

# Automated Billing System of Rural Water System Association (RUWASA)

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## Abstract

The Automated Billing System was developed for the Rural Water System Association (RUWASA) to eliminate problems with their current billing system and enable well-organized operations to become more productive. In building the software, we made use of the prototyping method, in which five steps have to be done: first is the requirements gathering and refinement. Our team conducted a series of interviews among RUWASA's employees, including access to data and observation of their current system. Second, is the Quick Design, this is the design phase in which the gathered data was analyzed, and diagrams were drafted and converted into a logical schema. Third is building the prototype. Our team made use of the MS Access 2000 software for the database and Visual Basic 6.0 for the system interface. Programming, coding the data, and determining system constraints were done. Fourth is the customer evaluation of the prototype. The developed prototype was delivered to the customer for testing and evaluation. The fifth and final step is refining the prototype and the Engineering Product. In this final stage, modifications in the prototype's specification were made to suit and satisfy customers' needs. The development system would greatly help the office of RUWASA in its daily work and thus serve the community efficiently.

**Keywords:** Automated, Billing, Programming, RUWASA, System

## Introduction

Almost all companies consider computers as indispensable tools today. They are fast becoming man's newest best friend or "sidekick," and it is quite unthinkable working without them. But of course, having them is not the end per se (CHERR, 1997). Quite several businesses, organizations, agencies, or corporations would want to have computer technologies that would cater to their needs, and get rid of the traditional paper filing system. This kind of innovation

would enable them to cope with the rigid competition in the world market. The Rural Water System Association has wanted to have software that could facilitate their present billing system. Currently, they are using a paper filing system, text documents, or a spreadsheet to keep track of their data. As we all know, these are becoming obsolete nowadays. This research proposes an improvement on the current billing system of RUWASA. the automation process. This will lessen and lighten the complex workload of the administrative staff. It will efficiently store and record data, making water billing fast and accurate. It is also a secure database in the sense that it prohibits unauthorized access to data and information. The emergence of computer technology has revolutionized its efficacy in business and organizational operations. Seldom can we find a business, no matter the size, that isn't computerized or using computers. Why? Because so many of their problems are sufficiently addressed. A computer is an indispensable tool for almost all tradesmen, professionals, corporations, organizations, associations, etc. The Rural Water System Association located at Magsaysay, Mati, Davao Oriental, was currently using a computer that helps them in their daily transaction processes, and that includes keeping track of records. On the other hand, they have encountered several problems such as redundancies, slow and inaccurate processes of transaction, and problems regarding security measures. The proposed automated billing system will greatly improve their present system and turn it into a more flexible data management system.

This undertaking developed the present billing system of the Rural Water System Association (RUWASA) to effectively monitor transaction processes and address key operational concerns. Specifically, the system was designed to eliminate redundancy in data encoding, ensure the integrity and accuracy of encoded data, provide efficient storage and recording of information, and improve the speed and accuracy of billing transaction processing. The purpose of this study is to develop the present water billing system of the Rural Water System Association (RUWASA) by eliminating redundancy in data encoding through an improved database system, implementing effective safeguards against unauthorized access and providing backup file support to ensure data integrity, improving procedures for recording transactions and storing data for more efficient management, and automating the manual process of calculating the rate of cubic meters consumed to achieve faster and more accurate billing transaction processing. The employees and the members of the Rural Water System Association (RUWASA) will benefit from the newly improved automated billing system. This will help their association attain a more productive and well-organized level of work because billing transactions will be made through the system. This will eliminate problems regarding the redundancy of encoding, inefficient storing, and recording of data by improving the procedures of recording transactions and the ways of storing data, such as consumer information and accounts. Solves the issue of data integrity by implementing an effective safeguard against unauthorized access and automates the calculation process of cubic meters consumed to attain a fast and accurate way of processing billing transactions. Whereas, the consumers or the community would be secured their files are safe, and confident that they are paying the right billing account. This study will help determine the acceptance of system automation in the public and private offices in the province of Mati. It will produce a new technology and will contribute to the body of knowledge regarding the utilization of computer technology. This study focuses on developing an automated billing system for the Rural Water System Association (RUWASA). This will (1) eliminate redundancy of encoding data by improving the current database of RUWASA, (2) implement an effective safeguard against unauthorized access, provide back-up file support to ensure integrity of data encoded, (3) improve procedures of recording transactions and the ways of storing data to efficiently store and record

transactions, and (4) automate the manual process of calculating the rate of the cubic meter consumed to attain fast and accurate way of processing billing transactions. It doesn't include the cashiering and the accounting transactions and it is a stand-alone system limited only to the computer in charge of the RUWASA office. The system specifications used are based on the available resources of their office: Windows 98 for the operating system, MS Access 2000 for the database, and Visual Basic 6.0 for the user interface.

## **Methodology**

Since this study falls within the transaction processing system, the group decided to use the prototyping method in developing the application software for RUWASA, on of the software engineering systems analysis and design methodologies. This method allows the software developer to rapidly constitute system model based on the user's requirement, which serves as a test model of system development (also named a prototype). This prototype is handed to the user to test, and then it will be modified according to the user's needs until both users and system professionals are all content with it (PROT, 2004).

## **Steps in the prototyping method**

### **Requirements gathering and refinement**

First step was writing a letter of permission to the manager of RUWASA to conduct a series of interviews in their office including access to their data, observation and experimenting on their current system. The letter was signed and approved by the RUWASA manager. The researchers worked together as a group in formulating and asking questions to the respondents, striking up the conversation the researchers was able to gather important information when the respondents were at ease and interested in the subject matter during the interview. And experimenting on their current system enabled them to gather more data faster.

### **Quick design**

After the team was able to define the requirements, gathered all the necessary data needed in building the system, the team then analyzed the data, design the diagrams, then converted it into a logical schema in the design phase, undergoing some of the normalization process.

### **Building a prototype**

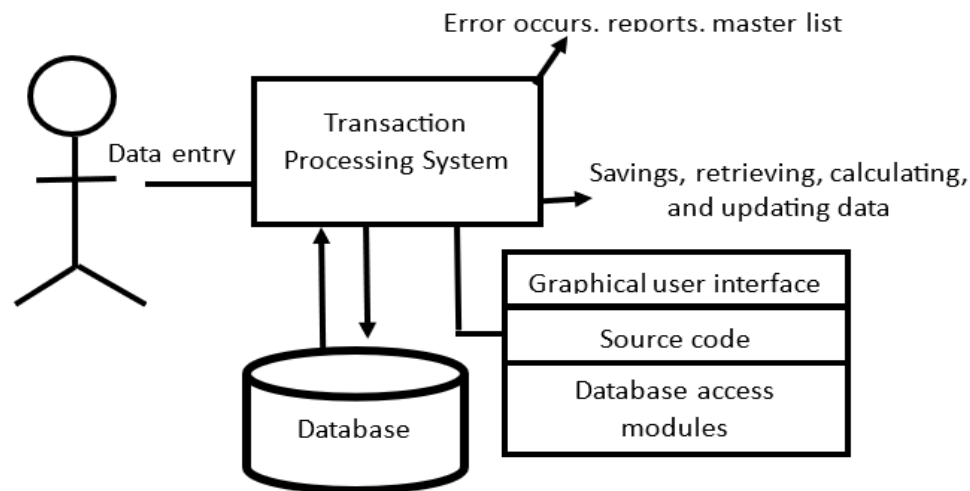
In building the database for their billing system, the team made use of the MS Access 2000 software. Programming, coding of data, and determining system constraints were done.

### **Prototype method**

This study made use of the prototyping method, one of the software engineering systems analysis and design methodologies. This formal method of building an information system uses a prescribed sequence of steps and deliverables to move reliably from user requirements to an information system in operation. Prototyping permits designers to present clients and users with a software application that can be the subject of evaluation (GENI, 2002).

Prototyping supports two requirements engineering processes: requirements elicitation and validation. In this process, system prototypes allow users to experiment to see how the system supports their work. They get new ideas for requirements and can find areas of strength and weakness in the software. They may then propose new system requirements. After that, the prototype may reveal errors and omissions in the requirements that have been proposed. A function described in a specification may seem useful and well-defined. However, when that function is

used with others, users often find that their initial view was incorrect or incomplete. The system specifications may then be modified to reflect their changed understanding of the requirements (BOEH, 2001).

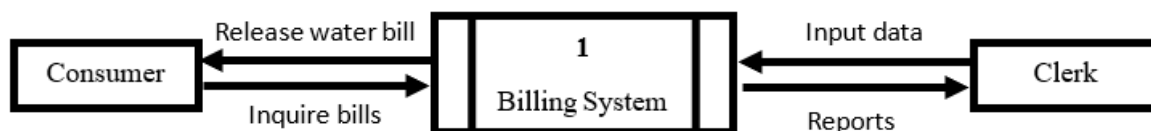


**Figure 1.** Theoretical framework.

Transaction Processing Systems (TPS) are information systems that perform daily routine transactions necessary for business functions. It automates the handling of data about business activities (transactions). The primary purpose of the TPS is to answer routine questions and track the flow of transactions through the organization. Covers things such as sales, receipts, cash deposits, payroll, credit, decisions, and flow materials [MACK, 2001]. It takes transactions and events as input from the user. Processes the sorting, listing, merging, and updating of data. And outputs detailed reports, lists, and summaries.

The following diagram shows the conceptual framework for the database design stage, represented as a step-by-step guide that takes you through the main phases of database design, namely: context, logical, and physical design. The context diagram in Figure 2 shows the transactions and interactions in the system. The clerk inputs data in the billing system, then the system releases a water bill for the consumer. If the consumer inquires about his bills, the system will generate reports to the clerk.

### Context diagram



**Figure 2.** The context diagram.

The logical diagram in Figure 4 shows the transactions during the billing period. Input of data collected and automatic computation of the total meter charge was done. After which, the billing slip will be produced as an output and then delivered to the consumer by the messenger. And lastly, the physical diagram shows the manipulation of data. First, the meter reader gave the collected consumed data to the clerk. Then the clerk plots the consumers' cubic meters consumed and stores it both in the water bill file and the consumers' file.

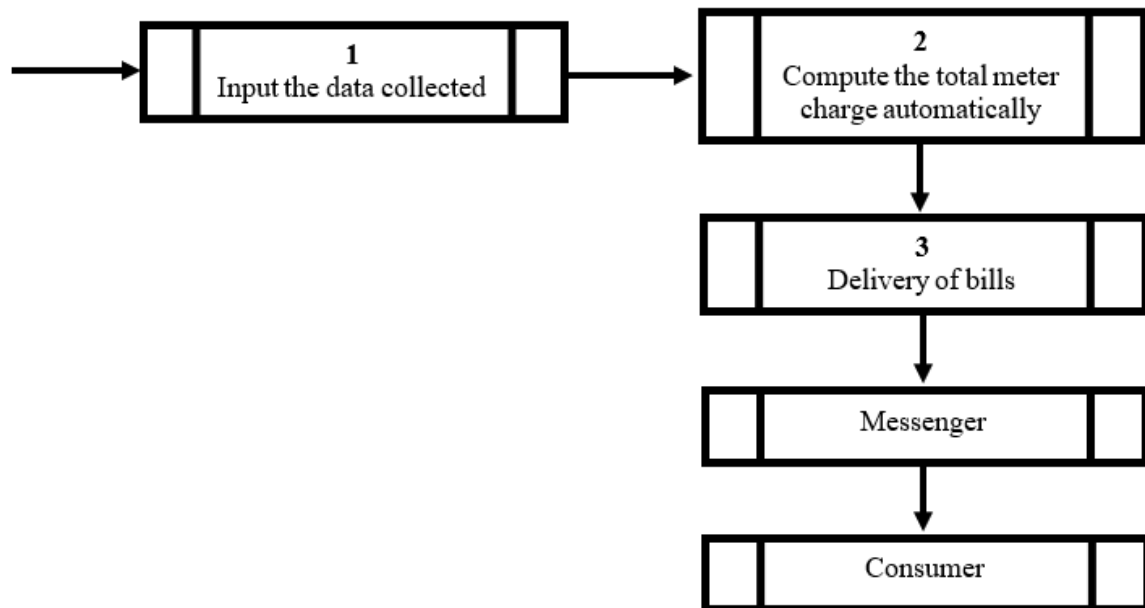


Figure 3. Logical diagram.

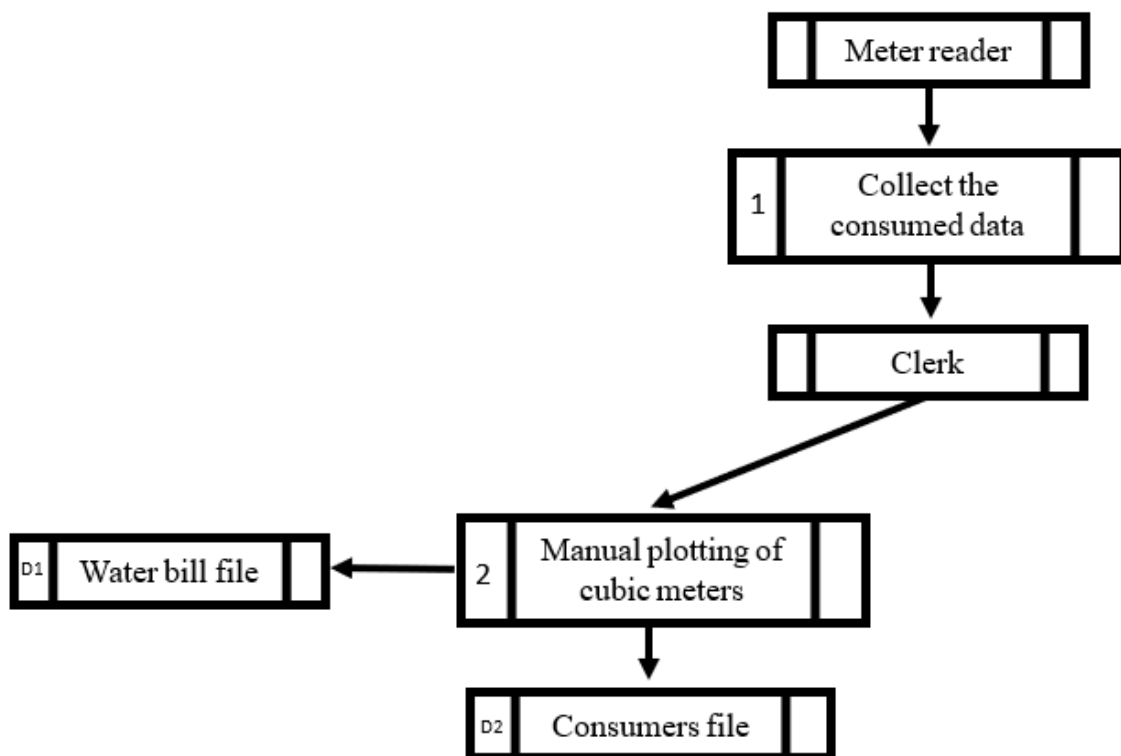


Figure 4. Physical diagram.

#### Data gathering procedures and output

Data gathering took place at the RUWASA Magsaysay Mati, Davao Oriental. The team first wrote a letter to the RUWASA manager asking permission to conduct a series of interviews in their respective office. The questions on the interview were formulated by the team after careful analysis of the system to be developed, readings, and examinations of the related literature and other similar studies. Through interviews and observations, the current system requirements

specification was generated from the respondents. Researching on the Internet to gather more information has also been done. This enabled the researchers to gather more data faster.

### **Documentation of the current system**

Description of Current System The Rural Water System Association (RUWASA) of Magsaysay Mati, Davao Oriental, is a non-profit and non-stock services association that offers 24 hours of service to its members or their consumers. They are currently using a computer-based billing system. RUWASA computes the charge amount of their consumer through the collected data of their meter readers. The meter reader will record the consumed cubic meters of every consumer. After recording the data, they will let the clerk input the data they have collected in the system and compute the total amount of charge manually. The system records the consumer's accounts and generates some forms and reports regarding billing transactions. And as soon as the clerk finishes his job, the meter readers will distribute or deliver the notice of collection to their consumers.

### **Hardware setup**

Processor: Intel Pentium 4 1.8 GHZ

Motherboard: ASUS

Hard Disk Drive: 40 G C-Gate

Memory Card: 128 MB SDRAM

Video Card: 128 MB Video Card

Monitor: 15" Colored Monitor

AVR. 500 Watts

Keyboard

Mouse with Mouse Pad

### **Software and applications used**

Their current billing system made use of the MS Access 2000 software. They also used MS Excel 2000 for the consumer list record. And Windows 98 Operating System and MS Office 2000.

### **Personnel**

At present, RUWASA has eight employees who handle its management and operational functions. The Manager serves as the head of the management and staff, overseeing personnel and monitoring all billing transactions of the association. The Treasurer is responsible for keeping records of all money entering and leaving the association, while the Auditor handles the auditing of financial transactions. The Clerk inputs consumer records into the system, manually computes the total cubic meters consumed and corresponding charges, and prepares billing reports. The Bookkeeper maintains records of important information, reports, and data of the association. Meanwhile, Meter Readers I, II, and III are tasked with reading the cubic meter consumption of each consumer, submitting the readings to the computer in charge, and delivering notices of collection to consumers.

### **Requirement analysis specification**

After gathering all the requirements and data during interviews with the employees and observations on their present system, the team was able to make some diagrams to model or illustrate their present system during the system analysis process. The team developed a use case shown in Figure 5, one of the Unified Modelling Language (UML) tools, during the requirements

analysis process. It is a description of a set of interactions between a user and the system. It describes the entire system the team is planning to create in a very clear and concise manner.

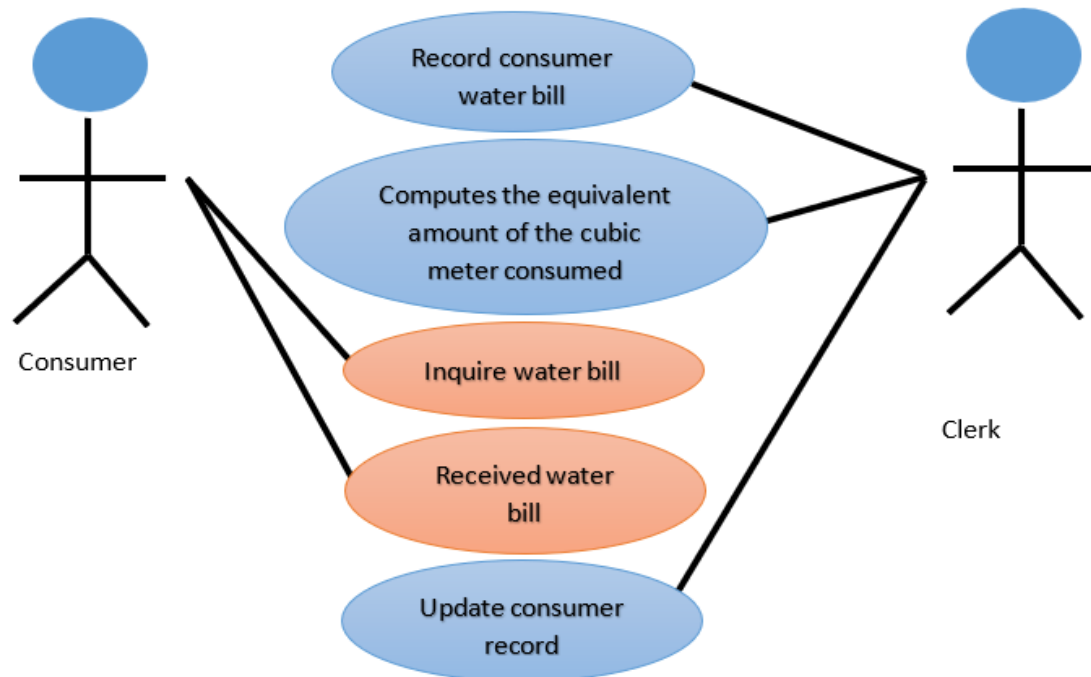


Figure 5. Use case diagram.

**Use case 1:** Record consumer water bill

**Primary actor:** Clerk

**Stakeholder and interests:**

**Clerk:** Wants reliable, fast data entry.

**Consumer:** Wants accurate records of their bills.

**Associations:** Wants to record bills and satisfy consumers' interests accurately.

**Pre-conditions:** Clerk is identified and authenticated.

**Post-conditions:** Recording of bills is made.

**Main success scenario (or basic flow):**

1. Clerk enters username and password to access the system.
2. The system accepts the username and password.
3. Clerk adds new consumer bill record.
4. The system records and presents the new consumer bill.
5. The clerk then verifies the new recorded consumer bill.

**Alternate flow(s):**

The clerk cancels the transaction.

Post Condition → No Consumer Bill is recorded.

**Exception flow(s):**

The clerk forgot his username and password. The user is informed, then the use case terminates.

**Use Case 2:** Calculates the equivalent number of cubic meters consumed and the total amount due.

**Primary actor:** Clerk

**Stakeholders and Interests:**

**Clerk:** Wants accurate and fast calculations of bills.

**Consumer:** Wants accurate calculations of their bills.

**Association:** Wants to accurately calculate bills and satisfy consumers' interests.

**Pre-conditions:** Clerk is identified and authenticated.

**Post-conditions:** Calculations of the bill are made.

**Main success scenario (or basic flow):**

- 1 Clerk enters username and password to access the system.
2. The system accepts the username and password.
3. Clerk adds a new consumer charge and inputs the consumer's present and previous cubic meters consumed.
4. The system calculates the total cubic meter consumed and the total amount due.
5. The system then presents the calculated amount.
6. Clerk verifies the calculated amount.

**Exception flow(s):**

The clerk forgot his username and password. The clerk is informed, then the use case terminates.

**Use case 3:** Inquire about the water bill

**Primary actor:** Consumer

**Pre-conditions:** The consumer has successfully inquired about his bills.

**Post-condition:** The billing history is recorded and presented by the system.

**Main success (or basic flow):**

1. Consumer inquire bill.
2. Clerk enters username and password to access the system
3. The system accepts the username and password.
4. Clerk enters the consumer account number to find the consumer's bill records.
5. The system finds the consumer account number and displays their bill records.
6. The clerk presents the bill records to the consumer.
7. The consumer verifies his bills and confirms the transaction.

**Alternate flow(s):**

The consumer cancels the transaction of inquiring about bills with the clerk.

**Post Condition** → No inquiry of the bill was made.

**Use case 4:** Receives Water Bill

**Primary actor:** Consumer

**Pre-conditions:** Consumer had received his Bill

**Post-conditions:** Statements of Bills are updated.

**Main success scenario (or basic flow):**

1. Clerk enters username and password to access the system.
2. The system accepts the username and password.
3. Clerk prepares the notice of collection forms or the statement of bills through system reports.
4. The system releases the notice of the collection form.
5. The clerk then releases the notice of collection form to the consumer.
6. The consumer receives his notice of collection form.

**Alternate flow(s):**

The clerk cancels the transaction.

Post Condition -> No issuance of bills made to the consumers.

**Exception flow(s):**

The clerk forgot his username and password. The clerk is informed, then the use case terminates.

**Use case 5:** Update consumer Record.

**Primary actor:** Clerk

**Pre-conditions:** Clerk is identified and authenticated.

**Pre-conditions:** Updating of bills is made.

**Main success scenario (or basic flow):**

1. The clerk enters their username and password to access the system.
2. The system accepts the username and password.
3. Clerk adds new consumer bill record.
4. The system records and presents the new consumer bill.
5. The clerk then verifies the newly recorded consumer bill.

**Alternate flow(s):**

The clerk cancels the recording transaction.

**Post Condition** → New consumer bill is recorded.

**Exception flow(s):**

The clerk forgot his username and password. The clerk is informed, then the use case terminates.

**Main transaction flow**

1. Water Bill has a unique bill month, from, to, and due date.
2. A consumer who receives his/her water bill has a unique account number, name, sex, and address.
3. When the consumer is billed, the following is being recorded: account number, bill month, discount, present meter reading, previous meter reading, billing for the period, cubic meter consumed, total amount due, remarks, mortuary fund, total, additional charges, death aid, penalty, surcharge, arrears, partial installation balance, and meter charge. Payment of the water bill will be due on or before the 15th day of the month after receiving the water bill, and if the customer fails to pay his water bill on its due date, a total amount of 25.00 Php as a penalty will be charged for every water bill overdue.
4. Discount is composed of a staff discount and a special discount. An equivalent of 10 cubic meters less is given to the employee who is at the same time a member of the RUWASA upon payment of their water bill, as a staff discount. While a special discount is for those members who lend some part of their land as space allotment for the water pipe and meter reader device of RUWASA, as an incentive for them, they are given an equivalent of 60 cubic meters less upon every payment of their water bill.
5. Minimum rate of 89.60 Php. For every one (1) to ten (10) cubic meters of water consumed.
6. An amount of 2.00 Php. will be added to the bill as an additional payment for the maintenance of the water meter unit.
7. If the water bill is not paid in two (2) consecutive months, disconnection will be done with out further notice.

**Sequence diagram**

The team also developed a Sequence diagram in analyzing the system. This diagram is useful in every different situation, especially at the design stage, because it shows everything the system needs to do. The description of how the objects in the system interact over time can be seen

in the diagram in Figure 6. It shows the billing scenario of the system, and the interaction between the consumer to clerk, and the clerk and the system. The clerk processes the billing transaction through the system, over time, and releases some collection output to the consumer.

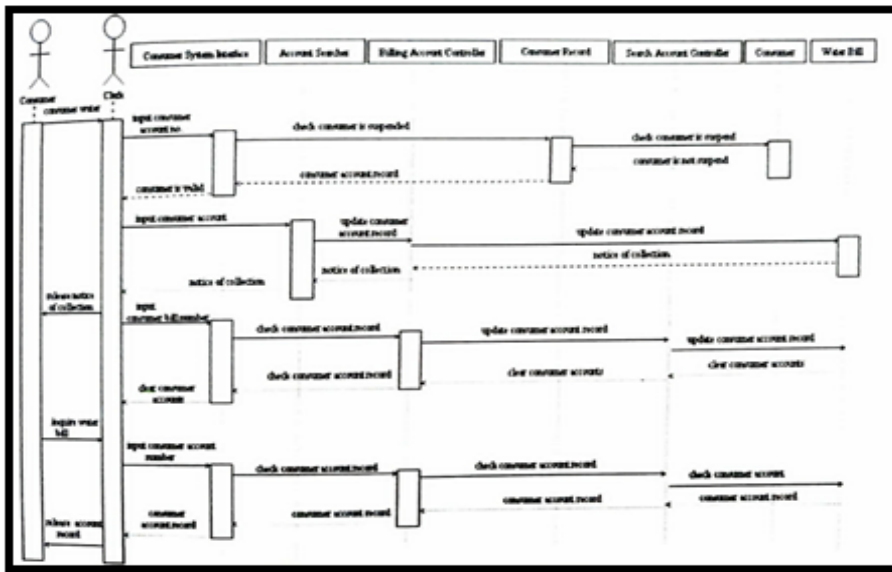


Figure 6. Sequence diagram.

**Data flow diagram**

The dataflow diagram is a modeling tool that allows the team to picture out the system as a network of functional processes, connected by “pipelines” and “holding tanks” of data. The diagrams in Figure 7 show the functions of the system.

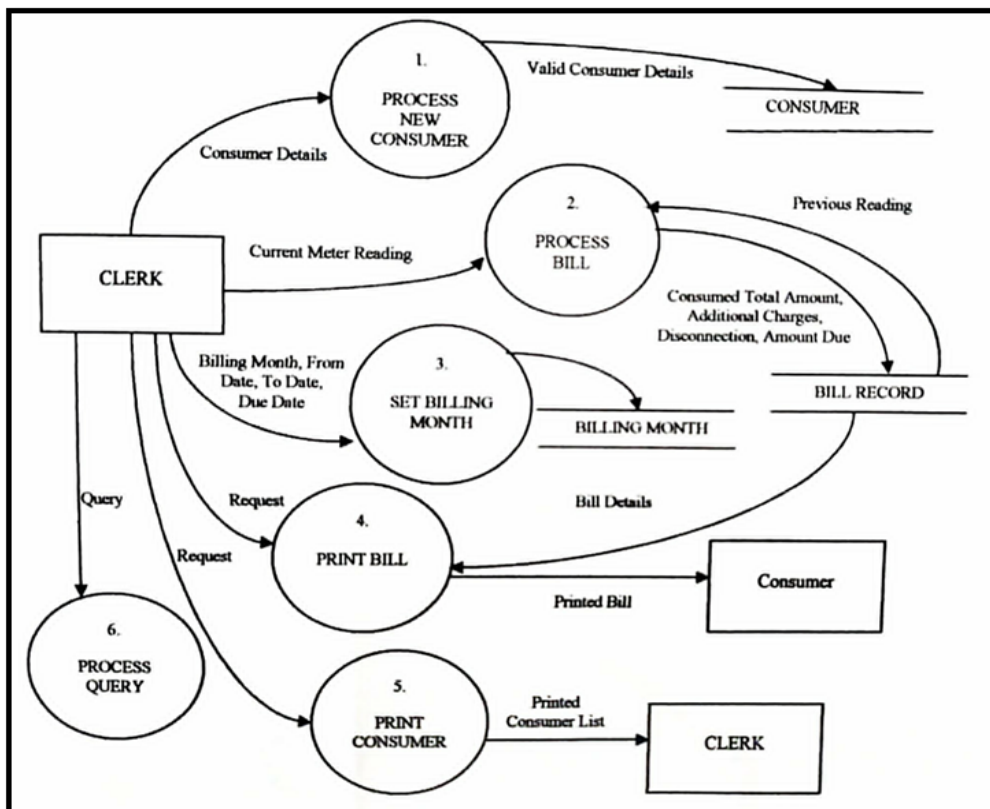


Figure 7. Data flow diagram (level 1).

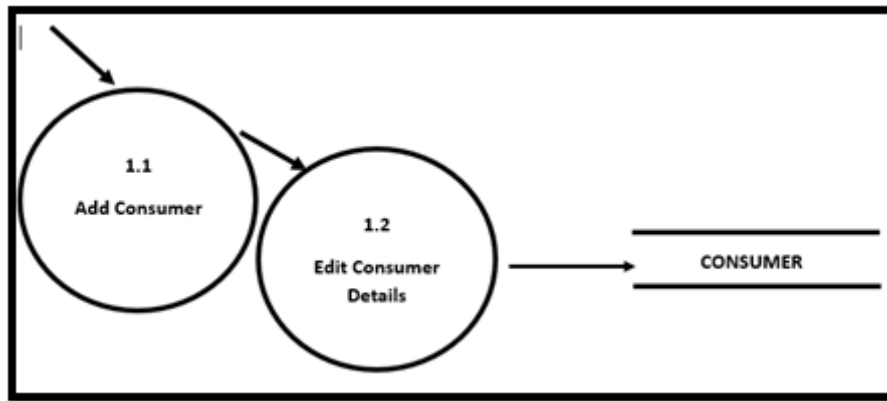


Figure 8. Data flow diagram (level 2)

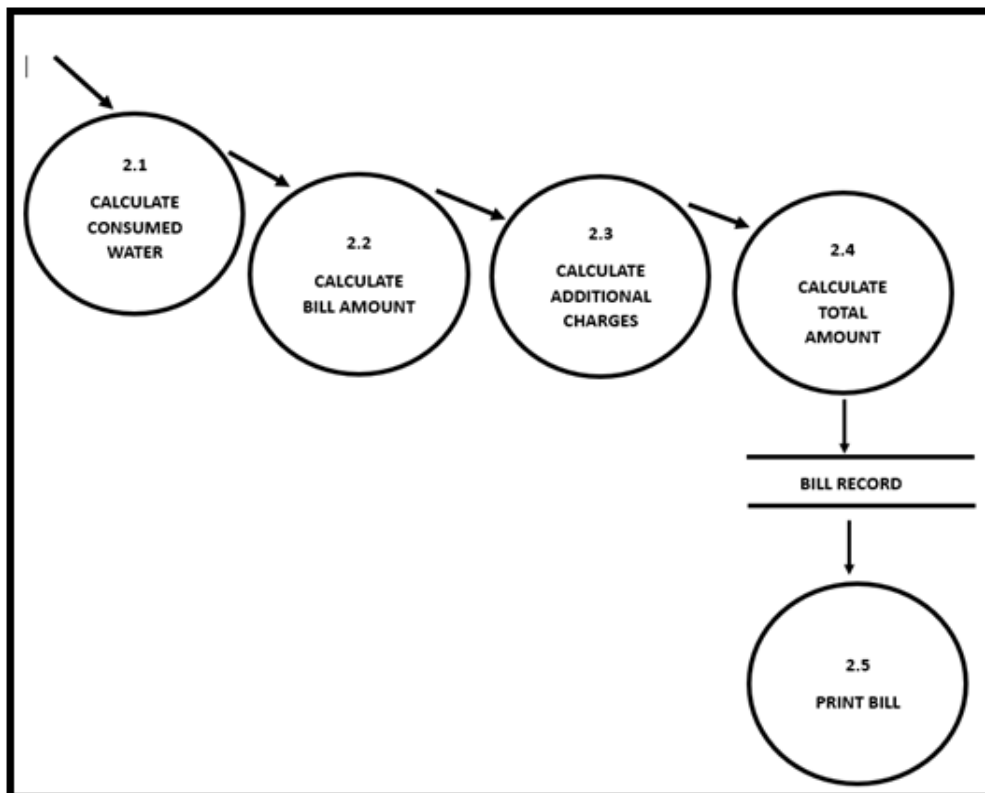


Figure 9. Data flow diagram (level 3).

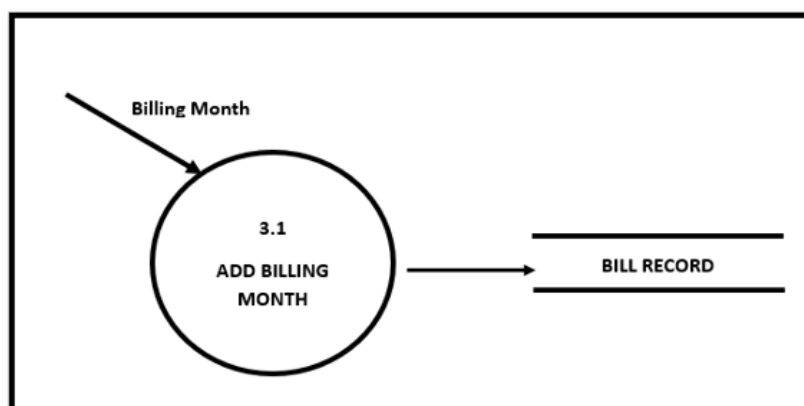
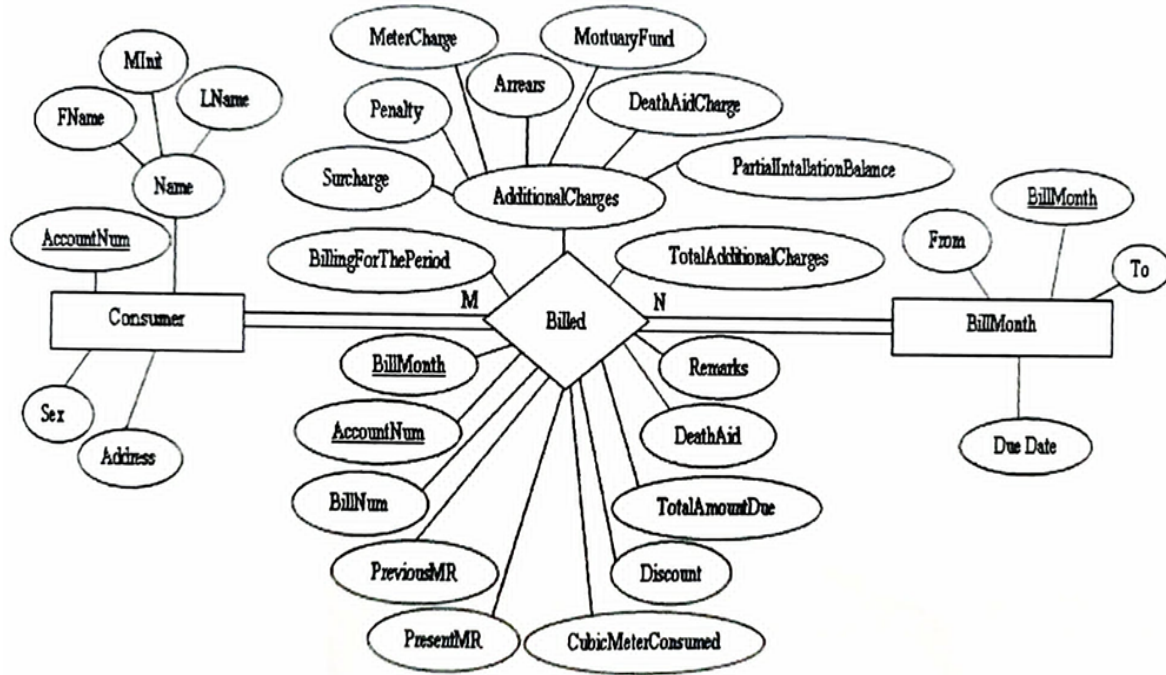


Figure 10. Data flow diagram (level 4).

**Entity relationship diagram**

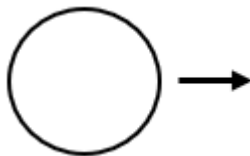
During the conceptual design phase, we build a conceptual representation of the database through creating an Entity Relationship diagram (ER Diagram) as shown in Figure 11, which includes identification of important entity and relationship types. It describes the stored data layout of the system being developed. This is quite different from the dataflow diagram (DFD), which models the functions performed by a system. All the data structures and relationships between data stores on the DFD are highlighted on this diagram.



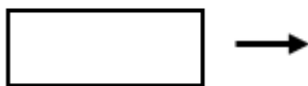
**Figure 11.** Entity relationship diagram.

**Notations Used**

**Data flow diagram**



The bubble represents the process. It shows a part of the system that transforms inputs into outputs, that is, it shows how one or more inputs are changed into outputs.

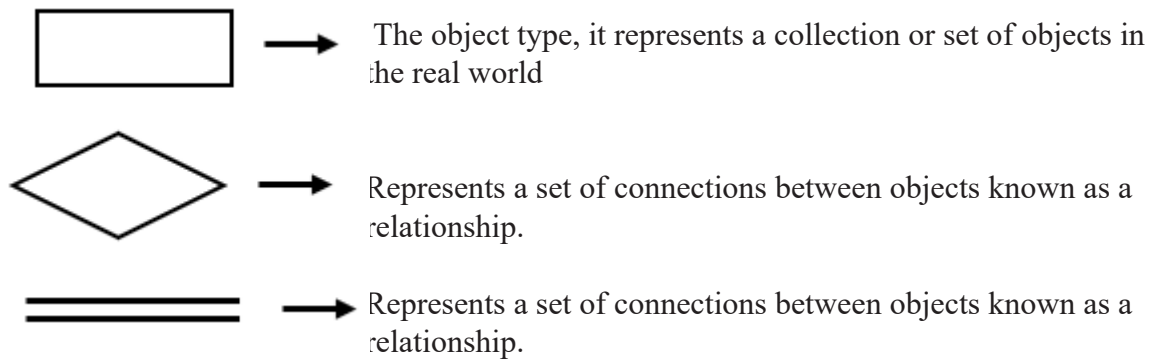


The terminator, it represents external entities with which the system communicates. Typically, a terminator is a person or a group of people.



The flow is used to describe the movement of chunks, or packets of information, from one part of the system to another part. It represents the data motion.

## Entity Relationship Diagram



## SYSTEM DESIGN SPECIFICATION

In presenting the database design methodology, we have the identification of important entity and relationship types in the table relationship.

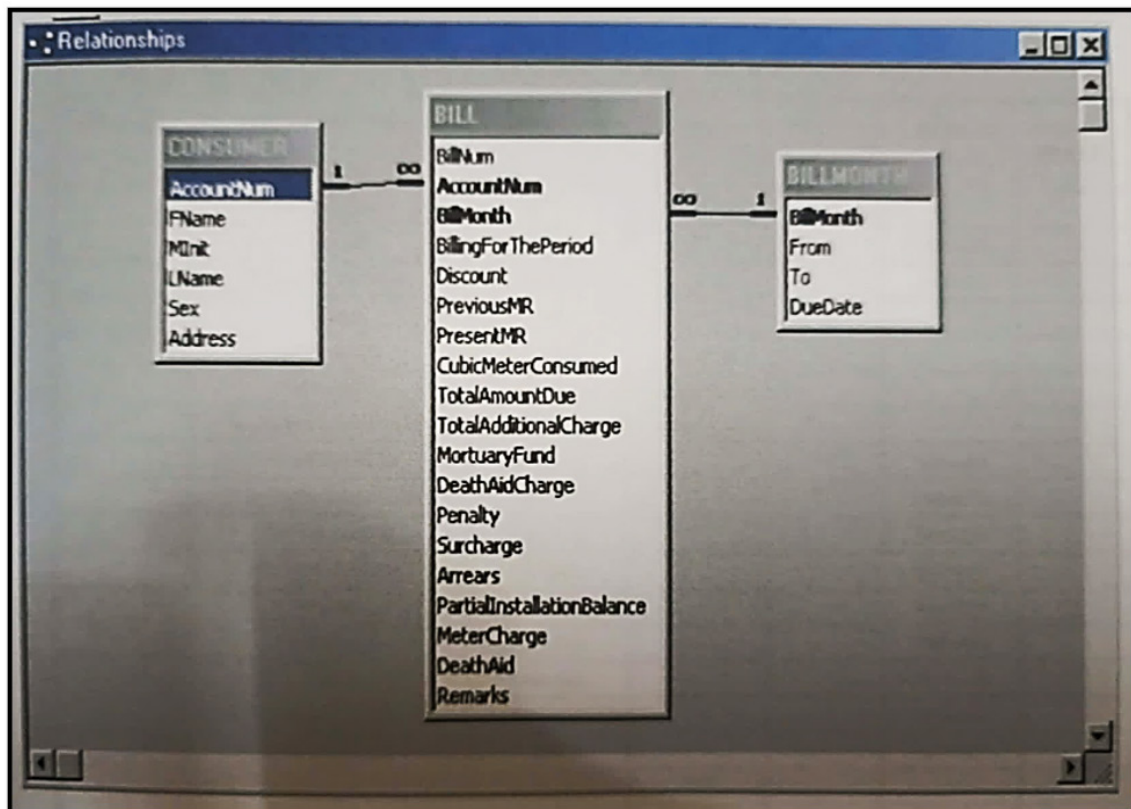


Figure 12. Table relationship

## Menu System

The menu system represents the flow that happens within the system.

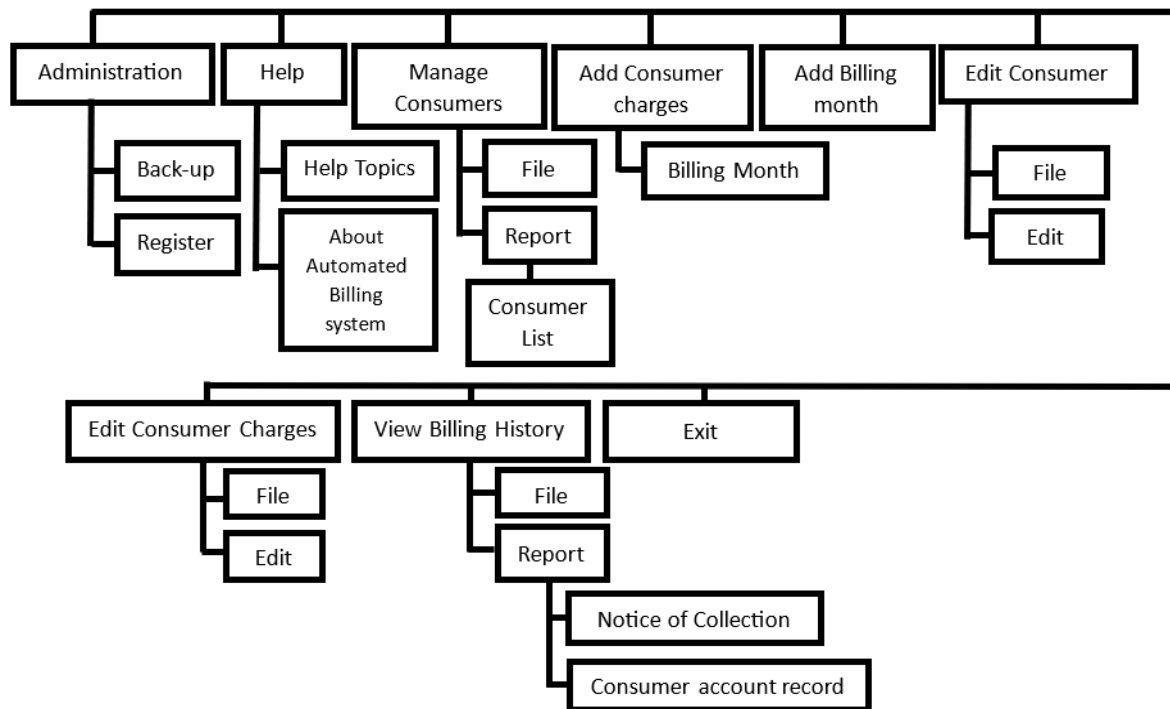


Figure 13. Menu system.

## SYSTEMS IMPLEMENTATION

### Programming considerations, issues, and tools

The user should have a single computer unit with its complete peripheral devices that follow the software and hardware requirements of the Automated Billing System, which is adequate for developing the said system. Software tools used are the following: Visual Basic 6.0 for the system interface and Microsoft Access 2000 for the database. The team encountered problems in developing the system because of insufficient knowledge in using Visual Basic 6.0. However, several research studies on how to use the different features of this programming language were conducted by the team to deal with these problems.

### Conclusion

The Rural Water System Association preferred to have an enhancement on their present system because of the following reasons: First, the need to eliminate the redundancy of encoding, inefficient storing, and recording of data. Second, there is the desire for security and integrity of the data encoded. Third, there is a need for efficient data storage and recording. Lastly, the need for fast and accurate processing of billing transactions. Thus, the team developed its present billing system. After conducting a series of interviews, observations, research, and studies, the team found that the best way to solve the problems regarding their current system is to develop a new, fast, and efficient system that eliminates redundancy of encoding data by improving the current database of RUWASA. This implements an effective safeguard against unauthorized access, provides backup file support to ensure the integrity of data encoded, improves the procedures of recording transactions, and the ways of storing data to efficiently store and record transactions, and finally automates the manual process of calculating the rate of the cubic meter consumed to attain a fast and accurate way of processing billing transactions.

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