Intelligent Safety Management for Solar Powered Elevators

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Abstract—The Solar-Powered Elevators with RFID Access Control and Intelligent Safety Management system represents an eco-friendly and technologically advanced approach to vertical transportation. This innovative elevator system harnesses solar power to minimize its environmental impact and reduce dependency on conventional energy sources. The integration of RFID (Radio-Frequency Identification) access control enhances security by allowing only authorized individuals to use the elevators, adding an extra layer of protection against unauthorized access. Furthermore, the system incorporates intelligent safety management features, utilizing sensors and advanced algorithms to monitor various aspects of elevator operation in real-time. These safety measures include automatic emergency response mechanisms, predictive maintenance capabilities, and the ability to detect potential malfunctions before they escalate. By combining sustainable energy practices, secure access control, and cutting-edge safety management, this solar-powered elevator system not only addresses environmental concerns but also prioritizes user safety and efficiency in vertical transportation.
Index Terms: **Arduino uno Microcontroller, Solar panel, RFID Reader, GSM Module, Sensor, Lcd display**

I. INTRODUCTION

The development of solar- powered elevators has the implicit to significantly reduce the energy consumption and environmental impact of perpendicular transportation systems. These elevators are designed to capture and exercise energy that would else be lost during operation, making them largely energy-effective and cost effective. This paper discusses the objects that should be considered when designing solar powered elevators. These objects include energy effectiveness, renewable energy, trust ability and safety, cost- effectiveness, availability, and invention. By fastening on these objects, regenerative solar- powered elevators can give a safe, dependable, and sustainable result for perpendicular transportation. The paper also discusses the colorful factors of a solar- powered elevator system, including the solar panels, battery storehouse system, inverter and control system. These factors work together and reduces the overall energy consumption of the system. Overall, the development of solar- powered elevators represents a significant step forward in sustainable transportation technology. By incorporating innovative design features and exercising renewable energy sources, these elevators can give a more environmentally friendly and cost effective volition to traditional perpendicular transportation systems. This paper also studies a new elevator intelligent monitoring and grading warning system, which uses ESP32 Microcontroller and detector to cover several unsafe elevator parameters.

II. RELATED STUDY

The students are faced with the elementary engineering problem of powering a vehicle (an electro-mechanical system) from a limited energy source such as a solar panel in this case. Apart from learning about and building a simple buck converter as their first power electronics system, they must also identify the interdependences between a limited energy source, energy conversion efficiency, weight and climbing speed. This method describes the motivation, the model space elevator, the learning outcomes and the experiences from this project. Further practical solar power projects, the solar car and mains interface, are presented that have proven to be excellent projects for teaching experimental power electronics[1]. The various advantages such as high torque to current ratio, high power density and higher efficiency of BLDC motor make it possible for using it in cranes, elevator system and many other industries. In this prototype four quadrant operation of BLDC motor worked out to control the elevator system and the, the motor is controlled without the loss of energy; instead regeneration of power is taken in account. The entire simulated system consists of a BLDC motor drive fed with an inverter where the DC bus feeds the drive. FPGA controller is used to provide the control signals to the inverter[2]. The purpose of this work is for effective elevator control system, which can be reprogrammed in a fashion to minimize the congestion on a particular lane by directing the lift on a particular floor using time management scheme. Present scope of the project is to provide an automatic congestion control[3]. This addresses the concept of Elevator System, a controller that consists of a programmable microprocessor which is programmed using a specialized computer programming language. Programmable logic controllers deliver a flexible range of functionality and also include basic control of relay, process control, motion control and complex networking. There are many types of interfaces which are used to interact with the programmable logic controller with the purpose of configuration or usage such as switch boards, text displays, lights

or even more complex systems such as a computer Web interface as a SCADA system[4]. This work introduces a new solution of elevator controlling system which is based on microcontrollers. The purpose of this work is to design an effective elevator control system, which can be reprogrammed in a fashion to minimize the congestion on a particular lane by directing the lift on a particular floor using time management scheme. These sensors senses when a person enters an elevator and it opens the door of the elevator and simultaneously increments the counter for the number of people entering the elevator. The IR transmitter is used to transmit IR rays straight to the receiver which receives the input and feeds this to a Microcontroller[5]. In existing lift door mechanism, standard controllers are used. As this controllers are costly hence, increase the cost of the lift. In order to reduce the cost, Field Oriented Control is used to design the driver.

The supporting frame analysis is carried out in ANSYS 16.0 and observed that there is a deformation in the ranger of e-6mm and hence system is found to be safe. Thus, various components were designed and fabricated for the automatic doors of the lift and it was controlled using a DSP micro-processor[6]. Generally a lift is understood to be Lifting device composed of the platform or cage that's elevated and decreased robotically inside a vertical shaft to be able to move individuals from one floor to a different inside a building. Additionally towards the normal function, a unique feature is within the system so that the device carries the folks in horizontal direction also, quite helpful for a lot of categories of individuals to mix very busy streets[7]. The details of load estimate PV array, battery and inverter selection and sizing show that less than 30m2 roof area and accessories are sufficient to facilitate the system. Further, economic feasibility analysis using RET screen shows a fast break even time period less than 4 years. This work describes the basic configuration selection and sizing of the solar PV system[8]. The Objective of this work is to design and implement intelligent Lift using RFID and GSM. The Lift is controlled by wireless communication using RFID and GSM module. The Lift control system designed by this model solves problem of floor control and the communication jamming between interrogator and tag and it is widely used in intelligent buildings centring on the users. In a typical RFID system, individual objects are equipped with a small, inexpensive tag. The tag contains a transponder with a digital memory chip that is given a unique electronic product code[9]. The security challenges being encountered in many places today require electronic means of controlling access to secured premises in addition to the available security personnel. Various technologies were used in different forms to solve these challenges. The Radio Frequency Identification (RFID) Based Access Control Security system with GSM technology presented in this work helps to prevent unauthorized access to controlled environments (secured premises).[10].

III. EXISTING SYSTEM

The traditional elevator systems primarily rely on grid-connected electrical power for their operation. These elevators typically use energy from the electrical grid to power their motors, lighting, and other components. While various energy-efficient measures and technologies have been implemented in elevators to reduce power consumption, widespread integration of renewable energy sources like solar power in conventional elevator systems has been limited. In terms of access control, existing elevator systems commonly use conventional methods such as physical keys or keycards. These systems may lack the sophistication of RFID access control, which provides a more secure and technologically advanced means of managing access to elevators is shown in Figure 1. RFID technology allows for seamless and contactless access, offering improved security by restricting elevator usage to individuals with authorized RFID credentials. This innovative approach not only contributes to sustainability by utilizing solar power but also enhances security and safety, providing a more comprehensive solution for modern vertical transportation needs. Please note that advancements in technology may have occurred since my last update, and it's advisable to check for the latest developments in elevator systems.

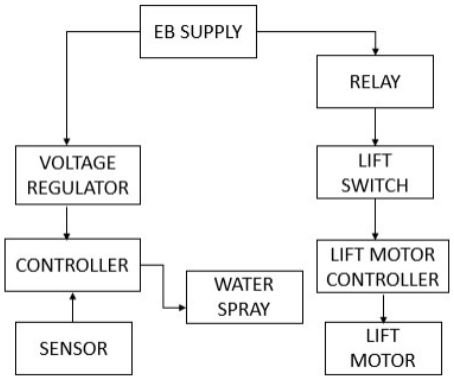


Fig.1 Block Diagram Representation of existing system

IV. PROPOSED SYSTEM

The proposed Solar-Powered Elevators with RFID Access Control and Intelligent Safety Management system envisions a revolutionary shift in vertical transportation technology, aiming to address energy efficiency, security, and safety concerns is described in Figure 1. Unlike traditional elevators, this innovative system harnesses solar power to significantly reduce its environmental footprint. The integration of solar panels on the elevator infrastructure allows the system to generate and utilize clean energy, contributing to sustainability efforts and reducing reliance on conventional power sources. In terms of access control, the system incorporates RFID technology, enabling a more secure and efficient means of managing elevator usage.

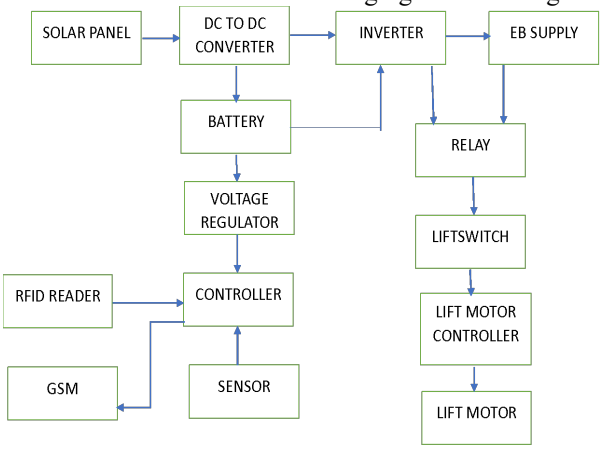


Fig.1 Block Diagram of Proposed System

RFID access control replaces traditional key-based systems, providing a contactless and easily configurable solution. Authorized users can gain access using RFID cards, enhancing security and preventing unauthorized entry. Safety Management system represents a holistic approach to modernizing vertical transportation. By seamlessly integrating renewable energy, advanced access control, and cutting-edge safety features, this proposed system strives to create a more sustainable, secure, and efficient elevator experience for users while contributing to environmental conservation efforts.

The solar panel serves as the primary energy source, converting sun into electrical energy is shown in Fig 2 and The DC to DC converter adjusts the voltage levels to ensure compatibility between the solar panel output and the system's

Fig.2 Solar panel

Fig.3 DC-DC Converter

V. ARD

WARE IMPLEMENTATION

This proposed system would operate using the Arduino software logs lift operations, keeping track of the number of lifts used by each student to enforce the daily limit. The lift is powered from the electrical grid (EB), ensuring a reliable power source for continuous operation. The Arduino continuously monitors the lift's status and provides real-time updates to the users through the LCD display. In case of a temperature rise beyond the threshold, the Arduino sends a message to the owner, alerting them to a potential issue. The system is designed to optimize energy usage, minimizing power consumption during idle periods. The system can generate maintenance alerts based on the lift's usage, helping in proactive maintenance planning. The user interface is designed to be intuitive, making it easy for college students to use the lift system. The combination of RFID authentication and limited daily lift movements enhances the security of the system, preventing unauthorized usage. The Figure 4 shows the hardware setup of the proposed work.

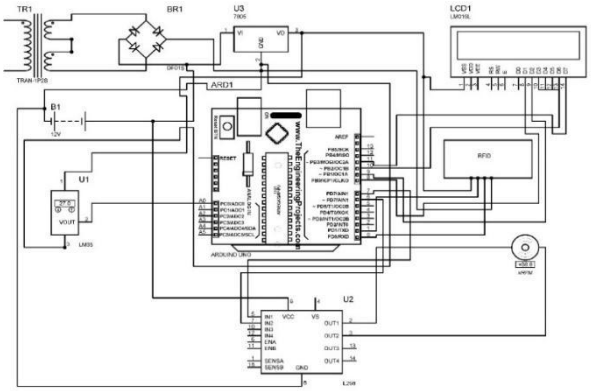


Fig.4 Hardware Circuit Design

In terms of access control, the system incorporates RFID technology, enabling a more secure and efficient means of managing elevator usage. RFID access control replaces traditional key-based systems, providing a contactless and easily configurable solution. Authorized users can gain access using RFID cards, enhancing security and preventing unauthorized entry. This feature is particularly advantageous in commercial and residential buildings where controlled access is paramount for safety and privacy. The intelligent safety management aspect of the proposed system introduces a sophisticated layer of real-time monitoring and proactive maintenance. Various sensors and algorithms continuously assess the elevator's performance, identifying potential issues before they escalate into critical problems. Predictive maintenance capabilities enable timely interventions, reducing downtime and enhancing the overall reliability of the elevator system. In emergency scenarios, the system employs dynamic response mechanisms, ensuring swift and efficient evacuation procedures, thereby prioritizing the safety of passengers. In summary, the Solar-Powered Elevators with RFID Access Control and Intelligent Safety Management system represents a holistic approach to modernizing vertical transportation. By seamlessly integrating renewable energy, advanced access control, and cutting-edge safety features, this proposed system strives to create a more sustainable, secure, and efficient elevator experience for users while contributing to environmental conservation efforts.

VI. RESULTS AND DISCUSSION

The following figures, Fig-5 and Fig-6 represents the normal temperature of the lift and the lift started to operate for users condition.

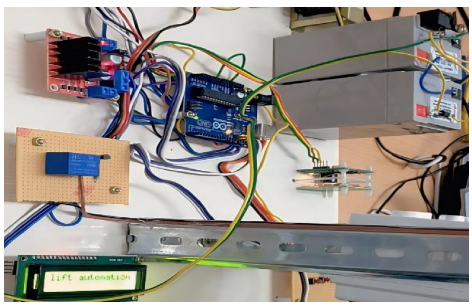
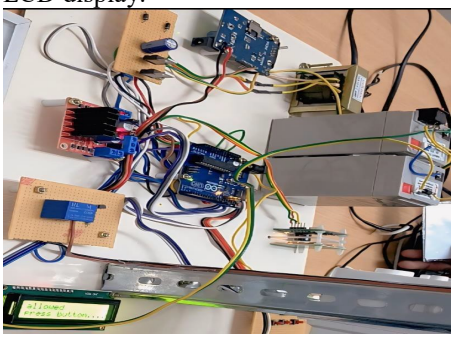


Fig.5 Optimum temperature

Fig.6 Lift automation

The following figures, Fig-7 and Fig-8 represents the user allowed to travel in the lift to specific floors and the user has been allowed to use the lift only 4 times per day. If the limit exceeds by the user, then alert message is shown in LCD display.



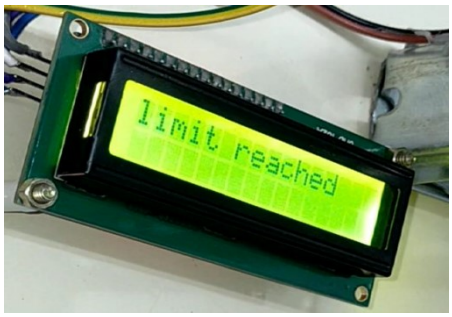
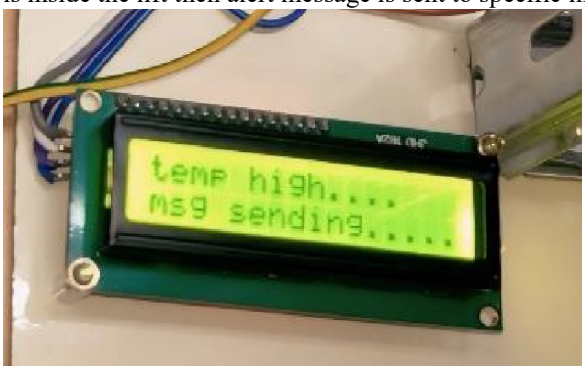


Fig.7 Processing message to next floor

Fig.8 Alert message

The below following figures, Fig-9 and Fig-10 display a message when the temperature is increased while the user is inside the lift then alert message is sent to specific in charge authority to take necessary steps.



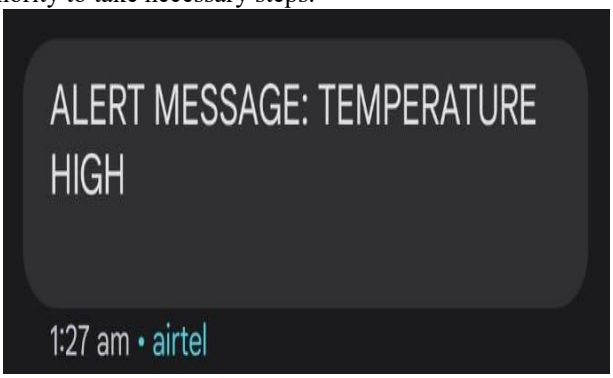


Fig.9 Emergency message

Fig.10 SMS message to authority

V.CONCLUSION AND FUTURE SCOPE

In conclusion, the integration of solar-powered elevators with RFID access control and intelligent safety management represents a forward-thinking and sustainable approach to vertical transportation systems. By harnessing solar energy, these elevators contribute to environmental conservation and reduce reliance on traditional power sources, aligning with the global shift toward renewable energy solutions. The goal of this study is to provide a framework that will reduce dependence on conventional power sources, lower operational costs, and contribute to a more sustainable and energy-efficient urban infrastructure. The incorporation of Radio-Frequency Identification (RFID) access control further enhances security and convenience by providing a seamless and contactless means of authentication, ensuring authorized personnel can access specific floors efficiently.

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