Islington College

Contactless Payment System
Final Year Project
Proposal

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1. Introduction

Completing a monetary transaction between two parties without the use of cash or direct contact between two parties is known as contactless payment system. Contactless payment is achieved by using mediums that operate on radio frequency to transfer data between the user and the receiver. Some popular forms of these mediums are RIFD cards, key fobs or tags that transmit radio frequency which is then read by a scanner. This exchange of data between the medium and scanner allows users to not use cash for monetary transaction.

With all the advantages of contactless payment system has over traditional payment; referenced in the next section, it would allow users to have faster transactions, easier travel and familiarize themselves with technology which other countries have been using for a while.

In a country where 95% of transactions are still cash based (Neupane, 2018), implementing contactless transactions into suitable sectors brings a lot of advantage to the economy in general (Durkin, 2018).Even with or without the concerns of coronavirus, cashless transactions help businesses a lot (Xiao, 2020). In the current scenario of the world, this technology sides to the advantages provided by cashless transactions over its disadvantages. (Pettinger, 2020).

With all these things in mind, I have decided to make a contactless payment system for public transportation which is suitable for Nepal. Using this technology in the most basic state of transportation would encourage people to use modern solutions for primitive problems which would not only be limited to this scenario. A user will be able to use card for payment on public transportations and the amount in card can be loaded using a web application, and a mobile application, which will have a subset of features from web app, will allow a user to see their travel data and statistics.

1.1 Problem Scenario
1) Cash based transaction, especially in transportation industry is slower than contactless transaction (Gundaniya, 2019).

2) Students and other people who can claim discounts in public transportation need to show their cards along with money every time they board a bus which makes it tedious if the person is travelling multiple times a day.

3) Middlemen like drivers and conductors of the vehicle have the ability to manipulate the total amount of cash that the bus owner makes or spends in a day.

4) Cost calculation methods for passengers is outdated in public transportation, since there is no proper implementation of bus stops in Nepal.

5) Foreigners visiting Nepal might not have the proper understanding of currency which makes it difficult to travel to spontaneous trips without planning.

6) Although cash is not the primary source of transmission of corona virus, it can be unsanitary in public transportation where one note is handled by a lot of people in a single day.

7) In Nepal, if a public transportation staff is tested positive for corona virus, there is no efficient way of contact tracing their passengers (Khabarhub, 2020).

1.2   Project as a Solution

This project acts as a direct solution to all of the problem scenarios stated above. People will not need to use cash in public transportation which will make the experience faster. Students won't need to carry both their money and ID cards to claim a discount since the discount data will be stored in their RFID card itself. Since all the transactions are done digitally, there is no need for drivers to submit their earnings to the main counter and it eliminates the time and effort to gather and deposit all the cash that needs to be distributed throughout the chain of vehicles.

The cost for the consumer will be calculated per kilometre basis which means that the customer will be charged per kilometre that they have travelled. This in turn makes it easier for tourists to understand how the travel fares work in Nepal and encourages them to spend more to travel on local transportation.

Since all records of passengers who have used a vehicle is stored in a database, it makes it easier to contact trace them. With this in mind, it can even make crime rates drop as investigators can use the travel history data of a person to determine their location in a particular point of time if they have used any public transportation.

2 Aims and Objectives

2.1 Aims

The aim of this project is to create a contactless payment system to make travelling within Nepal seamless, technology friendly and easier than currently existing system. A web application will be built where users can sign up and verify their credentials to use the cards, and login later to view their travel data and pay for the card. A mobile application will be built for registered users who can login and view their travel log and data.

2.2 Objectives

The objectives which are the basis of the completion of the project are:

- To learn about web applications, mobile applications and their workings.
- To use IOT devices to build a prototype of contactless payment system for the end user.
- To understand and implement usage of database along with web application and the card reader.
- To understand about API programming (street distance API and writing API to store and retrieve data).
- To learn about user interface.
- To learn about cost calculation in the travel market.

3 Expected Outcomes and Deliverables

The completion of the project would make it possible to achieve these tasks:

- A prototype of contactless payment device/system which can be scaled to work in real life.
- Usable RFID cards to simulate the demonstration of payment in public transportation.
    - Scanning RFID card on scanner will store the location and time of the scan, along with user details in the database which can be shown as travel log. Raspberry pi along with its modules will be used as the card scanner.
- The same hardware will be used to write the cards. (To avoid cost of duplicate hardware)
- Web application for user (for registered user and unregistered user):
    - Sign up for the service and provide their credentials for verification.
    - Simulation of pay or 'load' the card using available e payment options.
    - View log of their travel history.
    - View the longest and shortest ride.
    - View possible cycling or walking distances to promote eco friendliness.
    - View total amount of carbon emissions caused by their travelling and number of trees that the user could plant to help the environment.
- Mobile application for registered users:
    - Sign into their accounts
    - View travel details as in the web application.
- Web application for management:
    - Verify user
    - Deploy card
    - View user data
    - View necessary travel log
    - Manage faulty travel details

To register for the service, users need to sign up into the website and upload their official credentials. Users need to have their credentials confirmed by the administration before they can receive their cards.

After the cards have been received by the user and they start using it, they can view their data on the website and the mobile app. Registration and payment functionality for the mobile app will be added if it fits into the submission deadline.

4 Projects risks, threats and contingency plans.

4.1 Risk and Threats

- Hardware failure during development or deployment.

- Libraries for hardware might be unavailable.

- Lack of internet connection from the card reader may cause the service to be disrupted indefinitely, crippling the resources.

- Miscalculation in calculating cost per kilometre.

- API could limit usage quota.

- Difficulties in implementing user specific data in the web application.

- Newer iterations of the project could break the existing stable version.

4.2 Contingency plans

- Backup hardware should be purchased to increase redundancy.

- Vendor independent libraries should be used.

- A system where data should be stored offline until connection is established should be created.

- Proper research should be done to calculate cost which should be tailored according to Nepali market.

- Use free API services that fulfil the needs for development and write backup code to use other API services.

- Research about web frameworks that can implement user specific data.

- Use of version control system like git should mitigate the problem of unstable releases.

5 Methodology

For the development of this project, I have decided to follow the Rational Unified Process (RUP) methodology. This is a software development process from Rational which is a division of tech giant IBM (TechTerms, 2005).This methodology categorizes development of an application in four steps which have been listed, explained and categorized according to my project below.

- Inception

    This is the first stage of this methodology where the idea of project is initiated. It mainly focuses on analysing the requirements for the projects and the estimation of resources that come with the requirements. Inception phase for this project comprises of:

    o Finalizing the preliminary project idea.

    o Determination of hardware and software requirements.

    o Determination of feature requirements.

    o Discussion about development and documentation procedures with supervisor/s.

- Elaboration

    This second stage of this methodology further analyses the requirements that were assumed in the first stage of the development. Furthermore, architecture for development and planning with designing of the project is done in this stage of development. Elaboration phase consists of these steps for my project.

    o Time and cost re-evaluation of hardware and software.

    o Risk assessment of potential calamities during development.

    o Finalization of circuit diagram for the required IOT devices.

    o Finalization of tech stacks to be used.

    o Determination of expected expenditure and actual expenditure.

    o Development of diagrams essential for development including UML diagrams, class diagrams, ER diagrams etc.

    o Documentation of proposal.

- Construction:

  This is the penultimate stage of the development methodology. As its name suggests, this stage includes the main development of the project. The outcome of this development should be ready to use and deployed to the required destination. This involves coding, documenting and testing of the product. The construction phase will be carried out in these steps.

  - Building the system.
  - Testing and refining iterations of the build.
  - Completion of system operational manual and user manual.
  - Documentation for the project.
  - Development and conduction of test cases.

- Transition:

  This is the ultimate stage of this methodology which involves in the deployment of the product that comes out of the construction phase. Installation in case of software and teaching the users how to use the product, falls under this category which is one of the simplest yet vital part of this methodology. Transition phase for this project will carry out in these steps.

  - Verification of requirement completion.
  - Deploy hardware and applications.
  - If released in market:
    - Train professionals and public about the usage.
    - Publication of user tutorials for web application and hardware.
    - Collection of user and management feedback.

This methodology is particularly helpful for me as it allows for an iterative building process of the hardware and the software along with change of requirements during the development phase which could happen in this type of system. Things to consider using this methodology properly are,

- Polishing requirements before design
- Add believable estimates according to the project
- Develop iteratively

6 Resource Requirements

- Hardware Requirements:
  - [Raspberry Pi](#) to act as the brains of the operation which uses the sensors accordingly and store the data to the database.
  - RFID cards to store the user ID which will be used for reading.
  - [RFID module](#) to read the data present in the RFID cards to identify the user.
  - [GPS module](#) to collect the position of the vehicles to identify where the user enters or exits the vehicle.
  - Components to connect these modules (breadboard, wires, jumper wires) etc.
  - Hardware OS: Raspbian
  - Local machine to develop the application.
- Software Requirements:
  - For Web Application
    - Python and Django
    - Django-rest
    - HTML/CSS (bootstrap)
    - JavaScript
    - APIs for street distance
    - Git for version control
  - For Mobile Application
    - Flutter for front end
    - Django for backend
  - For Hardware GUI
    - Python guizero module.
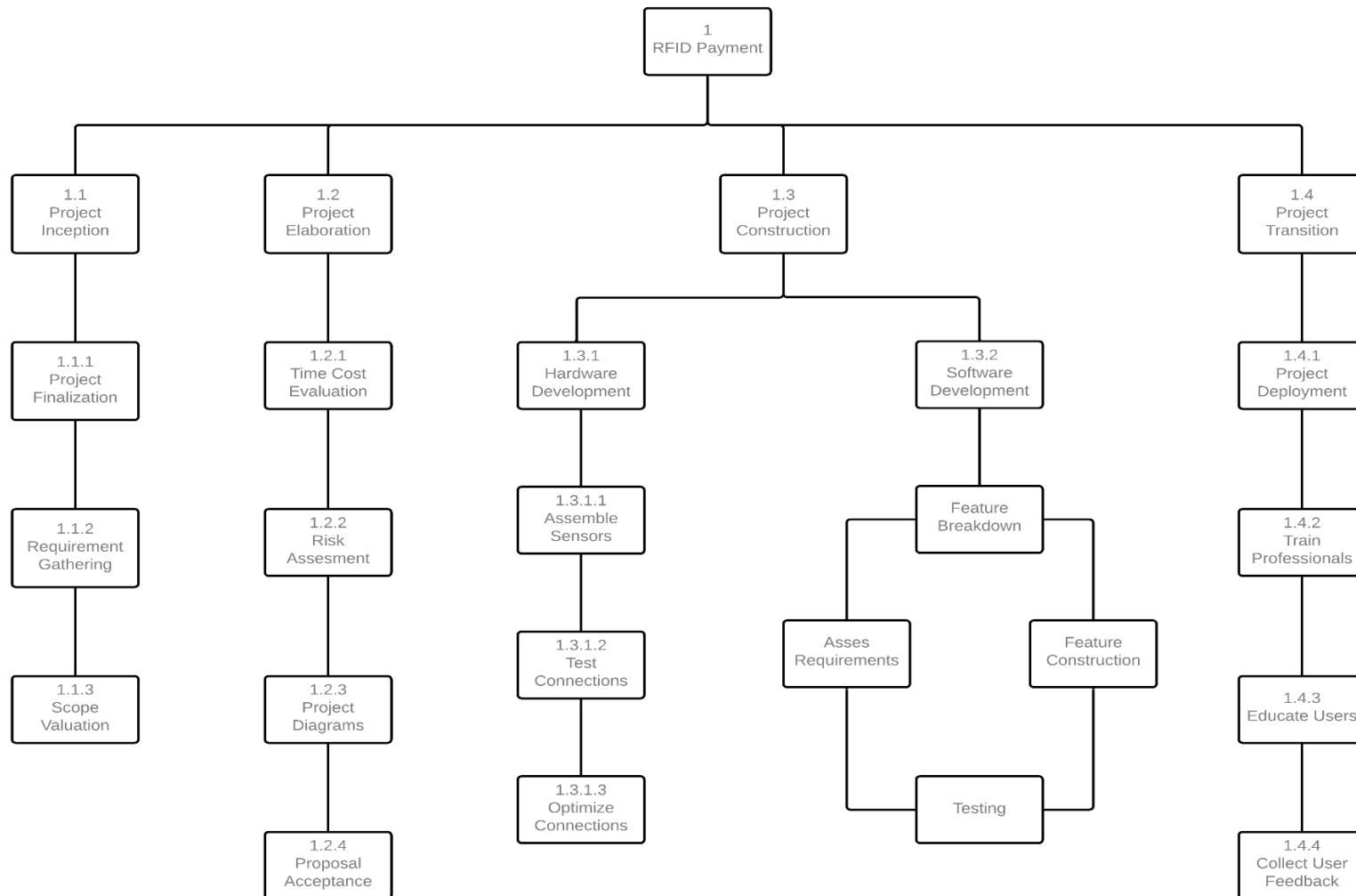
7 Work Breakdown Structure

Figure 1 Work Breakdown Structure
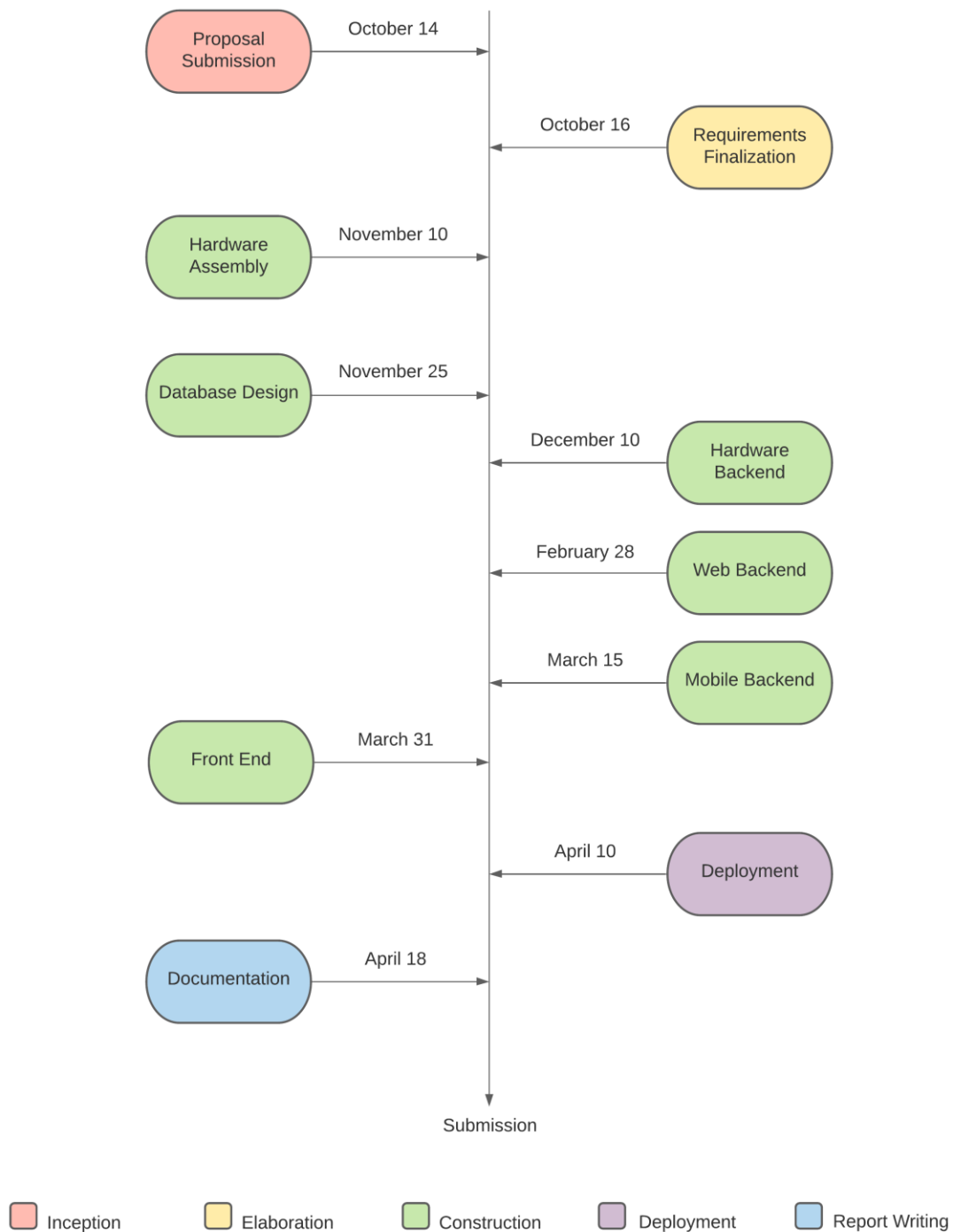
8 Milestones:

Figure 2 Milestone Chart

The actions for construction phase will be done concurrently, as shown in Gantt Chart.
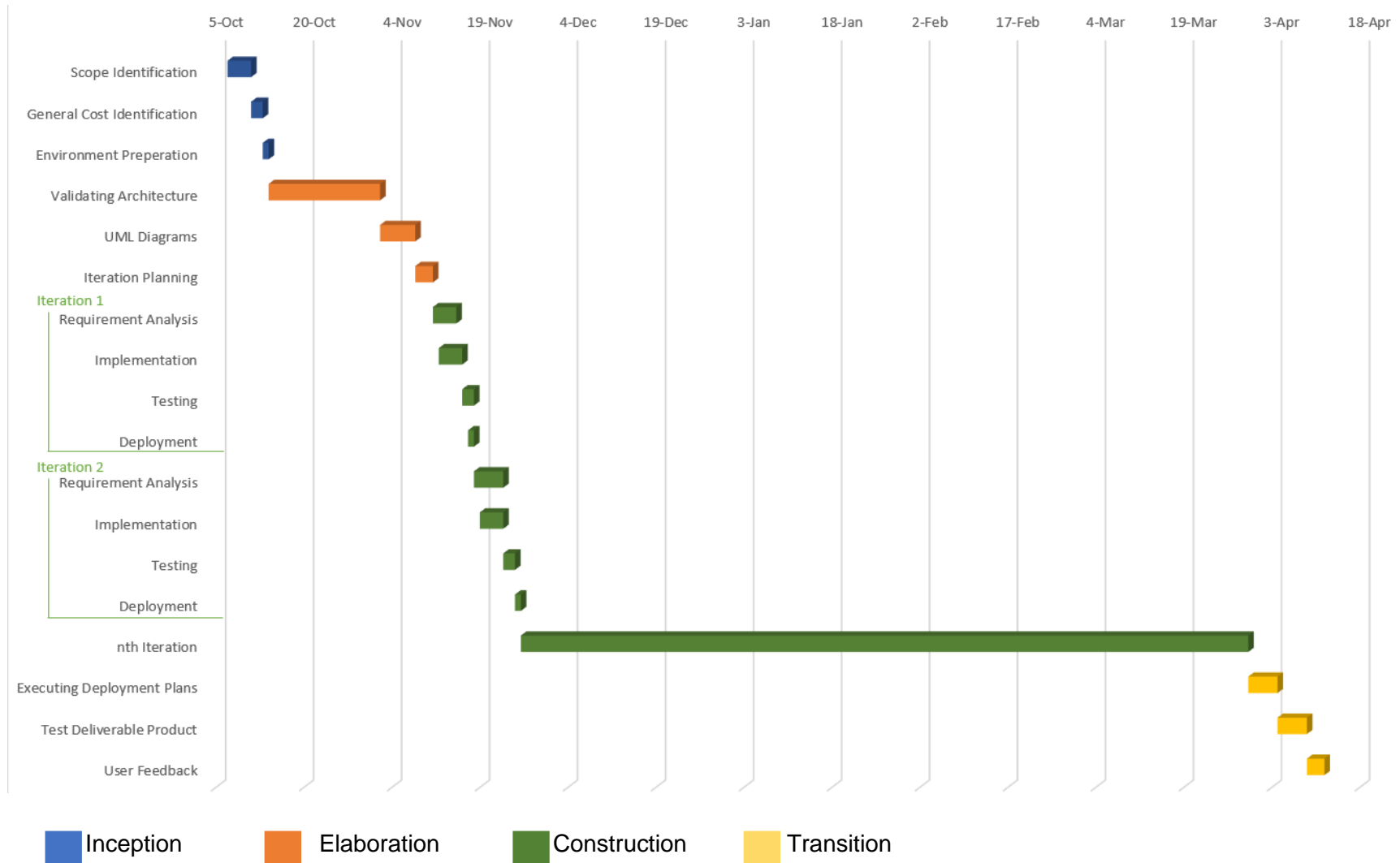
9   Project Gantt Chart

Figure 3 Project Gantt Chart

10 Conclusion

This payment system for public transportation will be a gateway to make transportation within Nepal fast, hassle free and sanitary. Most of the developed nations in the world have implemented contactless payment system and leading Nepal to the same path would make Nepali citizens open to the world for seamless travel. This prototype is just the starting for the wave of contactless travel for the system, there could be many possibilities using the same technology where proprietary cards are abandoned in favour of a universal card or a universal card reading system which could be implemented all over Nepal.

The possibilities of contactless systems are endless, and this project is aiming to be an implementation that everyone can easily use and make their lives a lot easier.

11 Bibliography & References

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