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Smart Pet Care System using Internet of Things

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Abstract

Since Internet of Things(IoT) have come to our lives, we have developed various smart services using IoT. This paper introduces a smart pet care system that is working in an environment of Internet of Things (IoT). Basic services of the proposed smart pet care system are: Remote feeding, remote controlled automatic defecation, CCTV service and Smart phone APP that can provide the control information of the above services. Basic architecture and system implementations are introduced with the details of services.

Keywords: *Internet of Things (IoT), smart services, architecture, system implementation*

1. Introduction

21st century has brought us new technologies based on wireless communications. Those technologies have started to change our lives in every aspect. The biggest change was initiated by the invention of smart phone. Since then, we could have more smart gadgets with various features. Those are acting by communicating with smart phones since most people nowadays carry smart phones with them. Smart phone now starts to catalyze the new technology: Internet of Things (IoT). Actually IoT means not only one technology but all the technologies used to make a wireless service dealing with the information collected from lots of sensors. Therefore we can refer IoT as a new concept of Internet in 21st century [1-2].

Not only the sensors are required to make the IoT services more attractive to people but the way to process the data collected from sensors are getting important. Therefore, the questions about how we could collect the information from sensors and process the information forced us to think about new architecture of networks and data processing: cloud computing and big data [3].

With the concepts and technologies mentioned earlier in our mind, we have started to think about the new services that could be implemented easily around our real lives. Nowadays we could meet lots of people living with their pets. And the number of single household are growing as the change of life style. And most of single household need a way to deal with their pets while they are away from their home. Even though the personal pet care services are found around us, they require more money and time of trust. Here, we could see the opportunity that IoT services can provide for personal convenience.

The pet care market is also related to the smart technologies such as Internet of Things (IoT) and smart phones, which can provide the convenient services with various aspects for pet owners. However, the current pet care products are restricted in the simple functioning products such as the automatic feeder with timer and monitoring camera. In order to provide the smart pet care services for pets and pet owners, we need to think about how to check the status of pets with owner's smart phone and provide the proper services for pets such as replacement of defecation pad and feeding bowl recharging. From the perspective of owners, the statistics of feeding and replacement of defecation pad are also one of concerns.

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In this paper, we have proposed a new pet care system that can feed the pets while the owners are absent at their homes and can monitor their movement and status and also control its defecation pad through owner's smart phones. The proposed system is distinctive from others in terms of that the proposed system is based on IoT technologies, which uses lots of sensor and wireless communications. Therefore, the proposed system is not restricted in the space and time only if the wireless communications are provided.

2. The Architecture of Smart Pet Care System

The proposed smart pet care system is depicted in Figure 1. As you can see in the figure, the major parts of the smart pet care system is composed of 5 components.

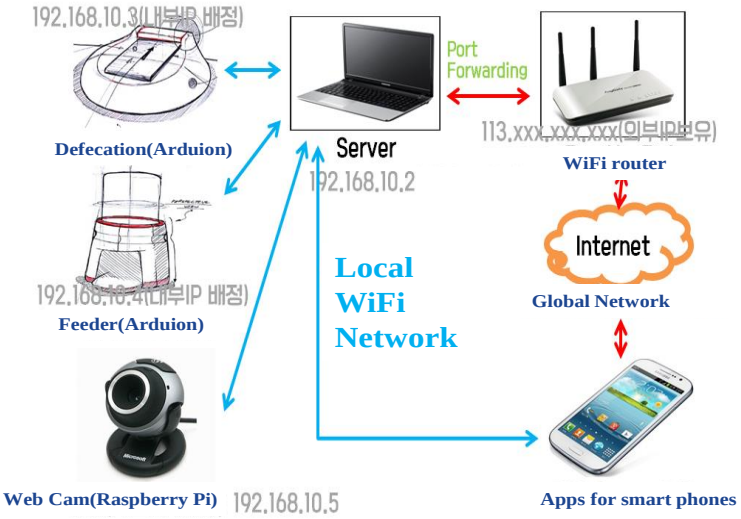

Figure 1. Architecture of Smart Pet Care System

As you can see in the figure, each component has its own platform with various sensors embedded in the platforms. We have chosen the platform for each device as Arduino MCU since it is cheap and easy to use. Those devices are designed to be linked in a home network based on WiFi WLAN. The connecting technologies, however, are not limited to WiFi. We could possibly use other technologies like Buetooth low energy(BLE) and LTE mobile communication technology. Mostly the smart phone can be used to monitor the status of smart pet care system and control the smart pet care system by changing the action process of each device in whole system. The smart phone can be used through 3G/4G mobile network and directly in WLAN.

3. Devices in Smart Pet Care System

1. Automatic Feeder

The basic functions of automatic feeder is mostly the same with the product that we can find in the market. The difference laid in the communication ability and sensing ability. We have designed the automatic feeder with the weight sensor and timer. It can measure the amount of the food and check the time interval. And it can act on time basis with timer set. Users can set the regular interval of feeding time for their pets. In addition, users can set the amount of food based on the weight of the amount of onetime food. Every control for setting could be done through user's smart phones. The automatic feeder has been implemented with Arduino MCU. The basic process of jobs in automatic

feeder is described in Figure 2. Users can see the status of the automatic feeder through the specific smart phone APP that we have developed.

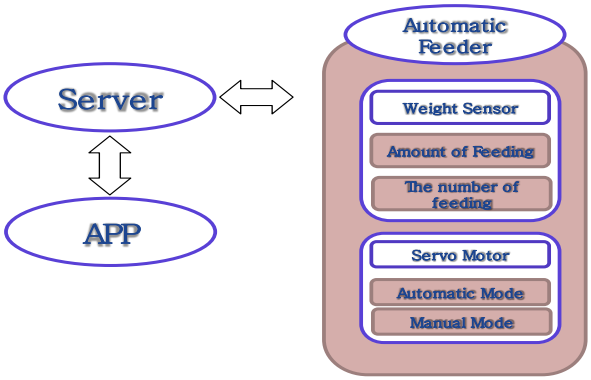

Figure 2. Processing Flow of Automatic Feeder

2. Automatic Pooping Pad

Recently most of pets are trained to poop in the dedicated area at home. However, while the pet owners are away from their home for a while, the rested area for their pets are hard to be cleaned and get massed easily. For the convenience of the pet owners, automatic pooping pad has been devised based on IoT technology.

The proposed automatic pooping pad can detect pet's defecation with a help of sensors: temperature sensor, humidity sensor and ultrasonic sensor. Ultrasonic sensor is mostly used to detect the presence of pets on the defecation pad. After the pet defecated, the ultrasonic sensor detects the presence of the pet. When the pet left the pooping pad, the pooping pad is rolled and replaced automatically. The poops are collected in the pooping case by the rolling pad.

The automatic pooping pad can be connected to smart phone. It can be controlled and monitored via smart phone. A database has been built to see the temperature and humidity in real time. Figure 3 shows the operational process of automatic pooping pad.

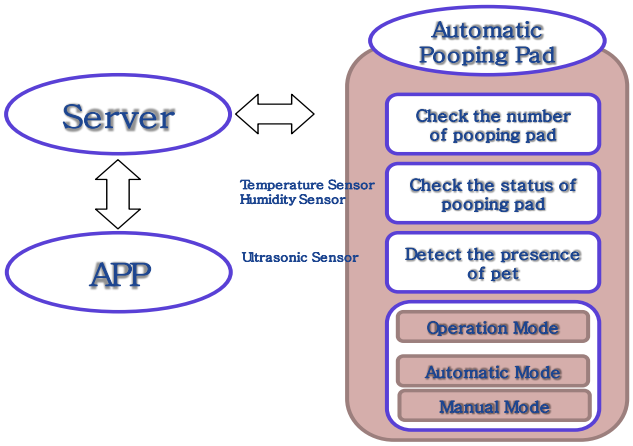

Figure 3. Processing Flow of Automatic Pooping Pad

3. Camera with Raspberry Pi

A camera system is added in the smart pet care system. The proposed camera system is specially implemented with Raspberry Pi server. The distinctive feature of the camera system is that it is focused on the pet. Its major interest is to monitor the movement of pet. Pet owners can monitor the pet's status through the camera and also look at the status of

other devices like feeder and pooping pad. Therefore, pet owners can see the whole life of pet through the camera system in addition to the information that would be provided through APPs. Figure 4 shows the processing flow in the camera system.

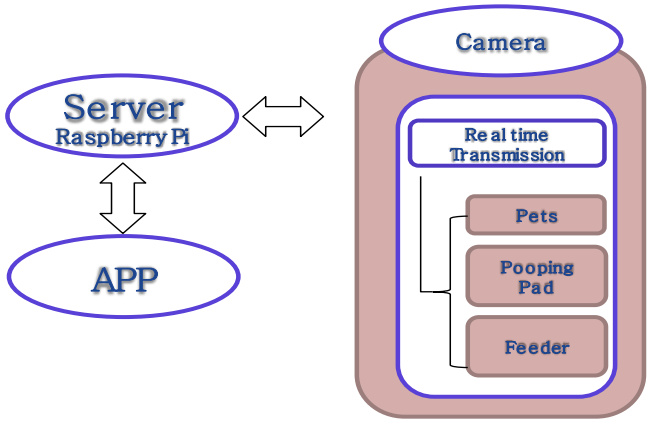

Figure 4. Processing Flow of Camera System

4. Mobile Web and APP for smart phone

The history of feeding or replacement of pooping pad is recorded in the home server and can be displayed through mobile web and APP for smart phone. For these jobs, APPs for smart phone are devised. And the home server is equipped with the functionality of web service.

Users can log in with ID and password, which is shown in Figure 5. Only the administrator can change the IP setting of feeder, pooping pad and camera. User can set the alarm setting for feeding and can monitor the status of pooping pad as shown in Figure 6.

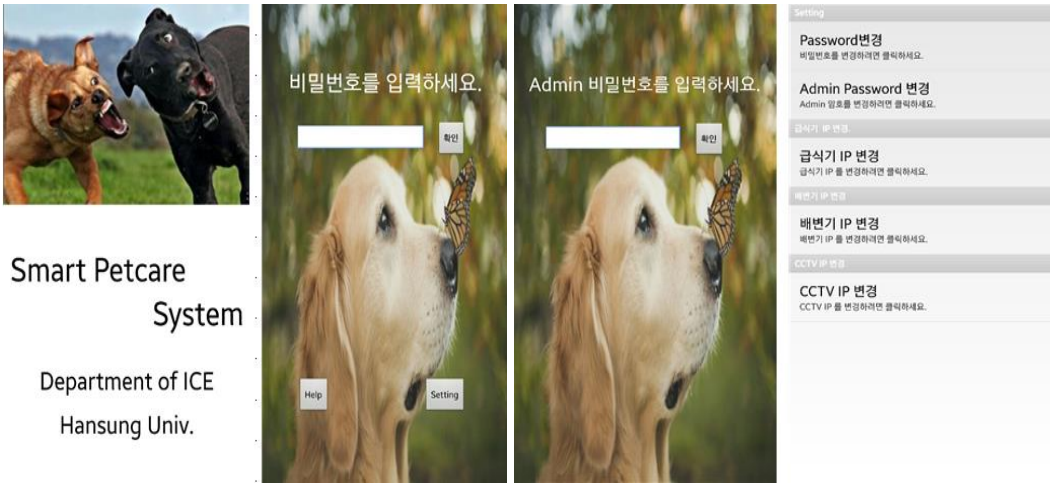

Figure 5. Login and Administration in Smart Pet Care APP

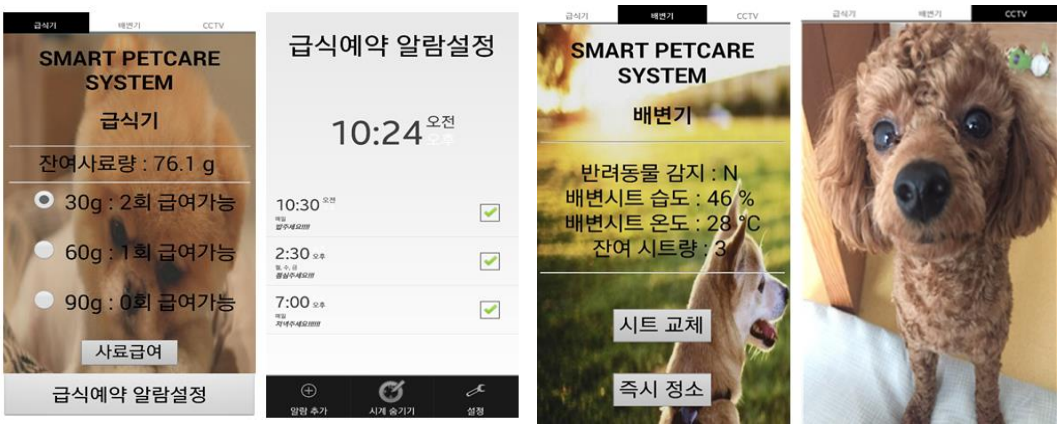

Figure 6. Controlling and Monitoring through Smart Pet Care APP

4. Implementations

The whole operation is through the home server, which collects every information regarding pet with the sensor implemented in Smart Pet Care System. The operational flow is shown in Figure 7.

The mentioned devices so far have been implemented as shown in Figure 8. As shown in the figure, the case of automatic feeder was implemented with 3-D printer. Inside of the automatic feeder is divided to 3 layers to contain and distribute the food easily. The pooping pad was hard to be implemented with 3-D printer. Therefore, we used a form board to make the exterior case of the pooping pad. Inside of the pooping pad, the step motor was used to roll the defecation pad and collect the pet's poop into the case.

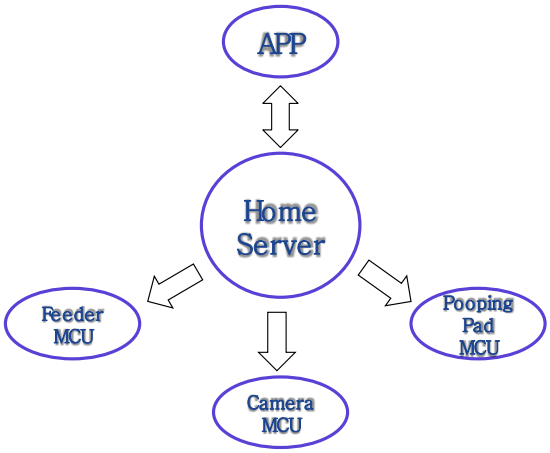

Figure 5. The Operation of Smart Pet Care System

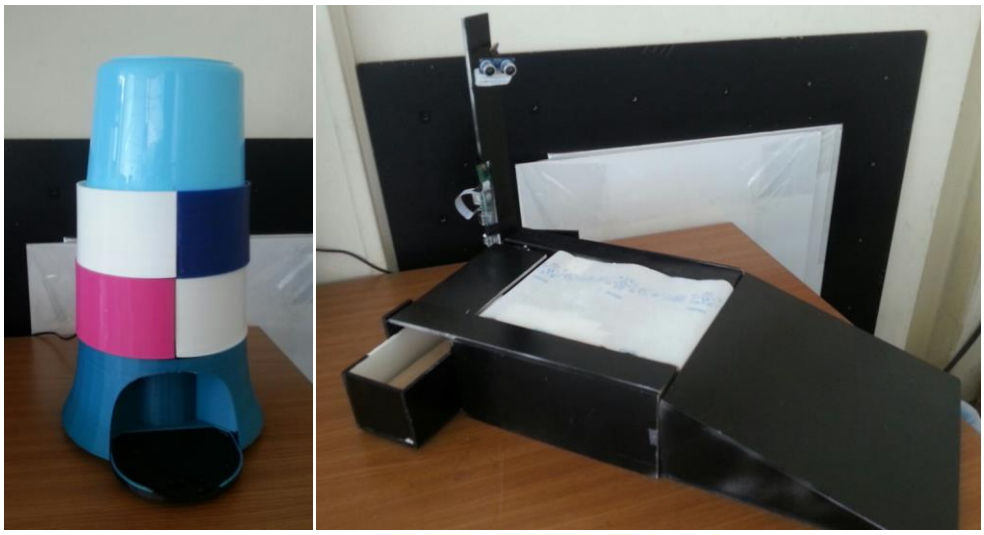

Figure 6. Implementation of Feeder and Pooping Pad

5. Conclusion

This paper introduces the novel smart pet care system based on IoT technology. As the number of single house hold is increasing, we can expect that the number of pet owners will increase. Nowadays we can see lots of new devices invented with the aid of IoT. We believed that IoT also can change the pattern of the existing structure of pet care system.

In this paper, we have proposed a new pet care system that can feed the pets while the owners are absent at their homes and can monitor their movement and status and also control its defecation pad through owner's smart phones. The proposed system is distinctive from others in terms of that the proposed system is based on IoT technologies, which uses lots of sensor and wireless communications. Therefore, the proposed system is not restricted in the space and time only if the wireless communications are provided. Up to now, only 2 devices are devised. However, we think that we can expand the usage of the smart pet care system along with the demand of the pet owners. Another pet care device that can collaborate with existing devices is scheduled to be developed. We believe that we can create whatever the pet owners want.

Acknowledgment

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