2011 Paper 7 Question 14

Topical Issues

A company making social networking systems is seeking to create a location-aware application to alert users when their friends are less than 50m away. The application should work in three public environments: parks, city streets and indoor spaces such as shopping centres. It will run on smartphones, which may be assumed to have radios for 2G/3G cellular networks, WiFi, Bluetooth, and GPS. These radios can be assumed to be permanently enabled.

(a) Characterise the three public environments in terms of the opportunities and challenges they present for location tracking. [6 marks]

(b) The company will use fingerprinting with 2G/3G cellular signals only in the three public environments. They will use the RSSI value reported for each cellular tower, and the nearest neighbour technique to match vectors of RSSI values.

  (i) Discuss how appropriate the fingerprinting technique is in this context. [4 marks]

  (ii) To compare RSSI vectors they intend to use Manhattan distance rather than Euclidean distance, i.e. for two vectors $\mathbf{x}$ and $\mathbf{y}$,

$$D_{Manhattan} = \sum_i |x_i - y_i|,$$

  where i spans every component of the vectors. By comparing the vector (2,2,2) with (8,8,8), (12,9,1), and (16,0,0), using both Euclidean and Manhattan distance, discuss the advantages and disadvantages of this approach. [7 marks]

  (iii) The database of fingerprints will be large and continually updated. By analogy with A-GPS, suggest how to distribute the map to smartphones efficiently. [3 marks]

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