autoHome Project Proposal

Group #1

http://autohome.cleanprogramming.com
https://github.com/autohomeproject

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Team Profile:

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The Problem:

Most houses have multiple subsystems such as electrical circuitry, security systems, and plumbing. These systems span multiple floors (basement, attic, and living spaces), then break down into separate rooms (living room, dining room, bedrooms, bathrooms, and kitchens), and these rooms can contain hundreds of appliances and interfaces that are used on a regular basis.

There is no denying that everyone forgets to perform daily tasks that are necessary to keep a home safe and well-maintained. Whether you forgot to close the garage door, or maybe you walked away and forgot to turn off that power hungry appliance in the kitchen. Not only did you forget to turn those appliances off, but you also neglect the fact that your energy bill is increasing with every passing second. Especially when many of these tasks are repetitive and are better suited to be handled by a central control center, rather than waste your precious and valuable time.

It is very easy to observe that consumers are not doing enough to monitor their energy usage as well as they could. This leads to wasting exorbitant amounts of money throughout the year, that could very easily be saved and put towards more useful needs, such as paying off your mortgage.

Lastly most, if not all parents would agree that they could do more around the house to ensure that their children are safe and well protected from criminal activity and environmental hazards such as fire and carbon monoxide to ensure that their children are more safe within the confines of their home.

The Solution:

Welcome to Advanced Utility to Operate Home, also known as autoHome. autoHome plans to tackle common everyday household problems by implementing a unique set of sensors and controls to fully maintain and secure ones household along with adding more modern conveniences that would further enable the customer to become more relaxed in an ever growing stressful environment.

Different sensors will be installed throughout the house to collect various data on the status of elements in the home. The data is then sent to the central server and is analysed to determine actions and triggers. All events are saved to a log file*, available to the user so that they may audit their home and make adjustments to further enhance their comfort and luxury. autoHome will also maintain a default profile that is not publicly available on the site, but will be used to recommend the user the most comfort available while at the same time, saving the customer money by using energy wisely and effectively.

On a side note, the information stored in the logs can also be exported by the user for access by the homeowners insurance company or local law enforcement. The homeowner is the only person who can export this data except with the request of a subpoena.

In order to improve convenience and quality of life in the home, autoHome plans to implement:

Initializing Devices

autoHome recognizes that it is difficult to move around and have to touch devices to turn them on. To fix this autoHome will have a web based panel where all devices can be listed and turned on through the interface as well as interacted with such as play music, load a DVD, and turn on an Xbox. Devices that can take advantage of this system include; lights, televisions, multimedia devices, gaming systems, and kitchen appliances.

Climate Control

Temperature control is very common in every household. Temperature sensors monitor room temperatures and will automatically adjust the thermostat to improve energy efficiency and also maintain comfort in the house, the system will also connect to the the National Weather Service (NWS) API to further optimize energy efficiency. Since the user is in control of their own home, manual settings may be used as well.

Humidity sensors are an optional feature that can be implemented as well. Humidity sensors on each floor will be monitored and connected to systems for adjusting humidity such as dehumidifiers and vaporizers. This feature is beneficial especially to families with new-born children to help prevent illness related to mold and also help maintain the household.

The climate control features of the home are very important for adding quality of life service to the house.

Inductive Charging

When current flows through a coil a magnetic field is created. If another coil is placed near the existing magnetic field current can be transferred through magnetic waves and charge a device that contains batteries [7] such as a digital camera, cell phone or even a portable laptop.

autoHome plans to place inductive charging plates on multiple surfaces throughout the house such as tables, counter tops, nightstands and coffee tables so that a home owner never has to worry about carrying plugs around the house, thus making the house less cluttered, more visually appealing, while also leaving the user not having to run around to charge his / her device when it is almost out of energy.

The system will be smart in that it will be able to detect a device and only turn on if a compatible device is present thus only using electricity when necessary thus saving the user from wasted energy by having wall warts plugged in to the wall

(wall warts consume power if they are plugged in and not being used) and making it more convenient to charge devices anytime).

Ambient Lighting and Windows Blinds Control

The system keeps track of sunrise and sunset data from NWS, in turn the system can connect to the users personal google calendar and gradually increase lighting in the bedroom to simulate a sunrise if the user needs to be awake later than the days actual sunrise. If the user wants to wake up according to sunrise time the blinds will automatically open to provide a more optimal and natural way to wake up. This will be known as the wake up period.

After the wake up period blinds will be left opened and closed based off of positioning of the house versus the position of the sun. For example, if it is the early afternoon or the hottest part of the day, windows on the west side of the house will be closed during the summer to not allow additional heat into the house while in the winter the blinds will be opened so that less energy will be used to heat the house. The user can determine their average bed time and afterwards all blinds will be closed to further assist with security at the house.

Motion sensors can be installed in areas of the house that have high amounts of activity and control the on and off actions of lights when there is no movement.

All of these options can be manually overridden as well.

Bathroom Automation

The most basic principles of autoHome believe that all users should not have to express any effort when attempting to complete tasks. As such, actions in the bathroom are fully automated. Shower temperature can be set by a dial near the shower as well as set online via the web based control system. Sinks, toilets, and soap dispensers will activate automatically through motion sensor.

The bathroom will also have the ability to clean and sanitize. This will be done by initiating the process online, bleach will be in a separate container in the toilet and be used to clean the toilet. This process will be the same for the shower as well.

Automatic Sliding Doors

Very common device in department stores. Motion sensors detect movement towards the door and automatically opens the door, then detects no movement and gradually closes.

Scheduled Control

Scheduled control is especially useful to conserve power because it activates devices only when they are needed at a particular moment. People tend to forget to switch off appliances, which results in increases in electric and water bills, and also a waste of energy.

Scheduled control is set up with respect to the user's daily practices. Most security measures are useful with scheduled control because it avoids unnecessary triggers that will probably cause an annoyance to the user. It can also be scheduled to limit usage, for example, parental controls on some devices.

Energy and Water Usage Monitoring

The user will be able to see the amount of consumption from every action performed in the house. Water flow will be calculated for example when the user takes a shower and electricity will be monitored on every device. In the end, the user will have an overview of all the resource consumption in their home, the system can then output advice to further save the users money.

To solve your home security and child protection concerns, autoHome plans to implement the following:

Fire/CO alarms

Smoke sensors are set up in various locations of your home and the server automatically notifies the user via text/email/call in addition to the fire alarm being triggered. The server also deactivates effected appliances to avoid the spreading of a potential fire. In the case that a user's response is not received after a certain period of time, the server should call 911 automatically, providing an generated message including the location of the home for immediate action. These alarms are also connected to different sensors responsible for other security concerns.

Oven/Stove

Sensors are also installed on the oven and stove to determine if the lids are open and functioning. If it is detected that the oven's lid is open and on for over a certain period of time (or threshold), the oven is automatically shut down, server notifies the user and fire alarm should also be triggered. To avoid false alarm, the threshold should be extended in the case that a user is present and using the device, in which case the user can disarm the system for a certain time interval. The system can also set the temperature of individual burners as well as the oven and set timers for popular dishes all customizable through the web interface.

High kiloWatt devices

The server monitors the current consumption of high powered devices such as filters for pools and hot tubs, if the current exceeds a specified threshold that is deemed unsafe the circuit will be shut off and the home owner will be notified.

Home Intrusion

Infrared sensors are set up at different areas in the house. It is set up with schedule control, e.g. the system is activated at some user-defined time during the day (to avoid false alarm caused when the system is triggered when home owner's movements are detected). When suspicious movements are detected while the system is activated, the system turns on all the lights in the house and triggers the fire alarm; the server will then notify the user and authorities. Server will trigger automatic door lock and open all of the blinds. The user can always configure the preferences of how the server reacts against burglary attempts.

Hazardous Appliances towards children

IP cameras are installed to monitor the house and are accessible remotely. Motion sensors are used to detect children if they are entering potentially dangerous rooms. Schedule controls are set up to lock all potentially hazardous appliances. These appliances include home workout equipment, blenders, garbage disposals, and paper shredders.

Flood Alarm

Flood sensor is installed in the basement to measure water level. A bumping system is connected to the server. When the sensor detects a rise in water level, the server activates the bump and notifies the user. When the water level is over a certain threshold, appliances and electricity (except the bump) can be disconnected to avoid electrical damage a pump in the basement will also be activated to evacuate excess water. The sensor will detect functionality of the bump and report any errors to server.

Alerts upon exit

Since all the appliances are connected to the server, when the last person in the house leaves, the server checks if there are any running appliance and notifies the user. High kW devices, such as the oven/stove and hazardous appliances can be set to shut down upon exit.

The system will also monitor the status of individual doors in the house to keep a record of whether or not doors are open and for how long. Using this data statistics can be taken on energy wasted by leaving a door open.

Targeted Market

autoHome is especially well suited for implementation within construction of a new house with modern appliances. When constructing a house, modules can be installed within walls and be connected through Ethernet down into the basement to the central station.

autoHome can also be a valuable feature that corporations may want to implement into their products and appliances. Through use of the autoHome API, corporations can install modules into their products and will make it easier for homeowners to install these applications into their autoHome enabled house.

Finally, autoHome can be installed into preexisting homes however it is not the preferred method because it may require making holes in walls to install wire and depending on the age of the house, the condition of existing wires in the house may not be optimal. As a result it can be done but any feature is dependent on its specifications and is not guaranteed.

The ideal candidate for this application is; a male / female in their mid twenties to late forties with an interest in saving money and is not afraid to get their hands dirty while at the same time interfacing with the latest and greatest in home automation.

Implementation, Programming, and Resources Required:

Programming is the most essential component of this application. The application will consist of a central access control interface located on a server. This control interface will be designed through the use of **PHP** and will connect to a custom made **MySQL** database. The application will log all events and triggers to form a history of the house. The database will include tables for collecting digital data such as for turning lights on and off in a room along with analog inputs such as receiving the temperature throughout the house. We will essentially be creating our own **API** that will create hooks that modules can use to easily interface with the control panel and dedicated website.

We also plan to create a few actual physical module that will demonstrate the abilities of our software, the implementation will most likely include an **Arduino** as an embedded system platform that will be programmed with **C** and take advantage of **TCP/IP** networking.

Secondary programming will include the addition of a **text messaging service** to send out alerts, this system already exists and we plan to connect to their API. [8]

We will ultimately require, a **Virtual Private Server** to host our code, we will use **GitHub** with an organization account to moderate our code and sub-versioning. A **MySQL** database to store all of the events and status of devices in the house. An **Arduino** with an **Ethernet shield** to interface physical devices with the website. We currently do not know all of the physical components we will need such as wiring and relays.

Plan of Action:

Below is how we plan to share our progress with the class:

- On the 1st demo we plan to display
  - ○ Completed web interface
  - ○ switches and dials for appliances
  - ○ controls for adding devices
  - ○ controls for most systems of the house
- On the 2nd demo we plan to display
  - ○ Show off physically created devices
    - ▪ Fire alarm interface
    - ▪ lights on / off
    - ▪ Potentiometer connection to website (simulates an analog device)
  - ○ Show event relations on website
  - ○ Data logging and advice interface
  - ○ More can be added to this but it is too soon to fully tell

References:

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[6] http://en.wikipedia.org/wiki/Home_automation

[7] http://en.wikipedia.org/wiki/Inductive_charging

[8] http://www.zeepmobile.com/developers/