PAY AS YOU PARK SMART PARKING SOLUTION

: IMAGE PROCESSING AND ML BASED PARKING PLACE VERIFICATION

2021-198

Project Proposal Report

M.D. Sachintha Madushan Antany

B.Sc. (Hons) Information Technology – Software Engineering

Department of Computer Science and Software Engineering

Sri Lanka Institute of Information Technology

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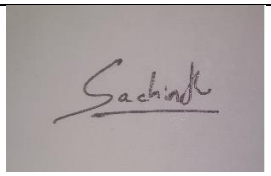
Declaration

We declare that this is our own work and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Name	Student ID	Signature
M.D.S.M Antany	IT18012552	

The above candidates are carrying out research for the undergraduate Dissertation under my supervision.

Signature of the supervisor Date

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Abstract

Land suitability evaluation is one of the important procedure before set that place for car parking. So that people have to waste more time and money for that to take advice from their expertise. When considering the real-world scenario of a car parking solution, registering and verifying the suitability of new land for a car parking application would not easily process for the system admin in his busy daily routine. And also when considering the world map there are millions of lands and garages are owned by people in different regions. So, once the registration begins after a Parking application deployment and if this process maintained by a human being, there would be a huge queue for private land and garage registration and verification processes. Therefore, in order to overcome these problems, machine learning and image processing based automated method is going to introduce in this paper. Using this method, the parking system can analyze the parking owner's image data of the parking land/garage which was taken while the registration process and provide the suitability level of the ground and the necessary suggestion to resubmit images after changes done by the parking lot owner.

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1. Introduction

1.1. Background & Literature survey

There are many Smart Parking solutions available in the worldwide which was created with deferent kind of new technologies [1]. But every solution does not cover all the problems users have. Usually, a Normal parking solution provides a service to the users to track a parking location and park as they want without finding a place searching here and there in the town. But when it comes to SMART parking, users must have SMART features to overcome the current problems in the world. The “Pay as you park” Smart parking concept is such a solution to make life easier for users all over the country.

When people come to the road with their own vehicle, they get rude and stressed with the current situation on the road. All driver are competing with others to even take the proper place parking the vehicle. This situation has can clearly see when there is a cinema or big event in some places, those time people face a lot of trouble inside the main parking lots and make a lot of traffics on the road also. None parking solution has introduced a method to overcome this lack of space problems in the urban areas. Traffic on the road is a normal situation in urban areas. There are many reasons for having such traffics on the road. However, in most cases, this traffics happen due to drivers inappropriate parking behaviours besides the main roads [2]. This mostly happens because drivers cannot find proper places for the parking and unavailability of the parking lots near to the driver's end destination.

So in this Smart parking solution, we have considered that matter and defined a feature to add private lands and garages to the internal map of parking lots by the owner of private properties. But in this case, we were found that there are

many such lands and garages available in urban cities without taking advantage of their owners. As shown in Figure 1.1 which depicts the data retrieved by the survey, there are a lot of people who have their own lands and garages. Most of them are not using those properties (Figure 1.2) and monthly earning is less than 5000 lkr (Figure 1.3). Most of the people who have empty lands and garages would like to earn extra money from those properties (Figure 1.4). According to the survey also it was confirmed that these kinds of scenario can widely adaptable all over the country.

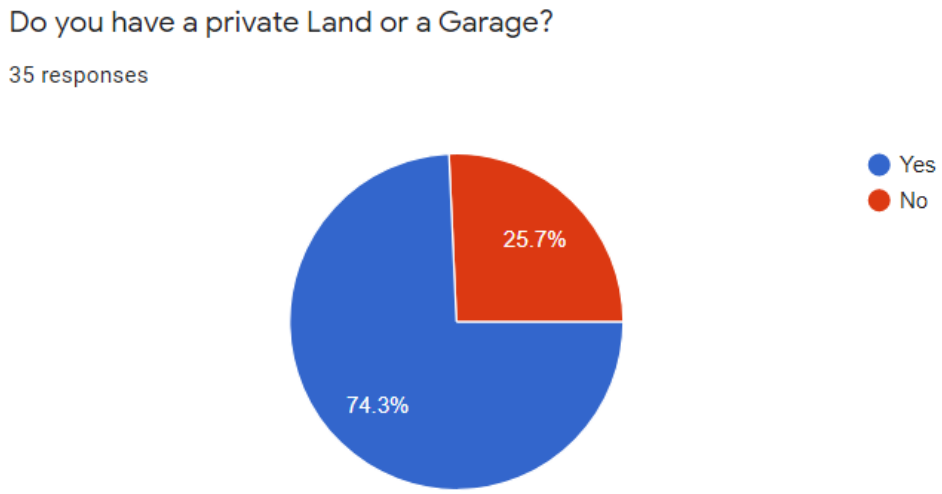

FIGURE 1.1 - PEOPLE WHO HAVE PRIVATE LANDS AND GARAGES.

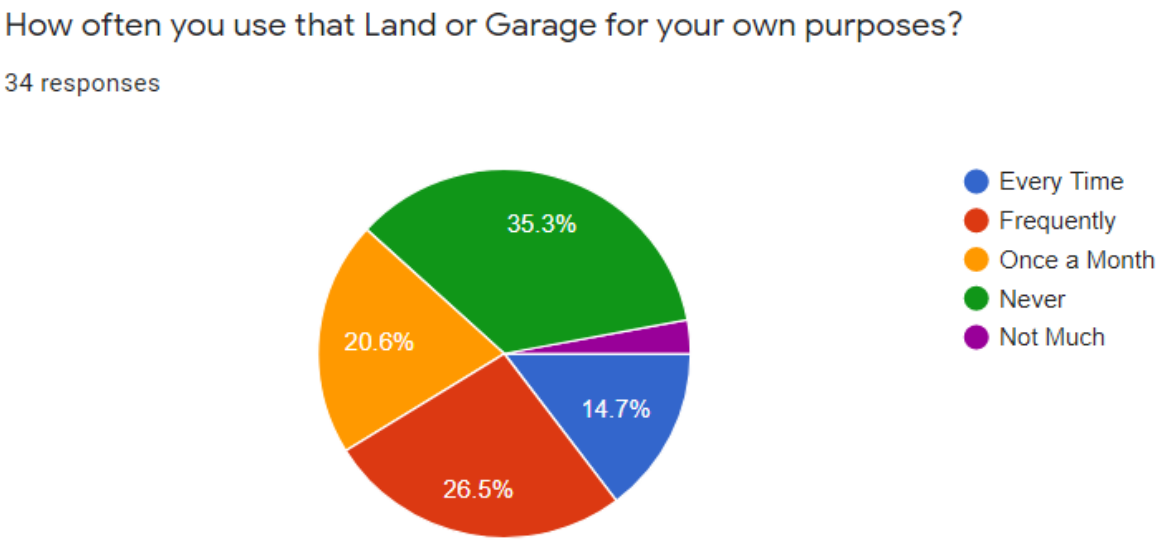

FIGURE 1.2 – USAGE OF THOSE LANDS AND GARAGES.

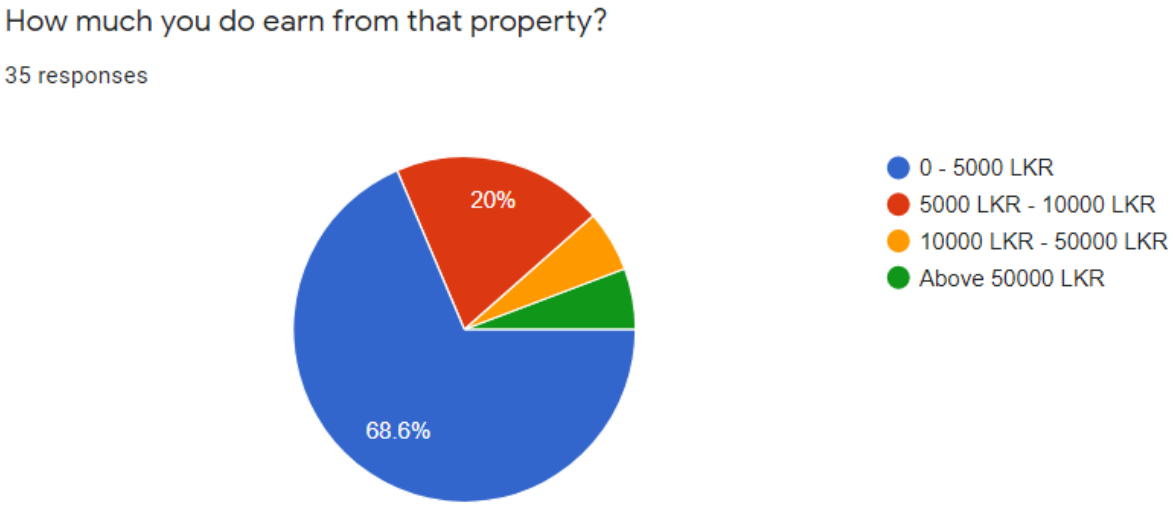

FIGURE 1.3 – EARNINGS RANGE FROM LANDS AND GARAGES.

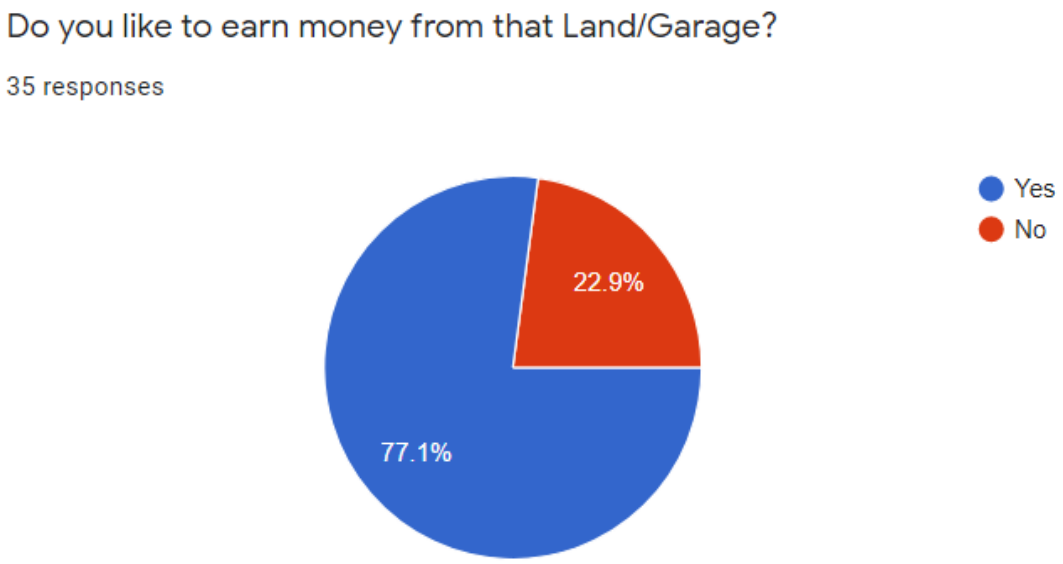

FIGURE 1.4 – EARNING PREFERENCE FROM LANDS AND GARAGES.

So, when come to registering these lands in the application, there should be a special procedure to conduct for the verification of the suitability of the land in each one of them. This is a time-consuming process because it needs to verify each place by a special agent actually whether that place is suitable for vehicle parking. This process should continue at least term basis because parking standardization is an important thing to maintain the client's trust on us and development of the business all over the country. But when comparing the survey (Figure 1.4) 77.1% of the crowd would like to start a business at home using their properties. So, this is not an easy task to assign agents for the verification to these lands and garages. Therefore, automating the verification method using the technology-based solution is needed by the interaction of the parking lot owner and system.

1.2. Research Gap

In this case, detecting potholes and identifying the surface soil type of the land is the major task of this system when registration of the lands and entrances. Otherwise, drivers may have to face various difficulties when parking those new places and that will leads to losing the trust in us. Many types of research have been implemented sensor-based systems to identify the potholes of land [3] but those are not suitable for this kind of scenario because this whole process should be conducted over the internet. So that optimal way to handle this problem is using image processing and machine learning-based technology [4][5] for verification.

Although there is so many research related to road pothole detection and surface soil type detection researches, there were not any researches related combined with both aspects. Furthermore, when we using the surface soil classification and identifying technics, we have to identify the parking land surface contained soil and predict the situations in a different season of the country (ex: rainy seasons). Based on that, a verification process has to be conducted.

Research	Surface soil classification	Pothole detection	Gravel Soil, and Clay Soil detection	Surface detection
Research paper 1 [5]	✓			
Research paper 2 [4]		✓		
Research paper 3 [7]			✓	
Research paper 1 [6]				✓
“Pay as you park” Smart parking solution	✓	✓	✓	✓

Table 1 – Comparison of the former researches

1.3. Research Problem

Car parking is a major problem in urban areas in both developed and developing countries. With the rapid incense of car ownership, many cities are suffering from lacking car parking areas with an imbalance between parking supply and demand which can be considered the initial reason for major cities parking problems. As a solution for that this system giving a function to register the new parking areas all over the country. Because of the high demand for such a system, people await to register as fast as possible to the application (Figure 1.4). In this situation as system admin cannot engage with all requests for the verification process. So that avoid such a problem, we have come up with an automated verification process using Image processing and machine learning-based technology.

When we going through deep into the problem of the verification process we have identified that we need to consider the surface soil type of the parking land and the road condition of the entrance to the garage or land. We found that users care about the safety and comfortability of a parking lot when choosing a parking area. To ensure those criteria we register the user to our system as a valid parking lot provider. And to ensure the standard of the land and garage we take the distance to the parking lot from the main road, availability of the garage or land, images of the entrance road to the garage or the land and if the place is not concreted basement we ask for an image of sample land surface soil images to check whether that place is okay to park vehicles daily without having any trouble in the rainy seasons also. We planned for an automated term based verification process to ensure the satisfaction of both vehicle owner and private parking lot owners by protecting the vehicles, private lands and garages.

2. Objectives

2.1. Main Objectives

The main objective of this project is to implement the “Pay as you park” smart parking system by giving Smart solutions for all identified drawbacks of previous parking solutions and main problems of the drivers faced in the past years. However, this research paper focused on one of a major part of the main four research component in the system which was registration and image-based land/ garage verification of the parking lots.

2.2. Specific Objectives

In order to accomplish the main objective, there are some specific objectives to cover up. Those sub-objectives are listed down below in brief.

1. Collecting the all data needs to create the models

   To create accurate models to retrieve the correct output from the given data to the system, we have the challenge to train the models with enough datasets. So that predefined collection of datasets should be collected gradually with the process of the research project.

   i. Road pothole datasets [8]
   ii. Surface and soil types datasets [9]
   iii. Cement and concrete datasets [10]

2. Setup a flow to get the user side information to the system for the registration

   In order to do the proper verification on the registration of lands or garages system needs accurate images in different views. So that making registration flow is an important thing when considering user aspects and also system aspects.

   i. Samples photos of surface of the land
   ii. Sample photos of garage in different views
   iii. Photos of the entrance to the garage or land

3. Creating an optimal architecture to handle the system

   Planning a way to build the system to run in an optimal way is another specific objective of this process. So, choosing the best and cost-effective cloud infrastructure provider for the system and how effective it is to integrate with such a platform to build up this system in an optimal way is a considerable matter.

3. Methodology

In the proposed system, we mainly focus on the smart solution to achieve our goal to overcome the current users of other existing application problems and the main problems people face during the time they spend on the road with their vehicle. So to identify those problems mainly we conducted a survey on that topic as a group and we collected data from the people. In that survey, we were able to find that most people are struggling to find a spot to park in urban cities (Figure 1.5).

So that after the survey period we decide to give the opportunity to the lands or garage owners to register their places in our system. Therefore to accomplish the requirement we introduce the verification procedure to the land/garage registration. After going through the old researches we found that the optimal and the novelty method to do this verification process is using image processing based and machine learning-based technology. So based on those technologies planed our methodology to conduct the project.

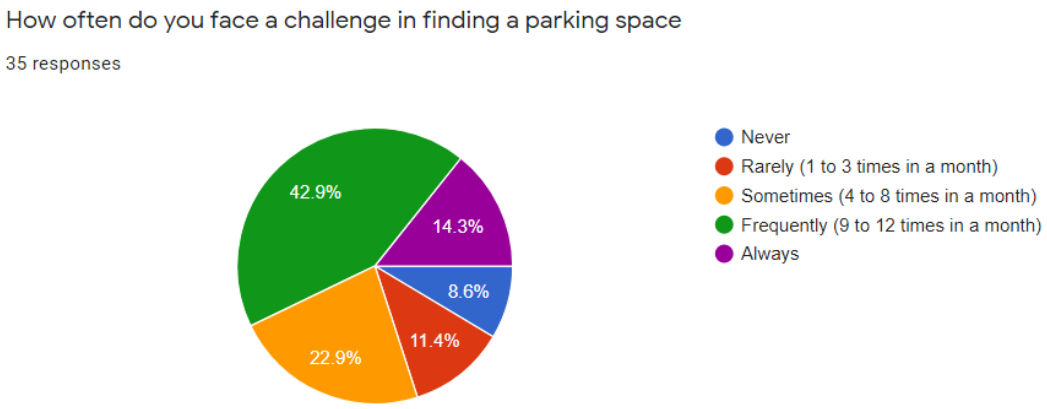

FIGURE 2.5 – FREQUENCY OF STRUGGLE TO FIND A PARKING PLACE.

After that, we search for the resources we need to feed our projects in the technology aspect and the data aspects. We were able to find open-source datasets of surface soil type [9], cement payments [10] and related to potholes on roads [8]. Based on these datasets it will be easy to do the future task from the technology side. After finding the image data resources we have moved to look at the technology we want. We have identified some main technologies, concepts and algorithms based on image processing and machine learning.

i. Image Preprocessing
ii. Feature Extraction
iii. Feature Selection
iv. Support Vector Machine
v. Artificial Neural Network
vi. K- Nearest Neighbors' Algorithm (k-NN)
vii. Model training

3.1. System Flow and flowchart diagram

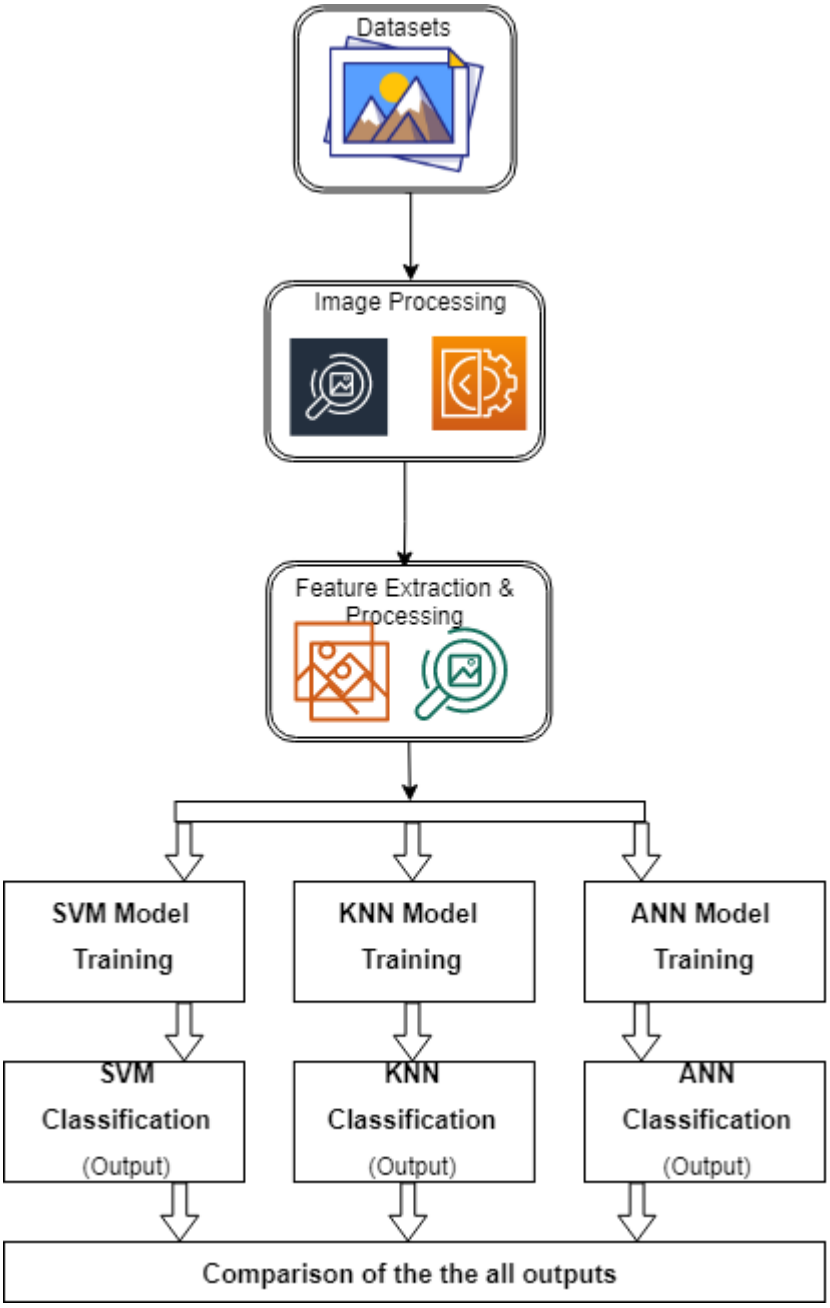

FIGURE 2.1 – FLOWCHART OF PROPOSED WORK

- Image Preprocessing

The picture collected from our users is not free of error. Pre-processing techniques are applied in order to get an error-free image. As the image is improved by enhancing its contrast and eliminating errors to achieve a better quality image for our future processes, this stage is also known as the enhancement of the image. The picture includes errors that must be removed before further operations, such as noise or objects such as scratches, lapping tracks, comet tails, etc. Image preprocessing also requires the identification and recovery of poor lines, geometric correction or registration of images, radiometric calibration, data transfer between various sources, atmospheric correction and data quality evolution.

- Feature Extraction and Selection

In this step, all the features needed for us to identify the form of surface are taken out. For the identification of surface soil type, a number of characteristics such as texture, colour, strength, saturation, hue, etc are extracted. For feature extraction, we use a filter known as the Gabor Filter. It is a linear filter used for edge detection. The extraction of features involved the selection of appropriate variables, which is a critical step for the effective implementation of the task of classification of soil surface photos. We select the variable in this step that is most suitable for a specific approach. After this, we can get a good representative dataset to feed our models.

Feature Selection is a method of dimensionality reduction commonly used for information mining and learning disclosure and makes the end of highlights while retaining the secret unfair data, including determination implies less transmission of information and efficient mining of information. In addition, it brings possible points of interest for correspondence in terms of bundle crashes, information rate, and storage. The purpose of the highlight option is to concentrate on improving the execution of expectations of the indicators, providing faster and more realistic indicators and providing a better understanding of the fundamental process that produced the data.

- Support Vector Machine

Support Vector machines (SVM) is a machine learning algorithm which is used to analyze date for classification and regression analysis. Using this algorithm we can design decision boundaries which classifies training vector in to two parts. These decision boundaries created with the maximum margin of the both two classified classes so it cause to reduce the misclassification in new entries.

- Artificial Neural Network

In information technology, an artificial neural network (ANN) is a system of hardware and/or software patterned after the operation of neurons in the human brain. Typically, an ANN is initially trained or fed large amounts of data. Training consists of providing input and telling the network what the output should be. As an example, In this scenario, to identify the surface soil type from the given sample surface soil photos of the land and potholes of the garage/land entrance. The initial training might be a series of pictures, including surface soil types and picture set of potholes on the road. Each input is accompanied by the matching identification, such as this clay type surface, this is sandy type surface and this is gravel surface like vice. Providing the answers allows the model to adjust its internal weightings to learn how to do its job better.

- K- Nearest Neighbors' Algorithm

The k-nearest neighbors (KNN) algorithm is a simple, easy-to-implement supervised machine learning algorithm that can be used to solve both classification and regression problems. For this algorithm, the training phase only consists of storing feature vectors and training image labels. The unlabeled query point is simply assigned to the label of its k nearest neighbors in the classification process. Usually, the object is identified by a majority vote based on the labels of its nearest neighbors k.

- Training Models

In this stage, using all collected datasets we will conduct our training models until getting the accurate output of that. At the final stage of training, the model should be able to predict the surface soil type with the highest percentage of accuracy. According to the result of these model will implement the other verification process in the coding level.

3.2. System Architecture

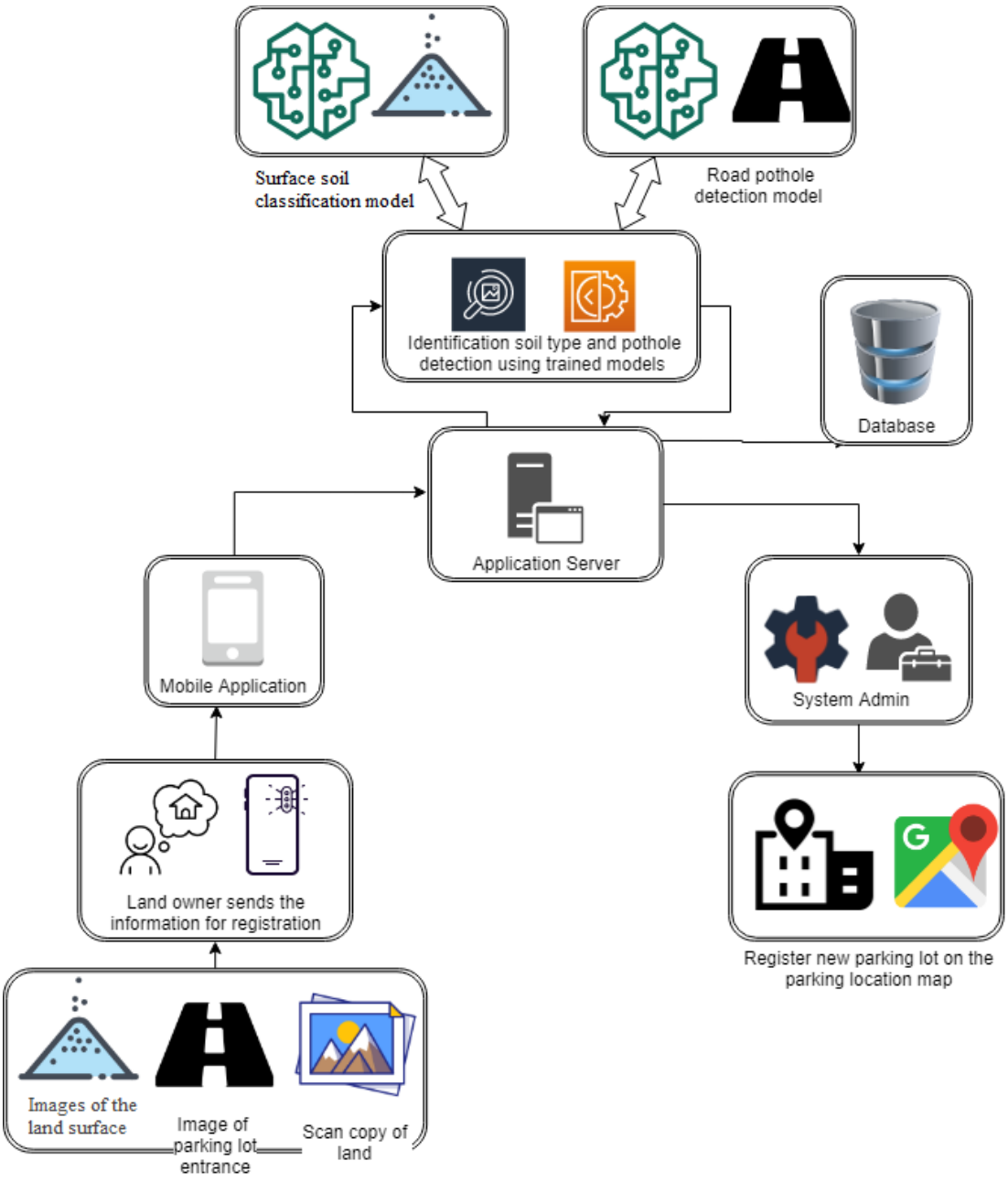

FIGURE 2.2 – SYSTEM OVERVIEW DIAGRAM

4. Gantt chart

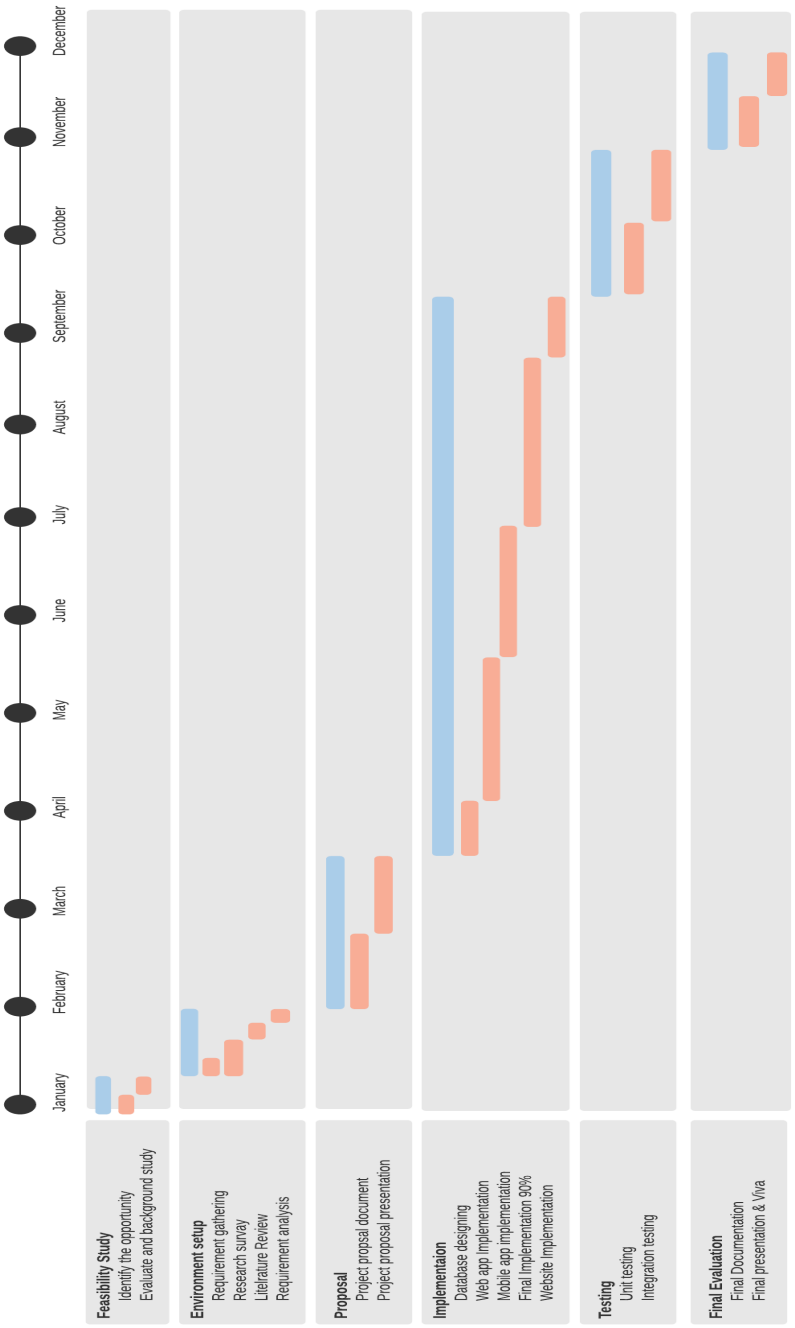

FIGURE 3 – TIME PLAN GANTT CHART

5. Budget and Budget Justification

Component	Amount(USD/Year)	Amount(LKR/Year)
Azure Machine Learning B1S: 1 vCPU(s), 1GB RAM	$53.00	Rs.10,279.59
Domain Name Registration	$8.00	Rs. 1,551.64
Hosting	$60.00	Rs. 11,637.28
Total	$121.00	Rs. 23,468.51

Table 2 - Budget

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