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SOLAR BASED SKYWAY ELEVATOR

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Abstract—This paper presents the design and practical implementation of hardware prototype and software to simulate the multi-directional elevator system, which is quite useful for the people for crossing the railway tracks at railway stations and for crossing the busy Roads. In addition to the vertical motion, the same system also travels in horizontal direction to reach other end of the road and from there the elevator cabin will be lowered to the ground level. 89C52 microcontroller is used to control the elevator. As for the hardware prototype, it is used to simulate the elevator system with three DC motors to control the movement and motion of the elevator in vertical as well as horizontal direction. Limit switches are used and they are arranged at various points of mechanical structure to identify the position of the elevator. As a power source , solar energy is used to run the mechanism. For this purpose 12V-10Watts solar panel is used and its output is connected to the rechargeable battery. The proposed system is an advanced multi-directional mobility platform designed to integrate both vertical and horizontal motion, aimed at providing universal accessibility in high-density urban environments.

Keywords— Microcontroller, DC motor, Solar panel, Relays, Limit Switches,12V Battery.

I. INTRODUCTION

Mechatronics; generally Electro Mechanical Machines are called as Mechatronics. Mechatronics has been defined as the synergistic integration of mechanical devices, electronics and software. Due to modernization, the elevator system has become a part and parcel of life as high-rise buildings is a common sight. High-rise building will not be realizable without the implementation of elevators. Elevators play an important part of our daily lives. But almost all elevators worldwide, more than 99% they are in use today are designed to carry the people in vertical direction. Only few elevators designed for special purposes can move in different directions, the hidden technology involved in these elevators is not popular, there by this project work is taken up to high light this technology. To prove the concept practically, a proto type module is constructed using simple technology for the live demonstration.

SCOPE AND OBJECTIVES

The Skyway Elevator Designed for Road Crossing is an innovative Mechatronics solution aimed at improving pedestrian safety and accessibility in high-traffic areas. Its primary scope includes: Safe Road and Railway Crossing, Designed to help elderly people, children, and physically challenged individuals, offering them a safe, automated way to cross hazardous zones independently.

The main objective of the project is to develop a hardware prototype and software to simulate the 3D type of multi-functional elevator system, which is quite useful for the people for crossing the railway tracks at railway stations and for crossing the busy Roads. To develop a transportation mechanism capable of both vertical and horizontal movement

II. SYSTEM DESCRIPTION

The proposed system basically aimed for crossing the busy roads of main cities and national high way roads where there is no chance for the public to cross these roads because of continuous flowing traffic. The same system also can be utilized at railway stations for crossing the railway tracks. The innovative concept involved in the system is to utilize non-conventional energy resource.

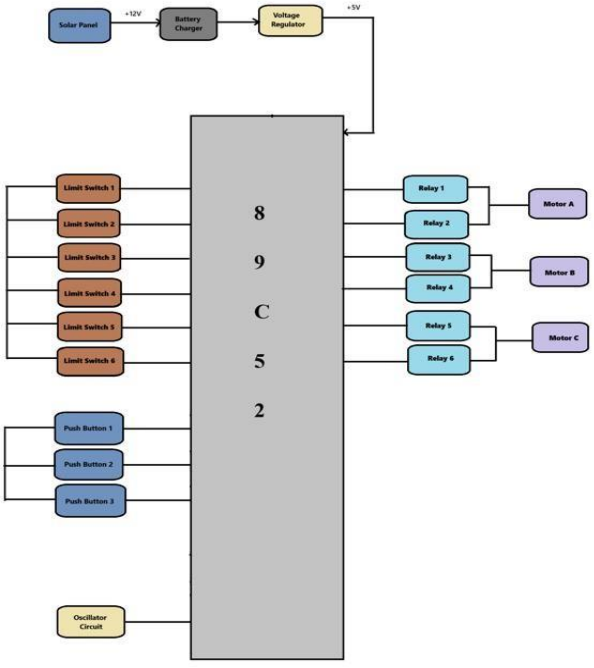

Fig. 1. Block Diagram of proposed system

The system is mainly consisting of solar panel & Battery 12V DC power source is adopted for the design ,a

small-scale model consisting of three DC motors of built in reduction gear mechanism are chosen for mechanical transmission section. The advantage of using reduction gear mechanism motor is that the motor speed will be decreased and torque will be increased, there by a small motor can drive heavy loads..

limit switches block is designed with six lever switches, and these switches are arranged at various points of the mechanism to control the mechanical transmission section at various levels.The mechanical movements are restricted through limit switches, when any moving mechanism reaches to its reference point either in horizontal or vertical motion. To sense weather the door of a cab is opened or closed, two limit switches are arranged at either side of the door. If the door remains in open condition, one switch remains in activated condition. The outputs of these two switches are fed to microcontroller, by which it can under stand the condition of the door, like wise all the switches outputs are fed to this controller for identifying the position of moving mechanism in all aspects. Based on the information produced by these switches, the controller controls the motors independently.

To control the three motors independently in both the directions (forward and reverse movements), six relays are used and they are interfaced with microcontroller through their drive circuits. Depending up on the signals generated by the push buttons and lever switches, the controller controls the motors through relay contacts. Each motor is driven through two relays, one relay for forward direction and the other relay for reverse direction. The motors used in this project work are DC motors.

III. CIRCUIT LAYOUT

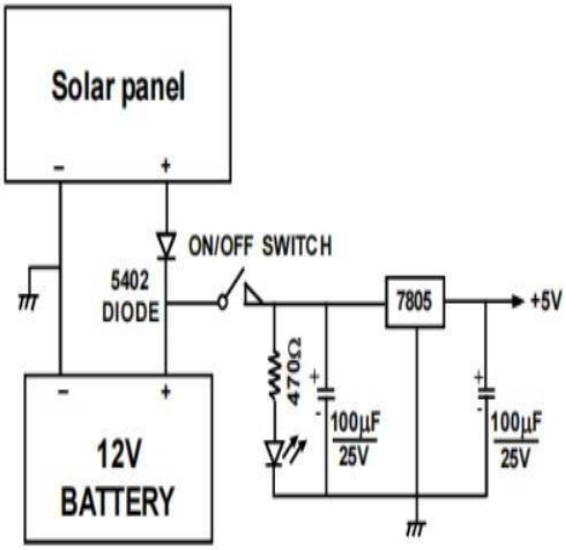

Fig: 2 Circuit Diagram of Solar Power Source

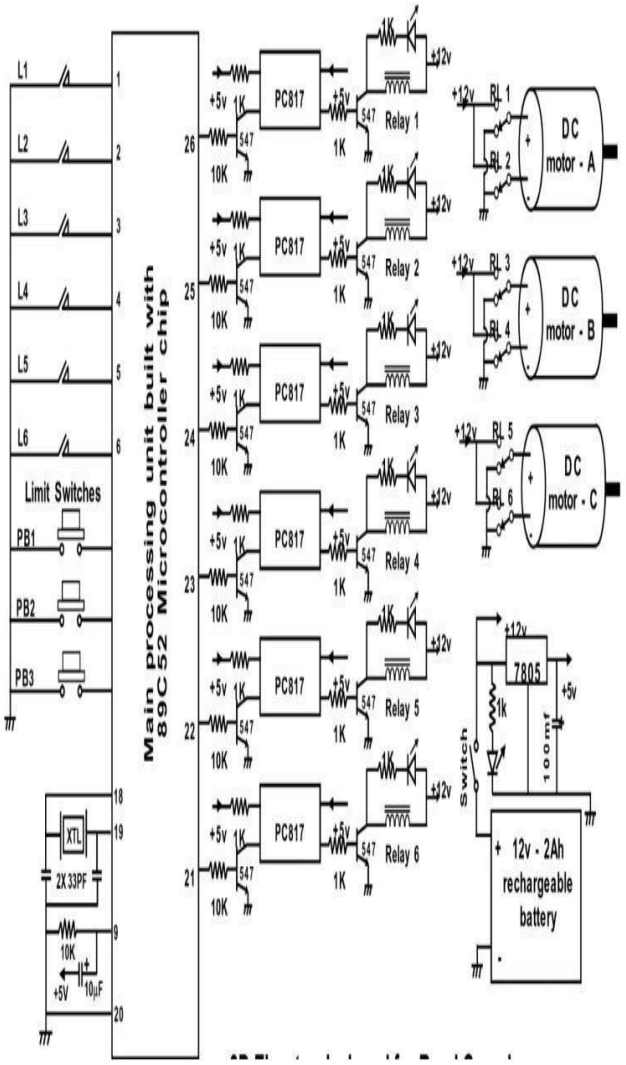

Fig 3: Circuit Diagram of Solar Based Skyway Elevator

IV. WORKING PRINCIPLE

Initially when the machine is in idle condition, the door of elevator remains in open condition, whenever any person wants use the elevator to cross the road or rail track, he/she will enter inside the cab and depresses the push button, by which the elevator door will be closed automatically and it will be traveled vertically up to certain distance, after that immediately the elevator direction will be changed and traveled in horizontal direction up to certain distance, from there again the same cab travels in vertical direction in down wards to reach the ground level. After reaching the elevator to other side, the cab door will be opened automatically.

A. POWER SUPPLY UNIT

The main power source to drive the entire machine is derived from 12V -10watts solar panel.

BATTERY: The battery used is rated for 12v – 2Ah, it is a rechargeable type of lead acid battery. If the battery is fully discharged, then it will consume more power from the panel, in this condition the voltage may fall down by less than 12V. As the battery is getting charged, the voltage level will be boosted slowly. Once the battery is charged fully, the battery terminal voltage will become equal to the charger voltage, when both levels are equal; battery will not consume energy from the panel.

VOLTAGE REGULATOR: The 7805 voltage regulator provides a fixed 5V DC output regardless of input voltage variations (typically 7–15V DC input). It is crucial for powering sensitive components like the microcontroller and logic ICs, which require a precise 5V.

B. LIMIT SWITCHES

The entire mechanical transmission section is designed with 6 limit switches. The limit switches used are having long levers and are intended to limit the mechanical transmission at particular prescribed position. For example, to limit the movement of cab in vertical direction, two limit switches are arranged over the mechanism for sensing the cab position at upper and lower levels. The lower level is nothing but ground level, whenever the cab reaches to the ground level, the lower level switch lever will be operated, there by switch will be activated. When the switch is activated the contact gets closed, and a logic zero signal is generated for the microcontroller.

C. RELAY DRIVING SEQUENCE

Pin numbers 21 to 26 of microcontroller are used to drive the six relays independently. These pins are belongs to port 2, and these lines are treated as output lines. Each output is used to conduct a low power switching transistor, whenever any out put is energized, that particular transistor is conducted, which in turn energizes the relay. Here BC 547 general purpose switching transistor is used, this is a NPN transistor and its emitter is connected to ground. The relay used here is a single changing over contact relay, and working voltage of the relay is 12V DC, means when the coil is energized through 12V Drelay will be activated. One end of the relay coil is connected to
+12V DC source and the other end is connected to ground through transistor collector. When the transistor is conducted, the emitter collector junction is closed and supply is provided to relay coil. These relays are energized and de-energized depending up on the input data that is obtained from limit switches and push buttons.

The push button which is mounted inside the cab is treated as one of the in put command signal to the microcontroller, whenever this button is depressed, the controller energizes relay – 2, where as relay – 1 remains in de-energized condition. In this sequence the supply connected to the relay coil is reversed, motor +Vcc is connected to the ground through relay – 1 contact, because this relay remains in off condition and motor positive is connected to ground through its normally closed contact.

Since relay – 2 is in on condition, normally open contact gets closed and motor negative is connected to +Vcc. In this concept polarity is reversed and motor rotates in anti- clock wise, by which the cab door will be closed automatically.

Once the cab door is closed, it remains in closed condition until it reaches to the other end. When the cab is reached to the ground level of other end, the corresponding limit switch arranged below the cab will be activated automatically; this is another input command signal to the microcontroller, by which the controller energizes relay – 1, and relay – 2 remains in off condition. In this logic the polarity is maintained by connecting the motor positive to +Vcc and motor negative to ground through relay contacts, there by motor rotates in clock wise, which in turn the cab door will be opened to allow the people out from the cab. Like wise depending up on the other input commands fed through the remaining four limit switches, corresponding relays are controlled and based on the supply sequence, the remaining two motors drives the cab in horizontal and vertical directions.

D. DC MOTORS

Depending up on the signals generated by the push buttons and lever switches, the controller controls the motors through relay contacts. Each motor is driven through two relays, one relay for forward direction and the other relay for reverse direction.

The three motors used to control the movement of the cab are denoted as motors ‘A’ ‘B’ & ‘C’, they are similar motors, motor ‘A’ is used to control the cab door, motor ‘B’ is used to drive the cab in vertical direction, and motor ‘C’ is used to drive the cab in horizontal direction.

V. RESULT

Fig 4: Elevator Cabin at Intial Position

Fig 5: Elevator Cabin in Vertical Direction

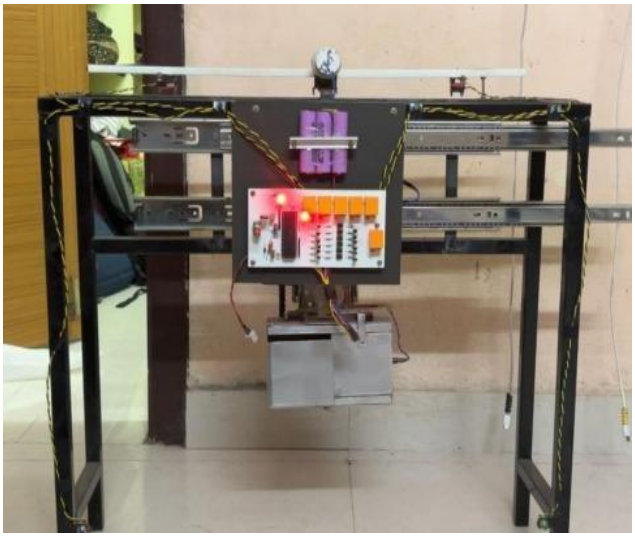

Fig 6: Elevator Cabin in Horizontal Direction

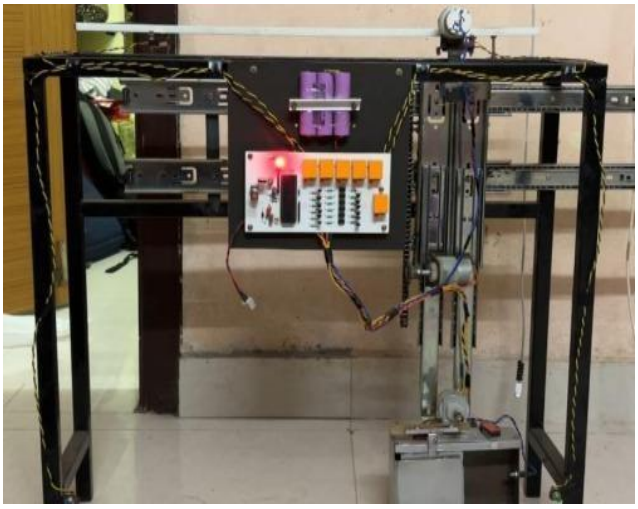

Fig 7: Elevator Cabin in Final Position

VI. CONCLUSION

The proposed system represents a basic module of bench type prototype module of "Solar Based Skyway Elevator". The elevator designed for road and railway track crossing is a groundbreaking solution that merges mechanical innovation with renewable energy to address a common yet critical public safety issue. Through the development and demonstration of this prototype, we have proven the feasibility and practicality of a multi-directional, solar-powered elevator system capable of vertical and horizontal movement. While designing and developing the prototype module lot of problems are faced, and a systematic step- by-step approach is followed to rectify the problems one after another. This project not only highlights the effectiveness of mechatronic systems controlled by microcontrollers but also underscores the importance of utilizing clean energy sources such as solar power for sustainable development. To charge this battery in less time, suitable solar panel is used which can deliver a maximum power of 9watts under the bright Sun. The integration of limit switches and programmable logic within the 89C52 microcontroller not only enhances safety but also automates the process, making it user-friendly and maintenance-friendly. Three small DC motors with built in reduction gear mechanism are used to drive entire machine to perform multiple tasks. This project not only serves as a practical engineering solution but also reflects a visionary step toward inclusive, eco-friendly, and technology- driven urban mobility.

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