A Language-Based Lifelogger System

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Introduction

- Lifelog systems, inspired by Vannevar Bush’s concept of “MEMory Extender” (MEMEX), are capable of storing a person’s lifetime experience as a multimedia database.
- Such systems have great potential to benefit people suffering from memory-related diseases, for example, the Alzheimer’s whose prevalence is thought to reach approximately 107 million people by 2050.

Challenges

- Efficiently index large and heterogeneous lifelog data.
- Understand the semantics of a person’s lifelog.
- Develop a lifelogging device using off-the-shelf components.

Solution – Language-Based Indexing

- Main idea: Represent sensory input as “activity language” through vector quantization.

\((a_{x1}, a_{y1}, a_{z1}) \ldots (a_{xn}, a_{yn}, a_{zn}) \rightarrow \text{K-Means Clustering} \rightarrow \text{“EC AB GV …”} \)

\[ S(P, Q) = \frac{1}{N} \sum_{n=1}^{N} \text{Prec}_n(P, Q) \]

\[ \text{Prec}_n(P, Q) = \frac{\sum_{\tilde{P} \in \text{All n-gram types in } P} \min(f_{\tilde{P}}, \text{freq}(\tilde{P}, P), \text{freq}(\tilde{P}, Q))}{\sum_{\tilde{P} \in \text{All n-gram types in } P} \text{freq}(\tilde{P}, P)} \]

- Index the generated activity language corpus using Inverted Index and Suffix Arrays.
- Application 1: Find similar activities in a person’s lifelog.
- The similarity between two lifelog segments P and Q is defined as \(S(P, Q)\):

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- Application 2: Hierarchically segment a person’s lifelog.
- While switching activity at time \(t\), the similarity between activity language strings \([t - w, t - 1]\) and \([t, t + w]\) should be much lower than if \(t\) is inside the same activity for a window of size \(w\).

\[ H(t, w) = -\log(0.00001 + S([t - w, t - 1], [t, t + w - 1])) \]

System Architecture

- Conduct more user studies for the system.
- Generate salient lifelog summaries.
- Discover the semantics of a person’s lifelog.

References