Field Reporting Irrigation System via Smartphone

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Abstract. Irrigation is one of the backbones in the field of agriculture. The role of technology in the industrial era 4.0 has increased tremendously in irrigation management systems. Areas, limited internet access, and validation of activity reports are separate issues in monitoring the performance of irrigation field workers in real-time. Therefore, we built a reporting system that is equipped with location tracking using the Smartphone Global Positioning System (GPS) and the Web Geographic Information System (WebGIS) application. This field reporting system starts from the report input form on the Android app that detects location coordinates automatically. Reports are stored in an offline SQLite database and sent to the MySQL database server online through the data synchronisation process. From the server-side, information displayed through the WebGIS application. This field reporting is more efficient in monitoring the performance of irrigation systems in real-time.

1. Introduction
Water is considered an essential resource in ensuring sustainable food production [1]. Irrigation plays a vital role in providing water in food security, especially for food development [2]. Successful management of irrigation in the field requires an effective irrigation system, including the management of irrigation systems and smart water management schemes [1].

Smartphone usage is now part of the human lifestyle [3]. Network technology very much needed in irrigation management. Investments in improving irrigation technology and techniques help increase savings in water use and equalise water distribution capacity, and the use of ICTs and various methods can minimise water shortages [4].
In optimising the performance of field workers, field workers need to be assisted using technology when carrying out their work, including reporting. Unfortunately, the reporting tools available are generally still done in the form of a manual process.

This study provides an alternative for irrigation managers to utilize existing information and communication technology, especially for reporting for field implementers, so that reporting well documented, and data stored electronically so that existing data can be an advanced material for decision-makers, both for field monitoring strategic planning and management, as well as in other forms.

2. Material
Several forms of technology applied in the world of irrigation, both the use of the Internet of Things (IoT), big data, and artificial intelligence. As a smart irrigation information system and the application of various sensors to monitor and control activities related to irrigation itself, so that water is used and managed optimally [5].

The core of technological support includes the use and management of water and energy that is minimal [4]. Besides, the use of technology, the use of software as a tool has also been studied to evaluate water, water planning, and management in irrigation [6], and the presence of field officers is an essential part of irrigation management [7].

In Indonesia, there are irrigation management regulations for irrigation operations and maintenance, including how the work systems of field workers carry out their work, including managing reporting for field officers [8].

Reporting is more likely to be done manually so that some problems can arise. So the existence of a reporting solution that uses technology for field officers is ideal [9]. The presence of current information technology has been able to make various things connected, not only information [10], [11], but also interactions between electronic devices, including smartphone assistance in the field [12].

University as a higher education and research institution [13] has made various contributions to various fields [14], including information and communication technology solutions that applied to the irrigation field.

The presence of information and communication technology that continues to develop also has an impact on the application of these technologies in irrigation, such as the application of GIS [15], how to apply technology efficiently [16], the use of robots [17], the application of satellite-based technology [18], [19], and the web application [20]–[22].

In the use of irrigation software, some researchers have applied several studies. Their study, such as the use of the Water Evaluation and Planning System called WEAP [6] and the use of decision models to support the system [23]. The use of mobile technology done for soil water [24], cloud-based irrigation scheduling tools [25], and Farmer’s marketing decisions [26].

ICT support for Water management in agriculture [27] also do in some fields. Such as the use of fuzzy control systems using remote sensing [28], smart watering system [29], and optimise land stability evaluation [30]. Besides that, research on sensing, intelligent, and sustainable technology was implemented in agri-food [31].

Other research related to irrigation is agriculture technology [32] and smart irrigation system in irrigation management [33], weather and water information [34], irrigation management system with solar energy production [35], smart land-space irrigation technologies [36].

Analysis of large-scale water demand for irrigation using the climate-smart decision support system model [37]. Model of ICT utilisation in irrigation in China [38], system dynamics of smart groundwater [39], the application of wireless sensor networks in agriculture and irrigation [40][41], digital innovation for smart farming [42].

3. Methodology
The method used in this research is qualitative and quantitative methods. Qualitative evaluations are carried out, starting from finding problems, analysing problems through various literature, solving solutions, and applying them in the form of software development.
The quantitative method carried out based on the prototype, the process carried out in the form of cycles, where each research result is always evaluated directly by its users.

4. Result and Discussion

4.1. Technology Scheme
The initial concept of the system illustrated in a technology scheme with hardware and software specifications that connected to the internet. There are three main components in this scheme, namely, Server, Mobile Application, and WebGIS Application (Figure 1).

![Technology Scheme](image)

The first device is a server computer with software tools with Linux Operating System specifications with an appropriate distribution such as Centos 7.6.1810 with several services installed in it such as Web Server, Apache 2.0, PHP 7.0.33 and the MySQL/MariaDB 10.2.21 database.

The second device is a mobile application on an Android smartphone with a minimum specification of Android 4.0.3 Ice Cream Sandwich (ICS), Dual-Core processor, RAM 2.0, GPS, and SQLite database to handle offline reports if in a location that does not have internet access. SQLite is an embedded SQL database engine that can read and write files directly on a hardware disk on Android.

The third device is a client computer with browser recommendations that are widely used by users, namely Google Chrome or Mozilla Firefox, to access the WebGIS application. The recommended browser used is the latest browser update.

4.2. Report System Scheme
The report tracking system starts when the irrigation field officer opens the report input form. The report input module will automatically detect the coordinates of the officer's location on the spot via GPS on Android.

The officer location coordinates will be part of the report parameters that will be saved and sent to the server. These parameters are latitude and longitude. The parameters are used as input data variables and then sent to the server via internet access. If there is no internet access, then the input data variable is stored first in the SQLite database. If the officer changes the location (move position) and gets internet access, the system will automatically send the report to the server and stored in the MySQL database.

When the irrigation field officer presses the send button on the report input form, the creation time and the time sent on the report will be the tracking time parameter in addition to the coordinates of the location. Reporting time is the real-time field worker when pressing the send button. Whereas the sent time is the time, the report sent when the Android smartphone is in a location that has internet access. Any data that has entered into the MySQL database server will be accessible via WebGIS by a supervisory officer. This system illustrated in Figure 2.
4.3. Database Synchronization

The database synchronization process occurs when the report status field value is 0 in the SQLite database. When the officer is in a location that has internet access, the report data sent to the MySQL/MariaDB database server, then change the report status field value in the SQLite database to 1.
The value of the tracking coordinate field that sent along with the report is the original field value when the officer is inputting reports, so it ascertained the value of the tracking coordinates comes from the location of the officer input the report.

4.4. Implementation

Only irrigation field officer has access to activity-report-input. When opening the report input form, latitude and longitude coordinates will be detected automatically (Figure x4a).

For a detailed view of the report, a photo of the activities of the irrigation field officer is accompanied by latitude-longitude coordinates and report location details on the Google Map (Figure x4b). WebGIS application is only accessible by the supervisor.

5. Conclusion

The report tracking system for an irrigation field officer is handy in the process of site validation by the supervisor officer. The performance of the irrigation field officer measured through the fact of the report is displayed via WebGIS with the parameters of the location coordinates and report input time. Report flexibility through database synchronisation technology makes it easy for field workers to input reports online and offline.

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