BULAK AIMS: A Web-Based Automated Inventory Management System using Multimodal AIDC Technologies

A Project Proposal
Presented to the College Department
Information Technology Program
St. Bridget College

In Partial Fulfillment of
The Requirements for
The Degree in
Bachelor of Science in Information Technology

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August, 2023

CHAPTER I

THE PROBLEM AND ITS BACKGROUND

Inventory management is one of the core areas of Education, IT infrastructure and facilities management. In educational institutions such as schools, colleges, and universities, inventory management covers all things used by staff and students. Educational institution inventory includes movable assets such as seats, desks, blackboards, projectors, library assets, and books. And without inventory management, it will be difficult to estimate the efficiency and cost-to-benefits ratio of inventory (Camu, 2022).

In schools and universities, keeping an inventory of all its assets is a major and challenging task. According to Comparesoft (2022), schools have hundreds, if not thousands, of assets. Including the IT hardware, furniture, books, teaching aids, as well as consumables like stationary and cleaning equipment. There are lots of assets to track and manage. And, in current time, these can be expensive assets such as computers and tablets. This means there is also a lot of financial responsibility attached to the management of school inventory. With this being said, the idea of **BULAK AIMS: A Web-Based Automated Inventory Management System using Multimodal AIDC Technologies** is to help in keeping track of the school's resources automatically with minimal human intervention. Aside from this, through the help of the Automated Inventory Management System it will also be easier to generate reports which is one of the most common challenges that manual inventory is facing.

According to Asset Infinity (2022), an inventory management system is very helpful in the education sector. However, a lot of schools are not utilizing this technology and are still using an old-fashioned inventory tracking method which is manual tracking which can be prone to several challenges such as wrong inventory evaluation, missing assets, theft, prone to human error, and time consuming. This said challenges can be lessen once inventory management is implemented. Implementing an inventory management system can help schools to improve resource management, reduce cost, increase accountability, and provide a more accurate inventory reports.

Having an automated inventory management system can lead to better organisation and gives greater visibility of all educational assets. It gives a better understanding of which teachers and students have access to specific equipment and resources. As well as more control in terms of allocating resources across departments. A digital school inventory system is usually cloud-based, accessible from anywhere, and with support for multiple users. This enables to streamline inventory management both on and off the school premises. Finally, it allows in utilizing assets properly and provides with accurate reporting capabilities. This is critical at times of auditing, and to support the leadership team with strategic decision-making (Comparesoft, 2022).

PROJECT CONTEXT

Inventory is one of the most valuable assets of a company or organization. An inventory has a huge effect on every organization because through this it can lead to problems such as inaccuracy if not taken care properly. With these being stated, the researchers proposed a capstone project entitled **BULAK AIMS: A Web-Based Automated Inventory Management System using Multimodal AIDC Technologies.** The web based inventory system works to create efficiency and cut administration times by automating many of the tasks that people find time consuming. The inventory system can be accessed anywhere and can track the way the item moves. The Automated Inventory management system will use multi-modal AIDC technologies such as RFID and Barcode.

In the RFID, RFID tagging will be used to track the high value assets of the school and for its security, by positioning tag-readers at points of high risk, such as exits, and causing them to trigger alarms. While for the Barcode, it will be used to track other asset that doesn't have a RFID tags. The barcode will also be used to help the school track inventory faster and easier.

The targeted users of this project are the people, mainly staffs, admin, and the inventory manager of St. Bridget College who are responsible for viewing and managing the inventory of the school. Upon assessing the needs of the school, one of the needs that arise is an Inventory Management System. The group comes up with the idea of developing a Web Based Automatic Inventory Management System using Multimodal AIDC Technologies that will be implemented in St. Bridget College. Its purpose is to

help the institution in listing, monitoring, deleting, and updating the school inventory. The researchers also aim to provide an Inventory Management System that is accurate and easy to use which is the common issue on the traditional inventory tracking.

PURPOSE AND DESCRIPTION

According to the researchers, establishing an organized, effective, and transparent inventory management system is essential for the school since it informs the organization of the quantity and worth of each item. This capstone project entitled: **BULAK AIMS: A Web-Based Automated Inventory Management System using Multimodal AIDC Technologies** for St. Bridget College aims to replace the physical or manual inventory that is prone to risk to human error. Furthermore, it is susceptible to data loss because inventory sheet can get torn up over time, lost, or replaced. Physical count or manual inventory is not that reliable because there has a chance of inaccurate collecting data, for the reason of multiple employees can access the documents easily. In automated inventory tracking, the process is organized as software is utilized and since inventory tracking is automated the accuracy is increased and human errors are minimized. Automated Inventory Management System is also the easiest way to store and generate reports.

The result and input of this study will provide understanding and ideas to the following:

Institution. The findings of this study will help the entire organization keep track of and regulate the products that need to be replaced or added.

Community. The findings of this study may benefit the community by assisting in meeting needs or altering what is required for public usage.

Custodian/s. The results from this study will benefit the custodians for the reason that they will keep an accurate and intact inventory for their handled resources precisely.

Researchers. The study benefits the Researchers for they gained knowledge about the inventory management which in return might prepare them for their future career.

Future Researchers. The findings and the conclusion of the study will help the future researchers to be aware and knowledgeable about the automated inventory management system which they might use in their own study

OBJECTIVES

The BULAK AIMS: A Web-Based Automated Inventory Management System using Multimodal AIDC Technologies aims:

General Objective: To develop a web application that can help St. Bridget College, College Department in monitoring, storing, compiling and generating reports of all equipment of the school that also offers an easy-to-use interface for any normal user and availability of computerized data information.

Specifically, this capstone project aims to:

1. Design a web-based automated inventory management system in terms of:

   1.1. Interface Design: The system should have a visually appealing and consistent interface design. The design should be based on industry best practices and should incorporate user feedback to ensure that it meets the needs of the target audience.

   1.2. User Interface: The system should have a user-friendly and intuitive interface that allows users to easily navigate and interact with the system. The interface should be designed to minimize errors and make it easy for users to perform tasks quickly and efficiently.

   1.3. User Experience: The system should provide a positive user experience by being responsive and reliable. The system should be

designed to minimize the amount of time required to complete tasks and provide real-time feedback to users.

1.4 System Design: The system should be designed to be scalable, flexible, and modular. The system should be able to handle large amounts of data and be able to adapt to changes in the inventory management process. The system should also be able to integrate with other systems and technologies to provide a complete solution for inventory management.

2. Develop an Automated Web-based system that will be capable of:

2.1. Developing a responsive web based automated inventory management system

2.2. Integrating AIDC technologies such as barcode scanners, RFID readers, and smart sensors using arduino.

2.3. Tracking inventory items using barcode technology for specific category of items.

2.4. Tracking inventory items in real-time using Arduino and RFID (Radio Frequency Identification) tags.

2.5. Generating a report that provides valuable insights into inventory management system using multi-modal AIDC technologies.

3. Evaluate the developed system to ensure it meets the requirements through system testing and identifying any issues or bugs.

4. Implement and install this system through installing the hardware and software components and preparing personnel on how to utilize or use the system.

SCOPE AND LIMITATION

The focus of this study is to develop a Web Based Automated Inventory Management System using Multimodal AIDC Technologies for St. Bridget College. The study focuses on inventory of equipment and other materials of St. Bridget College Inventory Management Division. The inventory management division is components of the proposed system. This project can help the offices of the institution such as Library, Dean's Office, and Maintenance to help managing the information and status of the equipment and materials to ease the workloads. The application can provide information, storing, compiling data and reports. It is a web-based system and with that being said, the system will not function if not connected to the internet. Transactions conducted in the finance office are also not part of this project. Aside from this RFID and Barcode will be used in order to monitor, list, delete, and update the information of the equipment.

The barcode scanning is faster and more efficient than manual data entry, allowing staff to complete inventory task more quickly and easily. However, barcode will only be used for the asset that has a lower value and those assets that cannot be moved easily. The barcode also does not provide an alarm system unlike RFID. However, RFID has a limited range, which means that items may need to be within the close proximity of the scanner to be detected.

The Web Based Automated Inventory Management System using Multimodal AIDC Technologies is limited only on St. Bridget College and the system is solely made

for St. Bridget College. The application only consist information for St. Bridget College and the other feature of the app is only limited to St. Bridget College.

DEFINITION OF TERMS

Inventory Management refers to the process of ordering, storing, using, and selling a company's inventory. This includes the management of raw materials, components, and finished products, as well as warehousing and processing of such items.

Inventory Management System is a combination of hardware and software technology, which tracks and manages product inventory, product sales and other production processes.

Multimodal refers to having or using a variety of modes or methods to do something.

AIDC Technologies is a broad category of technologies used to collect information from an individual, object, image or sound without manual data entry.

Radio Frequency Identification (RFID) refers to a wireless system comprised of two components: tags and readers. The reader is a device that has one or more antennas that emit radio waves and receive signals back from the RFID tag.

Barcode refers to a printed series of parallel bars or lines of varying width that is used for entering data into a computer system.

Arduino refers to an open-source electronics platform or board and the software used to program it.

CHAPTER II

REVIEW OF RELATED LITERATURE AND SYSTEMS

This chapter discusses the facts, concepts, principles and theories that have direct bearing or relation to the conceptualization of the design project. These related literatures include the critical view, and evaluation of related studies from readings, write-ups and previous projects.

Review of Related Foreign Literature

Inventory management has been used as a decision-making in countless firms and has been extensively studied in the academic and corporate spheres. The purposes of inventory system is to know the details of the items including code, name, condition, location and the year of purchase (Risqui and Rohmah, 2018).

Todd (2021) claims that schools face a variety of inventory-related difficulties, including tracking down the whereabouts of the equipment, keeping track of its condition, and spotting purposeful theft or damage. Double bookings are one issue that can arise from poor asset management. One of the most effective ways to guarantee that employees can complete their tasks with ease is to use inventory management software.

According to Jenkins (2020), an inventory management system optimizes inventory levels and ensures product availability across multiple channels. It provides a single, real-time view of items, inventory and orders across all locations and selling channels. This enables businesses to carry fewer inventories on hand and frees up

cash to be used in other parts of the business. An inventory management system helps keep low inventory costs while delivering on customer expectations.

Bagchi et al. (2018) stated that RFID is the latest application of IT to tracking goods and services or anything for that matter, including human beings. It is an evolution from bar code and palette technology. RFID is superior in reducing the mean and variance of inventory cycle times. As inventory cost is a function of these (among other variables, such as unit holding and shortage costs), the study show that RFID reduces this cost. Also, because RFID leads to rapid transmission of data, it would help avoid excessive inventories and shortages, further reducing total inventory cost. The researchers also argue that RFID is superior to existing identification technologies according to mean-variance stochastic dominance.

According to Tao et al. (2016), when RFID technology is adopted, the inventory control policy in the RFID case is much more stable than that of the non-RFID case, as the misplaced inventory can be recovered perfectly and instantly for sale and the inventory shrinkage can be reduced by RFID technology.

Review of Related Local Literature

Inventory management will always be a concern for any company that deals with tangible goods and the materials necessary to manufacture them. The practice of inventory management becomes more challenging the larger the company and the more diverse their product lineup. Having a reliable inventory management system can do more for a business than simply make ordering, warehousing, and shipping products

much easier. A more updated and data-driven system can actively spur the health of the company's cash flow and open up new opportunities for business revenue (Gaspar, 2020).

According to the study conducted by De Chavez et al. (2016), it is beneficial to develop an inventory management system because it is more convenient to use and errors in documenting the properties will be reduced. It will also save time and improve accuracy in tallying the properties for the documentation rather than doing manual counting and tallying using a tally sheet. Through the system, it is also easy to track the borrowers and identify a reliable person for property damage and losses.

Inventory systems play a vital role in a business setting because it lessens the time and burden in performing inventory of products. Inventory system save businesses from data inconsistencies and more importantly, prevent profit loss. The job of monitoring and recording stocks is considered to be a strenuous activity, by which computer and software come in order to alleviate the work. With the advent of different computer technologies, computer systems driven by human intervention speeds up the process and increase efficiency (dayday et al., 2017).

According to Raguindin and Ronquillo (2019), through the RFID, in combination with bar code, used to log-in and log- out borrowed equipment during laboratory and non-laboratory classes or even during research class. With the automated system, the dispensing process is reduced. A real-time inventory of equipment, as well as utilization reports, is easily generated and accessed by the authorized personnel.

Review of Related Foreign Systems

An RFID inventory management system is a tool that uses radio frequency identification (RFID) tags to track and manage inventory with real-time updates. The system is made up of three components: RFID readers, RFID tags, and an RFID software application. RFID tags for inventory management are attached to the items being tracked, and each of these RFID labels contains a unique identifier. RFID readers use radio waves to communicate with the tags, and the software application is used as a database to track and manage the data collected (Radiant, 2022).

According to Vaiana (2021), A barcode or bar code is a method of representing data in a visual, machine-readable form. Initially, barcodes represented data by varying the widths, spacing and sizes of parallel lines. A barcode inventory system is a method that helps businesses track inventory faster and easier. When a product has a barcode, it's scanned with a handheld mobile device and synchronized with inventory management software in real-time.

Application and integration of an RFID-enabled warehousing management system conducted by Lee et al. (2016), stated that RFID-based inventory management system has capability of interacting with a proposed RFID-enabled automated storage and retrieval mechanism without any human intervention. To maximize efficiency in material-handling operations and minimize operational costs, a selection algorithm was developed within the RFID-inventory management system to seek an optimal solution in which it allows a manipulation of RFID-tracked items under pre-defined rules by assigning a priority (in an order if applicable) to one of selected items to travel to a

specified collection point. A pilot test was carried out for examining the feasibility and applicability of the RFID-based management system based on the developed selection algorithm. In theory, such a system can be expanded by incorporating any pre-defined selection parameters.

According to the study conducted by Vamsi et al. (2019), which is entitled IOT Based Autonomous Inventory Management for Warehouses, nowadays warehouses and inventories are facing so many problems like huge amount of human's involvement in work and manual errors (or) human errors, and lot of workers are required for controlling or managing the process. May be sometimes human could make errors, but machines never could make errors. In line with this a new idea which is movable bar code scanner using IOT (industry automation and smart glasses) for reducing the problems in warehouses and inventories. It can make the industry foster (advance), quick, efficient, and better digitalized.

The study Implementation of Barcode on Warehouse Management System for Warehouse Efficiency stated that technology has the power to affect and shape modern life aspects. Technologies have speeded up and simplify every task. One of those technologies that we currently use is Barcode. Barcode system can be implemented in the warehouse management system. By using Barcode in every process of the warehouse management system, it helps to minimize human error and provide accurate data in a real-time. Barcode also helps to integrate every process and improves efficiency in the warehouse management system. However, there are lots of warehouses that using manual handling (Istiqomah et al., 2020).

Review of Related Local Systems

In the project conducted by De Ocampo et al. (2016) “Automated Inventory property management for the Boy Scout of the Philippines”, Both QR code and bar code is used to tag such equipment that being used by the Boy Scout. It provides report for inventory process. Moreover, it is important to government agencies to move towards an automated approach in their inventory systems. Annual inventory reports are required of all government entities to be submitted to the Commission on Audit. Under COA’s Audit Jurisdiction, COA has the right to collect inventories and audit of the properties of every government entities.

In the project “Development of a Hotel Inventory System through Agile Methodology” by Diaz et al. (2021) stated that the goal of the inventory system is to reduce the inaccuracy and loss of data and eliminate the bottleneck in the daily operations of the hotel. The system should be able to display the complete list of products and their respective quantities in order to avoid overstocking and under stocking of products of hotel inventory. The system also monitors the returnable and consumable products of the hotel. It would monitor the location of the returnable products at any point in time. Moreover, the data recorded should be kept securely such that it is only accessible by authorized personnel which are the admin and, senior manager, and those from the accounting, housekeeping, and purchasing departments.

Unicommerce’s Inventory Management Software is the best system in the Philippines as it is designed to catch an array of details of the inventory so that it can make the right inventory replenishment decisions quickly. While the system provides an

inventory snapshot, inventory inefficiencies can be prevented in the shortest possible time. Furthermore, the software is integrated with barcode systems to ensure tracking throughout the cycle (Souza and Nguyen, 2019).

Synthesis

RFID is the most advanced technology for retail stores to use. Unlike barcodes, RFID does not require line of sight for scanning which speeds up the scanning and payment process in the retail store. With RFID, inventory check-in, inventory counts, sales floor replenishment, and product locator can all be done in minutes. Processes that used to require employees to complete can be handled automatically with the RFID inventory system. RFID improves visibility of inventory by providing real-time updates.

According to Inturn (2022), Inventory management systems are valuable tools in helping to provide a clear view of all stock, allowing retailers to better handle things like inventory allocation, excess inventory and other stock related processes. The most common type of inventory used is the manual inventory management and According to PACKAGEX (2021), the manual inventory system involves a person manually maintaining and updating each record, increasing the risk of human error. Furthermore, this system is also susceptible to data loss because inventory sheets can get torn up over time, lost, or replaced. In contrast, an automated inventory system is controlled and managed by software. It is safe, more efficient, more secure, and almost impossible to lose data. Kivimaa (2022) stated that an automated inventory control system is much more efficient than manual methods. Since employees no longer need to fix spreadsheets, they have more time to focus on other tasks. And with a system keeping

track of inventory levels, stock takes don't need to be done as frequently. However, there are still disadvantage in Automatic Inventory Management System. According to Leonard (2019), one of the biggest problems with any computerized system is the potential for a system crash. Aside from this, it can also be prone from malicious hacks. Upon presenting the advantages and disadvantages of the automatic inventory management system, having an effective Inventory management system is really essential. An inventory management system can simplify the process of ordering, storing and using inventory by automating end-to-end production, business management, demand forecasting and accounting. Aside from this, Spreadsheets, hand-counted stock levels and manual order placement have largely been replaced by advanced inventory tracking software (IBM, 2022).

CHAPTER III

TECHNICAL BACKGROUND

St. Bridget College is a Catholic educational institution founded by the Religious of the Good Shepherd in 1913. At present, St. Bridget College is a K-12-recognized institution and is constituted of three departments: elementary, high school and college. It is one of the major schools located in Batangas City and throughout the Province of Batangas.

The institution recognizes the need of implementing an automated inventory management system in order to make inventory management easier. Aside from this, the institution also recognizes that an automated inventory management system is essential to effectively manage the assets, improve accountability, and enhance the assets' security. This is the reason why the proponent comes up to develop and design an Automated Inventory Management System for St. Bridget College, College Department

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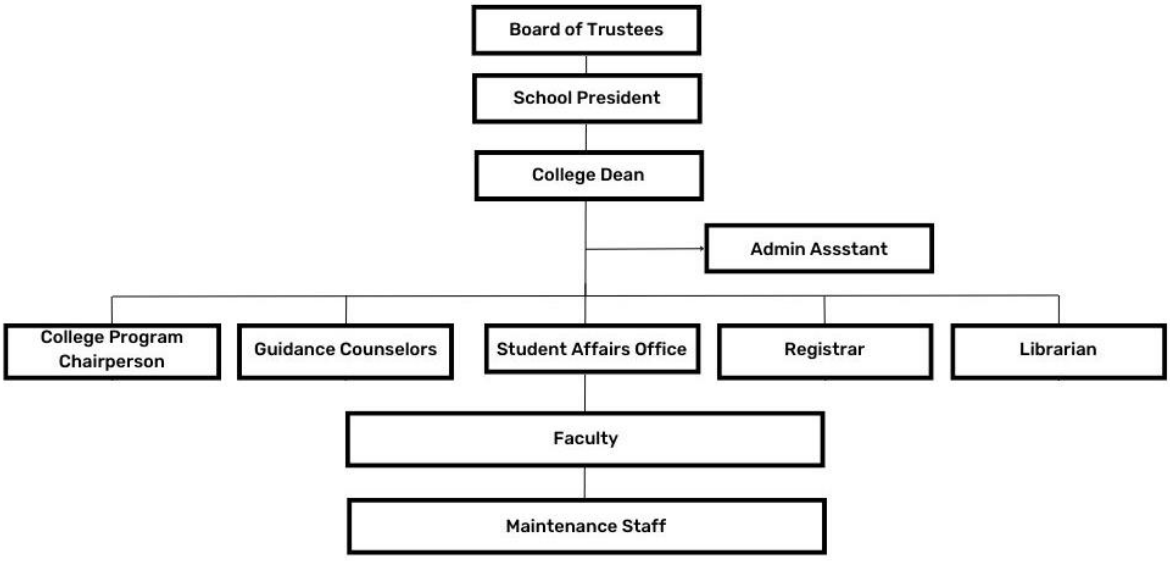

Figure 3.1

Organizational Chart

Automated Inventory Management System plays a vital role and is essential for the institution. With this being said, it is important to have a clearer view of who are the people that are involved in the said project and what is their roles and responsibilities through an organizational chart.

The figure 3.1 shows the organizational chart and the people who are involved to finish this project. The persons involved in this project together with their corresponding roles are listed below.

The College dean. The college dean is responsible for the approval of the system.

The IT Chairperson. The IT Chairperson check, review, and approve the system and its functionalities.

The Department Custodian. The department custodian have the authority to access and manage the system, and to generate reports.

Figure 3.2

Workflow Diagram

The figure 3.2 shows the working process of the system. The administrator or custodian must first connect/login in to the inventory management system's website using their user name and password. The second step is data gathering, which involves using AIDC technology to compile information on inventory items, including product details, serial numbers, and more. The third step is data processing, which involves organizing and storing the gathered information so that authorized custodians can access it and do analysis on it. In the fourth step, the system looks for the presence of security tags, enhancing the security of extremely valuable and RFID-tagged items to prevent theft. The fifth feature is stock control. If the tag is altered, an alarm will also go off to warn of a possible theft. The system gives the designated custodian reports on stock levels and stock movements as the final step

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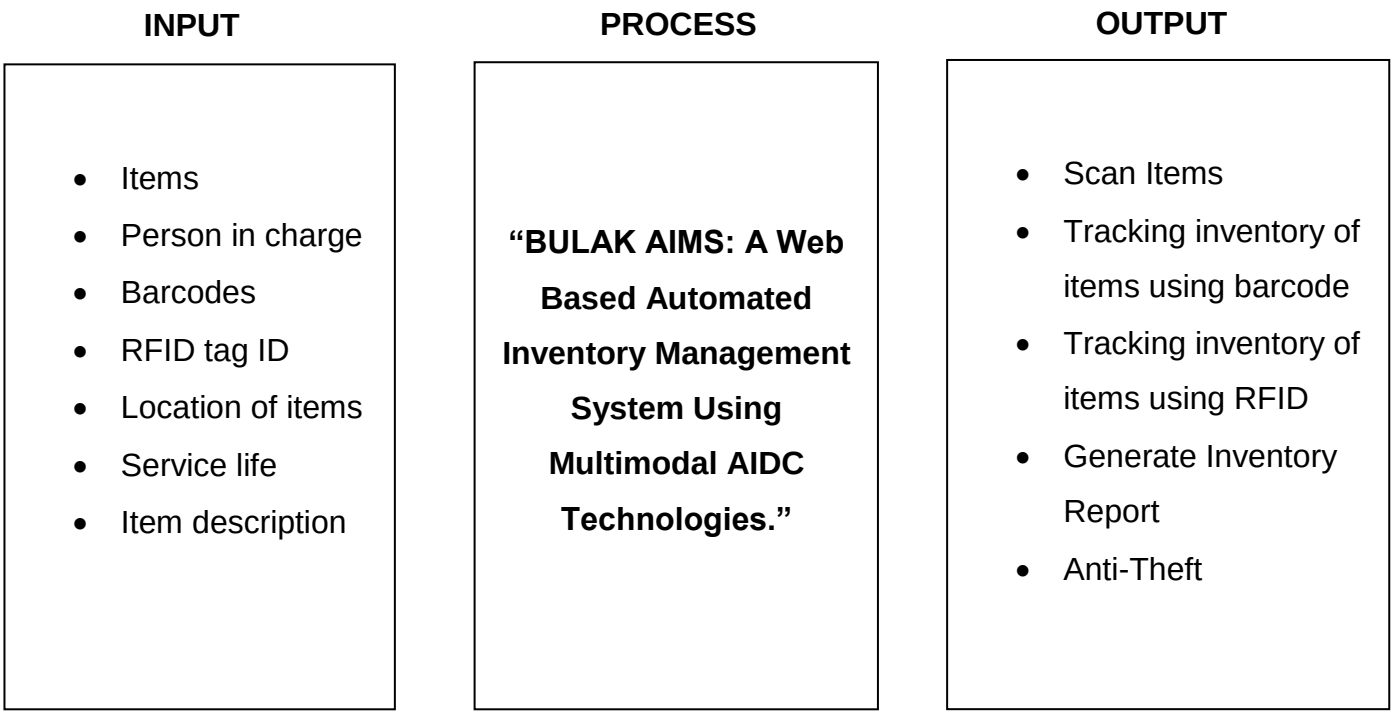

Figure 3.3

Research Paradigm

BULAK AIMS: A Web-Based Automated Inventory Management System using Multimodal AIDC Technologies contains three important aspects; the input, process and output. The input diagram shows the data and information needed by the developer in order to start the system. The process shows the system that will be developed which is the Web-based Automated Inventory Management System using Multimodal AIDC Technologies. Lastly, the output shows the things and features that the system can do and offer.