

# Evaluation of Industrial Usefulness of Pet Companion for Elderly

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**Abstract**—The concepts of pet companion for elderly were proposed. Wireless network technique enhances communication and emotion reception abilities between pet and elderly. Several kinds of interaction modes were proposed to fulfil the ability and living characteristics of the elderly. The sustainable and industrial applicability issues are evaluated. Zigbee attachment concept is much better in energy saving and flexibility of use. Based on the prior art, a process to evaluate useful and industrial applicability requirements is proposed. By the analysis step, wireless network technique can fulfil implementation requirements of the pet companion.

**Keywords**—Pet companion, industrial applicability, elderly

## 1. INTRODUCTION

While elderly people visit other places for a short period of time without bringing the pet, supporting function can be provide through technology. Previous study [1,2] surveyed the variables in the elderly-animal friendship bond. The study focused on self-perceived criteria by the old people regarding their intimate association with their dogs. Results indicated self-perceived variables of companionship, emotional bond, usefulness and loyalty. If we can reduce the problem between elderly and dog, we can certainly improve the relationship in between.

A preliminary investigation on owner behavior was conducted on sixty people [3,4] with different levels of hands-on experience with dogs. Among them are dog-owners, veterinarians, dog trainers and non-owners. They were asked to classify the behaviors of nine dogs in video clips as 'friendly' or 'aggressive'. The tail movements were the most common cues used by participants to interpret dog behaviors and feels [5]. The

concepts of pet companion robot for elderly were proposed to enhances communication and emotion reception abilities between pet and elderly. Several kinds of interaction modes were also proposed to support the ability and living requirements of the elderly.

## 2. CONCEPT DESIGN

### 2.1 Follower robot

Scenario help to visualize possible way to act with the design object in a particular situation. Potential user's requirement can be investigated to understand the relationship of user with new technologies. Figure 1 is the initial prototype of Follower robot concept [6,7]. The basement contains the main circuit board (Figure 2), which has the processor, memory, I/O unit and high-capacity battery. The main chassis has one guiding and two driving wheels which can be driven at different speeds. The environmental sensors include collision sensors and the leading edge infrared module for obstacles avoidance [8]. This can be implemented through MCU (micro-controller unit) and software instructions. Detection of unwelcomed targets can be implemented through high frequency RFID reader on upper front side of the chassis.

The Follower robot concept faces several barriers in field application such as...

- Complicated road situation.
- Battery loses power due to motor driven and MCU processing.
- Long range RFID reader's cost is much higher
- Loss of control.

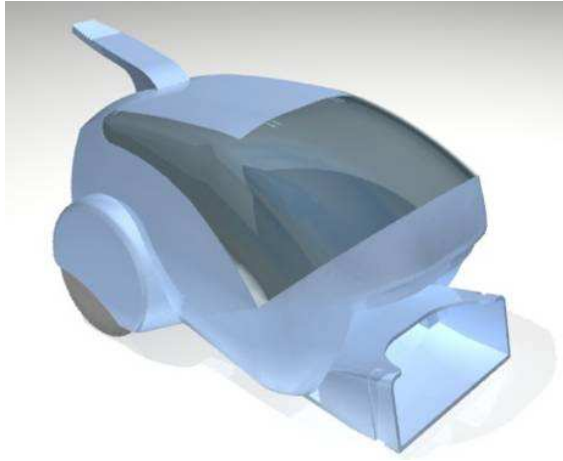


Fig. 1 Perspective view with front side display and trash collector [6], by Ming-Ching Jan.

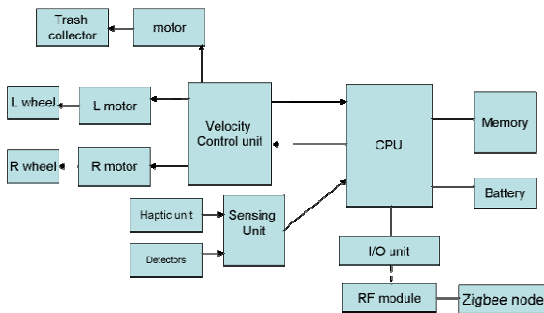


Fig. 2 Block diagram of the main controller

## 2.2 Zigbee attachment

Zigbee attachment concept focuses on outdoors activities monitoring and communication functionalities [7]. Pet companion robot is placed on the back of the pet. It automatically follows the route of pet. It can monitor the pet's condition in a distance, and issue commands using a voice pager and pet's emotion interpreter. The body sensors can decrypt the pet's emotion and inform the owner and enable a better communication in between.

Figure 3 is the parts placement of the emotion communication concept. The system has a flexible solar cell belt on the dog's back. The control chassis, which hanged at the edge of the belt, consist of battery, charger circuit and Zigbee module (Figure 4). The main circuit board (Figure 5) has the processor, memory, I/O unit and battery. The emotion communication unit determines the emotional status of the pet through the body sensor to send voice and

gesture information to the owner. Relative distance between the owner and the dog can be implemented through GPS technology. Remote command module can contact the pet through remote voice signal and haptic display device such as vibrating actuator.

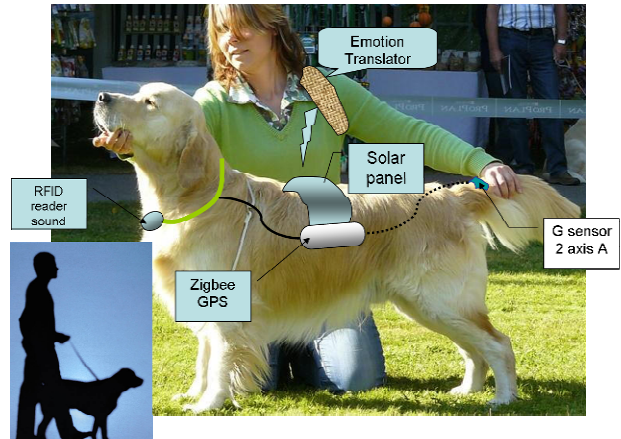


Fig. 3 Placement of the major components and main controller

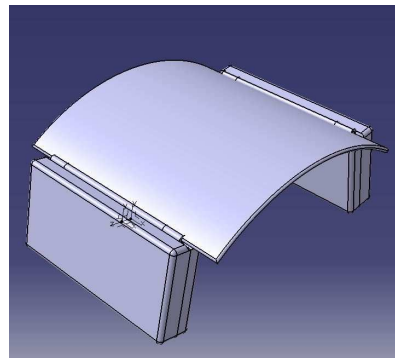


Fig. 4 Main chassis of the controller and solar cell placed on the middle region

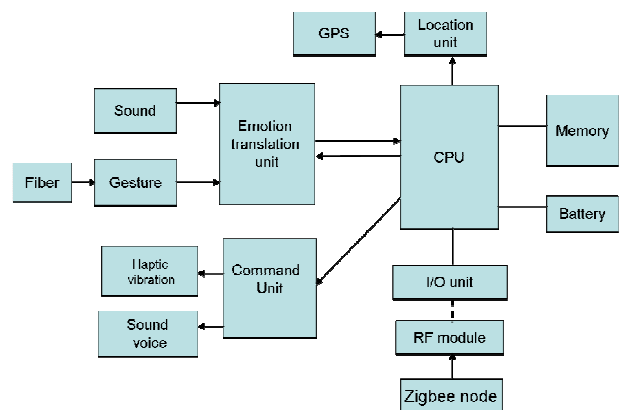


Fig. 5 Block diagram of the main controller [7]

### 3. SUSTAINABLE ISSUE

In order to choose a proper design that fulfils sustainable requirements, the comparisons concept based on manufacture process, utilization and recyclability. Follower robot concept requires more moving parts, the equipment itself needs lots of battery to maintain its mobility, and consequently it generates much more carbon footprint during manufacturing, product use, and end-of-life stages [9]. The energy consumption of Zigbee attachment concept is much lower through the power electronic elements and solar panel. It bring much less environmental impact.

The life cycle framework had been applied to concepts design based on energy used during material production, manufacturing, and transportation. The major green design considering span is shown in Table 1. For Zigbee attachment concept, the supporting network and system which provided information need extra energy, consequently, the major parts that can contribute within the life cycle is the use phase. The manufacturing phase impact can also be minimized by proper selection of technology and parts.

TABLE 1 GREEN DESIGN CONSIDERING OF ZIGBEE ATTACHMENT  
(where + means better, - means worse, compare with Follower robot concept)

	Manufacture	Use	Recycle
System	+	+	+
Circuit	++	-	-
Battery	+++	+++	+
Frame	+++	++	+

Trying to mitigate impact during design phase is much better than after production. The Zigbee attachment concept consists of four different devices; the network, the sensor control electronics, the battery and the mechanical frame. Environmental impact is related to factors such module size, battery size, frame and electronic packaging material required. Minimized environmental impact can be achieved through proper choice of those variables which included the global network related energy expense.

### 4. PATENT APPLICABILITY

Among patent applications review, it is crucial to establish better criteria and principles for

judging issues of patent validity and industrial applicability. Patentability also requires fulfillment of novelty and non-obviousness. By comparing the difference, one can evaluate whether the solution is obvious in the eyes of a skilled person. Being the first patentability evaluation steps, it also a common and important issues.

The legal requirements for getting utility patent can be represented by mountain climbing.

- Utility: Is it useful or industrial applicable? Does the design provide useful functionality?
- Novelty: Does it have an aspect that is different in any way from previous invention based on applied date?
- Progress (nonobviousness): Does it provide new and unexpected results?

#### 4.1 PHOSITA and the patent review

PHOSITA means person of skill in technical area. The prior art usually consists of published writing that was made publicly available and commercial use or on-sale item. The skilled person can be expected to access those prior art and also look for suggestions in a general technical field. Design that improves existing problem can be viewed as problem solving. If the inventor cannot state a realistic of use, the PTO reject the patent with the reason of industrial non-applicability.

In United States patent law, utility is a patentability requirement.[10] As provided by 35 U.S.C. § 101, an invention is "useful" if it provides some identifiable benefit and is capable of use [11]. Industrial applicability is also related to the requirement of sufficiency of disclosure. Patent applicant must disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art". Applicant has to give a sufficient description of the invention, as required by Art. 83 EPC (1973).

#### 4.2 Prior art study: Zigbee and emotion detection

Wireless sensor networks are an emerging technology for low-cost, unattended monitoring of a wide range of environments. A wireless sensor is characterized by its small size, its ability to sense environmental phenomena through a set of transducers and a radio transceiver with autonomous power supply. Current low-end sensors employ low cost Reduced Instruction Set Computer (RISC) microcontrollers with a small

program and data memory size. ZigBee standardizes the higher layers of the protocol stack. The network layer (NWK) is in charge of organizing and providing routing over a multihop network for distributed application development and communication. The APL comprises the Application Framework, the ZigBee Device Objects (ZDO), and the Application Sub Layer (APS). The APS offers an interface to data and security services to the APOs and ZDO. An overview of the ZigBee protocol stack is shown in Fig.6 [12].

ZigBee is designed for reliable wirelessly networked monitoring and control networks. Wireless communication standards contain features and behaviors in terms of transmission time, data coding efficiency, complexity, and power consumption. ZigBee over 802.15.4 protocol can meet a wider variety of real industrial needs than Bluetooth due to its long-term battery operation, greater useful range, flexibility in a number of dimensions, and reliability of the mesh networking architecture [13]. Bluetooth and ZigBee are suitable for low data rate applications with limited battery power.

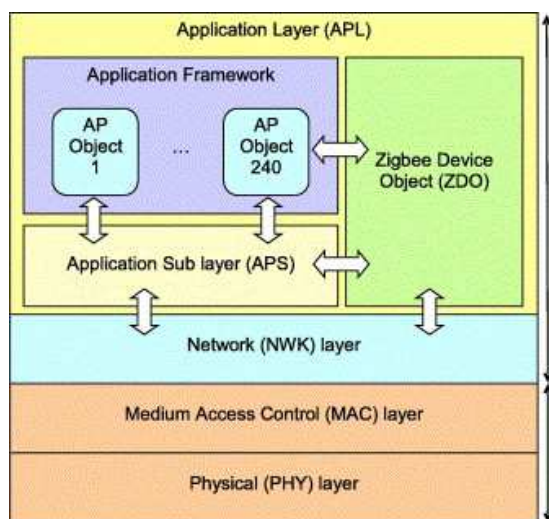


Fig. 6 Zigbee application layer

The dog's emotional properties can be verified through emotion factors by owner. Human cognition has highlighted its interaction with emotion. Five topics are explored: emotional learning, emotion and memory, emotion's influence on attention and perception, processing emotion in social stimuli, and changing emotional responses [14]. It demonstrated that the mechanisms of emotion and cognition are intertwined from early perception to reasoning.

In [15], a system, method and article of manufacture are provided for comparing user versus computer emotion detection of voice signals. First, a voice signal and an emotion associated therewith are provided. Then, the emotion associated with the voice signal is determined in an automated manner and subsequently stored. Next, a user determined emotion associated with the voice signal is determined by a user and received. The emotion associated with the voice signal may be identified upon the emotion being provided.

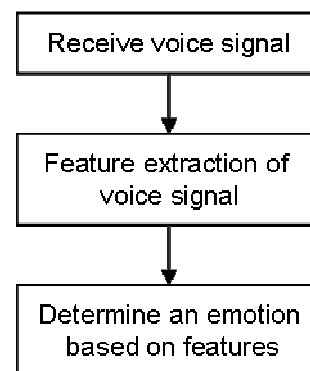


Fig. 7 Flowchart depicting one embodiment of the present invention that detects emotion using voice signal analysis and feature extraction

### 4.3 Review and evaluation

The case of Pet companion was rejected by reviewer of TIPO by the reason of industrial applicability. Indeed, it is difficult to evaluate an object's usefulness through the claims and application documents. Especially, while the examiner do not have the field experiences in the research area. The questions arise are:

- Do the opinions have supporting evidences? What are the reference facts to decide industrial non-applicability by the technical information provided on patent specification?
- Is there a guidance procedure on which examiner can make decision appropriately?
- What kinds of data is requiring for inventor to fulfill the requirement of industrial applicability?

A flow chart based on PHOSITA to determine the industrial applicability is shown in Figure 8. The steps are:

- Collect prior art before filing date, analysis of the major technical elements. Partition the elements based on whether it already exists or not.

- Does prior knowledge support the implementation of new function based on the old technical elements and the PHOSITA?
- If some function cannot be realized, remove one of the extra-function. Does the modified function realizable based on the old prior knowledge? If the answer is yes, go through the next steps.

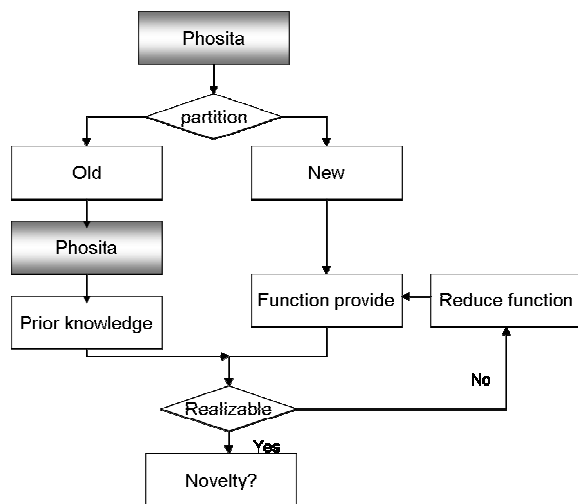


Fig. 8 Flow chart to determine the industrial applicability

Several facts were collected based on prior art before filing date. A wireless sensor network is a group of specialized transducers with a communications infrastructure for monitoring and recording conditions. Sometimes called a wireless sensor and actor network (WSAN) [16] are spatially distributed autonomous sensors to monitor physical or environmental conditions, such as sound, pressure, etc. Wearable devices are used on the body surface of a human or just at close proximity of the user. It monitors ill patients in hospitals and at homes. Body-area networks can collect information about an individual's health, fitness, and energy expenditure.

Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth. Haptic and vibration actuator has been used for hinting attention of cell phone user. It is an effective way to interact with user without disturbing surrounding activities. The advantages of piezoelectric vibration actuators are simple mechanical construction, low speed drives without additional

gear and high dynamics. To explore the possible design space, up to 6 actuators included in a phone prototype to find out about the user experience with multi-vibration output in a handheld device. Previous study applied to children with disabilities showed positive results [17].

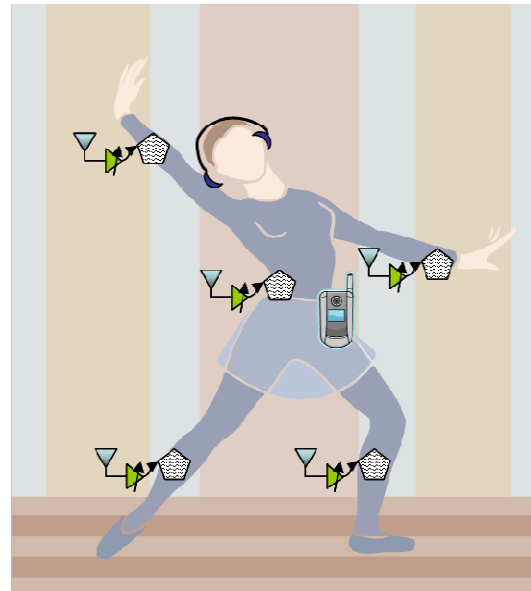


Fig. 9 Multi-vibration output driven by handheld device

The PHOSITA build up steps are (filing date: 2011.5):

- Collect prior art and partition based on the old technical elements (wireless network technique) and new functions (sensor on the pet, remote interaction, emotion detection).
- Build the PHOSITA: such as Zigbee, WiFi, Blue tooth and 3G interconnect protocols. Figure 9 shows multi-vibration output driven by wireless network.
- Prior knowledge can support the implementation of new function (sensor on the pet, remote interaction), but may have difficulty or uncertainty about realizing the function of “emotion detection”.
- Remove “emotion detection” function, then the new function is realizable based on the old prior knowledge. This modification can fulfill the Industrial applicability.

## 5. SUMMARY

The pet companion helps the elderly to feed the pet, detect its emotions and enhance the communication. Outdoors activity monitor can be implemented through wireless nodes. Interaction modes can be programmed to respond to pet's different activities collected by accelerometers, microphone and wireless transmission module.

The Zigbee attachment concept demonstrate less environmental impact (related to factors such module size, battery size, frame and electronic packaging material). A more detailed analysis is required in order to build on the study of life cycle assessment. Flow chart based on PHOSITA to determine the industrial applicability show helpful to reduce the influence of personal opinions.

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