AI Engineering Applications

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Abstract:

Artificial intelligence (AI) is revolutionizing sustainable engineering practices by introducing intelligent solutions that enhance resource efficiency and minimize environmental impact. Machine learning algorithms can analyze complex datasets to identify opportunities for improved energy efficiency, waste reduction, and overall system performance using advanced data analytics. AI-powered predictive models facilitate better planning and management of renewable energy sources, contributing to the development of a more environmentally friendly energy infrastructure. Additionally, AI-powered smart systems enable adaptive control and real-time monitoring, ensuring that infrastructure and processes can dynamically adapt to changing circumstances for optimal utilization of available resources. In conclusion, artificial intelligence has significantly transformed sustainable engineering by equipping various industries with the necessary tools and knowledge to construct more resilient, efficient, and ecologically friendly systems. Within the field of sustainable engineering, we came up with a project aiming to apply eco-friendly techniques and clever solutions to maximize resource use and reduce environmental effect, making a positive contribution to a future that is more robust and greener. The purpose of this project is to create a smart street lighting system that prioritizes safety and saves energy. Each streetlight will have sensors to monitor temperature and operational status. By using solar panels, the system promotes sustainability and efficiency. The temperature sensors serve a dual purpose by monitoring the environment and ensuring safety. If the temperature is too high, the sensor will alert the central authority to check for technical issues and safety concerns. This proactive approach improves community safety and energy usage. The project focuses on sustainability and public safety, offering a smart solution for urban infrastructure.

1. Introduction

A system comprising computer devices, digital machines, and mechanical machines that are networked with one another via the use of unique identifiers (UIDs) and have the capability to transmit data across the network without the need for human involvement is referred to as the Internet of Things (IoT). This system is also known as the Internet of Things (IoT).

Taking all of the things that are in the information from all around the world and connecting them via the internet is the concept that is known as the Internet of Things (IoT), which is really rather simple with regard to its implementation. That anything is able to send and receive information is shown by the fact that it is connected to the internet. Because of this, the apparatus is endowed with intelligence.

2. Basic Concepts

2.1 Devices: The process of obtaining information from the world around them is supported by sensors and gadgets, which allow for the collection of even the minutest data. The level of complexity of this information may vary from being very straightforward (like determining the temperature) to being quite intricate (like when face recognition is used to unlock the door or to operate devices). There is the possibility that gadgets might be equipped with a multitude of sensors or devices that are tied together in order to detect items in the environment around them. An essential step that must always be made is to choose and collect data from the environment or surrounds in which it is situated. This is the primary stage that must be taken.

2.2 Connectivity: At this very moment, we have acquired all of the data; it is now essential to move it to the cloud infrastructure; however, in order to make this transition, a medium is needed. By using the cellular network, Wi-Fi, Bluetooth, and a number of other Wide-Area Networks, we

will be able to connect our sensors in the appropriate manner. Taking into consideration the amount of power that each network uses, the range that it covers, and the bandwidth at which it runs, it is essential to keep in mind that each network has its own unique set of criteria and opportunities for compromise. Therefore, it is of the highest significance to choose the connection that is most suitable for the system that is connected to the Internet of Things.

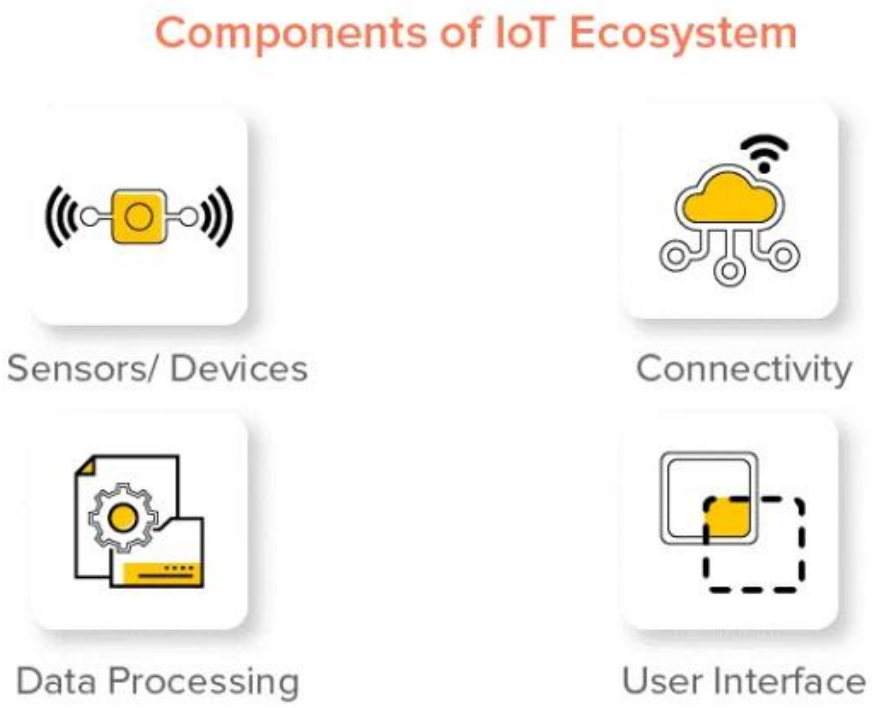

FIGURE 1: Components of IOT

2.3 Data Processing: Up to this point, we have acquired the data and uploaded it to the cloud; now we will start the process of processing it on our end. It may be as simple as checking the temperature on the gadget, or it could be as challenging as determining which face is the correct one for a facial recognition system.

2.4 User Interface: Since we have previously acquired, transmitted, and processed the data up to this point, we will now make the processed data (information) available to the end-user. This will

be accomplished via the user interface. You may do this by either sending a message to the user or setting off an alarm. Both of these options are available to you. Furthermore, we are able to design an application or website that will have a user interface that will enable the user to actively check the Internet of Things system. This is something that we are able to do.

The Internet of Things system may be built in a number of various methods, differing from one application to another, including the following: The user may also be liable for doing an activity that has the opposite consequence and has an influence on the system in some applications. This obligation may be placed on the user. B) In addition, the Internet of Things system will be able to automatically adjust the settings since it will be constructed with specific rules that have been defined.

3. Why IoT is Important?

By providing people with more control over their lives, the Internet of Things is making it possible for them to live and work in a manner that is more knowledgeable. It contributes significantly to the process of automating homes by providing intelligent devices, which is a big component of the process. Because it provides a real-time view on how the system is running by delivering insights, the Internet of Things also plays a vital part in the business sector. This is because it delivers insights on how the system is functioning. Monitoring the efficiency of supply chains and the activities of logistics teams is made easier with the provision of this information.

Companies have been able to enter automation, also known as Industry 4.0, which automates the process and reduces the cost of labour. This is made possible by the Internet of Things (IoT), which has enabled companies to enter automation. Not only can the use of automation in manufacturing bring about a reduction in the overall cost of production, but it also makes it possible to provide products of a greater quality. When it comes to improving the delivery of services, it is also helpful since it offers transparency into the transactions that clients carry out.

There is no industry or company that has not been impacted by the Internet of Things since its usage is seeing such broad adoption. A wide range of industries, such as agriculture, healthcare, manufacturing, retail, finance, and transportation, are among those that make use of the Internet of Things (IoT).

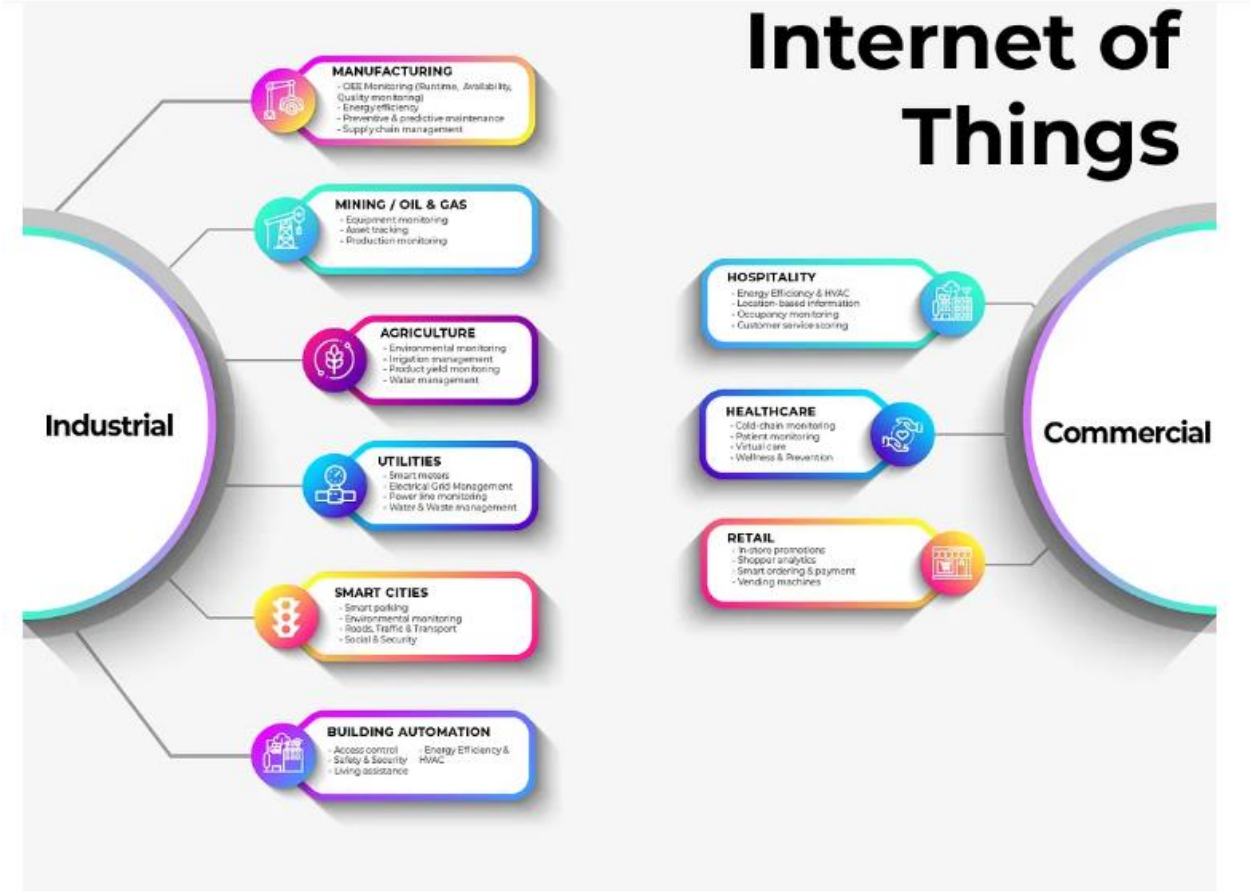

FIGURE 2: Industry division of IOT

In the same way that artificial intelligence is concerned with the replication of intelligent behaviour in machines of all kinds, the Internet of Things (IoT) is the basis upon which artificial intelligence is created. Connecting machines and making use of the data generated by those equipment is what the Internet of Things is all about. Together, the Internet of Things and artificial intelligence contribute to the enhancement of the device's intelligence.

3.1 Advantages of IoT

The capability of accessing the data while on the go, which means being able to access it from any location at any time using any device.

Through what is known as M2M (Machine to Machine) Communication, it enables the physical devices to maintain their connections with one another and communicate with one another.

The process of making decisions is simplified when there is a greater availability of data, which makes life simpler.

Getting jobs to be uniform, enhancing the quality of service, and controlling day-to-day chores without the need for human interaction are all benefits that may be achieved via automation. The communication between M2M devices contributes to the maintenance of transparency throughout the process.

Both the efficiency of labour and the prevention of skill mismatches, which leads to an increase in production, are improved by this.

3.2 Disadvantages of IoT:

As more and more of the things that we use on a daily basis become connected to the internet, an ever-increasing quantity of information is becoming more readily available to us. As a result of this, it becomes more challenging to secure the confidentiality of the information from being stolen by hackers and other users who are not permitted to access it.

It is tough and hard to verify that devices created by different firms are compatible with one another since there is currently no universal standard. This is what makes the situation difficult and confusing.

As a result of the fact that the Internet of Things is a very extensive and diverse network, even a single malfunction (whether it be in the hardware or the software) might potentially have disastrous consequences.

Because of the growing dependence on automation that the Internet of Things (IoT) is experiencing, the need for workers who lack specialised skills will steadily decline over the course of time.

As a consequence of an increasing reliance on technology, individuals are losing the basic talents that are necessary for them to interact with one another. This is happening throughout the whole society.

4. Literature Review

Street Light Glow is a concept that has been proposed by S. Suganya and his colleagues. This concept is centres on the detection of vehicle movement via the use of a sensor is system that makes use of the most modern technology for light sources, such as LED lights. The switching of street lights can also be controlled automatically according to the intensity of the light, flow-based dynamic control statistics can be developed with the assistance of infrared detection technology, and the management of a wireless connection between lampposts and control terminals can be accomplished with the assistance of the ZigBee Wireless protocol. In addition to this, it incorporates a variety of technologies, such as a timer, a statistics of the amount of traffic flow, photodiodes, green light emitting diodes (LEDs), and power transistors.

A survey was carried out by K.Santha and his colleagues as part of their research project known as the Street Lighting System Based on Vehicle Movements. The automatic mode of operation is used by the system, which may be utilized to modify the streetlight in accordance with the brightness and dimness algorithm as well as the light intensity readings. The fact that the situation may be regulated in line with the seasonal transition is something that happens. Furthermore, it is equipped with a time cut-out feature and an automatic control pattern, both of which are meant to contribute to the reduction of power consumption. Throughout the whole of the time that the project was being implemented, a PIC microcontroller was used.

ZigBee was presented as the foundation for an autonomous street light system that can be operated remotely and is based on the technology. ZigBee modules were used in the development of the system that was designed to detect and manage lamps that were not functioning properly. When it

comes to sensing and regulating the lighting, these modules also provide assistance. In addition to this, it encompasses an intelligent system that is able to make decisions automatically about whether the light should be turned on, off, or dimmed. These decisions are made by taking into consideration the movement of people and cars as well as the environment that surrounds them. As a result of its capacity to detect motion, a PIR motion sensor is able to detect the movement of both live and non-living things.

It was in the year 2015 that M.Abhishek and his colleagues were able to successfully create a concept for a traffic flow-based street light control system that makes effective use of solar energy. Solar power, which is a form of energy that is reasonably sustainable, was the method that they used in order to illuminate the streets. Additionally, they have used the 8052 series microcontroller, which was developed by replacing traditional light bulbs with LEDs. This was done in order to build the procedure. The quantity of electricity that is used has been reduced by a factor of three as a direct consequence of this modification. By using sensors that are positioned on both sides of the road, the microcontroller is able to make decisions on whether or not to switch the lights on and off. This microcontroller receives information from these sensors, which detect the movement of the cars and relay it to it. When it comes to this particular place, all of the street lights are turned out, and the only time anything illuminates is when it senses the movement of an automobile. As a consequence of this, the microcontroller is responsible for turning off the lights even when it is nightfall.

An investigation on the street light that integrates an auto tracking system has been carried out by C. Bhuvaneshwari and his colleagues. Utilizing this technology makes it possible to get a higher conversion efficiency in the process of producing solar electricity. This particular circumstance calls for the use of the sun tracking sensor as the sensing device. The amplifier receives an output that is decided by the light density of the sun, and it is responsible for identifying the position of the sun at regular intervals. Additionally, it is responsible for delivering the amplifier information. For the purpose of sun tracking, a low-duty-rate (LDR) sensor is used, and an amplifier unit is utilized in order to amplify the signals that are generated by the LDR sensor. Following the transformation of low-level signals into high-level signals by this amplifier unit, the output is sent to a comparator for further processing. The integrated circuit number LM324 is used in the role of

an amplifier. After the comparator has examined the signals and compared them, the instruction is then sent to the AT89C51 CPU for processing.

5. Motivation and Objectives

Expenses that are considerable for providing maintenance.

There are several instances in which intelligent street lighting is reliant on a power source that is reliable and constant.

There are instances of this, such as gaps or interruptions in network coverage, which are considered to be problems with connection.

Problem Statement

Streetlights that are powered by solar energy have the potential to be linked to an Internet of Things (IoT) network in order to simplify remote monitoring, control, and maintenance. As a consequence of this, it is feasible to undertake real-time monitoring of energy consumption, performance, and maintenance needs. This, in turn, makes it possible to implement proactive management solutions and to administer effectively.

Proposed Work

The streetlight is supplied with the required quantity of power by the current system, which makes use of a single-phase line to do this. The proposed system incorporates five additional components in order to regulate the distribution of electricity. These components are incorporated in the system. [7] : An Infrared Physical Distance A sensor is situated at the base of the street light, and its primary function is to detect the presence of individuals within a certain area around the street light. On the Arduino, which acts as the central processing unit (CPU) of the circuit, the data that is collected from the sensor is sent. Following that, the Arduino is able to alter the brightness of the street light by giving commands to switch between dim and bright modes depending on the needs. As a consequence, it is able to adjust the output of the street light. A battery eliminator, which is likewise powered by the single phase line, is used in order to complete the task of supplying 5V inputs to the Arduino and the sensors.

It is a software that is open source and streamlines the process of writing and uploading it to the board so that it may be utilised. This is referred to as the Arduino Integrated Development Environment (IDE). The software is compatible with a wide range of operating systems, including Windows, MAC OS, and Linux computers. Installation of Java software on the personal computer is required prior to the launch of the integrated development environment (IDE). Java is the language that is used in the process of writing the environment. Any Arduino board may be used with this code due to its compatibility.

A device that has a resistance that is dependent on the electromagnetic radiation that is incident upon it is referred to as a Light Dependent Resistor (LDR) or a photo resistor when it is used in electronic devices. On account of this, they are electronic devices that are sensitive to light. They are also frequently referred to as photo conductors or photo conductive cells. Photocells are another term for them; nevertheless, they are also occasionally called photocells. Their construction is based on semiconductor materials, which are characterised by a high resistance to the flow of electrical current.

One of the fundamental principles that underpins the functioning of a light-dependent resistor is the idea of photo conductivity.

An infrared sensor is a kind of electronic device that takes use of infrared radiation in order to detect and identify certain characteristics of the environment in which it is located. In order to do this, it either causes infrared radiation to be emitted or detects it.

Movement detection and temperature measurement are two more capabilities that it has. It is also able to detect motion. Wavelengths that are infrared cannot be seen by the human eye because they are outside its range of vision.

To put it simply, the design contains three distinct modes of operation, which are as follows:

In situations when there is an adequate amount of natural light in the surrounding area, more specifically during daytime hours, the OFF mode is triggered. When you choose this option, the whole system will be switched down, and the batteries will simultaneously be charged.

The active mode is a mode in which the system is enabled automatically and the motion sensors are triggered when the amount of natural light falls below a certain level.

Whenever the sensors identify the presence of individuals, the ON mode is engaged. This, in turn, causes the LED lights to turn on and illuminate the space. These lights will be turned out once a certain length of time has passed.

6. Implementation and Result

A solution that would save power while also minimizing the negative implications of the present lighting system was one of the aims of the project. The project's other goal was to find a solution that will do both of these things. The first thing that needs to be done in order to get started on this project is to ensure that the system's inputs and outputs are prepared in order for it to be able to effectively control the lights. The project that is shown in the picture has been put into operation, and it is functioning in the manner that was expected. In the long run, it will be used to a significant degree. An infrared sensor is used in the prototype of the system that recognizes barriers on the highway. The infrared sensor first detects the obstruction, and then it activates the lights to indicate that the obstacle has been identified.

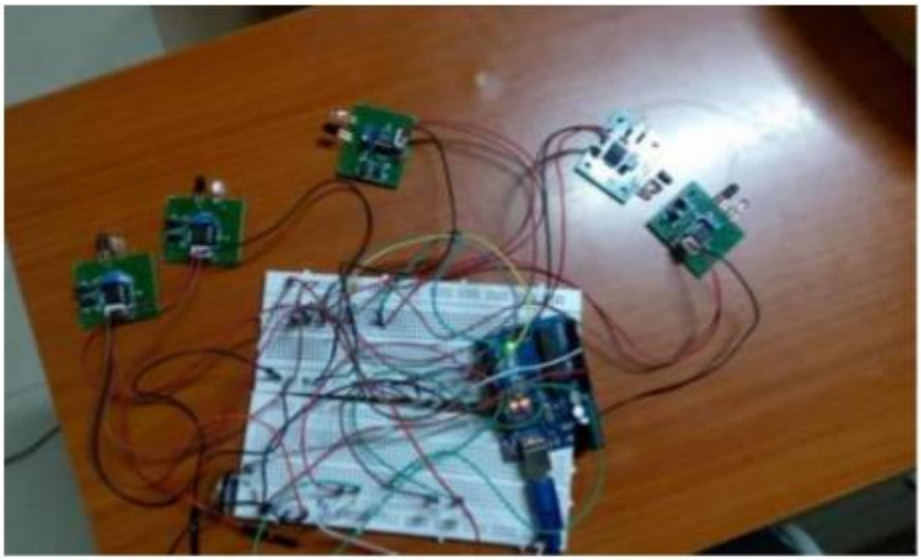

FIGURE 3: Initial phase of system

Each and every one of the components is in agreement with each and every other component. Infrared (IR) sensors are positioned in close proximity to one another. It is necessary to connect

the Arduino board to the external power source in order to ensure that electricity may flow. There is a connection between each of the five infrared sensors and the Arduino board. It is necessary to position the resistor on the bread board in order to regulate the flow of electricity.

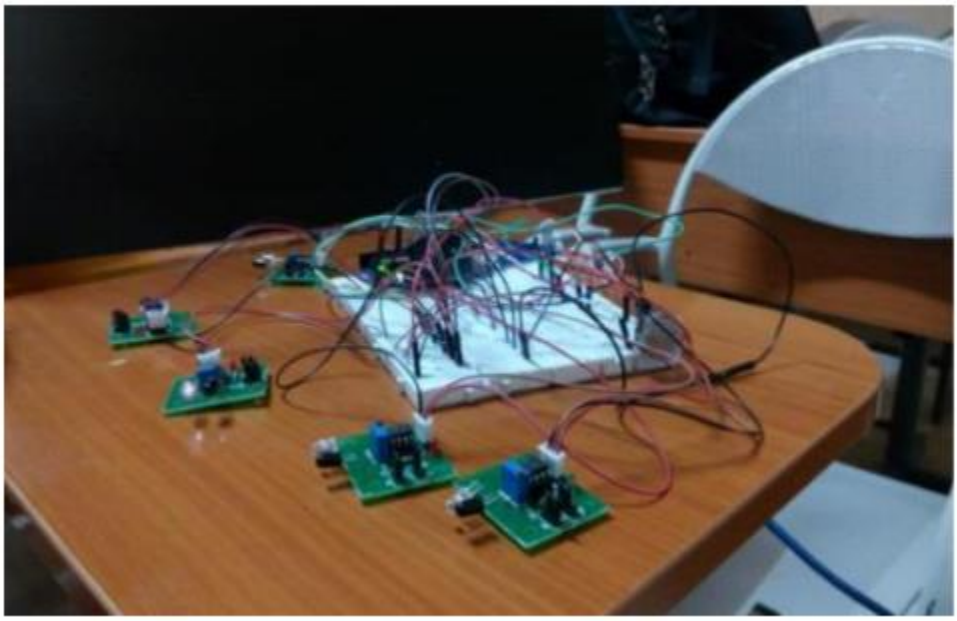

FIGURE 3: attachment of system to circuit

This is the second phase, in which all of the LEDs light brightly for a brief period of time before finally shutting off. The time when it starts to go dark is the moment that it starts to shine. Every single one of the LEDs, with the exception of the first one, is now being removed from operation.

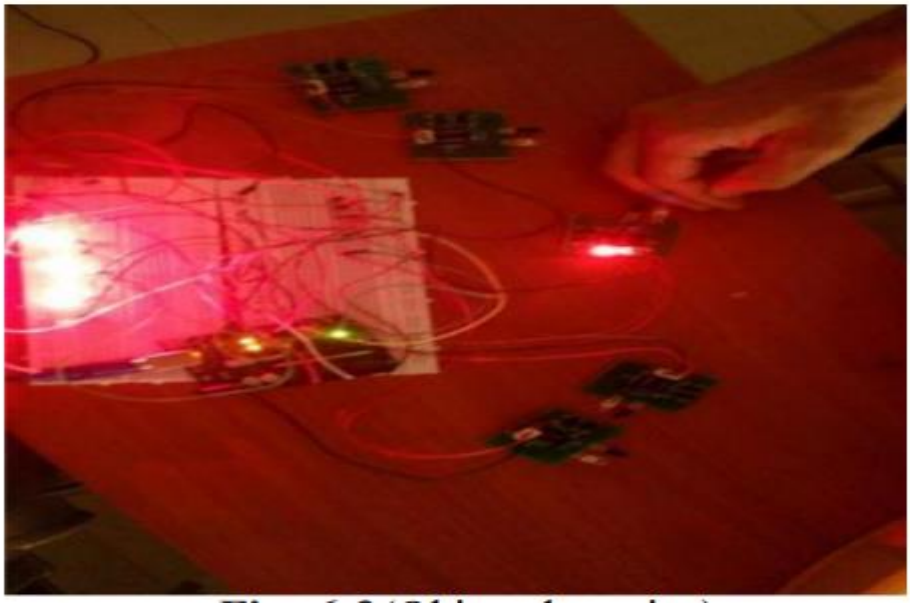

FIGURE 5: final phase of system

The movement of a vehicle or an object, whichever comes first. As can be seen in the illustration, the third streetlight gets turned on as a consequence of the object being discovered. These lights are quickly shut off as soon as the automobile is going by, and the next block of lights is switched on for the next block of lights to be illuminated.

Conclusion and Future Work

The infrastructure of urban regions may be improved by the implementation of intelligent street systems, which make use of cutting-edge technology.

These alternatives provide a number of benefits, including enhanced traffic flow, increased safety, and increased energy efficiency in comparison to other choices.

As a result of their utilization of renewable energy sources, these systems provide a contribution to the idea of sustainability.

Intelligent street systems, which enhance both the management of resources and the quality of life in the city, are aligned with the concept of smart cities, meaning that they are compatible with the concept.

There are a number of obstacles that need to be conquered, including initial costs, concerns around privacy, and dependence on technology systems.

Intelligent transportation systems have the potential to make cities safer, more environmentally friendly, and more efficient, despite the challenges that they provide.

Innovations in technology will have a significant impact on the future of intelligent highway systems in urban development. These improvements will define the future of urban development.

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