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Virtual Statistics Manager

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Abstract

This report illustrates the concept of a user friendly, handheld device which enables the user to formulate and interact with a preset list of statistical representations. An accelerometer is mounted on the handheld controller. The accelerometer readings represent the relative change in position of the user's hand and thus, the gesture is detected. The accelerometer readings are read by a microprocessor from the MSP430 family. The processor serially communicates the data to the computer using Standard UART. The serial data is processed using MATLAB and the chosen statistical graph is plotted and can be subsequently interacted with. The gestures, identified by the accelerometer readings, are used to increase or decrease the quantity or rating of the statistical feature. Initially used for formulating pi –charts, bar graphs and value proposition mappings, the application of the device can be expanded to include various other statistical representations. The device can be implemented for classroom teaching as well as a presentation tool in corporate meetings.

Keywords: Accelerometer, graph, gesture, axis.

Introduction

The accurate representation of statistical data is of key importance especially in the corporate world where key business decisions are taken based on the interpretations of such data. However the process of translating large amounts of data into graphical forms such as a pie charts and bar graphs is often a computation heavy and mundane activity. A device that allows a presenter to create such graphical representations in real time via the motion of his hand would not only reduce need for computation but also make for a livelier environment. With a small device affixed onto his hand, the user is only required to make small movements of the hand to see his desired graph being created on the screen. While our project has been developed to create three representations viz. the Pie Chart, Bar Graph and Value Proposition Mapping, the algorithm can be extended to cover all types of graphs that are commonly used. Such a device can also be useful in the classroom where students can study graphs interactively.

Features

The following graphical representations can be created using the device:

A) Pie Chart

A pie chart is a circular chart which is divided into various sectors in which each sector depicts a numerical proportion. The arc length and the central angle show the relative size of a particular quantity.

The chart is named so due to the resemblance of it to a pie which has been sliced. The area of each slice shows the proportion of each slice to the entire pie available. It also represents data only at a particular time so it does not represent the change of the data over a finite interval of time. A pie chart is constructed by plotting a circle and then dividing into various sectors where the ratio of the area of each sector to the area of the entire circle is proportional to the ratio of the value being plotted to the total value. Pie charts are widely used in the business world and mass media to represent various financial and marketing analysis performed by a particular company. It is also used to compare two companies on the basis of some factor on which the two companies needs to be compared on. For example it can be used to calculate a company's profits for each month can be shown with a pie chart as a percentage of the year's total profits.

B) Bar Graph

A Bar Graph is a diagrammatic representation in which the numerical values of the user supplied data is represented by height of rectangles of equal width. The rectangles can be graphed either horizontally or vertically. On the graph one axis is used to represent the quantities to be compared and other axis represents discrete values. Various generalizations about the data change or the trend about a particular quantity over a finite interval of time can be deduced from the graph. In order to create a bar graph we must determine the range of discrete values over which the data exists and accordingly map the two axes. Rectangles are plotted for each interval on one axis and the height of these rectangles is determined by the user data. Bar graphs can also be used for more complex comparisons of data with grouped bar graphs. A bar chart is very used for recording certain information whether it is continuous or not continuous data.

C) Value Proposition Mapping

Value Proposition Mapping is a method employed to find redundancies in two similar products. In Value Proposition Mapping (VPM) we have a reference hexagon over which parameters of both the products are mapped. The line joining the centre of the hexagon to the vertex defines a parameter for performance. The performance of each product with reference to a specific parameter is plotted along the corresponding line between the vertex and the centre, the magnitude being proportional to the rating. Once the rating of a particular product for all the parameters is plotted, all these points are joined to form a polygon. A similar polygon is constructed for the second product. If the polygons so plotted overlap, there exists a redundancy in one of the products. VPM is a commonly used method to determine whether a new product to be launched is, by comparison with an existing product, redundant.

The Process

We use an accelerometer in order to encode the angular displacement of the hand in the X, Y and Z axis in the form of an analog voltage. This analog voltage is then converted into a digital word using an on chip Analog to Digital Converter. This digital word is then transferred wirelessly onto the computer via serial communication. Based on the value of this digital word the program running on the computer decodes whether the user wishes to plot a Pie Chart, Bar Graph or Value Proposition Mapping. Following this, the incoming bit stream that depends on the orientation of the user's hand is indicative of the value the user wishes to enter into the graph and is used to plot the previously specified graph. In this way the user can plot a complete graph by a series of hand gestures.

A) Process Flow

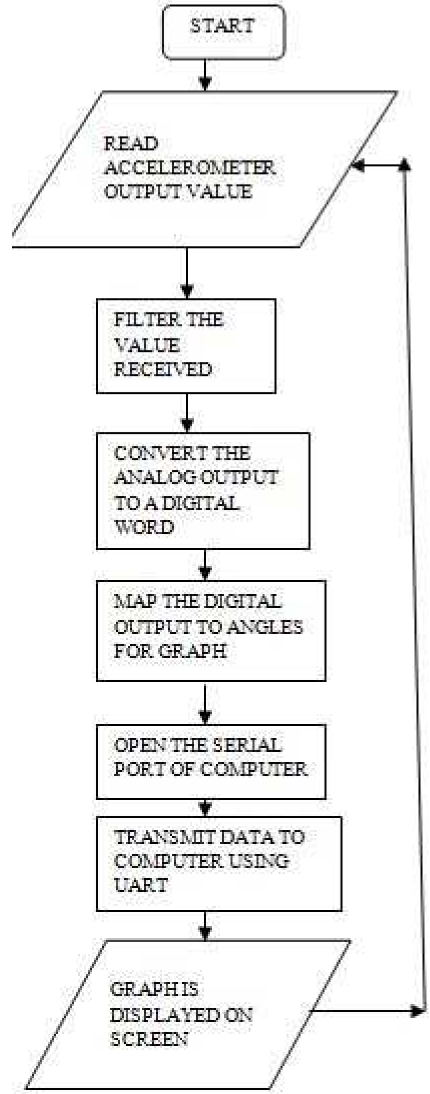

Fig 1: process flow

Testing and Results

Gesture Recognition is enabled by the accelerometer readings and is interpreted as follows:

Gestures for Selection:

- Hand shift in the positive x-direction (Horizontal Sweep) – Pi-chart
- Hand shift in the negative x-direction (Horizontal Sweep) – Bar Graph
- Hand Shift in the positive z-direction (Vertical Sweep) – Value Proposition Map

Gestures for Changing Value of Feature or Quantity:

- Hand shift in the positive z-direction (Vertical Sweep) – Increase Value
- Hand shift in the negative z-direction (Vertical Sweep) – Decrease Value

A) Pi Chart

User gesture for selection of Pi-chart:

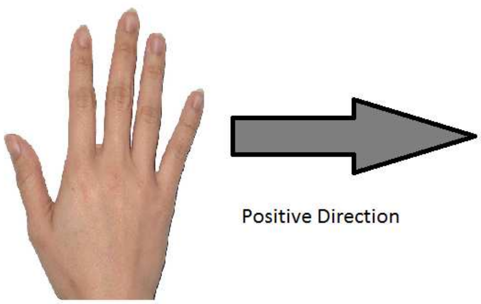

Fig 2(a): Hand Orientation

Pi-chart representation has been selected and the user is asked to define the number of sectors in the pi-chart.

>>Enter the number of sectors in the pi-chart

<<6

The user is now prompted to define the percentage representation of each sector.

The user defines the percentage by using the following gesture for increasing or decreasing the value:

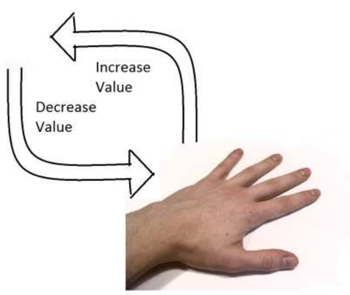

Fig 2(b): Hand movement

The final value, as decided by the user, is read.

>>Enter the percentage of Sector1:

<<30

>>Enter the percentage of Sector2:

<<15

>>Enter the percentage of Sector3:

<<20

>>Enter the percentage of Sector4:

<<5

>>Enter the percentage of Sector5:

<<25

The defined percentages of each sector are calculated in terms of angles corresponding to each sector and the pi-chart is plotted as shown in Fig.2(c).

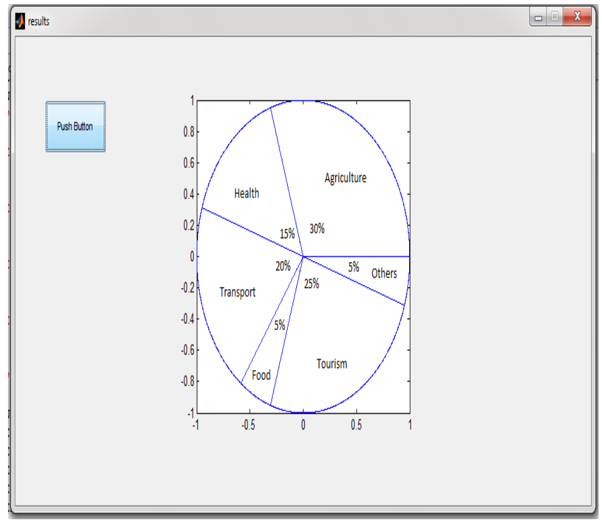

Fig. 2(c): Pi chart

B) Bar Graph

User gesture for selection of Bar Graph:

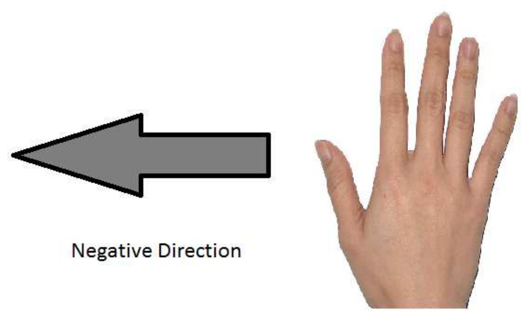

Fig 3(a): Hand orientation

Bar graph representation has been selected and the user has been asked to define the number of bars in the bar graph.

>>Enter the number of quantities to be represented in the bar graph

<<6

The user is now prompted to define the value representation of each quantity.

The user defines the value by using the following gesture for increasing or decreasing the value:

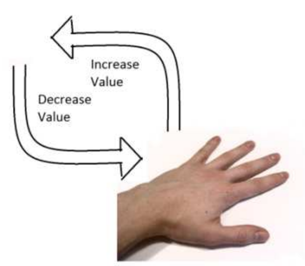

Fig 3(b): Hand movement

The final value, as decided by the user, is read.
>>Enter the value of Quantity1:
<<4
>>Enter the value of Quantity2:
<<6
>>Enter the value of Quantity3:
<<12
>>Enter the value of Quantity4:
<<11.4
>>Enter the value of Quantity5:
<<4.6
>>Enter the value of Quantity6
<<9

The defined values of each quantity are calculated against a threshold for each quantity and the bar graph is plotted as shown in Fig.3(c).

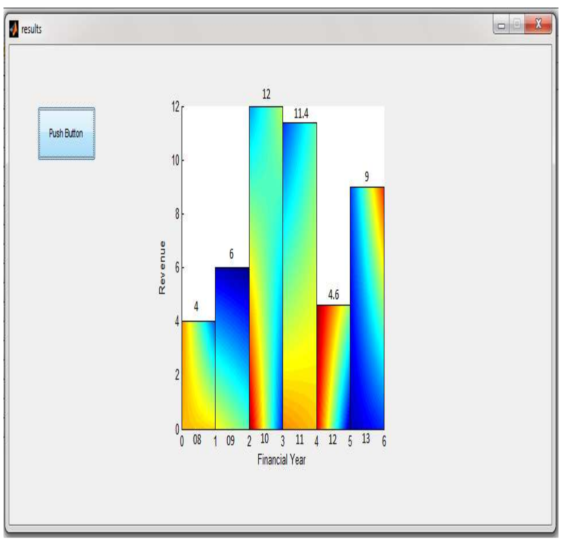

Fig 3(c): Bar Graph

C) Value Proposition Mapping

User gesture for selection of Value Proposition Map:

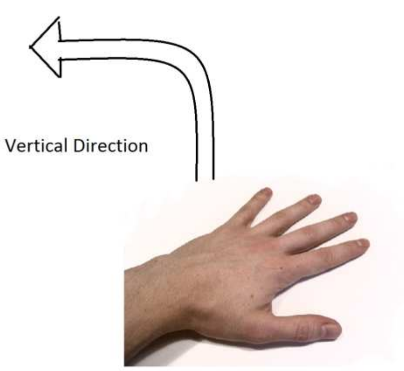

Fig 4(a): Hand orientation

Value Proposition Map has been selected and the Proposition Map has been plotted.

The user is now prompted to define the rating representation of each feature.

The user defines the rating by using the following gesture for increasing or decreasing the value:

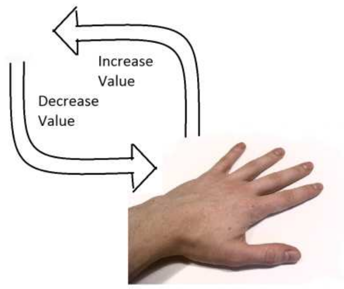

Fig 4(b): Hand movement

The final value, as decided by the user, is read.
>>Enter the rating of Feature1:
<<10
>>Enter the rating of Feature2:
<<6
>>Enter the rating of Feature3:
<<2
>>Enter the rating of Feature4:
<<8
>>Enter the rating of Feature5:
<<4
>>Enter the rating of Feature6:
<<3

The defined ratings of each feature are represented and the value proposition map is plotted as shown in Fig.4(c).

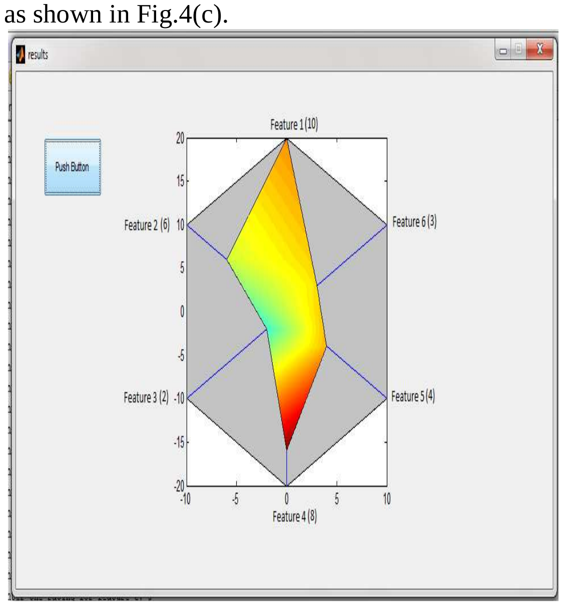

Fig 4(c): Value Proposition Mapping

Future Scope

Presently, the device supports the formulation of statistical representations – pi-charts, bar graphs and value proposition maps. The application can be expanded to include various other statistical representations which are frequently used in classrooms and boardrooms.

The Interactive Statistics Manager can be integrated with a designated surface in a room to simulate an Interactive Wall. Formulated statistics can be simultaneously projected on the wall and the laid out statistics can be interacted with and modified at any time.

The Interactive Statistics Manager can be implemented as a smart phone application using the .apk extension. The phone's accelerometer and gyro sensor can be used for detecting gestures, along with wireless transmission of data to the computer.

The Interactive Statistics Manager can be developed into an effective presentation and teaching tool to be implemented for classroom teaching and boardroom presentation.

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