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JOURNAL OF TECH-E

| 2581-1916 (ONLINE) | 2598-7585 (PRINTED) |

Article

Development of Machine Lerning-Based Website for Diabetes Patient Health Classification

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SUBMISSION TRACK

Recieved: 06, 25, 2024
Final Revision: 07, 06, 2024
Available Online: 08, 08, 2024

KEYWORD

Diabetes Detection, Support Vector Machine (SVM), Machine Learning, Medical Diagnosis Website

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A B S T R A C T

This research aims to develop a website utilizing the Support Vector Machine (SVM) algorithm for diabetes detection. The primary objective is to assist medical personnel in diagnosing diabetes efficiently by collecting and analyzing patient data to provide accurate health classifications. The SVM algorithm was chosen due to its high accuracy in managing complex and multidimensional medical data, making it ideal for diabetes detection. The website integrates SVM to process patient information and deliver precise predictions about their health status. By enhancing the diabetes diagnosis process, the system supports healthcare providers in making informed decisions and encourages patients to maintain regular check-ups. Additionally, the website features notifications for follow-up examinations, ensuring timely medical interventions and improving patient care and diabetes management. Its user-friendly interface allows medical staff to input and retrieve patient information with ease. This integration of advanced algorithms and intuitive design creates a valuable tool for both medical professionals and patients. By streamlining data collection and analysis, the website contributes to more accurate and timely diagnoses, fostering better health outcomes. This research highlights the potential of combining machine learning with healthcare to develop innovative solutions for chronic disease management, emphasizing the importance of regular monitoring and early detection in preventative healthcare.

DOI: 10.31253/te.v8i1.3184

I. INTRODUCTION

The World Health Organization (WHO) reported that in 2014, the number of people with diabetes worldwide reached 422 million. This number is expected to increase every year [1]. Diabetes is a chronic disease whose incidence continues to increase every year [2]. Diabetes not only affects the quality of life of patients, but also imposes a huge economic burden on health systems in many countries[3].

The classification of the health condition of diabetic patients is an important aspect in the management of this disease[4]. Knowing the patient's health condition quickly and accurately allows appropriate medical measures to be taken immediately, so that more serious complications can be avoided[5]. However, due to the complexity of medical data and the variety of patient conditions, sophisticated methods are required to achieve a high level of accuracy in classification[6].

Machine learning has proven to be a powerful tool in medical data analysis [7]. By utilizing machine learning algorithms, the system can study historical data to recognize patterns and generate precise predictions[8]. One method that is often applied in medical classification is Support Vector Machine (SVM). SVMs are capable of managing complex data and show superior performance in a variety of classification tasks[9].

This research aims to create a machine learning-based website that can classify the health conditions of diabetic patients. This website is expected to be an effective tool to assist medical personnel in diagnosing and monitoring the condition of diabetic patients. By integrating the SVM algorithm and ensemble learning method, it is expected that the classification accuracy can be increased, so that the prediction results produced are more precise and reliable in medical decision making[10].

In this study, we will describe the website development process, which includes data collection, data pre-processing, machine learning model development, and model implementation into the website. We will also discuss the performance evaluation of the model and its comparison with other methods. This research is expected to make a meaningful contribution to the health management of diabetic patients.

II. LITERATURES REVIEW

Machine learning has been widely applied in various medical fields to aid in the classification and prediction of health conditions[11]. Research on diabetes prediction shows that machine learning algorithms can provide accurate and reliable results. One technique that is often used is Support Vector Machine (SVM). Based on the study of Sarwar et al. (2018), SVM shows higher accuracy in diabetes classification compared to other methods such as K-Nearest Neighbor (KNN) and Decision Tree. SVM is effective in managing data that has many dimensions and shows good performance in the classification of complex medical data.[12].

The development of machine learning-based web applications in the healthcare sector has great potential to improve disease diagnosis and management[13]. These applications offer quick and easy access for medical personnel and patients, and can integrate machine learning models to present recommendations based on data analysis. Research by Liu et al. (2020) showed that a web application developed for diabetes prediction using machine learning models can provide appropriate health recommendations and support medical decision-making.[14].

III. FRAMEWORK

This diabetes detection system uses the SVM (Support Vector Machine) algorithm to classify a patient's health based on medical parameters such as glucose level, blood pressure, BMI, and several other health features. The SVM output is a classification of the patient's health condition, including whether they have diabetes or not. Figure 1 shows the process stages in the diabetes detection system.

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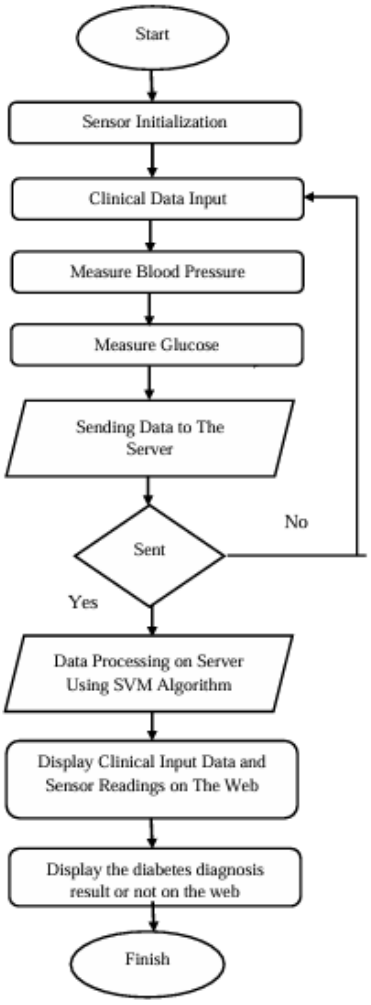

Figure 1. Flowchart of Software

Based on the Block Diagram shown in Figure 1, the program flow begins with the collection of patient clinical data and data readings from the sensors of the health monitoring device. In this tool design, the sensors used include a blood pressure sensor and a blood sugar level sensor. The clinical data collected includes age, pregancies, skinthickness, insulin, BMI and DPF. The collected data is then sent and stored in the virtual server. If the data transmission fails, the process will return to the clinical data collection stage. Next, the collected data is processed using a machine learning algorithm, namely SVM (Support Vector Machine), to determine the patient's health status. The processed data is then displayed in the form of input and output through the website interface.

IV. METHODS

In this research, the SVM (Support Vector Machine) approach is used. The use of the SVM (Support Vector Machine) algorithm serves to process input and output data. And also to diagnose diabetes. The data management process by collecting patient data including medical history, namely age, pregnancies, skin thickness, insulin, BMI (Body Mass Index), DPF (Diabetes Pedigree Fuction), blood pressure and blood sugar levels. Build the SVM model using the training data i.e. SVM will learn the decision boundary that separates diabetic and non-diabetic patient classes. Implement the trained SVM model into a system or website that can be used by medical practitioners to assist in diagnosing diabetes. The following is a flowchart of the data processing process:

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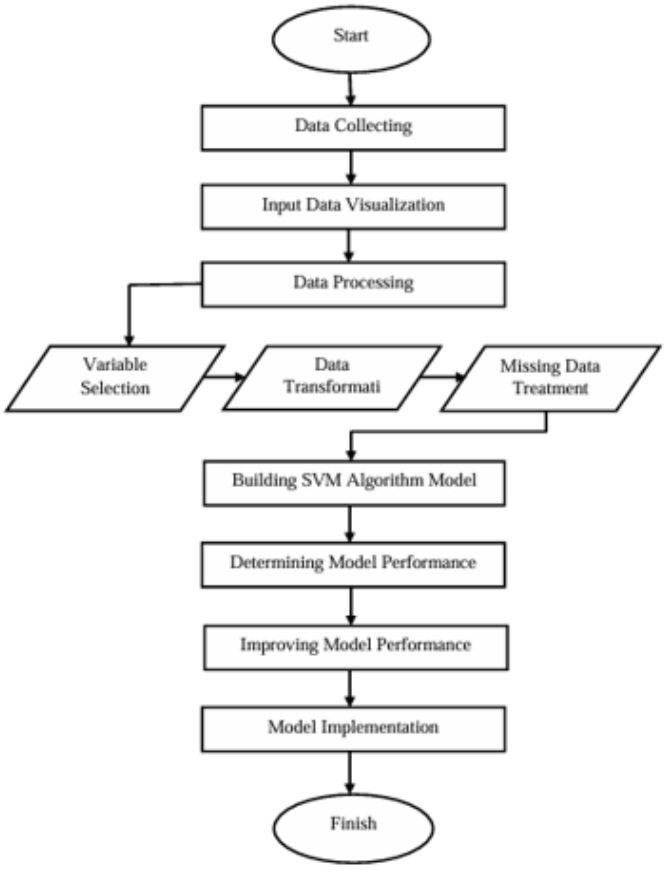

Figure 2. Data Processing Flowchart

Figure 2 above shows the data processing process using the SVM (Support Vector Machine) algorithm. The following is an explanation of the diagram above:

1. Data collection
   The dataset is collected from patient data. This dataset contains data on age, pregnancies, skinthickness, insulin, BMI (Body Mass Index), DPF (Diabetes Pedigree Function), blood pressure and blood sugar levels to determine diabetic and non-diabetic patients.
2. Input data visualization
   Provide an explanation of the visualization of input data and its relationship to health status data (y value) with the help of the seaborn library.
3. Data Processing
   There are several data processing processes, namely:
   a. Variable selection
      Describe the characteristics of the data and select data variables that do not have a relationship with health status (y-value).
   b. Data transformation
      Then transform data that is non-numeric.
   c. Missing data treatment
      Identify missing data with the help of the Seaborn library. Missing data is filled with the mean of each variable.
4. Building the SVM algorithm model
   Next is model building using the Support Vector Machine method, which requires understanding the input data patterns to create a prediction model [15]. This is done on VENV (Virtual Environment), using the Python programming language.
5. Determining model performance

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Model performance is done to find out how good a model is and whether it is feasible to use in a system.

6. Improving model performance
   Performance improvement is done using the ensemble learning model. By combining several approaches with the aim of increasing accuracy.
7. Model implementation
   The model that has been combined will be stored and combined and overwritten to the server. This model becomes a body health diagnosis system on the results of data from medical devices made and clinical data input from the website.

V. RESULT

This research produces a website that aims to facilitate medical personnel in detecting diabetic patients. This website allows filling in patient data efficiently and provides diagnostic results whether the patient is diabetic or not.

System Implementation

After going through the process of making the SVM (Support Vector Machine) algorithm model, then the system implementation is carried out. The following is a display of the results of the system implementation that has been made.

On the registration page, the Admin must register an account first by entering a username, email, password and pressing the register button. The registration page can be seen in Figure 3.

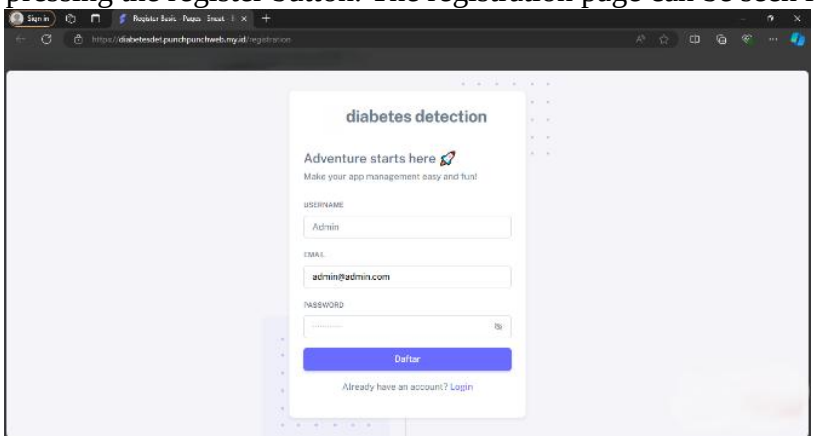

Figure 3. Registration Page Display

After registering, on the login page the admin enters the username and password that he already has and presses the sign in button. The login page can be seen in Figure 4.

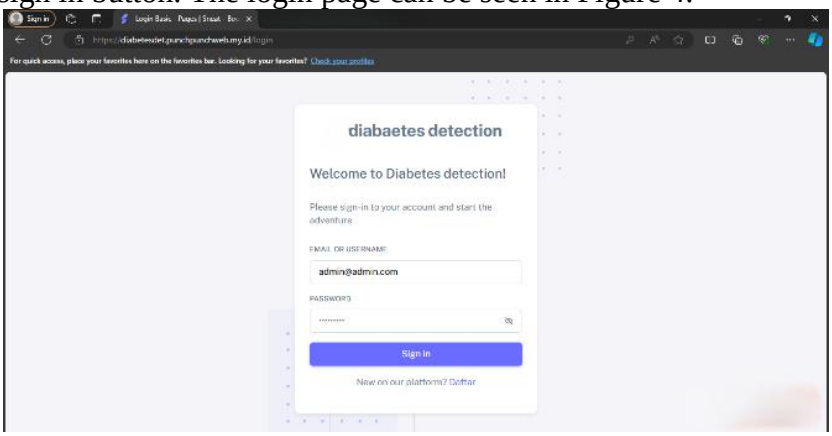

Figure 4. Login Page Display

The following is a web page on the dashboard section. On this page there is a check now button, which is to immediately register patient data that will be inputted. In addition, in the sidebar section there are also layout features that contain patient data, about and logout. The dashboard page can be seen in Figure 5.

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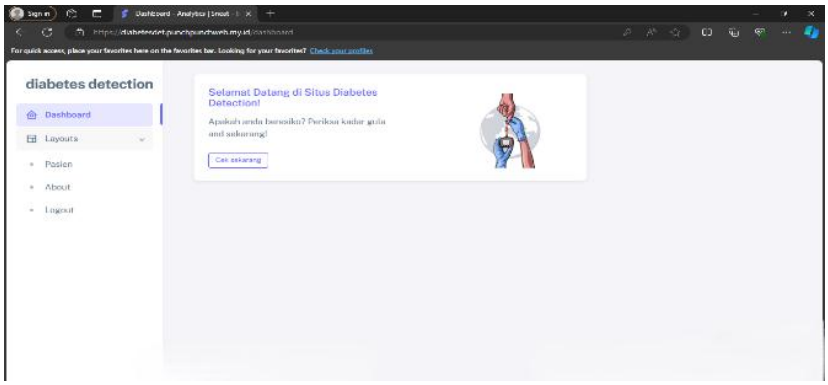

Figure 5. Dashboard Page Display

On this page the admin can view, edit and delete patient data as shown in Figure 6, and the admin can also add new patient data by clicking on the Register Patient button. Then input name, cellphone number, email, pregnancies, skin thickness, insulin, weight, height, DPF (Diabetes Pedigree Function) and age. Click the check button to see the detection results whether the patient has diabetes or not. Then click the submit button to save the patient's data. This page can be seen in Figure 7. For glucose and blood pressure, it is obtained from the results of the tool connected to firebase which can be seen in Figure 8.

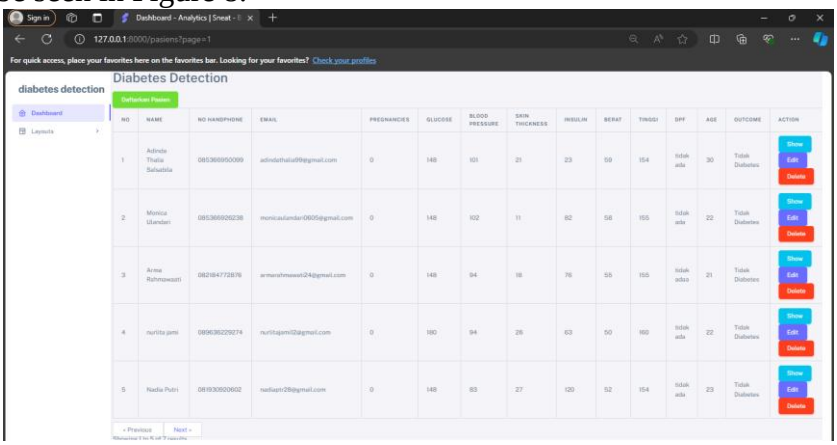

Figure 6. Patient Data Page Display

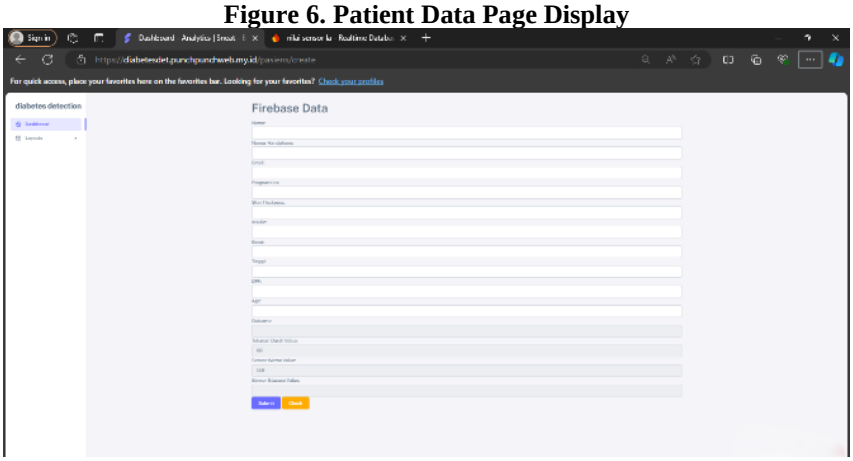

Figure 7. Display of the Add Patient Data Page

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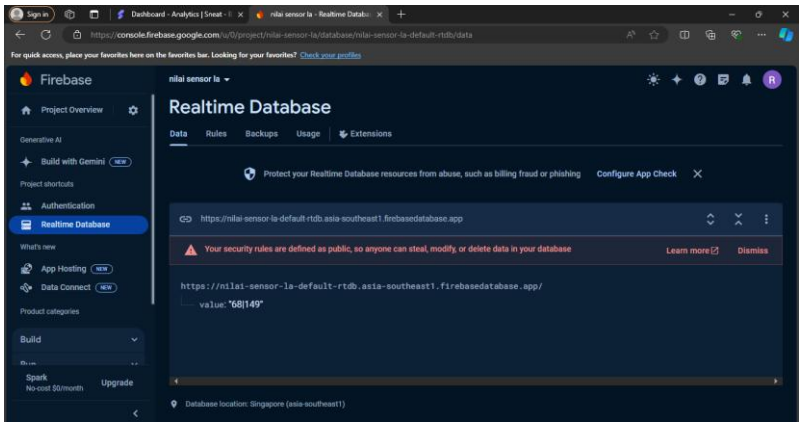

Figure 8. Firebase Page View

Furthermore, on the about page there is a brief explanation of the website and its mission. The mission of this website in short is to detect diabetes at an early stage or need to be followed up, raise awareness about the importance of early detection by providing educational resources on diabetes management, and offer support and guidance to those diagnosed with diabetes and help them on their journey to better health. The About page can be seen in Figure 9.

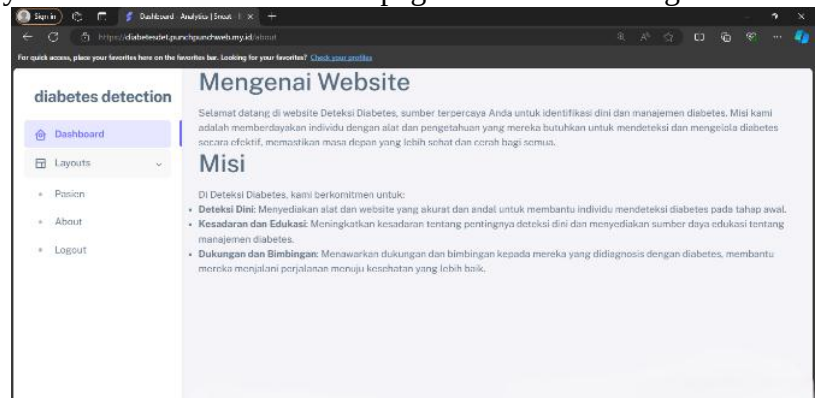

Figure 9. About Page Display

On this page the admin can exit the website page and return to the login page. The following is how it looks if the admin presses the logout button can be seen in Figure 10.

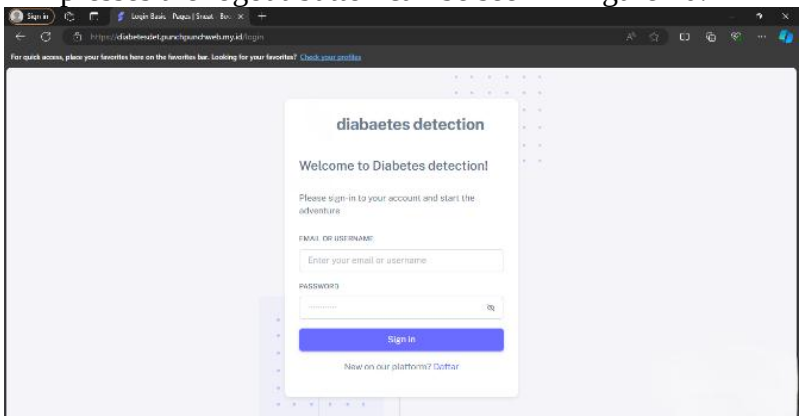

Figure 10. Display of the logout page

System Testing

In this test, we successfully tested using Black-box. Like the following table.

Table 1. Black-box Testing

Trial process	Expected results	Trial result
Users of can access the entire menu on the website	Settings URL settings are running well	Successful

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Machine learning integrated with website	Machine learning is able to detect diabetic patients that is inputted by the user	Successful
Website display detection results	detection result display "Diabetes" for patients with diabetes "Not Diabetes" for patients who are not diabetic	Successful

VI. DISCUSSION

Based on the test results of the diabetes detection website developed using the Support Vector Machine (SVM) algorithm, it was found that this method has a high level of accuracy in detecting the patient's diabetic condition. SVM shows good ability in managing complex medical data and producing accurate predictions. This method is effective in recognizing patterns from multidimensional data, which is very important in the context of diabetes detection.

The use of SVM in this website is proven to be able to classify diabetes conditions with sufficient accuracy, helping medical personnel in making the right decision based on the input data. Test results show that SVM has the advantage of managing high-dimensional data and providing clear decisions based on classification margins.

The implementation of the SVM method into a diabetes detection website allows users to utilize machine learning technology in detecting diabetes conditions more accurately and efficiently. This website not only facilitates the process of data collection and analysis, but also provides notifications to patients to conduct follow-up examinations based on the detection results.

VII. CONCLUSION

This research successfully developed a diabetes detection website using the Support Vector Machine (SVM) algorithm. This method shows high accuracy in classifying diabetes conditions based on patient medical data. SVM effectively manages high-dimensional data and provides accurate predictions.

The integration of SVM into this website facilitates the process of diabetes detection and management, helps medical personnel diagnose quickly and accurately, and increases patient awareness of the importance of regular check-ups.

Overall, this diabetes detection website is expected to improve the quality of life of diabetics and support the health system by providing better services.

Here are several sustainability aspects that can be applied to the development and implementation of the diabetes detection website based on the Support Vector Machine (SVM) algorithm:

1. Perform regular technical maintenance to ensure the website remains operational without technical disruptions.
2. Collaborate with various hospitals and clinics to expand the reach of the website's usage and ensure better integration with existing health systems.
3. Organize educational programs to increase patient awareness about the importance of early detection and proper diabetes management.

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DOI: 10.31253/te.v8i1.3184

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DOI: 10.31253/te.v8i1.3184