

Intelligent Road Lightning Design Using Wireless Sensor Network

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Abstract--- Customary lighting frameworks are out dated and have lost parcel of energy. These frameworks should be supplanted with clever frameworks and can detect their current circumstance for example sense light and temperature and dampness. To acknowledge necessities of such a framework abstract examinations should be directed to a useful proving ground. From the start, the cutting edge arrangements of various streetlamp frameworks in the writing are depicted then the plan of a shrewd light framework is proposed which hubs can speak with different hubs. These hubs can work alone or together in the organization. Likewise they are adaptable to utilize. Everything hubs can show voltage and current and their own force utilization and have capacity to drive both sodium light of high pressing factor and high force LEDs. These hubs can identify passer-by from sensor exhibit (PIR, US, IR).

Keywords--- WSN, ZigBee, GSM, PLC, ARM, USART

I. INTRODUCTION

Due to immense expense of energy, particularly power, Efficiency can be one of the primary approaches to save energy on the planet. Lighting devours for around 20% of the world's complete Electrical energy [1] in this manner, the effective lighting can save bunches of energy. Predominantly, exemplary outside light frameworks are broadly fanned out in around the world while they are wasteful with respect to cost and power utilization. They are controlled with photocell or clock and there is no distant association or checking or data about Energy utilization. In the event that flawed happened the obsolete framework can't figure out it on ongoing. In the other hand, Street Light Automation can diminish energy utilization and upkeep costs. To save significant force, the ON/OFF switches of the streetlamps can be distantly re-modified by necessity. Smart interface gadgets can advance the energy prerequisites by recording the progressions in dusk in various seasons. The framework uses remote correspondence strategies and offers ongoing observation of individual gathering of lights. The framework can address the flawed lights in the control screen and show energy utilization of every light hub. Quite a few new streetlamps can be added to the current organization with basic and simple changes. They can recognize walkers by utilizing US/IR (Ultra Sonics/Infrared) [2] and vehicles by multisensory exhibit [3]. A few correspondence media and conventions are

utilized to move control capacity and status information between light hub and neighborhood hub. As a rule, WSN and electrical cable are basic ways. This paper follows the degree which is planning of a shrewd framework for general use of lightings dependent on the Zigbee correspondence procedure.

The Local hub screens the sensors information and controls the term of on/off light hubs dependent on the input data from light hubs. This data sends in information outlines from Zigbee convention to a light hub to control the light, which is associated. Control hardware are accomplished force energy saving going from 10% to half [5]. This framework should drive both sodium light of high pressing factor and high force LEDs and should be proficient to deal with normal interest in the organization, for example darkening, on/off, estimating voltage, current and stage point and furthermore the fundamental organization capacities (join to framework, structure the framework, grant going along with others to the framework, empower information transmission mode, update security key, etc). These capacities ought to oversee simultaneously, as per the qualities of framework. Consequently, the product framework ought to permit simple adaptability and empower equipment extension, to meet the important prerequisites. [6] This paper is coordinated as follows. In Section 2, the Zigbee convention is depicted. The cutting edge keen light strategies are introduced in Section 3. In segment 4, the executed proposed framework is presented. Our point is to

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construct an adaptable hub which can work with traditional light sources and high force LEDs and this hub continue its work if network was down. Finally, in Section 5 the conclusion is drawn.

II. WIRELESS SENSOR NETWORK (ZIGBEE).

Zigbee correspondence convention can be utilized in a ton of use. The cheap expense, low transmission capacity and low force utilization are the fundamental attribute of the Zigbee module. It is reasonable for correspondence attributes. A few properties of the ZigBee module are brought underneath. [12] Information rate: 250kbps (2.4GHz) Power utilization: 60mW Distance: up to 100m Distance between shafts is lower than 100m and this is sufficient for our application. While, information rates are diminished for significant distance. There are some network topologies which use to different places. Three types of network topologies are shown in figure 1.

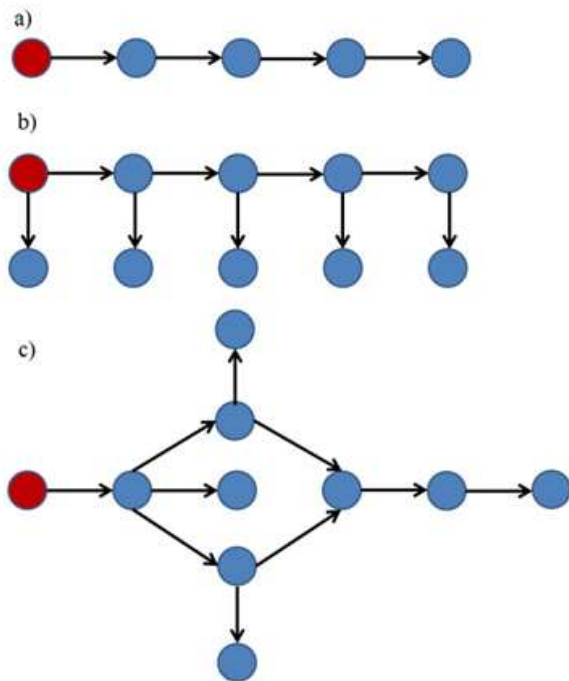


Fig. 1: Network topologies a) Linier network, b) lamp on both side of street, c) cross road

In this system the nodes are distributed and configured as router and there is just one node as coordinator. All nodes can permit joining the others, so we can expand it in the future. For our application these topologies are adequate. If the broken link between nodes is happened, a new path must be traced so that the network keeps stable.

III. RELATED WORK

As of late papers and reports show the frameworks which are made by brought together engineering with control terminal, some nearby hubs and heaps of light hubs [1]. In the framework are characterized an observing area for versatile streetlamp comprised of subsystems; street hardware, power fragment, nearby control framework, focal control framework and interchanges network [8]. A average outline is appeared in Fig. 2.

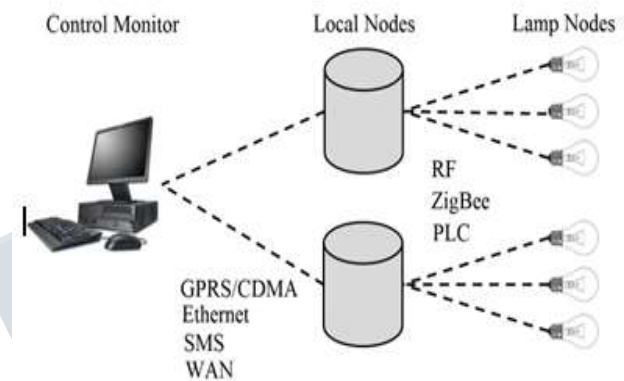


Fig. 2: Typical overview of street lights system

The light hubs are made out of light driver, sensors, etc. For instance, in [7], [2] and [9] the transfer, the TRIAC gadget and the dimmer are utilized to turn ON/off the light and control light force individually. In [10] power utilization of the line is estimated by line's voltage and current, which is directed to discover the spot of short or removals of electrical cable. Or on the other hand [11] is utilized photocell for recognizing flawed lights. Dampness and temperature sensors are utilized in [7] to detect climate of the hubs. (For example hazy or overcast climate) Another model [10] plans an interface to convey the hub and administrator. In these frameworks there are a brief distance and a significant distance transmission. RF (radio recurrence), Zigbee and PLC (Power Line Career) convention are three normal approaches to convey among nearby and light hub. For instance, in [2] and [10] the PLC and Zigbee modules are utilized to move information between neighborhood hub and lights separately. A model [12] utilizes General Packet Radio Service for correspondence between control terminal and the nearby hubs, which are associated with the light hubs by Radio recurrence. Another item utilizes SMS (short message administration) convention to control On/Off component of lights [11]. CDMA (Code Division Multiple Access) convention is utilized as information transmission between control focus and neighborhood hubs. The obligation of

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neighborhood hub is gathering light hub's status and deals with this data with its capacities and sends them back. (For example the need of hub, the on/off time, synchronizes the date, and so on) In the event that [5] brilliant worker network regulator are utilized to help the PLC malediction in neighborhood hub and it can deal with 100 light hubs. A LCD module can added to nearby hub for simple support which administrators can discover effectively what issue to fix [10] is. It likewise utilizes CDMA modem to move information between brought together control community and neighborhood hubs. Control terminal are intended to accumulate all data of nearby hub and it can shows data about broken lights, on/off the lights, traffic information, etc. A graphical interface was intended to show data in administrator's screen [10]. A portion of the frameworks use interface as a GIS framework and the guide of road are stacked.

IV. INTELLIGENT LIGHTING SYSTEM CONSIDERATION

As related works contemplated, diverse innovation has been investigated to carry out wise lighting frameworks. In table one and examination between these sorts of correspondence approaches are appeared in table I. The accessible PLC modules in Iran's market experience the ill effects of certain weaknesses such significant expense and no systems administration abilities. Gone against of Zigbee innovation, Z-wave innovation has lower information rates and supporting restricted gestures. The explanation of why Zigbee media are utilized basically is its effortlessness of establishment and upkeep. There are no necessities to introduce extra transmission line and it is more practical than other media's case.

Table I: comparison available technology

	PLC (Available in Iran's Market)	Z-Wave	ZiGBee
Data rate(kbps)	0.625-50	40	250
Power consumption	Very Good	Good	Very Good
Implementation	Good	Good	Best
Installation cost	Good	Very Good	Very Good

Maintenance cost	Good	Good	Very Good
Max number of nodes	-	232	2^16
Frequency	-	900MHz	900 and 2.4GHz
Range	-	30m	10m-1.6km

V. PROPOSED DESIGN

This system consists of lamp nodes, street controller (local node), Zigbee protocol and control center. Fig.3 shows the block diagram of lamp nodes

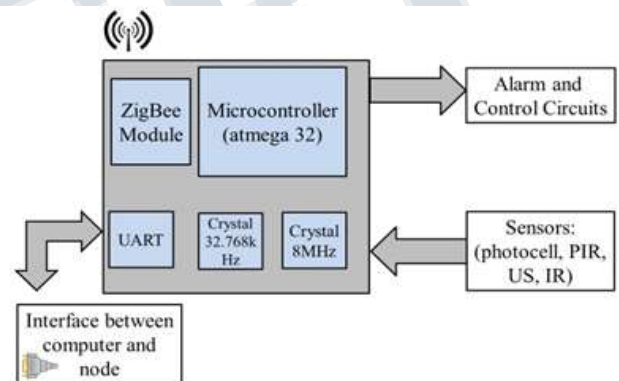


Fig. 3: block diagram of proposed lamp node

This hub has I/O channels to control the light and ADC (simple to advanced) to gauge status information (like light power, voltage, current, stage point). The center fundamental of this part is a microcontroller. It holds the time, make PWM (Phase Width Modulation) to drive high force LEDs and read/compose information to memory. There is a sequential interface among module and administrator's PC which assists with designing the hub. Zigbee OEM module is utilized to impart among nearby and light hubs. The watch method of microcontroller is initiated and each hub is concluded desolate to kill on/off light. For this case, we simply update the time register of microcontroller and if connect was broken the hub would work with old information yet at the same time working.

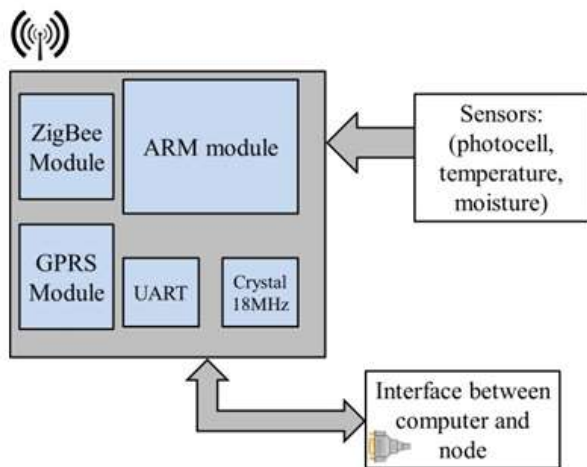


Fig. 4: Block diagram of proposed local node

Nearby hub accumulates data of light hubs and it ought to be quick. Along these lines, Arm Controller is utilized as CU (Control Unit) of this segment. Streak recollections are utilized to save the status data of hubs, (for example, time on/off, the principle clock, need of hubs, so on). The regulator can scene its current circumstance with Sensors (photo cell, dampness, temperature). There is a sequential interface for Connection among client and arm which can move hub data and check the lights.

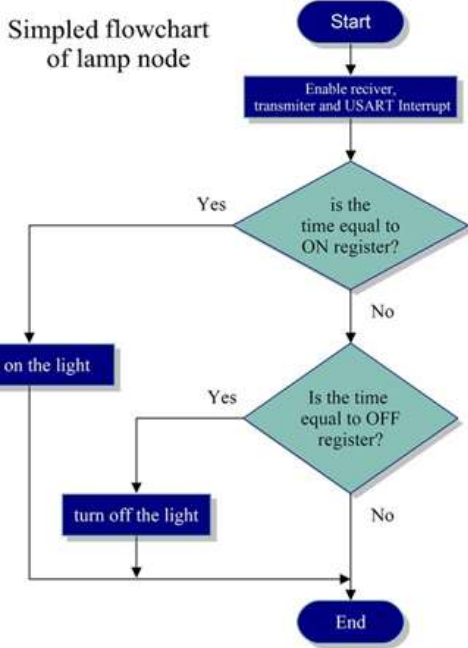


Fig. 5: sampled flowchart of lamp node

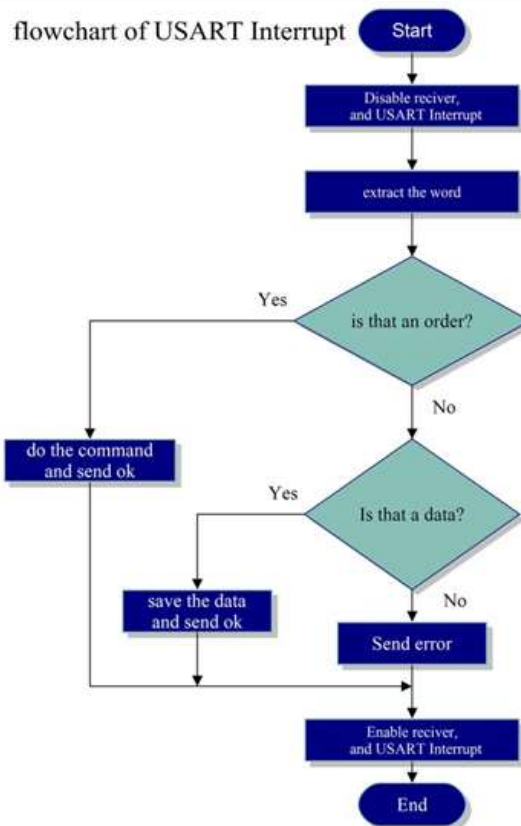


Fig. 6: Flowchart of USART Interrupt

Two different ways is considered for correspondence between control terminal and nearby hubs: Zigbee module for brief distance and sim900 module for significant distance. Light hub's Flowchart was appeared in Fig.5

VI. RESULTS

In this work, a model streetlamp framework is talked about. Specifically, the proposed framework is astute, which light hubs can work with or without nearby hub or control terminal. It implies light hubs can cooperate or forlorn. We tried our load up at one entire day with time switch on/off control and we discover this outcome in TABLE II

TABLE II: Energy saving of one whole day

	Lights	Energy saving
6am~ 5pm	All lamp are off	0%
5pm~ 10pm	All lamp are on	0%
10pm ~ 1am	Every two lamps are on	33%
1am ~ 5pm	Every other lamps are on	50%

The proposed test board devours most extreme 130mA current and 90mA out of gear mode with $\pm 5V$ and +12V power supply. Fig.8 shows created model little hub.

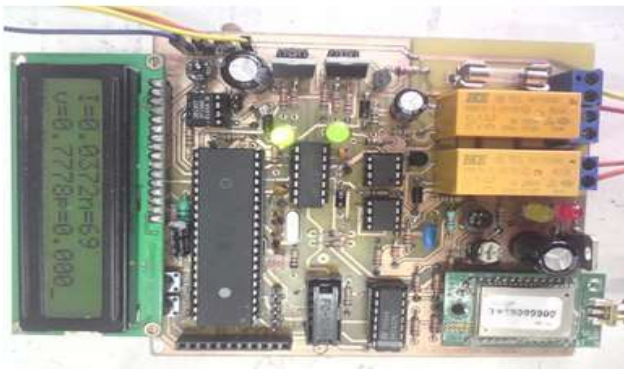


Fig. 7: prototype small node

VII. CONCLUSION

Streetlamps take up to 40% of a city's energy spending plan and they are a huge buyer of energy for urban communities [11]. The proposed framework can use in roads, burrows, streets, interstates. Likewise due to adaptable programming the framework can uphold lighting of parks and modern stockroom. This framework enjoy some benefit: control of each lighting light, decide the specific area of Cable break, Increase effectiveness and light life, Reduction of natural contamination in urban communities, Systematic upkeep of lighting offices, etc.

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