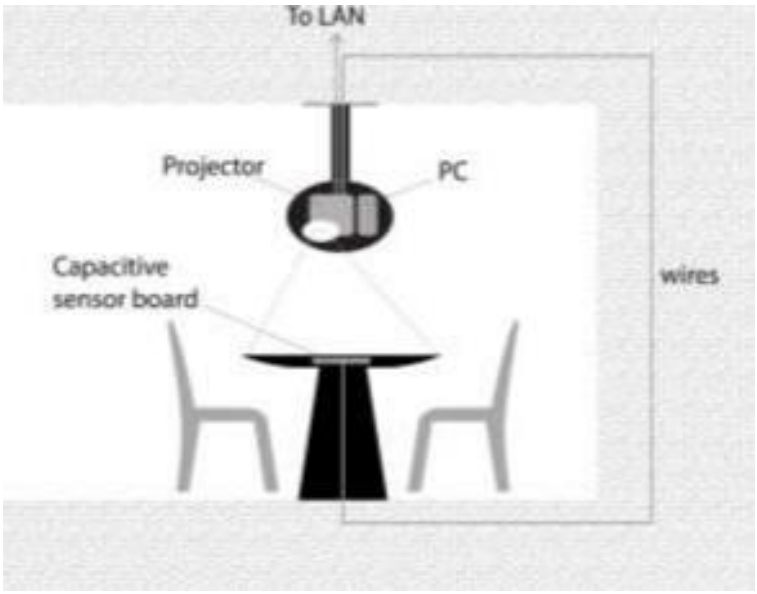

Figure 31 Inamo restaurant smart design

Park Avenue Restaurant New York, United States. 2007 Designer: Avroko

Project background. The design of the restaurant has four themes: spring, summer, winter, and fall. The owners wanted to make this seasonal change to ensure the popularity of the

restaurant throughout the year. They wanted their restaurant to be a famous destination for all people, not only to the local people from the neighborhood. This concept of seasonal change encourages people to come back every season to experience the new atmosphere. In a city like New York, you can find many restaurants, so catching people's attention was part of the challenge.

When the AvroKO team was designing the restaurant, they planned every detail carefully so it would not later take time to transform the restaurant from season to season. "More time planning equals less time doing" which meant they wanted the design to be flexible in changing as said by the AvroKO team: "like a theatrical show, a set change must be of both speed and quality" (Baraban & Durocher, 2010).

Graphic analysis

Figure 32: Spring theme was applied by using green and brass stripped vertical patterned upholstery and purple pendants with overall warn lighting. On the wall they used brass wall panels, and, in the ceiling, they used barrel vaulted in a smoked laurel burl wood. They used mostly flowers as accessories to represent this season and they used a different seating arrangement.

Figure 33: The Winter theme was inspired by the Antarctic. They used white leather upholstery and very cool lighting temperature. They changed the wall panels with white lacquered molding panels and changed the ceiling into a coffer ceiling with mismatched plaster rosettes. The accessories they used were empty tree branches.

Figure 34: The Autumn theme was applied by using Copper and ochre tones. they used burgundy leather backing and burgundy wall panels with vertical golden lines. The ceiling has copper pipes hanging from the ceiling with ropes and huge circular chromatic hanging lamps. The overall temperature used was very warm to match the theme.

Figure 35: The Summer season was represented by using canary yellow on most elements, such as yellow leather backing, square yellow pendants, and yellow wall panels with a fish in the middle. They used wooden ceiling and a cool lighting temperature.

Graphic and Information analysis. The restaurant follows a process that allows them to change the interior to match the year's four seasons. Each season the upholstery changes by using buttons that enable the staff to remove the upholstery and replace it with another. Lights are replaced with others that give a different temperature and different design of fixtures that match each season. The tracking lights rail on each side of the restaurant are used to ease the change between the different fixtures. As for the wall panels, they used removable wall panels to be able to change them each season easily. The ceiling is also changed each season to match the atmosphere. All the interior components, from the main elements to the small details, show the

theme of each season of the year. Any minor change in the interior, such as the change of the seating arrangement, makes a huge difference in the overall appearance.

Considering the process followed by the restaurant to change themes every season, it seems that it could be enhanced by the implementation of smart design. The restaurant does not employ any kind of smart design that could ease the change between themes, which makes the restaurant's current process of changing themes more time consuming and costly. To change from one theme to the other, the restaurant must close its operations for 48 hours. In addition, the amount of material needed to change the themes, including wall panel, upholstery, accessories, lighting fixtures, ceiling design, requires a lot of storage space.

Design development

Proposed Design

To enable changing the design four times a year, the proposed design employs smart materials, lighting, and technologies. In the entrance, the use of optic fibers in multiple elements can be noticed. In the ceiling, decorative chandeliers are used, which incorporate optical fibers that change between different colors every season. On the floor, fixed carpets are used, which incorporate optical fibers between their threads to illuminate in different colors each season. And lastly, the use of optical fibers on the reception counter is noticeable. On the back of the chairs, a certain type of fabric is utilized that can change color when heated because of the metal wires

incorporated in it. This fabric changes colors to match the color scheme of a particular season. Behind the chairs, fabric louvers are used on the walls. The different patterns that appear every season are printed on the louver fabric by electroluminescent ink using an inkjet printer. Each pattern represents a different season. In addition, rotating tiles are used on part of the wall as a decorative element that rotates each season to show a different face with different color.

Inside the dining area, the fiber optic carpet and color changing upholstery are used in a wider range and optical fibers are used on the ceiling as the main focal point and main decorative element of this restaurant. Moreover, the table linen also incorporates fiber optics that change colors every season. On the round tables and behind the bar area, a material called lumi splash is utilized that can change colors easily.

Smart technology is essential to enable control of all the design elements. The IoT system is employed due to its ability connect all elements to a single device which allows the users to control and change any element within the restaurant.

Overview of selected site. Etihad Towers are located in Abu Dhabi, within a 15-minute drive of The Corniche and Al Wahda Mall. It is 5.4 mi (8.7 km) from Abu Dhabi Mall and 8.3 mi (13.3 km) from Louvre Abu Dhabi. The five towers are located opposite the Emirates Palace hotel and feature offices, apartments and a hotel.

Figure 48 Location of the chosen restaurant

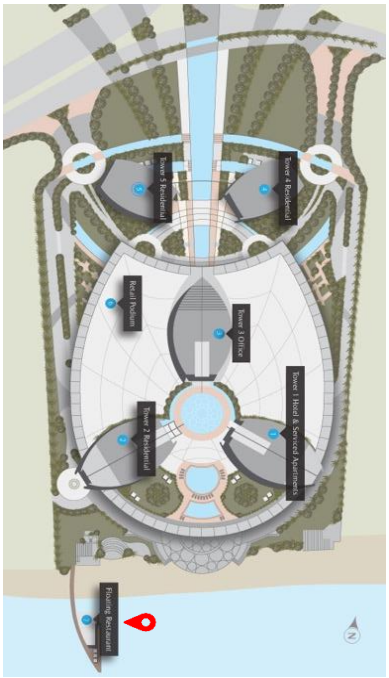

Figure 49 Floating restaurant site *Figure 50 Etihad Towers*

A Jumeirah 5-star hotel shares the project with four other towers including three towers of residential apartments – 885 units in total: and a 63-level office tower together with an ultra-luxury retail precinct. In combination, they form a 'mini-city' which is self-sustaining and

provides a variety and quality of facilities unrivalled in Abu Dhabi, or indeed in the UAE (DBI Design, 2011).

The author of this paper chose to design the "floating restaurant" associated to the Etihad Towers because the site of this project provides a spectacular setting with its own beachfront on the Arabian Gulf. The entire development respects this unique location with all major public spaces having panoramic views to the Gulf. It is a 2-floor restaurant with both indoor and outdoor seating areas. The restaurant is spacious, and it occupies an area of 1,090 m2.

Figure 51 The restaurant has a whole structure on its own

Figure 52 The floating restaurant at night

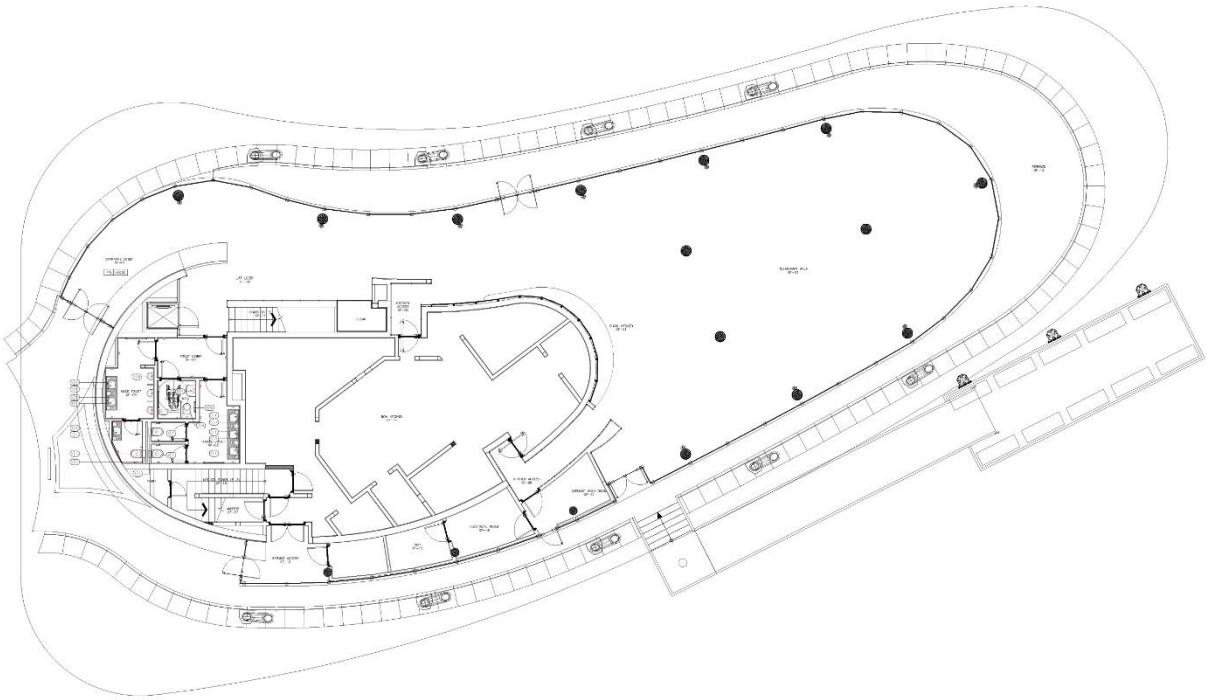

Figure 53 Existing plan of the restaurant

Existing design


Figure 54 Pictures of existing entrance and waiting area of the restaurant




Figure 55 Pictures of existing dining area and bar

Proposed design

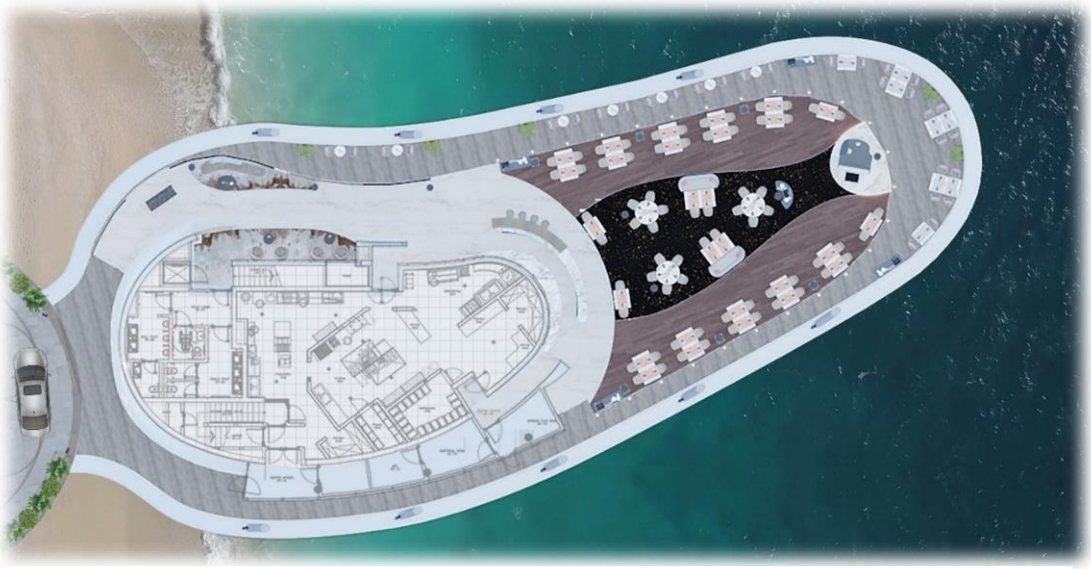

Figure 56 Autumn season Seating plan

Figure 57 Autumn Season mood board

Figure 58 Winter Season mood board

Figure 59 Color schemes of all four seasons

Figure 60 Spring Season mood board

Figure 61 Summer Season mood board

Theme & Color scheme

Figure 62 Autumn season: The falling leaves pattern on the louvers behind the chairs represents Autumn

Figure 63 using rotating tiles on the wall to show different color each season. The colors of the Autumn are red and orange.

Figure 64 Winter season: The pattern on the louvers changes by using Electroluminescent ink (EL Print) which was applied to the textile by using a special inkjet printer

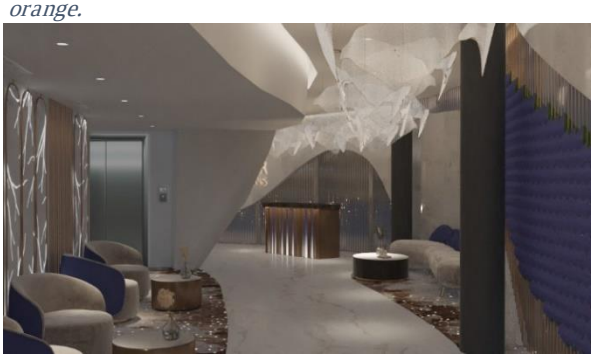

Figure 65 fiber optic used in the ceiling, carpet and reception desk that can change color each season. For this season the colors chosen are white and dark blue.

Figure 66 Spring season: the colors used to represent this season are green and pink. The blooming flowers of spring was the pattern used on the louvers

Figure 67 on the back of the chair, the upholstery used is smart fabric that can change color through heating thin metal wires that are incorporated within the fabric

Figure 68 Summer season: colors used to represent this season are ocean blue and yellow. Summer is a season most know of the beach and ocean

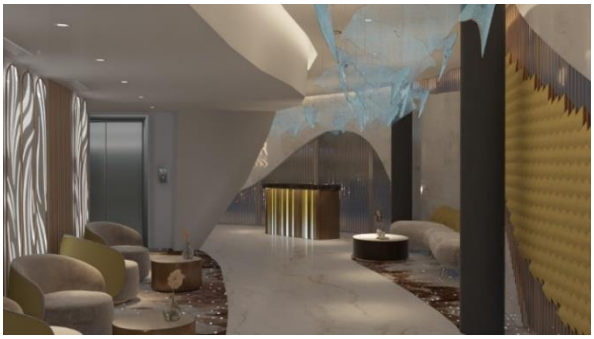

Figure 69 The tiles on the wall rotate to show a different color each season

Proposed design for entrance area

Proposed design for dining area

Figure 70 color changing fiber optic carpet, fiber optic table linen and fiber optic ceiling lights are used to emphasize the change between the themes

Figure 71 Falling leaves pattern representing Autumn is shown on the louvers behind the piano by using Electroluminescent ink (EL Print) which was applied to the textile by using a special inkjet printer

Figure 72 the back upholstery of the chairs is made of smart fabric that changes color through the thin metal wires incorporated in the fabric that are influenced by heat

Figure 73 Lumi splash is a type of material that can change color and pattern and can illuminate. it is used with the marble pattern on the walls of the back counter of the bar and on some of the tabletops

Autumn theme

Winter theme

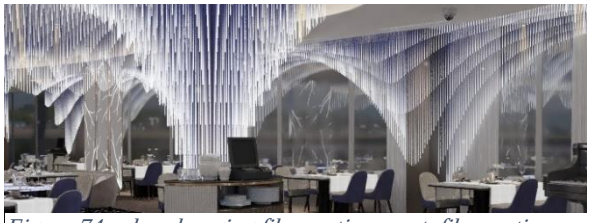

Figure 74 color changing fiber optic carpet, fiber optic

Figure 76 the smart fabric on the back of the chairs changes color to blue to match the winter theme

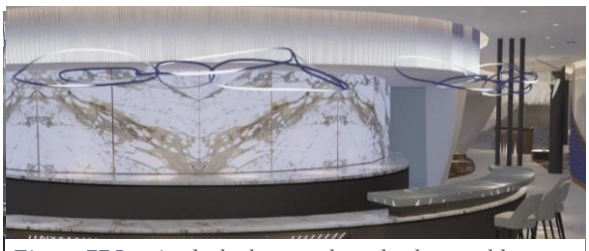

Figure 77 Lumi splash changes the color here to blue to match the winter theme

Figure 78 color changing fiber optic carpet, fiber optic table linen and fiber optic ceiling lights are used in the dining area

Figure 79 Ocean waves pattern representing Summer is shown on the louvers behind the piano by using Electroluminescent ink

Figure 80 the back upholstery of the chairs is made of smart fabric that changes color

Spring theme

Figure 81 color changing fiber optic carpet, fiber optic table linen and fiber optic ceiling lights are used in the dining area

Figure 82 Floral pattern representing Spring is shown on the louvers behind the piano by using Electroluminescent ink

Figure 83 the back upholstery of the chairs is made of smart fabric that changes color

Summer theme

Descriptive analysis

Smart design in changing themes' restaurants

Creating a restaurant that changes its theme occasionally makes the restaurant a famous and well-known destination to many people. This encourages them to go back to the same restaurant. Only few restaurants employ the concept of changing themes in their design, but they use conventional and manual ways to do that. Although smart design elements exist and are being used in hotels and homes, they are not used in restaurant design which has become a very competitive industry. Using smart design to create this change in theme would have a lot of benefits in the restaurant design, such as:

- Making the space flexible for future uses.

- Decreasing the amount of material and interior components used which would decrease the cost as well.
- Easily change the theme with little effort and time.
- Increasing the customer satisfaction which would encourage them to come back

Research Analysis

Based on the case studies and research, there are no four seasons themed fine dining restaurants, or any restaurants that employ smart design in Abu Dhabi. Such an innovative and advanced city can be considered a land of opportunity for a restaurant that utilizes smart design.

In the same vein, based on the results of the questionnaire in appendix (I), people enjoy going to restaurants to not only enjoy food, but also to enjoy the restaurant theme and environment. The theme of a restaurant can influence people when deciding on a restaurant to visit. This means that creating a theme changing restaurant should prove appealing to most people. Around 90% of people have not been to a restaurant that changes themes each season and are interested in visiting such a restaurant. Hence, the questionnaire findings serve as a real life back up to the feasibility of establishing a four seasons themed restaurant in Abu Dhabi, supporting the research gap mentioned earlier in this research. The full questionnaire and findings can be referred to in appendix (I).

Conclusion and recommendations

This project aims to encourage the use of smart design in interior spaces since the whole world is moving towards smart and sustainable design across all sectors.

The UAE encourages the use of smart and sustainable elements based on the 2021 vision and the large-scale use of smart components, with Expo 2020 being a key example. For instance, the New Zealand pavilion showcases the use of smart design on screens mounted on the walls that can sense any nearby movement. Additionally, the KSA pavilion allows visitors select from a variety of options on screens by simply waving their hand above the screens without having to touch them.

The use of smart design will aid in eliminating waste and toxic chemicals that are used daily in most of the traditional design elements. Furthermore, smart design is time and cost effective and can help in creating healthy, sustainable environments.

Having said that, the interior design sector should follow on the footsteps of other sectors that are employing smart design and technologies.

References

Addington, m., & Schodek, D. (2005). *Smart Material and New Technologies.* Oxford: Elsevier

About the United Arab Emirates. (n.d.). Retrieved from Protocol department - Duabi: https://www.protocol.dubai.ae/UAE-Dubai/About-the-United-Arab-Emirates

Anthropometrics in Archtectural Design. (2020, September 1). Retrieved from Designing Buildings: https://www.designingbuildings.co.uk/wiki/Anthropometrics_in_architectural_design

Aria Technology. (n.d.). Retrieved from Aria.mgmresorts: https://aria.mgmresorts.com/en/hotel/aria-technology.html

Baraban, R., & Durocher, J. (2010). *Successful Restaurant Design.* New Jersy: John Wiley & Sons, Inc.

Barbosa , J., Araujo, C., Braganca , L., & Mateus, R. (2015). Smart interior design of buildings and its relationship to land use. *Architectural Engineering and Design Management*.

Barbosa, J., Araújo, C., Mateus, R., & Bragança, L. (2015). Smart interior design of buildings and its relationship to land use. *Euro-ELECS 2015.* Portugal: Research Gate.

Bernard, S. (2007, September 27). *And Our Season Tonight Is…*. Retrieved from New York: https://nymag.com/restaurants/features/38326/

BOA Steakhouse - Eastern Mangroves Promenade, Abu Dhabi. (n.d.). Retrieved from Love that design: https://www.lovethatdesign.com/project/boa-steakhouse-eastern-mangroves-promenade-abu-dhabi/#photo_6

Breedon, P. (2013). Smart design : first international conference proceedings. *First International Conference Proceedings* (p. 113). Springer.

Canziani, B., Frash, R., & Almanza, B. (2016). (2016). Classifying restaurants to improve usability of restaurant research. *International Journal of Contemporary Hospitality Management*.

DBI Design. (2011). Retrieved from world atchitects: https://www.world-architects.com/ca/dbi-design-surfers-paradise/project/etihad-towers

Elisabeth, N. (2018, October 30). *What Are the Components of a Restaurant Floor Plan?* Retrieved from Small Business: https://smallbusiness.chron.com/components-restaurant-floor-plan-76876.html

Fabric has user-controlled color and pattern function. (2018, June 11). Retrieved from Advanced Textiles Source: https://advancedtextilessource.com/2018/06/11/fabric-has-user-controlled-color-and-pattern-function/

Ferrara, M., & Bengisu, M. (2014). *Materuals that change color. Smart Materials, Intelligent Design.* Milano: Springer.

FOOD SERVICE DESIGN & EQUIPMENT. (2019). Abu Dhabi.

Hakkasan Emirates palace Abu Dhabi. (2016, October 18). Retrieved from Love that design: https://www.lovethatdesign.com/project/hakkasan-emirates-palace-abu-dhabi/#project_image_gallery

Han, B., Zhang, L., & Ou, J. (2017). Light-Emitting Concrete. *In: Smart and Multifunctional Concrete Toward Sustainable Infrastructures* (p. Concrete with phosphorescent inorganic pigments). Singapore: Springer. https://doi.org/10.1007/978-981-10-4349-9_16.

Kesong, L., & Ye Tian, L. J. (2013). Bio-inspired superoleophobic and smart materials: Design, fabrication, and application. *Progress in Materials Science*, 503-564.

Kilic, T., & Bayir, E. (2017). An Investigation on Internet of Things Technology (IoT) In Smart. *International Journal of Engineering Research*, 197-206.

Koncar, V. (2018). SMART TEXTILES AND THEIR APPLICATIONS - VISUAL PERCEPTIONS. *University of Novi Sad*, 19-27.

Krzykowski, M. (2008, November 27). *Inamo Restaurant by Blacksheep*. Retrieved from Dezeen: https://www.dezeen.com/2008/11/27/inamo-restaurant-by-blacksheep/

Leydecker, S. (2008). Nano materials in architecture, interior architecture and design. Basel: Birkhauser.

Malekshahi, A. (2013). *Investigation on Restaurant Layout Design.* Gazimagusa: Eastern Mediterrianean University.

Nurai Restaurant. (2017, January 23). Retrieved from retail design blog: https://retaildesignblog.net/2017/01/23/nurai-restaurant-by-4space-dubai-uae/

Panero, J., & Zelnik, M. (1979). *Human dimension & interior space.* New York: whitney library of design.

Peterson, J., & Crystal, J. A. (2020, October 4). *United Arab Emirates*. Retrieved from Encyclopædia Britannica: https://www.britannica.com/place/United-Arab-Emirates

Plunkett, D. (2013). *Detail Contemporary Bar and Restaurant Design.* London: Laurence King Publishing Ltd.

Ritter, A. (2007). *Smart Materials in architecture, interior architecture and design.* Berlin: Birkhauser.

Samygina, A. (2017, may 13). *Basics of Interior Design*. Retrieved from Medium: https://medium.com/learning-about-interior-design/5-main-types-of-restaurants-908030a8d8cd

Scotts Sea Food Restaurant. (n.d.). Retrieved from Decovision: http://www.decovision.ae/projects/scotts-sea-food-restaurant-25

Smart Technologies for Interior Design. (2020, December 5). Retrieved from FOYR: https://foyr.com/learn/smart-technologies-for-interior-design/#:~:text=4.-,Smart%20lighting,light%20bulbs%20in%20your%20home.

TeamLab. (2015). *Worlds Unleashed and then Connecting*. Retrieved from TeamLab.art: https://www.teamlab.art/w/worlds-unleashed/maisonparis15-winter/

The Pearl Bar Berlin. (2013). Retrieved from Architizer.com: https://architizer.com/projects/the-pearl-bar-berlin/

Tourism, D. o. (2007). *Abu Dhabi Hotel Classification Manual.* Abu Dhabi.

U.AE. (2020, September 6). Retrieved from Abu Dhabi: https://u.ae/en/about-the-uae/the-seven-emirates/abu-dhabi

Walker, J. (2011). *The Restaurant From Concept To Operation.* New Jersey: John Wiley & Sons, Inc.

Walker, J. R. (2021). *The restaurant: from concept to operation.* John Wiley & Sons.

WHAT HAPPENS WHEN. (n.d.). Retrieved from The Metrices: http://www.metricsdesigngroup.com/work/whathappenswhen/whathappenswhen.html

What is Ergonomics? (n.d.). Retrieved from ergonomics: https://www.ergonomics.com.au/what-is-ergonomics/