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January 31, 2016

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### Recommended Citation

Ruhstaller, Matt, "AUTOMATED SCHEDULING OF AN INTERNET CONNECTED DEVICE", Technical Disclosure Commons, (January 31, 2016)  
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## **AUTOMATED SCHEDULING OF AN INTERNET CONNECTED DEVICE**

### **ABSTRACT**

An automatic scheduling system can be used to adjust behaviour of a user's Internet connected device based on a schedule of the user. The system identifies the schedule of the user from their client device such as an electronic communication device. The schedule may include information such as user's calendar appointments, alarms, meetings, reminders, etc. The system determines the user's physical location based on the identified schedule. The system modifies the behaviour of the user's Internet connected device based on the user's physical location.

### **PROBLEM STATEMENT**

Internet connected devices, such as thermostats, lighting systems, etc., operate automatically using algorithms that learn user's behaviour, usage patterns, hours of operation etc., over a period of time. As a result, the device's operation schedule is based on the user's past behaviour, manual set points, general settings, etc. For example, a user arrives at his home from his workplace at 5:00 PM everyday and manually switches ON an internet connected thermostat. The internet connected thermostat learns this user behaviour over the period of time. Based on this learned behaviour, the thermostat automatically switches ON when the user is predicted to arrive at his home. However, the user's schedule may not always conform to the scheduled learned by the thermostat. For example, the user may have an urgent appointment or an emergency and may not arrive at his home location at the time learned by the thermostat. The thermostat may still get turned on automatically as per the learned behaviour, resulting in wasted

energy. Current internet connected devices are unable to adjust to the change in the user's schedule.

A system that automatically schedules or adjusts the behaviour of an Internet connected device based on user's schedule is described.

### DETAILED DESCRIPTION

The system and techniques described in this disclosure relate to an automatic scheduling system that adjusts behaviour of an Internet connected device based on a user's schedule. The system can be implemented for use in an Internet, an intranet, or another client and server environment. The automatic scheduling system can be implemented as program instructions stored locally on a client device or implemented across a client device and server environment. The client device can be any electronic communication device such as a mobile phone, a smartphone, a laptop, a tablet, a wearable, etc.

Fig. 1 illustrates an example method 100 to adjust the behaviour of an Internet connected device associated with a user based on the user's schedule. The method can be performed by a system that adjusts the behaviour of the Internet connected device, e.g., the automatic scheduling system.

The system identifies the schedule of the user from the user's client device (102). The system may identify the schedule of the user by accessing information from various applications installed on the user's client device or from any type of web-based scheduling/calendar account associated with the user. The system may be required to ask for user's explicit permission in order to access the user information from these applications.

In an example, the system accesses user's calendar on the client device to identify information, such as, user's appointments for a particular day. For example, the system can identify user appointments, such as, "working from home," "out of office," "on a sick leave," "meeting from 4:00 PM to 6:00 PM." In another example, the system can access information from applications, e.g., note and reminder applications, installed on user's client device, to identify user's schedule for the particular day. In yet another example, the system may access an alarms application and identify an alarm that may be about an upcoming meeting at a friend's place.

The system may also access information related to user's commute via maps application installed on the user's client device. The system can access information related to the routes taken by the user for his commute to and from various places. Alternatively, the system may access a traffic information database for real time information on the traffic conditions on the user's daily commuting route.

The system may also access user's work and home locations if location information is activated at the user's client device. For example, the system may recognise a particular location marked as favourite on the maps such as "home" or "work." The system may also be aware of the location of the Internet connected device associated with the user. For example, the Internet connected device may have address information associated with it. This information may be associated/registered with the device at the time of device installation. The system may correlate this information with the user's home information to determine that the internet connected device is at the same location as user's home.

The system can also identify user's upcoming schedule by accessing user's email via an e-mail application installed on the user's client device or from any type of web-based scheduling/calendar account associated with the user. In an example, the system can recognise a flight reservation ticket present in user's inbox and determine that the user is scheduled to leave for his flight in the evening.

The system then determines the user's physical location based on the user's schedule (104). For example, if the system identifies that the user has a meeting from 5:00 PM to 6:00 PM at his workplace, the system may determine that the user's physical location from 5 to 6 PM will be his/her workplace. In another example, if the user's schedule includes a calendar appointment such as "work from home from 8:00 AM to 6:00 PM," the system determines that the user's location throughout the day will remain his/her home. In another example, the system can obtain a user's RSVP status to an event to determine the user's physical location. For example, if the user has RSVP'd "Yes" to an event such as "Summit Meet at C G Hall" on a specific date, the system determines that the user's physical location will be "C G Hall" on that day. The system may also determine the user's location from a maps application. For example, the system may determine that the user is currently on route from his workplace to his home.

The system modifies the behaviour of an Internet connected device based on the user's physical location (106). For example, if the system determines that the user's physical location in the evening will continue to be his workplace, instead of his/her home according to the learned behaviour, the system modifies the operation of the internet connected thermostat and keeps it switched off.

Additionally, the system can also estimate an amount of time the user may take to reach location of the Internet connected device. The system may determine, from the user's schedule, that the user's physical location is his workplace till 6:00 PM and that the user starts his commute for his home at 6:00 PM. The system may also receive other information from the client device such as traffic patterns on the user's route. Traffic pattern information may include information such as, whether there is heavy or light traffic on route to user's way home. Alternatively, the client device may obtain the traffic information from a maps and traffic database after identifying the user's route from the client device. The system can also obtain information related to how much time it might take for the user on a particular route. The system can then calculate an estimated arrival time (ETA) for the user to arrive at the location of the Internet connected thermostat. The system then modifies the behaviour of the Internet connected thermostat in accordance with the calculated ETA. For example, the system estimates that the user's estimate arrival time at the location of the Internet connected thermostat at his home location is 7:00 PM and as a result initiates thermostat heating at an optimum temperature 15 minutes prior to it, i.e. at 6:45 PM. The system can further modify the behaviour of the thermostat, i.e., increase or decrease the temperature based on the updated user's schedule information.

Fig. 2 shows an example implementation of an automatic scheduling system. As depicted, the system accesses information related to a user's schedule from a user's client device. The information accessed by the system from the user's client device include a calendar application 202 and a maps application 204. The calendar and map applications are installed on the user's client device and the user may have granted permission to the system to access the

applications. From the calendar application, the system determines that the user will remain in a meeting at his workplace till 5:00 PM. The system may also identify user's home location and a work location as described above.

The user has an Internet connected thermostat 206 installed at his home location. The system keeps a track of the user's schedule and on a particular day and determines from the user's schedule (calendar application 202) that the user will leave his workplace at 5:00 PM, which is different than user's normal schedule. The system accordingly modifies the behavior of the thermostat to switch it ON as per user's expected arrival time. The system may determine user's commuting information from maps application 204 to determine the user's expected arrival time. As depicted in the Figure 2, the thermostat is now in state 208, where it is switched ON 15 minutes prior to user's estimated arrival time.

Fig. 3 is a block diagram of an exemplary environment that shows components of a system for implementing the techniques described in this disclosure. The environment includes client devices 310, servers 330, and network 340. Network 340 connects client devices 310 to servers 330. Client device 310 is an electronic device. Client device 310 may be capable of requesting and receiving data/communications over network 340. Example client devices 310 are personal computers (e.g., laptops), mobile communication devices, (e.g. smartphones, tablet computing devices), set-top boxes, game-consoles, thermostat, embedded systems, and other devices 310' that can send and receive data/communications over network 340. Client device 310 may execute an application, such as a web browser 312 or 314 or a native application 316. Web applications 313 and 315 may be displayed via a web browser 312 or 314. Server 330 may be a web server capable of sending, receiving and storing web pages 332. Web page(s) 332 may

be stored on or accessible via server 330. Web page(s) 332 may be associated with web application 313 or 315 and accessed using a web browser, e.g., 312. When accessed, webpage(s) 332 may be transmitted and displayed on a client device, e.g., 310 or 310'. Resources 318 and 318' are resources available to the client device 310 and/or applications thereon, or server(s) 330 and/or web pages(s) accessible therefrom, respectively. Resources 318' may be, for example, memory or storage resources; a text, image, video, audio, JavaScript, CSS, or other file or object; or other relevant resources. Network 340 may be any network or combination of networks that can carry data communication.

The subject matter described in this disclosure can be implemented in software and/or hardware (for example, computers, circuits, or processors). The subject matter can be implemented on a single device or across multiple devices (for example, a client device and a server device). Devices implementing the subject matter can be connected through a wired and/or wireless network. Such devices can receive inputs from a user (for example, from a mouse, keyboard, or touchscreen) and produce an output to a user (for example, through a display). Specific examples disclosed are provided for illustrative purposes and do not limit the scope of the disclosure.



DRAWINGS

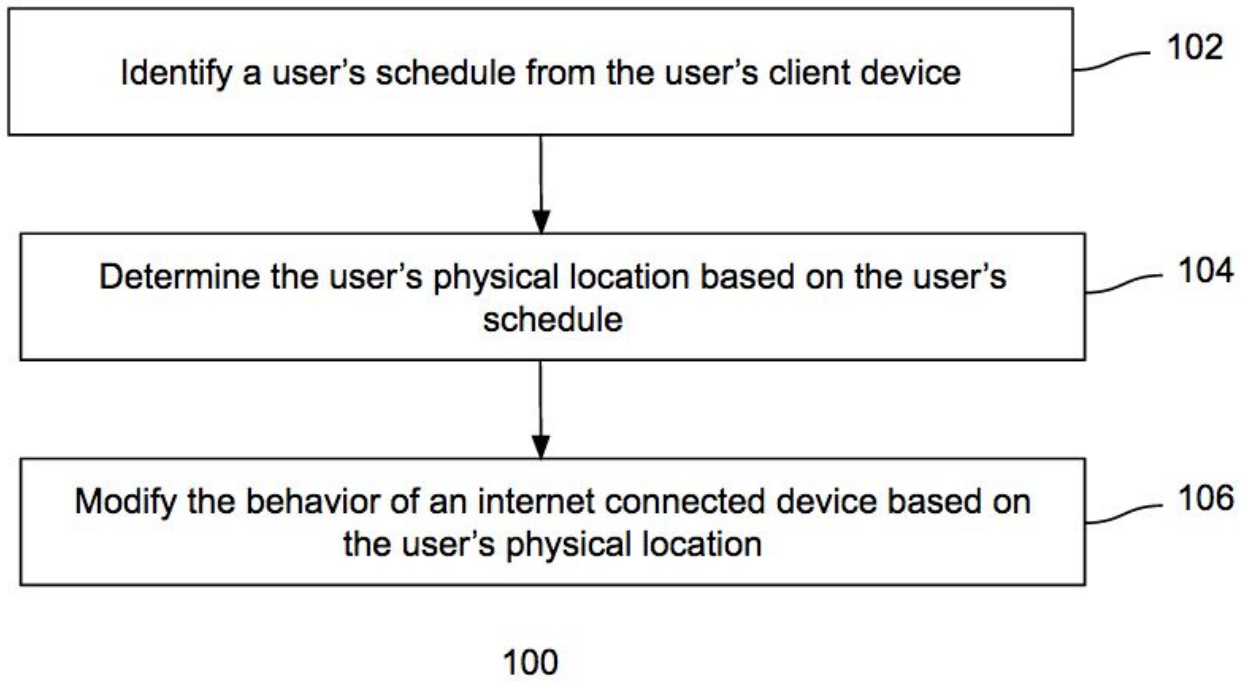


Fig. 1

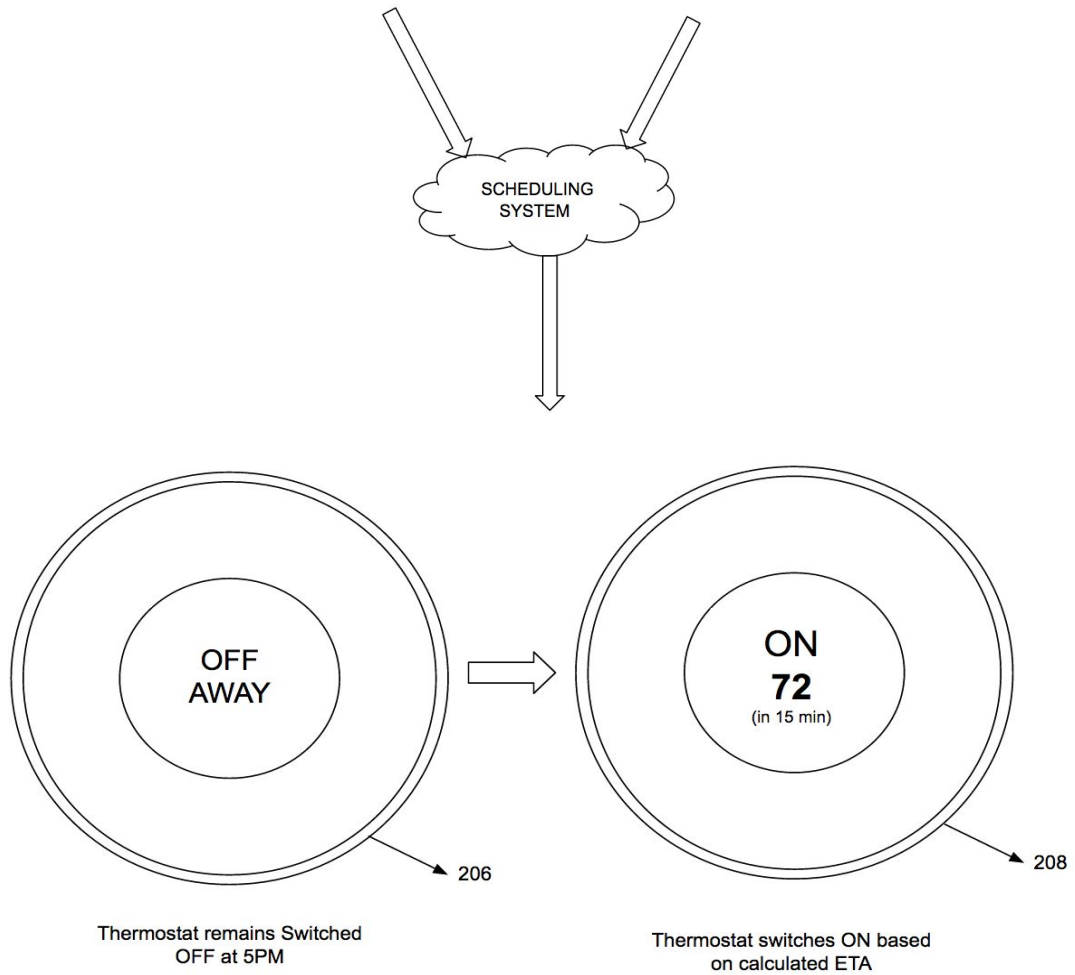
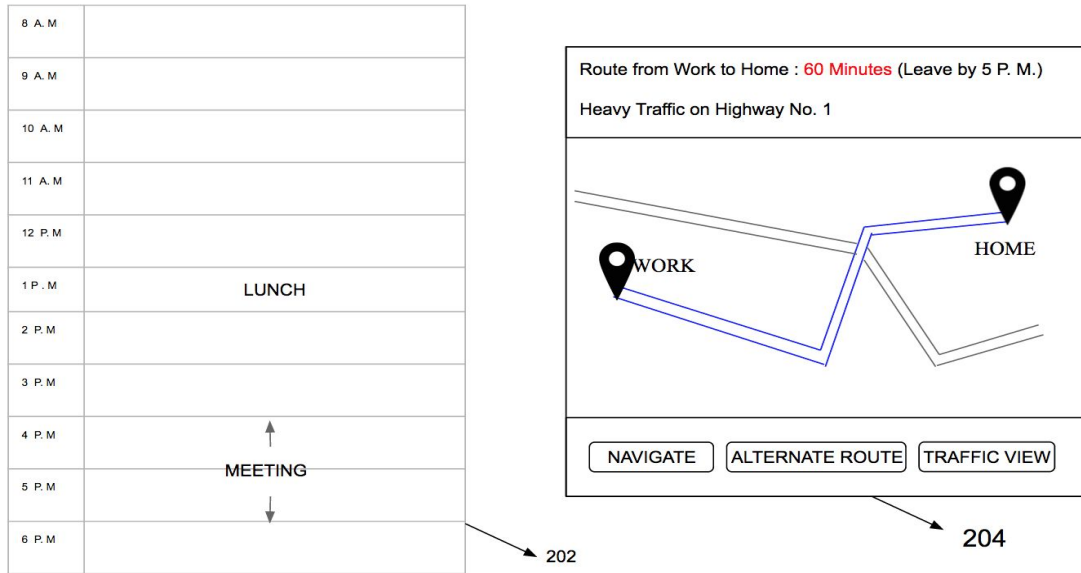


Fig. 2

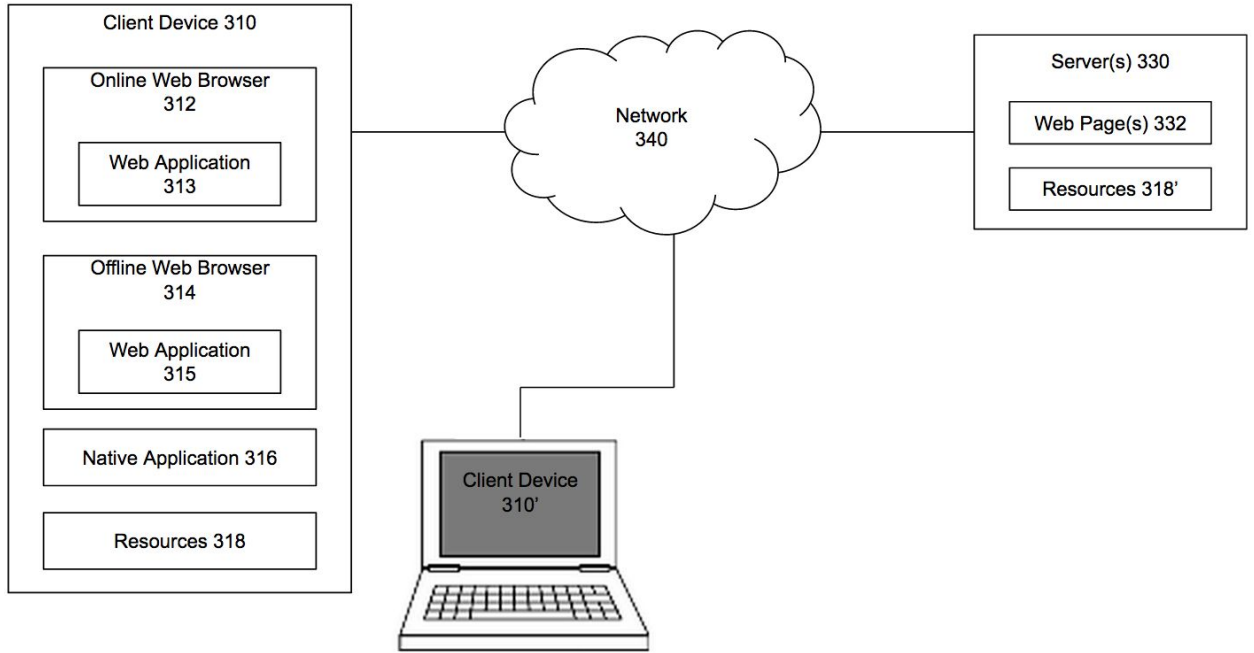


Fig. 3