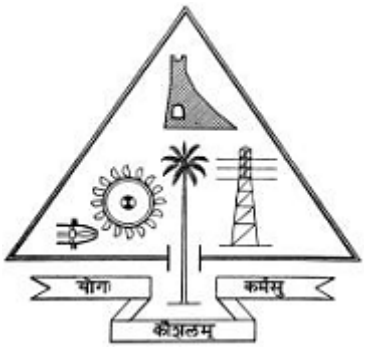
DETECTION OF DELAY IN TRUCK TURN AROUND TIME

Thesis submitted in partial fulfillment of the requirements for the award of the degree of ***Master of Computer Applications*** *of the* ***APJ Abdul Kalam Technological University***

submitted by

NIRMAL P KUMAR
(TCR20MCA2017)



DEPARTMENT OF COMPUTER APPLICATIONS
GOVERNMENT ENGINEERING COLLEGE
THRISSUR - 680009

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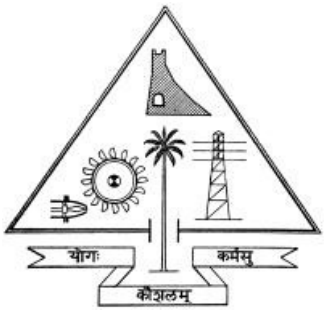
DEPARTMENT OF COMPUTER APPLICATIONS
GOVERNMENT ENGINEERING COLLEGE, THRISSUR
THRISSUR, KERALA STATE, PIN 680009



CERTIFICATE

This is to certify that the main project titled **"DETECTION OF DELAY IN TRUCK TURN AROUND TIME"** *is a bonafide work done by* **NIRMAL P KUMAR (TCR20MCA2017)** *under my supervision and guidance, and is submitted in July 2022 in partial fulfillment of the requirements for the award of the Degree of Master of Computer Applications from APJ Abdul Kalam Technological University(KTU).*

Seminar Guide	**Seminar Coordinator**	**HOD**
Dr. Prof.Husain Ahamed P	Dr. Sminesh C N	Dr. Sminesh C N
Assoc.Professor	Asst. Professor	Assoc. Professor

Place: Thrissur
Date :

DECLARATION

I hereby declare that the main project named, **DETECTION OF DELAY IN TRUCK TURN AROUND TIME**, is my own work and that, to the best of my knowledge and belief, it contains no material previously published by another person nor material which has been accepted for the award of any other degree or course of the university or any other institute of higher learning, except where due acknowledgement and reference has been made in the text.

Place : THRISSUR Signature

Date : **NIRMAL P KUMAR (TCR20MCA2017)**

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ABSTRACT

Any manufacturing industry is dependent on the effectiveness of the system to make the parts available on the assembly line in time. Material flow plays a vital role in the final production capacity of the industry. The turnaround time of trucks determine the efficiency of the unloading system and storage facility in the plant. The higher the number of parts involved, the higher will be the complexity of storage system and hence, the truck turnaround time will be higher. This turnaround time is a loss for the plant as it is the waiting time for materials in assembly line.

The proposed system aims to improve the accuracy of TCT prediction without human intervention or through an automated process.It helps to determine the trucks total turn around time and to further determine the delay in the loading unloading activity. This help in tracking the delay that happened during the loading unloading process. Necassary action can be taken at the same time, which will help the logistics reach the destination on time

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CHAPTER 1
INTRODUCTION

Truck turnaround time or the time taken by the truck to enter the gate, complete all operations inside the plant and exit the gate is a major concern for all industries. It increases traffic and hence coagulation of trucks at unloading bays, causing delays. Also increased number of trucks inside the plant campus also raises the safety concern of the plant [1]. In heavy manufacturing industries, where the number of parts involved is very high per unit product and also the parts are huge in size and cost effective and are mostly outsourced to vendors around the world, truck turnaround time becomes a major factor to ensure high productivity of the plant.

In transport economics ,the value of time is the opportunity cost of the time that a traveler spends on his/her journey. Production is meant for dispatch. If we cannot dispatch the produced goods to the customers at the right time it will be meaningless. If the truck turnaround time cannot be optimized,the buyer will be less interested to lift the material from the vendor. This will cause a loss to the vendor.

The suppliers are happy if they can supply the materials as much as possible to the customers by availing the required quantity of trucks easily. The customers are also delighted. All these are possible only by optimizing the truck turn around time.

1.1 Uncertainty in Estimating Truck Cycle Time

The construction industry is known as one of the largest industries in the world. It is also forecasted to grow at a compound annual growth rate of 4.8 from 2018 to 2023 due to the increasing demand for housing and infrastructure.

The accuracy in calculating truck productivity is affected by time estimation. Time estimation of truck movement in transporting the material in one cycle is defined as truck cycle time (TCT). Inaccurate estimation of TCT may affect the project cost and project result whether the time is overestimated or underestimated. Overestimation may cause ineffective expense because the project pays for unnecessary machinery and resources. Underestimation of TCT may cause poor project results due to machinery's low productivity and the number of resources. It may lead to the unavailability of the project on the stated completion date in the contract. The contractors have to pay the penalty and hire more human resources and equipment for completing the project. Therefore, an accurate time estimation of TCT is important for managing the resources.

1.2 Method to Estimate Truck Cycle Time

The objective of this project is "optimization of truck turnaround time in dispatch system". The project deals with all factors affecting truck turn around time in final goods dispatch. TIME is the subject, optimization can be defined by the lowest possible time. That's why we can construct our objective function as:

Min(TTotal)

Ttotal = Tp + Tq + Tl + Tex

- Ttotal is the total turn around time of the truck.
- Tp is terminal waiting time.
- Tq is the time taken between gate entry and tare weight.

- Tl is the time take for loading.
- Tex is the time taken to leave the premise after loading.

1.3 Project Objective

It is observed that there is always a delay during the loadingunloading activities in a logistics warehouse. This can happen mainly due to the human time consumption in the loading/unloading process. This has to be reduced or maintained one way or the other. As this requires a continous monitoring, lot of human time can be saved by using this mechanism.

The project aims to improve the accuracy of TCT prediction without human intervention or through an automated process.It helps to determine the trucks total turn around time and to further determine the delay in the loading unloading activity. This help in tracking the delay that happened during the loading unloading process. Necassary action can be taken at the same time, which will help the logistics reach the destination on time.

CHAPTER 2
ENVIRONMENTAL STUDY

2.1 System Configuration

System configuration describe the hardware and software requirement of the system for development

2.1.1 Hardware Requirements

- Memory : 4 GB RAM or above
- Processor : Intel Core i3 or above
- Hard Disk Space : 320 GB
- Keyboard : 104 keys
- Speed : 2.4 GHz

2.1.2 Software Requirements

- Operating system : Windows 8 or above
- Front End : HTML, Python
- Libraries : Numpy, Tensorflow, Keras
- Version control system : Git

2.2 Software Specification

2.2.1 Python

Python is an interpreted, excessive-stage, widespread-purpose programming language. Created by means of guido van rossum and first launched in 1991, python's design philosophy emphasizes code readability with its extraordinary use of significant white space. Its language constructs and item-oriented approach aims to help programmers write clean, logical code for small and huge-scale projects. Python is dynamically typed and rubbish-accrued. It supports multiple programming paradigms, together with procedural, item-oriented,and purposeful programming. Python is regularly defined as a "batteries included" language due to its comprehensive preferred library. Python is meant to be an effortlessly readable language. Its formatting is visually uncluttered, and it frequently uses English key phrases in which different languages use punctuation. In contrast to many other languages, it does now not use curly brackets limit blocks, and semicolons after statements are non-compulsory. It has fewer syntactic exceptions and unique instances than c or pascal. Python uses white space indentation, as opposed to curly brackets or keywords, to delimit blocks. An growth in indentation comes after positive statements; a decrease in indentation indicates the end of the present day block. Thus, the program's visual shape appropriately represents this system's semantic shape. This feature is likewise every now and then termed the off-side rule

2.2.2 Tensorflow

TensorFlow is an open-source framework developed by Google researchers to use machine learning, deep learning, and other analytical and statistical

work elements. Like similar platforms, it was designed to simplify the pro- cess of designing and implementing advanced analytic programs for users

such as data scientists. And typical programmers and forecasters. Tensor-

Flow handles data sets that are placed as graphical interfaces, and the edges connecting the nodes to the graph can represent vectors or multidimensional matrices, forming what is known as tensors.

We imported keras from tensorflow. Tensorflow provides libraries required for classification, data splitting (validation and training).h5py library used to convert array to HDF5 binary data format . We created validation and training files using h5py library in h5 format.

2.2.3 Keras

Keras is a small library of neural networks written mostly in Python and capable of running over TensorFlow or Theano. It is built with the focus on enabling fast test. It puts a front and centre user experience. Keras follows the best ways to reduce the load of understanding: provides consistent and simple APIs, reduces the number of actions by the user required for standard use cases, and provides clear and effective feedback about user error.

In particular, the neural layers, cost functions, optimizers, implementation schemes, implementation functions and general programs are all standalone modules that you can integrate to create new models. We used keras for implementing MobileNet architecture and LSTM. Mo- bileNet only have 16MB size and it can be implemented in mobile devices,cctv etc.

2.2.4 Numpy

NumPy is a library for Python. It adds support for large matrices and multidimensional arrays, along with a large collection of high-level mathematical functions to operate on these arrays. NumPy in Python gives functionality comparable to MATLAB since they are both interpreted. They allow the user to write fast programs as long as most operations work on arrays or matrices instead of scalars.

Trained model divides the given video into specified number of frames.A frames contains attributes such as width, height and RGB color code. Dataset trained with MobileNet stored as array values. And Validation set and

training set is also taken as array for training with lstm . We used numpy to fit these with the model

2.3 Functional Requirements

The system should be designed to resolve all types of grievances so that management can easily handle the application. Management should be able to fetch records easily when it needs.

2.4 Performance Requirements

The system would need least 4 GB of RAM. Less RAM will result in the poor performance of the system. Proper internet connection is a must. For running the application python and flask should be pre-installed.

CHAPTER 3
LITERATURE REVIEW

Study on truck turn around time has been a very active research field for a long time. Responding to the poor estimation of TCT, many experts tried to find the solution by proposing a new method to predict TCT accurately. Table 1 shows previous research which worked on improving the TCT prediction. Two main aspects are examined, such as the objective of the research and the method used.

Authors	Objective
Plaistowe	Calculate TCT
Peurifoy	Calculate TCT
Curi	Evaluate the avg fuel consumption and TCT
Sun	Explore the result of TCT on the 2 diff types of roads.

Table 3.1: Previous research

Before entering the digital era, experts use the manual calculation method to predict truck cycle time. Plastowe and Peurifoy proposed mathematic calculation for calculating Truck Cycle Time that can be done through manual calculation or without digital simulation.

Plastowe proposed the calculation of truck cycle time based on three major components, such as running, waiting, and loading. The research defined a constant in the TCT, which is from the calculation result of truck efficiency. The method proposed to sum up the running constant, accepted waiting constant, and loading time depending on the truck type. The result is proved to be reasonably simple and easy to be implemented in estimating TCT. However, the method requires the estimation of value for each

component, and it does not eliminate the accuracy of TCT.

Sun, X. used ML with a classification method to predict TCT using the k-nearest neighbours (KNN), support vector machine (SVM), and random forest (RF) algorithms. The research develops a predictive model of TCT from two different routes: fixed-route and temporary. The research also includes the weather as the feature for the ML input. The research result shows that SVM and RF result is more accurate than the KNN. However, the research uses the classification algorithm for continuous value, which is not an effective way. And, the final accuracy is unknown because the error is not be normalized.

Some experts propose a new method to estimate TCT accurately using record data with different approaches. For example, Curi et al. (2014) proposed a method to predict HT using the effective flat haul (EFH) parameter. EFH is defined as a calculated parameter that normalizes the elevation change of the route and the distance. This research applied the method toward two different trucks and two types of elevation change of haul routes to calculate the equipment's average cycle time. The research concludes several influence factors that can predict truck cycle time, such as material and site conditions. However, the accuracy of the prediction is unknown.

CHAPTER 4
SYSTEM ANALYSIS

System Analysis by definition is a procedure of deliberate examination to accumulate information, deciphering the realities, diagnosing the issue and utilizing this data to either manufacture a totally new framework or to prescribe the enhancements to the current framework.

A good system investigation includes the way toward looking at a business circumstance with the purpose of improving it through better strategies and systems. In its center sense, the investigation stage characterizes the necessities of the framework and the issues which client is attempting to explain independent of how the prerequisites would be practiced.

4.1 Requirements Analysis

Requirements analysis, likewise called requirements engineering, is the way toward deciding client desires for another or changed item. These highlights, called necessities, must be quantifiable, significant and itemized. Here such prerequisites are frequently called useful determinations.

4.2 Existing System

Usually turn around time is calculated manually. And as we all know manual calculations are most usually prone to errors. It requires a continous evaluation or monitoring which is practically a tudious task.

4.3 Limitations of existing system

- Lack of latest technologies.

- No proper timings.
- Manual errors.

4.4 Proposed System

The system proposed here determine the trucks total turn around time and to further determine the delay in the loading unloading activity.This help in tracking the delay that happened during the loading unloading process.Necassary action can be taken at the same time.

4.5 Advantages of proposed System

- Efficient
- Reduction in manual errors
- Time management
- Better user interfaces

4.6 Feasibility Study

A feasibility study is a significant level container form of the whole System examination and Design Process. The examination starts by grouping the problem definition.Feasibility is to decide whether the task is worth attempted. When an acknowledgment issue definition have been created, the expert builds up a legitimate model of the framework. A quest for choices is dissected carefully.There are 3 sections in feasibility study

4.6.1 Technical Feasibility

Technical feasibility is an investigation of function performance and requirements that may influence the capacity to accomplish an adequate framework. It is every now and again the most troublesome area to evaluate at this phase of framework advancement process. During specialized examination, the investigator assesses the specialized benefits of the system idea,

while simultaneously gathering extra data about performance,reliability, viability and reducibility, the principle specialized issues generally raised during attainability phase of examination incorporate. Understand the different progressions related with the proposed framework before starting the task the framework must be clear about what are the advances that are to be required for the advancement of the new framework. Current technical resources are sufficient for the new partner matching system. By considering these facts this project is technically feasible.

4.6.2 Operational Feasibility

The project is profitable only if it can be converted into information systems that will satisfy the needs of the organization. Automated detection gives us clear and accurate idea on how long a truck got delayed and is not prone to manual errors. This gives more satisfaction to the officials and smooth results are obtained.

4.6.3 Economical Feasibility

Cost-benefit-analysis is among the most significant data contained in a feasibility study, which is an appraisal of economic justification or a PC based framework project cost-benefit-analysis investigation portrays costs for projects advancement and loads them against tangible and intangible of system. To create system actually for the utilization it need money related advantages or on the other hand surpasses the expenses or made equivalent. The inquiries raised with the end goal of evaluating are

- Cost to conduct a full system investigation
- Cost of hardware and software for the class of application being considered
- Benefits in the form of reduced costs or few costly errors

This Application provides results in a secure manner and there is no bandwidth usage. Thus the system is economically feasible

CHAPTER 5
DATA SOURCE IDENTIFICATION

The gate register of any warehouse contains the IN and OUT time of each and every trucks. Truck turn around time may differ from one factory to another . It depends on the product and on the terms and conditions of the dispatch system. The table given below shows average turn around time in major factories:

FACTORIES	AVG TURN AROUND TIME(Hrs)
Tata chemicals Ltd	3.8
Hindustan Unilever Ltd	4.5
Exide Industries Ltd	3.6
Haldia Petrochemicals Ltd	4

Fig. 5.1: Average truck turn around time in major factories

Studies shows that, if all the parameters are fulfilled in each step ,then the standard turnaround time should be as per the following table:

PROCESS	JOBS	OPTIMUM TIME REQUIRED
1	Truck report at gate	30 Minutes
2	Gate entry and sent to weighbridge	20 Minutes
3	Truck unloading	45 Minutes
4	Truck loading	65 Minutes
5	Other works and truck release	30 Minutes
	Total	3 Hr 10 Minutes

Fig. 5.2: Optimum time required in each steps

Considering the average turnaround time listed in the Fig. 5.1 and Fig.5.2, we can conclude that the standard truck turnaround time should be approximately 4 hours.

5.1 PROBLEM IDENTIFICATION

In any production industry, the industrial business function can be broadly classified into "Manufacturing" and "Supporting Functions" like supply chain, quality management, administrative management, etc. In order to increase the hold of an organisation in the market, quality of the product and services associated with it must be improved continuously. Logistics and supply chain are the most important links in the supporting functions for the production. By understanding the variety and interrelationship of supply chain risks, managers can create balanced and effective risk-reduction strategies for companies.

The focus is shifting to post-manufacturing operations, an area that has been greatly neglected so far. Functions like logistics, supply chain, service, etc. are gaining more importance in order to provide value to customers and to quicken the cash flow.

Truck turnaround time is the most important key performance indicator in any kind of logistics operation. A short turnaround time is economically beneficial, making efficient use of the available time and materials. Improving the service quality of the supportive business function is bound to give a higher Return on Investment (ROI) in a shorter Payback Period . It ensures quick loading/unloading activity and hence fast material flow and quicker delivery at the assembly line.

Following is the copy of one page of the gate register for the date 28-05-2022 from Om Logistics Ltd at Trivandrum:

Date	Truck No:	In-Time	Out-Time	Out Date	Difference(Out - In)
28-05-22	KA 03 MJ 1011	11:56	19:42	28-05-22	7 Hr 46 Min
28-05-22	KA 04 JQ 5660	11:58	16:42	28-05-22	4 Hr 47 Min
28-05-22	HR 26 DQ 5551	23:57	12:15	29-05-22	6 Hr 55 Min
28-05-22	TN 57 AD 3604	15:55	19:05	28-05-22	3 Hr 10 Min
28-05-22	KL 18 T 333	16:05	10:52	29-05-22	18 Hr 47 Min
28-05-22	TN 77 Z 4455	15:57	19:58	28-05-22	4 Hr 1 Min
28-05-22	WB 29 A 6339	16:38	21:35	28-05-22	4 Hr 57 Min

Fig. 5.3: A true picture of turnaround time

Here one truck is taking 18 hrs 47 minutes, whereas another truck is taking only 3 Hrs 10 minutes. Here 5 out of 7 ,i.e, 71 per cent trucks are taking more than 12 hrs for its turnaround time and only 28 per cent trucks have turnaround time for less than 4 hrs.

The average time taken by trucks at various steps were tabulated and following observations were made:

- Few trucks are getting delivery order timely; i.e. within 30 minutes.
- 34 per cent trucks are detained for more than 10 hrs even for one or two days. Only 28 per cent trucks have the turnaround time for less than 5 hrs.
- Extra time is consumed in each stage.
- Take personality test
- Average turnaround time for each truck is 10-12 hrs which is approx. 3 times of standard time.

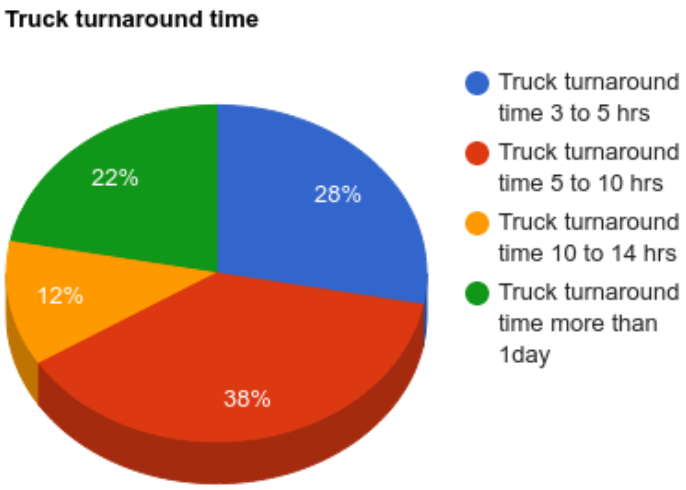

Fig. 5.4: Truck turnaround time

Inaccurate truck cycle time (TCT) prediction causes queuing of trucks for loading and unloading material. It causes a delay in completing the project on time and within budget due to a change in planning by adding additional equipment, machinery and human resources. It also negatively impacts the environment by increased fuel consumption, resulting in higher emissions. Hence, improving the accuracy of TCT is considered a critical element in increasing the construction industry's performance.

Therefore, many stakeholders aim to improve truck movement for instance, by minimizing fuel consumption or increasing truck productivity. One of the essential parts of the truck movement is time prediction because it relates to trucks' productivity, the number of trucks and human resources, the type of machinery, and the maintenance treatment in the warehouse.

CHAPTER 6
SYSTEM DESIGN

6.1 Application Architecture

Fig. 5.1 is the architecture of the proposed system.

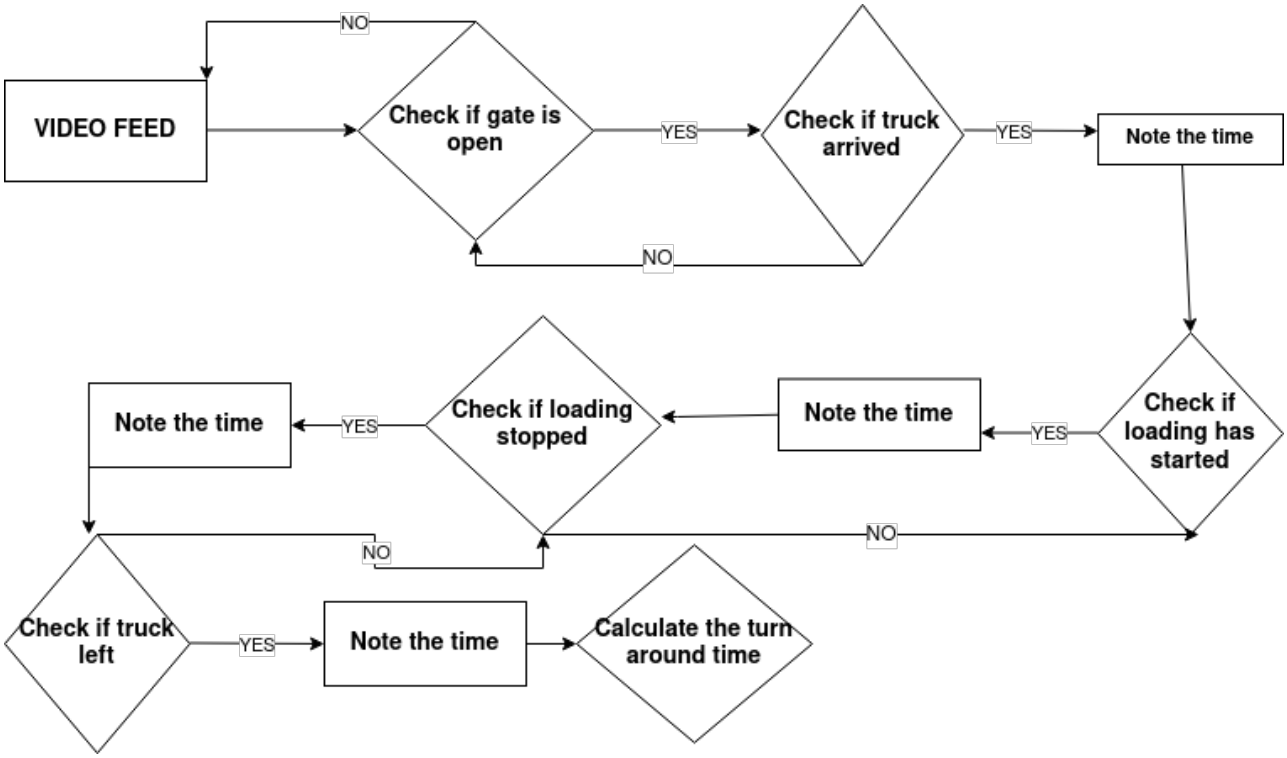

Fig. 6.1: Architecture Diagram

Noting the time manually is a tudious process and it will be easy if we make it automated. Automated time detection will make us clear whether the truck has got delay at any point of view and enable the officials to take the necessary action.

When the video feed is obtained the initial step is done to determine whether the gate is open or not. When the gate is opened it further checks for the incoming truck in the particular gate.

When a truck is entering the particular gate the number plate of the truck and the incoming time of the truck are noted. Thus the start time of the loading/unloading process is also noted and the delay to start the loading or unloading process is calculated. If this time delay exceeds a certain time,then a warning is given and the alert is given to the concerned officials.

Once the loading is completed the time is again noted and the next check is done to identify whether the truck has left the loading or uloading bay. The time delay between loading/unloading and truck out time is again calculated. If there is a delay greater than the particular time,then it is also alerted accordingly.

The total truck turn around time which is the difference between the truck out time and truck in time is thus found out.

CHAPTER 7
TECHNICAL EXPLANATION

7.1 Gate open/close detection

The first step in the whole process is to check whether the gate is closed or opened. This is achieved by using image processing technique called template matching in openCV in python.

7.1.1 Template matching

Template matching uses the template of the gate and maps it in the frame. If majority of the template of the gate is found in the frame, then it means that the gate is closed and vice-versa. The images of the gate at various lighting conditions are taken inorder to ensure template matching of the gate is done properly at all times.

7.2 Truck-in time detection

Once the gate is found to be opened, it searches for the incoming truck in the particular bay. This is again achieved by using image processing. Areas where the truck will enter in the particular bay is localized in the frames. When the truck arrives in the particular bay it is observed that the area turns black. When the localised area turns black we understand that a truck has arrived and then the truck-in time is noted in the particular bay.

Once the truck-in time is noted, the number of the truck is also detected using ***ANPR* (*Automatic Number Plate Recognition*)**.

7.3 Loading/Unloading detection

This is achieved using another image processing technique called as contour detection in openCV.

- Contour detection is a process that includes the creation of a curve joining all the continous points, having same colour or intensity. Here the absolute difference between consecutive frames is taken and the contour detection is applied on the region of interest (ROI).If any movement for a particular time is detected in the ROI we will assume that the loading or unloading activity has started and the time is also noted.
- If no contour has been detected for some consecutive frames we will consider that the activity has ended and the activity end time will be also noted.

CHAPTER 8

SAMPLE RESULTS

Fig. 8.1: Architecture Diagram

Here the truck-in time is noted when the truck arrives.

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