Summary of the administrative activities:

- At the end of the 1st quarter & during second quarters, the NTU team has prepared and shown two demonstrations for Intel visitors: (1) the Intel research Technology Day at Grand Hyatt Taipei on 10/19/2005, and (2) a visit from the Intel’s higher education director, Tim Saponas, at NTU on 1/25/2006. The NTU team has received very positive comments about our demonstrations and would like thank Intel visitors for their encouragements.
- As requested from Rachel, the NTU team has provided a list of our past and recent publications related to digital healthcare (with URLs pointing to the actual papers).
- Due to the administrative process, the NTU team has yet obtained access to the actual Intel funding. It is our hope that this issue can be resolved quickly in the next few weeks.
- This quarterly report covers activities from the previous report (8/1/2005 ~ 10/31/2005) as well as this quarter (10/31/2005 ~ 1/31/2006). As a result, this report is slightly longer.

Summary of the research activities:

- Indoor localization (subprojects 2 & 3): We have created an initial prototype of a Zigbee radio based indoor localization system. We have deployed this initial prototype in a small area of our department building, and the resulting accuracy has been promising – the error seldom goes beyond 3 meters. This level of accuracy is sufficient for tracking people at home. However, due to limited number of Zigbee units we currently have, we can only do a small area testing. We are currently in the process of producing large number of Zigbee units, enabling a wider area deployment and testing. We have also started working on energy-saving for the ZigBee based indoor localization system. We are exploring a sensor-assisted method for energy saving. That method incorporates an accelerometer sensor on a mobile Zigbee unit carried by a person. The accelerometer sensor can detect the human movement level. When the amount of movement is small (e.g., a person sitting on a sofa or sleeping on a bed), the sampling rate of location tracking can be significantly reduced to save battery on the mobile Zigbee unit.
- Activity of daily living inference (subproject 4): We have created an initial prototype of a RFID sensor unit, worn by a person, that can detect any RFID-tagged objects that he/she have touched. Based on where/when/how a sequence of objects that he/she has touched, we can construct a model to infer his/her current activity. Our initial prototype is consisted of a RFID antenna ring and a RFID reader connected to a Notebook. We are in the process of refining this initial prototype to create a RFID ring & a wrist-band (containing RFID reader & ZigBee-Telos).
- Infrastructure (subproject 1): this part is about wirelessly connecting the activity inference engine (running on a RFID wrist-band device worn on a person) and the indoor localization engine (running on a grid of Zigbee location sensors mounted on the home’s ceiling) to a home gateway PC, so that the context information can be streamed to remote caregivers. We are currently prototyping a data routing algorithm to carry location and activity data over the ceiling-mounted ZigBee sensor network infrastructure. The Gateway PC will also be plugged in a USB-enabled
ZigBee unit so that the sensor network data can be sent to the Gateway PC and out to the Internet.

- Demo scenario (interactive care wall): we have discussed a cool demo scenario that can incorporate 4 technology components from the four subprojects. This demo is called the "care-wall". The basic idea is to provide an environment to support "face-to-face" like care for caregivers who are in a different place from the care-receivers. We believe that this would be useful for elders (care-receivers) and their children (care-givers). This involves digitally-connecting two (or more) physically-disjoint spaces through digital "see-through" walls. Below is how we plan to incorporate these technology components:

  - Location tracking on the care-receiver allows the care-wall to "follow" the care-receiver, enabling the care-receivers to always be in the view of the care-givers. Of course, this is given the consent from both the care-receivers and the care-givers. This is similar to a "follow-me" display, except that in our case, it is the follow-care-receiver wall display.

  - A limitation with the care-wall is that the care-givers cannot physically grasp & touch the objects on the care-receiver's side. This limitation can place a restriction on the ability of the care-givers to provide care to the care-receivers. For examples, if the care-receiver is taking a new medication, the care-giver cannot physically retrieve to the medicine bottle and examine its content and instruction. To address this limitation, the wall provides interactivity by enabling objects shown on the care-wall, annotated with their digital representations, “graspable” by the care-givers. For example, it would be possible for the care-givers to grasp (hand-clicking on) the bottle on the care-wall, then, the information about the medicine will be shown/overlaid on the medicine bottle on the care-wall.

  - Activity recognition can recognize and record health-related activities & highlight those (objects) on the care-wall. This extends the Intel care-net display or Gatech family portrait by showing information on the wall. For example, the care-wall display can overlay statistics about the activity level of the elder.

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Scenario description: “It is evening time. The elder mother, Mary (sitting in her kitchen) and her daughter Molly (standing in her living room) are having a conversation over the care-wall. During their conversation, Mary is taking a new medication which Molly is not aware of. So Molly asks her mother - what is this new medicine? Mary said that this is a new medication from which the doctor gave her to control her diabetes. Molly is curious to find out more info about this medication, so Molly touches the medication bottle shown on the care-net wall, and the info about the medication is displayed on the care wall. Molly is curious about why the doctor gave this new (stronger) medication to Mary, so she enquires her mother about her recent diet. To find out more about her mother's diet, Molly checks the content of her mother's fridge. Mary grasps the fridge on the care-wall, from which the content of the fridge is shown (assume a camera is installed inside the fridge). Mary browses through the contents of the fridge (juice bottle, milk, fruits, etc.) Molly identifies that the juice that her mother is drinking contains too much sugar, so she advises her mother about this.

Molly asks about her mother about proper exercise. Molly has recently purchased an exercise machine for Mary, and she would like to know whether her mother is using it. Mary walks to her living room where she has placed the exercise machine. As Mary enters her living room, Molly's care-wall display automatically switches to Mary's living room & a wall in Mary's living room turns on automatically. Mary discussed how she has used this exercise machine.”