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Research Article

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Design and Simulation of a Smart Streetlight using Adriuno

Okolo C. C.[1], Ezeugbor I. C.[2], Sani O. M.[1], Uduh E. J.[1], Okeke O. N.[1]

[1]Elctronics Development Institute, Federal Min. of Science and Technology, Awka Capital Territory, Anambra State, Nigeria
[2]Department of Computer Science, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria

Abstract Due to advance electronics technology in the electronic which gave rise to automation of electronic system in domestic and industrial use? This development is what necessitated the courage to choose a project topic smart street light. With the aim of reducing cost in terms of numbers of street light needed to cover a particular street. The moveable bulb of these streetlights ensures the absolute safety of pedestrian especially late at night. In case of reptile like snake and robbers that look for dark spot to wait for their victims. The main objective design of the project is to design and construct an electronically operated system capable of picking infrared ray from objects and directing the streetlight to the appropriate location. And also economize the amount of power begin consumed by the streetlight as it will enter into standby mode on no detection of an object. It consume only 60% of the power from the source (generator) in it standby mode thereby saving energy. Arduino was used to achieve this

Keywords Streetlight, Arduino, Design, Smart, Simulation

Introduction

The major objective of this work was to develop a small easy to use system that will aid in the security of human beings especially late at night. This involved first defining the problem and developing a technique to solve this problem.

Advantages of Smart Streetlight System:

- This project provides security
- Power consumption is less
- Used commonly available components
- Project is simple and easy

Applications of Smart Streetlight System

- This simple circuit can be used at residential places to ensure better safety.
- It can be used at garden/parks to ensure maximum security late at night.
- With a slight modification this Project can be used.

Limitations of Smart Streetlight System

- It is brightness still remain dim when object is in between the range of both sensors.
- Due to weather condition the Arduino board might malfunction.

Background of the Arduino System

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs – lights on a sensor, a finger on a button, or a Twitter message – and turn it into an output – activating a motor, turning on a LED, or for publishing something online. You can tell your board what to do by

sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), And the Arduino Software (IDE), based on Processing.

Figure 1

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers – students, hobbyists, artists, programmers, and professionals – has gathered around this open – source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike.

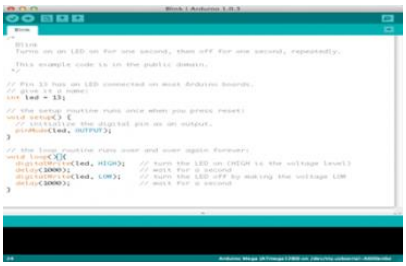

Figure 2: Background of the Arduino programming IDE

Types of Arduino boards

Over the years, after the emergence of the first board there have been alterations to this board in order to adapt to new requirements and challenges that includes IOT (internet of things) app, 3D printing, wearable, and embedded surrounding. They include;

(i) Arduino Uno
(ii) Lily Pad Arduino
(iii) Red Board
(iv) Arduino Mega
(v) Arduino Leonardo

i: Arduino Uno

This is the most used and documented board of the whole Arduino family. It is this board that I used for my projects during my IT training at ELDI. It is based on AT mega 328p microcontroller. It has 14 digital input or output pins, out of which 6 can be used as PWM outputs, 6 analog inputs, a 16MHZ quartz crystal, a USB connection port, a power jack, an ICSP header and a reset button.

Figure 3: Arduino Uno board

ii: Lilypad Arduino

This is a wearable e-textile technology. Each board was designed with huge connecting pads and a smooth back to let them be sewn into clothing using conductive thread. It comprises of input or output pins, power and sensor boards. It is based on ATmega168v (the low-power version of AT mega 168) or AT mega.

iii: Red Board

The redboard is an arduino-compatible development platform that enables quick-and-easy project prototyping. It can interact with real-world sensors, control motors, display information, and perform near-instantaneous calculations.

Figure 4

iv: Arduino Mega R3

This board is designed for more complex projects. It has 54 digital input or output pins, 16 analog inputs, reset button, power jack and USB connection port. The huge number of pins makes it very helpful for designing projects that need a bunch of digital input or output pins. It is recommended board for 3D printer and robotics projects.

v: Arduino Leonardo

This is the first development board of an Arduino. It is based on AT mega 32u4. It has 20 digital input or output pins out of which 7 can be used as PWM output pins and also it has 12 analog input pins.

Materials and Methods

Arduino Pin Layout

Power Supply:

There are 3 ways to power the Arduino Uno:

- Barrel Jack - The Barrel jack, or DC Power Jack can be used to power the Arduino board. The barrel jack is usually connected to a wall adapter. The board can be powered by 5-20 volts but the manufacturer specification sheet recommends keeping it between 7-12 volts. Above 12 volts, the regulators might overheat, and below 7 volts, might not suffice.
- VIN Pin- This pin is used to power the Arduino Uno board using an external power source. The voltage should be within the range mentioned above.

USB cable - when connected to the computer provides 5 volts at 500mA.

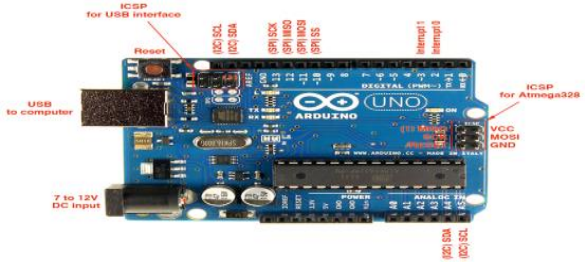

Figure 5: Arduino Pin lmage label

5v and 3v3- They provide regulated 5 and 3.3v to power external components according to manufacturer specifications.

0GND - In the Arduino Uno pin out, you can find 5 or less GND pins, which are all interconnected. The GND pins are used to close the electrical circuit and provide a common logic reference level throughout your circuit. Always make sure that all GNDs (of the Arduino, peripherals and components) are connected to one another and have a common ground.

RESET - This button if pressed resets the Arduino.

IOREF - This pin is the input/output reference. It provides the voltage reference with which the microcontroller operates.

Analog IN:

A0 - A5 - The Arduino Uno has 6 analog pins, which utilize ADC (Analog to Digital converter). These pins serve as analog inputs but can also function as digital inputs or digital outputs. ADC stands for Analog to Digital Converter. It is an electronic circuit used to convert analog signals into digital signals. This digital representation of analog signals allows the processor (which is a digital device) to measure the analog signal and uses it through its operation. Arduino analog Pins (A0-A5) are capable of reading analog voltages. On Arduino the ADC has 10-bit resolution, meaning it can represent analog voltage by 1,024 digital levels. The ADC converts voltage into bits which the microprocessor can understand.

Digital Pins

Pins 0-13 - These pins serve as digital input/output pins. Pin 13 is connected to the built-in LED. Pins 3, 5,6,9,10,11 have PWM capability - Pulse Width Modulation (PWM) is a modulation technique used to encode a message into a pulsing signal. A PWM is comprised of two key components: frequency and duty cycle. The PWM frequency dictates how long it takes to complete a single cycle (period) and how quickly the signal fluctuates from high to low. The duty cycle determines how long a signal stays high out of the total period. Duty cycle is represented in percentage.

It's important to note that:

(a) Each pin can provide/sink up to 40 mA max. But the recommended current is 20 mA.
(b) The absolute max current provided (or sank) from all pins together is 200mA.

Smart street light system:

Smart streetlight system is based on sensening with the PIR sensor and turning the bulb toward the desired direction as sensed by the PIR sensor with the aid of the PIR sensor. The design of a smart streetlight with PIR sensor, Servomotor and LED.

Components list:

1. Arduino UNO Buy
2. 2 PIR sensor
3. Servomotor
4. Electric bulb

Working explanation:

In this project, the two PIR sensor is connected to the Arduino Uno board. The two sensor send forth infrared signal and receive the infrared signal from the ECHO PIN. The signal from the two echo pins are been sent to the Arduino board. The Arduino compares the two inputs from the PIR sensor/ the sensor with lower value indicates an obstruction in the direction of that PIR sensor. The Arduino now turn the servo motor toward the desired direction and lighting the bulb to full capacity.

If both sensor seem to be receiving the same signal i.e no object in both direction the servomotor return back to it neutral position in between the two sensor. On return of the servomotor to neutral position the bulb dim to about 60%. economizing power been consumed by the bulb.

Result and Discussion

Source code and Program:

The code for the smart streetlight system is shown below.

```
#include <Servo.h>  //importing the servomotor library
int ledpin=9;     //the bulb control pin is connected to pin 9
int servopin=13;  // the servo control is connected to pin13
int pingPin1 = 5; // Trigger Pin of Ultrasonic Sensor 1
int echoPin1 = 3; // Echo Pin of Ultrasonic Sensor 1
int pingPin2 = 10; // Trigger Pin of Ultrasonic Sensor 2
int echoPin2 = 11; // Echo Pin of Ultrasonic Sensor 1
```

```
Servo Ledpointer; //telling the arduino the name of my servomotor
void setup() {
  Serial.begin(9600); // Starting Serial Terminal
  Ledpointer.attach(servopin);
}
void loop() {
long duration1, duration2, inches, cm;

  //activating the ultrasonic sensor 1
   pinMode(pingPin1, OUTPUT);
   digitalWrite(pingPin1, LOW);
   delayMicroseconds(2);
   digitalWrite(pingPin1, HIGH);
   delayMicroseconds(5);
   digitalWrite(pingPin1, LOW);
   pinMode(echoPin1, INPUT);
   duration1 = pulseIn(echoPin1, HIGH);
   duration1=duration1/1000;

//activating the ultrasonic sensor 2
   pinMode(pingPin2, OUTPUT);
   digitalWrite(pingPin2, LOW);
   delayMicroseconds(2);
   digitalWrite(pingPin2, HIGH);
   delayMicroseconds(5);
   digitalWrite(pingPin2, LOW);
   pinMode(echoPin2, INPUT);
   duration2 = pulseIn(echoPin2, HIGH);
   duration2=duration2/1000;

     // testing with the serial port to display values from both sensors
   Serial.print(duration1);
   Serial.print("in, ");
   Serial.print(duration2);
   Serial.print("in");
   Serial.println();
   delay(2000);

 //condition the servo motor and led bulb based on the result from both sensors
   if(duration2>duration1){
    analogWrite(ledpin,40);
    Ledpointer.write(15);
     }
     if(duration2<duration1){
      analogWrite(ledpin,25);
    Ledpointer.write(160);
     }
     if(duration1==duration2){
     analogWrite(ledpin,5);
    Ledpointer.write(15);
     }
```

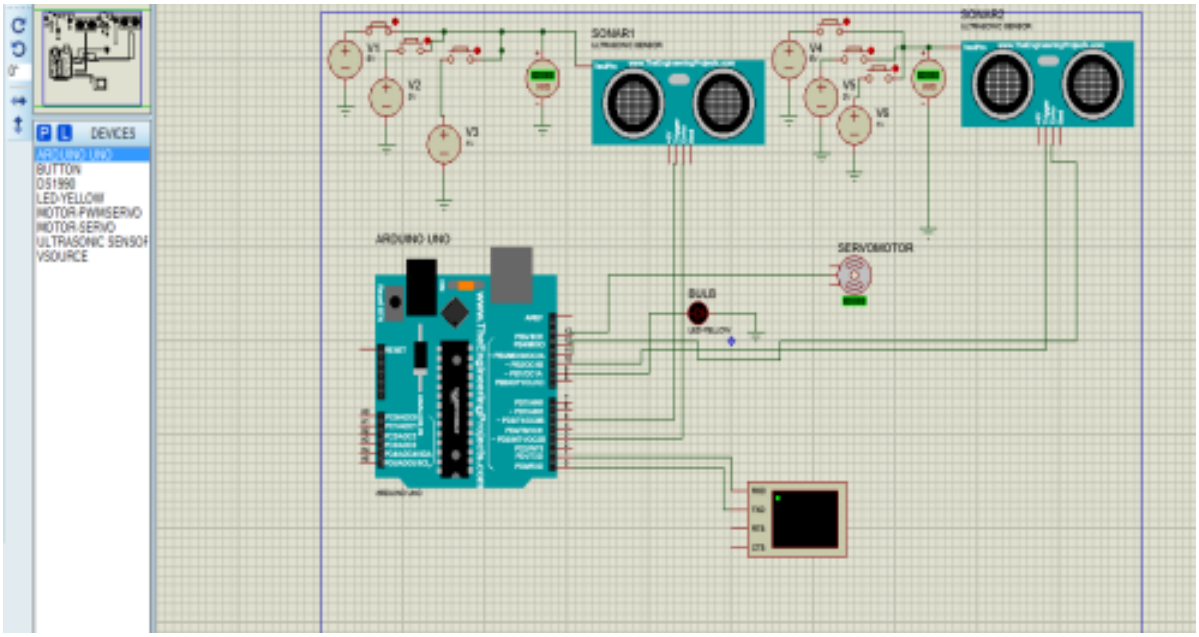

Figure 5: Complete Circuit Diagram of Smart Streetlight Simulation in Proteus

Conclusion

Once the circuit is powered ON, the Arduino set the bulb to 60%, and the two PIR sensors are been triggered and the echo is been received by the echo pin. Now the Arduino compares both signal reaching it by both sensors, and if both are giving off the same value it remain in neutral degree that is at 65 degree. If sensor 1 if off a lower reading, this indicate an obstruction in it path of sight. The servomotor is triggered with a signal of 15 degree with the bulb been light to maximum capacity. If sensor 2 gives off a lower reading, the servomotor motored is been trigger to 165 degree and the bulb is light to full capacity.

Reference

[1]. Leccese F., Remote control system of high efficiency and intelligent street lighting iusing zigbee network of devices and sensors, IEEE Transaction on power delivery, vol 28. January 2013.

[2]. Gaodima A.A."Arduino as a learning tool", in Electrical, Computer and Computation (ICECCO), 2014, 11th

[3]. International Conference ,Vol.no.pp.1-4, Sept, 29, 2014,-oct, 1, 2014.4.

[4]. Leo Louis," Working Principle of Arduino and using IT as a tool for study and Research", International Journal of Control, Automation Communication and System (IJCAS),Vol. 1, 2, April, 2016.5.

[5]. L. Miller, Masihuddin Mohammed and J.W. Kimball "Using the arduino UNO to tech Digital Controlof Power Electronic", Institute of Electrical and Electronics Engineering, 12- 15 , July , 2015.

[6]. Hitu Bansal, Dr. Lini Mathew, Ashish Gupta" Controlling of Temperature and Humidity for an Infant Incubator using Microcontroller ", International Journal of Advance Research in Electrical, Electronics