House Mate Model Service

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INTRODUCTION

This document provides the design approach and implementation details for the House Mate Model Service(HMMS).

OVERVIEW

The HMMS is a digital representation of any physical building(s) and its occupants. Any HMMS building can comprise the following elements:

- Occupant
- House
- Room
- Sensors
- Appliances

The HMMS is responsible for configuring and manipulating the above mentioned digital elements/models.

REQUIREMENTS

House

The “House” element is a digital model of a physical house and comprises the following properties:

- globally unique identifier
- Address (street, city, state)
- zero or more occupants
- one or more rooms
- zero or more IOT Devices

Room

The “Room” element is a digital model of a room and comprises the following attributes

- Type of Room (Kitchen, Closet, etc.)

- Floor of the house that the room is on
- Unique name of the room within the scope of the house
- Number of windows

Occupant

Occupant represents a person or animal. The HMMS can track and locate all occupant(s) locations and status. Persons can be either Adults or Children. Animals are usually pets. Occupants can be known (family member or friend) or unknown (e.g. guest or burglar). All occupants have a name for reference. Occupants also have a status, either active or sleeping.

Note that the same occupant can be recognized by more than one house.

Sensor

Sensors are IoT devices and capture and share data about the conditions within the house. Examples of Sensors include:

- Smoke Detector
- Camera: monitors location of occupants

Each sensor records data specific to its type. The data recorded by the sensor is automatically sent to the House Mate System. Each sensor has a unique identifier. Sensors are also located within a room of the house. In summary Sensors have the following features.

- unique identifier
- state
- room, location within the house
- sensor type

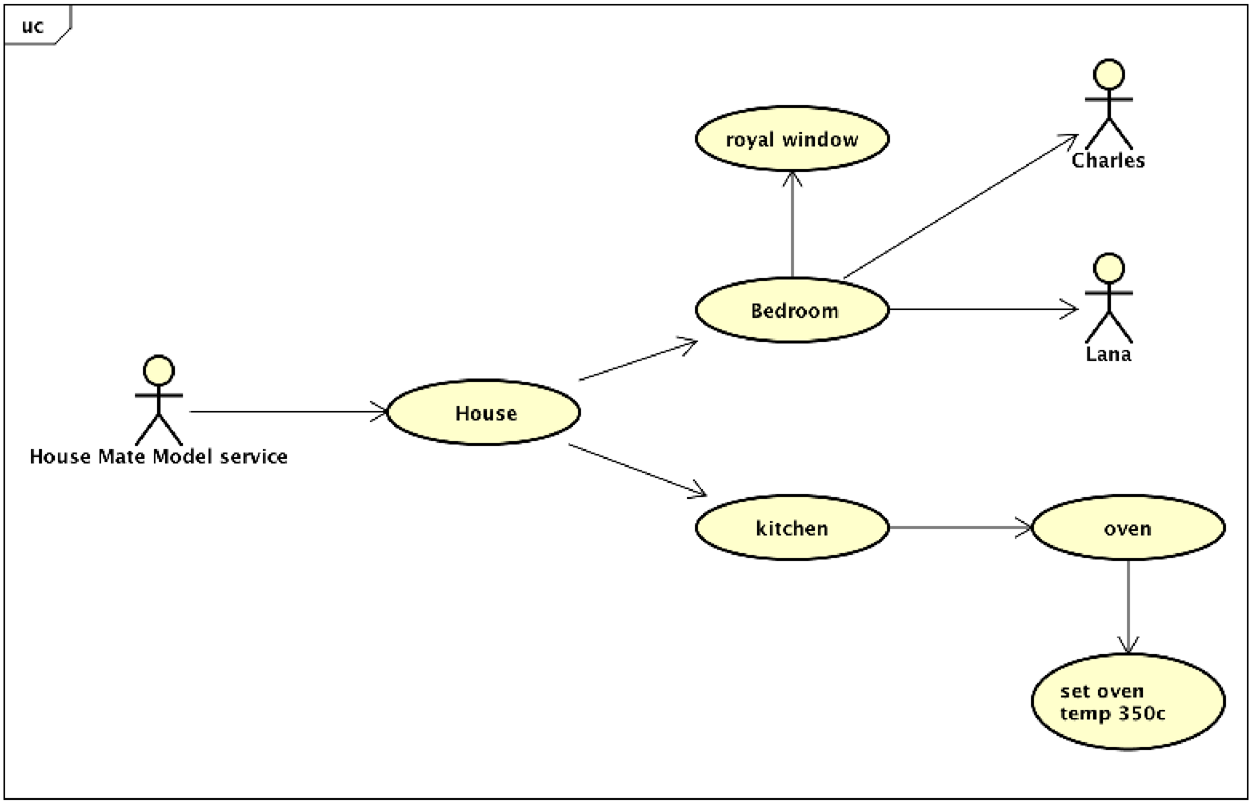
Appliance

An Appliance is similar to a Sensor since it is able to record and share data about itself or its surroundings. An Appliance differs from a Sensor since it can be also be controlled. Examples of Appliances include:

- Thermostat (adjust room temperature)
- Window (open, close)
- Door (open, close, lock)

USE CASES

The following use case diagram documents the use case examples of the HMMS.

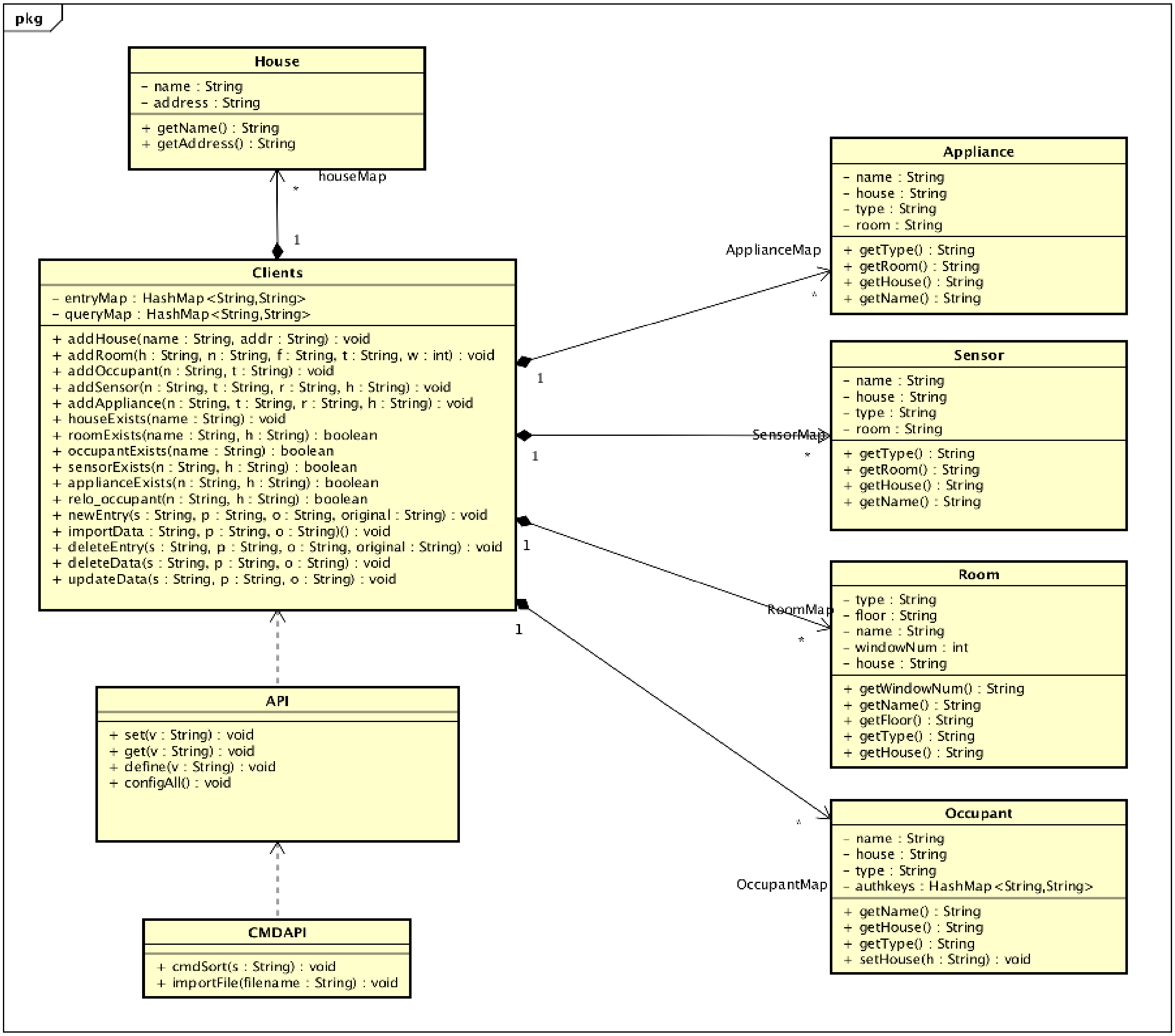


As shown above, the HMMS is able to create a digital representation of a house with two rooms (bedroom and kitchen), 1 window (royal window), 1 appliance (oven) and two occupants in the bedroom. As shown, the HMMS can also control the temperature of the oven. The HMMS is constantly monitoring the locations of Lana and Charles. The HMMS's potential real-life applications can include home automation systems that than remotely manage and configure several aspects of a physical home.

IMPLEMENTATION

Class Diagram

The following class diagram defines the House Mate Model Service classes contained within the package “cscie97.asn2.housemate.model”.


pkg
House
- name : String
- address : String
+ getName() : String
+ getAddress() : String
houseMap
*
1
Clients
- entryMap : HashMap<String,String>
- queryMap : HashMap<String,String>
+ addHouse(name : String, addr : String) : void
+ addRoom(h : String, n : String, f : String, t : String, w : int) : void
+ addOccupant(n : String, t : String) : void
+ addSensor(n : String, t : String, r : String, h : String) : void
+ addAppliance(n : String, t : String, r : String, h : String) : void
+ houseExists(name : String) : void
+ roomExists(name : String, h : String) : boolean
+ occupantExists(name : String) : boolean
+ sensorExists(n : String, h : String) : boolean
+ applianceExists(n : String, h : String) : boolean
+ relo_occupant(n : String, h : String) : boolean
+ newEntry(s : String, p : String, o : String, original : String) : void
+ importData : String, p : String, o : String)() : void
+ deleteEntry(s : String, p : String, o : String, original : String) : void
+ deleteData(s : String, p : String, o : String) : void
+ updateData(s : String, p : String, o : String) : void
API
+ set(v : String) : void
+ get(v : String) : void
+ define(v : String) : void
+ configAll() : void
CMDAPI
+ cmdSort(s : String) : void
+ importFile(filename : String) : void
ApplianceMap
1
*
Appliance
- name : String
- house : String
- type : String
- room : String
+ getType() : String
+ getRoom() : String
+ getHouse() : String
+ getName() : String
SensorMap
1
*
Sensor
- name : String
- house : String
- type : String
- room : String
+ getType() : String
+ getRoom() : String
+ getHouse() : String
+ getName() : String
RoomMap
1
*
Room
- type : String
- floor : String
- name : String
- windowNum : int
- house : String
+ getWindowNum() : String
+ getName() : String
+ getFloor() : String
+ getType() : String
+ getHouse() : String
OccupantMap
1
*
Occupant
- name : String
- house : String
- type : String
- authkeys : HashMap<String,String>
+ getName() : String
+ getHouse() : String
+ getType() : String
+ setHouse(h : String) : void

CLASS DICTIONARY

This section specifies the class dictionary for the House Mate Model Service. These classes should be defined within “cscie97.asn2.housemate.model”.

CMDAPI

The CMDAPI class

- read HMMS CLI commands from a specified file
- the CLI command to the appropriate API command

Methods

Method name	Signature	Description
importFile	(filename: String): void	Public method for reading CLI command lines from filename.
cmdSort	(s: String): void	Public method for evaluating the CLI commands and calling the applicable API class command to execute commands.

API

The API class contains methods that perform the following

- Defining or configuring a HMMS class instance.
- Setting the status or value of a HMMS class instance.
- Displaying the status or value of HMMS class instance.

Methods

Method name	Signature	Description
define	(v: String): void	Public method for creating a HMMS element class instance based on command “v”
set	(v: String): void	Public method for setting the status or value of an existing appliance/occupant element class instance based on command “v”
get	(v: String): void	Public method for displaying the status or value of an

		existing HMMS element class instance based on command "v"
configAll	():void	Public method for called by get() to display the configuration of all existing House instances

Clients

The Clients class is the container for all created home, room, occupant, appliance and sensor instances. It also serves as a knowledge graph to store sensor/appliance/occupant status/values. It also implements a singleton design and its instance is called by the getInstance() cmd. To improve performance, an additional queryMap association is created to contain all possible queries for all previous entries to the knowledge graph. This enables O(1) performance due to the efficiency of the HashMap.

Methods

Method name	Signature	Description
addHouse	(name : String, addr : String) : void	Public method that adds new house object to houseMap
addRoom	(h : String, n : String, f : String, t : String, w : int) : void	Public method that adds new room object to roomMap
addOccupant	(n : String, t : String) : void	Public method that adds new occupant object to occupantMap
addSensor	(n : String, t : String, r : String, h : String) : void	Public method that adds new sensor object to sensorMap
addAppliance	(n : String, t : String, r : String, h : String) : void	Public method that adds new appliance object to applianceMap
houseExists	(name : String) : void	Public method that checks if house already exists in houseMap

roomExists	(name : String, h : String) : boolean	Public method that checks if room already exists in roomMap
occupantExists	(name : String) : boolean	Public method that checks if occupant already exists in occupantMap
sensorExists	(n : String, h : String) : boolean	Public method that checks if sensor already exists in sensorMap
applianceExists	(n : String, h : String) : boolean	Public method that checks if appliance already exists in applianceMap
relo_occupant	(n : String, h : String) : boolean	Public methods that checks if occupant exists in occupantMap and relocates the existing occupant to a house
newEntry	(s : String, p : String, o : String, original : String) : void	Public method that updates the queryMap with a new entry
importData	(s : String, p : String, o : String) : void	Public method that updates entryMap with key "s+p+?" mapped to String "s+p+o" . It also updates queryMap with all possible "?" and s, p and o combinations.
deleteEntry	(s : String, p : String, o : String, original : String) : void	Public method that deletes an existing queryMap entry. It deletes "original" from the SET mapped by s+p+o
deleteData	(s : String, p : String, o : String) : void	Public method that deletes all existing queryMap entries of any String s+p+o
updateData	(s : String, p : String, o : String) : void	This updates queryMap with new s+p+o values

Associations

Association Name	Type	Description
houseMap	Map<String,String>	Public association containing all HMMS house instances
roomMap	Map<String,String>	Public association containing all HMMS room instances
sensorMap	Map<String,String>	Public association containing all HMMS sensor instances
applianceMap	Map<String,String>	Public association containing all HMMS appliance instances
occupantMap	Map<String,String>	Public association containing all HMMS occupant instances
entryMap	Map<String,String>	Public association containing all previous Clients.updateData() arguments
queryMap	Map<String,Set<String>>	Public association containing queries pointing to all previous Clients.updateData() arguments

House

The House class represents instances of houses. Each House has a unique name and address.

Methods

Method name	Signature	Description
getName	(): String	returns the name of the any House Object
getAddress	(): String	returns the name of the any House Address

Properties

Property Name	Type	Description
name	String	House instance Unique identifier

address	String	House instance address

Room

The Room Class represents instances of rooms. Each room has a unique name, type, floor, house and windows.

Methods

Method name	Signature	Description
getName	(): String	returns the room's unique identifier
getHouse	(): String	returns the name of the House where the room is located
getFloor	(): String	returns the room's floor
getType	(): String	returns the room's type
getWindowsNum	(): String	returns the room's window number

Properties

Property Name	Type	Description
name	String	Private unique identifier for room instances
house	String	Private name of house containing room instance
floor	String	Private floor in house where room instance is located
type	String	Private type of room instance
windowNum	int	Private number of windows in room instance

Sensor

The Sensor Class represents instances of sensors. Each sensor has a unique name, house, room and type.

Methods

Method name	Signature	Description
getName	(): String	returns the sensor's unique identifier

getHouse	(): String	returns the name of the House where the sensor is located
getRoom	(): String	returns the sensor's room
getType	(): String	returns the sensor's type

Properties

Property Name	Type	Description
name	String	Private unique identifier for sensor instances
house	String	Private name of house containing sensor instance
floor	String	Private floor in house where sensor instance is located
type	String	Private type of sensor instance

Appliance

The Appliance Class represents instances of appliances. Each appliance has a unique name, house, room and type.

Methods

Method name	Signature	Description
getName	(): String	returns the appliance's unique identifier
getHouse	(): String	returns the name of the House where the appliance is located
getRoom	(): String	returns the appliance's room
getType	(): String	returns the appliance's type

Properties

Property Name	Type	Description
name	String	Private unique identifier for appliance instances
house	String	Private name of house containing appliance instance

floor	String	Private floor in house where appliance instance is located
type	String	Private type of appliance instance

Occupant

The Occupant Class represents instances of occupants. Each occupant has a unique name, house and type.

Methods

Method name	Signature	Description
getName	(): String	returns the occupant's unique identifier
getHouse	(): String	returns the name of the House where the occupant is located
getType	(): String	returns the occupant's type
setHouse	(h: Strings): void	Sets the occupant house to h

Properties

Property Name	Type	Description
name	String	Private unique identifier for occupant instances
house	String	Private name of house containing occupant instance
type	String	Private type of occupant instance
authKeys	HashMap<String,String>	Private map of house authentication keys belonging to an occupant

IMPLEMENTATION DETAILS

In addition to the above Class dictionary and Class diagram

- CMDAPI class reads a file, extracts command lines and sends the command line to API
- API class accepts a command line, deciphers the command line and calls the appropriate Clients class function to execute the function.
- Clients Class contains all instances of house, room, occupant, sensor and appliance classes as well as the methods for manipulating these instances.

The implementation meets the requirements of the House Mate Model Service because the design is able to

- create all instances of House, Room, Occupant, Sensor and Appliance classes.
- set or change an appliance/sensor/occupant status using a knowledge graph
- display/return details of all existing instance configurations, status or values.
- It checks for accurate command syntax.

EXCEPTION HANDLING

There are two primary Exception handlers that are implemented in HMMS design. They are as follows:

ImportException: is thrown during the following situations

- Sample input file does not exist

CommandException: is thrown during the following situations

- Invalid command syntax
- Creating any instance that already exists.
- Setting the value of a non-existent instance.
- Getting the value of a non-existent instance.

TESTING

Implement a test driver called TestDriver that implements a static main() method. The main() method should accept 1 parameters, an input sample input file. The main method will call the CMDAPI.importFile() method, passing sample input file. The importFile() method invokes the cmdSort() method which identifies the command type and continues the execution of sample input file commands. The TestDriver class should be defined in the package “cscie97.asn2.test”.

RISKS

Because of the in memory implementation, the number of house, room, occupant, sensor and appliance instances are limited by the memory allocated to the JVM.