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Sensor based pervasive System for user controlled automation

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Abstract:

Computers are no longer single, stand-alone machines. They are now networks of lot of sensors and nodes that control behavior and functions of multiple machines. Connectivity everywhere and every time is the unique feature of such computers [1, 2].

Automation or automatic control is the use of various control systems for operating equipment. The biggest benefit of automation is that it saves labor; however, it is also used to save energy and materials and to improve quality, accuracy and precision [VIII]. The proposed system pairs the switches with the device and controls various environmental conditions.

The Just A Rather Very Intelligent System (JARVIS) group built a program to interface with the Internet and control a network of sensors. The entire system is DOS based and simple to handle but the system usually requires a lot of processing and extensive use of power. This leads to bulk and heavy losses [IV].

The proposed system will have an adhoc network of sensors monitored by a single machine as server. Each sensor will be on a board with a processor that controls its operation. These small processors serve as nodes (smart) and hence the entire network will be single pervasive computer. It however is not requiring a connection to the Internet to handle sensors but can access it on demand/requirement to provide different service to the user [2, 17].

Keywords: Pervasive, sensor networks, JARVIS, automation;

INTRODUCTION

A sensor network is a collection of sensor nodes which coordinate to perform some specific action. Each sensor node is capable of only a limited amount of processing. But when coordinated with the information from large number of other nodes, they have the ability to measure a given physical environment in great detail [1, 2].

A home automation system integrates electrical devices in a house with each other. Devices may be connected through a computer network to allow

Control by a personal computer, and may allow remote access from the internet. Through the integration of information technologies with the home environment, systems and appliances are able to communicate in an integrated manner which results in convenience, energy efficiency, and safety benefits [4, 8, 18].

LITERATURE SURVEY

Sensors and Sensor Networks

A sensor is a converter that measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument. Sensors are used in everyday objects such as touch-sensitive elevator buttons and lamps which dim or brighten by touching the base. Applications include cars, machines, aerospace, medicine, manufacturing and robotics [II].

Sensors that measure very small changes must have very high sensitivities. Sensors also have an impact on what they measure; for instance, a room temperature thermometer inserted into a hot cup of liquid cools the liquid while the liquid heats the thermometer [I].

Sensor nodes have various energy and computational constraints because of their inexpensive nature and adhoc method of deployment. Considerable research has been focused at overcoming these deficiencies through more energy efficient routing, localization algorithms and system design.

But when coordinated with the information from a large number of other nodes, they have the ability to measure a given physical environment in great detail. Thus, a sensor network can be described as a collection of sensor nodes which co-ordinate to perform some specific action. Unlike traditional networks, sensor networks depend on dense deployment and coordination to carry out their tasks [1, 2].

Another requirement for sensor networks would be distributed processing capability. This is necessary since communication is a major consumer of energy. A centralized system would mean that some of the sensors would need to communicate over long distances that leads to even more energy depletion. Hence, it would be a good idea to process locally as much information as possible in order to minimize the total number of bits transmitted [II].

POP3 (Post Office Version3 Protocol)

The POP3 service enables a server to host e-mail accounts and includes tools to administer the servers, domains, and mailboxes.

The POP3 service performs the tasks of message download and request handling on a Windows-based server, where message download consists of transmitting the

messages from a folder in the file system to clients and request handling is performed according to the POP3 protocol, which defines how the server responds to requests sent from an e-mail client.
The SMTP service receives e-mail from the Internet, saves the e-mail to the Queue folder, and notifies the SMTP delivery service for POP3 of the arrival of e-mail. The delivery service then moves the e-mail to the POP3 mail store, where it is available for download to POP3 e-mail clients. [VI].

POP3 Architecture
The POP3 service uses the SMTP service, an existing component of Internet Information Services (IIS), to provide inbound message delivery as well as outbound message sending for POP3 clients. The figure 1 shows the modularity of the POP3 service and the relationship with IIS and the file system.
The POP3 service is the interface between e-mail clients and the mail store. POP3 listens on TCP port 110 for connections from e-mail clients, authenticates the client, and manages the connection with the client.
The authentication store is the repository of user information needed to authenticate the user. The store can be the Active Directory database, the local SAM database, or the encrypted password file for the user. The authentication module accesses the authentication store to verify the credentials submitted by the client to the POP3 service.
The Mail Storage Access API is the common interface to the mail store for all processes. The POP3 service, the SMTP delivery service for POP3, and the POP3 Server Administrator use the API to access the mail store.
With the exception of the authentication store, the installation of the POP3 service installs all of the components shown in the figure POP3 Architecture. The POP3 service installation copies the files to the server and registers the dynamic-link libraries. The file names are listed in the table POP3 Components along with a description of the file. The files are copied to the systemroot\system32\pop3server directory, unless noted otherwise, and the installation path is added to the system path variable [VII].

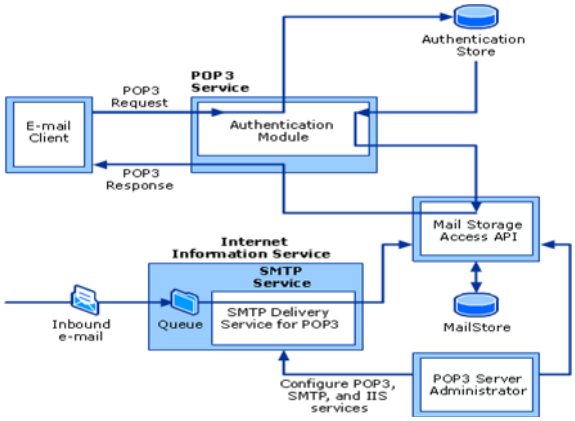


Fig. 1. POP3 Architecture

Automation

Automation or automatic control, is the use of various control systems for operating equipment such as machinery, processes in factories, boilers and heat treating ovens, switching in telephone networks, steering and stabilization of ships, aircraft and other applications with minimal or reduced human intervention The biggest benefit of automation is that it saves labor, however, it is also used to save energy and materials and to improve quality, accuracy and precision.

Types of Automation

Two common types of automation are feedback and control, which is usually continuous and involves taking measurements using a sensor and making calculated adjustments to keep the measured variable within a set range, and sequence control, in which a programmed sequence of discrete operations is performed, often based on system logic. Cruise control is an example of the former while an elevator or an automated teller machine (ATM) is an example of the latter.

Home Automation

A home automation system integrates electrical devices in a house with each other. Devices may be connected through a computer network to allow control by a personal computer, and may allow remote access from the internet. Through the integration of information technologies with the home environment, systems and appliances are able to communicate in an integrated manner which results in convenience, energy efficiency, and safety benefits [VIII].

Applications of Automated Systems

- Automatic translation
- Court reporting (Real-time Speech Writing)
- Hands-free computing: Speech recognition computer user interface
- Home automation
- Interactive voice response
- Mobile telephony, including mobile email
- Multimodal interaction
- Pronunciation evaluation in computer-aided language learning applications
- Robotics
- Speech-to-text reporter (transcription of speech into text, video captioning, Court reporting)
- Telemetric (e.g., vehicle Navigation Systems)
- Transcription (digital speech-to-text)Video games, with Tom Clancy's End war and Lifeline as working examples [IX].

Speech Recognition

In computer science, speech recognition (SR) is the translation of spoken words into text. It is also known as "automatic speech recognition", "ASR", "computer speech recognition", "speech to text", or just "STT".

Some SR systems use "speaker independent speech recognition" while others use "training" where an individual speaker reads sections of text into the SR system. These systems analyze the person's specific voice and use it to fine tune the recognition of that person's speech, resulting in more accurate transcription. Systems that do not use training are called "speaker independent" systems. Systems that use training are called "speaker dependent" systems.
Speech recognition applications include voice user interfaces such as voice dialing (e.g. "Call home"), call routing (e.g. "I would like to make a collect call"), domestic appliance control, search (e.g. find a podcast where particular words were spoken), simple data entry (e.g., entering a credit card number), preparation of structured documents (e.g. a radiology report), speech-to-text processing (e.g., word processors or emails),and aircraft(usually termed Direct Voice Input) [X].

PROPOSED SYSTEM

The proposed system will have an adhoc network of sensors monitored by a single machine as server and it can be made to function as an automated system. The switches used in the system are paired with the other domestic appliances. Further it does not require internet connection to handle sensors but can access it on demand/requirement to provide different services to the user [4, 8].

Merits of the Proposed System

- The user/admin can provide input/command from anywhere in the closed environment.
- The power consumption is minimized.
- It can be used as helper for physically challenged.
- Speech recognition used in our system provides a fairly natural and intuitive way of controlling
- The simulation while allowing the user's hands to remain free.
- Cost effective.

METHODOLOGY

The design and implementation of a system basically deals with the system's control flow and the interaction of the system with outside environment.

a. Hardware Components:

i. PIC16F84A-8 bit microcontroller.
ii. Relays.
iii. LM35-a precision IC temperature sensor.
iv. PIR Motion Sensors.
v. LDR (Light Dependent Resistors).

b. Software Modules:

i. Hidden Markov Model

Modern general-purpose speech recognition systems are based on Hidden Markov Models. These are statistical models that output a sequence of symbols or quantities. HMMs are used in speech recognition because a speech signal can be viewed as a piecewise stationary signal or a short-time stationary signal. In a short time-scale (e.g., 10 milliseconds), speech can be approximated as a stationary process. Another reason why HMMs are popular is because they can be trained automatically and are simple and computationally feasible to use [XXIII].

Pseudo code

Pseudo code is an informal high-level description of the operating principle of a computer program or other algorithm. No standard for pseudo code syntax exists, as a program in pseudo code is not an executable program. Pseudo code resembles, but should not be confused with skeleton programs, including dummy code, which can be compiled without errors. Flowcharts and Unified Modeling Language (UML) charts can be thought of as a graphical alternative to pseudo code, but are more spacious on paper [XXIV].

Pseudo code for Complete Proposed System

1. Begin the program.
2. A Voice training wizard runs to setup the speech recognition application.
3. Select the mode i.e. automatic or manual.
4. If voice command-> manual

a. If the command is “Light”, Light goes ON if it is OFF or it goes OFF if it is ON.

b. If the command is “Fan”, Fan goes ON if it is OFF or it goes OFF if it is ON

c. When “check mail” is given as the voice command, Proposed system opens the default email-id that is stored in Proposed system, and checks the number of unread mails and reads out the count. If any particular mail is to be read, command a number as input which depicts the position of the mail in the mailbox and it will display that particular mail.

d. When “Send Mail” is given as the voice command, it captures the screen shot of the system and sends to the email id stored in Proposed system.

e. It also takes System utility commands such as notepad, mails etc. as inputs which in turn runs the respective utility program like command “Firefox”, to open up Firefox. Say “exit window” it closes the current open window.

5. Voice command-> automatic,

a. Sensor values are taken from the database but if the database is not present then the values has to be entered for the first time. And sensor values can be changed anytime it’s needed.

b. LM35 is read for the values. If the range is set, accordingly fan or light will toggle.

c. LDR sensor values are read, which is used for 2 purposes.

i. Light is switched off if the value is more than the threshold.

ii. Monitor brightness is adjusted accordingly based on the value read.

d. If there is any motion detected by PIR sensor, a message will be displayed depending on the system time taken from the system.

6. Switch Control through SMS: Here the appliances can be controlled through mobile. When a SMS is sent through any mobile to a dedicated SIM (which is present in the hardware), that particular command executes.

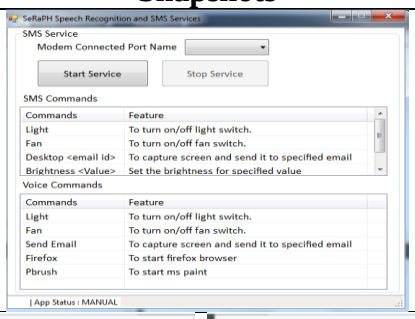
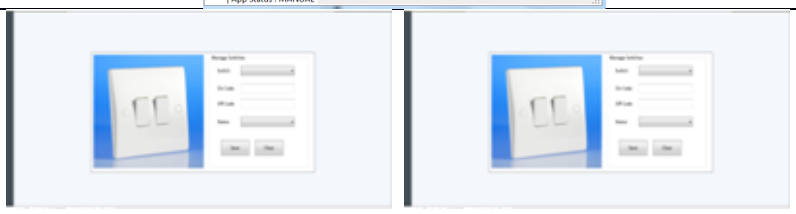
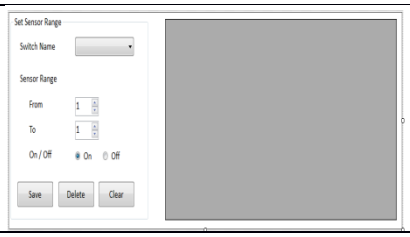
a. If an SMS with the content "Light" is sent, it will toggle the light. If it is OFF it will turn ON or the other way around.

b. Similarly the brightness of the system can be set through SMS, a message with content "Desktop 50", where 50 represents the brightness value, has to be sent.

Similarly to send a mail through SMS, a message has to be sent with the content "Mail {email id}", where {email id} represents the mail id to which the mail has to be sent. And the mail will be sent through the Email ID which is saved in the Proposed system.

EXPERIMENTAL RESULTS

Snapshots on the various operations of the proposed approach is as shown below in fig.2

Module Title	Snapshots
Speech Recognition	
Manage Switches	
Set Sensor Range	

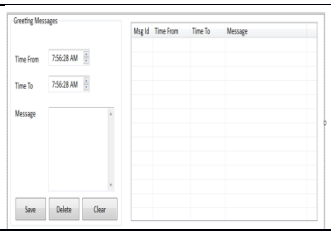
Greeting Message	

Fig. 2. Various GUI's of Proposed system

CONCLUSION

A fully functional real-world model that takes voice commands and the measured sensor values as input to control the appliances. The model is an automated system which uses distributed sensor networks to read voice inputs which facilitates monitoring and controlling of physical environment. Our proposed system is designed to control the operations of a single light and a single fan which can be further enhanced to automate an entire house or office premises, Voice authentication feature along with gestures can be included as a future enhancement.

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