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**Interim Report**

For

**Appezite: Blockchain based online ordering, Order Ahead application and Webstore generation**

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# Chapter 1: Intoduction

# Chapter Overview

The intention of the introduction chapter is to give an outline of ‘Appezite – Decentralized Order Ahead application generator’. This chapter focus on the problem that is addressed by Appezite, which will provide an in-depth knowledge of the projects background. Moreover, existing systems will be discussed in short followed by aim and the objective of the project and the high-level architecture of the application will be shown. Finally, the chapter covers the outline of the thesis.

# Project Background

## Introduction

The restaurant industry is one of the rapidly growing industries across the globe, with many new food chains opening up and increasing the competition within the industry. As the target customer base of the restaurants changes rapidly, they have to come up with solutions to attract their customers. The main solution for this problem has been to have their own website or an order-ahead app which will allow to increase the restaurant sales as people prefer to order using the website or order ahead applications. The technological area of innovation has become a must. The Internet has become a very important channel for business transactions and activities.(Ivkov *et al.*, 2016)

Online ordering systems can be either an Online aggregate site or an Order ahead application/ website. According to (Razak *et al.*, 2017) Food is one of the most popular products that sell online including fast food, bakery and vitamins. Aggregate online ordering which is a subcomponent of online ordering provides businesses a simple way to have a delivery mechanism. With the introduction of aggregate ordering businesses and customers have been moving to the available platforms. When the business register on a site, they are then added to the list of other restaurants that will be then given as a choice for the customers to order from.

A screenshot of a cell phone

Description automatically generated

Figure 1:Toasttabs survey on most popular aggregate sites

As shown in Figure 1, within the past year, guests ordered most on Grubhub (25%), UberEats (26%), and Doordash (21%), also those three aggregate sites have been the most popular aggregate sites among the restaurateurs according to ToastTab.(Toast Inc., 2018)

According to a ToastTabs survey done to collect the customer requirements for a restaurant, Guests listed online-reservations, and consumer ordering programs as restaurant technologies which are most important to improve their guest experience.(Toast Inc., 2018).

Order ahead applications and business websites allow users to order ahead of time, which allows the users to dine as they arrive, or get the order delivered to the house while allowing pay on arrival and pay on checkout. This allows businesses to increase their customer attraction.

Online ordering has been one of the most critical technological advancement that have been introduced to the restaurant industry. This was introduced due to the introduction of O2O model in the food and beverage industry.(Xie, 2017)

# 1.3 Problem

Online ordering has been one of the most important factors when it comes to the restaurant and fast-food industry. With the emergence of the aggregate online ordering sites and application the restaurateurs have been forced to use one of them to get more income to their business. When customers have to wait a long time to place an order or reserve a table it can turn customers away, and some may argue that they are been ignored purposely which would leave a bad remark on the restaurant.(Rarh *et al.*, 2018).Restaurants can overcome this problem with the use of online ordering, as it provides convenience to customers and overcomes the disadvantages of traditional queuing systems. (Magnani, Tilwani and Suvarna, 2017)

According to a survey conducted by (Toast Inc., 2018) Guests have listed than online reservations and consumer ordering as restaurant technologies that are most important for their guest experience. Alternatively, restaurant professionals have listed online ordering and gift card programs as some of the most important technologies for their business.

51% of the online ordering have been done using the restaurants own website, while 38% of the orders have been placed using online aggregators like Doordash, Grubhub and Uber Eats, and 29% have been placed using an app for Restaurant or a food ordering service.(Toast Inc., 2018)

As the amount of ordering using the restaurant websites have a 51% of customer usage the unavailability of a website will make the customers tend to find a different place to order from, so that they are able to enjoy their meals without waits.

## 1.3.1 General Problem

With the current available aggregate platforms, the restaurateurs have to pay a fee between 10% to 40% as a service fee per order, which reduces the income. The other mobile applications and websites generation platforms like Applova.inc charge a constant fee of $150(minimum) per month as a service charge disregarding the fact whether the restaurateurs have been able to get an increased sales revenue. With the service charges most of the current platforms puts the restaurateurs at a disadvantage, but the need of such an app makes the restaurateurs to stick with one of the existing platforms.

# 1.4 Justification

According to (HONG, 2016),the technological advancements in the industry have changed causing business models to grow and provide efficient systems that can help improve the productivity and profitability of restaurants using online food ordering. Online ordering has 3 perspectives, Websites, Order Ahead Applications, Aggregate sites. According to (HONG, 2016)Hong, the mobile ordering aspect is been covered. This research helps to prove that the online ordering aspect of a restaurant is one of the most important features. Moreover, according to (Pantelidis, 2009) investments in the food-ordering systems have been considered to be luxury as small and medium scale businesses find it difficult to afford such systems which can operate successfully. With the advancements in the technology many 4 creative solutions have been made to help this. The technological advancements have bought Websites, Order Ahead Applications, Aggregate site, Kiosks Terminals and many more advancements to the food industry. This proves that with the advancements the restaurants have to change accordingly to keep their customer base attracted.

Already existing system such as UberEATS, Grub hub charges restaurants with higher service charges per order whereas platform like Applova charge restaurants with a flat rate as service charges disregarding the fact whether the restaurants were able to get a reasonable amount of orders. With the charges been charged by the existing systems these put the restaurants at a disadvantage as the maintainability costs are higher, so the restaurants tend to withdraw their order ahead applications.

As already existing systems tackling the problem of order ahead application use a traditional database as their storage medium the customers of their platform (restaurants) face difficulties as they have to pay a higher starting fee and additional fees to maintain the application.

# 1.5 Aim

The aim of this project is to design, develop, and evaluate a platform using blockchain to allow restaurateurs to have their own order ahead application (website, mobile application) with reduced or eliminate service fees per order and reduce monthly service fees

# 1.6 Objectives

* To analyze how blockchain can be used to provide an effective solution to reduce or eliminate service charges
* To identify the importance of order ahead applications to a restaurant.
* To implement a blockchain based solution to handle the problem.
* To evaluate the fulfillment of the research objectives.

# 1.7 Motivation

Compared to other domains, order ahead application have a higher impact in the success of the business in the restaurant industry. Due to the increased competition in the industry, and the unavailability of platforms to address the problem solving this problem would be beneficial for the restaurant industry.

***“To contribute for the success for small scale restaurants increasing their incomes, and to increase the use of blockchain. This is an attempt that is been made to achieve the target”***

# Chapter 2: Literature Review

# 2.1 Chapter Overview

This chapter reviews the background of online ordering focusing greatly on the food ordering and the current problems that are faced by the restaurants and their consumers. Furthermore, a possible solution, and a summarization will be discussed further with the aid of the existing systems for online ordering.

Furthermore, this chapter reviews research on scripting languages and discussions are focused on which of the scripting languages are more suitable for the build automation process. Finally, the chapter reviews the suitability of blockchain for online ordering systems.

# 2.2 Online ordering

With the rapid advancements of the technology in, people are increasingly adapting and making use of the internet for leisure activities, communication, and shopping which are few of the major activities that people use internet for. In present days the computer is the center source for almost all of the activities, as most of the currently available work is computerized for the ease of people. As people adapt to the new technologies’ businesses are forced to adapt to these technologies for the business to attract new customers and retain the existing customer base. Once Online to Offline (O2O) was introduced to the food and beverages industry restaurants industry had to adapt it, therefore online ordering was introduced to the restaurant industry.

The restaurant industry is one of the most competitive industries as the popularity of restaurants increase and new competitors increasingly come in to the industry. Some restaurants may not be able to keep up with the ever-increasing competition causing them to leave the industry or stay in the industry incurring losses. As pointed out by (HONG, 2016), the technological advancements in the industry have changed causing business models to grow and provide efficient systems that can help improve the productivity and profitability of restaurants using online food ordering. Online ordering has 3 perspectives, Websites, Order Ahead Applications, Aggregate sites. Investments made on food ordering is considered to be a luxury as small scale and medium scale businesses find it hard to invest on such solutions and operate successfully (Pantelidis, 2009).With improvements in the technology create solutions as Websites, Order Ahead Applications, Aggregate site, Kiosks Terminals and many other solutions have been introduced, with the main aim of providing an online ordering, or food ordering systems for businesses.

As pointed out by (HONG, 2016) in areas which are equipped with a larger population, especially students, they tend to visit restaurants to have their meals but the busy schedules of people the traditional online ordering systems which is equipped in many of the restaurants put them at a tough spot as they have to wait in line for the order to be taken and another few more minutes or possibly hours till the order is prepared. With the people having busy schedules people are forced to find restaurants that allow them to order ahead of time as it will help them pick up the order as they arrive and continue with their other activities.

# 2.3 Online Ordering Systems

Online ordering can be defined as a “System that allows the customers to simply and conveniently order food online”. Online ordering systems can for restaurants can be an Online aggregate, Order Ahead Applications and Websites. Order Ahead Applications and Websites are businesses specific which means those applications only have a menu of one restaurant allowing customers to order ahead of time using that, while aggregate sites can be defined as a common place where businesses register allowing customers who uses the applications a wide range of restaurant choices to choose from. According to (Razak *et al.*, 2017) Food is one of the most popular products that sell online including fast food, bakery and vitamins.

# 2.4 Online Ordering Consumers

With the popularity of restaurants increasing, more restaurants have been starting to open up providing people a greater choice of food. With the increasing of restaurants, it has become a trend for the people to dine at a restaurant or get food delivered to their house rather than cooking at home. According to a survey done by (Toast Inc., 2018) the widely used online ordering method according to customers in the past year has been the restaurant websites with a percentage of 51%, leaving 38% online aggregate sites and 29% have been placed using an app for Restaurant or a food ordering service. However, it is difficult to provide conclusions with the above statistics, but as the tendency of people to order using websites mean that when a restaurant is lacking a website it will put the restaurant at a disadvantage since people prefer to order online.

According to a survey conducted by ToastTabs (Toast Inc., 2018) the most amount of orders by customers have been placed using the restaurants website.



Figure 3: Most popular online ordering systems

According to Figure 1, most of the orders are been placed using restaurant websites a restaurant without one may face difficulties in getting order as the newest trend in the 2019 is to get food delivered to the doorstep.

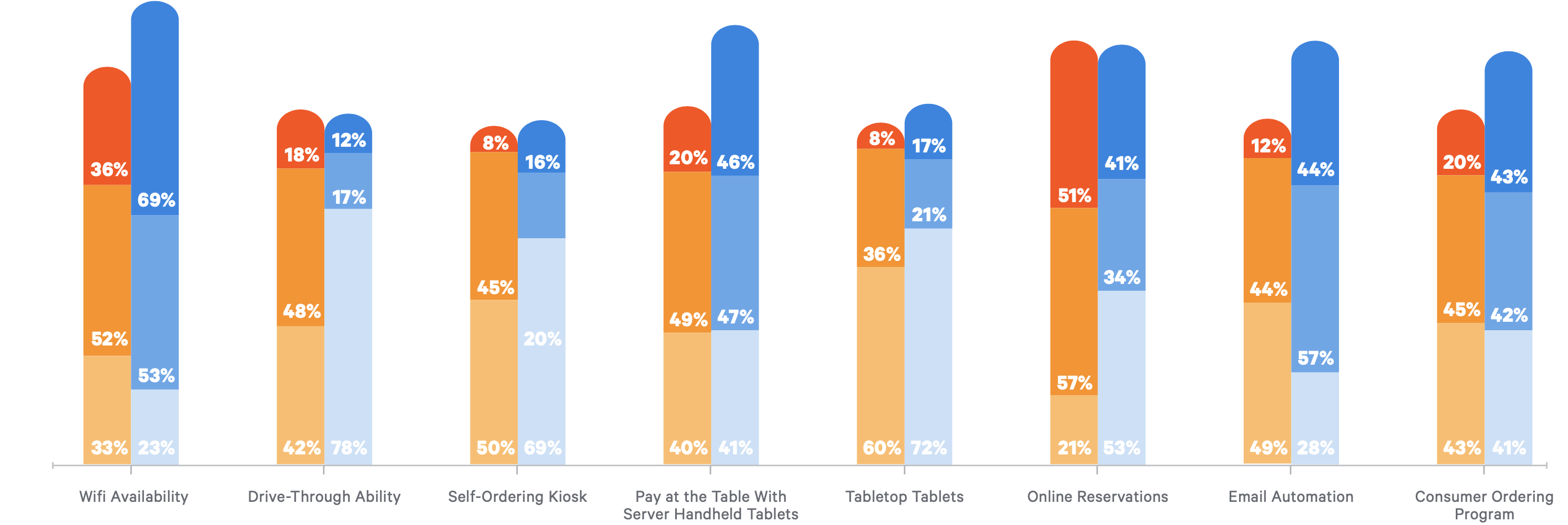


Figure 4: Most important technologies for guests

According to Figure 2 most of the customers expect online ordering, email receipt and confirmation automation and online reservation as key factors to improve their guest experience with the restaurant. According to (CardinalCommerce, no date) 75% of teens (GenZ) prefer online shopping over visiting the shop, and 54% of millennials have stated that ordering via a mobile application is easier than a website. They have also stated that the best way to reach GenZ consumers are to provide online ordering as the majority of the GenZ are comfortable with technology as technology is what they grew up with.

With the increasing trends in online ordering the proposed solution is a blockchain based application which has built in templates that allow the users to sign up via a merchant web portal and add products to a business to be sold. The application will then provide the business with a test APK to test the features.

# 2.5 Existing System Analysis

In this section the existing solutions and other similar solutions will analyzed providing the features, advantages and the pricing of each system. Furthermore, the remarkable systems will be discussed in detail, discussing on how they achieve the problem and the problems of the solution.

## 2.5.1 Order Ahead app and Online Menu App Builder

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Operating Platform | Cost | Application Type | Service |
| Apptizer | Android,  iOS  Webpage | $500 – setup  $119/mo | Webstore | Standalone Order ahead |
| App institute | Android,  iOS | $65/mo | Webstore | Basic Order Ahead Application |
| Shoutem | Android,  iOS | $58/mo | Webstore,  Android App,  iPhone App. | Menu Application |
| Appy Pie | Android,  iOS | $72/mo |  | Aggregate Ordering builder |
| Toast | Webpage | - | Webstore | Point of sale + Online Ordering |

Table 4: Similar App Comparison

## 2.5.2 Features Provided by existing systems

|  |  |
| --- | --- |
| Name - Package | Features |
| Apptizer - $119 | Responsive Mobile Web  Pay with Credit Card  Unlimited Orders  Marketing Digi Pack  Menu setup  Delivery and shipping matrix  Android app to manage orders  Multilocation support |
| App Institute | Progressive Web App  iPhone App  Android App  Push Notifications  App Analytics |
| Shoutem | iPhone App  Android App  Html 5 App  Push Notification |
| Appy Pie | Android App  Html 5 App |

Table 5: Features provided by existing systems

## 2.5.3 Detailed Review on Remarkable Systems

### 2.5.3.1 Apptizer

Apptizer is one of the leading solutions for providing the businesses with an Online ordering system which is either an Order Ahead Application or Webstore. This is a really great approach as this platform allows the businesses to register in the Apptizer Website and once registered they can add their categories and products and generate the website and a send a request for the development team to provide an android or iOS application.

Unfortunately, during the first few months of using a Website or Order Ahead Application a business may not see success using the application but with their current pricing plans the users have to pay for Apptizer even if the business does not get sales using their platform. As Apptizer use a database for their data storing the costs they incur for databases are reflected in the fees and other charges that are been charged.

Aa stated in Apptizer’s official website they currently charge restaurants a $500 setup fee and a $139 monthly fee for the restaurant to keep on accessing their service (Applova, no date), for small scale businesses $500 setup fee is a little bit too much as they might not have that much of an income to invest in such a solution, so for a restaurant that wants to have a way to reach their customers and attract more customer while allowing them to order online a solution like Apptizer put the businesses at a disadvantage. And for a monthly cost of $139 they only provide a simple webstore for the businesses, which only has the products of the business and a feature to order online, this does not provide people an insight on where the actual store is or any detail of the business.

### 2.5.3.2 App Institute

App institute is one of the leading app-building platforms, they provide a drag and drop builder platform that allows businesses to pick a template and edit the content accordingly and brand the application to be published. App Institute currently charges users $95 monthly fee and provide a webstore, android application and an iOS application.

### 2.5.3.3 Uber Eats

Uber Eats is one of the most famous aggregate online ordering services that is popular in most of the countries among restaurants and guests. Uber Eats allow the restaurants to register the business within their site and once registered the business is then added to a market place which is offered to the customers to choose from. Uber eats have had a 51% popularity among restaurants and a 26% popularity among guests according to a survey that was carried out by (Toast Inc., 2018)

According to (UberEATS, 2019) they charge a delivery fee of a certain amount depending on the distance from the ordering place to the restaurant, a service fee of 15%, and an additional charge if the order is below 10$, and an additional service fee can be charged according to the restaurant taxes.

## 2.5.4 Aggregate Site Popularity

Figure 5: Aggregate Site Popularity

## 2.5.5 Drawbacks of existing platforms

A lot of order ahead application generation platforms have flourished over the year, but these platforms are plagued with high costs as commissions rating from 20% - 30% are been charged, or high monthly fees are charged disregarding the fact whether the business gained sales through the app.

As all the existing systems use a centralized structure to store the data the expenses are higher, and the rate of being hacked is higher which might lead to tampering of data of loss of data. Using blockchain it will be possible to overcome the above limitations.

# 2.6 Blockchain

Blockchain serves as an immutable distributed ledger which allows transactions to take place in a decentralized manner.(Zheng *et al.*, 2017). The ledger is spread across the peers in the network, while all peers hold a copy of the complete copy of the ledger.

As compared to traditional distributed databases, blockchain provides significant advantages over the traditional database systems. The advantages can be reduced cost and time, security. In the distributed system each node within the network holds a ledger and relies on some intermediary to perform transactions.

## 2.6.1 Why Blockchain?

The security of blockchain is higher and it provides tamper resistance as the block are required to be verified using consensus algorithms. The costs of using blockchain as a storage medium is relatively cheaper compared to the traditional databases. eBay which is a similar marketplace which allows users to sell their items was compared (Ranganthan *et al.*, 2018) statistics were compared to analyze the cost effectiveness of blockchain over databases, the tests were carried out in the Rinkeby test network, and this proved even with the gas fees to buy and sell a product is cheaper compared to existing systems like eBay. The cost of the blockchain depends on the consensus algorithms as each algorithm has a unique way of verifying the transactions, which allows blockchains to have a higher data integrity level.

## 2.6.2 Types of blockchain

|  |  |
| --- | --- |
| Private | Public |
| Restricted a permissioned, joinable only by invitations. | Open to public. |
| Only allowed nodes can create new transactions. | Each node can create transactions. |
| Shorter transaction approval time/frequency. | Longer transaction approval time/frequency. |
| Higher speed on transaction completion. | Transactions take time to complete. |
| Relatively cheap transaction process cost. | Higher transaction process cost. |
| PoW, PoS consensus for verifying and adding blocks. | Pre-approved members accept blocks, PBFT (used by Hyperledger Fabric). |
| Higher energy consumption. | Lower energy consumption. |

Table 6: Private vs Public Blockchain

## 2.6.3 Ethereum

Launched in 2015 Ethereum is the worlds leading programming blockchain (*What is Ethereum?*, 2020). Similar to all other blockchains Ethereum equips their own cryptocurrency which is known as Ether (ETH). According to (Chinchilla, 2019) the state in Ethereum is made up of objects known as “accounts”, each of these accounts have a 20-byte address, and each account contains four fields

1. The **Nonce,** a counter used to make sure each transaction can be processed only once.
2. The accounts current **Ether balance.**
3. The accounts **Contract code,** if present.
4. The accounts **Storage.**

The contracts in Ethereum can be written in Solidity, Serpent, LLL. Solidity is a high-level object oriented language for implementing smart contracts (*Solidity*, no date), and this is the most commonly used language to write contracts in Ethereum.Ethereum uses the term “Transaction” to the signed data package that stores a message to be sent to an external account, the transactions contain fields such as:

1. The recipient of the message
2. The signature identifying the sender.
3. The amount of ether to transfer from sender to recipient.
4. Optional data field.
5. A **STARTGAS** value, representing the maximum number of computational steps the transaction execution is allowed to take
6. A **GASPRICE** value, representing the fee the sender pays per computational step.

The transactions done within the Ethereum network is validated using a simplified version of the GHOST (Greedy Heaviest Observed Subtree). GHOST was introduced in 2013 by Yonatan Sompilinsky and Aviv Zohar the motivation behind GHOST is that blockchains with faster confirmations times, suffer from reduced security (Sompolinsky and Zohar, no date). As transactions are published to the blockchain imposes the network the cost of needing to verify it, as a result a fee is introduced which is calculated according to the computational steps that is required to process the transaction.

## 2.6.4 Hyperledger Fabric

Hyperledger was started in early 2016 by the Linux Foundation.Hyperledger Fabric is a collaborative effort to create an enterprise grade, open source distributed ledger(Cachin, 2016). Hyperledger is a permissioned blockchain with immediate finality, the transactions will be verified using the PBFT consensus mechanism. Hyperledger will be used in the project as Hyperledger fabric provides faster transaction speeds. HF also provides scalability as only a fewer number of nodes are responsible for the management of data, so the network is able to process and support more transactions. In Hyperledger the smart contracts are compiled and are run directly on native machines within the docker environment, as a result Hyperledger is efficient in terms of speed and memory usage.(Dinh *et al.*, 2017). Fabric runs distributed applications that are written in general purpose programming languages without depending on any native cryptocurrency (Audience, no date a) as a result developers are allowed to write smart contracts in multiple languages as (Java, Go, JavaScript, TypeScript) whereas most of the other existing blockchains provide their own language to write smart contracts. Smart contracts in Hyperledger Fabric is split to two:

1. **System Chaincode** which handles the system-related transactions such as lifecycle management and policy configuration.(Audience, no date b)
2. **Application Chaincode** which manages the states in the ledger, including the digital assets.(Audience, no date b)

Within the smart contracts Hyperledger API exposes only simple key value Operations as putState(), getState(), deleteState(), getHistoryForKey(), which allows users to do the basic operations as Hyperledger manages the states in key value pairs. Once a transaction is submitted Hyperledger confirms and adds the blocks to the chain at the exact moment

In Hyperledger the content is organized in a two layered data structure whereas the states are stored in a disk-based key value storage, Hyperledger utilizes CouchDb to store the key values pairs. The states that are affected by changes are stored in the root has in Hyperledger. The hash tree for the transactions is a classic Merkle tree, as the list is not large, Hyperledger utilizes the Bucket Merkel Tree, which groups the states into a Bucket from which the Merkle Tree was built using hash functions.

## 2.6.5 Stellar

The stellar network is a worldwide collection of Stellar Cores, each maintained by different people and organizations (Stellar, no date). The distributed nature of stellar make is reliable and safe for transactions to take place as there is no central organization. Stellar equips SCP (Stellar Consensus Protocol) which considered a global consensus protocol. The ledger maintained in stellar contains the list of account and balances at any given point in time. At every SCP the network reaches a consensus on which transaction set should be applied to the close ledger, and on each SCP the final transaction gets updated.

# 2.7 Consensus mechanisms.

## 2.7.1 What is consensus.

Consensus is a fault tolerant mechanism which is used in blockchains to provide security which is achieved by a general agreement between the consumers, this provides a validation that only the valid and verified transactions are recorded. Consensus mechanisms empower the user in the blockchain to keep working even if some users come up short. Many consensus algorithms have been discussed in the literature pointing out the advantages and the disadvantages of each algorithm.

## 2.7.2 The Consensus Problem

The consensus is a problem in distributed computing where nodes within the system must reach an agreement given the presence of faulty processes or deceptive nodes(L.M.Bach, B.Mihaljevic and M.Zagar, 2018)

## 2.7.2 Consensus Approaches

### 2.7.2.1 PoW (Proof of Work)

PoW is a consensus mechanism that was used in the bitcoin network.(Satoshi Nakamoto, 2008).In PoW the crypto currency is dependent on energy consumption which introduces significant costs for the operations done in the network. Within a decentralized system someone has to be appointed to record the transaction within the network, the easiest way to achieve this is to do a random selection. However random selection is vulnerable to attacks. Here each node calculates the hash value of the block header, where the block header contains a nonce which is frequently updated by the miners. The miners are the nodes that computes the hashes, and the PoW procedure is called mining bitcoin.

### 2.7.2.2 PoS (Proof of Stake)

PoS is an energy saving alternative which is available to the PoS. Miners in PoS have to prove the ownership of the amount of currency. In comparison to PoW, PoS cost for mining is nearly as zero which makes it vulnerable for attacks as a consequence of it. According to (Zheng *et al.*, 2017)Many blockchains starts with PoW and gradually move to PoS. In PoS the older or the richest. PPcoin uses a coin age based selection (King and Nadal, 2012) where the older and the larger have a higher probability of mining the next block.

### 2.7.2.3 PBFT (Practical Byzantine Fault Tolerance).

Hyperledger fabric utilizes PBFT as its consensus algorithm (Cachin, 2016) as this could handle up to 1/3 malicious byzantine replicas.The process of PBFT is divided into three phases pre-phase, prepare and commit (Castro and Liskov, 2002). A block is determined in round which in each round a primary will be selected according to a set of rules. For PBFT to work every node is required to be known by the network. PBFT is a replication algorithm which was introduced to tolerate byzantine faults.(Hao *et al.*, 2018). The energy consumption of PBFT is relatively low compared to PoS.

### 2.7.2.4 DPoS (Delegate Proof of Stake)

DPoS is a more efficient PoS mechanism which uses a real time voting and a reputation system to achieve consensus (Dantheman, 2017).Here the stakeholders elect their delegates to generate blocks and validate them. Since the validation is done using a fewer nodes, the confirmation of the blocks is relatively fast, therefore improving the time taken to confirm the transactions.

### 2.7.2.5 PoI (Proof of Importance)

Proof of Importance is an consensus algorithm that is used within the NEM network (Lai, 2018), which uses XEM as an underlying cryptocurrency. Each account within the NEM network has a XEM balance which is split into two parts, vested and unvested. For an account to be eligible to Importance Calculation a XEM value of 10000 is required in the vested XEM balance.

### 2.7.2.6 SCP (Stellar Consensus Protocol)

The Stellar Consensus Protocol is a construction for FBA (Federal Byzantine Agreement) that achieves optimal safety against ill-behaved participants (MAZIERES, 2016). The nodes within the SCP does not need to trust the entirety of the network but have the ability to choose which nodes they trust. SCP starts with a nomination protocol where the nodes proposed new candidates values for the agreement, each node will receive these values and once completed it will move on to the Ballot Protocol, during this phase the nodes vote wether to commit or abort the values that were selected within the previous phase, if the nodes cannot reach consensus the values are moved to a higher ballot to be voted again(Sankar, Sindhu and Sethumadhavan, 2017)(L.M.Bach, B.Mihaljevic and M.Zagar, 2018)

## 2.7.2.7 RPCA (Ripple Protocol Consensus Algorithm)

RCPA is the consensus algorithm that is initially used by the Ripple cryptocurrency. RPCA algorithm is applied every few seconds by all nodes in order to maintain the correctness and agreement of the network(Schwartz, Youngs and Britto, 2018).

## 2.7.3 Consensus Algorithms Comparison.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | PoW | PoS | PBFT | DPoS |
| Management | Open | Open | Permissioned | Open |
| Energy Saving | No | Partial | Yes | Partial |
| Platform | Bitcoin | Peercoin | Hyperledger Fabric | Bitshares |

Table 7: Consensus Algorithm Comparison

### 2.7.4 Consensus in Hyperledger Fabric

Hyperledger Fabric equips Kafka as its consensus algorithm, which provides crash fault tolerance and the finalizing of the transactions happen within seconds. According to (Philosophy, no date)the consensus in Hyperledger is broken down into 3 phases:

1. **Endorsement** is driven by policy upon which participants endorse a transaction.
2. **Ordering** phase accepts the endorsed transactions and agrees to the order to be committed to the ledger.
3. **Validation** takes a block of ordered transactions and validate the correctness of the results.

This makes Hyperledger transactions to take place faster.

# 2.8 IPFS (InterPlanetary File System)

The IPFS (InterPlanetary File System) is a peer-to-peer distributed file system that seek to connect all computing devices with the same system of file (Benet, 2014). IPFS which is a peer-to-peer distributed file system aims to replace HTTP and build a better system for all users. HTTP which is one of the most successful file distribution systems within the world. However, IPFS think that HTTP has failed to utilize other file distribution techniques, which was invented in the last 15 years (Benet, 2014).IPFS is a distributed file system which synthesizes successful ideas from previous peer-to-peer systems, including DHTs, BitTorrent, Git, and SFS.(Benet, 2014)

## 2.8.1 Why IPFS

IPFS is a decentralized way of storing the data, the nodes within the IPFS store the data in the local storage allowing nodes to connect to each other and transfer the data when required. Once a file is uploaded a CID (Content Identifier) is given to the file combining the hash of the content within the file and a unique identifier (Cloudflare, 2019). As a result of the hashing algorithm that is used by IPFS to store the data, duplication if data is prevented and the hash of the already existing file will be returned to the user. Using IPFS the cost of hosting product images, category images and the APK files of the business can be reduced, as they are stored as parts of the file in different location rather than the whole file. With most of the current system using AWS servers to host their application the charges are high to maintain the application as endless increase in images and duplication of same images among other businesses make it costly. As a solution to prevent the duplication of data and cut down costs of image and data hosting IPFS will be used within Appezite to host images and the APK files of the business.

# 2.8 Scripting

Scripting is the process of automatic a set of tasks which have to been done repetitively by a user. Scripting can be of two types web-based scripting and system administration-based scripting. Shell scripting is the primary way for developers to interact with the operating system at a higher level. Shell scripts allow the developers to organize long and repetitive commands in a way that allows automation of various tasks. According to (Octoverse, no date) Shell is the 8th most popular language in 2019.

## 2.8.1 Scripting Languages

Scripting languages is a programming language that allows the developers to automate the executions of tasks. Scripts are mostly used within the run time environment to automate the execution of repetitive tasks. Scripting languages are interpreted from the source code or the byte code one command at a time rather than been compiled.

## 2.8.2 Scripting Languages Comparison

In this section a comparison of the scripting languages will be done stating the features, advantages, disadvantages and the popularity of each language.

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Features | Limitation | References |
| Python | Object Oriented  Readable Syntaxes  Extensible  Extensive Library Support  Rapid Development  General Purpose Language  Simple and easy to learn | Python is slower  New comers may be put off by the python’s indentation |  |
| Ruby | Object Oriented  Flexible Syntaxes  Extensible  Rich Set of Libraries  Simple and easy to learn | Slower compared to the other languages |  |
| JavaScript | Speed  Simple and easy to learn | Best Suited for web-based application  Different engines render JavaScript differently |  |
| PHP | Object Oriented  Open Source  Procedural | Best Suited for web-based application | (Sebastian, 2010) |
| Scala | Seamless integration with java  Object Oriented  Extensible | Limited developer pool | (TEAM, 2018) |

Table 8: Scripting language comparison

## 2.8.3 Python

Python which was introduced in 1991, by Guido van Rossum (W3schools, no date), is a general purpose dynamic programming language (Millman and Aivazis, 2011), which has gained popularity within the scientific computing community due to its simplicity of syntaxes, extended standard libraries, and a matured eco-system for of high quality third-party packages that are available for almost all tasks including ML and Scientific Computing. The language was influenced by ABC, ALGOL 68, C, Haskell, Lisp, Modula-3, Perl, and Java while influencing the design of other languages namely: Boo, Cobra, D, Falcon, Groovy, Ruby, and JavaScript. (Oluwagbemi *et al.*, 2013). Python which has been existent for over 21years are used by prominent tech companies like Google, Yahoo, NASA. Python will be used in the proposed solution as python provides simplicity in syntaxes and a wide variety of third-party packages.

# 2.9 Reflection

With the service charges that are been charged by services like UberEATS, and the pricing of Order Ahead Application providers like Applova restaurants are put at a disadvantage as the cost are higher to keep the services going. The proposed solution for this is to use a blockchain based platform where the data is stored in the blockchain, according to (Ranganthan *et al.*, 2018) testing that was conducted, it shows that blockchain is one of the most suitable solutions to overcome the fees and the monthly charges. As not much solutions are available for the Order Ahead Application generation a platform using blockchain will be able to help many restaurants to get their own Order Ahead Application. Blockchain also provides data security and integrity. With the use of python, the test build will be automated which will allow the users to test the application before purchasing the application, a React Native application will be provided to the user and the android version of the application will be provided for testing purposes.

# 2.10 Chapter summary

Shortage of low-cost order ahead application providers have restaurants to face many problems as it reduces the customer base who order via mobile. Online ordering has been discussed in details and the systems that allow online ordering to have been discussed and the details of the online ordering consumers and trends of online ordering have been discussed, and the importance of the online ordering have been discussed

Furthermore, the current systems that provide generation of online ordering systems have been reviewed and the cost, service provided, type have been identified and shown, also the features that are provided by each system have been pointed out. A more detailed review has been done about the most remarkable systems.

Furthermore, with the identification that the current online ordering systems are costly and other drawbacks like = data safety, integrity and low costs blockchain have been discussed in detail. A comparison was done between the private and public blockchains. A detailed review of the blockchain technology that will be used in the product have been discussed. The consensus algorithms have been discussed in detail and a comparison was done among the discussed consensus algorithms.

Moreover, this chapter reviews the languages that can be used for automation of APK generation, out of all the available languages the languages that support scripting have been supported and a comparison of the languages have been carried out. Python which will be the language that will be used have been identified and have been discussed in detail.

In conclusion with all the knowledge available about, online ordering, blockchain and scripting languages, order ahead application generation can be carried out with blockchain whereas the building and automation could be achieved via python.

# Chapter 3: Methodology

# 3.1 Chapter overview

This chapter covers the evaluation and the justification of the methodologies that will be used to build the proposed project, also this chapters covers the research methodologies that will be used to accomplish a successful research. This chapter also briefly describes the available research methodologies and the approaches that are available when conducting a research.

Furthermore, an in-detail review will be done on the software development methodologies and a few of them will be chosen and discussed on how it can be applied to Appezite. Finally, the chapter with identify the possible risks to Appezite, as this may decide the failure or success of the application.

# 3.2 Research methodology

Research is a systematic process that is done to collect new and useful information for a topic. The information in a research can be gathered in various means as experienced/knowledgeable people, journals, books, magazines and even nature. A research will allow addition of knowledge and information to already existing information. A research is conducted with a main purpose of understanding what needs to be done/ followed to finalize an idea, and to find the evidence that is required to justify the solution.

Research methodology is a systematic way to solve a problem, it is a process of studying how the research is planned to be carried out and what means, and procedures will be used by the researcher to achieve the goal. By doing a research the researcher will have a plan that needs to be followed.

# 3.3 Quantitative and Qualitative Methodology

There are two main approaches that are used to collect data in a research, qualitative and quantitative, some even combine the two available methodologies and do the research using a mixed mode methodology.

Quantitative research is where the result of the research is expressed in numbers and graphs and is used to confirm the assumptions that are made when starting a research. Quantitative research is conducted with a larger number of respondents as the research is analyzed and displayed in numerical figures. Here the questions are close ended as most of the time the respondents must select answers from a list of answers that are already provided.

1. Questionnaires.
2. Surveys.
3. Experiments.
4. Polls.

Qualitative on the other hand is a where the result of the research is expressed in words that is then used to understand the concepts, experiences. This type of research allows the researcher to get an in-depth understanding/insight of the topic. Qualitative research is conducted with a fewer number of respondents and the research is analyzed by summarizing and interpreting what was observed or interviewed. Here the questions are open ended as the views are experiences of people differ from each other.

1. One on One Interviews.
2. Observations.
3. Focused Discussions.
4. Content Analysis.

Are few of the methodologies that are mostly used in the qualitative methodology

In conclusion Qualitative methodology is used when you are in need of understanding something, and then analyzing the feedback to propose a solution, and Quantitate is used when you are in need of confirming an already existing theory and then displaying the results in a graphical or numerical manner.

# 3.4 Appezite Research Methodology

The research methodology that will be used for Appezite will be qualitative research as, the main objective id Appezite is to provide order ahead applications for a business. To get an understanding on how important an order ahead application is to a business One on One interview will be conducted with businesses that recently purchased their own order ahead platform. Another reason for using Qualitative methodology is that to build the proposed solution it is required to get an insight of what is lacking in the already existing platforms from an entrepreneur perspective. One more reason for the use of interviews is that as the researcher I will be able to get the most on what the restaurateurs expect from an order ahead application.

Furthermore a questionnaire will be used to get the customer perspective on how important an order ahead application is to a restaurant, moreover existing researchers that was done by other companies will be taken into account to get a better understanding of how important an order ahead system is to the restaurant and the consumers. Furthermore, having interviews with customer will help to get an understanding on what the customers expect from an order ahead application for a business.

# Chapter 4: Progress Report

The development Appezite progresses in a constant speed, making the development phase of the software almost 90% completed so far. Currently the functionality of the modules Merchant-Web, Mobile Application, Webstore] have been fully completed and have been moved to the developer testing phase, where bugs are been found and fixed accordingly. The UI in the webstore and the Mobile Application need a few tweaks and improvements. Furthermore, the automation scripts have been completed and testes with creation of new businesses and the APK was built and uploaded to the IPFS and is allowed to be downloaded by the business for testing purposes.

Moreover, interviews are been conducted to achieve the research objective of “Analyzing the importance of an order ahead application for a business” and positive feedback was received from the interviews. Also, the questionnaire provided positive feedback for the importance of an order ahead application for customers from the customer perspective, the questionnaire also proved that customers face many problems due to lack of order ahead applications, the development of the application was started after the results were gathered from the questionnaire., as this provided an overview on the importance of such an system.

Furthermore, from the perspective as a developer the development of the application progressed well resulting in completion of all the modules in the application making the overall completion around 95%. The UI’s are yet to be finalized and tweaked whereas the main functionality of the application is fully completed. Different frameworks were used to develop the front end and the back end of the application, whereas most of the frameworks and languages used are the newly available ones.

A screenshot of a cell phone

Description automatically generated

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