

Full Length Research Paper

A digital soil textural class determination from the percentages of silt and clay

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The input of the percentages of silt and clay on the interface generated with the C Sharp (C#) computer programme gave an automated soil textural class determination. The programme incorporated in the coding, the percentage silt and clay values in order to classify the soil into one of the categories of the sand, loamy sand, sandy loam, sandy clay loam, sandy clay and clay textural classes. The Design Interface was created in Microsoft Visual Studio and the Toolbox activated for the application of the Label, Text and Button Tools. The parameters 'Enter percent silt' and 'Enter percent clay' were typed in the two Label boxes respectively while empty box spaces were created against each for the information of percent silt and percent clay to be filled by the user. The debugging of code page brought up the User Interface. When the percent silt and clay were entered in the spaces on the User Interface and the 'Determine the Soil Texture' button clicked, the soil textural class category was generated and displayed. The automated method gave an instant soil textural class without the use of the soil textural triangle.

Key words: Soil texture, automated determination, percent silt, percent clay.

INTRODUCTION

Soil texture defined as the proportion of sand, silt and clay size particles that made up the soil mass had been adjudged a key component of data used for assessing soil quality and sustainability of agricultural management practices (Dexter, 2004; Shepherd and Bennett, 1998). The influence of soil texture on soil productivity and management with regards to tith, ease of tillage, resistance to soil erosion, water holding capacity and the ability to hold and release nutrients had been reported in previous studies (Phillips, 2001; Buschiazzi et al., 2004; Chaudari et al., 2013; Ismail and Ozawa, 2007; Ndema et al., 2010; Zettl et al., 2011; Li et al., 2013).

Soil texture influenced the plastic limit of agricultural soils and the investigation conducted by Keller and Dexter (2012) revealed that soils with very low organic matter should contain ten percent or above clay content to possess desirable plastic limit. The soil cone index which was a mechanical property to assess soil strength

during tillage operations was reported to decrease with the increase in clay fraction and increased with the increase in sand and silt fraction of soil (kumar et al., 2012). The investigation on the influence of soil texture on the economics of tillage operations with regard to tractor fuel consumption revealed that sandy soil with 5% of clay produced poor fuel consumption compared to loam sandy soil containing 18% of clay. This was because tillage with suitable water content of about 15%, improved tractor fuel economy (Khaoula and Sayed, 2012; Nguyen and Marschner, 2013). The parameters of soil-moisture retention curve, hydraulic conductivity and tortuosity factor were used as functions of texture by Vetterlein et al. (2007) on the investigation that confirmed soil texture to be important in nutrient transport from the bulk soil to the root surface.

The commonly used methods for determining soil texture included the hand texture method, separation by sieving, separation by sedimentation while the automated method included the laser diffraction analysis and the computer automated technique (Saxton et al., 1986; Taubner et al., 2009). The non specific method was estimating soil texture by the cation exchange capacity

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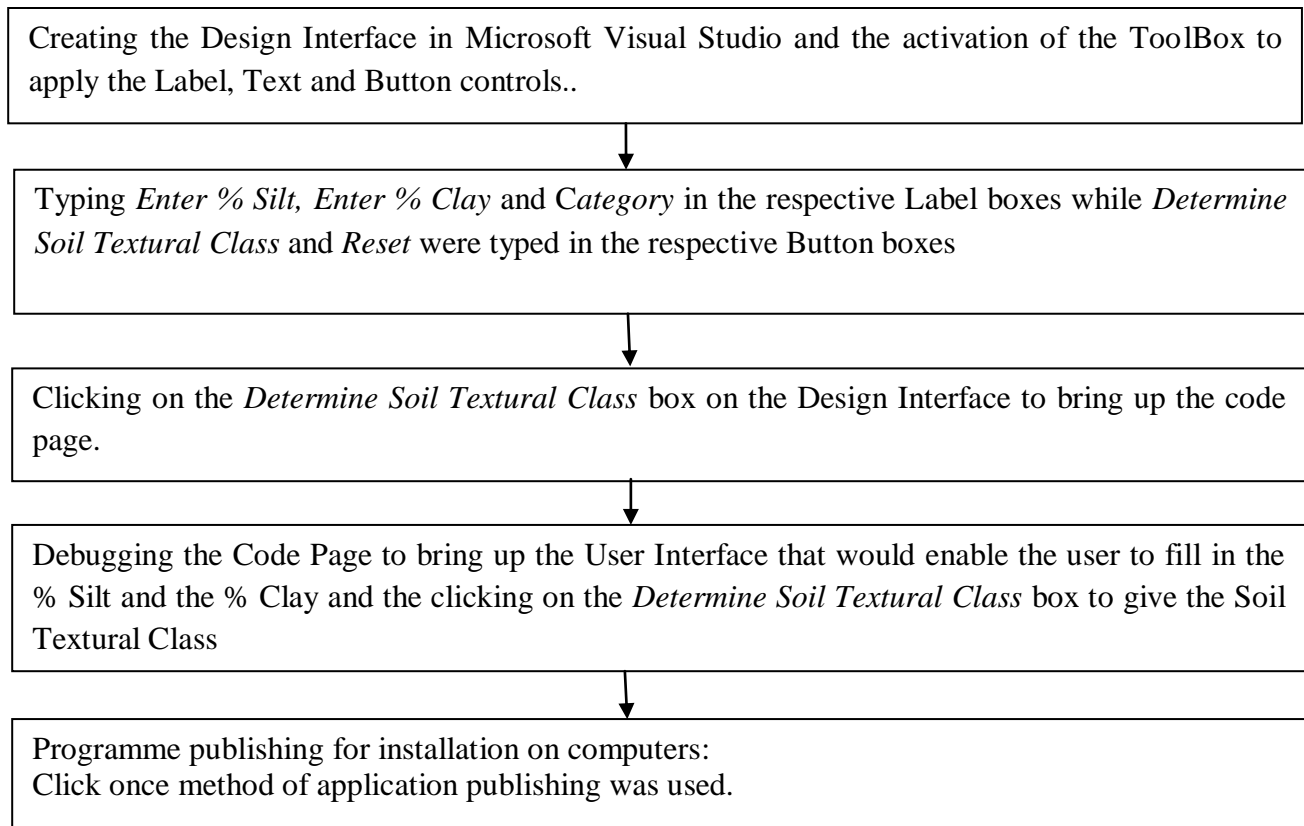


Figure 1. The Flow Chart of the sequence of invention of soil textural determination software

(CEC). This method was premised on the principle that soil CEC and texture were highly correlated as the lower the CEC of the soil the more coarse textured or lighter the soil could become (AGVISE, 2013). This method however had a limitation as it was pH dependent and would apply efficiently for soils with less than pH 7.6 because soils with higher pH could have high levels of calcium carbonate which would inflate the CEC values of the soil.

The conventional method was the use of laboratory analysis of sedimentation to determine the percentages of sand, silt and clay of soil samples with which the soil textural class would be determined from the soil textural triangle chart. To use the chart, a line from the point of percent clay would be drawn parallel to the base of the triangle labeled percent sand while also a line from the point of percent sand would be drawn inward, parallel to the triangle side labeled per cent silt. The name of the compartment in which the two lines intersected would indicate the soil textural class (Brady and Weil, 1999). The objective of the research was the development of a rapid automated method of determining the soil textural class from the percentages of silt and clay values on a digital interface without the use of the soil textural triangle. The textural class would be computer generated and displayed on the user interface using the percentages of silt and clay.

MATERIALS AND METHODS

The sequence of the programme development was creating a new visual studio C# project, adding components to the windows form, changing component names, changing component properties and adding behavior to a visual studio C# application (Figure 1).

The Development of the Design and User Interfaces

The Microsoft Visual Studio 2008 was launched and a new project created with Windows Forms Application Templates and Visual C# Windows Project Type. The Form 1 c.s Design interface was created and the Toolbox activated for the application of the Label, Text and Button controls. The two Label boxes created were filled with *Enter % Silt* and *Enter % Clay* respectively while empty box spaces were created against each for the values of % Silt and % Clay to be filled by the user.

Writing the Programme Code

The Form interface was double-clicked to bring up the coding expression page. The variables of % silt and % Clay were written in a programming language that enabled

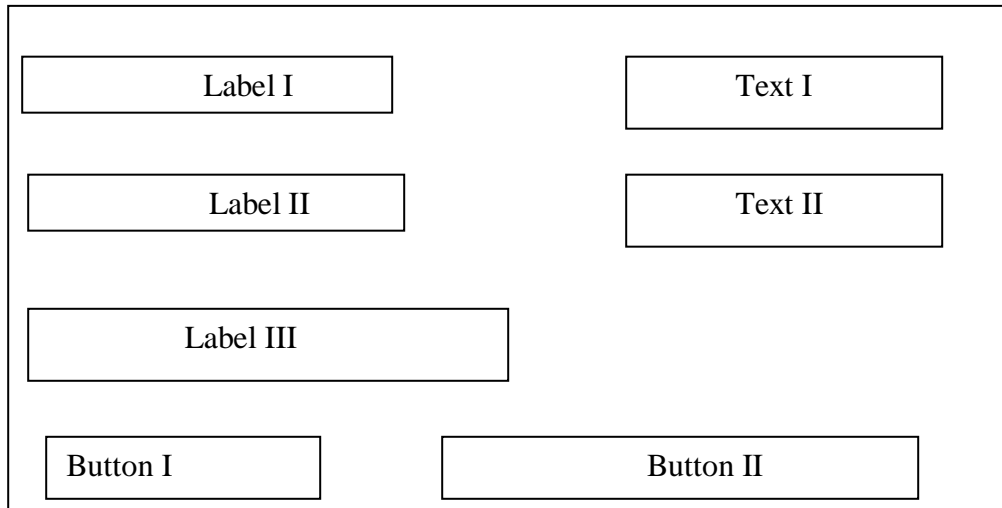


Figure 2. Framework of design interface .

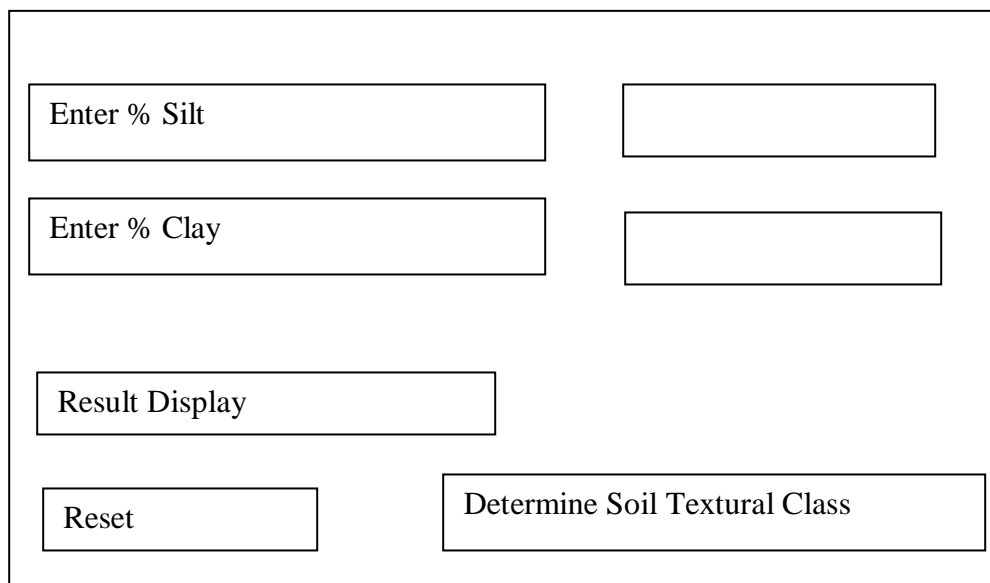


Figure 3. Framework of user interface.

the computation in the arithmetic Addition formula that depicted the relationship between Silt and Clay percentages in the double data type as follows:
 $\% \text{ Silt} + \% \text{ Clay}$.

This was written in a coded computer language as follows:

```
double TSilt = double.Parse(txtSilt.Text);
double TClay = double.Parse(txtClay.Text);
double Soil Texture = (TSilt + TClay);
```

The code page was debugged to bring up the user interface that would enable the user to fill in the % Silt and % Clay.

Programme Publishing for Installation on Computers

Click once method of application publishing was used. The publishing was initiated by clicking on the design Form 1.cs and activating the Solution Explorer Tools on the right side of visual studio screen for the application of Security Setting, Publish, Prerequisites, Application Files and Options Tools while the .NET Framework 3.0 was selected in the Downloading. The information on both the Publisher Name and Product Name respectively were supplied while the option to automatically start set up when CD is inserted was selected in order to effect installation of software on a computer.

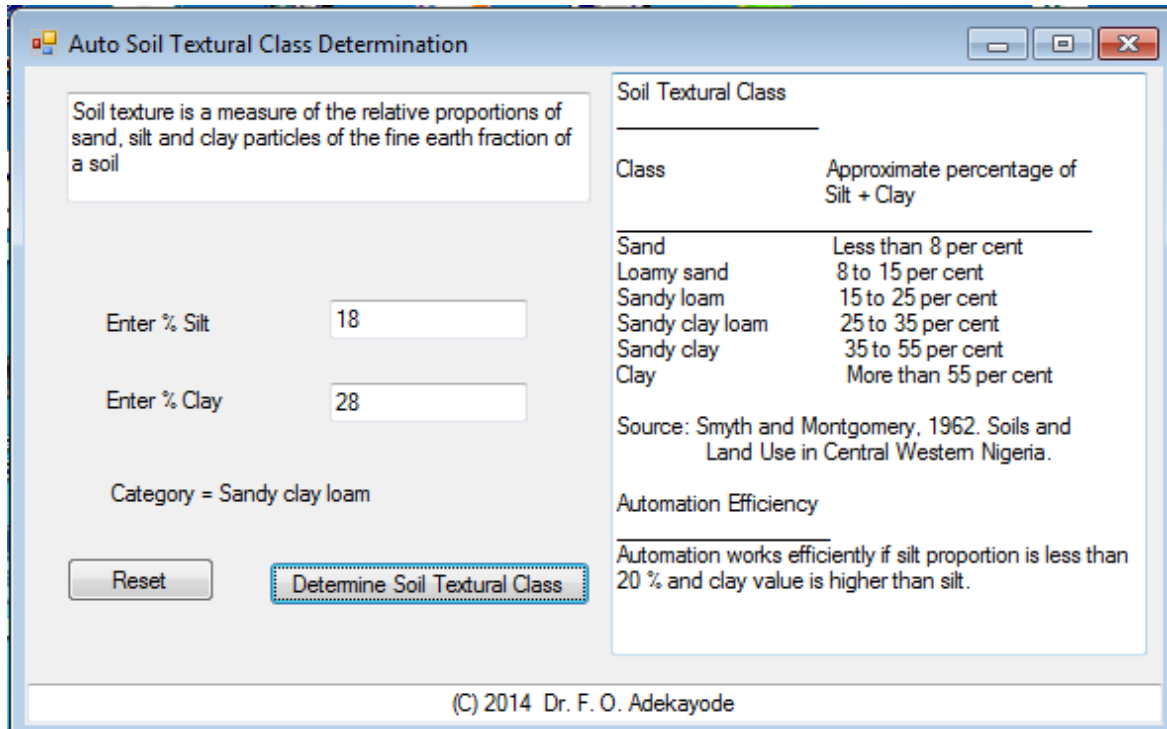


Figure 4. The computer generated user interface.

RESULT

The frame work of the design and user interfaces are shown in Figures 2 and 3 respectively while the computer generated user interface is shown in Figure 4. The design interface had the Label, Text and Button boxes which were filled with the respective command information. Text boxes I and II were placed against Label boxes I and II respectively while Label box III was meant only for output information. The Button boxes I and II were to be filled with specific command information (Figure 2).

The framework of the user interface had the Label, Text and Button boxes filled with the respective command information (Figure 3). Label boxes I and II were filled with *Enter % Silt* and *% Clay* respectively while the Button boxes I and II were filled with *Reset* and *Determine Soil Textural Class* command information respectively.

Figure 4 shows the computer generated user interface fashioned after the frame work design in Figure 3 with the activation of the Tool Box to draw the Label, Text and Button boxes and also the result

DISCUSSION

The first step in the programme development was the creation of the design interface in the Microsoft Visual

Studio programme. The activation of the Toolbox enabled the display of the Label, Text and Button boxes as diagrammatically illustrated in Figure 2 while the Properties Tools on the right side of visual studio screen were used to write the command operations assigned to each box space as diagrammatically illustrated in Figure 3. The Window Forms Application which was created by selecting window application as the template and visual C# as the project type in Microsoft Visual and the eventual display of design and user interfaces followed the procedures illustrated in Microsoft SQL Server (2012). The window forms provided the project with components of dialog boxes, menus and buttons that made up a standard window application user interface controls. When the controls were dragged onto the applications main forms, the integrated development environment (IDE) automatically added the source code to create an instance of the appropriate class and initialize it (Hicks, 2012; Mc Grath et al., 2013).

The command options such as text, size, in the properties window on the right side of visual studio screen were used to configure, name and manipulate label, text and button boxes. The Form 1 interface which had the label and text boxes displayed on it, had the label boxes filled with *Enter % Silt* and *%Clay* in Label I and Label II respectively while *Reset* and *Determine Soil Textural Class* were written in Button I and Button II as *btnReset* and *btnSoil Clay* respectively. The *% Silt* and *%*

Clay were input on the spaces provided in the user interface. The methods adopted followed the procedures in Microsoft SQL Server (2012).

The coding procedures in the programming language followed the method adopted in Berry (2011) in the development of system design using interfaces. The dragging of controls to the Form interface triggered visual studio to generate the code that corresponded to the control. This was responsible for the double click on the load information on Form 1 Design interface to display code message with first few lines that read:

```
using System;
using System.Collections.Generic;
using System.ComponentModel;
using System.Data;
using System.Drawing;
using System.Linq;
using System.Text;
using System.Windows.Forms;

namespace Soil_Textural_Class
{
    public partial class Form1 : Form
    {
        public Form1()
        {
            InitializeComponent();
        }

        private void btnSoil_TextureClick(object sender,
        EventArgs e)
        {
            double TSilt = double.Parse(txtSilt.Text);
            double TClay = double.Parse(txtClay.Text);
```

The debugging of the code page that brought up the user interface for entry of data by the user followed the procedures explained in Liberty (2002).

The Click Once method used in the publishing provided full support for publishing and updating applications. The publish wizard publishing method in Click Once provided the advantages of step-by-step configuration setup and also the pre-requisite file (setup.exe) for the application to be automatically created (MSDN_MCP, 2007). The .NET Framework selected in the publishing prevented conflict with existing software on the computer.

The System Testing was done to ensure that the developed application worked according to the specification. The functionality was attested to in the computer generated output in **Figure 4** with the soil textural class determination of sandy clay loam with the imputing of 18 % silt and 28 % clay.

CONCLUSION

The creation of C# graphic user interface (GUI) application with Visual Studio enabled the automated

determination of soil textural class with the input of % silt and % clay at the appropriate spaces on the user interface. The click to determine the soil textural class, triggered the mathematical computation in the background coding page and the result of the soil textural class was instantly generated and displayed.

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