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INTELLIGENT POWER AUTOMATION SYSTEM FOR APPLIED SCIENCE FACULTY BUILDING OF WAYAMBA UNIVERSITY

B. A. D. P. B. Jayawardena*, L. D. R. D. Perera

Department of Electronics, Wayamba University of Sri Lanka, Kuliyapitiya, Sri Lanka
104pasindu@gmail.com*

ABSTRACT

Building automation & power efficiency is one of the most prominent technology application areas in the world. It could be used for saving energy and utilizing natural resources. A building automation system is required for the building of the faculty of Applied Sciences Wayamba University of Sri Lanka as it waste energy by keeping lights ON at unwanted places without a need. The lights remained ON until the person who responsible for the lights would visits the place and switched OFF the lights. In this process there was high level of energy waste due to the unwanted consumption. To address this problem an Intelligent Automation system was developed with the intention of introducing an automated electrical equipment controlling system in order to reduce the power wastage from using the electrical equipment such as lights, fans, etc. The system was developed with the aid of 3 modules; Image processing, motion detection and wireless controlling which were introduced in the system for detecting persons and controlling the lights according to the requirement and controlling the lights from a remote place via a mobile phone. After implementing the prototype of the system it was identified that the lights and other equipment can be controlled to avoid unnecessary consumption of electricity in the faculty building.

Keywords: Intelligent power automation,Building Automation Systems, Image processing, Motion detection, Wireless communication

1. INTRODUCTION

With the increment of the business world power saving, cost benefit and time-consuming are the key issues that should be considered when dealing with the new technology. A modern centralized automation system can be used to manage the energy efficiency of building and processes to ensure the correct use of the system[1].An investment made to achieve energy saving is always a good investment. In an addition energy project improve the operational

reliability of the technical systems in the buildings and increase the value of the property[2]. With the improvement of the science, image processing, wireless control, and motion detection are some key technological processes that are widely used.

1.1. Energy efficiency Building Automation Systems

People spend the majority of their time in buildings. Creating comfortable and safe living and working environments is therefore rewarding in many ways. Buildings moreover account for a large part of society's energy consumption. Making investments in energy saving technology is worthwhile. Balancing the contradictory requirements of comfort, safety and energy efficiency and coping with the dynamics of constantly changing environmental conditions, usage patterns, user needs etc. is challenging. Solutions need to be found in co-operation between and adaptation of BAS in an attempt to achieve common goals[3].

1.2. Intelligent Automation System for the Faculty Building

The project was designed with the intention of reduce the energy consumption through switched off unwanted electrical equipment and switched on only the necessary lights. The main objective of the project was to provide intelligent building automation system with the functionalities;

- Human detection
- Automatically lights On/ Off
- Extra ports to include future installing electrical equipment.
- Intelligent lighting control
- Controlling lights from a remote place

2. EXPERIMENTAL

There are 3 modules in intelligent automation system. The three modules were interconnected as shown in Figure 1 for the desired purpose.

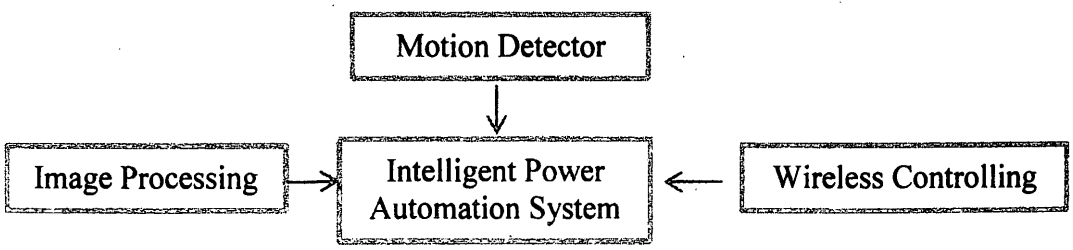

Figure 1: Intelligent Automation System

2.1. Motion detection

Motion detection module helps the system to detect human motions.

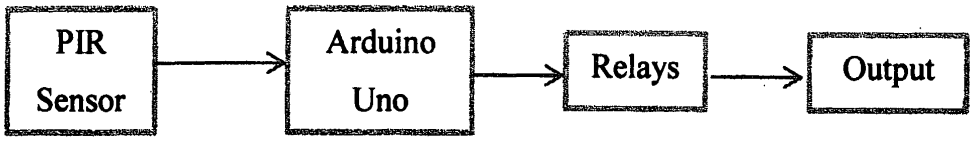

Figure 2: Motion Detection

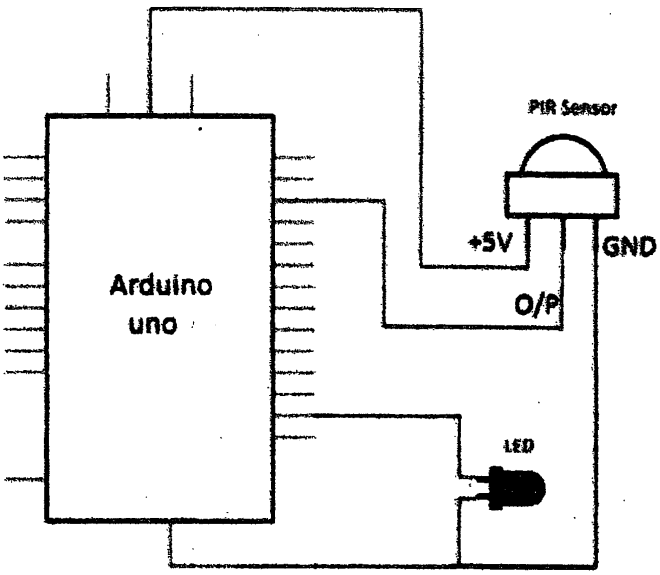

Figure 3: Motion detection circuit

The circuit for the motion detection module was constructed as Figure 3. The motion detection circuit was designed as the PIR sensor detects changes in the amount of infrared radiation impinging upon it, which varies depending on the temperature and surface characteristics of the objects in front of the sensor[4]. When an object, such as a human, passes in front of the background, such as a wall, the temperature at that point in the sensor's field of view will rise from room temperature to body temperature, and then back again. The objects of similar temperature but different surface characteristics may also have a different infrared emission pattern. The sensor converts the resulting change in the incoming infrared radiation into a change in the output voltage, and this triggers the detection. The detected signal would be sent to the Arduino Uno board and the program inserted to the Arduino uno has been reading the incoming signal continuously. Once the Arduino board detects a difference of the input signal it process the signal and gives the output signal which would be leads to electrical equipment such as lights.

2.2. Image processing

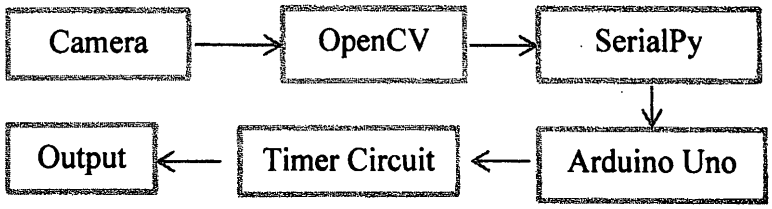

Figure 4: Image Processing

Face recognition process is done using image processing technique with the aid of a camera located a place where it can detect a human face against a lecture room wall. The image sent by the camera would be processed by OpenCV image processing library which can be run by python language in order to identify and isolate a face from the background. The image area was divided in to 9 parts and numbered from 1 to 9 respectively. The program would be identified in which part the face is located and the signal will be sent to the Arduino board via SerialPy which used to establish the communication between OpenCV and Arduino board. Arduino board was connected to the timers used for a specific reason. After the signal detection is done by the arduino board it will be sent to the timers which are used to keep a delay before function the system. The special aim of timer delays were that whenever a human enters the room and at the same instant if the human leave the room it will be harmful for the lights and it will consume more electricity than a bulb is switched on. To avoid this inconvenience the timers were connected with the circuit. The python program for the image processing was the codes shown in below Figures.

2.3. Wireless control via Global System for Mobile (GSM) technology

One of the most important parts of the project is wireless controlling module. In order to achieve the wireless controlling process it uses the GSM technology. The GSM shield helps to control the system via a mobile phone from a remote place. The floor chart of the GSM module is shown in Figure 5

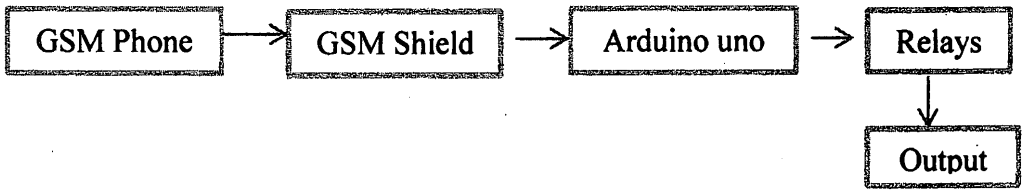

Figure 5: Wireless Control

The final module as illustrated in Figure 1 was constructed as a prototype for the complete system. The integrated system of 3 modules is shown in Figure 6

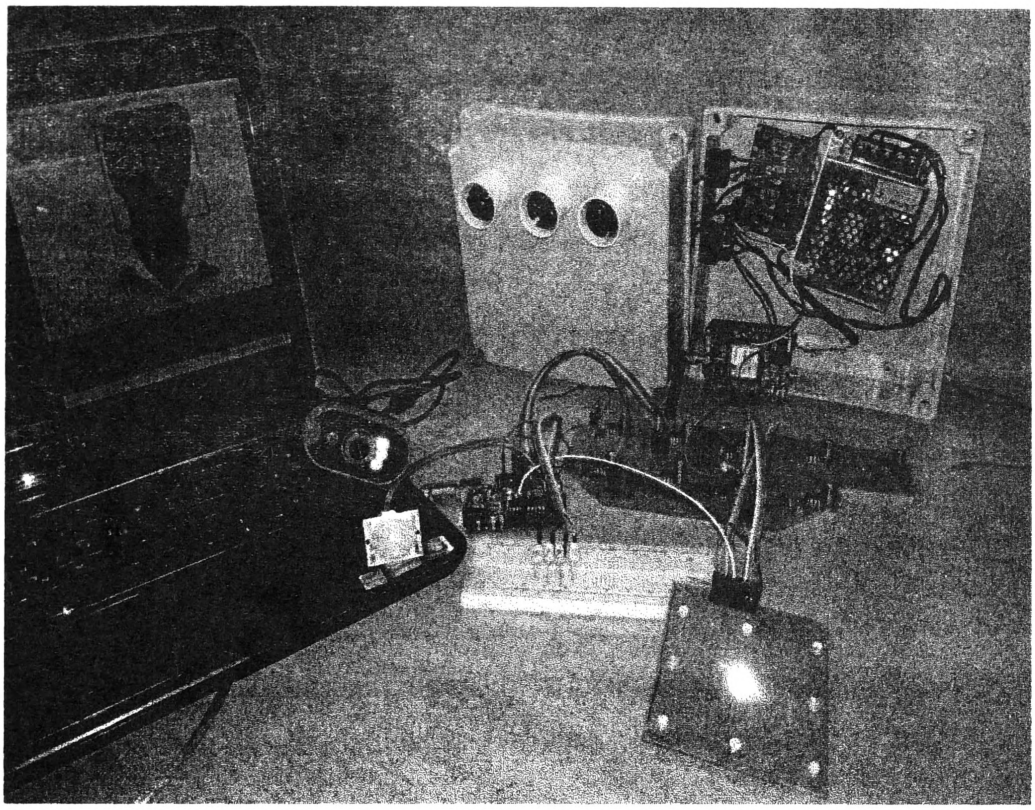

Figure 6: Integrated prototype

3. RESULTS AND DISCUSSION

The system was able to correctly recognize a person and control the light system according to the signals passed by any of three modules. The wireless controlling was an interesting feature includes in the system. The system was able to control from a remote place. Lights at the stair case was controlled by the motion detection module by whenever it detects a motion in front of the sensor it managed to switch On/ Off the lights according to the motion type and the delay times. Lights at lecture rooms and balcony were controlled by the Image processing module. Whenever the module detects a face in front of the camera it would be managed to switch on the respective lights of the area which the face was detected. At the same time the wireless control module introduced a system to control the lights of the faculty building from a remote place via the application installed to the mobile phone with the aid of GSM technology.

3.1. Limitations

- Initial cost. Although the system doesn't spend much amount, cost for the cameras for the whole building would be considerably high.
- Lack of knowledge about the technology within technical and maintenance staff
- Resistance for change to a new system

3.2. Future work

The same system can be improved to program for a preschedule in order to use for special occasions and also with the help of new technologies more accurate face detection systems could be implementing. By improving the designed system this can be used for control the Air Conditioning system and it would be leads to more saving of energy.

4. CONCLUSIONS

The system was tested with a prototype and it was a great success. Implementation of this system in the faculty building reduces the overhead work of the person who is responsible for controlling the lights and fans. The most important benefit of the system was the power efficiency throughout the faculty building. This system can be implemented in any place which would have similar requirements as the faculty building premises. The system should be beneficial for both students and the administration staff in since it solves the problem of forgetting to switch off lights and frequent visits to the place to checkouts.

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