

**MATLAB based servomotor controlled Wheelchair
using Arduino Uno board**

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Submitted by

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CERTIFICATE

This is to certify that the M. Tech. dissertation entitled “**MATLAB BASED SERVOMOTOR CONTROLLED WHEELCHAIR USING ARDUINO UNO BOARD**”, submitted by **DEVENDRA KUMAR DESHMUKH (DTU/13/MTECH/394)** in partial fulfilment of the requirement for the award of the degree of Master of Engineering, Delhi Technological University (Formerly Delhi College of Engineering, University of Delhi), is an authentic record of the candidate’s own work carried out by him under my guidance.

The information and data enclosed in this dissertation is original and has not been submitted elsewhere for honouring of any other degree.

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I hereby declare that the details furnished above are true and correct to the best of my knowledge and belief and I undertake to inform you of any changes therein, immediately. In case any of the above information is found to be false or untrue or misleading or misrepresenting, I am aware that I may be held liable for it.

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Signature of candidate

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Devendra kumar Deshmukh
2k13/BME/10

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MATLAB based servomotor controlled Wheelchair using Arduino Uno board

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ABSTRACT

This project basically deals with the new technology application in field of wheelchair. According to WHO report, 15% of world population living with physical disabilities. Physical disable people is world's largest minority.. To help these people with low cost smart wheelchair will be boon for them. To tackle this problem In project provide the solution. Recently the open source hardware Arduino get popularity. In this project using Arduino Uno board the servomotor is controlled via MATLAB interface the direction can be controlled via the graphical user interface. In result the servomechanism will be used to control the direction of wheelchair. The people diagnosed with disability, impairment and handicap can easily utilise. Though this project focuses on the simple model of servomotor its mechanism and Arduino based programmed and controlled. It provides great insight for future technology. The first part is dealing with literature associated with wheelchair in current scenario and trends and technology used in that solution. Various condition & type of disability is also discussed. The next part is dealing with the methodology used to design the graphical interface with Arduino board. Arduino Uno board is also discussed in briefly. Now the programming part which is very essential in this project, the serial communication between COM port and Arduino uno board has been explained. The last but not least the future perspective of this project with few ideas is shown and discussed.

1. INTRODUCTION

The market is currently full of different types of wheelchairs. To provide mobility for physically disabled people who face difficulties to drive conventional wheelchairs, is the main objective of this project

1.1 Control mode

Manual Mode

The wheelchair is only used to transmit and adapt data from the user and the mobility task.

Automatic Mode

The wheelchair has complete control of the system, once the desired goal is selected.

Semiautonomous Mode

Control is divided between the user and the wheelchair, sharing degrees of liberty. e.g.) the user: select path to go, the machine: keeping away obstacle. Human beings are having various mobility impairments and disability of which only few of them are discussed here where we use the wheelchair mostly.

1.2 Mobility Impairments Include:

Cerebral Palsy

Cerebral palsy is caused due to damage of developing brain. The cerebral palsy causes many physical & mental disabilities due to which a person is unable to do proper movement by their own so they need special kind of wheelchair to support their movement from one place to another. Infants are vulnerable to this disease. If a child is affected by meningitis disease during the initial year and any physical damage occurs to the brain may lead to meningitis.

Spina Bifida

This disease is also caused during the infant stage. The spinal cord is not properly developed and bifurcated during the developmental stage. The deficiency of folic acid can also be the cause of Spina bifida. So people grow with disabilities. To help them a proper wheelchair is needed.

Muscular Dystrophy

Muscular dystrophy is the inherited disease in which muscle becomes weaker. The disease rises progressively and its onset occurs at any age. Myotonic muscular dystrophy is found majority in male & female at childhood which causes the disability. Further, to help people the wheelchair is needed.

Heart Defects

Heart defects can be congenital or may be after birth. But defect cause the problem in proper circulation of blood. Which means obstructed or irregular supply, causes the difficulties in movement and locomotion. So wheelchair is required for their locomotion from one place to another.

2. REVIEW OF LITERATURE

The wheel chair which is the power assisted can even climbs the steps without any help or assistance. The patient maintains inverse pendulum the dc motors is more or less responsible for the motion. Here the front wheel raising method is discussed. The back and forth moving scheme is also explained here. The DC motors are extensively used here [1]

Generally people with disabilities have to seek the help from another person for moving one place to another place. Scientist and engineers are regularly trying their best to innovate so that they need not to depend on another person. Here we have used Single Ended primary Inductor converter (SEPIC) and maximum power point tracking (MPPT) algorithm which is responsible for better battery status for long time. The Estimate Perturb and Perturb algorithm for durable wheelchair battery is also applied.[2]

Here gearless drive for DC motor is presented for wheelchair. The three dimensional FEM modelling has been used for determining performance of motor. The experimental measurements are done on motor prototype to study and for validation. [3]

The socially assistive robots development is the new trend emerging it is multidisciplinary area required various expertise to solve various health problem. The focus here is to design Agent which can interact with people by various means and methods. Since people are less experience in results and field trial relating to it. Here design of companion robot called Robot chair have taken place. It is one kind of socially assistive robot. It is responsible to carry a person. The clinical measurements and several factors including obstacle avoidance, localization and human detection are taken place. The scalable module has been used here the robot operating system and open source robotic middleware framework are used. The distributed controller network is used many times and multiple hardware devices and operating systems are also being used. [4]

Wheelchairs are just a reason to survive and purpose to physically disabled people. The cost effective and reasonable wheelchair to the masses needed to the common masses is with present day technology. The joystick control is replaced with hand glove control system .Here by flexing the fingers one can control the wheelchair. The glove is generally fitted with flex or bend sensor by which we can control the movement and direction of the wheelchair. The wireless connection can also be established the unidirectional control. The more hi-tech wheelchairs are made of and required for people with disabilities. [5]

The independent mobility with wheelchair reduces the dependence and person feels more confident. The physical disable people due to their deficiency or inability feels very challenging. A wheelchair not only improves the life style but also improves the mobility of disable people. It allows them to explore surroundings. Here new technique is proposed to control the motorized wheelchair using Infrared radiation. Low intensity infrared is transmitted on eye lid. The eye lid movements cause change in voltage level due to change in intensity. This technique used for avoiding collision and navigate properly in all direction. The user is robustly able to interact. The human efforts are reduced directly. The self independence is achieved in daily life activities of the disable person. The range of mobility improved drastically.[6]



Figure1.Electronic Wheelchair

The Brain-computer interfaces (BCIs) is utilised for the communication between brain and external device. The person suffering from disease like strokes, amyotrophic lateral sclerosis (ALS) may have complete paralysis. So the BCI system may used to improve the quality of such patients. BCI system helps the person to navigate from one place to another using wheelchair. Using the control the different direction right, forward backward, left are controlled. The experimented trial has been performed here in virtual as well as real-time. The system has been practically established here. [7]

Day by day the robotic version of wheelchair has been developed .These are the machine which are developed for better means of human being. The specialise sensors and actuators are used to control such robots. The human physiological modelling is done for detail system understanding of the model. By which I is easier to operate effective here basically the paper outlines about wheelchairs and basic features of human physiological modelling and control system of wheelchair. [8]

Due to accident and aging & the health related problems the lost of limb is major prevalence. To assist people with such defects the wheelchair with dual system of having voice recognition and touch screen. The voice recognition is and touch screen are two modes where d by which direction and in puts are controlled. Different quadrant has been made in touch screen to control various directions. The finger against the touch screen is utilised to control direction. The simple voice command is also used where by voice recognition controller. By storing a single letter kit time is reduced drastically. The wheelchair consists of DC brushless motors the PWM techniques are another ones. A mechanism for braking system has been utilised.50% accuracy for direction control and 94.6% for movement control has been achieved. The device helps the needy and disables to have automatic advancement to needy o reach destination. Predefined indoor system path is also used here.[9]

For FES assisted wheel chaired stepping exercise the physiologically based mathematical model is needed especially of quadriceps muscle. The muscle model is used here to integrate with humanoid model. The femoris and vasti muscle are used in model they produce contraction and movement of elliptical stepping exercise. 220 us pulse and 30 Hz of stimulation frequency is provided. The active and passive knee, hip joint drive the elliptical stepping exercise. So this is very specialized technique the wheelchair assisted system for disable people which can rejuvenate them well.[10]

The intelligent sitting system i.e. i-seating is developed using controllable air pressure system. The patient with cerebral palsy having physical disabilities has utmost need. Cushion based system which can be controlled through automatic intelligent system is worked here. The automatic system is give support to deformity of spine where gaps are formed between back of patient and a wheel chair backrest. For preliminary urethane cushion are used. The characteristic test for rubber bag is performed. The pressure test is conducted for i-setting. [11]

Kinect™ from Microsoft is used for optical scanning method is used here. 3D data acquisition are methods are discussed here. The Image based algorithm which calculates the step width and height in order to support the wheelchair and control information. The detecting methods are work based on stair recognition and external lighting and material for stairs. The automatic stair climbing wheelchairs are work with these principles. [12]

EEG controlled wheelchair can also be used to improving the quality of life for the elderly and disabled people and providing them the proper care at the right time. The elderly grown people have not much muscular power so it is very difficult for them. To solve this problem EEG based technique is deployed. The signal is captured and through microcontroller it is acquired and then it is translated in to movement commands and commands can be deployed to control the wheelchair.[13]

Passive robotics is novel concept the wheelchair consist of frame wheels and servo brakes. The system consists of trajectory and controlling torques is present there. The system does not include actuators & its mechanism is simple. There is not any risk or malfunction associated with it is low cost as well. The own intentional force are used. This passive type assistive device wheelchair are suitable for practical use. The driving assistance algorithm with intention of users is taken in to account. For realizing such model trajectory model is used here the typical human movement is associated with it. The rowing motion user can drive rowing motion with natural feeling. With proposed assistance system and experiment the prototype are verified. [14]

A methodology is introduced for determinations of the dynamic were tested on an ANSI/RESNA curb-drop tester. Array of 12 accelerometers mounted as four three-axis groups. Finite element program is used for various estimation. The curb drop test is performed. Carbon fiber wheelchair is used the use of static factor and dynamic loads are present. Acceleration data and dummy software are used here for detailing the wheelchair functions. [15]

An external motorize system is another model for wheelchair. A kinematic model with joy stick control is depicted here. Electric power wheelchair with motors and set of batteries and 2DOF joystick are handled. Active caster prototype mechanism is designed and it is mounted on the manual wheelchair. The proper translational motion and the rotational motion are achieved. The flip motion of active caster is also achieved. [16]

To provide support and assistance to the driver is one of the primary concerns. The human following is also discussed here. The complex environment consist of the driver assistance can keep wheelchair away from falling & collision while driving. The obstacle avoidance can be used by odometry data. The shared control strategy is used. Since the sensor used here is ultrasound the system is low cost and can easily be implemented. The experimental results shows that proposed system can improve user's driving ability. It can handle target occlusion problem more effectively. [17]

For Hand free control of wheelchair the faces and eyes information can be used. The image processing based method and techniques are used here for wheelchair. The Panda board ES development kit based on the TI OMAP 4 SoC (System on Chip) chosen here for processing. The image segmentation and facial detection technique is used .The ARM processor are used which is cheap and have excellent processing qualities. The promising result have found here.[18]

The collaborative wheelchair assistance is rely on motion of user's motion skill and at same time flexible path guidance are also taken in account. The user decides where the person want to go and controls & regulate the speed (including start and stop), and the system guides the wheelchair with the software-defined guide paths. Using CWA the little effort is needed for safe simple and low-cost. The results depict that path guidance drastically simplifies the control. [19]

The development of the prototype based on speech controlled wheelchair on cloud platform is shown. The GUI and web kit are used the mobile platform are also used for streaming data. The ubuntu Linux and Arduino UNO microcontroller are adopted in this model and java script is used for development. [20]

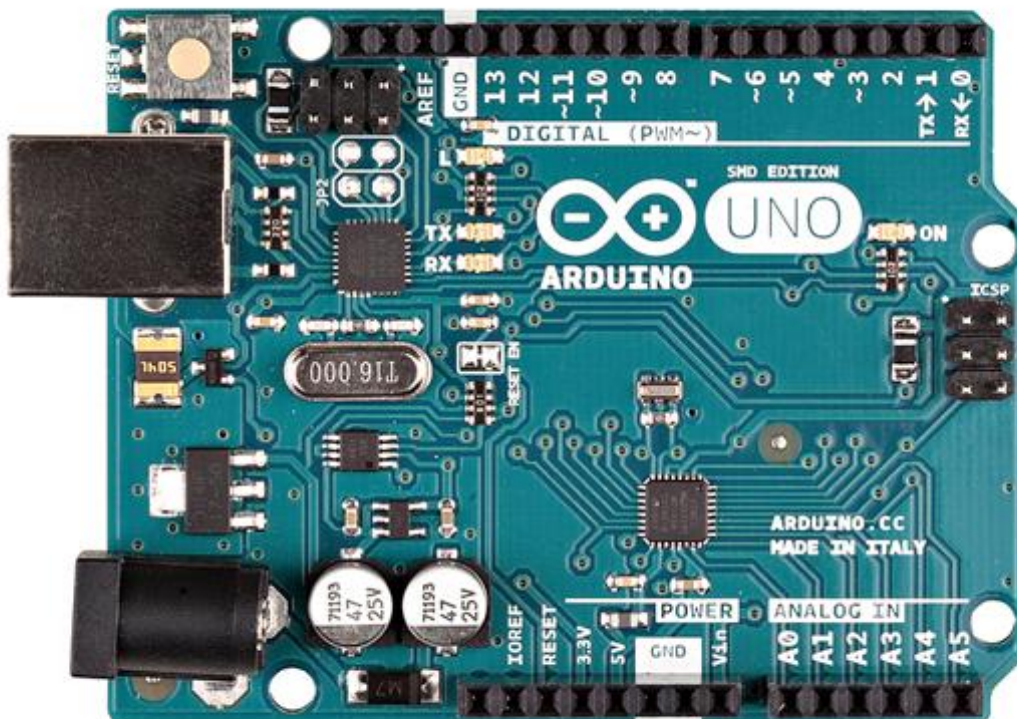
In recent decades the application of robotics significantly affected the progress of human being. Here the prototype robot is used to control using RF signal voice control and remote control option is also present. Mobility of motors of wheelchair is really a challenge. The utility of it is also a concern and challenge depicted here. The human voice controlled robot with obstacle avoidance feature and edge avoidance feature is yet another focus area. [21]

3. METHODOLOGY

3.1 Material & Methods

The Arduino uno , MATLAB and servo motor are three principle component .All modern day wheelchairs consist of the servomotors for control mechanism. A servomotor application is wide spread it is used in robotic arms and many medical devices. We are creating here a MATLAB GUI based interface connecting it with the Arduino uno and controlling the rotation of motor.

3.1.1 Arduino UNO



The Arduino Uno is ATmega 328 microcontroller based board. It has 14 digital input and output pins. Among these 6 pins can be utilized as PWM outputs. It has 6 analog inputs. The board consists of 16 MHz ceramic resonator. The board can be interfaced to computer via USB connection. The other parts are power jack, an ICSP header, and a reset button. It contains every other substitute to support the functioning of microcontroller. It is very easy to connect it to a computer with a USB power. We can power it with a AC to DC adapter or battery.

Uno is different from previous version of boards It features the Atmega16U2 (up to version R2).It programmed as a USB to serial converter. Revision 2 of the Uno board has a resistor pulling the8U2 HWB line to ground.

The following new features are added in Revision 3 (we have used in our project)

1. The new pin SDA and SCL pins are added to board near to AREF pin. Other than these two more new pins are added near to RESET pin.IOREF which will be used by shields for adapting the voltage.Sheild will be compatible with board which use AVR .Arduino operates at 3.3vbut 5v also can be provided. The another left pin is reserved for future purpose.
2. Very Robust RESET circuit is available.
3. Atmega 16U2 replace the 8U2

The word “Uno” is an Italian word which means one. Now Arduino Uno is the reference model for the Arduino platform

3.1.2 Schematic & Reference Design

Schematic diagram is shown here. Eagle software is needed to open it properly.

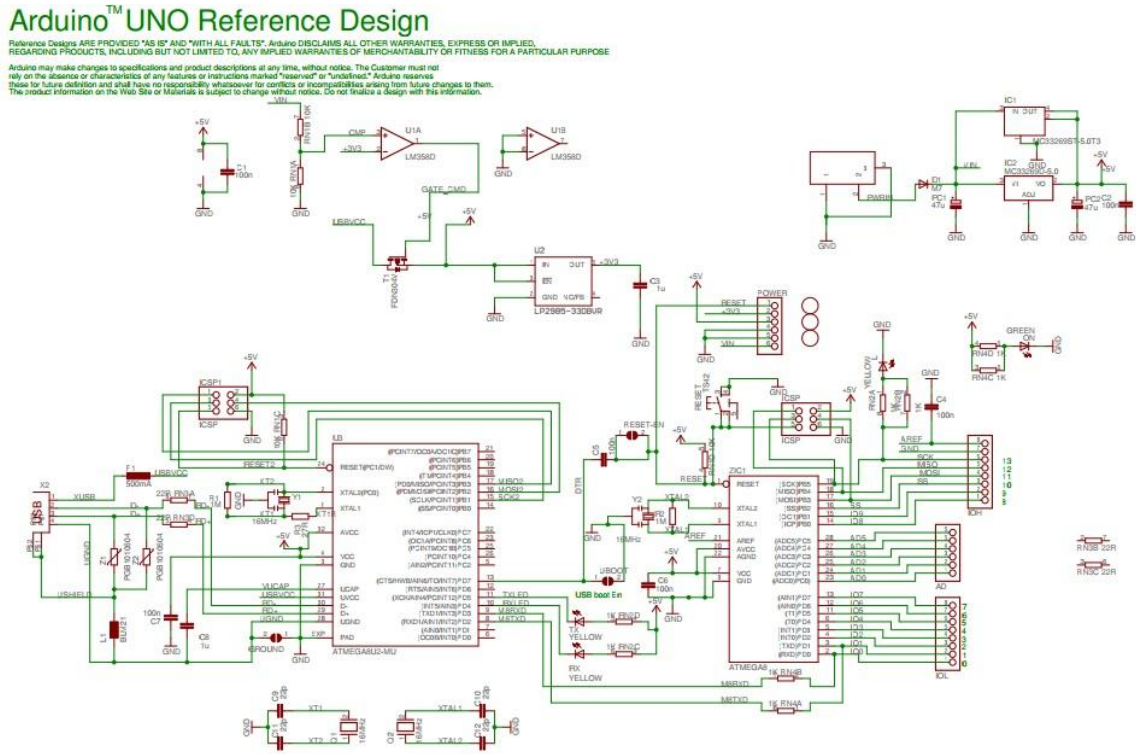


Figure 2: Schematic diagram of Arduino uno board

Note: The Arduino reference design can use an Atmega8, 168, or 328, Current models use an ATmega328, but an Atmega8 is shown in the schematic for reference. The pin configuration is identical on all three processors.

3.1.3 Power

The Arduino Uno is powered via the USB connection .An external power supply can also be utilized to power board.

The board needed external supply of 6 to 20 volts for operates. Board may be unstable if less than 5v supply is there. On using more than 12 volts cause damage to the voltage regulator and board as well. The preferred range is 7 to 12 volts.

The power pins are as follows:

1. VIN: When board is using external power source this pin is utilized. It is opposite to 5v power supply from USB and other regulated power supply. There is two role of this pin either we can supply power to the board or access it when power is supplied through power jack.
2. 5V: The board has supply of 7-12 volt by DC jack or 5v by USB connector. The 5v pin gives regulated power supply from board. If we supply power through 5v pin or 3.3v pin it will bypass the regulator and may damage the board.
3. 3.3 V: A 3.3 volt regulated power supply can be taken from this pin. Maximum current will be 50mA.
4. GND: 2 ground pins are available.
5. IOREF: This pin provides voltage reference to operate the microcontroller. Properly configured shields read the IOREF pin voltage and select the suitable power source or enable voltage translators on the outputs for working with the 5V or 3.3V.

3.1.4 Description of Arduino Uno board

The input voltage limit of the board is 6-20 Volts. The board consists of 14 digital pin out of these 14 pin the 6 pins are the PWM pin. Other than these pins it consists of 6 analog input pin. The permissible DC current for I/O pin is set to 40mA & DC current for 3.3 Volts pin is 40mA. It has flash memory of 32 kb and 0.5 kb is used for boot loader. It consists of SRAM of 2kb & EEPROM of 1kb. The clock speed for the board is set to 16Mhz. The dimension of the board is length wise 68.6 mm & width wise 53.4 mm. The weight of the board is 25 gram.

3.2 Servomotor

A **servomotor** allows for precise control of angular position, velocity and acceleration. There are two types of servomotor based on power supply the DC and AC servomotor. Servomotor uses the concept of servomechanism. Three things are important for servomechanism controlled device, an output sensor, a feedback system. The specification of their servomotor has been already mentioned. The Futaba S3003 has analog modulation. The torque generated is at 4.8V 3.17 kg-cm and the speed is 0.23 sec/60 degree weight is 37.0 gram & dimension is length wise 39.9mm, width 20.1 mm and height 36.1 mm. The rotational range of motor is 60 degree & pulse cycle is 30 ms. The pulse width is 500-3000 us.

Futaba S3003 - Servo Standard

Basic Information

Modulation:	Analog
Torque:	4.8V: 44.0 oz-in (3.17 kg-cm) 6.0V: 57.0 oz-in (4.10 kg-cm)
Speed:	4.8V: 0.23 sec/60° 6.0V: 0.19 sec/60°
Weight:	1.31 oz (37.0 g)
Dimensions:	Length: 1.57 in (39.9 mm) Width: 0.79 in (20.1 mm) Height: 1.42 in (36.1 mm)
Motor Type:	? (add)
Gear Type:	Plastic
Rotation/Support:	Bushing

Additional Specifications

Rotational Range:	60°
Pulse Cycle:	30 ms
Pulse Width:	500-3000 μs
Connector Type:	J



Brand:	Futaba
Product Number:	FUTM0031
Suggested Retail:	? (add)
Street Price:	11.99 USD
Compare:	add

Figure3:FUTUBA servomotor specification

3.3 Working of project

The project is divided into three parts. The first part of the project is the Arduino Uno board, the second part is the servomotor, and the third is the MATLAB-based GUI. The servomotor revolution is a prototype of a wheelchair as wheelchair systems consist of a servomechanism to control directional motion. Leftward movement, rightward movement, and forward movement are all directional movements controlled by the servomechanism. To depict this mechanism, a single servomotor is connected to the Arduino Uno board. The servo motor consists of three colored wires. The red wire is connected to the 5V power supply. The next one is a black wire which is connected to the ground pin of the Arduino board. The last blue wire is connected to pin number 9 of the board. Here, pin number 9 is utilized to control the servomotor. Servomotor side programming is done with the help of the Arduino IDE, whereas the GUI side programming is done with the help of MATLAB. Using the MATLAB GUI interface, we control the movement, and as a result, the servomotor movement is controlled. The board is connected via a USB port, and the serial communication between the computer and the Arduino board has been established. The project is a prototype of a wheelchair, and in real-time, there are various factors which hinder the movement of a wheelchair, such as the weight of the patient, etc. However, here we have neglected this condition. Mostly, the project deals with the control mechanism.

3.3.1 Connection

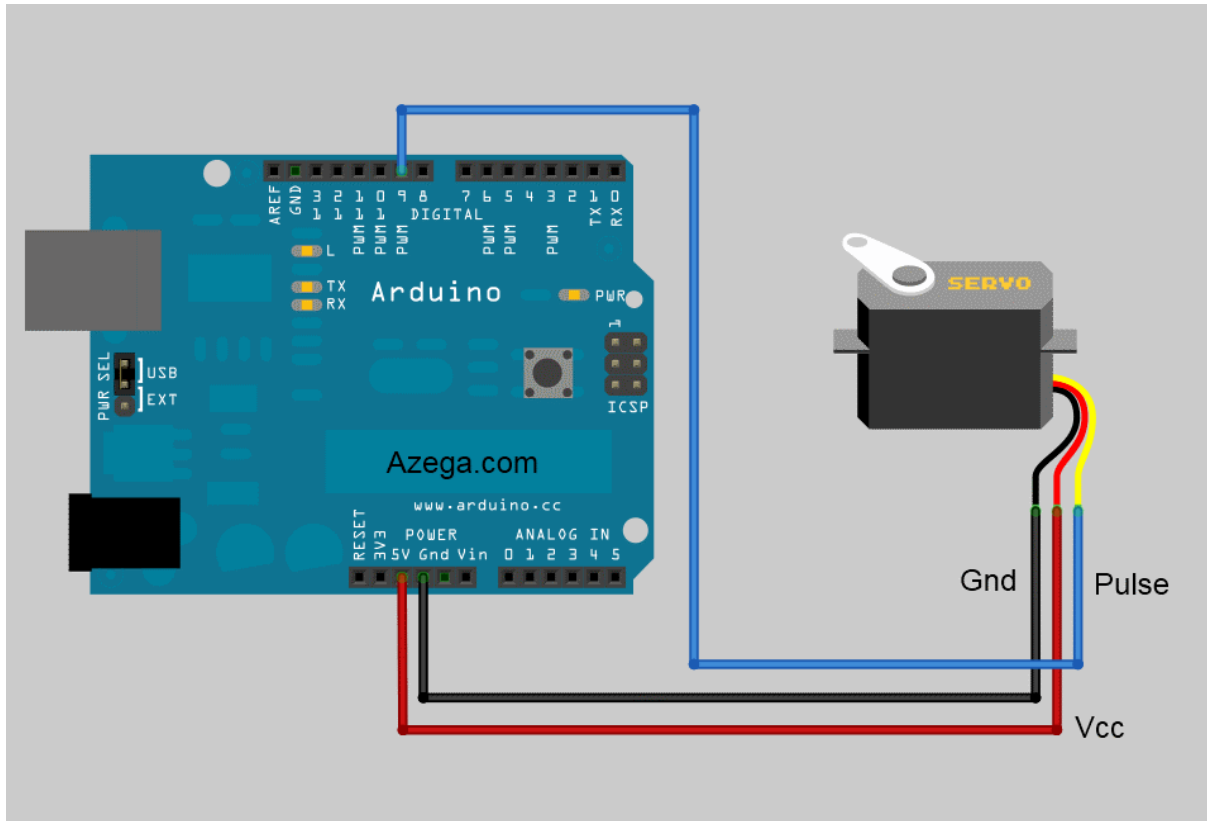


Figure4: Arduino & servomotor connection

3.3.2 Step for the working with Arduino board:

Step 1: Download the latest IDE from Arduino.org and install it on computer.

Step2: Open the new file to write new sketch or program for Arduino uno.

Step3: Now first put the header file servo.h in program which initialize & link all files required.

Step4: In this step create a object named servo & define variables.

Step5: Define a function & set the baud rate 9600 and pin number 9 to control the servo motor. Send serial data to port.

Step6: The next step is reading the data available at port using the condition available.

Step7: The code for character to integer conversion is to be written here & the comparison for rightward & leftward is also done .The ten second delays are given in this process.

Step9: Then lastly again ready for reading input.

Step10: After writing the code or sketch compile it and check for error and correct it if there is any.

Step 11.verify & Load the file into microcontroller & save it

3.3.3 Making GUI from MATLAB

Step1: Install latest version of MATLAB on computer.

Step2: go to new and click on graphical user interface.

Step3: select Blank GUI (default) .It will opens new untitled figure or window.

Step4: Click on Axes and draw on gui window. Change the value of Xlim & Ylim each from 0 to 20 ranges.

Step5: Click on slider and draw it on gui window. Double click on it and change the maximum value to 180.

Step6: Draw two push button and double click on it change the name by editing string & edit the font size and colours.

Step7: click on static text and draw it also. Put max value to 180 and min 0.

Step8: Run it to generate code and edit fro call back of each buttons so that gui can perform action.

4. Programming

4.1 Code for Arduino side

```
.  
  
#include <Servo.h>  
  
Servo servo;  
  
String readString = "";  
  
int motor1;  
  
int motor2;  
  
  
void setup()  
{  
  Serial.begin(9600);  
  servo.attach(9);  
  servo.write(90);  
}  
  
void loop()  
{  
  while (Serial.available() > 0)  
  {  
    delay(10);  
    if(Serial.available() >0)  
    {  
      char c = Serial.read();  
      readString += c;  
    }  
  
    else servo.write(90);  
  }  
  
  if (readString.length() == 6)
```



```
.  
{  
String m1 = readString.substring(0, 3);  
String m2 = readString.substring(3, 6);  
char chararray1[6];  
char chararray2[6];  
m1.toCharArray(chararray1, sizeof(chararray1));  
motor1 = atoi(chararray1);  
m2.toCharArray(chararray2, sizeof(chararray2));  
motor2 = atoi(chararray2);  
if(motor2 < motor1){  
    for(int i = motor2; i <= motor1; i++){  
        servo.write(i);  
        delay(10);  
    }  
}  
if(motor2 > motor1)  
{  
    for(int i = motor2; i >= motor1; i--){  
        servo.write(i);  
        delay(10);  
    }  
}  
readString = ""; }
```

```

SeminarskNP1 | Arduino 1.6.4
File Edit Sketch Tools Help

SeminarskNP1
#include <Servo.h>
Servo servo;
String readString = "";
int motor1;
int motor2;

void setup(){
  Serial.begin(9600);
  servo.attach(9);

  servo.write(90);
}
void loop(){
  while (Serial.available() > 0){
    delay(10);
    if(Serial.available() >0) {
      char c = Serial.read();
      readString += c;
    }
    else servo.write(90);
  }
  if (readString.length() == 6){
    String m1 = readString.substring(0, 3);
    String m2 = readString.substring(3, 6);
    char chararray1[6];
    char chararray2[6];
    m1.toCharArray(chararray1, sizeof(chararray1));
    m2.toCharArray(chararray2, sizeof(chararray2));
    motor1 = atoi(chararray1);
  }
}

```

Printing canceled.

31 Arduino Uno on COM7 17:36 16-06-2015

Figure6: Arduino sketch for serial communication

4.2 MATLAB GUI Interface

MATLAB GUI

The diagram below is the snapshot of the procedure for making GUI from MATLAB Tool.

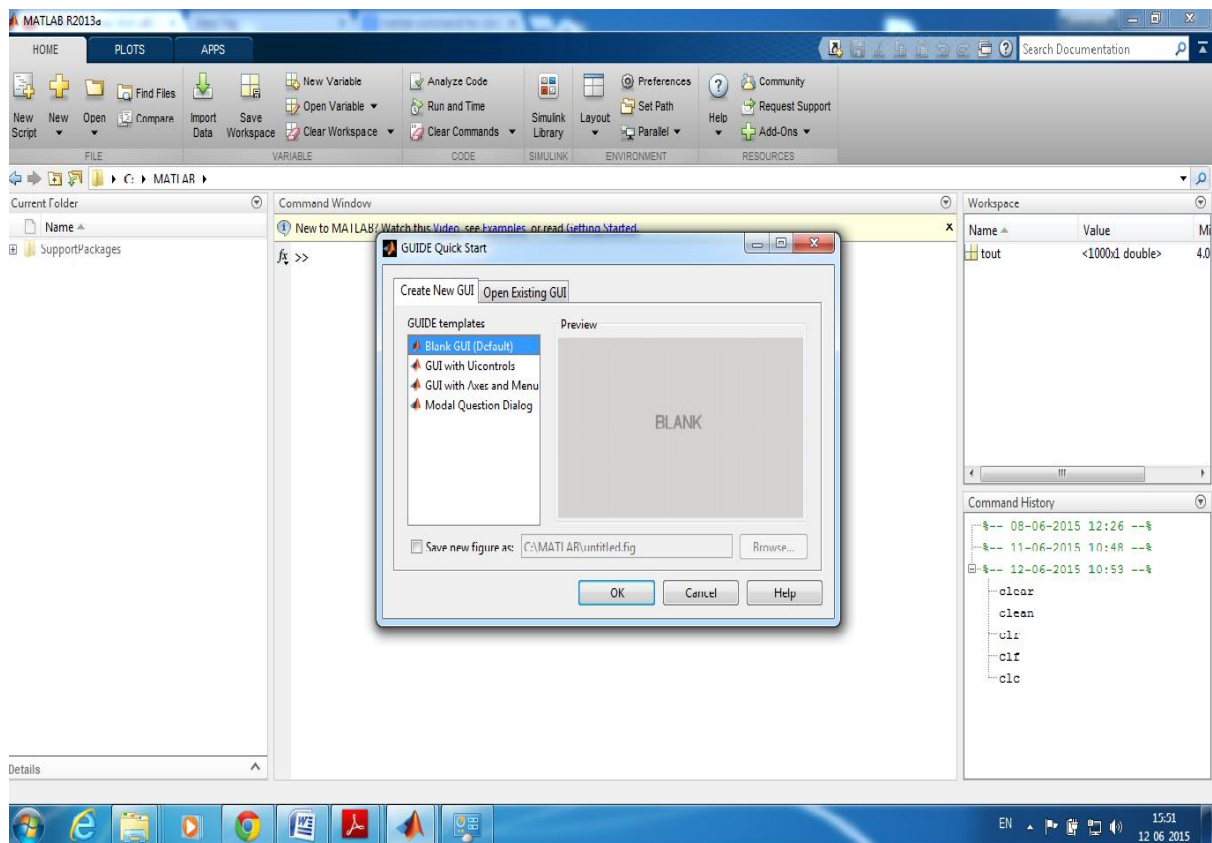


Figure5: Graphical user Interface using MATLAB

4.3 Code for MATLAB side

```
function varargout = deven(varargin)
gui_Singleton = 1;
gui_State = struct('gui_Name',    mfilename, ...
                  'gui_Singleton', gui_Singleton, ...
                  'gui_OpeningFcn', @deven_OpeningFcn, ...
                  'gui_OutputFcn', @deven_OutputFcn, ...
                  'gui_LayoutFcn', [] , ...
                  'gui_Callback', []);
if nargin && ischar(varargin{1})
    gui_State.gui_Callback = str2func(varargin{1});
end

if nargout
    [varargout{1:nargout}] = gui_mainfcn(gui_State, varargin{:});
else
    gui_mainfcn(gui_State, varargin{:});
end
function deven_OpeningFcn(hObject, eventdata, handles, varargin)
handles.output = hObject;
set(handles.slider1,'Value',90);
axes(handles.axes1);
set(handles.axes1,'XTick',[])
set(handles.axes1,'YTick',[])
axis square;
x=[8 12 12 8];
y=[1 1 8 8];
patch(x,y,([0.8 0.8 0.8]))
hold on
x1=[8.5 11.5 11.5 8.5];
y1=[4.5 4.5 7.5 7.5];
patch(x1,y1,([0.8 0.8 0.8]))
hold on
handles.ugao = 90;
left = handles.ugao + 90;
right = handles.ugao - 90;
x11 = 0.5*cosd(left)+10;
y11 = 0.5*sind(left)+6;
x12 = 0.5*cosd(right)+10;
y12 = 0.5*sind(right)+6;
x13 = 4*cosd(handles.ugao)+10;
y13 = 4*sind(handles.ugao)+6;
x2=[x11 x12 x13];
y2=[y11 y12 y13];
patch(x2,y2,'r')
t = linspace(0,2*pi,1000);
h=10;
k=6;
r=0.5;
```

```

X = r*cos(t)+h;
Y = r*sin(t)+k;
patch(X,Y,'r')
guidata(hObject, handles);
function varargout = deven_OutputFcn(hObject, eventdata, handles)
varargout{ 1 } = handles.output;

```

```

function slider1_
if isequal(get(hObject,'BackgroundColor'), get(0,'defaultUicontrolBackgroundColor'))
    set(hObject,'BackgroundColor',[.9 .9 .9]);
end

```

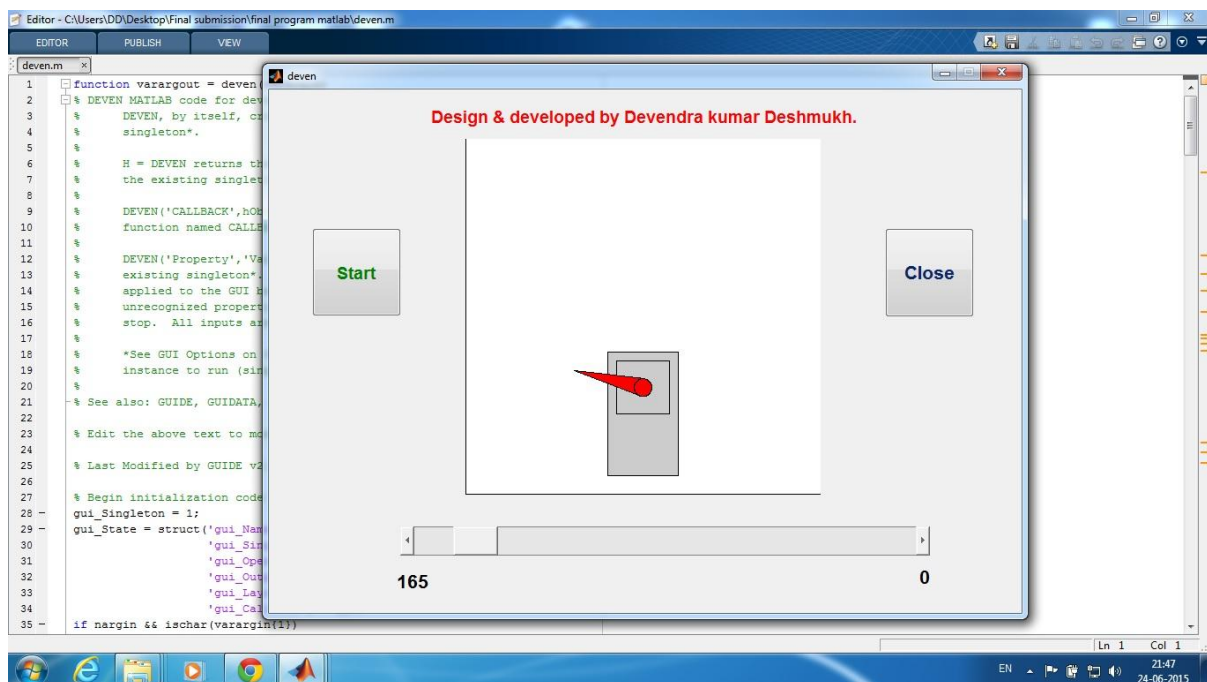


Figure7:GUI with slider left wards

```

function pushbutton1_Callback(hObject, eventdata, handles)
global gl
if isempty(gl)
    gl = 90;
end
arduino = serial('COM7','BaudRate',9600);
fopen(arduino);
try
while true
pause(1);
bro = 0;
clear bro;
tekst = "";
clear tekst;
granica = "";
dopunska = "";
vrijednost = get(handles.slider1,'Value');
vrijednostINT = int64(vrijednost);
tekst = num2str(vrijednostINT);
bro = 180 - str2num(tekst);
set(handles.text1,'String',num2str(bro));
if bro < 100 && bro > 9
    clear tekst;
    if gl < 100 && gl > 10
        granica = strcat('0',num2str(gl));
    end
    if gl > 99
        granica = num2str(gl);
    end
    if gl < 10
        granica = strcat('00',num2str(gl));
    end
    dopunska = strcat('0',num2str(bro));
    tekst = strcat(dopunska,granica);
    fprintf(arduino, '%s', tekst);
    fukcijaRotiranja(gl,bro);
end
if bro > 99
    clear tekst;
    if gl < 100 && gl > 10
        granica = strcat('0',num2str(gl));
    end
    if gl > 99
        granica = num2str(gl);
    end
    if gl < 10
        granica = strcat('00',num2str(gl));
    end
    dopunska = num2str(bro);

```

```

    tekst = strcat(dopunska,granica);
    fprintf(arduino, '%s', tekst);
    fukcijaRotiranja(gl,bro);
end

if bro < 10
    clear tekst;
    if gl < 100 && gl > 10
        granica = strcat('0',num2str(gl));
    end
    if gl > 99
        granica = num2str(gl);
    end
    if gl < 10
        granica = strcat('00',num2str(gl));
    end
    dopunska = strcat('00',num2str(bro));
    tekst = strcat(dopunska,granica);
    fprintf(arduino, '%s', tekst);
    fukcijaRotiranja(gl,bro);
end

```

```

gl = bro;
end
catch err
    fclose(arduino);
    clear all
    return;
end

```

```

function figure1_CloseRequestFcn(hObject, eventdata, handles)
clear all;
close all;
delete(hObject);

```

```

function pushbutton2_Callback(hObject, eventdata, handles)
clear all;
close all;

```

```

function [] = fukcijaRotiranja(od,do)
if od < do
    for i = od : 1 : do
        cla;
        x=[8 12 12 8];
        y=[1 1 8 8];
        patch(x,y,([0.8 0.8 0.8]))
        hold on
        x1=[8.5 11.5 11.5 8.5];
        y1=[4.5 4.5 7.5 7.5];
        patch(x1,y1,([0.8 0.8 0.8]))
        hold on
    end
end

```

```

left = i + 90;
right = i - 90;
x11 = 0.5*cosd(left)+10;
y11 = 0.5*sind(left)+6;
x12 = 0.5*cosd(right)+10;
y12 = 0.5*sind(right)+6;
x13 = 4*cosd(i)+10;
y13 = 4*sind(i)+6;
x2=[x11 x12 x13];
y2=[y11 y12 y13];
h = patch(x2,y2,'r');
zdir = [0 0 1];
centre = [10 6 0];
rotate(h, zdir, 1, centre);
d = linspace(0,2*pi,1000);
h=10;
k=6;
r=0.5;
X = r*cos(d)+h;
Y = r*sin(d)+k;
patch(X,Y,'r')
pause(0.00005);

end
else
for i = od : -1 : do
cla;
x=[8 12 12 8];
y=[1 1 8 8];
patch(x,y,([0.8 0.8 0.8]))
hold on
x1=[8.5 11.5 11.5 8.5];
y1=[4.5 4.5 7.5 7.5];
patch(x1,y1,([0.8 0.8 0.8]))
hold on
left = i + 90;
right = i - 90;
x11 = 0.5*cosd(left)+10;
y11 = 0.5*sind(left)+6;
x12 = 0.5*cosd(right)+10;
y12 = 0.5*sind(right)+6;
x13 = 4*cosd(i)+10;
y13 = 4*sind(i)+6;
x2=[x11 x12 x13];
y2=[y11 y12 y13];
h = patch(x2,y2,'r');
zdir = [0 0 1];
centre = [10 6 0];
rotate(h, zdir, 1, centre);
d = linspace(0,2*pi,1000);

```



```

h=10;
k=6;
r=0.5;
X = r*cos(d)+h;
Y = r*sin(d)+k;
patch(X,Y,'r')
pause(0.00005);
end
end

```

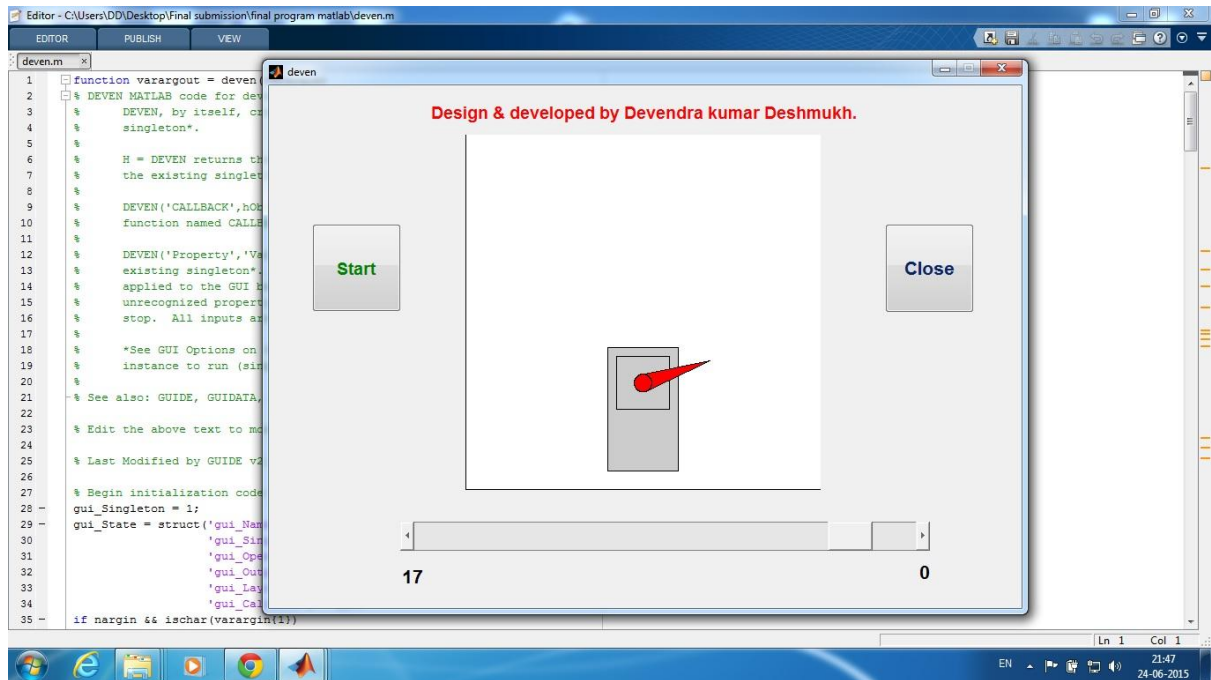


Figure8:GUI with slider Right wards

5. RESULTS

The output of a project is the controlled revolution of the servomotor by Arduino uno board using MATLAB GUI interface. This project shows the prototype of controlled wheelchair using Arduino uno board. The advantage of project laid upon the cost effectiveness of Arduino uno board, its availability and its user friendly features.

6. CONCLUSION

This project is prototype the actual implementation has many constraint & obstacle which can be eliminated by the putting patient into real time condition. Still and laboratory level these prototype exhibit excellent features. We may further customize the wheelchair according to needs of differently able person.

7. DISCUSSION AND FUTURE PERSPECTIVE

The deeper understanding of project may leads to the many progressive development of wheelchair. For wheelchair automation, Arduino board is very cost effective. In future the project can be modified into wirelessly control the wheelchair, Bluetooth enabled wheelchair, Jig bee technology enabled wheelchair, and the voice based commands controlled wheelchair. Using Arduino uno board, the project has become cheaper & the development in this board was quite user-friendly. The advance version of Arduino board equipped with many additional services can be utilised to make smarter wheelchair. The purpose is to reduce the cost and use of recent technology for wheelchair advancement. In future it is possible that, wheelchair may be controlled by brain computer interface using Arduino uno board.

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APPENDIX

DATASHEET ATMEL

ATmega328P

Features

- High Performance, Low Power AVR® 8-Bit Microcontroller
 - Advanced RISC Architecture
 - 131 Powerful Instructions – Most Single Clock Cycle Execution
 - 32 x 8 General Purpose Working Registers
 - Fully Static Operation
 - Up to 20 MIPS Throughput at 20 MHz
 - On-chip 2-cycle Multiplier
 - High Endurance Non-volatile Memory Segments
 - 4/8/16/32K Bytes of In-System Self-Programmable Flash program memory (ATmega48PA/88PA/168PA/328P)
 - 256/512/512/1K Bytes EEPROM (ATmega48PA/88PA/168PA/328P)
 - 512/1K/1K/2K Bytes Internal SRAM (ATmega48PA/88PA/168PA/328P)
 - Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
 - Data retention: 20 years at 85°C/100 years at 25°C(1)
 - Optional Boot Code Section with Independent Lock Bits
- In-System Programming by On-chip Boot Program
- True Read-While-Write Operation
- Programming Lock for Software Security
- Peripheral Features
 - Two 8-bit Timer/Counters with Separate Prescaler and Compare Mode
 - One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
 - Real Time Counter with Separate Oscillator
 - Six PWM Channels
 - 8-channel 10-bit ADC in TQFP and QFN/MLF package
- Temperature Measurement
- 6-channel 10-bit ADC in PDIP Package
- Temperature Measurement
- Programmable Serial USART
 - Master/Slave SPI Serial Interface
 - Byte-oriented 2-wire Serial Interface (Philips I2C compatible)
 - Programmable Watchdog Timer with Separate On-chip Oscillator
 - On-chip Analog Comparator
 - Interrupt and Wake-up on Pin Change
- Special Microcontroller Features
 - Power-on Reset and Programmable Brown-out Detection
 - Internal Calibrated Oscillator

- External and Internal Interrupt Sources
- Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standby, and Extended Standby
- I/O and Packages
 - 23 Programmable I/O Lines
 - 28-pin PDIP, 32-lead TQFP, 28-pad QFN/MLF and 32-pad QFN/MLF
- Operating Voltage:
 - 1.8 - 5.5V for ATmega48PA/88PA/168PA/328P
- Temperature Range:
 - -40°C to 85°C
- Speed Grade:
 - 0 - 20 MHz @ 1.8 - 5.5V
- Low Power Consumption at 1 MHz, 1.8V, 25°C for ATmega48PA/88PA/168PA/328P:
 - Active Mode: 0.2 mA
 - Power-down Mode: 0.1 μ A
 - Power-save Mode: 0.75 μ A (Including 32 kHz RTC)

8-bit

Microcontroller

with 4/8/16/32K

Bytes In-System

Programmable

Flash

ATmega48PA

ATmega88PA

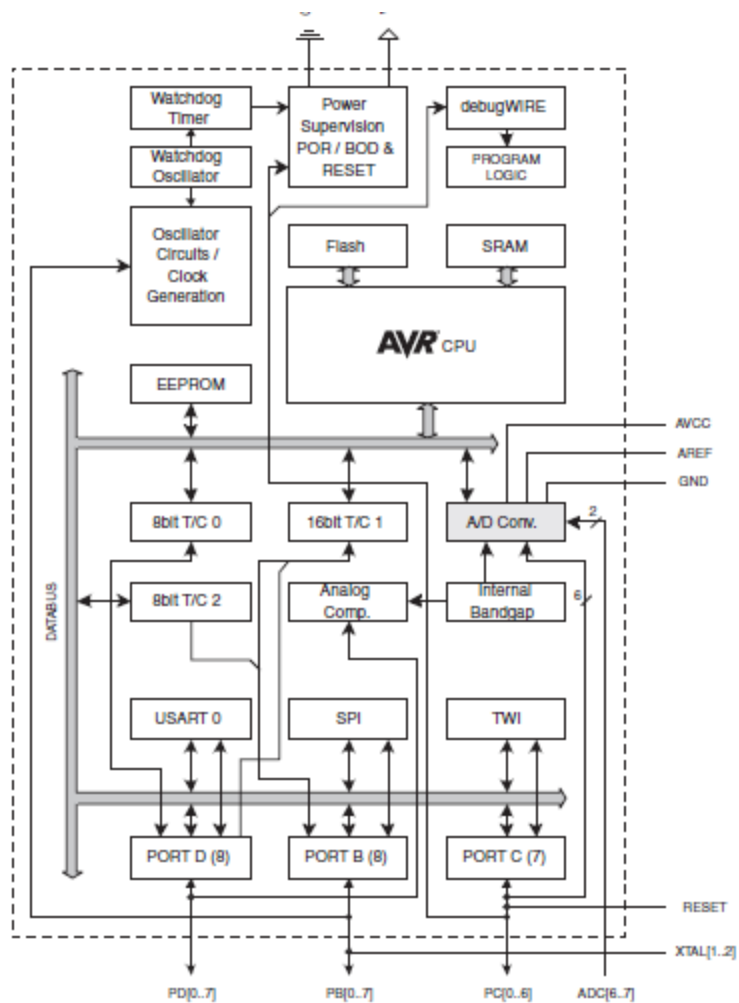
ATmega168PA

ATmega328P

Rev. 8161D-AVR-10/

Overview

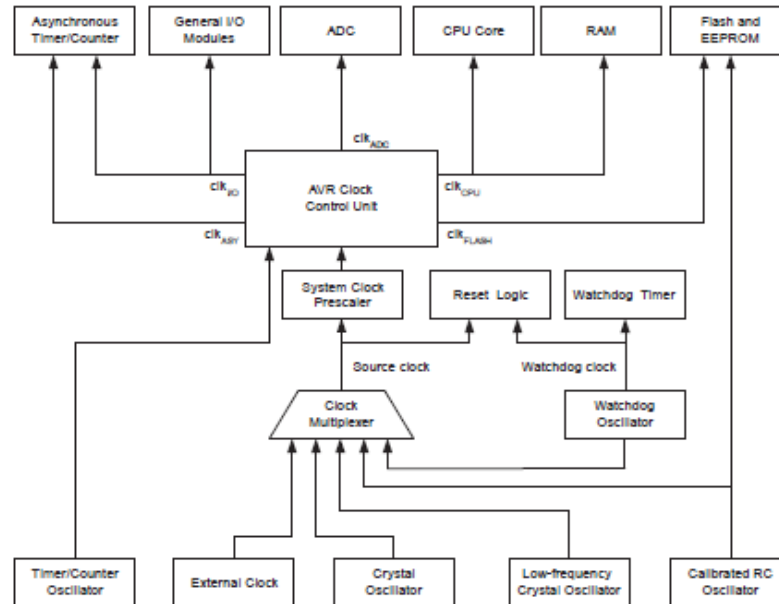
The ATmega48PA/88PA/168PA/328P is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega48PA/88PA/168PA/328P achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed.



8.1 Clock Systems and their Distribution

Figure 8-1 presents the principal clock systems in the AVR and their distribution. All of the clocks need not be active at a given time. In order to reduce power consumption, the clocks to modules not being used can be halted by using different sleep modes, as described in "Power Management and Sleep Modes" on page 39. The clock systems are detailed below.

Figure 8-1. Clock Distribution



S3003 FUTABA SERVO



...S3003 FUTABA SERVO...

Detailed Specifications

Control System:	+Pulse Width Control 1520usec Neutral	Current Drain (4.8V):	7.2mA/idle
Required Pulse:	3-5 Volt Peak to Peak Square Wave	Current Drain (6.0V):	8mA/idle
Operating Voltage:	4.8-6.0 Volts	Direction:	Counter Clockwise/Pulse Traveling 1520- 1900usec
Operating Temperature Range:	-20 to +60 Degree C	Motor Type:	3 Pole Ferrite
Operating Speed (4.8V):	0.23sec/60 degrees at no load	Potentiometer Drive:	Indirect Drive
Operating Speed (6.0V):	0.19sec/60 degrees at no load	Bearing Type:	Plastic Bearing
Stall Torque (4.8V):	44 oz/in. (3.2kg.cm)	Gear Type:	All Nylon Gears
Stall Torque (6.0V):	56.8 oz/in. (4.1kg.cm)	Connector Wire Length:	12"
Operating Angle:	45 Deg. one side pulse traveling 400usec	Dimensions:	1.6" x 0.8"x 1.4" (41 x 20 x 36mm)
360 Modifiable:	Yes	Weight:	1.3oz. (37.2g)