Acknowledgement:

Success of any project depends largely on the encouragement and guidelines of many others. I take this sincere opportunity to the people who have been instrumental in this project work.

Aeronspire team, we always feel motivated and encouraged every time by their valuable advice and constant inspiration, without their encouragement and guidance this project would not have materialized.

Words are inadequate in offering our thanks to them for their encouragement and cooperation in carrying out this project work. The guidance and support received from them is vital for the success of this project.

Contents:

Introduction to Robotic System

Robotics is the branch of technology that deals with the design, conception, construction, operation, and application of robots. The goal of robotics system is to produce automated intelligent machines, called robots that are designed to move material, parts, tools or specialized devices through variable programmed motions for the performance of a variety of tasks.
Robots can take on any form but some are made to resemble humans in appearance. This is said to help in the acceptance of a robot in certain replicative behaviors usually performed by people. Such robots attempt to replicate walking, lifting, speech, cognition, or any other human activity. Many robots are built to do jobs that are hazardous to people, such as defusing bombs, finding survivors in unstable ruins, and exploring mines and shipwrecks. Today, robotic system is a rapidly growing field for serving practical purposes.

While the overall world of robotics is expanding, a robot has some consistent characteristics:

- Robots all consist of some sort of mechanical construction. The mechanical aspect of a robot helps it complete tasks in the environment for which it's designed. For example, the Mars 2020 Rover's wheels are individually motorized and made of titanium tubing that help it firmly grip the harsh terrain of the red planet.
- Robots need electrical components that control and power the machinery. Essentially, an electric current (a battery, for example) is needed to power a large majority of robots.
- Robots contain at least some level of computer programming. Without a set of code telling it what to do, a robot would just be another piece of simple machinery. Inserting a program into a robot gives it the ability to know when and how to carry out a task.

Classification of Robotic system

The robotic systems are classified mainly into three main types on the basis of application. They are:

- Manipulation Robotic system
- Mobile robotic system
- Data acquisition and control robotic system

Manipulation Robotic system

The Manipulation Robotic system is the most extensively used robotic system that is found mainly in manufacturing industries. Manipulation robotic system comes in several forms, depending mainly on its application.

Mobile robotic system

A Mobile robotic system is usually an automated platform that carries goods from one place to another. The motion of the system can also be controlled autonomously and might have a pre-programmed destination from where the system might load or unload automatically.

Mobile robotic systems are also used mainly in industrial purposes for carrying tools and spare parts to the storage. One more application where mobile robotic systems are used is in farms, wherein they can be used for pulling equipments to plough the fields or for transporting agricultural products. Mobile robots are also used by petroleum and gas production companies for offshore oil and gas exploration and by salvage companies for searching for sunken ships. Mobility of these robots can be in the form of flying, swimming, or running on land.

Data acquisition and Control Robotic System

The Data acquisition and control robotic system is used for acquiring, processing, and transmitting important data used for generating various signals. Generally meant for activities that require less human participation, a control robotic system generates signals that can be used for controlling other robots. Data acquisition and control robotic system are also used for CAD systems used in engineering and business processes. Many mobile robotic systems, especially the unmanned craft used for the exploration of the sea bed are equipped with Data acquisition and control robotic system for procuring important information and sending it back to the shore in the form of signals.

Objective and Future scope

The objective of robotic system is

- to develop an advanced human-robot interface for the purpose of endowing the system with advanced action capabilities.
- to build automated quality check systems.
- to create automated assembly lines to eliminate as much human labor as possible, driven by the cost savings.

Future Scope

There is no denying that Robotic technologies are all set to change the way things are done in the industries in which they are being implemented. Entrepreneurs are voicing a similar sentiment and are clearly optimistic about the use of Robotics in various industrial segments. Robotics is mainly capturing industries like manufacturing, pharmaceutical, FMCG, packaging and inspection. A bit of Robotics would also be seen in the healthcare sector primarily in the form of assistive and skill development technologies. The other promising sectors are defense and education. World had come across PC revolution and mobile revolution in the recent past now it is the time for inevitable robotics. Considering that the global players, like Google, FESTO and Tesla are investing in Robotics along with substantial increase in amateur robotic enthusiasts, Open source tools and platforms available for robotics, It is assured that significant development in this field will occur in another 5-10 years.

Components of Robotics

The key components of robotics are:

Manipulators: Just like the human arm, the robot consists of what is called a manipulator having several joints and links. Robotic manipulators can be divided into two sections, each with a different function: Robot Arm and Body. The arm and the body of a robot are used to move and position parts within a work envelope. They are formed from joints connected by large links.

Power Supply: The working power to the robot is provided by batteries, hydraulic, solar power, or pneumatic power sources.

Actuators: Actuators are the energy conversion device used inside a robot. The major function of actuators is to convert energy into movement. Actuators are the muscles of robots. Actuators actually move the robot joints.
There are five general types of actuators used in robotics projects:
DC motor

Servo

Stepper

Linear actuator

Solenoids

Electric motors (DC/AC): Motors are electromechanical component used for converting electrical energy into its equivalent mechanical energy. In robots motors are used for providing rotational movement.

Sensors: Sensors provide real time information on the task environment. Robots are equipped with tactile sensor it imitates the mechanical properties of touch receptors of human fingerprints and a vision sensor is used for computing the depth in the environment.

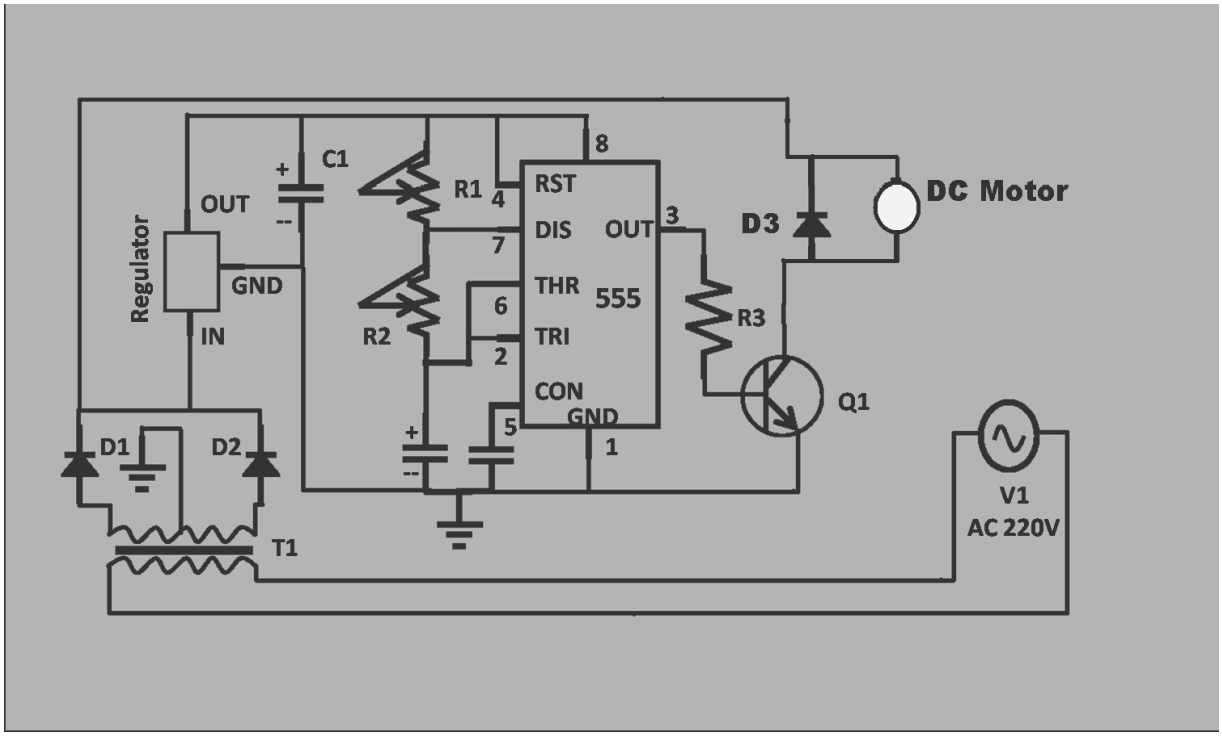
Controller: Controller is a part of robot that coordinates all motion of the mechanical system. It also receives an input from immediate environment through various sensors. The heart of robot's controller is a microprocessor linked with the input/output and monitoring device. The command issued by the controller activates the motion control mechanism, consisting of various controller, actuators and amplifier.

Projects

Speed control of DC Motor using PWM - Pulse Width Modulation Concept

The purpose of a motor speed controller is to drive a system at the demanded speed. For example in robotics it is generally used to control the moving speed of a robot whatever it may be Path Finder, Opportunity or any one industrial robot. The present project gives an idea to make it real for those people who keep interest to implement the theory in real life. The speed of a DC motor is directly proportional to the supply voltage, so if we reduce the supply voltage from 6 Volts

to 3 Volts, the motor will run at half the speed. How can this be achieved when the supply is fixed at 6 Volts..!

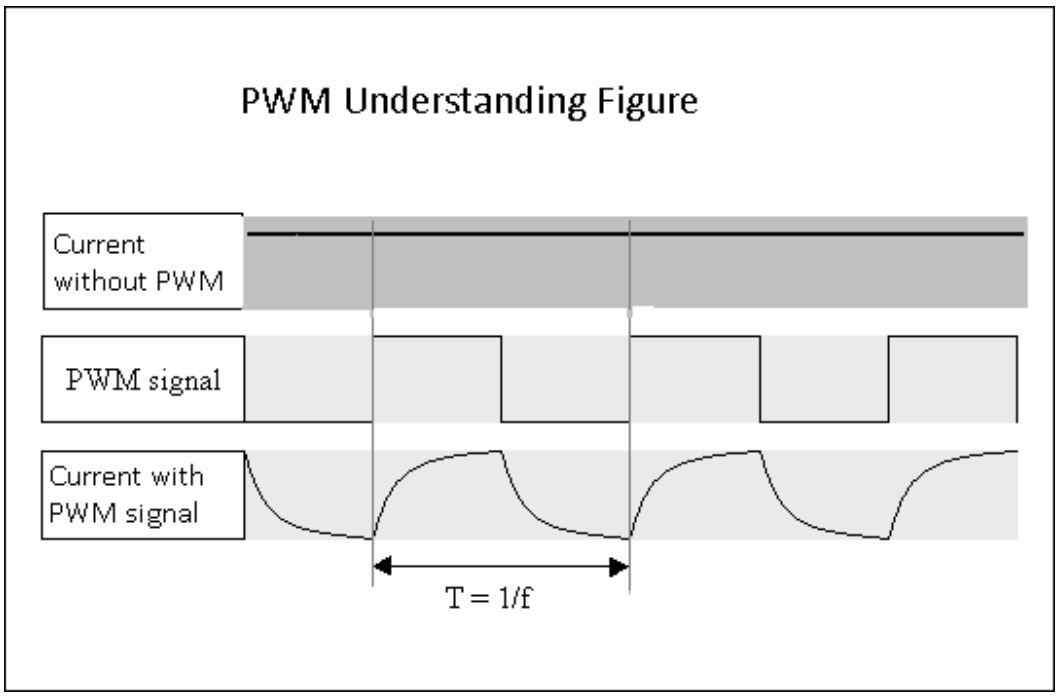


Circuit Diagram

The speed controller works by varying the average voltage sent to the motor. It could do this by simply adjusting the voltage sent to the motor, but this is quite inefficient to do. A better way is to switch the motor's supply on and off very quickly. If the switching is fast enough, the motor doesn't notice it, it only notices the average effect.

PWM is one of the technique to provide a very fast on-off switching.PWM (Pulse width modulation) is a technique in which pulses of different width for high and low voltage are generated to control the average voltage as well as average current. Pulse width modulation is used when a digital system needs to control a system that expects an analog signal of varying amplitude. A typical example is a 12V motor: the speed of the rotor can be regulated by changing the voltage from low (0 V) to high (12 V). At 12V the motor will go at full speed. The alternative is to pass the rotor always 12V, but in discrete pulses, as shown in Figure. If 40% of the

time is filled by pulses(40% duty cycle), then the motor will receive small discrete forces that keep it running at a low percentage of full speed.



The motor runs smoothly because of the inertia of the rotor and because the frequency of the pulses can be adjusted you can control the speed of the motor.

When PWM signal is given to the DC motor by switching on & off pulses, the average potential difference across the armature is decreased and due to this the speed of DC motor decreases.

Mathematical Description:

Suppose that

I_1 = armature current in the first case

I_2 = armature current in the second case

N_1, N_2 = corresponding speeds

V = Supply voltage

We know that

$N_1 \propto V - I_1R_a \propto E_1$ where, R_a = armature resistance

$N_2 \propto V - I_2R_a \propto E_2$

$N_1 / N_2 = E_1 / E_2$

Since, due to PWM I_1 and I_2 as well as E_1 and E_2 change so speed of the motor also changes. The advantage of controlling a motor with PWM instead of a real analog signal is that the full torque of the motor can be used. In DC motors, there is a linear relationship between the voltage supplied and the torque obtained from the motor: the higher the voltage, the higher the torque.

Circuit Description:

This project has been tested in lab. In this project 555 timer IC is used to provide PWM pulses, starting from power supply which is provided by a centre-tapped transformer (T1) to avoid diode complication. Rectification of AC voltage is done by using two diodes D1 and D2. For constant voltage supply, regulator has been used. The centre- tap is taken as the ground or zero voltage reference point. The function of capacitor (C1) is to minimize the ripple content in the rectifier output. Here, 555 timer is used as an astable multivibrator. The output frequency (ON-OFF timing) completely depends on the external resistors (R1&R2) and capacitor (C2). When the power is applied to the circuit, the capacitor (C2) is uncharged; therefore both the trigger (Pin 2) and threshold (Pin 6) will be at zero volts almost. Capacitor (C2) starts charging through resistors(R1 & R2) toward supply voltage (Vcc) but as it reaches just above threshold voltage (2Vcc/3 , Pin 6), the internal comparator (not shown) triggers the internal flip-flop(not shown) and the output(Pin 3) goes low. There is an internal discharge transistor (at Pin 7) which provides discharging path to the capacitor (C2) through external resistor (R2). As the capacitor discharges below the trigger level (Pin 2) voltage (Vcc/3), the internal flip-flop triggers for the next state and the discharge transistor returns back to off state.

This process goes on until voltage is supplied. On-Off time period is given by

$$T_{on} = 0.69*(R1+R2)*C2$$

$$T_{off} = 0.69*R2*C2$$

It is very difficult to get 50% duty cycle because R1 cannot be made zero ohm practically. But with little modification we can achieve it. Control voltage (Pin 5) provides the facility to vary the time period independently of the external resistors

and capacitor. That is why it is connected to capacitor (C3) for avoiding fluctuation in the output. The output pulse (Pin 3) drives the transistor (Q1) which acts as a switch. Through transistor (Q1) DC motor is connected in series, when transistor turns on the current passes through the collector via motor. The reverse process takes place in the similar manner. Diode (D3) protects the transistor (Q1) to get damaged due to high induced voltage (VL= L di/dt) across motor terminals. Due to on-off (PWM) supply the motor runs smoothly. The speed of the motor can be changed by changing the value of variable resistor (preset) R1 or R2. Since by changing the value of R1 or R2 at running condition of motor the frequency of PWM changes due to which the average current changes across the motor terminals which makes motor move fast or slow according to the PWM frequency supplied by 555 timer at pin3.

Components Required:

V1# 220V, 50Hz;
R1&R2# 100KΩ (Variable resistor port);
T1# 6-0-6V, 0.5Amp;
C1# 1000uf/25V;
C2# 100uf/25V;
C3# 0.01uf;
Q1# BC547 or 2N3055;
D1&D2&D3# 1N4007;
R3# 330ohm;
Regulator# 7805CV;
U1# LM555 or NE555;
Motor# 6 volt DC (You can also use 12 volt DC motor if you are using 12V transformer T1);

Microcontroller driver

Introduction

While working in your life, you find maximum number of electronics equipments, used today, are controller based. Aeronspire introduces Aeron micro driver which is a microcontroller based kit connected with peripheral devices to execute one programmable task, giving you a platform for complete embedded system development. This circuit has been specially designed for robotic works inbuilt

with motor driver circuit, Rx & Tx communication and interfacing facility with variety of sensors i.e. Obstacle sensor ,white surface detector , light sensor etc.

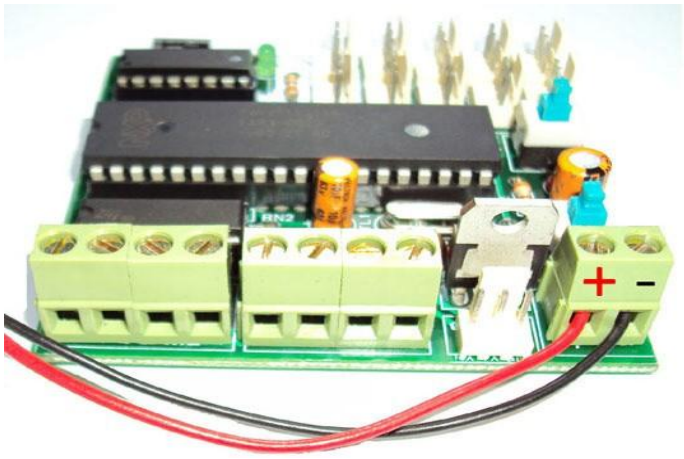
Aeron micro driver kit can be programmed for deferent tasks to perform desiredworkbyusingitsmotorandsensorinterfacingfacilities.Itsupportsall 8051 series microcontrollers manufactured by variety of companies like ATMEL, PHILIPS, and DALLAS etc.

Parts Identificationand their work

The figure shown below is the photograph of Aeron micro driver kit which is surrounded by numbering circles. Each numbering circle denotes specific part which has specific description of each part is given below according to numbering circle.

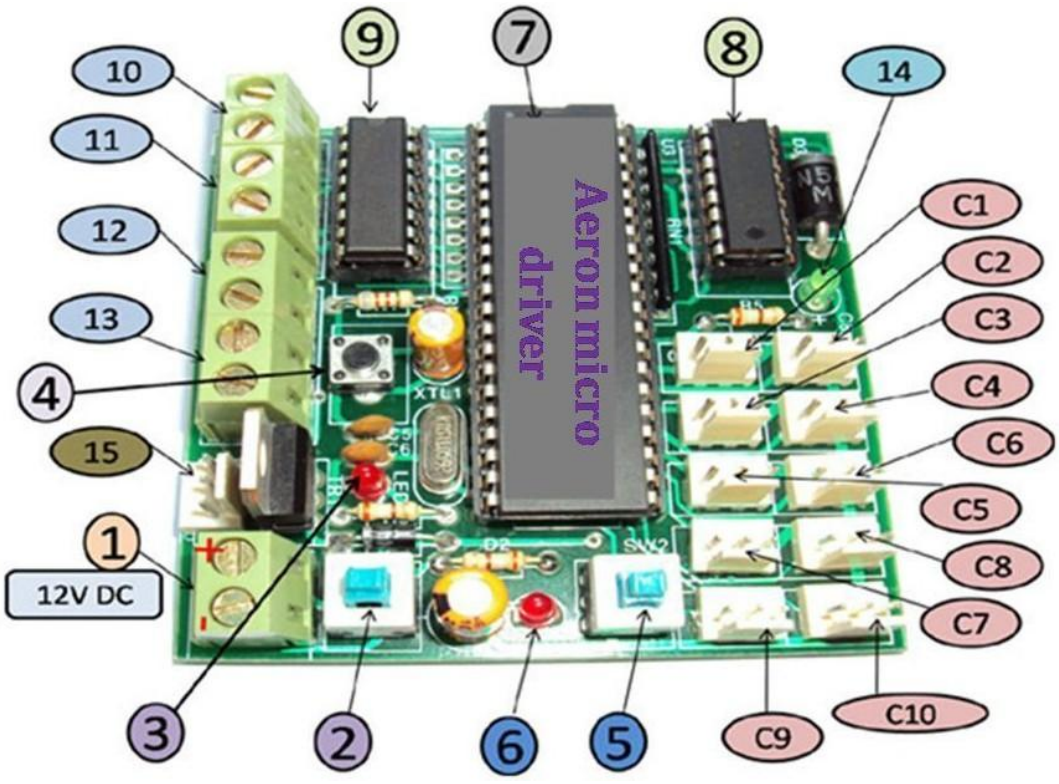
1 **Power Supply Point:**

This is two pin connector through which 12V DC power supply is given to the micro driver kit. See given figure for connection. In this figure the red wire is for positive supply and black wire is for negative supply. Supply voltage must be within 6V to 15V.



2 **Power Switch:**

When this switch is pressed down, the driver circuit turns on microcontroller and starts working.



3 **Supply Indicator:**

When Power switch is turned on this LED will glow red indicating the running condition of micro driver.

4 **Reset Switch:**

When you need to restart your program which is downloaded into microcontroller, just press it and then released, the microcontroller will restart its execution of program from starting address.

5 **Motor Power Switch:**

When this switch is pressed down, the motor connected to point 10, 11, 12 & 13 turn on and the all motors connected to these points can be driven by microcontroller instructions.

6 **Motor Power Indicator:**

When motor power switch is pressed, then this LED will glow red indicating power motors are consuming power from battery.

7 **Microcontroller:**

This is the heart of Aeron micro driver. It may be any one of the 8051 series microcontrollers as mentioned in the introduction part. You can download your own written program into the microcontroller and make it run by using Aeron micro driver.

8 **Motor Driver1:**

This is 1st motor driver IC which drives motors connected to points 10 & 11.

9 **Motor Driver2:**

This is 2nd motor driver IC which drives motors connected to points 12 & 13.

10 **Motor Connector 1:**

Here motor is connected which can be driven by microcontroller instructions provided at pin P0.0 & P0.1.

In the above figure, the motor is connected to motor driver point M3. Similarly other motors can be connected to other M1, M2 & M4 points.

11 **Motor Connector 2:**

Here, you can connect 2nd motor which can be driven by microcontroller instructions provided at pin P0.2 & P0.3.

12 **Motor Connector 3:**

Here, you can connect 3rd motor which can be driven by microcontroller instructions provided at pin P0.4 & P0.5.

13 **Motor Connector 4:**

Here, you can connect 4th motor which can be driven by microcontroller instructions provided at pin P0.6 & P0.7.

14 **Testing LED:**

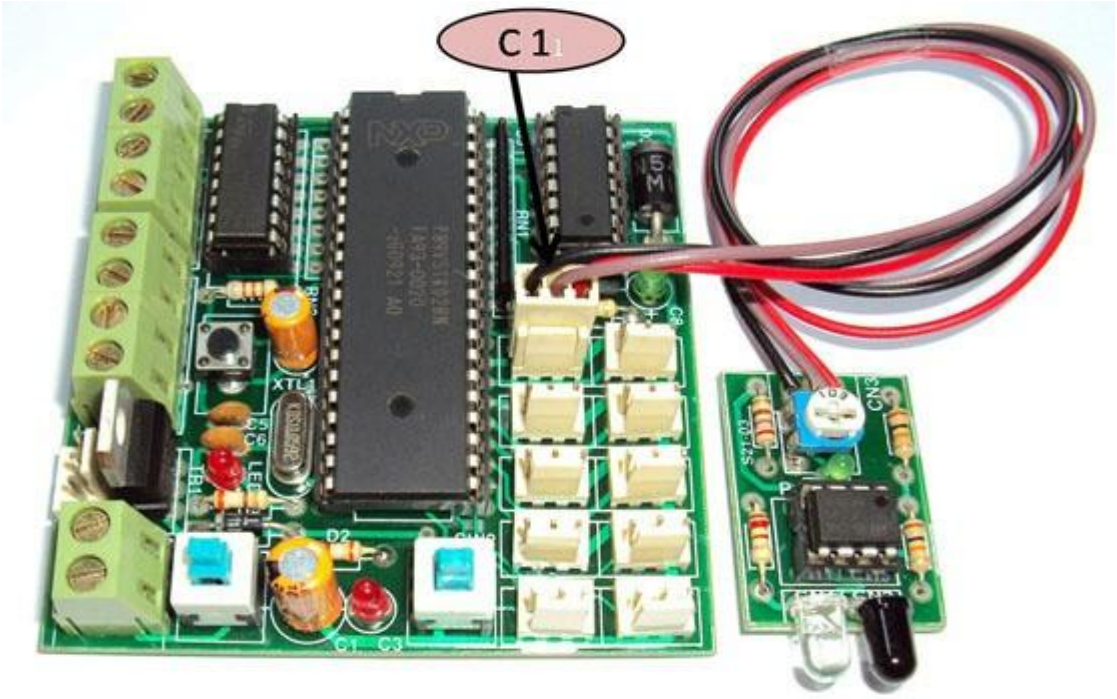
You can write small program to blink this green LED which is connected to pin No. 12(P3.2) of microcontroller.

15 **Rx and Tx Connector:**

This connector can be used for ISP programming without removing the microcontroller from its micro driver kit. This port can also be used for external communication with computer and other microcontroller.

C1 **Sensor Connector1:**

This connector provides interfacing of sensor with microcontroller. Either input can be taken or output can be provided to other devices like buzzer, LED etc.



In the above figure the white surface detector is connected to sensor connector C1.

Similarly, sensor connectors C2, C3, C4, C5, C6, C7, C8, C9 and C10 provide the same job as sensor connector C1. These sensor connectors points can be used same as sensor connector C1.

Microcontroller Pin Connection Description

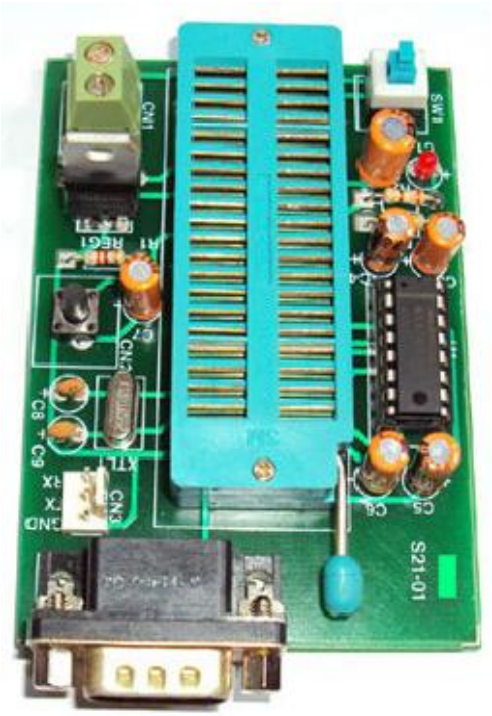
Microcontroller Pin Number	Pin Description	Aeron micro driver pin connection
1	P1.0	General purpose input-output
2	P1.1	General purpose input-output
3	P1.2	General purpose input-output
4	P1.3	General purpose input-output
5	P1.4	General purpose input-output
6	P1.5	General purpose input-output
7	P1.6	General purpose input-output
8	P1.7	General purpose input-output
9	RST	Switch to reset microcontroller
10	P3.0(Rx)	For external communication
11	P3.1(Tx)	For external communication
12	P3.2	Connected to green LED
13	P3.3	Not in use
14	P3.4	Not in use
15	P3.5	Not in use
16	P3.6	Connected to sensor connector 10
17	P3.7	Connected to sensor connector 9
18	X1	Connected to crystal
19	X2	Connected to crystal
20	GND	Ground Connection

Microcontroller Pin Number	Pin Description	Aeron micro driver pin connection
21	P2.0	Connected to sensor connector 8
22	P2.1	Connected to sensor connector 7
23	P2.2	Connected to sensor connector 6
24	P2.3	Connected to sensor connector 5
25	P2.4	Connected to sensor connector 4
26	P2.5	Connected to sensor connector 3
27	P2.6	Connected to sensor connector 2
28	P2.7	Connected to sensor connector 1
29	PSEN	Not in use(For programming purpose)
30	ALE	Not in use(For host programming)
31	EA	Not in use
32	P0.7	2^{nd} pin of motor connector 4
33	P0.6	1^{st} pin of motor connector 4
34	P0.5	2^{nd} pin of motor connector 3
35	P0.4	1^{st} pin of motor connector 3
36	P0.3	2^{nd} pin of motor connector 2
37	P0.2	1^{st} pin of motor connector 2
38	P0.1	2^{nd} pin of motor connector 1
39	P0.0	1^{st} pin of motor connector 1
40	V_{cc}	Connected to +5 volt supply

Microcontroller Programmer

Introduction

To download your hex/ihx files into microcontroller you need one IC programmer device which programs your hex/ihx file into the microcontroller. Aeron microcontroller downloader is such a device which programs your hex/ihx files into the microcontroller; it supports P89V51RD2, P89C51RD2 etc. flash microcontroller only. Your all hex/ihx files generated from your C language/assembly language compiler can be programmed into the microcontroller by using this programmer device.



Requirement

To program microcontroller you need following things with one Aeron microcontroller programmer:

- PC with windows 2000/windows XP.
- It must have serial common port or USB port.
- Flash magic software. It is available at Official website of Flash magic; you can download it from there.

- Serial port cable (RS232) with female to male socket or USB to Serial converter (If you are using USB port).
- 6 volt DC power supply. You can use any DC power supply within range of 5 volt to 15 volt.
- One hex/ihx file generated from your C language/assembly language compiler.

Procedure

If you have all things mentioned above; then just follow the instructions given below with figures your hex/ihx file will be programmed into the microcontroller:

1. Make connection according to the figures given below.

2. Insert microcontroller onto the 40 PIN ZIF IC base.
3. Give power supply to Aeron microcontroller programmer kit.
4. Switch on the power switch of Aeron microcontroller programmer kit.
5. Start Flash magic software in your system.
6. Select COM port in the Flash magic window. It may vary system to system. If you are using USB port with USB to serial converter then it may be any one of the COM1, COM2.COM2…up to COM9.Make sure which one is valid for your connection.
7. Select Baud Rate. It must be 9600.
8. Select device. If you are using P89V51RD2 then select P89V51RD2, similarly select P89C51RDxx if you are using P89C51RD2 etc.

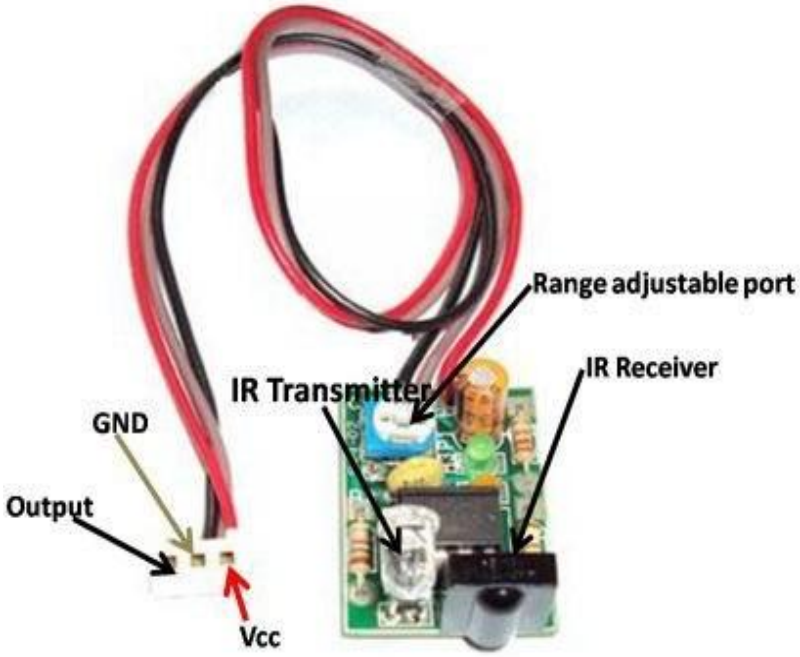
9. Interface. You do not need to do anything; it will be in None (ISP) mode by default.
10. Select Oscillator Frequency. It must be 11.0592 MHz.
11. Click on the block Erase all Flash + Security + Clks.
12. Browse your hex/ihx file.
13. Now click on the start button. If it asks to bring the device into ISP mode then press and release the reset button on the Aeron microcontroller programmer kit or if it asks to lower the baud rate then decrease the baud rate to 7200. It will automatically program your hex/ihx file into your microcontroller and you will get a message 'Finished' at the left bottom of the Flash Magic Window.

Now microcontroller is ready to use. Insert it onto the microcontroller driver kit, it will write the code into the microcontroller.

Different Interfacing Sensors

Obstacle Sensor

Obstacle sensor detects the presence of any object in front of it. This works on the principle of reflection of rays. IR LED emits IR rays and when it gets reflected by any object, the IR receiver detects it and makes the output low and at the same time green LED glows. When there is no object in front of the sensor the output remains high and green LED does not glow.



Color identification: Red is for V_{cc}, Gray is for Ground and Black is for Output.

NOTE:

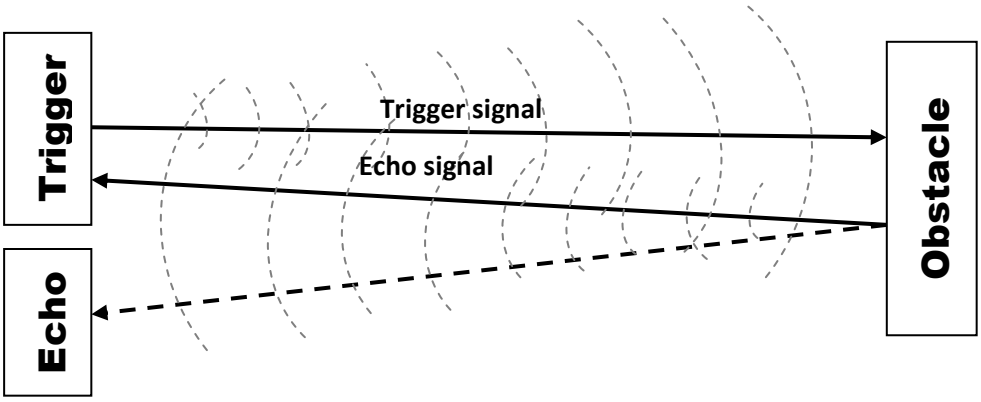
- ➔ When obstacle is present then output will be low.
- ➔ When obstacle is not present then output will be high.
- ➔ Input voltage V_{cc} = 5V
- ➔ Output voltage:
  For logic High it is approx 4.5V.
  For logic low it is approx 0V.

Distance Sensor

A distance sensor is a reliable tool for a variety of applications for accurate as well as fast measurement, accurate positioning, and discovery of an extensive range of materials. The probable applications of this sensor mainly include examining the unwinding of coils, twofold sheet recognition otherwise the precise high bay stackers positioning.

Working of Distance Sensor:

Generally, these sensors work by generating some kind of waves like a laser, IR LED, and ultrasonic then it reads how it has altered once it gets back. This change mainly depends on the returned signal's intensity, and the time it takes to return back, etc. The terms of distance sensor include resolution, range, and update rate.



There is several things reason for deciding the option for best interfacing of a distance sensor project like a type of sensor, speed, power utilization, wire length from board to the sensor, etc.

There are several unique choices to select and incorporate a sensor in your project. We focus mainly on four types of distance sensors like easy LEDs, LIDAR, ultrasonic and VCSEL. Each option has its pros and cons, and we have guides, projects, and tools to make sure you know which is right for you. The highlights of this sensor are reliable, low cost, easy setup, accurate, and measurement of non-contact distance in automation.

LED Benefits & Drawbacks

- Low-cost, minute footprint, the update rate is decent, and numerous interface choices
- Current utilization is high, the highest range is quite low

LIDAR Benefits & Drawbacks

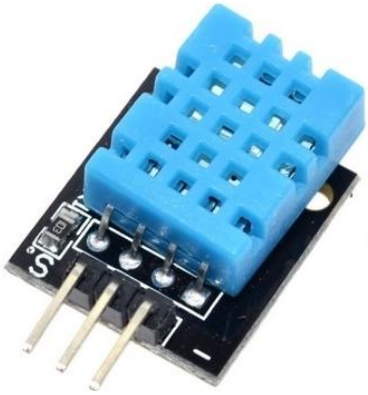
- Maximum range is excellent, the update rate is extremely fast
- The expensive, large footprint and high current draw

Ultrasonic Benefits & Drawbacks

- Current draw is very low, numerous interface options
- Resolution is low, and the refresh rate is slow

Temperature Sensor

A temperature sensor is an electronic device that measures the temperature of its environment and converts the input data into electronic data to record, monitor, or signal temperature changes.



DHT11 Humidity and Temperature Sensor

LM35 Temperature Sensor

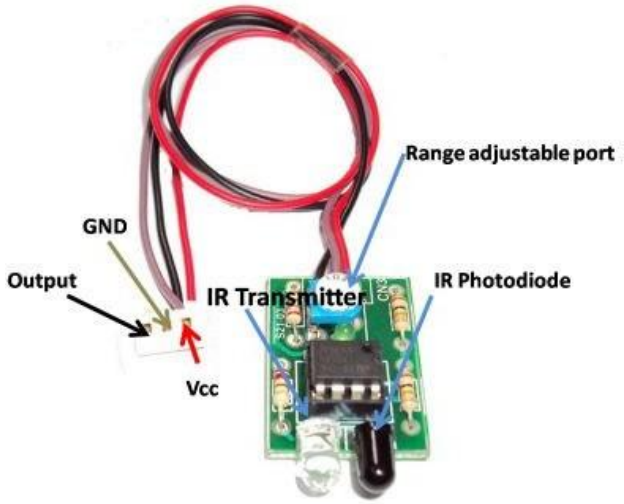
There are many different types of Temperature Sensor available and all have different characteristic depending upon their actual application. A temperature sensor consists of two basic physical types:

- Contact Temperature Sensor Types – These types of temperature sensor are required to be in physical contact with the object being sensed and use conduction to monitor changes in temperature. They can be used to detect solids, liquids or gases over a wide range of temperatures.
- Non-contact Temperature Sensor Types – These types of temperature sensor use convection and radiation to monitor changes in temperature. They can be used to detect liquids and gases that emit radiant energy as heat rises and cold settles to the bottom in convection currents or detect the radiant energy being transmitted from an object in the form of infra-red radiation (the sun).

White Surface Detection Sensor

White surface detector is a sensor which detects only reflective surfaces like white surface, yellow surface, blue surface etc. but it cannot identify the color of the surface. When it is kept in front of a black absorptive surface then it detects it and gives 0Volt output at its output terminal (see figure).

IR LED acts as IR ray source. Detection of surface is done by IR photodiode which receives reflected IR rays coming from the reflective surface. When the sensor is kept in front of a surface then the surface starts reflecting rays coming from the IR LED and the same reflected ray is detected by IR photodiode which gives input to the amplifier. The amplifier amplifies the signal. This amplified signal goes to output pin of the sensor and the same time green LED glows, but if the surface is absorptive black then green LED will not glow because the black surface does not reflect any rays coming from IR LED. For better understanding see the following figures.



Color identification: Red is for Vcc, Gray is for Ground and Black is for Output.

NOTE:

- ➔ When white surface is present then output will be high.
- ➔ When white surface is not present then output will be low.
- ➔ Input voltage Vcc = 5V
- ➔ Output voltage:
  For logic High it is approx 4.5V.
  For logic low it is approx 0V.

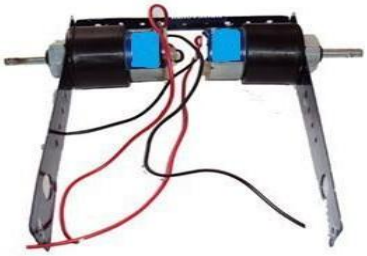
Robot Making

This tool makes your task easy. Now you can make your own robot easily by using this tools package. It contains Galvanize strips with different shapes that can be used to give desired shape to your robot. It also includes nuts & bolts, screws, wrench and screwdriver etc which you need to give best shape to your robot.

Procedure to make your own robot: Just follow the instructions given below with figures:

- Take two long strips and one medium strip and give shape according to the figure given below.

- Fit two geared motors as in the picture given below.



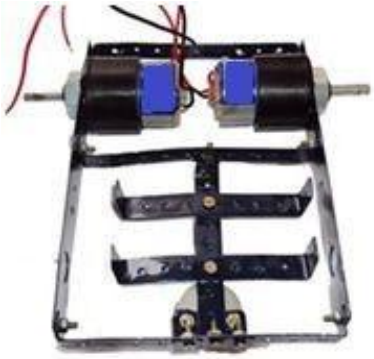
- Tight one medium strip as given in the picture.

- Take one cascading wheel, two bend strips and one medium strip and make shape as in the picture given below.

- Fit this shape with previous shape as in the picture given below.

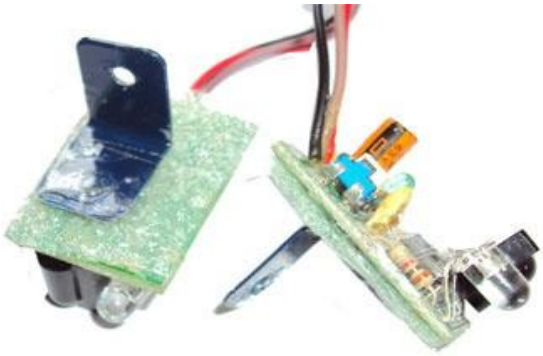
- Take four small strips and make frame as in the picture given below.

- Fit this frame onto the previous shape as in the picture given below



- Take one sensor and one bent strip and make shape as in the picture given below.

- Bring them in contact with the help of solo tape or with the help of any adhesive material.



- Tight these sensors onto the front side of previous shape and fit two wheels on the axels of the motors according to the pictures given below.

Now main body of robot is ready. You can give also other shapes. This shape can be used for manual robot, wireless robot and autonomous robot.

White Line Follower Robot

- Take one ***Aeron micro driver*** kit, one 12 Volt power supply and two white surface detection sensors and make connection accordingly.
- Write code into C compiler for microcontroller.

```
#include <8051.h>
//function for forward move
void move_forward(void)
{
 P0_0=1;          // for left side motor ,connected to 1st pin of motor connector 1.
P0_1=0;           // for left side motor, connected to 2nd pin of motor connector 1.
P0_2=1;           // for right side motor, connected to 1st pin of motor connector 2.
P0_3=0;          // for right side motor, connected to 2nd pin of motor connector 2.
}
//function for left turn
void take_left_turn(void)
{
 P0_0=0;          //Stop the left side motor connected to motor connector 1.
P0_1=0;
```

```
P0_2=1;             //let the right motor move forward so that robot will take left turn.
P0_3=0;
}
//function for right turn
void take_right_turn(void)
{
 P0_0=1;             //let the left motor move forward so that robot will take right turn.
P0_1=0;
P0_2=0;             //Stop the right side motor connected to motor connector 2.
P0_3=0;
}
int main()
{
P2_7=1;             // make sensor connector 1 as input pin which will act as left sensor.
P2_6=1;             //make sensor connector 2 as input pin which will act as right sensor.
// while loop is used for continuous checking of sensor's input.
while(1)
{
 if(P2_7==0 && P2_6==0)    // check both sensors and if condition meets then call
        // move_forward() function.
        move_forward();
if(P2_7==1 && P2_6==0)            // check both sensors and if condition meets then call
        // take_left_turn() function.
        take_left_turn();
if(P2_7==0 && P2_6==1)            // check both sensors and if condition meets then call
        // take_right_turn() function.
        take_right_turn();
}
}
```

The above program is written for white line follower robot. The motor connected to motor connector 1 must be fitted to the right side of the robot and the motor

connected to motor connector 2 must be fitted to the left side of the robot. In the similar ways the sensor connected to sensor connector 1 must be kept on the left side of white line and the sensor connected to sensor connector 2 must be kept on the right side of white line. For pin connection see pin description part.
In main function, program code is written under the while loop, because it keeps the loop running for infinite time so that the sensors will keep checking for their conditions for 0 and 1. In this loop the sensors give the inputs to the microcontroller and microcontroller checks condition for left turn, right turn and for forward move and accordingly it gives output to the motors.

- Program C code into microcontroller via microcontroller programmer.

Use of Robotic System in industry

1. **Collaborative Robots**
   These collaborative robots are built to work together with other robots, on enormous assembly lines. Robots must collaborate between handling and welding robots to make such assembly lines function properly.

2. **Robotic Painting**
   Robotic Painting is used in automotive production and many other industries as it increases the quality and consistency of the product. Cost savings are also realized through less rework.

3. **Materials Handling**
   Materials Handling robots are utilized to move, pack and select products. They can also automate functions involved in the transferring of parts from one piece of equipment to another. Direct labor costs are reduced and much of the tedious and hazardous activities traditionally performed by human labor are eliminated.

4. **Robotic Welding**

Robotic welding has been the top robotic application in the automotive sector for a long time, as every car needs a high number of welds before it's complete. Given the high value of the finished product, productivity from automation is enormous.

5. **Robotic Assembly**

   In many automotive plants, robots are assembling smaller components like pumps and motors at high speeds. Often, robots are performing tasks like windshield installation and wheel mounting to increase throughput.

Advantages of robotic system in modern industry

- **Improved working environment**

Some tasks are deemed as too dangerous or laborious and repetitive for humans to carry out and so instead robots can perform these tasks instead. Working conditions, therefore, can be vastly improved as well as the safety within factories and production plants by introducing industrial robots.

- **Increased profitability**

The results of introducing industrial robots can only ensure higher profitability levels with lower cost per product as by increasing the efficiency of your process, reducing the resource and time required to complete it whilst also achieving higher quality products, introducing industrial robots save money in the long run.

- **Longer working hours**

As human breaks in the working day are required, distractions happen and attention spans slow. Whereas robots can work 24/7 and keep working at 100% efficiency. On average a 40% increase in the output of a production line occurs when one key person is replaced by a robot who operates the same working hours, simply because of stamina. Also, robots don't take holidays or have unexpected absences.

- **Improved quality**

Given their higher levels of accuracy, industrial robots can be used to produce higher quality products which result in the reduction of time required for quality control and ensures that standards of quality are adhered to.

- **Increased efficiency**

Industrial robots can complete certain tasks faster and more efficiently than humans as they are designed and built to perform them with higher accuracy. This combined with the fact they are used to automate processes which previously might have taken significantly more time and resource results in the use of industrial robots to increase the efficiency of production lines.

Conclusion

During this project, we learned many areas of engineering to build a robot. We were evolved in mechatronics, which involves three types of tasks: electronics, electrical mechanical and computer engineering. Using the mechanical aspect of engineering, we constructed the Square Bot. We designed a four-wheel robot to perform tasks. We used soldering equipment to solder the appropriate components and connection for the infrared board. While working on electric aspect of the project, we started soldering non-polar component like resistor, connectors first and did the non-polar part like LED and capacitor. Furthermore, we used many aspects of computer engineering interchangeably to program the robot so that it can perform the task successfully. The programming part was little tricky and needed many trials to check the best performance of the robot. We also used different types of sensor for making different robots.

References

www.aeronspire.com

www.researchgate.net

www.electronicshub.org