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A SMART HIGH WAY BASED ON DEEP LEARNING USING IOT DEVICES

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Abstract. Internet of Things is an emerging technology that enhances our daily life activities efficiently and effectively. It reduces the cost of living by automating manual processes. Solar systems are often built along highways where electric utilities are not yet available. These systems are operated manually by humans. Therefore, there is a need for an efficient approach that automatically controls and monitors current, voltage and other parameters of solar systems and provides real-time statistics to users. A novel Toll Google Net is proposed to overcome these issues. The solar panel is utilized to develop lithium battery-storage capable renewable energy. The Adafruit software, which is used to assess the pollutants and save daily usage in the cloud, is interfaced with the IOT monitoring system. The proposed system's experimental setup gathers real-time field data like temperature, air quality, IR, and proximity sensor readings. The cloud system receives these sensed instances for timely analysis. The experimental arrangement of the proposed technique based smart appliances was implemented using MATLAB. Accuracy, specificity, precision, and recall are the different metrics used to evaluate it. Experimental results shows that the proposed Toll Google Net attains better accuracy than existing IoT-SGE, EMS-IoT, and MODDA respectively.

Key words: Internet of things, Solar systems, Toll Google Net, temperature, air quality, IR, and proximity

1. Introduction. The Internet of Things (IOT) is a cutting-edge technology that allows a machine to be sensed or controlled remotely with the aid of a cloud server [1]. Nowadays, technology is employed in every aspect of life, automating routine tasks, enabling data flow between humans and machines, and monitoring or manipulating physical objects remotely from a distance [2]. It affects a wider range of physical and digital items, machines, people, animals, etc.

Solar energy is evolving become an important source of future renewable energy [3]. More rooftop solar systems are being connected with networks like grids [4] and industrial areas in order to provide strong grid stability. In order to identify any problems and boost overall solar system production, it is becoming more and more important to track the power produced by solar power plants in real-time. Variations in sun irradiation, temperature, and other factors make solar panels' ability to generate power unpredictable [5]. So that we can apply cutting-edge IOT technology platforms and then automatically build the machines [6]. These components allow for easy tracking of wireless networks and the elimination of the flaws and risks related to present technological approaches [7]. They are based on a variety of sensors and microcontroller devices. As a result, the device's cost functions are significantly less than those of the earlier control systems [8].

The extensive wiring necessary for typical AC power-based lighting systems makes solar light systems a particularly appealing option [9]. Moreover, solar lights made of light emitting diodes (LEDs) are more effective than those made of the more common high-pressure sodium (HPS) that are used in AC lighting systems. The main contributions of the work are as follows:

- A novel Toll Google Net is proposed for smart highway.
- The solar panel is utilized to develop lithium battery-storage capable renewable energy.
- The Adafruit software, which is used to assess the pollutants and save daily usage in the cloud, is interfaced with the IOT monitoring system.

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- The proposed system's experimental setup gathers real-time field data like temperature, air quality, IR, and proximity sensor readings.
- Recall, precision, F1 score, and accuracy were used to analyze the proposed model.

The remaining section of the work was organized as follows. In Section-2 briefly explains the similar works. Section -3 explains the proposed Toll GoogleNet methodology. In section-4, the performance results and their analysis are presented. Section-5 contains the conclusion.

2. Literature Survey. In 2021 Zhang, X., et al., [10] had presented the IoT based Smart Green Energy (IoT-SGE) for Smart Cities. Smart cities may control energy with fine precision by using IoT through the all monitoring and secure communications. The energy management system balances power availability and demand optimally by stably retaining the states, which is made possible by the recurrent learning process.

In 2021 Raval, M., et al., [11] had developed the (EMS-IoT) energy management system for IoT devices. By simulating the energy used for sensing, processing, and communication, energy transparency has been attained. The parameters of the multi-agent system are optimized using a genetic technique.

In 2020 Ali, M., and Paracha, M. K., [12] had established an IOT-based strategy for solar power usage and monitoring that enable people to manage a solar plant using their mobile devices. The basic method uses sensors to record the solar panel's perimeters, including voltage, current, and temperature, and then uses Arduino to transmit the data over the cloud.

In 2018 Zafar, S., et al., [13] had introduced a system for tracking environmental conditions such as humidity and temperature in real time. The system uses an Arduino UNO board, a DHT11 sensor, and an ESP8266 Wi-Fi module to communicate data to the ThingSpeak open IoT API service, where it is processed and stored.

In 2021 Xiaoyi, Z., et al., [14] had proposed the Multi-Objective Distributed Dispatching algorithm (MODDA) has been used to introduce the IoT's role in the integration of green energy supplies into smart electrical grids. The algorithm aims to supply the thermal infrastructure with the available renewable green energy and battery storage limits, as well as to the load and battery storage.

In 2019 Rathod, K. S., et al., [15] had suggested an IoT based method for monitoring solar power usage. Energy is produced by solar panels and wind turbines, and it is stored in batteries that are kept in charging stations that have been erected on both sides of the highway. The energy produced by this was used to automate street lights and charge electric vehicles.

3. Proposed Methodology. In this paper, the solar panel is utilized to develop lithium battery-storage capable renewable energy. The Adafruit software, which is used to assess the pollutants and save daily usage in the cloud, is interfaced with the IOT monitoring system. The workflow of the proposed Toll GoogleNet is depicted in figure 3.1.

Solar Panel. Photovoltaic cells compose a solar panel. These PV cells transform solar radiation into electrical energy when sunlight or other solar radiation strikes them. These PV modules produce electricity by using photons from the sun's light. It is subsequently supplied to homes, offices, etc. after being stored in batteries. We utilise particular sensors to handle the fluctuations in the sun's radiation.

Converter (dc-dc). Electrical circuits known as DC-DC converters change alternating current (AC) electricity into the stable needed direct current. They require a consistent DC output and a power input of 12 volts with voltage fluctuations.

Battery. A device with one or more electrochemical cells is called a battery. Cathode and anode, its two terminals, are utilised to connect the battery to any device. These batteries store the electrical energy generated by the solar panels, which serves to power equipment.

Infrared Sensor. A sensor is an electrical device that emits infrared light to detect specific elements of its surroundings. An IR sensor may detect movement in addition to tracking the heat of an item. As they just measure infrared radiation instead of emitting it, these sorts of sensors are known as passive IR sensors. Generally, all infrared-emitting objects give off some form of thermal radiation. These radiations, which are undetectable to the human vision, may be detected by an infrared sensor. An IR photodiode that is sensitive to IR light with the same wavelength as the IR LED's emission serves as both the emitter and the detector in this system. When IR light hits the photodiode the resistances and output voltages vary proportionally to the intensity of the IR light received.

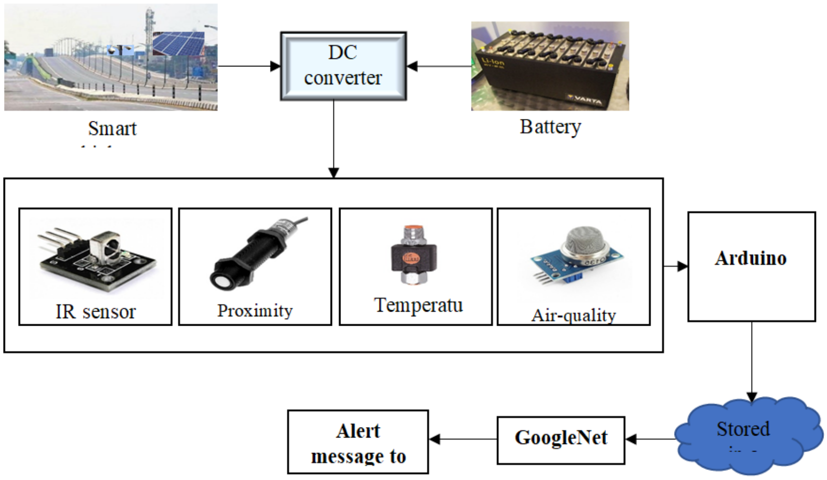

Fig. 3.1: The Workflow of the proposed Toll Google Net

Proximity Sensors. Using a proximity sensor, any adjacent object may be easily located without making direct physical touch. It detects the existence of an object by simply looking for any fluctuation in the return signal after emitting electromagnetic radiation, such as infrared. Many proximity sensor types exist, including inductive, capacitive, ultrasonic, photoelectric, magnetic, and others. This specific sort of sensor is frequently utilised in applications that demand efficiency and security. This sort of sensor has several applications, including object detection, item counting, rotation measurement, object positioning, material detection, movement direction measurement, parking sensors, and others. The finest applications for proximity sensors span a wide range of sectors.

Temperature sensors. By sensing heat energy, temperature sensors are useful for identifying physical changes in the highway. For the purpose of monitoring the local environment, authors employed temperature sensors. The acquired data is subsequently transmitted via Wi-Fi to the cloud for processing. All of this is done using an Android smartphone.

Air quality sensor. The monitoring and regulation of poisonous and dangerous gas emissions from companies and automobiles can be done with the help of sensors. If handled quickly, this can greatly safeguard the environment.

Arduino Uno. A microcontroller board featuring an open-source ATmega328 chip is called the Arduino Uno R3. The table has a USB connector, an on-board DC power connection, an ICSP header, a 16 MHz ceramic resonator, 6 analogue input pins, an ICSP header, and the reset button for microcontrollers. The microcontroller can support whatever it needs. The board is quite easy to use; just attach it to a computer.

Proposed Toll Google Net. The proposed Toll Google Net method extracts the data from the cloud and send alert message to tollgate using Google Net. The figure 2 illustrates the architecture diagram of Google Net.

For speed control test, alternative feature extraction strategies, were employed. The loss function was built from the cross-entropy loss that was observed through the training phase. In the case of conventional feature extraction, the cross-entropy loss converges to 0 after about 200 iterations. When Google Net is used, however, it quickly converges to zero after only about 100 iterations. This suggests that the model built using Google Net is more responsive to the extracts the data from the cloud and send alert message to tollgate. The contrastive loss function-based features are described in

$$S = \frac{1}{2}[(1 - z_q)(d(y_q^1, y_q^2))^2 + z_q\{max(0, \lambda - (d(y_q^1, y_q^2)))^2\}] \tag{3.1}$$

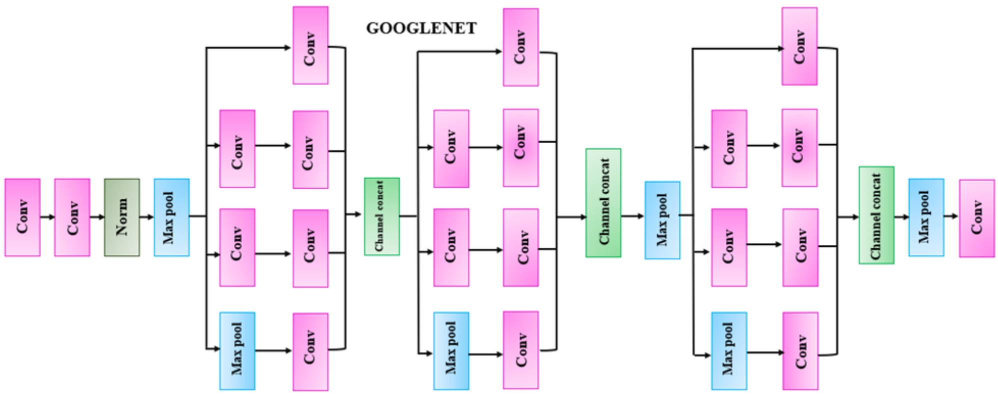

Fig. 3.2: Architecture diagram of GoogleNet

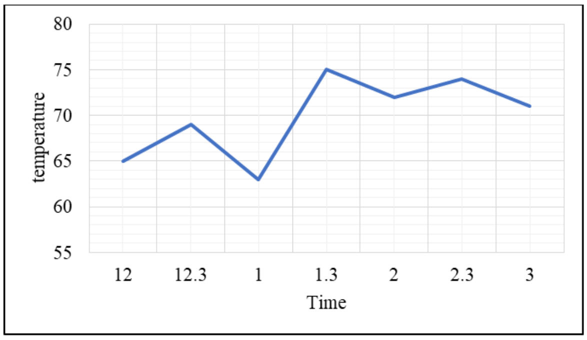

Fig. 4.1: Graph of a temperature sensor

where λ is a hyperparameter that stands for the margin and $d(y_q^1, y_q^2)$ represents Euclidean distance between y_q^1 and y_q^2. When y_q^1 and y_q^2 are members of the same class, the loss function is modest. When they are members of different classes, it is greater. Further, The margin (λ) makes sure that different image pairs are separated. The SNN encodes the features of the input $\mathrm{H}(y_k)$ into $G(y_k) \in R^2$.

4. Result and Discussion. The proposed system's experimental setup gathers real-time field data like temperature, air quality, IR, and proximity sensor readings. The cloud system receives these sensed instances for timely analysis. The experimental arrangement of the proposed technique based smart appliances was implemented using MATLAB. Accuracy, specificity, precision, and recall are the different metrics used to evaluate it. A comparison of the proposed technique Performance with IoT-SGE, EMS-IoT, and MODDA is made.

Figure 4.1 depicts how the temperature changes over time. There is just one temperature sensor employed, and the graph illustrates an increase in temperature value that has an impact on temperature value.

4.1. Performance Metrics. The performance analysis was calculated based on recall, specificity, precision and accuracy in this study. The region below the accuracy and recall curve for recognition is known as the Average Precision (AP). The following is the formula for accuracy and AP:

$$Accuracy = \frac{\text{True positive+True negative}}{\text{True positive+False positive+True negative+False negative}} \tag{4.1}$$

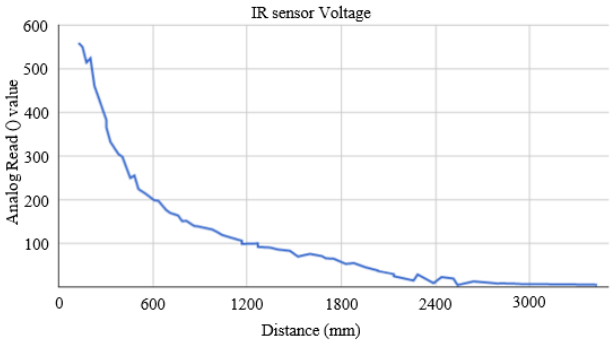

Fig. 4.2: Sensor in real distance

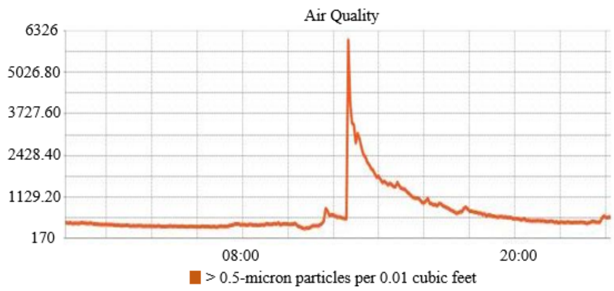

Fig. 4.3: Air quality

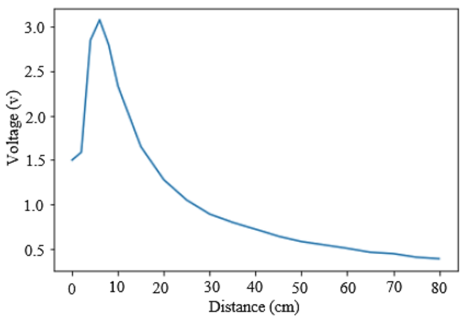

Fig. 4.4: Graphical representation of the proposed method

$$Specificity = \frac{\text{True negative}}{\text{True negative+False positive}} \tag{4.2}$$

$$Precision = \frac{\text{True positive}}{\text{True positive+False positive}} \tag{4.3}$$

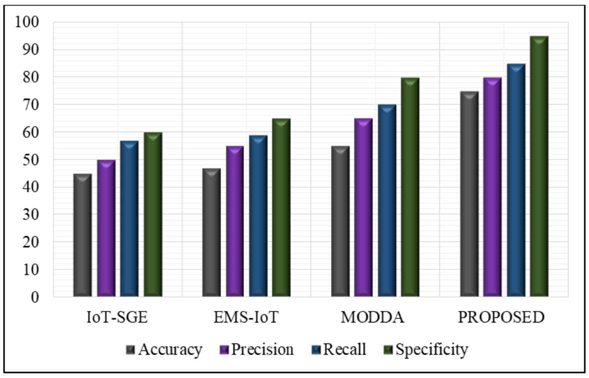

Fig. 4.5: Comparison of traditional and proposed method

$$Recall = \frac{\text{True positive}}{\text{True positive+False negative}} \tag{4.4}$$

The percentage of correctly identified labels is determined by precision, and a positive extraction of pertinent labels depends on recall. The weighted average of recall and precision is known as the F1-score. To evaluate the model's overall accuracy, it considers both false negatives and false positives. figure.4.5 shows the performance assessment of the proposed and the existing method.

As shown in fig.4.5, the accuracy of IoT-SGE, EMS-IoT and MODDA is very low. As compared to existing models, proposed provides a higher accuracy rate. Therefore, the proposed performs better than other techniques.

5. Conclusion. In this research, a novel Toll GoogleNet is proposed for smart highway. The solar panel is utilized to develop lithium battery-storage capable renewable energy. The Adafruit software, which is used to assess the pollutants and save daily usage in the cloud, is interfaced with the IOT monitoring system. The proposed system's experimental setup gathers real-time field data like temperature, air quality, IR, and proximity sensor readings. The cloud system receives these sensed instances for timely analysis. The experimental arrangement of the proposed technique based smart appliances was implemented using MATLAB. Accuracy, specificity, precision, and recall are the different metrics used to evaluate it. Experimental results shows that the proposed Toll GoogleNet attains better accuracy than existing IoT-SGE, EMS-IoT, and MODDA respectively.

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