Preliminary Study on Wearable Devices based on Artificial Intelligence Algorithms

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Abstract: In recent years, artificial intelligence technology increases continuously. With the introduction of artificial intelligence algorithms, networking hardware system whose hardware devices have matured can be intelligently integrated, from which, the energy consumption can be reduced and the efficiency of data transmission can be improved via the optimum algorithm. In this paper, the network wireless data transmission is well designed based on the boost algorithm and Qagent algorithm. With the context of path optimization on minimum tree model and the short-circuit model, the transmission efficiency is improved and the energy consumption rate is reduced. The interface is prepared and the model is simulated by MATLAB platform with a view to developing a good robustness and high precision real-time interactive platform of wearables devices of internet of things.

Key words: Wearable devices, Qagent algorithm, Artificial intelligence, Optimizing strategy

1. INTRODUCTION

With the rapid development of networking hardware technology and the implementation of internet plus policy in recent years, wearable devices gradually come to people within touch. Li et al. summarized the development course and development prospect of wearable devices in “research on the industrial chain and development trend of wearable device industry in China”. Based on the analysis of networking industry economic development, the authors preliminarily investigate the problems caused by the market behavior of wearable devices and the new industry, which has much guiding significance(Yunji,2014). Li et al. study the small electronic equipment and intelligent devices in “research and implementation of adaptive wireless transmission for wearable devices”. By exploring a variety of adaptive wireless data transmission and optimizing the data storage as well as appropriate compression, the interactive graphics interface software is developed, i.e., the preparation and algorithm of data communication are realized(Stephan,2013; Shakhakarmi,2014). From a perspective of algorithm design of system, the problem of human action recognition and its instantaneity are well solved by Lv et al. in “research on human behavior recognition technology based on wearable sensor network”, e.g., in the identification delay for 5 seconds, the recognition accuracy of the system reached 93.6%. Finally, in order to solve the problem of efficient behavior aware, they proposed a new sensing method based on the passive wearable high frequency RFID technology, and put forward an efficient data completion and feature extraction algorithm to deal with the inherent challenges of RFID technology. According to the recognition requirement of hard real-time behavior, a recognition prototype system of human behavior based passive wearable sensor network is realized. From the real data sets of experimental results, it could be found that, the recognition accuracy of the prototype system reached 93.6%, yielding, the platform for human action recognition is feasible and efficient, providing a reliable algorithm and hardware support for the organic combining of hardware and software of wearable devices(ösc, 2012). In summary, wearable devices have a certain foundation in the hardware, whose key is the influence of the system data real-time interaction algorithm and efficiency on energy consumption. Through the design of advanced algorithms, the data exchange algorithm can be optimized(minimum energy consumption rate). The development and application of modern intelligent algorithm can meet the requirements. In this paper, the network wireless data transmission is well designed based on the boost algorithm. With the context of path optimization on minimum tree model and the short-circuit model, the transmission efficiency is improved and the energy consumption rate is reduced. The interface is prepared and the model is simulated by MATLAB platform with a view to developing a good robustness and high precision real-time interactive platform of wearables devices of internet of things.

2. MODEL

2.1. WBAN principle of sensing

According to the real-time adaptive dynamic optimization algorithm, the transmission efficiency can be optimized on the basis of wearable devices hardware system. This algorithm, through the iterative evolution, can capture the external signal in real time and make a vector operation, accelerating the learning rate. This kind of
intelligent cluster has excellent properties such as self-learning, interactive, real-time fast response and predictive correction ability. The network architecture is shown in Fig. 1

![Diagram of the network architecture](image1)

In Figure. 1, $S$ is a vector set, the model is Agent transmission vector operation cluster, and the output is a feedback adaptive matrix, i.e., $\text{Agent} = \{I, R, P\}$ with:

$I; S \rightarrow S(X), R; S \rightarrow g(R), X \times R \rightarrow A$. And we define $W : S \times A \rightarrow S$.

The algorithm model of Agent is shown in Figure. 2.

![Algorithm model of Agent](image2)

Agent network architecture is divided into three operational processes: print vector collection, self-learning strengthen cluster, and the self judgment cluster after learning. After print the vector collection, we map the self-learning strengthen cluster, i.e., the computing layer of network. The self-learning strengthen cluster delivers the displacement modal of the vectorization set to the Agent matrix and integrate it via optimization. Finally, we judge the convergence of self judgment cluster and chat with the outside via boost algorithm in order to achieve highly efficient transmission and feedback.

According to the self-learning set, the adaptive ability in the unsupervised mode can be obtained. We use the boost algorithm to optimize the maximum threshold field, and set the external incentive function and relevant self learning momentum factor to optimize the mode state of tensor $e$ output. With the help of the previous genetic effect and the next genetic effect, we set the maximum convergence criterion. When the result is convergent or reaches the set threshold value, one optimal learning is completed. The principle of algorithm is shown in Figure. 3.

![Diagram of basic principle](image3)
The dimension of the algorithm is $R^4$, i.e., $\{S, A, r, T\} \in R^4$.

In the algorithm, state represents a vector state set, $S \in S$; action implies a dynamic scalar set, $a_{i} \in A$; reword depicts the feedback tensor, $S \times A \rightarrow R$; and $T$ is the offset scalar matrix, $(S, A) \times S' \rightarrow [0,1]$. Figure 2-3 is the diagram of basic principle, whose set target tensor is given by $\Phi$ (Thomas,2009).

Agent is carried out with action dynamic calibration in the $S$ vector state set, i.e., $\Phi(s) = a$. The threshold is adjusted by the feedback tensor: whole real-time adjustment with $a_{i} \in S$, and the set of the target bit feedback offset scalar being minimum. The feedback tensor operation rules are given by:

$$R^a(S_t) = r_1 + \gamma r_{i+1} + \gamma r_{i+2} + \cdots = r_t + \gamma R^e(S_{t+1}) = \sum_{i=0}^{l} \lambda r_{i+t+i}$$

where $r_t$ is the feedback threshold and $\gamma$ is the penalty term.

The feedback mapping can be expressed as the following formula:

$$V^r(S_t) = \sum \gamma^i r_{i+t+i}$$

$$V^a(S_t) = \sum r^i$$

$$V^z(S_t) = \lim_{h \rightarrow \infty} \left( \frac{1}{h} \sum r_t \right)$$

By means of reading the $\pi$ method, its state tensor reads:

$$V^z = E_{z} \{ R_t | S_t = s \} = E_{z} \{ r_{i+t+1} + \gamma r_{i+2} + \gamma r_{i+3} + \cdots | S_t = s \}$$

Yielding,

$$E_{z} \{ r_{i+t+1} + \gamma V^z(S_{t+1}) | S_t = s \} = \sum E_{x} \pi(s, a) \sum_{1}^{m} T_{x} \cdot [R_{x} + \gamma V^z(S')]$$

2.2. The design of BP Adaboost

With the help of multi layer mapping of ababoost, we obtain the high robustness and high accuracy physical layer cluster via tensor operations of each level. The operation mechanism reads: the rank tensor space mapping

$$(x, y) \text{ is extracted and integrated, with the mapping weighted function being } M. \text{ The convergence solution is obtained by the finite iteration. When updating the iterative algorithm, the mapping weighted function will be remapped in each step, i.e., } (f_1, f_2, \cdots, f_n). \text{ By solving the functional, high robustness and high accuracy level mapping functional group can be obtained(Chen,2015;Liu,2014). Assuming that BP function is used as the base vector, dynamic combination will be made by Ababoost. The algorithm flow chart is shown in Figure 4.}$$
Figure 4. The algorithm flow chart

The processes that the algorithm operates are as follows:

1) Initialization of the sample tensor. We select \( m \) dimension from the tensor at random, and set
\[
D_t(i) = \frac{1}{m}
\]
as well as \( w \) and \( \theta \).

2) Training and mapping the layered tensor. Divide the layered tensor into \( t \) groups. Normalized is obtained by mapping training:
\[
e_t = \sum_i D_t(i), \quad i = 1, 2, \ldots, n, \quad g(t) \neq y
\]

where \( g(t) \) and \( y \) respectively, the mapping matrix and the expected matrix.

3) Update the proportion. Label the error \( e_t \) according to \( g(t) \), and update the proportion, with the algorithm being:
\[
a_t = \frac{1}{2} \ln \left( \frac{1 - e_t}{e_t} \right)
\]

4) Strategy adjustment. The adjusting formula is given by:
\[
D_{t+1}(i) = \frac{D_t(i)}{B_i} \ast \exp\left[-a_t y_t g_t(x_t)\right], \quad i = 1, 2, \ldots, m
\]

5) Obtained the weighted strong mapping. \( T \) mature mapping tensor are obtained after reaching the specified number of iterations, i.e., the strong functional \( h(x) \) is obtained by a weighted combination of the \( T \) sensors.
\[
h(x) = \text{sign} \left[ \sum_{t=2}^{T} a_t \ast f(g_t, a_t) \right]
\]

3. SOLVING THE MODEL

The three-dimensional shape of the human body is complex. With the help of simplifying method, we obtain the node abstraction complement graph. Through the extraction of key points, we illustrate the topology graph and theoretically investigate the configuration of wearable devices. The topology graph is depicted in Figure 5 as follows.
We wirelessly link the key points according to wban network, the connected graph is illustrated in Figure 6.

**Figure 5.** The topology graph of key points

**Figure 6.** Network connection diagram

Based on the minimum tree model, it is not very difficult to optimize the connection of wearable devices. We use the set protocol to do real-time dynamic data transmission, and we generalize the prime algorithm by means of the preparation of a graphical user interface program, with the optimized connection diagram being shown in Figure 7.

**Figure 7.** Diagram of the optimized wireless connection path
Based on the boost algorithm, it is not very difficult to optimize the the combination mapping physical base group. With the help of self-learning of the momentum factor, the energy loss in the internet of things can be reduced (the optimal value of momentum factor after learning is 0.8). Figure 8 implies the energy consumption diagram in the path.

![Energy Diagram](image)

**Figure 8. Diagram of the momentum factor learning curve**

The energy that nodes accept is the bigger the better. After learning, when the momentum factor value is 0.8, the accepted energy is maximum and the loss is minimum.

![Accepted Energy Diagram](image)

**Figure 9. Diagram of the accepted energy by nodes**

By using the boost algorithm to optimize the energy path, we obtain the mapping relationship between the number of sink path coupling nodes and the network survival cycle. It is obviously that the positive coupling between the visible path and the number of nodes is positive correlation with the network life cycle.

![Mapping Relationship](image)

**Figure 10. The mapping relationship between the number of sink path coupling nodes and the network survival cycle**

4. CONCLUSION

In this paper, the network wireless data transmission is well designed based on the boost algorithm and Qagent algorithm. With the context of path optimization on minimum tree model and the short-circuit model, the transmission efficiency is improved and the energy consumption rate is reduced. The interface is prepared and the model is simulated by MATLAB platform. At last, a good robustness and high precision real-time interactive platform of wearables devices of internet of things is developed.

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REFERENCES


