

SmartHome Super Project



The Internet of Things (IoT) is currently at the top of the Gartner Hype Cycle for Emerging Technologies 2017 (<https://www.gartner.com/smarterwithgartner/top-trends-in-the-gartner-hype-cycle-for-emerging-technologies-2017>) and this super project is exploring how a SmartHome could enhance a person's real-life experience.

1 OVERVIEW

You will become a developer in a (pretend) start-up company that is taking advantage of the current hype around Internet of Things (IoT) devices in home automation.

The SmartHome consists of two controller modules (Web-app and VirtualHome) and many individual in-home modules connected to the controller systems via WiFi to access a common database. All modules will be purchasable separately from a commercial website to be developed. Figure 1 displays the overview of the system to be developed by several students.

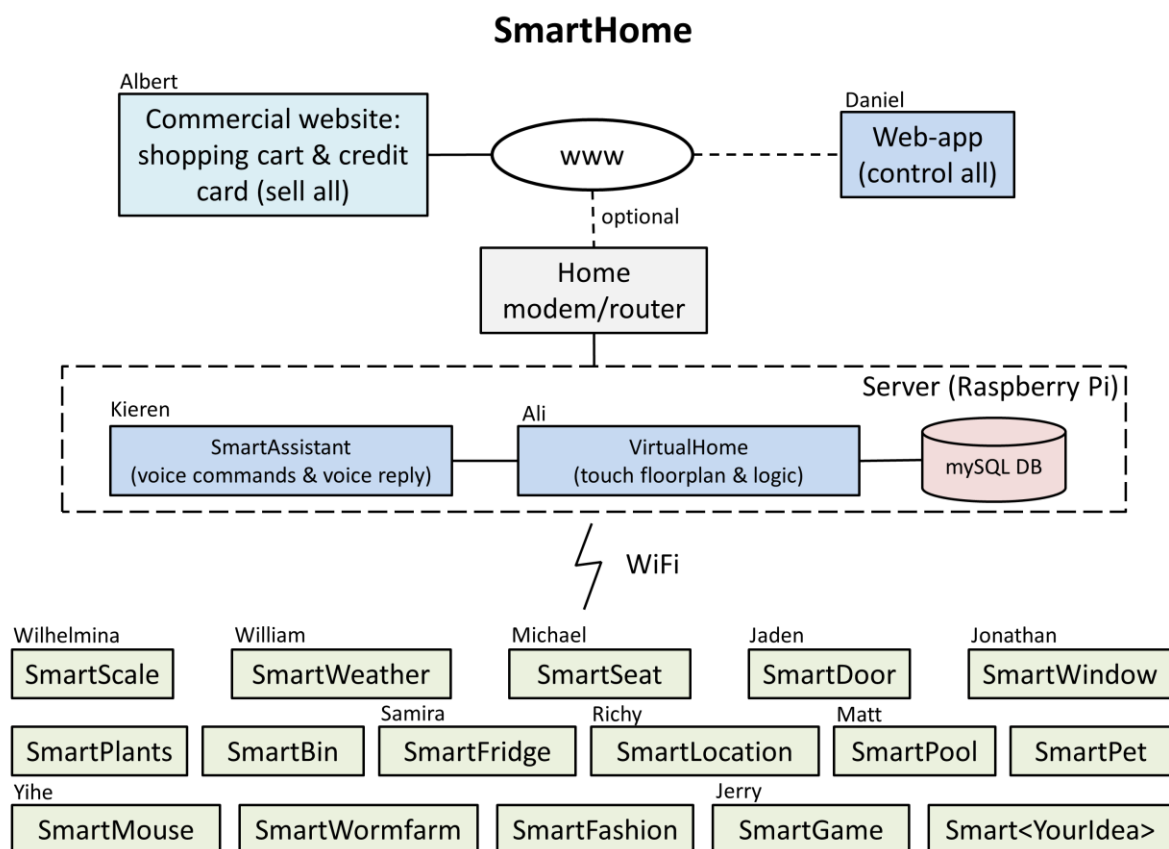


Figure 1- Modules to be developed for the SmartHome. All modules will have a WiFi connection (ESP8266 or ESP32) to the main server (Raspberry Pi).

In an attempt to support most mobile and desktop devices with a minimum development and maintenance effort all applications are to be developed as a Web-app using JavaScript, HTML5/CSS3 and PHP/MySQL.

2 MODULES TO BE DEVELOPED

The following chapters list the modules that are to be developed by a single student, however there is scope for your own creative ideas. The basic functionality is described but the scope is open ended and only limited by the creativity of the student and the whole team. Teamwork is strongly encouraged to reduce integration problems and to encourage sharing of knowledge.

2.1 COMMERCIAL WEBSITE

All SmartHome modules we are building will be sold over this marketing website which will feature a shopping cart with shipment (price to be calculated for different destinations) and credit card payment options. Each module will be presented on a dedicated web page the content of which will be developed in cooperation with the developer of the relevant module. Developers will be informed of any online sales via email and an inventory system will keep track of stock available, sales orders and manufacturing requests.

2.2 WEB-APP

The SmartHome and all its modules will be able to be remotely managed by this webapp. If the owner does not wish to connect the SmartHome to the Internet due to privacy concerns the SmartHome can still be controlled via the VirtualHome (screen) or SmartAssistant (voice) which are available by default.

2.3 VIRTUALHOME

This is the default controller module that all modules are connected to. It consists of two sub-modules, 1) an interactive floorplan and 2) a graphical programmable rule system.

1. The interactive floorplan (to be uploaded as a graphics file by the owner) will contain an icon for all other modules that indicates the current status of the modules and allows further details to be displayed and configuration option to be adjusted. All modules are auto configured on installation and will use WiFi to communicate with the central system.
2. The graphical programmable rule system will allow the owner to define rules that combine the inputs and outputs of the system to create the smarts of the system. It will make use of the voice inputs and outputs together with emails to announce or warn occupants at home and away if certain definable conditions are met. The SmartHome will come with several default templates to demonstrate the functionality of this feature and allow the owner to build upon.

2.4 SMARTASSISTANT

This is a voice input/output command module for the occupants of the SmartHome. It allows the users to activate or deactivate any function on all devices distributed in the SmartHome and to receive status updates on past and present activities. An example status request could be "Is my garage door closed?" to which the SmartAssistant could reply "Yes the garage door is closed at the moment, it was last opened yesterday at 5:18pm". Many SmartAssistant devices are distributed around the SmartHome.

2.5 SMARTSCALE

This bathroom scale identifies and records the weight of the occupant stepping onto it together with the result of a body fat analysis (<https://hackaday.com/2015/01/10/diy-electrical-body-fat-analyzer/>). It will provide some visual feedback via RGB LEDs and auditory feedback via the SmartAssistant.

2.6 SMARTWEATHER

This module consists of two different sensors, 1) an outdoor weather station that can be mounted to the outside of the SmartHome that records the temperature, humidity, wind speed and direction and the UV Index, and 2) several indoor temperature and humidity sensors that can be distributed into a number of rooms to report any variations of temperature and humidity between the different locations and to issue warnings (e.g. for a baby room).

2.7 SMARTSEAT

Based on over 10 years of research, the School of Health at UQ has launched the *BeUpstanding* campaign to encourage people to move more often to improve health and wellbeing (<http://www.beupstanding.com.au/>). To support the campaign a tangible reminder is to be developed that can be placed on a desk and is wirelessly connected to the seat of the person sitting at this desk. As an example a mechanical flower could start "wilting" over a period of 30 minutes with a delayed start if the seat is occupied, and rises again within 10 minutes of the person moving off the seat. The desktop device and seat sensor embedded systems are to be designed, developed and user tested to a high standard so that a commercial product can be fabricated immediately.

2.8 SMARTDOOR

The SmartDoor recognises occupants and opens a lock to let them enter. A camera can also send an image taken to the controller for remote activation by another authorised occupant. Occupants can schedule the door to open (n times on certain days) when certain MAC addresses are detected by the WiFi sniffing circuit in the door (delivery personnel, trusted visitors, etc.).

2.9 SMARTWINDOW

The SmartWindow will react to climate events and changes its transparency as a result of predefined light and/or temperature conditions. This is done via a special material that changes transparency when an electrical current is applied (<https://www.youtube.com/watch?v=0DfhrjpF9Gg>) similar to the SmartMirror.

2.10 SMARTPLANTS

This module monitors plant health inside and outside the SmartHome and supplies water, nutrients and alerts to selected occupants. It can use a variety of sensors and actuators to complete this task.

2.11 SMARTBIN

This module will be affixed to the inside of a standard Brisbane City Council (BCC) rubbish bin lid. Due to the lid moving and assuming fixed end positions under certain pre-defined angles and the measured fill level of the bin, usage patterns can be deducted (standing closed, being opened unauthorised by a neighbour depositing their garbage in the bin, tipped over, being emptied, etc.). Some usage pattern may be used to trigger alarms for the occupants together with reminders to put

the bin out for collection and graphs can be produced to visualise what activities were triggered at what days and times.

2.12 SMARTFRIDGE

The fridge should be able to sense its content via RFID tags and/or product barcodes and this information should be evaluated and made available to the user in form of alerts (out of date, empty), automatic shopping lists or product re-orders.

2.13 SMARTLOCATION

The SmartHome is always aware of who is in what area of the house and can thereby control its devices in a convenient fashion for its occupants via the VirtualHome programmable rule system. This includes registered guests that may or may not be able to control certain actions. Position of occupants can also be viewed on the VirtualHome interactive floorplan. Occupants will be monitored using Estimote location beacons (<https://estimote.com/products/>) or similar.

2.14 SMARTPOOL

The SmartHome has a pool that needs to be monitored (pH, ORP, temperature, etc.) and regulated with the SmartPool device. In addition the SmartPool device should also be able to alert the people in the house if a child falls into the pool accidentally.

2.15 SMARTPET

The owner of our SmartHome has a few pets (cats and/or dogs) that need to be monitored. This includes GPS tracking, noise monitoring (barking), finding the pet in the bush and in the dark (noise and light signal) etc. A single device should be suitable for a cat and a dog and the system must be able to monitor many pets in total.

2.16 SMARTMOUSE

The SmartMouse is an Internet connected pet mouse exercise wheel that measures the number of rotations of the wheel. There are some example building instructions already available for Hamsters (<http://www.instructables.com/id/RunningHam-Palace-Online-Hamsters/>) which are prohibited in Australia but very popular elsewhere in the world. However, the SmartMouse has the ability to be connected to a web portal containing a Google map of mouse/hamster wheel locations and life mouse/hamster performance data, photos etc. The web portal should be designed using a playful, fun and entertaining international theme (fastest mouse/hamster, longest distance this week, imperial/metric units etc.).

2.17 SMARTWORMFARM

The SmartWormfarm is fitted with an infra-red sensitive camera that will take a photo every hour, and temperature and humidity sensors that will be used by a watering system. The Farm will be capable of maintaining its moisture level by automatically topping up water levels if they are low and be powered by a solar panel array to make this outside project mostly self-sufficient and sustainable. The SmartWormfarm will be designed in collaboration with UQ Properties and Facilities and the Campus Kindergarten as a continuation of a 2017 project that has already received media attention (<https://sustainability.uq.edu.au/article/2017/09/wonders-worms>).

2.18 SMARTFASHION

The occupants of the SmartHome are keen to wear a creative fashion accessory which should be reactive to the wearer and/or her/his environment in the SmartHome. This could be other people present and/or the status of one or more SmartHome devices. The device should focus on an application outside of conventional fitness/health monitoring devices (see <http://www.smashingmagazine.com/2015/02/10/designing-for-smartwatches-wearables/>).

2.19 SMARTGAME

The younger occupants of the SmartHome are wearing a RGB LED wrist band that is sensitive to movement. The movement is transmitted via WiFi to other wristbands creating the possibility to design and play "wearable games" even outside the SmartHome (or over the Internet). A Web-app is to be developed that lets the players create different games for downloading into their wristbands and to compare scores on leaderboards. This could trigger the creation of a large number of followers around the world. For example a "BugMe" game could transfer an LED light pattern from one player to the next via vigorously shaking the wrist. The Cancer Council Queensland (CCQ) is interested in becoming a client for this project because there are many hospitalised children who could play alone or with other children in the same or neighbouring rooms to encourage communication between them and to provide a fun and entertaining distraction to their daily lives in hospital (WiFi and Bluetooth are permissible in these wards).

2.20 SMART<YOURIDEA>

BYO smart project idea that fits into our SmartHome theme, is highly innovative and has sufficient scope for the duration of the project. You will have to bring your own industry client/mentor to the project. Please come and discuss your idea with me (a.pudmenzky@uq.edu.au).