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SOLAR STREET LIGHTING DESIGN

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ABSTRACT:

This paper aims for designing and executing the advanced development in embedded systems for energy saving of street lights. Currently we have a manual system where the street lights will be switched ON in the evening before the sunsets and they are switched OFF in the next day morning after there is sufficient light on the outside. But the actual timing for these lights to be switched ON is when there is absolute darkness. With this, the power will be saved up to some extent. This paper gives a solution for electrical power wastage. Also, the manual operation of the lighting system is eliminated. Upon sensing the movement, the sensor transmits the data to the microcontroller which furthermore the Light to switch ON. Similarly, as soon as the vehicle or an obstacle goes away the Light gets switched OFF as the sensor senses any object at the same time the status (ON/OFF) of the streetlight can be accessed from anywhere and anytime through the internet. This paper is implemented with smart embedded system which controls the streetlights based on detection of vehicles or any other obstacles on the street. whenever the obstacle is detected on the street within the specified time the light will get automatically ON/OFF according to the obstacle detection and the same information can be accessed through internet.

Keywords: Arduino UNO, Battery(80230AMh), LDR sensor, IR Sensor, Atmega(328P) microcontroller, LCD, GSM Model, Solar Panel

1. INTRODUCTION

INTRODUCTION OF EMBEDDED SYSTEM

An Embedded System is a combination of computer hardware and software, and perhaps additional mechanical or other parts, designed to perform a specific function. A good example is the microwave oven. Almost every household has one, and tens of millions of them are used every day, but very few people realize that a processor and software are involved in the preparation of their lunch or dinner. This is in direct contrast to the personal computer in the family room. It too is comprised of computer hardware and software and mechanical components (disk drives, for example). However, a personal computer is not designed to perform a specific function rather; it is able to do many different things. Many people use the term general-purpose computer to make this distinction clear. As shipped, a general-purpose computer is a blank slate; the manufacturer does not know what the customer will do wish it. One customer may use it for a network file server another may use it exclusively for playing games, and a third may use it to write the next great American novel. Frequently, an embedded system is a component within some larger system. For example, modern cars and trucks contain many embedded systems. One embedded system controls the anti-lock brakes, other monitors and controls the vehicle's emissions, and a third displays information on the dashboard. In some cases, these embedded systems are connected by some sort of a communication network, but that is certainly not a requirement.

If an embedded system is designed well, the existence of the processor and software could be completely unnoticed by the user of the device. Such is the case for a microwave oven, VCR, or alarm clock. In some cases, it would even be possible to build an equivalent device that does not contain the processor and software. This could be done by replacing the combination with a custom integrated circuit that performs the same functions in hardware. However, a lot of flexibility is lost when a design is hard-cooled in this way. It is much easier, and cheaper, to change a few lines of software than to redesign a piece of custom hardware.

II. SYSTEM DESCRIPTION

A. *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'. The embedded system architecture can be represented as a layered architecture as shown in Fig.

The operating system runs above the hardware, and the application software runs above the operating system. The same architecture is applicable to any computer including a desktop computer. However, there are significant differences. It is not compulsory to have an operating system in every embedded system.

For small appliances such as remote-control units, air conditioners, toys etc., there is no need for an operating system and you can write only the software specific to that application. For applications involving complex processing, it is advisable to have an operating system. In such a case, you need to integrate the application software with the operating system and then transfer the entire software on to the memory chip. Once the software is transferred to the memory chip, the software will continue to run fora long time you don't need to reload new software.

B. *ARCHITECTURE OF EMBEDDED SYSTEM*

Now, let us see the details of the various building blocks of the hardware of an embedded system. As shown in Fig. the building blocks are:

- Central Processing Unit (CPU)
- Memory (ROM and RAM)
- Input Devices
- Output devices
- Communication interfaces
- Application-specific circuitry

Central Processing Unit (CPU):

The Central Processing Unit (processor, in short) can be any of the following: microcontroller, microprocessor or Digital Signal Processor (DSP). A micro-controller is a low-cost processor. Its main attraction is that on the chip itself, there will be many other components such as memory, serial communication interface, analog-to digital converter etc. So, for small applications, a micro-controller is the best choice as

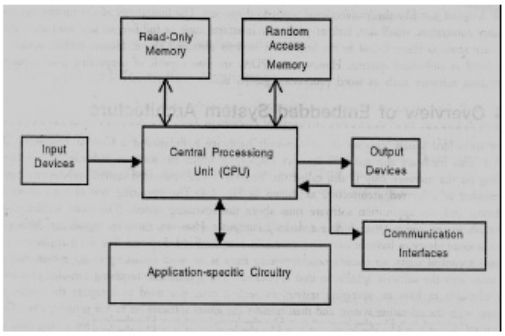


Fig 1.4 Blocks of hardware embedded system

the number of external components required will be very less. On the other hand, microprocessors are more powerful, but you need to use many external components with them. D5P is used mainly for applications in which signal processing is involved such as audio and video processing.

Memory:

The memory is categorized as Random Access 11emory (RAM) and Read Only Memory (ROM). The contents of the RAM will be erased if power is switched off to the chip, whereas ROM retains the contents even if the power is switched off. So, the firmware is stored in the ROM. When power is switched on, the processor reads the ROM; the program is program is executed.

Input devices:

Unlike the desktops, the input devices to an embedded system have very limited capability. There will be no keyboard or a mouse, and hence interacting with the embedded system is no easy task. Many embedded systems will have a small keypad-you press one key to give a specific command. A keypad may be used to input only the digits. Many embedded systems used in process control do not have any input device for user interaction; they take inputs from sensors or transducers 1'fnd produce electrical signals that are in turn fed to other systems.

Output devices:

The output devices of the embedded systems also have very limited capability. Some embedded systems will have a few Light Emitting Diodes (LEDs) to indicate the health status of the system modules, or for visual indication of alarms. A small Liquid Crystal Display (LCD) may also be used to display some important parameters.

Communication interfaces:

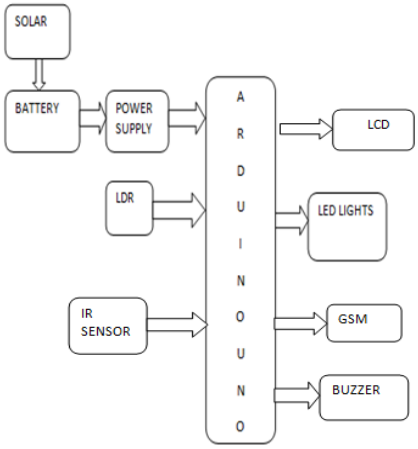
The embedded systems may need to, interact with other embedded systems at they may have to transmit data to a desktop. To facilitate this, the embedded systems are provided with one or a few communication interfaces such as RS232, RS422, RS485, Universal Serial Bus (USB), IEEE 1394, Ethernet etc.

Application-specific circuitry:

Sensors, transducers, special processing and control circuitry may be required fat an embedded system, depending on its application. This circuitry interacts with the processor to carry out the necessary work. The entire hardware has to be given power supply either through the 230 volts main supply

or through a battery. The hardware has to design in such a way that the power consumption is minimized.

C. BLOCK DIAGRAM



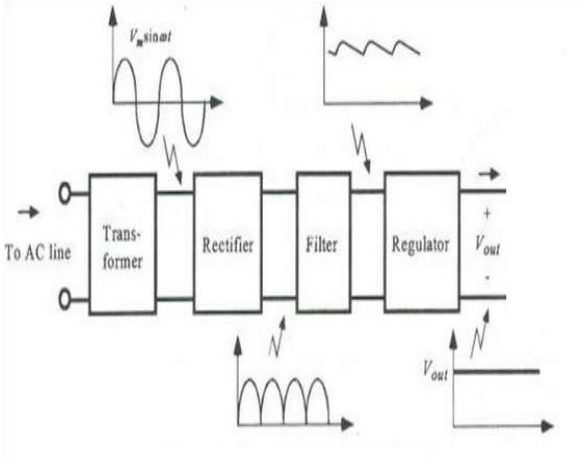
III. DESCRPITION OF COMPONENTS

A. ARDUINO

Overview 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.

B. POWER SUPPLY

The input to the circuit is applied from the regulated power supply. The a.c input i.e., 230V from the mains supply is step down by the transformer to 12V and is fed to a rectifier. The output obtained from the rectifier is a pulsating d.c voltage. So, in order to get a pure d.c voltage, the output voltage from the rectifier is fed to a filter to remove any a.c components present even after rectification. Now, this voltage is given to a voltage regulator to obtain a pure constant dc voltage.



C. LCD (LIQUID CRYSTAL DISPLAY)

Liquid Crystal Display also called as LCD is very helpful in providing user interface as well as for debugging purpose. The most used Character based LCDs are based on Hitachi's HD44780 controller or other which are compatible with HD44580. The most used LCDs found in the market today are 1 Line, 2 Line or 4 Line LCDs which have only 1 controller and support at most of 80 characters, whereas LCDs supporting more than 80 characters make use of HD44780 controllers.

D. LIGHT DEPENDENT RESISTOR (LDR)

A photo resistor is an electronic component whose resistance decreases with increasing incident light intensity. It can also be called a light-dependent resistor (LDR), or photo conductor. Other light dependent resistors, or photo resistors have been made using materials including Cadmium Sulphide, Lead Sulphide and the more commonly used semiconductor materials including Ge, Si and GaAs.
The photo resistor, or Light Dependent Resistor, finds many uses as a low-cost photo sensitive element and was used for many years in photographic light meters as well as other applications. Such as flame, smoke, and bugler detectors, card readers and lighting controls for street lamps.

Units for the light intensity are Lux or Lumens.

E. LED'S(LIGHT)

A **light-emitting diode** (**LED**) is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The colour of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor. White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device.

F. SOLAR PANEL

Solar panels are basically solar cells which convert light energy from sun into electrical energy. This converted electrical energy is stored in battery and then it is available for user applications. The most commonly used material in solar panel is silicon crystal. As we know, when light energy or photons from sun strikes these silicon crystals the electrical energy (DC) is generated. The Ratings of solar panel used is18 volts and 23 watts.

Fig: 4.3 solar panel

G. LCD (LIQUID CRYSTAL DISPLAY)

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Fig: 4.4Pin Diagram of LCD

H. GSM

SMS is a mobile communication modem; it is stands for global system for mobile communication (GSM). The idea of GSM was developed at Bell Laboratories in 1970. It is widely used mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands. GSM system was developed as a digital system using Time division multiple access (TDMA) technique for communication purpose. A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its own particular time slot. The digital system has an ability to carry 64 kbps to 120 Mbps of data rates.

Fig: 4.8 GSM model

I. IR SENSOR

IR TRANSMITTER:

TSAL6200 is a high efficiency infrared emitting diode in Gaia on GaAs technology, moulded in clear, blue grey tinted plastic packages. In comparison with the standard GaAs on GaAs technology these emitters achieve more than 100 % radiant power improvement at a similar wavelength. The forward voltages at low current and at high pulse current roughly correspond to the low values of the standard technology. Therefore, these emitters are ideally suitable as high-performance replacements of standard emitters.

IR Receiver:

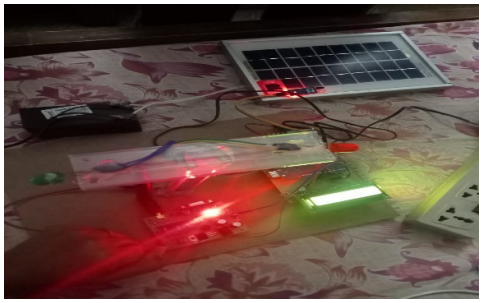
The **TSOP17.** – series are miniaturized receivers for infrared remote-control systems. PIN diode and preamplifier are assembled on lead frame, the epoxy package is designed as IR filter. The demodulated output signal can directly be decoded by a microprocessor. TSOP17XX is the standard IR remote control receiver series, supporting all major transmission codes.

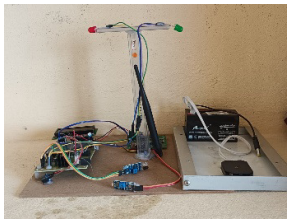
IV OPERATION OF THE PROJECT

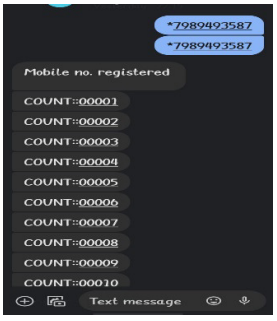
The Arduino is the heart of the system. This system contain webcam which is interfaced to Arduino the Arduino zero incorporates a number of enhancements and new features. These features of Arduino are improved power consumption, increased connectivity and greater IO which made this powerful, small and lightweight ARM based computer. The Arduino cannot directly drive the relay. It has only zero volts or 3.3 V. It needs 12V to drive electromechanical relay. In that

case it uses a driver circuit which provides 12V amplitude to drive the relay. Various sensors are connected to the Arduino board give a resistance variation at the output. This output signal is applied to the comparator and signal conditioning circuit which has potentiometer to decide the moisture level above which the output of comparator goes high. This output signal is given to the Arduino board. If the soil moisture value is above the moisture level, then the 3-phase induction motor will be OFF, whereas if the moisture level is low motor will be ON through the relay. LDR (Light Dependent Resistor) is used to control the light automatically and by using this we can monitor the farm at night also. We are using a GSM to have a alert count of Led light when it glows. IR sensor is used to sense the object passing through the Led light. When the IR sensor detect the object the LDR doesn't detect the alert count msg when the surrounding has a lighting. When the LDR sensor detect the dark mode or no light available in the surroundings the LDR gets active and the IR sensor detect the object passing a start giving a count of the Led light to mobile as notification. The count alert notification is giving when both the sensor is active. The buzzer is sounded when the object are passed through the street light.

V RESULT AND DISCUSSION







VI CONCLUSION

This project explains the construction of Automated Street light system with its working via flow diagram and circuit diagram. Circuit works properly and makes lights to be in ON/OFF state. LDR the two main components of the circuit design. If the components work properly and proper criteria for these components are met than the system works properly and produce desired result. With help of micro controller command, the lights glow when it is dark and vehicle passes by. Also, the microcontroller uses the embedded C code which is extremely fast language.

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