ENERGY SAVING SYSTEM FOR CLASSROOM BASED ON CAMPUS CARD

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Abstract:

The classroom energy-saving system leverages the campus card for efficient management. The goal of this project is to create a system that uses an IR sensor to count the number of people who have visited a location, recognizes human presence using a visitors counter, and displays the number of visitors who have switched appliances. Nowadays, The main issue addressed by this project is energy waste in classrooms that people deal with is electricity waste. Even when no one is in the classroom, fans and lights are turned on in schools and colleges. This occurs as a result of the pupils' carelessness in failing to quickly turn off the electrical appliances. A system based on the microcontroller TM4C123GH6PM, temperature sensor, light-dependent resistor, and RFID tag/reader is suggested to implement this. The way the system is built ensures that

Keywords: The classroom energy-saving system utilizes Campus Cards and wireless communication, integrating RFID readers and LDR sensors for precise lighting control.

Introduction:

In most schools, especially colleges, it is common to see The classroom energy-saving system smartly integrates Campus Cards and wireless communication, employing RFID readers and LDR sensors for efficient lighting control. during the day despite ample daylight. Additionally, it is not uncommon for lights to remain on in empty classrooms after people have left. These lights continue to burn needlessly until they are turned off at the end of the day, as per school regulations. This practice results in a significant waste of energy.Classroom lighting control is a well-explored topic, with numerous studies conducted both domestically and internationally. Despite this extensive research, a perfect solution has yet to be developed. Addressing the problem of "lit waste" and managing daytime lighting is relatively straightforward. However, the main challenge in current research, both at home and abroad, is accurately detecting whether someone is in the classroom at the lowest possible cost.

Objectives:

The objectives of an energy-saving system for a classroom based on a campus card include:

Occupancy-Based Automation: Utilize campus cards to accurately detect classroom occupancy. Implement automation systems that adjust lighting, temperature, and other environmental factors based on real-time occupancy data.

Resource Optimization: Optimize the use of resources such as lighting, heating, and cooling to match actual classroom usage patterns. Minimize standby power consumption by controlling electronic devices based on occupancy.

Education and Awareness: Integrate educational components into the system to raise awareness about energy conservation. Provide feedback to users about their energy consumption behavior and encourage sustainable practices.

Integration of Renewable Energy: Explore and implement the integration of renewable energy sources, linking them to the campus card system to promote sustainability.

1. SYSTEM FRAMWORK

The system comprises an information center, base stations, and sub-control nodes. The information center handles the management and updating of data on student and staff cards, transmitting this information to the base stations via the network. The base stations, in turn, relay the updated information to the control nodes in each classroom. Each control node manages the main switch for the classroom lights, operating based on the detection of a valid card and following a predefined scheme.

Figure 1 illustrates the interaction methods between the campus information center and sub base stations. The information center is responsible for managing campus card data and updating each base station within teaching buildings through communication networks. Given that teaching buildings are relatively dispersed with significant distances between them, network communication is essential. Each building is typically equipped with communication interfaces directly linked to the information center. This network communication mode ensures reliable data transmission while making optimal use of existing communication interface resources.

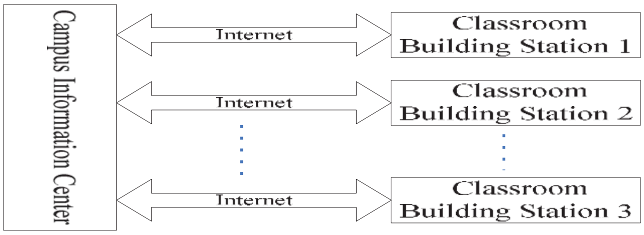

Fig 1. Communication between campus information centre and classroom building station

Figure 2 illustrates the communication between base stations and sub-control nodes in the classrooms of teaching buildings. Sub base stations update the data and transmit it to each control node via wireless communication. The use of wireless communication is primarily due to the limited distances within the same teaching buildings, which ensures effective data transmission. Additionally, wireless communication offers flexible placement, minimizing the need for rewiring in each classroom and consequently reducing costs

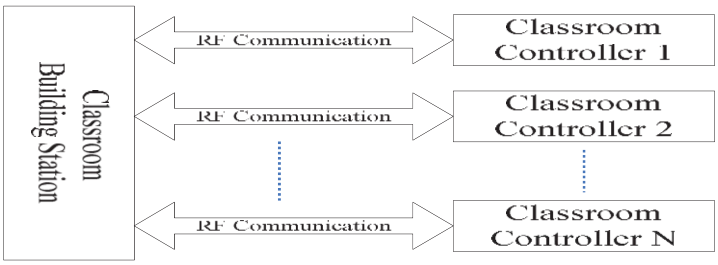

Fig 2. Communication between classroom building station and classroom controlle

4.THE HARDWARE DESIGN:

4.1THE DESIGN OF THE STATION:

As depicted in Figure 3, the base station's structure comprises a power supply module, a microcontroller, and a wireless module. The chosen microcontroller, which includes a network module, enables information transmission between the Ethernet communication and the Information Center. The wireless module is responsible for data interaction and control of the nodes.

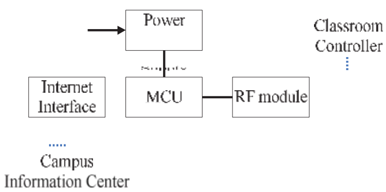

Fig 3. Structure of classroom building station

adheres to the IEEE802.3 specification, fully supporting the 10BASE-T and 100BASE-TX standards. This controller includes the 100BASE-TX scrambler/descrambler, supports full-function self-negotiation protocols, operates in multiple modes, and allows for programmable MAC addresses. With the ability to set interrupts, the LM3S8962 is an excellent choice for an Ethernet microcontroller. Since data communication between the information center and each base station is minimal and within a campus network, it is stable and reliable. Therefore, using the UDP network communication protocol is relatively simple to implement, offers high communication efficiency, and meets the system's requirements.

The wireless module is implemented using the CC1101[4], which boasts a programmable software modem supporting 2-FSK, GFSK, and MSK modulation formats, achieving data transmission rates of up to 500 Kbps. Furthermore, it features a high-performance power output, concentrating energy for long-distance signal transmission. Additionally, it enhances adjacent channel power (ACP) performance, effectively reducing the issue of close signal blocking. Operating at 433 MHz, the system offers robust penetrability and long communication distances, rendering it well-suited for fulfilling the communication requirements between base stations and each segmented control point within the teaching building.

5. SUB CONTROL NODE DESIGN:

The structure of the control nodes, as depicted in Figure T, primarily comprises the following components: a card reading module, power supply module, microcontroller, voice module, power switch, wireless module, and sensor modules, among others. The card reading module retrieves information from the card placed atop it. The sensor module monitors the ambient brightness, collaborating with the clock module to address the "daytime lighting" concern. The voice module delivers audio prompts when a card is removed, prompting others for the subsequent card operation. The lighting power switch manages the classroom lights' on and off functions. A storage module stores card information, ensuring uninterrupted lamp control by the microcontroller even during communication irregularities. The wireless module facilitates data exchange with the base stations.

The microcontroller utilized in the nodes is the STC12C5A series microcontroller, known for its enhancement mode. This microcontroller offers a cost-effective solution while delivering powerful performance. It supports serial communication, making it convenient for downloading and debugging tasks. The STC12C5A series effectively realizes system functions and is recognized for its competitive pricing, making it an optimal choice for the project.

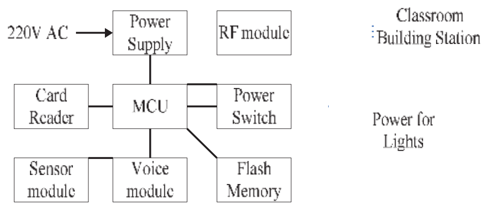

Fig 4. Structure of classroom controller

The voice module incorporates the WT588D [5] voice chip, lauded for its robust functionality. This chip permits repeated erasure by the programmer and facilitates online download and serial communication. Notably, it offers both PWM and DAC output capabilities. The PWM output directly powers a speaker with a potency of 0.5W/8Ω, while the DAC output can be externally linked to a power amplifier, ensuring top-notch audio quality. Within this system, serial port control and PWM output methods are employed to ensure efficient operation.

The card reading module is equipped with the CY-14443A [6] reader module, engineered in accordance with the ISO14443 standard. This module incorporates a non-contact special card reader chip and integrates analog modulation and demodulation circuits, necessitating minimal peripheral circuitry for operation. Supporting the UART interface, it is well-suited for identity recognition systems adhering to the ISO14443 standard. Within this system, the UART interface facilitates the recognition of IC card information.

The storage module utilizes the FM25VN10[7] ferroelectric memory, known for its high read and write speeds. This memory type also incorporates a data-power-off-protection function, guaranteeing data integrity even in instances of power loss. Such features ensure that the module effectively meets the functional requirements of the system.

The sensor module integrates brightness detection and human detection capabilities, pivotal for energy-saving control measures. By leveraging these sensors in tandem, the system dynamically adjusts lighting and environmental factors according to occupancy and ambient light levels, thereby enhancing energy efficiency.

6. THE SOFTWARE DESIGN:

The card information within the Information Centre is managed by the original card system, which operates within the Visual Studio environment. This system develops a background running application that continuously monitors updates to card information, such as freshmen registration or senior students leaving school. Upon updates, the application reads the new information and updates the database accordingly. This updated data is then transmitted to the sub-base stations of teaching buildings via the Internet. Sub-base stations subsequently relay the information using RF communication mode to update each classroom's control nodes.

The software of the Information Centre primarily involves database accessing and WinSocket programming techniques to facilitate communication and data transmission between the Information Centre and the sub-base stations.

Control nodes are installed in each classroom and are responsible for determining the opening or closing of the master classroom lighting power switch. They achieve this by detecting the insertion of an effective card and combining it with the control default scheme.

The software flow pattern of a branch control node is depicted in the accompanying figure 5.

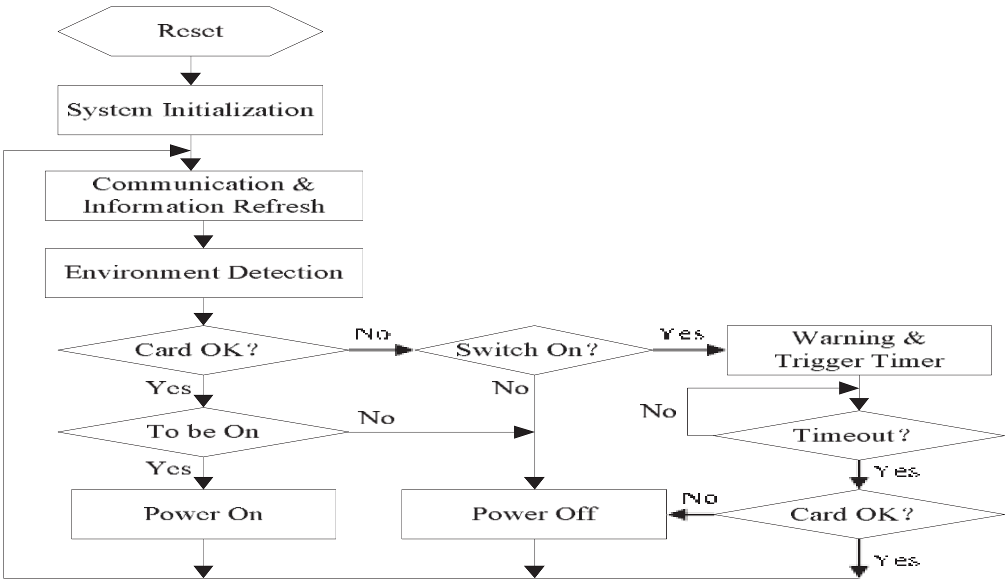

Fig 5. Control flow of the classroom controller

Upon a cardholder's entry into the classroom within the designated timeframe, they are required to insert their card into the card reader. The control nodes will subsequently read the card information to assess its effectiveness. Should the card be deemed effective, the classroom power switch will be activated, enabling the lights to illuminate. Conversely, if the card is deemed ineffective, the power switch will remain inactive.

Upon the removal of the card, a voice prompt will be generated to remind others to continue with card operations. In the absence of card reinsertion, the classroom power will automatically shut down after a few minutes as a precautionary measure.

Furthermore, the control nodes possess the capability to adjust timing and lighting conditions based on settings configured from the main control center. For example, lighting may be prohibited during the night or specific time periods, while during the daytime when natural lighting suffices, the lighting power may automatically deactivate. This flexibility enables efficient energy utilization tailored to diverse environmental conditions and tim

CONCLUSION

conclusion, the implementation of the Smart Energy Saving System for Classrooms represents a significant step towards creating sustainable and intelligent learning environments. By integrating RFID technology, Arduino microcontrollers, environmental sensors, and automated control mechanisms, this system offers a holistic approach to energy efficiency and user comfort. The benefits extend beyond classrooms, finding applications in various educational, commercial, and residential settings.

The advantages of the system include notable energy savings, cost efficiency, environmental impact reduction, and enhanced occupant comfort. The integration of RFID technology enables precise occupancy detection, allowing the system to tailor lighting and climate control to real-time needs. The use of sensors such as the DHT11 and LDR further refines the system's decisionmaking process, ensuring optimal conditions while minimizing unnecessary energy consumption.

The system's user-friendly interface, featuring an LCD display and manual override options, promotes user awareness and flexibility. By providing real-time information on energy savings, temperature, and occupancy, users are empowered to make informed decisions and actively participate in sustainable practices.

Moreover, the Smart Energy Saving System is not limited to classrooms; its adaptability makes it suitable for diverse applications such as meeting rooms, offices, public spaces, residential buildings, and more. This versatility positions the system as a scalable and valuable solution for promoting energy efficiency in various environments.

As we continue to address the challenges of climate change and resource conservation, the Smart Energy Saving System serves as a tangible example of how technology can contribute to sustainable practices. Its integration into educational institutions not only reduces operational costs but also educates students and staff about the importance of responsible energy use.

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In summary, the Smart Energy Saving System for Classrooms offers a comprehensive and scalable solution that aligns with the global push towards sustainability. REFERENCES

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