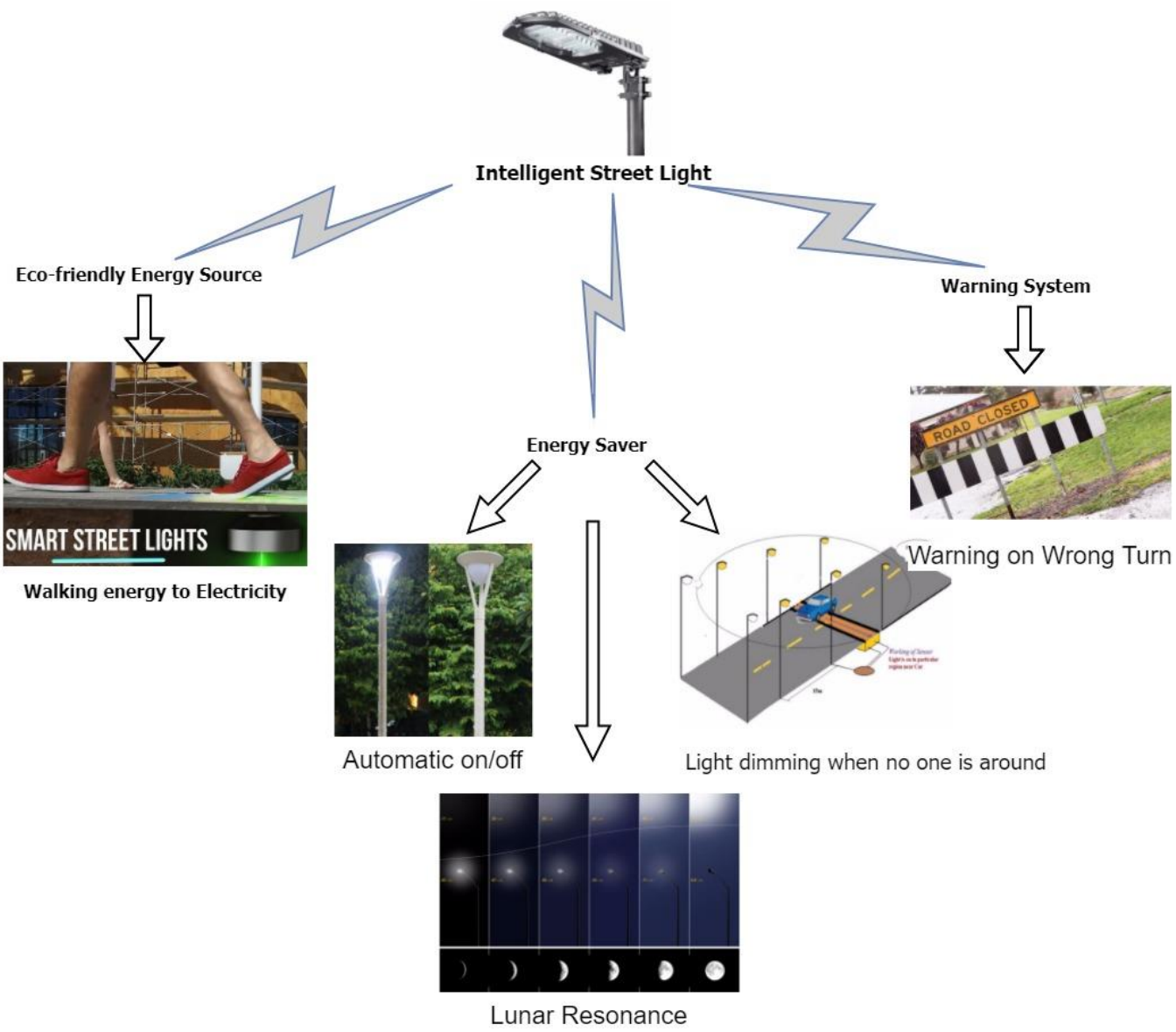
INTELLIGENT STREET LIGHTS

Introduction:

The increasing demand of energy, the depletion of fossil fuel reserves, the unexpected events taking place on the international scene (local armed conflicts, natural disasters like earthquakes, tsunamis, floods, hurricanes, etc.) needs the use of free and available sources of energy to be used for operating devices such as mobile phones, street lights, refrigerators etc.

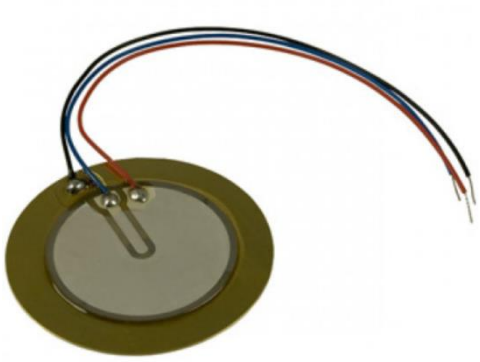
In this project, the focus is being on smart street lights which reduce the wastage of energy and CO2 emissions. The system would intelligently adapt the lighting levels based on the weather conditions and traffic density. These lighting levels or intensity will be adjusted dynamically through the sensors and microcontroller according to the current density of the lane. An external feature has also been included in this system, so that street lights will adapt lightning based on the naturalistic feature i.e. the lightning intensity will vary with the intensity of the moon light in the night.

Block Diagram:



Power Supply System:

Piezoelectric transducer



In most crystals (such as metals), the unit cell(basic repeating unit) is symmetrical; in piezoelectric crystals, it isn't. Normally, piezoelectric crystals are electrically neutral: the atoms inside them may not be symmetrically arranged, but their electrical charges are perfectly balanced: a positive charge in one place cancels out a negative charge nearby. However, if you squeeze or stretch a piezoelectric crystal, you deform the structure, pushing some of the atoms closer together or further apart, upsetting the balance of positive and negative, and causing net electrical charges to appear. This effect carries through the whole structure so net positive and negative charges appear on opposite, outer faces of the crystal.

By squeezing the crystal, a voltage is produced across its opposite faces—and that's piezoelectricity.

Piezoelectric ceramics are known for what are called the piezoelectric and reverse piezoelectric effects. Advantages of using piezoelectric materials include high electromechanical transformation efficiency, high machinability, a broad range of characteristics offered, high stability and suitability for mass production and economical. When a piezoelectric material is subjected to stress T, it produces polarization P which is a linear function of T: P = dT (d = piezoelectric strain constraint). This effect is called the normal piezoelectric effect.

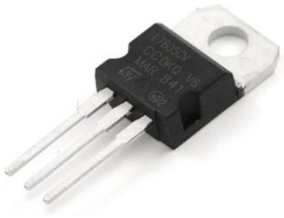
In our prototype, we have chosen 35mm ones in diameter. They are to be placed in series between silica gel sheets which would allow maximum bending ability to the piezoelectric materials without them going through enough stress required to break them. Depending on the amount of stress received by the piezo transducers, the voltage generated will be between 515V on an average but there were spikes of voltage that exceeded the voltage limit required by us.

AC to DC Converter (Bridge Rectifier):

A Bridge rectifier is an Alternating Current (AC) to Direct Current (DC) converter that rectifies mains AC input to DC output. Bridge Rectifiers are widely used in power supplies that provide necessary DC voltage for the electronic components or devices. They can be constructed with four or more diodes or any other controlled solid state switches.
Depending on the load current requirements, a proper bridge rectifier is selected. Components' ratings and specifications, breakdown voltage, temperature ranges, transient current rating, forward current rating, mounting requirements and other considerations are taken into account while selecting a rectifier power supply for an appropriate electronic circuit's application.
FEATURES:
* Good for automation insertion
* Surge overload rating - 40 amperes peak
* Ideal for printed circuit board
* Reliable low cost construction utilizing molded
* Glass passivated device
* Polarity symbols molded on body
* Mounting position: Any

DC Voltage Regulator:

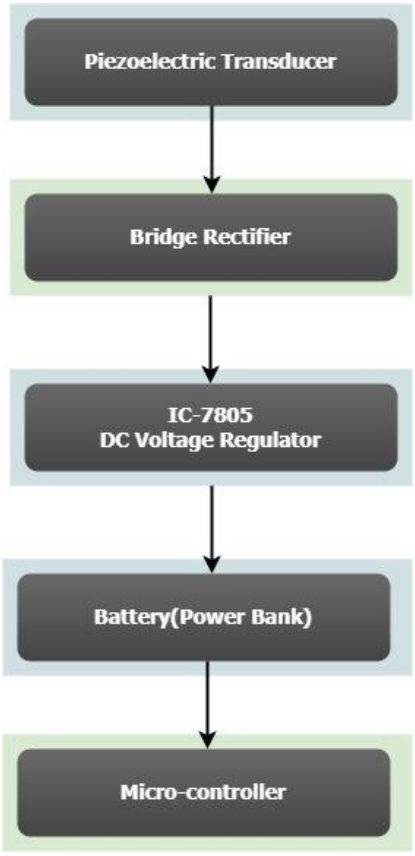
A regulated power supply is very much essential due to the semiconductor material employed in street lights have a fixed rate of current as well as voltage. The device may get damaged if there is any deviation from the fixed rate. The AC power supply gets converted into constant DC by this circuit. By the help of a voltage regulator DC, unregulated output will be fixed to a constant voltage. The circuit is made up of linear voltage regulator 7805 along with capacitors and resistors with bridge rectifier made up from diodes. From giving an unchanging voltage supply to building confident that output reaches uninterrupted to the appliance, the diodes along with capacitors handle elevated efficient signal conveyal.



- Output Voltage: 5V
- Output Current: 1.5A
- Thermal Overload Protection
- Short Circuit Protection
- Output Transition SOA Protection

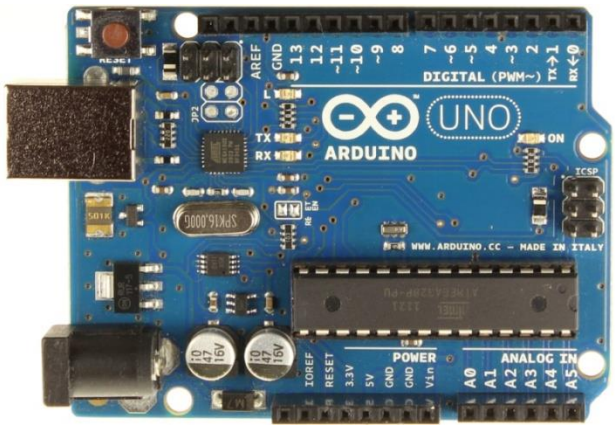
Battery (Power Bank):

To charge the battery and to use the battery at the same time while charging it, a 2500 MAh power bank is used. The power bank will get its input 5V from the output of AC to DC converter and will charge. The 5V output of power bank will be used to drive the microcontroller unit and the street lights and other sensors.



Microcontroller Unit:

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. Revision 2 of the Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DFU mode. Revision 3 of the board has the following new features:



 1.0 pin out: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible both with the board that use the AVR, which operate with 5V and with the Arduino Due that operate with 3.3V. The second one is a not connected pin, that is reserved for future purposes.

Light Dimming when no one is around:

Generally, street lights are switched on for whole night and during the day, they are switched off. But during the night time, street lights are not necessary if there is no traffic. Saving of this energy is very important factor these days as energy resources are getting reduced day by day.

Alternatives for natural resources are very less and our next generations may face lot of problems because of lack of these natural resources. We have already seen the circuit diagram and working of Auto Intensity Control of Street Lights circuit in the earlier post. This article describes about the circuit that switches the street lights on detecting vehicle movement and remains off after fixed time.

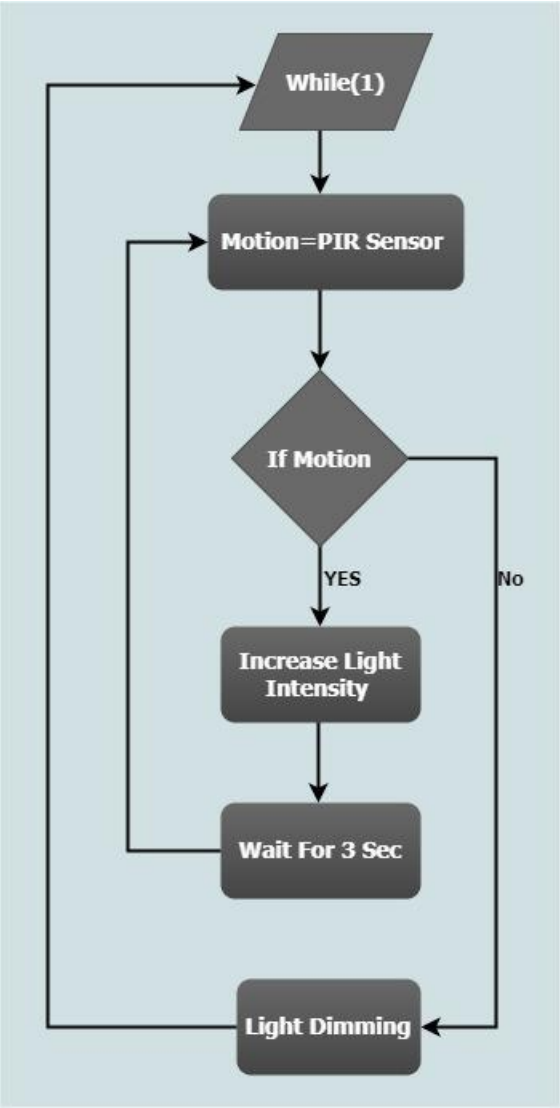
The street light will dim the intensity of the light when no person will be walking or no vehicle will be passing out. The street light will be brighten up on the presence of walking person or moving vehicle. This will be controlled through through microcontroller unit via PIR sensor.

PIR Sensor:

PIR sensors are more complicated than many of the other sensors explained in these tutorials (like photocells, FSRs and tilt switches) because there are multiple variables that affect the sensors input and output. To begin explaining how a basic sensor works, we'll use this rather nice diagram

The PIR sensor itself has two slots in it, each slot is made of a special material that is sensitive to IR. The lens used here is not really doing much and so we see that the two slots can 'see' out past some distance (basically the sensitivity of the sensor). When the sensor is idle, both slots detect the same amount of IR, the ambient amount radiated from the room or walls or outdoors. When a warm body like a human or animal passes by, it first

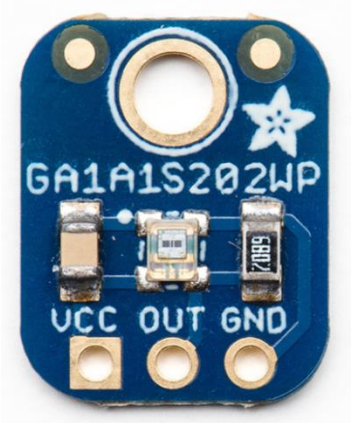
intercepts one half of the PIR sensor, which causes a *positive differential* change between the two halves. When the warm body leaves the sensing area, the reverse happens, whereby the sensor generates a negative differential change. These change pulses are what is detected.



Lunar Resonance:

Streetlights aren't really necessary when there's a full moon out, what with it bouncing all that sunlight down at us and everything. But your average streetlight isn't smart enough to know when it isn't needed, so it sits there, dumbly shining away for no real reason. That's not the case with the Lunar-Resonant Street Lights, conceptual LED-based lamps that dim down and turn off completely as the moon waxes. When it's a new moon, it'll be fully lit up, showing you your path. What results is an energy savings of 90-95%.

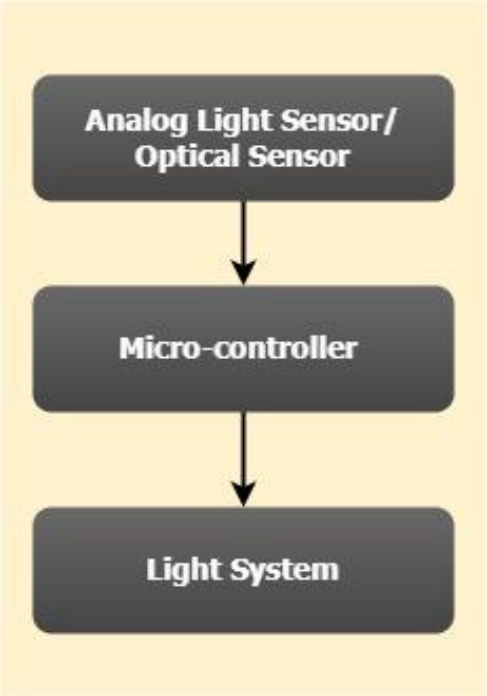
The lunar resonance is achieved using Analog Light Sensor

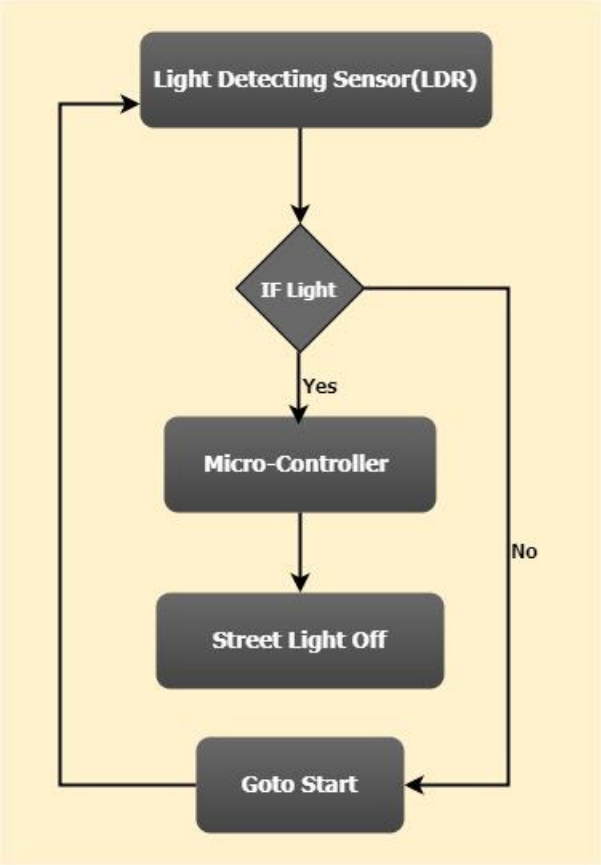


This GA1A12S202 based sensor breakout is a big step-up from the basic CdS photo-cell. The biggest improvement over plain photocells is a true log-lin relationship with light levels. Most light sensors have a linear relationship with light levels, which means that they're not very sensitive to changes in darkened areas and 'max' out very easily when there's a lot of light. Sometimes you can tweak a resistor to make them better in dark or bright light but its hard to get good performance at both ends.

This sensor is logarithmic over a large dynamic range of 3 to 55,000 Lux, so it has a lot of sensitivity at low light levels but is also nearly impossible to

"max out" so you can use it indoors or outdoors without changing code or calibration. Since the sensor is fabricated on a chip, there are also fewer manufacturing variations, so you won't have to re-calibrate the sensor from one board to another.
The GA1A12S202 sensor breakout is small and easy to integrate into any project. It makes a nice upgrade from a CdS photo-cell. It does not require a microcontroller, the analog voltage output increases with the amount of light shining on the sensor face.



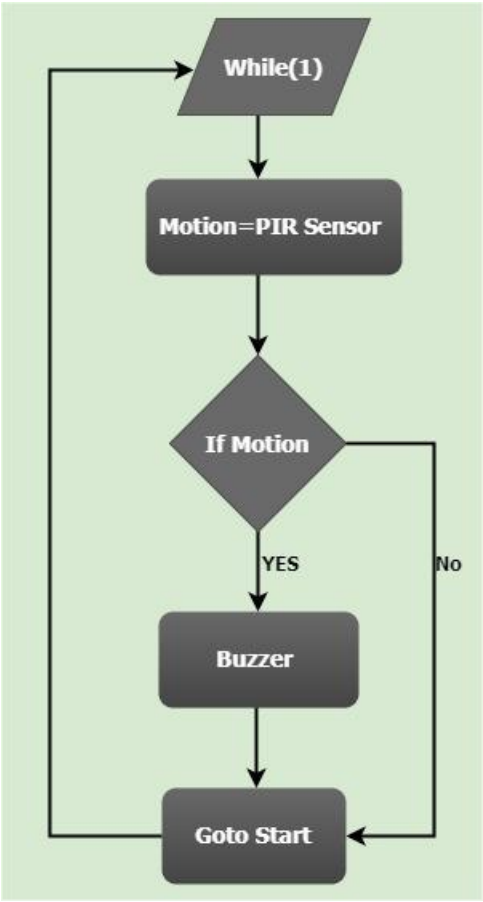


Warning Signal on Wrong Turn:

Sometime's people are not able to see the warning boards on the side by of a road. E.g. 'Turn round, Construction going ahead' and they continue going on the wrong path, this carelessness leads to damage to the road, to the vehicle and sometimes even to the people.

To avoid this kind of damages, an extra feature is added in these street lights that is whenever a vehicle or a person will lead to the wrong turn or to the wrong road, the street light will sound a buzzer indicating warning to go ion that path. In this way, the damage to the lives and property will be eliminated.

To achieve this, a buzzer is used as



Features of intelligent Street Lights:

1. Generation of Walking energy from electricity
2. Light dimming when no one is around
3. Lunar resonance
4. Automatic on/off mode
5. Warning on wrong Turn

Material Required for Small model

1.	Piezoelectric Transducer: 35mm –	Rs. 10/-
2.	Diodes	Rs. 1/-
3.	Bridge Rectifier DB107	Rs. 31/-
4.	Voltage Regulator 7805	Rs. 20/-
5.	Power Bank:2500 MAh	Rs. 300/-
6.	Arduino Uno	Rs. 450/-
7.	PIR Sensor : 7	Rs. 200/-
8.	Analog Light Sensor	Rs. 125/-
9.	Buzzer	Rs. 100/-
10.	LEDs	
11.	Wires	
12.	Solder	
13.	Glue Gun + Glue stick	
14.	Cardboard	
15.	Multimeter	

The small model of smart street lights will cost approximately Rs. 2000