Prediction Algorithms for Multimedia Communication Networks

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Abstract—The following information presents background to understand what is multimedia..? Why we need multimedia..? Why prediction algorithms are important in the multimedia applications..?. Basically communication helps the people to exchange the information through different forms of media. Multimedia systems combine a variety of information sources such as voice, graphics, animations, images, audio and full motion video into a wide range of applications. The advances in distributed multimedia systems have begin to significally affect the development of On-demand multimedia services. The multimedia is evolved as the merging of three industries like Computing, Communication, And Broadcasting. A prediction is a statement of uncertain event. Prediction can be useful to assist in making the plans about possible developments. A prediction algorithm helps in prediction of next probable state of occupant and is a key component in developing an active system. In this paper discussed about the Active LeZi prediction algorithm used in analyzing the smart home system. The example prediction model described in the paper focus on expectable results and assessment possibilities of the methods considering their specific capacity.

I. INTRODUCTION.

Communication is sending and receiving information between two or more people. The person sending the message is referred to as the sender, while the person receiving the information is called the receiver. The information conveyed can include facts, ideas, concepts, opinions, beliefs, attitudes, instructions and even emotions. Some of the primary methods that is used for communication are as follows:

1. Verbal communication is simply sending a message through a spoken language that is understood by both the sender and receiver of the message. Examples of verbal communications include face-to-face talking, listening to a lecture or seminar, and listening to a television program. In fact, if you are listening to this lesson, you are engaged in a verbal form of communication.
2. Written communication is sending a message by the use of symbols that are understood by both the sender and receiver of the message. If you are reading the transcript of this lesson, you are engaged in written communication.
3. Body language is a form of nonverbal communication that can be used to send a message. You can often tell if your boss is pleased or upset simply by looking at his facial expressions, posture and gestures.
4. Visualization is a process of sending the message using graphs and charts, maps, logos etc and also other visualization can communicate the messages in different forms[1].

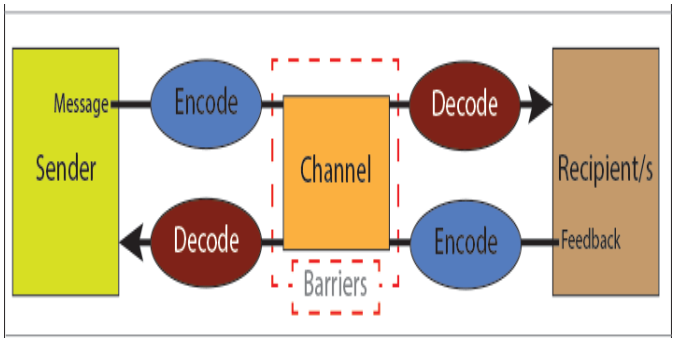

FIG 1: COMMUNICATION PROCESS.

The above block diagram represents the communication process which consists of source as sender, channel as the path to transfer the information from source to destination and receiver as recipient. A message or communication is sent by the sender through a communication channel to a receiver, or to multiple receivers. The sender must encode the message (the information being conveyed) into a form that is appropriate to the communication channel, and the receiver(s) then decodes the message to understand its meaning and significance. Communication Channel is the term given to the way in which we communicate. There are multiple communication channels available to us today, for example face to face conversations, telephone calls, text messages, email, the internet (including social media such as Face book and Twitter), radio and TV, written letters, brochures and reports. After the communication process the receivers of messages are likely to provide feedback on how they have understood the messages through both verbal and non-verbal reactions. Multimedia communication deals with the transfer of protocols, service, mechanism of discrete media data and continuous media data in digital networks. Multimedia itself denotes the integrated manipulation of at least some information represented as continuous media data[1].

II. MULTIMEDIA COMMUNICATION.

The term “multimedia” is used to indicate that the information or data being transferred over the network may be composed of one or more media types. Multimedia systems combine a variety of information sources, such as voice, graphics, animation, images, audio, and full motion video, into a wide range of applications. The big picture shows multimedia as the merging of three industries: computing, communication, and broadcasting. Multimedia an interactive presentation of speech, audio, video, graphics and text, has become a major theme in today’s information

technology that merges the practices of communications, computing, and information processing into an interdisciplinary field. In recent years, there has been a tremendous amount of activity in the area of multimedia communications: applications, middleware and networking. A variety of techniques from various disciplines such as image and video processing, computer vision, audio and speech processing, statistical pattern recognition, learning theory and data-based research have been employed[2].

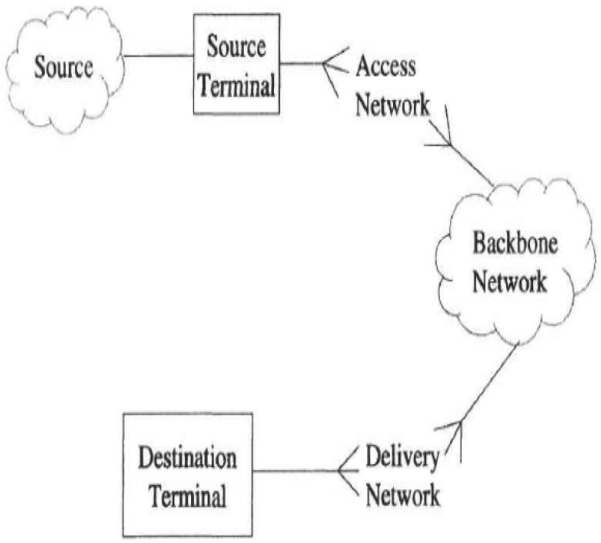

FIG 2: COMPONENTS OF MULTIMEDIA COMMUNICATION NETWORK.

The above block diagram represents the basic components of multimedia communication network consists of Source terminal, Access network, Backbone network, Delivery network and Destination terminal.The source consist of any one or more of the multimedia sources, and the job of source terminal is to compress the source such that the bit rate delivered to the network connection between the source terminal and the destination terminal is at least approximately appropriate. Source terminal may packetize the data in the special way to guard against packet loss and aid error concealment at the destination terminal. The access network may be reasonably modeled by a single line connection, such as a 28.8kbits/s modem, a 56kbits/s modem, a 1.5Mbits/s Asymmetric Digital Subscriber Line (ADSL) and so on, or it may actually be a network that has shared capacity hence packet loss and delay characteristics in addition to rate constraints. Backbone network may consist of physical circuit switched connection, Ip connections, among other possibilities. This network has characteristics such as bandwidth, latency, jitter and packet loss. The delivery network has the same general characteristics as access network. Finally destination terminal may have varying power, mobility, display, audio capabilities[3].

We need multimedia database for following reason:

- Integration.
- Data Independence.
- Concurrency Control.
- Persistence.
- Privacy.
- Integrity Control.
- Recovery.
- Query Support.

III. TYPES OF MULTIMEDIA DATABASE.

There are number of data types that can be characterized as multimedia data types. These are typically the elements or building blocks of multimedia environment.The different types of multimedia databases are Text, Images, Audio, Video, Graphical objects.

1. TEXT: Text includes unformatted text, comprising strings of characters from a limited character set, and formatted text strings as used for the structuring, access, and presentation of electronic documents.
2. IMAGE: Image includes computer generated images, comprising lines, curves and circles, and digitized images of documents and pictures.
3. AUDIO: Audio includes both low fidelity speech, as used in telephony, and high fidelity stereophonic music as used with compact disc.
4. VIDEO: Video includes short sequences of moving images and complete movies/films. One on the most space consuming multimedia data type is digitalized video. The digitalized videos are stored as sequence of frames. Depending upon its resolution and size a single frame can consume up to 1 MB.
5. GRAPHICAL OBJECTS: These consist of special data structures used to define 2D & 3D shapes through which we can define multimedia objects. These include various formats used by image, video editing applications[2][3].

IV. PREDICTION.

A prediction (Latin *pre-*, "before," and *dicere*, "to say"), is a statement about an uncertain event. It is often, but not always, based upon experience or knowledge.There is no universal agreement about the exact difference between the two terms; different authors and disciplines ascribe different conotations. Although guaranteed accurate information about the future is in many cases impossible, prediction can be useful to assist in making plans about possible developments[10].

Basically prediction methods are used in every field. We need prediction method for the possible development conditions. As per the current technology in order to know the need of prediction method the best example is social media prediction (SMP).

By using the predictions in social media we can predict the fact as follows:

- The social media feeds can be effective indicators of real-world performance.
- The rate at which movie tweets are generated can be used to build a powerful model for predicting movie box-office revenue.
- The analysis of the sentiment content in the tweets shows that they can improve box-office revenue predictions based on tweet rates only after the movies are released[19].

V. APPLICATIONS OF PREDICTION ALGORITHMS.

Predictions algorithms are used in wide range of multimedia applications. Some of them are listed below.

- Prediction algorithms used in Smart Homes.
- Enhanced Intra-Prediction Algorithm in AVS-M.
- Prediction based Outcome for Media Streaming Applications.
- Used in predicting Resource Usage for Optimal Multimedia Content Provision.
- Used in predicting the strange future relationship of Yahoo, Google and Face book.

In order to know benefits of prediction algorithms let us study the very first application listed above in detail.

VI. PREDICTION ALGORITHMS USED IN SMART HOMES.

A ‘Smart Home’ is defined as a living or working space that interacts in a natural way and adapts to the occupant. Adaptation refers to the fact that it learns to recognize and change itself depending on the identity and activity undertaken by the occupant with minimal intervention from the occupant. Hence, a Smart Home agent must be able to predict the mobility patterns and device usages of the inhabitants.The Smart Home behaves as a rational agent, perceiving the state of the home through sensors and acting on the environment through effectors. The goal of the Smart Homes is to maximize comfort and safety, optimize energy usage and eliminate strenuous repetitive activities. Prediction Algorithm helps in prediction of next probable state of the occupant and is a key component in developing an active Smart Home.The choice of the Prediction Algorithm used will in turn affect the efficiency of working of a Smart Home. This paper talks about the use of Active LeZi Prediction Algorithm in logical implementation of a Smart Home.

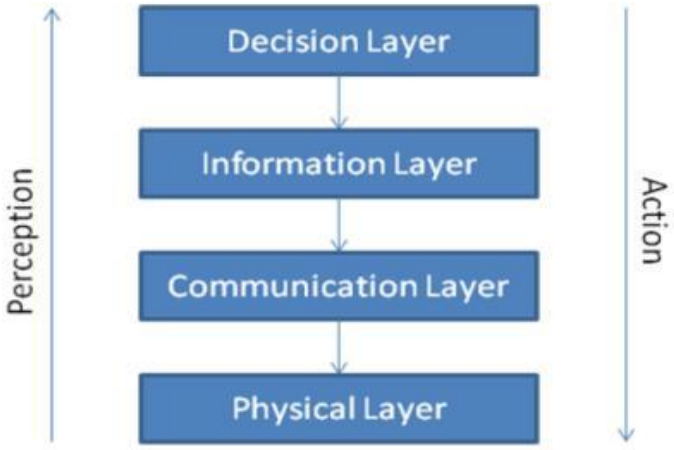

FIG 3: SMART HOME AGENT ARCHITECTURE.

The architecture of a Smart Home can be accurately depicted as four layers.

Physical Layer: This layer contains the basic hardware within the house including individual devices, transducers, and network hardware.

Communication Layer: This layer includes software to format and route information between agents, between users and the house, and between the house and external resources.

Information Layer: This layer gathers, stores, and generates knowledge useful for decision making.

Decision Layer: This layer selects actions for the agent to execute based on information supplied from other layers[12].

Perception is a bottom-up process. The sensors monitor the environment (e.g. the temperature of the home) and, if necessary, transmit the information to another agent through the communication layer. The database records the information in the information layer, updates its learned concepts and predictions accordingly, and alerts the decision layer of the presence of new data. The execution is a top down process. The decision layer selects an action (e.g. adjust the temperature to a lower value) and relates the decision to the information layer. After updating the database, the communication layer routes the action to physical layer. The physical allocates action to the appropriate effectors to execute.

VII. ACTIVE LeZi ALGORITHM.

The Active LeZi is an on-demand algorithm that is based on Markov models and primarily stores the frequency of input patterns in a tree according to the compression algorithm LZ78.

Characteristics of Active LeZi are as follows:

- A growing-order Markov model attains optimal FS predictability, due to the optimality of LZ78.
- As the length of the longest LZ78 phrase grows, Active LeZi stores more and more information; as the input sequence (the experience) grows, the algorithm performs better. This is a desirable characteristic of any learning algorithm.

ALGORITHM:

```
Initialize dictionary:= null
Initialize phrase w:= null
Initialize window: = null
Initialize Max_LZ_length = 0
Loop
        Wait for next symbol v
        if ((w.v) in dictionary):
        w:= w.v
else
        Add (w.v) to dictionary
        Update Max_LZ_length if
Necessary
        W:= null
Endif
        Add v to window
        if (length (window) > Max_LZ_length)
        Delete window[0]

end if
```

Update frequencies of all possible contexts within window that includes *v* forever

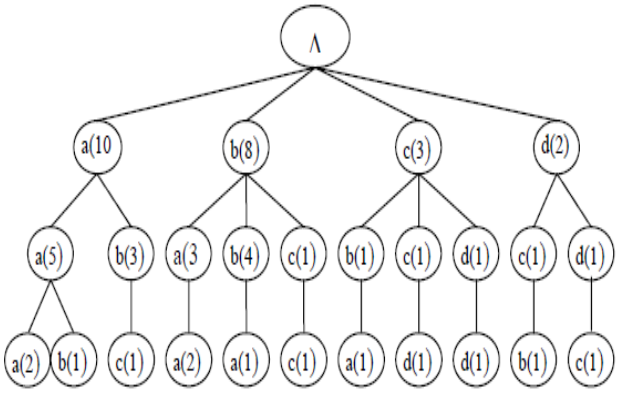

FIG 4: TREE FORMED BY ACTIVE LEZI PARSING OF THE STRING"AAABABBBBBAABCCDDCBAAAA".

This method of assigning probabilities has the following advantages:

- It solves the zero-frequency problem.
- This blending strategy assigns greater weight to higher order models in calculating probability if the symbol being considered is found in that context, while lower order models are suppressed owing to the null context escape probability.

The Episode Discovery can be analyzed as follows:

1) Construct an event sequence *S* from input *O*.
2) Partition *S* into episodes using a sliding window of length *w*.
3) Create candidate item sets from the episodes.
4) Compute compression values for each of the candidate item sets.
5) Using a greedy approach, identify the candidate item set that minimizes the description length of the set of episodes as a significant episode.
6) Remove all of the episodes associated with the candidate item set from the remaining candidate item sets.
7) Remove all candidate item sets that have an empty episode set.
8) Repeat steps 4–7 until the list of candidate.

The above Episode Discovery algorithm helps to gain significant insights to the episodes and the frequency of occurrences. For example, certain conclusions from these algorithms can be as-

- Alarm On, Alarm Off, Bedroom Light On, Coffeemaker On, Bathroom Light On (daily).
- Bedroom Light Off, Bathroom Light Off. Kitchen Light On, Kitchen Screen On (daily) Coffee Maker Off, Kitchen Light Off, Kitchen Screen Off (daily).
- Order Groceries (weekly)[16].

VIII. ADVANTAGES AND PROBLEMS OF PREDICTION METHOD

Prediction Markets use to Improve the Economic Impact Analysis We believe prediction markets can provide better estimates of the relevant parameters. Theoretically, a security could be created for each cost and benefit imaginable. We can recommend two securities can be created. One focuses on the economic benefits and the other on the costs.

The problems related to prediction markets are as follows

- Long-Shot Bias.
- Manipulation.
- Objectivity & Clarity.

IX. CONCLUSION

- Prediction is important in intelligent environments like capturing repetitive patterns (activities), helps automating activities (But: only tells what will happen next; not what the system should do next). Different prediction algorithms have different strength and weaknesses:
  - Select a prediction approach that is suitable for the particular problem.
  - There is no "best" prediction approach.
- The skeletal architecture for implementation of a Smart Home provides an approach to its deployment. The use of a Prediction Algorithm to predict the most likely next state or inhabitant action. This step facilitates decision making for automation of necessary actions; is the most crucial step and backbone of the entire Smart Home framework.
- The Active LeZi Prediction Algorithm is then introduced to help in effective prediction of probable next event. The episode discovery helps to find significant patterns in event history and determine the frequency of its occurrence. It helps to identify which patterns can be automated easily with least fault occurrence.
- The Active LeZi Prediction Algorithm having suitable performance for all the tested parameters. It is easy to understand and implement and thus, an optimum choice for the logical implementation of a Smart Home.

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