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A Novel Algorithm for Monitoring Field Data Collection Officers of Indonesia's Central Statistics Agency (BPS) Using Web-Based Digital Technology

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***Abstract*—This study focuses on the creation of a novel algorithm for monitoring field data collection activities by field data collection officers from Indonesia's Central Statistics Agency (BPS) using web-based digital technology. This study aims to check the accuracy and veracity of data collected by the BPS data collection officer. In this research, 200 respondents were collected by 10 data collection officers of Indonesia's Central Statistics Agency (BPS) and monitored by 5 supervisors' officers from BPS. Then the Head of BPS supervises process monitoring at a certain regional BPS office. We propose a novel algorithm that can be used with web-based digital technologies. The algorithm is developed by comparing data from the BPS office in the form of three variables that are a list of names of respondents, a list of questioners for respondents, and the location (area) of respondents with data from the respondent's NIK (ID Number), answers to respondents' questions entered into the system, and the GPS location of field data collection officers detected by the web-based system. This research employed a novel algorithm on web-based digital technology, increasing the accuracy and veracity of collected data. The score value of the respondent's name variable is 92 percent, the respondent's answer to the questionnaire variable is 93 percent, and the respondent's location variable is 95 percent. The data was evaluated by all field data collection officers, supervisory officers, and the BPS head.**

***Keywords*— Web-based; digital technology; monitoring; field data collection; central statistics agency (BPS).**

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I. INTRODUCTION

In digital technology, electronic components based on zero and one electrical impulse are used (0 and 1). It denotes that the circuit has no electrical signal (0) but does have an electrical signal (1) based on 0 and 1 signals [1]–[4]. To run and use digital technology properly, computer equipment is widely used. Furthermore, digital technology demands the usage of a communication network, known as the Internet network, to be used widely and collaboratively in a remote area. Thanks to digital technology, humans can now perform complex calculations quickly and communicate over large distances. Health, automobiles, education, information, and industry are other businesses that can benefit from digital technology [5]–[7]. One of the most prevalent applications of digital technology in the information realm, notably Website-based technology, is one of the most widely used.

Digital technology constructed on a website's foundation is known as web-based digital technology. Web-based technologies are HTML, PHP, CSS, and JS-based programs [8]–[10] that run on a web server and a browser like Chrome, Firefox, or Opera. Web applications can run on the Internet or local (LAN) networks. They contain consolidated data and are simple to use, making them increasingly in demand and easier to implement in various settings. Web-Based Applications have several competitive advantages, including application acceleration, low weight, few data sources, and the ability to be accessed quickly via a browser and an internet or intranet connection to the server [11]–[13]. Unlike desktop apps, which need users to install software or programs to access data and information, this lets users access their workplace data or information directly from their laptops, cellphones, or even personal computers.

The Indonesian Central Statistics Agency (BPS) is a non-ministerial government agency that reports to the President. The Central Bureau of Statistics, established in 1960 under Laws No. 6/1960 on Census and Law No. 7/1960 on Statistics, was previously known as the BPS. Law No. 16/1997 on Statistics was enacted to replace the two statutes. The name

of the Central Bureau of Statistics was formally changed to the Central Statistic Agency as a result of this Law, which was followed up with the legislation following (BPS). "Provider of Qualified Statistical Data for Advanced Indonesia" is the BPS's 2020-2024 goal based on performance successes, community ambitions, potential, and issues. In addition, BPS also works hard to accomplish the President and Vice President's Vision to promote Advanced Indonesia, develop statistics that contain exact truths, and accurately depict the current situation in providing national and international statistical data.

To carry out its obligations, BPS Indonesia establishes representative offices in each province in Indonesia, and subsequently, each Provincial BPS generates smaller representative offices in each city/district throughout Indonesia. One of the BPS representatives in one of Indonesia's provinces is the BPS Sumatera Barat Province, which has erected a smaller representative office in the provincial capital, BPS Padang City. BPS Padang City is located on Jl. Raya By Pass Km.13, Ex. Sungai Sapih, Kuranji, Sungai Sapih, Kec. Kuranji, Padang City, West Sumatra 25159 (https://padangkota.bps.go.id/).

The data acquired in the field must be precise, correct, and complete [14]–[17]. To accomplish so, the products or data samples collected must be of high quality and precision. Each data collection officer in the field is provided a map with a list of areas that must be visited. Officers are not permitted to travel or collect data from locations outside their designated region unless the appropriate BPS office has permission. Officers are also provided a list of people, businesses, and organizations in the community whose data will be requested and questioned. Officers were also given a set of questions to ask each respondent. Each officer also receives a paper with questions that will be made public to guarantee that the information gathered is accurate and does not differ. The information acquired as a filled-in document is considered secret, and its contents may not be shared with the general public [18]–[20]. BPS will only offer the facts in the form of conclusions.

This study aims to build web-based digital technologies to assure the quality and correctness of data collected by data collection officers at the Central Statistics Agency (BPS). The Padang City BPS office is one of the BPS offices we used as a case study. The data obtained by police will be accurate, correct, and of high quality if the findings of this study are implemented. This is demonstrated by the precise respondent being questioned, the precise question being asked, and the precise location is recorded.

Previous research was conducted by Lefèvre et al. [21] from universitaire de Nancy, Paris, France in 2020. This study is based on data and methodologies. Data and methods are used in this study. We asked all passengers coming at or departing from the international airport at Pointe a Pitre to complete the online health questionnaire about four days after arriving or departing from Paris Orly international airport in range time 2015 and 2017. SPIRE 1 was designed as a pilot project and was meant for travelers arriving at Pointe a Pitre. SPIRE 2 was an upgraded version of SPIRE 1 with three components that allowed for a more thorough evaluation of pre-flight requests' benefits and emailed follow-up. The study's endpoints were the connection and answer rates to an online health questionnaire. This study's findings are as follows: For SPIRE, 14/1038 tourists (0.4 percent) came at or departing from the international airport at Pointe a Pitre. Response rates in SPIRE 2 ranged from 3/1059 (0.3 percent) to 19/819 (1.9 percent) (2.3 percent). When passengers were solicited before their flight, response rates were much higher. According to this study's findings, an online health questionnaire yielded a shockingly low result.

Another Previous research was conducted by Dumke et al. [22] from Max-Planck-Institut für Plasmaphysik, Greifswald, Germany, in 2018. This study is The Wendelstein 7-X stellarator experiment that needs continual live data monitoring by its very nature. The monitoring infrastructure, which dates back to the turn of the century, must be updated to meet new technical and security requirements. Aside from that, new technology breakthroughs, interfaces of the user, and IT-supported general processes establish new benchmarks among system users, including the ability to participate in live remote meetings. To satisfy these expectations, the CoDaC team at Wendelstein 7-X developed a novel architecture for monitoring the management of data, delivery, and observation. New access tools have much support thanks to a touch-friendly interface design (such as tablets, smartphones, and smart TV sets) as well as a highly flexible and intuitive workflow. This research result This article describes the new MonA-LISA monitoring architecture and provides an overview of the options available through the web-based monitoring client.

II. Material and Method

The materials and methods employed in this study are as follows:

A. The Materials

The materials are the data processed in this research. The data that is processed later will produce conclusions. In this research, we use two kinds of data from the office and from the officer. Data from the office consists of three kinds: respondent name list, respondent location list, and respondent questionnaire. Three kinds of data from the office are given in the form of hardcopy or printed data on paper. Data from the officer also consist of three kinds as follows:

- NIK (ID Number) of the respondent that has been taken and entered into the website.
- The location of the respondent that has been visited from GPS shows on the website.
- The answer of the respondent has been collected and entered into the website.

Three kinds of data from the officer are produced in the form of softcopy or digital data on the website.

In this research, the total number of respondents whose data was collected is 200 respondents that were collected by 10 data collection officers of Indonesia's Central Statistics Agency (BPS). Then the total of the data has been collected by data collection officers of BPS monitored by 5 supervisors officer that from Indonesia's Central Statistics Agency (BPS) is to check the accuracy and veracity of the data. After that, the process monitoring is conducted by the supervisor's officer supervised by one person that is Head of Indonesia's Central Statistics Agency (BPS) at a certain regional BPS

office. The hierarchy model of material data used in this research can be seen in Figure 1 below.

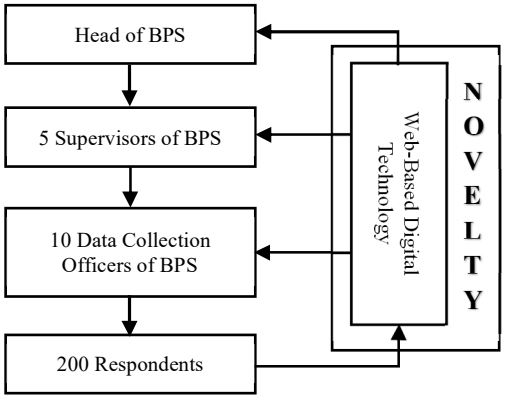

Fig. 1 Hierarchy Model of Data Monitoring

B. Research Framework

Figure 2 depicts the research framework that was used in this study:

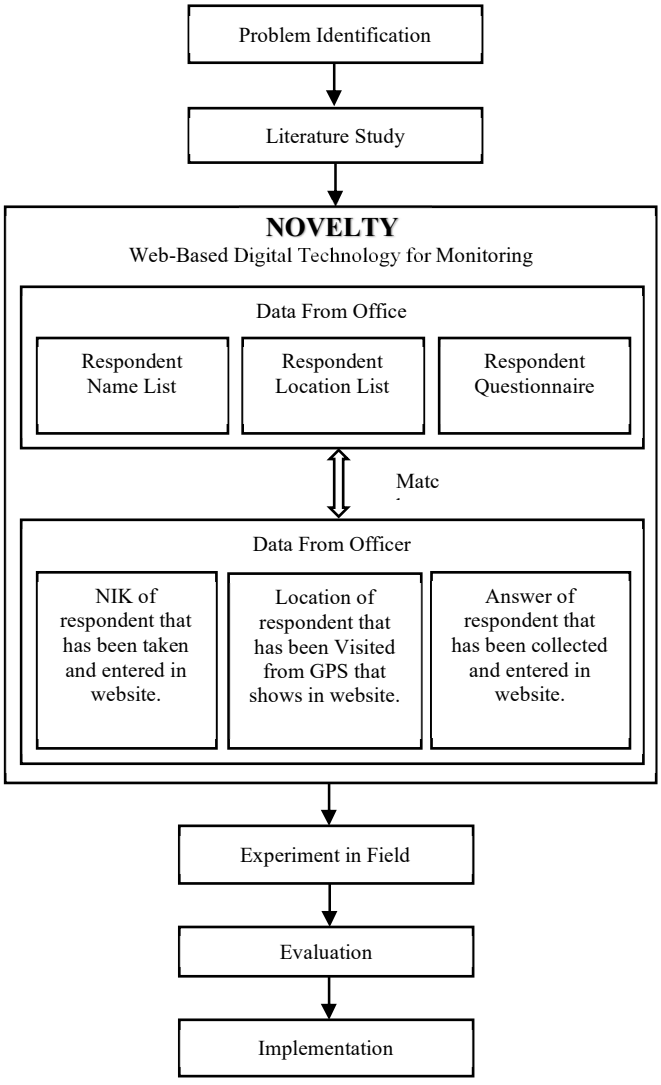

Fig. 2 Research Framework

C. Research Framework Details and Method

The procedure for locating the true problem in the field is known as problem identification [23]–[26]. This study is being placed in Padang City, West Sumatera Province, at Indonesia's Central Statistic Agency (BPS). The process of analyzing a large amount of literature that examines this subject and suggests some potential solutions is known as literature review [27]–[30].

Data from the office and data from the officer are used in the development of web-based digital technology for monitoring methodology. The data from the office is divided into three categories:

- Respondent name list. The respondent name list is the list of people or organizations that will be interviewed based on the questionnaire list created by the Central Statistic Agency (BPS) that the field data collection officer collected.
- Respondent questionnaire. The respondent questionnaire is the questionnaire that will ask respondents by the officer that has been created by the Central Statistic Agency (BPS).
- Respondent location list. The respondent location list is the location or addressee list of people or organizations that will be visited and interviewed by the officer using the questionnaire list that has been created by the Central Statistic Agency (BPS).

After every field data collection officer of the Central Statistic Agency (BPS) has three types of documents listed above, the officer visits the responder at their address. The officer shall enter the following three types of data into the website as part of the Central Statistics Agency's (BPS) supervisory counter's monitoring:

- NIK of the respondent that has been taken and entered in the website. The officer should note the NIK of the respondent and then enter the number into the website to match the data from the name list.
- The answer of the respondent has been collected and Entered into the website. The officer should enter the sample and random answer of the questionnaire that has been asked of the respondent into the website.
- Location of Respondent that has been Visited from GPS that shows in website. The officer should activate the smartphone's GPS when visiting the respondent. The data GPS will automatically appear on the website after the contact number of the officer is registered to the website system.

The information from the office should be compared to the information obtained by the officer and entered into the website. The algorithm that is designed and implemented in the website program/coding performs the matching procedure automatically.

An experiment in the field is a method that involves experimenting with real Central Statistics Agency officers and supervisors (BPS). The police went to the respondent's address and activated the smartphone's GPS before asking the questioner some questions. After gathering the information, the officer entered the respondent's name and some sample responses into the website. Simultaneously, the supervisor compares the data from the office with the information gathered by the officer via the Internet. The data match result will be announced by the website system. How much data has been matched and how much data has not been matched?

The term "evaluation" refers to the process of determining how accurate and matching the online system is [31]–[35]. If

the accuracy and matching results are nearly 100 percent, the system monitoring is working properly [36]–[38]. Integrating the website system into the survey and census conducted by the Central Statistic Agency (BPS) of Padang City, West Sumatera, Indonesia is known as implementation.

III. Result and Discussion

A. Use Case Diagram

Before building a website, we must create a use case diagram [39]–[41]. A use case diagram displays the user-system link and visually represents a user's engagement with a system. A Use Case is represented by a basic sequence of actions, making it easy to understand. The use case diagram in this site design is depicted in Figure 3.

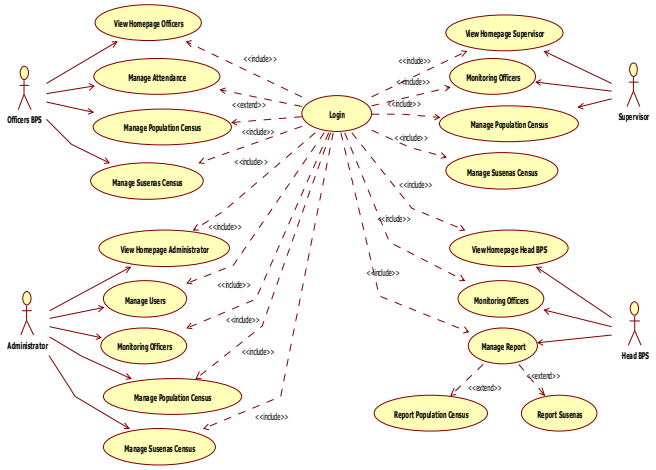

Fig. 3 Use Case Diagram

Figure 3 shows four different types of performers who can use this website. They are the administrator, BPS head, field data collection officer supervisor, and field data collection officer. All actors can use the website to keep track of the field data collection officer's activities as well as the data that needs to be collected and entered into the website. Depending on the function, each actor has a separate menu, and the administrator is the only actor with access to the website's menus. The flow of the monitoring system by the website system, Table 1, shows the results.

TABLE I
THE MONITORING FLOW OF OFFICER

Users/ Actor	Monitoring	Function	The Menu Can Use
Administrator	• Head of BPS • Supervisor • Officer of BPS	• Activate website system • Shut down the website system • Monitoring the system works good and well	• View homepage administrator • Manage user • Monitoring all Users/actors • Manage Population Census • Manage susenas census
Head of BPS	• Supervisor • Officer of BPS	• Monitoring the supervisor of the field data collection officer • Monitoring the field data collection officer	• View homepage Head BPS • Monitoring supervisor and officer • Manage Report
Supervisor	• Officer of BPS	• Monitoring the field data collection officer	• View Homepage Supervisor • Monitoring Officer • Manage Population Census • Manage Susenas Census
Officer of BPS	• His data	• Monitoring his data.	• View Homepage Officers • Manage Attendance • Manage Population Census • Manage Susenas Census

Table 1 shows all users/actors who can access the website system. Aside from that, we can check who can be seen by each user/actor. We can also observe that any user/actor can use the function and menu. There is a layered mutual monitoring condition with this design for the website system, so the data acquired by the field data collection officer becomes more precise, correct, and accurate.

B. Class Diagram

A class diagram depicts the structure of the program system as it is divided into groups and represents the database flow on the system [42]–[44]. A class diagram depicts the database's flow through the software, and Figure 4 depicts the class diagram in this site design.

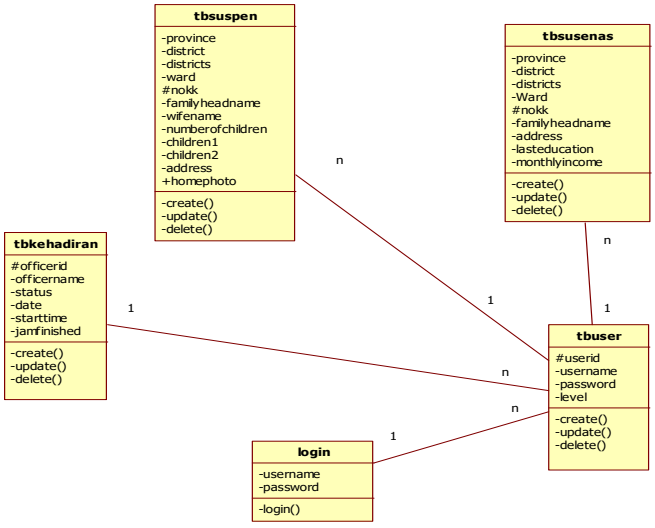

Fig. 4 Class Diagram

As shown in Figure 4, this website has five different types of tables that can store the website's database. tbsuspen, tbsusenas, tbkehadiran, tbuser, and login are the names of the

tables. All of the tables in the website system are linked together so that the system can store and retrieve the database as efficiently as possible. Table tbsuspen is the one with the most users. Table 2 shows the cardinality of each table with the other table in detail:

TABLE II
THE CARDINALITY OF TABLES IN CLASS DIAGRAM

Table Name	Cardinality	With the table	Description
tbsuspen	many to one	tbuser	For many data in tbsuspen can be accessed by only one user
tbsusenas	many to one	tbuser	For many data in tbsusenas can be accessed by only one user
tbkehadiran	one to many	tbuser	Every one data in tbkehadiran can be accessed by many users
login	one to many	tbuser	Every one data in login can be accessed by many users

C. *Activity Diagram*

The multiple activity flows in the system under development are depicted in activity diagrams [45]–[47], which show how each flow begins, the decisions that may be made, and how they end. The activity diagram of this site design is shown in Figure 5.

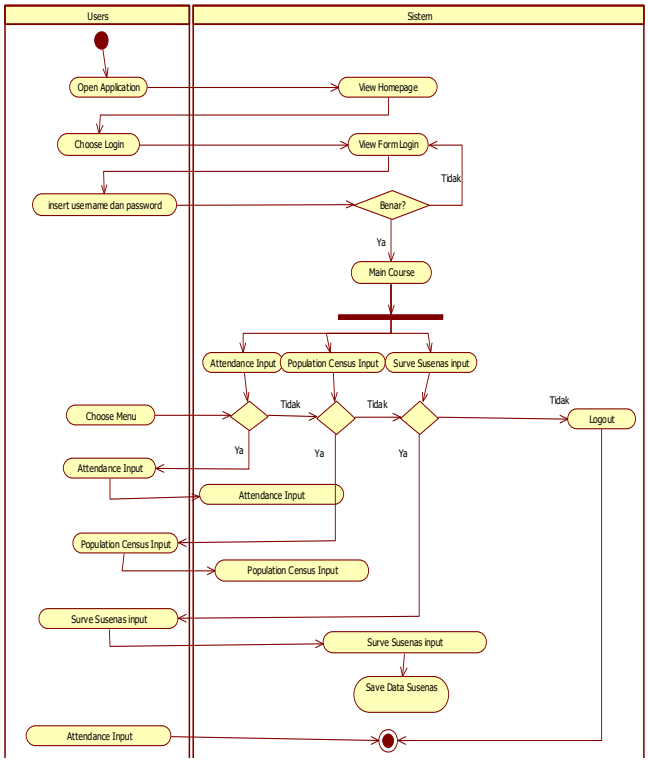

Fig. 5 Activity Diagram

Figure 5 depicts the website's activity process between users and the website system. Each user must first open the system before logging in using a username and password. If the user's login and password are accurate, they can access the website's system menu, which is determined by each actor's access credentials.

D. *Proposed Algorithm*

We Proposed a novel algorithm for monitoring field data collection activities by field data collection officers from Indonesia's Central Statistics Agency (BPS) that was implemented in the website. The proposed algorithm is as follows:

Algorithm:

1. **Declare Variable:**
2. DO1: Respondent Name List from Office
3. DO2: Respondent Location List from Office
4. DO3: Respondent Questionnaire from Office
5. DR1: NIK of Respondent that has been taken and entered in website.
6. DR2: Location of Respondent that has been Visited from GPS that shows in website.
7. DR3: Answer of Respondent that has been Collected and Entered in Website
8. **Read** DO1
9. **If**
10. DO1 = = DR1
11. **Then**
12. **Begin**
13. **Write** DR1 is Accurate
14. **End**
15. **Else**
16. **Read** DO2
17. **If**
18. DO2 = = DR2
19. **Then**
20. **Begin**
21. **Write** DR2 is Veracity
22. **End**
23. **Else**
24. **Read** DO3
25. **If**
26. DO3 = = DR3
27. **Then**
28. **Begin**
29. **Write** DR3 is Accurate
30. **End**
31. **Else**
32. **End**

E. The Flowchart Program of Proposed Algorithm

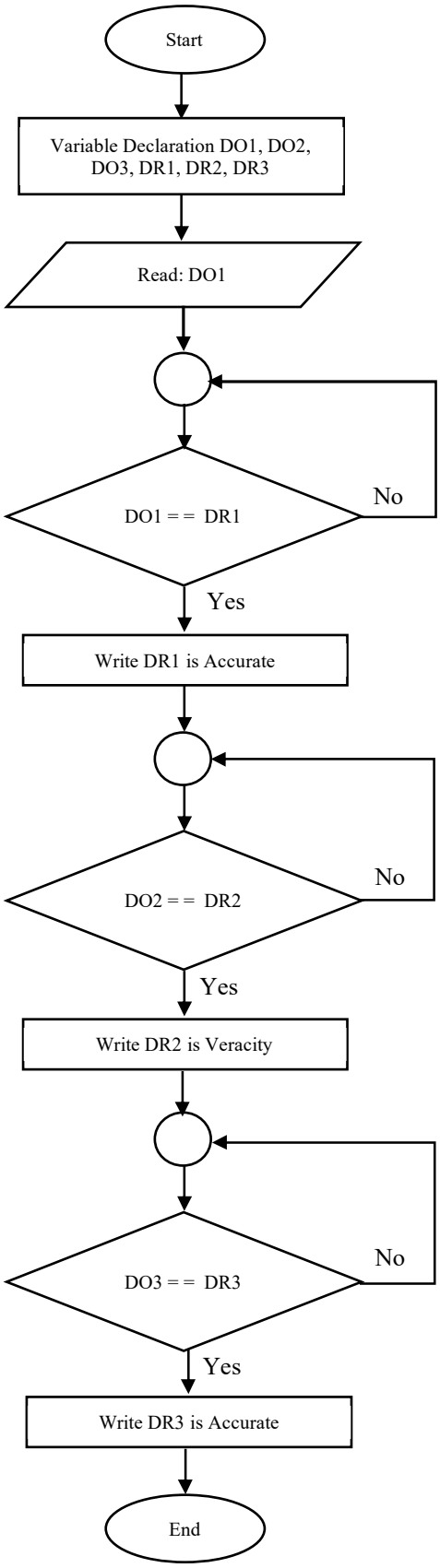

Fig. 6 The Flowchart of Proposed Algorithm

F. The Home Page of The Website

The website's home page is the main menu at the beginning when some access the website. On this home page, we need authentication for every user using email and password to use the system. Four kinds of users that can login to this website are data collection Officers of BPS, Supervisors of BPS, heads of BPS, and administrators of the website.

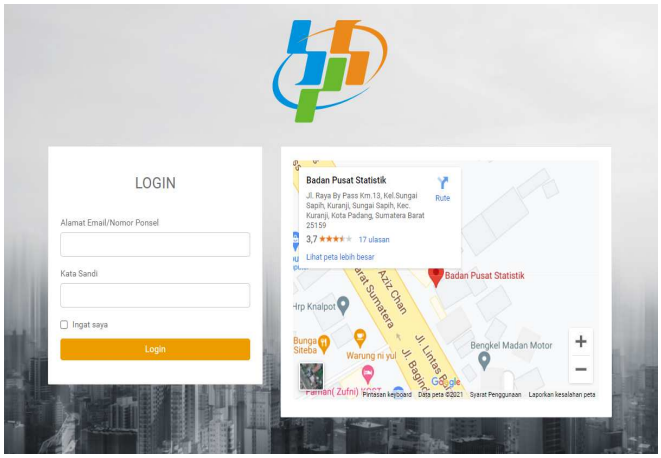

Fig. 7 The Home Page of The Website

In Figure 7 above, we can see a sample coding program that builds the website system for this website. This coding is to make the home page menu and email/phone number as a username and password fill then the bottom to execute that data.

G. Evaluate the System

We perform a data comparison to evaluate our proposed algorithm applied to the website system. The data we compared was the data collected in the field, which is assigned to the officer, with the data that has been collected in the field by the officer. In this comparison, we use three indicators, namely a list of names of respondents compared with data from the respondent's NIK, a list of questioners for respondents compared with data answers to respondents' questions entered into the system, and the location (area) of respondents compared with the data GPS location of field data collection officers detected by the web-based system. The result of comparing those three indicators will be evaluated using questioner by three people: all field data collection officers, supervisory officers, and the BPS head. The questionnaire that was used to evaluate the system consisted of 10 questions for each indicator that was answered by all field data collection officers, supervisory officers, and the BPS head. The scoring system to calculate scores used Linkert scaling. The scoring result of questionnaire filling on the respondent's name question, respondent answers question, and respondent location question that filling by 10 field data collection officers (FDCO), 5 supervisory officers (SO), and 1 BPS Head is shown in table 3 -5 below.

TABLE III
SCORING RESULT OF QUESTIONNAIRE FILLING ON RESPONDENT'S NAME

Respondent	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Sum	%
FDCO 1	5	4	5	5	5	5	4	5	5	3	46	92%
FDCO 2	5	5	4	5	3	5	5	5	4	5	46	92%
FDCO 3	5	5	5	5	5	5	5	5	5	5	50	100%
FDCO 4	5	5	4	4	5	5	5	5	5	5	48	96%
FDCO 5	5	5	5	4	5	4	5	5	5	5	48	96%
FDCO 6	5	4	5	5	5	3	5	5	5	5	47	94%
FDCO 7	5	5	5	4	5	5	5	5	5	5	49	98%
FDCO 8	5	5	4	5	5	5	3	5	5	4	46	92%
FDCO 9	5	5	4	5	5	3	5	5	5	5	47	94%
FDCO 10	5	5	5	5	5	5	5	5	5	5	50	100%
SO 1	5	4	5	5	4	5	4	4	5	3	44	88%
SO 2	5	5	5	5	4	5	5	4	5	5	48	96%
SO 3	5	5	5	4	5	5	3	5	5	5	47	94%
SO 4	5	4	5	5	3	5	5	5	5	3	45	90%
SO 5	4	5	5	5	5	5	3	5	5	4	46	92%
BPS Head	5	5	5	4	5	5	5	5	5	5	49	98%
											Total	95%

TABLE IV
SCORING RESULT OF QUESTIONNAIRE FILLING ON RESPONDENT'S ANSWER

Respondent	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Sum	%
FDCO 1	5	5	5	5	5	5	4	5	5	4	48	96%
FDCO 2	5	5	4	5	4	5	5	5	4	5	47	94%
FDCO 3	5	5	5	5	5	5	5	5	5	5	50	100%
FDCO 4	5	5	4	4	5	5	5	5	5	4	47	94%
FDCO 5	5	5	5	4	5	4	5	5	5	5	48	96%
FDCO 6	5	4	5	5	5	4	5	5	5	5	48	96%
FDCO 7	5	5	5	4	5	5	5	5	5	5	49	98%
FDCO 8	5	5	3	5	5	5	4	5	5	4	46	92%
FDCO 9	5	5	4	5	5	4	5	5	5	5	48	96%
FDCO 10	5	4	5	5	5	5	5	5	5	5	49	98%
SO 1	5	4	5	5	4	5	4	4	5	4	45	90%
SO 2	5	5	5	5	4	5	5	4	5	5	48	96%
SO 3	5	5	5	4	5	5	5	5	5	5	49	98%
SO 4	5	4	5	5	3	5	5	5	5	5	47	94%
SO 5	4	4	5	5	5	5	4	5	5	4	46	92%
BPS Head	5	5	5	4	5	5	5	5	5	5	49	98%
											Total	96%

TABLE IV
SCORING RESULT OF QUESTIONNAIRE FILLING ON RESPONDENT'S LOCATION

Respondent	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Sum	%
FDCO 1	4	5	5	5	5	5	4	5	5	5	48	96%
FDCO 2	5	5	5	4	4	5	5	5	4	5	47	94%
FDCO 3	5	5	4	5	5	5	5	5	5	5	49	98%
FDCO 4	5	5	4	4	5	5	5	5	5	5	48	96%
FDCO 5	5	5	5	5	5	4	5	5	5	5	49	98%

Respondent	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Sum	%
FDCO 6	5	4	5	5	5	4	5	5	5	5	48	96%
FDCO 7	5	5	5	5	5	5	5	5	5	5	50	100%
FDCO 8	5	5	4	5	5	5	5	5	5	5	49	98%
FDCO 9	5	5	4	5	5	5	4	5	5	5	48	96%
FDCO 10	5	5	5	5	5	5	5	5	5	5	50	100%
SO 1	5	5	5	5	4	5	5	5	4	5	48	96%
SO 2	5	5	5	5	5	5	5	5	5	5	50	100%
SO 3	5	5	5	5	5	5	5	5	4	5	49	98%
SO 4	5	5	5	5	4	5	5	5	5	4	48	96%
SO 5	5	5	5	5	5	5	5	5	5	5	50	100%
BPS Head	5	5	5	4	5	5	5	5	5	5	49	98%
											Total	98%

IV. Conclusion

The development of web-based digital technology is extremely valuable for an institution or agency in monitoring (monitoring) its field officers, particularly for the Indonesian Central Statistics Agency (BPS) in general and BPS Padang City in particular. Both field data collection officers and BPS managers and leaders will find this system very user-friendly. Developing the method of Web-Based Digital Technology compared to the manual method can improve data accuracy and data truthiness of the data collected by BPS field data collection officers. The results score value of the respondent's name is 95 percent, respondent's answer to the questionnaire is 96 percent, and the respondent's location is 98 percent. Adding checking signs to the accuracy of the data, such as live streaming for a moment at the research place, can be done for further investigations.

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