Design and implementing of Passenger Information System at stations of AALRT

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I, the undersigned, declare that this paper is my original work, has not been presented for a degree in this or any other university, and all sources of materials used for the paper have been acknowledged.

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Place: Addis Ababa, Ethiopia

Date of submission: _____

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Abstract

Information matters to the railway's customers; it is a common phenomenon in many countries which is also significant problem in AALRT. It always determines the quality of the transportation system. Therefore designing passenger information system is necessary to realize transportation quality, safety and reliability. In this paper the design of passenger information system is presented (possibly) the design was implemented using the platform. For the design of this system three modules which are global positioning system train locator unit, central control system (central server), and passenger information display unit will be used. It uses global positioning system technology to collect the real time information about the train including vehicle location, direction, speed and others. Global system for mobile telecommunication module is used for data transmission between central command and moving train. A passenger information system (PIS), fixed at station provide real-time passenger information it received from the central server to a passenger at stations. It may include present location, time to reach the platform, delay time, train space, updated schedule and safety information. Finally it is expected that this system will provide information to passengers with a little delay and a better accuracy in local language.

Key terms: Passenger information system, Global positioning system, graphical user interface

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List of abbreviations

AALRT	Addis Ababa Light Rail Transit
AP	Audio processor
APC	Automated Passenger Counting
ATOS	Autonomous Train Operation control System
CAN	Controller Area Network
CCTV	Closed Circuit Television
CREC	China Railway Engineering Corporation
CTC	Central Train Control
CU	Control Unit
ERC	Ethiopian Railway Corporation
ETA	Estimated Time of Arrival
EW	East-West
GPS	Global Positioning System
GPRS	General Packet Radio Service
GSM	Global System for Mobile telecommunications
GUI	Graphical User Interface
HTTP	Hypertext Transfer Protocol
IP	Internet Protocol
IRMA	Infra-Red Motion Analyzer
I/O	Input-Output
KML	Keyhole Markup Language
LAN	Local Area Network
LCD	Liquid crystal display
LED	Light Emitting diode

LRT	Light Rail Transit
NS	North-South
OAS	Operation Assistance System
OBD	On Board Diagnostics
OCC	Operation Control Center
PIS	Passenger Information System
POI	Passenger Onboard Information
PVC	Poly Vinyl Chloride
RPM	Revolution Per Minute
SIM	Systematic Identification Module
SMS	Short Message Service
SQL	Structured Query Language
UI	User Interface
VGA	Video Graphical Array
WAP	Web Application Proxy
2G	Second Generation
3G	Third Generation

CHAPTER ONE

Introduction

1.1 Background

Railway transport is a means of conveyance of passengers and goods, by way of wheeled vehicles running on rails. The railway is an excellent transportation system with respect to both people and the natural environment, so expectations for effective use of railways in the future are on the increase worldwide. Improvement of the functions of railway systems has been a goal over the 180 years of railway history, which began in United Kingdom. Now, the social role of rail travel is being reconsidered with hope for solutions to the global environment problem, traffic congestion in large urban areas and other such problems, and there is a demand for development of systems that even more people can use in comfort [1].

A railway system is a complex system with many interacting processes that depend on technical devices, passenger, and the external environment, and therefore contains many means of communications for different purpose. Thus communication may be between train and train, between central system and local control center, between local station and train, or between central system and local passenger information system. So the disturbance or lack of such communication has great effect on the transportation.

In general railway transportation is popular modes of transportation in the present society and economic gains of mass transport. It needs high initial investment and low maintenance cost. It requires high safety, high communication system. Railway transportation can demands, speed, comfort, cost and high quality of services, improve punctuality and predictability. So one of the infrastructures satisfy this requirement is passenger information system (PIS).

1.2 Railway system in Ethiopia

Railway transportation system had been used as a major freight and passenger transport to the eastern part of Ethiopia from 1917 to 2007 E.C. The system comes to existence during the reign of Emperor Menelik II and covers a total of 781km powered by diesel engine and jointly owned by Ethiopia and Djibouti. Great improvement of road network is prevailing in Ethiopia, but with limited connectivity, high cost of transportation and poor quality of service. The mobility need of the country population and the development of transportation system are far from compatibility. Therefore; the country is in need of modern, economic, comfortable, time saving and long lasting transportation which will ease import-export system and result in fast development. To this end, the government of Ethiopia has embarked on railway system. The main reasons for the renewed interest in the railway are environmental, economical, and safety related issues are presented in the referenced papers [2] [3].

Addis Ababa Light Rail Transit (AA-LRT) Project is Ethiopian government plan of Transformation plan to satisfy the demands of transportation shortage problem in Addis Ababa. It is Electrified light rail transit with total length of 34.25 kilometers (North-South line 16.9 kilometer and East-West line 17.35 kilometers). To effectively solve the problem of urban transportation, especially that of the Addis Ababa city, the government of Ethiopia decides to build a light rail in the city of Addis Ababa. Currently this project has planned two lines, the east-west line and the south-north line. About 3 kilometers is the sharing section for both E-W route and N-S route, which has the greatest passenger current. The altitude of the plateau is 2,400 meters with an urban population of over 3,400,000. The urban area is 530.14 kilometer square, and the density reached 5,607.96 per kilometer square [3].

The east-west line project starts from Ayat and ends at Torhailoch. The total length is 17.4kilometers. There are 22 stations, among which 5 are elevated stations, 1 underground station and 16 ground stations. The 22 LRT stations are placed in phase one of E-W route project, 5 of which are shared with N-S route. Average interval between two adjacent stations is 815 meters. The longest interval is 1210 meters and the shortest interval is 525 meters [3].

The south-north line phase I project starts from Menelik II Square and ends at Kality. The total length is 16.97kilometers. There are 22 stations, five of which are shared with E-W route among which 9 are elevated stations 5 common stations at the common line), 2 underground station and 11 ground stations. Average interval between two adjacent stations is 793 meters. The longest interval is 1370 meters and the shortest interval is 510 meters. The depot locates at the south end of the project. The control center (commonly used by both lines) is temporarily considered to be placed inside the parking yard [3].

The AA-LRT project as said earlier has two routes and these route share a common route with length of around 3 Km. EW line starts from Ayat is shares with the Kality line which meet at EW16/NS16 at stadium and ends EW20/NS20 with 5 stations.

1.3 Overview of passenger information system

Information matter to the railway's customers is a common phenomenon in many countries. It is always related to the quality of the transportation system.

To meet the demand of railway operation and management, the communication system of the transportation should be built into a safe, reliable, economical and practical communication network with reasonable functions, flexible networking and, expandability. It also should be able to transmit various informations such as voice, text, data, images and others for passengers.

Passenger Information System (PIS) is a method or technological gadget to give information to public about status of Train running, rescheduling, accident and others to all points of transit passenger. Passenger Information Systems began as a way to help passengers get arrival and departure information. This system were standalone segmented systems which provided the most basic audio and visual information to passengers using primarily analog technology with a little or no integration or interface to any other systems on-board.

Now a day this system integrate multiple technologies including advanced visual displays, public address, personal entertainment, emergency intercommunication, video surveillance (CCTV), IP networks, wireless networks and others [2].

Passenger Information System includes information management on routes and their display via different display elements deployed at passenger platforms. These devices may be of different types:

- Screens
- Indicators at platforms
- Indicator panels in general

The technology delivers the scheduled information and real-time information updates and offers a variety of valued information on-board trains as well as in stations. This information includes:

- Travel information
- Safety information
- rescheduling
- Delay information and others.

The wealth of information is limitless and PIS is the channel to deliver such information to transit passengers in a mixture of text, graphic and video formats for passengers' safety, entertainment and planning.

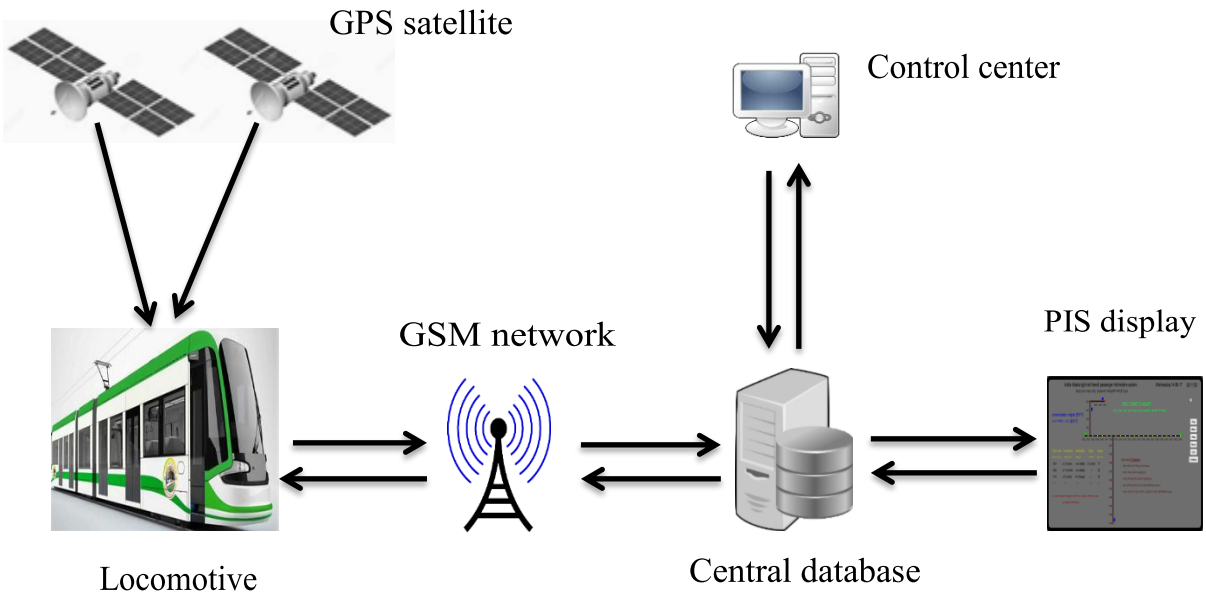

Figure 1: passenger information system architecture

The overall system of architecture is as shown in the above figure. The most basic function in this system is train tracking & public information system. It uses GPS technology to collect the real time information all about the train. Once vehicle location, direction, speed and others are determined from the GPS components, it transmit this information to the server (central monitoring and control) and passenger information module at station through GSM network. Onboard module deliver about present station, next bus stop, speed, and time and predetermined schedule, safety information, and operation.

Additional to location, speed, and direction of the train, this system can inform passenger about delay of train (delay occurrence, delay time, delay reason (stop over or under speed), and next station arriving time after delay). In case when a train is delayed at a station or outside station, the next station where the train has a stopover automatically acknowledges the delay as there is a comparison of scheduled and every sent information. Again the passenger at station can recognize status of the train load, that means whether the train can onboard additional people or not when it arrives at station. Automated Passenger Counting (APC) is used for collection of accurate boarding and alighting data and subsequent evaluation and analysis of the load. Finally, analyzed data is displayed at station for passenger information.

The layout of all information to be displayed may be adapted to the needs of different clients and languages. Furthermore, the same visual and audio means can be used to display corporate or commercial information at passenger platforms. In turn, all information displayed in visual format may have an associated audio accompaniment issued over the Systems, and it is possible to limit this emission to specific station areas, a series of stations or throughout a complete line of stations. The system allows for the management of operating plans to permanently control valid routes. These operating plans may be generated through the system itself, or imported from external operation assistance systems (OAS). The emission of these events may be manual or automated, based on the information provided by the route control and monitoring systems.

Centralized, distributed architecture is used for this system's design, thereby permitting the management of an entire line of stations from a central post, resulting in savings on human resource expenses in not requiring the presence of operating personnel at each station. Distributed architecture based on IP technology simplifies adding and restructuring information devices at passenger platforms.

1.4 Problem statement

Many people choose rail as a means of transportation, and to respond to social expectations, further expansion on safety and punctuality, which are the main features of rail travel, and improve quality in various respects from the users' point of view are always main issue. Development of information processing technology to supplement an existing travel information service system that is used by the passenger before boarding the train and provides ticket issuing, seat reservation and operating information is very necessary. The control systems that support train operation include various kinds of technology concerning the railway cars in which passengers ride and the signaling systems and traffic management systems, are also crux of safety support and which are moving toward integration into a single, huge system.

From unstructured interview and visual data, passenger information to the railway's customers at station is essential for Addis Ababa LRT transportation system. Train delay, safety matters and other related problems are inevitable and an acceptable scenario in this transportation. From unstructured interview, many passengers did not prefer Addis Ababa railway transportation as their always choice due to lack of train information. This can be mentioned as the main issue that affects the economy and quality of the transportation system at large.

In railway system one of the parameters that determine the customer satisfaction and operation safety and reliability is its communication system. Passenger information system at station is a communication system which is used to inform passenger about all condition in the transportation system. Besides, in AALRT communication system consists of digital transmission net, telephone, CCTV, wireless communication and the relevant affiliated facilities [1]. But at stations of Addis Ababa LRT, there is no standard passenger information system at all. This can cause confusion, especially to passengers unfamiliar with this transportation system. However, it is a prerequisite that the passengers should have full information about the transportation they use.

In general, the following are significant problems.

- The passengers do not know any information about the current location of the train and also the status of the train. This can result in a long waiting time for train at stations. It also affects readiness of passengers to board.
- The passengers can get on the wrong train. This is because of they do not know the arrival time of the train that travel towards certain position (direction). Especially when trains are being operated out of sequence, the passengers should have to recognize the special case.
- The passengers do not know arrival times at next stations after leaving of current stations (a feature of some systems). So the passengers (both commuters and leisure passengers) cannot have their own schedule to be at some place. This can affect working environment of the country.
- Again at some interval of a time (at morning peak hour and at evening peak hour) the transportation is very crowded. This is due to arrival time to be at expected place is not recognized. In other words, all passengers those travel a short distance, medium distance and long distance are go to stations at the same time.
- Passengers observed that the train company name, train number, the direction it will go (at branch stations), departure time and others on routes when is in visual site. Again this also determines the readiness of passengers and the accuracy of train schedule.
- Distress of passengers due to delay of the train is also another problem. Since there is no information about delay of the train, they do not break hope of waiting for it. This may take their time to use another option of transportation.

1.5 Objective

1.5.1 General objective:

The main goal of this study is to design and implementation of passenger information system (PIS) at stations of AALRT depending on what passengers required from information desk at station.

1.5.2 Specific objectives:

The specific objectives of this research are:

- To increase customer familiarity regarding travel and safety information
- To improve the service quality by improving certainty
- To make the railway transport usage easy and comfortable for both commuters and leisure passengers
- To improve consistency and reliability of train schedule
- Avoid distress of passengers due to delay of the train without schedule

1.6 limitation and Contribution

1.6.1 Limitation

This thesis develops means of passenger information at station of AALRT. It did not include designing of mobile application passenger for PIS. During design of this system, some assumptions are considered since there was a shortage of references and company infrastructure. Because of a limitation of time, cost & technological equipments, there is no testing and analyzing of the system on field test.

1.6.2 Contribution

Passenger information system is the major functional system that realizes the quality, safety and reliability of the transportation system. Generally, this thesis will contribute to the AALRT in:

- Improving Passenger information system
- Providing full and real time information to passenger at station
- Simplifying usage of the transportation system (make it all passenger considering service that elders, pregnant and disabled people)
- Contribution real data for other operation section
- Increasing quality of the transportation system
- Improving satisfaction of customer

1.7 Research methodology

The methods used to achieve the desired objectives of this thesis where as follows. First, literature reviews about passenger information system, from different source such as scientific journals, papers, books and publications will be revised. From unstructured interview and observation the passenger information system requirement analysis will be analyzed. Secondly the passenger information system modules will be described and system design will be done. In this step the lay out or arrangement of the data collection system, data transferring system, data processing and storing system etc will be arranged. Relevant data's were also gathered from Ethiopian Railway Cooperation and PIS will be designed based on the passenger requirement. Thirdly, the system will be programmed in C++ using Microsoft visual studio 2010 software as simulation tool. The simulation was done at different stations using train come from different source. Finally, the results were interpreted and conclusion was drawn based on the results obtained.

1.8 Thesis organization

This thesis is organized in to six chapters. The first chapter includes introduction which provides clear information about the background of the thesis work, statement of the problem, research method and contribution of the thesis. Chapter two is about technologies of PIS and analysis made in the research. This section provides technologies used in each module of PIS and what in Ethiopia. Additionally, this chapter provides analysis made for this thesis fulfillment. Chapter three is about system description and design PIS. It includes System Architecture, System structure, required components and Design of the process of the PIS modules.

Chapter four is about overall hardware and software design of the system. In chapter five, the simulation and result of the PIS will be presented. The final chapter is conclusions and recommendations. On this chapter the work has been concluded based on the result obtained and discussed in previous chapter. Further recommendations were suggested for the development of new model or improvement of the results of this thesis.

CHAPTER TWO

Theoretical background and literature review

2.1 Theoretical background

As early as first railway terminals were built in the 19th century one could find roots of specific information systems for passengers. Starting with the published public timetable sheets and ticket sales, the most crucial aim of those systems was (and still remains) to navigate passengers to the correct train at a station and provide them with other information such as service alterations [1]. Changeable signs and human serviced audio coverage of the station featured an acceptable mix of technical possibilities and expectations of the passengers in the past. However, standards in numbering tracks and stations, in providing arrival and departure data and in providing information for national and international timetables established very early and remained very robust over the decades.

As the information panels at the terminals became mechanical and later electronic, not much effort was done to redefine this view, so most of the contemporary visual systems (departure and arrival tables) have no other functions than of an electronically operated providing almost the same information as more than a century ago, just in a more effective way.

When come to Ethiopian railway, the railway transportation system comes to existence during the reign of Emperor Menelik II [2]. Great improvement of road network is prevailing in Ethiopia, but with limited connectivity, high cost of transportation and poor quality of service. Therefore the country is in need of modern, economic, comfortable, time saving and long lasting transportation which will ease import-export system and result fast development. As I mentioned in the previous chapter, the government of Ethiopia has embarked on railway system. The main reasons for the renewed interest in the railway are environmental, economical, and safety related issues. One of this projects implemented in Ethiopia is Addis Ababa light rail transit (AALRT) [2] [3]. AALRT communication system consists of digital transmission net, telephone, CCTV, wireless communication and the relevant affiliated facilities. But this is enough communication system for the transportation. Most of the times many facility providers are concentrate on the side of providing quantitative enough facilities rather than its quality. Let's come to AALRT, it is a great progress on solving transportation system in Addis Ababa and moderating it. But still

now there is problem of quality, safety, and user information. So the main parameter that measure the quality of the service is the information delivered to the users (passengers) regarding the transportation safety, operation and time table. Those information can be onboard or at station. Onboard information system provides information about present station, the next station, safety information and others related. Still it is enough even if there is some failure and inconsistency. But when come to information system at station of Addis Ababa LRT, there is no standard passenger information system at all. This can cause confusion, especially to passengers unfamiliar with this transportation system. However, it is a prerequisite that the passengers should have full information about the transportation they use.

2.2 PIS technology

The state of the art of electronic communication technologies is changing rapidly. New types of electronic information can be provided to passengers because of recent developments in the integration of real-time information and next-stop announcements. Railway information system is generally built upon a computer based network to support rail information collection transmission, processing and dissimilation in order to ensure safe and stable rail transportation and provide high quality operational service as well as passenger information system.

Developments are also being made outside the transit industry that may have potential for transfer to the transit operating environment. In assessing advanced technologies for providing passenger information on board vehicles, United State transit agencies have made assumptions about basic information needs but, for the most part, have not identified passenger requirements through customer research prior to installing these systems.

It is improved from time to time depending on the device used to display information at station (LED or LCD display) [4], the way of collecting information about the status of train, the way of sharing information between the train, central control system and platform display system and other parameters.

In previous railway system, railway information system uses sensors and PVC insulated Copper Cables to track the train status [5]. The sensor is mounted on the lamp-post near the station which senses the train and sends the information regarding the arrival of a train, its arrival time, train number and others to the receiver in the station. This receiver receives the information. The information received is updated into the local server manually. This server has the master clock and is interfaced with display boards and coach guidance boards, signal posts and many slave clocks in the station, to inform the public through them. In this passenger information system, the tracking train information between the stations is impossible.

Besides, there was passenger information system that utilizes the current transport operation system for train location display in the lines which is operated by transport operation control system such as Autonomous train operation control system (ATOS) [4]. This system indicates train locations by two data sources, train location data which transport operation control system (ATOS) has and the current train approaching data. However such train operation system is not introduced in the rural area, and thus in such area, there is no means to learn about the train in that area. So this kind of passenger information system has also limitation for customer satisfaction. Therefore it is necessary to narrow such service gap between metropolitan area and local area as much as possible.

In this research, a GPS mobile phone installed in each train to track the train location is proposed. This system is obtains train location information from GPS instead of ATOS. So it can be used for both urban and rural transportation system. According to this the researchers conducted on the area PIS and related to this work are briefly reviewed below.

i. Information providing

Visual displays were most frequently used for providing messages and audio announcements were used mainly for next-stop information and emergency messages. Many countries were likely to produce systems that provided information in both visual and audio formats specialize in one format. Vendors who have placed their information devices on the interior of transit vehicles most commonly have used LED technology for visual displays and digital recording technology to provide audio messages [14]. Therefore for multi section display system LED screen is not clearly visible and prerecording audio is also not enough especially for disabled people. Supporting local language is also the necessary issue.

ii. Train tracking

In different country different means of train location detection are used. A train location detection system using eddy current sensor is previously used [11]. It is purely train-based in the sense that no further installations are required on the track. The eddy current sensor system consists of two identical sensors placed at a distance in longitudinal direction. Thus, the time delay between the two sensor signals obtained by cross-correlation is a measure for the velocity of the vehicle. In addition, the sensor signals are analyzed for characteristical events. The shape of the sensor signals highly depends on the irregularities of the magnetic properties of the rail arising along the track. In particular, it is shown that the characteristic signals of the components in switch areas differ significantly from the signals caused by rail joints along the straight track. This knowledge can be exploited for detection and classification of switches and switch components. But this type of detection has limitation to find train location [12]. Sizing of detection in rails is unreliable due to the large number of parameters that affect the eddy current inspection response. The depth of penetration is of major importance in eddy current inspection. Deep inspection is desirable, but it is unattainable in practice, since signal-to-noise ratio decreases while penetration increases. Also, deep inspection is more affected by variations in steel's electromagnetic properties.

Another train detection technique is by magnetic field measurement with giant magnetoresistive sensors. Magnetic field measurement has been applied in vehicle detection and car speed measurement [13].

iii. Passenger counting

Passenger counting in particular has been a tedious process in the past. Going back to the start of the transportation industry, drivers were required to count passengers manually – an inaccurate and nearly impossible feat considering all of the other tasks at hand. Although technology has advanced to light sensors, infrared curtain sensors and thermal imaging [14], these legacy systems still fail to account for the diverse nature of transit vehicles and passengers. Passengers may be tall, short, or average height; in wheelchairs, walking slowly or moving quickly; seniors, young adults, students, or children.

Some vehicles have wide doors while others have more narrow doors. Some routes have heavy traffic with standing room only. Many sensors simply cannot handle these diverse situations. Add in multiple fare zones, free fares, and intersystem transfers, and one can see why advanced technology is necessary to ensure accurate passenger counting and fare collection in today's transportation industry.

Automated vision-based passenger counters connected to a database through a wireless connection will more accurately count passengers today, leading to better budgets, schedules, and an improved customer experience.

iv. Graphical User Interface

The invention of GUI started back in the late year of 1970s. This was originated at the Xerox Palo Alto Research Laboratory before the Apple Company used it in their first Macintosh computers [6][7].

In [8], the authors investigated that is gathering as much information about railway system GUIs, GUI builders and good UI design. However, the review will emphasize more on the areas of GUI builders and UI design. The reason being is, both are specified to be the problematic domains that need to be carefully identified, as their roles in contributing to the production of the generic guidelines to design GUI for railway system.

In reference [9], the author clearly distinguishes GUI builders into four kinds of tools. These are:-

- Language-based tools
- Application framework
- Model-based generation and
- Interactive tools.

In Getting Started GUI Development with Java [10] the author outlined that, there are two basic types of GUI program in Java: these are, Applets and Stand-alone applications.

To conclude, in order to make this system more efficient, it is valuable to consider the performance of the system using an appropriate framework. And the selection and implementation method is must be follow standard procedures. Therefore, these and other related reviewed references have a vital rule to design and GUI for PIS in railway system. Even though, the above literatures focused on the applications those need to use in the user interface side, it must be consider that there are other related issues exist between onboard equipment and GUI such as, communication equipment , protocols and medium (or transmission medium).

CHAPTER THREE

Analysis and system description

3.1 Introduction

As mentioned in previous chapter, some related works are discussed. In this chapter analyzing the requirement of PIS and system application description are presented. The overall system application is divided in to two sections. The first one is field device and public information system at the station (station units) and the second is central monitoring and command (central data processing server). The detailed works the mentioned discussion are described in the subsequent sections.

3.2 data analysis

AALRT project (passenger information) is supervised and monitored by the Clint (ERC) and the design and system installation and configuration work by CREC. Addition to this in AALRT project there is no passenger information system at station. The only present is onboard passenger information system. Therefore options to get necessary data was asking information system and other related issues of the new railway system to CREC staffs by a latter. Since my thesis area is not previously implemented for AALRT, by finding contract agreement document, it is not possible to get necessary information. Although, using other resource to find any related topics is to get some information.

After the data collection phase it had been able to define the related data for each part and analyze the relations between them and gather the data for the research. The first part to analyze the data was gathering information about the collected frameworks' in the context of railway communication system. On the second part, as mentioned earlier the objective of this research paper is to recommend a good PIS for AALRT by selecting appropriate frameworks to provide information to passenger at station. Therefore, based on gathered data and following international standard requirements, decision made to select the most preferable PIS at station.

3.3 Requirements analysis

Passenger information systems in the modern concept of transport as a service play key role in creating the passengers feeling about the service. Passengers accustomed to smart telematics services in all branches of service expect that especially in the highly structured, managed and monitored public transport the information system will provide just the information needed and just in the time needed. However, for several reasons these expectations are not met with today's realities.

It is obvious, that communication of service is still mostly incorporated only as an add-on over the AALRT system, since it is not delivered to the passengers. But a good information system providing relevant information is needed more than ever before. The technology of tracking train delays is also not implemented, and available for public use; the technology of predicting their further operation and interactions is the current challenge of the industry. Providing all those data to the information systems and even to the individual passengers was never easier.

Information is actually relevant for every service. Most of today's train services, local or long-distance, are offered and marketed as lines, group of trains with same service and stop order operating in a fixed interval, not individual train services. The same things observed for AALRT train services also.

For example, for the train moving from Kaliti to menilik II or vice versa, the words "Menilik II" or "Kaliti" displayed on the front and back of the train. But here addition to line name, there must be specific code for each train which should have to visible for passengers. The line name (destination) is already displayed on the train, but still it is not fully visible since it should have to be displayed at station of AALRT.

Again the station name for AALRT is written on the wall of the waiting shade. This is also not fully visible and audio station name announcement is also not there. So static information display and audio announcement (especially for blind and literate people) are must be there.

According to unstructured passenger's interview taken, passengers expect not only easy navigation, but also accurate, online and precise information about alterations and connecting trains. In this regard our transportation systems unfortunately do not have systems implemented into them especially at station. Let's say it is for the carrier to inform the passenger about eventual serious problems and personalized solutions even before the train arrives at the station. That means the delay of train due to some series problem is there. But the passenger still relies on the coming of the train. The passengers cannot make decision on their navigation. So train delay and predicted arrival time are very necessary.

Again uninformed delay may come with another problem such as crowdedness of service, unplanned navigations, unplanned cost (using contract taxi) and others. So in such case, disabled and pregnant people cannot use our service. But it must be assured that the transportation system meet all the standards required for disabled, pregnant, and oldsters and retain their usability.

Another scenario that can solve the quality of the service is announcing the passenger whether the train on coming can boarding a number of passengers. This is also very necessary to give the chance to the passengers to make their own decision on their navigation.

In generally, a set of disturbance scenarios for managing disturbances and communicating planned alterations to the passengers at the stations and on the trains consistently should be prepared between stations managing department and the train operating department in advance, usually for each timetable period and each infrastructure segment which may become out of operation. Planned outages should be incorporated to the daily plans and in advance available to all participating parties and those plans must be reaching to passenger at station. Sophisticated prediction of future operation instead of current (or even last known) position of trains for providing information and making decisions, use automatic monitoring of planned connections and information workflows must be there. It should be propagated to passenger information systems automatically and made available not only in the information systems on the stations and on the trains. The public transport systems should provide relevant connection data to other transport modes at terminals as seamlessly as possible.

As the prerequisites for an effective passenger information system are already discussed above, let's see requirements for each component of the information system. One important point is that the system should be consistent at the station and on the train, based on same data and provided in the same way.

At the station, visual and audio information system should provide very basic information under normal circumstances. Visual information system should be adaptable to provide information not only about the current train operated on time, but also accommodate enough space for communication of emergency information according to scenarios. In heavy traffic terminals there should be an option to show not only the current train, but also the list of following two or three trains departing from this track.

Information on the train is provided with visual systems (one-line LCDs or screens) and audio system now in AALRT. The information on the train should completely match to the information provided at the station table. The audio system should be used carefully not to disturb passengers with unwelcomed information as listing of train stops. A good practice is to announce next stop just when the train leave the current station. But the system announces the arriving (approaching) information after the cab of the train reach at the entrance of the station. This is one problem for readiness of passengers to alighting from the train. So it can affect the schedule of the train. So the approaching information should have to provide to the passenger at least Twenty meters (depending on the speed of the train) before entering station platform.

When the train approaching stations, the LCD screen should provide information on their platforms and departure times. Again when it leaves the station, the arrival times of the next station should display on LCD platforms. When the train is at the station in the common line (from stadium to lideta) the information system on the train should inform the alighting passengers to refer the information systems at the station for line transferring services which is just like telling the passenger nothing.

In case of disturbance of the trip PIS at station plays great role. At least when the train stops for more than two minutes, even when according to the plan, or any other worse case, the visual and audio system must be able to provide the passenger with explanatory information (like waiting for a crossing train) and estimated time of departure.

3.4 Data collection system

The main part of passenger information system for railway system is how the system collecting the information (data) about the transportation. Onboard modules and station modules are used for such a purpose. It mounted on the train for the purpose of collecting different data, processing it and sending it to server. It includes different sub units such as GPS onboard module (tracking device), GSM modem (stationary and on-board), passenger Automatic passenger counter (counting and analyzing system), and others related units. The GPS module (receiver) receives signals from the GPS satellite and dynamically calculates the bus current location. This data is sent to the central server by the GPRS module.

Each module has a GPRS activated Systematic Identification Module (SIM) card installed. Data from these GPS/GPRS units installed in the train are sent to a dedicated server in control center with a fixed global internet protocol (IP) once every ten seconds. This data packet received by the server is added to a Structured Query Language (SQL) database. Data from each bus for the day is stored in a different file. Detail of each module is presented in the following section.

3.4.1 GPS tracking system

The ability to accurately detect a vehicle's location and its status is the main function of passenger information monitoring systems. These systems are implemented using several hybrid techniques such as wireless communication, geographical positioning and embedded applications.

The Global Positioning System (GPS) is a satellite-based navigation system made up of at least 24 satellites. GPS works in any weather conditions, anywhere in the world, 24 hours a day. GPS satellites circle the Earth twice a day in a precise orbit. Each satellite transmits a unique signal and orbital parameters that allow GPS devices to decode and compute the precise location of the satellite [15]. GPS receivers use this information and trilateration to calculate a user's exact location. Essentially, the GPS receiver measures the distance to each satellite by the amount of time it takes to receive a transmitted signal. With distance measurements from a few more satellites, the receiver can determine a user's position and display it electronically to measure your running route, map a golf course, find a way home or adventure anywhere.

Onboard GPS module is composes of a GPS receiver, onboard controller and a GSM Modem. The GPS Receiver retrieves the location information from satellites in the form of latitude and longitude real-time readings. The controller has three main functions which are reading certain engine parameters from train data (onboard diagnostics (OBD)) port, processing the GPS information to extract desired values and transmitting this data to the server using GSM modem by SMS. The chosen engine parameters are revolution per minute of the engine (RPM), engine coolant temperature, train speed and others related.

The GPS receiver computes the current location of the vehicle. The latitude, longitude and speed of the bus are transmitted periodically to a central server using GPRS. The onboard unit initially downloads the names and coordinates of stops and POIs (passenger on board information) on the current route from the server. This is used to display and announce the name of stop or POI when it is approached, for the benefit of passengers inside the bus. The configuration parameters and audio files for announcement are stored in memory. The controller sequences the series of operations such as periodic transmission of GPS coordinates, audio and display operations.
The UI (keypad and display) is meant for the bus driver, and is used to change the route number of the bus, indicate breakdown and trace a new route.

The Firmware for the vehicle unit consists of a Real Time Operating System (RTOS), application tasks that run on the controller and application that run on the GPS/GPRS module which is used as a coprocessor. RTOS has been used in the onboard unit for modular firmware development. Functions related to positioning and communications with the server are handled by GPS/GPRS module, and controller application tasks handle the remaining functions of the vehicle unit. The tracking unit consists of two main inputs which are the input received from GPS output and other input obtained by the automobile data port, typically called On Board Diagnostics port. The unit sends an SMS using Hayes command (AT Command).

On-Board Diagnostics port (OBD) is a universal automotive protocol supported by modern automobiles to retrieve diagnostic errors over a Controller Area Network (CAN) bus of the controller [16]. The used GSM module supports standard AT command and compatible with several GSM networks. The GPS module supports up to a 10 Hertz update rate. The GPS receiver collects the latitude, longitude and speed information and forwards them to the onboard controller [17]. The GSM module communicates with the controller (processor) to send the information package to another GSM Module at the recipient station [18].

3.4.2 GSM data transferring system

The other data collection unit of passenger information system is a recipient onboard and stationary GSM modem. GSM is a cellular network, which means that mobile phones connect to it by searching for cells in the immediate vicinity. There are five different cell sizes in a GSM network which are macro, micro, pico, femto and umbrella cells. The coverage area of each cell varies according to the implementation environment. GSM uses General Packet Radio Service General Packet radio service (GPRS) for communication system which is a packet oriented mobile data service on the second generation (2G) cellular communication systems of GSM. It is a method of enhancing 2G mobile communication devices to enable them to send and receive data more rapidly. With a GPRS connection, the device is "always on" and can transfer data immediately, and at higher speeds typically 32 - 48 kbps.

There is also different modem which provides the required GSM services. So the modem must be compact for data communication and efficiently be used for web browsing, sending and receiving SMS, data transfer and fax services. The modem receives the SMS that includes GPS coordinates and engine parameters. This text is processed using a Visual Basic program to obtain the numeric parameters, which are saved as a Microsoft Office Excel file. The received reading of the GPS is further corrected by Kalman filter. To transfer this information to Google Earth, the Excel file is converted to KML (Keyhole Markup Language) format. Google Earth interprets KML file and shows train's location and engine parameters on the map. The system's efficiency is dependable on the sufficiency of the used communication network.

By using stationary modem, connection between onboard modem and a station control center is established. Text messages can be sent and received through this wireless network. As mentioned previously, inside the train there will be a transmitter that will transmit a text message to the receiver in the station continuously. The trains will transmit information such as its arrival time, departure time, train number, platform number and next stop. Using the HyperTerminal in the computer, connection between modem and local computer can be created with specific name.

There is WAP to HTTP converter used here that uploads the data into the server. As the distance from one station to the consecutive station where the train stops is known and is loaded into the memory of the system inside the train, it keeps sending text messages to the receivers present in the stations in this manner.

3.4.3 Automatic passenger counting system

Another data collecting module is Automatic passenger counter (APC) which is mounted onboard (on vehicle). It used passenger at station to recognize status of the train load, that means whether the train can onboard additional people or not when it arrives at station. This is also one way to save passenger time that gives alternative of using another means of transportation. Automatic passenger counting technology is used for collection of accurate boarding and alighting data and subsequent evaluation and analysis of the load. This people and passenger counting technology is based on non-contact stereoscopic vision technology specifically designed for accurately counting individuals entering or leaving public transport vehicles such as trains, metros or buses.

Clearly, the most important feature for a passenger counter is accurate counting. A good design must be smart and flexible enough to account for variations such as passenger height or several passengers boarding simultaneously.

The automatic passenger counter (APC) achieves high accuracy with two stereoscopic cameras and four high luminosity infrared diodes. Stereoscopic cameras capture images of the area below the device and instantly analyze the data in real time through a sophisticated algorithm. The algorithm analyzes the height, shape and direction of any objects that are passing through the field of view. Instead of needing an entire body to pass through the view of the camera to count, these advanced cameras can count from just a shoulder or part of the body, greatly reducing the margin of error.

When the device determines that a person is entering or leaving, the incoming and outgoing counters are incremented accordingly, along with time information. Time-stamping the passengers provides additional metrics to plan and route for more efficient use of the available transportation.

The APC design provides an easy and unobtrusive mounting flush in the ceiling space above a doorway and can be adapted to different roof and door styles. The angle of the optical panel can be adjusted; therefore, it can be placed in different positions and on non-horizontal surfaces. Dedicated input/output lines for door sensor connections and easy integration for multiple units makes installation simple in any type of transit vehicle. This counter it has become more flexible in how high it can be mounted in relation to the width of the gate. In order to offer accuracy across the lighting spectrum, the APC uses an integrated high luminosity infrared LED system that can operate in any type of lighting and environmental condition, even complete darkness. The counter features digital I/O interfaces that communicate directly with intelligent doors or flow control systems, guaranteeing the best counting performance. For instance, the digital inputs can be used to detect when a door is open or closed and then stop or start the counting process accordingly. The counter can be easily and quickly integrated with an on-board unit by cable. So the train space information is continuously sent to the onboard controller.

This controller processes this data and sends the information to the local control center using GSM modem. Through local control center the data from train can be sent to central server via cable. Here the vice versa process is also possible. This cable is currently available (already installed) for the purpose of operation control, Operation control center (OCC) display [3].

In general, the main data collection functions are as follows.

- Download names and coordinates of stops and points of interest from the server
- Compute current location, direction and speed of the bus.
- Compute train space for additional onboarding
- Compute delay of the train
- Transmit the computed information to the central server using GPRS and others related.

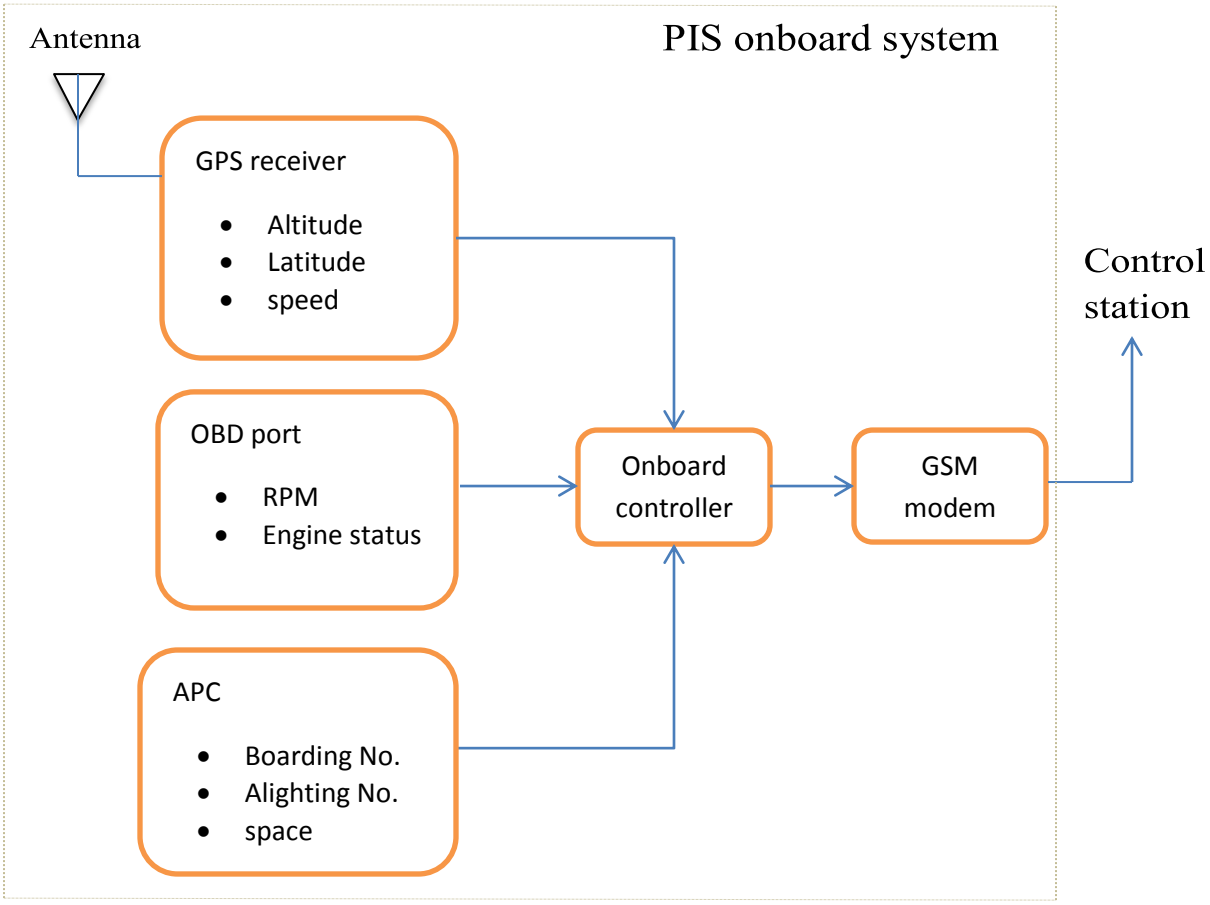

Figure 2: Architecture of onboard data collection system (*Reference [18]*)

3.5. Data storage system

The data about a train collected from different source such as GPS and APC should have to be saved for both current and future use. The raw data from the GPS units are obtained approximately every ten seconds. The raw data contains information on Train number, Clock time, latitude and longitude in comfortable format. As mentioned in the previous section, APC also collect a row data about number of passenger onboarding and alighting in the form of count and direction. There are different storages for those collected data. Memory (onboard), Desktop (Laptop) at local station and main server are the mainly mentioned storage.

3.5.1 Onboard storage and local desktop

Different data collected from different source are passing through onboard system and station control center. For example the data collected APC system is processed and analyzed in the train before upload on the server. So on doing this function, data storage is necessary in onboard system. Again some static data regarding the train, route, station and others related data which are prerequisite for others derived data.

In the same manner there are many data stored at station. fixed station name, fixed sound and visual announcement data, detail route, station and train information and others necessary dynamic information are stored at station control center.

3.5.2 Central server

The server is the central module of passenger information system. All data collected from different module are stored here. The detail information of route, train, station and others related data base are stored on the central server. The central server is interchange the data with station (local) control center through a cable already installed in AALRT. Currently it is installed for the purpose of operation control, station and Operation control center (OCC) interconnection [3]. So for central server and local control center interconnection (data interchange), we can use this cable.

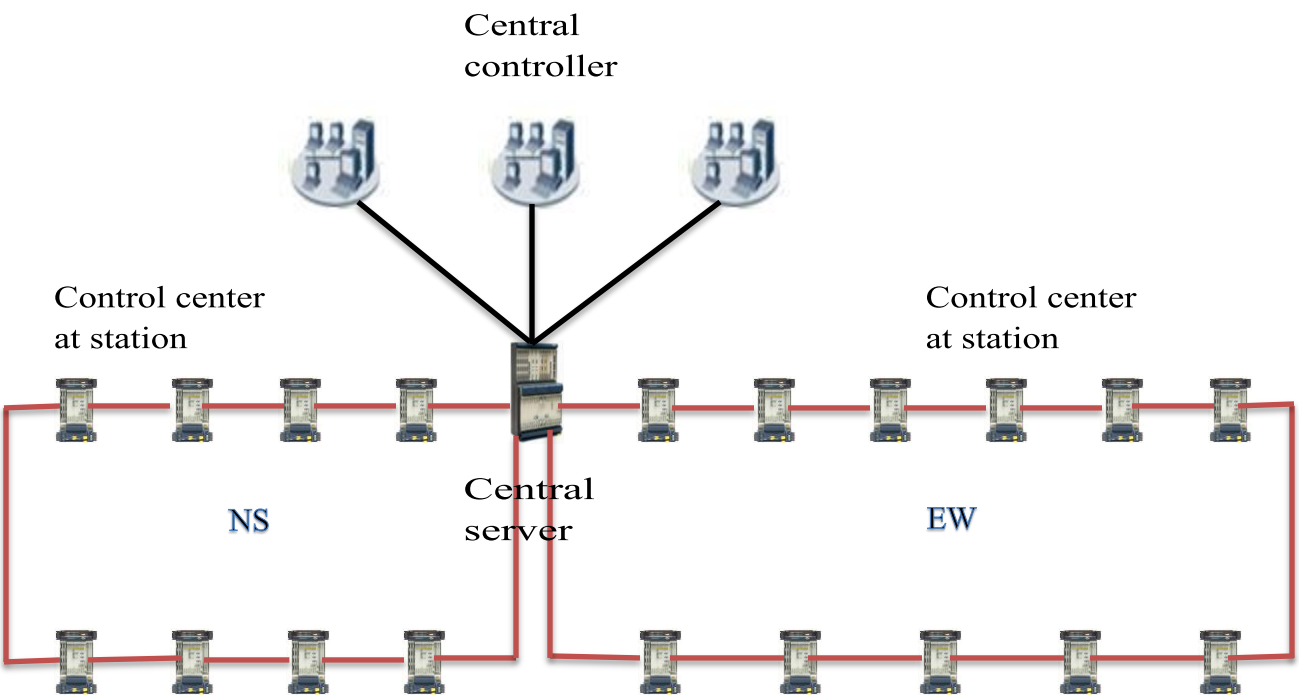

Figure 3: local controller and central server interconnection

The server maintains a database of information pertaining to the train, routes, stops and schedule in the form of tables. The server database can be organized in many ways, to reduce memory requirement, improve access speed, or reduce the number of queries. To improve the query speed, the tables related to train are partitioned into static and dynamic ones. The train table stores static data while the train position and log tables store dynamic data. The relation between the unique train number and route number is stored in the train table. The position, direction and train space updates from the train are stored in the train Position and train Position Log tables. Addition to this there is route detail and layout of the overall system.

The direction field indicates the direction in which the train is headed. The direction is calculated in the vehicle unit by comparing time-separated position values with route details. The average speed is the weighted average of the current speed and the previous average speed. The status of the train changes to invalid, when its driver signals a breakdown.

The train is excluded from estimated time of arrival (ETA) calculations based on this field. The Train Position Log table stores a copy of the position update sent by trains.

Table name	Contents
Bus	Bus number, type and route
Bus Position	Bus number, current coordinates, speed, average speed, direction, current link, link entry time, estimated end time, status
Bus Position Log	Log of changes made to bus position table
Station	station number, coordinates, name
Link	Link number, station pair, travel time
Route	Route number, sequence of links
Trip	Trip number
Stop	Stop name, station number, route number, ETA

Table 1: Database tables name

The data received from each train is stored in the server under a different file name of the format "TrainNumber_Date". All the data files created on the same day are stored under the file name "Date" for proper organization of the data. A backup of these files is created every day. From this data, the information of interest in the present study namely travel time can be easily estimated. All folders and database are in local language that in Amharic.

In this system, data from two previous trains are used as input addition to train and route detail to predict the arrival time of the current train. Thus, the real time data received from three consecutive trains are used. The first step in this process is assigning unique identification numbers to trains and stations. For every route there are two route numbers, one for each direction. For assigning the route number, the current latitude and longitude of the train are compared to the latitude and longitude of the route terminal. In order to accomplish this, latitude and longitude details of all terminals are collected and stored in the data base.

Once the train is within a 50 meters radius of the terminal, it is assigned a route number. A trip is assumed to start when the trains enter this region and its velocity is greater than five kilometers per hour (5 kmph). The velocity is then calculated from the known latitude and longitude using Haversine's Formula. This formula is more accurate to avoid the problems associated with small distances.

Since trains make multiple trips within a day, a new trip is created every time it departs from the terminal in that specific route and is assigned a new trip number. New route number and trip number are assigned to the train only when it starts on a new trip. From this point onwards, the incoming data from the train is stored in the file "TripNumber_RouteNumber" until it reaches its destination terminal, where the route number and trip number changes. This process is carried out throughout the day and the data is segregated into different trips during that day. These trip data files are stored under the folder name "RouteNumber_Date".

Generally the functions of the server are:

- To maintain a database of all the routes, the trains that move on a route, the stops along each route and others related.
- To continuously receive location and speed from the vehicle units of all the trains
- To calculate the estimated time of arrival (ETA) of all the trains at their next and subsequent train stop stations.

3.6. Data filtering system

The next necessary process in providing information to the passenger is distinguishing the necessary data for a given tasks. All the data received at the server are not necessary for passenger information system. Hence, this raw data must be filtered in order to input only the required data into the algorithms. The unfiltered data consists of location details of the bus for the entire duration for which it is being monitored. Such as data sent while train is parked in the depot, or while it is kept waiting at the terminal during driver interchange. Such data must be filtered out and only the essential data has to be fed into the algorithm in order to get the required results. A program is developed for automating this filtering process. The filtered data can be used for the application.

For this purpose, Kalman filtering technique is the mostly used approach because of:

- Good results in practice due to optimality and structure.
- Convenient form for online real time processing.
- Easy to formulate and implement given a basic understanding
- Measurement equations need not be inverted

A Kalman filter is an optimal estimator that infers parameters of interest from indirect, inaccurate and uncertain observations. It is recursive so that new measurements can be processed as they arrive. It minimizes the mean square error of the estimated parameter [24].

3.7 Information providing system

Information providing system is the other section of passenger information system which gives out the final output of the previous section for the users. This out may be provided for the users in form of visual display (text, video, and image) or audio announcement.

As mentioned in the previous section, all the equipments in the system are connected to the central server, allowing flexibility to determine the real time train information. At the same time, all the communications of data and messages between passenger information system equipment are made following the internet protocol. One of this equipment is information provider mounted at station. The control center both central and local control center operators can do the configuration of the information provider by means of graphical user interface with Ethernet LAN connection, Browser software for the access to the data base of the PIS.

All the data involved in the operation management of the PIS is stored on the database in the PIS host computers. Information provider receives these data from the central database or manually (if there is no data base system) and stores them for its internal use and as a backup copy for using it when a communications failure occurs.

3.7.1 Display system

The Passenger Information Display System (PIDS) is basically provided for indication of Train service information, General Station Information, route information, train schedule and others related information in stations. It includes both LED / LCD display systems entry, exit and station platforms. It is fully software programmable for all parameters and settings. The display systems can be driven either from Operations Control Center (OCC) through the server. The messages from the OCC will be sent to stations via existing transmission fiber.

The station display system mainly supplies the necessary passenger information and high-quality video information through the special transmission and assignment network to the passenger. All media festivals, the item was saved including table chart and video document on the media server.

The Control unit (CU) at station contains a network switching. It uses two main lines to pass through between two compartments. These two main lines mutually for redundancy, when any line separates, another line can still maintain the network service. When two lines simultaneously work, it can provide high band width.

The LCD digital display (built at station) receives the streaming media signal that the switch board sends out, after the decoding broadcasts on LCD directly. The displayer hard disk can save those data for some specific days. The program must be smooth program one after another broadcasts, that auto cycle broadcast. Based on LCD Display System, PIS sends the station information to the CU on, is controlled the LCD monitor to demonstrate by CU.

On the LCD, screen can be divided into many demonstration regions, the arrangement of demonstration can establish through software. The system can obsolete the document and record according to the time automatic clearing hard disk of hypothesis and ensure has enough space to accept the new media file and text or table file slightly.

LCD broadcast system and core of video monitor system, is mainly managed by the CU. It is mainly responsible for saving and broadcasting regards the audio frequency festival Item. It should have very high reliability, very good impact resistance and vibration characteristics.

The main functions of CU are the following:

- Media file management and broadcast strategic management
- System inspection and error report, system clock synchronization
- Hard disk media broadcast
- The camera image decoding and demonstrated on the monitoring device
- Monitoring device operations to the LCD Display system operation and others

3.7.2 Voice announcement system

Voice announcement is another type of information providing system for the passenger at station. Addition to the information display system the voice announcement is very help full for the clear and all people consider information system. This system is used for safety information, fixed station information (station name, next station name and others related), dynamic information (train coming, the coming train number and direction, train delay, train space and others timely needed information) announcement. The announcement information reveals stands together the synchronized hypothesis with the automatic rearranging controller. Station information of demonstration is in the PIS system defines.

The system has the record to broadcast the announcement function, can record the times of all media files, to broadcast the way and other back constraints. This module is also controlled from controller both local and central controller. The necessary data are collected from central server through the station control center connected to it via fiber optics.

CHAPTER 4

System design and implementation

4.1 Introduction

In the previous chapter the passenger information system application description and infrastructure for passenger information system are discussed. Database table form and their description are also discussed in the previous chapter. In this chapter, using the previous chapter concept the preliminary design of the passenger information system is presented.

In PIS system, the communication system, station passenger information display board and the central control display board are the main parts to be designed. The detail discussion is presented in the following section.

4.2 Preliminary design

To achieve the goal and objectives, a preliminary design of the passenger information system at station was proposed featuring functions of two categories:

a. Railway station information system
b. Graphical user interface system

4.2.1 Communication system

One of the objectives of this thesis is to provide an inclusive railway system that helps people with special needs to board train easily. Different system has developed in different country to help a blind person getting to the railway station, but at the railway station it is very challenging for the person to know when and which train is arriving. To resolve this issue, the first solution is to enable communication between a train and a passenger information system mounted at station, which gives real time information via audio and visual system, so that the user can follow the information board at a certain railway station. The system use the railway station to connect a train and a Passenger information board via 3G modem that can send and receive data through message. This will require all train and station control center to have 3G modem installed.

The modem at the railway station will be able to communicate with the modem on locomotive that where now and when it will arrive the station, and then inform the user's (passenger's).

However, the downside is that when the train is delayed because of different cases, the schedule of the train is interrupted. This is difficult for people who do not have a time for waiting delayed train. In this case, a railway transit service central controller is established as a hub to connect train, railway station operator, and passenger's information board to notify delay and estimated arrival time. Train sends GPS coordinates, speed and status to the transit central system in real-time to update train schedules, and the information system service makes this information available at railway stations.

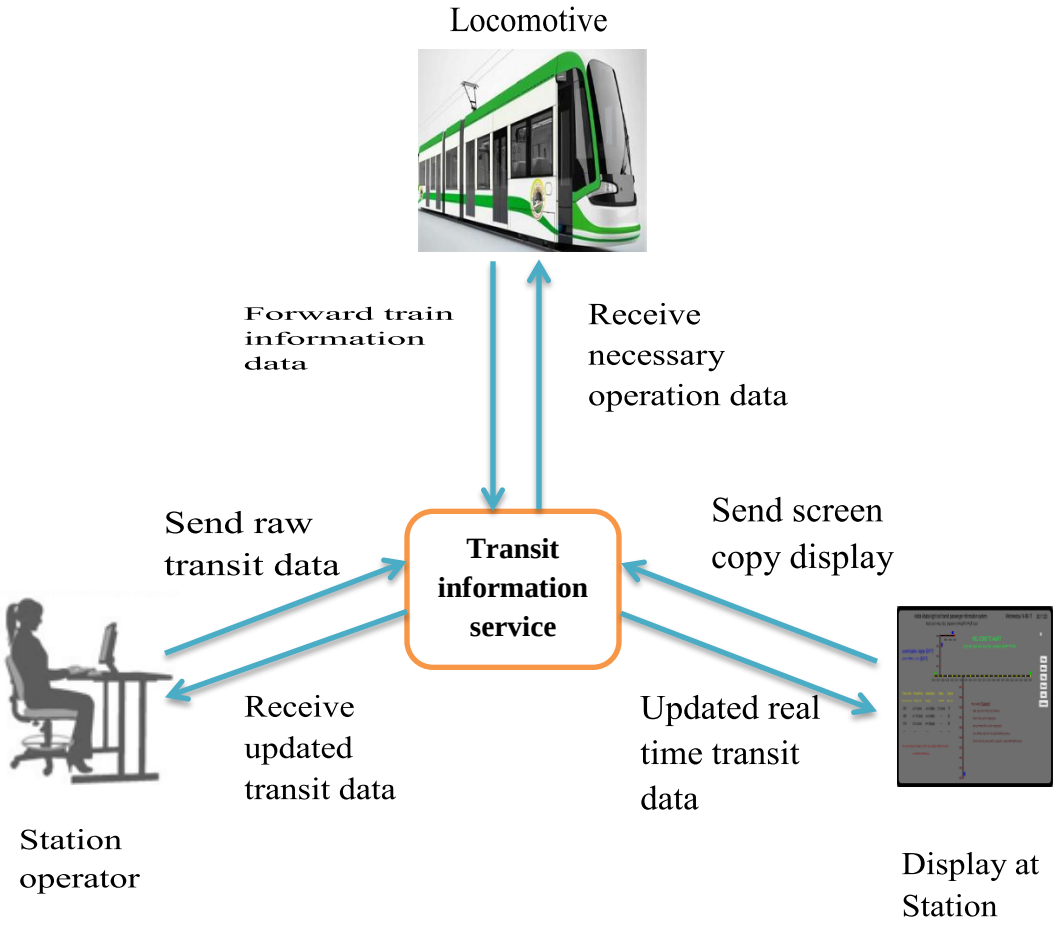

Figure 4: PIS communication system

4.2.2 On-board infrastructure

To support the communication backbone, existing train and railway station need to integrate with new communication technology. GPS antenna to track train locations and Automatic Passenger Counters (APC) to estimate bus capacity at different times of a day the basic infrastructure. In the proposed passenger information system, each bus will install an on-board computer that is interfaced with GPS enabled microcontroller and 3G router to enable real-time processing and transferring GPS coordinates and passenger information to the transit center via 3G. A double-line LCD sign and speakers will announce train information triggered by real-time GPS coordinates relative to a railway station. Firstly, with the information display and voice announcing system, passengers will know where they are and when to get off the train. People unfamiliar with the route or area will be more likely to take train as the announcing system provides a navigation guide. Secondly, the passenger data collected from the Automatic Passenger Counter (APC) will be translated into statuses for people to know the space availability on a train. The transit dispatch center can use this information to determine the need to dispatch extra train during peak-passenger hours. A set of desired functionalities and proposed infrastructures are summarized in table below.

Function	**Infrastructure and technology**
Communicating with transit control center	3G router
Train and station announcement	LCD display, speaker
Real-time position tracking	GPS antenna, microcontroller chips
GPS navigation	On-board computer with VGA display
Estimate train space capacity and availability	Automatic Passenger Counter (APC)

Table 2: On-board technology

4.2.3 Railway station infrastructure

In the proposed passenger information system, each railway station will install LCD signs that displays real-time arrival times, bus capacity and train destination, and others related information for all train servicing the station, a microcontroller with 3G router that requests updated train arrival times from the Transit schedule server over 3G networks. As well, paper schedule will remain as a backup in case of electronics failure. Railway route maps, assistance phone numbers and cab numbers will also be available on the paper schedule. A set of desired functionalities and proposed infrastructures are summarized in table below.

Function	**Infrastructure and technology**
Receive real-time transit data from the transit Center	3G router, microcontroller
Display transit data	LCD display
Railway route map locating all stations	Provide static transit information as a backup Paper schedule

Table 3: Railway station PIS technology

The passenger information system at station is mainly provides the following merit energy:

Audio broadcast system

Broadcast system is very necessary system in passenger information system. So for AALRT passenger information system at station it is one basic system for serving all type of passengers. The special attention must be paid on language and quality of the voice announcements. The one proposed for on this thesis is broadcasting system which support local language (Amharic). It plays via the PA system. This technology provides the best clarity and voice intelligibility. Standard voice libraries can be extended or re-created based on customer needs within a few weeks. Voice libraries are not limited to general announcements such as train information or safety information, but can include a full range of railway related announcements as necessary as it is.

In general the following announcements are the basic broadcast for AALRT station:

- ✓ The caution broadcasts to the passenger cross the track
- ✓ The caution broadcasts to the passenger cross on waiting for train at station
- ✓ The broadcast of train coming and another related train information
- ✓ The broadcast of safety system on boarding the train

Passenger display system

The passenger display system the screen board that display train information and other related information. It is controlled by the central and local control unit and synchronized with central server. The display system mainly supplies the train schedule information and other necessary passenger information through the LCD screen to the passenger. The item was saved including the schedule, safety and train information document on the server.

Control unit of the screen contains a connection switching and it uses two main lines to pass through between two compartments. These two main lines mutually for redundancy, when any line separates, another line can still maintain the service. The LCD digital television (built at the station) receives the data that central system sends out, broadcasts on the screen. The information displayed can save on hard disk for about five days if necessary. The system can on obsolete the document and record according to the time automatic clearing hard disk and ensure has enough space to accept the new file and broadcast plan Slightly. Based on LCD display system, PIS sends the station information back to control unit to monitor the LCD display.

On the LCD screen can be divided into many demonstration sections, the arrangement of demonstration can establish through software. Train information table, track layout, header and safety and apologies are the main section of the LCD screen. Each section has their own tasks perform for the display of the passenger information. Those main sections are also having another sub section which performs different function. Let us see them in detail.

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I. Section of railway track layout:

The task of this section is to draw the layout, representing the train and station with their name or representation code. Each function of this section has specific jobs to fulfill the display of the screen during runtime process.

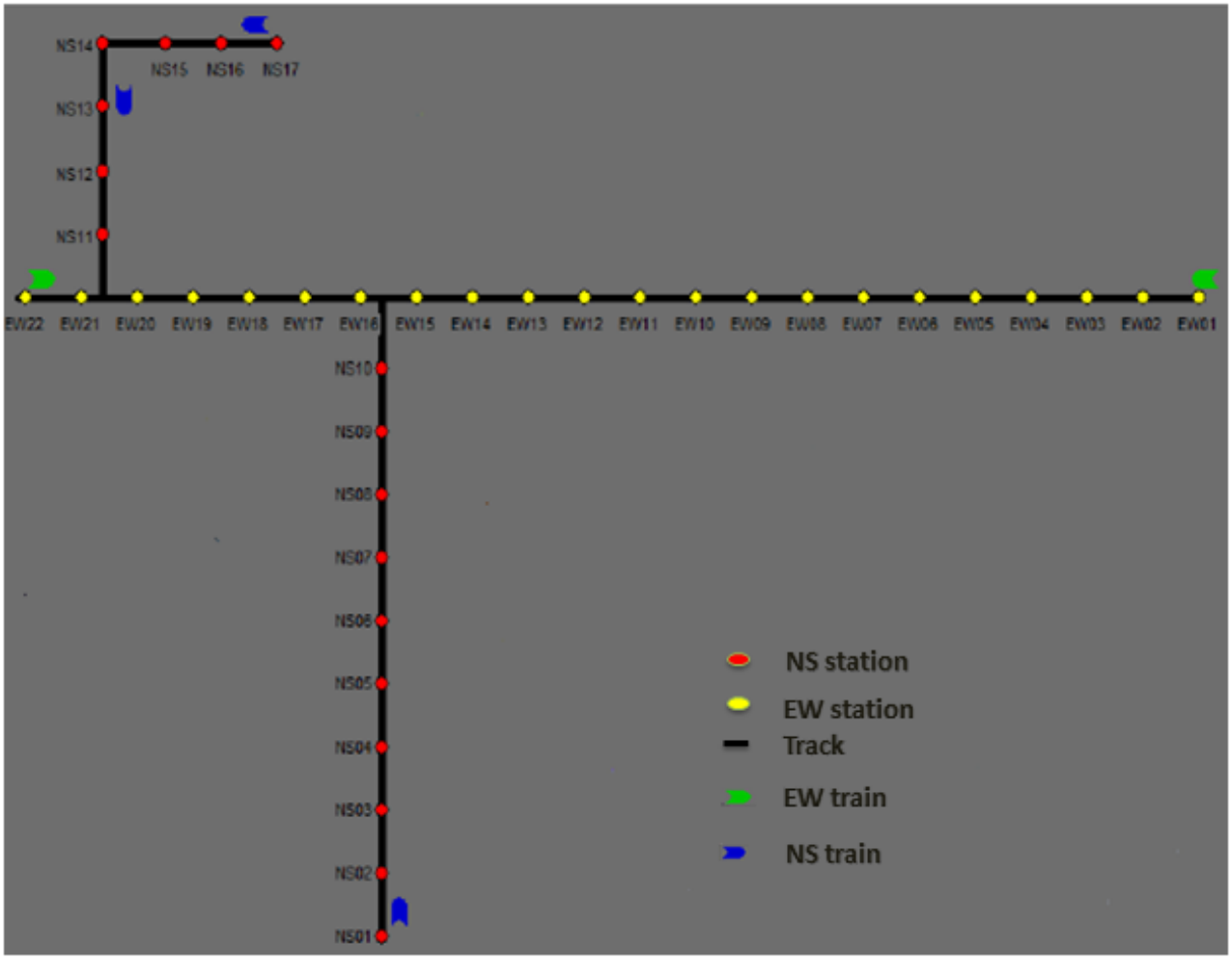

Figure 5: Track, station and train display

Algorism for this section execution is as follows:

- First it check the database connection
- If it is connected, retrieve data from the database, if not connected to the database, it try to connect to database until it succeed.

- After retrieve data from the database, it displays track, station (including station name) and train.
- Wait until the database is updated (one minute)
- Retrieve the new data and display it.
- Repeat until the all train stop trip

.

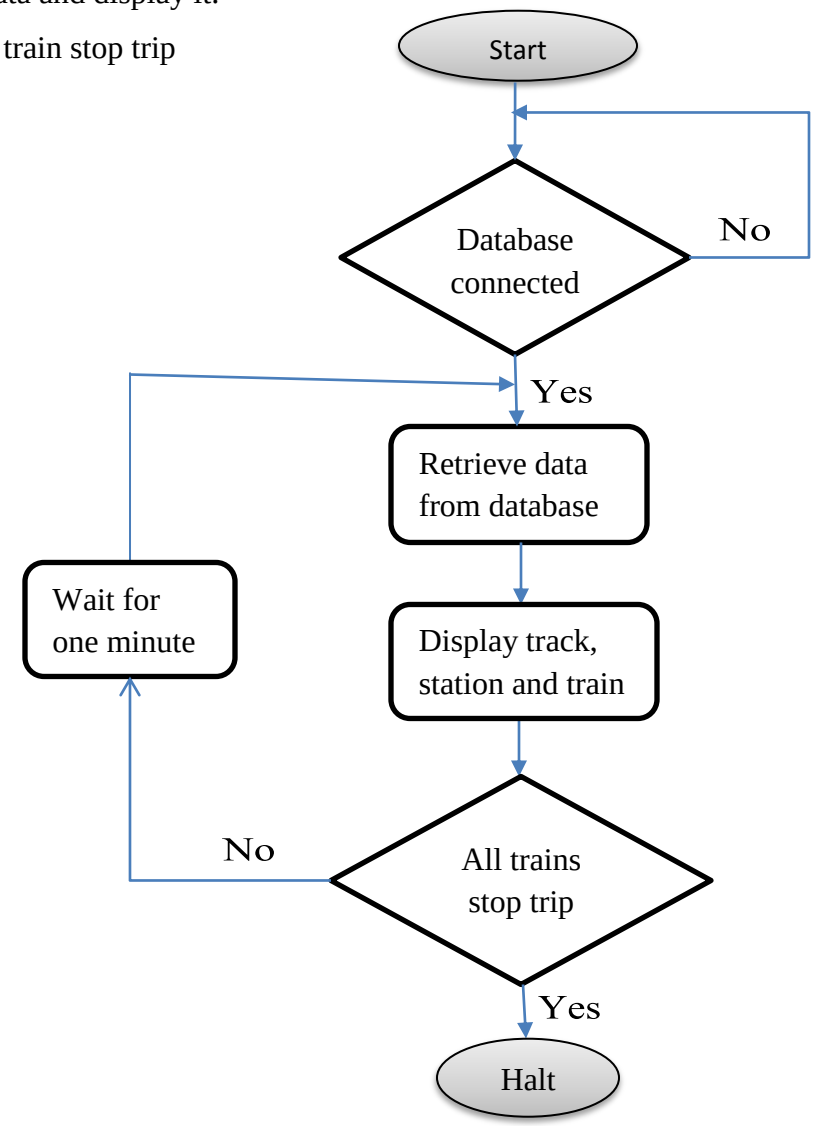

Figure 6: Track layout station display section flow chart

II. Section of train information table display:

Displaying of current information of the two consecutive trains on the trip those have the same destination is done by this section. For the common station of AALRT, current information of the four consecutive trains (two of them have the same destination and another two have the same destination) on the trip is displayed. It may be in the table format.

Train code	Arrival time	destination	Delay	Space
የባቡር መለያ ቁ.	መድረሻ ሰዓት	መጨረሻ	መዘግየት	ክፍት ቦታ
001	in 7ደ.(min)	ቃሊቲ (Kaliti)	2 ደ.(min)	17
002	in 11ደ.(min)	ቃሊቲ (Kaliti)	---	32
014	in 5ደ.(min)	ሀያት (Hayat)	---	39
---	---	---	---	---

Figure 7: Train information table

In this section arrival time is calculated by ETA and the APC analyze the space available and send it to display system. The algorithm for this function is as follows.

- Check database connectivity
- Retrieve data from database Current Information table
- Display retrieved data in local language
- Repeat until all train stop trip

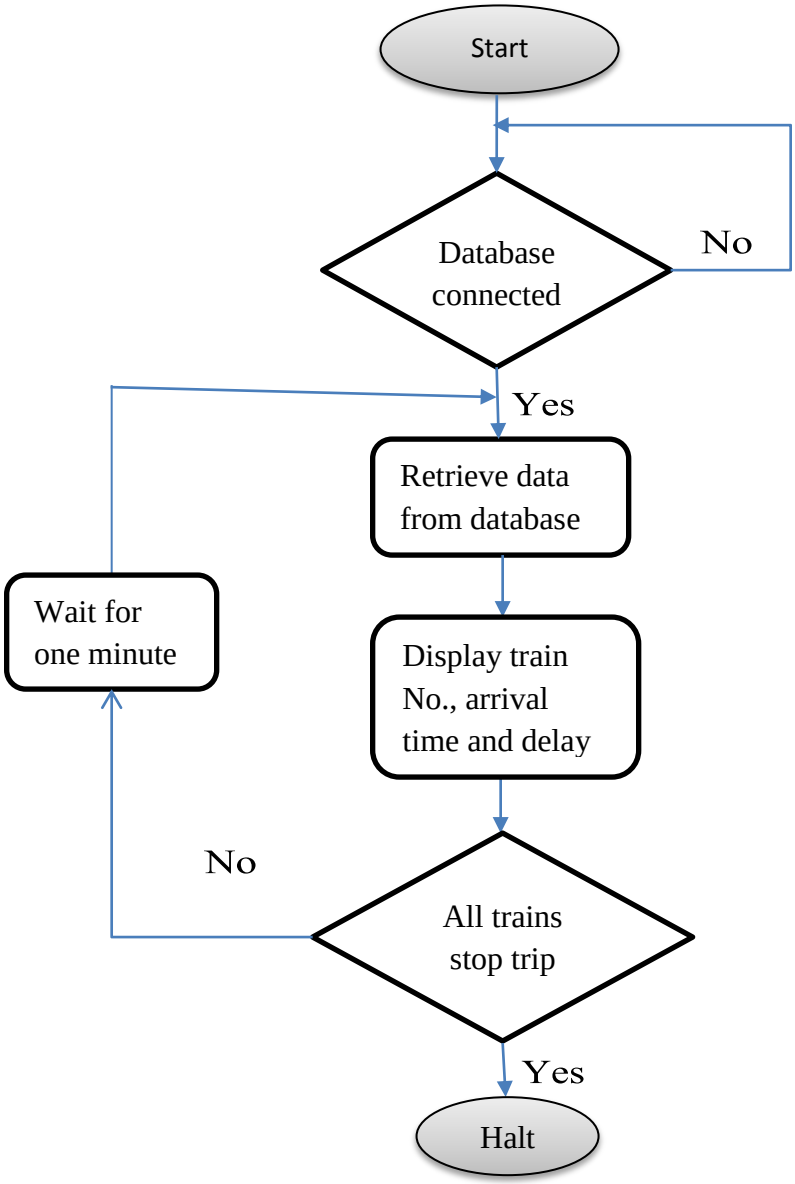

Figure 8: Train information table station display section flow chart

III. Header display section

This section has four different sub sections. The first subsection is the one that display the welcome and heading title of the screen display. The second and the third are date and current time subsection. They retrieve this information from central clock master. The fourth sub section display the name of the station with its code, where the passenger is now.

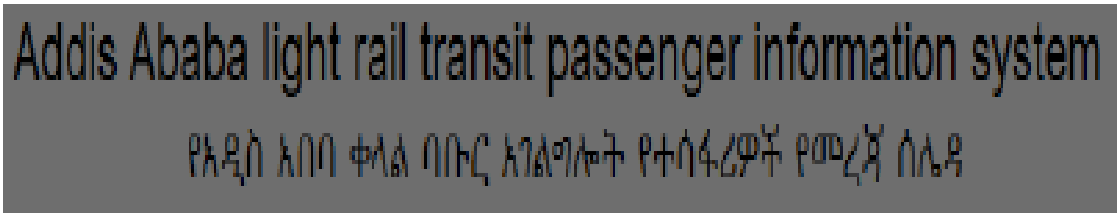

Figure 9(a) Screen name

Figure 9(b) Welcome information

Figure 9(c) current date and time information

Figure 9(d) Current station name display

IV. Safety and Apologies display section

This section has two different sub sections. The first subsection is the one that display the apologies and patience of waiting for the passengers if there is delay of the train. The second subsection display safety information during using the service.

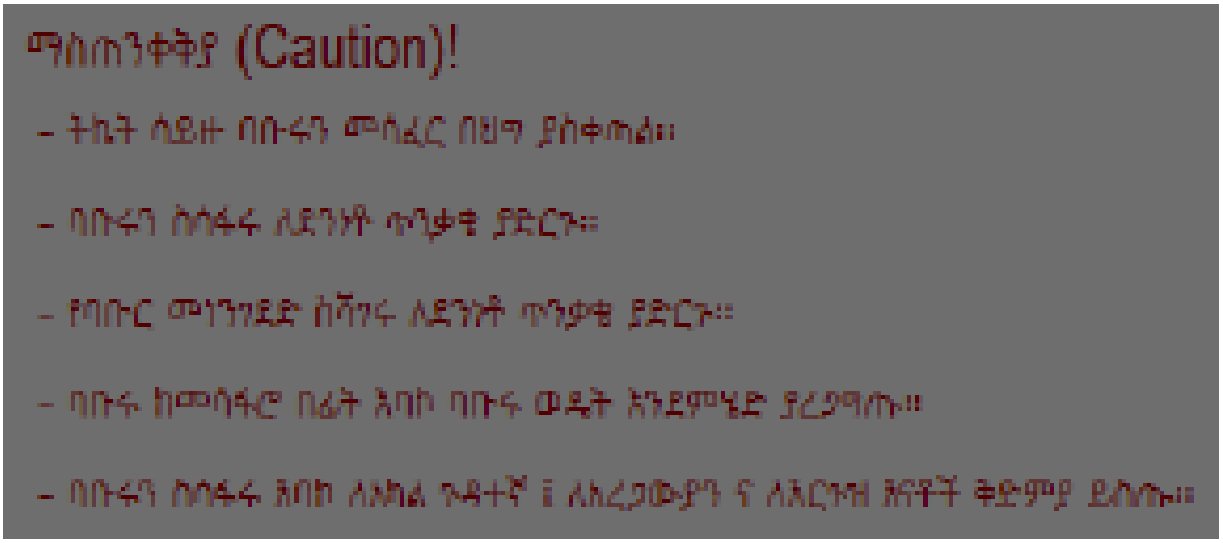

Figure 10(a): Safety information

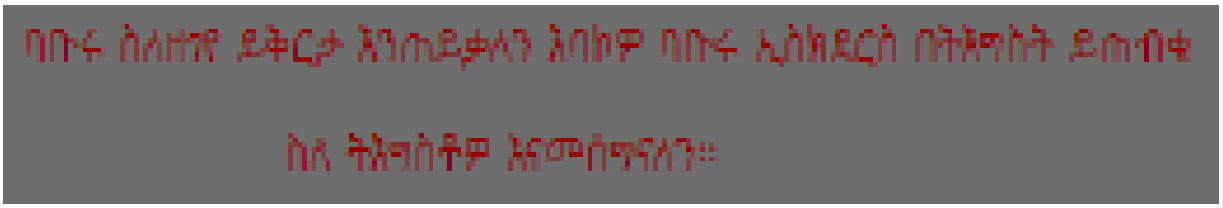

Figure 10(b) Apology of train delay

The safety information is updated as it is necessary. The algorithm for this function is as follows.

- Check database connectivity
- Retrieve data from database updated caution and delay information
- Display caution and apologies (if delay occur) in local language
- Repeat until all train stop trip

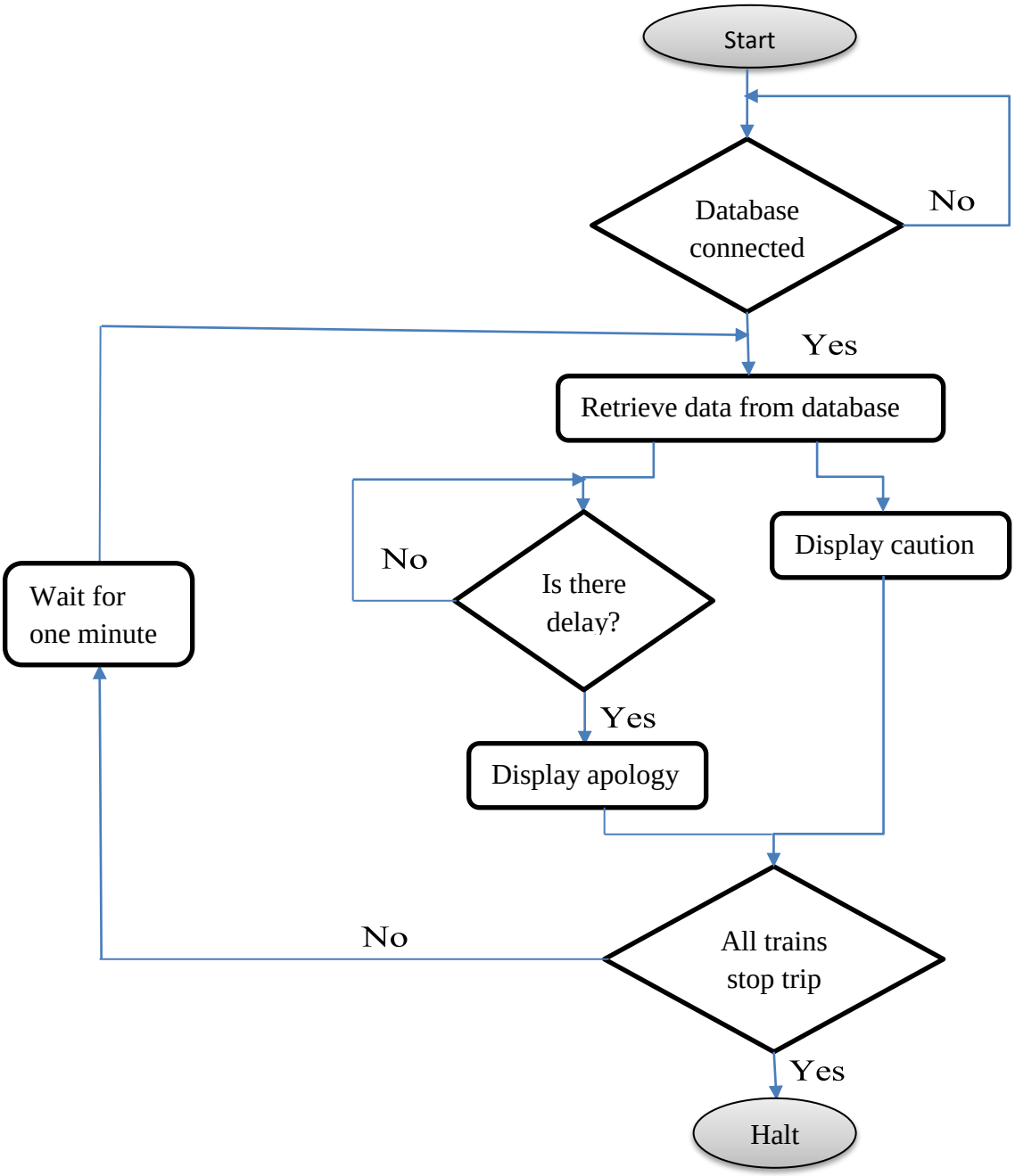

Figure 11: Safety and apologies display section flow chart

4.2.4 Graphical user interface

This section describes the process of the passenger information system GUI design and interface of GUI to central server based on the latest version of the communication protocol using XML formatted messages. This process is dedicated according to the requirements specification.

As I mentioned earlier, at the beginning consider the requirement specifications which to design this system by adding local language feature. The system must be understandable for all these different kind of users. The GUI display has different section. Each section has their own tasks perform for the control of the passenger information. For instance the main sections are:-

A. Section of railway track layout:

The task of this section is to draw the layout, representing the train and station with their name or code. Each function of those displays has specific jobs to fulfill the operation of GUI during runtime process. Algorism for this section execution is as follows:

- First it check the database connection
- If it is connected, retrieve data from the database, if not connected to the database, it try to connect to database until it succeed.
- After retrieve data from the database, it display track, station(including station name) and train
- Assume the database connection is good, the trains, train status, and track layout on specified position of the screen are displayed.
- Wait until the database is updated (one minute)
- Retrieve the new data and display it.
- Repeat until the all train stop trip

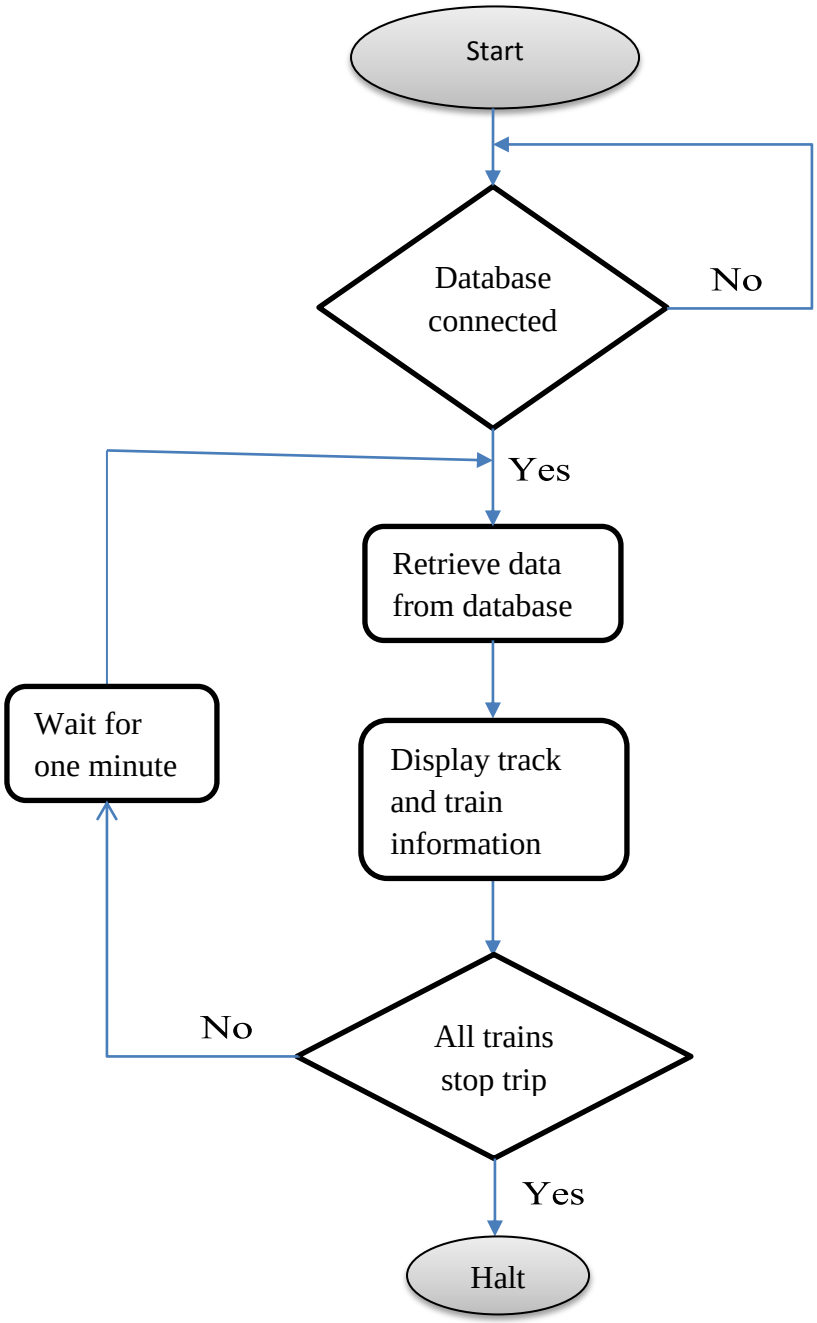

Figure 12: GUI Track layout display section flow chart

B. Section of current information updater:

This section is responsible to update the database information to share updated stored data in local languages to other section display (process) the information. The algorism for this process is specified as follows:

- Check database connectivity
- If connected, retrieve data from database from specified tables
- If not connected, try until database connectivity is available.
- Store data in current information table in local language
- Repeat retrieving data until all train stop trip.
- If all train stop trip halt process.

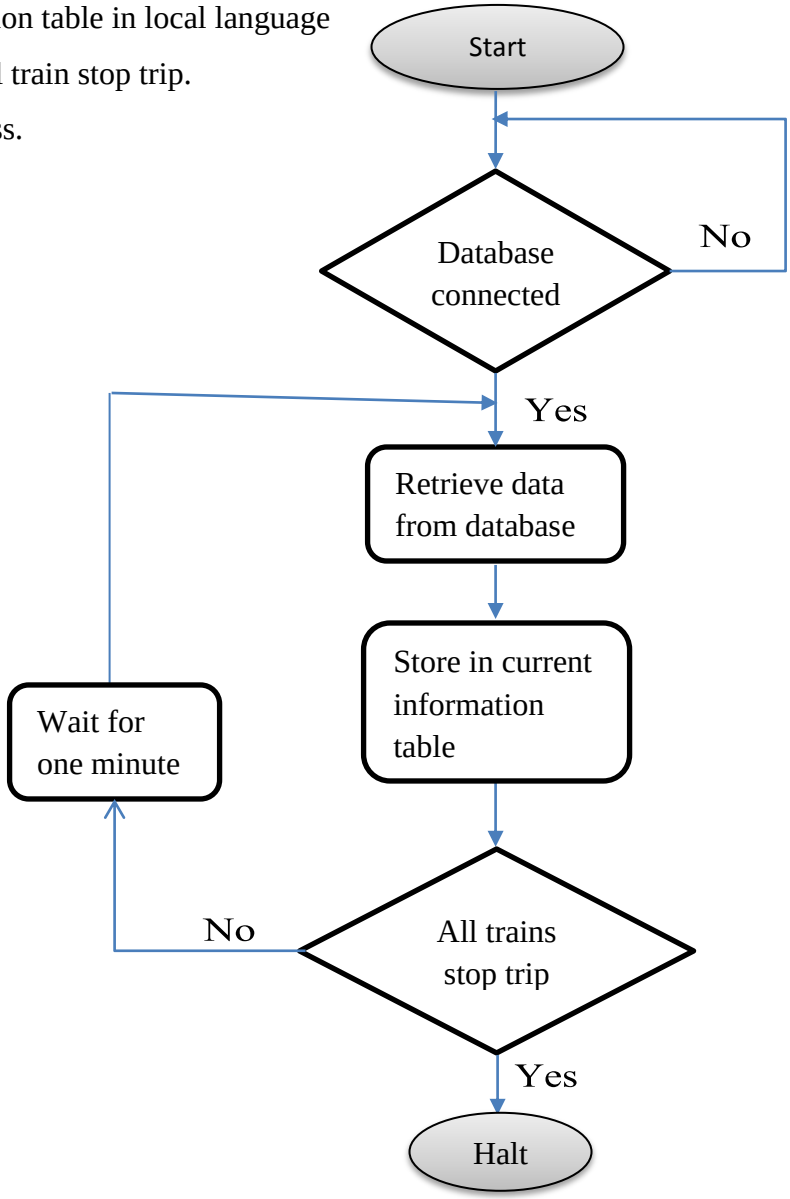

Figure 13: GUI Current information updater class flow chart

C. Section of train information:

Displaying of current information of all train on the trip is done by this section. It may be in the table format. The algorithm for this function is as follows.

- Check database connectivity
- Retrieve data from database Current Information table
- Display retrieved data in local language
- Select station
- Select route(up or down)
- Repeat until all train stop trip

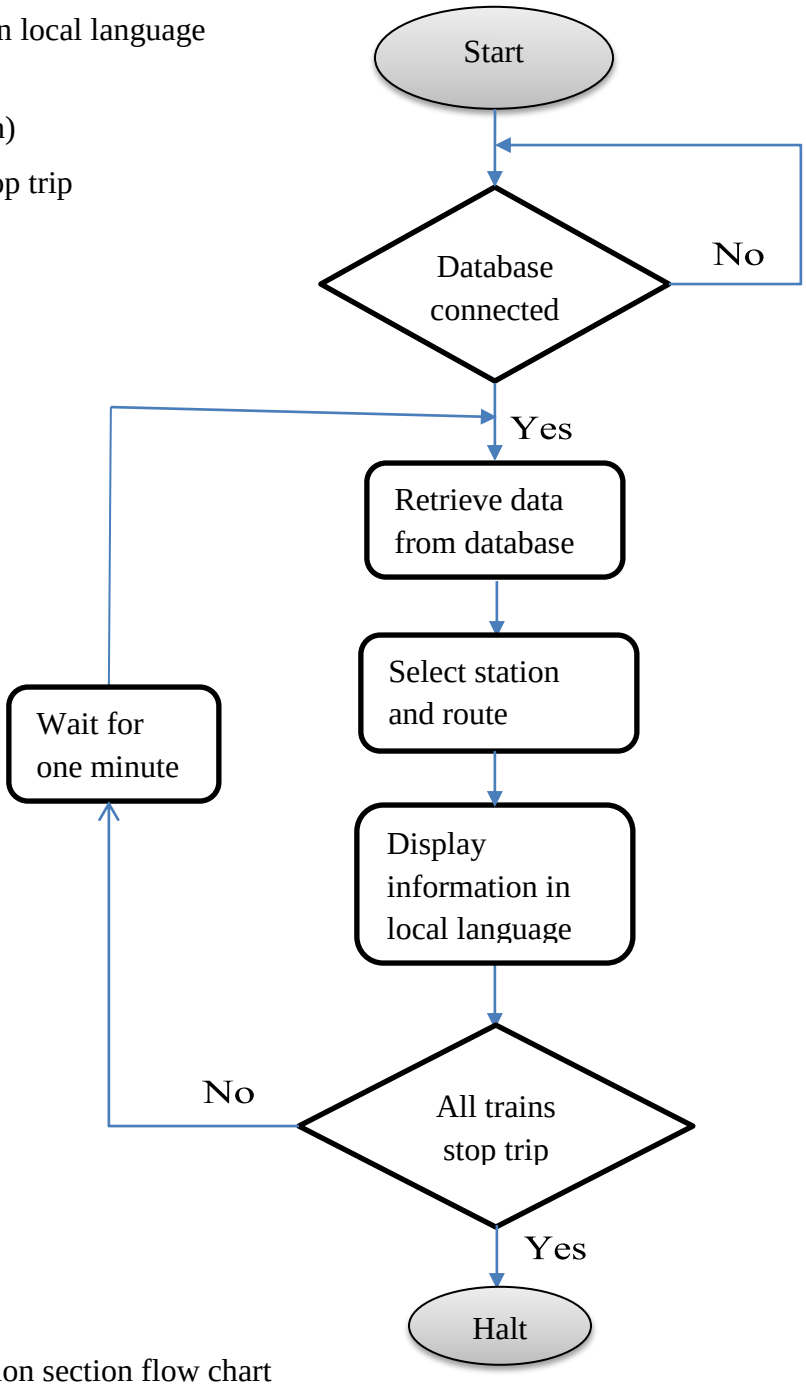

Figure 14: GUI Train information section flow chart

D. Station selection section

This section is the menu (option) part of the graphical user interface to select different section and view what is display at that station. The controller can know the problem with every train and each station waiting. It has four combo box for different direction station selection such as East-West up for Hayat to Torhayiloch trips, East-West down for Torhayiloch to Hayat trips, North-South up for Kaliti to Giorgis trip and North-South down for Giorgis to Kaliti trips view.

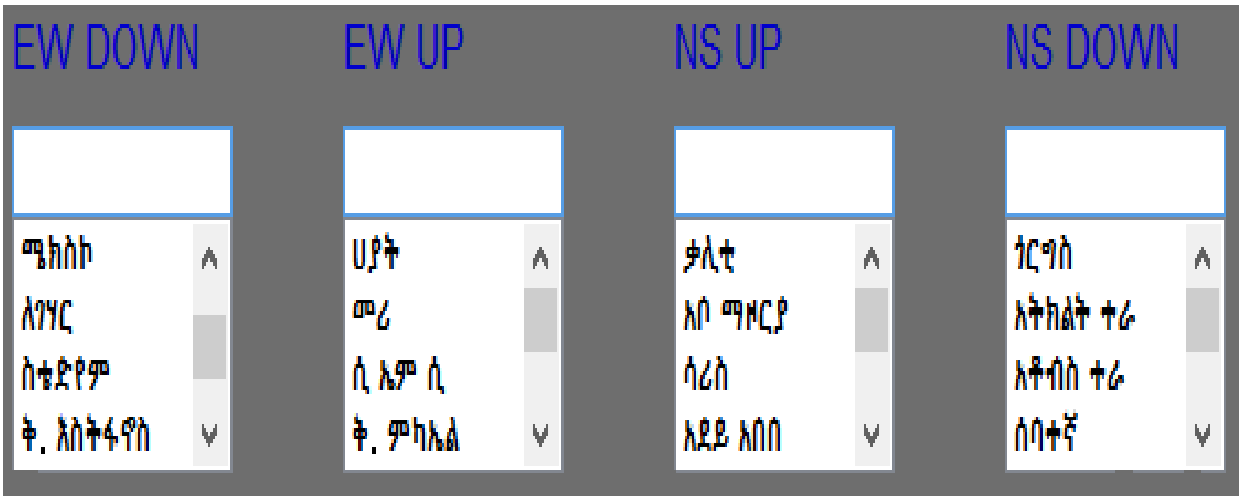

Figure 15: Station selection option menu

4.2.5 Unscheduled cases

There are different scenario cases for a system deviation. In this system there are different premises such as:

- Communication method between the two entities is 3G
- Assume real-time schedule
- Transit Centre holds station operators special requests in their queue (for storing operators requests) and delivers it to train the special case

A. Train delay:

When there is a delay occurrence, the train sends a delay notification to the transit control center. Transit control center has all the information of train on route in real-time so transit center will know if train delays. Transit center sends a message to station information board to notify the passenger that the train is delayed. The estimated arrival time of the delayed train is also sent to information display system. This gives options to the users:

a. Cancels the request (Person Decides to Leave Scenario applies)
b. Keep Waiting (Bus Delay Scenario)

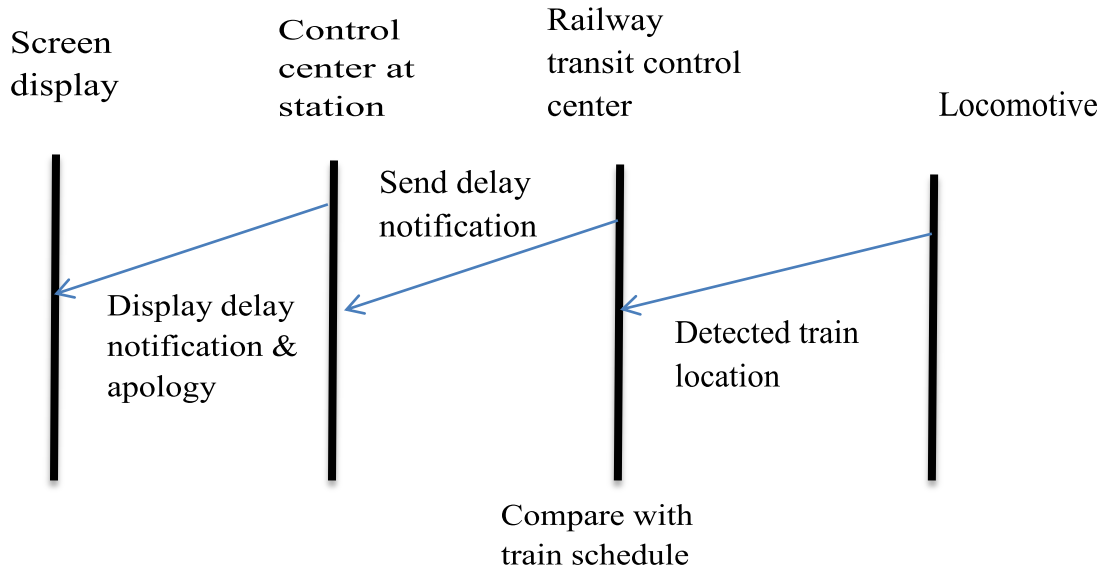

Figure 16: Train delay scenario

B. Incorrect data Sent:

The train may send a data with invalid information due to different problem. In this scenario the transit control center could recognize the invalidation of the data sent and therefore delivering a message back with negative acknowledgement.

C. Train unavailable:

Case 1: locomotive failer

If the locomotive breaks down or fail in the middle of the route, transit control center will be notified from redundant data received from the train. Therefore, train delay scenario applies.

Case 2: Transit cancels trip

Due to emergency case the trip may be cancelled by transit control center. The transit center recognized the trip has been cancelled and will send a message trip has been cancelled to user information board. This allows passengers with two options:

- Continuing waiting (Delay Scenario)
- Cancels the request

CHAPTER 5

PIS simulation and results

In chapter four, the passenger information system display at station and also graphical user interface flow chart designing has been done and the components of the designed passenger information are summarized in a tabular form. In this chapter using the flow chart design and some assumptions the simulation PIS done using the C++ programs are presented and discussed.

5.1 PIS at station

In this thesis, the passenger information display board is designed. For a moment a simulation of the screen board using three trains from different source done. For real data operation the train information (time span between station, train speed, and others related) is determined from global positioning system. But since the global positioning system component is not there for this simulation there is some assumption used:

- Assume that average time train takes to arrive next station is two minutes
- Assume that the all train speed is the same
- Assume that the display board layout at all station is the same

Finally, the passenger information display board at legehar station for three trains coming from different direction is simulated. The updated information is displayed on the board. The following figure shows the screen for different train instance.

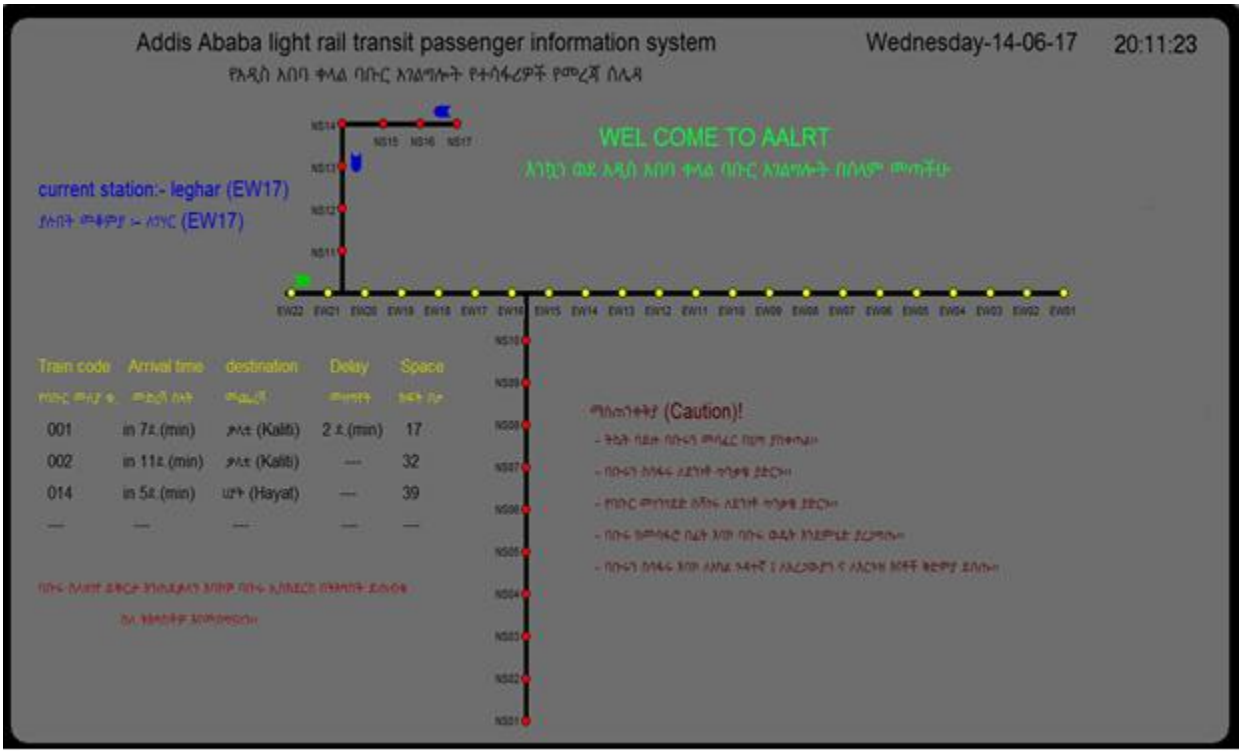

Figure 17(a): passenger information display screen

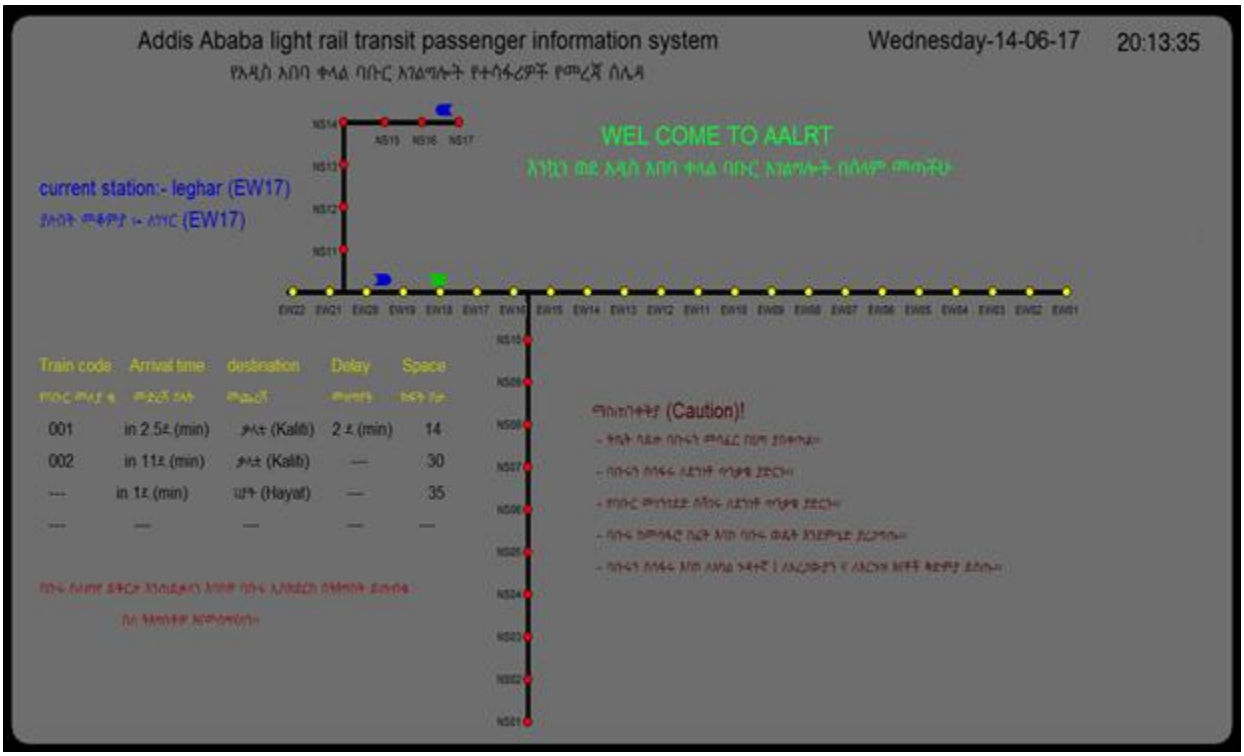

Figure 17(b): passenger information display screen

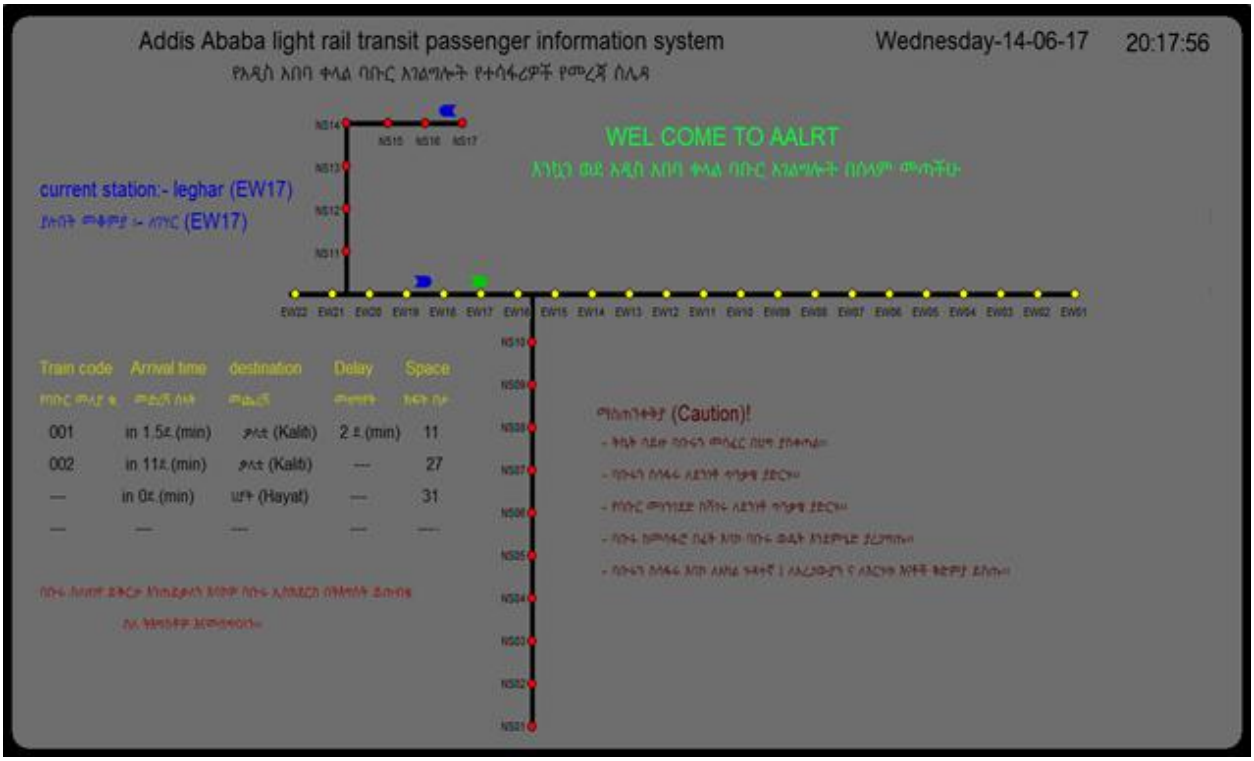

Figure 17(c): passenger information display screen

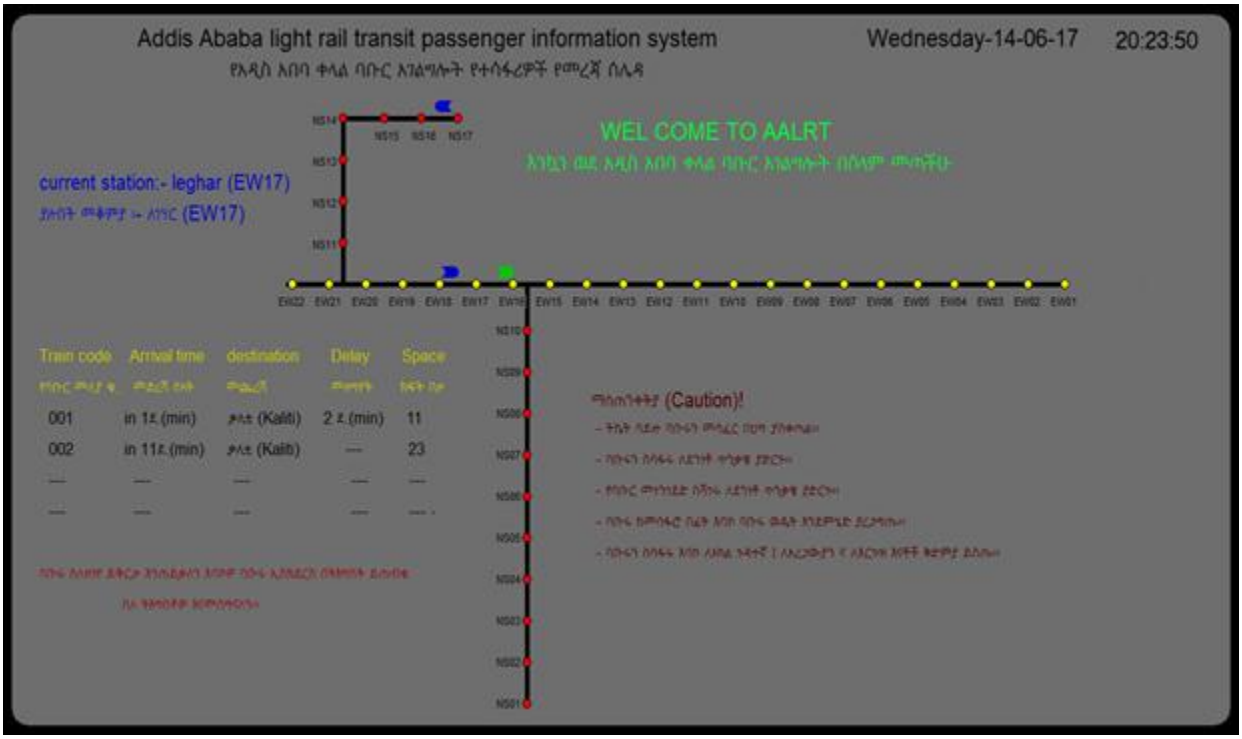

Figure 17(d): passenger information display screen

5.2 Graphical user interface

Graphical user interface display screen for passenger information system control is also designed in this thesis. The operator or controller can see the screen of all AALRT by selecting station and trip direction (down and up). For instance in this paper, the two station (leghar and meshuwalakiya) are selected and simulated as follows.

The below figure shows the GUI display screen of PIS at control center when it displaying leghar station down trip screen.

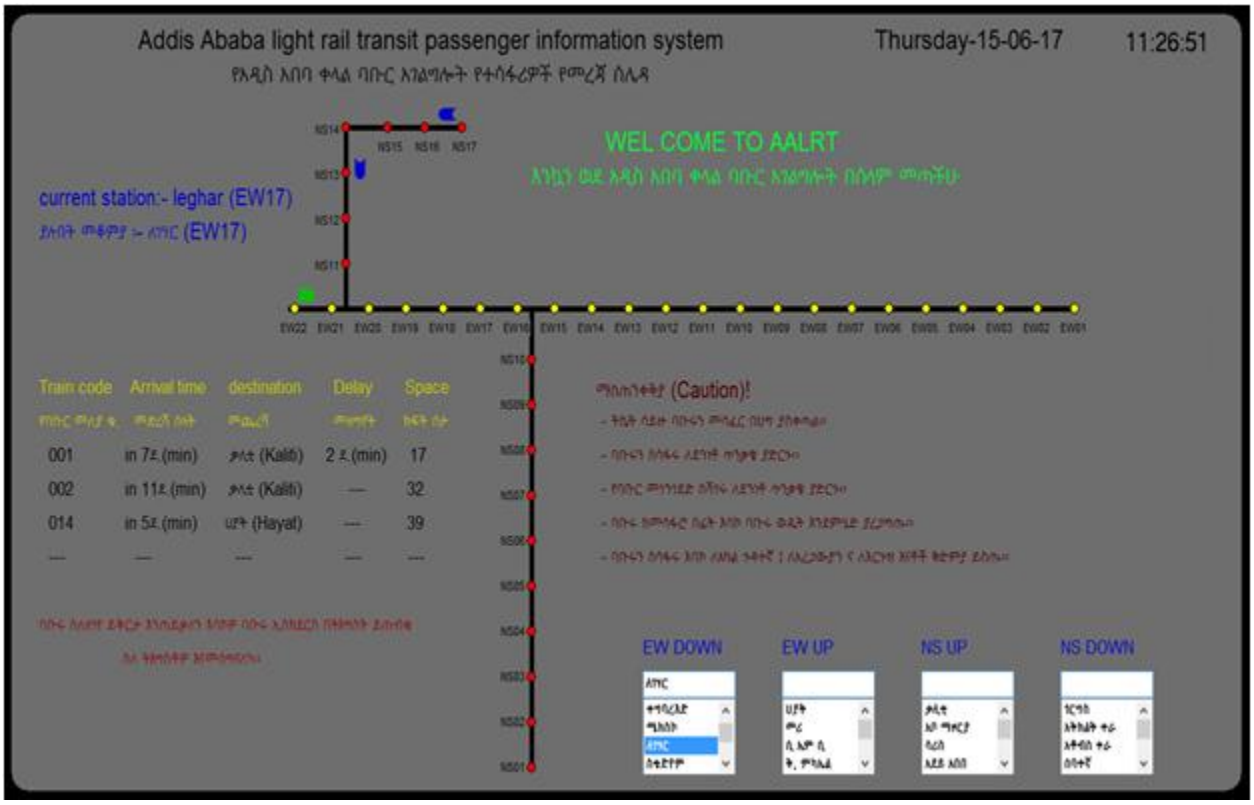

Figure 18: Control center GUI screen of PIS on displaying leghar down trip information screen

The below figure shows the GUI display screen of PIS at control center when it displaying meshuwalakiya station down trip screen by selecting the option.

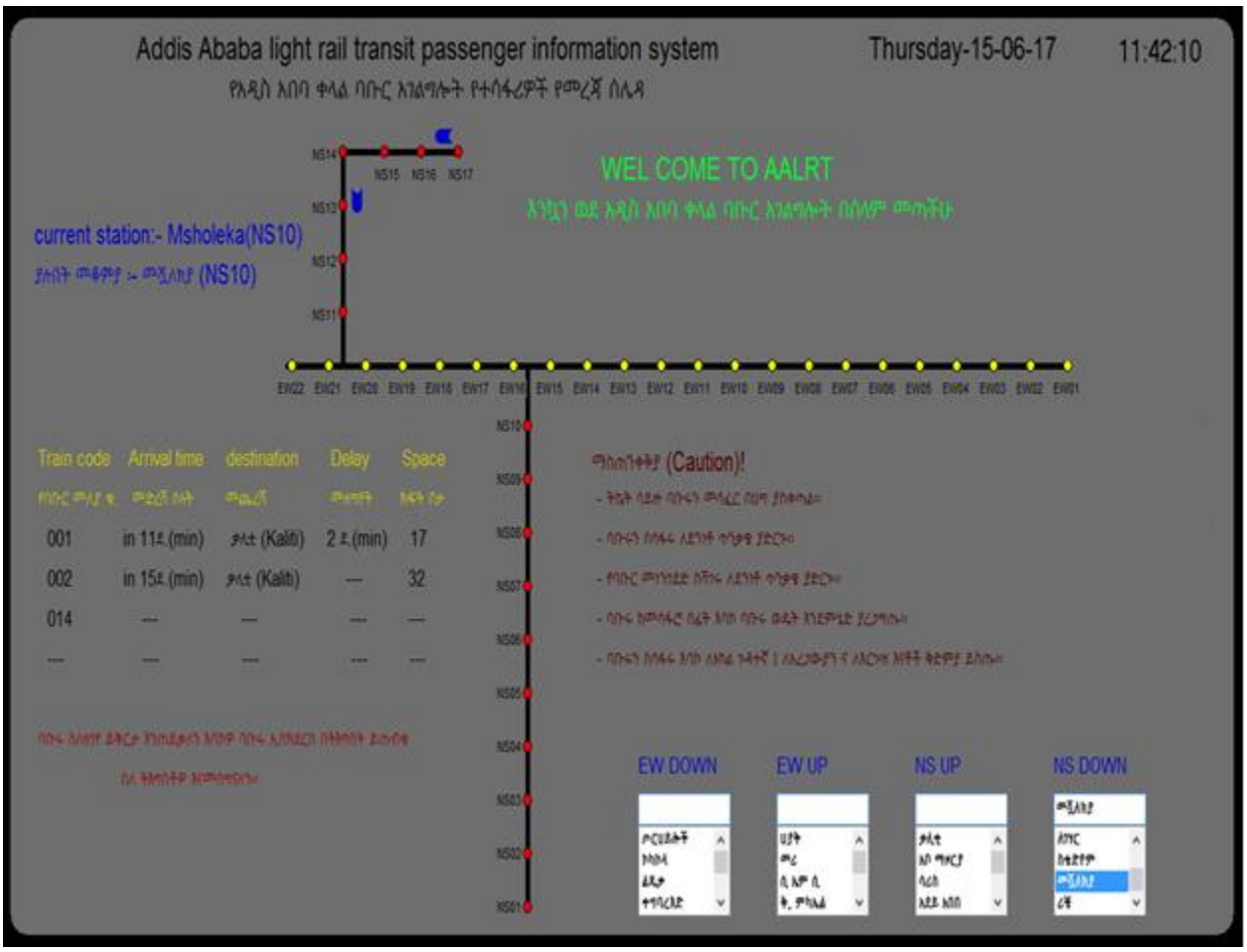

Figure 19: Control center GUI screen of PIS on displaying meshuwalakiya down trip screen information

Finally starting from the passenger information system simulation at station it possible to have the following results:

- familiarity and simplicity of usage:

Since there is information displayed about safety of passengers, they can understand what they have to do even they are new for the service. Getting the destination of every train and at which station they should have to alight is very easy.

- service quality:

As mentioned previously, the PIS is one of the criteria to measure transport service quality. The passenger did not have unnecessary waiting for a train. Because they are familiar to the status (presence or absence, stop or on moving, etc) of the train on the route. Additionally the PIS control center can look for a train problem and report it to the one it considers to fix the problem quickly.

- Consistency and reliability

The data of PIS can be used as raw data for other section of AALRT operation system such as train scheduler section, operation management section and train dispatcher section. For example train scheduler can improve the schedule of the train by analyzing the train delay and improve the consistency and reliability of the schedule.

CHAPTER 6

Conclusion and Recommendation

6.1 Conclusion

In this paper, the design of Passenger Information System at station is discussed. The GPS tracks the necessary information of the locomotive and estimates their arrival time at different stations in their respective routes. Passenger counting system mounted on the train is track the number of passenger onboard and alighting from the train and estimate the available space. Estimates are updated every time the train sends an update. It distributes this information to passengers using display terminals at railway station. GUI central controller at PIS center and local controller at specified stations used to view the display and status of each station. So with the advent of GPS and APC, real time train formation for better PIS is possible.

The information provided to the passenger is clear and understandable since it is in local language. Addition to this audio system configured to the system provides necessary information in local language. This is the basic for fulfillment of all passengers (disabled, illiterate, elders etc) request. A simulation model of this paper concentrate on passenger information display screen and its control system.

6.2 Recommendation

In this thesis work preparation process, the available information system in AALRT has seen. As followed by standard railway transportation information system evaluation process, passenger information system is very necessary to have comfortable transportation system. As seen from unstructured interview, the main headache for users of Addis Ababa railway transportation information system. Starting from this, the work of passenger information system with the following specific points are discussed:

- Collecting of real time data
- Designing of GUI of passenger information system in local language
- Designing of information display screen at station in local language
- Connecting station with central system

Therefore, the following points are recommendation to Ethiopian Railway Corporation and other researcher:

- Ethiopian Railway Corporation is recommended to test and implement PIS at its station for building passenger based comfortable transportation system.
- In this design process there was some part that was need more detail work. So researcher is recommended to work on those parts in detail.
- The design process was focused on passenger interest, which is capable to use in local languages, such that, the idea will encourage local developers to add different features. Therefore, Ethiopian Railway Corporation recommended that, by inviting different skillful students and other interested local sectors, it can work on this advanced area.

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Appendix A: PIS at station simulation code

```
#include "stdafx.h"
#ifndef SHARED_HANDLERS
#include "eers.h"
#endif
#include "eersDoc.h"
#include "eersView.h"
#ifdef _DEBUG
#define new DEBUG_NEW
#endif
// CeersView
IMPLEMENT_DYNCREATE(CeersView, CView)
BEGIN_MESSAGE_MAP(CeersView, CView)
// Standard printing commands
ON_COMMAND(ID_FILE_PRINT, &CView::OnFilePrint)
ON_COMMAND(ID_FILE_PRINT_DIRECT, &CView::OnFilePrint)
ON_COMMAND(ID_FILE_PRINT_PREVIEW, &CeersView::OnFilePrintPreview)
ON_WM_CONTEXTMENU()
ON_WM_RBUTTONUP()
ON_COMMAND(5, CeersView::OnButtonExit)
ON_COMMAND(1, CeersView::OnButtonAbout)
ON_COMMAND(7, CeersView::OnButtonView)
ON_COMMAND(8, CeersView::OnButtonMove)
ON_COMMAND(9, CeersView::OnButtonStop)
ON_COMMAND(11, CeersView::OnButtonContinue)
ON_COMMAND(10, CeersView::OnButtonReset)
ON_WM_TIMER()
ON_WM_ERASEBKGND()
END_MESSAGE_MAP()
// CeersView construction/destruction
```

```
CeersView::CeersView()
{
x1=340;
x2 = 1180;
y1 = 680;
y2 = 160;
y3 = 275;
}
CeersView::~CeersView()
{
}
BOOL CeersView::PreCreateWindow(CREATESTRUCT& cs)
{
return CView::PreCreateWindow(cs);
}
// CeersView drawing
void CeersView::OnDraw(CDC* /*pDC*/)
{
CeersDoc* pDoc = GetDocument();
ASSERT_VALID(pDoc);
if (!pDoc)
return;
CClientDC dc(this);
CPen pen1(PS_DOT,5,RGB(0,0,0));
CPen pen_ellipse(PS_SOLID, 1, RGB(0, 0, 0));
CBrush brush_red_ellipse(RGB(255, 0, 0));
CBrush brush_yellow_ellipse(RGB(255, 255, 0));
CBrush brush_green_ellipse(RGB(0, 255, 0));
dc.SelectObject(&pen1);
CPen pen_Roundrect(PS_SOLID, 5, RGB(0, 0, 0));
CBrush brush_red_Roundrect(RGB(110, 110, 110));
```

```
CBrush brush_black_Roundrect(RGB(0, 0, 0));
// header
CFont font1;
font1.CreatePointFont(180,_T("Arial"));
dc.SelectObject(&font1);
dc.SetBkColor(RGB(110,110,110));
dc.SetTextColor(RGB(0,255, 51));
dc.TextOutW(660,120,_T("WEL COME TO AALRT"));
dc.TextOutW(580,150,_T("እንኳን ወደ አዲስ አበባ ቀላል ባቡር አገልግሎት በሰላም መጣችሁ"));
dc.SetTextColor(RGB(0,0, 0));
dc.TextOutW(150,30,_T(" Addis Ababa light rail transit passenger information system"));
dc.TextOutW(250,60,_T(" የአዲስ አበባ ቀላል ባቡር አገልግሎት የተሳፋሪዎች የመረጃ ሰሌዳ"));
// time and date
CFont font3;
dc.SetTextColor(RGB(0,0,0));
CString m_strTime;
CTime theTime;
theTime = CTime::GetCurrentTime ();
m_strTime = theTime.Format ("%A-%d-%m-%y");//date
dc.TextOut(950,30, m_strTime);
font3.CreatePointFont(180, _T("Berlin SansFB"));
dc.SelectObject(&font3);
m_strTime = theTime.Format("%H:%M:%S");// current time
dc.TextOut(1220,30, m_strTime);
}
// CeersView printing
void CeersView::OnFilePrintPreview()
{
#ifndef SHARED_HANDLERS
        AFXPrintPreview(this);
#endif
```

```
}
BOOL CeersView::OnPreparePrinting(CPrintInfo* pInfo)
{
return DoPreparePrinting(pInfo);
}
void CeersView::OnBeginPrinting(CDC* /*pDC*/, CPrintInfo* /*pInfo*/)
{
}
void CeersView::OnEndPrinting(CDC* /*pDC*/, CPrintInfo* /*pInfo*/)
{
}
void CeersView::OnRButtonUp(UINT /* nFlags */, CPoint point)
{
ClientToScreen(&point);
OnContextMenu(this, point);
}
void CeersView::OnContextMenu(CWnd* /* pWnd */, CPoint point)
{
#ifndef SHARED_HANDLERS
theApp.GetContextMenuManager()->ShowPopupMenu(IDR_POPUP_EDIT, point.x, point.y,
this, TRUE);
#endif
}
// CeersView diagnostics
#ifdef _DEBUG
void CeersView::AssertValid() const
{
CView::AssertValid();
}
void CeersView::Dump(CDumpContext& dc) const
{
```

```
CView::Dump(dc);
}
CeersDoc* CeersView::GetDocument() const // non-debug version is inline
{
ASSERT(m_pDocument->IsKindOf(RUNTIME_CLASS(CeersDoc)));
return (CeersDoc*)m_pDocument;
}
#endif //_DEBUG
// CeersView message handlers
void CeersView::OnInitialUpdate()
{
CView::OnInitialUpdate();
SetTimer(1, 120, NULL);
myButton4.Create(_T("Start"),WS_CHILD|WS_VISIBLE|BS_AUTOCHECKBOX,CRect(1250
,100,1310,130), this,4);
myButton5.Create(_T("Exit"),WS_CHILD|WS_VISIBLE|BS_PUSHBUTTON,CRect(1250,340,
1310,370), this,5);
ButtonView.Create(_T("View"),WS_CHILD|WS_VISIBLE|BS_PUSHBUTTON,CRect(1250,2
00,1310,230), this,7);
ButtonMove.Create(_T("Move"),WS_CHILD|WS_VISIBLE|BS_PUSHBUTTON,CRect(1250,2
35,1310,265), this,8);
ButtonStop.Create(_T("Stop"),WS_CHILD|WS_VISIBLE|BS_PUSHBUTTON,CRect(1250,270
,1310,300), this,9);
ButtonReset.Create(_T("Reset"),WS_CHILD|WS_VISIBLE|BS_PUSHBUTTON,CRect(1250,3
05,1310,335), this,10);
ButtonContinue.Create(_T("Continue"),WS_CHILD|WS_VISIBLE|BS_PUSHBUTTON,
CRect(1240,375,1320,405), this, 11);
myButton4.EnableWindow(FALSE);
ButtonSwitch2.EnableWindow(FALSE);
}
BOOL CeersView::OnCommand(WPARAM wParam, LPARAM lParam)
```

```
{
return CView::OnCommand(wParam, lParam);
}
void CeersView::OnButtonExit(void)
{
exit(0);
}
void CeersView::OnTimer(UINT_PTR nIDEvent)
{
if (myButton4.GetCheck())
{
CClientDC dc(this);
CPen pen_black(PS_DOT, 11, RGB(0,0,204));
CPen pen_white(PS_DOT, 11, RGB(110,110,110));
CPen pen_green(PS_DOT, 11, RGB(0,200,0));
dc.SelectObject(&pen_green);
dc.MoveTo(x1-15,268);
dc.LineTo(x1,268);
dc.SelectObject(&pen_white);
dc.MoveTo(x1-30,268);
dc.LineTo(x1-15,268);
x1 ++;
dc.SelectObject(&pen_black);
dc.MoveTo(395, y2-15);
dc.LineTo(395,y2);
dc.SelectObject(&pen_white);
dc.MoveTo(395,y2-30);
dc.LineTo(395,y2-15);
y2 ++;
if (x1>560)
{
```

```
x1 --;
}
if (x1>395)
{
dc.SelectObject(&pen1);
dc.MoveTo(380,280);
dc.LineTo(380,246);//BL darmar
}
if (x2<620)
{
x2++;
}
if (y1<340)
{
y1++;
}
if (y2>260)
{
y2--;
}
if (x1>480)
{
dc.SelectObject(&pen_white);
dc.MoveTo(395,245);
dc.LineTo(395,260);
dc.SelectObject(&pen_black);
dc.MoveTo(x3-15,268);
dc.LineTo(x3,268);
dc.SelectObject(&pen_white);
dc.MoveTo(x3-30,268);
dc.LineTo(x3-15,268);
```

```
x3++;
dc.SelectObject(&brush_red_Roundrect);
dc.RoundRect(50,400,490,500,42,38);

//update arrival time
CFont font1;
font1.CreatePointFont(130,_T("Arial"));
dc.SelectObject(&font1);
dc.SetBkColor(RGB(110,110,110));
dc.SetTextColor(RGB(200,200, 0));
dc.TextOutW(50,370,_T("የባቡር መለያ ቁ.  መድረሻ ሰኣት  መጨረሻ  መዘግየት  ክፍት ቦታ"));
dc.TextOutW(50,340,_T("Train code  Arrival time  destination  Delay  Space"));
dc.SetTextColor(RGB(0,0, 0));
dc.TextOutW(50,400,_T("  001  in 2.5ደ.(min)  ቃሊቲ (Kaliti)  2 ደ.(min)  14"));
dc.TextOutW(50,430,_T("  002  in 11ደ.(min)  ቃሊቲ (Kaliti)  ---  30"));
dc.TextOutW(50,460,_T("  ---  in 1ደ.(min)  ሀያት (Hayat)  ---  35"));
dc.TextOutW(50,490,_T("  ---  ---  ---  ---  ---"));
}
if (x3>500)
{
x3--;
}
if (x3>480)
{
dc.SelectObject(&brush_red_Roundrect);
dc.RoundRect(50,400,490,500,42,38);
dc.TextOutW(50,370,_T("የባቡር መለያ ቁ.  መድረሻ ሰኣት  መጨረሻ  መዘግየት  ክፍት ቦታ"));
dc.TextOutW(50,340,_T("Train code  Arrival time  destination  Delay  Space"));
dc.SetTextColor(RGB(0,0, 0));
dc.TextOutW(50,400,_T("  001  in 1ደ.(min)  ቃሊቲ (Kaliti)  2 ደ.(min)  11"));
dc.TextOutW(50,430,_T("  002  in 11ደ.(min)  ቃሊቲ (Kaliti)  ---  23"));
```

```
dc.TextOutW(50,460,_T("  ---          ---          ---          ---       ---"));
dc.TextOutW(50,490,_T("  ---          ---          ---          ---       ---"));
}
}
CView::OnTimer(nIDEvent);
}
void CeersView::OnButtonView(void)
{
dc.SelectObject(&brush_black_Roundrect);
dc.RoundRect(6,6,1359,720,42,38);
dc.SelectObject(&brush_red_Roundrect);
dc.RoundRect(17,17,1348,709,42,38);
// train schedule and delay
dc.SetTextColor(RGB(200,200, 0));
dc.TextOutW(50,370,_T("የባቡር መለያ ቁ.  መድረሻ ሰኣት  መጨረሻ  መዘግየት  ክፍት ቦታ"));
dc.TextOutW(50,340,_T("Train code  Arrival time  destination  Delay  Space"));
dc.SetTextColor(RGB(0,0, 0));
dc.TextOutW(50,400,_T("  001  in 7ደ.(min)  ቃሊቲ (Kaliti)  2 ደ.(min)  17"));
dc.TextOutW(50,430,_T("  002  in 11ደ.(min)  ቃሊቲ (Kaliti)  ---  32"));
dc.TextOutW(50,460,_T("  014  in 5ደ.(min)  ሀያት (Hayat)  ---  39"));
dc.TextOutW(50,490,_T("  ---  ---  ---  ---  ---"));
//delay apology
dc.SetTextColor(RGB(150, 0, 0));
dc.TextOutW(50,550,_T("ባቡሩ ስለዘገየ ይቅርታ እንጠይቃለን እባኮዎ ባቡሩ ኢስክደርስ በትእግስት ይጠብቁ"));
dc.TextOutW(50,580,_T("  ስለ ትእግስቶዎ እናመሰግናለን።።"));
// caution
dc.SetTextColor(RGB(80, 0, 0));
dc.TextOutW(650,370,_T(" - ትኬት ሳይዙ ባቡሩን መሳፈር በህግ ያስቀጣል።።"));
dc.TextOutW(650,400,_T(" - ባቡሩን ስሳፍሩ ለደንነቶ ጥንቃቄ ያድርጉ።።"));
dc.TextOutW(650,430,_T(" - የባቡር መነንገደድ ስሻገሩ ለደንነቶ ጥንቃቄ ያድርጉ።።"));
dc.TextOutW(650,460,_T(" - ባቡሩ ከመሳፍሮ በፊት እባኮ ባቡሩ ወዴት እንደምሄድ ያረጋግጡ።።"));
```

```
dc.TextOutW(650,490,_T(" - ባቡሩን ስሳፋሩ እባኮ ለአካል ጉዳተኛ ፤ ለአረጋውያን ና ለእርጉዝ እናቶች ቅድምያ ይስጡ።።"));
font1.CreatePointFont(150,_T("Arial"));
dc.SelectObject(&font1);
dc.TextOutW(650,340,_T("ማስጠንቀቅያ (Caution)!"));
//current station name
dc.SetTextColor(RGB(0, 0,204));
dc.TextOutW(50,170,_T("current station:- leghar (EW17)"));
dc.TextOutW(50,200,_T("ያሉበት መቆምያ ፡- ለገሃር (EW17)"));
//track
dc.MoveTo(320,280);//BL torhayloch
dc.LineTo(360,280);//BL cocacola
dc.MoveTo(360,280);
dc.LineTo(400,280);//BL lideta
dc.MoveTo(400,280);
dc.LineTo(440,280);//BL tegbared
dc.MoveTo(440,280);
dc.LineTo(480,280);//BL mexico
dc.MoveTo(480,280);
dc.LineTo(520,280);//BL leghar
dc.MoveTo(520,280);
dc.LineTo(560,280);//BL stadium
dc.MoveTo(560,280);
dc.LineTo(600,280);//BL st. estfanos
dc.MoveTo(600,280);
dc.LineTo(640,280);//BL banbis
dc.MoveTo(640,280);
dc.LineTo(680,280);//BL st.urael
dc.MoveTo(680,280);
dc.LineTo(720,280);//BL 22 two
dc.MoveTo(720,280);
```

```
dc.LineTo(760,280);//BL 22 one
dc.MoveTo(760,280);
dc.LineTo(800,280);//BL lem hotel
dc.MoveTo(800,280);
dc.LineTo(840,280);//BL megenagna
dc.MoveTo(840,280);
dc.LineTo(880,280);//BL gurdshola 2
dc.MoveTo(880,280);
dc.LineTo(920,280);//BL gurdshola 1
dc.MoveTo(920,280);
dc.LineTo(960,280);//BL mngement
dc.MoveTo(960,280);
dc.LineTo(1000,280);//BL civil service
dc.MoveTo(1000,280);
dc.LineTo(1040,280);//BL st. michael
dc.MoveTo(1040,280);
dc.LineTo(1080,280);//BL cmc
dc.MoveTo(1080,280);
dc.LineTo(1120,280);//BL meri
dc.MoveTo(1120,280);
dc.LineTo(1160,280);//BL ayat
dc.MoveTo(380,280);
dc.LineTo(380,240);//BL darmar
dc.MoveTo(380,240);
dc.LineTo(380,200);//BL abinet
dc.MoveTo(380,200);
dc.LineTo(380,160);//BL sebategna
dc.MoveTo(380,160);
dc.LineTo(380,120);//BL A.tera
dc.MoveTo(380,120);
dc.LineTo(420,120);//BL G. berenda
```

```
dc.MoveTo(420,120);
dc.LineTo(460,120);//BL Atkilt tera
dc.MoveTo(460,120);
dc.LineTo(500,120);//BL st.giorge
dc.MoveTo(580,280);
dc.LineTo(580,320);//BL meshuwalekia
dc.MoveTo(580,320);
dc.LineTo(580,360);//BL riche
dc.MoveTo(580,360);
dc.LineTo(580,400);//BL temenga yazh
dc.MoveTo(580,400);
dc.LineTo(580,440);//BL lancha
dc.MoveTo(580,440);
dc.LineTo(580,480);//BL nfs silk 2
dc.MoveTo(580,480);
dc.LineTo(580,520);//BL nfs silk 1
dc.MoveTo(580,520);
dc.LineTo(580,560);//BL adey abeba
dc.MoveTo(580,560);
dc.LineTo(580,600);//BL saris
dc.MoveTo(580,600);
dc.LineTo(580,640);//BL abo junc.
dc.MoveTo(580,640);
dc.LineTo(580,680);//BL kaliti
// Station
dc.SelectObject(&pen_ellipse);
dc.SelectObject(&brush_green_ellipse);
dc.Ellipse(320, 275, 330, 285);//torhyloch
dc.Ellipse(360, 275,370, 285);//cocacola
dc.Ellipse(400, 275,410, 285);//lideta
dc.Ellipse(440, 275,450, 285);//tegbared
```

```
dc.Ellipse(480, 275,490, 285);//mexico
dc.Ellipse(520, 275,530, 285);//leghar
dc.Ellipse(560, 275,570, 285);//stadium
dc.Ellipse(600, 275,610, 285);//st.estifanos
dc.Ellipse(640, 275,650, 285);//banbis
dc.Ellipse(680, 275,690, 285);//st u
dc.Ellipse(720, 275,730, 285);//22 2
dc.Ellipse(760, 275,770, 285);//22 1
dc.Ellipse(800, 275,810, 285);//lem h
dc.Ellipse(840, 275,850, 285);//
dc.Ellipse(880, 275,890, 285);//
dc.Ellipse(920, 275,930, 285);//
dc.Ellipse(960, 275,970, 285);//
dc.Ellipse(1000, 275,1010, 285);//
dc.Ellipse(1040, 275,1050, 285);//
dc.Ellipse(1080, 275,1090, 285);//
dc.Ellipse(1120, 275,1130, 285);//
dc.Ellipse(1160, 275,1170, 285);//
dc.SelectObject(&brush_red_ellipse);
dc.Ellipse(375, 235,385, 245);//darmar
dc.Ellipse(375, 195,385, 205);//abinet
dc.Ellipse(375, 155,385, 165);//sabategna
dc.Ellipse(375, 115,385, 125);//atobis tera
dc.Ellipse(420, 115,430, 125);//g. berenda
dc.Ellipse(460, 115,470, 125);//Atkilt tera
dc.Ellipse(500, 115,510, 125);//st.giorge
dc.Ellipse(575, 320,585, 330);//meshulakia
dc.Ellipse(575, 360,585, 370);//riche
dc.Ellipse(575, 400,585, 410);//t.yazh
dc.Ellipse(575, 440,585, 450);//lancha
dc.Ellipse(575, 480,585, 490);//N. silk 2
```

```
dc.Ellipse(575, 520,585, 530);//N. silk 1
dc.Ellipse(575, 560,585, 570);//A. abeba
dc.Ellipse(575, 600,585, 610);//saris
dc.Ellipse(575, 640,585, 650);//abo junc.
dc.Ellipse(575, 680,585, 690);//kaliti
//station name
CFont font2;
font2.CreatePointFont(80,_T("Arial"));
dc.SelectObject(&font2);
dc.SetBkColor(RGB(110,110,110));
dc.SetTextColor(RGB(0,0, 0));
dc.TextOutW(310,290,_T("EW22"));
dc.TextOutW(350,290,_T("EW21"));
dc.TextOutW(390,290,_T("EW20"));
dc.TextOutW(430,290,_T("EW19"));
dc.TextOutW(470,290,_T("EW18"));
dc.TextOutW(510,290,_T("EW17"));
dc.TextOutW(550,290,_T("EW16"));
dc.TextOutW(590,290,_T("EW15"));
dc.TextOutW(630,290,_T("EW14"));
dc.TextOutW(670,290,_T("EW13"));
dc.TextOutW(710,290,_T("EW12"));
dc.TextOutW(750,290,_T("EW11"));
dc.TextOutW(790,290,_T("EW10"));
dc.TextOutW(830,290,_T("EW09"));
dc.TextOutW(870,290,_T("EW08"));
dc.TextOutW(910,290,_T("EW07"));
dc.TextOutW(950,290,_T("EW06"));
dc.TextOutW(990,290,_T("EW05"));
dc.TextOutW(1030,290,_T("EW04"));
dc.TextOutW(1070,290,_T("EW03"));
```

```
dc.TextOutW(1110,290,_T("EW02"));
dc.TextOutW(1150,290,_T("EW01"));
dc.TextOutW(495,130,_T("NS17"));
dc.TextOutW(455,130,_T("NS16"));
dc.TextOutW(415,130,_T("NS15"));
dc.TextOutW(347,115,_T("NS14"));
dc.TextOutW(347,155,_T("NS13"));
dc.TextOutW(347,195,_T("NS12"));
dc.TextOutW(347,235,_T("NS11"));
dc.TextOutW(547,318,_T("NS10"));
dc.TextOutW(547,358,_T("NS09"));
dc.TextOutW(547,398,_T("NS08"));
dc.TextOutW(547,438,_T("NS07"));
dc.TextOutW(547,478,_T("NS06"));
dc.TextOutW(547,518,_T("NS05"));
dc.TextOutW(547,558,_T("NS04"));
dc.TextOutW(547,598,_T("NS03"));
dc.TextOutW(547,638,_T("NS02"));
dc.TextOutW(547,678,_T("NS01"));
// train
dc.SelectObject(&pen_green);
dc.MoveTo(x1-15,268);
dc.LineTo(x1,268);
dc.SelectObject(&pen_white);
dc.MoveTo(x1-30,268);
dc.LineTo(x1-15,268);
x1 ++;
dc.SelectObject(&pen_black);
dc.MoveTo(395, y2-15);
dc.LineTo(395,y2);//train
dc.SelectObject(&pen_white);
```

```
dc.MoveTo(395,y2-30);
dc.LineTo(395,y2-15);//hide
y2 ++;
dc.SelectObject(&pen_black);
dc.MoveTo(500, 108);
dc.LineTo(485,108);
dc.SelectObject(&pen_white);
dc.MoveTo(515,108);
dc.LineTo(500,108);
}
void CeersView::OnButtonMove(void)
{
myButton4.EnableWindow(TRUE);
ButtonView.EnableWindow(FALSE);
}
void CeersView::OnButtonStop(void)
{
KillTimer(1);
ButtonMove.EnableWindow(FALSE);
}
void CeersView::OnButtonContinue(void)
{
SetTimer(1, 120, NULL);
}
void CeersView::OnButtonReset(void)
{
CView::OnInitialUpdate();
ButtonView.EnableWindow(TRUE);
ButtonMove.EnableWindow(TRUE);
CheckDlgButton(4, BST_UNCHECKED);
myButton4.EnableWindow(FALSE);
```

```
myButton6.EnableWindow(TRUE);
x1 = 340;
x2 = 1180;
y1 = 680;
y2 = 160;
SetTimer(1, 120, NULL);
}
// change bachground
BOOL CeersView::OnEraseBkgnd(CDC* pDC)
{
CBrush backBrush(RGB(110, 110, 110));
CBrush* pOldBrush = pDC->SelectObject(&backBrush);
CRect rect;
pDC->GetClipBox(&rect);//erase area needed
pDC->PatBlt(rect.left, rect.top, rect.Width(), rect.Height(), PATCOPY);
pDC->SelectObject(pOldBrush);
return TRUE;
return CView::OnEraseBkgnd(pDC);
}
```

Appendix B: Graphical user interface simulation code

```
#include "stdafx.h"
#ifndef SHARED_HANDLERS
#include "GUI.h"
#endif
#include "GUIDoc.h"
#include "GUIView.h"
#ifdef _DEBUG
#define new DEBUG_NEW
#endif
IMPLEMENT_DYNCREATE(CGUIView, CView)
BEGIN_MESSAGE_MAP(CGUIView, CView)
// Standard printing commands
ON_COMMAND(ID_FILE_PRINT, &CView::OnFilePrint)
ON_COMMAND(ID_FILE_PRINT_DIRECT, &CView::OnFilePrint)
ON_COMMAND(ID_FILE_PRINT_PREVIEW, &CGUIView::OnFilePrintPreview)
ON_WM_CONTEXTMENU()
ON_WM_RBUTTONUP()
ON_COMMAND(1, CGUIView::OnButtonExit)
ON_COMMAND(2, CGUIView::OnButtonView)
ON_COMMAND(7, CGUIView::OnButtonStop)
ON_COMMAND(8, CGUIView::OnButtonReset)
ON_COMMAND(9, CGUIView::OnButtonContinue)
ON_WM_TIMER()
ON_WM_ERASEBKGND()
ON_WM_TIMER()
ON_WM_ERASEBKGND()
END_MESSAGE_MAP()
// CGUIView construction/destruction
CGUIView::CGUIView()
{
```

```
x1=340;
x2 = 1180;
y1 = 680;
y2 = 160;
y3 = 275;
x3 = 420;
}
CGUIView::~CGUIView()
{
}
BOOL CGUIView::PreCreateWindow(CREATESTRUCT& cs)
{
return CView::PreCreateWindow(cs);
}
// CGUIView drawing
void CGUIView::OnDraw(CDC* /*pDC*/)
{
CGUIDoc* pDoc = GetDocument();
ASSERT_VALID(pDoc);
if (!pDoc)
return;
CClientDC dc(this);
CPen pen1(PS_DOT, 5, RGB(0,0,0));
CPen pen_ellipse(PS_SOLID, 1, RGB(0, 0, 0));
 CBrush brush_red_ellipse(RGB(255, 0, 0));
CBrush brush_yellow_ellipse(RGB(255, 255, 0));
CBrush brush_green_ellipse(RGB(0, 255, 0));
CPen pen_Roundrect(PS_SOLID, 5, RGB(0, 0, 0));
CBrush brush_red_Roundrect(RGB(110, 110, 110));
CBrush brush_black_Roundrect(RGB(0, 0, 0));
dc.SelectObject(&pen1);
```

```
dc.SelectObject(&pen_Roundrect);
// Header
CFont font1;
font1.CreatePointFont(180,_T("Arial"));
dc.SelectObject(&font1);
dc.SetBkColor(RGB(110,110,110));
dc.SetTextColor(RGB(0,255, 51));
dc.TextOutW(660,120,_T("WEL COME TO AALRT"));
dc.TextOutW(580,150,_T("እንኳን ወደ አዲስ አበባ ቀላል ባቡር አገልግሎት በሰላም መጣችሁ"));
dc.SetTextColor(RGB(0,0, 0));
dc.TextOutW(150,30,_T(" Addis Ababa light rail transit passenger information system"));
dc.TextOutW(250,60,_T(" የአዲስ አበባ ቀላል ባቡር አገልግሎት የተሳፋሪዎች የመረጃ ሰሌዳ"));

// Time and date
CFont font3;
dc.SetTextColor(RGB(0,0,0));
CString m_strTime;
CTime theTime;
theTime = CTime::GetCurrentTime ();
m_strTime = theTime.Format ("%A-%d-%m-%y");//date
dc.TextOut(950,30, m_strTime);
font3.CreatePointFont(180, _T("Berlin SansFB"));
dc.SelectObject(&font3);
m_strTime = theTime.Format("%H:%M:%S");// current time
dc.TextOut(1220,30, m_strTime);
}
// CGUIView printing
void CGUIView::OnFilePrintPreview()
{
#ifndef SHARED_HANDLERS
        AFXPrintPreview(this);
```

```
#endif
}
BOOL CGUIView::OnPreparePrinting(CPrintInfo* pInfo)
{
return DoPreparePrinting(pInfo);
}
void CGUIView::OnBeginPrinting(CDC* /*pDC*/, CPrintInfo* /*pInfo*/)
{
}
void CGUIView::OnEndPrinting(CDC* /*pDC*/, CPrintInfo* /*pInfo*/)
{
}
void CGUIView::OnRButtonUp(UINT /* nFlags */, CPoint point)
{
ClientToScreen(&point);
OnContextMenu(this, point);
}
void CGUIView::OnContextMenu(CWnd* /* pWnd */, CPoint point)
{
#ifndef SHARED_HANDLERS
        theApp.GetContextMenuManager()->ShowPopupMenu(IDR_POPUP_EDIT,      point.x,
point.y, this, TRUE);
#endif
}
// CGUIView diagnostics
#ifdef _DEBUG
void CGUIView::AssertValid() const
{
CView::AssertValid();
}
void CGUIView::Dump(CDumpContext& dc) const
```

```
{
CView::Dump(dc);
}
CGUIDoc* CGUIView::GetDocument() const // non-debug version is inline
{
ASSERT(m_pDocument->IsKindOf(RUNTIME_CLASS(CGUIDoc)));
return (CGUIDoc*)m_pDocument;
}
#endif //_DEBUG
// CGUIView message handlers
void CGUIView::OnInitialUpdate()
{
CView::OnInitialUpdate();
SetTimer(1, 60, NULL);
DWORD dwStyle;
HWND hWnd = AfxGetMainWnd()->GetSafeHwnd();
dwStyle =::GetWindowLong(hWnd, GWL_STYLE);
::SetWindowLong(hWnd, GWL_STYLE, dwStyle & ~(WS_MINIMIZEBOX |
WS_MAXIMIZEBOX));
GetParentFrame()->MoveWindow(x,y, width, height);
//create button
ButtonExit.Create(_T("Exit"),WS_CHILD|WS_VISIBLE|BS_PUSHBUTTON,CRect(1250,340,
1310,370), this,1);
ButtonView.Create(_T("View"),WS_CHILD|WS_VISIBLE|BS_PUSHBUTTON,CRect(1250,2
00,1310,230), this,2);
myButtonStart.Create(_T("Start"),WS_CHILD|WS_VISIBLE|BS_AUTOCHECKBOX,CRect(1
250,80,1310,100), this,3);
myButtonStart1.Create(_T("Start1"),WS_CHILD|WS_VISIBLE|BS_AUTOCHECKBOX,CRect
(1250,110,1310,130), this,4);
myButtonStart2.Create(_T("Start2"),WS_CHILD|WS_VISIBLE|BS_AUTOCHECKBOX,CRect
(1250,140,1310,160), this,5);
```

```
myButtonStart3.Create(_T("Start3"),WS_CHILD|WS_VISIBLE|BS_AUTOCHECKBOX,CRect
(1250,170,1310,190), this,6);
ButtonStop.Create(_T("Stop"),WS_CHILD|WS_VISIBLE|BS_PUSHBUTTON,CRect(1250,270
,1310,300), this,7);
ButtonReset.Create(_T("Reset"),WS_CHILD|WS_VISIBLE|BS_PUSHBUTTON,CRect(1250,3
05,1310,335), this,8);
ButtonContinue.Create(_T("Continue"),WS_CHILD|WS_VISIBLE|BS_PUSHBUTTON,CRect(
1240,375,1320,405), this, 9);
// create GUI menu
m_myCombo1.Create(WS_CHILD|WS_VISIBLE|CBS_SIMPLE|WS_VSCROLL,CRect(700,6
00,800,700), this,20);
m_myCombo1.InsertString(0, _T("ጦርሀይሎች"));
m_myCombo1.InsertString(1, _T("ኮካኮላ"));
m_myCombo1.InsertString(2, _T("ልዴታ"));
m_myCombo1.InsertString(3, _T("ተግባረእድ"));
m_myCombo1.InsertString(4, _T("ሜክስኮ"));
m_myCombo1.InsertString(5, _T("ለገሃር"));
m_myCombo1.InsertString(6, _T("ስቴድየም"));
m_myCombo1.InsertString(7, _T("ቅ. እስትፋኖስ"));
m_myCombo1.InsertString(8, _T("ባንብስ"));
m_myCombo1.InsertString(9, _T("ቅ. ኡራኤል"));
m_myCombo1.InsertString(10, _T("22 ሁለት"));
m_myCombo1.InsertString(11, _T("22 አንድ"));
m_myCombo2.Create(WS_CHILD|WS_VISIBLE|CBS_SIMPLE|WS_VSCROLL,CRect(850,6
00,950,700), this,21);
m_myCombo2.InsertString(0, _T("ሀያት"));
m_myCombo2.InsertString(1, _T("መሪ"));
m_myCombo2.InsertString(2, _T("ሲ ኤም ሲ"));
m_myCombo2.InsertString(3, _T("ቅ. ምካኤል"));
m_myCombo2.InsertString(4, _T("ሲቪል ሰርቭስ"));
m_myCombo2.InsertString(5, _T("ስራ አመራር"));
```

```
m_myCombo2.InsertString(6, _T("ጉርድሾላ ሁለት"));
m_myCombo2.InsertString(7, _T("ጉርድሾላ አንድ"));
m_myCombo2.InsertString(8, _T("መገናኛ"));
m_myCombo3.Create(WS_CHILD|WS_VISIBLE|CBS_SIMPLE|WS_VSCROLL,CRect(1000,
600,1100,700), this,22);
m_myCombo3.InsertString(0, _T("ቃሊቲ"));
m_myCombo3.InsertString(1, _T("አቦ ማዞርያ"));
m_myCombo3.InsertString(2, _T("ሳሪስ"));
m_myCombo3.InsertString(3, _T("አደይ አበበ"));
m_myCombo3.InsertString(4, _T("ንፋስ ስልክ አንድ"));
m_myCombo3.InsertString(5, _T("ንፋስ ስልክ ሁለት"));
m_myCombo3.InsertString(6, _T("ላንቻ"));
m_myCombo3.InsertString(7, _T("ጠመንጃ ያዥ"));
m_myCombo3.InsertString(8, _T("ሪቼ"));
m_myCombo4.Create(WS_CHILD|WS_VISIBLE|CBS_SIMPLE|WS_VSCROLL,CRect(1150,
600,1250,700), this,23);
m_myCombo4.InsertString(0, _T("ነርግስ"));
m_myCombo4.InsertString(1, _T("አትክልት ተራ"));
m_myCombo4.InsertString(2, _T("አቶቡስ ተራ"));
m_myCombo4.InsertString(3, _T("ሰባተኛ"));
m_myCombo4.InsertString(4, _T("አብነት"));
m_myCombo4.InsertString(5, _T("ደርመር"));
m_myCombo4.InsertString(6, _T("ልደታ"));
m_myCombo4.InsertString(7, _T("ተግባረእድ"));
m_myCombo4.InsertString(8, _T("ሜክስኮ"));
m_myCombo4.InsertString(9, _T("ለገሃር"));
m_myCombo4.InsertString(10, _T("ስቴድየም"));
m_myCombo4.InsertString(11, _T("መሿለኪያ"));
m_myCombo4.InsertString(12, _T("ሪቼ"));
}
BOOL CGUIView::OnCommand(WPARAM wParam, LPARAM lParam)
```

```
{
return CView::OnCommand(wParam, lParam);
}
void CGUIView::OnTimer(UINT_PTR nIDEvent)
{
if (m_myCombo1.GetCurSel()==5||m_myCombo4.GetCurSel()==10)
{
ButtonView.EnableWindow(FALSE);
myButtonStart.EnableWindow(TRUE);
myButtonStart1.EnableWindow(FALSE);
myButtonStart2.EnableWindow(FALSE);
myButtonStart3.EnableWindow(FALSE);
CClientDC dc(this);
CPen pen1(PS_DOT, 5, RGB(0,0,0));
CPen pen_ellipse(PS_SOLID, 1, RGB(0, 0, 0));
CBrush brush_red_ellipse(RGB(255, 0, 0));
 CBrush brush_green_ellipse(RGB(255, 255, 0));
CPen pen_Roundrect(PS_SOLID, 5, RGB(0, 0, 0));
CBrush brush_red_Roundrect(RGB(110, 110, 110));
CBrush brush_black_Roundrect(RGB(0, 0, 0));
dc.SelectObject(&pen_Roundrect);
dc.SelectObject(&brush_black_Roundrect);
dc.RoundRect(6,6,1359,720,42,38);
dc.SelectObject(&brush_red_Roundrect);
dc.RoundRect(17,17,1348,709,42,38);
CFont font1;
font1.CreatePointFont(130,_T("Arial"));
dc.SelectObject(&font1);
dc.SetBkColor(RGB(110,110,110));
dc.SetTextColor(RGB(0,0, 204));
dc.TextOutW(700,570,_T("EW DOWN"));
```

```
dc.TextOutW(850,570,_T("EW UP"));
dc.TextOutW(1000,570,_T("NS UP"));
dc.TextOutW(1150,570,_T("NS DOWN"));
// train schedule and delay
dc.SetTextColor(RGB(200,200, 0));
dc.TextOutW(50,370,_T("የባቡር መለያ ቁ.  መድረሻ ሰኣት  መጨረሻ  መዘግየት  ክፍት ቦታ"));
dc.TextOutW(50,340,_T("Train code  Arrival time  destination  Delay  Space"));
dc.SetTextColor(RGB(0,0, 0));
dc.TextOutW(50,400,_T("  001  in 7ደ.(min)  ቃሊቲ (Kaliti)  2 ደ.(min)  17"));
dc.TextOutW(50,430,_T("  002  in 11ደ.(min)  ቃሊቲ (Kaliti)  ---  32"));
dc.TextOutW(50,460,_T("  014  in 5ደ.(min)  ሀያት (Hayat)  ---  39"));
dc.TextOutW(50,490,_T("  ---  ---  ---  ---  ---"));
//delay apology
dc.SetTextColor(RGB(150, 0, 0));
dc.TextOutW(50,550,_T("ባቡሩ ስለዘገየ ይቅርታ እንጠይቃለን እባኮዎ ባቡሩ ኢስክደርስ በትእግስት ይጠብቁ"));
dc.TextOutW(50,580,_T("  ስለ ትእግስቶዎ እናመሰግናለን።።"));
// caution
dc.SetTextColor(RGB(80, 0, 0));
dc.TextOutW(650,370,_T(" - ትኬት ሳይዙ ባቡሩን መሳፈር በህግ ያስቀጣል።።"));
dc.TextOutW(650,400,_T(" - ባቡሩን ስሳፍሩ ለደንኑቶ ጥንቃቄ ያድርጉ።።"));
dc.TextOutW(650,430,_T(" - የባቡር መነንደድ ስሻገሩ ለደንኑቶ ጥንቃቄ ያድርጉ።።"));
dc.TextOutW(650,460,_T(" - ባቡሩ ከመሳፋሮ በፊት እባኮ ባቡሩ ወዴት እንደምሄድ ያረጋግጡ።።"));
dc.TextOutW(650,490,_T(" - ባቡሩን ስሳፍሩ እባኮ ለአካል ጉዳተኛ ፤ ለአረጋውያን ና ለእርጉዝ እናቶች ቅድምያ ይስጡ።።"));
font1.CreatePointFont(150,_T("Arial"));
dc.SelectObject(&font1);
dc.TextOutW(650,340,_T("ማስጠንቀቅያ (Caution)!"));
//current station name
dc.SetTextColor(RGB(0, 0,204));
dc.TextOutW(50,170,_T("current station:- leghar (EW17)"));
dc.TextOutW(50,200,_T("ያሉበት መቆምያ ፡- ለገሃር (EW17)"));
```

```
//Track
dc.MoveTo(320,280);//BL torhayloch
dc.LineTo(360,280);//BL cocacola
dc.MoveTo(360,280);
dc.LineTo(400,280);//BL lideta
dc.MoveTo(400,280);
dc.LineTo(440,280);//BL tegbared
dc.MoveTo(440,280);
dc.LineTo(480,280);//BL mexico
dc.MoveTo(480,280);
dc.LineTo(520,280);//BL leghar
dc.MoveTo(520,280);
dc.LineTo(560,280);//BL stadium
dc.MoveTo(560,280);
dc.LineTo(600,280);//BL st. estfanos
dc.MoveTo(600,280);
dc.LineTo(640,280);//BL banbis
dc.MoveTo(640,280);
dc.LineTo(680,280);//BL st.urael
dc.MoveTo(680,280);
dc.LineTo(720,280);//BL 22 two
dc.MoveTo(720,280);
dc.LineTo(760,280);//BL 22 one
dc.MoveTo(760,280);
dc.LineTo(800,280);//BL lem hotel
dc.MoveTo(800,280);
dc.LineTo(840,280);//BL megenagna
dc.MoveTo(840,280);
dc.LineTo(880,280);//BL gurdshola 2
dc.MoveTo(880,280);
dc.LineTo(920,280);//BL gurdshola 1
```

```
dc.MoveTo(920,280);
dc.LineTo(960,280);//BL mngement
dc.MoveTo(960,280);
dc.LineTo(1000,280);//BL civil service
dc.MoveTo(1000,280);
dc.LineTo(1040,280);//BL st. michael
dc.MoveTo(1040,280);
dc.LineTo(1080,280);//BL cmc
dc.MoveTo(1080,280);
dc.LineTo(1120,280);//BL meri
dc.MoveTo(1120,280);
dc.LineTo(1160,280);//BL ayat
dc.MoveTo(380,280);
dc.LineTo(380,240);//BL darmar
dc.MoveTo(380,240);
dc.LineTo(380,200);//BL abinet
dc.MoveTo(380,200);
dc.LineTo(380,160);//BL sebategna
dc.MoveTo(380,160);
dc.LineTo(380,120);//BL A.tera
dc.MoveTo(380,120);
dc.LineTo(420,120);//BL G. berenda
dc.MoveTo(420,120);
dc.LineTo(460,120);//BL Atkilt tera
dc.MoveTo(460,120);
dc.LineTo(500,120);//BL st.giorge
dc.MoveTo(580,280);
dc.LineTo(580,320);//BL meshuwalekia
dc.MoveTo(580,320);
dc.LineTo(580,360);//BL riche
dc.MoveTo(580,360);
```

```
dc.LineTo(580,400);//BL temenga yazh
dc.MoveTo(580,400);
dc.LineTo(580,440);//BL lancha
dc.MoveTo(580,440);
dc.LineTo(580,480);//BL nfs silk 2
dc.MoveTo(580,480);
dc.LineTo(580,520);//BL nfs silk 1
dc.MoveTo(580,520);
dc.LineTo(580,560);//BL adey abeba
dc.MoveTo(580,560);
dc.LineTo(580,600);//BL saris
dc.MoveTo(580,600);
dc.LineTo(580,640);//BL abo junc.
dc.MoveTo(580,640);
dc.LineTo(580,680);//BL kaliti

// Station
dc.SelectObject(&pen_ellipse);
dc.SelectObject(&brush_green_ellipse);
dc.Ellipse(320, 275, 330, 285);//torhyloch
dc.Ellipse(360, 275,370, 285);//cocacola
dc.Ellipse(400, 275,410, 285);//lideta
dc.Ellipse(440, 275,450, 285);//tegbared
dc.Ellipse(480, 275,490, 285);//mexico
dc.Ellipse(520, 275,530, 285);//leghar
dc.Ellipse(560, 275,570, 285);//stadium
dc.Ellipse(600, 275,610, 285);//st.estifanos
dc.Ellipse(640, 275,650, 285);//banbis
dc.Ellipse(680, 275,690, 285);//st urael
dc.Ellipse(720, 275,730, 285);//22 2
dc.Ellipse(760, 275,770, 285);//22 1
```

```
dc.Ellipse(800, 275,810, 285);//lem hotel
dc.Ellipse(840, 275,850, 285);//megenagna
dc.Ellipse(880, 275,890, 285);//gurdshola 2
dc.Ellipse(920, 275,930, 285);//gurdshola 1
dc.Ellipse(960, 275,970, 285);//managment
dc.Ellipse(1000, 275,1010, 285);//civil service
dc.Ellipse(1040, 275,1050, 285);//st. mikael
dc.Ellipse(1080, 275,1090, 285);//cmc
dc.Ellipse(1120, 275,1130, 285);//meri
dc.Ellipse(1160, 275,1170, 285);//hayat
dc.SelectObject(&brush_red_ellipse);
dc.Ellipse(375, 235,385, 245);//darmar
dc.Ellipse(375, 195,385, 205);//abinet
dc.Ellipse(375, 155,385, 165);//sabategna
dc.Ellipse(375, 115,385, 125);//atobis tera
dc.Ellipse(420, 115,430, 125);//g. berenda
dc.Ellipse(460, 115,470, 125);//Atkilt tera
dc.Ellipse(500, 115,510, 125);//st.giorge
dc.Ellipse(575, 320,585, 330);//meshulakia
dc.Ellipse(575, 360,585, 370);//riche
dc.Ellipse(575, 400,585, 410);//t.yazh
dc.Ellipse(575, 440,585, 450);//lancha
dc.Ellipse(575, 480,585, 490);//N. silk 2
dc.Ellipse(575, 520,585, 530);//N. silk 1
dc.Ellipse(575, 560,585, 570);//A. abeba
dc.Ellipse(575, 600,585, 610);//saris
dc.Ellipse(575, 640,585, 650);//abo junc.
dc.Ellipse(575, 680,585, 690);//kaliti
//station name
CFont font2;
font2.CreatePointFont(80,_T("Arial"));
```

```
dc.SelectObject(&font2);
dc.SetBkColor(RGB(110,110,110));
dc.SetTextColor(RGB(0,0, 0));
dc.TextOutW(310,290,_T("EW22"));
dc.TextOutW(350,290,_T("EW21"));
dc.TextOutW(390,290,_T("EW20"));
dc.TextOutW(430,290,_T("EW19"));
dc.TextOutW(470,290,_T("EW18"));
dc.TextOutW(510,290,_T("EW17"));
dc.TextOutW(550,290,_T("EW16"));
dc.TextOutW(590,290,_T("EW15"));
dc.TextOutW(630,290,_T("EW14"));
dc.TextOutW(670,290,_T("EW13"));
dc.TextOutW(710,290,_T("EW12"));
dc.TextOutW(750,290,_T("EW11"));
dc.TextOutW(790,290,_T("EW10"));
dc.TextOutW(830,290,_T("EW09"));
dc.TextOutW(870,290,_T("EW08"));
dc.TextOutW(910,290,_T("EW07"));
dc.TextOutW(950,290,_T("EW06"));
dc.TextOutW(990,290,_T("EW05"));
dc.TextOutW(1030,290,_T("EW04"));
dc.TextOutW(1070,290,_T("EW03"));
dc.TextOutW(1110,290,_T("EW02"));
dc.TextOutW(1150,290,_T("EW01"));
dc.TextOutW(495,130,_T("NS17"));
dc.TextOutW(455,130,_T("NS16"));
dc.TextOutW(415,130,_T("NS15"));
dc.TextOutW(347,115,_T("NS14"));
dc.TextOutW(347,155,_T("NS13"));
dc.TextOutW(347,195,_T("NS12"));
```

```
dc.TextOutW(347,235,_T("NS11"));
dc.TextOutW(547,318,_T("NS10"));
dc.TextOutW(547,358,_T("NS09"));
dc.TextOutW(547,398,_T("NS08"));
dc.TextOutW(547,438,_T("NS07"));
dc.TextOutW(547,478,_T("NS06"));
dc.TextOutW(547,518,_T("NS05"));
dc.TextOutW(547,558,_T("NS04"));
dc.TextOutW(547,598,_T("NS03"));
dc.TextOutW(547,638,_T("NS02"));
dc.TextOutW(547,678,_T("NS01"));
// train
dc.SelectObject(&pen_green);
dc.MoveTo(x1-15,268);
dc.LineTo(x1,268);
dc.SelectObject(&pen_white);
dc.MoveTo(x1-30,268);
dc.LineTo(x1-15,268);
x1 ++;
dc.SelectObject(&pen_black);
dc.MoveTo(395, y2-15);
dc.LineTo(395,y2);
dc.SelectObject(&pen_white);
dc.MoveTo(395,y2-30);
dc.LineTo(395,y2-15);
y2 ++;
dc.SelectObject(&pen_black);
dc.MoveTo(500, 108);
dc.LineTo(485,108);
dc.SelectObject(&pen_white);
dc.MoveTo(515,108);
```

```
dc.LineTo(500,108);
}
if (myButtonStart.GetCheck())
{
dc.SelectObject(&pen_green);
dc.MoveTo(x1-15,268);
dc.LineTo(x1,268);
dc.SelectObject(&pen_white);
dc.MoveTo(x1-30,268);
dc.LineTo(x1-15,268);
x1 ++;
dc.SelectObject(&pen_black);
dc.MoveTo(395, y2-15);
dc.LineTo(395,y2);//train
dc.SelectObject(&pen_white);
dc.MoveTo(395,y2-30);
dc.LineTo(395,y2-15);//hide
y2 ++;
if (x1>560)
{
x1 --;
}
if (x1>395)
{
dc.SelectObject(&pen1);
dc.MoveTo(380,280);
dc.LineTo(380,246);
}
if (y2>260)
{
y2--;
```

```
}
if (x1>480)
{
CPen pen_black(PS_DOT, 11, RGB(0,0,204));
CPen pen_white(PS_DOT, 11, RGB(110,110,110));
dc.SelectObject(&pen_white);
dc.MoveTo(395,245);
dc.LineTo(395,260);
dc.SelectObject(&pen_black);
dc.MoveTo(x3-15,268);
dc.LineTo(x3,268);
dc.SelectObject(&pen_white);
dc.MoveTo(x3-30,268);
dc.LineTo(x3-15,268);
x3++;
dc.SelectObject(&brush_red_Roundrect);
dc.RoundRect(50,400,490,500,42,38);

//update arrival time for display at legehar
CFont font1;
font1.CreatePointFont(130,_T("Arial"));
dc.SelectObject(&font1);
dc.SetBkColor(RGB(110,110,110));
dc.SetTextColor(RGB(200,200, 0));
dc.TextOutW(50,370,_T("የባቡር መለያ ቁ.  መድረሻ ሰኣት  መጨረሻ  መዘግየት  ክፍት ቦታ"));
dc.TextOutW(50,340,_T("Train code  Arrival time  destination  Delay  Space"));
dc.SetTextColor(RGB(0,0, 0));
dc.TextOutW(50,400,_T("  001  in 2.5ደ.(min)  ቃሊቲ (Kaliti)  2 ደ.(min)  14"));
dc.TextOutW(50,430,_T("  002  in 11ደ.(min)  ቃሊቲ (Kaliti)  ---  30"));
dc.TextOutW(50,460,_T("  ---  in 1ደ.(min)  ሀያት (Hayat)  ---  35"));
dc.TextOutW(50,490,_T("  ---  ---  ---  ---  ---"));
```

```
}
if (x3>500)
{
x3--;
}
if (x3>440)
{
dc.SelectObject(&brush_red_Roundrect);
dc.RoundRect(50,400,490,500,42,38);
dc.TextOutW(50,370,_T("የባቡር መለያ ቁ.  መድረሻ ሰኣት  መጨረሻ  መዘግየት  ክፍት ቦታ"));
dc.TextOutW(50,340,_T("Train code  Arrival time  destination  Delay  Space"));
dc.SetTextColor(RGB(0,0, 0));
dc.TextOutW(50,400,_T("  001  in 2ደ.(min)  ቃሊቲ (Kaliti)  2 ደ.(min)  14"));
dc.TextOutW(50,430,_T("  002  in 11ደ.(min)  ቃሊቲ (Kaliti)  ---  30"));
dc.TextOutW(50,460,_T("  ---  in 0.5ደ.(min)  ሀያት (Hayat)  ---  31"));
dc.TextOutW(50,490,_T("  ---  ---  ---  ---  ---"));
}
if (x3>480)
{
dc.SelectObject(&brush_red_Roundrect);
dc.RoundRect(50,400,490,500,42,38);
dc.TextOutW(50,370,_T("የባቡር መለያ ቁ.  መድረሻ ሰኣት  መጨረሻ  መዘግየት  ክፍት ቦታ"));
dc.TextOutW(50,340,_T("Train code  Arrival time  destination  Delay  Space"));
dc.SetTextColor(RGB(0,0, 0));
dc.TextOutW(50,400,_T("  001  in 1ደ.(min)  ቃሊቲ (Kaliti)  2 ደ.(min)  11"));
dc.TextOutW(50,430,_T("  002  in 11ደ.(min)  ቃሊቲ (Kaliti)  ---  23"));
dc.TextOutW(50,460,_T("  ---  ---  ---  ---  ---"));
dc.TextOutW(50,490,_T("  ---  ---  ---  ---  ---"));
}
}
```

```
if (m_myCombo4.GetCurSel()==11)
{
ButtonView.EnableWindow(FALSE);
myButtonStart.EnableWindow(FALSE);
myButtonStart1.EnableWindow(FALSE);
myButtonStart2.EnableWindow(FALSE);
myButtonStart3.EnableWindow(TRUE);
CClientDC dc(this);
CPen pen1(PS_DOT, 5, RGB(0,0,0));
CPen pen_ellipse(PS_SOLID, 1, RGB(0, 0, 0));//Pen for ellipse if your background is white
CBrush brush_red_ellipse(RGB(255, 0, 0));//Brush red for ellipse
CBrush brush_green_ellipse(RGB(255, 255, 0));
CPen pen_Roundrect(PS_SOLID, 5, RGB(0, 0, 0));
CBrush brush_red_Roundrect(RGB(110, 110, 110));
CBrush brush_black_Roundrect(RGB(0, 0, 0));
dc.SelectObject(&pen_Roundrect);
  dc.SelectObject(&brush_black_Roundrect);
dc.RoundRect(6,6,1359,720,42,38);
dc.SelectObject(&brush_red_Roundrect);
dc.RoundRect(17,17,1348,709,42,38);
// train schedule and delay
dc.SetTextColor(RGB(200,200, 0));
dc.TextOutW(50,370,_T("የባቡር መለያ ቁ.  መድረሻ ሰኣት      መጨረሻ          መዘግየት     ክፍት ቦታ"));
dc.TextOutW(50,340,_T("Train code    Arrival time     destination      Delay      Space"));
dc.SetTextColor(RGB(0,0, 0));
dc.TextOutW(50,400,_T("  001         in 10ደ.(min)     ቃሊቲ (Kaliti)     2 ደ.(min)     21"));
dc.TextOutW(50,430,_T("  002         in 14ደ.(min)     ቃሊቲ (Kaliti)        ---         35"));
dc.TextOutW(50,460,_T("  ---           ---              ---               ---        ---"));
dc.TextOutW(50,490,_T("  ---           ---              ---               ---        ---"));
//delay apology
dc.SetTextColor(RGB(150, 0, 0));
```

```
dc.TextOutW(50,550,_T("ባቡሩ ስለዘገየ ይቅርታ እንጠይቃለን እባኮዎ ባቡሩ ኢስክደርስ በትእግስት ይጠብቁ"));
dc.TextOutW(50,580,_T("                ስለ ትእግስቶዎ እናመሰግናለን፡፡"));
// train
dc.SelectObject(&pen_black);
dc.MoveTo(395, y2-15);
dc.LineTo(395,y2);
dc.SelectObject(&pen_white);
dc.MoveTo(395,y2-30);
dc.LineTo(395,y2-15);
y2 ++;
dc.SelectObject(&pen_black);
dc.MoveTo(500, 108);
dc.LineTo(485,108);
dc.SelectObject(&pen_white);
dc.MoveTo(515,108);
dc.LineTo(500,108);
}
if (myButtonStart3.GetCheck())
{
dc.SelectObject(&pen_black);
dc.MoveTo(395, y2-15);
dc.LineTo(395,y2);//train
dc.SelectObject(&pen_white);
dc.MoveTo(395,y2-30);
dc.LineTo(395,y2-15);//hide
y2 ++;
if (x3>500)
{
x3--;
}
if (y2>260)
```

```
{
y2--;
dc.SelectObject(&pen_white);
dc.MoveTo(395,245);
dc.LineTo(395,260);
dc.SelectObject(&pen_black);
dc.MoveTo(x3-15,268);
dc.LineTo(x3,268);
dc.SelectObject(&pen_white);
dc.MoveTo(x3-30,268);
dc.LineTo(x3-15,268);
x3++;
dc.SelectObject(&brush_red_Roundrect);
dc.RoundRect(50,400,490,500,42,38);
dc.TextOutW(50,370,_T("የባቡር መለያ ቁ.  መድረሻ ሰኣት  መጨረሻ  መዘግየት  ክፍት ቦታ"));
dc.TextOutW(50,340,_T("Train code  Arrival time  destination  Delay  Space"));
dc.SetTextColor(RGB(0,0, 0));
dc.TextOutW(50,400,_T("  001  in 5.5ደ.(min)  ቃሊቲ (Kaliti)  2 ደ.(min)  14"));
dc.TextOutW(50,430,_T("  002  in 14ደ.(min)  ቃሊቲ (Kaliti)  ---  30"));
dc.TextOutW(50,460,_T("  ---  ---  ---  ---  ---"));
dc.TextOutW(50,490,_T("  ---  ---  ---  ---  ---"));
}
if (x3>500)
{
x3--;
}
if (x3>460)
{
dc.SelectObject(&brush_red_Roundrect);
dc.RoundRect(50,400,490,500,42,38);
dc.TextOutW(50,370,_T("የባቡር መለያ ቁ.  መድረሻ ሰኣት  መጨረሻ  መዘግየት  ክፍት ቦታ"));
```

```
dc.TextOutW(50,340,_T("Train code    Arrival time     destination      Delay      Space"));
dc.SetTextColor(RGB(0,0, 0));
dc.TextOutW(50,400,_T("  001         in 4.5ደ.(min)     ቃሊቲ (Kaliti)    2 ደ.(min)    11"));
dc.TextOutW(50,430,_T("  002         in 14ደ.(min)     ቃሊቲ (Kaliti)       ---          27"));
dc.TextOutW(50,460,_T("  ---           ---              ---                ---         ---"));
dc.TextOutW(50,490,_T("  ---           ---              ---                ---         ---"));
}
}
if (m_myCombo2.GetCurSel()==2)
{
ButtonView.EnableWindow(FALSE);
myButtonStart1.EnableWindow(TRUE);
myButtonStart.EnableWindow(FALSE);
myButtonStart2.EnableWindow(FALSE);
myButtonStart3.EnableWindow(FALSE);
dc.SelectObject(&brush_black_Roundrect);
dc.RoundRect(6,6,1359,720,42,38);
dc.SelectObject(&brush_red_Roundrect);
dc.RoundRect(17,17,1348,709,42,38);

// train schedule and delay
dc.SetTextColor(RGB(200,200, 0));
dc.TextOutW(50,370,_T("የባቡር መለያ ቁ.  መድረሻ ሰኣት      መጨረሻ           መዘግየት     ክፍት ቦታ"));
dc.TextOutW(50,340,_T("Train code    Arrival time     destination      Delay      Space"));
dc.SetTextColor(RGB(0,0, 0));
dc.TextOutW(50,400,_T("  011         in 2ደ.(min)     ጦር ሀ.(Tor h.)     ---          38"));
dc.TextOutW(50,430,_T("  ---           ---              ---                ---         ---"));
dc.TextOutW(50,460,_T("  ---           ---              ---                ---         ---"));
dc.TextOutW(50,490,_T("  ---           ---              ---                ---         ---"));

//current station name
```

```
dc.SetTextColor(RGB(0, 0,204));
dc.TextOutW(46,170,_T("current station:- CMC(EW03)"));
dc.TextOutW(46,200,_T("ያሉበት መቆምያ ፡- ሲ ኤም ሲ (EW03)"));
// train
dc.SelectObject(&pen_green);
dc.MoveTo(x2-15,268);
dc.LineTo(x2,268);
dc.SelectObject(&pen_white);
dc.MoveTo(x2,268);
dc.LineTo(x2+15,268);
x2--;
}
if (myButtonStart1.GetCheck())
{
dc.SelectObject(&pen_green);
dc.MoveTo(x2-15,268);
dc.LineTo(x2,268);//train 2
dc.SelectObject(&pen_white);
dc.MoveTo(x2,268);
dc.LineTo(x2+15,268);//train
x2--;
if (x2<620)
{
x2++;
}
if (x2<1120)
{
dc.SelectObject(&brush_red_Roundrect);
dc.RoundRect(50,400,490,500,42,38);
dc.TextOutW(50,370,_T("የባቡር መለያ ቁ.  መድረሻ ሰኣት  መጨረሻ  መዘግየት  ክፍት ቦታ"));
dc.TextOutW(50,340,_T("Train code  Arrival time  destination  Delay  Space"));
```

```
dc.SetTextColor(RGB(0,0, 0));
dc.TextOutW(50,400,_T("  011          in 1ደ.(min)      ጦር ሀ.(Tor h.)      ---          27"));
dc.TextOutW(50,430,_T("  ---          ---              ---               ---          ---"));
dc.TextOutW(50,460,_T("  ---          ---              ---               ---          ---"));
dc.TextOutW(50,490,_T("  ---          ---              ---               ---          ---"));
}
if (x2<1080)
{
dc.SelectObject(&brush_red_Roundrect);
dc.RoundRect(50,400,490,500,42,38);
dc.TextOutW(50,370,_T("የባቡር መለያ ቁ.  መድረሻ ሰኣት      መጨረሻ          መዘግየት     ክፍት ቦታ"));
dc.TextOutW(50,340,_T("Train code   Arrival time    destination      Delay      Space"));
dc.SetTextColor(RGB(0,0, 0));
dc.TextOutW(50,400,_T("  ---          ---              ---               ---          ---"));
dc.TextOutW(50,430,_T("  ---          ---              ---               ---          ---"));
dc.TextOutW(50,460,_T("  ---          ---              ---               ---          ---"));
dc.TextOutW(50,490,_T("  ---          ---              ---               ---          ---"));
}
}
if (m_myCombo3.GetCurSel()==3)
{
ButtonView.EnableWindow(FALSE);
myButtonStart.EnableWindow(FALSE);
myButtonStart1.EnableWindow(FALSE);
myButtonStart2.EnableWindow(TRUE);
myButtonStart3.EnableWindow(FALSE);
// train schedule and delay
dc.SetTextColor(RGB(200,200, 0));
dc.TextOutW(50,370,_T("የባቡር መለያ ቁ.  መድረሻ ሰኣት      መጨረሻ          መዘግየት     ክፍት ቦታ"));
dc.TextOutW(50,340,_T("Train code   Arrival time    destination      Delay      Space"));
dc.SetTextColor(RGB(0,0, 0));
```

```
dc.TextOutW(50,400,_T("  017          in 1.5ደ.(min)    ጎርማስ              ---          43"));
dc.TextOutW(50,430,_T("  ---            ---              ---              ---          ---"));
dc.TextOutW(50,460,_T("  ---            ---              ---              ---          ---"));
dc.TextOutW(50,490,_T("  ---            ---              ---              ---          ---"));
//current station name
dc.SetTextColor(RGB(0, 0,204));
dc.TextOutW(46,170,_T("current station:- Saris(NS03)"));
dc.TextOutW(46,200,_T("ያሉበት መቆምያ ፡- ሳሪስ (NS03)"));
// train
dc.SelectObject(&pen_black);
dc.MoveTo(592,y1-15);
dc.LineTo(592,y1);
dc.SelectObject(&pen_white);
dc.MoveTo(592,y1);
dc.LineTo(592,y1+15);
y1--;
}
if (myButtonStart2.GetCheck())
{
dc.SelectObject(&pen_black);
dc.MoveTo(592,y1-15);
dc.LineTo(592,y1);//train
dc.SelectObject(&pen_white);
dc.MoveTo(592,y1);
dc.LineTo(592,y1+15);//hide
y1--;
if (y1<500)
{
y1++;
}
if (y1<640)
```

```
{
dc.SelectObject(&brush_red_Roundrect);
dc.RoundRect(50,400,490,500,42,38);
//update arrival time
dc.TextOutW(50,370,_T("የባቡር መለያ ቁ.  መድረሻ ሰኣት  መጨረሻ  መዘግየት  ክፍት ቦታ"));
dc.TextOutW(50,340,_T("Train code  Arrival time  destination  Delay  Space"));
dc.SetTextColor(RGB(0,0, 0));
dc.TextOutW(50,400,_T("  017  in 1ደ.(min)  ጎርግስ  ---  36"));
dc.TextOutW(50,430,_T("  ---  ---  ---  ---  ---"));
dc.TextOutW(50,460,_T("  ---  ---  ---  ---  ---"));
dc.TextOutW(50,490,_T("  ---  ---  ---  ---  ---"));
}
if (y1<600)
{
dc.SelectObject(&brush_red_Roundrect);
dc.RoundRect(50,400,490,500,42,38);
dc.TextOutW(50,370,_T("የባቡር መለያ ቁ.  መድረሻ ሰኣት  መጨረሻ  መዘግየት  ክፍት ቦታ"));
dc.TextOutW(50,340,_T("Train code  Arrival time  destination  Delay  Space"));
dc.SetTextColor(RGB(0,0, 0));
dc.TextOutW(50,400,_T("  ---  ---  ---  ---  ---"));
dc.TextOutW(50,430,_T("  ---  ---  ---  ---  ---"));
dc.TextOutW(50,460,_T("  ---  ---  ---  ---  ---"));
dc.TextOutW(50,490,_T("  ---  ---  ---  ---  ---"));
}
}
CView::OnTimer(nIDEvent);
}
// background
BOOL CGUIView::OnEraseBkgnd(CDC* pDC)
{
CBrush backBrush(RGB(110, 110, 110));
```

```
CBrush* pOldBrush = pDC->SelectObject(&backBrush);
CRect rect;
pDC->GetClipBox(&rect);//erase area needed
pDC->PatBlt(rect.left, rect.top, rect.Width(), rect.Height(), PATCOPY);
pDC->SelectObject(pOldBrush);
return TRUE;
return CView::OnEraseBkgnd(pDC);
}
void CGUIView::OnButtonStop(void)
{
KillTimer(1);
}
void CGUIView::OnButtonReset(void)
{
ButtonView.EnableWindow(TRUE);
CheckDlgButton(4, BST_UNCHECKED);
x1 = 340;
x2 = 1180;
y1 = 680;
y2 = 160;
SetTimer(1, 120, NULL);
}
void CGUIView::OnButtonContinue(void)
{
        SetTimer(1, 120, NULL);
}
```