# Design for emotional pacifification robot

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***Abstract*—Boston Dynamics' Atlas robot is a service-oriented smart robot that can service people and act on user's commands. It was very popular at the beginning and greatly expanded the demand for robots. However, as the increasing complexity in user's needs, Atlas is falling out of customer's favor.**

**As a result, the research team upgraded the Atlas and named it the Atlas-2 robot (hereinafter referred to as the Atlas-2).**

**Atalas-2's speech recognition and language expression are superior to the same type of robot, and its behavior patterns are closer to human. Its main function is to appease the user's bad emotions, give basic behavioral care and psychological crisis intervention. We combine technologies related to psychology, biology and machine engineering to develop diverse emotional comfort patterns. In addition, in the face of out-of-control emotions, Atalas-2 will trigger an alarm system to protect the user's personal safety.**

**Compared with its predecessor, the advance of hardware and information processing technology enables Atlas-2 to obtain more comprehensive and accurate external information, so there have been significant improvement in information acquisition, environmental awareness, and behavior patterns.**

***Index Terms*—robots, design, emotion, teamwork**

## I. Introduction

After a year and a half of research, our team completed the design of the Atlas-based emotional pacification robot —- the Atlas-2.

For emotional recognition and feedback, we collected a large number of social network dialogue contents, established multi-modal emotion analysis model, and used deep learning algorithms for model optimization.

In terms of design and hardware, the robot uses a humanoid design. It is 1.70 meters high and weighs 60 kg. With a built-in solar charging battery and charging identification socket, the Atlas-2 can be charged through the motor which controls the dynamic contact movement and makes the contact and the charging seat docking. The Atlas-2 also has infrared cameras, lidar, high-definition microphones and micromolecules sensors and other advanced hardware equipments.

## II. Design

### A. Information retrievals and processing

The robot Atlas-2 mainly uses bionic design, which imitates human through collecting image information, sound information, environmental information and Social network information.

Fig. 1. Atlas-2

Besides, it uses QUALCOMM 996 and Harmony OS, the most advanced OS in China, and can process the incoming data quickly.

*1) Image Information Acquisition and moving prediction:* The Atlas-2 head-mounted camera, Microsoft Kinect 4D pro, captures more accurate and comprehensive visual information than the human eye does. Then, the system processes the collected image information by compression coding technique and sends to a behavioral prediction neural network.

The neural network consists of four parts: character behavior module, character interaction module, track Generator, activity prediction. The first two modules are responsible for identifying each personal movement and relationships in the scene. The identfied information is compressed into a visual feature tensor Q in the LSTM encoder, and transmitted to the last two parts for generating the prediction stakes and activity. based on the prediction, it can calculate the risk of self-harm. In addition, the activity prediction module can correct the error of the trace generator by predicting where the activity is about to occur. Moving module combined micro-radar data with SLAM technology data to get a path, making robot flexibly avoid obstacles and reach destination accurately.

*2) Collecting, processing and expression sound Information:* The high-definition microphones capture the sound signals and use sound processing models of deep learning to get legible vocals and transmit them to the emotion perception module. After receiving instructions from the emotion perception module, the Atlas-2 voice message is sent through the non-destructive speaker.

*3) Environmental information collection and processing:* The physical modules and their corresponding functions are shown in Tables 1 and 2 on page 2.

TABLE I

| Name | Function |
|---|---|
| Human Body Temperature Monitor | Detect the user's body temperature within 1 m |
| Micromolecule Sensor | Detect hormone levels in user saliva |
| Sleep Monitor Ring | Detect sleep quality |
| Mobile Communication Module | Make a call |
| GPS Module | Location |
| IR Camera | Detect the surrounding environment image |
| Laser Radar | Detect the surrounding topography |
| Gyroscope-stabilized Platform | Maintain the stability of a given attitude in relative inertial space |
| Wifi6 Module | Receive Wifi signal |

TABLE II

| Target | Impact |
|---|---|
| Emotion perception module | Judge emotional stability |
| Emotion perception module | Judge emotional polarity |
| Emotion perception module | Deduce emotion |
| Emotion perception module | Notify emergency contact, call the police and ambulance |
| Voice expression module | Notify emergency contact, call the police and ambulance |
| PMNNB, Behavior expression module | Predict and make reasonable actions |
| PMNNB, Behavior expression module | Predict and make reasonable actions |
| Behavior expression module | Make reasonable actions |
| Network module | Connect Internet |

*4) Internet information collection and processing:* Atlas-2 provides the APIs of social media account to import the user public activity records to Atlas-2 Data Cloud after being authorized, in order to analyze the user's physical and mental state through the Internet.

### *B. Emotional analysis and expression*

*1) Emotion perception module:* The core of emotion analysis module is facial recognition and semantic recognition with some variables, like life habits and hormone levels.

At the superficial layer, we recognize facial characteristic emotion by the deep environment perceptual emotion recognition network of CAER-Net.

At the deep layer, we collect user's saliva with a cup equipped micromolecule sensor to analyze the hormone level, and summary diet, length and quality of sleep, and body temperature data.The above data are respectively transmitted to the emotion analysis layer for further emotion recognition.

At the emotion analysis layer, the multi-modal emotion analysis model processes and analyzes the input data, then sends feedback instructions to voice expression module and behavior expression module respectively.

*2) Way of appeasement:* Before using, users set personality of the Atlas-2 and input some personal information, so that the Atlas-2 can set tentative behavior mode. When the robot collects enough user interaction data, it will automatically update to a better behavior mode.

Appeasement methods mainly include communication, entertainment and encouraging action.

The man-machine communication system, based on natural language processing and deep learning, enables robots to understand language and emotions. The Atlas-2 helps users clarify main causes of bad moods, then provides practical suggestions.

According to users' preferences, it recommends suitable entertainment activities, such as playing Lego, watching comedy and so on.

In addition, the Atlas-2 can nod, give a thumbs-up, clap, pet and embrace.

If users have extreme behavior, the Atlas-2 will alarm and notify emergency contact.

## III. Conclusion

The Atlas-2 is a new intelligent robot of Boston Dynamics. Compared with the previous robots, it has outstanding technological advantages in image recognition, language recognition and emotional analysis. Based on these advantages, the Atlas-2 has outstanding ability in easing the mood and improving life happiness. In addition, Boston Dynamics takes personal information security seriously. All user data will not be uploaded to the cloud server. Therefore, users have no worries about information disclosure and can use it safely. The research team will continue to update the models to optimize the user experience.

People of all ages would be influenced by bad moods. Teenagers tend to be emotional when being misread in study, life and thought. Adults are often exhausted in heavy work or marriage. And the elderly feel lonely for lack of company. In the near future, emotional pacification robot will become an indispensable partner of human.

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