

DIGITAL FRAME GRABBING

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ABSTRACT

A system for delivering news and information to cable television subscribers using "digital frame grabbing" is being developed. The use of digital frame grabbing instead of video frame grabbing is rationalized in the light of present technology. Alpha-numeric information in digital form is transmitted repetitively at a very high data bit rate making use of the wide band capability of cable television channels. Information recycle rate is set according to the expected public demand for each particular class of information being handled. A subscriber controlled digital "frame grabber" compares the requested "page number" with the "page numbers" in the data stream in the cable. When the required digital page number is recognized the frame grabber reads the entire "page" into local memory where it is displayed on the subscriber's TV receiver through a local character generator. The cable transmission system acts like a long delay line memory being constantly refreshed by a computer at the "head-end" and being scanned for desired information items by the subscriber's frame grabber. Access times contemplated range from an average one second up to times in the 10-20 second range.

INTRODUCTION

Information delivery on cable systems began more than ten years ago by placing a camera in front of newswire teletype machine. Cable subscribers could tune to one of the cable TV channels and see the teletype machine printing out news and weather information in just the same way that news editors in radio and TV newsrooms were watching the news being printed out in their newsrooms. At the same time similar cameras were mechanically scanning time clocks and weather display dials to provide this information on a cable television channel. The development of electronic character generators allowed the newswire lines to be transferred directly to electronic television format and these systems were gradually refined and improved. As these services grew more popular the news services took the trouble to re-write and re-edit their services specifically for this delivery medium. The service in its present form is an alpha-numeric character generator system operated at TTY speeds, or slightly faster and displayed on TV screens at a speed judged slow enough to suit the lowest

common denominator of reading speed in the subscribing public. Most systems make no special charge for this service, the cable system usually absorbing the charges made by the wire services for supplying the copy. The material displayed, order of presentation and duration of display is controlled by the wire service and the subscriber can only tune in and take "pot luck". Some newer cable systems with surplus channel capacity have installed multi-channel character generator systems with computer controlled formatting and editing which allows the editing of newswire feeds into various categories for display on specialized channels, e.g. a "sports channel", "news channel", "weather channel". These augmented systems usually provide facilities for generation and display of information on a local basis to supplement the wire service feeds.

All of these improvements still leave the service as a rather rudimentary display of information. Channels are used rather wastefully and users still participate on a "pot luck" basis - only the number of "pots" has been increased.

THE IDEAL SYSTEM

At the other end of the information system technology spectrum we have seen demonstrations of interactive information retrieval systems in which the cable system acts as a communications medium between a computerized information bank and a computer terminal in the subscriber's home. Ideally the whole system would be capable of handling "pictures" as well as alpha-numeric information. These idealized systems require a bi-directional transmission capability in the cable system. Such capability is not generally available on Canadian cable television systems except on a strictly experimental basis nor have we seen any systems elsewhere in the world with a fully developed, practical two-way transmission capability.

A PRACTICAL SYSTEM

We have developed concepts and practical designs for a system that permits a useful information system to operate on conventional cable television systems, i.e. on "one-way" systems of the type currently in widespread operation. System and detailed circuit designs

have been developed and now await successful market research studies before large scale pilot operation is attempted.

Our first decision was that a cable information system would have to depend on "frame grabbing" and that such frame grabbing would have to be digital, limiting the system capability to alpha-numeric information and simple graphics. Video frame grabbing, particularly in full colour, was considered too expensive and too complicated to be used in practical home terminals at low cost for perhaps a decade. Digital frame grabbing could be executed with digital integrated circuit technology. Digital IC technology is low cost and is becoming increasingly cost-effective year by year. The phenomenal technical and commercial success of pocket calculators and the long delay and expected high cost of video cassette and disc devices convinced us that digital technology was the route to follow at the present time.

We decided to simulate interactive operation by repetitively feeding information into the cable at very high speed. We also decided that digital transmission at rates of 2 MBit minimum would be required to build a usefull system. Our previous experience with conventional character generators for cable television indicated that a 256 character page of 8 lines of 32 characters each would be suitable as an initial format. This is a rather small number of characters compared with computer type CRT displays but this service is intended for display on home type television receivers in a home type environment. Tube masking is rather uncertain and unpredictable and the sharpness and resolution on many home receivers is marginal. The information displays would be viewed at regular "home distances" as a short term alternative to entertainment viewing.

We decided also to contain the basic service within the bandwidth of a standard television channel - 6MHz. Modems would be developed with this constraint, i.e. the transmission must fit within a 6MHz RF channel and be compatible with conventional television signal transmission on adjacent channels if necessary. We then decided that the first level of information would be provided with a 2 second repeating cycle time so that the average access time for a subscriber would be one second. A subscriber requesting a particular page number might get it immediately if that page happened to be "passing by" or he might wait as long as two seconds if the subscriber "just missed it". The average time would be about one second. Provision has been made for handling full upper and lower case alphabetic characters and the usual complement of numerics and special characters. An 8 bit ASCII code has been selected for initial work. A full 256 character page requires about 2,000 bits and a 2 MBit data rate is capable of transmitting about 1,000 such pages per second. Compare this with the 30 or 60 frames of video transmitted in a television channel each second. A 2 second cycle time means that the full information magazine will be about 2,000 pages.

The "magazine" size can be increased by developing hierarchies of information on longer cycle times interleaved with the shorter cycle time information. Types and items of information judged less popular would be interleaved with cycle times of 4, 8, 16 or more seconds. Subscribers requesting these less popular categories or items would have to wait longer average times for the requested frame to appear. We estimate that the usefull "magazine" size can be increased to about 10,000 frames in this way.

Magazine size is also limited by the data transmission rate. Our initial design is based on simple AM NRZ modulation. We are studying more complex modem technologies that would push our data rate up toward 6 MBit/second. This transmission rate is limited by the economics of the data demodulator that has to be provided in each home terminal and the economics of the refresh memory and data buffer for each home terminal.

The home terminal which we have designed has a simple numeric keyboard on which the subscriber keys the page number desired. It is proposed that the information system be designed around a system of index pages which guide the subscriber to the desired level through three levels of indexing. The terminal grabs the desired digital frame from the system as it becomes available and stores it internally. A complete character generator system within the home terminal provides a colour alpha-numeric display for the home receiver. Initial design integrates the terminal with a conventional set-top converter for tuning function.

Present design uses shift register memory within the home terminal. Present technologies seem to limit us to the 2,000 bit storage requirement of one page as economical for consumer terminals. This means that the subscriber grabs and reads one page at a time. When the subscriber finishes a page he keys a "next page" key which automatically increments the page counter to await the next page. We are watching the development of CCD type shift registers which will give us up to 1,000 characters in local storage at very attractive prices. This is equivalent to four pages and will allow a whole "story" or at least four pages of it to be grabbed at one time for local storage and display. Display of "next page" up to the full four page local memory would be instantaneous. Use of these larger local memories would allow us to increase the size of the magazine since cycle times could be lengthened. A subscriber getting four pages at a time would be more tolerant of a longer waiting time between "stories".

The present design is in the form of conventional TTL digital IC's, and LSI's for character generator ROM and TV sync generator. Pilot tests will use terminals built from these or slightly updated designs. Economical expansion of a successful pilot project to a full scale

operating system will require use of several specialized LSI's.

PROJECTED IMPROVEMENTS FROM PRESENT DESIGNS

We are working on improving our modem techniques to allow economical demodulators for very high speed data transmission (up to 6 MBit). We are experimenting with techniques that would use available, low cost colour television receiver IC's. Colour television chroma demodulation involves "clock recovery" and a complex demodulation of phase and amplitude demodulation. We believe that it should be possible to design a data transmission system that would be compatible with colour television principles. This would allow use of colour television receiver devices and possibly allow future integration of the data terminal into home television receivers as an optional feature. We are also studying the problem of making the terminal compatible with other sources of digital data, e.g. cassette systems which might be plugged in locally. This would allow the terminal and television set to be used with local inputs other than the high speed cable feed.

System capacity can be multiplied by using additional RF channels in the cable system, if these are available.

SOFTWARE

The system has been designed as a generalized alpha-numeric information system. Some market studies have been undertaken and additional studies are under way to determine the best and most economic uses to which this system might

be put. Our corporate interest is in the consumer market, i.e. home subscribers as contrasted to commercial subscribers. Initial studies indicate that "hard news" is the likeliest application for this system although the principles can of course be used for other purposes. For hard news delivery we expect that the system would be operated either by or in co-operation with a local newspaper or other undertaking which already has an active news gathering and editing facility. News for cable delivery would be re-edited and reformatted for this particular medium with the help of a "head-end" computer that would also handle the repetitive data transmission.

ACKNOWLEDGEMENTS

This particular system development began about four years ago. Similar systems have been developed in the United Kingdom using broadcast transmission in vertical interval with a much smaller "magazine". Such systems are now being operated experimentally by both the BBC and IBA. A similar system appears to have been developed in about the same time by Reuters and is being operated experimentally in New York City. The U.K. systems have been widely described under the names "CEEFAX" (BBC) and "ORACLE" (IBA). The Reuters system has, to my knowledge, not yet been described in public.

The contribution of ETC Systems Limited, Rexdale, Ontario, to the detailed circuit designs is acknowledged, and the contribution of Dr. Wes Vivian, of Ann Arbor, Michigan, to some of the system concepts is acknowledged.