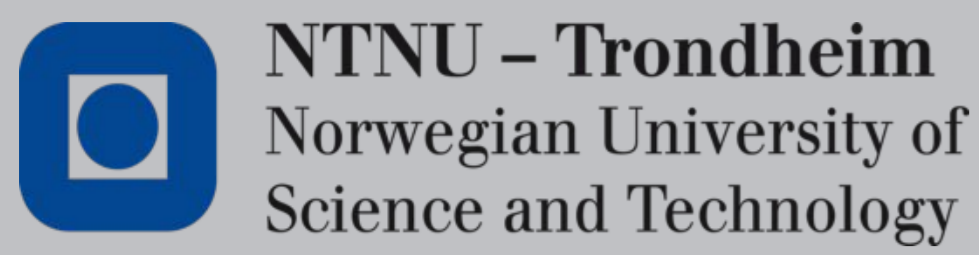


# A Rapid-Prototyping Framework for Designing Sensorised Modular Strollers

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## INTRODUCTION

This work is a proposal for a cooperative research project with Stokke AS, a Norwegian manufacturer of children's furniture and accessories. A virtual and physical rapid-prototyping framework that allows for the optimal design of high quality sensorised modular strollers is proposed. By combining the rapid-prototyping approach with the modular concept, different stroller configurations can be designed. A one-to-one correspondence between virtual and physical prototypes is established.

By using a low-cost sensing approach, functions for force and torque sensing at the wheel axles, sensitive collision detection and effort monitoring are possible. Moreover, a Global Positioning System (GPS) sensor and an accelerometer can be used to monitor the route, elevation and mileage. Other sensors such as temperature sensors, microphones, etc. can be employed. Some of these sensor data can be used during the design phase to find the optimal design for the prototypes according to specific requirements. In addition, during the operation phase, other information can be used to actively adjust some parameters (suspension stiffness, wheel friction, etc.) to the current operation scenario and to improve the user experience. Safety devices like airbags or emergency breaks can be also triggered on run-time. A 3-D visualization environment allows for an intuitive visual feedback during the designing phase, while a possible mobile application allows the user to visualise usage data and other statistics. The idea is shown in Fig. 1.



Fig. 1 The idea of realising an integrated virtual and physical rapid-prototyping framework for the design and simulation of high quality sensorised modular strollers.

## POSSIBLE ARCHITECTURE

The proposed architecture is shown in Fig. 2. A controller board of very small dimensions and weight is installed on the stroller. This controller board is the core of the system. Several low-cost sensors can be connected to the controller board as, for instance, encoders and force/torque sensors on the wheels, a GPS sensor, an accelerometer, a microphone, a temperature sensor, etc. The sensor data is collected by the controller board and it can be stored on a memory card for offline analysis in a 3-D simulation environment or transferred wireless to a potential mobile application. These data can be used for several application.

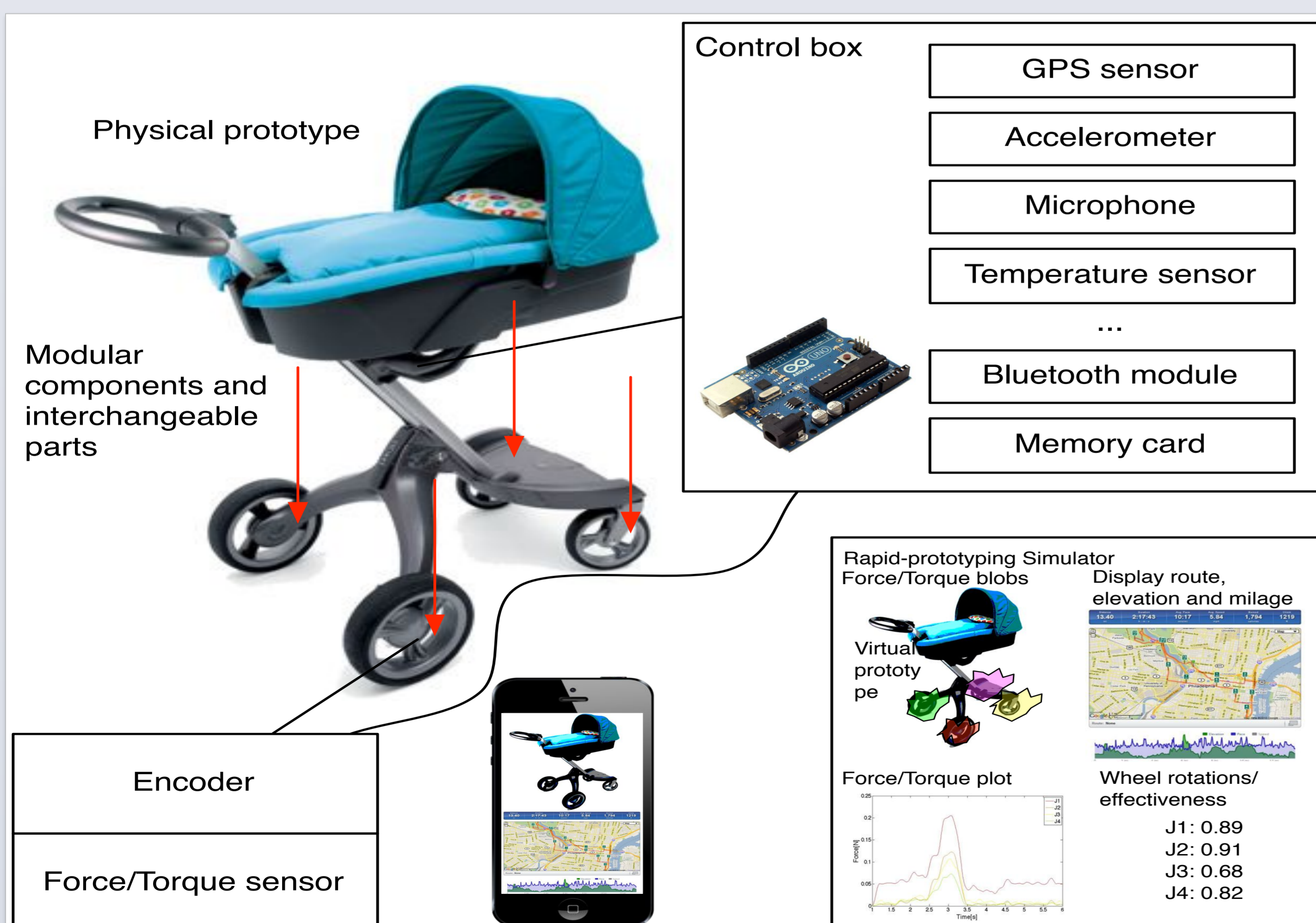


Fig. 2 The system architecture: a master-slave modular pattern is used for the communication protocol.

## POSSIBLE APPLICATIONS

**Innovative design process.** During the design process, an iterative developing approach can be used to find the most effective design for the strollers according to specific requirements. In addition, the effort of each wheel axle can be monitored

and optimised during the design process. To do this, a force/torque sensor is used to continuously measure the load of each wheel. Encoders are used to count the number of revolutions of each wheel and calculate the corresponding effectiveness.

**Safety.** Other important functionalities that can be achieved in a possible operation scenario concern the safety of the baby. Safety devices like airbags or emergency breaks can be triggered on run-time as shown in Fig. 3.



Fig. 3 Safety devices like airbags can be triggered on run-time.

**Smart companion.** The stroller can be used not only as a means of transport for the baby but also as a training device for the parent, which can carry the baby and go jogging in the same time, while monitoring the training section on a possible mobile application through the stroller's sensors.

**Monitoring.** The optimal temperature for the baby can be monitored. An alarm signal can be triggered on a mobile application when the temperature reaches a predefined threshold, as shown in Fig. 4 (a). A microphone could be used to monitor the baby voice and trigger an alarm on a potential mobile application so that the parent would take care of the child, as shown in Fig. 4 (b).



Fig. 4 The temperature and the sound can be monitored and transmitted to a mobile application.

**An Open-Source Framework.** The possibilities for new possible applications are almost endless and new ideas can be integrated to the framework at a later stage. A public Application programming interface (API) can be released so that software developers will be attracted by a new potential market.

## CONCLUSIONS

From an application perspective, the project will improve the technological level and productivity of Stokke AS. From a research perspective, to the best of the author's knowledge, to date there are no similar prototyping framework available in Norway, nor in Europe or in the United States. The system will feature an efficient design approach and several remarkable improvements to the user experience and safety. The project will therefore be unique and it will strengthen the name of Stokke AS in the region, nationally and abroad. All products and figures cited in this proposal belong to the corresponding owners and are for illustration purposes only.

## CONTACTS

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