

# DIY Smart Home for the Elderly: Implement wellness monitoring for parents living elsewhere using IoT



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## 1. Smart home for the elderly

After my father passed away last year, I spent several months converting our family home, where my 79-year-old mother lived by herself, to a DIY smart home. My goal was to watch over my mother, who is at risk for stroke, and to prevent falls and hyperthermia remotely. With early dementia, difficulties due to mistaking the date or day of the week is common, so I also wanted to help her check the date and day of the week, and to check any upcoming plans.

The results were beyond my expectations. The time and psychological burden on family watching over her remotely was greatly reduced, and being able to see inside the home enables us to handle any trouble that occurs quickly. She also has difficulty walking, so adding voice commands to appliances and lighting also greatly reduced discomfort and inconvenience in daily life. I found her playing songs from her favorite singers on YouTube and enjoying it.

It also changed me. Sometimes I would lose my patience and speak harshly, “Mom! I’m always telling you, you have to check the date first!” and hate myself for it. But I am doing that less now, and when faced with a new difficulty, I now get excited thinking, “I’m sure I can solve this using IoT too!” I can handle visitors remotely with the smart door bell that I installed, and I can use it to connect with neighbors and my mother’s friends too.

This article introduces my initiatives to convert a family home to a smart home to help and watch over an elderly person, some points of note from the installation, and some issues for the future.

## 2. First, a list of issues

The highest priority was to check wellness. Creating a system to notice if something goes wrong in the house as quickly as possible, helps reduce not only my concern, but also my mother’s concerns. She has also suffered a mild stroke, and with vascular brain disease, starting treatment as soon as possible after onset can greatly affect the prognosis for life and recovery. There is also increased risk of broken bones from a fall, and of hyperthermia when remaining immobile for long periods of time during the summer.

Regarding fall prevention, hand rails were already installed and steps were eliminated, but falls could still happen easily if she gets up during the night and moves around in the dark, or in the early mornings when her body is stiff from the cold. She has difficulty walking, and just getting up is onerous, so she has sat for

long periods after sunset without turning on the lights, and spent the whole day without opening the curtains. These conditions are not desirable for mental health.

She also has difficulty knowing the date and day-of-the week, due to disorientation that occurs in the early stages of dementia. As a result, she has called a taxi and travelled 30 km to the hospital on a day that she does not have an appointment, and often has waited in the entry-way to meet the home care service person for long periods on the wrong day. Hearing her grieve, “Is there something wrong with my head?” was heartbreaking!

## 3. Cameras and other sensors: The eyes for watching over

I first worked on network cameras. I installed two cameras in the living room and the bedroom, where my mother spends most of the day. These were from the American company, Arlo Technologies, and originally intended for crime prevention. They are connected to the network by Wi-Fi and automatically record video for about 10 seconds before and after they detect movement, which is stored in the cloud for a set period of time. This recorded video and the live video can be checked using a smartphone app, so by just looking at the list of recorded videos, I can check that the daily routine is going smoothly, meals are being eaten, interactions with home helpers are okay, and I get clues to any changes in her bodily condition by watching how she moves around the room. She has also fallen in front of the bathroom and

■ Figure 1: “Arlo Pro 2” 130 degree, wide field of view network camera



in the entryway, so I also installed a Xiaomi network camera with a lens that can rotate 360 degrees in the hallway.

To help with wellness monitoring using the cameras, I also installed three sensors from SwitchBot Inc. One was a person detector in the toilet. It is configured to notify my smartphone each time she uses the toilet, so I can check that everything is okay without having to check the camera app frequently throughout the day.

I attached an opened-closed sensor to the front door. It also has movement and light-level sensors, so I get notifications on my smartphone if my mother approaches the door. If she is at the entrance getting ready to go out when there is no scheduled home care or hospital appointment, I can talk to her through the speaker of the network camera in the hallway and let her know she is mistaken. I also get a notification when she returns home, so I can say “Welcome home!” through the same camera.

I installed a networked temperature and humidity sensor in the living room. This is configured to send a notification to my smartphone if the room temperature exceeds a set value during the summer, mainly to prevent hyperthermia. The price was moderate, just under 2,000 yen, so I plan to add one to the bedroom as well this year.

#### 4. Smart remote controls for high cost-performance

What my mother was most happy about were the “Google Nest Hub” smart display and the “SwitchBot Hub Mini” smart remote control. By registering the infrared remote controls of existing home appliances, a smart remote can control all of the appliances at once from a smartphone. By also linking with a smart speaker or smart display with an AI assistant, such as Google Assistant or Alexa, household electronics can be controlled with voice commands such as, “OK Google, turn on the air conditioner,” or “Alexa, turn off the television”.

All of the electronics in our family home are ten years old

■ Figure 2: Moving the curtains using the roller on the top



or more, so they certainly do not support IoT. Nevertheless, by installing a smart remote control for only about 4,000 yen, the air conditioner and ceiling lights can be turned on and off with voice commands through a smart speaker, and I can also do it remotely. It is an all-powerful device for home monitoring. The house is 40 years old, so there is no remote control for the ceiling lights, but attaching a “finger robot” to the wall switch for about 2,000 yen, makes them smart. It is a marvelous device with a short arm that comes out and physically pushes the switch on the wall when it receives a Bluetooth signal. I also attached a special device to the curtain rods so I can say “OK Google, open the curtains half-way,” to open the left and right curtains.

Doing complex actions, like opening the door to the living room and pushing the wall switch to turn on the light while holding a coffee cup in one hand, can lead to a fall, so just adding voice control for the lights can reduce this risk.

If she forgets to turn off the living room air conditioner, she can do it from the bedroom, and by starting it automatically, the room can be warmed up before she gets up.

#### 5. AI assistant complements an elderly person's cognitive function

Someone asked me, “Can a 79-year-old use an AI assistant?” Actually, I was also a bit skeptical, but advances in current speech-recognition technology have been great, and they can understand and answer questions even if they are a bit unclear. I also wrote some common phrases, such as “Okay Google, turn on the lights,” and “What is the schedule for today?” on tape using a magic marker and attached them to the table and in the bedroom.

■ Figure 3: Voice commands needed to use the AI assistant



The AI assistant also actively manages her schedule and gives reminders to take her medicines in the morning and evening. My tasks were to create a Google account for her and enter plans such as her hospital and rehabilitation appointments into the online calendar. When she says “Okay Google, good morning,” the assistant reads out here plans for the day, and she can say “What are this week's plans?” to check upcoming plans. After breakfast,

it asks, “Did you take your medicine this morning?” Just having this reminder greatly reduces the times she forgets to take the medicine. If a family member asks her each time, “Did you take your medicine?” she is likely to resist saying, “I know, I know! I was just taking it now!” but it does not seem to hurt her self esteem to be reminded by the AI assistant.

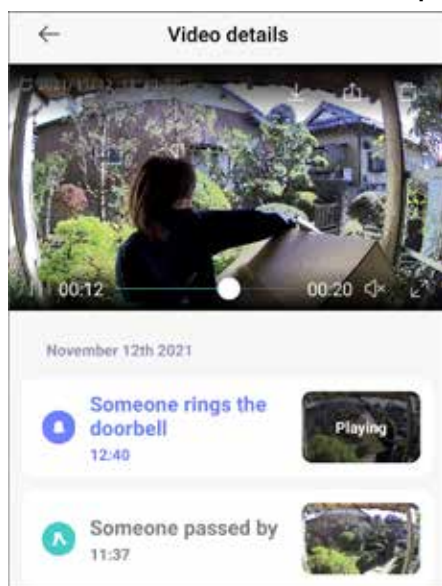
There is one more reason why voice commands are necessary. As my mother’s cognitive and decision making functions have declined, she is having more difficulty with operations that require “pushing a lot of buttons,” in other words, with remote controls and her smartphone. She has no trouble with voice commands.

Now, she can enjoy music on the smart display, just by specifying a singer’s name, such as “Okay Google, play a song by Ichiro Toba.” She is not aware that this is playback from YouTube Music, so when I checked the app history, I noticed that she tried to stop playback unsuccessfully several times with the command, “Okay Google, stop the CD.” I added a setting so that playback would also stop with the command “Stop the CD.”

## 6. Meet visitors remotely by making the entryway smart

The entryway is an important part of the house because it connects the inside with the outside, but problems can also occur there. My mother has difficulty getting to the door when visitors ring the doorbell so increasingly often, she just pretends not to be home. Thus, even people worried about her who come to visit can get turned away. For this, I installed a smart lock and a smart doorbell. Both connect to the internet by Wi-Fi, so I get notified on my smartphone when someone comes to the door. I can check using the camera and respond if she is having a nap or otherwise cannot. If it is a familiar delivery company or a neighbor, I can temporarily unlock the door remotely and have them leave the

■ **Figure 4: Smart door bell screen in the smartphone app**



parcel or a note in the entryway. If she falls out of bed and cannot move, I can also unlock the door remotely and ask a neighbor to help her back into bed, or I could ask them to call an ambulance if that was necessary. Before now, I had no way to know what was happening in the house without going home, so I would not have been able to call an ambulance either. Actually, there was a time when I stopped work and travelled three and a half hours to the family home to find her fallen out of bed and had to call an ambulance. She had been there more than half the day and was dehydrated, so it was a dangerous situation.

## 7. Family home smart-home conversion exceeds expectations

I am still continuing by trial and error, but it has been very effective so far. Earlier, if the weather report said “Today will be a mid-summer day,” I would worry all day long about whether my mother had turned on the air conditioner properly. If I called to ask her to turn it on, she might start an unpleasant argument saying, “Who do you think you’re worried about?” Now, if the living room gets warmer than a set temperature, I get a notification, and if she has not turned on the air conditioner despite the higher risk of hyperthermia, I can do it remotely.

Increasingly, my mother cannot answer her mobile phone when I call, but this is not a problem because we can talk through one of the cameras or smart speakers. I also see her smiling more often in video calls.

It has improved my relationship with my mother. It takes time to accept that parents are aging, even though you understand it in your head. There can be even life-threatening risk so, while I might have spoken harshly earlier, saying, “Mom! How many times do I have to tell you!” I have changed my mind-set now, to saying, “It’s no longer reasonable to depend on her judgment and cognitive ability, so maybe we can solve this with smart technology.” Thinking about the best way to handle a situation also feels a bit like a game challenge, so I can react more positively to new difficulties than I did before.

Google Assistant has a bigger heart than her own daughter. It answers brightly, without a hint of irritation, even if she asks, “What day is it today?” over and over. Looking at the logs, I even saw interactions like “Okay Google, thanks a lot!” “You’re welcome!” It acts like a personal valet for my mother, so I hope to expand what it can do for her in the future.

Providing care to a parent whose physical and mental abilities are weakening can be depressing because it can sow seeds of fear and uncertainty regarding one’s own old age. Through these efforts, I can now envision a brighter future. I now think, “I can use IT to complement declining physical and mental abilities and to reduce inconvenience and disability somewhat,” “Technology will continue to advance, so I should be able to have a comfortable life even when I’m old,” and “Soon I’ll even be able to climb Mount Everest in VR, even if I can’t leave the house!” This is another result of converting our family home to a smart home.

## 8. Issues with smart homes for seniors

When I published stories of this experience on a web site and SNS, they attracted interest and concern from people of my generation, saying things like, “I want to do the same thing in my family home,” and “One of my parents is also living alone, so I have the same worries and needs.” Another person said, “I’ll need this information in the near future too.”

Even if both parents are still healthy, just a small event can change things quickly, so it may be good to start introducing these technologies early, so they can get used to them.

Another issue is that smart home devices are now available at volume appliance shops and net shops, so they are very easy to obtain and set up. However, for elderly people to install them themselves, the hurdles are high. Their children could also be in their 50s or older, so not everyone will be skilled at setting them up, which consists mainly of configuring a smartphone app.

Since the person configuring it is not the user, it can be difficult to know how to best link multiple user accounts, and it takes effort to restore everything if trouble occurs.

Current apps for smart-home devices have not been created with “wellness monitoring” in mind either, so in some cases they do not fit with what is needed. For example, when I installed the person sensor in the toilet room, I needed an alert if a person was not detected for over three hours, but when setting an automatic notification for not detecting movement, the maximum time was 30 minutes. I suspect this was designed for applications such as automatically turning off lights or air conditioning when a room is empty. The need to respond as quickly as possible if a parent has a stroke and cannot move was not envisioned.

The preconception that the elderly cannot use the internet is also a barrier to using smart technology. In fact, if the initial setup can be done by someone who is comfortable with smartphone apps and IT devices and can anticipate elderly people’s needs and risks, the elderly person can manage well using voice commands. Family can also use the devices for remote wellness monitoring. Many older people with early-stage dementia may also find using voice commands to be more fun than using a remote control covered with buttons.

Of course, as dementia progresses further, voice commands may also become difficult, but even in that case, devices can be configured to turn on the air conditioner and read out the day’s schedule with a single command, such as “Okay Google, good morning.” Various sensors can also be configured to trigger actions.

## 9. The need for a wellness-monitoring Tech Coordinator

I also received inquiries from people who wanted to set up smart-home technology for their aging parents, but did not have the time or know-how. There is a need for a so-called “Wellness monitoring Tech,” a person who can provide advice on introducing IT technologies and products for wellness monitoring for the elderly, and sometimes installing and configuring it. I could use the experience and know-how I have gained converting my family home with smart-home technology to provide free consultation online or if necessary, to start acting as an agent or giving support for a fee. Just as it helped me, such an effort would reduce the burden on those worrying about monitoring wellness for parents who live apart from them using smart-home technology. It could also contribute to having fewer people left behind in the unfortunate situation of dying in isolation, which is a heavy burden to bear.

Many products such as network cameras, smart door bells and smart locks have been appearing on the market these past years. If care managers and others involved in care and welfare of the aged could get the necessary product information and knowledge to use them, they could reach more of the people that need them. Family homes without an internet connection are also an easy problem to solve, using a low-cost SIM + mobile router, among other options.

### ■ Figure 5: Configuring to give a periodic reminder to take medicine



## 10. Conclusion

How and where will we spend the final stages of life, perhaps reaching 100 years of age? At the moment, my mother can just manage life by herself in her home, and she earnestly desires to live there with her pet cat, as she has become accustomed. She could also move to an institution, but this is not what she wants and I do not want to insist, just because it is dangerous to be alone. At the same time, I do not want to quit work, return home, and devote myself to her care.

Wellness monitoring tech is a powerful tool to enable elderly people to live in their own homes safely and to reduce the burden on family members watching over them. I look forward to further advances in technology and seeing products and services on the market that are optimized for wellness monitoring of the elderly.