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Smart Street Light on Highway with Energy Conservation and Accident Prevention

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Abstract: ***In this project, we are going to build the smart streetlight system along with the accident avoidance and detection system which will help society to reduce the energy consumption from streetlights and also reduce the number of accidents which are usually happening on highways. Streetlights play an important role in cities which means to avoid accidents, secure roads and provide better vision since evening to morning. As the world is ready to accept the technology, we need to upgrade that street light system which will reduce the energy consumptions and save energy. As our goal is to save energy, so we are using LEDs. The IR sensors detect the objects and set the intensity of LEDs to high for some time. The work will achieve better performance and reduce the energy consumption as compared to the current system. One of the major problems happening in cities is accidents, so we are applying IR mechanism to avoid the accidents that usually happens in highways. But, in case an accident occurs we use an alert system in this paper that helps to strengthen the emergency system of the crash system. This device senses the occurrence of the accident and alerts the rescue team for help. The idea is about making vehicles more self-regulating and automatic which may inform or combat vehicle drivers under terrible conditions. The system also consists of MQ-3 alcohol sensor to continuously observe the alcohol blood concentration level.***

Keywords: Smart Highway, Arduino Uno, Light Emitting Diode, Accident Prevention, Automatic.

I. INTRODUCTION

A. Introduction

Today, driving drunk is to blame for the majority of automobile accidents. Because of their unpredictable mental states, bibulous drivers frequently make hasty decisions on the road that endanger the lives of many other people. Due to the significant increase in the number of vehicles on the road, traffic deaths are now more likely than before. Worldwide, drunk driving may significantly contribute to traffic accidents. The creation of a system that can ascertain how much alcohol the driver of the car has drank is the aim of this project. By barring users from operating a vehicle after drinking, the proposed system hopes to reduce the number of accidents caused by drunk driving. The alcohol detection gadget (MQ-3) and Arduino are used as the main components of the constructed model. As a safety measure, the vehicle ignition (DC Motor) is turned off once the alcohol level exceeds an allowed limit, and the responsible authorities is notified via the GSM module. The invention of transportation has given some people the ability to have the most advanced civilization among earth's inhabitants. The relevance of the automobile to our standard of living is nice. We frequently use it to get to our destination, spend time with our loved ones, and transport our goods. But it also has the potential to kill us accidentally. One of the most important and fundamental danger factors when driving is speed. It not only influences the severity of an accident, but it also raises your risk of getting hurt in a severe one. Accidents continue to occur despite the extensive efforts made by various governmental and non-governmental organizations throughout the world via multiple programmers to raise awareness about irresponsible driving. If the emergency services were to receive the crash information in a timely manner, however, many lives might be spared. According to a study by Virtanen et al., 4.6% of accident fatalities may be avoided if emergency services were available at the scene of the accident in a timely manner. In order to save the precious human life, cost-effective automatic accident detection and an automatic notification to the emergency service with the accident location may be required. Within the global economy and in terms of living standards, automation is becoming an increasingly important factor. Any technology that is relatively manual is not as popular as automatic systems. Intelligent light sensing is the term for lightweighting on public streets that adjusts to the movement of vehicles, bicycles, and people. Intelligent street lighting, also known as adaptable street lighting, dims when there is no activity but shines when there is. Ancient, writing paper and illumination, or dimmable street lighting that dims at set intervals are completely unrelated to this type of lighting.

When a route climbs up or down a steep hill, hairpin turns are typically built so that it would move primarily across the slope with only a moderate slope and are typically covered in an extremely zigzag pattern. It becomes difficult to control and increases the risk of accidents if two vehicles turn while facing each other. To prevent such mishaps, we often deploy a warning system.

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B. Accident Alert System Features

This system is based on modern technology, and its major objective is to find accidents and make the victim aware of the room so that some assistance may be provided. Without any visible contact from the room, it will be able to determine how severe the injury was. It is simple to determine how many automobiles are involved in an accident and how severe it is if this technology is installed in every vehicle in order for the room's help to be consistent with the room. The current board design has both accident and vehicle pursuit alarm systems, which add to its value and utility. This board warns us about theft and accident detection at the same time. By connecting a fire detector to one of the interrupt pins, this gadget also detects house fires.

C. Problem Statement

The analysis study demonstrates automatic streetlight control as a result of the power being somewhat conserved. Automation may be a step beyond mechanisation in the context of industrial enterprise. Automation significantly reduces the need for human sensory and mental necessities, just as mechanisation had given human operators with equipment to assist users with muscle labour needs. Basically, one of the essential elements is street lighting. Because of this, installing streetlamps is relatively simple, but as cities grow and have higher traffic densities, the number of streets will quickly expand.

Automobiles are essential for getting to work, meeting up with family and friends, and delivering goods. However, they frequently provide the groundwork for major catastrophes. Even though they occur frequently, road accidents are the worst thing that may happen to a road user. The biggest regret is that we don't learn from our driving errors. The majority of road users are quite aware of the general regulations and safety precautions when using roads, however accidents and wrecks only occur as a result of road users' negligence. Human mistake is the primary cause of accidents and crashes.

Following area unit the key reasons of accidents:

1) Speeding up
2) Inebriated driving
3) Driver Distraction
4) The color red Jumping
5) Refusing to wear protective gear like seat belts and helmets
6) Failure to maintain lane discipline and extremely improper passing.

Research on accident detection systems is widely disseminated. Older methods of predicting traffic accidents make use of semi-permanent data on traffic, such as annual average daily traffic and hourly volume. Real-time traffic accident prediction, as opposed to historical traffic accident prediction, links accident events to historical traffic data gathered from a variety of detectors, including induction loops, infrared detectors, cameras, etc. While traffic incident detection studies are concerned with the modification of traffic conditions when "an incident an event an occasional happening a prevalence" occurrence, Prediction of historical traffic accidents focuses on the evolution of traffic patterns prior to the occurrence of accidents. In addition to the automated detection system, manual incident observation methods can also find the accident from the driver's report, the report from the transportation department or public workers, the investigation by aerial police, or the investigation by police using closed-circuit cameras. This type of detection system's drawback is that a witness to the incident is required. Additionally, there are delays and errors due to the witness's speech limitations. The driver initiated incident detection system has many advantages over the existing detection method.

D. Proposed Solution

However, because accidents occurring after alcohol is detected and breathalyser use is manual, it is unlikely to catch most cases of drunk driving. Additionally, this method isn't always believed to be accurate due to physiological changes such as an individual's weight, ambient temperature, respiratory habits, etc. In this essay, an open-source, easily-usable microcontroller named Arduino Uno is used. Utilizing the MQ-3 gadget, the system detects the presence of alcohol that the driver has consumed. The excellent feature of this device is that it may be mounted on an automobile's steering wheel and that a range of 5 to 10 cm will be generated to detect alcohol use in just the driver. The vehicle's engine (DC Motor) is shut off and a brief message is sent as an alert via GSM to the relevant authorities if the alcohol level exceeds the legal limit. The planned technology is intended to safeguard the people within the car as well as those who enter the surrounding area. While this is going on, lighting systems will be categorised according to the types of lamps that are utilised, such as incandescent, mercury vapour, metal salt, air mass atomic number 11, depression atomic number 11, compact fluorescent, induction, and light-emitting diode (LED) lightweight. Different types of lightweight technologies are used in lighting design, each with its own lucent potency, lamp life, and problems.

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The lighting Emitting diode is regarded as a promising alternative to trendy street lighting systems because of its characteristics and advantages. Other than that, the advantages of LEDs are probable to replace traditional streetlamps such electric lamps, lamps, and powerful atomic number 11 lighting. Future lamps will use light-emitting diode technology, however this is a challenging approach that calls for a combination of modern manufacturing techniques. As a result, the analytical work emphasizes how the streetlighting system uses energy-efficient light-emitting diode bulbs with IR device interface for dominant and managing.

A controlling unit called an Arduino UNO is used to communicate between modules. Tri-lateral axis motions can be utilized to determine the collision direction using an accelerometer. Through the GSM module, the family members who were saved are informed of the accident. A system with modules for vehicle management in weather-affected areas and curve is also included in the model. It warns the vehicles when two are about to collide, preventing accidents.

II. LITERATURE REVIEW

1) A popular idea proposed by J. Dai [4], which was implemented by an android phone. An android app is installed in the system with stores the data about the average vehicle acceleration speed and sudden braking system. If the vehicle crosses the speed limit, sudden braking was to be initiated and the app would activate a startling alarm. The drawback of this system was that the entire network was based on a single algorithm and was dependent on the functioning of the phone application. Though the method was simple and efficient, the margin of error also increased significantly.

2) Another, Z. Xiaoronget [5] proposed a model based on alcohol detection using sensor MQ-3 and IoT. An STC12C516A microcontroller and alcohol sensor was used as main components, to detect the alcohol content in the breath. If the alcohol content detected was over the limit, would start buzzing, ignition would be turned off and at the same time, would send the information to nearby cops with the exact location of the vehicle.

3) The drawbacks of this system were that although it was easy to implement, the entire setup was dependent on the MQ-3 sensor, whose malfunction would render the entire operation useless.

4) Another method involved the physiological behavior and changes of the drunken person [6], which could be detected by using special sensors like heartbeat sensors, eye blink detection, etc. The main drawback of this method was the need for real-time data transmission and verification, which would lead to slightly complex systems.

5) In the following paper “Energy Consumption Saving Solutions Based On Intelligent Street Lighting Control System” [1Energy consumption in the public lighting system represents the largest part of the energy usage of a community, while the maintenance and operation of the system is a considerable expense for every city. The paper focuses on products and innovative components for street lighting, proposing a consumption reducing solution based on an intelligent system for remote measurements and control with dimming technologies for HID lamps. The results indicate that considerable energy savings are achieved, and the service life of the lamps is extended.

6) In the following paper “Design and Implement of Wireless Sensor Street Light Control and Monitoring Strategy along with GUI” [10], As of late improving the lattice unwavering quality amid the top moment is picked up a great deal of considerations. Also, utilizing renewable vitality frameworks to nourish remote regions which are not wanted to be encouraged from the utility since they are a long way from it is another objective of numerous scientists. One out of these heaps is the road lighting particularly. In this manner, this paper proposes a standalone sunlight-based vitality free framework for road lighting as there is no force requested from the matrix. The proposed framework comprises of a PV board, stockpiling framework, LED light, control molding framework (PCS) and the controller which can deal with the force bearing and framework operation. Utilizing LED as a part of lighting applications has numerous focal points contrasted with other light. It is extremely proficient (high productivity lighting source) and financially savvy (the lifetime is long contrast with different lights). In augmentations to, it needs low dc voltage source to be worked. The capacity framework will be charged amid the daytime utilizing the accessible daylight. Then again, amid the evening time the controller will give a sign to the framework to associate the LED light to be prepared for use. Subsequent to the LED needs a low dc voltage to be worked, so a basic dc-dc converter will be sufficient for this framework bringing about diminishing the expense of the general framework. Chosen of recreation results have been given to approve the proposed framework.

7) In the following paper “Automated Street Light Controlling System” [12], An Internet of Things has taken the world by storm since its conception. The idea of connecting everything by wireless technology sums up IoT. We can connect anything using the sensor designed specifically for objects. Automated Street Lighting System will automatically switch the street light ON and OFF based on the amount of sunlight present using the LDR sensor and ADC module. By this technique power wastage will get reduced.

8) In this paper "Design and Development of Automatic Adjustment of Street Light Intensity" [13], The reduction in energy consumption has become a major concern for developing countries in order to achieve sustainable development. This paper presents a low-cost design of an automatic lighting system with the aim of energy saving and autonomous operation, using an embedded system. According to Central Electrical Authority report in 2015, 61% of the electricity in India is generated using natural resources like coal, thus endangering the environment. The per capita electricity generation in India during the year 2014-2015 was 1010 kWh. Therefore, an automatic street light system is developed that senses the ambient sunlight and responds accordingly. An LDR sensor was used to regulate the intensity of LEDs through voltage divider concept. At the same time, an IR sensor was implemented to switch the LEDs between their minimum and maximum intensity. AT89C51 microcontroller is used to control and coordinate the working of this system.

9) In the following paper "Instrument to Measure Variation in Intensity Of Light In Terms Of Resistance Of Light Dependent Resistor" [14], The proposed instrument is capable of measuring and displaying resistance of LDR (light dependent resistor) with precision. It is created by using MCU (microcontroller unit) as a processing device. This concept of the proposed system has many applications like as itis seen in the day-to-day life that many times accidents occur when a high beam light falls on the eyes due to the sudden coming of the any vehicle but if the intensity of the light can be varied automatically at that time, then the accident may not occur. Human brain and eyes are not so fast to take decision on this sudden event, but this system can make SMART CARS where car is itself taking decision. Similar way the proposed system has applications in streetlights, flashlights etc.

10) In the following paper "Design and Implementation of Automatic Street Light Control Using Sensors and Solar Panel" [15], Solar Photovoltaic panel-based street lighting systems are becoming more common these days. But the limitation with these ordinary street light systems is that it lacks intelligent performance. It is very essential to automate the system so that we can conserve energy as well as to maximize the efficiency of the system. In this paper a new method is suggested so as to maximize the efficiency of the street lighting system and to conserve the energy usage the LED lights sensors. Here automation of streetlights is done by LDR sensor. Intensity of led streetlights can be controlled by IR sensor and pulse width modulation.

11) In the following paper "Automatic Street Light Control and Damage Detection" [16], This paper presents an automatic street light control and its damage detection. Controlling of streetlight is of utmost importance in developing country like India to reduce the power consumption. Saving of this energy is a very important factor in these days as energy resources are getting reduced day by day. This project describes about the circuit that switches the streetlights automatically during night using LDR sensors. Solar energy is one of the major renewable sources and is non-polluted. Hence, the utilization of this energy is essential everywhere, with having the maximum possibility of utilization of the solar energy. LDR sensors are used to control the switching of the streetlights. Suppose, If any street light is damaged it can be detected by the help of relay.

12) In the following paper "Smart Roadways Lighting Prototype System for Public Awareness" [17], Saving and efficient utilization of electricity is utmost importance in the present world. The proposed street lighting automation system is designed using Light dependent resistor (LDR), IR sensor and Raindrop sensor for day or night detection, vehicle detection and rainfall detection. The system is developed using ARM7 microcontroller. In the proposed system the sodium or halogen bulb are replaced with LED's. During night LDR allows all lights to glow at less intensity, IR sensor detecting vehicles allow LED's ahead of vehicle to glow at high intensity and dim the trailing lights, and intensity varied using PWM. Raindrop sensor detecting rainfall allows all lights to glow irrespective of vehicle movements. Implementation of this system saved energy to great extent.

13) In the following paper "Driver Alert System for Hilly Roads at Hair Pin Bends" [18] ,Road accidents are caused due to High speed or when the driver is not aware of the other vehicles coming opposite to it especially in the deep curves. Such types of curves are called as HAIR PIN CURVES. The existing system makes use of convex mirrors at the curves so that the driver can easily detect the vehicle coming in the opposite direction. This system works well during the day but not effective in night. The proposed system makes use of sensors at hairpin curves which work very efficiently during the night time. Placing the sensors at each side of the curves will help us to solve the problem. The usage of sensors is that if the vehicle is far away from the curve the sensor sends the signal to the vehicle coming in opposite direction in the form of light. In the same way the sensor at the other side of the curve will send signal to the vehicle coming from the opposite direction. In this way by using sensors, we can avoid a greater number of accidents mainly at the deep curves. Reducing the rate of accidents increases the well-being of a person.

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III. SYSTEM COMPONENTS

A. Software

Much of the work in this project is made easy by the ATMega328p microcontroller IC with Arduino bootloader since Arduino code is written in human readable language. These human-readable programming languages include C++and C. A "sketch" is the term used to refer to code files. These codes are created for Arduino board and then processed before being translated into machine language.

The primary text editor while programming an Arduino is the Arduino Integrated Development Environment (IDE). Before uploading our code to the board we wish to programme, we will write it here. Sketches are a common term for Arduino based source code.



Fig. 1 Arduino Integrated Development Environment

B. Hardware Used

1) Arduino Uno Microcontroller
2) IR Sensors
3) LDR Module
4) 16x2 LCD
5) Switch
6) 7805 Voltage Regulator
7) DC Motor
8) Relay
9) Shock Sensor
10) Alcohol Sensor MQ-3
11) LED Light
12) Buzzer
13) Resistor
14) Soldering Iron
15) Soldering Wire
16) Zero PCB
17) Connecting Wire

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IV. IMPLEMENTATION

A. Block Diagrams



Fig. 2 Block Diagram inside vehicle

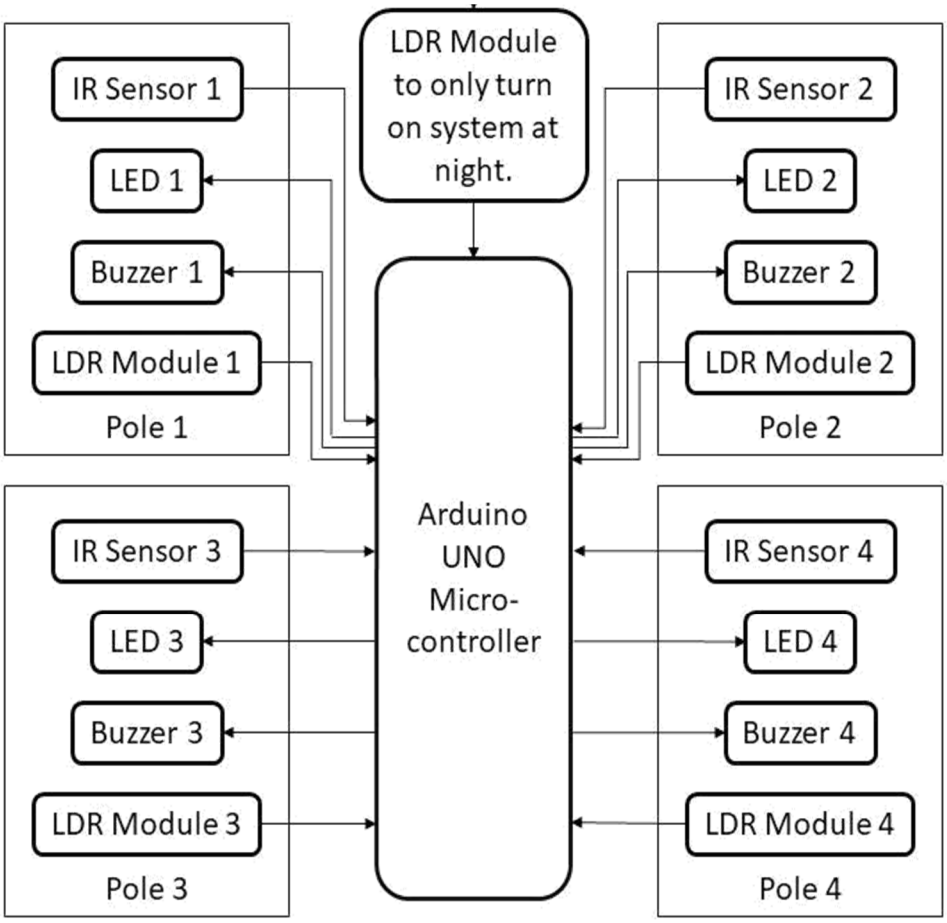


Fig. 3 Block Diagram of Street Light

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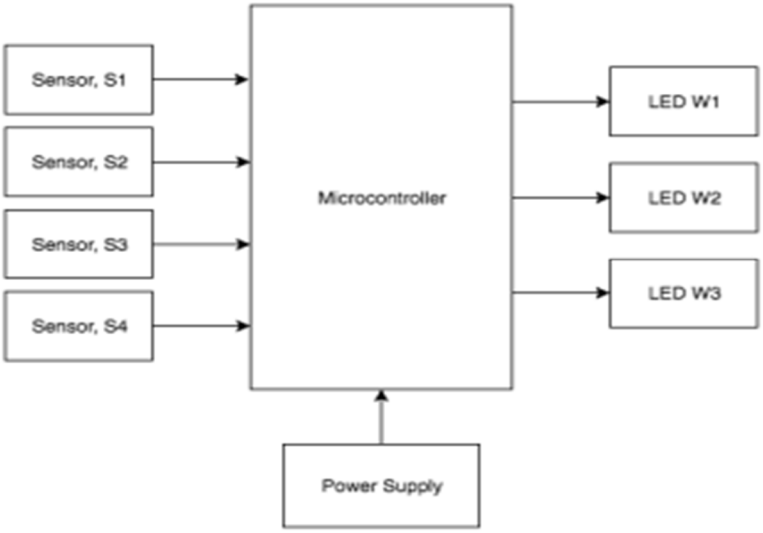


Fig. 4 Block diagram of collision avoidance system for hairpin bends

B. Workflow Description

Figures display the proposed model's block diagram. It has a switch that is used to turn on the car's engine. Alcohol levels exceeding a certain threshold are found using the MQ-3 alcohol sensor. After that, the input is delivered to the Arduino, and if the predetermined value is exceeded, it is then sent on to the GSM module to send an SMS to the relevant authorities. The DC motor represents the car's ignition system, which is turned off when alcohol is detected.

All poles work parallelly. The system will turn on only at night using LDR Module to power the system. The IR Sensor detects the vehicle in front of the pole and turns on the light at night. If the light doesn't turn on, then the LDR detects that LED is not on when it should, so it means it needs to be replaced and alarm the corresponding buzzer to indicate the faulty LED.

The sensors present on each side of the road work on principle of reflection of object. The 'Tr' present in the sensor sends the light on the objects. The object reflects the light back to the 'Rt' of the sensors. This received signals trigger the output voltage at the terminal of IR sensors. The output voltage triggers the BJT transistor which is used for switching the circuit from green signal to red signal and also triggers the buzzer. This red signal and the buzzer alert the driver on the other side of the road. If there are no vehicles present on the other side of the road a green signal is produced. Thus, this system provide safety for drivers to ride safely and prevent accidents on hill side roads.

V. PERFORMANCE ANALYSIS

A. System Testing

The framework for delicate items involves examining a fully-integrated machine to see whether it is in line with the product's precise requirements. Testing of gadgets would likewise fall within the purview of staring into a dark compartment, therefore there would be no requirement for information regarding how the code or presence of mind is internally structured. The intentional lowercase lettering is exactly the same. We should be able to write both the use cases and the check case circumstances inside the check case lettering.

B. Black Box Testing

A technique known as "test programming that uncovers out the ability and running of a product without the peering into the internal structures or into the operations, explicit data of the products inside shape, code, and programming understanding is typically not required" is known as "black-box looking at." Additionally, the analyzer is admirably cautious about precisely what our item is supposed to do even while it isn't sensitive to how it would do it. As an illustration, whilst our analyzer acknowledges that a careful input may restore a definite, endless yield, it is unsure just how the item would deliver the yield inside the crucial location.

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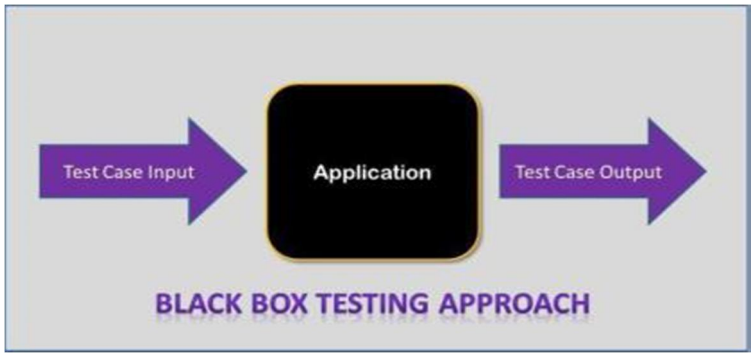


Fig. 5 Black Box Testing

C. Unit Testing

A fixed number of 1 and occasionally additional PC programming components, along with related control records, managing procedures, and working methodologies, are experienced and analysed to determine whether they are strong for use. This unit testing is used to help with computer programming and coding. Naturally, we may also identify a unit as the smallest checkable component of an instrument. Our unit may have been an entire module for this procedural programming scenario, but it's more common for it to be a person's behaviour or trait.

The purpose of unit testing is to dissect every aspect of this system and show that the individual aspects are reliable.

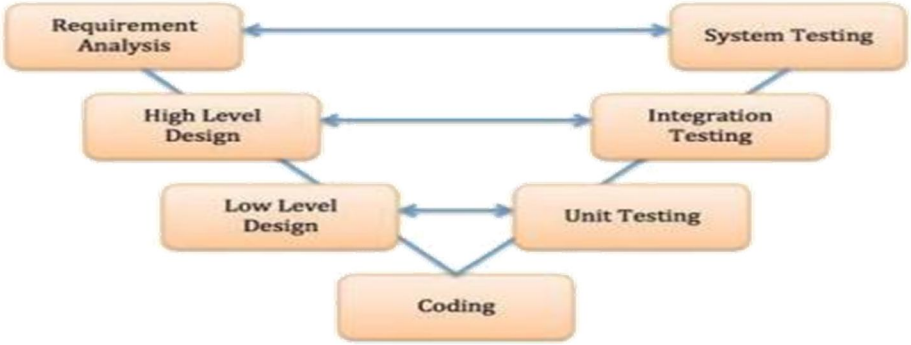


Fig. 6 Unit Testing

VI. CONCLUSION

One can conserve excess energy by adopting Smart Street Light, which works by switching out sodium vapour lamps with LEDs and including an extra security feature. It stops excessive electricity waste brought on by manually turning off streetlights when it's not essential. With the use of IR sensors, it offers an effective and clever automatic streetlight management system. It can keep costs the same while reducing energy consumption. The system is flexible, scalable, and completely adaptable to user requirements.

1) One-way traffic on highways is the only use now made of the system.
2) Constant usage of IR and LDR sensors, even during the day.
3) Not turned on before to nightfall.

The adopted approach is the most safe, practical, economical, and environmentally friendly way to conserve energy. According to statistics, local streetlights, state roadways, and national highways currently use between 35 and 40 percent of the electricity produced.

A system for accident event detection has been created. The suggested system focuses on the alerting and identification of accidents. It determines the precise latitude and longitude of the accident-related vehicle and transmits this data to the closest emergency response provider. Arduino assists in sending the message to various system components.

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The direction of the collision is monitored by the accelerometer, and the vehicle's rollover is determined by the gyroscope. Through the GSM module, the data is sent to the registered number.

In the section on automatic signal alerts, we suggested an algorithm to reduce accidents and traffic jams in mountainous terrain and around hairpin bends. Intimation will transfer more quickly using our suggested method, which will help vehicles avoid collisions and reduce traffic congestion.

We are aware that the two IR sensors used to detect the motion of the vehicle and establish priority are located on either side of the hairpin corners. The priority to cross the bend first will go to the vehicle approaching the curve more quickly. The vehicle on the road that is closest to the uphill curve is given priority by default if both are travelling at the same speed as they approach the curve.

VII. FUTURE SCOPE

The potential of this system can be expanded in the future by employing a wireless webcam to capture photos that will aid in offering driver assistance. By automatically locking all the brakes in the event of an accident, this can also be improved. Most often in collisions, it gets worse when the drivers lose control and can't get the car to stop. In certain circumstances, the CPU will additionally process the vibrations detected and cause the vibration sensor to be activated. The devices that, when activated, can lock the brakes must be connected to the CPU. With this development, we can halt the car and lessen the severity of the collision.

Additionally, this system can be used for fleet management, food services, incidents of traffic violations, rental car services, etc.

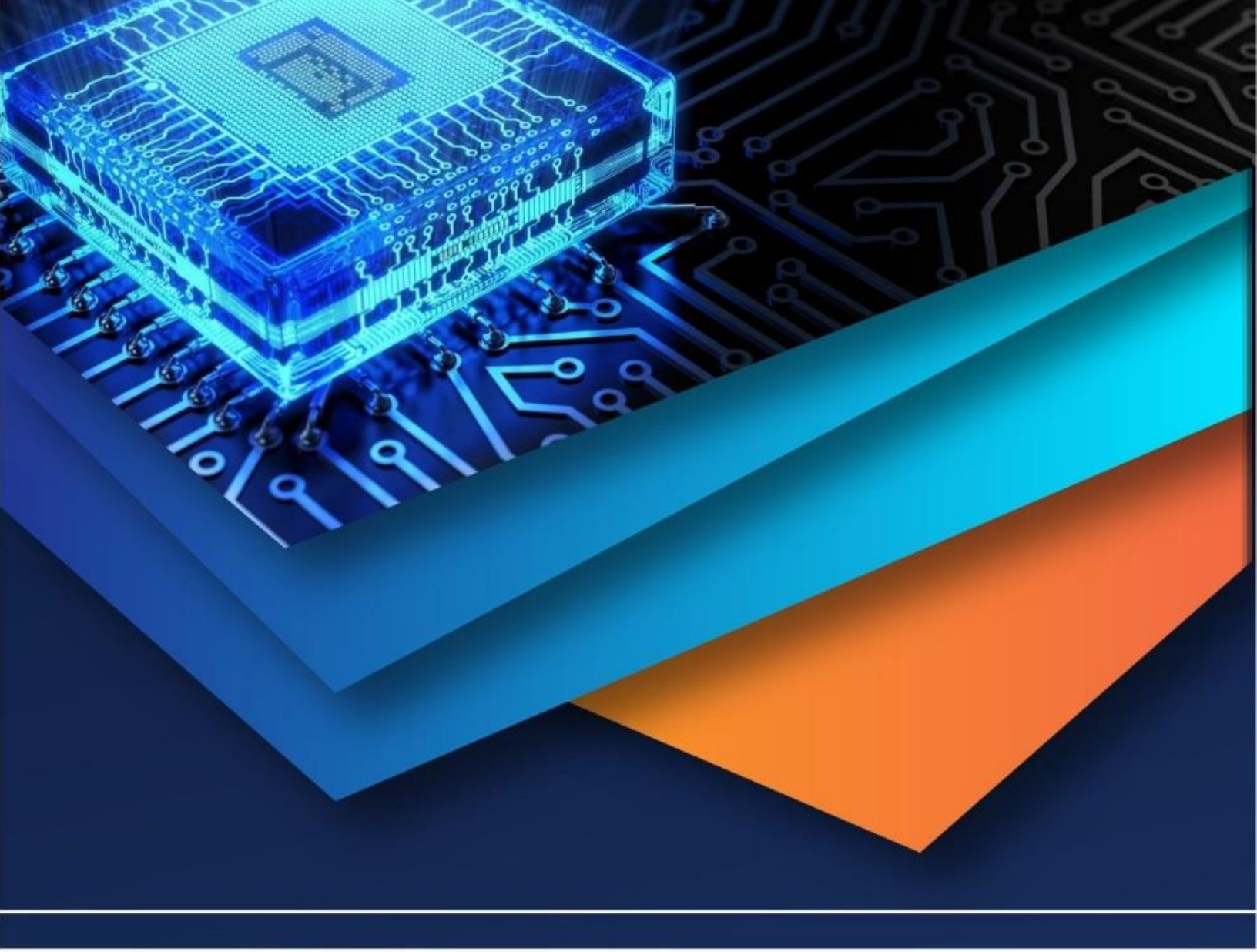
Additional upgrades to the Smart light system include:

1) To convert the existing system to two-way travel
2) Increasing the system's adaptability in case of inclement weather
3) The introduction of gsm-based services for lighting control.
4) The solar-powered LED streetlight with automatic light intensity control allows you to regulate the energy charge and brightness of the lights.
5) By including timer- and photosensor-based items, this project can be improved.
6) Fast charging is possible with a solar tracking device.

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