Goals and project plan

EXPANDING TEST CAPABILITES WITH CAN CONTROLLED TEST INTERFACE

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Background

ASSA ABLOY is a multi-national concern that provides locking, safety and access solutions. The company ASSA ABLOY Entrance Systems which is one division of the concern develops and manufactures powered and automatic doors for both industrial and human uses.

All their powered doors are controlled by multiple ECUs which communicates on a CAN-bus. Each door systems need to be tested both during and after the development phase to validate all functionality, validate that safety functions holds up to requirements and guaranteeing that the promised life cycle is true to reality. This has historically been a time and labor-intensive task. ASSA ABLOY as well as the rest of the industry is now moving towards automated tests.

Today this is done by using the test software Vector CANoe connected to a CAN interface. This allows for reading the messages on the bus as well as simulating nodes and setting signals. To widen the test scope there is a need to set and read I/O from the ECUs, make voltage measurement and control relays.

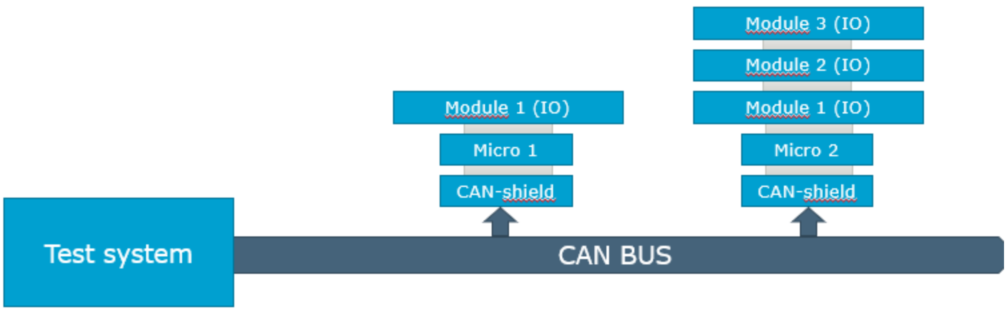
Today they have a solution which uses a programmed FPGA together with LabView to set the I/O. LabView in turn shares variables with the testing software which runs the automatic tests. This needs to be replaced both for complexity and support reasons. The system is not agile enough to be viable for a wide range of systems. LabView have also expressed that support for smaller companies in need of this will be phased out.

ASSA ABLOY and other companies without extensive CAN networks need a solution to expand their testing scope in an agile way that is also economically viable. Today's solution and other integrated solutions are too expensive to be viable.

The testing system Vector CANoe is today industry leading and is being used at ASSA ABLOY to run their automatic test on CAN. It would therefore be suitable to implement a solution which also uses CAN or communicates with Vector CANoe.

ASSA ABLOY have suggested a solution of using microcontrollers with CAN shields and test-cards as a "test interface" on the CAN-bus. This can then be run and controlled by the same system that today runs the tests. Proposed sketch found below.

ASSA ABLOY have expressed that there are time requirements on this testing interface. I/O must be able to be set every 10 *ms*.



Purpose of this project

This project aims to investigate and develop a way to expand testing capabilities on CAN based testing environments. The company has suggested a solution using a microcontroller together with a CAN shield allowing to connect to the CAN bus. Then using in house-built test-cards for controlling I/O or relays. Both the CAN shield, and the test-cards will communicate over SPI. The test-cards should be able to be stacked to increase the number of outputs or to run distributed over multiple microcontrollers on the CAN bus. The requirements for the system aren't final but a time requirement for setting signals has been decided to be 10ms. To achieve this, I will investigate the impact of having one or multiple SPI channels on the microcontroller and using filters on the CAN bus. For a fully completed project the PCB design for the test-cards should be developed and a human-machine-interaction layer should be added.

In this project I will mainly focus on the software and communication part of this problem by completing the modules below.

Project scopes

PROOF OF CONCEPT

The proposed solution has two separate challenges which first needs to be validated separately. The use of a CAN-shield to communicate with multiple units on a distributed network reliably, and the use of SPI to communicate with multiple cascaded units. This part seeks to investigate the following:

- Can Arduinos and CAN shields be used to run the test interface from a CAN-bus?
- Can the same type of Arduino be used to communicate with the test-card-modules over SPI?
- Can the code for SPI communication be generic for all setups and still support both multiple cascaded cards of the same type and different types of cards.
- Does these two steps combined hold up to the time requirements.

RELIABLE COMMUNICATION FROM I/O TEST CARDS TO CAN BUS

Once the proof of concept has been developed it will be combined into one solution. In this part the following will be developed and investigated:

- Can this system be reliably built using a microcontroller with only one SPI channel, running on a single thread.
- Compare to a microcontroller with two SPI channels.
- Implement filters on the CAN bus and compare results.
- Priority management between CAN shield and test-card-modules using interrupt.
- Solve addressing of either cascaded or distributed test-cards. Can the same address for each pin be used?
- Build CAN library

PCB DESIGN OF TEST-CARD-MODULES

Once the software is working and the design of the test-card-modules are finished a PCB design for the cards is to be produced. The final product needs to be easy to set up and use. Addressing of each card will be able to be set on the PCB using switches.

HUMAN-MACHINE-INTERFACE

Sometimes manual testing is also desired. To make this possible a human-machine-interface (HMI) will be made. It can either be programed as a digital panel in the testing software or as a physical unit which will use an Arduino to send the required messages instead of the testing software.

Project goals

This thesis will answer the following questions:

- What are the available options today for CAN based HIL testing
- Why is there a need to automate the testing process
- What would be the benefits of expanding this process.
- Can programable microcontrollers be used to affordably expand this process.
- Is there a performance benefit to using a microcontroller with multiple SPI channels.
- Is there a performance benefit to using filters in the CAN transceiver.
- What is the theoretical and practical limit for how fast this system could operate.

Method

- Program an Arduino to communicate on a CAN bus
    - Using preexisting library or by creating own library.
- Program an Arduino to communicate with test-cards over SPI
    - Using preexisting library or by creating own library.
    - If using preexisting library investigate possibility to use different pin assignment to accommodate both CAN shield and test-cards
    - Make the code applicable for any combination of test-cards.
- Combine the two solutions to a working prototype.
    - Solve priority with SPI communication (possibly interrupt service routine)
    - Find a reliable way to address different I/O.
    - Build a CAN database.
- Test prototype against time requirements.
- If prototype holds up to required specifications, rebuild into a robust long-term solution.
- If there is time, develop PCB for test-cards.

Resources

The resources that will need to be provided are listed below:

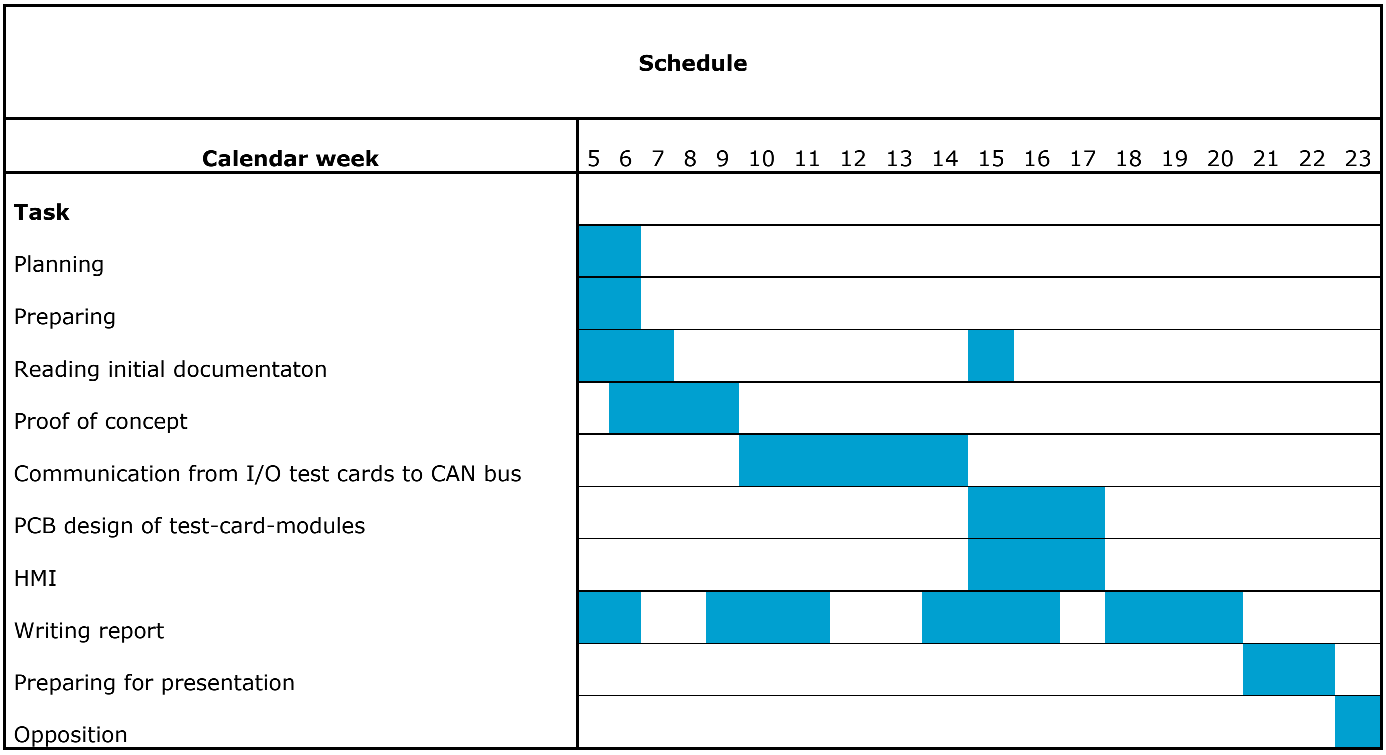
- Multiple Arduinos together with CAN shield.
- Multiple Raspberry Pi Pico together with CAN shield.
- Access to license for CANoe Pro together with USB test equipment.
- Access to multiple 16-bit SPI I/O expander cards to build test-cards from.
- Necessary equipment build testcards.
- Workstation and PC.

The one responsible to make sure all resources are provided is my supervisor at ASSA ABLOY Eric Warnquist.

Motivation of this project

I chose this project since it fits well together with the knowledge I've gained so far during my degree in electrical engineering as well as prior knowledge I've gained during summer internships as an engineer. It combines knowledge I've gained from courses in data communications and networks, digital circuit design, programing 1 and 2 and computer organization. It is also a great opportunity for me to try something challenging as well as expanding on my knowledge while performing a real project.

Schedule


Schedule
Calendar week
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Task
Planning
Preparing
Reading initial documentaton
Proof of concept
Communication from I/O test cards to CAN bus
PCB design of test-card-modules
HMI
Writing report
Preparing for presentation
Opposition