An Implemented of Intelligent Access Gate Control (IAGC)

By

Aswandi Bin Abu Samah

Dissertation submitted in partial fulfillment of
the requirements for the
Bachelor of Technology (Hons)
(Information Technology)

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Universiti Teknologi PETRONAS
Bandar Seri Iskandar
31750 Tronoh
Perak Darul Ridzuan

CERTIFICATION OF APPROVAL

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A Project Dissertation submitted to the

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BACHELOR OF TECHNOLOGY (Hons)

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Approved by,

_____

(Mr. Jale bin Ahmad)

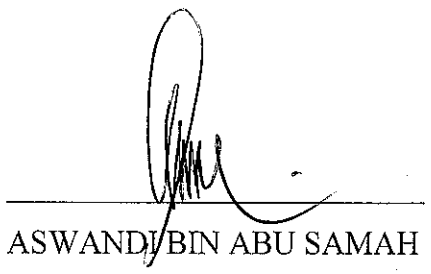
UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

JUNE 2004

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is on my own except as specified in the references and acknowledgements, and original work contained herein have not been undertaken or done by unspecified sources and persons.



ASWANDI BIN ABU SAMAH

ABSTRACT

The author's project is focusing on developing application on **Intelligent Access Gate Control (IAGC)** of UTP. The entrance gate in the UTP campus is chosen as the case study for this project. The aspects that will be covered are the features and the functionality of **(IAGC)**. Another important element that has been considered on **IAGC** application is to provide online system on centralized source of information and data. Besides that, **IAGC** application also tends to provide a 'drive-thru' as well as it will eliminate waiting time due to long lines at the entrance gate. It is also helps in conserve fuel consumption, and ease traffic congestion. In accomplishing the project, the designed application for **IAGC** was modeled by using motor controlled infrared detector circuit as simulation. From this simulation, the complete prototype of **IAGC** was designed, which were used in designing the desired entrance access gate application for Security Department at UTP. Once the learning stage of the collected information and feedback has been completed, it is used as discussion for the feasible implementation of **IAGC** application.

ACKNOWLEDGEMENTS

In the name of Allah, the Most Graceful and Most Merciful

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

CHAPTER 1
INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Currently, the students and the staffs of Universiti Teknologi PETRONAS are using plastic-based sticker as permanent pass to get into the campus. The sticker is being given by the security department to the owner as to register their vehicle. This is also easy for the security department to monitor and keep track of any vehicles in the campus. There are about 3000 students with different personal vehicles (e.g. car & motorcycle).

At the moment, for any registered motorcycles & cars that are against the University's vehicles and transportation rule, summon will be issue by security staff (e.g. speed over limit, wrong parking, no sticker & etc). The summon particular then will be recorded into the owner's file as they have already registered their vehicle. In the end, they have to pay summon.

During peak hours (e.g. office and lunch hour), there are quite number of vehicles lining up in order to get-in or out from the campus. This will lead into long queues at the entrance gate. Sometimes it is hard for security staffs to trace registered and unregistered vehicle. For this particular situation also, required more security staff to manage and control the traffic in order to ensure the vehicles movement is smooth.

The purpose of this project is to implement an **Intelligent Access Gate Control (IAGC)** application for the security department as well as the student or staff at the university or private organization, specifically for the administration of students and staffs' vehicle management. It is also intended to be implementing at any private house residential, private condominium, hotel or any other organizations that need to authorize or secure the person of the vehicles belongs to.

The implementation of **Intelligent Access Gate Control (IAGC)** application separated into two major parts;

The external system will be an automated gate control, which required the bar code reader to scan the bar code printed on the plastic-based sticker, as it will be placed on the windscreen of the car. The control device will then emit a beep sound and the traffic light turn into green. Then, the automatic lane barrier will open.

The internal system will be visual basic (graphical programming language and development environment application) as platform capabilities. The system is designed to display data and information about the owner particulars such as name, id, course, year of study, driver license registration number and expiry date and vehicle information such as registration number, road tax expiry date and vehicle details. This system is determine by the process of retrieving information resulted on the process of scanning the bar code printed to the new proposes plastic-based sticker.

1.2 PROBLEM STATEMENT

1.2.1 Problem Identification

Currently, plastic-based sticker is used at UTP as permanent pass for registered vehicles. For this particular problem, it is hard to differentiate the original version compared to the student's printed sticker as they simply can make a copy of it. As result, the action on manual procedure done to trace the original sticker, potentially lead into long queue of the vehicles at the entrance gate. The process also, required the security department to utilize the human workforce.

1.2.2 Significant of the Project

Through this project, the study on the project of **Intelligent Access Gate Control (IAGC)** application for the UTP entrance gate is carried out. The outcome of the study serves as the base information in designing the need on sophisticated technology for entrance gate control.

1.3 OBJECTIVES AND SCOPE OF STUDY

1.3.1 Objectives of Study

The first objective of this project is to reduce the fraud by using **Intelligent Access Gate Control (IAGC)** application as permanent pass in UTP campus. Besides that, this project also aimed to provide sophisticated technology that can minimize human workforce. Another important element that has been considered on **IAGC** application is to provide online system on centralized source of information and data. In addition, **IAGC** application also tends to provide a 'drive-thru' as it will eliminate waiting time due to long lines at the main gate.

1.3.2 Scope of Study

This research project focuses on the security value for the implementation **Intelligent Access Gate Control (IAGC)** application at UTP campus. Current security system applied at entrance gate of UTP and the plastic-based sticker used as permanent pass for vehicles will be considered as the case study of this project.

1.3.3 The Relevancy of the Project

A lot of research and study for security issue has been done on the sophisticated technology application needed to be implementing at entrance gate for any organization, house residential or highway toll lane throughout the past few years. The outcomes were very promising in which some are already tried in the real entrance gate. As UTP has its own entrance gate, networking and bar code technology, this project was conducted fairly conveniently. The present worldwide bar code technology application and automated barriers gate system was used as reference for prototype modeling purposes. In short, the project is relevant.

1.3.4 Feasibility of the Project within the Scope and Time Frame

An information technology final year students have been assigned the task to complete the project in one semester. The project is given approximately 4 months to be completed starting from January 2004. After conducted some research about SmartTAG and bar code technology, this project is feasible to be done within the time frame. The time allocated should be enough to achieve both research and product elements required from the Final Year Project course.

CHAPTER 2

LITERATURE REVIEW/ THEORY

At any organization, good communication, centralized system and security system are the most critical factors in order to success in their business. This situation also applied in our university. As the process of registering vehicles, the owner needs to fulfill personnel information and a brief particular for the specific vehicle. Security department then will give a plastic-based sticker and the owner needs to attach the sticker on the windscreen of the vehicles, especially car.

The limited for this system is that, the security staffs only can recognize the sticker by looking at sticker attached to the windscreen but yet do not know the exact owner. If the security staff needed the details information of the owner, they have to do it manually. There is also being an issue for certain student to make a copy of his or her own plastic-based sticker.

As this became to the author's mind, the author think of UTP must have a proper system for security department and the students or staffs as well, specifically for the administration of students or staff vehicle's management. The system intended must be able to trace on registered vehicle only and be able to display particular of the owner instantly. Besides that, the system also applied the used of automatic barriers gate which is for violation enforcement - to prevent outsider's vehicle from entering the campus without permission.

By using this system, UTP security department will act as the administrator. The administrator will monitor the operations according to the effectiveness of the system, its functionality, etc. By implementing this system, it is hope that the process of monitoring vehicles by security department will be more systematic.

Regarding to the matter discuss above, this section explain in detail the theory as it used on the project. The section is divided into three subtopics: *Bar Code application, infrared technology, Automated Barriers Gate and SmartTAG.*

2.1 BAR CODE APPLICATION

The key technologies employed to deliver **Intelligent Access Gate Control (IAGC)** application are the bar code technology. It seems that this particular **IAGC** function is similar application as implemented to the student matrix card. There are several different types of barcode standards for different purposes – these are called symbologies. Each type of symbology (or bar code type) is a standard that defines the printed symbol and how a device such as a barcode scanner reads and decodes the printed symbol.

The industrial use of barcodes can be traced back as far as the 1960s. Some of this implementation was used to identify railroad cars. Common barcodes started appearing on grocery shelves in the early 1970s as the UPC code to automate the process of identifying grocery items. Today, barcodes are just about everywhere and are used for identification in almost all types of business. "*When barcodes are implemented in business processes, procedures can be automated to increase productivity and reduce human error. Bar coding should be used when ever there is a need to accurately identify or track something.*" **[Reference B - 1]**

For project Intelligent Access Gate Control (IAGC), the author has used sample **Code 128** of barcode type. The reason is that, UTP has the same barcode application, which is used as student verification identity card and also used, in library – as student card to borrow book.

Figure 1 – Sample Code 128 type

2.2 INFRARED TECHNOLOGY

Infrared (IR) radiation is electromagnetic radiation of a wavelength longer than visible light, but shorter than microwave radiation. The name means "below red" (from the Latin infra, "below"), red being the color of visible light of longest wavelength. Infrared radiation has wavelengths between 700 nm and 1 mm.

A more common use of IR is in television remote controls. In this case it is used in preference to radio waves because it does not interfere with the television signal. "*IR data transmission is also employed in short-range communication among computer peripherals and personal digital assistants.*" **[Reference B – 2]**

These devices usually conform to standards published by IrDA, the Infrared Data Association. Remote controls and IrDA devices use infrared light-emitting diodes (LEDs) to emit infrared radiation, which is focused by a plastic lens into a narrow beam. The beam is modulated, i.e. switched on and off, to encode the data. The receiver uses a silicon photodiode to convert the infrared radiation to an electric current. It responds only to the rapidly pulsing signal created by the transmitter, and filters out slowly changing infrared radiation from sunlight, people and other warm objects.

2.3 AUTOMATIED BARRIER GATE

Automatic barriers play an essential role in regulating and restricting the flow of traffic everywhere. Similarly, when visitors arrive, barriers are often their first contact with the company, so appearance is important. This is reflected in the design of **IAGC** application. Whether the requirement is for a simple, low-cost barrier for relatively low volume usage, a heavy-duty barrier for frequent operation, or a motorized barrier that can operate at high speeds for particularly busy premises.

The automatic barrier series are used for parking lots, tollgates, goods yards, railway crossings, commercial premises, apartment block access and other applications.

As we known, the implementation of automatic barrier gate is widely used in our country, Malaysia. As example, Project Lebuh Raya Utara Selatan (PLUS) has already used the automatic barrier gate which is for violation enforcement - to prevent a vehicle from leaving the toll without paying the necessary fees. This technology only dedicated for the owner of car, lorry, bus and taxi throughout the toll's lane. Automatic barriers gate mainly consist of two main parts, which is;

- **Motor Drive**
- **Gate Arm**

Below are the tables for minimal specifications of automatic barriers gate that can operate at high speeds for particularly busy premises.

Specifications	***Details***
Wt. excluding boom	46 kg
Max. Arm length	4m
Motor Type	240V split phase
Frequency	50 Hz / 60 Hz
Speed	0.7 or 1.5 seconds
Power Consumption	2.6 amps

Table 1: Basic specifications of automated barrier gate.

2.4 SMARTTAG / TOUCH `N GO

As we know, the combinations of SmartTAG and Touch `N Go as electronic payment system are fantastic new method for toll and fare payment in Malaysia. This technology stresses on the convenience and ease of use for expressway users. *"The Touch 'n Go card must be fully inserted into the SmartTAG unit before use. Enter the SmartTAG lane and Drive-Thru' at speed not exceeding 40km/h..."* **[Reference B – 3]** The author has used the same concept for the project of IAGC, but the different is that, SmartTAG unit replaced by bar code.

CHAPTER 3

METHODOLOGY/ PROJECT WORK

3.1 PROCEDURE IDENTIFICATION

Stage	Activity
Research and Analysis	• Plan the activity regarding to the steps involve in this project within the timeframe and scope of study **(Appendix 1).**
Design	• Design use case diagram and working prototype flowchart **(Appendix 2, 3 & 4).**
Implementation	• Result and discussion being carried out regardless the outcomes of the used on bar code.

Table 2: Steps for project phase

Research and development process on **Intelligent Access Gate Control (IAGC)** application need the author to adapt software engineering paradigm as a discipline that integrates the process, methods and tools in the system development. The author used System Development Life Cycle (SDLC) to ensures consistency and reproducible in the development area. Analysis and planning (requirement specification), designation and implementation are three basic terms in SDLC as used by the author.

3.1.1 Project Research

The topic approved is, an implemented of **Intelligent Access Gate Control (IAGC)**. The application has been purpose is to design the automated access gate control on vehicle authorization and centralized data of information for the security department.
The research done by using several data gathering method such as interviewing with students and security staffs of Universiti Teknologi PETRONAS, observation, internet searching, books and journal.

3.1.1.1 Feasibility Study

The author consideration is on the constraints in completing the project. Mainly, the author has identified three important constraint for the project which is time, scope and cost. Since the time given only one semester (4 months) to complete the **Intelligent Access Gate Control (IAGC)** project, the author must determine the tasks to be accomplished as well as the time needed. Microsoft project is the tool that the author used to plan for the time frame **(Appendix 1)** regarding to this the project.

3.1.1.2 Project References Research

This phase involved the author in data and information gathering from various sources such as internet, interviewing the students and the staff at security department of Universiti Teknologi PETRONAS, observation and collected information from book and journal. The finding must be related to the topic, which is **Intelligent Access Gate Control (IAGC)**. From the finding, these materials will be used in completing the project and to support the system development.

3.1.2 PROJECT ANALYSIS

Project analysis phase involve analyzing the problem statement as the author has conducted the study and research by interviewing the student and security staff at Universiti Teknologi PETRONAS. The author specified certain problem and aimed to solve the problem as well as the project objectives. The final outcome of this project analysis phase will be the completion of system requirement documentation, which detailed on the problem analysis, requirement analysis and specification, data process and prototyping modeling.

3.1.2.1 Problem analysis

For research part, the author has identified overall problems and objectives in automated environment as the term suit to the author topic, **Intelligent Access Gate Control (IAGC).** For the case problem and detail, the author has selected Universiti of Teknologi PETRONAS (UTP) as the entity of the environment in the research. The author does some research on the application architecture design, performances, basic requirements and system requirement specifications. For the application development part, the author has identified the functionality of the application and the requirement needed to accomplish the project. As described earlier, the application design is to provide automated access gate control and centralized data of information of the vehicles owner.

3.1.2.2 Requirement Analysis and Specification

The application is design into 2 major parts for the system requirement specification. There are internal application and external application.

Internal Application

The function of the system is to display the owner detail information. The information include on user details like owner's name, id number, contact number, address, email and some optional features for the university student such as year of study and course.

Other than that the vehicle details such as vehicle registration number, color, ownership, model also being included. This internal application of **Intelligent Access Gate Control (IAGC)** will be only visible to the security department staff only.

External Application

This application is visible to the user for using the **Intelligent Access Gate Control (IAGC)** application. The user will experience on the automated gate control which required the system on scanning the barcode as it printed to the new propose plastic-based sticker placed on the windscreen of the owner's vehicles. The control system will then emit a beep sound when authorization process is successful and the automatic lane barrier will open.

3.1.3 PROJECT DESIGN

This design phase will include two sub phases, which are architecture design **(Appendix 2, 3 & 4)** and interface design **(refer appendix 6)**.

3.1.3.1 Architecture Design

For architecture design, the author uses the use-case and flowchart model in designing the complete system application. This process is to identify the process flow that will be use to design both internal and external application of **Intelligent Access Gate Control (IAGC)**.

3.1.3.2 Interface Design

The main guidelines for this stage would be developing the interface architecture for internal user. This interface architecture will highlight on each functionality and system flow included. As result, the outcome for the stage would be internal user interface prototypes **(Appendix 5)**.

3.2 HARDWARE AND TOOLS

3.2.1 For Development (internal application)

Software:

Visual Basic

For development language, Visual basic has been chosen to create the simulation. This is because this language is familiar to millions of prospective developers. With Microsoft Visual Basic, developers can customize the operating system, adding and subtracting functionality depending on memory and application needs.

Adobe Photoshop

With its comprehensive set of retouching, painting, drawing, and Web tools, Photoshop helps to complete any image-editing task efficiently. It will be use for system cosmetics.

Hardware:

Workstation with minimum specification to execute the above mentioned software.

3.2.2 For User Experience (external application)

In addition of the very basic equipment that are going to be needed in the project (such as monitor, CPU, mouse etc.), there is also a need for special equipment to assist the whole process. The **IAGC** will need a combination of several electronic components as a platform to construct the prototype. Among an item that has been identified are;

- Breadboard
- Transmitter & Receiver component (Infrared Emitter)
- Light Emit ion Diode (LED)
- Light Dependent Resistor

3.3 DELIVERABLE CONCEPT

This deliverable describes how the different system component will relate to each other. The deliverable of this process will affect implementation design of the system component based on the design that is done parallel with the other design process. It is to decide the technology that will be use for the system component and the communication between all of the related components. Below is the table that shows the system component and its infrastructure design.

System Component	*Concept*	*Technology/Programming Language*
Interface	Graphical programming language and development environment.	Visual Basic
System Detection and Communication	Radio wave signal.	Infrared Detector
Automated Barrier System	Automatic barrier gate control	Controlled Motor

Table 3: System components

3.4 CONSTRAINT

Working on complete prototype by the author aims to show users on how **Intelligent Access Gate Control (IAGC)** function does. By having this kind of prototype, the author manages to give better overview of the **IAGC** application.

The author faces the cost constraint on the development of end product. As the real application, the specification requirement required higher cost to be allocated on the hardware itself as well as others component to be installed. So, the author managed to get advice and guide from his friend to use electrical component to develop the prototype on similar function and working flow. This kind of method reduces the actual cost incurred by the author on the development stage.

3.5 ASSUMPTION

For this system, the author assumed that every student or staff would only own one type of vehicle, which is car. In case they want to register another vehicle on the same name, the previous vehicle particular must be eliminating first.

The author also assumes that for current plastic-based sticker is still in use. But the new propose of plastic-based sticker will have bar code printed on it.

Assuming that each vehicle registered is under the student name as it eases the process of identifying and tracing the vehicle. Beside that it will help to directly identify the owner of every vehicle registered.

The sticker renewal must be done on every academic semester, meaning to say that it is compulsory for each registered vehicle to update their registration to the security department every one academic semester. By doing this also can help database administrator to trace which vehicle is no longer available in campus and deletes the particular.

CHAPTER 4

4.1 RESULT

As discussed in previous chapter, the author has use sample code 128 of bar code in order to generate the output. The bar code reader had been used as method of try and error for the bar code to be readable. The activities involved also need the author to record the time as the sample code move from point A to point B **(Appendix 7).** The distance between point A and point B used during the activity is fix for one meter. As the distance change over time, the author has used the velocity equation as shown below;

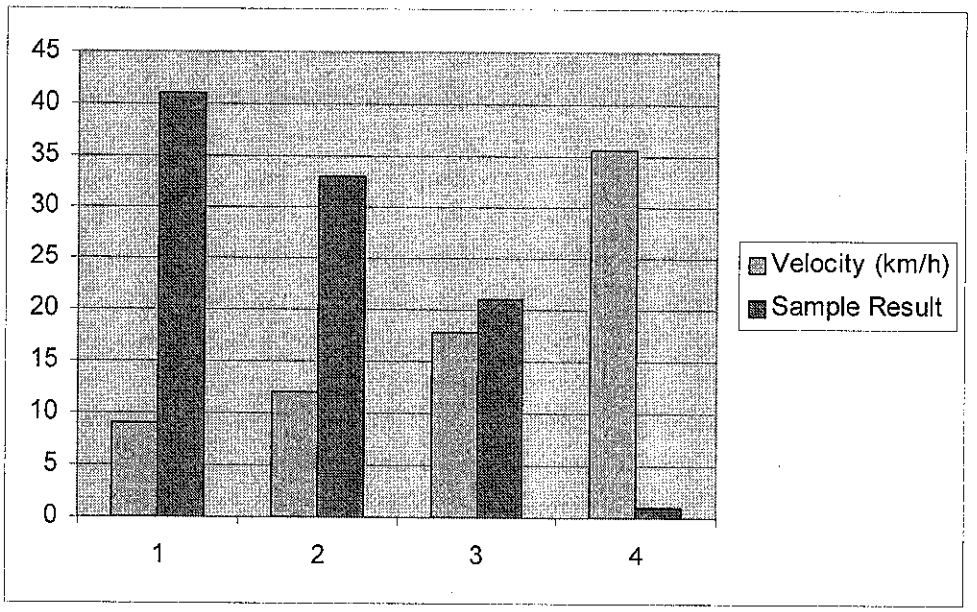
*Change in Distance/Time

$$V = \frac{S_2 - S_1}{t}$$

Where;

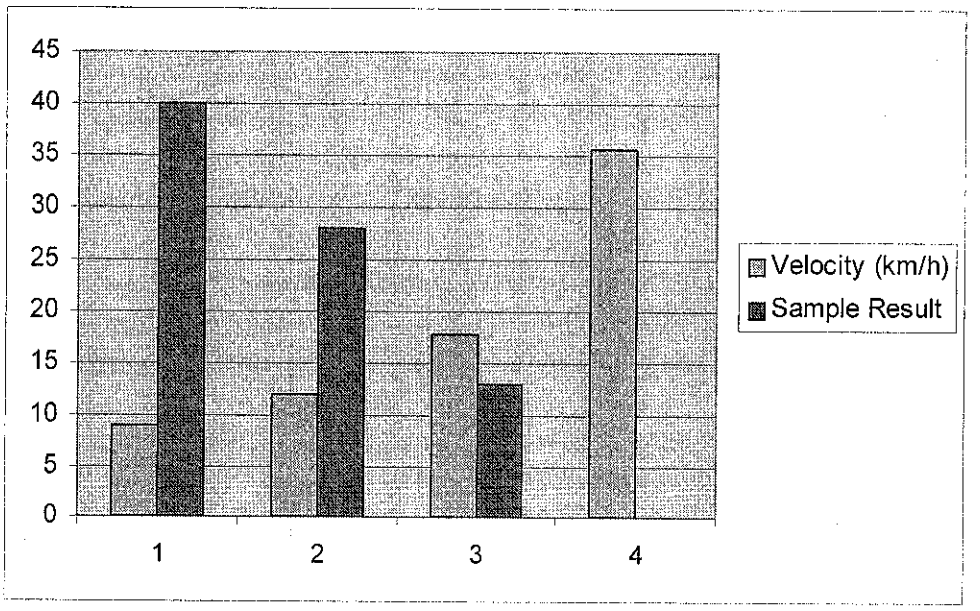
S_2 = End point (m)
S_1 = Start point (m)
t = time taken in second (between point A and B)

As hundreds time trial for try and error, the author can conclude that; the increased in speed or velocity will give lower possibility for the bar code reader to read the code. While, the decreased in speed enable bar code reader to read the code efficiently. The author also used the technique on the different bar code positioning method **(Appendix 7)** in order to determine the ability of bar code reader to read straight in-line or not. The bar chart below shows the overall output that is used by the author.



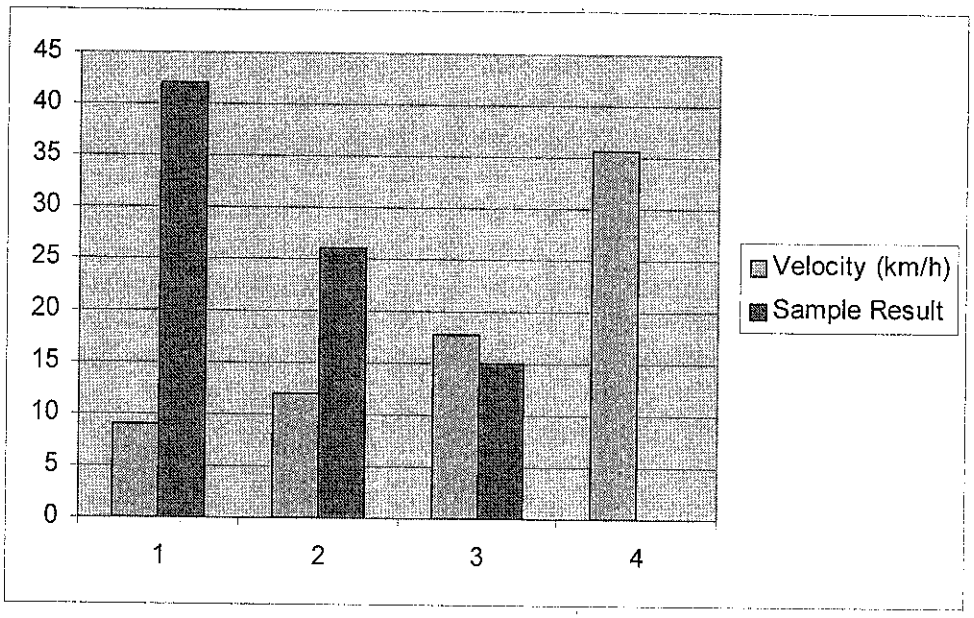
Velocity (km/h)	9.1	12	17.86	35.7
Sample Result	41	33	21	1

Figure 2: Bar code reader position at 90°



Velocity (km/h)	9.1	12	17.86	35.7
Sample Result	40	28	18	0

Figure 3: Bar code reader position at 88°



Velocity (km/h)	9.1	12	17.86	35.7
Sample Result	42	26	16	6

Figure 4: Bar code reader position at 92°

4.2 DISCUSSION

The author has completed all activities for his project. During the development on Intelligent Access gate Control (IAGC), the author only concern on the use of bar code application if similar system such SmartTAG technology to be implemented at Universiti Teknologi PETRONAS or any others entrance gate that need to administer vehicles. The author admitted that his idea cannot be compare to SmartTAG technology but the implementation has meet about sixty percent as expected.

There is another factors to be consider if the idea to be carry on such as the effectiveness and the harm of using infrared technology. The worldwide scientist has revealed that the exposure on infrared can cause bad effect on human health. One of the issues is on skin cancer. Another effect that can bring harm to human health is on pregnant woman.

4.3 ADVANTAGES OF IAGC

Although the idea can only have sixty percent as expected, the author still can concluded that there is an advantage element such;

4.3.1 Minimized Human Workforce

For this purpose, by having automated access gate control at any main entrance will reduce the number of staff to monitor the vehicles within the gate. The implementation of **Intelligent Access Gate Control (IAGC)** at the entrance gate of Universiti Teknologi PETRONAS will only required the security staff to monitor the through the computer only.

4.3.2 Provide Non Stop Drive-Thru

Provide a 'drive-thru' as it will eliminate waiting time due to long wait. It is also helps reduce emissions, conserve fuel consumption, and ease traffic congestion.

4.3.3 Better Monitoring Process to Keep Track Vehicles.

Immediate information on the owner's particular during the authorization process. For registered vehicles, the retrieval of information stored in the database will be recognizing by the process of scanning the bar code printed on the sticker, the system then will then search and collect the data regarding to the owner to be displayed for security staff. Meaning that, each sticker has it own identical bar code, which is different from each other. So, student cannot simply make copy of it since the security staff can easily monitor the particular on the owner's vehicles.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

For conclusion, this project and research area that has been conducted has met its objectives within the scope of the project work. Therefore, this project is mainly meant to determine the feasibility and the practicality of **Intelligent Access gate Control (IAGC)** application as it to be implemented at Universiti Teknologi PETRONAS campus. This project work will only focus on the application of automatic barriers gate and centralized system for security department only. Therefore, the project work scope has been narrowed down in order to make it feasible to be completed within a semester (4 month). The systematic procedure identification process that started with identified background of study, given problem statement and with detailed literature review on the usage of bar code technology, automatic barrier gate and networking will help in the completion of this project work.

This application provides an overall view on how does the interrelation between the main elements in the system. Relations between the user, the system and the system administrator are clearly shown. Any information flow that occurs between the main elements is tried not to be miss out as it may affect the overall daily operations.

With the proposed application for the UTP Security Department, the author believes that it can assist the department to perform their operation more dynamic and much systematic. This is because improvements are made on working style and norms and also eliminate the possible of lagging time. It also serves as an alternative way to help the Security Department in managing its workforce and collaboration between its staffs and users.

REFERENCES

A - Books:

1. Robert Cura (2002), *Technology Corner: Smart Cards 101*, Vol 1, 2002
2. Ian Sommerville, 2001, Software Engineering 6th Edition, Addison Wesley
3. Net Age, Looking at Real-World Convergence, 1999

B - Internet URL:

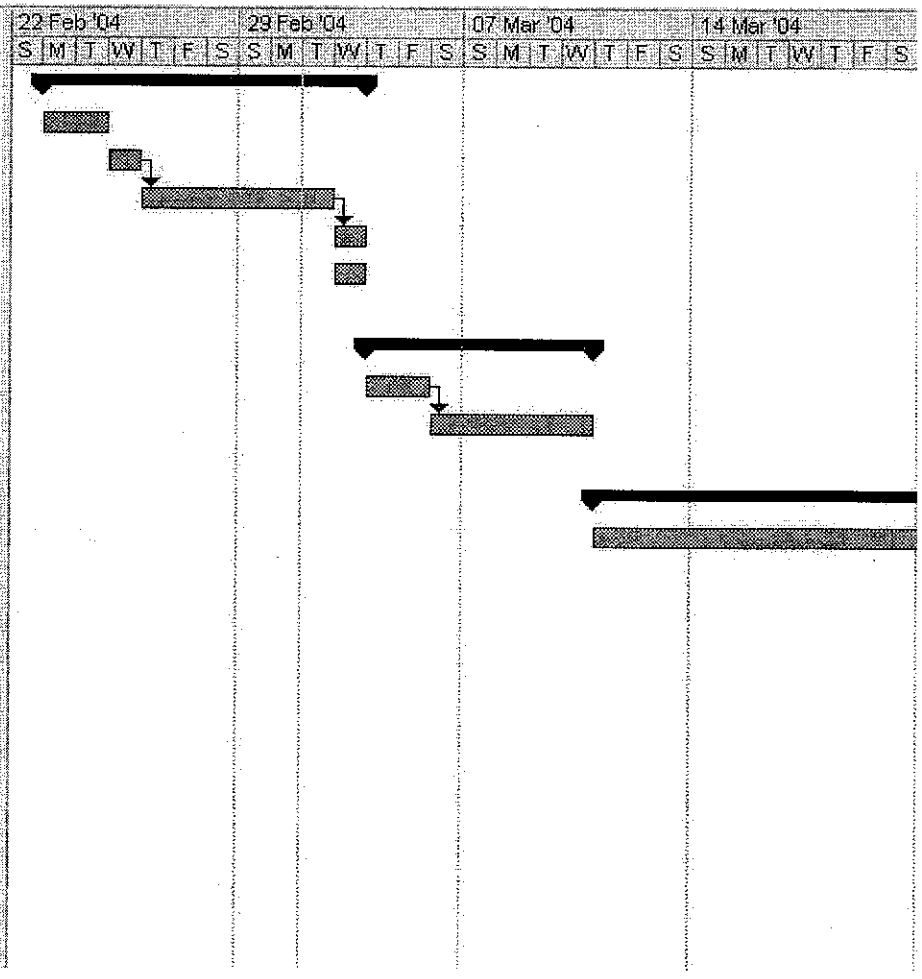
1. http://www.idautomation.com/barcoding4beginner.html
2. http://www.unisys.com/infra_tech.htm
3. http://www.touchngo.com.my/aboutsmarttag_lane.htm
4. http://java.sun.com/products/javacard/smartcard.html
5. http://www.frontierpitts.com/spec_autobarrier.htm
6. http://www.electra-com.uk.com/security_gates.html
7. http://cardtechnology.com/

Appendix 1: Project Gantt chart

Appendix 1

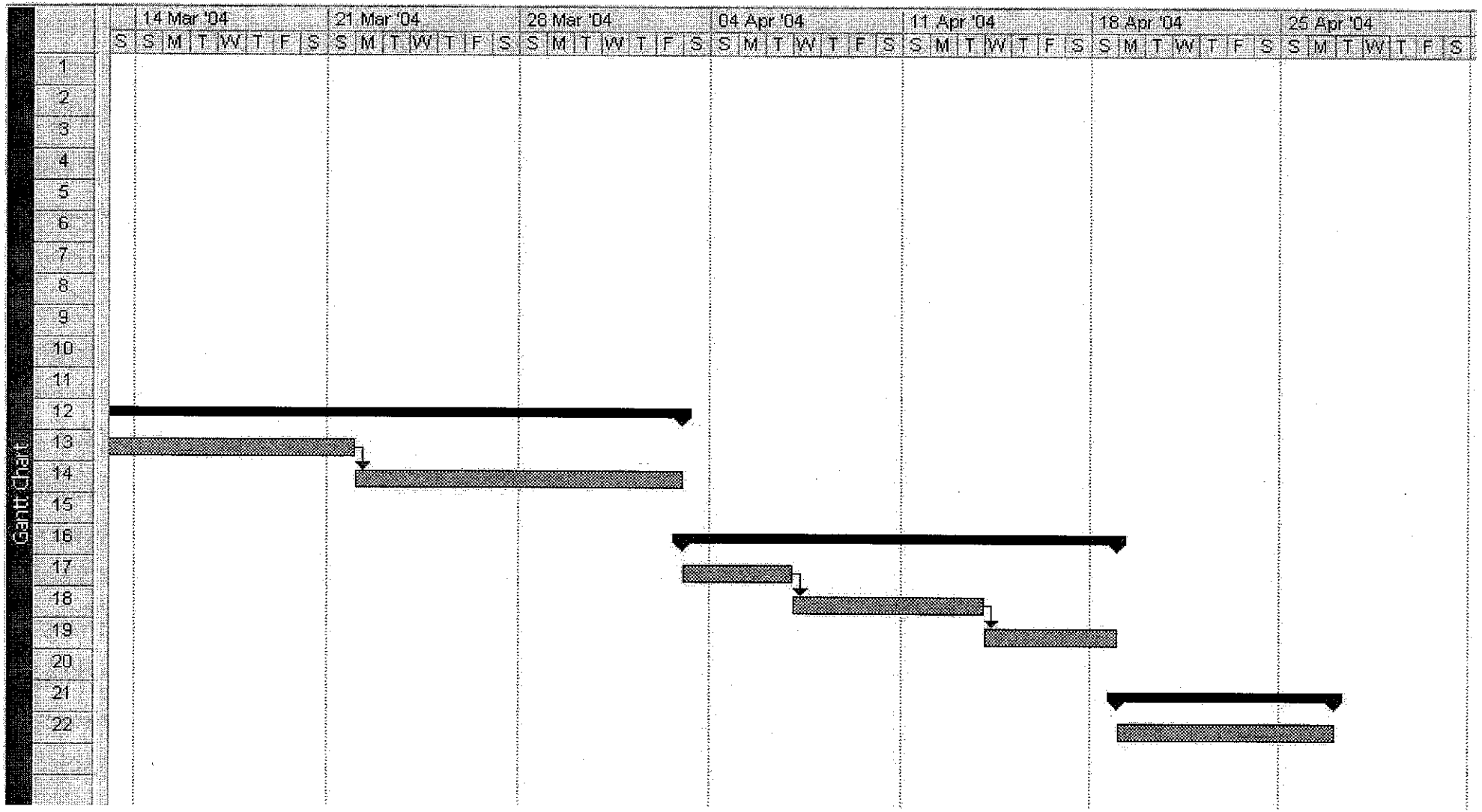
Gantt Chart

	Task Name	Duration	Start	Finish
1	**Project Definition And Planning**	**10 days**	**Mon 23/02/04**	**Wed 03/03/04**
2	Initiate project and proposal	2 days	Mon 23/02/04	Tue 24/02/04
3	Obtain supervisor's approval and advisory	1 day	Wed 25/02/04	Wed 25/02/04
4	Identify and search information needed	6 days	Thu 26/02/04	Tue 02/03/04
5	Preliminary report submission	1 day	Wed 03/03/04	Wed 03/03/04
6	Finalize project workplan	1 day	Wed 03/03/04	Wed 03/03/04
7				
8	**Analysis And design**	**7 days**	**Thu 04/03/04**	**Wed 10/03/04**
9	Research on current access gate control	2 days	Thu 04/03/04	Fri 05/03/04
10	Design IAGC workflow	5 days	Sat 06/03/04	Wed 10/03/04
11				
12	**System Development**	**23 days**	**Thu 11/03/04**	**Fri 02/04/04**
13	Develop front-end work units	11 days	Thu 11/03/04	Sun 21/03/04
14	Develop back-end work units	12 days	Mon 22/03/04	Fri 02/04/04
15				
16	**System Testing**	**16 days**	**Sat 03/04/04**	**Sun 18/04/04**
17	Plan system test	4 days	Sat 03/04/04	Tue 06/04/04
18	Conduct system test	7 days	Wed 07/04/04	Tue 13/04/04
19	Debug possible system error	5 days	Wed 14/04/04	Sun 18/04/04
20				
21	**Project Close Out**	**8 days**	**Mon 19/04/04**	**Mon 26/04/04**
22	Finalize final documentation	8 days	Mon 19/04/04	Mon 26/04/04



Appendix 2 & 3: Use Case – Internal Application

Use Case – External Application


Gantt Chart
14 Mar '04
21 Mar '04
28 Mar '04
04 Apr '04
11 Apr '04
18 Apr '04
25 Apr '04
S S M T W T F S S M T W T F S S M T W T F S S M T W T F S S M T W T F S S M T W T F S S M T W T F S
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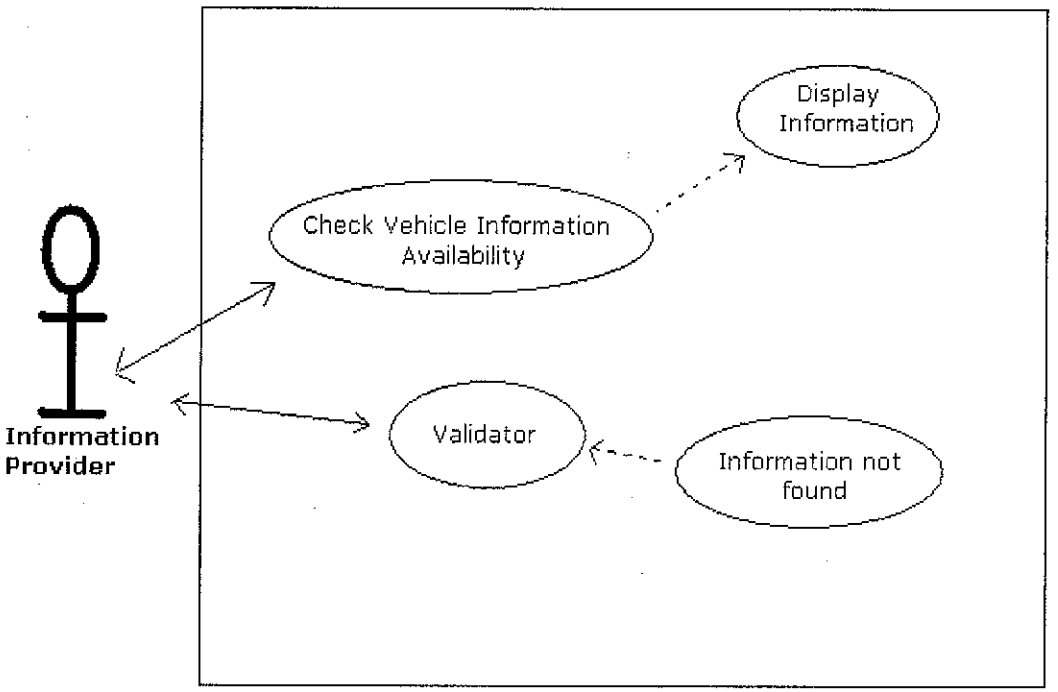
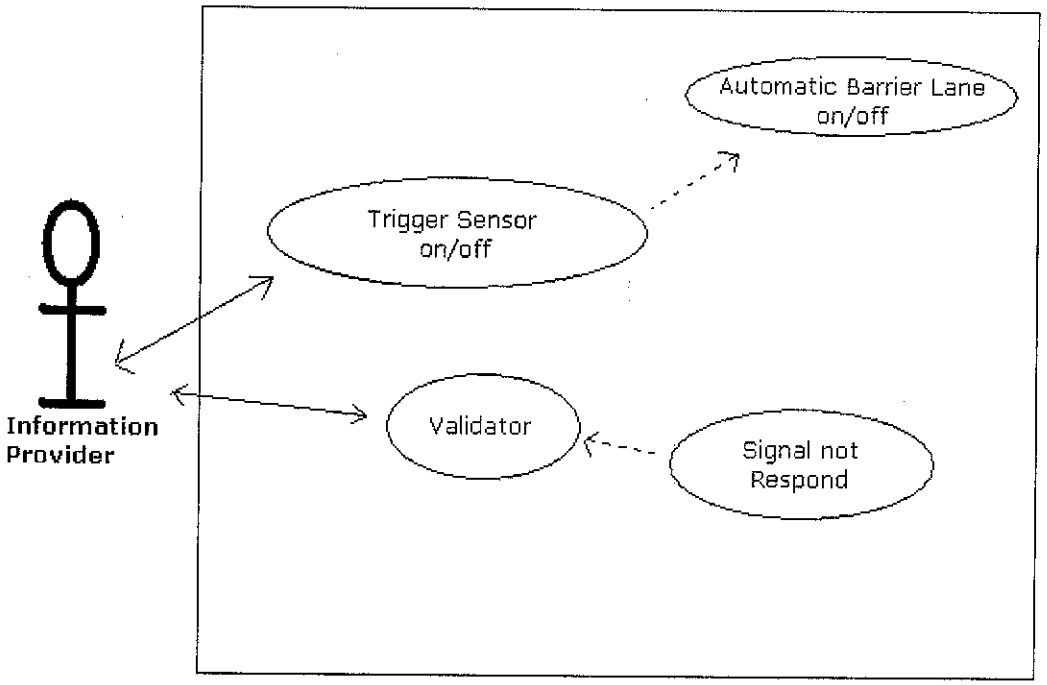
Appendix 2



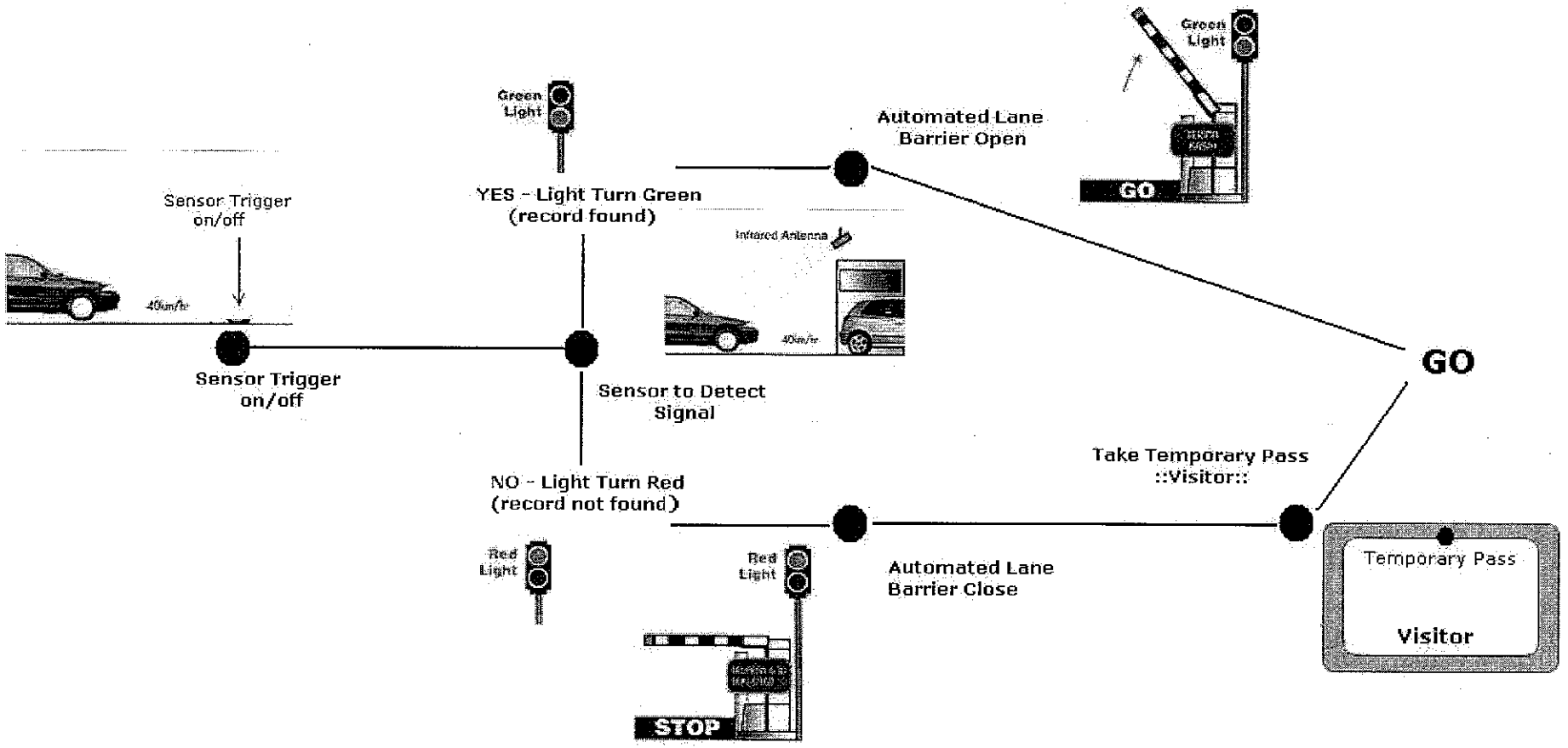
Use Case for Internal Application



Use Case for Enternal Application

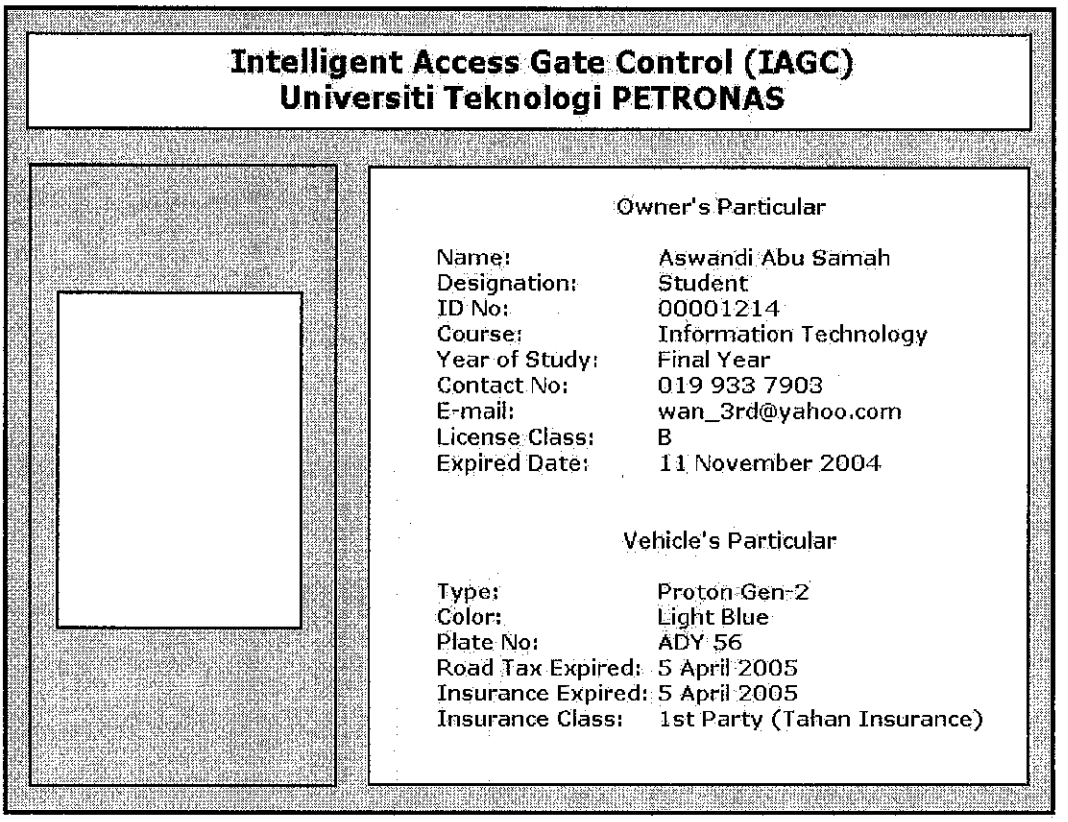
Appendix 4: Overview of Intelligent Access Gate Control

Appendix 4



Overview of Intelligent Access Gate Control (IAGC)

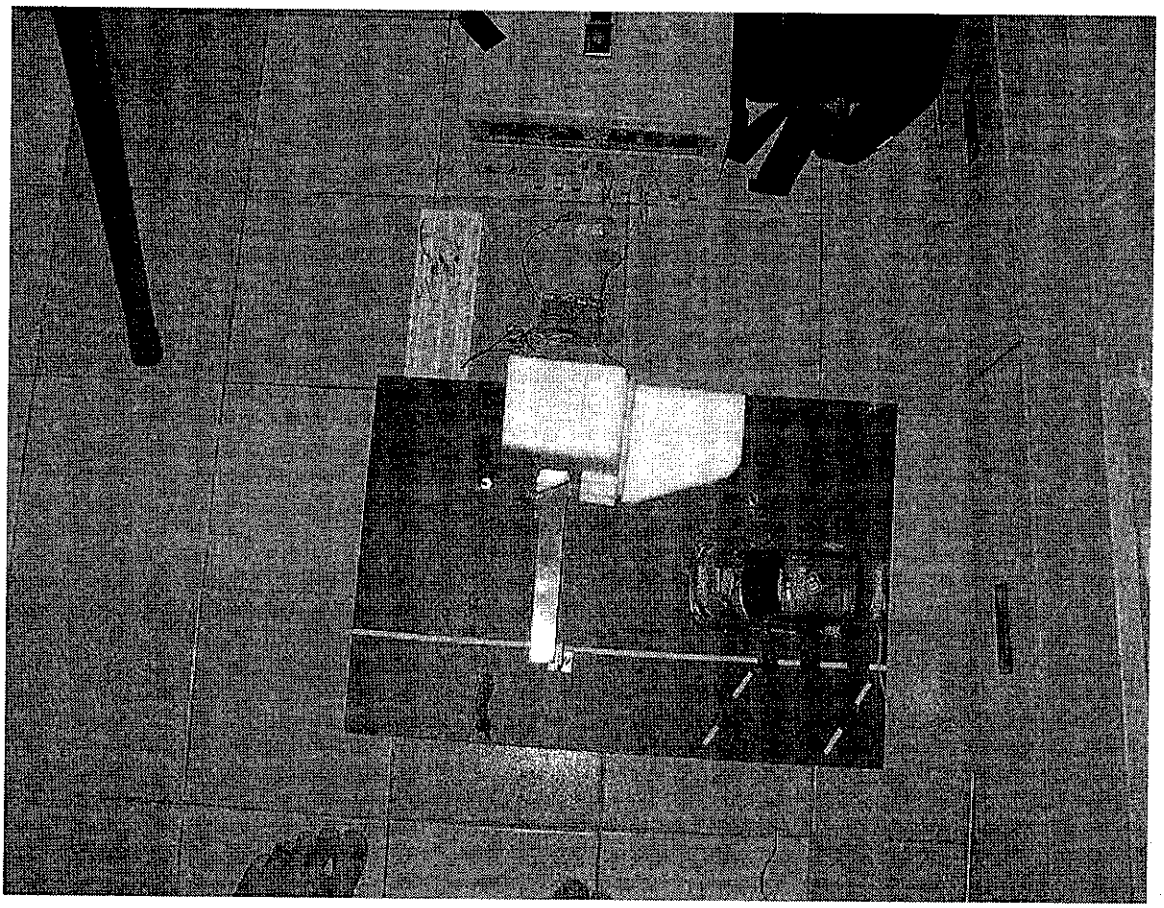
Appendix 5: User Interface



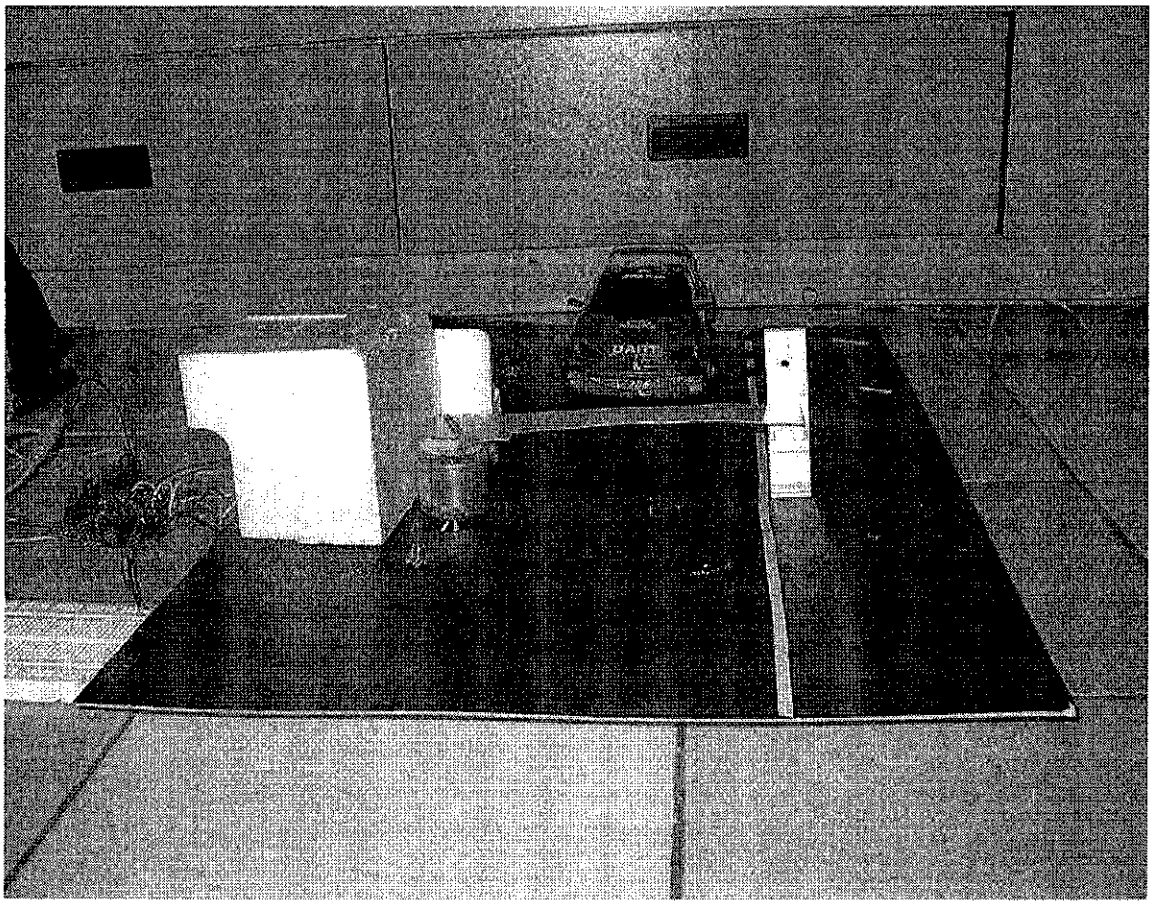
Owner detail

Appendix 6: Prototype of IAGC

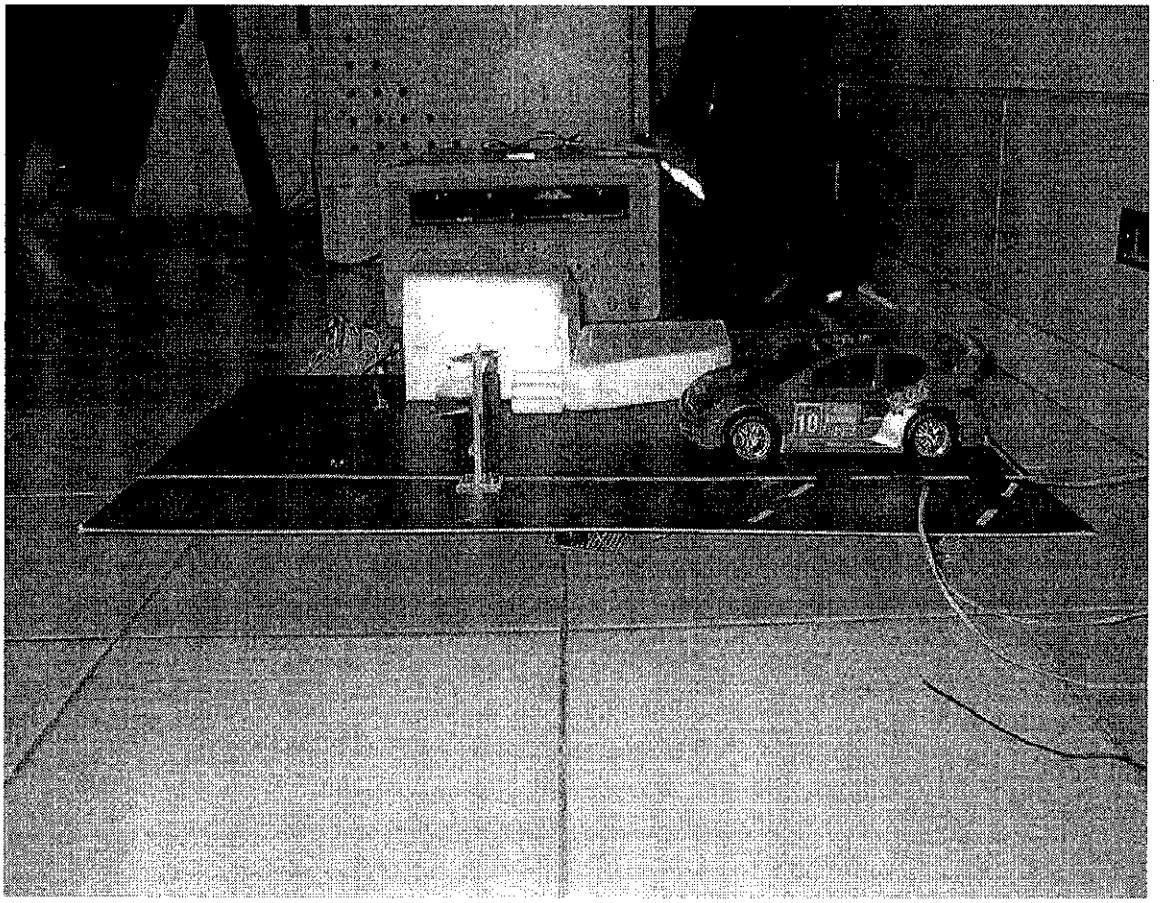
Appendix 6



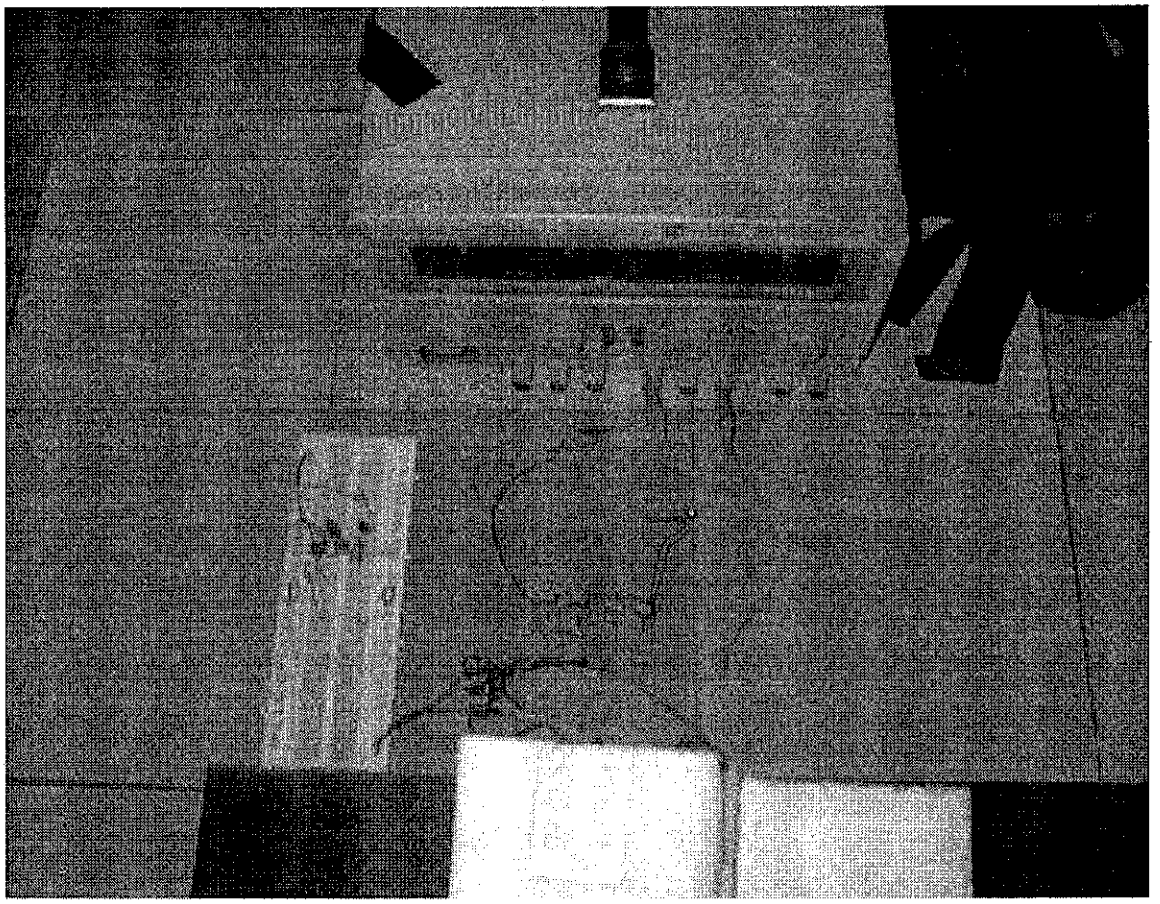
Prototype – Top view



Prototype – Front view

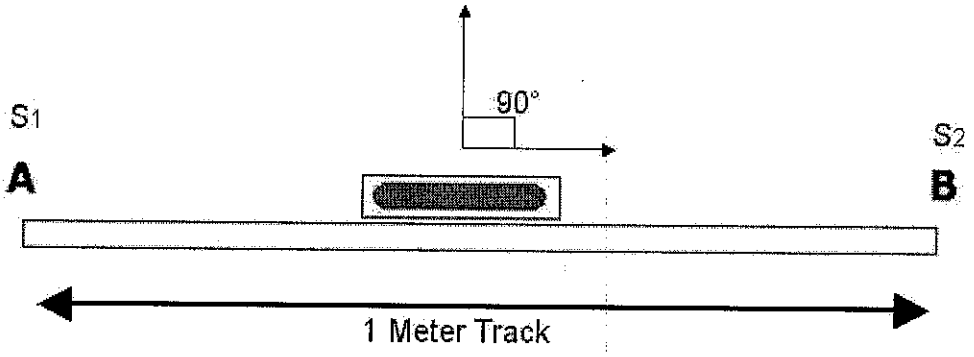


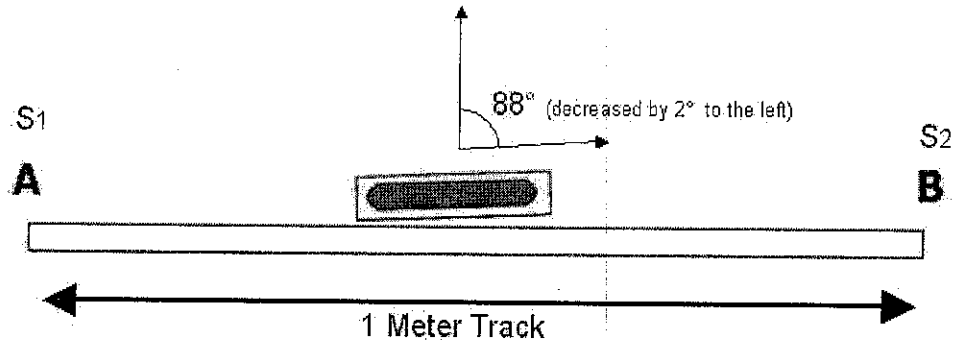
Prototype – Side view



Prototype – Working circuit

Appendix 7: Bar Code positioning


90°
S1
S2
A
B
1 Meter Track


88° (decreased by 2° to the left)
S1
S2
A
B
1 Meter Track

Appendix 8: Sample Result

Result indicated for positioning (1 = readable, 0 = not readable)

Number Of Trial	Distance (m)	Distance (km)	Time (s)	Time (h)	Velocity (m/s)	Velocity (km/h)	Positioning 90°
1	1	0.001	0.4	0.00011	2.5	9.1	1
2	1	0.001	0.4	0.00011	2.5	9.1	0
3	1	0.001	0.4	0.00011	2.5	9.1	0
4	1	0.001	0.4	0.00011	2.5	9.1	1
5	1	0.001	0.4	0.00011	2.5	9.1	1
6	1	0.001	0.4	0.00011	2.5	9.1	1
7	1	0.001	0.4	0.00011	2.5	9.1	1
8	1	0.001	0.4	0.00011	2.5	9.1	1
9	1	0.001	0.4	0.00011	2.5	9.1	0
10	1	0.001	0.4	0.00011	2.5	9.1	1
11	1	0.001	0.4	0.00011	2.5	9.1	0
12	1	0.001	0.4	0.00011	2.5	9.1	1
13	1	0.001	0.4	0.00011	2.5	9.1	0
14	1	0.001	0.4	0.00011	2.5	9.1	1
15	1	0.001	0.4	0.00011	2.5	9.1	1
16	1	0.001	0.4	0.00011	2.5	9.1	1
17	1	0.001	0.4	0.00011	2.5	9.1	1
18	1	0.001	0.4	0.00011	2.5	9.1	1
19	1	0.001	0.4	0.00011	2.5	9.1	1
20	1	0.001	0.4	0.00011	2.5	9.1	1
21	1	0.001	0.4	0.00011	2.5	9.1	0
22	1	0.001	0.4	0.00011	2.5	9.1	0
23	1	0.001	0.4	0.00011	2.5	9.1	0
24	1	0.001	0.4	0.00011	2.5	9.1	1
25	1	0.001	0.4	0.00011	2.5	9.1	1
26	1	0.001	0.4	0.00011	2.5	9.1	1
27	1	0.001	0.4	0.00011	2.5	9.1	1
28	1	0.001	0.4	0.00011	2.5	9.1	1
29	1	0.001	0.4	0.00011	2.5	9.1	1
30	1	0.001	0.4	0.00011	2.5	9.1	1
31	1	0.001	0.4	0.00011	2.5	9.1	1
32	1	0.001	0.4	0.00011	2.5	9.1	0
33	1	0.001	0.4	0.00011	2.5	9.1	1
34	1	0.001	0.4	0.00011	2.5	9.1	1
35	1	0.001	0.4	0.00011	2.5	9.1	1
36	1	0.001	0.4	0.00011	2.5	9.1	1
37	1	0.001	0.4	0.00011	2.5	9.1	1
38	1	0.001	0.4	0.00011	2.5	9.1	1
39	1	0.001	0.4	0.00011	2.5	9.1	1
40	1	0.001	0.4	0.00011	2.5	9.1	1
41	1	0.001	0.4	0.00011	2.5	9.1	1
42	1	0.001	0.4	0.00011	2.5	9.1	1
43	1	0.001	0.4	0.00011	2.5	9.1	1
44	1	0.001	0.4	0.00011	2.5	9.1	1
45	1	0.001	0.4	0.00011	2.5	9.1	1
46	1	0.001	0.4	0.00011	2.5	9.1	1
47	1	0.001	0.4	0.00011	2.5	9.1	1
48	1	0.001	0.4	0.00011	2.5	9.1	1
49	1	0.001	0.4	0.00011	2.5	9.1	1
50	1	0.001	0.4	0.00011	2.5	9.1	1

Result indicated for positioning (1 = readable, 0 = not readable)

Number Of Trial	Distance (m)	Distance (km)	Time (s)	Time (h)	Velocity (m/s)	Velocity (km/h)	Positioning 90°
1	1	0.001	0.3	0.000083	3.3	12	1
2	1	0.001	0.3	0.000083	3.3	12	0
3	1	0.001	0.3	0.000083	3.3	12	0
4	1	0.001	0.3	0.000083	3.3	12	1
5	1	0.001	0.3	0.000083	3.3	12	1
6	1	0.001	0.3	0.000083	3.3	12	1
7	1	0.001	0.3	0.000083	3.3	12	1
8	1	0.001	0.3	0.000083	3.3	12	1
9	1	0.001	0.3	0.000083	3.3	12	0
10	1	0.001	0.3	0.000083	3.3	12	1
11	1	0.001	0.3	0.000083	3.3	12	1
12	1	0.001	0.3	0.000083	3.3	12	1
13	1	0.001	0.3	0.000083	3.3	12	0
14	1	0.001	0.3	0.000083	3.3	12	1
15	1	0.001	0.3	0.000083	3.3	12	1
16	1	0.001	0.3	0.000083	3.3	12	0
17	1	0.001	0.3	0.000083	3.3	12	1
18	1	0.001	0.3	0.000083	3.3	12	0
19	1	0.001	0.3	0.000083	3.3	12	1
20	1	0.001	0.3	0.000083	3.3	12	1
21	1	0.001	0.3	0.000083	3.3	12	0
22	1	0.001	0.3	0.000083	3.3	12	0
23	1	0.001	0.3	0.000083	3.3	12	1
24	1	0.001	0.3	0.000083	3.3	12	0
25	1	0.001	0.3	0.000083	3.3	12	0
26	1	0.001	0.3	0.000083	3.3	12	0
27	1	0.001	0.3	0.000083	3.3	12	1
28	1	0.001	0.3	0.000083	3.3	12	1
29	1	0.001	0.3	0.000083	3.3	12	1
30	1	0.001	0.3	0.000083	3.3	12	1
31	1	0.001	0.3	0.000083	3.3	12	1
32	1	0.001	0.3	0.000083	3.3	12	0
33	1	0.001	0.3	0.000083	3.3	12	0
34	1	0.001	0.3	0.000083	3.3	12	1
35	1	0.001	0.3	0.000083	3.3	12	1
36	1	0.001	0.3	0.000083	3.3	12	1
37	1	0.001	0.3	0.000083	3.3	12	1
38	1	0.001	0.3	0.000083	3.3	12	0
39	1	0.001	0.3	0.000083	3.3	12	1
40	1	0.001	0.3	0.000083	3.3	12	1
41	1	0.001	0.3	0.000083	3.3	12	0
42	1	0.001	0.3	0.000083	3.3	12	1
43	1	0.001	0.3	0.000083	3.3	12	1
44	1	0.001	0.3	0.000083	3.3	12	1
45	1	0.001	0.3	0.000083	3.3	12	1
46	1	0.001	0.3	0.000083	3.3	12	1
47	1	0.001	0.3	0.000083	3.3	12	0
48	1	0.001	0.3	0.000083	3.3	12	1
49	1	0.001	0.3	0.000083	3.3	12	1
50	1	0.001	0.3	0.000083	3.3	12	0

Result indicated for positioning (1 = readable, 0 = not readable)

Number Of Trial	Distance (m)	Distance (km)	Time (s)	Time (h)	Velocity (m/s)	Velocity (km/h)	Positioning 90°
1	1	0.001	0.2	0.000056	5	17.86	0
2	1	0.001	0.2	0.000056	5	17.86	0
3	1	0.001	0.2	0.000056	5	17.86	1
4	1	0.001	0.2	0.000056	5	17.86	0
5	1	0.001	0.2	0.000056	5	17.86	1
6	1	0.001	0.2	0.000056	5	17.86	1
7	1	0.001	0.2	0.000056	5	17.86	1
8	1	0.001	0.2	0.000056	5	17.86	0
9	1	0.001	0.2	0.000056	5	17.86	0
10	1	0.001	0.2	0.000056	5	17.86	0
11	1	0.001	0.2	0.000056	5	17.86	0
12	1	0.001	0.2	0.000056	5	17.86	0
13	1	0.001	0.2	0.000056	5	17.86	1
14	1	0.001	0.2	0.000056	5	17.86	1
15	1	0.001	0.2	0.000056	5	17.86	0
16	1	0.001	0.2	0.000056	5	17.86	1
17	1	0.001	0.2	0.000056	5	17.86	1
18	1	0.001	0.2	0.000056	5	17.86	0
19	1	0.001	0.2	0.000056	5	17.86	1
20	1	0.001	0.2	0.000056	5	17.86	0
21	1	0.001	0.2	0.000056	5	17.86	1
22	1	0.001	0.2	0.000056	5	17.86	0
23	1	0.001	0.2	0.000056	5	17.86	0
24	1	0.001	0.2	0.000056	5	17.86	0
25	1	0.001	0.2	0.000056	5	17.86	0
26	1	0.001	0.2	0.000056	5	17.86	1
27	1	0.001	0.2	0.000056	5	17.86	0
28	1	0.001	0.2	0.000056	5	17.86	1
29	1	0.001	0.2	0.000056	5	17.86	1
30	1	0.001	0.2	0.000056	5	17.86	0
31	1	0.001	0.2	0.000056	5	17.86	0
32	1	0.001	0.2	0.000056	5	17.86	1
33	1	0.001	0.2	0.000056	5	17.86	1
34	1	0.001	0.2	0.000056	5	17.86	0
35	1	0.001	0.2	0.000056	5	17.86	0
36	1	0.001	0.2	0.000056	5	17.86	1
37	1	0.001	0.2	0.000056	5	17.86	1
38	1	0.001	0.2	0.000056	5	17.86	0
39	1	0.001	0.2	0.000056	5	17.86	0
40	1	0.001	0.2	0.000056	5	17.86	1
41	1	0.001	0.2	0.000056	5	17.86	1
42	1	0.001	0.2	0.000056	5	17.86	0
43	1	0.001	0.2	0.000056	5	17.86	0
44	1	0.001	0.2	0.000056	5	17.86	0
45	1	0.001	0.2	0.000056	5	17.86	1
46	1	0.001	0.2	0.000056	5	17.86	1
47	1	0.001	0.2	0.000056	5	17.86	0
48	1	0.001	0.2	0.000056	5	17.86	0
49	1	0.001	0.2	0.000056	5	17.86	0
50	1	0.001	0.2	0.000056	5	17.86	0

Result indicated for positioning (1 = readable, 0 = not readable)

Number Of Trial	Distance (m)	Distance (km)	Time (s)	Time (h)	Velocity (m/s)	Velocity (km/h)	Positioning 90°
1	1	0.001	0.1	0.000028	10	35.7	0
2	1	0.001	0.1	0.000028	10	35.7	0
3	1	0.001	0.1	0.000028	10	35.7	0
4	1	0.001	0.1	0.000028	10	35.7	0
5	1	0.001	0.1	0.000028	10	35.7	0
6	1	0.001	0.1	0.000028	10	35.7	0
7	1	0.001	0.1	0.000028	10	35.7	0
8	1	0.001	0.1	0.000028	10	35.7	0
9	1	0.001	0.1	0.000028	10	35.7	0
10	1	0.001	0.1	0.000028	10	35.7	0
11	1	0.001	0.1	0.000028	10	35.7	1
12	1	0.001	0.1	0.000028	10	35.7	0
13	1	0.001	0.1	0.000028	10	35.7	0
14	1	0.001	0.1	0.000028	10	35.7	0
15	1	0.001	0.1	0.000028	10	35.7	0
16	1	0.001	0.1	0.000028	10	35.7	0
17	1	0.001	0.1	0.000028	10	35.7	0
18	1	0.001	0.1	0.000028	10	35.7	0
19	1	0.001	0.1	0.000028	10	35.7	0
20	1	0.001	0.1	0.000028	10	35.7	0
21	1	0.001	0.1	0.000028	10	35.7	0
22	1	0.001	0.1	0.000028	10	35.7	0
23	1	0.001	0.1	0.000028	10	35.7	0
24	1	0.001	0.1	0.000028	10	35.7	0
25	1	0.001	0.1	0.000028	10	35.7	0
26	1	0.001	0.1	0.000028	10	35.7	0
27	1	0.001	0.1	0.000028	10	35.7	0
28	1	0.001	0.1	0.000028	10	35.7	0
29	1	0.001	0.1	0.000028	10	35.7	0
30	1	0.001	0.1	0.000028	10	35.7	0
31	1	0.001	0.1	0.000028	10	35.7	0
32	1	0.001	0.1	0.000028	10	35.7	0
33	1	0.001	0.1	0.000028	10	35.7	0
34	1	0.001	0.1	0.000028	10	35.7	0
35	1	0.001	0.1	0.000028	10	35.7	0
36	1	0.001	0.1	0.000028	10	35.7	0
37	1	0.001	0.1	0.000028	10	35.7	0
38	1	0.001	0.1	0.000028	10	35.7	0
39	1	0.001	0.1	0.000028	10	35.7	0
40	1	0.001	0.1	0.000028	10	35.7	0
41	1	0.001	0.1	0.000028	10	35.7	0
42	1	0.001	0.1	0.000028	10	35.7	0
43	1	0.001	0.1	0.000028	10	35.7	0
44	1	0.001	0.1	0.000028	10	35.7	0
45	1	0.001	0.1	0.000028	10	35.7	0
46	1	0.001	0.1	0.000028	10	35.7	0
47	1	0.001	0.1	0.000028	10	35.7	0
48	1	0.001	0.1	0.000028	10	35.7	0
49	1	0.001	0.1	0.000028	10	35.7	0
50	1	0.001	0.1	0.000028	10	35.7	0

Result indicated for positioning (1 = readable, 0 = not readable)

Number Of Trial	Distance (m)	Distance (km)	Time (s)	Time (h)	Velocity (m/s)	Velocity (km/h)	Positioning 88°
1	1	0.001	0.4	0.00011	2.5	9.1	1
2	1	0.001	0.4	0.00011	2.5	9.1	1
3	1	0.001	0.4	0.00011	2.5	9.1	0
4	1	0.001	0.4	0.00011	2.5	9.1	1
5	1	0.001	0.4	0.00011	2.5	9.1	0
6	1	0.001	0.4	0.00011	2.5	9.1	1
7	1	0.001	0.4	0.00011	2.5	9.1	0
8	1	0.001	0.4	0.00011	2.5	9.1	1
9	1	0.001	0.4	0.00011	2.5	9.1	0
10	1	0.001	0.4	0.00011	2.5	9.1	1
11	1	0.001	0.4	0.00011	2.5	9.1	1
12	1	0.001	0.4	0.00011	2.5	9.1	1
13	1	0.001	0.4	0.00011	2.5	9.1	1
14	1	0.001	0.4	0.00011	2.5	9.1	1
15	1	0.001	0.4	0.00011	2.5	9.1	1
16	1	0.001	0.4	0.00011	2.5	9.1	1
17	1	0.001	0.4	0.00011	2.5	9.1	1
18	1	0.001	0.4	0.00011	2.5	9.1	0
19	1	0.001	0.4	0.00011	2.5	9.1	1
20	1	0.001	0.4	0.00011	2.5	9.1	1
21	1	0.001	0.4	0.00011	2.5	9.1	1
22	1	0.001	0.4	0.00011	2.5	9.1	1
23	1	0.001	0.4	0.00011	2.5	9.1	1
24	1	0.001	0.4	0.00011	2.5	9.1	1
25	1	0.001	0.4	0.00011	2.5	9.1	1
26	1	0.001	0.4	0.00011	2.5	9.1	1
27	1	0.001	0.4	0.00011	2.5	9.1	1
28	1	0.001	0.4	0.00011	2.5	9.1	1
29	1	0.001	0.4	0.00011	2.5	9.1	1
30	1	0.001	0.4	0.00011	2.5	9.1	1
31	1	0.001	0.4	0.00011	2.5	9.1	1
32	1	0.001	0.4	0.00011	2.5	9.1	1
33	1	0.001	0.4	0.00011	2.5	9.1	1
34	1	0.001	0.4	0.00011	2.5	9.1	1
35	1	0.001	0.4	0.00011	2.5	9.1	1
36	1	0.001	0.4	0.00011	2.5	9.1	1
37	1	0.001	0.4	0.00011	2.5	9.1	1
38	1	0.001	0.4	0.00011	2.5	9.1	0
39	1	0.001	0.4	0.00011	2.5	9.1	1
40	1	0.001	0.4	0.00011	2.5	9.1	1
41	1	0.001	0.4	0.00011	2.5	9.1	1
42	1	0.001	0.4	0.00011	2.5	9.1	0
43	1	0.001	0.4	0.00011	2.5	9.1	0
44	1	0.001	0.4	0.00011	2.5	9.1	1
45	1	0.001	0.4	0.00011	2.5	9.1	1
46	1	0.001	0.4	0.00011	2.5	9.1	1
47	1	0.001	0.4	0.00011	2.5	9.1	1
48	1	0.001	0.4	0.00011	2.5	9.1	1
49	1	0.001	0.4	0.00011	2.5	9.1	0
50	1	0.001	0.4	0.00011	2.5	9.1	0

Result indicated for positioning (1 = readable, 0 = not readable)

Number Of Trial	Distance (m)	Distance (km)	Time (s)	Time (h)	Velocity (m/s)	Velocity (km/h)	Positioning 88°
1	1	0.001	0.3	0.000083	3.3	12	0
2	1	0.001	0.3	0.000083	3.3	12	0
3	1	0.001	0.3	0.000083	3.3	12	1
4	1	0.001	0.3	0.000083	3.3	12	0
5	1	0.001	0.3	0.000083	3.3	12	1
6	1	0.001	0.3	0.000083	3.3	12	1
7	1	0.001	0.3	0.000083	3.3	12	1
8	1	0.001	0.3	0.000083	3.3	12	0
9	1	0.001	0.3	0.000083	3.3	12	1
10	1	0.001	0.3	0.000083	3.3	12	1
11	1	0.001	0.3	0.000083	3.3	12	0
12	1	0.001	0.3	0.000083	3.3	12	0
13	1	0.001	0.3	0.000083	3.3	12	0
14	1	0.001	0.3	0.000083	3.3	12	1
15	1	0.001	0.3	0.000083	3.3	12	1
16	1	0.001	0.3	0.000083	3.3	12	1
17	1	0.001	0.3	0.000083	3.3	12	1
18	1	0.001	0.3	0.000083	3.3	12	0
19	1	0.001	0.3	0.000083	3.3	12	0
20	1	0.001	0.3	0.000083	3.3	12	0
21	1	0.001	0.3	0.000083	3.3	12	1
22	1	0.001	0.3	0.000083	3.3	12	1
23	1	0.001	0.3	0.000083	3.3	12	1
24	1	0.001	0.3	0.000083	3.3	12	1
25	1	0.001	0.3	0.000083	3.3	12	0
26	1	0.001	0.3	0.000083	3.3	12	1
27	1	0.001	0.3	0.000083	3.3	12	0
28	1	0.001	0.3	0.000083	3.3	12	1
29	1	0.001	0.3	0.000083	3.3	12	1
30	1	0.001	0.3	0.000083	3.3	12	1
31	1	0.001	0.3	0.000083	3.3	12	0
32	1	0.001	0.3	0.000083	3.3	12	0
33	1	0.001	0.3	0.000083	3.3	12	1
34	1	0.001	0.3	0.000083	3.3	12	1
35	1	0.001	0.3	0.000083	3.3	12	1
36	1	0.001	0.3	0.000083	3.3	12	0
37	1	0.001	0.3	0.000083	3.3	12	0
38	1	0.001	0.3	0.000083	3.3	12	0
39	1	0.001	0.3	0.000083	3.3	12	1
40	1	0.001	0.3	0.000083	3.3	12	1
41	1	0.001	0.3	0.000083	3.3	12	1
42	1	0.001	0.3	0.000083	3.3	12	0
43	1	0.001	0.3	0.000083	3.3	12	0
44	1	0.001	0.3	0.000083	3.3	12	1
45	1	0.001	0.3	0.000083	3.3	12	0
46	1	0.001	0.3	0.000083	3.3	12	1
47	1	0.001	0.3	0.000083	3.3	12	1
48	1	0.001	0.3	0.000083	3.3	12	0
49	1	0.001	0.3	0.000083	3.3	12	0
50	1	0.001	0.3	0.000083	3.3	12	1

Result indicated for positioning (1 = readable, 0 = not readable)

Number Of Trial	Distance (m)	Distance (km)	Time (s)	Time (h)	Velocity (m/s)	Velocity (km/h)	Positioning 88°
1	1	0.001	0.2	0.000056	5	17.86	0
2	1	0.001	0.2	0.000056	5	17.86	0
3	1	0.001	0.2	0.000056	5	17.86	0
4	1	0.001	0.2	0.000056	5	17.86	0
5	1	0.001	0.2	0.000056	5	17.86	0
6	1	0.001	0.2	0.000056	5	17.86	0
7	1	0.001	0.2	0.000056	5	17.86	1
8	1	0.001	0.2	0.000056	5	17.86	0
9	1	0.001	0.2	0.000056	5	17.86	0
10	1	0.001	0.2	0.000056	5	17.86	1
11	1	0.001	0.2	0.000056	5	17.86	1
12	1	0.001	0.2	0.000056	5	17.86	0
13	1	0.001	0.2	0.000056	5	17.86	0
14	1	0.001	0.2	0.000056	5	17.86	0
15	1	0.001	0.2	0.000056	5	17.86	1
16	1	0.001	0.2	0.000056	5	17.86	0
17	1	0.001	0.2	0.000056	5	17.86	0
18	1	0.001	0.2	0.000056	5	17.86	0
19	1	0.001	0.2	0.000056	5	17.86	0
20	1	0.001	0.2	0.000056	5	17.86	0
21	1	0.001	0.2	0.000056	5	17.86	0
22	1	0.001	0.2	0.000056	5	17.86	0
23	1	0.001	0.2	0.000056	5	17.86	1
24	1	0.001	0.2	0.000056	5	17.86	0
25	1	0.001	0.2	0.000056	5	17.86	1
26	1	0.001	0.2	0.000056	5	17.86	0
27	1	0.001	0.2	0.000056	5	17.86	0
28	1	0.001	0.2	0.000056	5	17.86	0
29	1	0.001	0.2	0.000056	5	17.86	1
30	1	0.001	0.2	0.000056	5	17.86	1
31	1	0.001	0.2	0.000056	5	17.86	0
32	1	0.001	0.2	0.000056	5	17.86	0
33	1	0.001	0.2	0.000056	5	17.86	0
34	1	0.001	0.2	0.000056	5	17.86	1
35	1	0.001	0.2	0.000056	5	17.86	1
36	1	0.001	0.2	0.000056	5	17.86	0
37	1	0.001	0.2	0.000056	5	17.86	1
38	1	0.001	0.2	0.000056	5	17.86	0
39	1	0.001	0.2	0.000056	5	17.86	0
40	1	0.001	0.2	0.000056	5	17.86	0
41	1	0.001	0.2	0.000056	5	17.86	1
42	1	0.001	0.2	0.000056	5	17.86	0
43	1	0.001	0.2	0.000056	5	17.86	0
44	1	0.001	0.2	0.000056	5	17.86	0
45	1	0.001	0.2	0.000056	5	17.86	1
46	1	0.001	0.2	0.000056	5	17.86	0
47	1	0.001	0.2	0.000056	5	17.86	0
48	1	0.001	0.2	0.000056	5	17.86	0
49	1	0.001	0.2	0.000056	5	17.86	0
50	1	0.001	0.2	0.000056	5	17.86	0

Result indicated for positioning (1 = readable, 0 = not readable)

Number Of Trial	Distance (m)	Distance (km)	Time (s)	Time (h)	Velocity (m/s)	Velocity (km/h)	Positioning 88°
1	1	0.001	0.1	0.000028	10	35.7	0
2	1	0.001	0.1	0.000028	10	35.7	0
3	1	0.001	0.1	0.000028	10	35.7	0
4	1	0.001	0.1	0.000028	10	35.7	0
5	1	0.001	0.1	0.000028	10	35.7	0
6	1	0.001	0.1	0.000028	10	35.7	0
7	1	0.001	0.1	0.000028	10	35.7	0
8	1	0.001	0.1	0.000028	10	35.7	0
9	1	0.001	0.1	0.000028	10	35.7	0
10	1	0.001	0.1	0.000028	10	35.7	0
11	1	0.001	0.1	0.000028	10	35.7	0
12	1	0.001	0.1	0.000028	10	35.7	0
13	1	0.001	0.1	0.000028	10	35.7	0
14	1	0.001	0.1	0.000028	10	35.7	0
15	1	0.001	0.1	0.000028	10	35.7	0
16	1	0.001	0.1	0.000028	10	35.7	0
17	1	0.001	0.1	0.000028	10	35.7	0
18	1	0.001	0.1	0.000028	10	35.7	0
19	1	0.001	0.1	0.000028	10	35.7	0
20	1	0.001	0.1	0.000028	10	35.7	0
21	1	0.001	0.1	0.000028	10	35.7	0
22	1	0.001	0.1	0.000028	10	35.7	0
23	1	0.001	0.1	0.000028	10	35.7	0
24	1	0.001	0.1	0.000028	10	35.7	0
25	1	0.001	0.1	0.000028	10	35.7	0
26	1	0.001	0.1	0.000028	10	35.7	0
27	1	0.001	0.1	0.000028	10	35.7	0
28	1	0.001	0.1	0.000028	10	35.7	0
29	1	0.001	0.1	0.000028	10	35.7	0
30	1	0.001	0.1	0.000028	10	35.7	0
31	1	0.001	0.1	0.000028	10	35.7	0
32	1	0.001	0.1	0.000028	10	35.7	0
33	1	0.001	0.1	0.000028	10	35.7	0
34	1	0.001	0.1	0.000028	10	35.7	0
35	1	0.001	0.1	0.000028	10	35.7	0
36	1	0.001	0.1	0.000028	10	35.7	0
37	1	0.001	0.1	0.000028	10	35.7	0
38	1	0.001	0.1	0.000028	10	35.7	0
39	1	0.001	0.1	0.000028	10	35.7	0
40	1	0.001	0.1	0.000028	10	35.7	0
41	1	0.001	0.1	0.000028	10	35.7	0
42	1	0.001	0.1	0.000028	10	35.7	0
43	1	0.001	0.1	0.000028	10	35.7	0
44	1	0.001	0.1	0.000028	10	35.7	0
45	1	0.001	0.1	0.000028	10	35.7	0
46	1	0.001	0.1	0.000028	10	35.7	0
47	1	0.001	0.1	0.000028	10	35.7	0
48	1	0.001	0.1	0.000028	10	35.7	0
49	1	0.001	0.1	0.000028	10	35.7	0
50	1	0.001	0.1	0.000028	10	35.7	0

Result indicated for positioning (1 = readable, 0 = not readable)

Number Of Trial	Distance (m)	Distance (km)	Time (s)	Time (h)	Velocity (m/s)	Velocity (km/h)	Positioning 92°
1	1	0.001	0.4	0.00011	2.5	9.1	0
2	1	0.001	0.4	0.00011	2.5	9.1	1
3	1	0.001	0.4	0.00011	2.5	9.1	1
4	1	0.001	0.4	0.00011	2.5	9.1	1
5	1	0.001	0.4	0.00011	2.5	9.1	1
6	1	0.001	0.4	0.00011	2.5	9.1	1
7	1	0.001	0.4	0.00011	2.5	9.1	0
8	1	0.001	0.4	0.00011	2.5	9.1	1
9	1	0.001	0.4	0.00011	2.5	9.1	1
10	1	0.001	0.4	0.00011	2.5	9.1	1
11	1	0.001	0.4	0.00011	2.5	9.1	1
12	1	0.001	0.4	0.00011	2.5	9.1	0
13	1	0.001	0.4	0.00011	2.5	9.1	1
14	1	0.001	0.4	0.00011	2.5	9.1	1
15	1	0.001	0.4	0.00011	2.5	9.1	1
16	1	0.001	0.4	0.00011	2.5	9.1	1
17	1	0.001	0.4	0.00011	2.5	9.1	0
18	1	0.001	0.4	0.00011	2.5	9.1	1
19	1	0.001	0.4	0.00011	2.5	9.1	1
20	1	0.001	0.4	0.00011	2.5	9.1	1
21	1	0.001	0.4	0.00011	2.5	9.1	0
22	1	0.001	0.4	0.00011	2.5	9.1	1
23	1	0.001	0.4	0.00011	2.5	9.1	1
24	1	0.001	0.4	0.00011	2.5	9.1	1
25	1	0.001	0.4	0.00011	2.5	9.1	1
26	1	0.001	0.4	0.00011	2.5	9.1	1
27	1	0.001	0.4	0.00011	2.5	9.1	1
28	1	0.001	0.4	0.00011	2.5	9.1	1
29	1	0.001	0.4	0.00011	2.5	9.1	1
30	1	0.001	0.4	0.00011	2.5	9.1	0
31	1	0.001	0.4	0.00011	2.5	9.1	1
32	1	0.001	0.4	0.00011	2.5	9.1	1
33	1	0.001	0.4	0.00011	2.5	9.1	1
34	1	0.001	0.4	0.00011	2.5	9.1	0
35	1	0.001	0.4	0.00011	2.5	9.1	1
36	1	0.001	0.4	0.00011	2.5	9.1	1
37	1	0.001	0.4	0.00011	2.5	9.1	1
38	1	0.001	0.4	0.00011	2.5	9.1	1
39	1	0.001	0.4	0.00011	2.5	9.1	1
40	1	0.001	0.4	0.00011	2.5	9.1	0
41	1	0.001	0.4	0.00011	2.5	9.1	1
42	1	0.001	0.4	0.00011	2.5	9.1	1
43	1	0.001	0.4	0.00011	2.5	9.1	1
44	1	0.001	0.4	0.00011	2.5	9.1	0
45	1	0.001	0.4	0.00011	2.5	9.1	1
46	1	0.001	0.4	0.00011	2.5	9.1	1
47	1	0.001	0.4	0.00011	2.5	9.1	1
48	1	0.001	0.4	0.00011	2.5	9.1	1
49	1	0.001	0.4	0.00011	2.5	9.1	1
50	1	0.001	0.4	0.00011	2.5	9.1	1

Result indicated for positioning (1 = readable, 0 = not readable)

Number Of Trial	Distance (m)	Distance (km)	Time (s)	Time (h)	Velocity (m/s)	Velocity (km/h)	Positioning 92°
1	1	0.001	0.3	0.000083	3.3	12	1
2	1	0.001	0.3	0.000083	3.3	12	1
3	1	0.001	0.3	0.000083	3.3	12	1
4	1	0.001	0.3	0.000083	3.3	12	1
5	1	0.001	0.3	0.000083	3.3	12	0
6	1	0.001	0.3	0.000083	3.3	12	0
7	1	0.001	0.3	0.000083	3.3	12	1
8	1	0.001	0.3	0.000083	3.3	12	0
9	1	0.001	0.3	0.000083	3.3	12	0
10	1	0.001	0.3	0.000083	3.3	12	1
11	1	0.001	0.3	0.000083	3.3	12	1
12	1	0.001	0.3	0.000083	3.3	12	1
13	1	0.001	0.3	0.000083	3.3	12	0
14	1	0.001	0.3	0.000083	3.3	12	0
15	1	0.001	0.3	0.000083	3.3	12	1
16	1	0.001	0.3	0.000083	3.3	12	0
17	1	0.001	0.3	0.000083	3.3	12	0
18	1	0.001	0.3	0.000083	3.3	12	0
19	1	0.001	0.3	0.000083	3.3	12	1
20	1	0.001	0.3	0.000083	3.3	12	1
21	1	0.001	0.3	0.000083	3.3	12	0
22	1	0.001	0.3	0.000083	3.3	12	0
23	1	0.001	0.3	0.000083	3.3	12	1
24	1	0.001	0.3	0.000083	3.3	12	0
25	1	0.001	0.3	0.000083	3.3	12	1
26	1	0.001	0.3	0.000083	3.3	12	0
27	1	0.001	0.3	0.000083	3.3	12	1
28	1	0.001	0.3	0.000083	3.3	12	1
29	1	0.001	0.3	0.000083	3.3	12	1
30	1	0.001	0.3	0.000083	3.3	12	1
31	1	0.001	0.3	0.000083	3.3	12	0
32	1	0.001	0.3	0.000083	3.3	12	0
33	1	0.001	0.3	0.000083	3.3	12	0
34	1	0.001	0.3	0.000083	3.3	12	1
35	1	0.001	0.3	0.000083	3.3	12	1
36	1	0.001	0.3	0.000083	3.3	12	0
37	1	0.001	0.3	0.000083	3.3	12	1
38	1	0.001	0.3	0.000083	3.3	12	1
39	1	0.001	0.3	0.000083	3.3	12	0
40	1	0.001	0.3	0.000083	3.3	12	0
41	1	0.001	0.3	0.000083	3.3	12	1
42	1	0.001	0.3	0.000083	3.3	12	0
43	1	0.001	0.3	0.000083	3.3	12	1
44	1	0.001	0.3	0.000083	3.3	12	0
45	1	0.001	0.3	0.000083	3.3	12	1
46	1	0.001	0.3	0.000083	3.3	12	0
47	1	0.001	0.3	0.000083	3.3	12	0
48	1	0.001	0.3	0.000083	3.3	12	1
49	1	0.001	0.3	0.000083	3.3	12	1
50	1	0.001	0.3	0.000083	3.3	12	0

Result indicated for positioning (1 = readable, 0 = not readable)

Number Of Trial	Distance (m)	Distance (km)	Time (s)	Time (h)	Velocity (m/s)	Velocity (km/h)	Positioning 92°
1	1	0.001	0.2	0.000056	5	17.86	0
2	1	0.001	0.2	0.000056	5	17.86	1
3	1	0.001	0.2	0.000056	5	17.86	0
4	1	0.001	0.2	0.000056	5	17.86	1
5	1	0.001	0.2	0.000056	5	17.86	0
6	1	0.001	0.2	0.000056	5	17.86	0
7	1	0.001	0.2	0.000056	5	17.86	1
8	1	0.001	0.2	0.000056	5	17.86	0
9	1	0.001	0.2	0.000056	5	17.86	0
10	1	0.001	0.2	0.000056	5	17.86	1
11	1	0.001	0.2	0.000056	5	17.86	0
12	1	0.001	0.2	0.000056	5	17.86	0
13	1	0.001	0.2	0.000056	5	17.86	0
14	1	0.001	0.2	0.000056	5	17.86	0
15	1	0.001	0.2	0.000056	5	17.86	1
16	1	0.001	0.2	0.000056	5	17.86	0
17	1	0.001	0.2	0.000056	5	17.86	0
18	1	0.001	0.2	0.000056	5	17.86	0
19	1	0.001	0.2	0.000056	5	17.86	1
20	1	0.001	0.2	0.000056	5	17.86	0
21	1	0.001	0.2	0.000056	5	17.86	0
22	1	0.001	0.2	0.000056	5	17.86	0
23	1	0.001	0.2	0.000056	5	17.86	1
24	1	0.001	0.2	0.000056	5	17.86	0
25	1	0.001	0.2	0.000056	5	17.86	1
26	1	0.001	0.2	0.000056	5	17.86	0
27	1	0.001	0.2	0.000056	5	17.86	0
28	1	0.001	0.2	0.000056	5	17.86	0
29	1	0.001	0.2	0.000056	5	17.86	0
30	1	0.001	0.2	0.000056	5	17.86	1
31	1	0.001	0.2	0.000056	5	17.86	0
32	1	0.001	0.2	0.000056	5	17.86	0
33	1	0.001	0.2	0.000056	5	17.86	0
34	1	0.001	0.2	0.000056	5	17.86	1
35	1	0.001	0.2	0.000056	5	17.86	1
36	1	0.001	0.2	0.000056	5	17.86	0
37	1	0.001	0.2	0.000056	5	17.86	1
38	1	0.001	0.2	0.000056	5	17.86	0
39	1	0.001	0.2	0.000056	5	17.86	0
40	1	0.001	0.2	0.000056	5	17.86	0
41	1	0.001	0.2	0.000056	5	17.86	1
42	1	0.001	0.2	0.000056	5	17.86	0
43	1	0.001	0.2	0.000056	5	17.86	0
44	1	0.001	0.2	0.000056	5	17.86	0
45	1	0.001	0.2	0.000056	5	17.86	1
46	1	0.001	0.2	0.000056	5	17.86	0
47	1	0.001	0.2	0.000056	5	17.86	0
48	1	0.001	0.2	0.000056	5	17.86	1
49	1	0.001	0.2	0.000056	5	17.86	0
50	1	0.001	0.2	0.000056	5	17.86	0

Result indicated for positioning (1 = readable, 0 = not readable)

Number Of Trial	Distance (m)	Distance (km)	Time (s)	Time (h)	Velocity (m/s)	Velocity (km/h)	Positioning 92°
1	1	0.001	0.1	0.000028	10	35.7	0
2	1	0.001	0.1	0.000028	10	35.7	0
3	1	0.001	0.1	0.000028	10	35.7	0
4	1	0.001	0.1	0.000028	10	35.7	0
5	1	0.001	0.1	0.000028	10	35.7	0
6	1	0.001	0.1	0.000028	10	35.7	0
7	1	0.001	0.1	0.000028	10	35.7	0
8	1	0.001	0.1	0.000028	10	35.7	0
9	1	0.001	0.1	0.000028	10	35.7	0
10	1	0.001	0.1	0.000028	10	35.7	0
11	1	0.001	0.1	0.000028	10	35.7	0
12	1	0.001	0.1	0.000028	10	35.7	0
13	1	0.001	0.1	0.000028	10	35.7	0
14	1	0.001	0.1	0.000028	10	35.7	0
15	1	0.001	0.1	0.000028	10	35.7	0
16	1	0.001	0.1	0.000028	10	35.7	0
17	1	0.001	0.1	0.000028	10	35.7	0
18	1	0.001	0.1	0.000028	10	35.7	0
19	1	0.001	0.1	0.000028	10	35.7	0
20	1	0.001	0.1	0.000028	10	35.7	0
21	1	0.001	0.1	0.000028	10	35.7	0
22	1	0.001	0.1	0.000028	10	35.7	0
23	1	0.001	0.1	0.000028	10	35.7	0
24	1	0.001	0.1	0.000028	10	35.7	0
25	1	0.001	0.1	0.000028	10	35.7	0
26	1	0.001	0.1	0.000028	10	35.7	0
27	1	0.001	0.1	0.000028	10	35.7	0
28	1	0.001	0.1	0.000028	10	35.7	0
29	1	0.001	0.1	0.000028	10	35.7	0
30	1	0.001	0.1	0.000028	10	35.7	0
31	1	0.001	0.1	0.000028	10	35.7	0
32	1	0.001	0.1	0.000028	10	35.7	0
33	1	0.001	0.1	0.000028	10	35.7	0
34	1	0.001	0.1	0.000028	10	35.7	0
35	1	0.001	0.1	0.000028	10	35.7	0
36	1	0.001	0.1	0.000028	10	35.7	0
37	1	0.001	0.1	0.000028	10	35.7	0
38	1	0.001	0.1	0.000028	10	35.7	0
39	1	0.001	0.1	0.000028	10	35.7	0
40	1	0.001	0.1	0.000028	10	35.7	0
41	1	0.001	0.1	0.000028	10	35.7	0
42	1	0.001	0.1	0.000028	10	35.7	0
43	1	0.001	0.1	0.000028	10	35.7	0
44	1	0.001	0.1	0.000028	10	35.7	0
45	1	0.001	0.1	0.000028	10	35.7	0
46	1	0.001	0.1	0.000028	10	35.7	0
47	1	0.001	0.1	0.000028	10	35.7	0
48	1	0.001	0.1	0.000028	10	35.7	0
49	1	0.001	0.1	0.000028	10	35.7	0
50	1	0.001	0.1	0.000028	10	35.7	0