Smart Home System For Saving Electricity

Project Report
Internet of Things
BTech ICT (Sem VII)

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CHAPTER_1

INTRODUCTION

1.1 OVERVIEW

The project deals with an interesting manner of how energy can be saved by just turning instruments of room off when not in used.

1.2 MOTIVATION

In India most of the people forgets to switch off fans and lights when they leave the room which cause a big loss of energy. Currently India Faces a huge Problem of Electricity Shortage And there are many Villages in India which still Doesn't have electricity. So, saving Electricity is a huge task and very important for a developing Country like India.

1.3 OBJECTIVE

- Our main objective is to control lights, fans and A/C's on the basis of human presence.
- We will be using IR sensors to count humans inside the room.

- As the person moves inside the lights will be controlled in that way.
- And as the temperature changes fans and A/C's will be operating accordingly.
- Also, we have 4x4 Keypad for Entering the Password. And Servo Motor for Opening the Door.

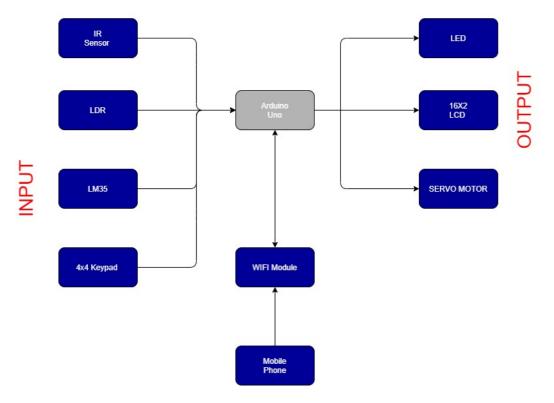
CHAPTER 2

MARKET SURVEY

Sr No. System Communi Controlle User Applicatio Benefit r Interface ns s

1.	Philip s Hue Bridg e	Zig bee wireless Network	Home gateway and Router	Smart device	Monitorin g and Controlli ng Home Applian ces	Effectively Manages and Controls Home Appliance s and Other devices
2.	LIFX Lighting Systems	Wi-Fi Module	Works on Wi- Fi System.	Led Lights	Switching LED	Smart, Economic and Efficient
3.	Comfy Lights	Wi-Fi Network	Build in Sensors (Motion Sensor, LED, Wi-Fi, Light Sensor).	Androi d Phone	Comfy Light simulates Human presence at home realistically through light, so deterring intruders.	Convenienc e, safety, and Power- saving

CHAPTER 3 BLOCK DIAGRAM



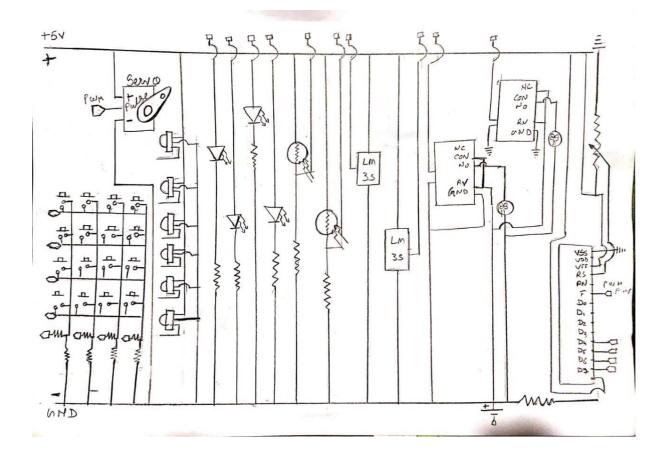
- First, Person will Enter the Password in 4X4 KeyPad. If the password is Correct the door (Servo Motor) will open (Rotate 90 Degree).
- After That when person will pass through the Door, IR Sensor will detect it and display the Count of No of Persons in the Room on 16X2 LCD.
- The Room will be divided in 2 Parts, Left & Right and there will be an IR Sensor in each part which will detect presence of person in each part.
- In Each part there will be a LM35 and a LDR to check the temperature and light intensity.
- Fan and A/c's will be Controlled and turned ON and OFF on the bases of temperature readings provided by LM35.
- Lights will be Controlled and turned ON and OFF on the bases of Natural Light Intensity readings provided by LDR.

- All this data will be available to the user on his mobile phone. This data will be transferred using internet by ESP8266WiFi Module.
- Input for the System will be password on the 4X4 KeyPad, The Human Presence detected IR Sensors, Natural Light Intensity detected by LDR, Temperature Readings Taken by LM35.
- Output for the System will be Counts of No of Humans & Current Temperature on 16X2 LCD, Fans, AC's and Lights as LED's and Servo Motor as door.

CHAPTER 4

SYSTEM ARCHITECTURE

CIRCUIT DIAGRAM



HARDWARE AND SOFTWARE REQUIREMENTS

Hardware Components

- 1. ARDUINO MEGA
- 2. 16x2 CHARACTER LCD
- 3. IR SENSOR
- 4. LDR
- 5. LM35 TEMPERATURE SENSOR
- 6. 12V FAN
- 7. SERVO MOTOR
- 8. 4x4 KEYPAD

- 9. RELAY DRIVER
- 10. RESISTORS
- 11. LEDS
- 12. JUMPER WIRES
- 13. BREAD BOARD

Software Requirements

- 1. Embedded C programming
- 2. ARDUINO
- 3. TinkerCad
 - There Are Several Inputs and Several Outputs in the System
 - Inputs: IR Sensors, LM35, LDR, 4X4 KeyPad.
 - Outputs: 16X2 Lcd, Led, Servo Motor.
 - Selection Criteria:
 - A) LM35: Minimum and Maximum Input Voltage is 35V and 2V respectively. Typically, 5V. Can measure temperature ranging from -55°C to 150°C. Output voltage is directly proportional (Linear) to temperature (i.e.) there will be a rise of 10mV (0.01V) for every 1°C rise in temperature. ±0.5°C Accuracy. Drain current is less than 60uA. Low cost temperature sensor. Small and hence suitable for remote application. Available in TO-92, TO-220, TO-CAN and SOIC package.
 - B) LDR: Can be used to sense Light. Easy to use on Breadboard or Perf Board. Easy to use with

- Microcontrollers or even with normal Digital/Analog IC. Small, cheap and easily available. Available in PG5, PG5-MP, PG12, PG12-MP, PG20 and PG20-MP series.
- C) IR Sensor: IR sensors read moving objects. Contact-based temperature sensors do not work well on moving objects. Infrared temperature sensors are ideally suited for measuring the temperatures of tires, brakes and similar devices. IR sensors don't wear. No contact means no friction. Infrared sensors experience no wear and tear, and consequently have longer operating lives. IR sensors can provide more detail. An IR sensor can provide greater detail during a measurement than contact devices, simply by pointing it at different spots on the object being read. IR sensors can be used to detect motion by measuring fluctuations in temperature in the field of view.
- D) 4X4 KeyPad: Maximum Voltage across EACH SEGMENT or BUTTON: 24V. Maximum Current through EACH SEGMENT or BUTTON: 30mA. Maximum operating temperature: 0°C to + 50°C. Ultra-thin design. Adhesive backing. Easy interface. Long life.
- E) 16X2 LCD: Operating Voltage is 4.7V to 5.3V. Current consumption is 1mA without backlight. Alphanumeric LCD display module, meaning can display alphabets and numbers. Consists of two rows and each row can print 16 characters. Each character is built by a 5×8-pixel box. Can work on both 8-bit and 4-bit mode. It can also display any custom generated characters. Available in Green and Blue Backlight
- F) Servo Motor: The servo motor is specialized for highresponse, high-precision positioning. As a motor capable

of accurate rotation angle and speed control, it can be used for a variety of equipment.

CHAPTER 5

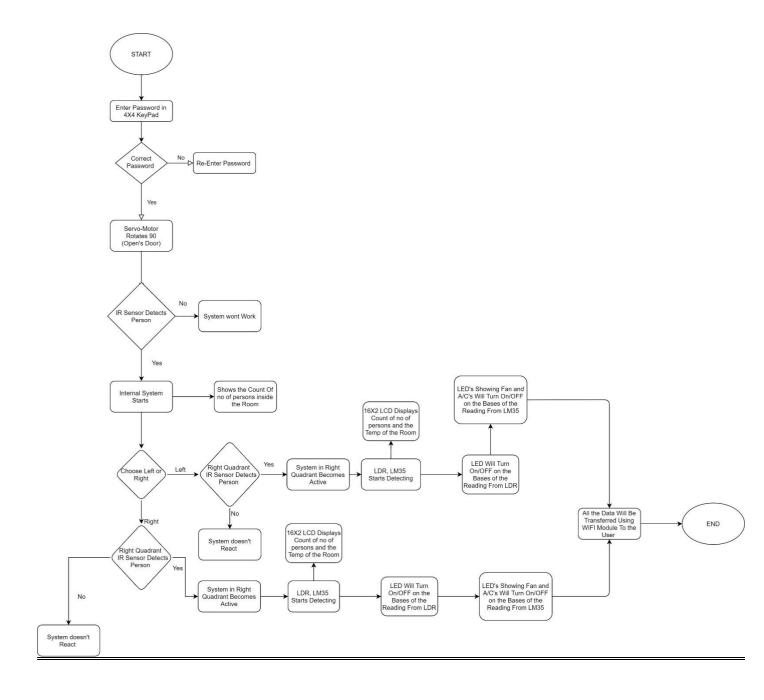
MICROCONTROLLER FEATURES

Microcontr oller Features	Ardui no UNO	Raspber ry Pi	Beagl e Bone	Intel's Galile o	Intel's Ediso n
Microproc ess or	ATmega 32 8	1.2 GHz 64-bit quad- core ARM Cortex- A53	1GHz AM335 x ARM® Cortex- A 8	Intel Quark SoC X1000 Application Processor	Intel Atom 500MHz dual- core, dual-threaded CPU and an Intel Quark 100MHz microcontroller
Clock Speed	16MHz	700 MHz to 1.4 GHz	300 MHz to 1 GHz	400 MHz	500 MHz
Operating Voltage	7 to 12 V	5.1 V	5 V	3.3V or 5V	1.8V
Flash Memory	32 KB	4 GB	4 GB/256 MB	8M	
SRAM	2 KB			512 KB	192 KB
EEPROM	1 KB			8 KB	
Digital I/O pins	14	26	92	14	20
Analog input pins	6	-	8	6	6

Programi ng Languag es	C, C++	Python, C, C++, Java, Scratch, and Ruby	C, C++, Pytho n, Perl, Ruby, Java, or even a shell script	C, C++, Python, Node.js/ JavaScript	Python, Node.JS, C/C++
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CHAPTER 6

FLOW CHART



CHAPTER 7

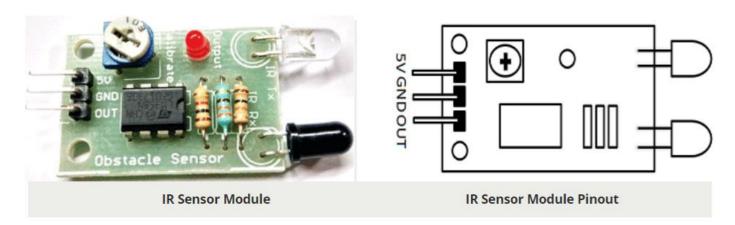
SENSOR'S DETAILS

IR Sensor

1. Operating Principle with Diagram

An infrared sensor is an electronic instrument that is used to sense certain characteristics of its surroundings. It does this by either emitting or detecting infrared radiation. Infrared sensors are also capable of measuring the heat being emitted by an object and detecting motion.

Infrared technology is found not just in industry, but also in every-day life. Televisions, for example, use an infrared detector to interpret the signals sent from a remote control. Passive Infrared sensors are used for motion detection systems, and LDR sensors are used for outdoor lighting systems. The key benefits of infrared sensors include their low power requirements, their simple circuitry and their portable features.



2. Measurement Range

The Range of IR Sensor is up to 20cm.

3. Physical Dimension

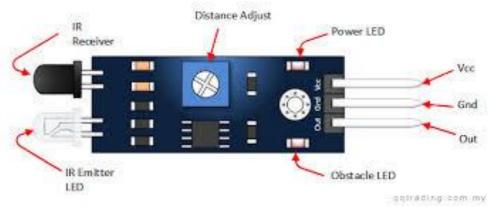
Size: $50 \times 20 \times 10 \text{ mm} (L \times B \times H)$

Hole size: $\phi 2.5 mm$

4. Power rating details

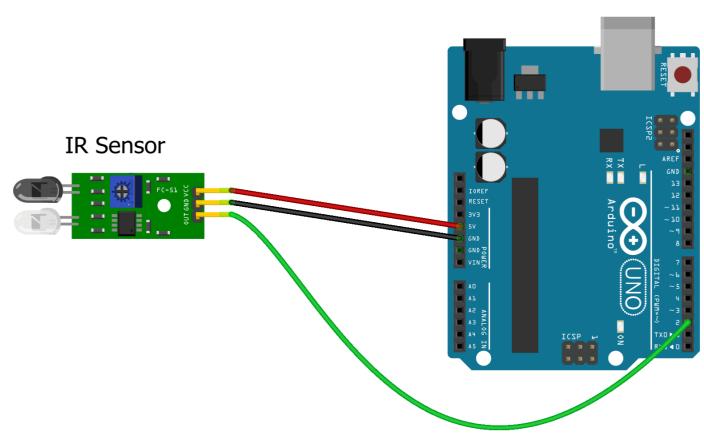
Operating voltage 5VDC I/O pins are 5V and 3.3V compliant

5. Pin Diagram



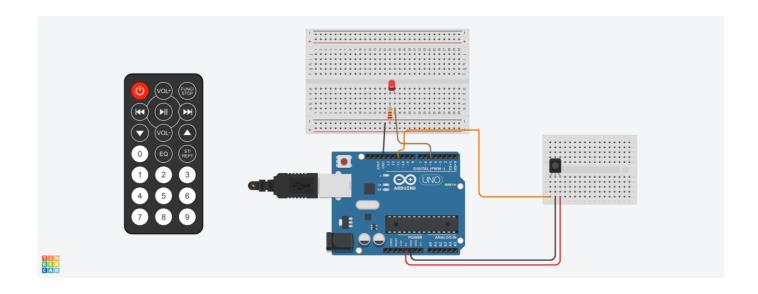
6. Interfacing with Arduino

Arduino UNO



fritzing

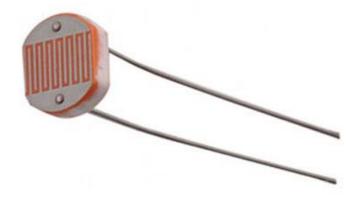
Simulation Interface of IR And Arduino



LDR

1. Operating Principle with Diagram

Photoresistor or LDR (Light Dependent Resistor), as the name suggests will change it resistance based on the light around it. That is when the resistor is placed in a dark room it will have a resistance of few Mega ohms and as we gradually impose light over the sensor its resistance will start to decrease from Mega Ohms to few Ohms. This property helps the LDR to be used as a Light Sensor. It can detect the amount of light falling on it and thus can predict days and nights or can be used for changing the intensity of lights.



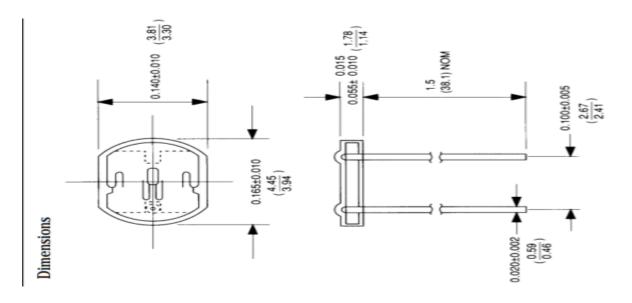
2. Measurement Range

Operating temperature: -25 Degree Celsius to +75 Degree Celsius

Guide to source illuminations

Light source Illumination	LUX
Moonlight	0.1
60W Bulb at 1m	50
1W MES Bulb at 0.1m	100
Fluorescent Lighting	500
Bright Sunlight	30,000

3. Physical Dimension

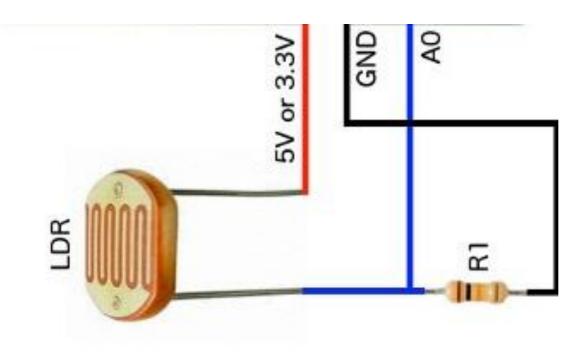


4. Power rating details

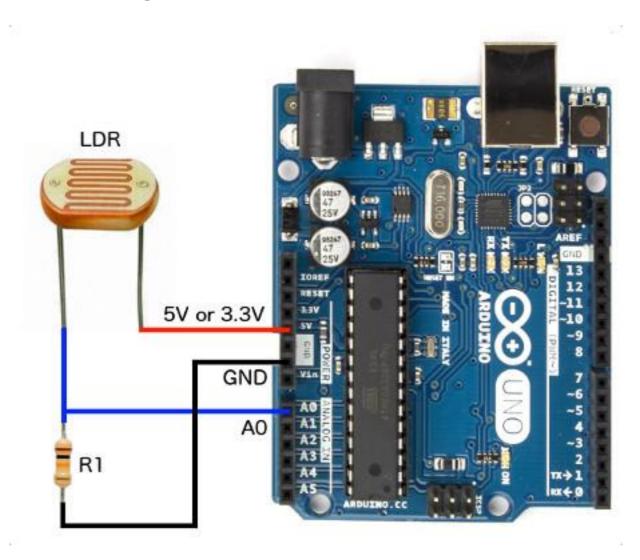
Peak Voltage: 100V Max

Current: 5mA

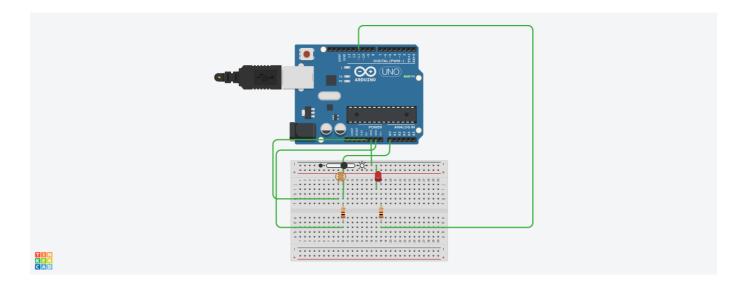
5. Pin Diagram



6. Interfacing with Arduino



Simulation Interface of LDR And Arduino



LM35

1. Operating Principle with Diagram

In principle, the sensor will perform sensing when the temperature changes every 1 °C temperature will show a voltage of 10 mV. In placing the LM35 can be affixed with adhesive or can be cemented on the surface but the temperature will be slightly reduced by about 0.01 °C being absorbed in the surface temperature. In this way the expected difference between the air temperature and the surface temperature can be detected by a sensor LM35 same temperature as the surrounding, if the surrounding air temperature is much higher or much lower than the surface temperature, the LM35 is the surface temperature and the temperature of the surrounding air.

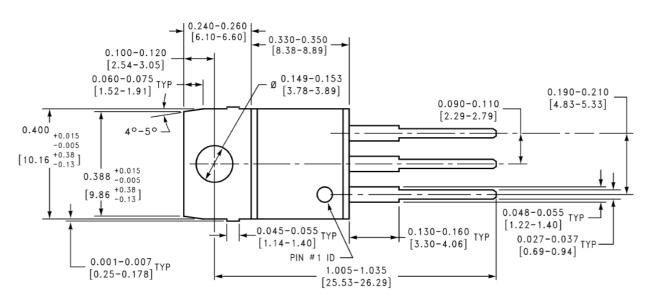


2. Measurement Range

LM35 Measurement Range is from -55 degree Celsius to +150 Degree Celsius

3. Physical Dimension

-

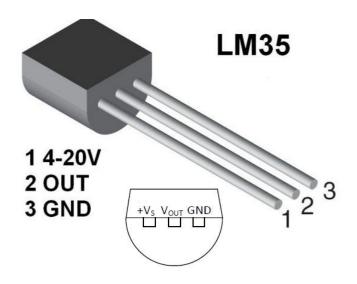


4. Power rating details

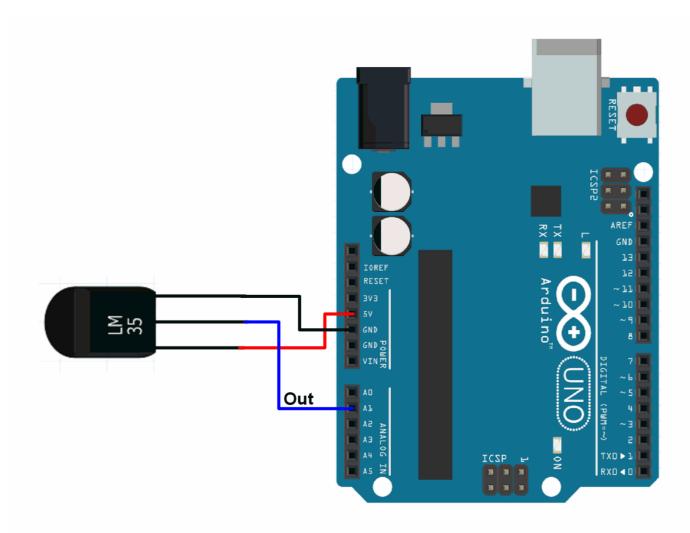
Operating Voltage: 4V – 30V

Supply Voltage: 5V

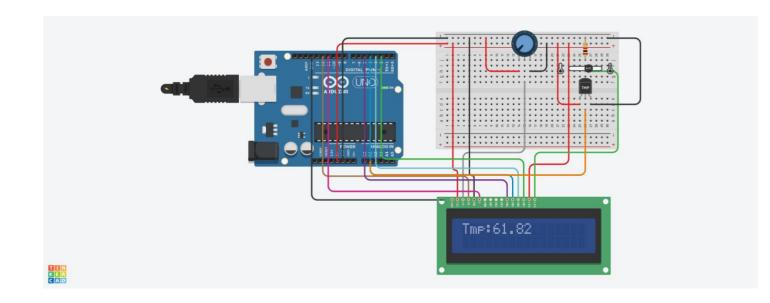
5. Pin Diagram



6. Interfacing with Arduino



Simulation Interface of LM35 And Arduino



CHAPTER 8 ACTUATORS AND DISPLAYS

Liquid crystal display (LCD 16x2)

1. Operating Principle with diagram

LCD modules are very commonly used in most embedded projects, the reason being its cheap price, availability and programmer friendly. Most of us would have come across these displays in our day to day life, either at PCO's or calculators. The appearance and the pinouts have already been visualized above now let us get a bit technical.

 16×2 LCD is named so because; it has 16 Columns and 2 Rows. There are a lot of combinations available like, 8×1 , 8×2 , 10×2 , 16×1 , etc. but the most used one is the 16×2 LCD. So, it will have ($16\times2=32$) 32 characters in total and each character will be made of 5×8 Pixel Dots. A Single character with all its Pixels is shown in the below picture.

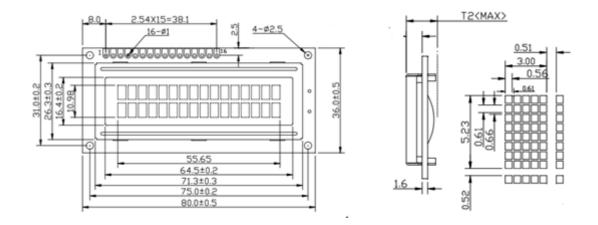


Now, we know that each character has (5×8=40) 40 Pixels and for 32 Characters we will have (32×40) 1280 Pixels. Further, the LCD should also be instructed about the Position of the Pixels. Hence it will be a hectic task to handle everything with the help of MCU, hence an Interface IC like HD44780is used, which is mounted on the backside of the LCD Module itself. The function of this IC is to get the Commands and Data from the MCU and process them to display meaningful information onto our LCD Screen. You can learn how to interface an LCD using the above-mentioned links. If you are an advanced programmer and would like to create your own library for interfacing your Microcontroller with this LCD module then you have to understand the HD44780 IC is working and commands which can be found its datasheet.

2. Measurement Range

This Bluetooth module can cover maximum 9 meter of signal.

3. Physical Dimension

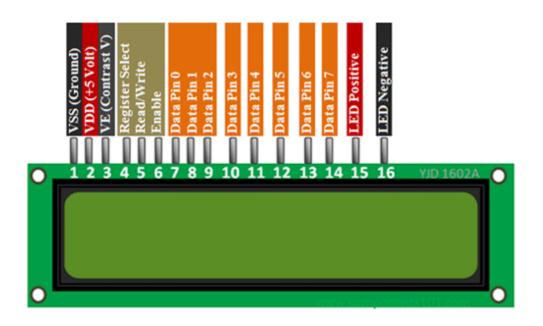


4. Power rating details

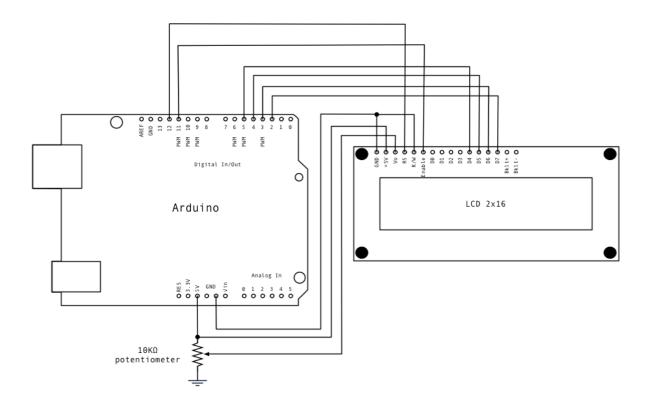
Operating voltage : 4.7V – 5.3V

DC Supply voltage : 5V DC

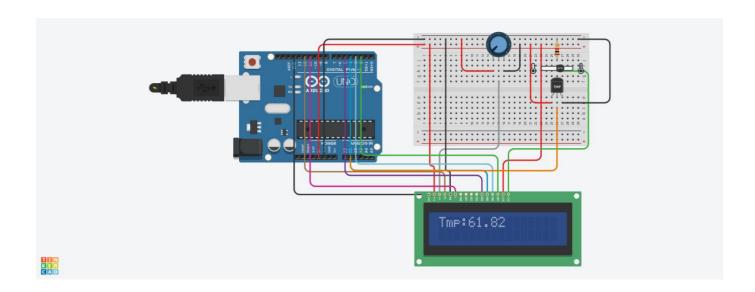
5. Pin Diagram



6. Interface with Arduino



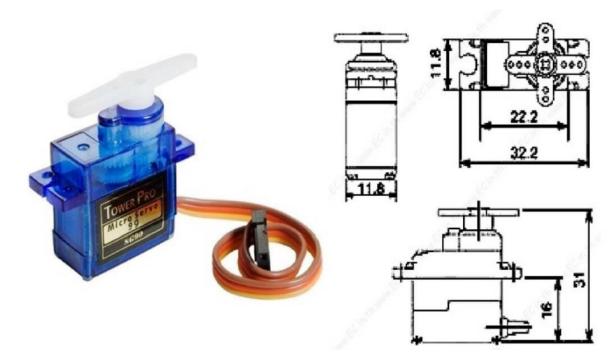
Simulation Interface Of 16X2 LCD Display and Arduino



Servo Motor (Actuator)

1. Operating Principle with diagram

Servo motor works on the PWM (Pulse Width Modulation) principle, which means its angle of rotation is controlled by the duration of pulse applied to its control PIN. Basically, servo motor is made up of DC motor which is controlled by a variable resistor (potentiometer) and some gears.

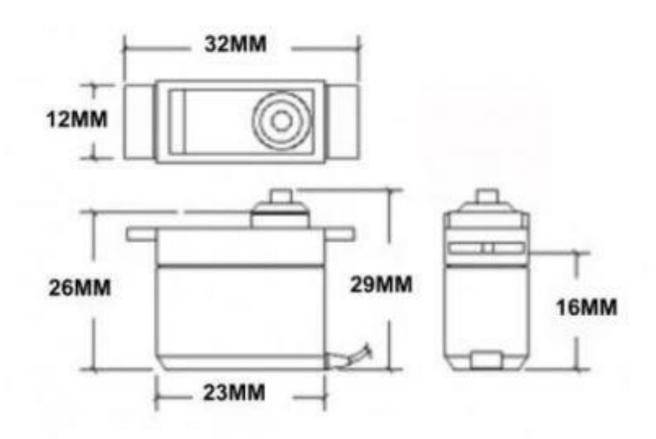


2. Measurement Range

Rotational Range Is 180 Degree

3. Physical Dimension

Length: 0.91 in (23.1 mm) **Width:** 0.48 in (12.2 mm) **Height:** 1.14 in (29.0 mm)

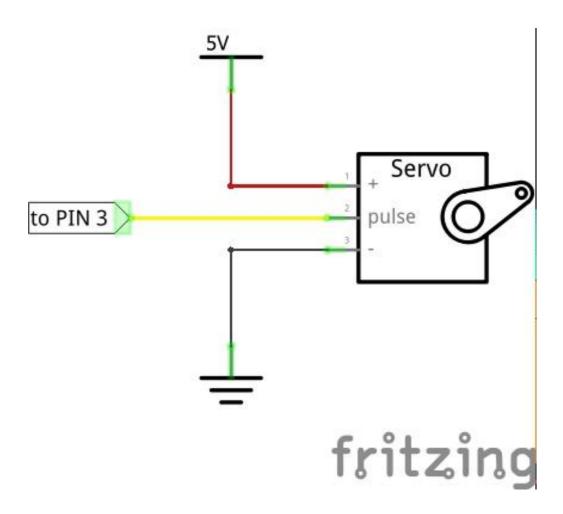


4. Power rating details

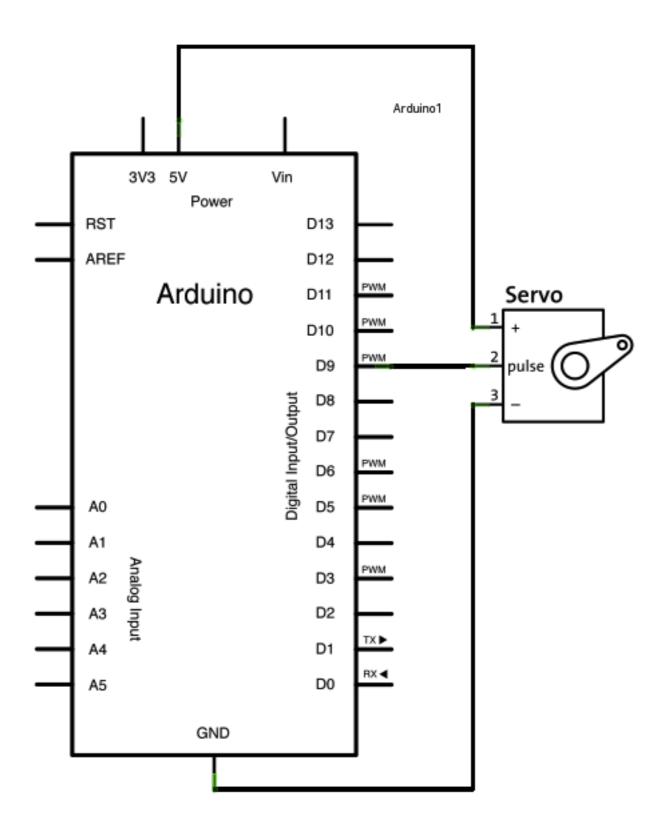
Operating voltage : 4.8V DC

Supply voltage : 5V DC

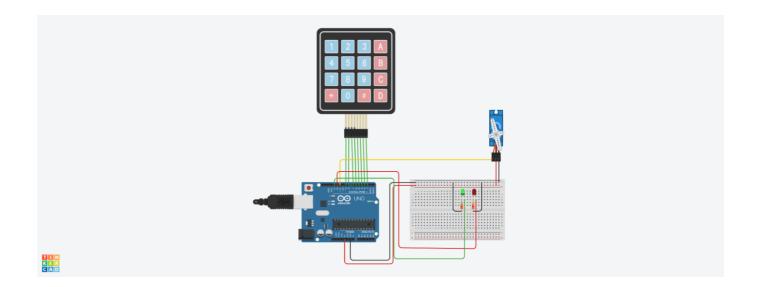
5. Pin Diagram



6. Interface with Arduino



Simulation Interface of Arduino And Servo Motor.



4X4 KeyPad

1. Operating Principle with Diagram

A matrix keypad is a small compact input device that accepts user inputs and processed by Microcontrollers. You might have seen this in most commonly used devices like Calculators, Digital locks, Gas pumps and DIY projects. It comes in different types, one of them is membrane keypads, it is thinner in size and you can paste it on top of your creative projects.

If we have to connect 16 buttons to the microcontroller, then each button takes 1 GPIO pin. But if we use the matrix keypad, we just need 8 pins only.

Initially, all rows are set to 0(LOW) and all Columns are set to 1(HIGH). When a key press occurs the **column pin** will get contacted to the **row pin** and makes the entire column state to low. To identify the exact pin at the column, we need to **scan each row by sending 1 (HIGH)** and **read the state at Column pins**. The column which changes the state from 0(LOW) to 1(HIGH) then that is the location of the pressed key (Passes the HIGH signal from Row to Column pin). Let's see this in detail with an example

In the idle state, the row and column will be like this,

Row R1 R2 R3 R4 – 0000

Column C1 C2 C3 C4- 1111



2. Measurement Range

3. Physical Dimension

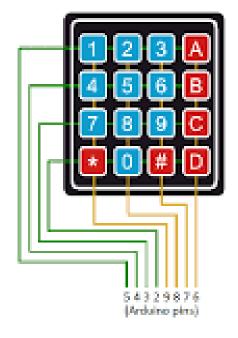
Keypad, 2.7 x 3.0 in (6.9 x 7.6 cm) Cable: 0.78 x 3.5 in (2.0 x 8.8 cm)

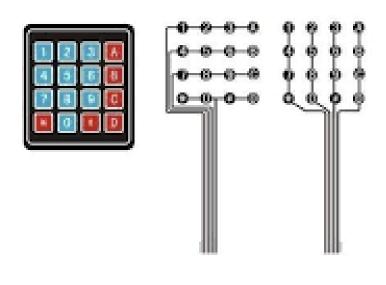
4. Power rating details

Maximum Voltage across EACH SEGMENT or BUTTON: 24V.

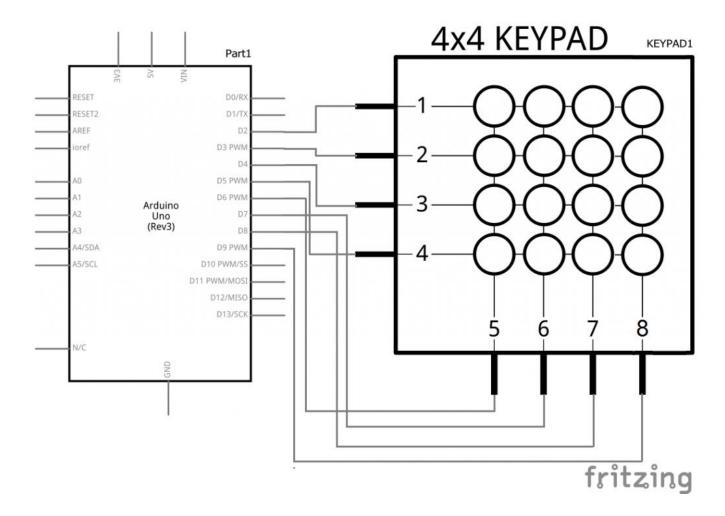
Maximum Current through EACH SEGMENT or BUTTON: 30mA.

5. Pin Diagram

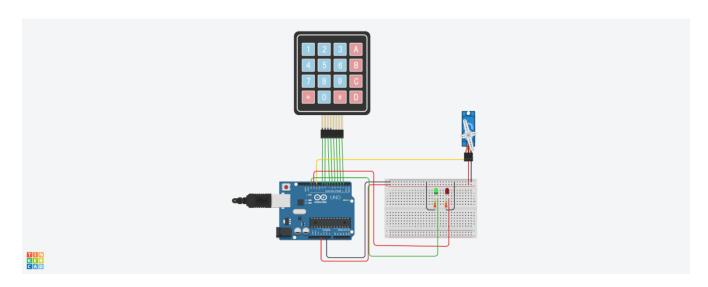




6. Interfacing with Arduino



Simulation Interface of 4X4 KeyPad and Arduino



Appendix A

1. IR Sensor

Silicon TechnoLabs

IR Proximity Sensor

1. Descriptions

The Multipurpose Infrared Sensor is an add-on for your line follower robot and obstacle avoiding robot that gives your robot the ability to detect lines or nearby objects. The sensor works by detecting reflected light coming from its own infrared LED. By measuring the amount of reflected infrared light, it can detect light or dark (lines) or even objects directly in front of it. An onboard RED LED is used to indicate the presence of an object or detect line. Sensing range is adjustable with inbuilt variable resistor.

The sensor has a 3-pin header which connects to the microcontroller board or Arduino board via female to female to male jumper wires. A mounting hole for easily connect one or more sensor to the front or back of your robot chassis.

2. Features

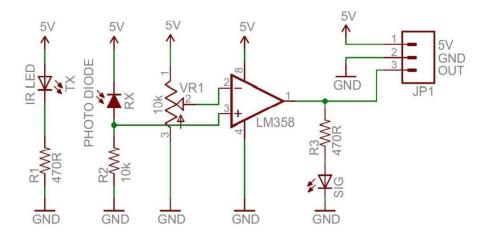
- 5VDC operating voltage.
- I/O pins are 5V and 3.3V compliant.
- Range: Up to 20cm.
- Adjustable Sensing range.
- Built-in Ambient Light Sensor.
- 20mA supply current.
- Mounting hole.

3. Specifications

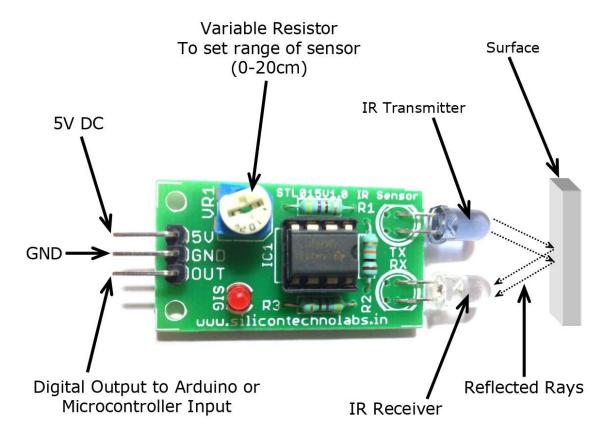
• Size: 50 x 20 x 10 mm (L x B x H)

• Hole size: φ2.5mm

4. Schematics

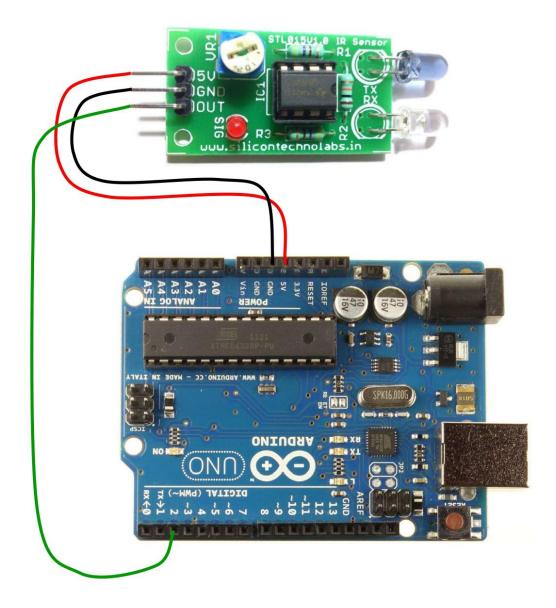


5. Hardware Details



6. Interface to Arduino

Now let's we build simple object counter using IR Proximity Sensor that's counts the Number of objects.Connect Silicon TechnoLabs IR Proximity Sensor to your arduino board as shown in below image.





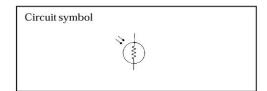
Light dependent resistors

NORP12 RS stock number 651-507 NSL19-M51 RS stock number 596-141

Two cadmium sulphide (cdS) photoconductive cells with spectral responses similar to that of the human eye. The cell resistance falls with increasing light intensity. Applications include smoke detection, automatic lighting control, batch counting and burglar alarm systems.

Guide to source illuminations

Light source	Illumination (Lux)
Moonlight	0.1
60W bulb at 1m	50
1W MES bulb at 0.1m	100
Fluorescent lighting	500
Bright sunlight	30,000



Light memory characteristics

Light dependent resistors have a particular property in that they remember the lighting conditions in which they have been stored. This memory effect can be minimised by storing the LDRs in light prior to use. Light storage reduces equilibrium time to reach steady resistance values.

NORP12 (RS stock no. 651-507)

Absolute maximum ratings

Voltage, ac or dc peak	320V
Current	75mA
Power dissipation at 30°C	250mW
Operating temperature range	-60°C to +75°C

Electrical characteristics

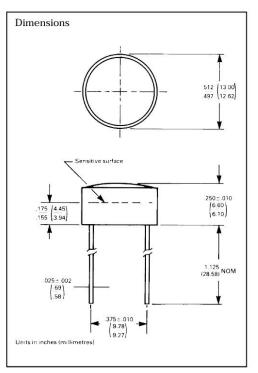
 $T_A = 25$ °C. 2854°K tungsten light source

Parameter	Conditions	Min.	Тур.	Max.	Units
Cell resistance	1000 lux 10 lux	-	400 9	-	Ω
Dark resistance	-	1.0	-	_	ΜΩ
Dark capacitance	~	-	3.5	2	рF
Rise time 1	1000 lux 10 lux	5	2.8 18	5	ms ms
Fall time 2	1000 lux 10 lux	1	48 120	ā	ms ms

- $\begin{array}{l} 1.\, \text{Dark to } 110\%\, R_L \\ 2.\, \text{To } 10 \times R_L \\ R_L = \text{photocell resistance under given illumination.} \end{array}$

Features

- Wide spectral response
- Low cost
- Wide ambient temperature range.



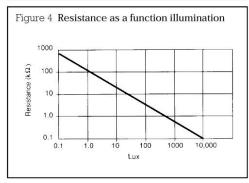
Absolute maximum ratings

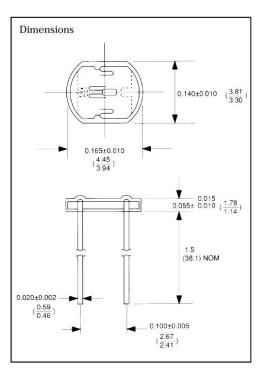
Voltage, ac or dc peak	100V
Current	5mA
Power dissipation at 25°C	50mW*
Operating temperature range	25°C +75°C

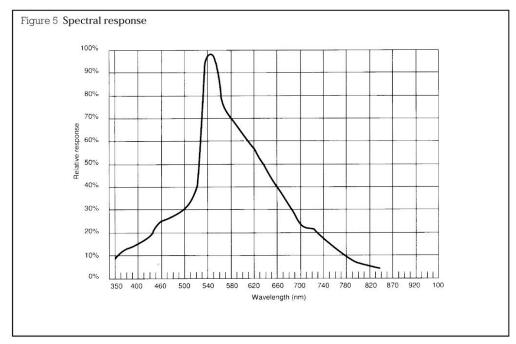
*Derate linearly from 50mW at 25°C to 0W at 75°C.

Electrical characteristics

Parameter	Conditions	Min.	Тур.	Max.	Units
Cell resistance	10 lux 100 lux	20	- 5	100	kΩ kΩ
Dark resistance	10 lux after 10 sec	20	2	_	МΩ
Spectral response	-	- 0	550	2	nm
Rise time	10ftc	-	45	=	ms
Fall time	10ftc	-	55	#1	ms









November 2000

LM35

Precision Centigrade Temperature Sensors

General Description

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of $\pm 1/4$ °C at room temperature and $\pm 3/4$ °C over a full -55 to +150 °C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1 °C in still air. The LM35 is rated to operate over a -55° to $+150^\circ$ C temperature range, while the LM35C is rated for a -40° to $+110^\circ$ C range (-10° with improved accuracy). The LM35 series is available pack-

aged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a plastic TO-220 package.

Features

- Calibrated directly in ° Celsius (Centigrade)
- Linear + 10.0 mV/°C scale factor
- 0.5°C accuracy guaranteeable (at +25°C)
- Rated for full -55° to +150°C range ■ Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts
- Less than 60 µA current drain
- Low self-heating, 0.08°C in still air
- Nonlinearity only ±1/4°C typical
- Low impedance output, 0.1 Ω for 1 mA load

Typical Applications

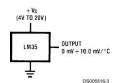


FIGURE 1. Basic Centigrade Temperature Sensor (+2°C to +150°C)



Choose R₁ = -V_S/50 μA V _{OUT}=+1,500 mV at +150°C = +250 mV at +25°C = -550 mV at -55°C

FIGURE 2. Full-Range Centigrade Temperature Sensor

DS005516

260°C

Absolute Maximum Ratings (Note 10)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Supply Voltage Output Voltage +35V to -0.2V +6V to -1.0V Output Current 10 mA

Storage Temp.; TO-46 Package, -60°C to +180°C TO-92 Package, -60°C to +150°C SO-8 Package, -65°C to +150°C TO-220 Package, -65°C to +150°C

Lead Temp.: TO-46 Package, (Soldering, 10 seconds)

TO-92 and TO-220 Package, (Soldering, 10 seconds) SO Package (Note 12)

215°C Vapor Phase (60 seconds) 220°C Infrared (15 seconds) ESD Susceptibility (Note 11) 2500V Specified Operating Temperature Range: T_{MIN} to T _{MAX} (Note 2)

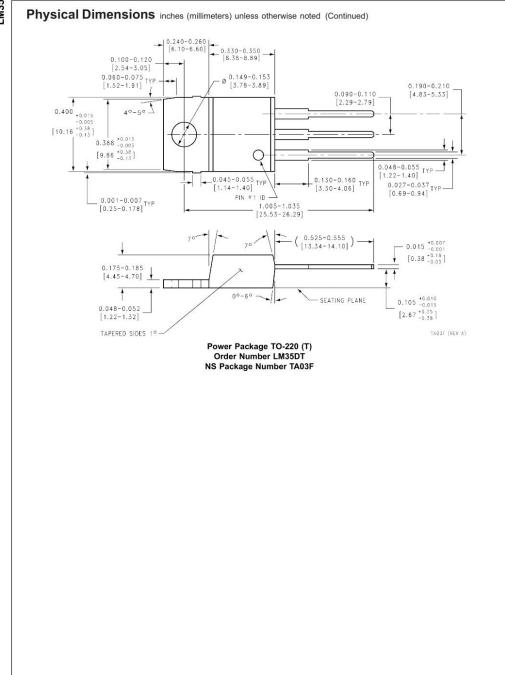
LM35, LM35A -55°C to +150°C -40°C to +110°C LM35C, LM35CA LM35D 0°C to +100°C

Electrical Characteristics

		LM35A			LM35CA			
Parameter	Conditions		Tested	Design		Tested	Design	Units
	1 5027-0 5000 4 50040 5 500 57 500 600 600 600	Typical	Limit	Limit	Typical	Limit	Limit	(Max.)
			(Note 4)	(Note 5)		(Note 4)	(Note 5)	
Accuracy	T _A =+25°C	±0.2	±0.5		±0.2	±0.5		°C
(Note 7)	T _A =-10°C	±0.3			±0.3		±1.0	°C
	T _A =T _{MAX}	±0.4	±1.0		±0.4	±1.0		°C
	T _A =T _{MIN}	±0.4	±1.0		±0.4		±1.5	°C
Nonlinearity	T _{MIN} ST _A ST _{MAX}	±0.18		±0.35	±0.15		±0.3	°C
(Note 8)								
Sensor Gain	T _{MIN} ST _A ST _{MAX}	+10.0	+9.9,		+10.0		+9.9,	mV/°C
(Average Slope)	5.00.00 May 100.00 May		+10.1				+10.1	
Load Regulation	T _A =+25°C	±0.4	±1.0		±0.4	±1.0		mV/mA
(Note 3) 0≤I _L ≤1 mA	T MINSTASTMAX	±0.5		±3.0	±0.5		±3.0	mV/mA
Line Regulation	T _A =+25°C	±0.01	±0.05		±0.01	±0.05		mV/V
(Note 3)	4V≤V _S ≤30V	±0.02		±0.1	±0.02		±0.1	mV/V
Quiescent Current	V _S =+5V, +25°C	56	67		56	67		μΑ
(Note 9)	V s=+5V	105		131	91		114	μΑ
	V _s =+30V, +25°C	56.2	68		56.2	68		μΑ
	V _s =+30V	105.5		133	91.5		116	μΑ
Change of	4V≤V _S ≤30V, +25°C	0.2	1.0		0.2	1.0		μA
Quiescent Current	4V≤V _S ≤30V	0.5		2.0	0.5		2.0	μA
(Note 3)	8820							931
Temperature	2	+0.39		+0.5	+0.39		+0.5	μΑ/°C
Coefficient of								
Quiescent Current								
Minimum Temperature	In circuit of	+1.5		+2.0	+1.5		+2.0	°C
for Rated Accuracy	Figure 1, I _L =0							
Long Term Stability	T _J =T _{MAX} , for 1000 hours	±0.08			±0.08			°C

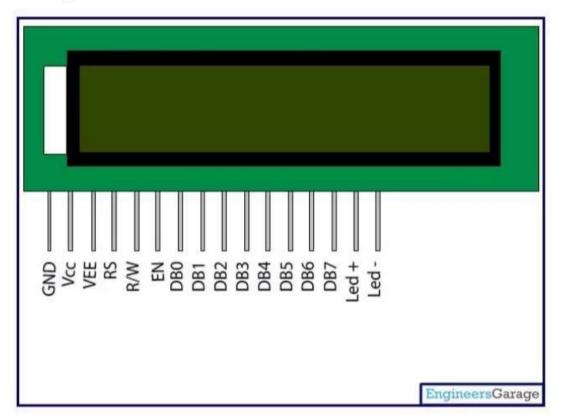
300°C

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4. 16X2 LCD Display

Pin Diagram:



Pin Description:

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V - 5.3V)	Vcc
3	Contrast adjustment, through a variable resistor	V _{EE}
4	Selects command register when low, and data register when high	Register Select
5	Low to write to the register, High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7		DB0
8		DB1
9		DB2
10	0.14.4-4-4-1	DB3
11	8-bit data pins	DB4
12		DB5
13		DB6
14		DB7
15	Backlight V _{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

5. Servo Motor

TowerPro SG90 - Micro Servo



Basic Information

Modulation: Analog

Torque: **4.8V:** 25.0 oz-in (1.80 kg-cm)

Speed: **4.8V:** 0.10 sec/60°

Weight: 0.32 oz (9.0 g)

Dimensions:

Length: 0.91 in (23.1 mm)

Width: 0.48 in (12.2 mm)

Height: 1.14 in (29.0 mm)

Motor Type: 3-pole Gear Type: Plastic Rotation/Support: Bushing

Additional Specifications

Rotational Range: 180° Pulse Cycle: ca. 20 ms Pulse Width: 500-2400 µs

6. 4X4 KeyPad



Web Site: www.parallax.com Forums: forums.parallax.com Sales: sales@parallax.com Technical: support@parallax.com Office: (916) 624-8333 Fax: (916) 624-8003 Sales: (888) 512-1024 Tech Support: (888) 997-8267

4x4 Matrix Membrane Keypad (#27899)

This 16-button keypad provides a useful human interface component for microcontroller projects. Convenient adhesive backing provides a simple way to mount the keypad in a variety of applications.

Features

- Ultra-thin design
- Adhesive backing
- Excellent price/performance ratio
- Easy interface to any microcontroller
- Example programs provided for the BASIC Stamp 2 and Propeller P8X32A microcontrollers

Key Specifications

- Maximum Rating: 24 VDC, 30 mA
- Interface: 8-pin access to 4x4 matrix
- Operating temperature: 32 to 122 °F (0 to 50°C)
- Dimensions: Keypad, 2.7 x 3.0 in (6.9 x 7.6 cm)
 Cable: 0.78 x 3.5 in (2.0 x 8.8 cm)

Application Ideas

- Security systems
- Menu selection
- Data entry for embedded systems

