Smart Elevators with Automated Lighting System

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Abstract: Electricity has a positive correlation with increasing population. The mere act of forgetting to switch off lights contributes a lot to the wastage of electricity and also decreases the lifespan of the lighting systems. This paper proposes an ATMEGA8A microcontroller based elevator system which has an automatic lighting system that operates on human detection. This system is an innovative step towards efficient use of electricity and occupies a niche in the development process of Smart Cities.
Keywords: Elevators; automated; embedded; micro-controller; ATMEGA.

1 INTRODUCTION

The growing population creates an ever increasing demand on electricity. The development of science and technology has given us varied electronic systems that make our lives comfortable, e.g. elevators. In Urban areas, whether in commercial spaces or residential complexes, elevators are used extensively. This vertical transportation plays a critical role in the development of cities. [1] According to Kheir Al-Kodmany's paper 'Tall Buildings and Elevators: A Review of Recent Technological Advances', "more than 7 billion elevator journeys are taken in tall buildings all over the world. Efficient vertical transportation has the ability to limit or expand our ability to build taller and taller skyscrapers, and recent innovations in elevator design promise to significantly reduce energy consumption."Andreas Bernard's research highlights how elevators have been responsible for reshaping modern cities by concentrating large masses of people and activities in smaller areas, creating vibrant communities. [2]Elevators have enabled vertical spreading of large number of people and human activities within a more restricted footprint. Advancement of elevator technologies will facilitate the development of taller buildings.

Lighting systems play a major role in meeting our needs of visual comfort. Optimal lighting of a certain place generates a positive response to engage in activities in that area. Lights associated with the elevators not only aids in our visibility but also makes us use the system more frequently. But we often forget to turn them off when we come out of the elevators. This contributes to the wastage of electricity which in itself is very large even if we consider a single metropolis. Moreover the type of lights used also becomes a factor in power consumption. [1] According to Robert Boog, energy efficient LED cab lights within an elevator car and their adjustment to movement detectors are one of the main contributors toward efficient power consumption in a building. LEDs (light-emitting diodes) save substantial energy for they require less power than incandescent, halogen, and fluorescent lamps. LED also emits less heat, resulting in less energy needed to cool the cab. LED lighting is currently utilized in many new buildings. Additionally, building owners are replacing

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traditional elevator lighting systems with LED lighting. Efficient lighting sources and luminaries are not sufficient in itself to meet the requirements of visual comfort and economical energy consumption. [5]Lighting control strategies and lighting control system helps to provide optimal light levels where it is needed and when it is needed. These systems, utilizing efficient lighting sources not only reduce the overall energy consumption but also provide a rich, productive environment for our activities. An automated lighting system implemented in association with a simple elevator system is a step towards economical use of electricity. This paper proposes to do the same. An elevator system has been designed using Atmega 8A microcontroller. An automated lighting system is embedded in it. The lighting system operates on human detection. The automation of the lighting system can save up to 50% of electricity wasted due to improper use of elevator lighting systems. [5]The system we have developed falls under the Real Occupancy Control Strategy (ROCS) of lighting systems. It restricts the operation time of the lighting system based on the duration of occupancy of a space. The system turns the lights on when it detects that the space is occupied. If there is no activity detection, the system considers the space to be empty and turns off the lights. To prevent any discrepancy, a delay time (according to our preference) can be programmed. Studies show that Real Occupancy Control Strategies are best used in applications where occupancy does not follow a set schedule and is not predictable. Here, apart from elevators, classic applications include private offices, corridors, stairwells, conference rooms, library stack areas, storage rooms and warehouses. The savings potential of real occupancy control has been found varying widely from 20 to 50% (system combination) (Maniccia et al. 2000, NBI 2003). It has a positive correlation with the level of detection, the place of the sensor, the coupling with daylight-harvesting and of course the movements of the occupants

2 PROPOSED WORK

2.1 Working principle

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC. Dual H-bridge Motor Driver integrated circuit (IC). There are 4 input pins for l293d, pin 2, 7 on the left and pin 15, 10 on the right as shown on the pin diagram. Left input pins will regulate the rotation of motor connected across left side and right input for motor on the right hand side. The motors are rotated on the basis of the inputs provided across the input pins as LOGIC 0 or LOGIC 1. There are two Enable pins on l293d. Pin 1 and pin 9, for being able to drive the motor, the pin 1 and 9 need to be high. For driving the motor with left H-bridge you need to enable pin 1 to high. And for right H-Bridge you need to make the pin 9 to high. If anyone of the either pin1 or pin9 goes low then the motor in the corresponding section will suspend working.

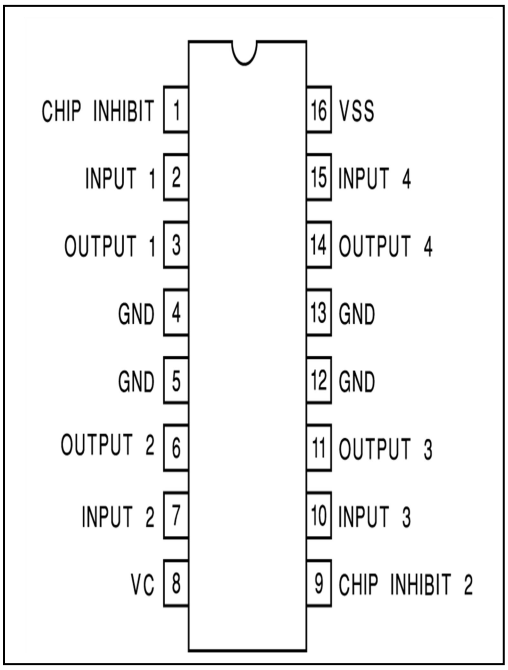

Fig. 1. L293D motor driver.

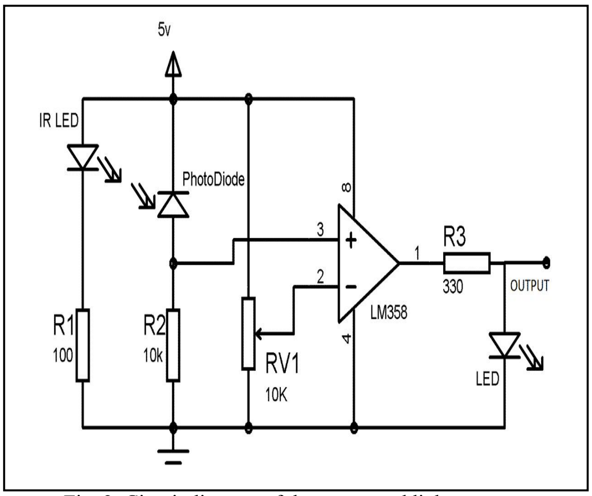

Fig. 2. Circuit diagram of the automated light sensor.

is connected to a 16*2 LCD display module and a motor driver L293D. When the user presses the switch of the system, the LCD displays the floor in which the elevator is to come and the motor driver starts to respond according to the given code of the system and makes the elevator stop at the floor where the user pressed the switch. The user gets into the elevator and the IR Sensors detects the human body as an obstacle. When the IR transmitter emits radiation, it reaches the object and some of the radiation reflects back to the IR receiver. Based on the intensity of the reception by the IR receiver, the output of the sensor is defined. In this case the lights of the elevator switches on automatically.

When the light emitted by the IR LED is incident on the photodiode after hitting an object, the resistance of the photodiode falls down from a huge value. One of the input of the op - amp is at threshold value set by the potentiometer. The other input to the op-amp is from the photodiode's series resistor. When the incident radiation is more on the photodiode, the voltage drop across the series resistor will be high. In the IC LM358, both the threshold voltage and the voltage across the series resistor are compared. If the voltage across the resistor series to photodiode is greater than that of the threshold voltage, the output of the IC Op - Amp is high. As the output of the IC is connected to an LED, it lightens up. The threshold voltage can be adjusted by adjusting the potentiometer depending on the environmental conditions.

The pin-out of the IC LM358 is shown in the figure below.

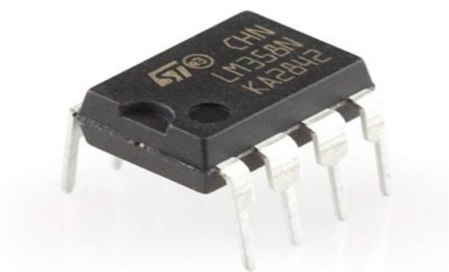

Fig. 3. Iclm358.

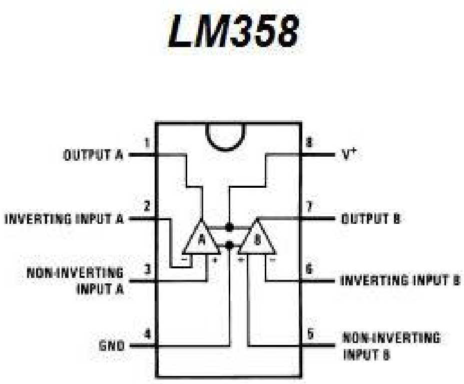

Fig. 4. Pin-out of IC lm358.

Table 1. Hardware components.

SL. NO.	*NAME OF THE COMPONENT*	*SPECIFICATION*	*QUANTITY*
1.	POWER SUPPLY	12V/1A	1
2.	REGULATOR IC	7805	1
3.	OP-AMP	LM 393	1
4.	RESISTORS		25
5.	CAPACITORS	1000Uf/63v	1
		10Uf/25v	1
6.	LED	RED	1
		GREEN	5
7.	PRINTED CIRCUIT BOARD	KS 98A	1
8.	16 BIT LCD DISPLAY		1
9.	MICRO-CONTROLLR	ATMEGA 8A	1
10.	MOTOR DRIVER	L293D	1
11.	RECEIVER		1
12.	TRANSMITTER		1

Table 2. Software components.

SL. NO	*NAME OF SOFTWARE*	*VERSION SPECIFICATION*
1.	MICROSOFT WINDOWS	10
2.	ATMEL STUDIO	7
3.	EXTREME BURNER	1.4.2.705

2.2 Components Used

The hardware components are given in Table I and correspondingly, the software components are given in Table II.

2.3 Block Diagram

Admin turns on the system, the elevator gets prepared to be used. The user presses the switch of the elevator and the elevator reaches to the floor where the user is waiting, as soon as the user enters the elevator, the automatic light system which is present in the elevator turns on, as the IR sensors detects human body as an obstacle. Then as normal the desired floor is reached, the user leaves the elevator, the automatic light turns off as there is no obstacle present in the elevator, this processes continues till the admin turns off the system.

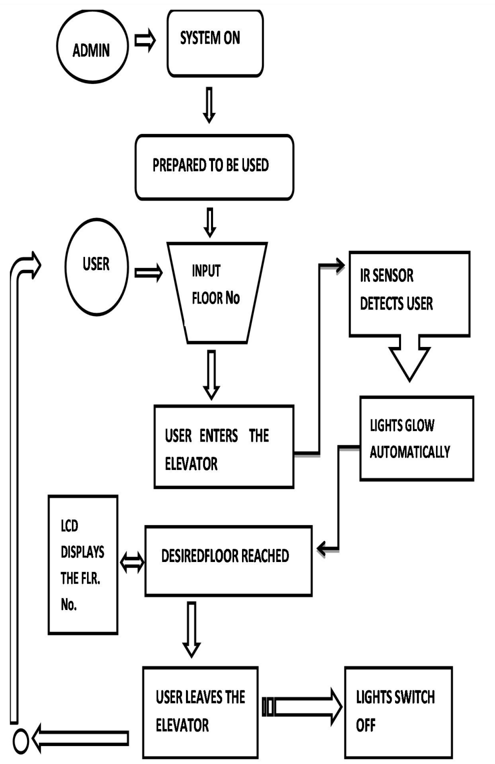

Fig. 5. Block diagram of the project.

The ports B and C of the microcontroller are initialized as high input values, which means the microcontroller will respond when a high value is achieved from the switches through port B. Then an infinite loop is given which checks the pressing of the switches. If switch S1 is pressed then the value of ‘a’ is stored as 1, which means ground floor. If the switch S2 is pressed then value of ‘a’ changes to 2 and it gets stored as 2, which means first floor. If the switch S3 is pressed then the value of ‘a’ gets stored as 3, that means second floor and for switch S4 the value of ‘a’ gets stored as 4, that means 3rd floor. The difference of these floor numbers are taken by the difference of the previously pressed switch with the current pressed switch. If the difference is a positive value then the motor is given an instruction to rotate in clockwise direction, rising up the elevator and if the difference is negative the motor is given an instruction to rotate in anticlockwise, bringing down the elevator.

Suppose the current pressed switch is S2 and the switch pressed before S2 was S3. This means initially the elevator was on 1st floor and the new pressed switch is on 2nd floor, so the difference is positive and the value is 1, so the motor rotates in clockwise direction making the elevator rise up. Different delays, in seconds, have been given to the motor driver at different floor situations to make the motor driver stay on, to allow the elevator to rise up or down to its specific destination. The LCD display has also been initialized, and a delay is given to the elevator making the LCD which is attached with the microcontroller to show the floor number to the user for a specific time period in seconds. This whole process will continue till the power switch is turned OFF.

3 RESULTS AND ANALYSIS

Initially the elevator is on the ground floor, when switch S4 is pressed the signal is passed from the microcontroller to the motor driver and the motor is given a signal to rotate in clockwise direction three times, hence the elevator climbs up three floors and waits for the user, when switch S3 is pressed the signal is passed again from the microcontroller to the motor driver and the motor is given a signal to rotate in anti-clockwise direction, and the floor comes down from the third floor to the second floor, this direction of rotation is determined by the microcontroller using the difference between the two floors. If the switch of the floor number pressed is less than that of the previously pressed switch, then it rotates in anti-clockwise direction, and the elevator comes down each floor per rotation of the motor, if the pressed switch of the floor number is greater than the floor number of the previously pressed switch, then the motor rotates in clockwise direction, and the elevator rises up to the next floor with each rotation of the motor, hence all the floors gets covered using this logic.

The IR sensors in the elevator makes the automatic light switches on as soon as the user enters the elevator, and switches off when there is no one in the elevator.

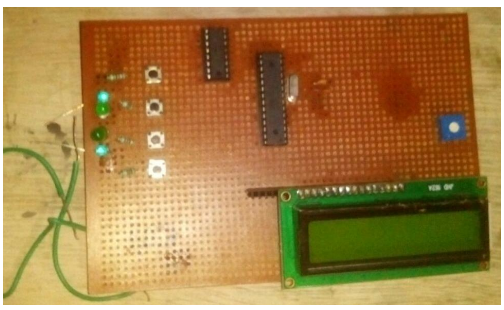

Fig. 6. Hardware realization of the project.

CONCLUSION

Elevators as a medium of vertical transportation play a key role in the development of 'the vertical city'. Over the course of 150 years, from the Otis elevator systems to Mitsubushi's high-powered elevators, elevator technology has developed by leaps and bounds. In the future, elevator technology will continue to grow. Innovative, "green" and energy efficient elevators will come into play soon enough. The increasing demand for space in conjunction with the lack of availability of deployable land will only lead to the creation of more and more skyscrapers. Hence, elevator technology will play a crucial role in the modern urban world. It goes without saying that the ride provided by these systems needs to be comfortable as well. The most basic need will be that of the visual comfort that will elicit a greater acceptance. So, effective lighting systems in these elevators need to be developed as well. Keeping in mind the recent demand for energy efficiency, intelligent lighting systems, such as an automated lighting system that operates on human detection, plays well in that frontier.

This paper highlights an automated lighting system that senses the presence of occupants in an elevator cab for its operation. Here, the implementation is quite simple yet genuine. Internet of Things (IoT) can help to incorporate these systems with the building management systems as a whole. Thus, a greater control on all these subsystems will definitely help us to keep our electricity consumption in check.

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