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AN ANALYSIS OF DESIGN OF PROTOTYPE OF LAPAROSCOPIC MORCELLATOR IN LOW- COST

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Abstract: The main review is based on Morcellators which is surgical tool that doctors use to cut bigger chunks of tissue into smaller once, usually during laparoscopic surgery we intend to built prototype of low-cost morcellators using dc motor controlling .By studying techniques of PWM and various other morcellators. Now days the cost of abdominal surgery is high the main reason behind this is the surgical cost involve in this process.The machinery is mostly imported from German countries as a result the cost is high so we intended to build an morcellator which is low in cost and built in India. We are mainly using PWM property of Atmega328 to control the speed of motor.Also SMPS to control the input voltage and DC Buck converter to step down input voltage and IC7805 to give input voltage to our IC

Keywords: Laparoscopy,Morcellators,PWM,Atmega328p.

I. INTRODUCTION

Laparoscopy is a type of surgical procedure that allows a surgeon to access the inside of the abdomen and pelvis without having to make large incision in the skin. This allows your doctor to view tissue or take a tissue sample, such as removing a damaged or diseased organ, or removing a tissue sample for further testing, called a biopsy. What used to happen earlier, doctors used large cut on stomach to diagnose and perform the operation after that result used to come. In that process the patient used to suffer more, and it takes one or one and half months for him to recover. So to decrease in the cost of the surgery can be done by reducing the operation cost so we came with this low cost morcellator.A morcellator is a surgical instrument used for division and removal of large masses of tissues during laparoscopic surgery.A morcellator has rotating a tool whose speed is control by the doctor with the increment and decrement . The PWM property of AtEmega328p is used in our system..Atmega328P is the heart of our system .We are aslo using SMPS ,IC7805,LM2596, and CD4051C and crystal oscillator in our proposed system.

II. LITERATURE SURVEY

Shubham Banerjee, Sandipta Mondal, Bhaskar Saha, ArnabJyoti Mandal [1]: The authors presented the paper “Speed Control of a DC Motor Using Pulse Width Modulation, Potentiometer and IR Sensor”. It was published in International Journal of Advanced Research in Science, Engineering and Technology. Speed control of DC motor is very crucial in applications where large variation of speed is required. In our research, an initiative has been adopted to control the speed of DC motor using Pulse With Modulation (PWM) method by embedding a control system into a DC motor using PWM property of AEmega328p is used .Atmega328P is the heart of our system .We are also using SMPS ,IC7805,LM2596, and CD4051IC.To measure the speed of the motor, to fulfill the requirements for controlling and measuring the speed of a DC motor.

Mary I. Frecker, PhD, Jeremy Schadle,Published in 2016[2]: The authors presented the paper "Laparoscopic Multifunctional Instruments”". , MS JSLS (2005)9:105–112.This paper has helps us in learning the basic of instruments of laparoscopic surgeries.Morcellator used in surgeries are important part.We learn about the functions of morcellator in an surgery from this paper.

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III. COMPONENTS

A. *System Components*

1) Atmega328p

ATMEGA328P is high performance, low power controller from Microchip. ATMEGA328P is an 8-bit microcontroller based on AVR RISC architecture.It is a 28 pin chip. It has 6 PWM channels. In order to get the PWM from Atmega, we need to use the timer/counter module of the Atmega. This module can be used in several modes to generate different PWM signals of different characteristics; we use the counter in the "Phase Correct PWM" mode. Atmega32 has 3 timer/counters and we are using timer/counter 0In "Phase Correct PWM" mode, the counter counts repeatedly from 0 to its maximum value (0xFF) and then back from the maximum to zero.

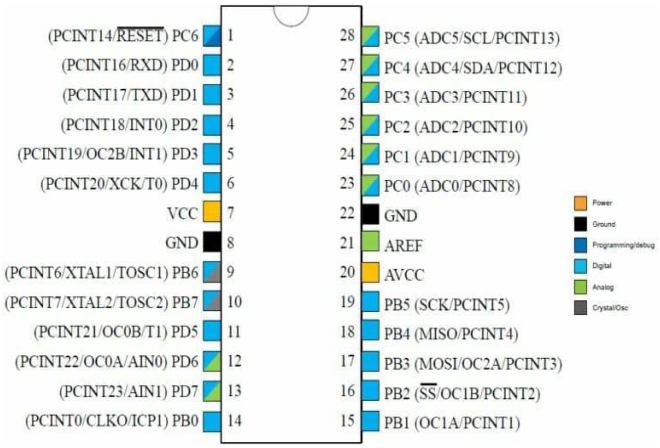

Fig. 1 Atmega328P Pin Diagram

2) SMPS

A switched-mode power supply (SMPS or switcher) is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently. An SMPS transfers power from a DC to AC source to DC loads, such as a personal computer, while converting voltage and current characteristics. In a SMPS, the output current flow depends on the input power signal, the storage elements and circuit topologies used, and also on the pattern used to drive the switching elements. In our project SMPS convert 240v into 24v power supply.

3) LM2596

The LM2596 is a commonly used popular step down switching regulator IC. It is 12v adjustable regulator IC. It is used in Switch mode power supply. It commonly used to power/control heavy loads. Fig. 1.3 LM2596

Fig1.3LM2596

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4) 7805 IC

IC 7805 is used to make supply 5Volts for Digital Devices from 24V SMPS Source. IC 7805 is a 5V Voltage Regulator that restricts the output voltage to 5V output for various ranges of input voltage. It acts as an excellent component against input voltage fluctuations for circuits, and adds an additional safety to your circuitry. It is inexpensive, easily available and very much commonly used. The voltage regulator IC 7805 is actually a member of the 78xx series of voltage regulator ICs. It is a fixed linear voltage regulator. The xx present in 78xx represents the value of the fixed output voltage that the particular IC provides. For 7805 IC, it is +5V DC regulated power supply.

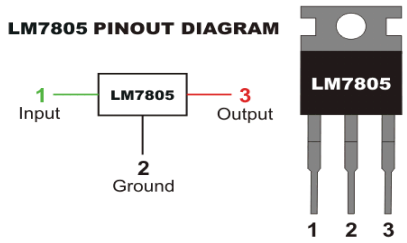

Fig1.4 IC7805

5) Relay

Single pole Single throw relay is a device that has only input and one output. It only connects or disconnect only one contact when it is operated. Including the coil terminal, it has a total of four terminal or electronic circuit.it has a total of four terminal. The SPST relay can control a single electrical or electronic circuit. It generally provides a switching function or on/off function as an electrical switch provides, just the difference is, it controlled by an electrical or electronic signal.

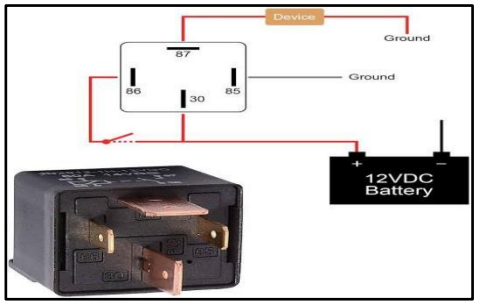

Fig1.5 Relay

6/)LCD Display (20*4)

A Liquid Crystal Display (LCD) has liquid crystal material sandwiched between two sheets of glass. Without any voltage applied between transparent electrodes, liquid crystal molecules are aligned in parallel with the glass surface. LCD Display send to Show The Speed Status of our Motor. It is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizers. Liquid crystals do not emit light directly.

7)DC motor

DC motor is an electrical machine that converts electrical energy into mechanical energy.

The working of CD motor on the principle that when a current carrying conductor is placed in a magnetic field, it experiences a mechanical force.

The direction of this force is given by Fleming's left-hand rule and magnitude is given by;

F=BIL Newton

According to Fleming's Left-hand rule when an electric current passes through a coil in a magnetic field, the magnetic force produces a torque that turns the DC motor.

- **Specification:**

  Brand: JHONSON
  Motor diameter: 27.5mm
  Motor length: 37.8mm

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Shaft Diameter:2.3mm
Mounting hole:2-M2
Weight: 97g
Rated voltage: 12v
No-load speed: 6800RPM

Fig1.7 DC motor

IV. METHODOLOGY

The main aim is to control the speed of motor very efficiently. Cosidering a lot of components we designed PCB using proteus. The components used are very fragile in nature .we have tried to made them as much compact as possible so failure ratio is decreased and can be used efficiently is surgeries. Our Morcellators has basically 3 main PCB division one is SMPS. Firstly we have use 24 v dc SMPS where 240 volt AC domestic supply is converted to 24 V DC with 5 ampere of current. Another one is ATmega328p board and other is power control board .Atmega 328p is used to control our motor speed using pulse width modulation. Then LM2596 step down 24 V dc voltage to 12 V dc which is supplied to atmega board where 7805 again regulates it and gives 5V to our Atmega 3208p .

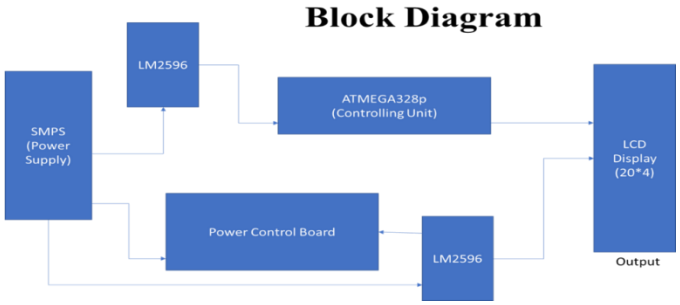

Fig1.8 Block Diagram

I.)INTERFACING LCD MODULE WITH AVR

As shown in the circuit diagram, port B and port D of the controller is used for interfacing it with LCD module. In 4bit mode only 4 lines D4-D7, along with RS, R/W and E pins are used. This will save us 4 pins of our controller which we can use it for other purpose. Here we only need to write to the LCD module. So the R/W pin can be ground it as shown in the schematic diagram.

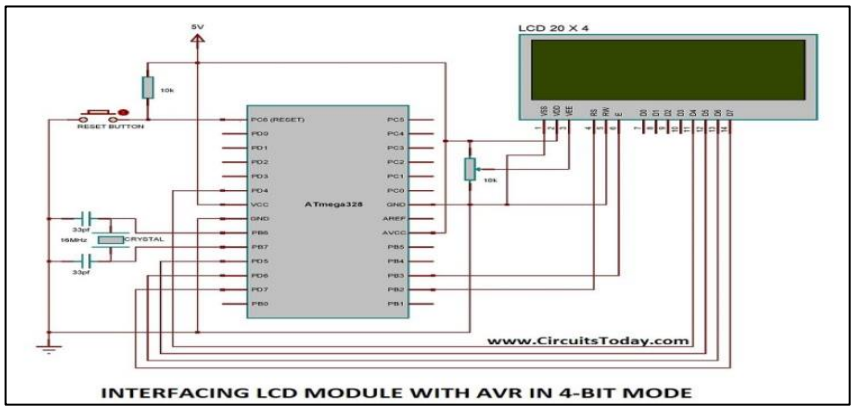

Fig1.9 Block diagram of interfacing of LCD

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II.) PULSE WIDTH MODULATION

PWM stands for Pulse Width Modulation and it is a technique used in controlling the brightness of LED, speed control of DC motor, controlling a servo motor or where you have to get analog output with digital means.
The Arduino digital pins either gives us 5V (when turned HIGH) or 0V (when turned LOW) and the output is a square wave signal. So, if we want to dim a LED, we cannot get the voltage between 0 and 5V from the digital pin but we can change the ON and OFF time of the signal. If we will change the ON and OFF time fast enough then the brightness of the led will be changed.
Before going further, let's discuss some terms associated with PWM.
TON (On Time): It is the time when the signal is high.
TOFF (Off Time): It is the time when the signal is low
Period: It is the sum of on time and off time.
Duty Cycle: It is the percentage of time when the signal was high during the time of period

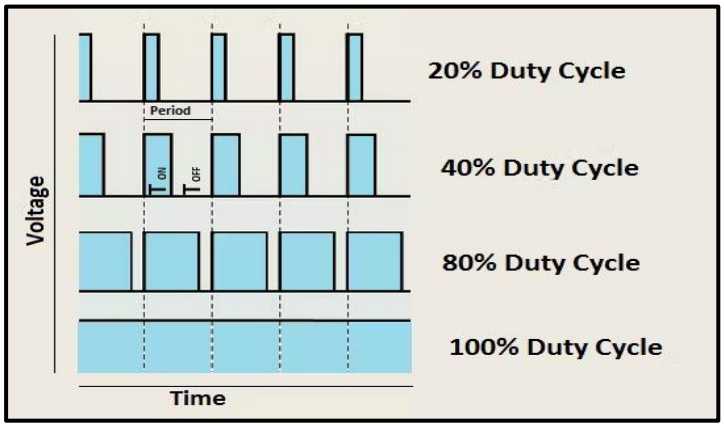

FIG:10 REPRESENTS THE PWM

The PWM in Atmega328 is modulate using this program .

```
#include <LiquidCrystal.h>

#define  rs          12
#define  en          11
#define  d4          10
#define  d5          9
#define  d6          8
#define  d7          7

#define BUTTON_INC      2
#define BUTTON_DEC      3

#define ENC_1          19
#define ENC_2          18
#define ENC_3          17
#define ENC_4          16

#define MOTOR_STATUS_ON   14
#define MOTOR_STATUS_OL   15
```

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```
#define MOTOR_STATUS_OUT  4

#define BUZZER            13


LiquidCrystal lcd(rs, en, d4, d5, d6, d7);

int i = 0, v=0;
int8_t motor_speed            = 0;
bool motor_status             = false;

const uint8_t encoder_pins[4]  = {ENC_1, ENC_2, ENC_3, ENC_4};

void gpio_init(void);
void lcd_init(void);




void setup()
```

```
  gpio_init();
    lcd_init();
}

void loop()
{
    lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("SPEED:- ");
  lcd.setCursor(10, 0);
  lcd.print(" %");
  lcd.setCursor(8, 0);
  lcd.print(motor_speed);
  lcd.setCursor(0, 1);
  lcd.print("Motor:-     ");

  if(motor_speed >= 1)
  lcd.setCursor(8, 1);
  lcd.print("ON         ");

  if(motor_speed == 0)
  lcd.setCursor(8, 1);
  lcd.print("OFF        ");

  lcd.setCursor(0, 2);
  lcd.print("            ");
```

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```
 lcd.setCursor(0, 3);
 lcd.print("            ");

 delay(250);



 check_button_input();
 update_encoder();

}



void gpio_init(void)
```

```
{
 pinMode(BUTTON_INC, INPUT_PULLUP);
 pinMode(BUTTON_DEC, INPUT_PULLUP);

 pinMode(MOTOR_STATUS_ON, INPUT);      //**
 pinMode(MOTOR_STATUS_OL, INPUT);      //**

 for(uint8_t i = 0 ; i < 4 ; i++)
 pinMode(encoder_pins[i], OUTPUT);

 pinMode(BUZZER, OUTPUT);
 }


void lcd_init(void)
{
 lcd.begin(20, 4);
 lcd.setCursor(0, 0);
 lcd.print("      Welcome      ");
 lcd.setCursor(0, 1);
 lcd.print("    LAPAROSCOPIC    ");
 lcd.setCursor(0, 2);
 lcd.print("    Morcellator    ");
 lcd.setCursor(0, 3);
 lcd.print("      Ver 1.0.1     ");
 delay(3000);
 lcd.clear();
 /*
```

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```
  lcd.setCursor(0, 0);
  lcd.print("Powered By");
  lcd.setCursor(0, 1);
  lcd.print("      ");
  lcd.setCursor(0, 2);
  lcd.print("Nagpur");
  lcd.setCursor(0, 3);
  lcd.print("      ");
  delay(3000);
  lcd.clear();
  */
}
```

```
void update_encoder(void)
```

```
  uint8_t b = 0, a = (uint8_t)(motor_speed/10);

 if(a == 0)
  { a = 0;}

  else if(a >= 0)
  {  a = a - 1; }

  for(b = 0 ; b < 4 ; b++)
    digitalWrite(encoder_pins[b], (a & (1 << b))?1:0);
}

void check_button_input(void)
{
  if(!digitalRead(BUTTON_INC))
  {
    motor_speed += 10;
    if(motor_speed > 100)
      motor_speed = 100;
    motor_status = true;
    digitalWrite(MOTOR_STATUS_OUT, 1);
    digitalWrite(BUZZER, 1);
    delay(70);
    digitalWrite(BUZZER, 0);
//    hc05_send_data();
    while(!digitalRead(BUTTON_INC));
  }
  if(!digitalRead(BUTTON_DEC))
  {
    motor_speed -= 10;
    if(motor_speed <= 0)
```

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```
  {
    motor_speed = 0;
    motor_status = false;
    digitalWrite(MOTOR_STATUS_OUT, 0);
  }
  digitalWrite(BUZZER, 1);
  delay(70);
  digitalWrite(BUZZER, 0);
//  hc05_send_data();
  while(!digitalRead(BUTTON_DEC));
}
```

V).CONCLUSION

The proposed morcellator has the potential to greatly increase patient safety and to decrease the morcellation time required by current designed, especially for large tissue. A shorter procedure time translates to lower operating room costs and less time that a patient spends under anesthesia. The danger of seeding and accidental destruction of healthy tissue are potentially significantly reduced in the design, which could position this device as a prime candidate for the being able to safety perform laparoscopy tissue removal in case of malignant or premalignant tissue. We have successfully implemented our prototype of morcellator with motor controlling.We got the desired speed of motor in different stages. and results are shown in Figure given below.

FIG 1.10.MORCELLATOR

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We have to connect our motor to the GTx16 connectors and also our paddle to it .When we press our paddle the motor starts .We were able to control the speed of our motor in ten different stages by clicking increment and decrement buttons.

ACKNOWLEDGMENT

We acknowledge the support given to us by our guide **DR .Pankaj.M Shende** who guided us throughout in this project and also Seven Star Hospital for supporting us and explaining the surgery and functioning of instruments. .

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