Title: Scheduling Sensor Duty Cycling Based on Event Detection Using Bi-Directional Long Short-Term Memory and Reinforcement Learning

Summary:

In this paper, the authors proposed a Bi-Directional Long Short-Term Memory model to predict human activities and turn on the relevant home sensors in order to reduce the energy consumption of the home sensors. By adopting a monitor sensor, the method could detect the unexpected event. Finally they use reinforcement learning to optimize the model and improve the sensors network lifetime.

Main points:
- Human activity recognition based on BiLSTM
  Lots of work has been on human activity prediction by RNN. It is not new but it is useful to turn on the relevant sensor so as to save energy.
  Assumption: However, if the daily routine is irregular, could this method work well?
- Unexpected event monitoring using sentry sensors
  Selecting a sentry sensor and turning it on periodically could detect the unexpected.
  Assumption: However, it is not a good way as the sentry sensor may run out of power quickly then affect other sensors in the sensor network. How to define the duty cycle is another problem.
- Algorithm optimization using reinforcement Learning(Q-Learning)
  It is a common method. Assumption: Why use Q-learning?

Limitations:
- Experiment & Results
  The authors conducted the experiment by simulation based on the open source dataset. How to do that in real life?
  There is no result about how Q-Learning optimized the proposed method?
- How to detect unexpected activity correctly
  This method still will miss some activities, as the accuracy of the detection method is 96.02%.
- How to detect more activities if the power is limited? How to detect the activities with high priority? Such as fall, eating?
- We can use home sensors to detect the position of human beings so that we can find out the related activities, however, it is hard to detect the details. For example, we can detect that the user is in the kitchen and does kitchen activities, but we could not know the food the user eats.

New ideas:
- If the user's movement could be noticed and send the information to the relevant home sensors, could that detect the unexpected better?
- Could the human activity detection method be used on wearable devices?
  Compared with adopting home sensors, a wearable device(like a wearable camera) is more convenient and cheaper, and the wearable device could detect the details of the activities. Of course, we need to figure out the energy consumption problem on wearable devices, i.e. detect more activities while consuming less power.

Reference papers to read:
- Du, Y.; Lim, Y.; Tan, Y. Activity Prediction using LSTM in Smart Home. In Proceedings of the IEEE 8th Global Conference on Consumer Electronics (GCCE), Osaka, Japan, 15–18 October 2019; Institute of Electrical and Electronics Engineers (IEEE): Piscataway, NJ, USA, 2020; pp. 918–919. [CrossRef]