CHALLENGING ASSIGNMENT

EMBEDDED SYSTEMS

SUBMITTED BY

KSHITIJ KHANDELWAL (13BIT0074)

SAMEER GUPTA (13BIT0076)

Cyber-Physical Systems (CPS) are integrations of computation, networking, and physical processes. Embedded computers and networks monitor and control the physical processes, with feedback loops where physical processes affect computations and vice versa. The economic and societal potential of such systems is vastly greater than what has been realized, and major investments are being made worldwide to develop the technology. The technology builds on the older (but still very young) discipline of embedded systems, computers and software embedded in devices whose principle mission is not computation, such as cars, toys, medical devices, and scientifi c instruments. CPS integrates the dynamics of the physical processes with those of the software and networking, providing abstractions and modeling, design, and analysis techniques for the integrated whole.

As a discipline, CPS is an engineering discipline, focused on technology, with a strong foundation in mathematical abstractions. The key technical challenge is to conjoin abstractions that have evolved over centuries for modeling physical processes (differential equations, stochastic processes, etc.) with abstractions that have evolved over decades in computer science (algorithms and programs, which provide a "procedural epistemology" [Abelson and Sussman]). The former abstractions focus on dynamics (evolution of system state over time), whereas the latter focus on processes of transforming data. Computer science, as rooted in the Turing-Church notion of computability, abstracts away core physical properties, particularly the passage of time, that are required to include the dynamics of the physical world in the domain of discourse.

CPSs can be deployed in many different contexts and application areas. Here are some examples:

* Improving efficiency and safety in homes and offices, for example by monitoring and controlling heat and humidity.
* Supporting elderly people living alone, for example by detecting problems (such as illness or accidents) and raising the alarm automatically, using non-intrusive wearable sensors or detectors installed in the house.
* Monitoring safety and movements of passengers in a public transport system, or of vehicles on a road network.
* Optimizing crop yield and reducing pesticide/fertilizer use, by using CPSs to identify and deliver them only where they are needed.