Building Rail-Vehicle Braking Distance Calculation Tool Using C# Programming Language

Andinet Kumella

School of Mechanical and Industrial Engineering, Addis Ababa Institute of Technology

Abstract- This Research work presents the development of computer programming software namely; IBM PC® based modular tool for the prediction of vehicle deceleration, and braking time for various position of the transport vehicle at any time. Finally, particular attention is devoted to the accurate prediction of vehicle stopping distance. These will help to improve the braking system design in the rail vehicle industry, with respect to the safe movement of the transportation industry.

Index Terms- Vehicles, Braking, acceleration, distance, time.

I. INTRODUCTION

For trains to safely travel on a railway, trains must be provided with sufficient distance in which to stop. Allowing too long a distance reduces the capacity of the line and hence the return on rail infrastructure investment. Too short a distance and collisions would occur, because the train would not be able to stop within the available distance and would therefore occupy a section of track that could be allocated to another train. Consequently it is important that the distance be adequate, but not overly so [1].

The purpose of this IBM PC® based tool is to:
- Assist the signal designer to provide an adequate distance for the safe stopping of trains operating on a given line whilst at the same time maximizing line capacity;
- Put in place controls to ensure that the data used for the calculation is verified and traceable, and any changes controlled;
- Allow the ready evaluation of a new train by performing multiple calculations in one execution;
- Readily highlight those Limits of Authority that need to be relocated to allow for changes in speed or train braking performance.

II. CALCULATING BRAKING DISTANCE

Influencing Factors for Braking Distance
- The speed of the train when the brakes are applied;
- The deceleration rate available with a full-service brake application, which varies according to the coefficient of friction between wheel and rail;
- The delay from when the brakes are commanded by the train driver to when they are actually become effective (brake delay time);
- The state of the wear of the brake pads and the air pressure available in the brake cylinders;
- The geography of the track, in particular the track gradient the train travels over from when the brakes are commanded to where the front of the train stops;
- The mass distribution of the train.

III. C# PROGRAMMING TOOL

C# is a modern, general-purpose, object-oriented, high-level programming language. Its syntax is similar to that of C and C++ but many features of those languages are not supported in C# in order to simplify the language, which makes programming easier.

The C# programming language is a good choice, because it is an elegant language through which the program’s representation in the computer memory is of no concern to us and we can concentrate on improving the efficiency and elegance of our program.

Advantage of C#

C# is object-oriented programming language. Such are all modern programming languages used for serious software systems (like java and c++). The advantages of object-oriented programming are brought up in many passages throughout the book, but, for the moment, you can think of object-oriented languages as languages that allow working with objects from the real world.

Development of C# Modular Tool

The tool is used in the design process for a railway signaling application. It is only used when required to calculate train braking distances. There are two versions of the tool; 1. Microsoft Windows®2 environment 2. IBM OS/2®3 environment.

Both versions are written using the C++ language. However C++ compilers from different suppliers are used. The two versions have been designated as “ISAAC” and “NEWTON”. Both ISAAC and NEWTON versions of the tool need to be used before any calculated result can be accepted.
New window forms

- The number buttons should have their text be the actual numbers. I will use this text in the program.
- The function buttons names are not important.

Name of the form

Copy / Paste, make it look nice
- Copy and paste the buttons to keep size and placement consistent.
- Alter the text values to correspond to the buttons
- Adjust the size of the form and placement of the elements
- Change the background color of the form

The Finished Layout

Add a text box for the display

Create buttons
Let's Program the Reset Button

private void btnReset_Click(object sender, EventArgs e)
{
    txtaccelaration.Text = "";
    txtdistance.Text = "";
    txtvf.Text = "";
    txtvi.Text = "";
    txtcos_alpha.Text = "";
    txtsine_alpha.Text = "";
    radiobtnFalling.Checked = false;
    radiobtnRising.Checked = false;
    groupBoxCalculate.Visible = false;
}

Program the Calculate Button

private void calculate_Click(object sender, EventArgs e)
{
    if (CheckTxts())
        return;
    else
    {
        String name = txtName.Text;
        double vf = Convert.ToDouble(txtvf.Text);
        double vi = Convert.ToDouble(txtvi.Text);
        double cos_alpha = Convert.ToDouble(txtcos_alpha.Text);
        double sine_alpha = Convert.ToDouble(txtsine_alpha.Text);

        // calculate acceleration
        if (radiobtnRising.Checked == true)
        {
            acc = (1 + X + (Y * cos_alpha) - (Y * sine_alpha)) / 100;
            status = "Rising";
        }
        if (radiobtnFalling.Checked == true)
        {
            acc = (1 - 1 - (Y * cos_alpha) - (Y * sine_alpha)) / 100;
            status = "Falling";
        }
        txtaccelaration.Text = Convert.ToString(acc);

        // calculate distance
        if (acc == 0)
        {
            dist = 0;
            time = 0;
        }
        else
        {
            dist = ((vf * vf) - (vi * vi)) / (2 * acc);
            time = (vf - vi) / acc;
        }
        txtdistance.Text = Convert.ToString(dist);
        txttime.Text = Convert.ToString(time);
    }
}
Let's Program Export To Excel Button

```csharp
public OleDbConnection connection = new OleDbConnection(@"Provider=Microsoft.ACE.OLEDB.12.0;Data Source=D:\calculation.accdb");

private void export_Click(object sender, EventArgs e)
{
    try
    {
        // creating Excel Application

        // creating new Workbook within Excel application
        Microsoft.Office.Interop.Excel._Workbook workbook = app.Workbooks.Add(Type.Missing);

        // creating new Excelsheet in workbook
        Microsoft.Office.Interop.Excel._Worksheet worksheet = null;

        // see the excel sheet behind the program
        app.Visible = true;

        // get the reference of first sheet. By default its name is Sheet1.
        // store its reference to worksheet
        worksheet = workbook.Sheets["Sheet1"];  //worksheet = workbook.ActiveSheet;

        worksheet.Name = "Exported from Student";

        // storing header part in Excel
        for (int i = 1; i < dataGridView1.Columns.Count + 1; i++)
        {
            worksheet.Cells[1, i] = dataGridView1.Columns[i - 1].HeaderText;
        }

        for (int i = 0; i < dataGridView1.Rows.Count - 1; i++)
        {
            for (int j = 0; j < dataGridView1.Columns.Count; j++)
            {
            }
        }
    }
    catch
    {
    }
}

Let's Program To View Button

```
private void button1_Click(object sender, EventArgs e)
{
    displayResult();
    
}

Let’s Program To Delete Button

private void btndelete_Click(object sender, EventArgs e)
{
    this.panel1.Visible = true;
    this.btnexport.Visible = true;
    if (connection.State == ConnectionState.Closed)
        connection.Open();
    DataSet ds = new DataSet();
    DataTabledt = new DataTable();
    ds.Tables.Add(dt);
    OleDbDataAdapter da = new OleDbDataAdapter();
    da = new OleDbDataAdapter("DELETE * from CALCULATE", connection);
    da.Fill(dt);
    dataGridView1.DataSource = dt.DefaultView;
    connection.Close();
    displayResult();
}

IV. CONCLUSION

Let’s Program To Rising Button

private void radiobtnRising_CheckedChanged(object sender, EventArgs e)
{

}

Let’s Program To Falling Button

private void radiobtnFalling_CheckedChanged(object sender, EventArgs e)
{

}
The Finished product

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AUTHORS

First Author – Andinet Kumella, M.Sc in Mechanical Engineering under Railway Engineering, Addis Ababa Institute of Technology(AAiT), andinet_kumella@yahoo.com/andinetkumella48@gmail.com