Fingerprint Sensor Testing Using Force Feedback Control

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Abstract

Testing and validation of fingerprint sensors with human labor are time consuming, costly and lack the speed, accuracy and repeatability required for sufficient results. In this article a brief introduction of an automated solution with a robot that solves these problems is presented.

I. Introduction

The result of the thesis [2] shows that it is possible to automate testing and validation of fingerprint sensors using an industrial robot and a force sensor.

Advantages such as increased productivity, better product quality and lowered costs are some of the reasons why the industry adapts more and more automatized solutions. Further reasons why robots get a greater use are the robots' ability to handle more complex tasks. The reason why robots can handle more complex tasks is the integration of different sensors. This gives the possibility to combine the exact movements of a robot with sensors such as cameras and force sensors. Robots are thereby able to adapt to variations in the environment, which benefits both safety and increase the area of use. All these advantages do unfortunately come with some disadvantages. A robot has to be programed to handle all the sensor data and refer this to a predefined trajectory. Writing the algorithm that can handle all possible cases is both time consuming and hard.

A company that wants to explore these advantages and investigate if it is possible to get a test setup that tests and validates fingerprint sensors is Fingerprint Cards.

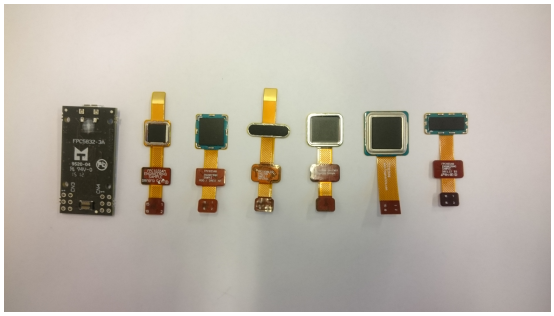

Figure 1: *Fingerprint Cards's sensor module (left) and some of Fingerprint Cards's sensors.*

II. Methods

To get to a conclusion if it is possible to perform validation and tests on fingerprint sensors using force feedback control, an investigation of several controllers and force sensors was done. The different controllers were first simulated using Matlab/Simulink software and then the best controllers were tested on a real robot. Three different force sensors were evaluated: one JR3 6 DOF force sensor, one Optoforce 3 DOF force sensor and one force sensor designed within the project that only measured force in one direction. The controllers were tested using an ABB IRB120 robot utilizing

a sensor and controller interface called ExtCtrl developed at LTH [1]. ExtCtrl is operated through a graphical user interface called Opcom [1]. The robot is controlled by an ABB IRC5 controller that is running a Rapid program for the position and velocity control, when the robot is not in contact with a surface. When the robot's end effector comes in contact with a surface (hopefully a fingerprint sensor) the Matlab/Simulink controller takes over and manages the force control by utilizing the Opcom extension.

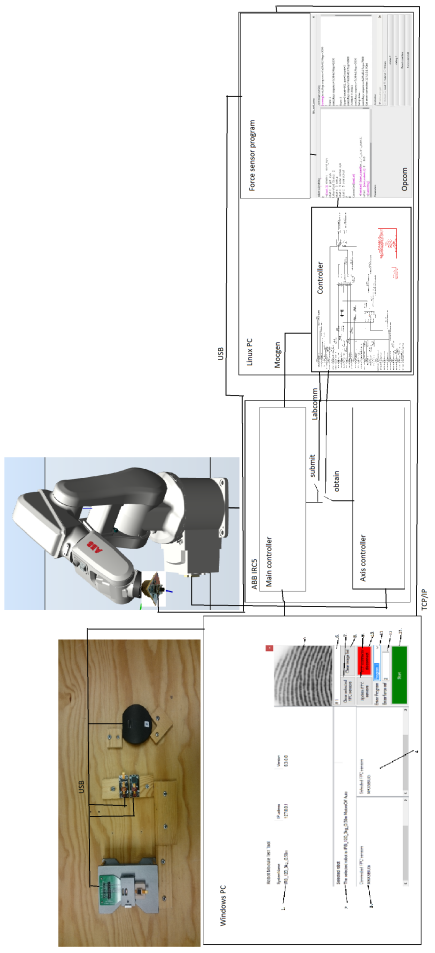

Figure 2: *Figure of the complete system.*

III. Results

The final setup includes a graphical user interface that is able to control the Rapid program, the force controller implemented in Matlab/Simulink and the fingerprint sensors. The final controller is a discrete PID-controller. A result from when two pictures taken with a fingerprint sensor when different forces are applied is shown in Figure 3.

Figure 3: *Pictures taken with fingerprint sensor when different forces are applied.*

IV. Conclusions

The purpose of this thesis was to develop and examine a force feedback controller that could be used to test and validate fingerprint sensors. This controller should be implemented in a system that is able to: perform different tests of the fingerprint sensors and be controlled through a simple interface, preferably in a Windows environment. All these things were implemented and showed a satisfying result. The final conclusion one can draw from this is that as long as the force sensor is good enough, a robot using force feedback is suitable for use when testing fingerprint sensors, even though the forces applied are very small.

References

[1] A. Blomdell, I. Dressler, K. Nilsson, and A. Robertsson. Flexible application development and high-performance motion control based on external sensing and reconfiguration of ABB industrial robot con-

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[2] V. Johansson. Fingerprint Sensor Testing Using Force Feedback Control. Master's thesis, TFRT-6014, Dept of Automatic Control, Lund University, Lund, Sweden, 2016. Available at http://www.control.lth.se/Publications.