FORM 2

THE PATENTS ACT 70
(Act 39 of 70)

COMPLETE S P E C I F I C A T I O N
(See Section 10)

TACTOGRAPH

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The following description particularly describes the nature of the invention and the manner in which it is to be performed.

FIELD OF INVENTION:

The present invention relates to a device for tactiling books. More specifically, the present invention relates to a device with a semi-autonomous plotting mechanism for tactiling existing printed images, so that a person can feel the pictures.

BACKGROUND OF THE INVENTION:

Picture books are of vital importance in children's development and equally so for the blind and visually impaired children. Young children are constantly exposed to images and texts in their environment and therefore quickly learn to recognise different letters and pictures. This recognition of letters and pictures is the first stage in the development of reading.

Blind and visually impaired children are often less familiar with letters and words when they start school than their sighted peers. The books available in the market for the visually impaired children are in Braille which is only text. At a young age reading books without images are uninteresting and a poor learning process. There is a need to tactile pictures in the books so that the children can feel the images with their fingers. Tactile pictures can give the visually impaired child an idea of how an object looks like. The main principle is that the pictures should be simple and lack detail, and that the structures must be perceptible. There are several ways of making tactile pictures. Embossing on books is costly and tactiling by hand is a laborious and slow process. Hence a need for a tactiling machine was felt.

Thus, the device of the present invention is designed to create accessible reading material for the visually impaired by tactiling existing printed images at a rate faster than the present manual process, as well as make the tactiling of such images cost effective.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a device with semi-autonomous plotting mechanism for tactiling existing printed images, or creating new tactile images, for visually impaired children.

The device of the present invention includes a five bar plotter head with a five bar mechanism with 2 degree of freedom for tactiling images . The five bar mechanism requires 2 actuators to control the 2 degrees of freedom. The actuators used are stepper motors with a resolution of 0.9°. Hence only a certain number of points can be reached by the linkage. Software simulation of the mechanism is used to identify possible toggle points and decide upon the link lengths appropriately. Another software code is written to generate the total reachable points which are used to optimize the plotting region by varying the following parameters: moving link lengths, ground link length and distance of the ground link from the top of the A4 sheet.

The inclusion of stepper motors in the model makes computer control of the device very easy and user friendly. The two stepper motors are controlled through USB communication. For this purpose, a microcontroller is used. The microcontroller has the capacity to generate a clock pulse as and when required, sample and digitize an input signal and also communicate with a computer. The logic sequence for the stepper motors is generated using a stepper motor controller. The motors are powered by an external power supply with a series of current limiters to limit the current drawn. The power handling of the motors is done using power driver IC.

BRIEF DESCRIPTION OF THE DRAWINGS:

Fig. 1 illustrates the five bar linkage of plotter head of the present invention
Fig. 2 illustrates external pump of present invention
Fig. 3 illustrates a typical software output plot of reachable points on an A4 sheet
Fig. 4 illustrates parallelogram linkage for plotter head
Fig. 5 illustrates slider Crank of plotter head
Fig. 6 illustrates rack and Pinion of plotter head
Fig. 7 illustrates the current prototype of the invention
Fig. 8 illustrates electronics circuit boards used in the present invention
Fig. 9 & Fig. 10 illustrates the 3D CAD model of the present invention
Fig. 11 illustrates the location of the camera relative to the plotter head

DETAILED DESCRIPTION OF THE INVENTION:

The present invention relates to a device with semi-autonomous plotting mechanism for tactiling existing printed images, so that visually impaired person can be enabled to feel the pictures. The existing printed image may be any image including communication chart, image from children's book etc. The device is used to create accessible reading material for visually impaired children, while also making them available to the normal children. It also helps the visually impaired parents to teach their small children, which would be a boon to both parents and the children.

Referring to fig.1, the device of the present invention includes a five bar plotter head with a five bar mechanism with 2 degree of freedom, also called a pantograph, for tactiling images . The advantages of a five bar – 2 degree of freedom mechanism are (i) A 2-degree of freedom motion is obtained with static actuators. (ii) Good manufacturability. (ii) Standard parts available in the market can be assembled together. (iv) No specially machined components are required. (v) Small size and good portability. (vi) The bending load requirement for a five bar is less compared to that of a 2-link or 3-link robotic arm because of a closed chain configuration.

The five bar mechanism requires 2 actuators to control the 2 degrees of freedom. The actuators used are stepper motors with a fine resolution. The present embodiment of the device used stepper motors with a resolution of 0.9°. The resolution determines the location of the points that can be reached by the linkage. Software simulation of the mechanism is used to identify possible toggle points and decide upon the link lengths appropriately. Another software code is written to generate the total reachable points which is used to optimize the plotting region by varying the following parameters: moving link lengths, ground link length and distance of the ground link from the top of the A4 sheet. A typical output plot of reachable points on an A4 sheet is shown in Fig. 3. The present invention includes the method of drawing straight lines by identifying the nearest points accessible by the linkage.

The present invention further includes a separate mechanism for engaging and disengaging the plotter head. The circuits and software required for the control of the pantograph are developed. Different modules of electronics and software have to be integrated to make it an autonomous machine. For the purpose of tactiling, a fluid is required that is quick in drying and doesn't spread on paper. The fluid of fabric pen or in a fluid correction pen or a whitener is felt to be the most appropriate and economic. In the case of a fabric pen or a whitener pen, the pressure on the pen controls the amount of fluid. The pressure on the pen is controlled by means of a tightening mechanism such as a screw and wing nut. In another embodiment the fluid can be injected using a separate mechanism. A parallelogram mechanism plotter head is proposed as shown in fig.4

The inclusion of stepper motors in the model makes computer control of the device very easy and user friendly. The two stepper motors are controlled through a means of communication such as a USB communication. In another embodiment, the motors could be controlled by wireless communication channels such as bluetooth. In the present embodiment, microcontroller generates the clock pulse as and when required. The clock pulse is then sent to the stepper motor controller which in turn controls the current that is sent to the motors. The motors are powered by an external power supply of 16 volts with series current limiters to limit the current drawn. In the current embodiment, the power handling of the motors is done using a Darlington array power driver IC.

The present invention further includes a camera mounted above the pantograph. The camera is also connected to the computer and is controlled by the software. The camera takes a picture of the page, the picture from the camera is transferred to the computer and the lines that are required to be made tactile are identified by a set of points. The computer then communicates these points to the stepper motors, through the microcontroller and stepper motor controller. The stepper motors in turn control the linkages and position the plotter head at the correct location. The fluid pen is then brought in contact with the paper to begin tactiling the picture along the identified set of points.

The present invention also envisages the repeated tactiling of different instances of the same picture on different pages. The first page with the picture is placed under the plotter head and a photo taken by the camera. The set of points on the first page are identified and the plotter head traces out picture. The first page is removed and a second page with an instance of the same picture is placed under the plotter head. The camera takes a second photo and sends it to

the computer. The image processing software on the computer then compares the first and second photographs and corrects the set of points to be tactiled for any offsets in translation and rotations in the placement of the second page, relative to the position of the first page. This process is then repeated for every new instance of the same picture. These activities are facilitated by a graphical user interface on the computer.

The software that accompanies the present invention is also capable of correcting for any aberrations between the estimated location of the plotter head and the actual position of the plotter head. The computer directs the stepper motor to position the plotter head at specific locations, or calibration points. The computer then uses the camera to take photogrpahs of the plotter head after it has stopped moving. The software then checks the location of plotter head in the photo taken by the camera against the location of caliberation point. The software then employs an inversion algorithm to determine the correction required to position the plotter on the calibration points. Thereafter, the correction is incorporated by the software in the commands sent to the stepper motor controller so that the plotter head can correctly trace the picture on the page.

Advantages of the invention

1 Tactiling of a printed picture by identifying points on the picture that need to be joined by lines
2 Use of quick drying fluid such as fabric paint or correction fluid to create a tactile line
3 Use of calibration and control software to auto-position the plotter head
4 Use of camera and image processing software to correct for translation and rotation errors.