PROCEEDINGS OF CITA'07

CITA'07

Fifth International Conference on Information Technology in Asia 2007

Social Computing: Engaging Communities

9 th - 12 th July 2007

Kuching, Sarawak, Malaysia

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Global Information & Telecommunication Institute

FIFTH
INTERNATIONAL CONFERENCE ON
INFORMATION TECHNOLOGY
IN ASIA
2007

PROCEEDINGS OF CITA'07

Edited by

Alvin W. Yeo
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Organised by

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Editorial Preface

This is the Proceedings of the 5th International Conference on Information Technology in Asia (CITA'07), held between 9th – 12th July 2007 in Kuching Malaysia. CITA'07 is organised by Universiti Malaysia Sarawak in collaboration with the ICT Unit, Chief Minister's Department of Sarawak, and Global Information and Telecommunication Institute.

The conference provides an important platform to showcase, in particular, state-of-the-art research in and applications of Information and Communication Technologies (ICTs) in Asia while promoting the exchange of ideas and research results with researchers all over the world. The theme of CITA'07 on Social Computing: Engaging Communities underlies our efforts to highlight emerging trends and technologies. This theme not only covers the traditional roles ICTs play in our lives, but also contemporary ones as well. In addition, the new technological paradigm encompasses not only the technological aspects but also the social aspects of computing, bringing people and communities closer together in their work and play.

This year, we have received a good response of 166 submissions from 10 countries. An International Review Committee reviewed these submissions, and from these, 46 full papers and 22 short papers have been included in this conference proceedings. These papers are presented under 10 major tracks which includes: Agents and Autonomous Systems, Communications Technologies, Community Informatics, Computational Models and Systems, Education Technologies, Emerging Technologies and Platforms, Image Processing and Visualisation, Information Systems, Knowledge Networks and Management, and Software Engineering. This diverse yet complementary range of topics cover the omnipresent nature of ICTs applied in all aspects of our lives.

It is hoped that this conference will also provide a platform to bring together researchers and practitioners to share their knowledge and experiences in preparing us in staying ahead in today's challenging and dynamic environment.

We would like to acknowledge and express our gratitude to the many people who have contributed greatly to the conference. I would like to thank the members of the International Review Committee for reviewing the papers, and the members of the organising committee for their tireless effort in making this conference a success. We extend our sincere appreciation to all sponsors for their generous contribution.

We wish you all an enjoyable conference with fruitful deliberations and bid a warm "Selamat Datang" to our visitors to the Land of the Hornbills.

Dr. Alvin W. Yeo
Conference Chair

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Adaptive Threshold for Lane Detection with Hough Transform

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Abstract - *Lane detection is essentially the problem of locating lane boundaries. It is a difficult problem because of the varying conditions of the lane and surrounding that the robot can encounter while moving. In this paper we present an improvement to our previous lane detection in indoor environment by using adaptive threshold to deal with dynamic environment. Given a real-time video acquired from a camera mounted on top of the mobile robot, the gradient of the current lane in the near field of view are automatically detected, so that the robot wheels are steered appropriately to the intended direction. Parameter space search optimizations and tracking strategies are outlined. Results are presented from the application of the technique to real-time data acquired from indoor scenario of a building.*

Keywords: Lane detection, Hough transform, adaptive threshold, indoor mobile robot.

1 Introduction

Lane detection is a well-researched area of computer vision with applications in autonomous mobile robot and vehicles. However, it is a very difficult problem and remains unsolved. The reason is that it can be very difficult to determine lane markings on various conditions, particularly noise due to the dynamic of the environment, shadows, varieties and inconsistency of the lane markings. A lane detection system must be able to pick out all manner of markings and filter them to produce a reliable estimate of the robot position and trajectory relative to the lane as well as the parameters of the lane itself such as its curvature and width.

Various lane detection methods have been proposed. They are commonly classified into infrastructure-based and vision-based approaches. Infrastructure-based approaches achieve highly robustness, but construction cost to embed magnetic markers on the road surface is high. In contrast, vision-based approaches with camera on a mobile platform use existing lane markings on the road. This approach, however, is very sensitive to the dynamic of the environment. Thus, in this paper we proposed adaptive threshold to analyze the statistical pattern of the image to be used during conversion of the image to greyscale. This is an improvement to our previous work [1] that relies on static threshold value that tends to fail in a dynamic environment.

2 Related Work

A common technique applied to lane detection is based on detecting line via the Hough Transform [3]. Neural networks have been used to attempt to detect lanes and control vehicles [4], but have difficulties on roads not included in their training set. Techniques using tangent vectors have also been shown to be quite robust on well-marked roads, but can fail when lane markings are not well defined [5]. Others have attempted to overcome problems of differing lane markings by using multiple detectors. For example Gehrig [6] detect bots dots on California highways using a specific detector for bots dots using matched filters and detect solid lane markings using more classical methods.

Others, such as Southall et. al [7], propose stochastic methods that able to overcome lighting and road changes while Broggi [8] developed the GOLD system for robust obstacle and lane detection. Earlier, Taylor et. al [9] used a real-time approach for the same problem. Later McCall et. al [10] examined the use of steerable filters in provide robust lane tracking. Comparative survey has been done in the state of the art of lane detection [11].

3 Hough Transform

The Hough transform [2] is a technique which, using some curve representation, transforms a set of points defined over the image space to a set of points defined over some parameter space. Points in parameter space represent particular instances of the curve in the image. Therefore, the strategy used by the Hough transform is to map sets of points from a particular instance of the considered line to a single point representing the line in

Hough space and, in effect, cause a peak to occur at that point. This approach is considered for fitting a straight line, as in equation (1) to data.

$$y = mx + c \quad (1)$$

Here x and y are observed values, and mnd c represent the parameters. If the values of the parameters are given, the relationship between the coordinates of the point is clearly specified. Rewrite the above equation as

$$c = y - mx \quad (2)$$

and, assume that m and c are variables of interest, and x and y as constants. Equation (2) above represents a straight line in the $m - c$ space. The slope and intercept of this line are determined by x and y. A point (x, y) corresponds to a straight line in $m - c$ space, as shown in Figure 1. In practice, the polar form of the line (equation 3) is used rather than the explicit form to avoid problems with lines that are nearly vertical.

$$\rho = x \cos\theta + y \sin\theta \quad (3)$$

If there are n points lying on the straight line, then these points will correspond to a family of straight lines in the parameter space, as shown in Figure 1. All these lines will pass through the point (m, c) in the parameter space. This point gives the parameters of the original straight line.

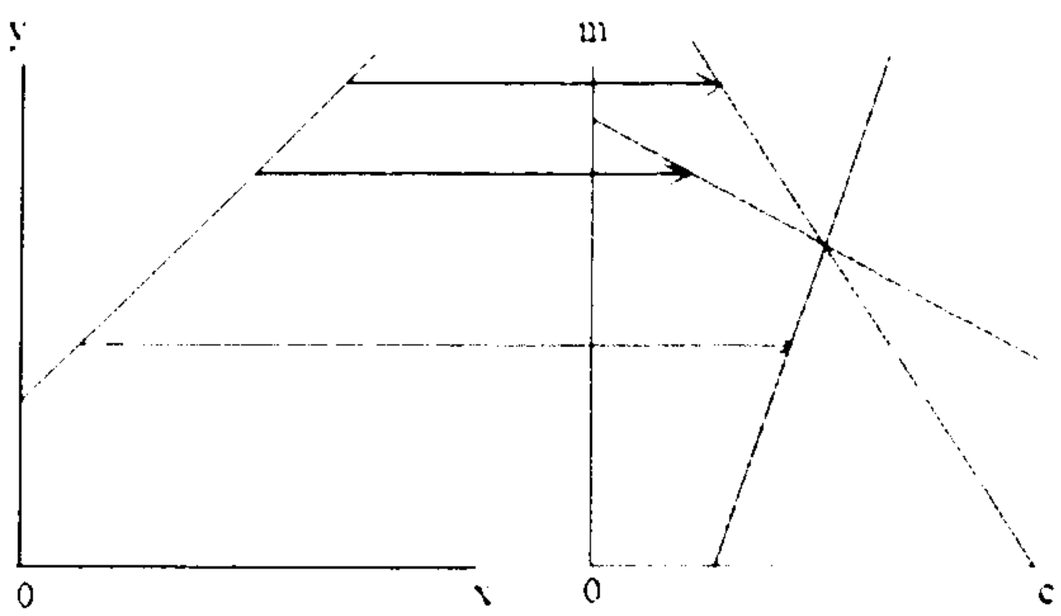

Figure 1. Image-to-parameter space mapping of a point in the Hough transform

In digital image processing, equation(3) can be interpreted as evaluating the total pixel intensity along a line parameterised by ρ and θ. Other interpretations of this transform view the process as that of accumulating votes for each possible line in the image. Lines for which a high number of votes accumulate result in occurrence of peaks in Hough space.

One of the main advantages of the Hough transform is its robustness to noise and occlusion. This is due to the fact that each image point is considered independently of the others. Hence, within reason, the removal of valid edge points, or the introduction of spurious noise points only alters peak intensities in Hough space. A direct consequence of this is the techniques capability to detect broken line patterns used in central lane markings, or lane markings partially occluded by obstacles such as other robots, people and unexpected objects.

3.1 Hough Transform Algorithm

In the case of a straight line, if there are n points lying on this line, then these points will correspond to a family of lines in the parameter space. All these lines will pass through the point (m, c) in the parameter space. This point gives the parameters of the original line.

In finding the straight line that best fits n points in an image,the mapping from image space to the parameter space is used. In this approach, the parameter space is represented as an array of accumulators, representing discrete parameter values. Each point in the image votes for several parameters, according to the transformation equation. To find parameters that characterize the line, one should detect peaks in the parameter space. These steps are summarized as below:

- Quantize the parameter space appropriately.
- Assume that each cell in the parameter space is an accumulator. Initialize all cells to zero.
- For each point (x, y) in the image space, increment by 1 each of the accumulators that satisfy the equation.
- Maxima in the accumulator array correspond to the parameters of the model instances.

4 Lane Detection System

The overall implementation steps of the system are shown in Figure 2 for the purpose of testing the system. The video inputs are taken from a forward looking camera, on top of the mobile robot.

Step 1:
Image acquired from the camera.

Step 2:
Image is threshold to be converted into binary form.

Step 3:
Edge detection is applied to find points of candidate line.

Step 4:
Perform edge thinning process to reduce edge pixels in the image.

Step 5:
Hough transform is applied to find the straight line that best fits the candidate line.

Step 6:
Find maxima, remove fake lines, and pick the best possible line, then send signal to steer the robot to the intended direction.

Figure 2. Steps in lane detection

These inputs are then fed into the lane detection system to determine the state of the robot and its path. A Sobel edge detector is applied on the image to find points of candidate line. The greyscale colours in the image are reduced to black and white using the adaptive threshold operator so as to remove unwanted details before applying a thinning operation.

The threshold value is dynamically selected by performing a statistical analysis on the sampled pixel intensity values. Here the histogram and cumulative histogram of the gradient magnitude image can be created. This approach, the top 10% to 20% of the largest gradient values are selected as edge points.

Because of the nature of the Sobel operator, the thinning operator must be applied to reduce the lines with several pixels width to a single pixel width. The key method is the Hough transform which involves the conversion of pixels in the image from image coordinates (x, y) to parameter space (ρ, θ), and then search in the Hough space to find the long straight lines, which are lane marking candidates. Finally, the best fit candidate line will trigger signal that steer the robot to the intended direction.

In order to perform fast detection, some more post processing on the filter results is performed. First, only the filter candidates within the vicinity of the lanes are used in updating the lanes. This removes outliers from other objects or obstacles in the environment. Moreover, this filtering process reduce computation, thus speed up the calculation.

Secondly, for each lane, the first and second moments of the point candidates are computed. Straight lane markings should be aligned so that there is a high variance in the lane heading direction and a low variance in the other direction. Outliers are then removed based on these statistics. Thirdly, only lanes that start from the lower part of the image are considered, to reduce number of fake lanes.

Finally, fake lines are removed. At this stage, the line cluster need to be grouped as one lane marking and other fake lines need to be deleted. The candidate lines are sorted according to their position in the image from left to right. Then for each line group consisting of closing straight lines, the most possible line as the lane marking is selected and other fake lines (the distance between two lines and their count numbers are used as criteria to judge whether or not this line is a fake lane marking) is deleted.

Because the algorithm uses a local search about the lanes for candidates, it requires initialization. In testing, it was sufficient to initialize the lane tracker position and trajectory to zero (corresponding to the centre of the lane).

5 Experimental Results

The method via Hough Transforms is tested using real-time data acquired on camera mounted on top the mobile robot. The scenario is an indoor environment of the School of Engineering and Information Technology, i.e. the corridor with existing permanent lane marking on the floor, occurrence of shadow and non-uniform lighting condition.

Below are images taken from these tests that demonstrate the system working under these conditions. Figure 3a is the original image acquired from the camera. This image is then threshold to get its greyscale values as shown in Figure 3b.

Figure 3a. The original picture acquired from the camera

Figure 3b – Grayscale of image 3a

In Figure 3c, Sobel operator is chosen for edge detection. This edge detector, however, produce thick lines, which will produce many fake lines later in the post-processing stage. Therefore, edge thinning process is done to reduce number of edge pixels for better computational speed. Figure 3d shows the output of edge thinning process.

Figure 3c – Output image of Sobel edge detector

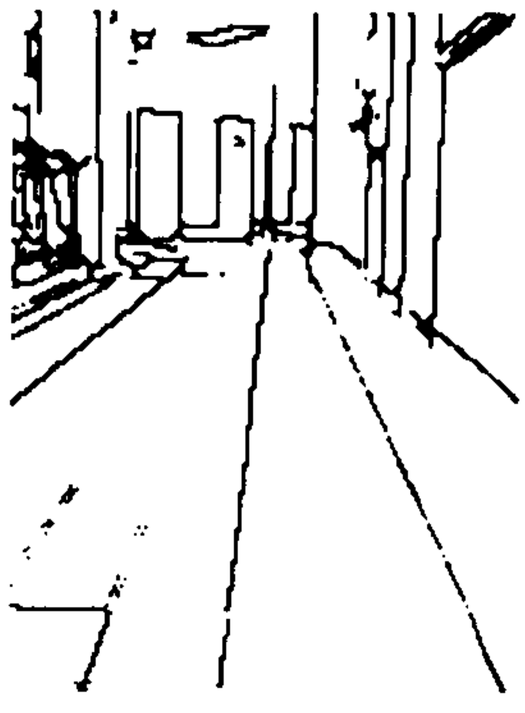

Figure 3d – The output of edge thinning process

Finally, the Hough transform produces the candidate lines as shown in Figure 3e. The initial output, however, contains many fake lines. Thus, in the post-processing step, the candidate lines are sorted and grouped together. Only one best possible line from a group of lines is chosen. This process deletes many fake lines, and produces only a handful of thin straight lines as shown in Figure 3f. As the lane detection system traverse each line from left to right, it will pick the middle as the most possible line.

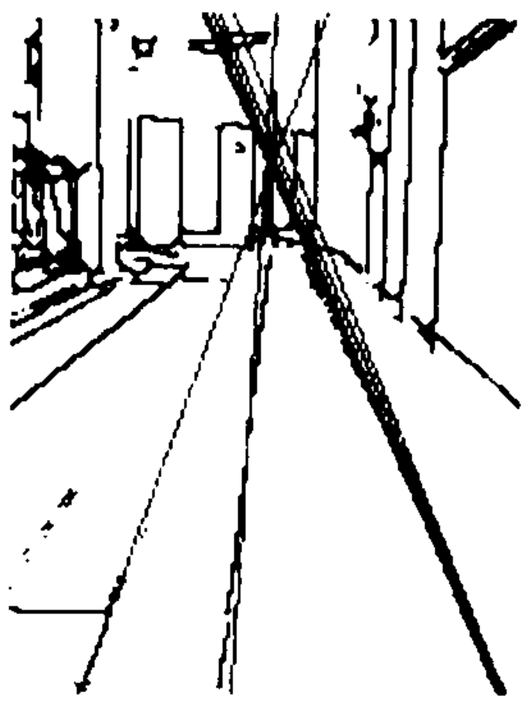

Figure 3e – The initial output of Hough transform produces many fake lines

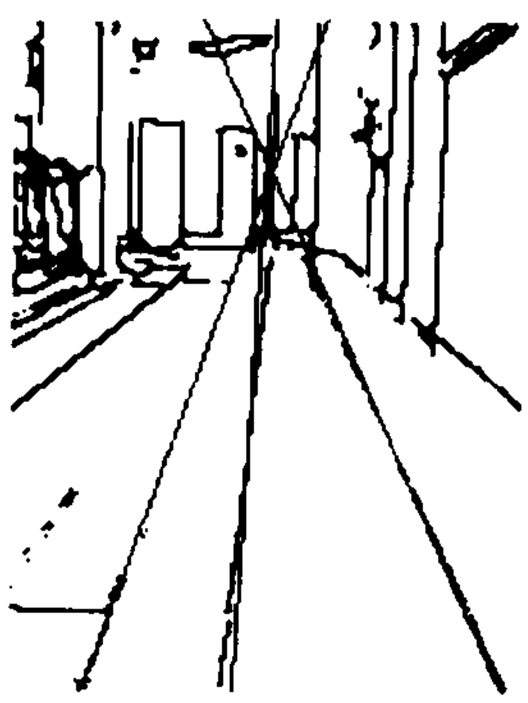

Figure 3f –Final result after fake lines are removed

The performance shows that the method is robust to varying condition of the environment. However, much improvement can be done to speed up the processing, particularly in the pre-processing stage and post-filtering.

One particular challenge in indoor environment is that the lane marking are not uniform in different areas of the corridor.

6 Discussion

Lane detection is often complicated by varying markings in indoor environment, clutter from other objects and shadows, lighting changes, and occlusion from other objects or obstacles. In this paper, a preliminary work to the problem of lane detection in indoor environment is presented. The system demonstrates that it is capable of handling varying conditions of the environment. Future work will emphasize on improving the technique to speed up computation and better algorithm to reduce computational complexity. Wireless transmissions of data to a more powerful processing power and parallel computation for faster performance will also be considered.

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Benefits of In-House e-Procurement System

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Abstract - *The performance in electronic procurement (e-Procurement) may affect the efficiency and effectiveness of the procurement process of an organisation. However, organisations were reluctant to implement this system due to its intangible advantages and potential benefits and the difficulties in using available software. Thus, this research measures the performance level of an in-house e-Procurement system and identifies the differences in e-Procurement performance based on demographic factors. Multi-method approach was used where distribution of questionnaires, interviews and observations were conducted accordingly over time. It was found that the level of performances of the system was moderate at 50.8%. The findings showed a difference between education level and e-Procurement performance exists, significant at 0.05. Few barriers were identified but they were considerably low (2.31) and were overcome during the early stages of the system's development. The system is relatively cheaper and perhaps provides more advantages than those offered by the existing system in the market.*

Keywords: e-Procurement, information technology, Internet, e-Commerce.

1 Introduction

Electronic procurement or e-Procurement is one of the information technologies that apply Internet as a medium of transaction. The e-Procurement system enables suppliers to sell their goods and services online to their customers. It also engages the suppliers and customers directly in a global commerce environment. The use of Internet in Malaysia saw an increasing trend and the number of broadband Internet users have surged to 1.3 million residents in 2006. This phenomenon reflects the importance of Internet not only to individual users but also the industries [1]. However, Malaysia is still lagging behind in Internet-related infrastructure when compared to the western countries. The government has been working hard to ensure that it is not left behind [2] and continues building the knowledge economy in order to uplift the country's competitiveness. Traditional Malaysian retail industries such as shopping malls, financial and security sectors have been undergoing rapid transformation due to the dynamic developments of information technology and telecommunication (ICT). The advent in the Internet has enable procurement to be made online and enhance the effectiveness and efficiency of doing business. E-Procurement system gives a new platform for companies to run their business via online locally and globally [3].

The results from a survey among companies in Penang showed that there was strong interest in the development and potential of e-Procurement system. By using standardized protocols, efficiency and effectiveness may be achieved and will enable companies to participate in the global supply chain [4]. Most companies were positive in terms of their acceptance towards using new e-Procurement technology as a competitive strategy. The benefits provided by e-Procurement system were the main driver for companies to implement this system. The system allows suppliers to introduce and promote their new products through web pages, to receive, manage and process purchasing orders and receive payments. Furthermore, companies can publish their product catalogues innovatively and furnish quotations, tender documents and submit tenders online.

2 Literature review

There were some research studies on the level of Internet used in this country. From the research on all the states in Malaysia, the average usage of Internet is just around 25 percent and Malaysia still far behind if compared to the developed countries. As the country increases its ICT uptake, some of the local companies in this country suffered huge setbacks simply because they were not ready to face the ongoing challenges. For example, the Malaysian Small and Medium Industries (SMI) Association revealed that only 30 percent of the local SMIs have their own websites, and even worse, most of these sites were not regularly updated. The implication here is that the companies still lag far behind in the acceptance of this new but necessary technology [5].

E-Procurement system is one of the technologies that assists companies in managing purchasing process. The acceptance of the system in Malaysia is still low and yet to capture the interest of the masses [2]. The intangible

advantages among the suppliers were one of the reasons why suppliers were hesitant to use this system [6].

Understanding of the e-Procurement system is imperative to ensure the ability of each company to compete in future. Another problem faced by organisations in implementing a procurement system was the difficulties to use the existing software in the market [7]. This was due to the difficulties in integrating the software with their existing procurement process and the longer time needed to design such a system.

Most research on e-Procurement in Malaysia focused on the application of the technology in the industrial sector. However, research on the e-Procurement system which is developed in-house was insufficient. As has been mentioned, the purpose of this research is to measure the level of performance for an e-Procurement system developed in-house by Telekom Research and Development Sdn. Bhd (TMR&D) to cater its own procurement needs.

3 Methodology

The data for the study was collected through questionnaires, interviews and personal observations. One of the authors was given the permission by the case study organisation to stay for almost half a year to conduct this study. The survey instrument was adapted from Quesada [8] and has been tested for its validity. Semi-structured interview was selected because it gives more insights particularly on the problems and barriers of the system. Participant observation was carried out to understand the research phenomena more in-depth and has allowed researcher to gain hands on experience in using the e-Procurement system.

Data was collected from secondary sources via company's documents, journal, articles, seminar papers, newspaper cuttings and also past thesis. Descriptive analysis including means, standard deviation, multiple regressions, ANOVA and t-test were used. For qualitative analysis, data was filtered and all unnecessary data was eliminated in the process of deducing data, displaying data and conclusion and verification of the study [9].

4 Analysis and findings

Factor analysis was carried out at the early stages of the research. Table 1 elaborates the results of factor analysis and Eigen values acquired in each factor and the loading factor for each item in the probability for the benefits of e-Procurement.

From the factorial analysis on e-Procurement benefits, the benefits were grouped into three factors: benefits to user (9.718%), benefits to suppliers (2.103%), and benefits to organization (1.613%). These three factors describe 61.065% from the total of variance for e-Procurement benefits. All the variables have loading values of more than 0.40 in each factor.

Table 1. Factorial analysis and Eigen values for e-Procurement benefits

e-Procurement benefits	**Loading factors**		
Factors*	**Factor 1**	**Factor 2**	**Factor 3**
Benefits for user			
Reduce transaction time	0.828	0.173	2.279E-02
Deliver information to internal customer on time	0.716	0.142	0.352
Reduce transaction costs	0.708	0.403	-1.44E-03
Increase products/services quality to internal customer	0.699	0.199	0.308
Increase flexibility to internal customer's changing needs	0.695	-8.20E-03	0.330
Reduce order processing errors	0.694	0.345	-9.39E-03
E-Procurement system was sufficient	0.664	0.140	0.187
Improve overall service quality to internal customers	0.661	0.553	0.104
Increase communication with internal customers	0.644	0.557	0.149
Meeting internal customer expectations	0.617	0.465	0.274
Increase materials service qualities	0.600	6.329E-02	0.297
Increase reliability of information to internal customers	0.598	0.344	0.300
Reduce paper work	0.511	0.407	0.144
Benefits with regard to the relationship suppliers			
Improve communications	0.150	0.872	8.199E-02
Improve partnership	0.242	0.868	0.152
Improved data sharing	0.164	0.703	0.403
Benefits to the organization			
Reduce inventories	0.191	0.131	0.828
Reduce maverick buying	0.209	8.577E-03	0.812
Reduce number of suppliers	6.267E-02	2.186E-03	0.802
Eigen Value	**9.718**	**2.103**	**1.613**
% Variance	**44.172**	**9.560**	**7.332**

*
Factor 1: Benefits to the users
Factor 2: Benefits with regard to the relationship with suppliers
Factor 3: Benefits to the organization

The benefits for users of the system included reduction in the transaction time (0.828), cost (0.708), paper work (0.511) and decrease in order processing errors (0.649). This system was able to increase material service qualities (0.600), services (0.661) and reliability of information to the internal user (0.598). From the weight value, reduce transaction time was the most significant for e-Procurement system as at TMR&D.

E-Procurement system is also beneficial to the case company in reducing (i) inventory (0.828), (ii) maverick buying (0.812), (iii) number of suppliers (0.82), (iv) delay in the delivery of products (0.465) and (v) cost of materials services (0.402). When compared to all the loading factors higher than 0.8, reduction in the inventory, maverick buying and number of suppliers were the three

main factors that contribute to the benefits received by the organisation.

4.1 Level of e-Procurement

Table 2 shows that the benefits of TMR&D e-procurement system is at a moderate level (50.8%). Many researchers agreed that e-Procurement system provides numerous benefits to its user (e.g. [10], [11]). In this research, the benefits were divided into three categories: benefits to the users, benefits with suppliers and benefits to the organisation. The comparison of frequencies among these three benefits indicates that the benefits to the users was the highest level at 42 followed by the benefits to the organisation and benefits with regard to the relationship with suppliers with frequencies of 46 and 47 respectively.

Table 2. The level of performance of e-Procurement

Level/ Benefits	High	Moderate	Low
Benefits to organization	13	46	30
Benefits to user	42	41	5
Benefits from suppliers	33	47	8
Total	**88**	**134**	**43**

The head of TMR&D procurement unit iterated that this system was introduced to facilitate the procurement process and at the same time provide advantages to the users. With this system, the users felt that executing purchasing was easier as compared to their previous experience with the traditional procurement process.

4.1.1 Performance of e-Procurement and demographic factors

Table 3 shows the significant value for e-Procurement performance based on demographic factors. There was no significant difference between e-Procurement performance and gender, designation and working experience factors. This may be because this system was designed for all the TMR&D workers and more user-friendly. Studies have also found that there were no differences within behaviour and gender [12] and that gender and designation have no effect on the purchasing aspect [13].

On the other hand, there was a difference between e-Procurement performance (benefits for user) and education level. Post Hoc test indicated that this difference exists among Masters and Bachelor degree holders. Leticia (2002) argued that the higher the education level, the higher the preference toward using the Internet or computer [14, 15, 16]. Therefore, the authors believe that the workers with higher education felt more comfortable using the e-Procurement system because education level is related to the acceptance of new technologies [19].

Table 3. Statistical value for e-Procurement benefits based on demographic factors

e-Procurement benefits	Statistical value (siginificance)			
Demographic factors	**Gender**	**Education**	**Experience**	**Designation**
Benefits to organization	0.485	0.734	0.179	0.880
Benefits to suppliers	0.911	0.228	0.672	0.306
Benefits to internal users	0.765	0.042	0.930	0.313

4.2 Effects of e-Procurement system

Results from the interviews with the management indicated that huge benefits can be earned from the implementation of e-Procurement system. For TMR&D organization, the benefits from the system were:

1. The procurement process was more effective and efficient
2. Increased profit
3. e-Procurement was a new technology and in tandem with the current needs for organizational competitiveness
4. More transparent and easier to monitor the procurement process
5. Reduced the abuse of power
6. Better decision on selection of the best product and services

All these benefits were the motivator for the company to develop and adopt its e-Procurement system. From all the listed benefits, the main benefits were transparency, less purchasing process time; reduced purchasing time, and also lower cost and better product specifications.

4.2.1 Transparency

Transparency is an important aspect in running a business especially in purchasing. Attention on transparency can make the purchasing process runs smoother. From the interview conducted, transparency was crucial for the managers to ensure that there is no misuse of power. Conducting purchasing online may increase the level of control of the system which is more open and to avoid suspicions since it may be accessed by any of the staff.

By having this e-Procurement system, all information about purchasing such as the list of suppliers and other purchasing activities are kept in the system database. In addition, the system is also capable of producing latest reports on suppliers' performance and updating of purchasing activities. Thus, every activity related to procurement can be monitored by all the TMR&D staff while getting crucial data about the company's suppliers.

4.2.2 Shorter procurement cycle time

The adoption of e-Procurement system has also shortened the process time for purchasing activities. Report from TMR&D procurement unit shows that the time taken for a transaction process has been reduced from 3 weeks to 3 days.

The short span of time has indirectly helped the researchers at TMR&D to obtain their research materials and equipment faster while at the same time help produce their research products according schedule. Reducing the procurement cycle time lessens the idle period for products and researchers can avoid delays in a particular R&D project.

Previously at TMR&D, the traditional procurement method is used to make purchasing and this purchasing needs to be applied at least three months before any R&D project commences. Normally, purchasing for R&D activities may reach millions of ringgit. The amount includes purchases of machine and equipment from local and foreign countries. On the other hand, careful evaluation must be conducted to ensure that the products purchased fulfill the specification to support and conduct the research. The analysis shows that the system is capable to increase the level of efficiency of the company's procurement.

4.2.3 Reduce procurement cost

Reduction in the overall cost is one of the reasons why majority of organizations adopt e-Procurement system. In the case of TMR&D, the cost is further reduced because its e-procurement system was developed in-house. In terms of the usage of the system, it reduces the cost for sending the information through mail as well as for preparing and printing proposal reports. Users are only required to complete the online forms and the applications will be advertised to the company's registered vendors, making it cheaper, simpler and eventually translated into cost and time savings.

4.3 Advantages of developing in house e-Procurement system

Developing e-Procurement system internally enables organisations to conduct its own maintenance for the system. Different forms of maintenance, updating and upgrading of the system which can be carried out by the staff without having to wait for technical assistance from outside.

The maintenance aspect was also important in making decision whether or not to implement a certain system. This is because changes in technology require changes in organisations to suit the new technology. Therefore the system users must always ensure that they continuously fulfil the current needs. The needs to use different types of system may differ from one company to another depending on the choice of top management.

By developing its own system, the procurement unit is able to make changes immediately according to the management needs. These changes and upgrading are done without maintenance cost and is therefore preferable by the management in the short span period of time compared to the usage of the existing software in the market.

5 Conclusion

ICT plays a significant role to enhance a company's effectiveness and efficiencies and enable companies to compete in the global market. The use of ICT applications such as Internet in procurement is one of the strategies to upgrade and improve procurement process. Previous studies have already proven that the use of ICT in e-Procurement provides many advantages for the company's procurement. E-Procurement improves the purchasing activity and makes it simpler than the traditional method which is more complex, cumbersome and inefficient.

Overall, internally developed e-Procurement serves as an alternative to those companies that are eager to improve their purchasing process but are constrained in terms of capital and expertise needed. Although there were few weaknesses in the e-Procurement system, it should be a hindrance for companies to implement the system as it proves to offer more advantages and benefits.

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HCI for Non-Literates: An Experience from Sambad Project

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Abstract *- Trends in social computing has shown that Internet users have evolved from consumers into producers and contributors. However, these trends are not true for countries like Nepal, where the literacy level is just above 50%. Literacy has been a prerequisite for the use of computers. Still, the illiterate societies have a strong thirst of knowledge and hold valuable indigenous knowledge that can be shared on the Internet, but there is no proper Human Computer Interface for them. Software which allows illiterates to create and browse their multimodal webpage using speech and images can be a solution for this problem, if there is a better interaction design. Sambad attempts to build an interaction design which exploits visual, aural, observational and tactile learning human behavior for access of computers for non-literate people.*

Keywords: ICT for Rural Communities, Human Computer Interaction for non-literates, Multi modal web authoring and browsing tool.

1 Introduction

New IT enabled devices have been the reason behind the emergence of new types of social organisation and cultures in the developed world. Online networks, communities, blogs, pod casts are some of the new examples of these cultures.

However literacy seems to be a prerequisite for computing because user interfaces for software are conventionally text based. Literacy in Nepal is 48.6% [1], thus, half the population is denied access to, and benefit from computers, before other issues like connectivity, economics and so on are taken into account. We use the terms 'illiterate' and 'non-literate' interchangeably, though we prefer the latter because it is less pejorative. The sense we intend is being unable to read and write written text, and not the broader views of literacy as a being able to understand pictures, use technology, and so on.

We want to help illiterate people to join the information society, and recognise that they needed software that did not depend upon writing but instead was 'text-free' which stored information and interacted with the user though speech and images.

Available applications focus mainly on literate users preventing the use of computers by the illiterate. So we surveyed, interviewed and conducted focus group discussions in different parts of the country to gather information on what type of applications could be useful to the non-literate people. From our survey that a strong thirst for knowledge and rich indigenous knowledge was evident in the rural communities. It was obvious that this information is needed to be delivered text free, with pictures and speech, and with a user interface that is easy to use. Hence we decided to build a Multimodal Web Editor and Browser which uses 'speech as data' and has support for touch screens.

We have been addressing two fundamental research questions:

Question 1: Could we put together software working with speech and images but no written text, providing all the functions that would have been provided for text, taking standards and modules from the public domain and open space?

Speech needs to be compressed and decompressed, and many of the compressions algorithms like MP3 are subject to patent and license fees. We want to be able to do standard editing operations on speech of which searches and cut and paste seems to be the most challenging. In section 2 we discuss the various choices we had to make, and the architectural framework that we used to guide those choices.

Question 2: Could we present these functions addressed in question 1 to non-literate users so that they could understand what to do and do it effectively?

Illiterate users will also be technically inexperienced and never have seen a computer before, though they may have used televisions and mobile phones. This meant that we had to be open to different kinds of interfaces, questioning ourselves continually about what would be an appropriate interface, evaluating and modifying our interfaces in cycles of user-centered design. We give a flavour of those interfaces and how we evaluated them in section 3, though a fuller description is given in Sambad – the design of computer interfaces for non-literates.[2]

Neither of these questions are trivial questions.

2 The System

2.1 Software System Overview

Sambad is a text free system, Multimodal Web Authoring and Browsing Tool, designed to provide all the functions that would have been provided for text. It can be broadly divided into five parts: file management, Custom UI Widgets, file importer, file editor and synchronizer as well as login, which comes under the initialization process (see Figure 1). File Playersub-component is used commonly by file editor, file management and Custom UI Widgets. Sambad reuses various open source projects and open standards for lower level functionalities like SPEEX codec [3], XML, audio speed adjustment etc., and uses different design patterns to integrate these components.

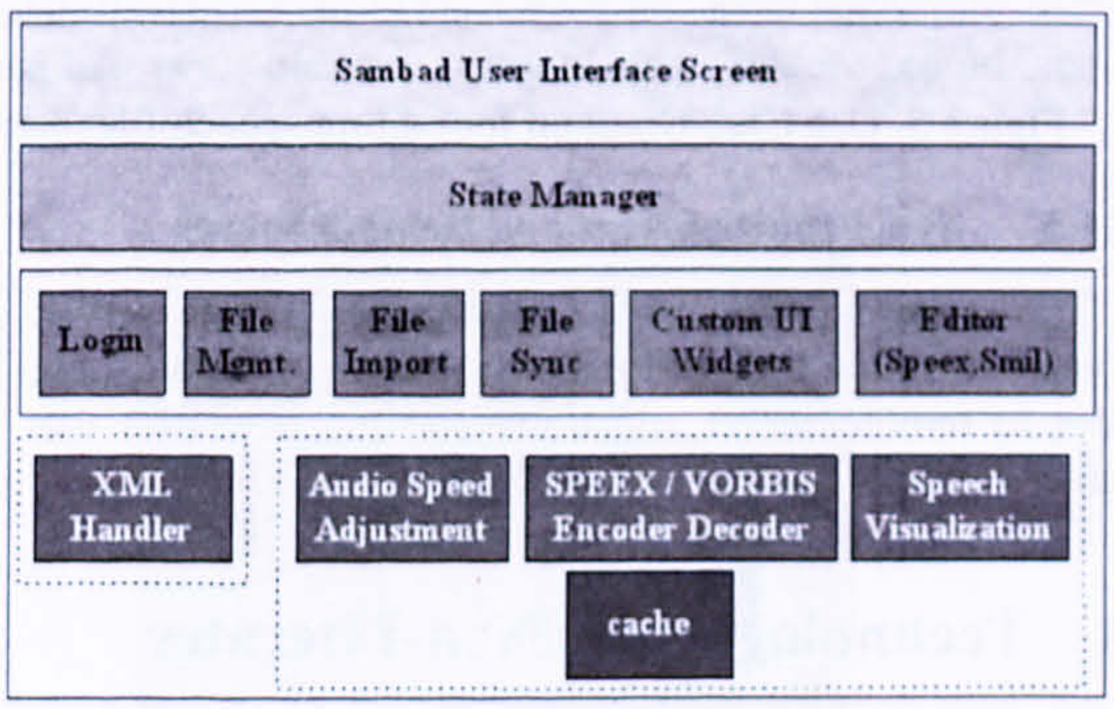

Figure 1. Block Diagram

The activity diagram in Figure 2 shows the basic business and operational workflows of components in Sambad. When the program is started, after the successful login Sambad client synchronizes with remote Server. Synchronization is the process of downloading new files from the server and uploading newly created or edited files to the server. Users can start doing various activities as shown in the use case diagrams that follow.

2.1.1 File Management

Sambad file system is a hierarchical file system, with three levels which simplifies the conventional file hierarchy. This hierarchy is maintained using an XML file. The village is a root under which there are different places (e.g.: home, school, etc.). These places have private and public cupboards. A user is provided with private and public cupboard in one's home directory, where one can create SMIL [4] presentation, record speech, import files and export them. There will be domain experts to administer places apart from home.

The system currently supports 4 types of files namely SPEEX, image, SMIL, and album. SPEEX files are the audio files encoded in SPEEX format that the system uses to play instructions. Sambad supports all file formats for image files that Java Swing supports. Album is a collection of these image files.

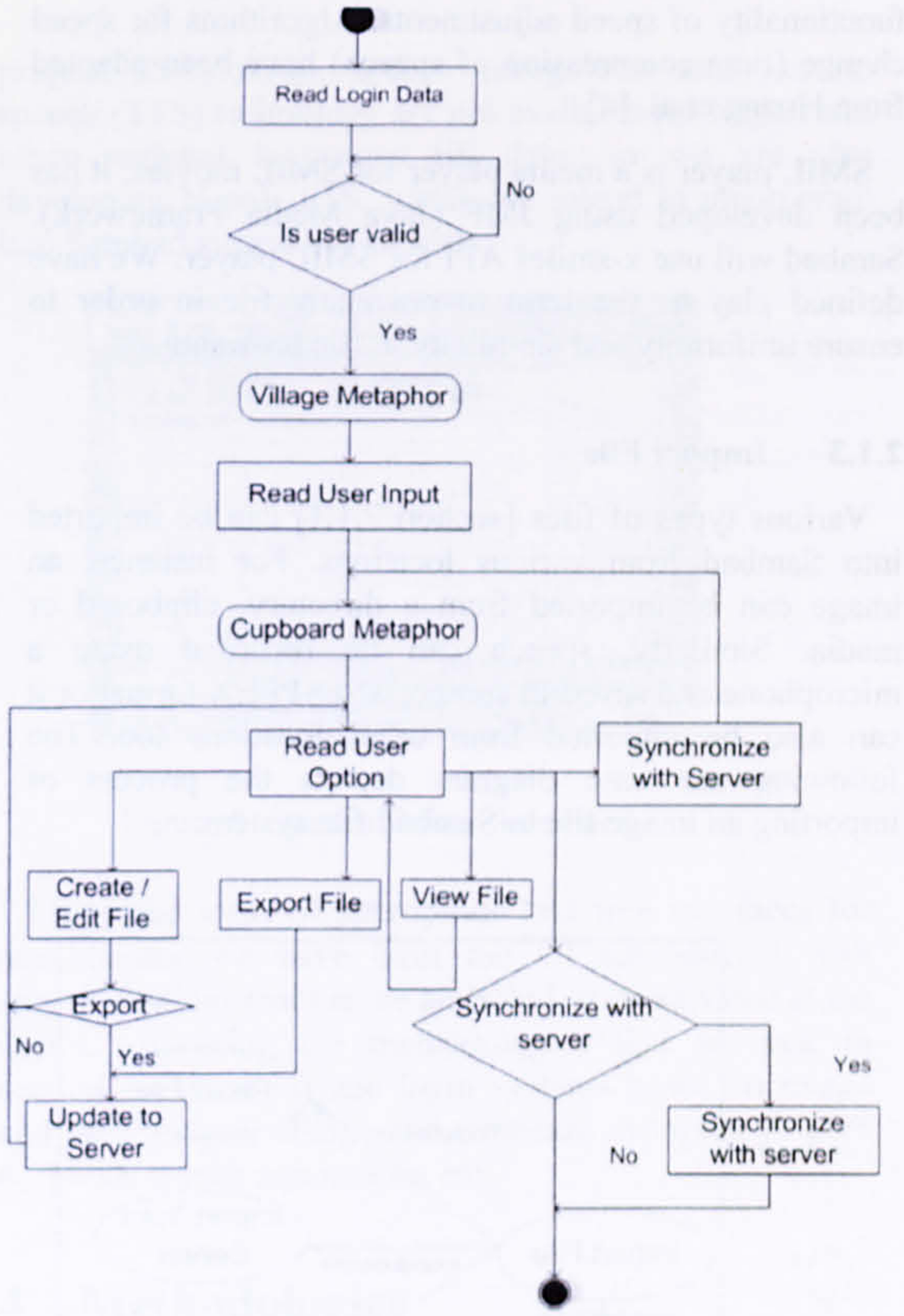

Figure 2. Activity Diagram of the System

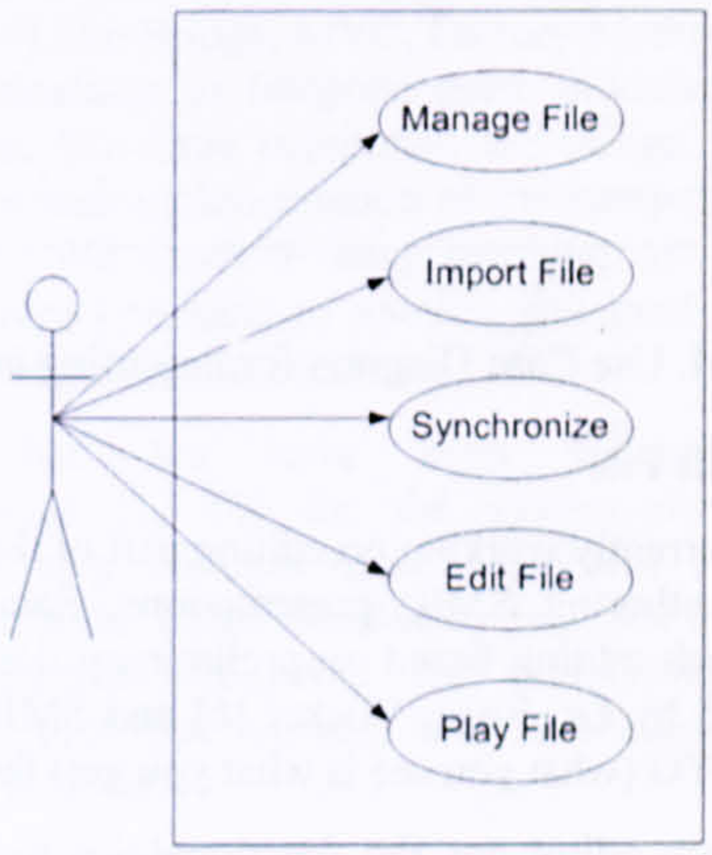

Figure 3. Use Case Diagram of the System

2.1.2 Play File

Sambad identifies all file previewing as File Play. Based on the file types, there are 4 different types of players namely image viewer, album viewer, SPEEX player, and SMIL player. Image and album viewer are components that display images in JPEG, PNG, GIF, BMP, etc. format. SPEEX player is an audio player which decodes audio files in SPEEX format and has the