THE POSSIBILITY OF APPLICATION AS-INTERFACE IN A ELEVATOR CONTROL DESIGN

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ABSTRACT

In modern control systems, the reliability and big amount of transferred data is emphasized. If there's a problem, it usually involves cabling, because the more cables are used, the lower the reliability index is**.** One possible solution of this problem is to use the AS-Interface.

In the case of modern elevators, the communication between control unit and single service stations (finger tip controls) is more complicated. For instance from cabin of elevator it is necessary to pass not only the information about pushed-off buttons, but also dozens of other information. Older control systems had to be equipped with dozens of conductors, which were far too heavy and expensive. Using of AS-Interface could be very interesting solution, because this system enables the power supply and communication of controls to be provided by a single twin core cable. It also makes communication between other control elements easier. Furthermore, the AS-Interface meets high safety standards.

1. INTRODUCTION

The first part of this paper is focused on AS-Interface system. In this section, basic principles and properties of this bus will be presented. Secondly, after knowing the AS-Interface problem, model of elevator controlled by AS–Interface is given. There are proper components chosen, based on found information about the AS-I. The next part is aimed at hardware design of drivers for the floors and the box of elevator. There must be a scheme designed, and the PCB (printed circuit board) has to be generated and fixed. After that, control system will be complete. The last part is about programming PLC and programming special drivers for all slaves. In this section, many aspects of elevator operation are taken into consideration (floor counting, elevator stopping, power outage…). The program will be debugged and the utility of an elevator design will be tested.

2. AS-INTERFACE

The AS-Interface (Actuator Sensor Interface) technology is intelligent communication system for the lowest level of automation systems. The AS-Interface system enables the incorporation for net and correct function of sensors and actuators from different

manufacturers. This incorporation is using just one cable. Structure is open to superior levels and it is the base for professional advanced solution.

Aforementioned cable has yellow colour - and very same yellow cable became the trade-mark of AS-Interface. Big advantage is that cable carries power supply and data interchange together. Other advantage is an easy addition of all components. It uses the slash method thus there are no complications with stripping. The AS-Interface technology was designed in early 90's by partnership of 11 automatization companies. In this case industrial communication bus miss typical sheaves of cables - all sensors and actuators are interconnecting by only one special twin core cable.

The AS-Interface cable provides power supply for incorporate components by voltage 24V DC and numerical data transmission 167 kb/s [1]. Data transmission is cyclic, principle master/slave (or master/multislave if you like). Its driving control is supplied with data by one control module (master), which asks for all data from controlled modules (slaves) in exactly defined moments of time. To one control module we can connect 62 modules as slaves (older version 1.0 just 31), each of these modules (slave) can have four digital inputs and three outputs (version 2.0) or four outputs (version 3.0). Practically it means, that one control equipment can communicate with many as 248 inputs and 186 (248) outputs. The whole network takes off at the most 8 A (one module slave up to 100 mA). Shortest period of cycle of fully loaded network is 10 ms and maximum bus length is 300 m (version 3.0 600 m).

Some users think that with this simple network architecture it is possible to save up to 20% of costs compares to other.

3. APLICATION

Based on information about possibilities of AS-I, following terms of trial model were designed:

- Consist of 4 floors and mobile cabin.
- If we add controllers for levels and button controllers of cabin, we can extend system for up to 24 floors; software must be designed in a way that enables the service of all 24 floors.
- Engine of the elevator, meaning the elevation of cabin is connected through frequency converter, which is providing smooth start and landing motion of cabin.
- Back-up source must be connected to all control system; it supplies power to safety circle of elevator.
- In each floor a control panel is installed. The control panel contains a button controller for way up (without highest floor), button controller for way down (without lowest floor) and 3x matrix display 5 x 7, which displays position of cabin and information about movement of cabin (directions up/ down/ stands).
- Inside the cabin there is control panel, which contains button control, it support cabin control by user (for each floor one button), 3x matrix display 5x7 with position and other information about the cabin movement. We suppose that inside the cabin it's possible to make a text line scroll providing the user with situation status update in case an accident. This control panel contains also cabin overload indicator and an emergency help button in case an accident occurs.

3.1. ELEVATOR CONTROL SYSTEM

Resulting elevator design is shown on in the following figure:

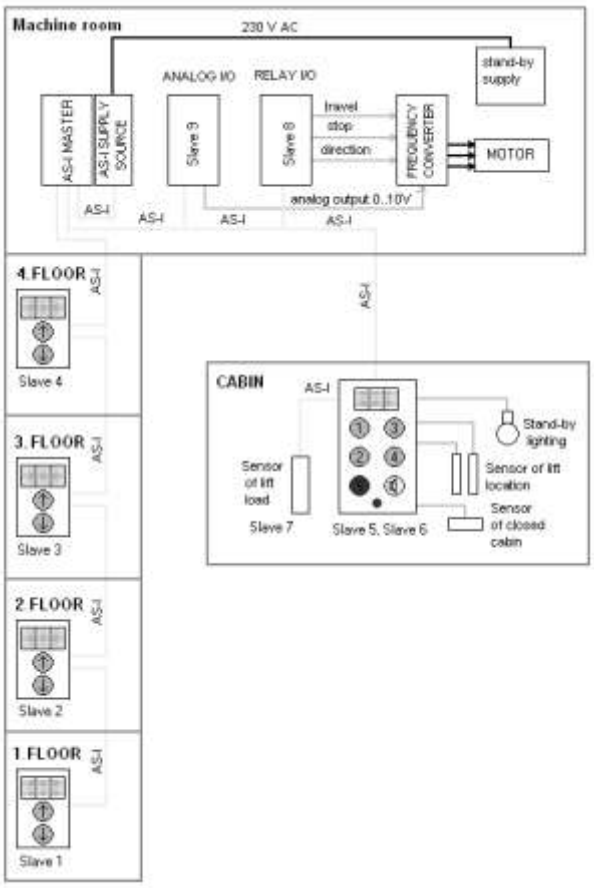

Figure 1: Design of elevator

Used components:

- AC1309, ifm electronic, master, 1 piece
- AC1216, ifm electronic, supply source AS-I - 2,8A, 1 piece
- AC2726, ifm electronic, slave, 6 pieces
  4 pieces in floors
  2 pieces in controles of cabin
- IG5886, ifm electronic, sensor of elevator load, 1 piece
- AC2258, ifm electronic, module with relay I/O,1 piece
- Induction sensor of elevator location, 2 pieces, position in cabin
- AC2619, ifm electronic, slave with analog voltage outputs for control FC (frequency converter), 1 piece
- Control of cabin, 1 piece(must be designed)
- Control of floors, 4 pieces (must be designed)

3.2. SPECIAL SLAVES – BUTTON DRIVERS

In each floor the control panel is installed, containing a button controller for direction up (without highest floor), a button controller for direction down (without lowest floor) and matrix display 5x7 with position of cabin and information about cabin movement

(direction up/ down/ stands – this can be pictures as a common arrow indicator for standing and rolling indicator for moving).

Control of cabin looks similar, differences from control of cabin are in:

- communication with AS-I master by the help of two slave modules- 2x4I/4O
- more buttons (numbers of floors, bell, STOP)
- signalling of cabin overload
- addition of two sensor for checking of cabin landing run to floors

All these controls are controlled by microprocessors. The drivers are inside the microprocessors, which contain a special protocol. This protocol enables two-way transfer of all information (displaying, data collection from buttons…) by just two wires (similarity of transmission analog values [3]).

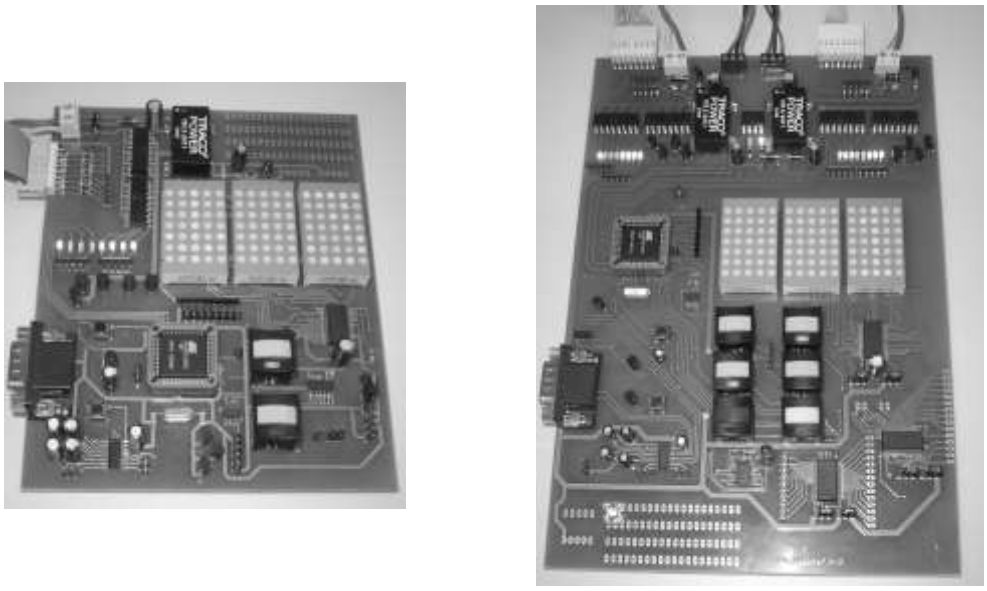

Figure 2: Button drivers (left - floor, right - cabin)

3.3. STOPPING OF ELEVATOR

Stopping and starting of elevator must be fluent. This is the reason, why we use frequency converter, which is controlled by slave module AC2619. To be able do this control, we have this solution: Two sensors are fixed on the cabin of elevator in equal level. Two lamellas are fixed to each floor. Lamellas supply to switch on the sensors. Lamellas are fixed in different levels; one higher that the other. When the cabin goes to a floor, where it's supposed to stop, the lamella switches on the first sensor. This is a signal for master to send information to frequency converter (by slave module AC2619). Frequency converter starts to level down speed fluently, until a certain stopping rate speed is reached. When the second sensor is switch on, then the cabin must stop promptly. Start of elevator is in same moment the doors are closed. Speed of cabin will level up fluently to requested speed rate. Lamellas can be used for detection of last floor, meaning the lowest floor. That actuality is important for initialization of elevator, or more precisely, after start PLC we have to somehow point out the position of elevator. In this last floor the lamellas change position.

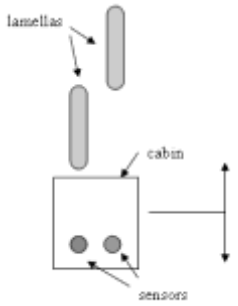

Figure 3: Sensors and lamellas

3.4. POWER OUTAGE

In case of power disconnection master will send the information for all controls in floor and in the cabin. (It will be one bit). After that the control unit is powered from back-up power supply. Controls in each floor won't show information on displays, because it will save energy. Different situation will be in the cabin, where display will show the information for users. For example: staff is already on their way. Then the stand-by lighting will be switched on. As an alternate light source will be used light emitting diode (good luminous intensity and low power consumption).

4. CONCLUSIONS

AS-I like as the instrument of automation solution. Especially controlling of processes with a lot of data from a lot of sensors is very useful and effective. For example in our case, where we need to work with many information, big advantage is, that we don't need many cables and cabin can easily go on. With implementing of control to real operation, we'd need to thing over it more thoroughly, because on electric elevators (machines for transportation people) are claimed very high claims of safety standard by ČSN EN 81-1. Our model is a proof that elevators controlled by AS-I system are reliable. Its main advantage is in cabling. This solution is very effective and profitable. Removing of old cable work is a guarantee of reliable operation. And that's what the AS-I engineers try to achieve at minimum possible costs. The AS-I system offers interesting, reliable, flexible and cheap solution for many industrial applications.

ACKNOWLEDGEMENTS:

This research was particulary supported by GACR project No 102/03/1097 and project No 102/05/0663.

The paper has been prepared by cooperating with association AS-Interface Česká republika and with company Regultech servis.

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[2] Complete Specification, Version 2.11, Januar 31, 2002,AS-International Association