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Programming in MikroBasic for Automation in Pattern Based Manufacturing

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Abstract

In this work the microcontroller is programmed in MikroBasic where the pattern shape is first determined using Fast Fourier Transforms offline and then the Fourier Coefficients are embedded in the program to perform calculations online to obtain the desired pattern. The stepper motors are used for accurate manufacturing. The program shows that microcontrollers do have sufficient memory to incorporate complex programs for intricate shape production.

Keywords: *Microcontroller programming, Cartesian robots, Pattern based manufacturing*

1. Introduction

In modern manufacturing, it is necessary that the capital is utilized in optimal manner. One naturally uses machines for such manufacturing but one has to select the process and machines such that they can manufacture variety of products first of all, and then the products should be made with specified precision and economically. To achieve these goals one has to have judicious choice of components or elements that go in manufacturing.

For an example, if we want to set up stitching / weaving type of industries in rural areas where electrical grid is not there then we can set up small power consumption machines. If the process is labour intensive then the cost will go up. To reduce the cost – automation and mechanization is needed even here because hand-made products of matching quality are difficult to be produced economically in large quantities since the probability of error is there in every piece made. These errors are much less with the use of machines. Machines can produce products with much higher degree of accuracy.

Therefore, the need is there to replace human labor with machines – those too with automatic type [1]. To run these machines in rural areas, one can easily convert solar energy widely available using efficient processes [2]

Secondly, we also know that robots can make many more variety of products than earlier generation of machines like lathes and milling machines [3, 4]. To make variety of products, one would need more than one such machines and for faster and accurate manufacturing, it would be desirable that these machines work in conjunction with each other i.e. there has to be a co-ordination between the machines. This is possible by co-ordinating the motions involved in the manufacturing process. This objective is also achieved in this work.

This paper deals with programming a microcontroller to make a pattern using a coordinated motion of the needles of a sewing machine and an X-Y robot. The microcontroller is used to provide motions to a X-Y or Cartesian robot as well as to a sewing machine as shown in Figure 1 [4]. The motion is provided using stepper motors

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which provide highly accurate motions. The advantage of using a microcontroller is that it can perform accurate computations besides they keep very accurate timing.

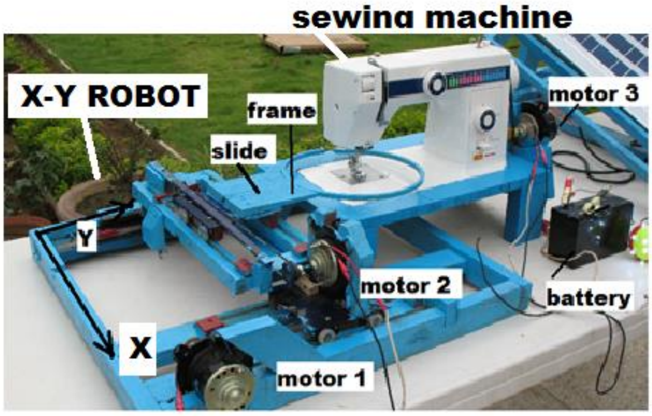

Figure 1. Motion to Embroidery Frame being Provided by x-y Motion Robot

2. Illustration of Devices for Automated Manufacturing

Figure 2 shows an arrangement where on a fabric, a geometrical shape has to be weaved (made). If one has a Cartesian robot, one can move the frame in X-Y plane ,In Figure 1, there are two motors 1 and 2 which provide X and Y motions respectively to the slide on which the frame for embroidery is rigidly attached. These are stepper motors which can provide highly accurate displacements [6]. These motors derive their electrical energy from batteries which can be charged either by solar panel (Figure 1) or Diesel generators can be used if the place does not have electrical grid. Motor 3 provides the motion to the needles in the Z direction [5].

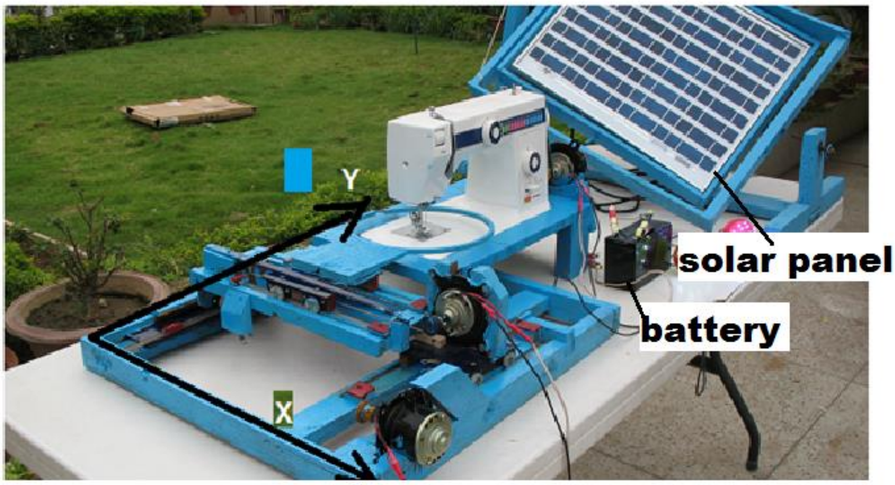

Figure 2. Battery being Charged by a Solar Panel

To have co-ordinated motion in the X, Y and Z directions, one uses microcontroller shown in Figure 3. Here, two Pulse Width Modulated (PWM) signals are generated and sent to two respective MOSFETS (Figure 4) corresponding to X and Y motions. The third motion, that of the needle along the Z direction, is given by motor 3. These MOSFETS are switching devices which open the high current gates [7]. The signals generated by microcontrollers in Figure 3 can drive the stepper motors.

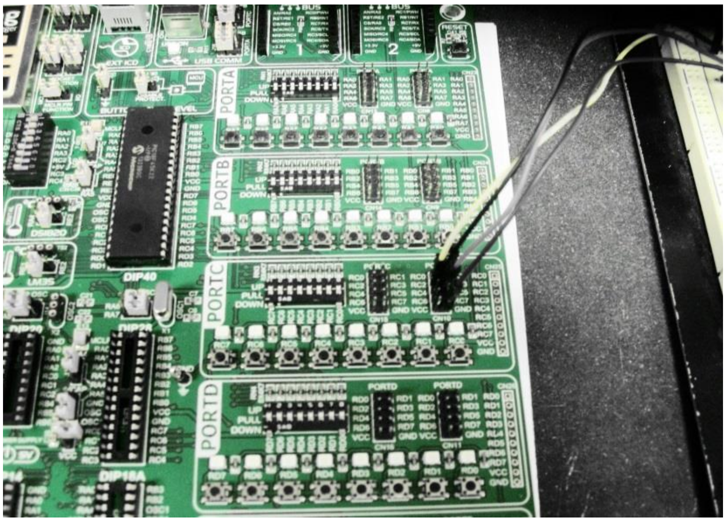

Figure 3. Use of Microcontroller to Provide Motion Control in the x,y, and z Directions

3. Programming Microcontroller

The experimental set up is shown in Figures 4 and 5. The associated computer program was written by referring to [9]. The chip used was PIK 18F45K22 which was mounted on a Easy Pic V7 Development Board.

Figure 4. The experimental set up

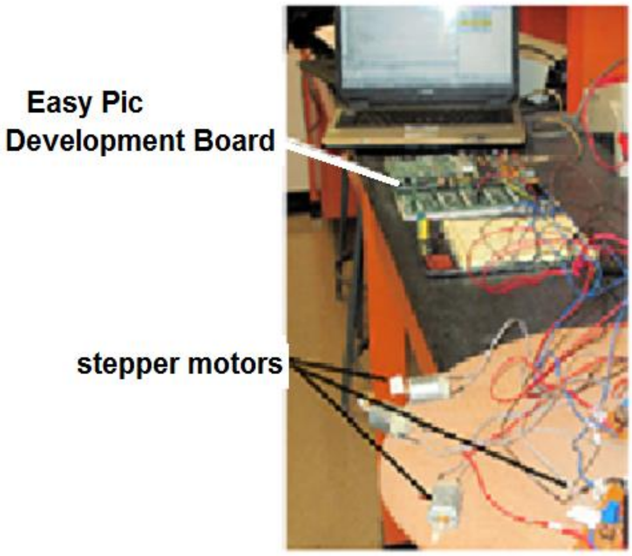

Figure 5 Experimental set up showing signal generation using a laptop computer

A computer program written in MikroBasic was used to drive the motors in Figure 5. The program was written for making embroidery of circular shape as shown in Figure 6. This figure shows a circle whose equation was obtained using a Fourier series. The Fourier coefficients were obtained using Fast Fourier Transform subroutine in MATLAB software [9]. These coefficients were stored in the memory of the controller.

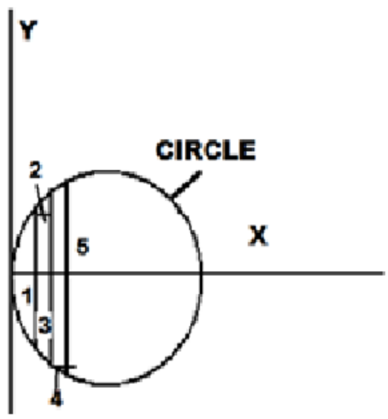

Figure 6. Weaving sequence along vertical direction (numbers 1,3,5) and horizontal direction (numbers 2, and 4)

The pattern to be weaved was carried out in a sequential manner where a vertical line of variable length (1) as shown in Figure 6 was stitched followed by a very small horizontal line of fixed length(2) and then, again a vertical line(3) and so on. Clearly, the end points of the vertical line were computed using Fourier coefficients on line. The horizontal movement was very small and of equal value until the entire circular pattern was filled up.

Using these principles, one can introduce automation in rural and remote areas where one can manufacture other parts or products at reduced cost and of far better quality than what is being done presently.

4. Conclusions

In this paper, a methodology was presented to introduce automation for precession manufacturing at reduced cost. By the introduction of microcontrollers, one can automate several machines which can act with co-ordinated motions to each other. This kind of manufacturing is also possible in rural areas where one can use solar energy. This way, the emissions of greenhouse gases can be reduced plus people do not have to migrate to urban areas in search of employment.

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References

[1] P. F. Ostwald, B. H Amstead and M. L. Begeman, "Manufacturing Processes", 7th Edition, **(1987)**, pp 450-466.
[2] A.M. Sharan and M. Prateek, M., "Automation of Minimum Torque Based Accurate Solar Tracking Systems Using Microprocessors, vol. 86, **(2006)**, pp. 415 – 437.
[3] J.J. Craig," Introduction to Robotics, and Control", 3rd Edition, Prentice Hall, **(2005)**, pp 62-92.
[4] R.A. Klafter, T.A. Chmielewski, and M. Negin, "Robotic Engineering: An Integrated Approach", Prentice Hall, **(1989)**, pp 58-70
[5] B.S.,Guru, and H.,R Hiziroglu, "Electric Machinery and Transformers ",Third Edition, BJS Publishers, New York, USA, **(1988)**, pp 201-244 ; 421-428.
[6] Sewing Machines, http://en.wikipedia.org/wiki/Sewing_machine
[7] MOSFET, http://en.wikipedia.org/wiki/MOSFET
[8] N. A. Mazidi,J. G. Mazidi, and R. D. McKinlay", The 8051 Microcontroller and Embedded Systems", 2nd Edition, Prentice Hall, New Jersey, USA, **(2006)**, pp 153-178.
[9] Fourier Analysis of Time Series, http://people.uncw.edu/hermanr/signals/Notes/ Signals.htm

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