Intelligent Energy Management System Based On Arm Processor For Home Automation

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ABSTRACT

Power saving and management are very much important in every house. The increase in electricity rate and the demand for renewable energy resources shift the concern towards saving electricity. One way of saving electric power is by implementing automation in-house. Also, automation reduces the constant human effort in monitoring the system. Hence, this research aims to minimise human effort and save electricity. The proposed system operates based on the sunlight intensity, and when the door lock is opened from the outside, it activates the fan and light automatically. The system automatically switches the light when the sunlight intensity increases during the day. Also, when the door is closed, it shuts down the light and fan and saves electricity. Therefore, the light and fan are monitored and switched on and off automatically without physical involvement. The electronic component used in this research is made up of Silicon and Germanium. The circuit and the working of the system are addressed in this article. The miniature of the proposed system is developed, and the system is accurate in implementing home automation.

Keywords: ARM processor, Home automation, Embedded system,

1. Introduction

Energy saving in the house has been very much important in recent days. With the scarcity of electricity and the wastage of electricity due to unwanted running of household resources, there needs a great need for automation in home applications [1]. Some research is done to automate the house using Bluetooth and wifi devices [2]. But there is a limitation in the operation distance and a constant electric source in these devices [3]. Hence there is a need for automation without any wireless signals in the home appliances [4].

From the literature, the usage of fans and light with automation proves that it reduces electricity by 35% [5]. When the person leaves the room, the light and fan are switched off automatically without supervision [6]. In this way, the electricity consumption used to operate appliances is reduced. In one research, home appliances are controlled by voice commands. But the drawback of the system is that the human voice is sometimes not properly understood by the system [7]. Also, training the voice to the system for multiple users is another drawback. In another research, the door lock acts as a switch for switching on and off the electricity. But the drawback is that if the door is unlocked, the appliances are switched on and may not be needed for the time [8].

In some research, automation focuses on safety aspects like making an alarm, sending an email, and photographing the unauthorised person entering the house [9]. The one advantage of the system is that the system responds to unauthorised access within 3 seconds; in the research, the internet and embedded system control home automation. When the internet connection is low, the embedded system comes into action to enhance the security of home automation [10]. The most common kind of automation in the market is biometric access or face recognition with password unlock in each room for the operation of home appliances and security purposes [11], [12].

In this research, embedded system-based home automation is used with the hemp of arm processors. The dual operation of both hardware and software components are a combination of the embedded system, and with the microprocessor-based arm control, the automation becomes very easier. The advantage of the system is shown below

- It is designed to perform a single task with higher accuracy.
- The system itself has sufficient memory for storage and processing, and the additional secondary memory is not required
- The overall electric power needed for the system is minimal
- The input to the system and the outputs are easy to take and handle without any accusation system.
- The system is more reliable and has higher safety aspects.
- Programming is easy and requires no disk to operate the system.

The overall energy saving with the automation system from the literature is tabulated in table 1. From the table, we can see how electricity is saved with the the use of an automation system at each environment [13], [14].

Table 1 The total saving in electricity with home automation from literature

Places	Without home automation (KWH)	With home automation (KWH)	Savings (KWH)	Price savings
Hall	5044	3780	2264	337
Cooking places	3087	3061	35	5

Bedroom	4366	3736	629	113
Dining environment	283	223	50	12

2. The proposed system design

The design of the proposed system is shown in figure 1. The input power supply is 230 V, and 50 Hertz is needed for the system. The inverted-based power monitoring system provides a constant power supply to the system. The IR sensor describes the infrared light sensor. Two IR sensors are placed at the entrance to detect the number of people going inside and outside the room. The sensor is placed at the room entrance; when the person passes inside the room, the IR sensor counts and similarly, when the person comes out of the room, the IR sensor once again counts the signal. In this way, the person going in and out can be monitored, which denotes the presence and absence of the person and the total number of persons inside the room. LDR sensor denotes the photo sensor, which measures the light intensity of the room. When the light intensity value is less, the sensor output is less, and similarly, when the intensity value is higher, the sensor output is higher. The temperature and the humidity of the entire room is measured by employing a temperature and humidity sensor. This sensor is interfaced with the ARM processor, and the processor makes different decision based on the sensory input.
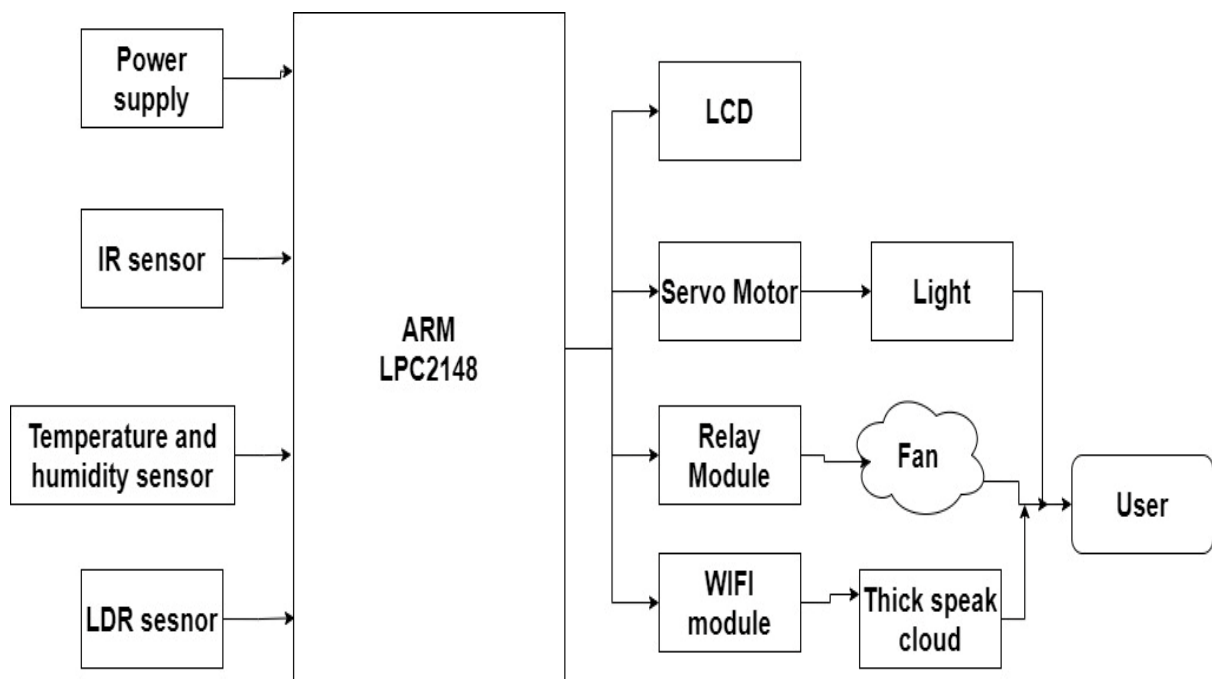
Figure 1. The architecture of the proposed system

The temperature and humidity value of the room is displayed using the LED system as shown in figure 2. The LED display is used in much research, and it is most cheap and easier way of representing the output signal. The servo motor is used in this system to extract the air from the room for ventilation purposes. The relay switches operate the fan

and the light. The switches get activated when energised and switched off when de-energised. The electromagnet principle activates the switches and is operated by the microprocessor.

Figure 2 LED display showing the activities and parameters of the atmosphere
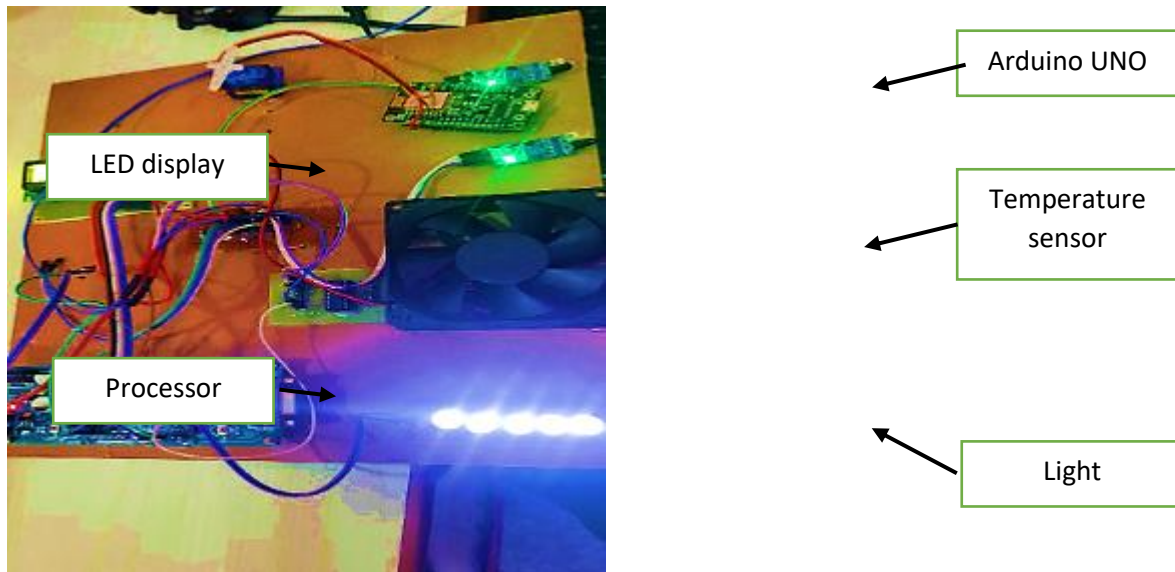
3. Working of the system

The working of the entire system is shown in figure 3 and the figure 4 symbolises the ciruct and the prototype constructed in this research. The system wrks in the following way. When the person enters with the biometric access the entry of the total number of person are monitored by the IR sensor. The signal is communicated to the Arduino UNO board and exectuets the program. If the entry is greter than one the the command is send to the ARM processor. The processor after receiving the command it switches on the light and fan. The temperature and humidity of the room is monitored by the sensor and signal is then comminucated to the circuit. Based on the signal from the temperature and humidity sensor the servo motor is operated to operate the speed of the fan. The entire working is monitored in the LCD display. When the person exits the room the signal is communicated using the IR sensor amd the ARM processor shuts down the entire system. By this way the total electric power is saved without the human involvement.
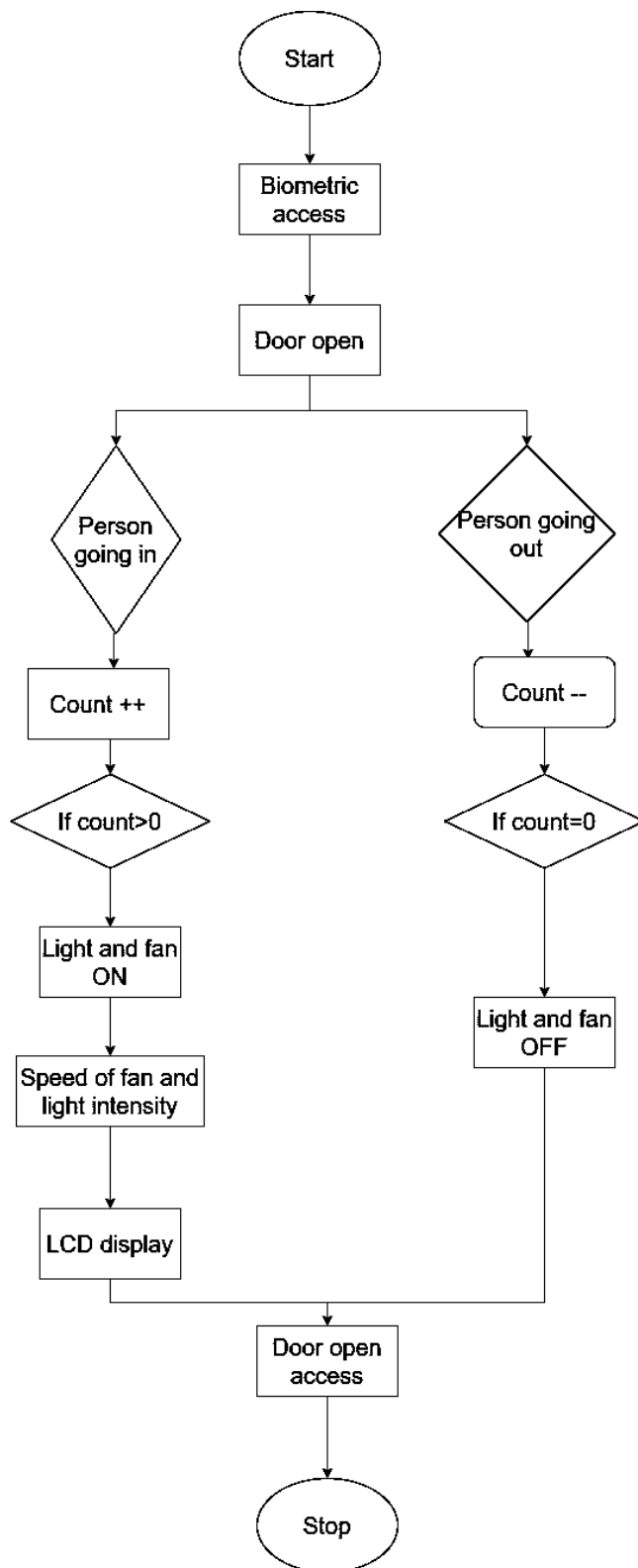
Figure 3 Flow chart describing the working of the system

In the figure 4 the various circiuits and its connetsions are described. The entire system is tested with various number of entry and exit and in all the cases the system works in the excellent manner. The proposed system can be used to automate the home applilances for saving electricity. The table 2 summarises the rotation of fan at various

temperature. From the table 2 it is clearly understood that when the fan speed increases with the increase in the room temperature.

Figure 4 Circuit and working of the proposed system

Table 2 Rotation of fan at various temperature

Temperature of the room (C)	Fan rotational speed (RPM)
26	400
35	900
42	1500

CONCLUSION

In this research a system is a system is proposed to automate the home appliances for saving the electricity. The system is operated by means of ARM processor. The various input are obtained using the IR sensor and temperature and humidity sensor. The output servo motor, fan and light are controlled using the ARM processor. The number of person count to the room and the exit count are continuously monitored using the sensor. Based on the sensor input the room appliances are operated and monitored. By this way the entire room is optimised for reducing the electricity and saves power without human involvement. The system is tested with various input and in all the cases the system operated efficiently.

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