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Field Data Capture in the Exploration & Mining Industry - Digital way

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Abstract: ***Prima facie exploration data is a paramount foundation of any mining project. Mineral industry generates quantum of data every day. Exploration geologists conventionally collect this data on ground by manual means of standard templates and procedures. The conventional practice of collating varied exploration data is a time consuming process. This practice was highly beneficial in 'old mining days' but now we are heading into 'digital mining world' where industry expectation is to transform the old practices by way of technology. Automation of this key process is a growing need of the mining industry. The key objective of this paper is to provide solution for collecting all exploration data digitally: Exploration automation. This will have high impact on time reduction, cost saving and environment friendly too.***

Keywords: Mining, Exploration, Digital technology, Geology, Data capture

1. Introduction

The nature of work of mining industry is sandwiched between remote site field environment and office environment. Data is generated in this environment and transmitted across locations. Data is a valuable resource for mining industry and used in multiple business vertical of a mining industry. Broadly exploration data comprises of many components like geology, geochemistry, structural, petrology, sampling, mapping, drilling, health, safety, environment and community. Exploration geoscientists and other mining professionals conventionally collect this data on ground by manual means of specific standard templates and procedures. This is time consuming process and an old day practice. The collected data then transferred to computers and later sync with server in an office environment for long term storage. Mining industry profoundly relay on exploration data and a substantial amount of cost is infused for this activity. The mining industry is putting a great emphasis on automating their current operating process with aid of new technology to enhance productivity.

Figure 1: Shows field geological data capturing, Source [1]

2. Literature Survey

Desktop research has been carried out to collect relevant literature on geological sampling, mapping, survey, drilling, environment, health and safety, spreadsheet and procedures applicable in exploration mining industry. Digital technology is playing a vital role in this and to support 'the future of mining vision' [2]. Rapid developments in portable computer hardware and software, GPS, laser ranging devices, mobile devices, digital cameras, unmanned mini aircrafts, mean that digital capture of geological information in the field is a reality. New off-shelf technologies are providing a quick way for geologists to 'capture' observations in the field digitally and may become the standard tools of the early 21st century [3].

In the last decade, digital field data collection has become increasingly important in regional geological mapping and exploration programmes. In the initial stages, computers were used in the field to collect observations either via database or spread sheet and after the field season, used to generate maps via GIS and CAD programmes. With the technological shift towards producing geology maps as GIS products, the conversion of the field database and the AutoCAD files to a GIS product either was done in-house and database product had to be easily importable to GIS. Both procedures involved more time and effort to ensure a smooth transition of data into a GIS platform. Several mining companies currently use hand held mobile devices the cabled GPS to enter point data in a dBase-compatible format, which is then downloaded and imported into a GIS. To have truly useful field system, three components of the system must work together; hardware, software and human-ware. The geologist's enthusiasm to use the first two to their full extent is paramount [4].

More over digital data capture provides a ready-to-use database for easy note taking and its integration with GIS by syncing data generated from mapping crews. Less time is spent in transferring the data to build a map and data table by instantaneous creation of map which saves, time, energy and cost in exploration programs. Digital field data collection allows firstly for frequent updating of progress in the fieldwork and rapid compilation of data later in the office. There exists an exciting potential to further improve on the hardware used in aggregate exploration by implementing new technologies, specifically for field data collection [5].

3. Methodology

3.1 Data Inputs

Various data collected, for instance, geological sampling sheets i.e. soil, stream sediment, rock chip, and mapping, drilling, geochemical, geotechnical, environment, health and safety. The input data is customized and streamline to build specific templates for test work.

3.2 Database Design

Database design is a visual representation of the database model which describes process, interface, data-flow and data storage. Below are the following points we have pondered to frame this database model:

1) Design digital data entry templates to enable efficient and consistent in-field data capture.
2) Develop specific application for aforesaid devices compatible to host test data
3) Upload standard data to devices like iPAD, tablets/mobile etc.
4) Check working offline reliability
5) Create export/import function with Google Earth and GIS system
6) Integration ability with ArcGIS and corporate databases

The database is designed in a simplified manner so that it should enable mining professionals to collect various data in field by using an application on mobile devices. After capturing complete data on the system user should be able to synchronize the collected data to the centralized RDBMS system. The application should be capable to handle both network disconnected or connected modes.

3.3 Solution Approach

We propose following high-level approach process to develop a mobile/tablet application for any platform like IOS, Android and Windows. The generic diagram below (Fig. 2), for instance, represents how a geologist should able to collect geological data at field and later sync back the collected data to the centralized database through network available location.

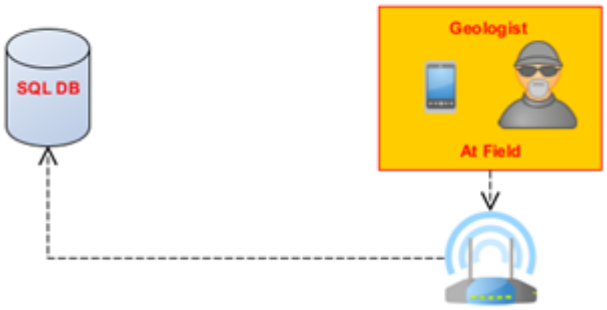

Figure 2: Data collection by geologist at field and synchronization

Various steps involved in the process are shown in detail in Fig.3.

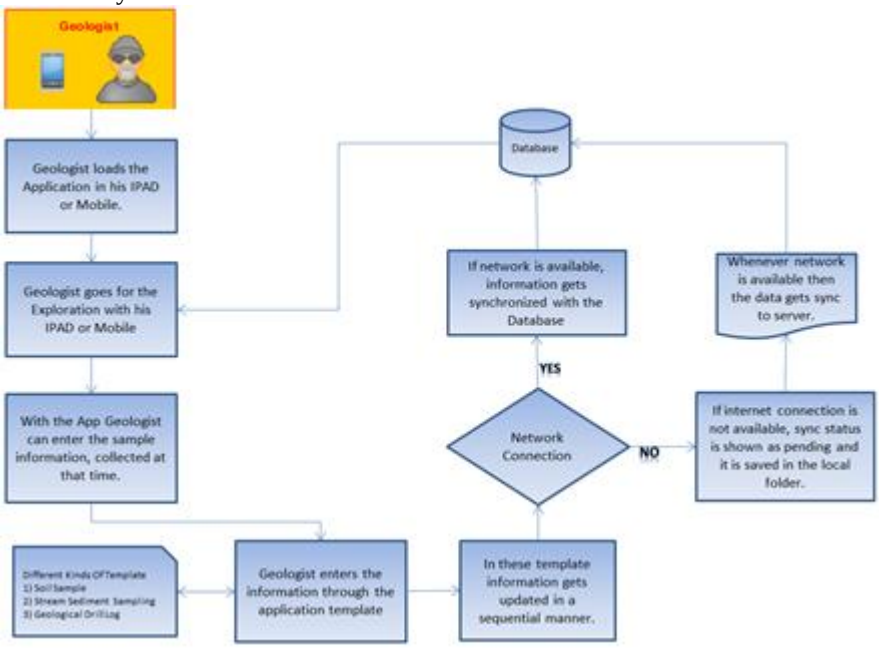

Figure 3: Schematic Flowchart of the Process

Database Relationship Diagram of Geological Sampling: As an example, we have considered geological sampling activity which is a core part of mineral exploration to design model database for the application development. The data model (Fig.4) referred below is generic for all geological sampling templates ranging from soil, rock, to stream sediments.

3.4 Hardware and Software

We have taken into account following requirements to accomplish this work.

a) Server class machine required to setup the RDBMS database.
b) SQL server 2010

c) Asp.net, HTML5, Javascript, Bootstrap, Jquery and any other mobile application development related software's.

3.5 Results and Discussion

A) Assumptions: Following are the assumption in relevance to the functionality of the proposed process and application development.

1) The application should be installed at user mobile device/tablet before heading to fieldwork.
2) Sampling templates are predefined it would not change field to field.
3) Mobile device/tablets should have suitable configuration to setup the application.

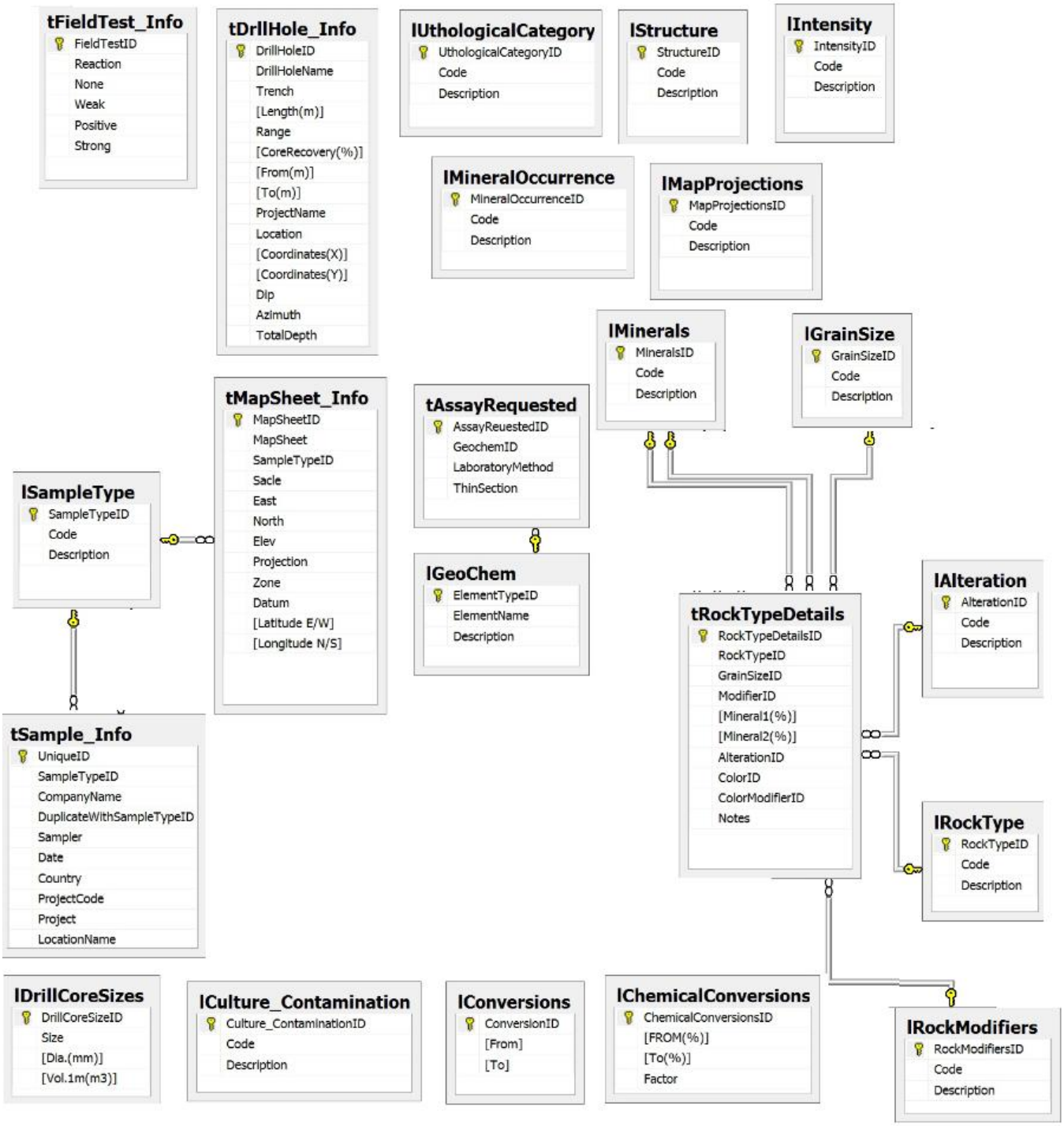

Figure 4: Database relationship diagram of geological sampling

4) Mobile device/tablets should have GPS to collect coordinates.
5) Mobile device/tablets should have good resolution cameras to capture quality pictures.

B) Limitations: Apart from aforesaid assumptions, there could be certain limitation for this process.
1) Mobile screen size to accommodate application interface.
2) Network speed to synchronize the collected data.

In addition to above points, transferring the collated data from ground to an office environment is a prolonged job. And also it is not amalgamated with backend system like GIS, Google earth, in-house data repository etc. This application provides work reliably offline and have ability to integrate with backend systems like GIS and in-house data management structure.

C) Impact: The proposed solution may have significant impact on mining exploration industry and to some extent in oil and gas industry which is close parallel to former in terms of working nature. Some noteworthy areas of impact are,

1) Time reduction – time saving by aligning multiple facets
2) Cost effective
3) Easy processing of data – recoding, tracking, and no-data loss
4) Environmental friendly – replace paper forms
5) Enhance production efficiency
6) Viable technology

D) Future scope: The future of mining is reliable on automated technologies for competitive advantage, cost-effectiveness and safety compliance. Access quality information anytime anywhere with faster means is the need of the hour to improve productivity. Our technology solution will add value in this line for the mining industry and can be practically implemented with an ease to do so.

4. Conclusion

Mining industry is in a transition phase - moving from conventional way to digital way. The future of mining is reliable on automated technologies for competitive advantage, cost-effectiveness and safety compliance. Developing new ways of collecting and managing complex data on ground is what mining industry is eagerly working on and looking solution from the technology providers as well. Our proposed application is doable for collecting and managing exploration data in greenfield/brownfield projects, mine sites and mills. Capture data in motion is possible with this application and could be time-cost-effective play for the mining industry. On the other hand, this application can also be workable for oil and gas sector which is most closely parallel to the mining sector.

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Author Profile

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