

# Automated Manufacturing in Remote Areas Using Micro- Controllers

Punit Anand, Anand M. Sharan

**Abstract**— To achieve economical production, automation using micro-controllers have been used. This is carried out by mounting a frame for weaving a pattern on the end effector of an X-Y robot. The robot operates in conjunction with a sewing machine. The energy for driving these dc motor powered machines is obtained using photo-voltaic panels. The co-ordinated motions for the robot and sewing machine are obtained by programming a controller in mikrobasic language.

**Index Terms**— Robots in manufacturing, Microcontroller based manufacturing, Robot and machines having co-ordinated motions.

## I. INTRODUCTION

In vast areas of the world, economical manufacturing in rural areas has become a necessity as the cities are becoming over-crowded. This requires introduction of high- tech industries to be located in such areas. Quite often, such places require introduction of low cost machines due to the shortage of capital in these areas.

For an example, stitching / weaving type of industries require very small amount of power but are labour intensive. 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. The need is to replace human labor with machines – those too with automatic type<sup>1</sup>. To run these machines in rural areas, one can easily convert solar energy widely available using efficient processes<sup>2</sup>.

Secondly, if we introduce robots, they can make many more variety of products than earlier generation of machines like existing lathes and milling machines with human operators<sup>3,4</sup>.

This paper deals with programming a microcontroller to make a pattern using a sewing machine. 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.

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## II. 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 dc motors which can have displacement encoders mounted for feed-back<sup>5</sup>. 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<sup>6</sup>.

To have co-ordinated motion in the X, Y and Z directions, one uses micro- controller shown in Figure 3. Here two Pulse Width Modulated (PWM) signals are generated and sent to two respective H-Bridges (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 H Bridges are switching devices which open the high current gates using MOSFETs<sup>7</sup>. The signals generated by micro-controllers in Figure 3 can drive the two dc motors shown in Figures 1, and 2 using these H Bridges.

## III. PROGRAMMING A MICRO-CONTROLLER

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 5. 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<sup>8</sup>. These coefficients were stored in the memory of the controller.

The pattern to be weaved was carried out in a sequential manner where a vertical line of variable length (1) 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.

The associated computer program was written by referring to<sup>9</sup>. The chip used was Pic 18F45K22 which was mounted on

a Easy Pic V7 Development Board. The experimental set up is shown in Figure 7.

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.

These days, information through internet is available in many rural areas which can help in marketing of products or ordering of components for production.

#### IV. CONCLUSIONS

In this paper, a methodology was presented to introduce automation in rural and remote areas. By the introduction of micro-processors, these automated machines can be manufactured in rural areas, as well as such machines can be used to manufacture products.

By introduction of automation, people will find employment in villages and it will reverse the migration to cities for better life.

#### ACKNOWLEDGMENT

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#### LIST OF FIGURES

Figure 1 Motion of Embroidery Frame Being Provided by X-Y Motion Robot.

Figure 2 Battery Being Charged by Solar Panel.

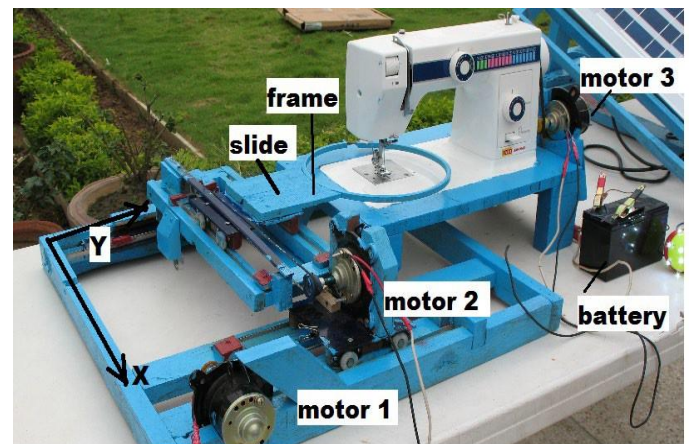
Figure 3 Use of Micro-Controller to Provide Motion in X, Y , Z Directions.

Figure 4 Three DC Motors are Controlled by Micro-Controller Through H Bridges.

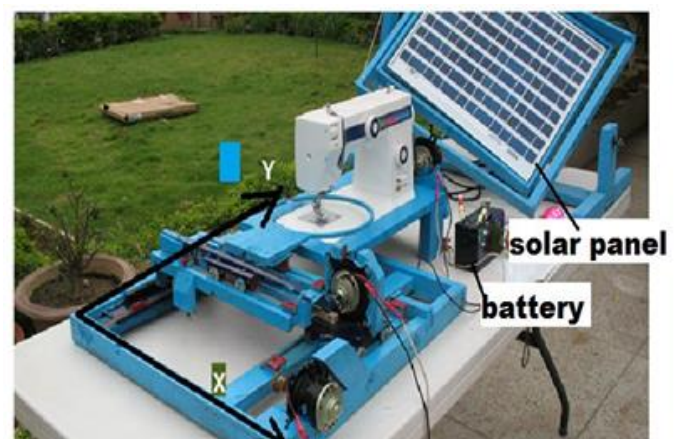
Figure 5 Weaving Sequence Along Vertical and Horizontal Directions.

Figure 6 Diagram Showing PWM Signal to H Bridge

Figure 7 Experimental Set Up for DC Motor Drive.



**Figure 1 Motion of Embroidery Frame Being Provided by X-Y Motion Robot.**



**Figure 2 Battery Being Charged by Solar Panel**

**Pic DEVELOPMENT BOARD BOARD**

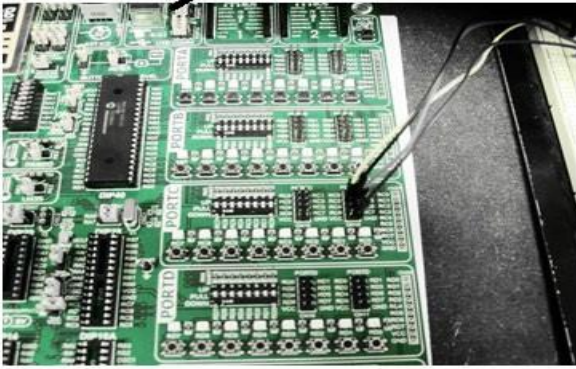


Figure 3 Use of Micro-Controller to Provide Motion in X, Y, Z Directions.

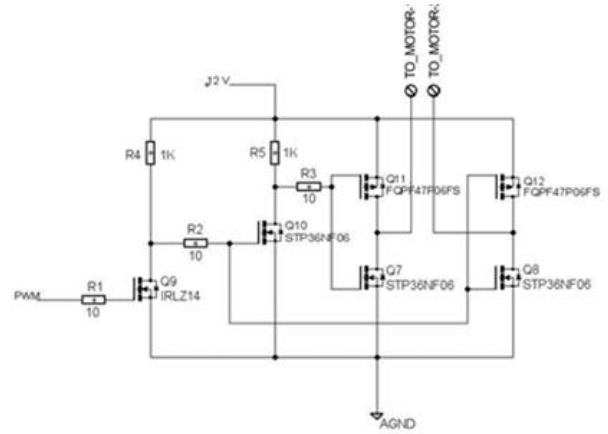


Figure 6 Diagram Showing PWM Signal to H Bridge

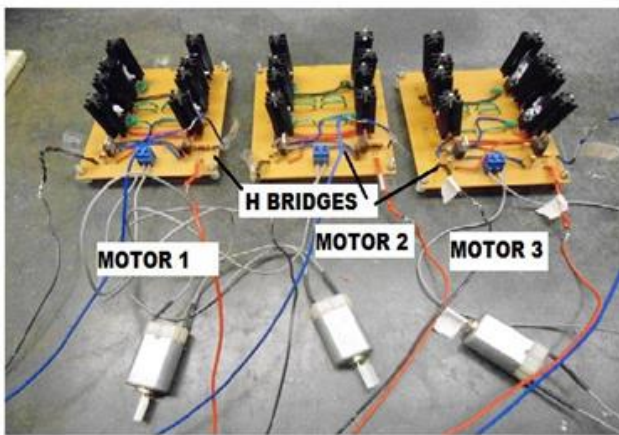


Figure 4 Three DC Motors are Controlled by Micro-Controller Through H Bridges

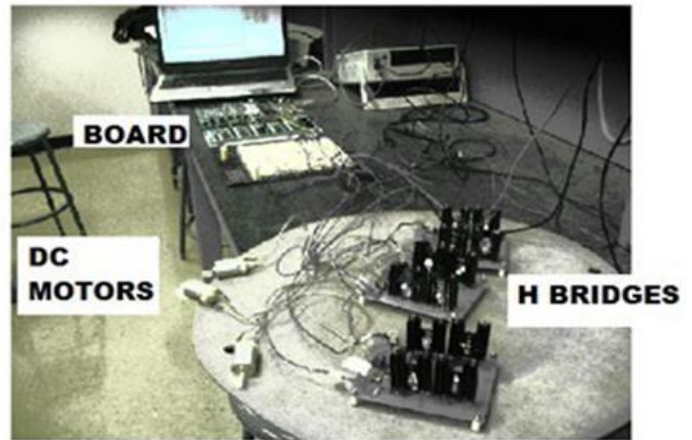


Figure 7 Experimental Set Up for DC Motor Drive

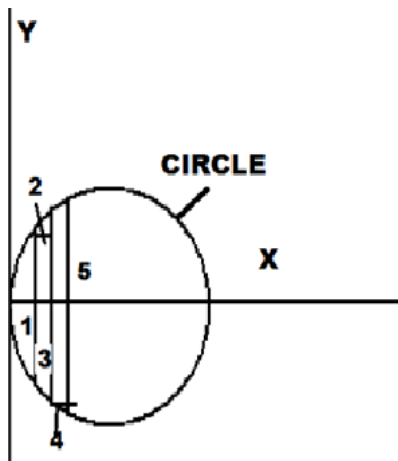


Figure 5 Weaving Sequence Along Vertical and Horizontal Directions

**APPENDIX A**

**DC MOTOR PROGRAM**

MASTER

h master.c

C:\Users\asharan.ENGR\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.Word\master.c

C:\Users\ASHARA~1.ENG\AppData\Local\Temp\master.c

/\*\*\*\*\*\*

AUTOMATIC WEAVE MACHINE

MASTER CODE

\*\*\*\*\*/

/\* header files \*/ #include<16f876.h>

#fuses HS,NOWDT,NOPROTECT #fuses NOBROWNOUT,NOPUT,NOLVP



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```

#use delay(clock=2000000) #org 0x1F00,0x1FFF{ }          {break;}

                                                    /*          loop on y */ yold=ymin; while(TRUE)

/* declare variables */ float xnew,ynew; float xold,yold;    {
float xmax,ymax; float xmin,ymin; float delx,dely;          ynew=yold+dely; set_pwm2_duty(2*power);
                                                            delay_ms(480); set_pwm2_duty(power);

int power;                                                  /*          needle motion */

                                                            spi_write(2*power); delay_ms(80); spi_write(power);
/* main code */                                             yold=ynew; if(ynew>ymax)

                                                            {break;}

void main()                                                 }

                                                            xnew=xold+delx; set_pwm1_duty(2*power);
                                                            delay_ms(480); set_pwm1_duty(power); xold=xnew;

// setup ports //

setup_spi(SPI_MASTER); setup_adc_ports(ALL_ANALOG);
setup_adc(ADC_CLOCK_INTERNAL);
setup_timer_2(T2_DIV_BY_16,254,1);
setup_ccp1(CCP_PWM); setup_ccp2(CCP_PWM);

//          data // delx=1.0;dely=1.0;
xmax=10.0;ymax=10.0; xmin=0.0;ymin=0.0;
xold=xmin;power=127;

// stop motors //
set_pwm1_duty(power); set_pwm2_duty(power);

// setup delay // delay_ms(7000);

/* control loop */

while(TRUE)
{
/*          loop on x */ xnew=xold+delx;
set_pwm1_duty(2*power); delay_ms(480);
set_pwm1_duty(power); xold=xnew;
if(xnew>xmax)

```

```

#fuses HS,NOWDT,NOPROTECT #fuses
NOBROWNOUT,NOPUT,NOLVP
#use delay(clock=2000000) #org 0x1F00,0x1FFF{ }

/* declare variables */ int signal;

int power;

/* main code */

void main()
{

// setup ports // setup_spi(SPI_SLAVE);
setup_timer_2(T2_DIV_BY_16,254,1);
setup_ccp1(CCP_PWM);

power=127; set_pwm1_duty(power);

/

```

## I. APPENDIX B STEPPER MOTOR PROGRAM

```

/*****
AUTOMATIC WEAVE MACHINE
STEPPER MOTOR

*****//
// PORT_C_PULLUPS(True); // delay_ms(7000);

// data // delx=1.0;dely=1.0; xmax=10.0;ymax=10.0;
xmin=0.0;ymin=0.0; xold=xmin;lag=3;
times=12;

/* header files */

#include <16f876.h>

#fuses HS,NOWDT,NOPROTECT #fuses
NOBROWNOUT,NOPUT,NOLVP
#use delay(clock=2000000) #org 0x1F00,0x1FFF{ }

#USE
FIXED_IO(A_outputs=PIN_A3,PIN_A2,PIN_A1,PIN_A0)
#USE
FIXED_IO(B_outputs=PIN_B3,PIN_B2,PIN_B1,PIN_B0)

```

```

#USE
FIXED_IO(C_outputs=PIN_C3,PIN_C2,PIN_C1,PIN_C0)

BYTE const one[4] =
{0b00001010,0b00000110,0b00000101,0b00001001};

BYTE const two[4] =
{0b00000110,0b00001010,0b00001001,0b00000101};

/* declare variables */

signed int bits; float xnew,ynew; float xold,yold; float
xmax,ymax; float xmin,ymin; float delx,dely; int it,lag;
int times;

/* main code */

void main()
{
// setup ports // setup_timer_2(T2_DIV_BY_16,254,1);
// PORT_A_PULLUPS(True); //

// PORT_B_PULLUPS(True); //

// PORT_C_PULLUPS(True); // delay_ms(7000);

// data // delx=1.0;dely=1.0; xmax=10.0;ymax=10.0;
xmin=0.0;ymin=0.0; xold=xmin;lag=3;
times=12;

/* control loop */

while(TRUE)
{
/* loop on x */

```

```

it=0;bits=0; while(it<times){it++;                               {break;}
    OUTPUT_A(one[bits]); delay_ms(lag);bits++;
if(bits==4) {bits=0;};} xnew=xold+delx; xold=xnew;                }
if(xnew>xmax)                                                    }

    {break;}                                                    }

/* loop on y */ yold=ymin;                                       }

while(TRUE)

{

it=0;bits=0; while(it<times){it++;

OUTPUT_B(one[bits]); delay_ms(lag);bits++; if(bits==4)
{bits=0;};} ynew=yold+dely; yold=ynew;

/* needle motion */ it=0;bits=0; while(it<times){it++;
OUTPUT_C(one[bits]); delay_ms(lag);bits++; if(bits==4)
{bits=0;};}

if(ynew>ymax)

{break;}

}

it=0;bits=0; while(it<times){it++; OUTPUT_A(one[bits]);
delay_ms(lag);bits++; if(bits==4) {bits=0;};}

xold=xnew; xnew=xold+delx;

/* loop on y */ while(TRUE)
{

it=0;bits=0; while(it<times){it++; OUTPUT_B(two[bits]);
delay_ms(lag);bits++; if(bits==4) {bits=0;};}

ynew=yold-dely; yold=ynew;

/* needle motion */ it=0;bits=0; while(it<times){it++;
OUTPUT_C(one[bits]); delay_ms(lag); bits++; if(bits==4)
{bits=0;};}

if(ynew<ymin)

```