Algorithms are ubiquitous in nature and human society, and algorithms in national sports are the internal mechanisms for the creation and development of national sports. Algorithms from nature, society, and culture act as the external driving force for the development of ethnic sports. Different ethnic sports are based on physical behaviors, including physical recreation, social interaction, and life-shaping behaviors. In this paper, we suggest an algorithm for health and wellness elevation of ethnic sports in the context of body-medicine integration, examine the fall situation in sports life, and propose a bidirectional LSTM fall detection model, which can automatically extract deeper data features within the fall behavior for the input data (taken from inertial sensors) and realize the processing of data from preprocessing to detection results. Medical disciplines provide scientific ideas and pathways that are founded on a rigorous medical way of thinking and knowledge system to summarize sports, so that they can be prescribed to explore new pathways of exercise for health, to carry out deliberate, planned, and scientific exercise. Finally, the superiority of the proposed algorithm in this paper is verified on a relevant dataset.

1. Introduction

Chinese medical and health care are progressing in tandem with the advancement of the country’s social, economic, and cultural development; the national fitness movement is gaining momentum; the overall quality of life for the people is improving; the physical development of children and adolescents is improving; the average height of Chinese people is increasing, but physical quality of Chinese people is declining. For the purpose of improving the physical quality of the entire population, the State Council on issuing the National Fitness Plan (2016–2020) notice recommended that the national fitness campaign be implemented widely in 2016. The Health China 2030 Plan, which was released the same year, intends to expand the incorporation of physical medicine and non-medical health interventions into the healthcare system [1–5].

The integration of sports and medicine is not simply a fusion of the two disciplines; rather, it is a fusion of the theoretical, cognitive, managerial, resource, technical, and application aspects of the two disciplines that collide and come into contact with one another, resulting in a more holistic integration of the two disciplines [6, 7]. Sport disciplines provide targeted and practical methods, whereas medical disciplines provide scientific ideas and pathways, which are based on a rigorous medical way of thinking and knowledge system to summarize sports, so that they can be prescribed to explore new pathways of exercise for health, to carry out purposeful, planned, and scientific exercise, in order to achieve the goals of maintaining health, treating disease, and preventing it [8, 9].

From Comrade Mao Zedong’s proposal of “developing sports and strengthening people’s physical fitness” in 1952 to the State Council’s promulgation of the “National Fitness Program Outline” in 1995 to provide policy support for mass sports activities, to the implementation of the Health China Strategy proposed by General Secretary Xi Jinping in 2017 around the theme of “Healthy Chi,” sports and medical care have both been important means and measures for health promotion in China [10]. The establishment of the Center for
the Promotion and Innovation of Sports-Medicine Integration is the central focus of the conference. Its goal is to improve the study and practice of physical medicine integration as well as non-medical health interventions, as well as to promote the deep integration of national fitness and national health on a national scale. Physical medicine integration and non-medical health interventions are among the research and practice goals of the center, which also seeks to promote the deep integration of national fitness and national health into national policy. A medical intervention is a response to disease symptoms that occurs after the event, has a time lag, and has an unknown effect. It is not an ideal solution for those who are experiencing physical difficulties. With the rise in popularity of health management concepts and ideas, the health management model of prior intervention is becoming more and more well known among the general public. Integration of body medicine aims at prior control and early intervention through the concepts of early detection, early intervention, and early consultation, combined with sports methods, early detection of problems, problem solving, reducing the likelihood of physical pathology, and reducing medical costs, which is the most effective method of controlling physical problems and the key to improving them, according to the World Health Organization [11–15].

In recent years, the gradual aging of populations around the world has led to an increased level of concern about aging issues among members of the international community [16, 17]. The elderly are mainly vulnerable to accidental falls, which are among the most serious accidents that can occur. According to a poll, 33.3 percent of the elderly will experience at least one accidental fall every year. A fall is distinct as a negligent accident that causes the body to come into contact with the ground, the floor, or another lower position. It does not include forceful impact, loss of consciousness, stroke, or seizure, but it does include slipping and falling [18–21].

Falls can cause non-fatal injuries as well as fatal injuries in older persons who are not properly secured. Falls in older individuals can result in minor injuries such as sprains and bruises, but they can also result in significant complications such as fractures and brain bleeding, increasing the financial burden on families and reducing the quality of life for older adults who suffer from these injuries. In order to reduce the number of injuries and consequences of falls in the elderly, it has become increasingly vital to accurately detect falls in the elderly and to rescue them in a timely way, according to the National Institute on Aging. As a result, the research on fall detection has considerable societal implications, as demonstrated above [22, 23].

The problems at hand are both practical and theoretical, and they necessitate a thorough analysis. It is critical to note that a thorough understanding of these difficulties has a direct bearing on the practical efficacy of sports-medicine integration. Sports, as well as public health management, public policy, fiscal policy, health ecology, and health economy, are all part of this knowledge. It has the potential to not only raise the level of awareness of the combination of sports and medicine but also add a rich knowledge base to these fields and have specific academic value.

In order to avoid overlooking essential elements inherent in the fall data, this paper uses neural networks (NNs) to extract the features of falls from the fall data. It is necessary to collect data prior to the occurrence of falls in order to discriminate fall behavior, but it is also necessary to collect data after the occurrence of falls to some extent [24, 25]. A new bidirectional LSTM fall detection model is proposed as a result of the above-mentioned investigation. The model first processes the original fall dataset using a low-pass filtering approach, then obtains sensor data using a sliding window algorithm, and extracts the corresponding features as input to the model using a feature extraction algorithm. Following that, the NN is used to learn the training set in order to obtain the suitable fall data features, and lastly, the final judgment result is output by the NN. A number of studies have demonstrated that the model presented here can achieve a better balance between accuracy and detection delay than any other model in the literature [26].

The recognition of the social benefit of research on the integration of body medicine demonstrates the research’s multifaceted significance. Longevity is a desirable goal and a worthy goal for human society to pursue. This study offers a body-medicine-integrated algorithm for ethnic sports wellness and health promotion and encourages the mutual integration of ethnic sports wellness and health diagnosis using bidirectional LSTM to identify falls in sports activities.

This paper is organized as follows. Section 2 defines the various problem orientations and the integration of sports and health care for the construction of health China. Section 3 discusses the different proposed methods and SFIC model of ethnic sports wellness and health promotion. They improve the initial conditions of sports medical integration and the innovative system design of sports medicine integration. Section 4 discusses the experiments. Section 5 concludes the article.

2. Problem Orientation of Research on the Integration of Body Medicine

The merging of sports and medicine is a novel research idea in the health China effort, according to the program’s researchers. The implementation of the health China strategy, the significance of the integration of sports and health care, the relationship between sports and healthcare systems, the significance of the integration of sports and health care for the construction of health China, the significance for the country, society, and individuals, how to promote the integration of sports and health care, the internal logic of the integration of sports and health care, and the operation mechanism of the integration of sports and health care are all discussed. The challenges at hand are both practical and theoretical in nature, and they require in-depth investigation. It is vital to recognize that the understanding of these concerns has a direct impact on the practical efficacy of the integration of sports and medicine. This understanding encompasses sports as well as public health management, public policy, fiscal policy, health ecology, and health economy. It can not only improve the height of understanding of the integration of sports and medicine but also
add a rich knowledge base to these disciplines and have distinct academic value.

The academic value of research on the integration of sports and medicine is also reflected in the formation of specialized research fields and specialized knowledge through disciplinary crossover, which contributes to the enrichment of social science theory of sports with distinctive Chinese characteristics. In order to understand the combination of sports and health care, it is necessary to draw on theoretical knowledge from various disciplines to reveal the essential features and intrinsic links between sports and health care from a materialist perspective, and to explain the role and value of the combination of sports and health care from an epistemological perspective. In order to consider the policy formulation and institutional guarantee of the integration of sports and medicine, it is necessary to understand the fundamental principles of policy science, and in order to explore the policy implementation and action strategies of the integration of sports and medicine, it is necessary to understand the fundamental principles of law. The practice of corporate-medical incorporation can benefit from targeted theoretical research and in-depth academic work, and the development of the creation of a healthy China can be furthered by deep academic work. On the other hand, it contributes to the building of a philosophical and social science discourse system with Chinese features by bringing together the knowledge and theory of sports social science and other disciplines.

The academic value of research on the integration of sports and medicine is also reflected in the promotion of the construction and development of sports social science disciplines from the perspective of methodology. Sports social science disciplines are disciplines that study the integration of sports and medicine. Studies on the integration of sports and medicine are still in their early stages, and the majority of those that have been conducted so far have been qualitative in nature, employing the interpretivist paradigm. There have been few empirical studies that have dug deep into actual practice and obtained first-hand data through surveys. Experimental research using first-hand data is more scientific in terms of transferring theoretical understanding of physical medicine into practice, as well as in terms of strategic planning, policy response development, model construction, and performance evaluation of the integration of physical medicine into healthcare delivery. While using the interpretive paradigm to analyze basic theoretical issues, research on the integration of health care and wellness should also pay attention to the following scientists’ recommendations for quantitative evaluation of research on the integration of health care and wellness to obtain broader scientific support for the policy design of health care integration from empirical studies in order to make the design and model selection of health care integration more positive. According to the interpretivist paradigm and the positivist paradigm, which complement each other and make up for each other’s shortcomings, improve research quality, and promote the development of sports social science disciplines, the research on corporate-medical integration is guided by the methodological aspect of the research.

It is important to recognize that the value of sports-medicine integration research is multiple, and this multidimensional value is mirrored in the economic component of the field. It is beneficial to the creation of a healthy China and the improvement of national health, as well as the value of cutting national medical expenditures and reducing the economic burden on society, when sports medicine is integrated. According to health economics, health is a form of capital, and investing in it may effectively provide healthy time for the individual. Healthy living is a two-way street that includes inputs and outputs, as well as a benefit with monetary worth. Science-based fitness and scientific body maintenance provide significant benefits in terms of both physiological and psychological health, and the reduction of medical expenses is a significant economic benefit of physical medicine integration. The economic benefits of physical medicine integration can be split into two categories: direct economic benefits and indirect economic benefits. Direct economic benefits include the following. For the sake of this definition, direct economic advantages are benefits that are directly caused by scientific fitness that can be measured in money and that are explicit, such as calculable personal medical expenses or calculable public medical expenses, among other things. It is possible to obtain indirect economic benefits other than those that can be quantified by scientific fitness, such as personal and social benefits that are difficult to quantify in monetary terms and are in the form of potential benefits such as life ability, health status (both physical and mental), or a long and healthy life expectancy. The explicit economic benefits measured in money have the same value as these benefits from the standpoint of health economics, and they even have a higher value than the implicit economic benefits assessed in money. In truth, the contribution of the health industry to the creation of social wealth as well as the promotion of new forms and dynamics of economic development cannot be overstated or overlooked. It is necessary for scholars and practitioners to pay attention to the economic value of integrating physical medicine into their practices.

The acknowledgment of the social value of research on the incorporation of body medicine reflects the multidimensional significance of the research on the integration of body medicine. Endurance is a noble ambition and a worthy objective pursued by human society. It is directly associated with socioeconomic growth, but it can also be reached through the process of disease prevention and treatment. It is estimated that the expense of aging diseases will exceed $1 trillion in 2018 and will reach $2 billion by 2030, according to the World Health Organization. It is undeniable that fighting disease is a tremendous stressor and a significant financial burden on both society and individual citizens. Our large population has always been a significant burden in the struggle against sickness, as well as a significant impediment to socioeconomic progress. Concentrating on human health and establishing a longer healthy life span is an effective technique for
addressing this social challenge. Accordingly, while revealing the academic and economic value of the integration of health care, the social value and social implication of the health industry, as well as the allowance of its industrial chain in promoting social employment, bridging social class divisions and fractures, and enhancing social integration, are issues that require attention and research in the multidimensional value of the integration of health care.

3. The Proposed Method

In this section, we evaluate the SFIC model, and the model is composed of four elements. While using the interpretive paradigm to analyze basic theoretical issues, research on the integration of health care and wellness should also pay attention to the following scientists’ recommendations for quantitative evaluation of research on the integration of health care and wellness to obtain broader scientific support for the policy design of health care integration from empirical studies in order to make the design and model selection of health care integration more positive. There are many misjudged cases in fall detection algorithms.

3.1. SFIC Model-Based Scheme for Promoting the Health and Wellness of Ethnic Sports in the Context of Corporate-Medicine Integration.

This study first introduces the SFIC model of ethnic sports wellness and health promotion in the context of physical medicine integration, followed by a discussion of the model’s application to ethnic sports. The model is composed of four elements: the starting condition, the initial condition, and the final condition. S is a requirement for establishing a cooperative relationship and is the most important factor influencing the initial level of trust among participants; it is also referred to as catalytic leadership. F is the driving force behind the process’s effectiveness and is a necessary factor in mediating the synergy process and uniting the participating subjects; the institutional design I refers to the process’s basic action rules and is the institutional guarantee for the legitimacy of the participation procedure of multiple subjects; the synergy process itself is a necessary factor in mediating the synergy process and uniting the participating subjects. In the model, C is defined as the closed-loop process formed by the introduction of the three influencing factors mentioned above, which has a significant impact on the final output of the synergistic results. C is defined as the core of the model. This study presents the SFIC model as a basic theory into the study of health care incorporation, in order to provide reference for promoting the development of health care integration. Because the SFIC model has an extensive application space and also pays enough attention to the synergistic process, which can help us have a more comprehensive understanding of the synergistic process, this study introduces the SFIC model as a basic theory into the study of health care integration. The following is the program for boosting the health and wellness of ethnic sports participants, which is based on the SFIC model and is viewed through the lens of body-medicine integration.

3.1.1. Improving the Initial Conditions of Sports Medical Integration.

Health promotion departments, such as sports and medical treatment, are integrated in developed countries, and management power is concentrated in a single institution. Integrated departments also promote the healthy development of sports and medical integration, as well as the sharing of sports and medical resources as well as departmental coordination within institutions. For example, the Department of Health and Human Services of the United States, the Department of Health and Sports of Australia, and the Department of Health, Welfare, and Sports of the Netherlands are all departments of health and human services. To achieve compromise and increase the efficiency of integration, these countries combine sports departments with health departments to form new sections, which then organize and manage business integration under the supervision of that department. China’s sports and health management departments are still operating under a state of separation at the moment. Significant inequalities persist in the way people think about health, power structures, and resource distribution. Power, resources, and knowledge are very asymmetrical in terms of who has what and when. An integration of the management departments of national fitness and health organizations, as well as the establishment of a major department management organization, is reasonable. In the state of not yet integrated, the two departments should strengthen work coordination, build a mutually collaborative organization and management system in the development planning, policy guidance, and financial support of sports and medical integration businesses. Information, abilities, and knowledge resources should be shared across healthcare providers, and independent and complementary technical operation norms for public health promotion should be conventional. Law enforcement departments and other cooperating subjects, such as the statistical department, are required to severely crack down on illegal acts that violate people’s health rights and benefits. The Administration for Industry and Commerce is required to investigate and improve the pricing mechanism of sports and medical integration services, as well as verify the scope of their application.


It is important to focus on the entire integration of source to process to result in a unique solution to the sports medical integration challenge as well as the high transparency in this integration process. We will create a comprehensive system of sports and medical integration policies, laws, and procedures through systematic scientific planning, comprehensive needs planning, standard management, and increased oversight. Sports medical integration service industry development in developed countries is characterized by the strengthening of industry standards and oversight in compliance with applicable laws.
3.2. Fall Detection Algorithm. There are many missed or misjudged cases in fall detection using unidirectional LSTM, while the feature of bidirectional LSTM output is that the final output result is determined by the forward and reverse layers, which can greatly reduce the missed or misjudged cases. Therefore, this paper adopts bidirectional LSTM. The calculation formula of neurons in unidirectional LSTM at a certain time is as follows:

\[
\begin{align*}
  f_t &= \sigma(W_{xf}X_t + W_{hf}h_{t-1} + b_f), \\
  i_t &= \sigma(W_{xi}X_t + W_{hi}h_{t-1} + b_i), \\
  c'_t &= \left\{ \begin{array}{ll}
    \tanh(W_{xc}X_t + W_{hc}h_{t-1} + b_c), & c'_t = f_t \ast c_{t-1} + i_t \ast c'_t, \\
    c_t = f_t \ast c_{t-1} + i_t \ast c'_t, & \end{array} \right. \\
  o_t &= \sigma(W_{xo}X_t + W_{ho}h_{t-1} + b_o), \\
  h_t &= o_t \ast \tanh(c_t),
\end{align*}
\]

where \( \sigma(x) = 1/1 + e^{-x} \) and \( \tanh(x) = 1 - e^{-2x}/1 + e^{-2x} \). Bidirectional LSTM is composed of two-layer recurrent NNs. Their inputs are the same, but the direction of information communication is diverse. The final desired result is composed of the preceding input and the following output. Figure 1 shows a two-way recurrent NN expanded by time.

The calculation of each part of bidirectional LSTM neuron at time \( t \) is as follows:

\[
\begin{align*}
  h_t &= f(W_{1x}X_t + W_{2h}h_{t-1}), \\
  h'_t &= f(W_{1x}X_t + W_{2h}h'_{t-1}), \\
  o_t &= f(W_{1x}X_t + W_{2o}h'_t).
\end{align*}
\]

The operating idea of LSTM is that it learns the underlying properties of the data and receives the final result through the classifier. We utilize bidirectional LSTM, which runs forward and backward in chronological sequence. The final output result is determined by two unidirectional LSTM networks through the internal characteristics of the classifier. The advantage of this is that the algorithm can better learn the internal characteristics of fall data and improve the accuracy of fall detection and classification. Through the fall detection experiment, it is found that there are more missed or misjudged cases in fall detection using one-way LSTM, and the feature of two-way LSTM output is that the final output result is determined by the forward and reverse layers, which can greatly reduce the missed or misjudged cases.

An improved fall detection model based on bidirectional LSTM network is proposed in this paper in order to attain a high accuracy of fall detection target using wearable sensors. Figure 2 depicts the model structure, which is comprised mostly of the four components listed below.

3.2.1. The Input Layer. The input layer receives feature vectors from the triaxial accelerometer and stores them in the memory. The original fall data are processed using a sliding window, and the intercepted sequence data are extracted and economized using principal component analysis to produce the feature vectors. The feature vectors are then used to analyze the original fall data.

3.2.2. LSTM Hidden Layer with Bidirectional Transmission. It is possible for the model to teach rich enough features by putting the data through a sequence of linear or non-linear transformations. This is accomplished through the bidirectional LSTM hidden layer.

3.2.3. Non-Linear Layer. In between the hidden layer and the fully connected layer, we introduce a non-linear activation layer for the purpose of introducing more non-linear features and reflecting the change pattern of the data. The sigmoid activation function is used in the non-linear layer.

3.2.4. The Output Layer. The output layer makes use of the fully connected layer and the classifier to decide if the data
processed by the NN correspond to a fall or not, which is the fourth layer. The fully connected layer (dense layer) obtains a specified value first, and then the final classification result is created using the softmax classifier to determine the classification outcome.

The loss function LOSS of our model is as follows:

$$\text{loss} = \sum_{i=1}^{N} [y_i \log y_i' + (1 - y_i) \log (1 - y_i')]$$

$$\text{LOSS} = \frac{1}{N} \text{loss}.$$

### 4. Experiment Results

We engaged the MMA fall dataset for a fall detection study, in which we tested the accuracy of the model as well as the latency of the method. Two accelerometers and a gyroscope were used to acquire data for this dataset, which was collected by 100.0 volunteers while wearing the acquisition equipment around their waists. The sampling frequency for this dataset was 200.0 Hz. One hundred and fifty volunteers were separated into two groups. For the sake of computational simplicity, only one accelerometer was employed to detect the occurrence of a fall. Totally, 8000 datasets were obtained after the data were processed using a time window. We received 5000 cases of non-fall data and 3000 cases of fall data after utilizing the time frame.

Figures 3 and 4 show the variation of acceleration signals for the typical 2 fall cases. The vertical axis represents the combined acceleration, the horizontal axis represents the number of samples, and the sampling frequency is 200 Hz. From the 3 fall conditions in Figure 4, it is clear that the action of falling is about 3 s from the onset to the end.

It is necessary to first introduce the common evaluation metrics of the algorithm model in order to evaluate the merits of the fall detection algorithm model in order to determine its merits. This paper’s fall detection metrics are sensitivity SE, specificity SP, and accuracy ACC, which are determined using the formulas shown below:

$$\text{SE} = \frac{TP}{TP + FN}$$

$$\text{SP} = \frac{TN}{TP + FN}$$

$$\text{SE} = \frac{TP + TN}{TP + FN + TN + FP}$$

Figure 5 shows the accuracy of fall detection in two examples of sliding window of three seconds and six seconds, where

![Figure 1: The structure of bidirectional network.](image1)

![Figure 2: The structure of our model.](image2)
the vertical axis represents the accuracy of fall detection and the horizontal axis represents the three evaluation indices.

When the sliding window is expanded to 6 s, as illustrated in Figure 5, it can be observed that the model accuracy is much higher than that when the sliding window is reduced to 3 s. The sensitivity, specificity, and accuracy have all increased by 3.33 percent, 4.67 percent, and 4.54 percent, respectively, since the beginning of the study. As a result, the size of the sliding window in this study is taken to be 6 s.

Further, we compare our method with the recent fall detection algorithms BAK and BCAK, and the comparison results are shown in Figure 6.

5. Conclusion

The integration of sports and health care, as a key initiative in the implementation of the Health China strategy, provides a unique practical field for the reform and development of sports and healthcare systems for the benefit of society, with a distinct practical orientation, as well as a pressing need for theoretical research on the integration of sports and health care, with a distinct theoretical orientation. This paper focuses on the reality of sports-medicine integration and discusses the basic strategies of research on sports-medicine integration from several aspects. This study introduces the SFIC model as a basic theory into the study of health care integration, in order to provide reference for promoting the development of health care integration. Because the SFIC model has a wide application space and also pays enough attention to the synergistic process, which can help us have a more comprehensive understanding of the synergistic process, this study introduces the SFIC model as a basic theory into the study of health care integration. Moreover, this paper proposes an algorithm for ethnic sports wellness and health promotion under the perspective of body-medicine integration and promotes the mutual integration of ethnic sports wellness and health diagnosis through bidirectional LSTM to detect falls in sports activities. The fall detection model developed in this study achieves good accuracy and meets the time delay of quasi-real-time detection, according to experimental data.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

This study was supported by the 2021 Sports Research Project of Jiangxi Sports Bureau (Intervention study of Taijiquan prescription on upper cross syndrome in office population) (no. 202110).
References


