CHAPTER III

Design and Methodology

This chapter contains the design and methodology for developing the IOT Based restaurant information system. This chapter includes the frameworks and collection methods used to determine the data required for the system development. Also, this chapter comprises the minimum hardware and software requirements.

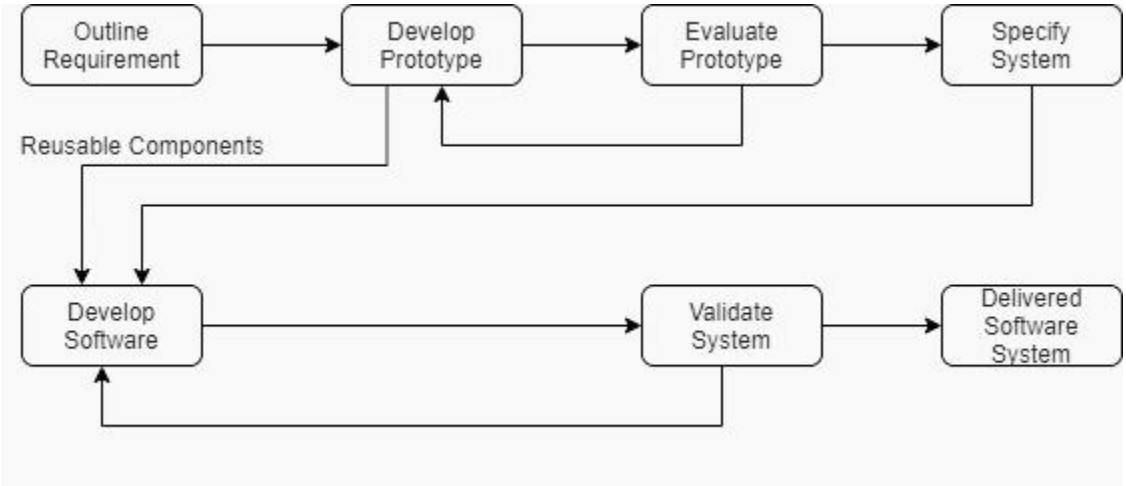
3.1 Systems Development Method

The researchers utilized the descriptive research design in this study. Descriptive research design systematically describes variables that deal with a population, a situation, or a phenomenon. This research design fits for the study as it will accept responses to questions such as what, where, when, and how. This research design was used to investigate the information gathered through questionnaires and observation. The responses analyzed were used as a foundation for the development of this study. The researchers gathered the needed information to determine the current problems that the business is experiencing. Throughout the process, the researchers can supply solutions and requirements required by the business to perform the goals and improve the business' productivity, effectiveness in the field, and development. A developmental research approach is utilized in this study. Developmental research is the study of analyzing, designing, developing, and evaluating products and programs that must

comply with the required specifications and objectives. It involves situations in which the product development process is analyzed and described, and the final product is evaluated (Luciano et.al, 2020).

Figure 1

Prototyping Developmental Model



The methodology used in this study is the Prototyping Developmental Method. In this methodology, a prototype is defined with the primary or selected function to see the result and to discover what is missing in the project. A prototype of a software project must be developed quickly and often ignores best programming practices (Saed S., et al, 2019). It is a model that focuses on developing an initial prototype and refining the design before that development. Prototyping Development includes seven phases and as follows:

Requirements Phase (Outline Requirement)

In this development phase, the researchers brainstormed the ideas and requirements for the project development. It starts by identifying the problems encountered by the beneficiary. After the said process, the team proceeds with the proper data gathering through a face-to-face interview with the beneficiary. After gathering the current issues, the team proposes the solutions and requirements for the current problem before finalizing the needs. The objectives are identified to strengthen further the criteria needed for the project development.

Prototyping Phase (Develop Prototype)

In this phase, the team creates a prototype of how the system will look like. The team builds the interface of the pages accurately for each intended end user. The Prototype created is the initial output shown to the beneficiary for their approval and feedback. The developers started creating the Prototype using drawings, wireframes, and mock-ups.

Evaluation Phase (Evaluate Prototype)

After the developer creates the Prototype, the team then presents it to the beneficiary to gather insights and suggestions according to the beneficiary's preferences and needs. Then, after initiating changes, the team finalizes the user interface design that the development team will follow upon creating the system.

Review and Refine (Specify System Phase)

After the beneficiary's evaluation and feedback, the team proceeds to refine the system prototype. In this phase, the team identified the final look and interface of the system for specific end users. A final prototype is made. Then, the Prototype was presented to the beneficiary for approval before the actual development.

Development Phase (Develop Software)

In this phase, the team's programmer starts to write the codes for the system to function according to the objectives, needs, and requirements. After completing the first fifty percent (50%) of the system development, the team lets the beneficiary assess the system to see if it works according to the agreed system functions and design. The team also reviewed the system to measure its capability to function. After gathering the suggestions and insights of the beneficiary, the team then proceeds with the modifications and updates. After completing it, the team's programmer then completes the remaining fifty percent (50%) of the system that needs to be accomplished.

Testing Phase (Validation)

After completion, the team reviews the system to catch errors, assess the interface, and measure the functions before the beta testing. It is to ensure that before the end users use the system, little to no errors are ideal to appear. The team will conduct their testing using test cases.

It include testing the features, such as the functions, inputs and outputs,

and buttons. Additionally, IT experts are adhered to test the system using the system quality assurance tool. The tool ISO 25010 (SQuaRE) encompasses eight (8) components used to measure the system's overall function. After the team tests the system, it will also be presented to the beneficiary and the end users for them to utilize it and measure the functions, design, and information provided by the system using the PSSUQ questionnaire. If the beneficiary wishes to make other changes, the development team then catered to the suggestions and update the system according to the beneficiary's aims. After the modifications, the team and the beneficiary tested the system again.

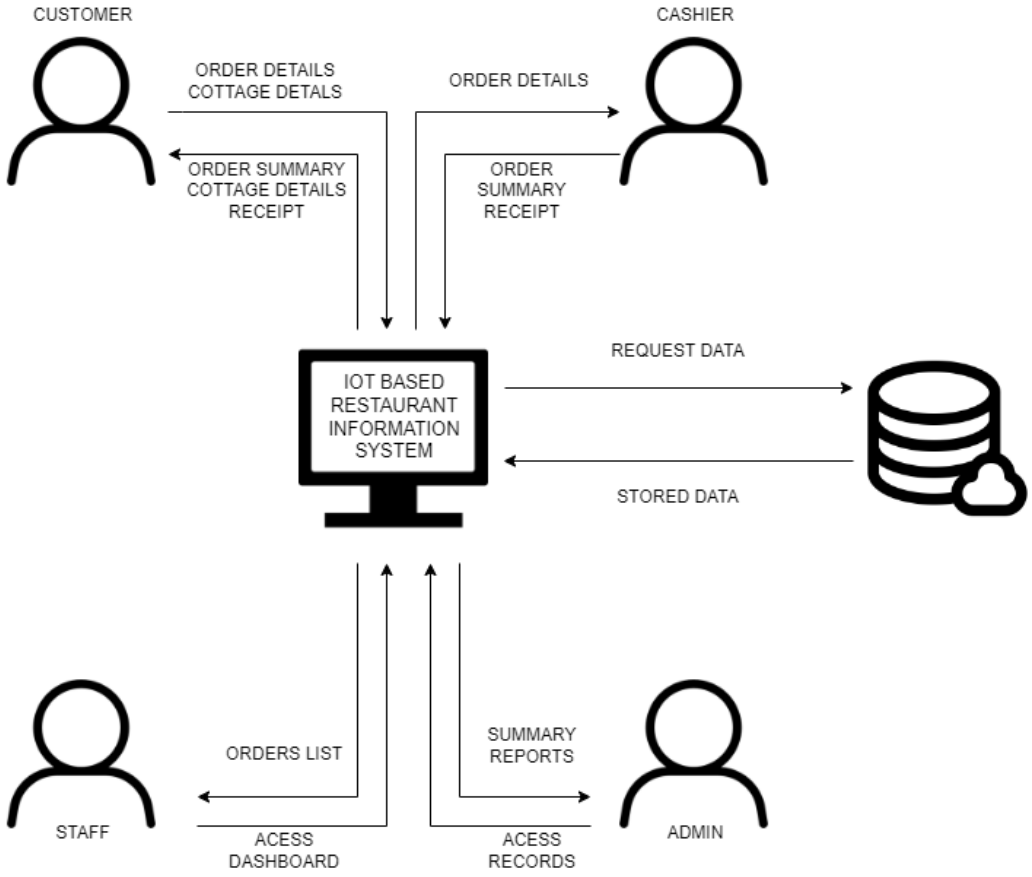
Release Phase (Deliver System)

In this phase, the team delivers the fully developed system for the beneficiary. The deployment followed a specific agreement between the developers and the beneficiary. The training for the end users also took place in this phase. It is to ensure the users are fully aware and knowledgeable on how to correctly use the system and be more productive while using it.

3.2 Operational Framework

Figure 2

Operational Framework of IOT Based Restaurant Information System



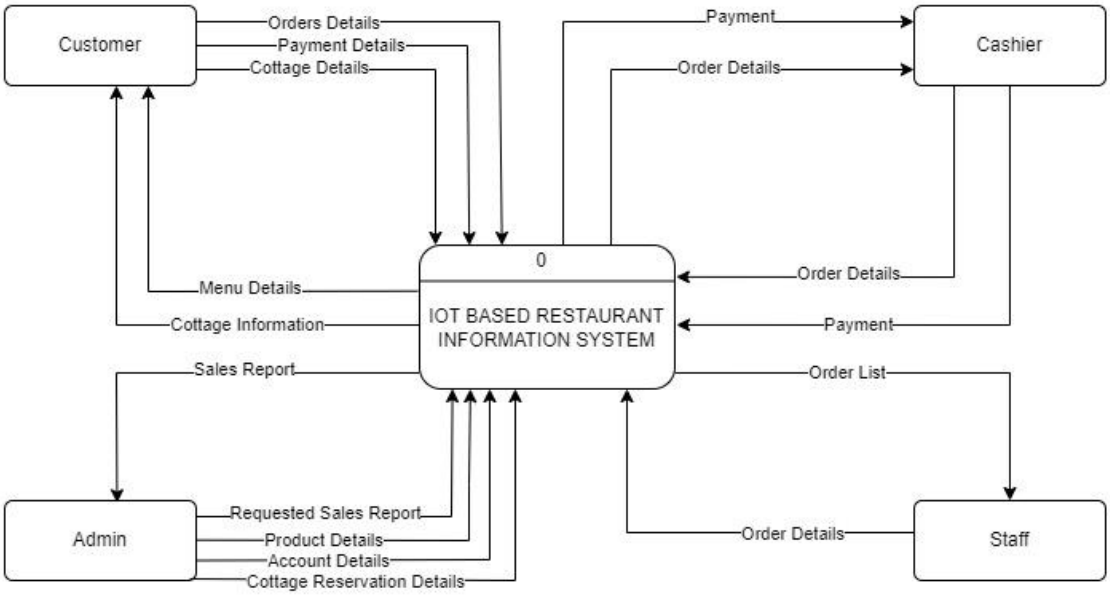
The figure above shows the developed Operational Framework of the system. The customer inputs the order and cottage details using the system, and after processing the data, the summary is reflected in the customer's interface; the cashier will view these data for further confirmation of the order and cottage reservation. The order and cottage reservation record are sent to the admin interface. The cashier can still manually input order details into the system, where the summary and receipt will then be retrieved after processing the said order, and

the data is sent to the admin interface for records. The data provided, modified, added, and saved by the users will all be stored on the cloud database available for viewing by specific system users once needed.

3.3 Context Diagram (Level 0)

Figure 3

Context Level Data Flow Diagram of IOT Based Restaurant Information System

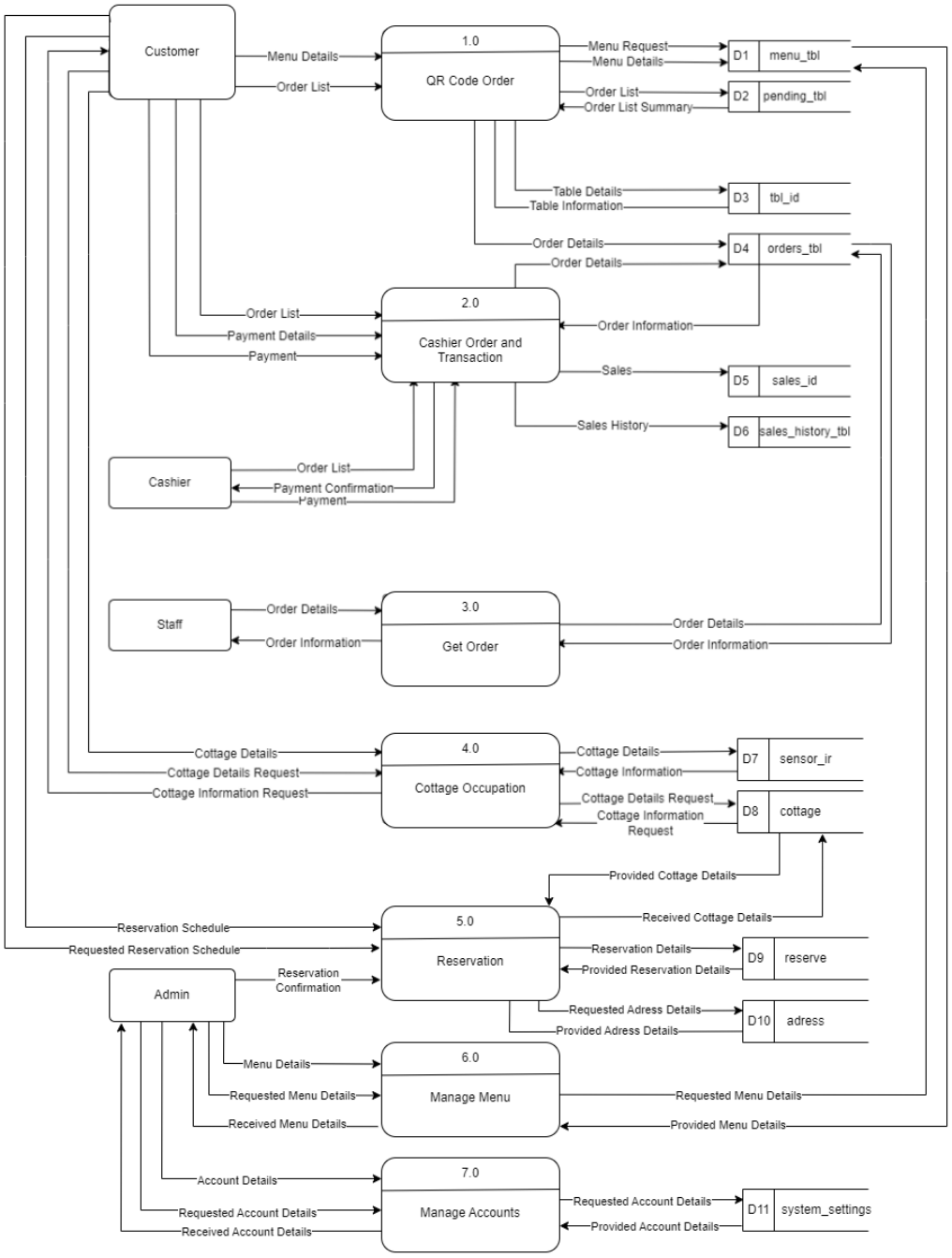


The figure above shows the context diagram of the system. It includes the main processes held while the users are utilizing the system. It consists of the data provided and the data outputs. The users of the system are the customer/s, the cashier, the kitchen staff, and the system administrator.

3.4 Data Flow Diagram (Level 1)

Figure 4

Level 1 Data Flow Diagram of IOT Based Restaurant Information System



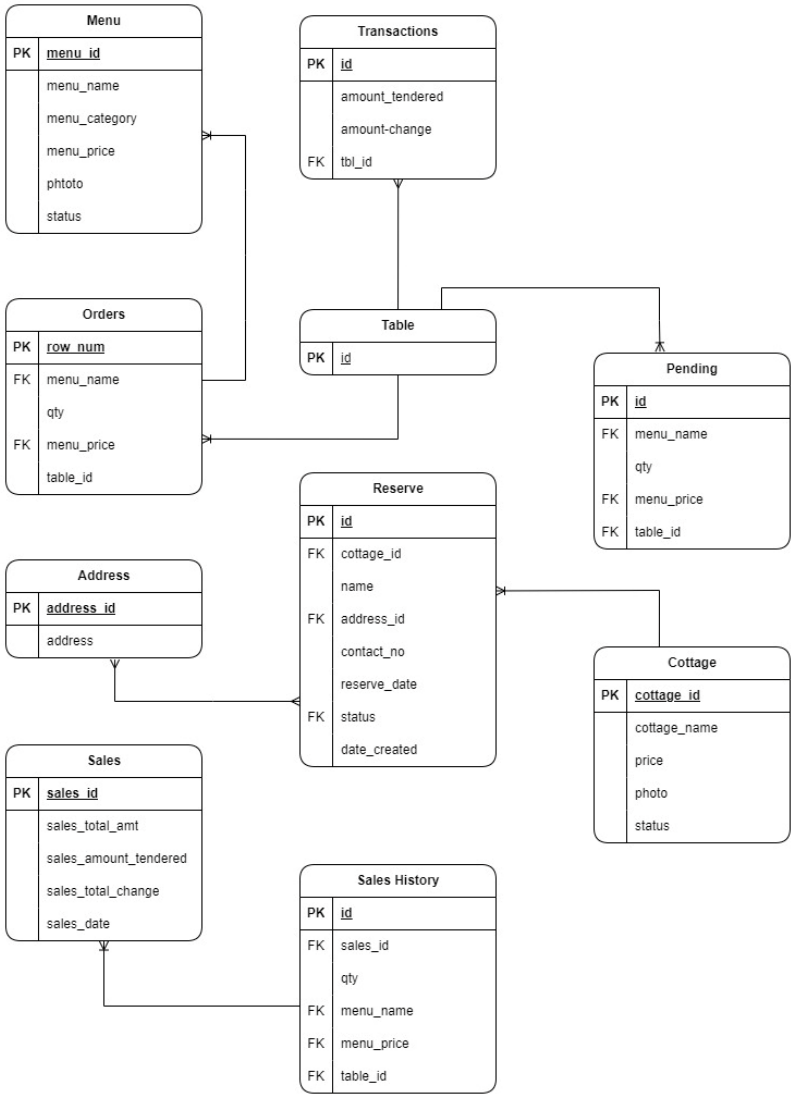
The figure above shows the Level 1 Data Flow Diagram of the system. It

illustrates the data that flows between the end users, such as the customer and the cashier. The included processes in the figure, also known as the sub-processes, were derived from the context diagram.

3.5 Entity Relationship Diagram

Figure 5

Entity Relationship Diagram of IOT Based Restaurant Information System



The figures represent the entity relationship diagram of the system. The diagram represents the relationship of entities/tables in the database. The diagram ensures the database architecture is correctly visualized so stakeholders know the data relationships clearly.

3.6 Use Case Diagram

Figure 6

Use Case Diagram of IOT Based Restaurant Information System

The figure above shows the use case diagram of the system. It represents how the users can simultaneously interact with the system. The scenarios are specified according to the intended end users.

3.7 Data Dictionary

Data Dictionary includes detailed data about the business. This includes the standard name of data elements, their meaning, and allowable values.

Table 1

Menu

Field	Optional	Field Type	Length	Key	Description
menu_id	No	Integer	11	PK	Unique identifier of menu.
menu_name	Yes	Varchar	30		Specific name of menu.
menu_category	Yes	Text	30		Category of menu item.
menu_price	Yes	Float	6,2		Price of the menu item.
photo	yes	Image			Photo of the specific menu.
status	Yes	Text	11		Availability of menu item.

Table 2

Pending

Field	Optional	Field Type	Length	Key	Description
row_num	No	Integer	11	PK	Unique identifier of pending reservation.
menu_name	Yes	Varchar	11	FK	Specific name of menu.
Qty	Yes	Integer	11		Quantity of pending reservation.
table _id	No	Integer	11	FK	Unique identifier of table.

Table 3

Table

Field	Optional	Field Type	Length	Key	Description
table _id	No	Integer	11	FK	Unique identifier of table.

Table 4

Orders

Field	Optional	Field Type	Length	Key	Description
id	No	Integer	11	PK	Unique identifier of pending order.
menu_name	Yes	Varchar	30		Specific name of menu.
qty	Yes	Integer	11		Quantity of orders.
menu_price	Yes	Float	6,2		Price of the menu item.
orders_qty	Yes	Integer	11		Quantity of orders.

Table 5

Sales

Field	Optional	Field Type	Length	Key	Description
sales_id	No	Integer	11	PK	Unique identifier of sales.
sales_total_amt	Yes	Float	6,2		Total amount of sales.
sales_total_change	Yes	Float	6,2		Amount tendered minus total amount of order.
sales_date	No	Date			Date when sales was made.

Table 6

Sales History

Field	Optional	Field Type	Length	Key	Description
id	No	Integer	11	PK	Unique identifier.
sales_id	No	Integer	11	FK	Unique identifier of sales.
Qty	Yes	Integer	11		Quantity of orders.
menu_name	Yes	Varchar	30		Specific name of menu.
menu_price	Yes	Float	6,2		Price of the menu item.
table _id	No	Integer	11	FK	Unique identifier of table.

Table 7

Sensor IR

Field Name	Optional	Field Type	Length	Key	Description
id	No	Integer	11	PK	Unique identifier.
status	Yes	Text	30		Availability of the cottage.
cottage_id	No	Integer	11	FK	Unique identifier of table.

Table 8

Cottage

Field	Optional	Field Type	Length	Key	Description
cottage_id	No	Integer	11	PK	Unique identifier of table.
cottage_name	Yes	Text	30		Specific name of cottage.
price	Yes	Float	6,2		Price of the cottage.
status	Yes	Text	30	FK	Availability of the cottage.
photo	Yes	Image			Image of the specific cottage.

Table 9

Reserve

Field Name	Optional	Field Type	Length	Key	Description
id	No	Integer	11	PK	Unique identifier.
cottage_id	No	Integer	11	FK	Unique identifier of table.
name	Yes	Text	255		Name of the customer.
address_id	No	Integer	11	FK	Address id of the customer.
contact_no	Yes	Varchar	30		Contact number of the customer.
reserve_date	Yes	Date			Reservation date.
status	Yes	Tiny Integer	4	FK	Status of the cottage.
date_created	Yes	Date			Date reservation was created.

Table 10

Address

Field	Optional	Field Type	Length	Key	Description
address_id	No	Integer	11	PK	Address id of the customer.
address	Yes	Text	255		Address of the customer.

Table 11

System Settings

Field	Optional	Field Type	Length	Key	Description
id	No	Integer	30	PK	Unique identifier.
name	Yes	Text	25		Name of the user.
email	Yes	Varchar	200		Email of the user.
contact	Yes	Varchar	20		Contact number of the user.

Table 12.

Transactions

Field	Optional	Field Type	Length	Key	Description
id	No	Integer	11	PK	Unique identifier of transaction.
amount_tendered	Yes	Float	10,2		Amount given by customer to pay for purchase.
amount_change	Yes	Float	10,2		Change of customer from amount tendered.
table _id	No	Integer	11	FK	Unique identifier of table.

Table 13.

User

Field	Optional	Field Type	Length	Key	Description
id	No	Integer	11	PK	Unique identifier of user.
name	Yes	Varchar	16		Specific name of user.
username	Yes	Varchar	16		Username of the user account.
password	Yes	Varchar	16		Password of user account.
name	Yes	Varchar	16		Specific account name of user.

3.8 Hardware and Software Requirements

Hardware and Software Requirements provide detailed minimum requirements needed to support the developed system's functions and executions.

Recommended Software Requirements

The following is the list of software requirements utilized by the proponents that support the function and the proposed system's executions.

- Microsoft Edge Browser / Google Chrome Browser / Opera Mini Browser / Mozilla Firefox Browser
- Windows 10 Operating System
- Android / iOS Browser
- Android / iOS Operating System

Recommended Minimum Hardware Requirement

The following is the list of hardware requirements utilized by the proponents that support the function and the proposed system's executions.

- Intel Core i3, 2.4Ghz (4GB or above RAM Storage 250GB HDD / 128GB SSD or above ROM Storage) 1366 x 768 Resolution
- Ethernet Connection: LAN or Wireless Adapter (Wi-Fi)
- Android 8 or above / iOS 6 and above Mobile Phone (2GB RAM Storage, 16GB ROM Storage)
- Android 8 or above / iOS 6 and above Tablet (2GB RAM Storage, 16GB ROM Storage)
- Arduino – Raspi 4 (Broadcom BCM2711, Quad core Cortex-A72 (ARM v8) 64-bit SoC @ 1.8GHz)
- PIR Sensors (Input voltage: DC 4.5-20V, Static current: 50ua, Sensing range: Max 7 m)

3.9 Time Table (Gantt Chart)

Table 14

Gantt Chart of IOT Based Restaurant Information System

PROJECT SCHEDULE OF ACTIVITIES						FEB	MARCH					APRIL				MAY				JUNE				JULY				AUGUST				SEPTEMBER				OCTOBER					NOV	
TASK NO.	TASK TITLE	START	END	DAYS	STATUS	FEB 4	1	2	3	4	5	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	5	1	2
1	Requirements Phase (Outline Requirement)																																								
1.1	Brainstorm ideas for the system.	20-Feb	27-Feb	7	100%																																				
1.2	Formulate title and finalize ideas.	25-Feb	27-Feb	3	100%																																				
1.3	Identify current problems of the beneficiary.	6-Mar	10-Mar	5	100%																																				
1.4	Identify the requirements and needs of the beneficiary.	11-Mar	17-Mar	7	100%																																				
1.5	Finalize requirements.	21-Mar	30-Mar	10	100%																																				
2	Prototyping Phase (Develop Prototype)																																								
2.1	Develop system prototype.	3-Apr	28-Apr	26	100%																																				
3	Evaluation Phase (Evaluate Prototype)																																								
3.1	Present prototype to the beneficiary.	3-May	5-May	3	100%																																				
4	Review and Refine (Specify System Phase)																																								
4.1	Develop final design of prototype.	8-May	22-May	15	100%																																				
5	Development Phase (Develop Software)																																								
5.1	System development.	2-Jun	6-Oct	127	100%																																				
6	Testing Phase (Validation)																																								
6.1	System testing and identify errors.	11-Oct	Oct-23	13	100%																																				
6.2	Develop the changes needed and correcting errors.	18-Oct	31-Oct	14	100%																																				
6.3	System testing and review.	30-Oct	3-Nov	5	100%																																				
7	Release Phase (Deliver System)																																								
7.1	System deployment.	5-Nov	7-Nov	3	100%																																				
7.2	Train end users.	7-Nov	12-Nov	6	100%																																				
	PROJECT TITLE	IOT BASED RESTAURANT INFORMATION SYSTEM																																							
	PROJECT LEADER	JOSHUA N. MAQUIMOT																																							
	SYSTEM ANALYST	JEHU EMMANUEL U. BALDAGO																																							
	RESEARCHER	JUVELYN B. COJA																																							
	GROUP NAME	TRIPLE J																																							

The table above illustrates the project schedule of activities for the project development. It encompasses seven (7) phases that follow the Prototyping Model development methodology. The seven (7) phases are the Requirements Phase (Outline Requirement), Prototyping Phase (Develop Prototype), Evaluation Phase (Evaluate Prototype), Review and Refine (Specify System Phase), Development Phase (Develop Software), Testing Phase (Validation), and Release Phase (Deliver System) that incorporate the tasks done by the team members to complete the project development within a specific period of timeline.

3.10 System Usability and Reliability Testing

System usability and reliability testing was conducted to assess the IOT Based restaurant information system's overall function. The testing was done to ensure that the system will work functionally according to the objectives and requirements needed by the business. The testing determines if the system has no errors and if it is easy, understandable, and convenient to use. Fifteen (15) respondents were asked to evaluate the developed system. The non-IT professionals were the system's possible end users.

The Post-Study System Usability Questionnaire was used as the basis for testing the overall functionality and usability of the system by end users. The PSSUQ includes sixteen (16) questions that will reflect the overall functionality of the system in accordance with the objectives of this study. System Usefulness will determine the system's usability if it complies with the proposed functions. The Information Quality will assess if the information provided by the system is adequate, accurate, and valuable. The Interface Quality were examined to prove that the system's user interface is easy to utilize, understand, and navigate. These factors will contribute to the evaluation of the system's overall usability.

Additionally, three (3) IT experts were asked to evaluate the system's functionality. It were a standard criterion to determine the quality and consistency of the developed system if it satisfies or exceeds the stated needs and requirements. Test cases will also be used with the experts to assess the system's overall functionality the system is easy to utilize, understand and navigate. These

factors will contribute to the evaluation of the system's overall usability.

Seven (7) Point Likert Scale with Verbal Interpretation

Responses	Scale	Range	Verbal Interpretation
Strongly Agree (SA)	1	1:00 – 1.84	Very High (VH)
Agree (A)	2	1.85 – 2.69	High (H)
Slightly Agree (SLA)	3	2.70 – 3.54	Above Average (AA)
Undecided (U)	4	3.55 - 4.39	Average (A)
Slightly Disagree (SLD)	5	4.40 - 5.24	Below Average (BA)
Disagree (DA)	6	5.25 - 6.09	Low (L)
Strongly Disagree (SDA)	7	6.10 - 7.00	Very Low (VL)

The researchers used the assessment tool ISO 25010 (SQuaRE) for the overall system design and development. ISO 25010 (SQuaRE) quality model consists of 8 (eight) software quality characteristics: Functional Suitability, Performance Efficiency, Compatibility, Reliability, Usability, Security, Maintainability, and Portability. These components are the basis of the Software's quality. The primary purpose of conducting a system evaluation is to assess the system's functionality. These quality characteristics are also subdivided into more comprehensive sub-characteristics, which are the basis for measuring the system's quality and contribute to evaluating the system's overall usability.

Mean Score	Verbal Interpretation
4.21-5.00	Excellent
3.41.4.20	Very Highly Acceptable
2.61.-3.40	Highly Acceptable
1.81-2.60	Acceptable
1.-1.80	Not Acceptable