Big and Meta Data Management for U-Agriculture Mobile Services

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Abstract

Big Data is a huge amount of data generated continuously and it extracts the meaning, structure, and relationships in enormously large data sets. Metadata is defined as data about data, where it comes from, and when it was taken etc. Metadata is a supplementary data and is generally related with a certain piece of data (big data) that is more important. Metadata helps in making value added decisions and information about own data travelling for big data. This paper communicates about big data, metadata and their management associated to u-agriculture mobile services and lime lights more on sensors that are integrated and built-in. B&M (Big and Meta) data management is very challenging and is strong topic for research currently. Firstly, this paper reviews B&M data and their management. Also presents relationship between big data and Metadata and challenges. And also types of sensors, techniques, technologies, applications, and advantages of various types of sensors for u-agriculture mobile services in their decision making. Finally presents architecture for U-Agriculture Mobile Services based on Sensor-Cloud Infrastructure which helps not only farms and also applications, services provides and organisations in management of B&M data.

Keywords: Big Data, Metadata, Big data management, Metadata management, Mobile services, Sensors, U-Agriculture

1. Introduction

Agriculture has played a crucial role in the development and also a basic activity of human life. Human started cultivating crop approximately 10,000 years ago also called as the Neolithic Age as per the history [1]. It started by utilizing simple tools such as sticks and stones to wireless computing technologies and advances in the development of agriculture has utmost contribution [2]. Requirement of food rises as population grows; people had kept so many efforts and tried unusual or special techniques to improve the food production. Usage of different kinds of technologies concerning agriculture is one of such attempt.

Apart from use of scientific technologies in agriculture, Information is fundamental essential element in any agricultural activity. It is only useful if it is handy at right time and accessible to users in suitable or understandable way. Multiple ways are available by which information communicates. One of them is Information and Communication Technology (ICT) is now being heavily utilized in this area which provides requisite information at proper time and cost effective way. It also collects information (or data) via sensing technologies like wireless sensor networks, mobile sensors services and also from participatory sensing by human which can be utilized by experts for providing agricultural advisory services. But the current scenario of agriculture, farmers are facing problems related to crop pest/diseases, water scarcity, weak linkages with agro commodity market,
agricultural supply chain, transportation, equipment and labor etc. [3]. In addition to previous problems, there is major one which needs focus at present world situation is: Loss of agricultural land which is happening because of the rapid population growth. As population grows, more land is required for housing which tends to loss in land for agricultural purpose but for living, the same population also needs food. To feed the rapidly growing world's population in the following years, agriculture must produce more.

Computer technology during the last decade has numerous changes in the many fields. Looking back the evolution of the computer, in the early ages, the mainframe era was made a big evolution in which only expert accessed the computer. But today, the popular devices as laptops, tablets and Smartphone are owned and accessed by all ages. The third wave of computing (ubiquitous computing) is already upon us, leading to the departure of mainframe and personal computer [4]. The technologies like satellite navigation, sensor network, grid computing, context-aware computing and the ubiquitous computing are supporting the domain for improved monitoring and decision making capabilities [5]. Agriculture is also reaping the benefits of technological innovation which helps in quantitative and qualitative food production. Ubiquitous computing in agriculture is emerging remarkably in this fast processing pervasive environment, owing to wireless sensor network (WSN) [6].

In agricultural environments, knowledge and experience of skillful agricultural experts, who may are farmers, researchers, market analysts, distribution specialists, and so on, have been more important roles than ever. Especially, for farmers newly trying to cultivate a high value crops, the knowledge and the experience of experts for the crops will be very important factors for successful cultivation. So, for higher productivity and better quality, the valuable information has to be able to be supplied easily and quickly to a user in agricultural environments [8]. To make a better and intelligent decision and monitoring, we need raw material which is nothing but data/Information. Data was a simple and an old buzz word everywhere and everyone’s file system and database. After ‘Big’ buttoned up with the ‘Data’, it becomes new buzzword “Big Data”. It is all about volume of data. In a simple way, Big Data means data that is Too-big in size, Too-fast in generate and Too-hard for tools to access and retrieve [7]. Big data and its management holds are the crucial keys for farmers, but it’s also a weapon that could be used against them. One of the most important technologies in agriculture nowadays is to create agriculture big data. Now-a-days data is creating by using field sensing technology is distributed widely and measured data are shared on cloud storage services [15]. Before the term big data became common parlance, it was about very large databases (VLDBs). VLDBs usually contain exclusively structured data, managed in a database management system (DBMS) [9].

Metadata is linked to data to support in its understanding. Information systems process and interpret the data using the associated metadata which, in more and more cases, are getting very large. Hence the importance of dealing with an appropriate way of managing these large metadata sets. Metadata is data that fully describes the data and the areas they represent, allowing the user to decide on their use as best as possible. Allow reporting on the existence of a set of data linked to specific needs. The use of metadata has the purpose of documenting and organizing a structured organizational data in order to minimize duplication of efforts to locate them and to facilitate maintenance. It also provides the administration of large amounts of data, discovery, retrieval and editing features. The global use of metadata is regulated by a technical group or task force composed of several segments such as industries, universities and research firms. Agriculture in particular is a good example for the development of typical applications using metadata is the integration of systems and equipment, the integration of different computer systems via web services or other type of solution requires the integration of structured data [25].

Metadata management has had a long history. The first generation of metadata management system was file-based data dictionary systems. The second generation was
metadata repositories based on relational database systems. There are several vendors of federated database systems, now being called enterprise information integration systems. A metadata management system is always an integral part of such systems [26].

2. Big Data and Metadata Management:

Two types of data managements are paying significance role in any vertical: Big Data and Meta data. The short overview below helps in understanding and managing both the data types and their importance in any service. Big data analytics has to reckon the importance and criticality of Metadata.

2.1. Big Data:

The base definition “Big data” is first and foremost about data volume, namely large datasets measured in tens of terabytes, or sometimes in hundreds of terabytes or petabytes. In addition to very large data sets, big data can also be an eclectic mix of structured data (relational data), unstructured data (human language text), semi-structured data (RFID, XML), and streaming data (from machines, sensors, web and mobile applications, and social media) [7]. In this paper, the term data refers to data sets or data environments related to mobile services. Not only modern science, business, ubiquitous, and smart applications etc. but also ubiquitous agriculture is revolving around big data and its management. These data are generated from transactions through web/mobile, e-mails, multimedia (Images, videos...), logs, Electronic health records, social networking services and interactions, sensors and web or mobile services etc. The mobile services dimension deserves to be revised to increase the scope of our work.

This data storing database raising enormously and become tough for capturing, arranging, storing, managing, sharing, analysing, and visualizing via classic or traditional database software tools. Big data demands a revolutionary move towards from classical data analysis. However, the definition basically states the most obvious dimension of Big Data: volume, but obviates velocity and variety. The convergence of these three V’s comprises the primitive Big Data characterization [14].

![Figure 1. Big Data Characterization](image-url)
2.2. Big Data Management:

This is about two things – Big data and data management plus how these two work together to reach the goal. This is where data management disciplines, tools, and platforms are applied to the management of big data. Traditional data and new big data can be quite different in terms of content, structure, and intended use, and each category has many variations within it. To accommodate this diversity, there is need of multiple types of data management tools and platforms, as well as diverse user skills and practices [7]. Relative to big data, [21] identified two complementary types of resources:

- The data itself
- The capability to handle/control and utilize big data.

It is good news from [9], a survey conducted in this paper mention that there are so many options to manage big data. But there is also a bad news, it’s hard to know them all and select the best one. An option can be many things, including vendor tool types and tool features, as well as user’s techniques and methodologies. Regardless of what project stage you’re in with big data management, knowing the available options is foundational to making good decisions about approaches to take and software or hardware products to evaluate. This survey provides a list includes options that have arrived fairly recently (Hadoop, Map Reduce, event processing), have been around for a few years but are just now experiencing broad adoption (in-database analytics, in-memory DBMSs, clouds), or have been around for years and are firmly established (metadata management, data federation, appliances, columnar DBMSs).

2.3. What is the Big Data’s Big Deal?

Big data is about data sets which are too big and too complex to operate or examine with classical methods or tools. The availability, accessibility of information and its data has become more. For better understanding, start with the corresponding terms: Metadata, Taxonomy, Controlled vocabulary, Different formats of data, Master data and its management etc.

2.4. Meta Data:

Metadata describe a data source, a particular collection of data (a file or a database or a table in a relational database or a class in an object-oriented database), an instance of data (tuple in a relational database table, object instance in a class within an object-oriented database) or data associated with the values of an attribute within a domain, or the particular value of an attribute in one instance [30]. Metadata also describes:

1. Data models.
2. Processes and software.
3. Overall processing system environment, a processing system, a process, a component of a process.
4. A suite of software, a program, a subroutine or program fragment, a specification.
5. An event system, an individual event, a constraint system and an individual constraint.
6. A process and /or event model.
7. People and their roles in any system or organization.
8. An organization, a department, individuals or individuals in a certain role and so many.

The topic of Metadata has recently found more limelight than in the past, largely due to a sudden realization of its necessity in making the WWW usable effectively. Metadata is essential for WWW to scale up to an astronomical number of users, for finding information of relevance, and for integrating together data and information from heterogeneous sources. Metadata are essential for refining queries so the latter return that what the user intends. It is also essential for understanding the structure of information, its quality and its relevance. Metadata are required for explaining answers from ever more
complex information systems. It assists in distilling knowledge from information and data. It assists in multilingualism and in multimedia representations. There are different types of metadata [26]:

1. System catalogs metadata  
2. Relationship metadata  
3. Content metadata  
4. Data lineage metadata  
5. Technical metadata  
6. Data usage metadata  
7. System metadata  
8. Process metadata

The engineering of systems from components (data, processes, software, events, and subsystems) is assisted by metadata descriptions of those components. Metadata have been used in information systems engineering for many years, but usually in a specialist, one-off and uncoordinated way.

2.5. Metadata and Big Data Relationship:

The structure and meaning that metadata delivers, generates ‘value’ to big data. The importance of metadata is about understanding and utilizing information and behaviour within data infrastructures permits us to find and converge data, and to analyse its lifecycle and background. Metadata also brings similar information together and distinguishes dissimilar. In other words, convergence (creates and increases the value) and fragmentation (creates isolation by decreasing value). Not only ‘value’ but also gives meaning to ‘variety’ of data- Integration of this variety of data information and structure, relevance etc.,

2.6. Metadata Management:

Of course metadata encapsulates the structure and meaning of data. But the level of difficulty and variety now big data is addressed; the old methods to metadata failed. Metadata has to be managed in a most aggressive style, where the data platform has to sense the changes in data structures and correlations continuously, and influence machine learning to assist in understanding standards and semantics. Decision making depends on metadata, so having an out-dated metadata is useless. From survey of list of techniques, tool types, tools features, and user practices of different organisations using for big data management [9], Metadata management top the list as 44% using today and will keep using, 46% will use within three years, and only 10% have no plans to use. This is showing the importance of metadata management for potential growth and 90% of commitment.

3. B&M Data Management Challenges:

Big data management’s presents a number of challenges relating to its complexity [15]:

- **Heterogeneity**: How to understand and use big data when it comes in an unstructured format such as text or video.
- **Timeliness**: How to capture the most important data and deliver that to the right people in real-time.
- **Scale**: How to store the data, and how we can analyze and understand it given its size and our computational capacity.

There are numerous other challenges, from privacy and security to access and deployment is **Personal Privacy**, everyone one has to think about all the personal information that is stored and transmitted through Internet service providers, mobile
services, medical and financial service organizations (e.g. banks, insurance and credit card agencies) [17]. Each organization has the headache of organizing, securing and exploiting their business, operational and customer data. Big data management’s toughest challenges simultaneously involve scale, speed, and diverse data types [9].

The freedom to boost farming performance is apparently endless, because there is increasing number of choices on the market for farmers. This freedom also comes along with range of challenges as it develops for U-Agriculture [16]:

1. **Adoption**

2. **Relevancy**: How to make the data collected relevant and useful for the farmer you are targeting.

3. Collecting data where a farmer does not own his own sensory hardware, or where there aren’t existing images or databases, will be another challenge.

4. Some farmers might be relatively tech-savvy and want a system that is quite advanced, whereas others are really starting from scratch.

5. **Data privacy** that could have an impact on the progression of the industry. Without any current laws or regulations enforcing the data arrangement between farmers and data analytics providers, it is unclear how this will play out in the future.

For many agricultural operations, acquiring and using software system like many of those on the market will be a big adjustment from the Excel spread sheets and paper/pencil approaches that many farmers still rely on. So, not only Agriculture big data companies/organisations need to convince a farmer to make the switch, but also need to make sure that the user interface is easily usable and that the farmer gain an obvious returns on investment in a relatively short timeframe.

There are three identifiable types of difficulties in metadata management, namely metadata definition and management, technology, and standards [26]. Metadata definition and management is about defining, creating, updating, transforming, and moving all types of metadata that are relevant and important to a user’s objectives. Metadata management technology includes metadata design tools that allow users to model the schema of metadata across all data sources, and metadata repository systems that allow the users to extract metadata from various data sources, search and query metadata, and exchange metadata with other users, etc. Metadata standards include not only those for modeling and exchanging metadata, but also the vocabulary and knowledge ontology. These difficulties have stunted universal adoption of metadata management technologies [26]. In [20], Metadata considered as a common and essential ingredient/solution for some important problems in Information systems: For Integration of heterogeneous data sources, for data collection quality, for queries and for answers consolidation. And metadata concluded as future of information systems.

### 4. B&M Data Management for U-Agriculture Mobile Services:

Ubiquity entrusted as one of the most key characteristic of mobile services. A small keyboard and a screen, the main obstruction to the acceptance of smart phones were replaced by a multifunctional touch screen. This easy-to-use electronic visual display allows users to directly interact with the device by using their fingers. This breakthrough in technology, along with advanced computing and connectivity capabilities, brought about the explosive worldwide growth of smart phone use [11]. Mobile Communication Technology has quickly become the most familiar way of communicating data and services in today’s world. They could furnish a lot [10] of inexpensive ways for millions of people to access information previously unavailable to them. According to some reviews, the ubiquitous nature of mobile services may change the paradigm in Agriculture [10, 12]. The massive data and abundant applications call for mobile analysis, but also bring about a few challenges. As a whole, mobile data has unique characteristics, e.g., mobile sensing, moving flexibility, noise, and a large amount of redundancy. On the
contrary, mobile phones can support rich interaction at anytime and anywhere [13]. Farmers and agriculture businesses have to take multitudinous decisions each year and agriculture has become an apparent target for big data. Probably climate and market price situations are making it on-topic for farmers to use any information they can get their hands on to help make crucial decisions. Big data raised as a key role of the advances made in ubiquitous agriculture, where as to attain maximum yields: farmers and agriculture businesses are trying to use their resources in the very productive manner. So, in acknowledging the enormous advantages that access to big data analytics have and number of divergent agriculture big data technologies have turn out for farmers and their mobile service providers to utilize. Sensors on the hardware side are present in collecting data of heterogeneous formats. Sensors include [16]: 1. Devices fixed in the ground to measure oil moisture and nutrient density, 2. Devices attached to a tractor that measures crop yields, 3. Weather forecasting and suitable conditions, and 4. Measuring crop health etc.

On software side: data collection, processing and analysis regularly with the aim of displaying rich vision to farmers in an accessible form. This software will use data from the hardware sources (sensors), either purchased by the farmer or by hardware businesses that the software service provider partnership with machinery manufacturers or data provided by farmers from third party data services or from public possessions such as local governments. Based on software, the data presentation and analysis differs. But now, most of the programs are available through computers, tablets, and smart phones and usually comprise of a dashboard of the various data sets which is customizable to whomever tracking. Software also helps farmers to make crucial decisions, some of them listed in Table 1, enables farmers to save money on areas that don’t need and also improves yield.

### Table 1. Farmers U-Agriculture Decision Making Based on Sensors Data

<table>
<thead>
<tr>
<th>Decision Making</th>
<th>Based on Data</th>
</tr>
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<tbody>
<tr>
<td>When and How to irrigate a field</td>
<td>Soil moisture data</td>
</tr>
<tr>
<td></td>
<td>Weather predictions data</td>
</tr>
<tr>
<td></td>
<td>Crop health data</td>
</tr>
<tr>
<td>Planting and harvesting decisions</td>
<td>Yield data</td>
</tr>
<tr>
<td></td>
<td>Weather data</td>
</tr>
<tr>
<td>Fertilizer applications and prescription</td>
<td>Soil nutrient density data</td>
</tr>
<tr>
<td></td>
<td>Plant/Pest diseases data</td>
</tr>
</tbody>
</table>

Apart from sensors on hardware and software side, sensors are of two types in mobiles: Built-in sensors and External sensors. Table 2 shows the some sensors and its potential application and advantages in U-Agriculture [18, 3, 19], which helps in generating and providing agricultural data for further management and analytics etc. Big data analytics also alert farmers about field problems such as a pest disease, or dryness conditions etc. which curtail the need for manual inspection of land frequently/repeatedly. Due to increasing labor shortage problems [16], the ability for big data analysis that reduces the need for manpower is a big benefit for the industry particularly for very large scale operations.
### Table 2. Mobile Sensor Types and their Applications in U-Agriculture and also Technologies, Techniques involved and their Advantages

<table>
<thead>
<tr>
<th>Mobile Sensors</th>
<th>Function</th>
<th>Relevant U-Agriculture Application</th>
<th>Advantage</th>
</tr>
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<tbody>
<tr>
<td><strong>Built-In Sensors</strong></td>
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</table>
| Camera (Human participatory sensing)  | Takes Picture & Video          | Image analysis. This sensing operation is done with the help of farmers or workers involvement. Using techniques like Image processing and Pattern matching techniques. | Helps in taking necessary actions or precautions which in turn helps in yields maximization.  
1. Detection of the pest or disease attack.  
2. Current stage of a particular disease.  
3. The disease severity from a particular farm. |
| GPS and Acceleration sensors          | GPS receiver                    | Position and clock. Captures data to detect various activities like sowing, irrigation, harvesting, bed making etc. get recorded in the database automatically and in real time. Also closely monitoring the farm to record various events like plant growth, disease attacks, and inappropriate irrigations due to undulating land and so on. Using Radio Frequency technology. | Helps to provide right farming practices to the farmers at the right time.                                                                 |
| Microphone sensor                     | Recording/Detecting Voice       | Sound and noise measurement for the detection of pest presence in the field. Using Sound technology and techniques like signal processing, estimation and detection algorithms. | This helps farmers to take necessary measures in order to minimize the losses due to pest attack.                                           |
| **External Sensors (Interfaced with mobiles)** |                                 |                                                                                                      |                                                                                                                                              |
| Chemical or Gaseous Sensors           | Detection of gases & gas ingredients. | Measures the gaseous emissions from the agricultural fields like Ethylene emission occurs during different stages of plant growth like fruit ripening, flower pollination etc. | 1. Number of gases are released in atmosphere might contributes to the global warming.  
2. Detection of various stages of plant as well as plant disease.  
3. The emissions can be represented on spatial-temporal graphs for better visualization to study its effects to the environment. |
| Soil Moisture Sensors                 | Detection of moisture level     | Communicate information about the level of moisture present at certain depths in the soil or ground. | Precise control of water and other inputs like fertilizers that are applied by irrigation pivots.                                          |
However, with recent developments in technologies such as sensors, computer hardware and the Cloud, the storage and processing power increase and the cost comes down rapidly. As a result, many sources (sensors, humans, applications) start generating data and organizations tend to store them for long time due to inexpensive storage and processing capabilities. Once that big data is stored, a number of challenges arise such as processing and analysing. Thus big data has become a buzz word in industry [22]. Typically, we can identify three main categories: occasional, frequent, and real-time. This research considers ‘Value’ also as a main characteristic of big data. This means from figure.2, using value creation steps for big data management helps in creating value to within that data, there is some valuable information – golden data to extract and supports in critical decision making, though most of the pieces of data individually may seem valueless.

Figure.2 also shows the metadata role in through these value creation steps which also plays a vital role in decision making using DIKW pyramid. Big data is everywhere, even in agriculture. U-Agriculture also generates big data from mobile sensors (Built-In and External sensors). As mobile services economy drives new challenges: Rising customer expectations, Data for analytics, increasing in mobile applications and devices. One application of sensing technologies in U-Agriculture is U-Agriculture monitoring explained along with value creation steps in figure.2. It is an application that collects and tracks information such as soil or crop details, detection of moisture level, water management etc. Further, it allows uploading data and results back the final data or decision to mobile devices. The data becomes ‘big’ when consider millions of users.

![Figure 2. Big Data Value Creation and Metadata Role in Managing U-Agriculture Using DIKW Pyramid](image.png)
Generating the correct metadata automatically to describe what data is recorded and how it recorded and measured is also considered as a challenge in big data. This metadata is likely to be crucial to downstream analysis. Metadata acquisition systems can minimize the human burden in recording metadata. Recording information about the data at its birth is not useful unless this information can be interpreted and carried along through the data analysis pipeline [23].

Metadata management is categorizing information about data objects. Metadata management provides the tools, processes, and environment to enable an organization or service providers to answer the question, “How do we know what we know about our data?” The capability to easily and conveniently locate and retrieve information about data objects, their meaning, physical location, characteristics, and usage is powerful and beneficial to the enterprise. This capability enhances the ability of the organization to deal with risk, meet regulatory requirements, and improve IT productivity. Good metadata management gives organizations confidence in their information. Confidence flows from the trustworthiness of the information received. Information confidence helps organizations make better decisions because they know they can trust what they see. Trustworthiness comes about by knowing the information received is governed, approved, and therefore true [24].

![Image of U-Agriculture Mobile Services Architecture based on Sensor-Cloud Infrastructure](image)

**Figure 3. U-Agriculture Mobile Services Architecture based on Sensor-Cloud Infrastructure**

From [9], a cloud can be central to a data management strategy. Users have a clear preference for private clouds over public ones due to concerns about data security, privacy, and governance with public clouds. There are some good examples of software and hardware vendors that provide tools, services, and platforms for managing big data: Cloudera, Dell software, Oracle, Pentaho, SAP, and SAS. And also Microsoft [28] is offering mobile services using azure app services. Azure App Service is a new and unique cloud service that enables developers to create web and mobile apps for any platform and any device. App Service is an integrated solution designed to streamline repeated coding functions, integrate with enterprise and SaaS (Software as a Service) systems, and
automate business processes while meeting your needs for security, reliability, and scalability.

Sensor-Cloud can be used in the field of agriculture to monitor the crop fields in order to upkeep it. For this, a field server is developed that comprises of a camera sensors, air sensor, temperature sensor, CO2 concentration sensor, soil moisture and temperature sensors, and so forth. These sensors continuously upload the field data via Wi-Fi access point to the field owner to track the health of their crops [29]. This can also be used for harvesting. Figure.3 gives a simple architecture of u-agriculture mobile services based on sensor-cloud infrastructure.

5. Future of B&M Data:

Future is obvious and powerful for big data for creating value based decision making for potential growth of any system or organization or application. Quantify the use of big data management options today and predict their future increase or decline. Commitment and potential growth are two indicators for quantifying the future of big data management options. To get a complete picture of any service or organization or system, it’s important to balance both commitment and potential growth. For this growth of any vertical by in taking more information has to collect from big data and learning from it. Future of big data changes how we live, how we eat, how much to eat, what we eat, how to grow them, what are the soil properties and how much water to use to increasing production more etc.

People who are publishing valuable information to the Internet want to be able to create or at least to control the metadata describing their resources. Metadata that are generated not by a single entity such as a search engine, but by many different entities requires some recognized standard metadata formats. Without standard metadata formats and semantics, metadata would be just as unprocessable and unmanageable as the original data. Existing barriers in business, modeling, and technology will have to be addressed for metadata in order for them to play the important role of alleviating barriers between heterogeneous users and applications. Metadata collection has attained a sufficient level of maturity; however, metadata management today is at an elementary phase. In the future, there is a need for an extended ecology of metadata artifacts that will constantly evolve [27]. Metadata will require extensible models, richer variations, and underlying trust mechanisms. The future of the Internet will rely on this evolution.

6. Conclusion and Future Works

This paper has reviewed B&M data (big data and metadata) management related research in present world scenarios. This paper also adds types of sensors, technique’s, technologies, applications, and advantages of various types of sensors for ubiquitous agriculture mobile services in their decision makings are tabulated. Also describes the relationship between big data and metadata and their challenges. This paper presented architecture for U-Agriculture Mobile Services based on Sensor-Cloud Infrastructure. At last, includes the future of B&M data for potential growth and commitment. It is obvious that the increasing heterogeneity of today’s networked data sources will lead to an increase of the amount of B&M data rigorous applications in the future. We believe that the both big data and metadata plays crucial roles in ubiquitous agriculture in managing the increasingly complex amount of data that are being associated with applications or services or systems.

The further works will expands with the cloud based frameworks for U-Agriculture which also includes IoT (Internet of Things) to run parallel with fast growing world and massive increase of IoT devices.
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