Journal of Applied Engineering, Technology and Management (JAETM)

Offline Entry and Exit Gate Management System: A Barcode-Based Registration System at Jigme Namgyel Engineering College

Younten Tshering[1*], Wangchuk Dorji[2], and Khina Maya Ghalley[3]

[1-3]*Department of Information Technology, Jigme Namgyel Engineering College, Royal University of Bhutan*

[*]*Corresponding author: Younten Tshering, yountentshering.jnec@rub.edu.bt*

Published: June 2024

DOI: https://doi.org/10.54417/jaetm.v4i1.121

Abstract

The barcode system is used to automate data collection, eliminating the possibility of human error. The data obtained through the barcode is generated rapidly. Further, barcode scanning automatically enters a large amount of data into a system, making it efficient for recordkeeping and streamlining the records. Previously, Jigme Namgyel Engineering College (JNEC), had a paper-based registration system. It consumed a great deal of paper, and time was consumed in long queues while students entered and exited the campus. Therefore, a QR system was developed whereby users scan outgoing/incoming QR through Google scanners and fill an online form. The system was also found to be time-consuming as the user had to punch in details manually and there was also a need for an internet connection. Although the system did help curb paper wastage. Therefore, to overcome the limitations of both systems, a Barcode System has been developed, wherein the barcode present in the user ID card is scanned and the user details are auto-generated in the system. This system was developed and designed using Microsoft Access (MS Access). Problem-Based Learning (PBL) methodology was also implemented along with the System Development Life Cycle (SDLC). The system allows users to view and print the user record based on department, generate users' entry and exit reports, and also sort the report by date. The Barcode system is found to be the quickest and easiest way for the user to get registered. It is essential because it fulfills the primary role of keeping the record of outgoing or incoming users faster and easier. The Barcode system also fulfills the aim of going green by reducing paper wastage.

Keywords— Barcode, MS Access, Problem-Based Learning, Scanner, and System Development Life Cycle

1 Introduction

Record keeping is the way to store, maintain, and keep track of the current data. Good management of records will prevent data loss and systematically manage records. Microsoft Access (MS Access)

is a technology used to record data regularly and it is specifically designed to store a large amount of data. Previously, the gate system in Jigme Namgyel Engineering College (JNEC) used to maintain records physically in the registration book. Later this system was replaced by the QR system where the students had to scan the QR code and manually punch details to get registered before exiting and entering the college campus. The previous system had many issues where the students had to be in queues in front of the gate to register and there was a risk of losing data if the register got misplaced. It was also inefficient due to excessive use of paper and time-consuming procedures. Therefore, to prevent these problems QR system was introduced, which had its own drawbacks. Users needed internet to use this system and had to manually fill in their details. To solve the drawbacks of both systems mentioned above, a system using a barcode was developed. A barcode system is used to automate data collection through the use of barcodes and barcode scanners. The students and staff will have to scan their cards and every detail will be generated in the system automatically. For maintaining the records MS Access is used as it has forms that provide a convenient interface than Excel Worksheet while working with large amounts of data. The achievement of this barcode system is that it fulfills the goal of zero paper involvement while getting registered. It also achieves the goal of saving more time than using the QR scanner. People who will benefit from this system are the students and staff of JNEC. This system will also create a convenient way for the data to be collected faster and reduce the work of the users compared to previous systems.

2 Related Work

For the QR system, a 2-dimensional (2D) barcode is used. 2D is a combination of patterns consisting of squares and dots and it can be only scanned through imagers.

Sources [1] and [4] indicate that unlike 2D barcodes, 1-dimensional(1D) barcodes do not include images or website addresses, allowing them to be used offline. As per [2] and [3], the major drawback of the 1D barcode is that it can store only a small amount of data. In this work, the 1D barcodes are used as it is easier and faster to decode by the scanner.

MS Access is used in the barcode system as it helps to store and maintain all kinds of information. We can manage data efficiently and analyse large amounts of information that cannot be worked in Microsoft Excel. It uses an accdb as the default Access file format. According to [5], MS Access also has an advanced and attractive graphical interface, which makes it ideal for creating, managing, analysing databases, and producing reports. The disadvantage of MS Access is that if we are using the old version of MS Access and shift to a new version then data will not look the same due to compatibility issues.

System Development Life Cycle (SDLC) is a conceptual model used to describe the stages involved in a project [6]. There are many SDLC models such as the waterfall model, spiral model, and rapid application development (RAD). All the planning, analysis, design, development, and testing phases were carried out sequentially while developing this system. SDLC model helped give a clear view of the entire project since goals are clearly defined. For this system, the SDLC approach was adopted.

As per [7], they have created an IoT-based platform where they have followed UML methodology to enhance the process of understanding the system to be robust. According to [8], they work with the collaborative technique where they have followed Rapid Application Development (RAD) to enhance the development process. Similarly for this project, the collaborative technique is implemented with UML and incorporated into the process of RAD during SDLC.

3 Methodology

The existing QR system towards the proposed system is shown in Fig. 1. In the earlier system, the users had to scan the QR code to register for entry and exit from the college. The users had to fill out the Google form which is time-consuming and there is also a need for an internet connection. To overcome the limitation of the QR system, we propose a system using the barcode reader. In the barcode system, the barcode reader reads the barcode present in the user ID card and the details of the users will be auto-generated from the user table in the MS Access.

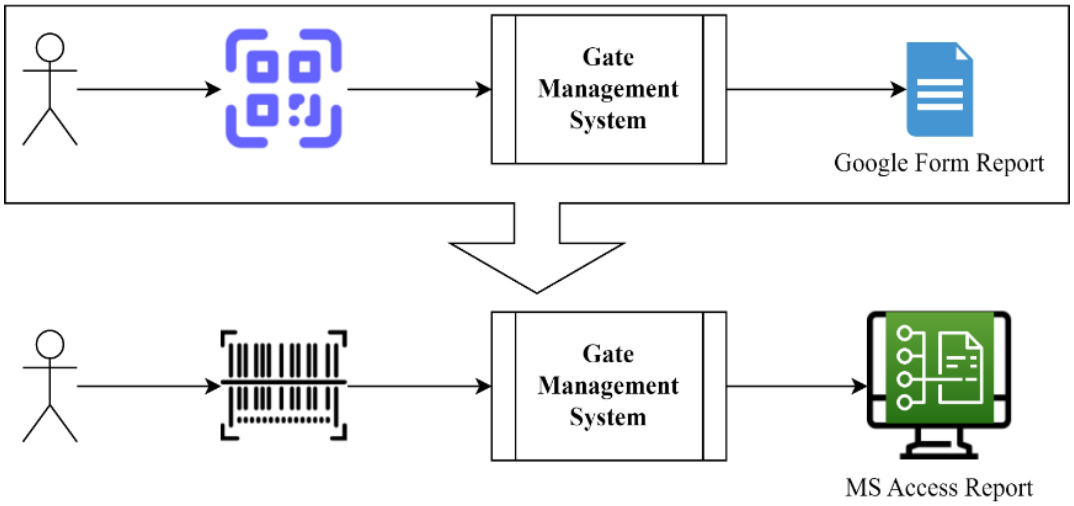


Figure 1: Conceptual diagram

As per [9], the Problem-Based Learning (PBL) concept helps in realizing meaningful knowledge and skills development. Thus, the PBL Approach was practiced as shown in Figure 2, firstly the project member discovered the problem in the existing system and brainstormed to get the solution. The solution was generated based on prior knowledge and then applied the SDLC approach to solve the problem. The feedback was collected and reflected among team members and implemented for the betterment of the system.

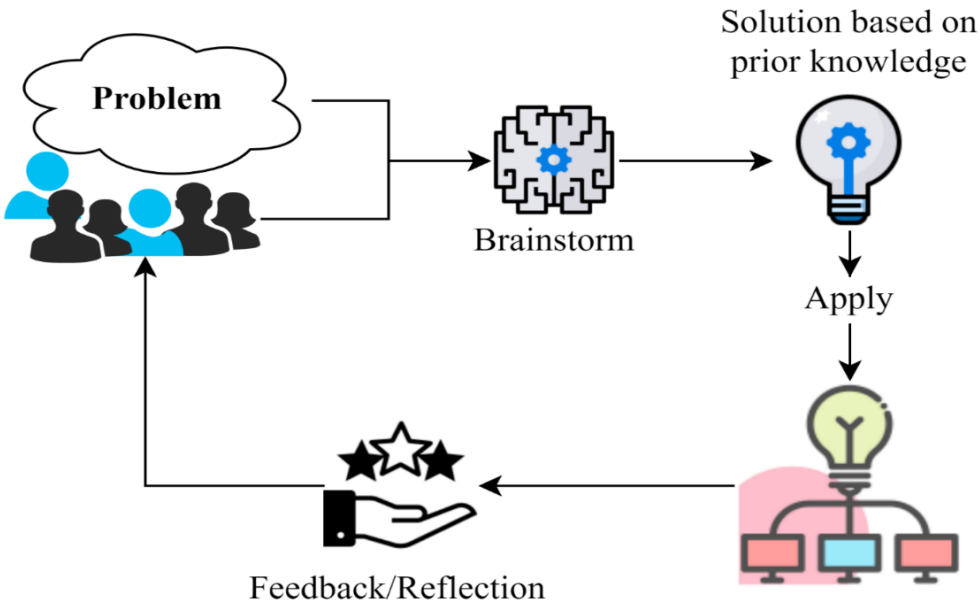


Figure 2: PBL Approach Pract

Figure 3 represents the system development process applied during the development of this system. In the planning phase, the project team created the task list, resource plan, communications plan, and initial schedule for the project. In the designing phase, designs were created to achieve the project result. Depending on the project, the design phase product includes ER diagrams as shown in Figure 4 and requirement definition.

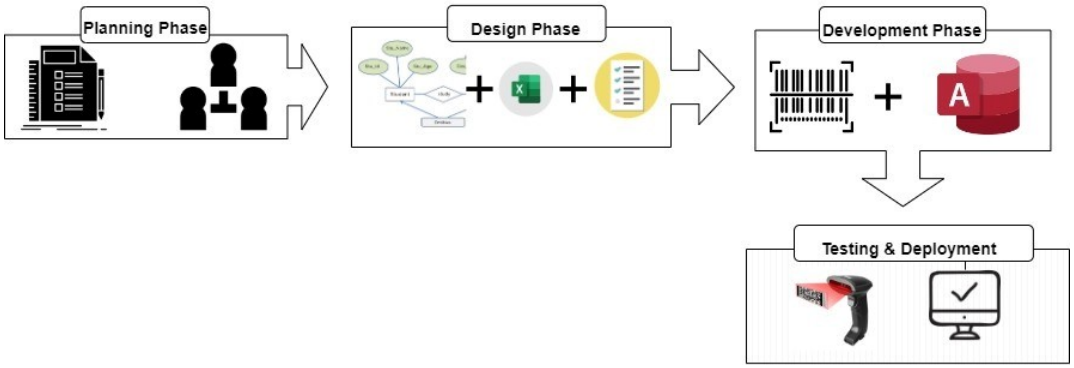


Figure 3: System Development Process Applied

During the development phase, the system developer took the detailed logical information document and transformed it into MS Access form and ensure that all of the components function correctly. In the testing phase, the barcode was integrated to be scanned and the details of the user were autogenerated in the database table where the testing was done.

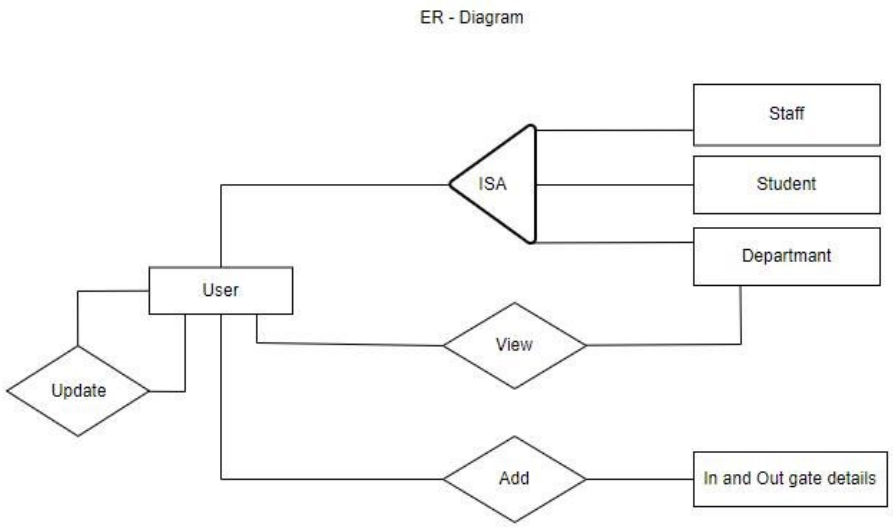


Figure 4: Overview of Data Modelling during the design phase

4 Result

The barcode system auto-generates the details after the barcode present in the user ID card is read by the barcode scanner. It is a user-friendly system that allows users to register faster and easier. This system can be used by anyone since it does not necessarily require a technical person. Figure 5 shows the landing page of the barcode system. There are eight navigation bars present in the landing page such as Add User, Delete User detail, Edit User detail, Department wise user detail,

In_Out report, Outgoing report, Incoming report, and Report sort by date. The barcode present in the user ID card will be read by the barcode reader and the user ID number will be generated in the textbox.

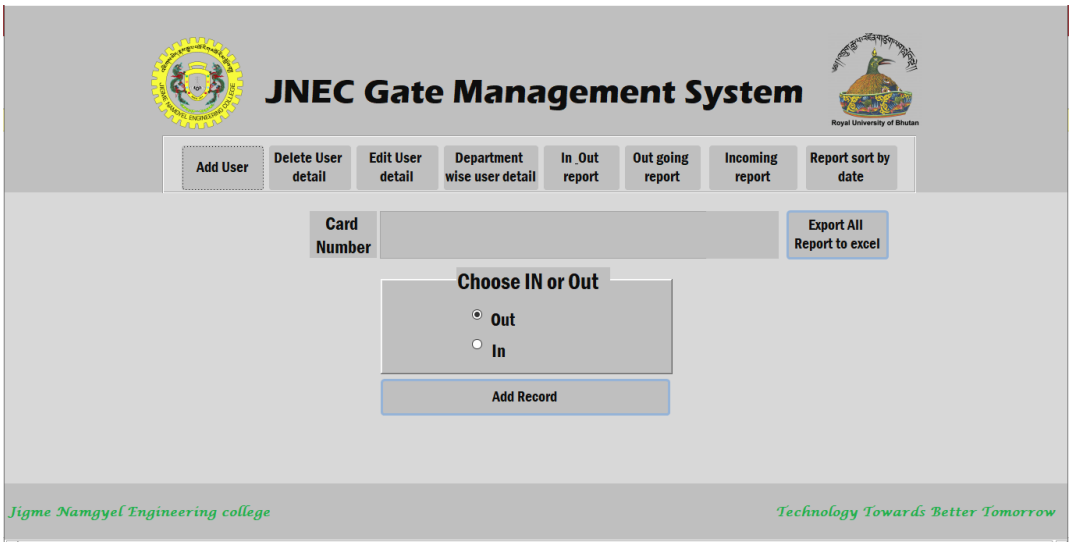


Figure 5: Landing page

The 'Out' radio button indicates that the users are going out of the college and the 'In' radio button indicates that the users are entering the college. The security guard will scan the barcode present in the user ID card. After the barcode is read, the user ID number will be displayed and the security guard will select the In or Out radio button. The 'Add Record' will add the entry and exit records of the users into the database. The 'Export All Report to Excel' button will export all the details of incoming and outgoing users in Excel and this report can be sent to those who need it. Fig. 6 shown below will be displayed when clicking on the 'Department-wise user detail' tap. It has a drop-down button that contains the name of all the departments and programmes. While choosing a particular name, details of all the users will be displayed based on the selected drop-down.

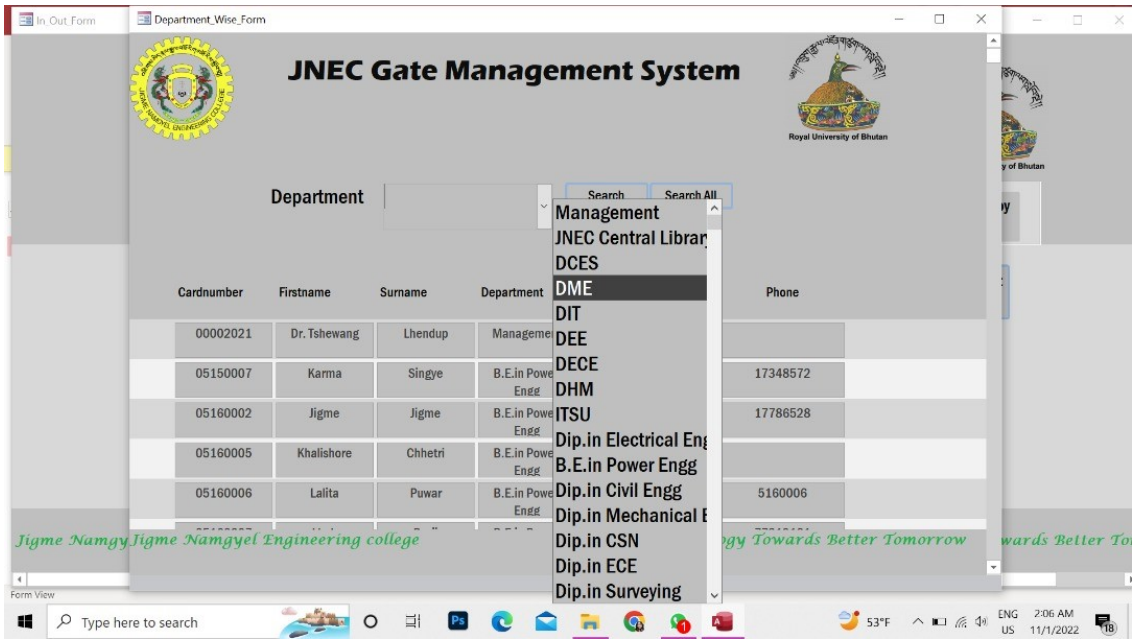


Figure 6: Department wise user detail

The 'In Out report' button will generate the report of incoming and outgoing users altogether. As you click on the 'In Out report' button, Fig. 7 shown below will be displayed. The '0' status indicates the outgoing users and the '1' status indicates the incoming users. The system allows users to print the report by clicking on the print button.

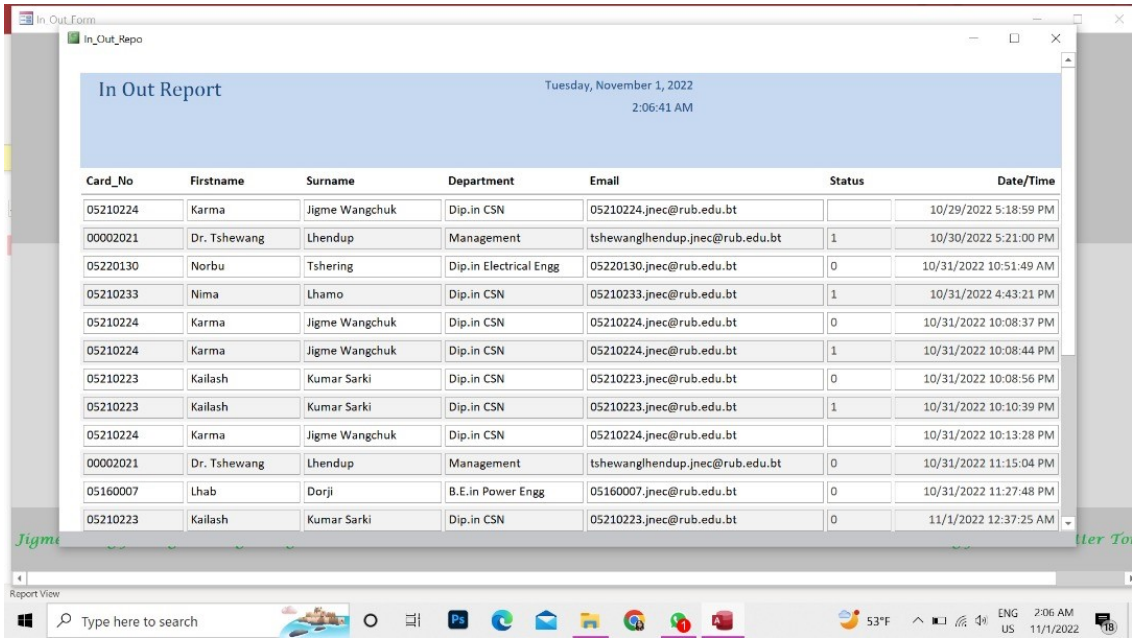


Figure 7: Department wise user detail

The 'Report sort by date' tap will generate the report based on the incoming and outgoing date of the users. You can select the date by clicking on the calendar icon and then clicking on the search button. The details of the users will be displayed based on the date of users coming in and going out of the college.

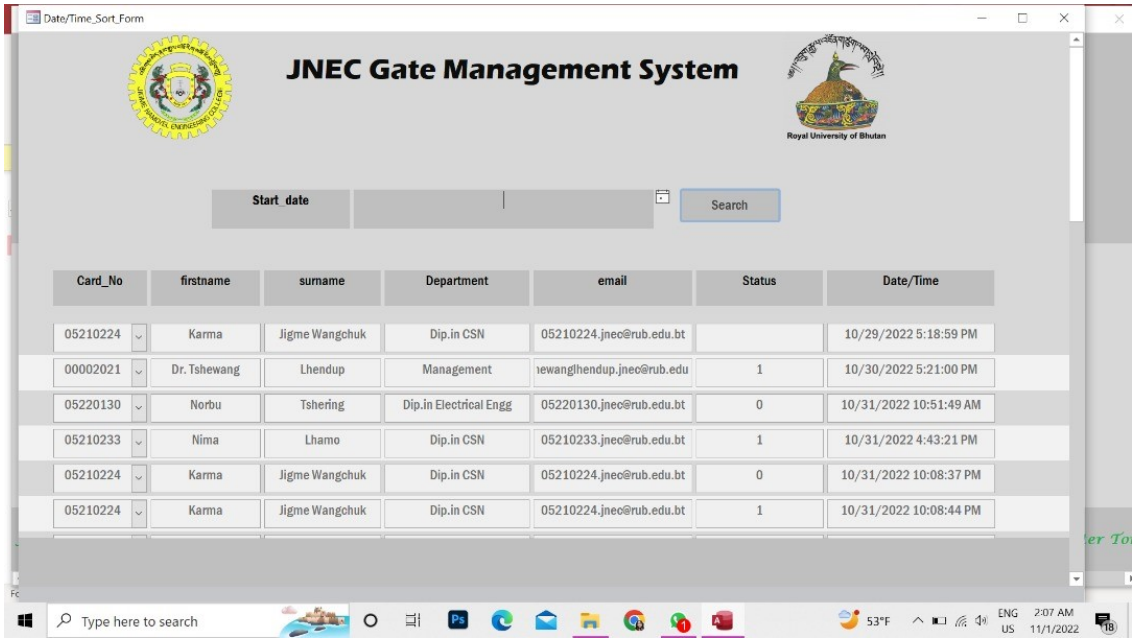


Figure 8: Report sorted by date

5 Discussion

The inconveniences found in the system used by the college were solved by developing the barcode system. The students and staff no longer have to punch their details manually and need not have to wait in queues with internet connection. Moreover, it is less time-consuming as students have to only scan their cards while going out and coming into the college. The main advantage of the proposed system is that it allows real-time data to be collected accurately and rapidly. It enables fast data entry operations with fewer errors. Some of the possible drawbacks could be not having auto-read and write capabilities. It is labor intensive as it requires to be scanned individually and it is susceptible to environmental damage since scratched or crumpled barcodes may cause problems while scanning. However, the system has led the college to eliminate the possibility of human error, whereby the details of the students and staff including the date and time are stored when the barcode reader is used. The system allows to view and print the record of users going out and coming into the college based on certain conditions. It also allows to export the report to MS Excel and send it to the required personnel. This barcode system can be implemented by other colleges and schools in the future.

6 Conclusion

The existing QR system includes drawbacks such as manually punching the data, the need for the internet, and a time-consuming system. To eliminate the drawbacks of the QR system and paper registration system, a new system known as the barcode system was developed. This system was developed based on the PBL approach whereby a problem in the existing system was discovered and a solution was brainstormed based on prior knowledge of the project member. The barcode system helps us to achieve the goal of having a paperless registration system and going green. In the proposed system, the barcode present in the user ID card is scanned by the barcode reader and the information is autogenerated making the information more accurate. This system uses MS access to maintain the data of the users. This system eliminates the possibility of human error and make registration faster. The system can be extended to an attendance system and other similar functions.

Acknowledgement

We are very grateful to Jigme Namgyel Engineering College (JNEC) for its continuous support. The team also would like to thank Dr. Tshewang Lhendup (President, JNEC) and Mr. Sangay Chedup (Dean of Research & Industrial Linkages, JNEC) for the support related to the requirement composition. Further, we would like to extend our heartfelt gratitude to Mr. Sandip Biswa, Mr. Partap Rai, Ms. Nima Lhamo, Ms. Sonam Delkar, Mr. Sherab Loday, and Ms. Bilana Ghalley for helping with data preparation and DIT for providing the necessary infrastructure.

References

[1] "1D and 2D Barcode Scanning: What is the Difference? | Lowry Solutions." Accessed: Oct. 02, 2022. [Online]. Available: https://lowrysolutions.com/blog/what-is-the-difference-between-1d-and-2d-barcode-scanning/

[2] "Advantages of Barcode | disadvantages of Barcode." Accessed: Nov. 12, 2023. [Online]. Available: https://www.rfwireless-world.com/Terminology/Advantages-and-Disadvantages-of-Barcode.html

[3] "1D and 2D Barcodes Advantages and Disadvantages - ByteScout." Accessed: Feb. 02, 2023. [Online]. Available: https://bytescout.com/blog/2013/09/linear-barcodes-advantages-and.html

[4] "Complete guide to barcode scanners | Honeywell." Accessed: Oct. 09, 2022. [Online]. Available: https://sps.honeywell.com/us/en/support/blog/productivity/interesting-facts-about-barcode-scanners

[5] "Advantages and disadvantages of Microsoft Access - IT Release." Accessed: Feb. 22, 2023. [Online]. Available: https://www.itrelease.com/2022/09/advantages-and-disadvantages-of-microsoft-access/

[6] "What is Systems Development Life Cycle? - Definition from WhatIs.com." Accessed: Feb. 02, 2024. [Online]. Available: https://www.techtarget.com/searchsoftwarequality/definition/systems-development-life-cycle

[7] Y. Tshering, S. P. Kamishetty, and H. Sarwarzadah, "Event Management for Social Service Website Using Ruby on Rails: BTO Event View Application Developed Implementing Collaborative Technique," *World J Res Rev*, vol. 13, no. 6, Dec. 2021. doi: 10.31871/wjrr.13.6.5.

[8] Y. Tshering, S. R. Tamrakar, S. Gontia, and S. Baral, "IoT-based Platform with Big Data using Apache Kylin: Air Quality Monitoring System (AQMS)," *World J Res Rev*, vol. 13, no. 3, Sep. 2021. doi: 10.31871/wjrr.13.3.12.

[9] H. Bhattarai, "Approaches and Growing Impacts of Problem-Based Learning in Teaching and Learning at Jigme Namgyel Engineering College," *International Multidisciplinary Research Journal*. Accessed: Feb. 02, 2023. [Online]. Available: https://www.academia.edu/81306776/Approaches_and_Growing_Impacts_of_Problem_Based_Learning_in_Teaching_and_Learning_at_Jigme_Namgyel_Engineering_College