Project Research Document – Building Management System IOT

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Detailed Discussion

A building management system (BMS), also known as a building automation system (BAS), is a computer-based control system installed in buildings that controls and monitors the building's mechanical and electrical equipment such as ventilation, lighting, power systems, fire systems, and security systems. The BMS I would like to build using a Raspberry PI computer as a controller for a domestic house. The systems controlled by the BMS in this project will be the domestic heating, electricity, fire and burglar alarms and access and entry control. Some of these systems will be managed automatically and remotely with some being controlled solely by remote. I plan to have data from the system be recorded in the cloud and to have an application dashboard to pull information from the cloud and display that data to the user even if they are off site. The information that will be collected and displayed will be the homes temperature, a warning from both intruder and fire alarms using different sensors to detect gas and smoke, a list of all electrical circuits that are active, notification if a visitor tries to gain access to the home. This BMS system will allow the user to have control of the heating system through the use of actuators and will also give the user control of the electricity allowing the user to switch all circuits in the home through the use of relays and signals, this project will also cover the access and entry to the home through the user of a camera and a door release.

Automated Management

The system that will be managed automatically in the home will be the heating system. This will be done by reading the current temperature of the home and having the BMS regulate this using an on-off relay control for the boiler. This part of the BMS can also be controlled remotely by changing the temperature setting around the home and with the use of actuators to fine tune the heating from room to room.

Remote Management

Aspects of the system that can be controlled remotely will be the heating, the electricity and the access and entry. The electrical control will be done through a series of relays to switch the power to sockets and lighting circuits around the house. The access and entry control for the home will be managed by the owner of the property, the owner will be sent a message and an image or a video feed from the BMS to notify them that someone is trying to gain entry. The owner will then be able to grant the visitor entry by sending a signal to an entry door latch. The heating control is explained above.

Data Stored

The data from the home will be collected and stored at set intervals into the Azure cloud, once the data is collected I am planning to have that information accessible via a web based application and displayed to the users dashboard. I would like to add an update system so the user can retrieve the data in real time.

User Dashboard

The application dashboard will display to the user the following.

- Current temperature of the home
- Active electrical circuits in the home
- Health signals from both fire and intruder alarms
- If possible a direct camera feed for security
- Active heating circuits (by room)

Functional aspects of the system.

Accessing the BMS from off site will require the user to do one of the three following options depending on what is possible to build.

1. SSH into the Raspberry PI directly
2. Access via a web application & SSH
3. An interactive dashboard & SSH

Out of the three above options my first choice would be to give the user the easiest option by allowing them to access the system using an interactive dashboard as it will simplify the user experience. My second option would be to give the user access via a web based application and finally if all fails the user can access the system by using SSH to control the Raspberry PI but this would be more directed towards a professional user with knowledge of command line.

Additional options.

An option I plan to explore during the course of this project is SIM access to the BMS. This will allow the system to give the user access without a local network available and also give the system the ability to contact the user via text message when there is a problem.

The user.

The user I am aiming for is the non-technical user by keeping the controls as simple and intuitive as possible.

Existing Applications in this domain

One of the leading brands used to build a BMS in today’s industry are made by Cylon Control Systems. A Cylon system is controlled by a central application gathering data from slave controllers dispersed throughout a building. These slave controllers receive their initial instructions via the application and then automatically control the areas they have been assigned to. The slave controllers send data on their area in real time to the application (master controller), which is then displayed to the user via a dashboard. These systems are usually bespoke and have to be tailored to the buildings they are managing by an engineer but once installed are fully automated. A Cylon BMS can control every aspect of a buildings infrastructure including.

- Water systems control
- Air conditioning and heating control
- Access and entry control
- Building alarm systems control

- Fire suppression systems
- System monitoring controls
- Electrical system controls

Systems Controlled	Cylon BMS	Raspberry PI BMS
Water systems control	YES	NO
Air conditioning and heating control	YES	YES (heating only)
Access and entry control	YES	YES
Building alarm systems control	YES	YES (partial control)
Fire suppression systems	YES	NO
System monitoring controls	YES	YES
Electrical system controls	YES	YES
Remote access	YES	YES

Platform, Technologies and Libraries

The platform being used to control and manage the BMS is the Raspberry PI platform. The Raspberry PI will be used to automatically control the building and also give the user remote access to change variables. The language being used to program the Raspberry PI will be C# and XML. The Raspberry PI will collect data from connected sensors and store this data in the Azure cloud. The controller will also make us of internal relays to effect change in the system. The Azure cloud will store numerical data from the system and feed that data into tableau to achieve the functional dashboard. For the user input part of this project I will be using HTML, XML and SSH to communicate with the onsite Raspberry PI. Other technologies used in this project include a hardware aspect as follows.

- 10V, 24V and 230V power supply
- Damper actuators to control the heating distribution
- Switched relays to control heating, electricity and access and entry release

The library used on the Raspberry PI will be the GPIO access library. The details of this library can be accessed from http://wiringpi.com/

The IDE's being used in this project are webStorm10 and Visual Studio 2015 and on the Raspberry PI the IDE is called Geany https://www.geany.org/

The risks

The risks that this system can have is in the fact that it has remote access. Remote access would allow anyone that gained control of the system to access all aspects of the system including access and entry. Another risk is through the use of the Raspberry PI because if there is a problem with the device the whole system would be left inactive including the electricity supply. Another risk would be if one of the sensors malfunctioned as the user would be receiving incorrect data from the system and the automated aspect of the system would lose accurate control of the heating system. These risks can be counteracted by using tighter access control to the controller and with a series of redundant systems installed.