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Android based Smart House Control via Wireless Communication

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Abstract - Smart house is a house that uses information technology to monitor the environment, control the electrical and electronic devices, automate simply daily tasks and communicates with the outer world wirelessly. The main objective of the proposed system is to ease and assist users in managing their home without the need of their physical presence and most importantly to provide an affordable smart home system. In this project, a simple smart house prototype will be built, monitored and controlled through an android application based on smart phone via wireless communication. The approached wireless communications are both Bluetooth and the Internet. The system mainly includes lighting, temperature and motion features. The software used to develop the app is The Massachusetts Institute of Technology (MIT) App Inventor.

Keywords: Smart House Control, Android Application, Wireless Communication

I. Introduction

Smart Home System has become common in this era of technology especially with fast growth in Internet. There are various smart home systems with different technologies that have been implemented which have
different objectives to meet. Most of them are based on android application which provides user interface for monitoring and controlling their home remotely. Previous works on the smart home implementation includes the use of android app which communicates to an ARM based processor through GSM (Global System for Mobile Communications) network and controls the electric appliances at home via radio frequency. Other than that, there is also an Arduino based system which uses wireless Zigbee and wired

X10 technologies. This design includes smart task scheduling using specific algorithms which emphasizes on effective energy management. Website based smart home automation also available which implements Google Cloud messaging. Besides that, there is also system implementing LAN (Local Area Network) and WAN (Wireless Area Network) which uses private IP (Internet Protocol) and DNNS (Dynamic Domain Name Server) respectively. However, with more advanced technologies, the affordability of a smart home system is increasing as well. Hence, not everyone is able to have a smart home system especially those living a middle class life. Therefore, the main purpose of the designed system is to provide a smart home system which is affordable by most of people without comprising the common features of a smart home system. The system must also be convenient to be used by different age groups. The designed system basically has three sensors, a PIR (Passive Infrared) motion sensor, an LDR (Light Dependant Resistor) and a LM35 temperature sensor which will be responsible to control and automate an alarm, outdoor light, and fan respectively. The sensors can be enabled or disabled and the status of the alarm, outdoor light and the fan can be monitored through an android app. The wireless communication used in the design is both Bluetooth technology and Internet. Bluetooth technology will allow the user to manage the smart house while they are at home and Internet can be used when they are away from home.

II. The Massachusetts Institute Of Technology (Mit) App Inventor

The android app was developed using the Massachusetts Institute of Technology App Inventor that was originally provided by Google. MIT App Inventor is a blocks-based programming tool that allows everyone to program and design apps for Android based devices. As it is blocks-based programming, the programmer does not have to remember the coding or syntax and does not have to worry about syntax errors. This efficiently saves time in writing and debugging the code. The MIT App Inventor is highly user-friendly however it is a web-based service hence a Google account is required in order to access.

III. NEARBUS

NearBus is an Internet of Things (Iot) open project and free platform which allows remote controlling of microcontroller through Internet. NearBus is a Cloud Connector which provides easy integration with any microcontrollers through HTTP (HyperText Transfer Protocol). Basically, NearBus works through memory mirroring system where a small portion of the microcontroller's memory is mapped to the cloud memory. Hence, modifying the cloud memory will have the same effect of modifying and programming the microcontroller, thus eventually controlling the microcontroller. The controlling is provided by a NearAPI web service which requires the user to create a personal account for access.

IV. ARDUINO

The smart house system will be controlled using an Arduino based microcontroller. Arduino is an open-source electronics platform which reduces the complexities of hardware and software development need to be done in order for a system to work. The Arduino hardware platform has a power and reset circuitry setup and can be directly powered, programmed and communicated over USB (Universal Serial Bus). An Arduino Uno board will be used in this project which is based on the ATmega328 architecture. On the software side, Arduino has its own IDE (Integrated Development Environment) where the user can write and program their coding. The IDE also has

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several libraries to make programming the microcontroller easier.

V. HARDWARE DESIGN

The central control system, Arduino is interfaced with HC-06 Bluetooth module and Arduino Ethernet Shield, based on Wiznet W5100 Ethernet chip for communication. Analog pin 4 and 5, and digital pin 2 are initialized as inputs from PIR motion sensor, LDR and LM35 temperature sensor respectively. While, digital pin 4, 7 and 8 are initialized as outputs for buzzer, LED (Light Emitting Diode) and fan respectively. The remaining analog pins A0 to A4 and digital pins D3, D5, D6 and D9 are allocated for interface with NearBus cloud memory. Digital pins D10 to D13 are connected to the Ethernet shield and Rx (Receive) and Tx (Transmit) pins to the Tx and Rx of the Bluetooth module, respectively.

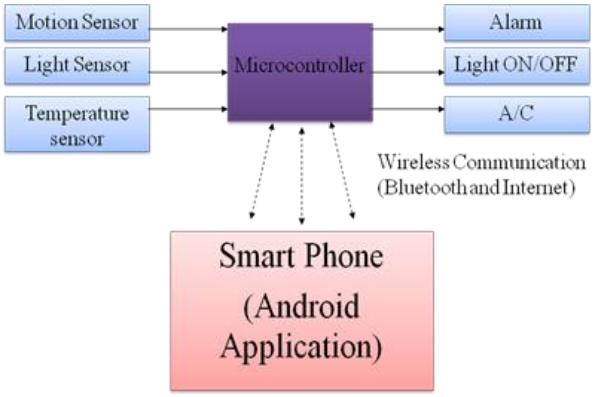

Figure 1: Block Diagram of the Designed System

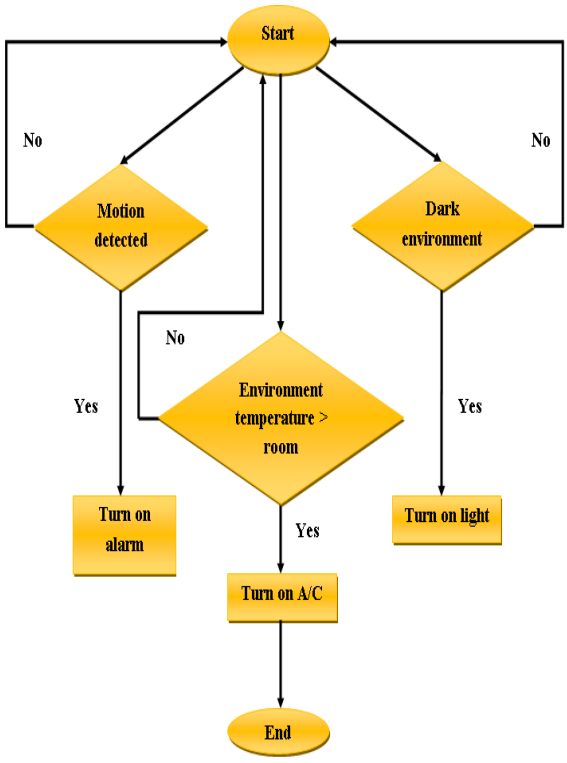

Figure 2 Flowchart of Hardware Mechanism

VI. SOFTWARE DESIGN

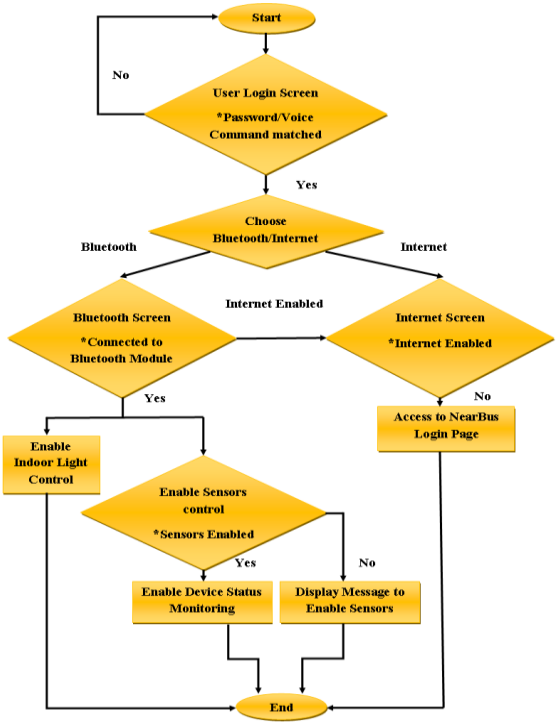

Figure 3 Flowchart of Software Mechanism

The flowchart basically describes the design of android app which consists of three screens. In the user login screen, once the password written or voice command is matched with the stored data, the Bluetooth and Internet buttons will become visible from where you can choose the connections. It is important to note that, the Internet feature in the Bluetooth screen has to be enabled first in order to connect through Internet as we are telling the microcontroller through Bluetooth to allow Internet connection. Hence, the user has to enable the Internet settings before leaving home in order to connect remotely.

VII. Results

(a)

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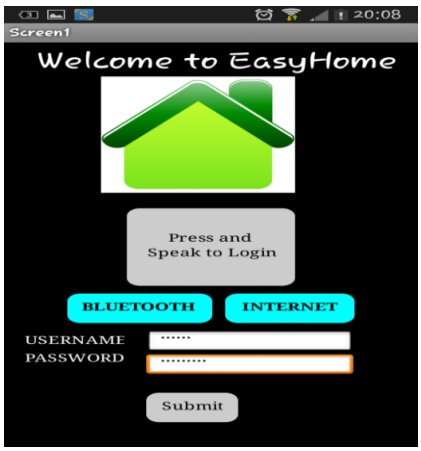

(b)

(c)

(d)

Figure 4: Screenshots of Android App (a) User login screen (b) Bluetooth or Internet access screen (c) Bluetooth screen (d) Internet screen (NearBus)

The app designed was tested with hardware components and the results observed are as shown in Figure 4 above. Figure 4(a) shows the user login screen where the user can login through voice command or by entering the username and password. Once the voice command or the user name and password are matched with the stored data, then the options to access through internet or Bluetooth will become visible. This is shown in Figure 4(b). From here, the user can choose the communication technology depending on the conditions. If Bluetooth is chosen, then the Bluetooth screen will appear as shown in Figure 4(c). In this screen, we can enable or disable all the three sensors and thus monitor the output status of the alarm, fan and outdoor light respectively. It is important to note that the user can't monitor the status of the output loads without enabling the sensors as the sensors are in OFF state. In this case a message "Sensor is disabled" will be displayed as can be seen from Figure 4(c). Meanwhile, user can also control the indoor light from this screen. There is also internet enable icon from where the user can enable the internet access. Note that the internet command will be send to the microcontroller through Bluetooth hence, the user have to ensure that they enable the internet icon before leaving home in order to control their home remotely through internet. Only through this, the user can access to the NearBus webpage and hence perform the controlling of the three sensors and indoor light. As for now, through internet, the user can only control the sensors but can't monitor the status of the output load.

VIII. Conclusion

After testing and validations, it is concluded that the android app is able to communicate with the hardware components without any obstacles. The controlling and monitoring tasks are performed within microseconds upon receiving the command from the app. However, the user can only control the sensors but unable to monitor the status of the output loads when using internet communication. Hence as the future work, the monitoring part can be included into the design system for further enhancements.

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