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Smart Street Lighting System

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ABSTRACT: The process of providing light for clear vision on the roads during the darkness is called Street lighting. The streetlights are continuously used for almost 12 hours in every day (irrespectively needed or not). This shoots the consumption of electrical energy by streetlights to a very high value. The objective of the project is to design, develop and implement a Smart Street Lighting System which works with LED street lamps that can be controlled wireless technology through IoT. Here the Street lights are controlled (ON/OFF) depending on the surrounding light intensity. Also the dimming/brightening of LED lamps is decided by the motion sensor modules. Traditionally this will be a IR senor, which needs of line of Sight requirement. But here PIR sensor is utilized as motion sensor. The dim/bright operation of the street lights is done through a dimmer logic. The whole control of the system is built around a Wi-Fi integrated Arduino microcontroller board. This will enhance the coverage of the project that the street lights can be controlled from any place through Wi-Fi communication. For this communication, a dedicated Android App was developed through MIT APP Inventor, which voice feedback.

KEYWORDS: PIR Sensor Module, LDR Sensor module, Micro controller, Internet of Things, Android App.

I.INTRODUCTION

The field of automation and sophistication entered into a tremendous changes and created many impacts in the human life style [1, 2]. Undoubtedly, electricity has a major role in the betterment of human life style. The expectation of sophistication in our day to day life is on the increasing trends. The field of automation drives the controllability of Street lights to an innovative level, for meeting the future requirements.

According to the Law of Conservation of Energy, "Energy can neither be created nor destroyed; it can be converted from one form to another". By reading this statement, it is evident that the energy loss happening in the electrical appliances can be conserved. In addition, conservation of energy is very much required to save the loss of energy, which can be utilized for any other useful purposes. The larger portion of electricity consumption in a modern city is by streetlights. These streetlights are very essential requirement for the avoiding accidents and for the better living quality of humans. Nowadays, the amount of energy that streetlights consume is in great demand. Almost 30% of the overall energy consumption of any region in a country will be utilized by Streetlights.

The movement of vehicles will be there in major places of the city, while in the other places there will be less density of traffic and even in some places, there will be zero traffic. Even for these zero traffic places the street poles will be lighted, during the night-time. All the streetlights are off normal type, which uses the HPSV, HPMV, etc. These lamps will have larger energy consumption and larger time for giving the full brightness.

With the modernization of any city, the population and the residence area for the population is going on increasing which in turn increases the number of required street lights. Due to these facts, the energy wastage due to the streetlights will increase further. The proposed Smart Street Lighting System is a new confident solution, to meet out the function of traditional street lighting system, and the proposed system overcomes the drawback of the traditionally followed lighting system, by using recent technologies, mechanism, and controllers.

The control of street lights was done in accordance with the surrounding light intensity, i.e. dark / bright [3, 4]. The street lights will be dimmed / Brightened depending on the motion sensors vicinity. This will reduce the power consumption of the street lamps. Also to increase the performance of the Street lights, cooling system is used to reduce the heat dissipated by the LED Lamps [5, 6]. The role of LDR sensor and IR sensor were utilized in the Street Lighting System. The LDR sensor used to sense the surrounding light intensity and IR sensor is used to detect the motion [7, 8]. The different automation techniques were demonstrated for different applications [9-15].

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II. HARDWARE ARCHITECTURE

Fig. 1 Fabricated Street Light Model

The PIR sensor will be connected to the Micro Controller board. The street light will be connected to one of the output ports of the microcontroller board, through a dimmer circuit. The street light is powered from the municipality electricity. The LDR sensor module will sense the surrounding light intensity level and it will be given to the microcontroller. The motion sensor module and the dimmer module will be activated only during the night time. During the day time, LDR sensor module will deactivate the motion sensor module and the dimmer module; thereby the street light will be switched off. The PIR sensor will detect the human movement and this signal also sent into the micro controller. There are four PIR sensors taken to demonstrate a street lighting system. Whenever any vehicle or a pedestrian comes in the perceptibility of PIR sensor, the output of the sensor will go high. Due to which the Street light of the corresponding section of the road will be lighted with full brightness, for a pre-set time period. After the pre-set time period, if no vehicle or pedestrian appears in the perceptibility of PIR sensor, the PIR sensor output will drop to zero level, for which the microcontroller will make the street light to ON with a reduced brightness (Dim). According to the received signals, the micro controller will decide the brightness of the LED Street Light.

III. METHODOLOGY

Arduino board is taken for the full control of "Smart Street lighting system". There are three PIR sensors taken to demonstrate a street lighting system. Whenever any vehicle or a pedestrian comes in the perceptibility of PIR sensor, the output of the sensor will go high. This will be sensed by the Arduino board and it will drive the MOSFET circuit to change the duty ratio as 100%. Due to which the Street light of the corresponding section will be lighted with full intensity, for a pre-set time period. After the pre-set time period, if no pedestrian appears in the perceptibility of PIR sensor, the PIR sensor output will reduce and also the voltage, by which the Arduino will dimming the street light, through the MOSFET driver circuit. Also, the Street Lights can be controlled from remote places from an Android Mobile phone, through Wi-Fi communication. This option will be used for checking the condition of the Street light.

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IV. RESULT AND DISCUSSIONS

In order to show the impacts of this Smart Street Lighting System, some comparison is made between the proposed lighting system and the traditional street system.

	Traditional Street Light	LED Street Lamp [Day / Night Sensor Only]	LED Street Lamp Day / Night Sensor with Relay Dimming	LED Street Lamp Day / Night Sensor with MOSFET Dimming
	KWhr	KWhr	KWhr	KWhr
For Same Rating of Lamp (100 W)	6712.32 KWhr	1318.56	800.4	327.36

Table 1 – Energy Consumption taken for a period of 12 Hours (6.00 pm to 6.00 am)

The energy consumed by the different configuration of lamps were measured using energy meter and the readings were noted. The above table presents the energy consumed by the different configuration of Street Lamps.

Here in the first column, the energy consumed by the traditional lighting system is measured by a Metal halide lamp. The cost of the consumed energy was coated with the two-tariff value i.e, one for residential consumer and second for commercial consumer.

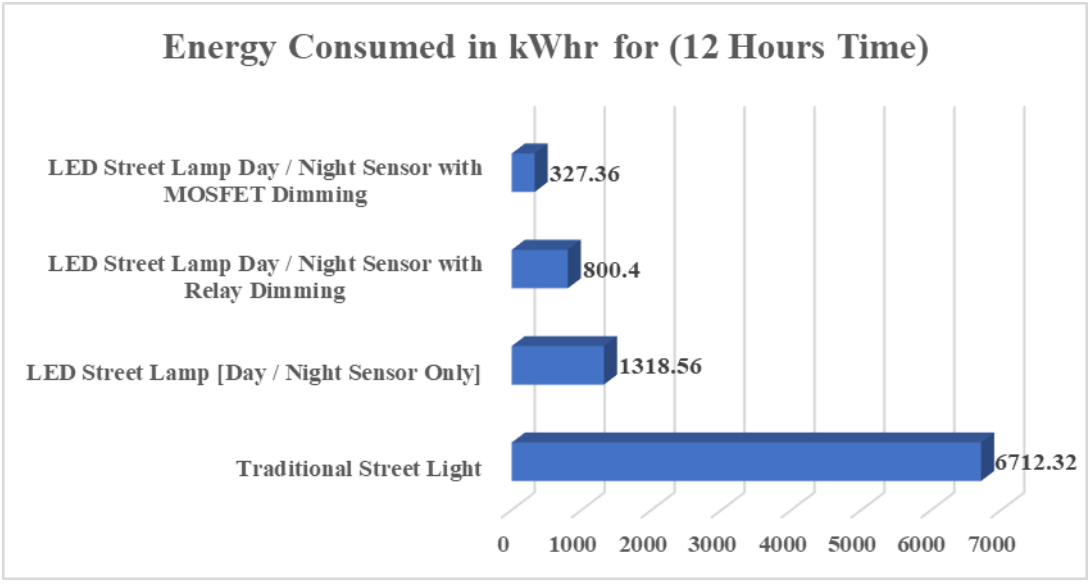

Fig. 2 Comparison of Energy consumed by different configuration of lamps

A chart was made to illustrate the energy consumed by the different lamps. In the chart we can see and come into a conclusion that the traditional street light was consuming more energy than the proposed lighting system.

The most important feature of the project is the graphical user interface (GUI) developed in MIT App inventor. This in general called as Android application (as shown in figure 3). This will be installed in the android smart phone. This user interface is developed in such a way that, it will help the user to pair the smart phone with the Arduino ESP 32 module, through its IP address, one at a time. Also, two buttons were provided in the application, one to switch on the Street Light and another to switch off the street light. To increase the facility for elderly/physically changed people, voice reply is added in the application to say the status of street light.

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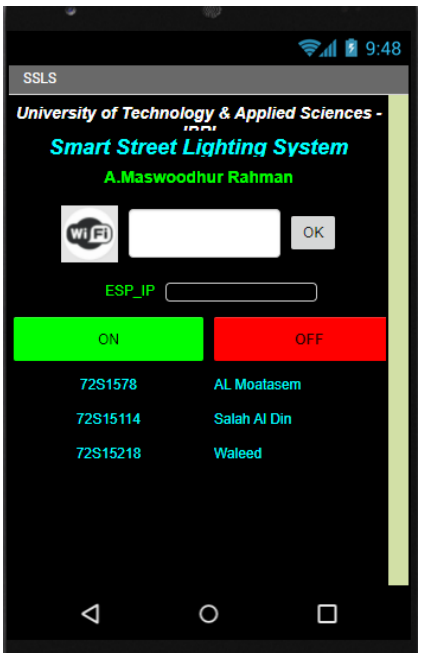

Fig. 3 Android Application developed for the Project

VI.CONCLUSION

This project will be helpful for electricity generating and distributing companies. The project is implemented using PIR sensors and controllers, with energy efficient LED light. From the outcomes and outputs value of the project, it was evident that the proposed "Smart Street Lighting System" is a confident, effective and energy efficient system which conserves the electrical energy with more convenience for the suppliers and the consumers of electricity. From the results obtained for the proposed system, it is evident that the "Smart Street Lighting system" will reduces the consumption of electrical energy via Street lamps to a lesser value. It's because the proposed system uses energy saving LED lights with cost cutting technologies and mechanism. Usage of such a Street lighting system will be having advantages in many aspects. The project has the advantage of automated operation and consumes less electricity. Due to the use of LED lights, the emission of carbon dioxide will also be reduced. This project work can be implemented in all the buildings which are ideal after the evening times, particularly at the night times. Also, Smart Home Lighting System can be implemented for the conservation of electrical energy. The idea of this project and its efficiency can be extended in future by incorporating Renewable energy for lighting up the lamps, Wireless Communication between Street lamp poles, etc. The Communication channel can be any short range or long-range communication.

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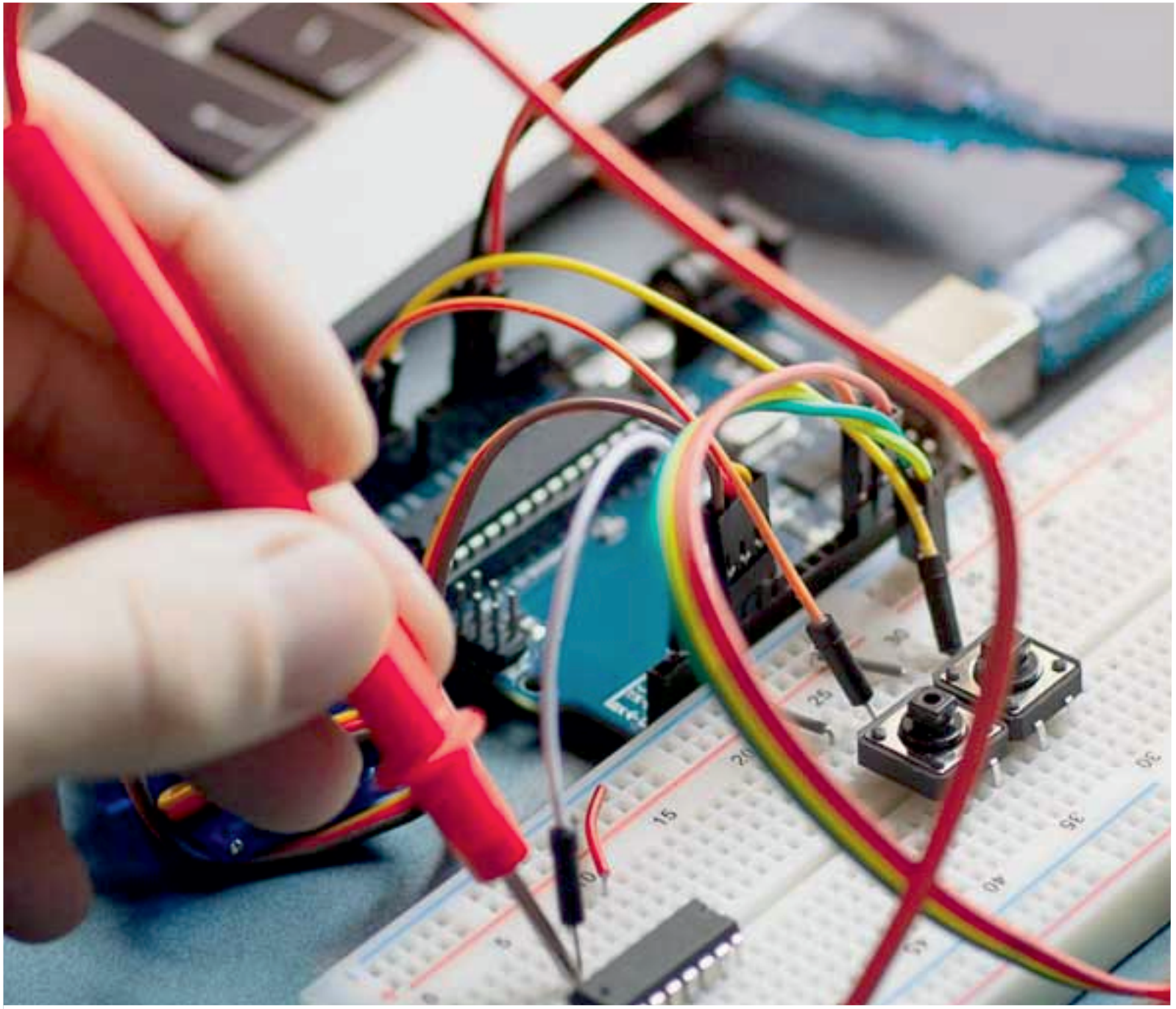

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