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Electro Hydraulic Goods Elevator

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Abstract: This paper present a microcontroller based elevator control system. An elevator is a type of vertical transport equipment that efficiently moves people or goods between floors of a building. Elevators are generally powered by electric motors that either drive traction cables or counterweight systems like a hoist, or pump hydraulic fluid to raise a cylindrical piston like a jack. This paper mainly focuses on using microcontroller to control the circuit and building the elevator model. Limit switch is used for the elevator position. Hydraulic fluid cylinder is used to control the up and down movement of the elevator car. Push buttons are used to call the elevator car. The elevator position is described by using the display unit.

Keywords: Electro Hydraulic, Elevator, Microcontroller, Hydraulic fluid cylinder, Limit switch.

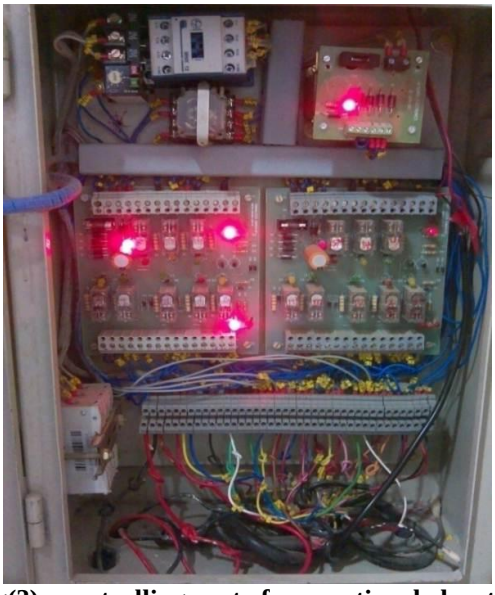
INTRODUCTION

For most people residing in urban cities, elevators have become an integral part of their daily life. Simply stated, an elevator is a hoisting or lowering mechanism, designed to carry passengers or freight, and is equipped with a car and platform that typically moves in fixed guides and serves two or more landings. Hydraulic and roped elevators are the two types of elevators in use today. The main design considerations for choosing either electric traction drive or hydraulic for a particular project are the number of floors, the height of the building, the number of people to be transported, desired passenger waiting times and frequency of use. The circuit of conventional elevator is very complex as relays are used for controlling purpose. Since relays were used, most of the connections were made by wires and this is the reason for complexity of the conventional elevator. In such complex circuit error detection and correction is very difficult and to find out error, the whole circuit has to be checked which consumed more will time to search error. This project is to design and construct an elevator using a microcontroller which will overcome the limitations mentioned above.

LITERATURE SURVEY

Fig (2) Elevator circuit seen at Asmita Engineering Equipment

Fig(1): Hydraulic Elevator



Fig(3): controlling part of conventional elevator

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Fig (2) is the elevator which we have seen during survey in some industries and shops, where conventional elevators are present . Fig(3) shows the controlling part of conventional elevator which is observed during survey. After this survey we come to conclusion that there are following drawbacks present in conventional elevator:

i. Complex circuit
ii. Error detection and correction is difficult
iii. Due to lots of relays, size of pcb increases and also wire requirement is more
iv. More pit area is required for implementing elevator
v. Power consumption is more.

BLOCK DIAGRAM:

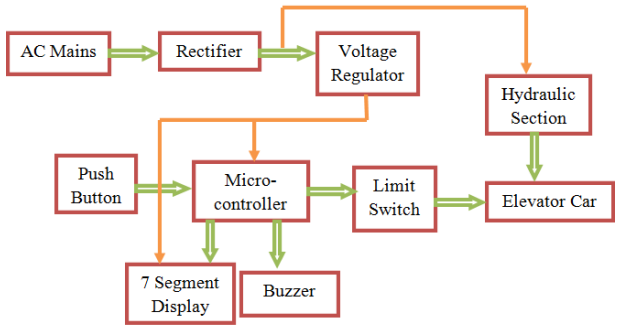

Fig 4: Block Diagram of Electro-Hydraulic Goods Elevator

Explanation:
Basically the goods elevator consists of the blocks mention below.

- Power supply section
- Hydraulic section
- Controlling section
- Indicator section
- Elevator car

Power supply section: As we can see in block diagram, power supply section consists of AC mains, rectifier, and voltage regulator. 230V from main supply is supplied to hydraulic section and also converted into DC supply using rectifier. It is made constant at 5V to run microcontroller and 7 segment display.

Hydraulic section: The hydraulic system has three parts:

- A tank (the fluid reservoir)
- A pump, powered by a electric motor
- A valve between the cylinder and reservoir.

The pump forces fluid from the tank into a pipe leading to the cylinder when the valve is opened, the pressurized fluid will take a path list resistance and return to the fluid reservoir. But when the valve is closed, the pressurized fluid has nowhere to go except into the cylinder. As the fluid collects in the cylinder, it pushes the piston up, lifting the elevator car. When the car approaches the correct floor, the control system sends a signal to the electric motor to gradually shut off the pump. With the pump off, there is no more fluid flowing into the cylinder, but the fluid that is already in the cylinder cannot escape. The piston rests on the fluid, and the car stays where it is. To lower the car, the elevator control system sends a signal to the valve. The valve is operated electrically by a basic solenoid switch. When the solenoid opens the valve, the fluid that has collected in the cylinder can flow out into the fluid reservoir. The weight of the car and the cargo pushes down on the piston, which drives the fluid into the reservoir. The car gradually descends. To stop the car at a lower floor, the control system closes the valve again.
Controlling section: It consist of microcontroller, push button and limit switch. This section in explained below.
Indicator section: It consists of 7 segment display and buzzer. Display is used to indicate whether elevator is moving upward or downward and also indicate to which floor it is moving. When elevator car is overloaded buzzer ring give indication about overload.
Elevator car: It is a cabin in which passengers or goods are moved up and down between the floors. It has a particular weight handling capacity. It is moved between the floors with the help of any lifting system like counter weight, hydraulic pumps, etc. Among these systems we are using hydraulic pumps in this project.

In power supply section AC motor are used to supply the power to the whole lift body. Transformer steps down high voltage AC mains to low voltage AC. Transformers convert AC electricity from one voltage to another with little loss of power. Transformers work only with AC and this is one of the reasons why mains electricity is AC. AC main supply is applied to rectifier. Rectifier converts AC to 24V DC, This 24V supply is directly given to hydraulic section which will drive the body of lift. This 24V supply is also applied to voltage regulator. At the output of regulator we get 5v DC supply, which will use for controlling other circuitry. Voltage regulator is a regulator IC which converts 24V DC to 5V DC supply. Because the microcontroller device we are using operates on 5V DC supply. Hydraulic section consists of hydraulic cylinder which is filled with hydraulic fluid. This fluid generates the pressure which helps in up-down movement of the lift body. Hydraulic section is connected to the motor of the lift. Here we are using ATmega328P Microcontroller. Because it is cheap and easily available in market. Microcontroller is connected to lift body via motor driver. 7 segment display is used to display the lift position. It is digital display. Push button is used to indicate microcontroller at which floor it has to stop.

CIRCUIT DIAGRAM:
Fig (5) shows the circuit diagram of controlling panel of elevator. As we have to design circuit that will eliminate drawback of conventional elevator. We are using microcontroller ATMEGA328P in place of relays. Here we are using push button and limit switch as input devices. Push button are connected at each floor near elevator body. Command is given through these push button at which floor elevator car has to move. These push buttons are connected through optocoupler to microcontroller at port D. optocoupler 4N35 are used as isolation device between buttons and microcontroller. LEDs are connected between port D push button to indicate which push button is pressed.

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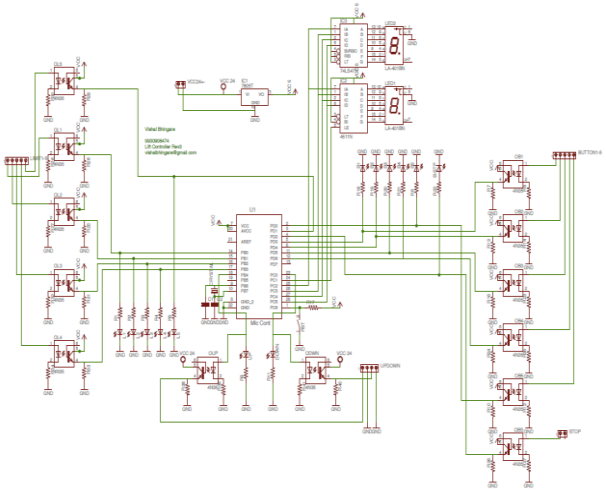

Fig(5): Circuit diagram of ground + four floor elevator.

Limit switches are connected to each floors. This is a position determining device. It is just like a relay having NO and NC connection. When lift body comes in contact with limit switch NO connection get close and this signal is given to controller. These limit switches are connected to port B of microcontroller through optocoupler. LED's are connected between them for indication purpose. As elevator car will move it will come in contact with limit switches at each floor and signal will be given to microcontroller and corresponding LED will glow.
Hydraulic cylinder which move elevator car up and down is connected to microcontroller pins PC0 and PB4 through optocoupler and LED's are also connected.

Now let us consider second push button is pressed and elevator car is resting at ground then elevator car should move from ground floor to second floor. Microcontroller will give signal to hydraulic cylinder to move up. Now elevator will start moving upward. It will touch the limit switch at first floor. This limit switch will give signal to microcontroller. Microcontroller will not take any action, so elevator will continue moving upward. It will now come in contact with second limit switch. Again limit switch send signal to microcontroller. Now as the second push button is pressed and second limit switch has send signal. Microcontroller will send signal to hydraulic cylinder to stop there and elevator car will stop at desired second floor. It will work same for other floors.

1. **ATmega328P microcontroller:** The ATmega328P is a 28 pin low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture.
2. **4N35 optocoupler:** Optocoupler is a component that transfer electrical signal between two isolated circuits by using light signal. A common type of optocoupler consists of an LED and a phototransistor in the same package. Optocoupler are mainly used in delicate system like between sensor and PLC.
3. **CD4511BE BCD-to-7 segment latch decoder**: CD4511B types are BCD-to-7-segment latch decoder drivers constructed with CMOS logic and n-p-n bipolar transistor output devices on a single monolithic structure.
4. **Voltage regulator:** 7805 is a voltage regulator integrated circuit. It is a member of 78xx series of fixed linear voltage regulator ICs. The voltage regulator IC maintains the output voltage at a constant value. 7805 provides +5V regulated power supply.

In the above circuit, optocouplers are connected to the various ports of the microcontroller on floors and also in the car elevator. Each floor's display is depicted in seven-segment displays which are interfaced to the microcontroller unit. The indications of the upward and downward directions of the elevator are indicated using light emitting diode. For moving the elevator, a motor is driven through a optocoupler which is given in the circuit. The microcontroller is programmed logically in such a way that for the corresponding input switch, it rotates the motor and also drives the seven-segment display and LED display.

COMPARISON BETWEEN CONVENTIONAL ELEVATOR AND ADVANCE ELEVATOR:

Parameters	**Conventional elevator**	**Advanced elevator**
Pit area	Large	Small
Relay Required	Relay is required	Relay is not required
Power consumption	More	Less
circuit	Complex	Simple
Error detection & correction	Difficult	Easy
System based on	Analog	Digital

ADVANTAGES:

- Circuit is compact and easy as compared to analog lift
- Error detection is easy due to optocoupler.
- Relays and transistor are replaced by ICs hence wiring is reduced.
- It acquires less area.
- Power consumption is less.

CONCLUSION

Although some calibrations and requirements may have, the modeling microcontroller IC based on elevator control system is done. The traditionally used relays have been replaced by IC for easy and cheap controlling of machines used in this elevator. By developing this proposed system, the result of elevator control system can be applied in the real world. By using microcontroller IC based elevator control system, the desired position can be forecasted. The simulation results of the ground + four floors system have been discussed. As a future work, various sensors and LEDs can be used to indicate area where error is present.

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