

VEHICLE MOVEMENT BASED STREET LIGHT CONTROL SYSTEM

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ABSTRACT :

This article describes a smart street lighting system that uses Wi-Fi and an Arduino board to monitor vehicle movement and adjust street light illumination. The system's goal is to save energy by automatically shutting off lights in areas with little traffic or pedestrian activity and putting them back on when needed. The device also uses a mercury vibration sensor for accident warning and anti-theft measures to prevent anybody from removing the streetlights without authorization. The two main components of the proposed system are the street light controller and the anti-theft and accident detection module. The street light controller uses a Wi-Fi module to gather vehicle movement data from nearby sensors and uses that information to turn on or off the lights. Any tampering or damage to the street light pole is detected by a vibration sensor in the anti-theft and accident detection module. If the sensor detects any strange behaviour, it will sound an alert and notify the authorities.

Keywords: Wi-Fi, vibration sensor, Arduino, lighting system

INTRODUCTION

In today's modern world the development in transportation system plays a vital role. It consists of roads, streets, highways etc., these pathways must be illuminated brightly with the help of several types of glowing bulbs or LEDs. The main purpose of providing the light to these highways, roads or street is to provide safety to the vehicle and number of persons crossing these paths and prevent them from any mis happening or accident. Another purpose of providing lighting to these places is that during the night times when a smaller number of vehicles passes the road, the pedestrian can easily cross the roads without feeling any darkness on the road. But, for providing large amount of illumination, huge amount of electricity is required which causes high cost.

1.1 PROPOSED SYSTEM

Nowadays, street lights are one of the major requirements in today's life for safety purposes and avoiding accidents during the night. The security of our environment which includes the protection of life and property is part of the priorities of every nation. A street lighting is any electrical lighting that is fixed outside the house for the illumination of the environment or a raised source of light on the edge of a road. certain time every night. Street lighting is very important as it aids in the illumination of our streets and serves for beautification of the environment at night-time. Failure and irregularities in power supply hinder the continuous illumination of our streets due to manual operation of the streetlights results in increasing crime on our streets and support for evil activities. The streetlight ensures safe, fast, and efficient movement of people and goods from one place to another. Street lighting in particular is one of the critical concerns for both public authorities and places like Barangay Calunasan, Calape, Bohol.

LITERATURE SURVEY

Automation plays an increasingly very important role in the world economy and in daily life. Automatic systems are being preferred over any kind of manual system. We can also call it an "SMART

STREET LIGHTSENSING”. Intelligent light sensing refers to public street lighting that adapts to movement by pedestrians, cyclists and cars. Intelligent street lighting, also referred to as adaptive street lighting, offs when no activity is detected, but brightens when movement is detected. This type of lighting is different from traditional, stationary and illumination, or dimmable street lighting that offs at pre-determined times. The research workshows automatic control of streetlights as a result of which power is saved to some extent. In the scope of industrialization, automation is a step beyond mechanization

INTRODUCTION TO EMBEDDED SYSTEM

EMBEDDED SYSTEM

An embedded system is a combination of software and hardware to perform a dedicated task. Some of the main devices used in embedded products are Microprocessors and Microcontrollers. Microprocessors are commonly referred to as general purpose processors as they simply accept the inputs, process it and give the output. In contrast, a microcontroller not only accepts the data as inputs but also manipulates it, interfaces the data with various devices, controls the data and thus finally gives the result.

OVERVIEW OF EMBEDDED SYSTEM Every embedded system consists of custom-built hardware built around a Central Processing Unit (CPU). This hardware also contains memory chips onto which the software is loaded. The software residing on the memory chip is also called the ‘firmware’.

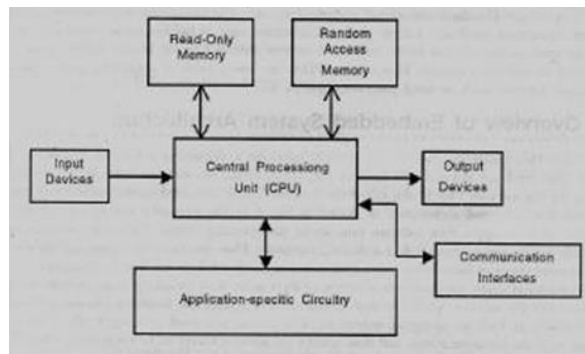


Fig: 1 Building blocks of the hardware of an embedded system

DESIGN OF HARDWARE

ARDUINO UNO

The most common version of Arduino is the Arduino Uno. This board is what most people are talking about when they refer to an Arduino. The Uno is one of the more popular boards in the Arduino family and a great choice for beginners. There are different revisions of Arduino Uno, below detail is the most recent revision (Rev3 or R3).

TECHNICAL SPECIFICATIONS

Microcontroller	:	ATmega328	Operating Voltage	:	5V	Input Voltage	
(recommended)	:	7-12V	Input Voltage (limits)	:	6-20V		
Digital I/O Pins	:	14 (of which 6 provide PWM output)	Analog Input Pins	:			
		6					
DC Current per I/O Pin	:	40 mA	ADC Current for 3.3V Pin	:	50 mA		
Flash Memory:		32 KB (ATmega328) of which 0.5 KB used by bootloader	SRAM:		2 KB		
(ATmega328)							
EEPROM	:	1 KB (ATmega328)					

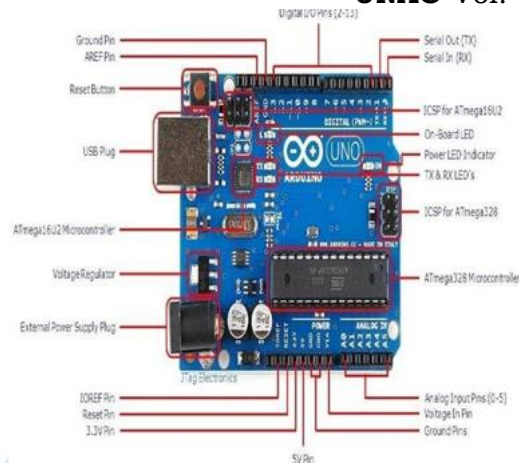


Fig.2 Arduino Uno R3 Board

POWER PIN

Voltage In Pin – The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source).

POWER SUPPLY

The power supplies are designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronic circuits and other devices. A power supply can be broken down into a series of blocks, each of which performs a particular function.

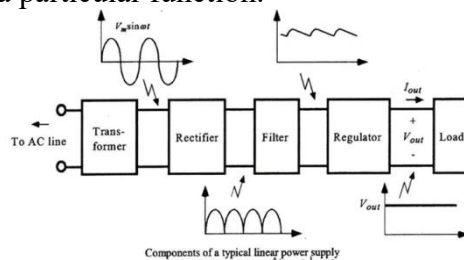


Fig.3. Block Diagram of Power Supply

RECTIFIER

A circuit which is used to convert A.C to dc is known as RECTIFIER. The process of conversion A.C to D.C is called "rectification."

Bridge Rectifier:

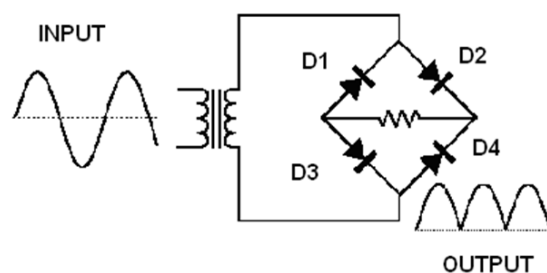


Fig. 4. Bridge Rectifier

PINS FUNCTIONS

There are pins along one side of the small printed board used for connection to the microcontroller. There are total of 14 pins marked with numbers (16 in case the background light is built in). Their function is described in the table below:

Fig: 4.4 2x16 Line Alphanumeric Lcd Display

WORKING OF LED

A P-N junction can convert absorbed light energy into a proportional electric current. The same process is reversed here (i.e., the P-N junction emits light when electrical energy is applied to it). This phenomenon is generally called electroluminescence, which can be defined as the emission of light from a semiconductor under the influence of an electric field.

LDR (Light Dependent Resistor)

LDR stands for Light Dependent Resistor. It is also known as a photoresistor, which is a type of resistor that changes its resistance based on the amount of light falling on it. LDRs are made up of a semiconductor material that exhibits the photoconductive effect.

LDRs are usually made of cadmium sulfide or lead sulfide, and they are commonly used in combination with other components such as transistors, amplifiers, or microcontrollers to form more complex circuits.

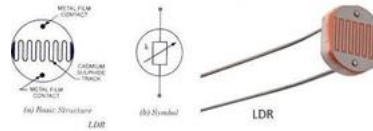


Fig:5 Light Dependent Resistor

When the light level is low the resistance of the LDR is high. This prevents current from flowing to the base of the transistors. The preset resistor can be turned up or down to increase or decrease resistance, in this way it can make the circuit more or less sensitive.

WHAT IS INFRARED?

Infrared is a form of energy radiation with a frequency below our eyes' sensitivity, so we cannot see it. Even though we cannot "see" sound frequencies, we know that it exists; we can listen to them.



Fig: 6 Infrared Ray

Even though we cannot see or hear infrared, we can feel it at our skin temperature sensors. When you approach your hand to a fire or warm element, you will "feel" the heat, but you can't see it.

INFRARED IN ELECTRONICS

Infra-Red is interesting, because it is easily generated and doesn't suffer from electromagnetic interference, so it is nicely used for communication and control, but it is not perfect; some other light emissions could contain infrared as well, and that can interfere with this communication. The sun is an example, since it emits a wide spectrum.

IR GENERATION

To generate a 36kHz pulsating infrared is quite easy; more difficult is to receive and identify this frequency. A square wave of approximately 27μs (microseconds) injected at the base of a transistor, can drive an infrared LED to transmit this pulsating light wave. Upon its presence, the commercial receiver will switch its output to high level (+5V).



Fig: 7 IR Generation

Those IR demodulators have inverted logic at their output; when a burst of IR is sensed, it drives its output to a low level, meaning logic level = 1.

The TV, VCR, and Audio equipment manufacturers have long used infra-red in their remote controls.

RC-5

Various remote control systems are used in electronic equipment today. The RC5 control protocol is one of the most popular and is widely used to control numerous home appliances, entertainment systems, and some industrial applications including utility consumption remote meter reading, contactless apparatus control.

The next 5 bits are the address bits and select the destination device. A number of devices can use RC5 at the same time. To exclude possible interference, each must use a different address. The 6 command bits describe the actual command. As a result, a RC5 transmitter can send the 2048 unique commands. The receiver performs the reverse function. The photo detector converts optical transmission into electric signals, filters it and executes amplitude demodulation. The receiver output bit stream can be used to decode the RC5 data word

IR RECEIVER Description

The TSOP17 – series are miniaturized receivers for infrared remote control systems. PIN diode and preamplifier are assembled on lead frame, the epoxy package is designed as IR filter.

Features

Photo detector and preamplifier in one package Internal filter for PCM frequency

The circuit of the TSOP17 is designed in that way that unexpected output pulses due to noise or disturbance signals are avoided. A band pass filter, an integrator stage and an automatic gain control are used to suppress such disturbances. The distinguishing mark between data signal and disturbance signal are carrier The SW- 420 vibration sensor module is a module that can detect vibrations and movement. It typically consists of a small metal ball that is free to move within a metal enclosure. When the module experiences a vibration, the ball inside the enclosure makes contact with two pins, completing an electrical circuit and sending a signal to the output pin of the module.

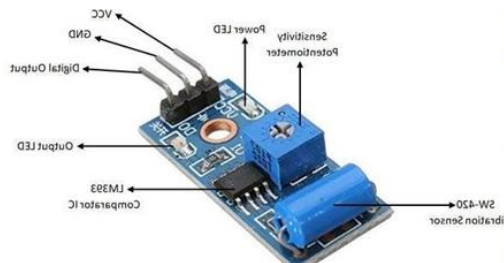


Fig: 8 SW – 400 Vibration Module Sensor

DESIGN OF SOFTWARE

INTRODUCTION TO ARDUINO IDE SOFTWARE

This is free software (evaluation version) which solves many of the pain points for an embedded system developer. Here is simple guide to start working with Arduino IDE Vision which can be used for:

Writing programs in Arduino IDE Compiling and assembling programs Debugging programs

PROJECT DESCRIPTION AND CONTROL DESIGN

Project Description: Vehicle Movement-Based Street Light Control System with Anti-Theft and Accident Detection. The Vehicle Movement-Based Street Light Control System is a smart and efficient solution

designed to optimize energy consumption by controlling street lights based on the presence or absence of vehicles on the road. Additionally, the system incorporates anti-theft detection to prevent unauthorized removal of street lights and accident detection using a mercury tilt vibration sensor to enhance safety on the roads.

HARDWARE COMPONENTS

To design the vehicle movement-based street light control system, the following hardware components are required:

Arduino UNO R3 board Wi Fi module (ESP8266) Infrared sensor (IR sensor) SW – 400 Vibration sensor Mercury Tilt switch

LED lights Relay module Power supply

SOFTWARE COMPONENTS

To program the Arduino microcontroller and the Wi Fi module, the following components are required:

Arduino IDE

ESP8266 library Relay module library

SW - 400 Vibration Sensor module

WORKING

IR sensor Microcontroller:

LED anti-theft feature:

SW-400 vibration sensor:

Alert system

CODE IMPLEMENTATION

7.1 CODE IMPLEMENTATION

```
#include<LiquidCrystal.h> #include <SoftwareSerial.h> #include <stdio.h> LiquidCrystal lcd (13, 12, 11, 10, 9, 8);
unsigned char rcv, count, gchr, gchr1, robos = 's'; int ldr1=2; int led=4; int buz=7; int ldr2=5; int ir1=3;
int ir2=6; int sti = 0;
String inputString = "";          // a string to hold incoming data boolean stringComplete = false; //
whether thestring is complete
void okcheck() unsigned char rcr; do {rcr = Serial.read();
} while (rcr != 'K');
}
void setup
lcd.begin(16, 2); Serial.begin(115200); pinMode(buz, OUTPUT); pinMode(ldr1, INPUT);
pinMode(ir1, INPUT); pinMode(ir2, INPUT); pinMode(ldr2, INPUT); pinMode(buz, OUTPUT);
pinMode(led, OUTPUT);digitalWrite(buz, LOW); lcd.setCursor(0, 0);
lcd.print("SOLAR STREET LIGHT");
lcd.setCursor(4, 1); lcd.print(" In Highways "); delay(1000);lcd.clear();
lcd.print("Wifi init");
```

RESULTS

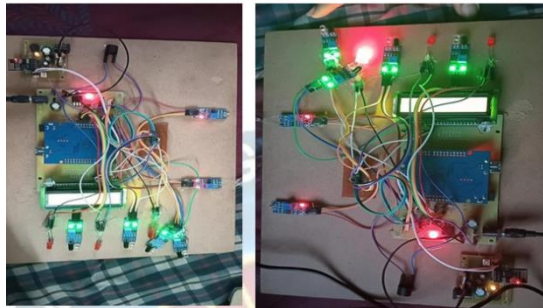


Fig: 9 Street Light Control System is ON

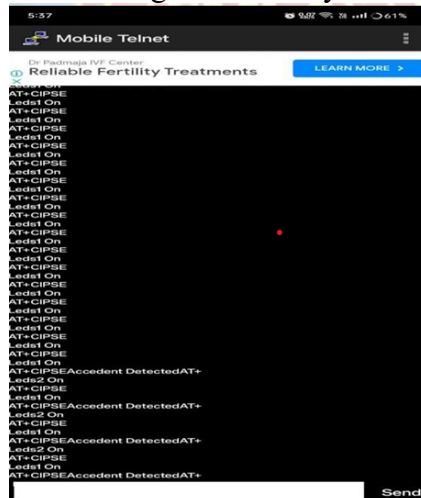


Fig: 10 Notification in Control Room

CONCLUSION

In conclusion, an inventive and effective solution for contemporary street lighting systems is the vehicle movement based street light control system with Arduino and WiFi module, LED anti-theft detection with IR sensor, and accident detection with mercury vibration sensor. With this technology, we can illuminate just the areas where cars are present, saving a great deal of energy and lowering our carbon impact. Furthermore, the anti-theft mechanism strengthens the street lights' security by prohibiting unwanted access to the expensive parts of the system. In addition, the accident detection capability guarantees prompt help to anyone engaged in a collision, potentially saving lives and lowering the number of road deaths.

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