PROJECT TITLE: DESIGN OF A N FPGA BASED CONTROL SYSTEM FOR SMART WHEELCHAIR

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TECHNICAL DETAILS.

1 PROJECT SUMMARY & BACKGROUND

(max. 200 words)

Nearly five million individuals in the US have limited arm and hand movement, making it difficult or impossible for them to use computers and products with embedded computers, such as wheelchairs, household appliances, office electronic equipment, and robotic aids. Although some current wheelchair systems have embedded computers, they have very little computer control and require precise, low-level control inputs from the user; interfaces are similar to those found in passenger cars. The rider must continuously specify the chair's direction and, in some cases, velocity using a joysticklike device. Unfortunately, many users who could benefit from powered wheelchairs lack these fine motor skills. For instance, those with cerebral palsy might not be able to guide a chair through a narrow opening, such as a doorway, without repeatedly colliding into the sides. These types of physically challenging environments can be frustrating and require a lot of user effort.

Adequate sensing capabilities are the key issue in system working autonomously (or semi-autonomously) in unstructured, unfamiliar environments such as the wheelchair. Networks of sensing devices are one of the emerging technologies for providing such systems with information about status and conditions in a large fragment of the environment. In such networks, a huge amount of sensed data that should be acquired and processed in real time requires both hardware-implemented (or hardware-supported) processing algorithms and intelligent data selection mechanisms (to prevent informational

saturation). The main objective of this project is to improve functionality of networks of sensing devices by incorporating FPGA technologies. FPGA-based solutions can potentially combine advantages of both hardware implementations (small size, optimized timing, high level of parallelism, lower power requirements, etc.) and software approach (flexibility, numerous alternative algorithms, etc.).

This proposal originates from the MIAPS project (CFTD/03/425), in which a prototype for a miniaturized wireless telemetry capsule as developed by our research group, comprising hardware, software and sensors. Originally the prototype proved to has a potential advantage in the medical field and it can be employed to measure or transfer number of signals to the wheelchair.

The main idea behind this study is to develop a very adaptive control system for a wheelchair based on the new partial reconfiguration property of the FPGA technology. Increased system performance, ability of change the hardware and hardware sharing are among the benefits that can be obtained with this FPGA property. Our final goal is to make a smart wheelchair system control that can be configured to a certain state level based on the user commands and environment conditions.

2 PROJECT OBJECTIVES

(Max. 200 words)

- Using the developed wireless module to measure both temperature and blood pressure of the chair user and send the data to controller which will save it as a record through either data logger or external memory.
- IR proximity sensors on the back of the chair detect any obstacles located behind the wheelchair.
- The user will have the choice to select one of thee ways to control the movement of the wheelchair, these are:
  - Drive the chair using the joystick.
  - Use a touch finger system.
  - If the user can't use hands to drive the chair by any of the above two methods, a small wireless module can be used in the mouth and send signals to the control unit by changing the tongue position.
- When human inputs are incorporated in the system, different scenarios can occur. The system should be ready to deal with all the possibilities and configure itself accordingly. For example, the obstacle avoider will be always one and if the wheelchair was near to collide with any close; the controller will act immediately and ignore any other commands from the user that could interrupt this task. At the same time, the controller is continue performing actively on the other jobs