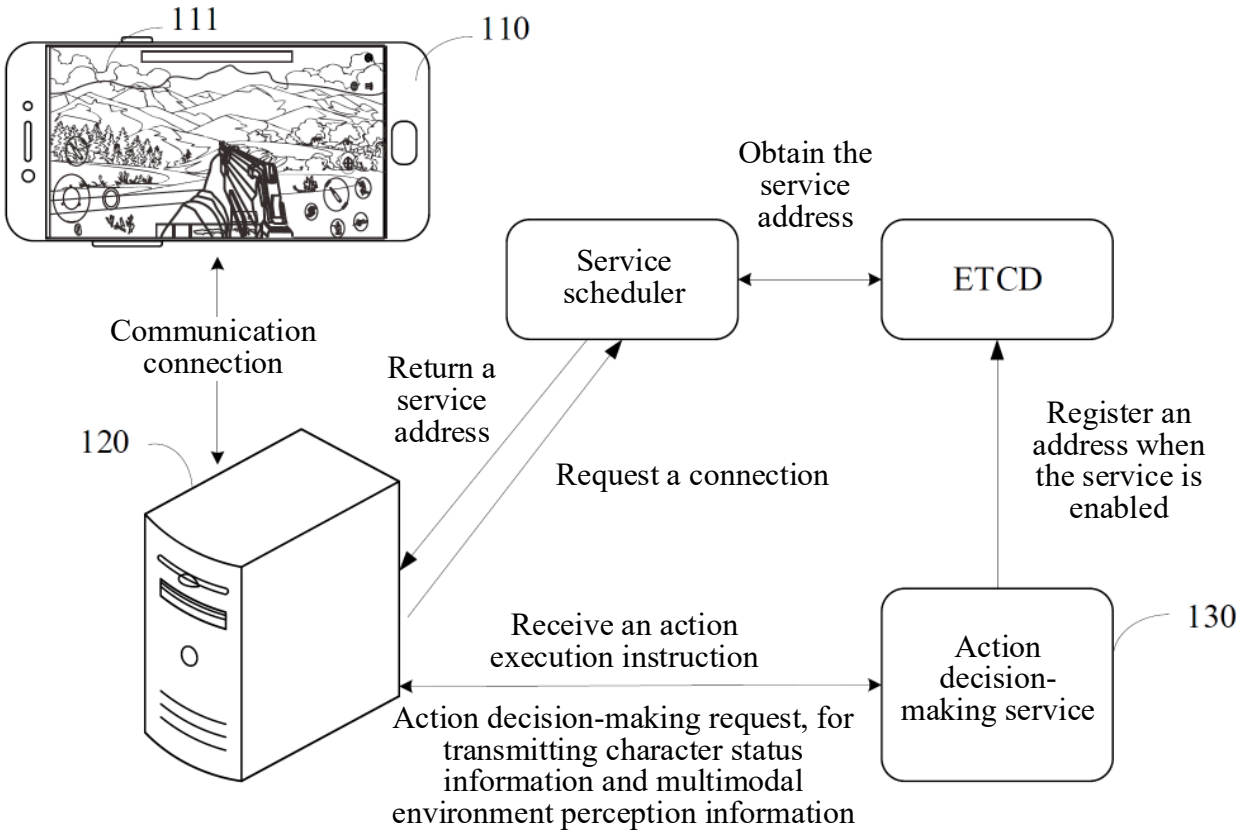

111
110
Obtain the service address
Service scheduler
ETCD
Communication connection
Return a service address
Request a connection
Register an address when the service is enabled
120
Receive an action execution instruction
130
Action decision-making service
Action decision-making request, for transmitting character status information and multimodal environment perception information

FIG. 1

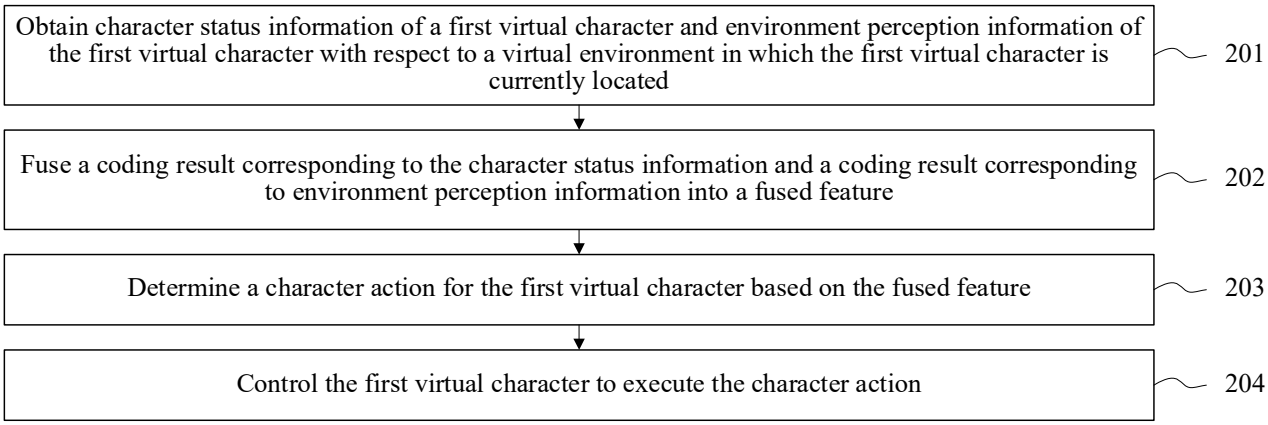

Obtain character status information of a first virtual character and environment perception information of the first virtual character with respect to a virtual environment in which the first virtual character is currently located
201
Fuse a coding result corresponding to the character status information and a coding result corresponding to environment perception information into a fused feature
202
Determine a character action for the first virtual character based on the fused feature
203
Control the first virtual character to execute the character action
204

FIG. 2

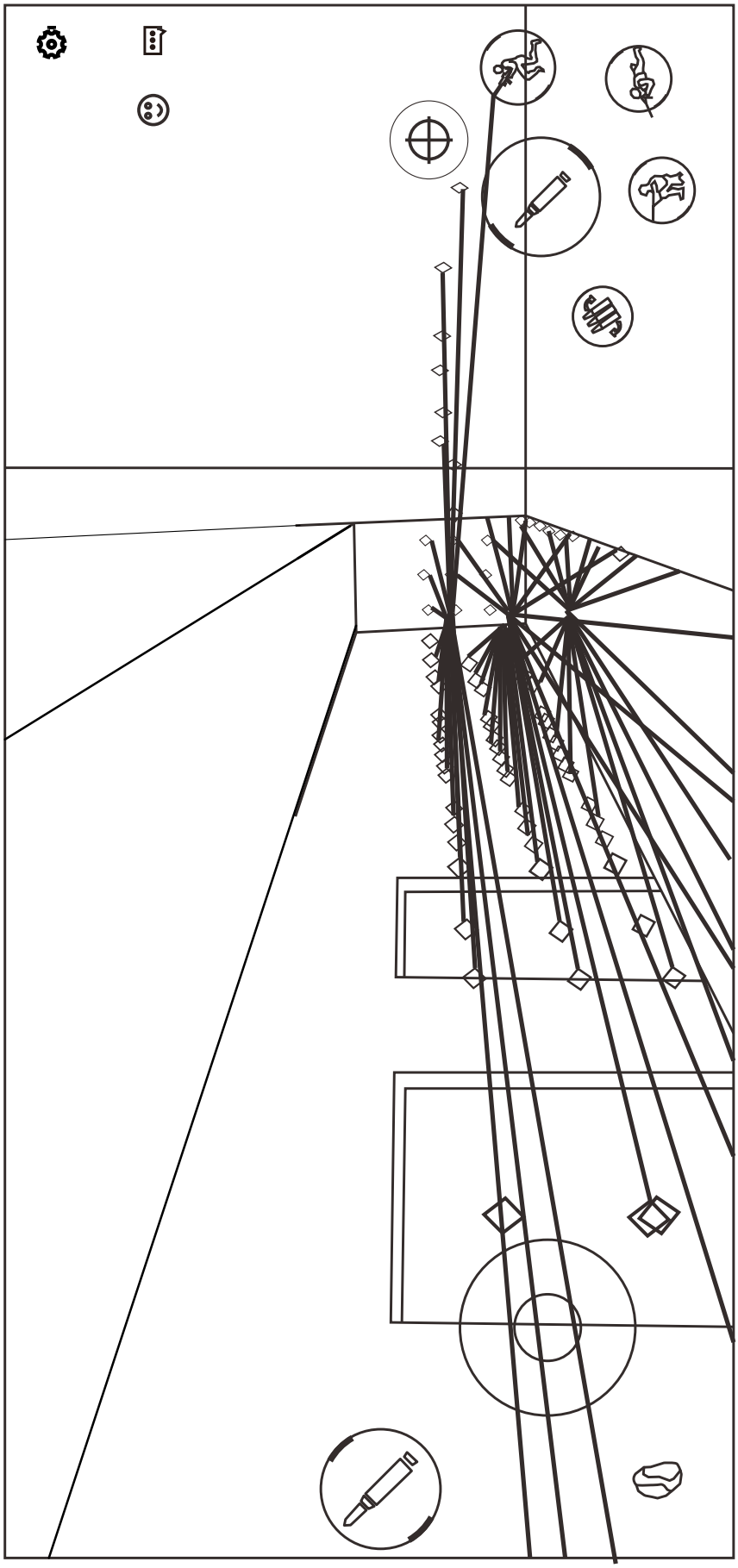


FIG. 3

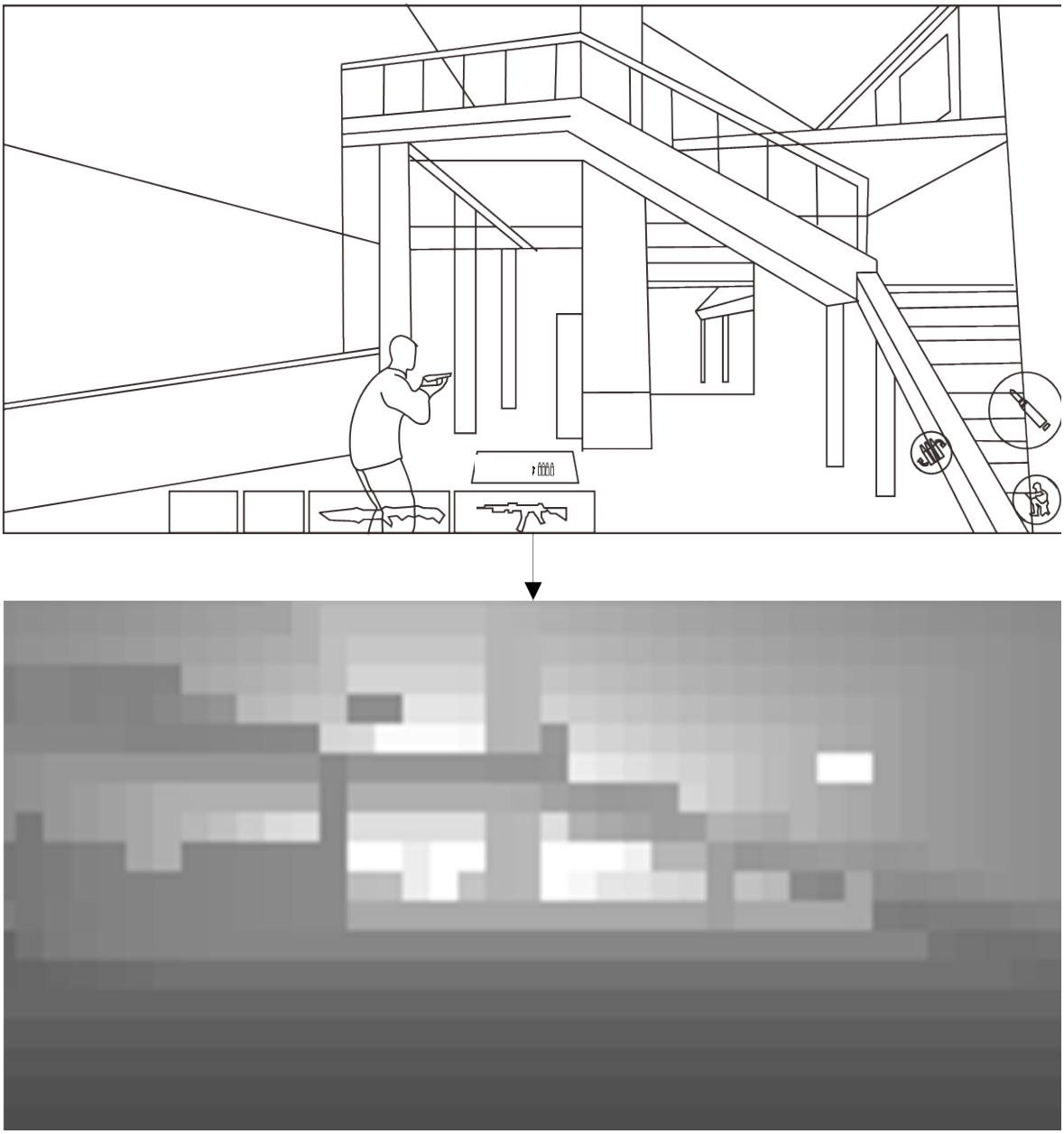


FIG. 4

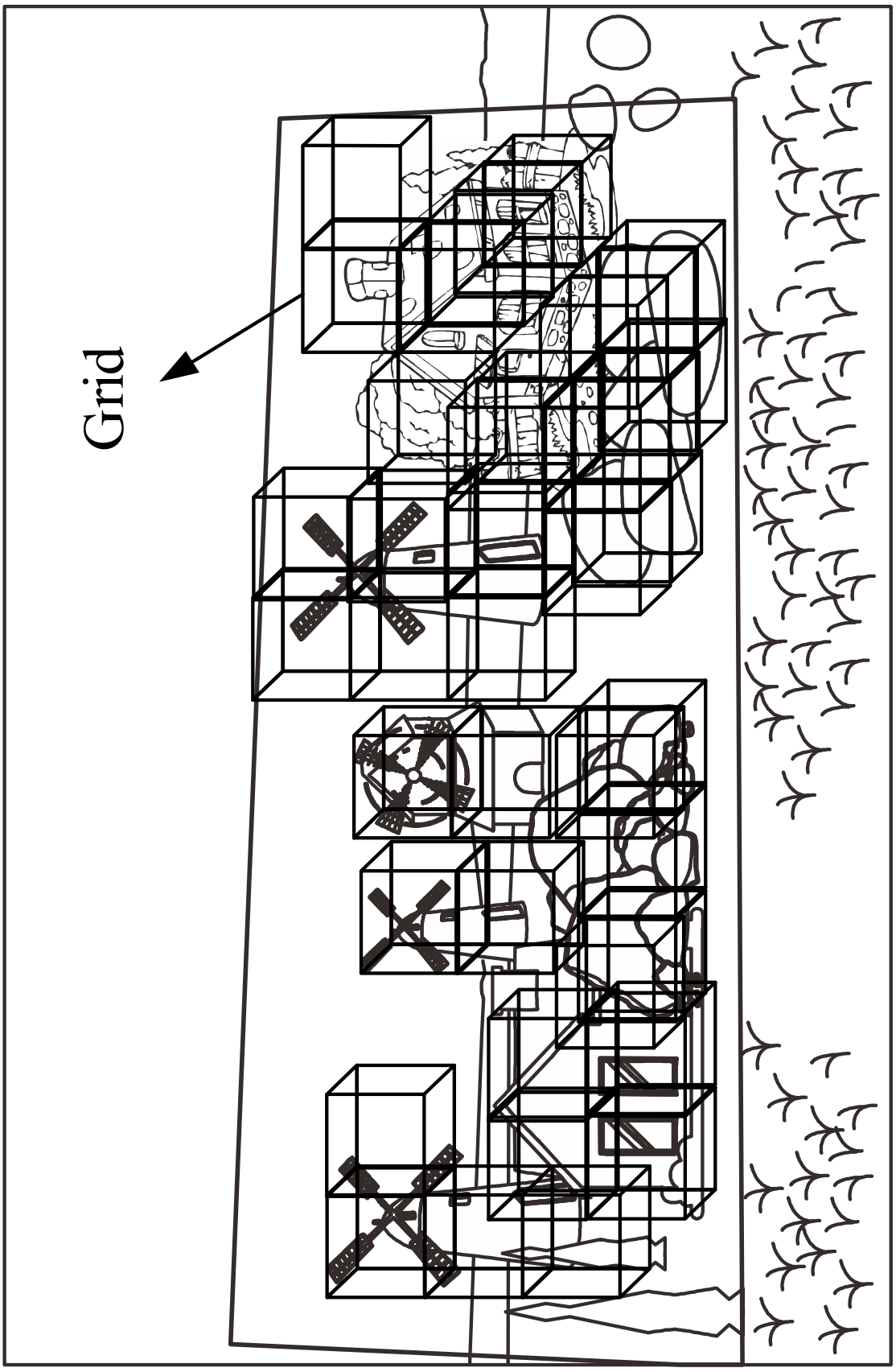


FIG. 5

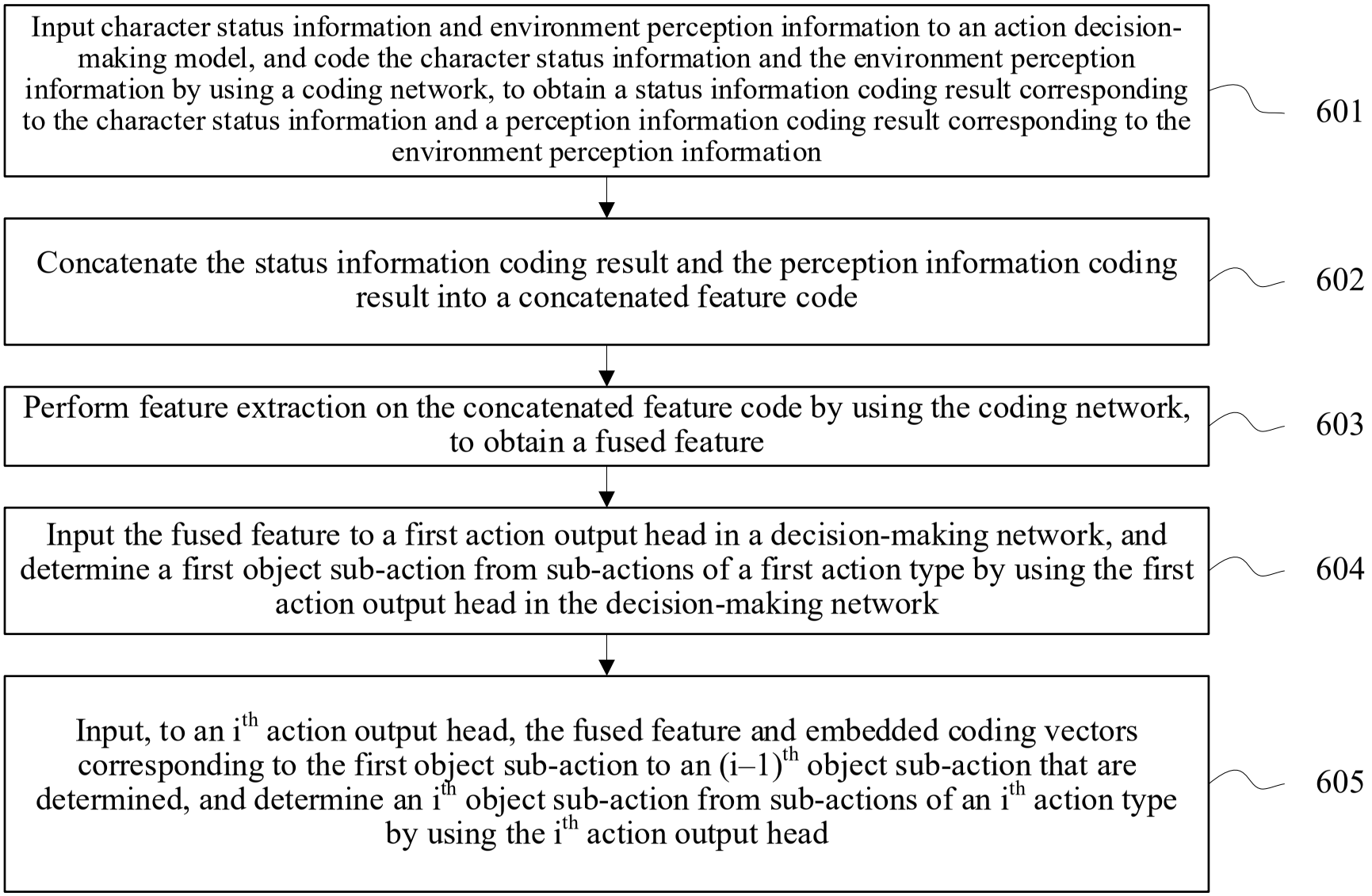

Input character status information and environment perception information to an action decision-making model, and code the character status information and the environment perception information by using a coding network, to obtain a status information coding result corresponding to the character status information and a perception information coding result corresponding to the environment perception information
601
Concatenate the status information coding result and the perception information coding result into a concatenated feature code
602
Perform feature extraction on the concatenated feature code by using the coding network, to obtain a fused feature
603
Input the fused feature to a first action output head in a decision-making network, and determine a first object sub-action from sub-actions of a first action type by using the first action output head in the decision-making network
604
Input, to an i^{th} action output head, the fused feature and embedded coding vectors corresponding to the first object sub-action to an $(i-1)^{th}$ object sub-action that are determined, and determine an i^{th} object sub-action from sub-actions of an i^{th} action type by using the i^{th} action output head
605

FIG. 6

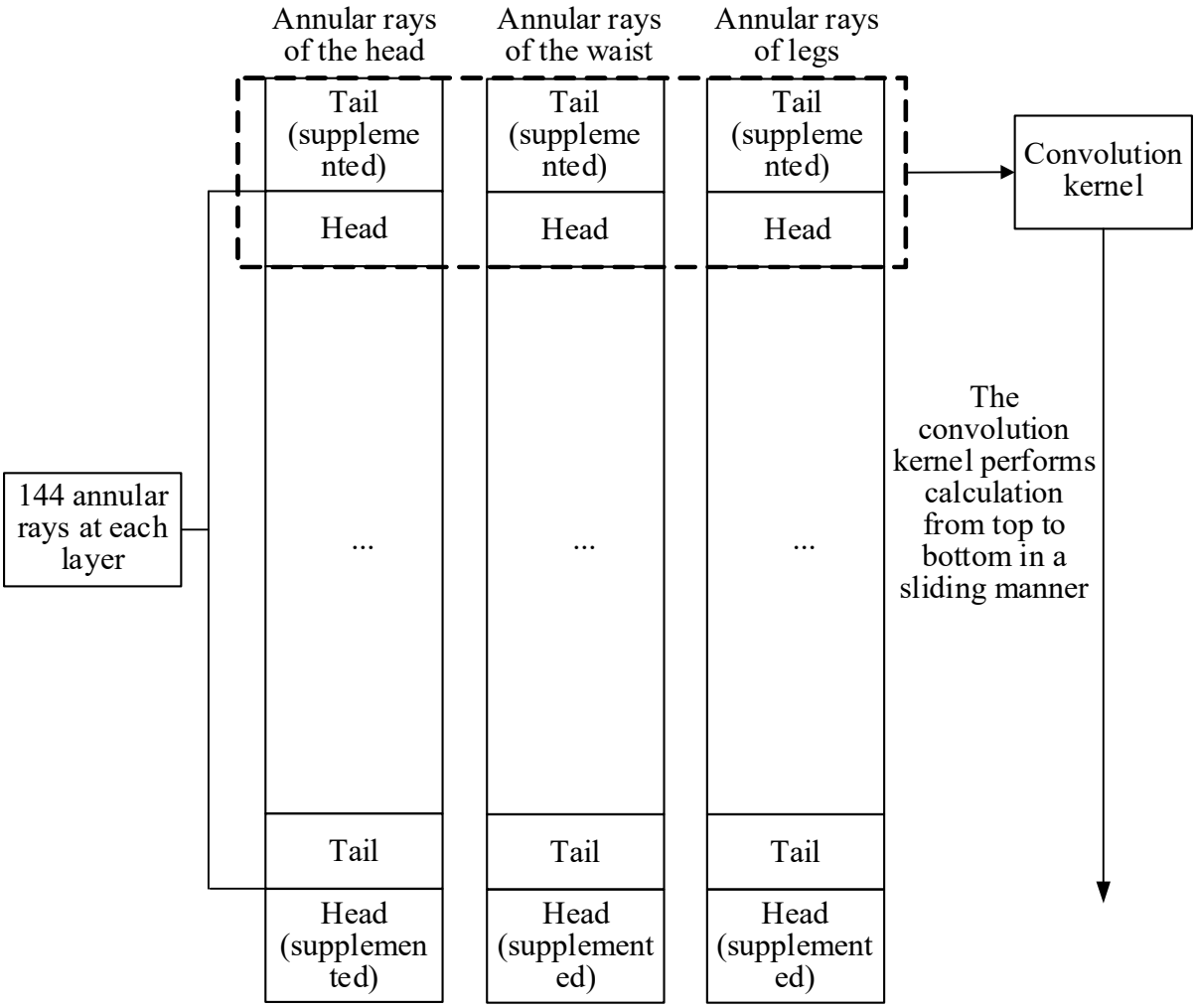

Annular rays of the head
Annular rays of the waist
Annular rays of legs
Tail (supplemented)
Tail (supplemented)
Tail (supplemented)
Head
Head
Head
Convolution kernel
144 annular rays at each layer
...
...
...
The convolution kernel performs calculation from top to bottom in a sliding manner
Tail
Tail
Tail
Head (supplemented)
Head (supplemented)
Head (supplemented)

FIG. 7

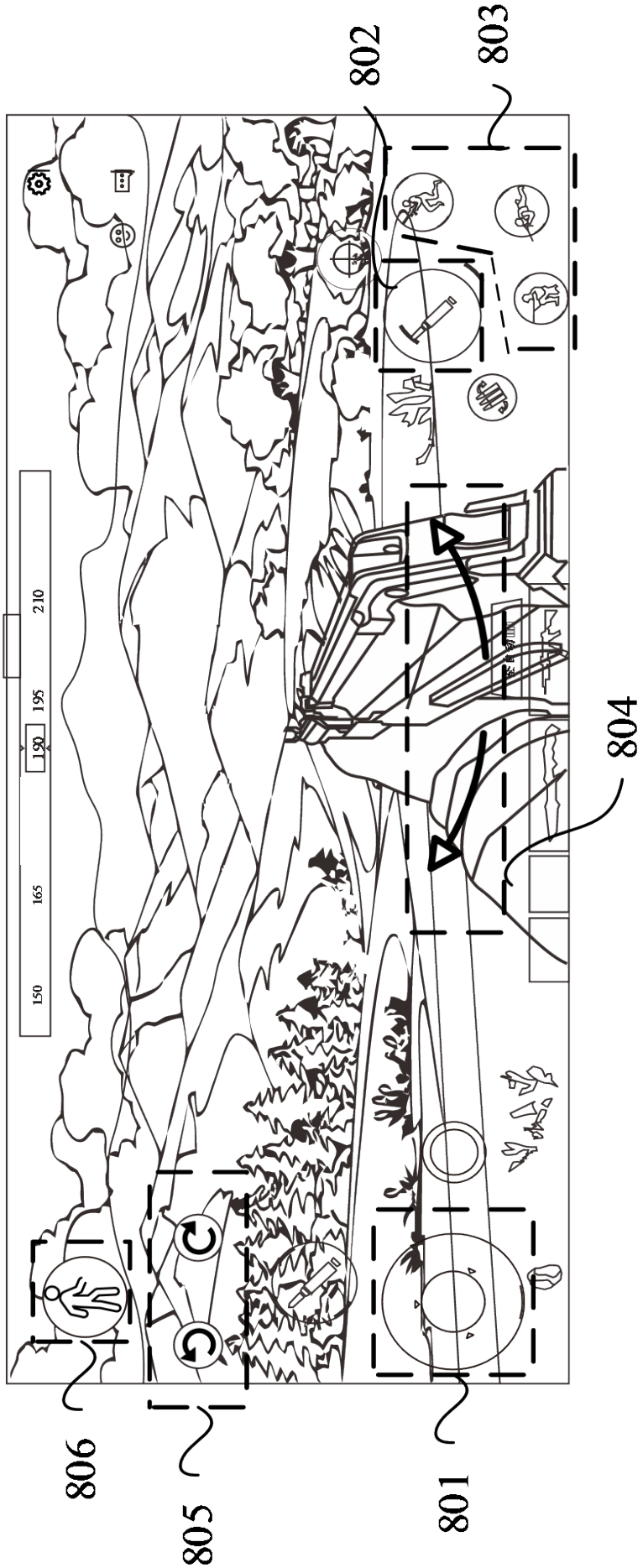


FIG. 8

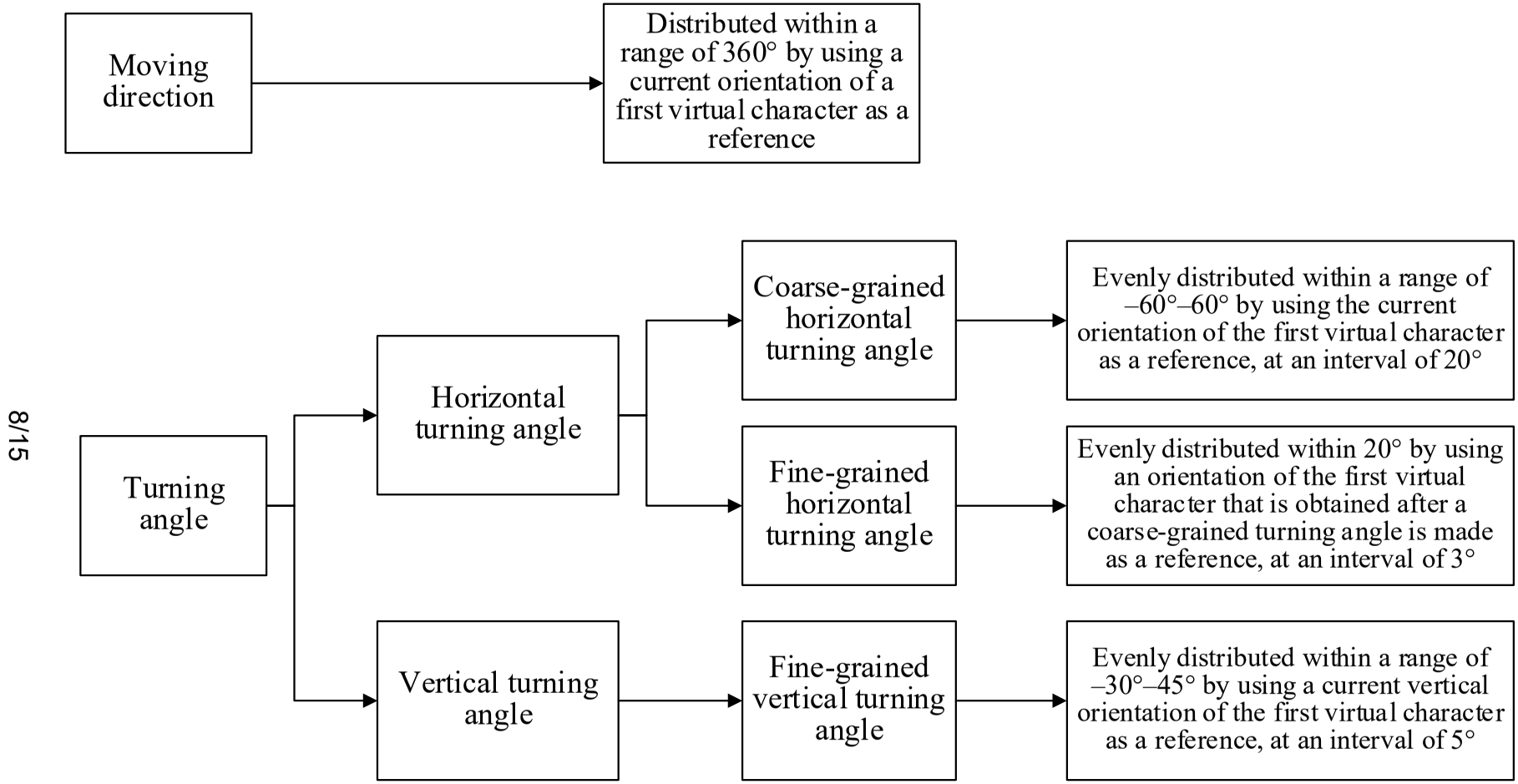

Moving direction
Distributed within a range of 360° by using a current orientation of a first virtual character as a reference
Turning angle
Horizontal turning angle
Coarse-grained horizontal turning angle
Evenly distributed within a range of –60°–60° by using the current orientation of the first virtual character as a reference, at an interval of 20°
Fine-grained horizontal turning angle
Evenly distributed within 20° by using an orientation of the first virtual character that is obtained after a coarse-grained turning angle is made as a reference, at an interval of 3°
Vertical turning angle
Fine-grained vertical turning angle
Evenly distributed within a range of –30°–45° by using a current vertical orientation of the first virtual character as a reference, at an interval of 5°

FIG. 9

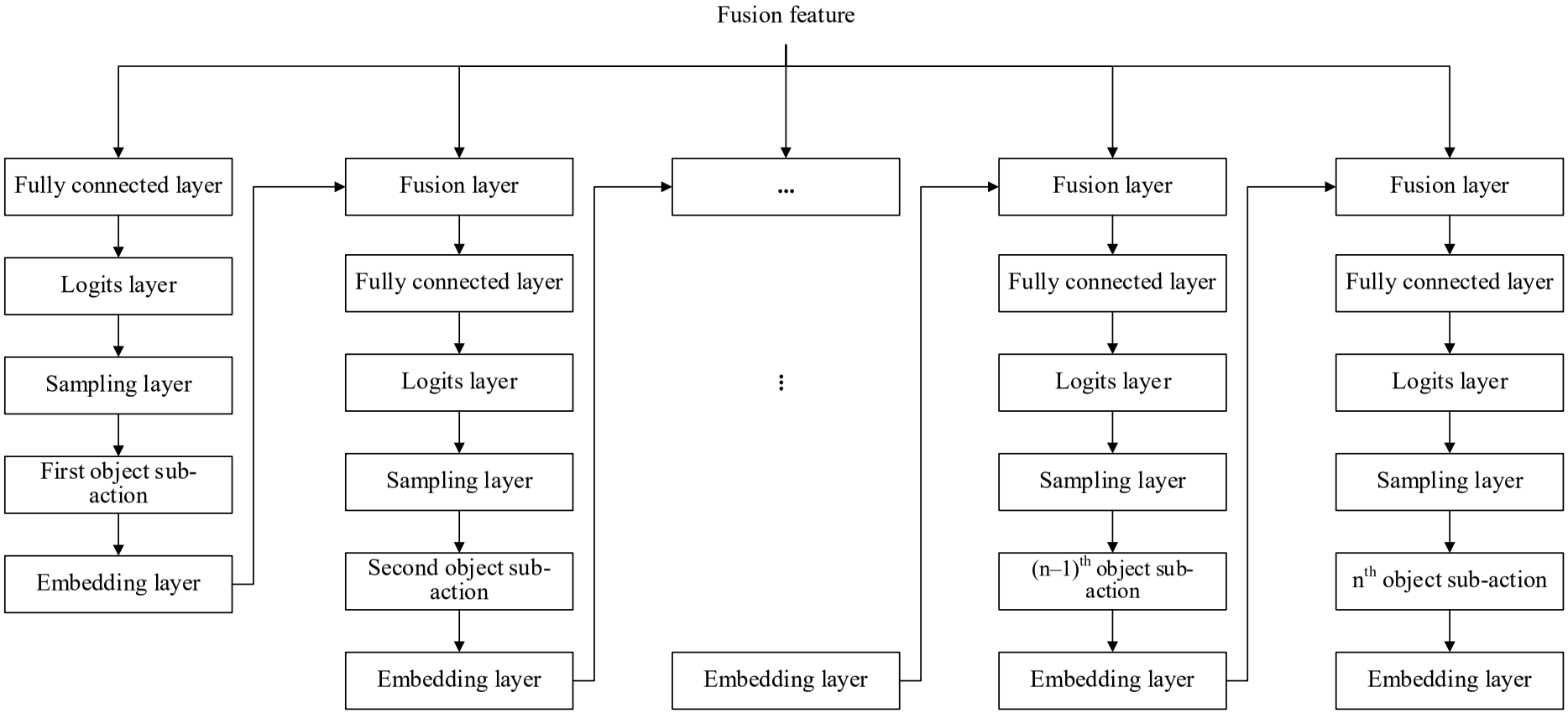

Fusion feature
Fully connected layer
Logits layer
Sampling layer
First object sub-action
Embedding layer
Fusion layer
Fully connected layer
Logits layer
Sampling layer
Second object sub-action
Embedding layer
...
Embedding layer
Fusion layer
Fully connected layer
Logits layer
Sampling layer
(n–1)th object sub-action
Embedding layer
Fusion layer
Fully connected layer
Logits layer
Sampling layer
nth object sub-action
Embedding layer

FIG. 10

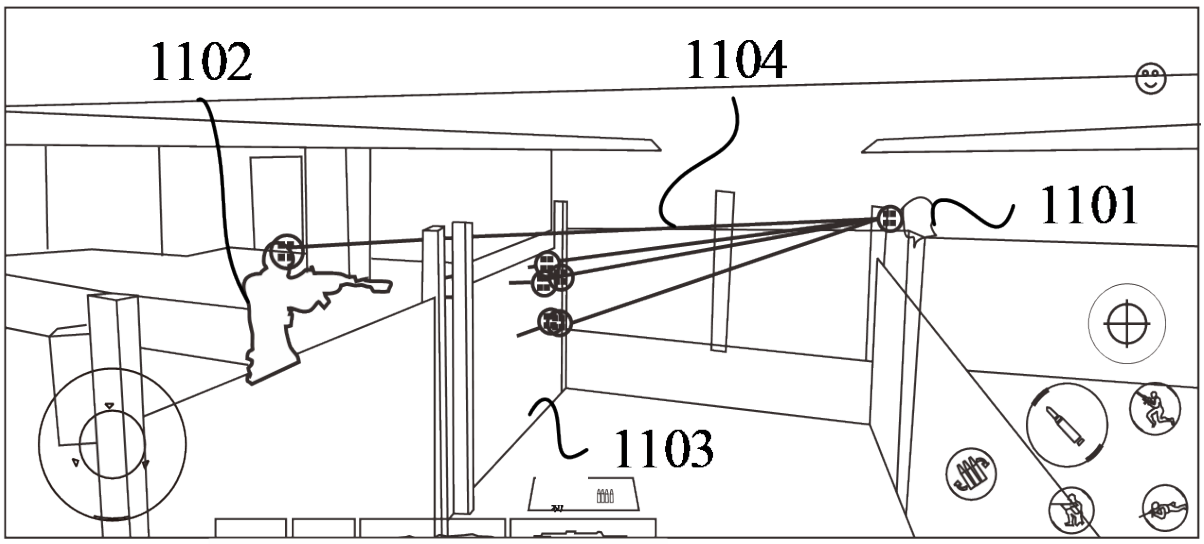


FIG. 11

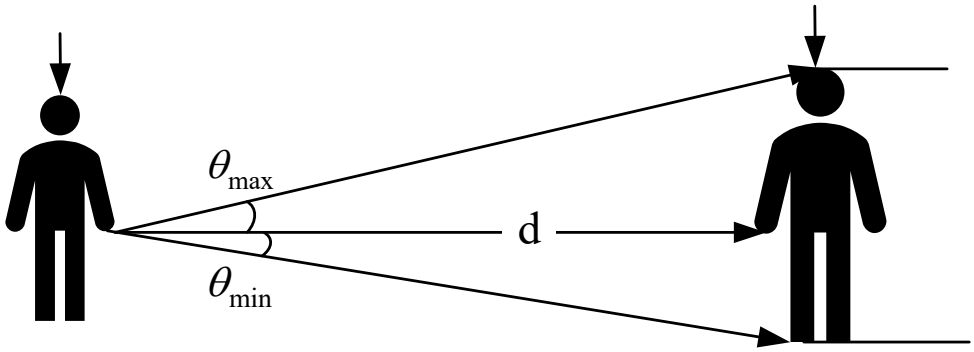


FIG. 12

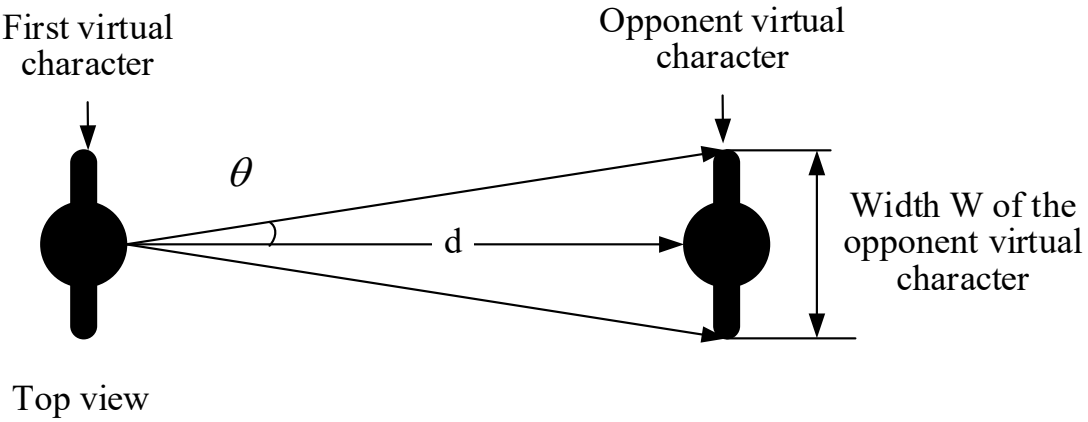


FIG. 13

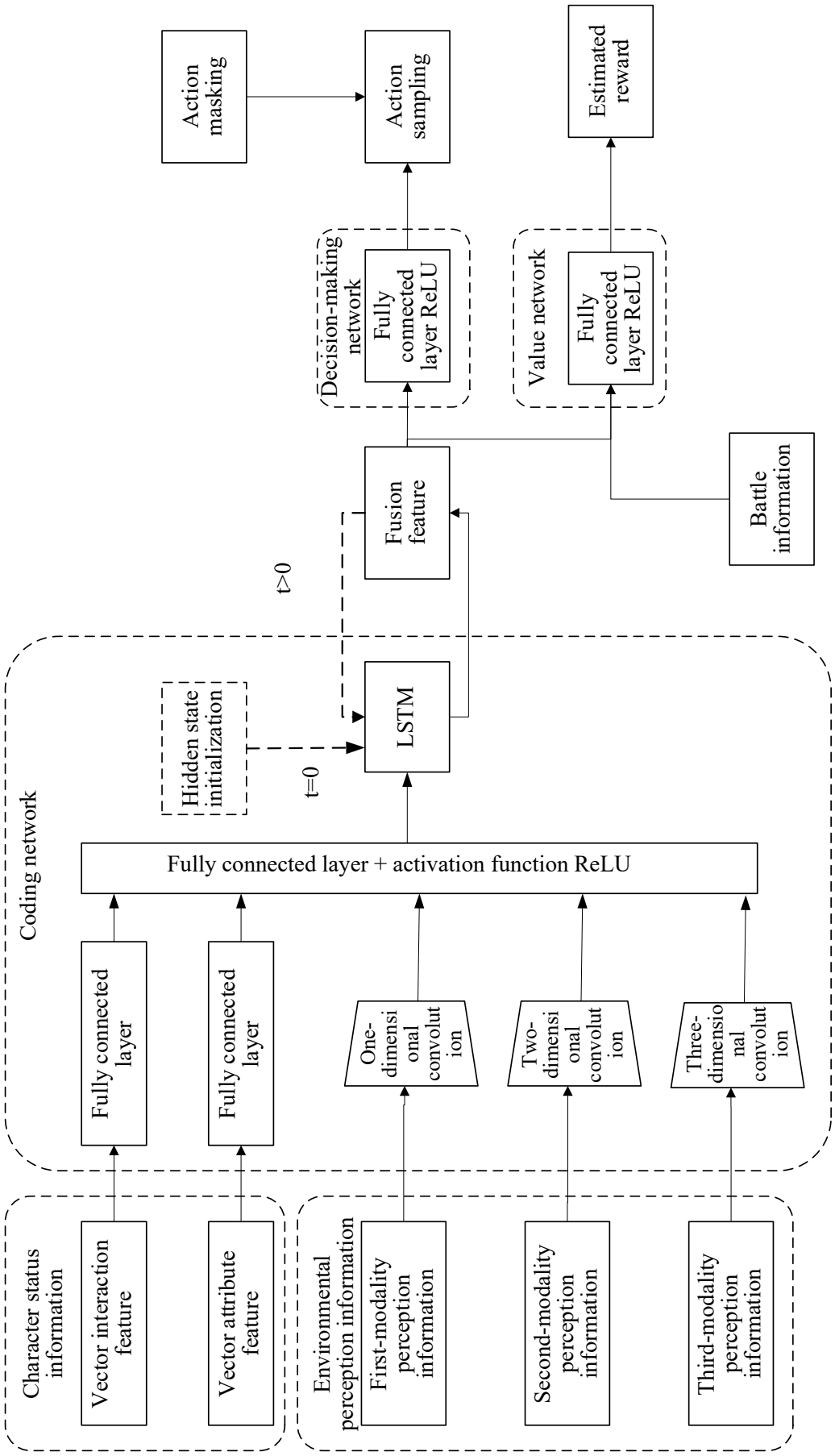

Character status information
Vector interaction feature
Vector attribute feature
Environmental perception information
First-modality perception information
Second-modality perception information
Third-modality perception information
Coding network
Fully connected layer
Fully connected layer
One-dimensional convolution
Two-dimensional convolution
Three-dimensional convolution
Fully connected layer + activation function ReLU
Hidden state initialization
t=0
t>0
LSTM
Fusion feature
Battle information
Decision-making network
Fully connected layer ReLU
Value network
Fully connected layer ReLU
Action masking
Action sampling
Estimated reward

FIG. 14

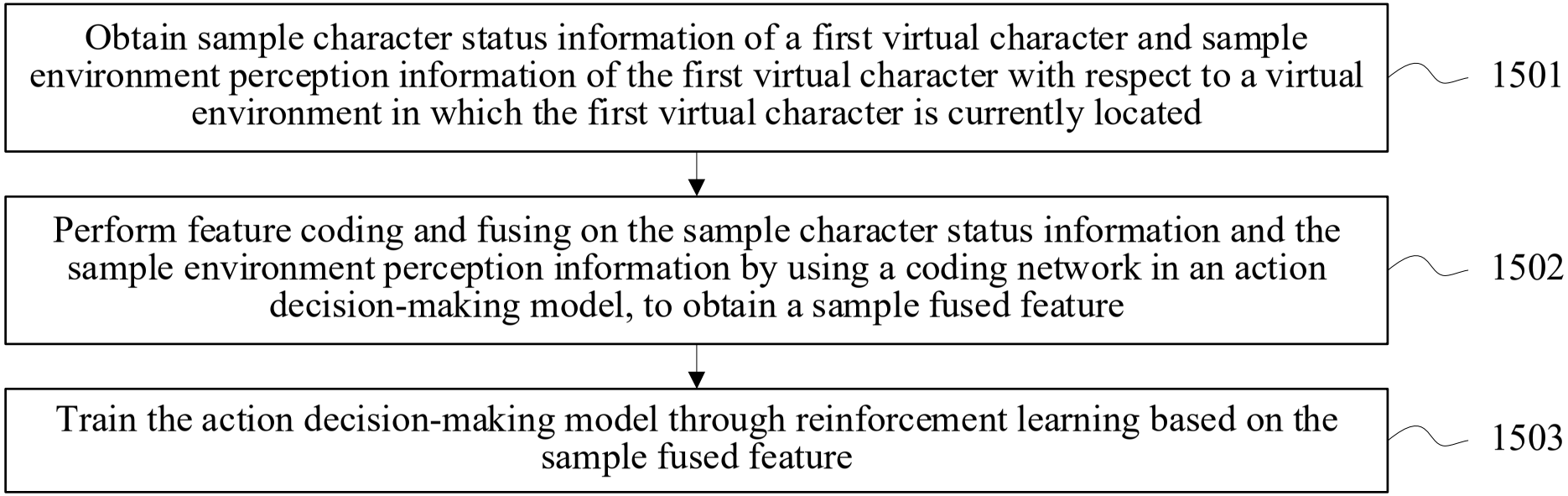

Obtain sample character status information of a first virtual character and sample environment perception information of the first virtual character with respect to a virtual environment in which the first virtual character is currently located
1501
Perform feature coding and fusing on the sample character status information and the sample environment perception information by using a coding network in an action decision-making model, to obtain a sample fused feature
1502
Train the action decision-making model through reinforcement learning based on the sample fused feature
1503

FIG. 15

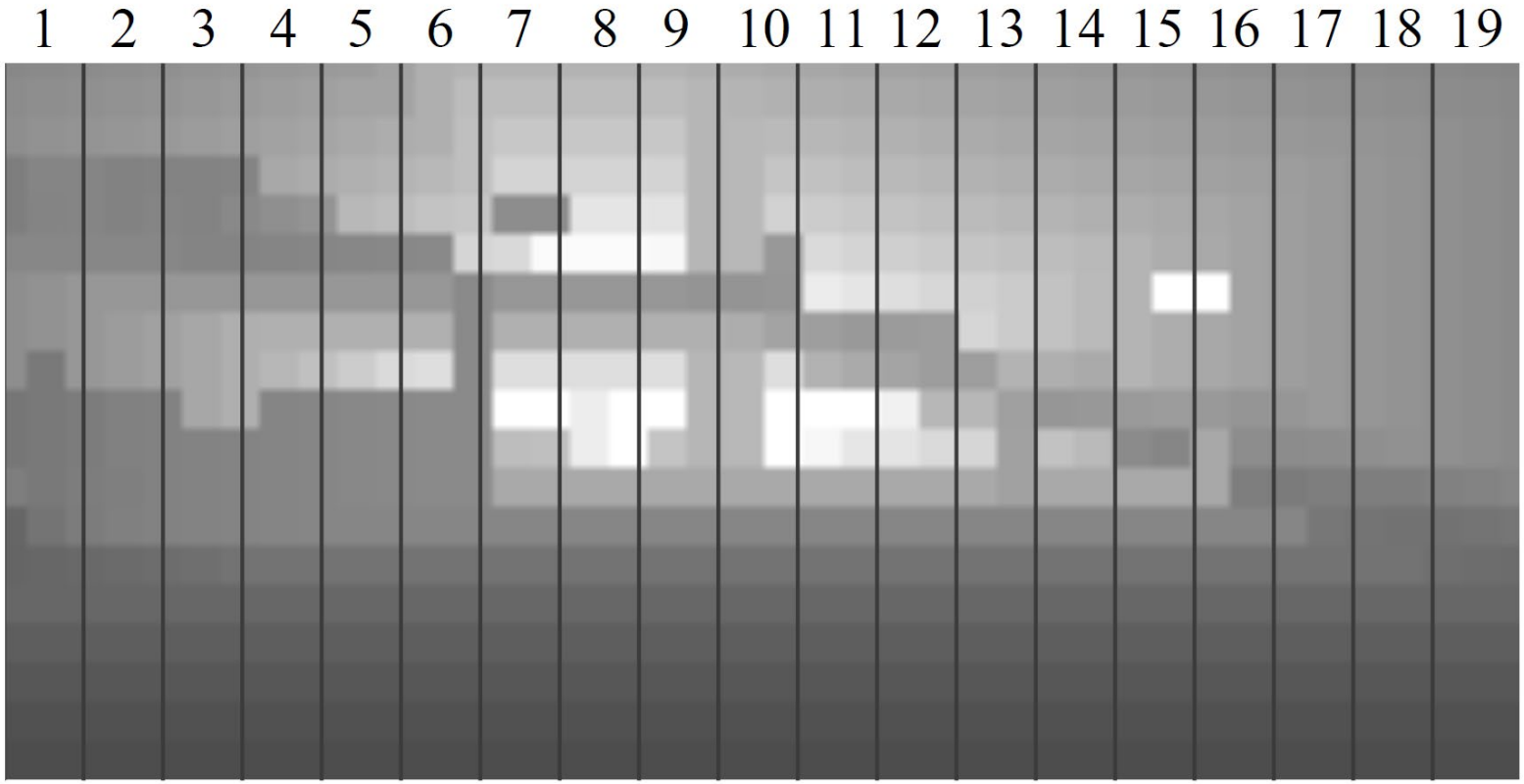

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Brightness v1 v2 . . . v9 v10 v11 . . . v18 v19

FIG. 16

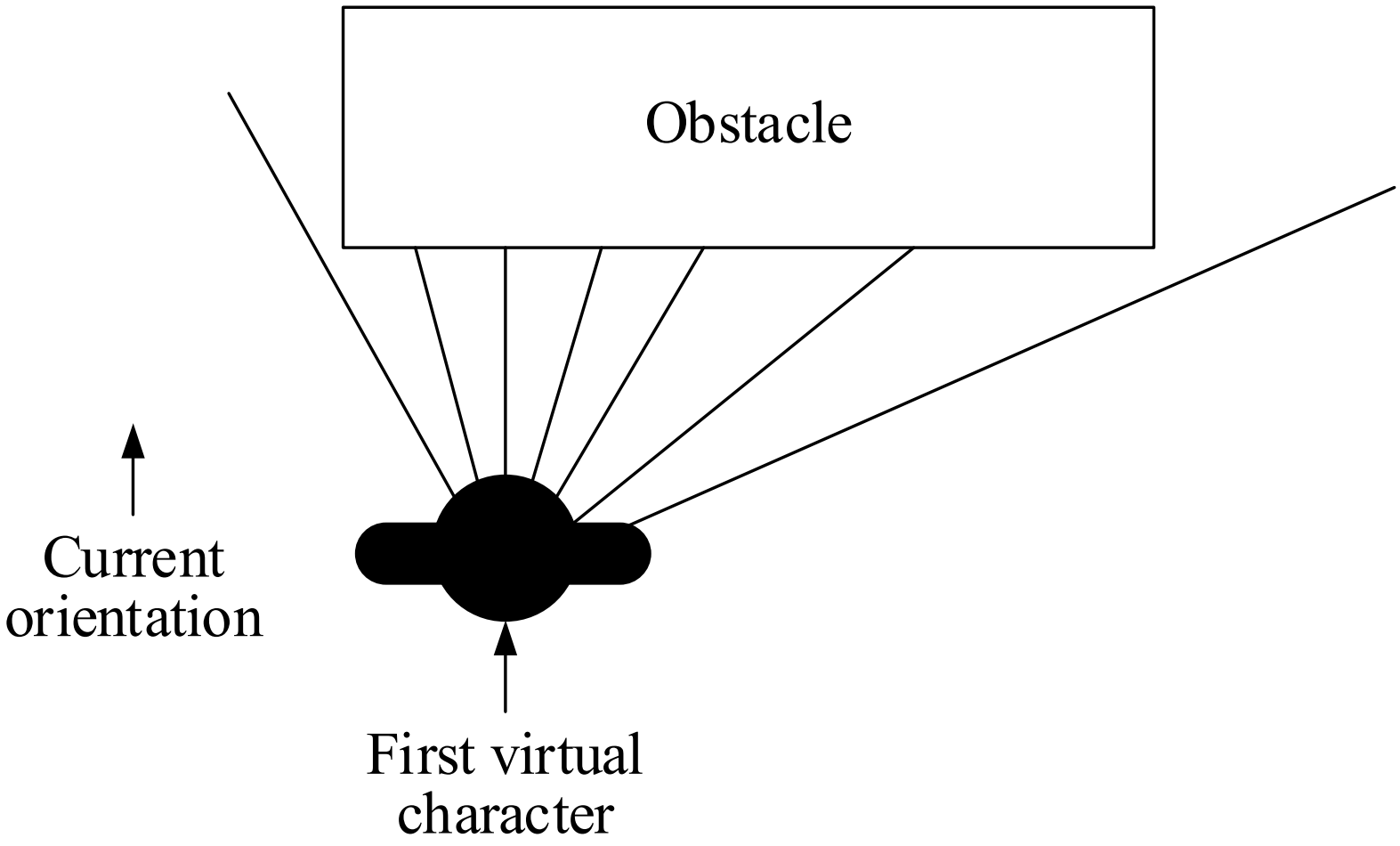


FIG. 17

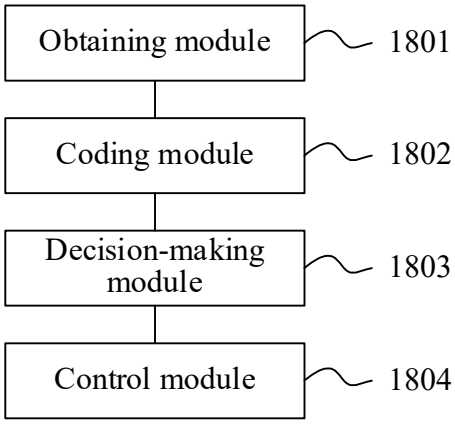

Obtaining module
1801
Coding module
1802
Decision-making module
1803
Control module
1804

FIG. 18

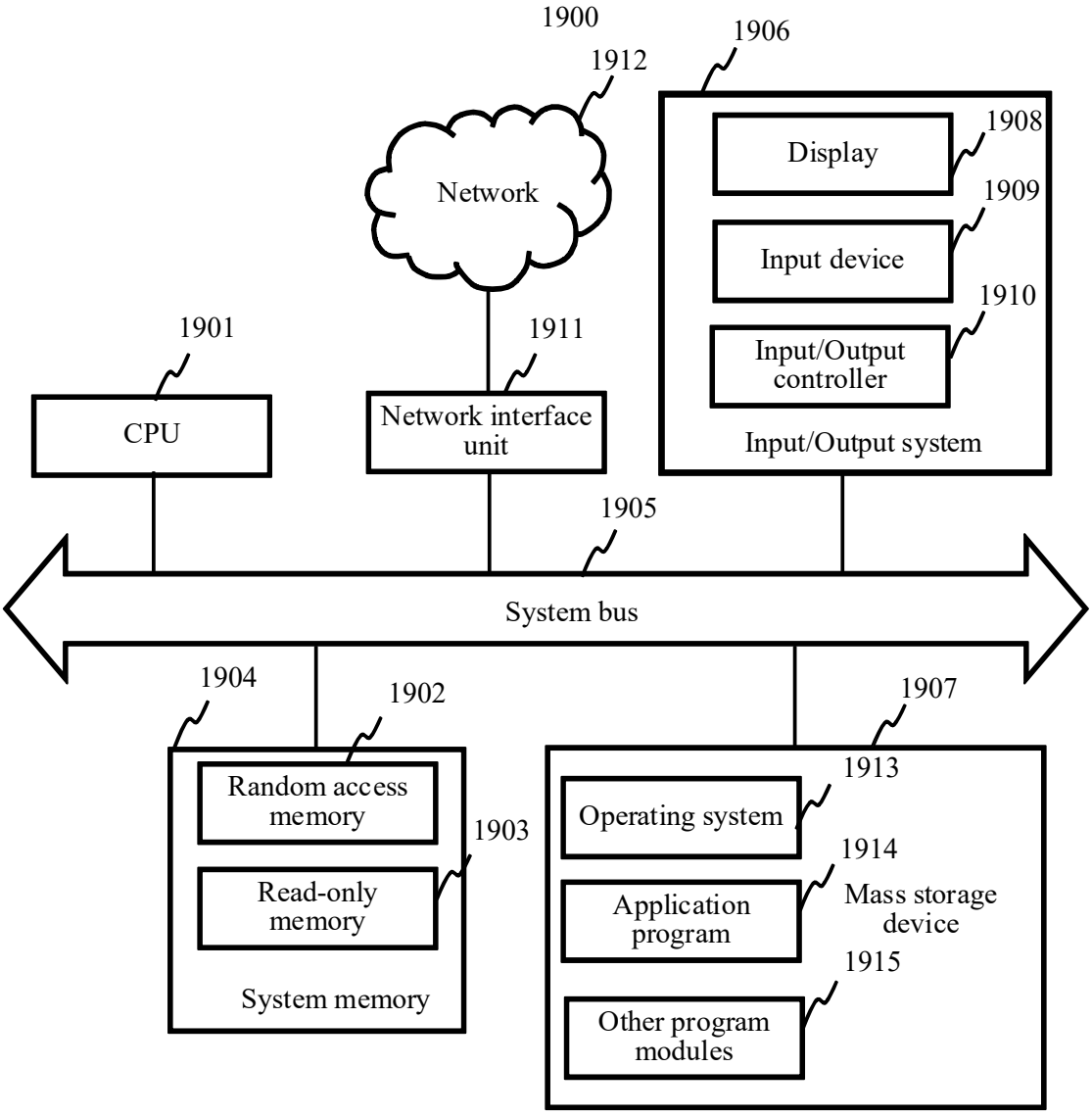

1900
1912
1906
Network
Display
1908
1909
Input device
1910
Input/Output controller
Input/Output system
1901
1911
CPU
Network interface unit
1905
System bus
1904
1902
1907
Random access memory
1903
Read-only memory
System memory
1913
Operating system
1914
Application program
Mass storage device
1915
Other program modules

FIG. 19