國立台灣科技大學

工業管理系

碩士學位論文

A survey on tourism revenue model of night market using affective computing

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Table of content

CHAPTER 1. INTRODUCTION

1.1. RESEARCH BACKGROUND

Taiwan hosts numerous night markets in each of its major cities, concretely, hosts more than 300. Locals as well as foreign people feel attracted for the night markets; therefore, there is the perfect place to take advantage of commercial opportunities.

According to NTU Tourism research (Tsai, 2013), night markets are the most popular destination in Taiwan; in particular more than 65% of visitors attend during their visit to Taiwan. In addition, as is defined in visitor expenditure statistics, the main activity in which visitors engage is tasting Chinese cuisine. As a result of these statements, this research aims to take advantage of these favourable conditions to increase the revenues and the profits of food trucks in a Night Market.

1.2. RESEARCH OBJECTIVE

The main idea is to study the tourist behaviour in a night market in order to design a smart mobile device application that maximizes the benefit based on the affective computing and different data such as:

- Raw material cost
- The target profit
- The benefits obtained at some point

Thanks to using all this information in addition to marketing techniques like discounts, upselling and cross selling the night market food trucks will be able to obtain greater economic benefits.

To make it clear, the application has to be able to identify customer behaviour and take a commercial advantage of it. In the Figure 1 there is an idea of how the smartphone application is going to work.
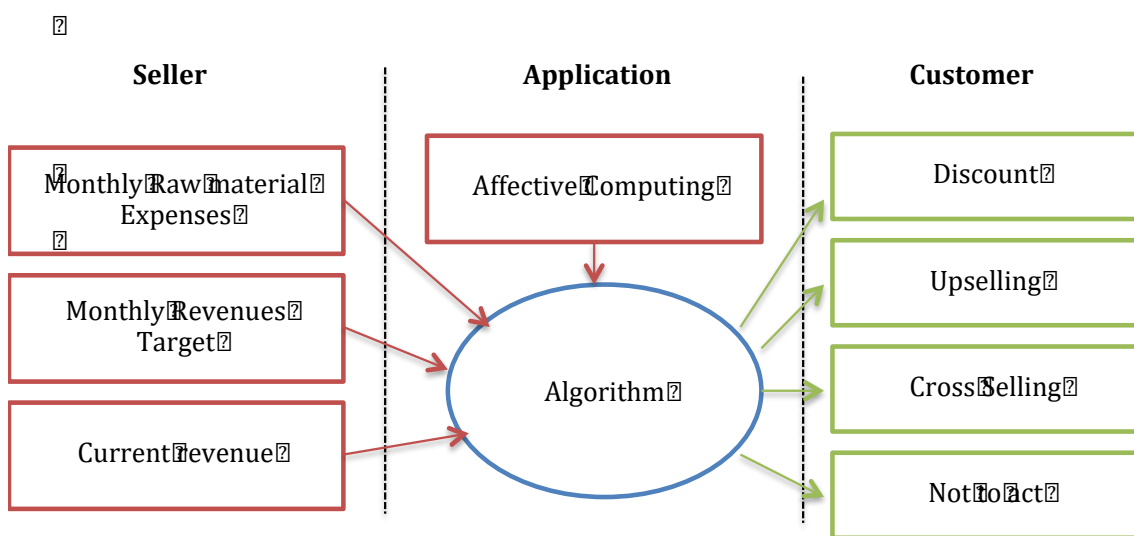

Figure 1. System inputs and outputs

As a summary, the objective is to design a smart mobile device application capable of helping the seller to obtain more benefits and at the same time giving to the customers the opportunity of saving money. Therefore, with this win-win relationship between seller and customer we will be able to increase the economical transactions in a night market.

1.3. RESEARCH ASSUMPTIONS

To carry out this project it's important take into account several assumptions.

First of all, using mobile point of sale (mPOS) the seller has to be able to monitor all the transactions made in order to know the revenues and the expenses in raw material at whatever point in the time. As a consequence of monitoring the revenues, the seller will be able to make a forecast and define targets.

Secondly and lastly, customers and sellers have a smartphone or a smart device to interact with the application in question.

1.4. THESIS STRUCTURE

The rest of this thesis is organized as follows. Chapter 2 provides the related literature review. Chapter 3 provides the analysis for understanding the business and the consumer properly. Chapter 4 provides the technical solution for the app proposal. Chapter 5 draws conclusion, provides the project budget and suggest the future steps of the project.

CHAPTER 2. LITERATURE REVIEW

2.1. NIGHT MARKETS

Night markets in Taiwan have become famous for their *xiaochi,* an important category of Chinese food which literally translates to "small eats". Served in portions similar to Spanish tapas, these dishes are often served as take away items, but many sellers provide small folding tables and stools for customers who would like to sit while they eat. These dishes are offered at low prices, usually around $30 to $50 NTD ($1–$1.75 USD). Visitors who expect to eat enough to be full during a trip to the night market will usually spend around $100NTD - $300NTD ($3–$10 USD). Most night markets also have some small restaurants, which provide a number of simple courses that allow people to finish a full meal without having to eat their way through the entire market. (Taiwan's Night Markets., 2018).

Though some of the snack foods available will change from year to year with passing fads, but certain snack foods such as oyster omelettes, chicken shawarma, and stinky tofu persist during the years and have become staples in many night markets. Sometimes, the night markets of a city, or even just one particular market within that city, become well known for a certain type of food that is unique to the area, or prepared particularly well there. (Taiwan's Night Markets., 2018).

In recent years, many of the night markets have become popular tourist destinations among sightseeing foreign travellers. It is common to see many travellers with cameras, snapping photographs amidst the crowds. Some of the night markets, such as the Shilin (at Yuanshan, Taipei) and Shida night markets are

among the first places that Taiwanese students will bring international students for a cultural experience. (Taiwan's Night Markets., 2018).

In addition to food, night markets feature various forms of entertainment and a lot of shopping. Numerous products for sale include clothes, bags, shoes, trinkets, kitchen items, among other things. Some night markets will have areas that are dedicated to certain products such as clothes, which are sold both by street vendors in the 100 to 300 NTD ($3–$10 USD) range and in the small storefronts lining the streets usually priced slightly higher in the 300 to 500 NTD range. These shops are often open during the day as well, especially during the afternoon before the evening rush. Carnival-style games are typically available to play for the price of a few coins. (Taiwan's Night Markets., 2018).

Vendors practice a type of small-scale entrepreneurship run, for the most part, by family. The Vendors are recognized and protected by law for this reason they are required to pay taxes and have licenses. Merchants are managed through their Night Market committee. The night markets provides a way for local people to take part in the Taiwanese tourist industry (Taiwan's Night Markets., 2018).

2.2. AFFECTIVE COMPUTING

Affective computing is an emerging field of research that aims to enable intelligent systems to recognize, feel, infer and interpret human emotions. It is an interdisciplinary field, which spans from computer science to psychology, and from social science to cognitive science. It can be analysed a single modality (video, text, audio, etc...), or a combination of multiple sources (multimodal analysis). It is

proved that multimodal analysis is more effective. Figure 2 exposed the overall framework of a typical multimodal affect detector. The framework consists of two fundamental steps: processing unimodal data separately and fusing them all together. (Poria et al., 2017)
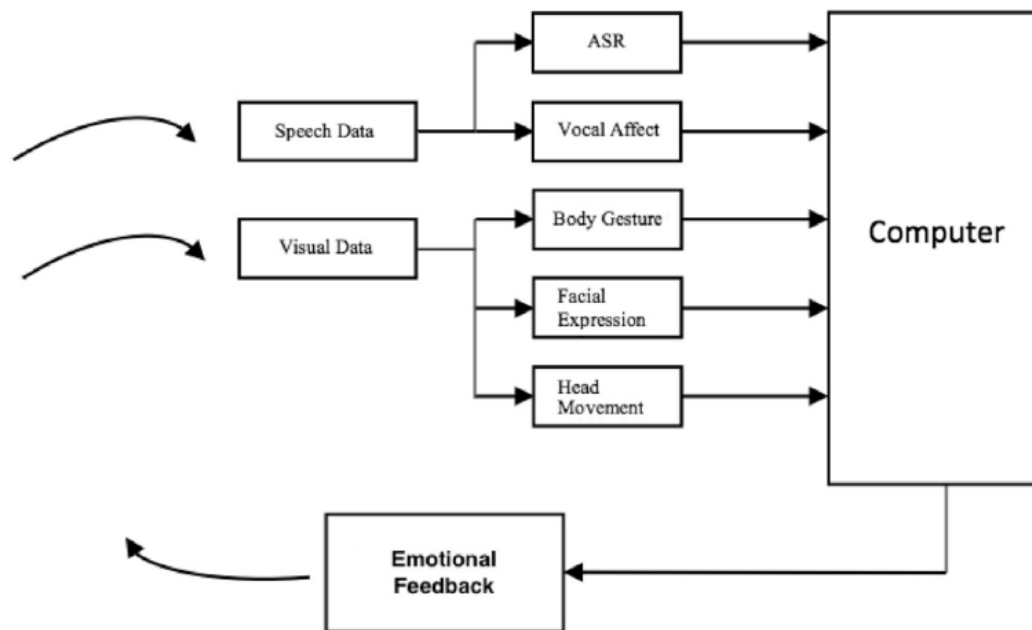

Figure 2. Multimodal Analysis Framework

2.3. CONSUMER BEHAVIOUR

Several studies have been conducted to define consumer behaviour as the decisions and actions that influence the purchasing behaviour of a consumer. What drives consumers to choose a particular product with respect to others is a question, which is often analysed and studied by marketers. Most of the selection process involved in purchasing is based on emotions and reasoning.

The study of consumer behaviour does not only help understand the past but even predict the future. The below underlined factors pertaining to the tendencies, attitude and priorities of people must be given due importance to have a fairly

good understanding of the purchasing patterns of consumers (iResearch Services, 2018).

Marketing Campaigns

Advertisement plays a greater role in influencing the purchasing decisions made by consumers. They are even known to bring about a great shift in market shares of competitive industries by influencing the purchasing decisions of consumers. The Marketing campaigns done on regular basis can influence the consumer purchasing decision to such an extent that they may opt for one brand over another. Marketing campaigns if undertaken at regular intervals even help to remind consumers to shop for not so exciting products such as health products or insurance policies.

Economic Conditions

Consumer spending decisions are known to be greatly influenced by the economic situation prevailing in the market. This holds true especially for purchases made of vehicles, houses and other household appliances. A positive economic environment is known to make consumers more confident and willing to indulge in purchases irrespective of their personal financial liabilities.

Personal Preferences

At the personal level, consumer behaviour is influenced by various shades of likes, dislikes, priorities, morals and values. In certain dynamic industries such as fashion, food and personal care, the personal view and opinion of the consumer pertaining to style and fun can become the dominant influencing factor. Though

advertisement can help in influencing these factors to some extent, the personal consumer likes and dislikes exert greater influence on the end purchase made by a consumer.

Group Influence

Group influence is also seen to affect the decisions made by a consumer. The primary influential group consisting of family members, classmates, immediate relatives and the secondary influential group consisting of neighbours and acquaintances are seen have greater influence on the purchasing decisions of a consumer.

Purchasing Power

Purchasing power of a consumer plays an important role in influencing the consumer behaviour. The consumers generally analyse their purchasing capacity before making a decision to buy and products or services. The product may be excellent, but if it fails to meet the buyers purchasing ability, it will have high impact on it its sales. Segmenting consumers based on their buying capacity would help in determining eligible consumers to achieve better results.

Understanding, analysing and keeping track of consumer behaviour is very critical for a marketing department to retain their position successfully in the market place. There are various other factors too that influence consumer behaviour apart from the five listed above.

CHAPTER 3. BUSINESS RESEARCH

3.1. MARKET RESEARCH

There are many night markets in Taiwan. The longer list of night markets found is of 67 broken down by it is shown in Figure 3. Probably it is a low sample of the many night markets located in Taiwan, but is good enough for appreciating how night markets are distributed in Taiwan. As it is displayed, Taipei and New Taipei are hosting a high proportion of them all.
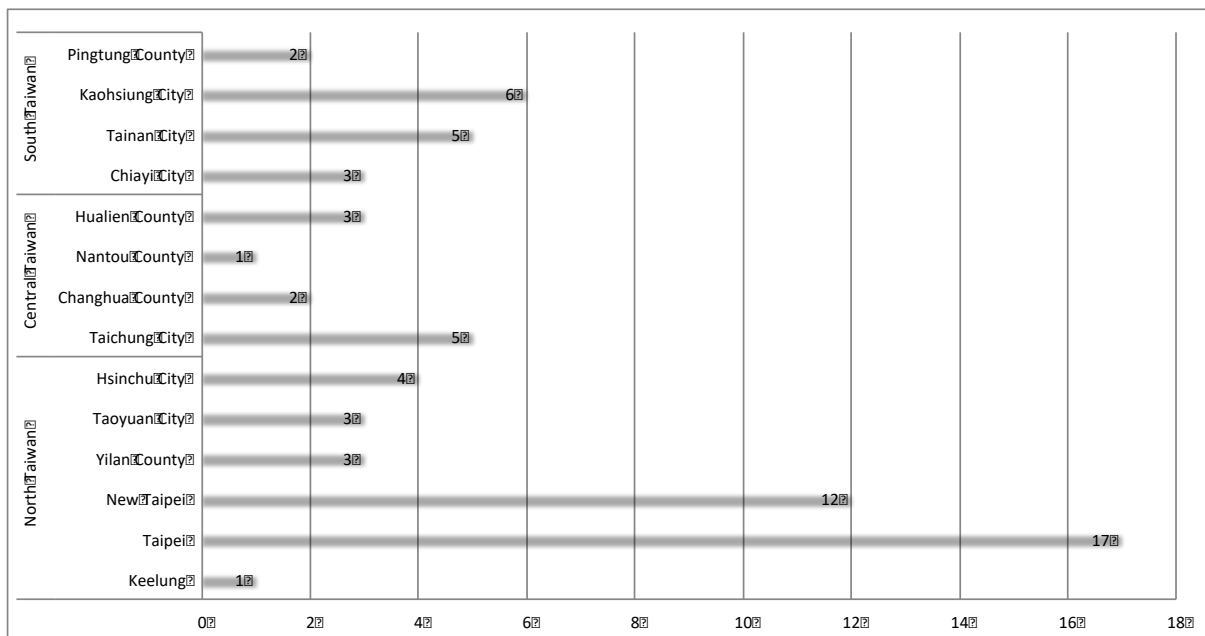

Figure 3. Night Market in Taiwan

According to a survey done in a National Taiwan University research, as it is shown in Table.1 the most popular destination in Taiwan are night markets follow by National Palace Museum and Taipei 101 (Tsai, 2013).

Ranking	Tourist Spot	Times	Ranking	Tourist Spot	Times
1	Night Markets	62.27	6	Ximen District	21.24
2	National Palace Museum	44.12	7	Joufen	19.01
3	Taipei 101	39.92	8	Longshan Temple	18.62
4	C.K.S. Memorial Hall	35.01	9	Damsui	15.21
5	Taipei Martyrs' Shrine	27.44	10	Taroko Gorge	14.01

Table 1 Ranking of Desirable Tourist Spots in Taiwan 2010 Unit: person/hundred person-times

Furthermore, according to the data published in the Tourism Bureau, M.O.T.C. Republic of China (Taiwan), the tourism is increasing year by year reaching the 10,7 millions of visitors as it is shown in the following Table 2 and Figure 4 in which it is also displayed the positive evolution of the tourism during the last ten years (Tourism Bureau, M.O.T.C. Republic of China, 2018).

年別 Year	總計 Total			外籍旅客 Foreigners			華僑旅客 Overseas Chinese		
	人數 No. of Visitors	成長率 Growth Rate %	指數 Index 1991=100	人數 No. of Visitors	成長率 Growth Rate %	占總計百分比 % of Total	人數 No. of Visitors	成長率 Growth Rate %	占總計百分比 % of Total
96 年 2007	3.716.063	5,58	200,38	2.988.815	4,66	80,43	727.248	9,49	19,57
97 年 2008	3.845.187	3,47	207,34	2.962.536	−0,88	77,05	882.651	21,37	22,95
98 年 2009	4.395.004	14,30	236,99	2.770.082	−6,50	63,03	1.624.922	84,10	36,97
99 年 2010	5.567.277	26,67	300,20	3.235.477	16,80	58,12	2.331.800	43,50	41,88
100 年 2011	6.087.484	9,34	328,25	3.588.727	10,92	58,95	2.498.757	7,16	41,05
101 年 2012	7.311.470	20,11	394,25	3.831.635	6,77	52,41	3.479.835	39,26	47,59
102 年 2013	8.016.280	9,64	432,26	4.095.599	6,89	51,09	3.920.681	12,67	48,91
103 年 2014	9.910.204	23,63	534,39	4.687.048	14,44	47,30	5.223.156	33,22	52,70
104 年 2015	10.439.785	5,34	562,94	4.883.047	4,18	46,77	5.556.738	6,39	53,23
105 年 2016	10.690.279	2,40	576,45	5.703.020	16,79	53,35	4.987.259	−10,25	46,65
106 年 2017	10.739.601	0,46	579,11	6.452.938	13,15	60,09	4.286.663	−14,05	39,91

Table 2 Visitors Arrivals in Taiwan 2007 to 2017

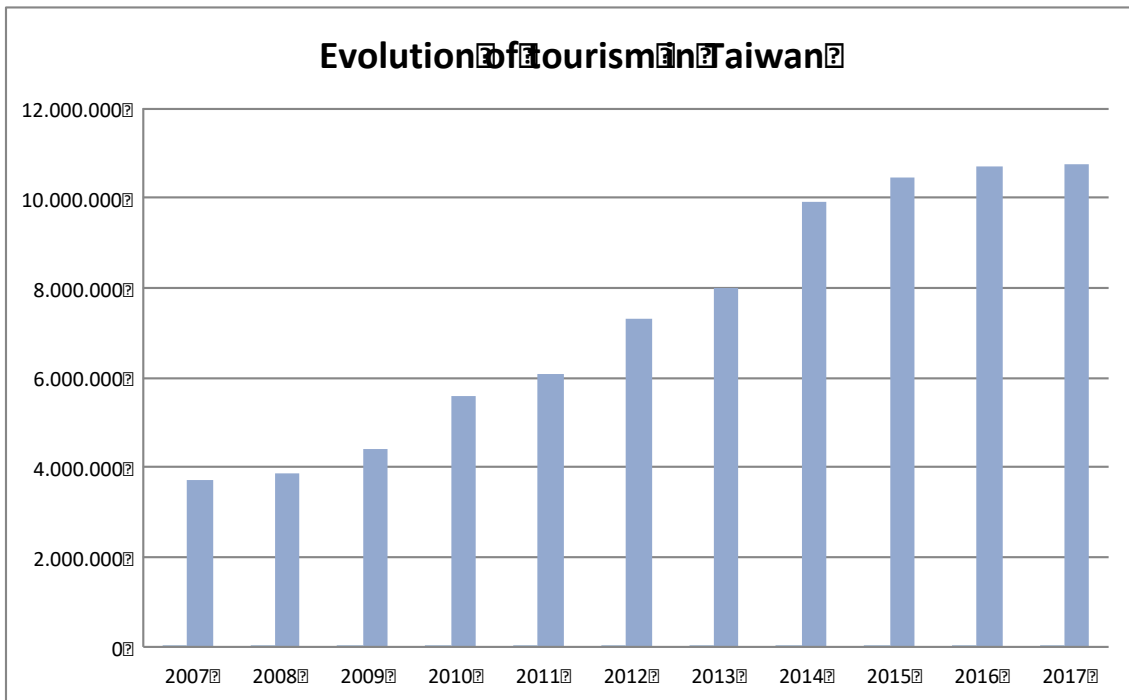**Evolution of tourism in Taiwan**

Figure 4. Evolution of Tourism in Taiwan during the last 10 years

Is for all these reasons, that the application has to be targeted to tourist and night market. The tourism growth, as well as, conserving night market as the most popular destination in Taiwan, will lead the app to a large turnover and the opportunity to occupy this market gap.

3.2. VALUE PROPOSITION

Who has not seen a tourist skipping a food truck after looking at their food in a night market? Figure 5 is the perfect example for this statement. How many people are looking at the different food trucks without buying anything? As it can be seen there are probably more than 20 people looking at the food truck without buying anything. This is probably the main problem, which the application will be able to solve.

Figure 5. Liuhe Night Market, Kaohsiung

The app will have two points of view the customer and the seller one. For this reason, is going to be analysed the value proposition for the customer and for the seller.

- Purchaser's point of view: In this case the customer will be able to benefit from many discounts and many commercial campaigns totally for free. Moreover with the app, the purchaser will be able to check the reviews from other tourist and this will help in the selection of the best places to eat in a night market. This fact brings more competitive between the different food trucks, consequently the customer will be capable of taking profit of a better product quality.

- Seller's point of view: From the seller point of view, they will be able to increase the revenues thanks to special promotions and commercial campaigns offered by the application. For this reason, it will help to achieve the revenues monthly target. In addition, the app will be a source for

improving the business thanks to the reviews posted by the customers because the sellers will be able to know their business weak and strong points.

Due to the win-win relationship between all the actors will also help to increase the transactions in a night market. As a result, because of the large business volume of the night markets, the effect of the app could probably be reflected in Taiwan's economy.

As shown in Figure 6, the canvas model will help show the application as a profitable business supported by the value proposal for customers. As well as this statement, the Canvas Model will help to describe the business model of the future application.

Key Partners	**Key Activities**	**Value Propositions**	**Customer Relationship**	**Customer Segments**
Affective computing software provider Affective computing hardware provider Cloud Service provider	Platform development and maintenance Marketing Customer Support **Key Resources** App platform Consultants for the Sellers Cloud Information Storage	CUSTOMER: Safe money thanks to commercial offers Check the reviews of different customers. Help them to choose the best option. SELLER: The seller will be able to increase the revenues thanks to the commercial offers	Rating and Feedback System Build a community to share customers experiences Sales Representative **Channels** Smartphone App Website Social Media Sales Representative	People who own a food truck in a touristic night market Geographical segmentation

Cost Structure	**Revenue Streams**
Salaries to permanent employees Platform development Events and Marketing Legal	License (one payment) Maintenance (annual payment)

Figure 6. Canvas Model

3.3. BUSINESS STRATEGY

Figure 7 displayed a SWOT Analysis. The SWOT Analysis is going to identify the Strengths, Weaknesses, Opportunities, and Threats related to the app business. It is intended to specify the objectives of the business and identify the internal and external factors that are favourable and unfavourable to achieving those objectives.

Strengths

Attractive for the seller and for the night market purchaser

Cheap development and maintenance cost

Weaknesses

Lack of technology in the night markets

Difficulty to convince the sellers to use the affective computing technology

Opportunities

Growing night market business

Change people mentality for using new technologies in night markets

SWOT

Threats

The seller could give discounts without using the application
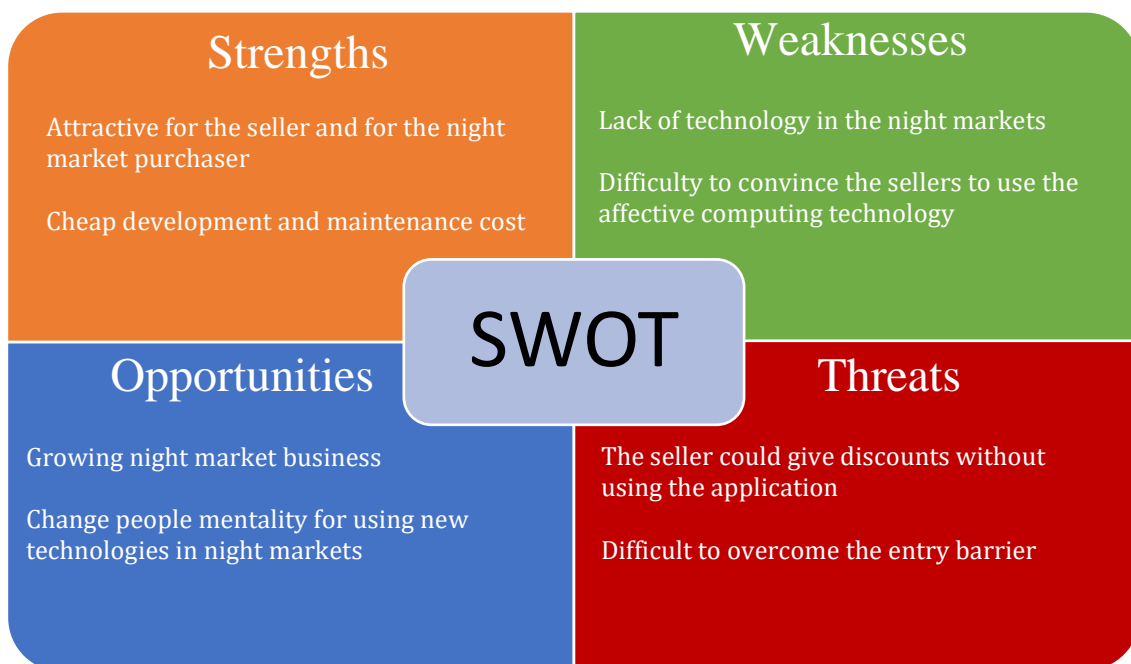
Difficult to overcome the entry barrier

Figure 7. SWOT analysis

After defining the strengths, weaknesses, opportunities and threats, is going to be defined TOWS matrix exposed in Table 3 which is used to generate and compare strategies.

Table 3. TOWS matrix

Internal Factors / External Factors	Strengths(S) S1 Attractive for the seller and for the night market purchaser S2 Cheap development and maintenance cost	Weaknesses(W) W1 Lack of technology in the night markets W2 Difficulty to convince the sellers to use the affective computing technology
Opportunities(O) O1 Growing night market business O2 Change people mentality for using new technologies in night markets	SO Strategies 1. Increase night market revenues by offering an attractive and efficient product 2. Increase product portfolio, once the night markets are getting used to technology	WO Strategies 1. Invest in technology training for night market sellers 2. Change night markets image by the use of the app
Threats(T) T1 The seller could give discounts without using the application T2 Difficult to overcome the entry barrier	ST Strategies 1. Penetrating the market by offering attractive and cost-efficient products 2. Promote the usage of the app by offering attractive fidelity offers	WT Strategies 1. Offering discounts and fidelity campaigns 2. Promoting the app as a useful tool for increasing the revenues

3.4. CONSUMER BEHAVIOUR ANALYSIS

Once it is introduced the main factors in consumer decision-making in section 2.3, it is necessary to analyse the influence of these decision factors in a night market.

- **Marketing Campaigns** are a good tool to influence the consumer in a night market, more especially if these campaigns affect the prices. Lower prices are always a good option to keep the attention in potential customers. Furthermore, it could also imply to get a real advantage on the competitors

- **Economic Conditions** is a factor not really important in night market because of the lower price of the night markets products. As it is written in the section 2.3, this factor has more influence in big purchases such as vehicles, houses and other household appliances. In addition, as a starting app, the influence power in economic conditions is really low.

- **Personal Preferences** is an important factor, which can make the difference. In night market case, changing the taste of a tourist is quite an impossible task, but the application will be able to make easier the final decision between the preferences of the tourist.

- **Group Influence,** who has not been influenced by a friend? It is clearly an important factor, which is really difficult to have influenced on. Doing good commercial campaigns to persuade as much people as possible and having a good rate in customer satisfaction could be essential for winning the confidence of a group of influence.

- **Purchasing Power** is not a really important factor in our case for the lower prices in a night market. Furthermore, with the commercial campaigns, the

offers made by the app will reduce the prices, which is going to influence the customer positively.

Table 4 is a summary of the analysis made before. It shows the importance that the factor has in a night market as well as the degree of influence of the application on that factor in potential consumers.

Table 4. Costumer Decision-Making Factors Analysis

Factors	Importance	Degree of Influence
Marketing Campaigns	🟢	🟢
Economic Conditions	🟡	🔴
Personal Preferences	🟢	🟡
Group Influence	🟢	🟡
Purchasing Power	🟡	🟡

	Importance	Degree of Influence
🟢	Very Important	High
🟡	Partially important	Normal
🔴	Not Important	Low

As a result of the analysis made, the application will focus on marketing campaigns using many marketing techniques such as discounts, cross selling and upselling. Due to these marketing campaigns the app will influence positively the purchasing decision and the users of the app will get a real advantage on the competitors.

After carrying out the analysis of the most important factor in the consumer behaviour, in the following lines, after many days of studying the tourist consumer behaviour on-site, is going to be described the main costumer behaviour observed in a night market.

- When potential customer is paying attention to the food track and then leaves the position

- When potential customer is paying attention to the food track and then he has the intention of purchasing the food truck product

- When potential customer is ignoring the food track and he is just passing in front of it.

- When a potential customer is waiting in a line for buying a food truck product

CHAPTER 4. TECHNICAL MANAGEMENT

4.1. FEATURES

Before surveying the existing technologies, it is necessary to gather the functions that need the application to work as independent for the seller as possible. In Table 5 we gathered the different functions along with the technology needed in each case.

Table 4. Costumer Decision-Making Factors Analysis

	Features	Technology needed
Input Data	Collect data from the business economic transaction including revenues and raw materials expenses	MPOS
	Locate the potential customers	Internet of things
	Collect affective data from the located potential customers focusing on the eye tracking and facial recognition	Affective Computing
Analysis	Analyse the data and define offers based on the data collected of the customers and sellers	Algorithm
Output Data	Send customized offers to potential customers	Internet of things
Customer Feedback	Send reviews for helping others customers	Application programming

In order to carry out all this features, it is also needed a hardware for storing the data as well as doing the data processing. For this reason, the app will use cloud technology.

Figure 8 shows the main features and the workflow of how the application is going to work.
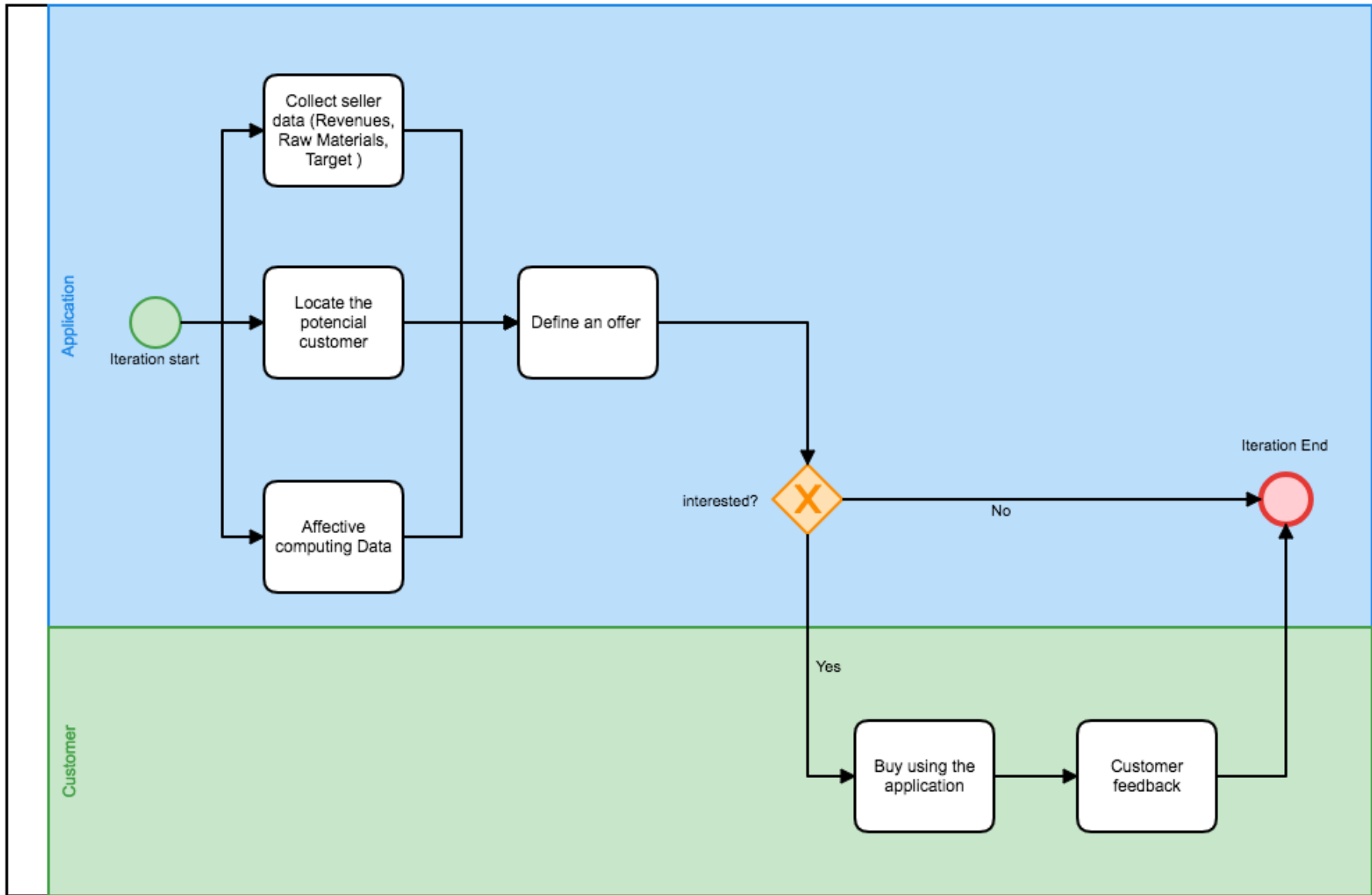
Figure 8. Features Workflow

4.2. TECHNOLOGY SURVEY

To develop the smartphone application is necessary to survey the technologies available in the market to select the best option in order to build the application as efficient as possible. In the following lines are gathered some technologies which could be used by the application.

INTERNET OF THINGS

BEACON

A beacon is a Bluetooth Low Energy (BLE) device that enables a business to provide certain location-based services to their customers. Beacons have an edge over GPS services – they do not require any kind of satellite, and they provide location services indoors and even underground (Bluetooth Beacon Applications and Real World Developer Issues, 2016).
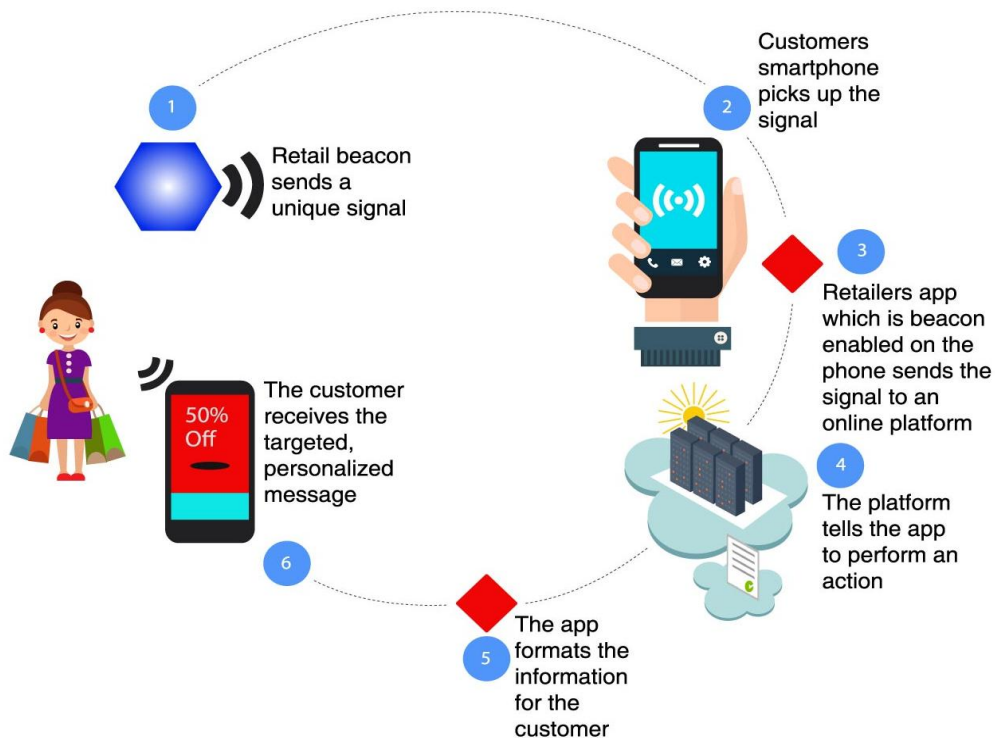
Figure 9. Beacon workflow

The basic process that is responsible for the functioning of beacons is known as 'advertising'. In this process, the devices emit packets of data using Bluetooth low energy and other scanning devices nearby, such as smartphones that are in the vicinity, detect this data. Beacons work in tandem with mobile apps to trigger particular messages or actions based on rules, such as triggering a push notification when a user is within a certain distance from a beacon. A beacon fixed on to a shop wall or event location or any public place, can communicate easily with a corresponding smartphone app and figure out where the person is located currently, with great accuracy. The retailers or event organizations can then come up with a much targeted or personalized communication based on the proximity of the customer (Happiest Minds, 2018). In Figure 7 is exemplified the workflow of a beacon.

The Beacon price varies depends on the quantity. For a single Beacon the average price is 25 US$ and for quantities over 1000 is expected a cost around 15 to 17US$ per beacon.

WEARABLES

Wearable are smart electronic devices (electronic device with micro-controllers) that can be worn on the body as implants or accessories. Wearable devices such as activity trackers are a good example of the Internet of Things, since "things" such as electronics, software, sensors, and connectivity are effectors that enable objects to exchange data through the internet with a manufacturer, operator, and/or other connected devices, without requiring human intervention (Donovan, Tony O et al., 2009).

Wearable technology has a variety of applications, which grows as the field itself expands. It appears prominently in consumer electronics with the popularization of the smart watch and activity tracker. Apart from commercial uses, wearable technology is being incorporated into navigation systems, advanced textiles, and healthcare.

The common uses of wearable for increasing the sales are listed in the following points (Friedman, E., 2017)

- Improving customer service by helping customers visualize designs; enabling them to remotely view or virtually experience products and services; providing contactless payments, proof of service, and remote access to an in-store salesperson
- Creating a more personalized customer experience to increase customer satisfaction and close more sales (using wearable tech to view client information at the point of sale or service)
- Giving customers behind-the-scenes access by streaming video from a job or allowing them to shop remotely (builds trust, shorter sales process, reduces returns)
- Innovative marketing, advertising and customer engagement strategies
- Using AR/VR in the sales pitch; bringing the design or sales pitch to the customer

- Becomes a major differentiator for the business (can market use of the tech to improve brand reputation, revamp company image, compete, and attract new business)

AFFECTIVE COMPUTING

In the following lines are listed 20 popular APIs for emotion recognition from photos, videos, text and speech. The main categories of emotions that are detected using the APIs are Joy, Anger, Contempt, Fear, Surprise, Sadness and Disgust. Sentiment analysis is also explored by some of the APIs, in addition to emotion recognition, to determine whether the expressed emotion is positive or negative (Poria et al., 2017)

1. **Emotient** detects Attention, Engagement and Sentiment from facial expressions. These factors are considered key performance indicators for adding business value to advertising, media, consumer packaged goods and other industries, which need consumers' feedbacks to improve the quality of their products. (Poria et al., 2017)

2. **Imotions** combines Emotient face expression technology to extract emotions and sentiments from various observed bodily cues. It can also be easily combined with other technologies such as EEG, eye tracking, Galvanic Skin response, etc., to improve emotion recognition accuracy. (Poria et al., 2017)

3. **EmoVu** by Eyeris is a comprehensive face analytics API that employs deep learning for emotion recognition. The API also provides vision software to support ambient intelligence and is also useful for detecting age and gender

identification, eye tracking and gaze estimation. (Poria et al., 2017)

4. **nViso** uses 3D facial imaging technology for emotion recognition from facial expressions in real time. The software is completely automated and received the IBM award for smarter computing in 2013. ((Poria et al., 2017)

5. **Alchemy API** is also powered by IBM Watson. The API performs sentiment analysis on large and small documents, news articles, blog posts, product reviews, comments and tweets. (Poria et al., 2017)

6. **Kairos** provides an API for analysing facial expressions and features for emotion recognition, gender and age detection and attention management. It provides applications for various industries such as advertising, market research, health, financial services, retail, etc. (Poria et al., 2017)

7. **Tone API** provides emotional insights from written text. It focuses mainly on marketers and writers to improve their content on the basis of emotional insights. (Poria et al., 2017)

8. **Project Oxford** by Microsoft provides APIs for categories such as Vision, Speech, Language, Knowledge and Search. (Poria et al., 2017)

9. **Face reader** by Noldus is widely used for academic purposes. It is a facial expression analysis software for analysing universal emotions in addition to neutral and contempt. The software is also used to observe gaze direction and head orientation. (Poria et al., 2017)

10. **Sightcorp** is a facial expression analysis API and is also used for eye tracking, age and gender estimation, head pose estimation, etc. (Poria et al., 2017)

11. **SkyBiometry** is a face recognition and face detection, cloud biometrics API. This API is used to detect emotions such as happy, sad, angry, surprise,

disgust, scared and neutral from faces. (Poria et al., 2017)

12. **CrowdEmotions** detects the dynamics of six basic emotions: happiness, surprise, anger, disgust, fear and sadness. It also captures people's engagement, emotions and body language, towards a particular event. (Poria et al., 2017)

13. **Affectiva** is an API for emotion recognition using deep learning. It is said to have nearly 4 million faces as emotion database in order to provide great accuracy. (Poria et al., 2017)

14. **The Tone Analyzer** is an API, powered by IBM Watson, for analysing emotional states in text. (Poria et al., 2017)

15. **Repustate API** is used for sentiment analysis in text. This API is based on linguistic theory and review cues based on POS tagging, lemmatization, prior polarity and negations. (Poria et al., 2017)

16. **Receptiviti API** is used to analyse texts, tweets, emails, chats, surveys and voice data to provide insights into various aspects of people's personal lives, such as personality, emotion, tone and relationships. (Poria et al., 2017)

17. **Bitext** is a text analysis API that is used for sentiment analysis, categorization, entity extraction and concept extraction. It is mainly focused for market research specialists. (Poria et al., 2017)

18. **Mood Patrol** is used to detect emotions from given text. It was developed by Soul Hackers Lab and works reasonably well on small documents. (Poria et al., 2017)

19. **Synesketch** is an open source software used for textual emotion recognition, sentiment recognition and visualization. It analyses text in

terms of emotions such as happiness, sadness, anger, fear, disgust, and surprise, and the intensity of emotion and sentiment, such as positive or negative. (Poria et al., 2017)

20. **Sentic API** is a free API for emotion recognition and sentiment analysis providing semantics associated with 50,000 common sense concepts in 40 different languages. (Poria et al., 2017)

In order to make the selection easier the app will concretely use a technology focused on facial recognition and eye tracking, which are the most important features in the customer behaviour analysis. This statement reduces our options down to 5 possibilities, which are Imotions, EmoVu, Kairos, Face reader and Sightcorp.

Imotions

Imotions is a company that provides software and hardware solutions for Neuromarketing, Psychology, UX, Gaming, Simulator, Medical, Neuroscience and Engineering & VR based on a multimodal system analysis (iMotions, 2018).

In our case, the application require a Neuromarketing solution in order to get access to cognitive and emotional responses of costumers in detail to gain better insights into the drivers of consumer attention, preference and adoption. Thanks to combine different biometric sensors iMotions reveals exactly what a person is looking at (Attention), whether he is feeling a positive or negative sentiment (Valence), the intensity of that sentiment (Arousal) and the emotions he is expressing at that specific point in time (Figure 10).
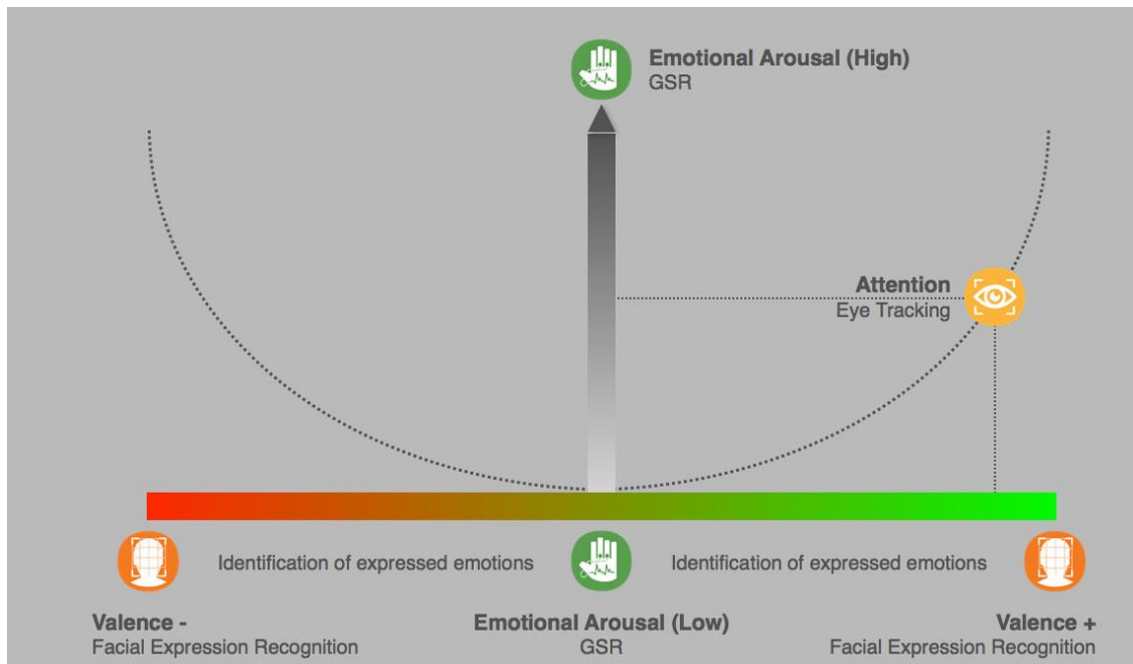
For carrying out the analysis shown before is needed the following technology:

- Facial Expresion Recognition for measuring valence (Positive/Negative/ Neutral emotional states) and emotional reactions by analyzing facial expressions. Imotion use the Affectiva engine, called AFFDEX**,** identifies the face and then locates the main feature points on the face, such as eyes and mouth.

- GSR (Galvanic Skin Response) for measuring arousal by analysing skin conductance. It reveals the intensity of emotional responses and measures optical heart rate. The Shimmer GSR (Figure 11) monitors skin conductivity between two reusable electrodes attached to two fingers of one hand.

- Eye Tracking for measuring attention by analysing eye movements. It measures and quantifies visual attention and reveals how, when and what people see, gaze position, pupil dilation and distance. For instance, the app

could use Tobii X2-30 (Figure 12), which is a small eye tracking system highly portable. This device is ideal for usability and market research studies in the field so you can test participants in their familiar surroundings. It could be extremely useful for this case of study.
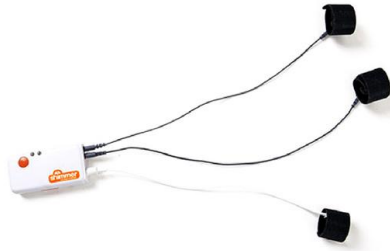
Figure 11. Shimmer GSR   Figure 12. Tobii X2-30

EmoVu (Eyeris)

EmoVu by Eyeris specializes in creating emotionally intelligent tools that can perceive the emotions of people by analysing micro expressions using webcams. Supporting standard video, image, as well as image sequence formats; this emotive predictive analysis can help determine a user's opinion on the content they are viewing in real time. This allows developers to smartly tailor content to highly niched demographics, using data acquired on age, gender, mood, and more to affect content either before or after the content debuts, ideally helping to boost ROI for lean campaigns. This API uses GPU capability for increased processing power, returning nearly 20 unique metrics per user.
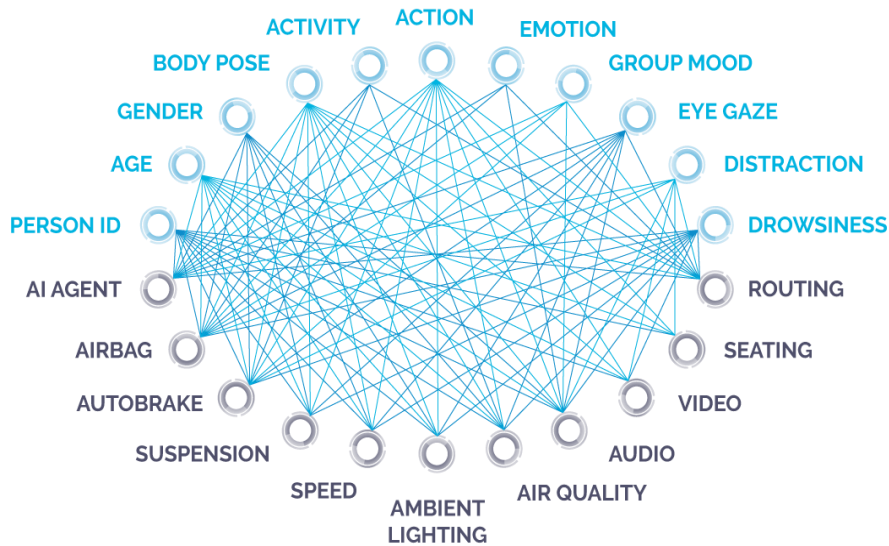
Eyeris focus his research on ensures safety and comfort for occupants of highly automated vehicles. Eyeris confirms that driver attention and distraction can no longer be solely assessed through rudimentary eye gaze and/or head pose analytics. A whole host of additional safety-critical visual metrics are imperative to ensuring the highest level of confidence throughout the decision-making AI process. Eyeris AI enables personalized in-car experiences with Interior Ambient Intelligence (AmI) by augmenting smart interior environments to adapt seamlessly to occupants' demographic, body positions, mood and overall visual behavior. With Eyeris in-cabin intelligence, automotive manufacturers can learn about the likes and habits of all occupants, automatically adjusting the interior space to their needs and preferences (*Automotive*, 2018) (Figure 13).

Kairos

Kairos it is an API that gathers unique, real-time insights about people as they interact with a company, brand or product. Kairos API is capable of identifying different features such as face detection, face identification, face verification, emotion detection, age detection, gender detection, attention measurement and

other features. Its prices goes to 500$ to 3000$ depending on the usage (Belyeu, R., 2018).

Face Reader(Noldus)

FaceReader by Noldus is facial expression analysis software with more than 10.000 manually annotated images used for training the software. FaceReader automatically analyses 6 basic facial expressions, neutral, contempt, and boredom, interest, and confusion. It also calculates gaze direction, head orientation, and person characteristics. The solution is used worldwide at more than 500 universities, research institutes, and companies in many markets, such as consumer behaviour research, usability studies, psychology, educational research, and market research (*FaceReaderTM*, 2018).

For doing the app is needed the following software:

- **Viso** for AV recording and immediate playback of consumer tests
- **FaceReader** for facial coding and assessment of interest, confusion, and boredom
- **The Observer XT** for perfect data integration and synchronization

Noldus also offers eye tracking hardware solutions such as glasses and desktop eye trackers.

Sightcorp

For building our own solution Sighcorp offers The CrowdSight SDK that enables tracking of multiple people at the same time. This technology can be used to analyze the demographical profiles of your shopping audience and converted customers. The analysis includes former information about the shopping

experiences of your audience. The CrowdSight SDK is able to identify different features such as emotion recognition, age estimation, gender estimation, ethnicity estimation, head gaze, facial landmarks and attention time. As a requirements they demand (Sightcorp, 2018):

- C++ expertise needed

- Windows, OS X, Linux, iOS, Android supported

- Processors: Intel i5 3.5 GHz recommended

- RAM : 2 Gb min (Android), all other 4 Gb min

- Camera: 1280×720 (recommended) and Optical zoom for long distance tracking

DATA TREATMENT AND STORAGE

As many market solution, the app needs to carry out different data treatment and storage it for future use. Consequently, is needed a hardware in which process the different operations mentioned before. Therefore, cloud technology is going to be extremely useful in order to treat large volume of data. The products required for the proper functioning are:

- Machine Learning Platform: It is an end-to-end machine learning service, including data processing, feature engineering, model training, model prediction, and model evaluation. Machine Learning Platform For AI combines all of these services to make AI more accessible. It's highly recommended to use it to extract features from customer's historical shopping behaviour.

- Storage Service: It is an easy-to-use service that enables you to store, backup and archive large amounts of data on the cloud.

Then, down below in the Table 6 is going to be survey the prices of the most important companies that provides cloud services such as Alibaba, Amazon and Google.

Table 6. Price Comparison

	Alibaba(Alibaba Cloud, 2018)	Amazon(Amazon Web Services, 2018)	Google(Google Cloud, 2018)
Machine Learning Platform	Data processing: 0,16$ per compute hour Data mining and analysis: 0,21$ per compute hour	Data processing and Data mining and analysis: 0,42$ per compute hour	Data processing and Data mining and analysis: 0,54$ per compute hour
Storage Service	0-5 GB: Free >5 GB: 0,02$ GB per month	0-50 TB: 0,023$ GB per month 50-500 TB: 0,022$ GB per month >500 TB: 0,021$ GB per month	0-1 TB: 0,023$ GB per month 1-10 TB: 0,022$ GB per month >10 TB: 0,020$ GB per month

4.3. TECHNOLOGY SELECTION

In this section we defined and justified the technology used in the application. The selection is based basically on the cost and the performance of the technology.

Firstly, for collecting the data related to the seller like the raw material cost, the updated revenues information and the revenues monthly target, the application will give the seller the necessary technology to link the application to his MPOS system. Thanks to this feature, the information collected in the application will be perfectly updated. Furthermore, with this feature the application will reduce the error probability because of the less seller-application interaction.

Secondly, the application will use Beacon Technology for locating potential customer and sending the customized offers to them. Therefore, the application will carry out the workflow shown in Figure 9, following the next steps:

1. Retail beacon sends a unique signal

2. Customer smartphone picks up the signal (Locate the potential customer)

3. The application which is enabled to use beacon will send the information to the algorithm (cloud)

4. The algorithm will tell the application to perform a customized offer or not to act

5. The application formats the offer for the potential customer

6. The customer receives the targeted and personalized offer

Thirdly, related to the affective computing technology, Emovu and Kairos are going to be ruled out. On one hand, Emovu is focusing on the automotive industry, not the target we are looking for. On the other hand, Kairos does not sell an integrated hardware and software solution they only sell an API that is just a helpful tool for programmers. Table 7 compares the pros and cons of Imotion, FaceReader and Sightcorp used as a tool for selecting the final affective computing technology

Table 7. Pros and Cons comparison between different affective computing technologies

Technology	Pros	Cons
Imotions	• Totally hardware an software integrated solution • Customized solution • Solution focus on the target needed (neuromarketing)	-
FaceReader	• Partially hardware an software integrated solution • Customized solution • Solution focus on the target needed (neuromarketing)	• Different software needed, they need to be synchronized
Sighcorp	• Solution focus on the target needed (neuromarketing)	• C++ programmer needed • Not hardware solution

After comparing the different technologies, Imotions is going to be the technology selected for all its advantages. In spite of selecting Imotions, is not rule out the possibility of using different technologies depending on the pricing.

Fourthly and lastly, regarding to the cloud technology, the decision is made based on the price of the providers (Table 6). As shown, Alibaba Cloud is the cheapest option for Asia.

4.4. TECHNOLOGICAL FRAMEWORK

As it is displayed in Figure 14, this section will be explained how the application is going to work and which technology will use for doing every feature. Then, the application will work following the next steps:

1. First of all, the app will gather the information required for the algorism on-site. For collecting all the data needed, is necessary to carry out three operations at the same time. These operations are:

   a. Locate the customer: Using beacon technology enables to locate the different smart devices. This information will allow the application to assign a face to each smart device thanks to the location services that beacon technology provides

   b. Gather face information: Thanks to a video camera is going to be recorded the faces of all potential customers

   c. Gather eye tracking information: Using an eye tracking hardware provided by Imotions the app will be capable of collecting the information related to customer attention.

   d. Gather MPOS data: Using a link to the MPOS system allows the app to check the information such as raw material cost, the target profit and the benefits obtained at some point in the time.

2. Secondly, the information collected in the video camera and eye-tracking hardware will be analysed by the Imotion software. The software will be located in the cloud, therefore, the data collected by the food truck

hardware will be sent to the Alibaba online platform (cloud). This analysis will give the following answers:

a. Facial Analysis: Negative/Neutral/ Positive

b. Attention Analysis: Visual Contact/ Not Visual Contact

3. Thirdly, after analysing the affective computing data and collecting the location of the potential customer, all the data collected will be sent to the algorithm. Before introducing the data to the algorithm, it will be needed a processing in order to adapt the data provided by the different hardware to the data required by the algorithm. The algorithm will be located in the Alibaba online platform (cloud).

4. Fourthly, the algorithm, that will be defined in the following sections, will define an action, specifically it will define an offer, otherwise the algorithm can decide not to act. The algorithm will make the different operation in the cloud.

5. Fifthly, once the offer is defined, the app will send the offer and the information related to the customer location to the beacon. Finally, the potential customer will receive the offer. Then the app will store the information for future use in the cloud.

6. Sixthly and lastly, if the potential customer decides to purchase with the application, he will have the chance to write a review of the food truck in order to help other possible customers.

FOODTRUCK HARDWARE

Eye Tracking Hardware

Video camera

Gather attention information

Gather face information

Imotions Software

Gather MPOS information

Sentiment analysis

Data Processing

Receive the offer

CUSTOMER HARDWARE

Data Processing

ALGORITHM

Beacon

Locate the potential customer

Define an offer

Data Processing

Send the offer to customer

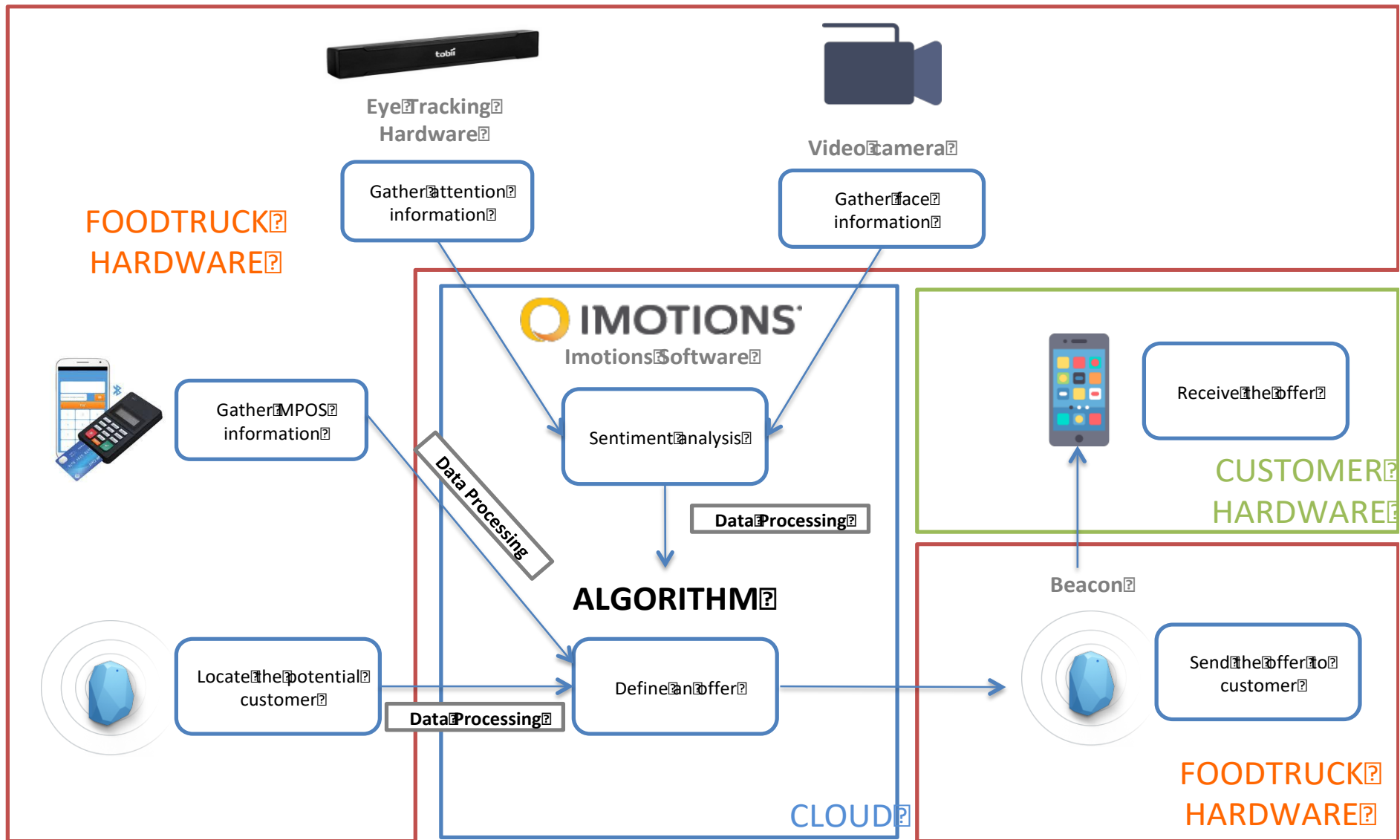**CLOUD**

FOODTRUCK HARDWARE

Figure 14. Technological Framework

4.5. DATA STRUCTURE

Regarding the data structure, as displayed in Figure 15, the app will have three data generation sources, which are the beacon system that will generate location information, the eye tracking hardware that will also generate several locations information pointing the zones where the customer is looking at and the video camera that will generate the video file in order to be analysed by the facial recognition system. Moreover, the MPOS software will give access to its database to check whatever data is in it.

Once this generated information is analysed, it will be deleted. The app will just save the information of the sell such as the purchaser, the offer and the selling price, as well as, the answer given by the Imotions Software. For this reason, the application will use an SQL database provided by Alibaba. This database provides all the security needed such as (Alibaba Relational Database Hosting on the Cloud, 2018):

- Anti-DDoS: Provides real-time traffic monitoring at network entry point. If any high traffic attack is identified, source IPs are either cleaned or blacklisted.

- IP Whitelist Configuration: Supports configuration of up to 1,000 IP addresses. These can be connected to an ApsaraDB for RDS instance so that the risks are directly controlled at source.

- Protection of Database from Various Attacks: Intercepts SQL injection, brute force attacks and other forms of database attacks. ApsaraDB for RDS also provides SQL audits, allowing you to keep track of who accessed the instance when, and what action was taken at that time.

FOODTRUCK
HARDWARE

**Eye Tracking
Hardware**

Video camera

Data Generation

Data generation

IMOTIONS

Imotions Software

Location

Video

FOODTRUCK
HARDWARE

CUSTOMER
HARDWARE

Accessible
Database

Data Analysis

Float

Offer information

Array

ALGORITHM

Beacon

Data Generation

Location

Data analysis

Location + Offer
information

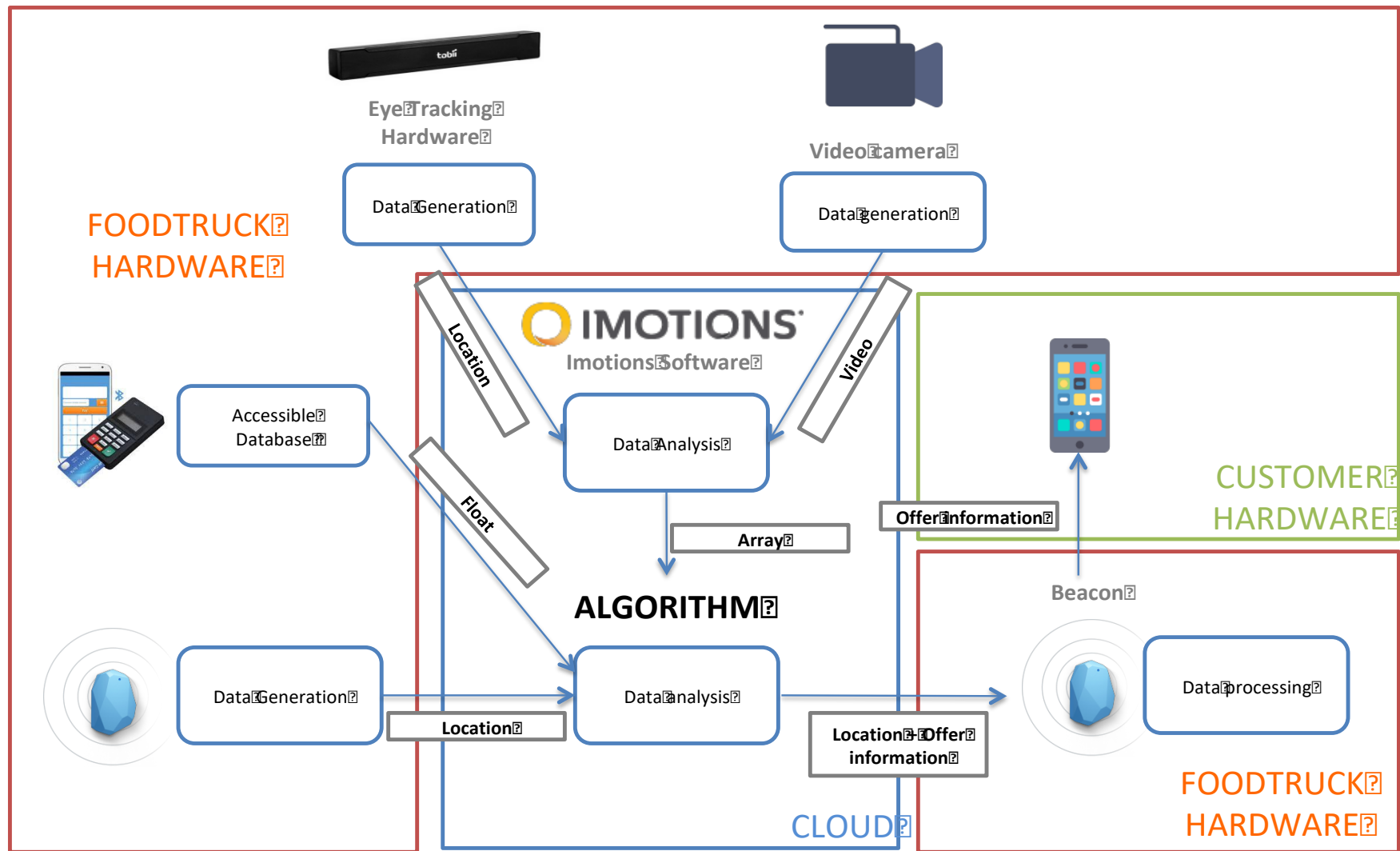Data processing

FOODTRUCK
HARDWARE

CLOUD

Figure 15. Data Framework

4.6. ALGORITHM

Through this section is going to be designed theoretically the algorithm based on knowledge gained in the section before.

INPUT AND OUTPUTS

As an input we should consider the following items:

- **Location information** is used for assigning the face information to a smart device. As a result, the app will send the offer to the correct person.

- **MPOS information** such as raw material cost, the target profit and the benefits obtained at some point will be available for being accessible at any time.

- **Affective computing information** will give the following input to the algorithm:

    o Facial Analysis: Negative/Neutral/ Positive

    o Attention Analysis: Visual Contact/ Not Visual Contact

- **Historical Data** will give the information of previous sales made by the potential customers

By the use of the information described before, the app will determine the following outputs:

- The algorithm will design an **offer** depending on the inputs. The app will use the following commercial tools.

    o **Upselling** is a sales technique that induces the customer to purchase more expensive items, upgrades or other add-ons in an attempt to make a more profitable sale.

- o **Cross selling** is the action or practice of selling an additional product or service to an existing customer.

- o **Discounts** are a deduction from the usual cost of something.

- Also the algorithm will send the location information to the beacon for sending the offer to the correct smart device.

Finally, Figure 16 shows a brief summary of this section.
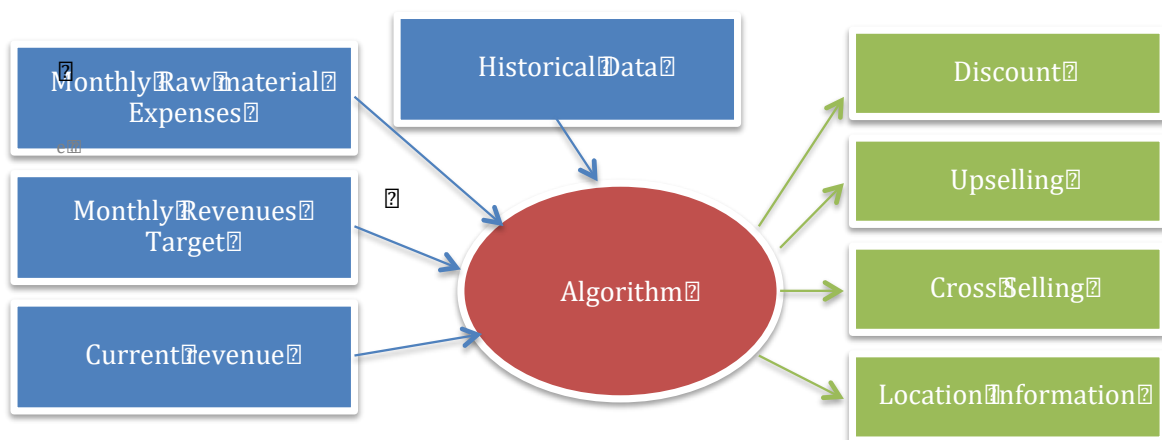
Figure 16. Algorithm Input/Output

KNOWLEDGE TRANSFER

In this section, is explained how is going to be the response of the algorithm depending on the inputs. Table 8 shows the response of the algorithm and the situations in which the algorithm can be useful. This choice is made in function of the affective computing information input. Nevertheless, affective computing will not be the unique information used, the app will also take into account the time spent in a queue.

Table 8. Alorithm Response

Facial Analysis	Attention Analysis	Algorithm Response	Helpful Situation
Positive	Visual Contact	Send the potential customer a cross selling or upselling for taking profit of his interest in order to make a more profitable sale. The algorithm would check that the offer is over 50% the raw material cost.	• When a potential customer is going to buy and he decides to take the offer and make the sale more profitable • When a potential customer is undecided leaves the location of the food truck, but later he decides to take the offer
	Not Visual Contact	In this case, the algorithm will check the historical data. If the potential customer appears as a former customer the app will make a discount offer. Otherwise, the app will not act. The algorithm would check that the offer is over 50% the raw material cost.	• When a former customer is just crossing in front of the food truck and as a reminder the app will send him an offer • An offer has to be made in the correct moment. Otherwise it can loose its commercial effect and it could reduce the satisfaction of the app user
Neutral	Visual Contact	In this case, the algorithm will check the historical data. If the potential customer appears as a former customer the app will make a cross selling or upselling offer. Otherwise the application will make a discount offer.	• When a former customer seems to be interested in the food truck product and sending the offer will help to decide positively
	Not Visual Contact	In this case, the algorithm will check the historical data. If the customer appears as a customer the app will make a discount offer. Otherwise, the app will not act. The algorithm would check that the offer is over 50% the raw material cost.	• When a former customer is just crossing in front of the food truck and as a reminder the app will send him an offer • An offer has to be made in the correct moment. Otherwise it can loose its commercial effect and it could reduce the satisfaction of the app user

|			
Negative	Visual Contact	In this case, the algorithm will check the historical data. If the potential customer appears as a former customer we will make a discount offer. Otherwise, the app will not act. The algorithm would check that the offer is over 50% the raw material cost.	• When a former customer is just crossing in front of the food truck and as a reminder the app will send him an offer • An offer has to be made in the correct moment. Otherwise it can loose its commercial effect and it could reduce the satisfaction of the app user
	Not Visual Contact	Not to act	• An offer has to be made in the correct moment. Otherwise it can loose its commercial effect and it could reduce the satisfaction of the app user
Queue Information		**Algorithm Response**	**Helpful Situation**
If our location system detect that there is a waiting line		In this case, the algorithm will provide a discount if the waiting time is over 10 minutes	• When a customer is waiting for a long time he can give up the line, for this reason, the app will increase the number of customers and it also will increase the customer satisfaction

WORKFLOW
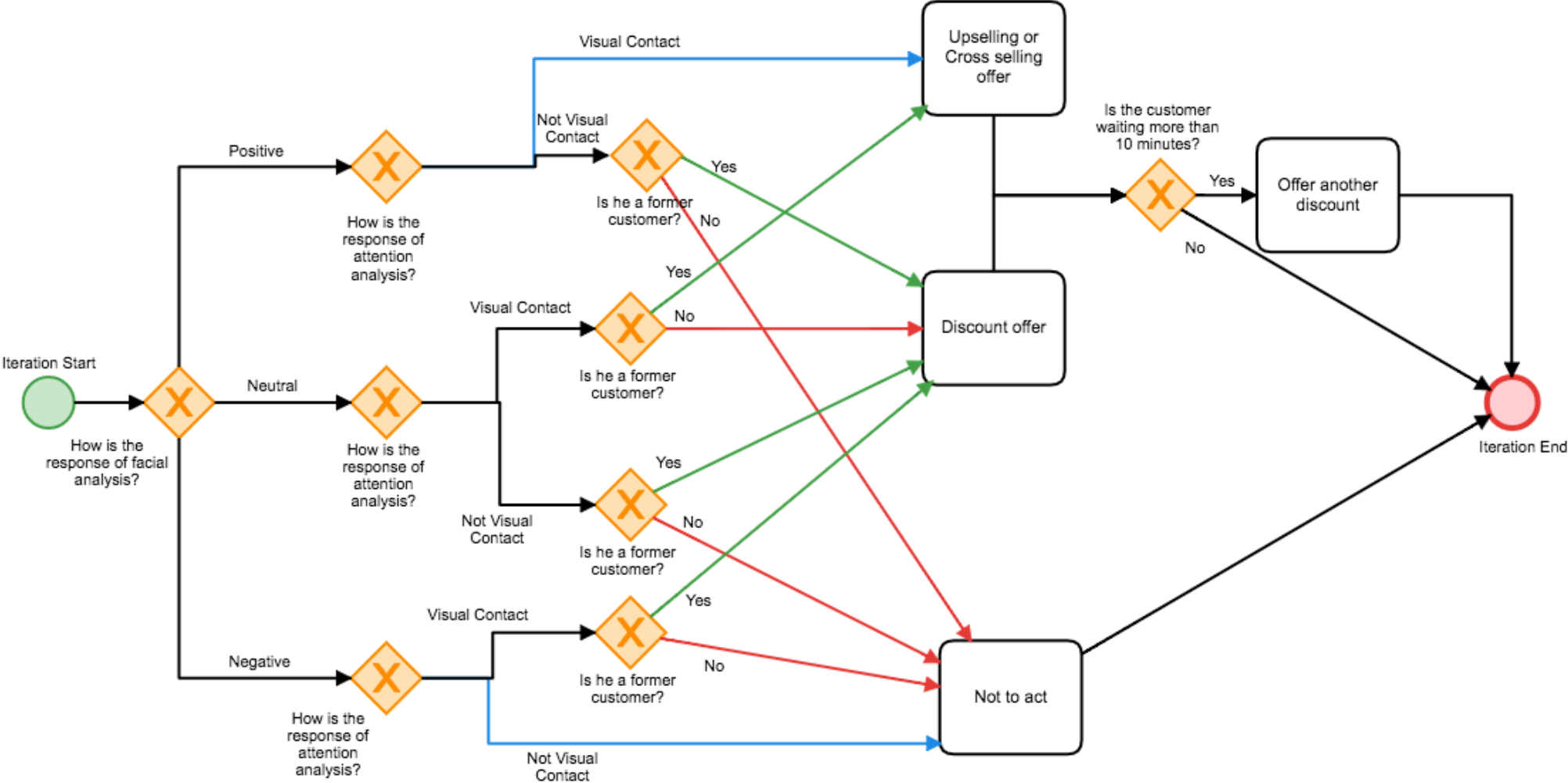
Figure 17. Algorithm Workflow

4.7. PROJECT BUDGET

This section is intended to detail the final cost of the project. We can clearly differentiate three main costs:

- Infrastructure: Amortization of the workplace, computer and software use, office equipment use (pen, paper, notebooks, among others).

- Power consumption: Lighting, air conditioning and electrical consumption of the computer.

- Human cost: Salary

Due to the low cost of some items compared to others, the costs of infrastructure and also the costs of energy consumption are not taken into account. Then, the salary cost will be broken down by different activities, assuming that an average of 4 hours has been worked every day and the engineer cost is 1000 ntd per hour. The final cost is summarized in Table 9.

	Section	Duration (days)	Cost (Ntd)
	NIGHT MARKET IN TAIWAN	10	40.000
	VALUE PROPSITION	14	56.000
	TECHNOLOGY SELECTION	20	80.000
HUMAN COST	TECHNOLOGY FRAMEWORK	14	56.000
	CONSUMER BEHAVIOUR	14	56.000
	ALGORITHM	18	72.000
	COST TOTAL		**360.000**

Table 9. Project Cost

4.8. FUTURE STEPS

To implement this project it is necessary to follow the next steps shown in Table 10 and in Figure 18. As it is displayed, it has been defined a project to carry out the app based on 6 important parts:

- Specifications: The project part in which will be described the plans, hardware, software, dimensions and all other functional and non functional requirements proposed for the installation of the app.

- Design: The project point in which will be created a plan or convention for the construction of the app and the system behind it.

- Building and integration: The project part in which is created the value based on the design. Normally, the code is made in several parts and then is needed and integration or assembly of the different parts.

- Validation: Once the programme is built, it's necessary to check all the specifications.

- Deployment: The part of the project in which will be transformed the computer system from a packaged form to an operational state.

- Maintenance: The project part in which the application will be preserved. The team will take into account the corrective maintenance for correcting the errors made and also the evolutionary maintenance for improving the app as much as possible.

Table 10. Project Management Timetable

| Task	Start	End	Duration (Days)
1. Specifications	1/1/19	16/2/19	46
1.1. Analysis of the customer requirements	1/1/19	7/1/19	6
1.2. Scope and objectives definition	7/1/19	11/1/19	4
1.3. Project programming definition	11/1/19	15/1/19	4
1.4. Functional and non functional requirements definition	15/1/19	16/2/19	32
2. Design	16/2/19	9/4/19	52
2.1. System architecture definition	16/2/19	5/3/19	17
2.1.1. Infrastructure	16/2/19	20/2/19	4
2.1.2. Technological environment	20/2/19	24/2/19	4
2.1.3. Development tools definition	24/2/19	28/2/19	4
2.1.4. Security requirements definition	28/2/19	5/3/19	5
2.2. Functional and non functional requirements evaluation	5/3/19	20/3/19	15
2.2.1. Features and use-case definition	5/3/19	13/3/19	8
2.2.2. User interface definition	13/3/19	20/3/19	7
2.3. Class design	20/3/19	28/3/19	8
2.4. Data structure design	28/3/19	2/4/19	5
2.5. Structure requirements generation	2/4/19	9/4/19	7
3. Building and integration	9/4/19	7/8/19	120
3.1. App coding	9/4/19	19/5/19	40
3.2. Database creation	19/5/19	8/6/19	20
3.3. Graphic interface development	8/6/19	28/6/19	20
3.4. App coupling	28/6/19	18/7/19	20
3.5. Interface with external software preparation and configuration	18/7/19	7/8/19	20
4. Validation	7/8/19	27/8/19	20
4.1. Functional requirements check	7/8/19	17/8/19	10
4.2. Non Functional requirements check	17/8/19	27/8/19	10
5. Deployment	27/8/19	11/10/19	45
5.1. Hardware setup and validation	27/8/19	11/9/19	15
5.2. Operating data loading	11/9/19	21/9/19	10
5.3. User training	21/9/19	1/10/19	10
5.4. Customer support coordination	1/10/19	11/10/19	10
6. Maintenance	11/10/19	Lifespan	Lifespan
6.1. Corrective maintenance	11/10/19	Lifespan	Lifespan
6.2. Evolutionary Maintenance	11/10/19	Lifespan	Lifespan
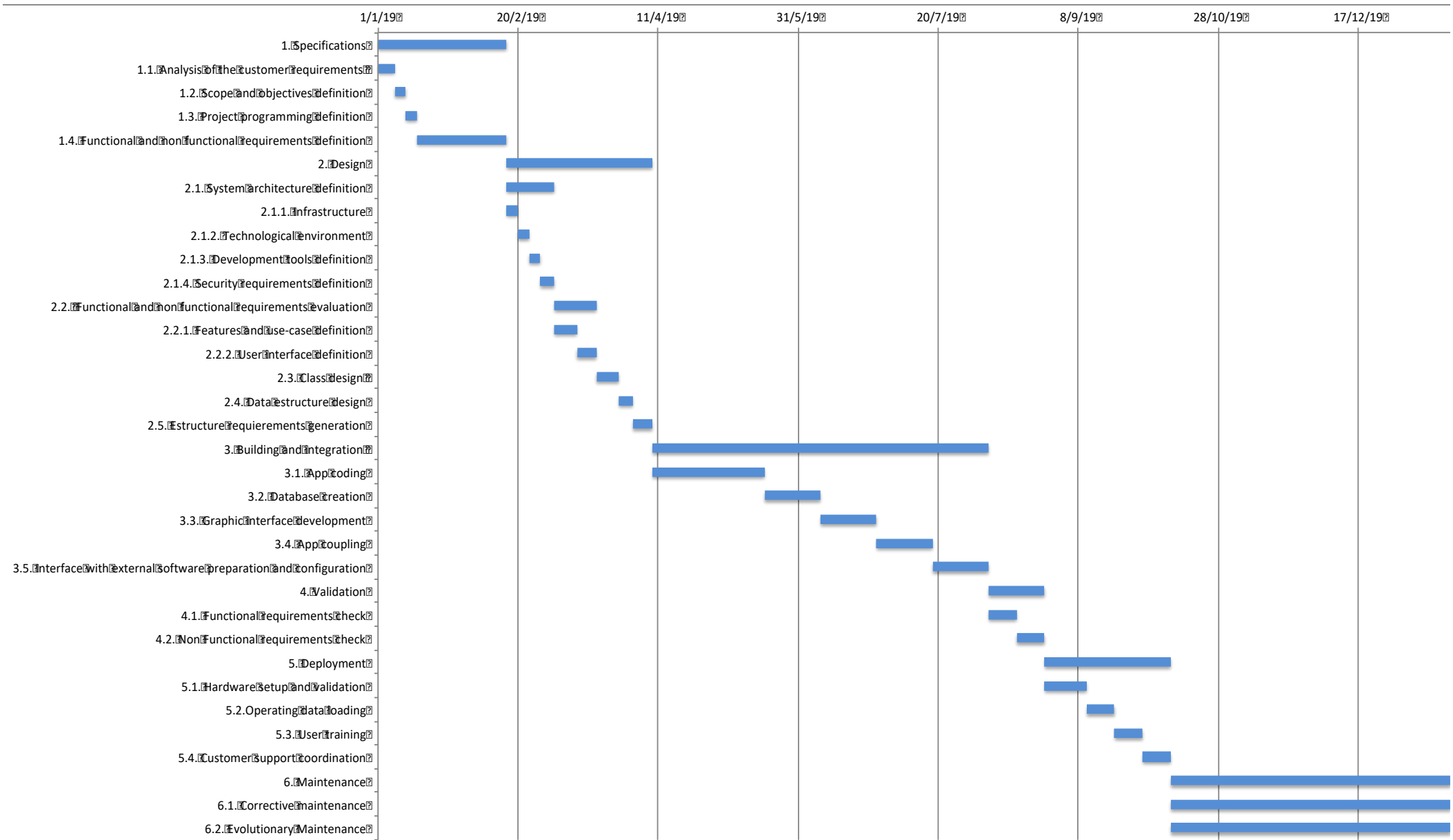
Figure 18. Project Gantt chart

CHAPTER 5. CONCLUSION

5.1. CONCLUSION

Once the project is completed, the conclusions drawn will be listed in the following lines.

First of all, the objective of designing a smart mobile device application capable of helping the seller obtain more benefits and at the same time giving to the customers the opportunity of saving money has been achieved rigorously. Designing this app has led to make a market research as it is done in chapter 3, to survey the technology available for finally selecting the technology, to suggest a possible technological framework and also to design how the algorithm has to work for achieving the objectives.

Secondly, as shown in the market research section, the future of the night markets is assured. The tourism growth together with the attraction of tourist for night markets should encourage this project to keep going in order to take profit of the market gap is occupying.

Thirdly and lastly, it is made a really important part of the project, but as it is described in the future steps section, there is a long way to achieve the final objective of this project.

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