Intelligent Rock Vertical Shaft Impact Crusher Local Database System

Zamani Md Sani[1], Nor Ashidi Mat Isa[2], Shahrel Azmin Suandi[3], Mohammad Subhi Al-Batah[4] Kamal Zuhairi Zamli[5] and Khairun Azizi Azizli[6]

[1,2,3,4,5] School of Electrical & Electronic Engineering,
[6]School of Mineral and Material Resources Engineering,
Universiti Sains Malaysia, Engineering Campus, 14300 Nibong Tebal, Penang Malaysia

Summary
Aggregates are one of the major components in the concrete production. The aggregates output from the Rock Vertical Shaft Impact Crusher **(RoR VSI)**, had been classified to six groups of shapes then divided further into two categories namely the high quality aggregates and the low quality aggregates. The characteristics of the aggregates such as shape, size and color, do play an important roles in the development of high strength concrete. In order to produce high quality aggregates, the system would need to be monitored and maintained continuously by analyzing the past and current data. Presently, there is no database system to store the images for the classified data. The conventional method of the aggregates is done manually which is slow, highly subjective and laborious. Therefore, a local database system is proposed to store information could help to overcome this problem. The images and aggregates' recognition and classification data will be kept in order and it will have a simple and easy way of storing and retrieving information. The machine performance can be retrieved for any period of time by calculating the output for high quality aggregates out of total of aggregates produced. The shapes break down for all six recognizable shapes also can be displayed. These could help the engineer to monitor the system on output performance with continuous analysis, with shorter time. Other than that, the strength of the concrete can be determined by counting the number and the percentage of good quality of aggregate being used.

Keyword:
Rock Vertical Shaft Impact Crusher (RoR VSI); Local Database System; System Performance; Shape Breakdown

1.Introduction

The Granite and the Limestone are still remained the main rocks types used for the aggregates production. The aggregates are referred to these crush rocks which normally used in road and other construction purposes [1]. It is a fast growing and emerging industry as one of the most demanding with a lot of expectations to fulfill the needs and the requirement for various industry and domestic purposes.

The characteristics of the aggregates such as the shape, size and color do play an important role in the development of high strength concrete. The most current trend in aggregate production is changing towards producing high quality aggregates with improvement in its characteristics such as more cubical or equidimensional in shape and better graded or distributed size for 'high strength' concrete [2]. Also, improvement in the shape has been proven to be a major factor in the reduction of the water to cement ratio needed to produce a concrete mixture [3][4]. Stronger or high quality aggregates tend to produce stronger concrete as the weak planes and structures are being reduced. These aggregates also can reduce the water to cement ratio needed to produce a concrete mixture and producing higher density and strength concrete while the lower quality aggregates such as elongated would has less surface area per unit volume and therefore packed tighter when consolidated [3].

At Engineering Campus, University Sains Malaysia, a group called COMMREC (The Comminution Research Consortium) is actively working on the production of high quality aggregates to produce better concrete with higher strength, Several researches which had been successfully carried out by COMMREC are the studies on the effect of shaped aggregate on strength concrete [5] and also the studies on the production of high quality aggregate from the vertical shaft impact crusher as a feedstock for high technology construction material. By using Metso Barmac Rock on the Rock Vertical Shaft impact (RoR VSI) crusher from New Zealand, Rajeswari

et al. [6][7] had classified the aggregates into six groups of shapes namely cubical and angular for high quality aggregates while irregular, flaky, elongated and flaky and elongated classified as low quality aggregates as shown in Figure 1.

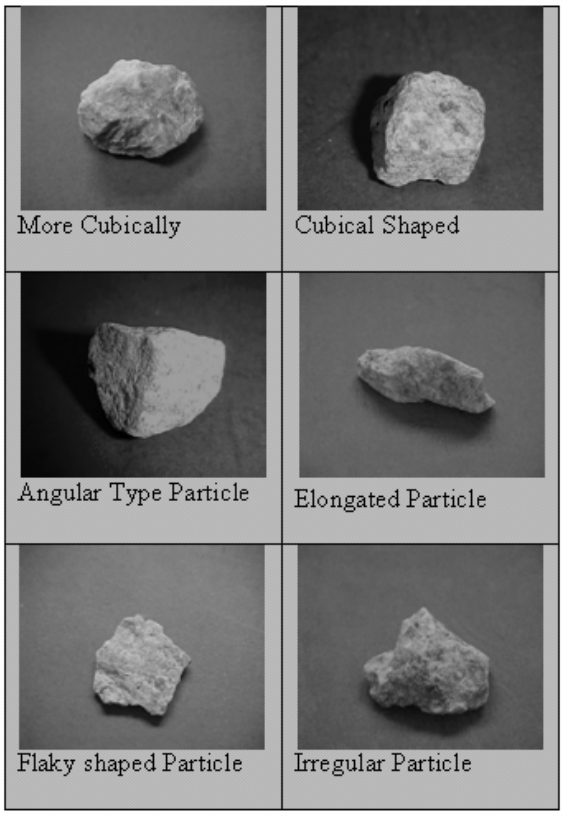

Fig. 1 Aggregate Classification

Presently, the conventional method which is by manual classification and paper records for storing the information would be easy to lose or mix up the information with other data. The methods involves determining and counting aggregates one by one which would seriously consuming time and effort to record the information into the log on the aggregate produced. With this output monitoring and no database system to store all the information and the images of the aggregates by the machine, it is hardly for the engineers to determine the quality of concrete produced by specific crusher. The determination of system performance based on how many high quality aggregates from all total aggregates produced, would take longer time and there would be chances to have inaccurate data for system analysis.

Database system is a structured collection of records or data that is stored in a computer [7] and it is also a good source of image references because the images in the database do not degrade with time [12]. A single tiered application is proposed because it can be easily developed and implemented in a personal computer. The database would be a system which can be applied to store the data in logic order and reduce the data redundancy. Therefore it would improve significantly the conventional method in recording and storing the data for future retrieval. It will definitely ease the process of storing and retrieving data. The data send to the database would be the image and the details information after the aggregates had going through the real time recognition process. By storing all these information in one place, engineers would easily determine the RoR VSI system performance for any duration period of time. Furthermore, the breakdown of all six recognizable shapes for aggregates can be retrieved also with shorter time. The database would be able to segregate the shape information and present the breakdown in a chart form. From the pareto, engineers can easily determine the strength of the concrete by looking at the number and percentage of high quality aggregates being used.

2. Methodology and Data Samples

Database is designed to be for the local database (single tiered application) since it is being developed in a personal computer. It is being developed by using the C++ Builder program which using the ActiveX Data Objects (ADO) to access database information through the Object Linking and Database (OLEDB). ADO is a Microsoft Standard while the OLEDB is an Application Programming Interface (API) designed by Microsoft for accessing different type of data stores in a uniform manner [8]. By using the ADO-based component, it will integrate the application into an ADO-based environment [9][10][11][13]. Therefore, the table used in the design created in the Microsoft Access software. The database table as in Figure 2, consists of Aggregate ID, Machine ID, Operator ID, Shift, Date, Time, Shape, Quality, Image and Test Status. Table will be updated with the new records periodically. Database and system utilities are two main parts for the system. System utilities are combination of system performance indicator tool and the shape breakdown in charts.

AggMain : Table

Agg ID	Machine	Operator	Shift	DateTime	Elapsed Time	Shape	Quality	Image Name	Date	Status
1	A	Zam	A	4/18/2007 6:52:09 AM	0	Angular	High	20070418065209.jpg	4/18/2007	PASS
2	A	Zam	A	4/18/2007 6:53:09 AM	0	Cubical	High	20070418065309.jpg	4/18/2007	PASS
3	A	Zam	B	4/18/2007 12:25:32 PM	0	Cubical	High	20070418122532.jpg	4/18/2007	PASS
4	A	Sham	B	4/18/2007 1:12:11 PM	0	Cubical	High	20070418131211.jpg	4/18/2007	PASS
5	A	Sham	A	4/19/2007 9:06:52 AM	0	Elongated	Low	20070419090652.jpg	4/19/2007	FAIL
6	A	Sham	A	4/19/2007 10:12:15 AM	0	Elongated	Low	20070419101215.jpg	4/19/2007	FAIL
7	A	Zam	B	5/30/2007 1:10:32 PM	0	Flaky	Low	20070530131032.jpg	5/30/2007	FAIL

Fig. 2 Access Table Format

675 samples of aggregates with different size and shapes were used for the data storing in the database. All samples will be going through the real time recognition process and each of the sample images and data will be sent to the database for processing and eventually store in the database. All these processes would be done automatically. To avoid redundancy on the data format, the date and time format is being used for the images store in the database system as in Figure 3. The JPG format is used for the data storage to reduce the usage of the computer.

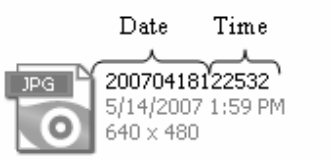

Fig. 3 JPEG name format

3. Results and Discussion

The main interfacing by default displaying the selected single record, (test information details and image) pointed by the cursor in the data grid resembles as the aggregate database table as shown in Figure 4.

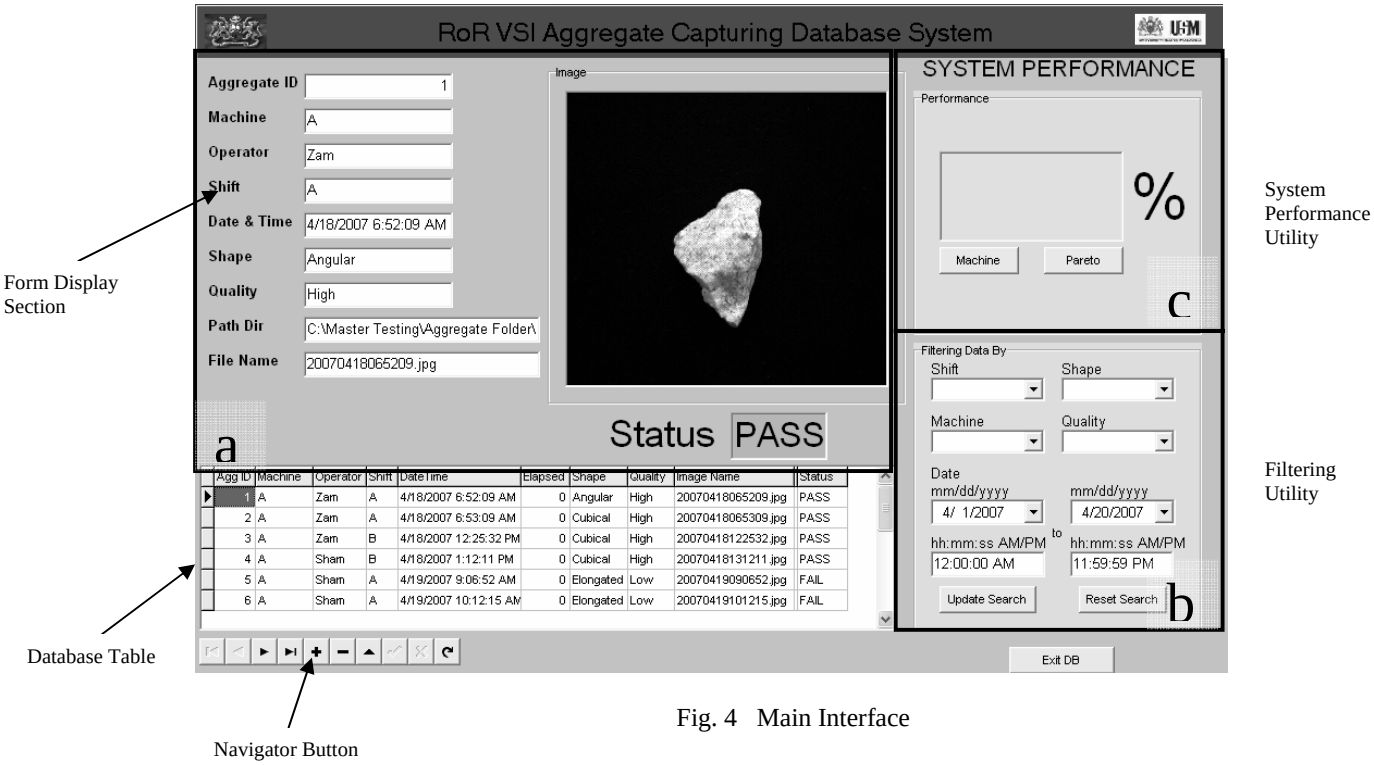

Fig. 4 Main Interface

User can scroll the data by using the mouse pointer at the records or by using the navigator button. This will display the selected information and the image selected by user as shown in the Figure 4 section a. The filtering tool can be used to filter record in database based on the requirement needed. Six criteria are available for the filtering methods which are by Shift, Machine, Shape, Quality, Date and Time as in Figure 5. User can set their inputs in the combo box and update the search by hitting the Update button. This method can give user an easy way to do filtering instead of writing a query language which may not be able by few people. The filtered data will also be displayed as per normal at the main interface. The system performance utility will calculate the performance of the machine as in Figure 6. This indicator could help the engineers to be alert on the system performance. User simply can get the status by selecting the date and time and perform the calculation. It will calculate the ratio of good

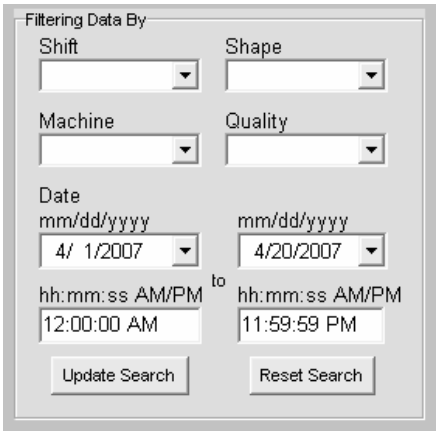

Fig. 5 Filtering Utility

aggregates produced and total of the aggregates produces can be expressed as in equation (1).

$$System\ \ performance\ = \frac{Total\ \ good\ \ aggregates}{Total\ \ number\ of\ \ aggregates} \times 100$$
$$= \frac{Total\ \ angular + total\ \ cubical}{Total\ \ number\ of\ \ aggregates} \times 100 \quad (1)$$

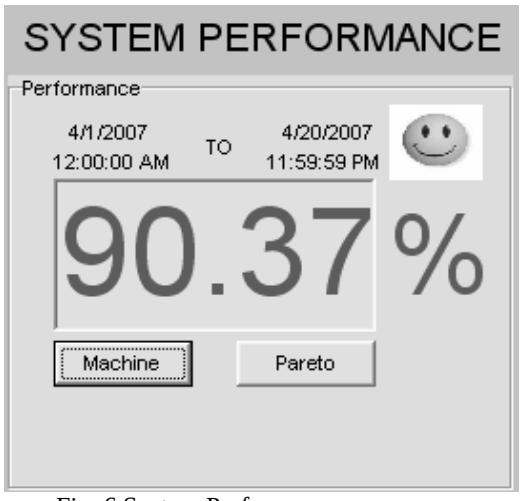

Fig. 6 System Performance

In order to find details of the system performance, the breakdown by shape utility is available as in Figure 7. The utility will calculate the total of aggregates produced for any duration of time and segregate it accordingly to 6 shapes recognize by the system. By having this information, the concrete strength can be determined.

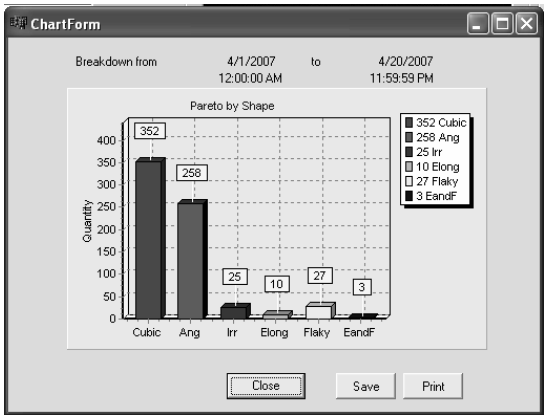

Fig. 7 Shape Breakdown

The conventional method is time consuming and highly subjective in doing all the segregation as it will involve by looking one by one for the features which are the faces, edges and corners of the aggregates plus the manual data recording would probably cause inaccurate data thus misinterpreting the system performance. Comparing with the propose system, it would improve the time taken for the data storage and retrieval which will contain accurate data analysis thus improve the performance in the real time application.

4. Conclusion

From these results, it is proven that the database system can be applied to store the data in logic order. Data can be kept electronically reducing the risk of missing and inaccurate results while working with the data, which improve the data integrity for the machine. The system would definitely ease the process of storing and retrieving data. In the other hand, information on the machine performance, plus the aggregate breakdown by shape would ease the user to perform system analyzing faster and effectively, eventually will benefit the user as a source of information for relationship of machine performance relatively with the aggregates produced. Commonality studies also could be performed by querying and analyze the data for faster and efficient troubleshooting. It will provide the essential data used by engineers or statisticians to perform Machine Capability Analysis or Correlation between machines.

ACKNOWLEDGEMENT

This work is supported under eScience Fund Grant entitled 'Development of an Automatic Real Time Intelligent Aggregate Classification System Based on Image Processing and Neural Networks'

References

[1] Barry H. Better aggregates mean less expensive concrete, 1998. Available from http://aggman.com/Pages/Agg%01198/Processing1198.html.
[2] Hamer, M.D. "The Vertical Shaft Rock on Rock Impact Crusher as a Producer of Quality Construction Materials" Tidco International , New Zealand, 1991
[3] Hudson, B. "The Effect of Manufactured Aggregate and Sand Shape on Concrete Production and Placement" Svedala New Zealand Limited. August 1995
[4] Kwan, A.K.H. & Mora, C.F. "Effects of Various Shape Parameters on Packing of Aggregate Particles" Magazine of Concrete Research, Vol.53, No.2 pp. 91-100.2001.
[5] Kamarulzaman, K.B., Diah, A.B.M., Khairun Azizi, A. & Sri Raj Rajeswari, M. "Effect of Shaped Aggregate on Strength of Concrete",
[6] School of Materials and Mineral Resources Engineering, USM, pp. 76-78,2002
[7] Rajeswari. M.S.R. Khairun Azizi, M.A. & Abu Bakar, M.D. "Studies on the Production and Properties of Shaped Aggregates from the Vertical Shaft Impact Crusher", Proceedings of the 3rd International Conference on Recent Advances in Material and Environment 2003. pp. 192-197. Penang Malaysia, 20-22 October 2003
[8] Rajeswari. M.S.R. Khairun Azizi, M.A. & Abu Bakar, M.D. & Kamarul Badlishah, K. "Production of High Quality Granite Aggregates As A Feedstock for High Technology Construction Material" Post Graduate Research Papers 2001/2002, School of Materials and Mineral Resources Engineering, USM, pp. 67-78 2002.
[9] Wikipedia.com at http://en.wikipedia.org/wiki/Main_Page
[10] Reisdorph, K. 1998. Teach Yourself Borland C++ Builder in 3 in 21 Days. Indianapolis: SAMS Publishing
[11] Borland Software Corporation. Developers Guide Borland C++ Builder 6 for Windows. Scotts Valley, California
[12] Brown C.E., Petrusha R. Access VBA programming. McGraw Hill, Emerville, California.
[13] Ghafar, G., Mashor, M.Y., Othman, N.H., Mat Isa N.A. 2003 Local Database System for Pap Smears. In Investing in Innovation 2003, Vol 5: Science and Engineering, ed. Y.A. Khalid et al., pp. 389-392. Universiti Putra Malaysia Press, Serdang, Selangor Malaysia.
[14] Lewin M, Access 2003 in easy steps 2006; Warwickshire UK.

[1]**Zamani Md Sani** received his B.Eng Hons in Electrical Engineering from Universiti Sains Malaysia in 2000. He is currently doing his MSc in Real Time application at the same University.

[2]**Nor Ashidi Mat Isa** obtained his B.Eng Hons in Electrical Engineering from Universiti Sains Malaysia in 2000 and PhD in Image Processing and Neural Networks from the same university in 2003. He is currently lecturing at the School of Electrical and Electronics Engineering, USM Engineering Campus in Transkerian. He specializes in the area of image processing, nerural networks for medical applications and software engineering.

[3]**Shahrel Azmin Suandi** received the B.Eng., M.Eng. and Dr. Eng. from Kyushu Institute of Technology, Japan, in 1995, 2003 and 2006, respectively. He is currently a lecturer at Universiti Sains Malaysia, Engineering Campus, Penang, Malaysia. His research interests are in the fields of real-time object tracking, biometric security system and machine learning.

[4]**Mohammad Subhi Al-Batah** obtained his B.Sc in Electrical Engineering from Philadelphia University in 2001 and Master in Communication and Computer Engineering from Universiti Kebangsaan Malaysia. He is currently doing his PhD in Image Processing and Neural Networks in Universiti Sains Malaysia.

[5]**Kamal Zuhairi Zamli** obtained his B.Sc in Electrical Engineering from Worcester Polytechnic Institute, Worcester, USA in 1992, MSc in Real Time Software Engineering from CASE, Universiti Sains Malaysia in 2000 and PhD in Software Engineering from the University of Newcastle upon Tyne, UK 2003. He is currently lecturing at the School of Electrical and Electronics Engineering, USM Engineering Campus in Transkerian. His research interests include software engineering, software process, software testing, visual languages and object oriented analysis and design.

[6]**Khairun Azizi Azizli** received her B.Sc hem.Tech from Univervisiti Kebangsaan Malaysia and PhD from MIMEM, MIQM Birmingham. She is currently the Dean for the School of Material and Mineral Resources Engineering.