

# Smart City using Ubiquitous Computing

**Yasmin R. Shaikh**

*UG Student*

*Department of Computer Engineering  
Sanghavi College of Engineering, Nashik*

**Tanaya D. Jadhav**

*UG Student*

*Department of Computer Engineering  
Sanghavi College of Engineering, Nashik*

**Ritu P. Shejawalkar**

*UG Student*

*Department of Computer Engineering  
Sanghavi College of Engineering, Nashik*

**Kiran G. Deshmukh**

*UG Student*

*Department of Computer Engineering  
Sanghavi College of Engineering, Nashik*

**Prof. Puspendu Biswas**

*Head of Department*

*Department of Computer Engineering  
Sanghavi College of Engineering, Nashik*

## Abstract

This study aims to develop and design the system that can be used by android phone for controlling the light and water management of an urban area and also the simple home appliances via Local Area Network and internet. This system is developed by using Raspberry Pi and Relay. This system can handle upto four devices at the same time. The whole system is based on the IoT. The Raspberry Pi and Relay can be integrated with each other and perform their functions. The IoT aims at making the internet more immersive and pervasive. The IoT can always help to provide the communication, connections and internetworking in between the devices. This system is designed for developing the Smart city vision. This study can avoid the wastage of Water and Light. The communication with server permits the user to pick out the acceptable device. Now a day's due to abundant amount of advancement in wireless sensor network and other computation technologies, it is possible to provide flexible and low cost smart city automation system. Smart cities sponsor future situations where sensor extensiveness, data transfer and interchange, and information mash-up permit enhanced support of every phase of (social) life in human reimbursement.

**Keywords: Android Phone, IoT, Pubnum Cloud, Raspberry Pi, Relay, Smart City, Wi-Fi**

## I. INTRODUCTION

Now a days there is increasing the wastage of light and water. There are different ways of avoiding the wastage of water and light. Home automation can also done in different ways. There are different techniques are available such as by Radio Frequency, SMS, and Bluetooth. This system including the Raspberry Pi and Relay. Here raspberry Pi can perform the work like computer. The microcontrollers are cheaper than the computers.

Another reason is based on the OS of smartphone. On the present days the android gets more popular. By the survey the android OS have more than one billion users at present as compare to other OS like iOS/Mac OS based installed system. That's why used the Android OS than any other OS. Android OS have the large amount of demand but iOS / Windows gaining the more percentage as OS matured.

Another aspect of concern is the IoT. IoT can be used. IoT is used to connect the everyday objects like smartphone/Android phone, Internet TV, sensors or actuators to the internet where these devices are linked intelligently which enables new forms of communication between people and things, and between things themselves. The IoT is the system in which physical items are talking to each other or machine to machine communication and person to computer communication to be extended to "things". IoT is the next generation of the Internet, it's like taking a abundant leap in its ability to collect, analyze, and distribute data which ultimately we can turn into information then knowledge and finally into wisdom.

The popularity of the wireless LAN is also increasing for the communication purpose. Today all the smartphone can have the facility of wireless LAN. So here the wireless LAN can be used for accessing the internet to manage the control of all devices by android phone. The most important advantage of wireless LAN is that it can allow users to access the network access from anywhere anytime. This system is low cost and extensible.

If the study is developed for implementation, it will help home owners to save time and money. Furthermore, the study will provide more convenient ways of accessing home appliances and experience the innovation of technology to make their works easier.

### **A. Objective of the study**

This study aims to develop and design an android application that can be used, together with an android phone. Specifically. This study aims

- To design and control the light and water management system for smart city
- To design the system for the common use of home appliances
- To develop an android app for interface with the android phone and the Raspberry Pi
- To test and evaluate the functionality, accuracy and reliability of the prototype.

## **II. INTERNET OF THINGS**

The Internet of things (IoTs) can be defined as connecting the various types of objects like android phones, personal computer and Tablets to internet, which brings in very contemporary type of communication between things and people. The introduction of IoTs, the research and development of home automation are becoming popular in the recent days. So this system can be used for the developing the smart city by using an android app based on IOT. Many of the devices are controlled and monitored for helps the human being. Additionally various wireless technologies help in connecting from remote places to improve the intelligence of home environment. An advanced network of IoT is being formed when a human being is in need of connecting with other things. IoTs technology is used to come in with innovative idea and great growth for smart homes to improve the living standards of life.

### **A. IoT Architecture**

The IoT project aims to bring out the various opportunities of using IPv6 and other related standards to overcome the disadvantages using of the Internet of Things. The IoT-based architecture provides high-level flexibility at the communication and information. It is an approach which is relevant in many different environments such as patient monitoring system, security, traffic signal control, water management, light management or controlling various applications. The IoT projects proves a dominant and thorough study of all sensible functionalities, mechanisms and various protocols that can be used for building IoT architectures however interconnections may occur between all totally different IoT applications.

In the networking field, where many solutions emerged at his infancy to leave place to a common model, the TCP/IP protocol suite, the emergence of a common reference model for the IoT domain and the identification of reference architectures can lead to a faster, more focused development and an exponential increase of IoT-related solutions. These solutions can provide a strategic advantage to mature economies, as new business models can leverage those technological solutions providing room for economic development.

## **III. LITERATURE SURVEY**

In this section, the different studies are referred by the proponents from local author's research and foreign countries authors. The studies can provided an idea and also knowledge that helped to develop the most helpful proposed system. From the analyzation of that studies, he proponents were able to construct the well system. On the review of the studies, it can be summarized that the existing system can be used only for Home Automation only. The existing system can be based on Bluetooth and Zigbee.

The existing system can be used only for limited area. The In recent years home automation popularity has been increasing mainly because of its simplicity through smartphone connectivity and higher affordability. In home automation system various electrical devices in a house interacts with each other by use of the information technology to increase energy proficiency and security. And also there are some problems with this system like complexity, high competition with other vendors, incompatible standards and high expense which results to this home automation system is limited to wealthy or ambitious users only.

In past home automation, a network topology is made up of sensor nodes for data collection and transmission and servers or gateways for information collection and analysis and the relationship between a sensor and an actuator was defined clearly. In one study researcher introduce home automation system based on Bluetooth, that using Android Smart phones. The devices that we used to access and control is physically connected to a Bluetooth controller. The Smart phone is then connected to it by using in-build Bluetooth connectivity which control that devices.

Using the Internet as medium is most common because it does not have distance limitations unlike Bluetooth or infrared. Also, the Internet is more reliable than GSM and it has a lower latency too. Using phones as input device are more common because of its portability and availability. Combining information from analyzed related studies, the proponents decided to use Arduino microcontroller as the main control unit, the Internet as the medium and a smartphone as the input device. The proponents also decided to develop an Android application to provide a more user-friendly system.

These system can provide the services to the whole city not only for the limited area. So, the proponents can develop this system for users. The system is in very low cost so anyone can use that system. It is also user friendly.

## IV. PROPOSED SYSTEM

### A. System Design

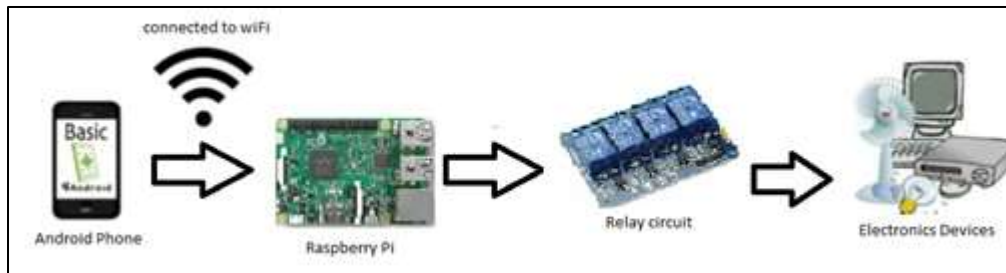


Fig. 1: Components of system

The components in the system are as follows:

### B. Android OS

Android is a software made for mobile application. The android OS is based on Linux kernel. The Android OS is developed by Google. The Android OS is written in Java(UI), C(core), C++. The Android SDK provides the tools and APIs necessary to begin developing applications on the Android platform using the Java programming language.

### C. Mobile Application

A mobile application is commonly known as an app. It is a type of application software. It is designed to run on mobile devices such as smartphones, tablets. The mobile application can serve to give users with similar services to those accessed on PCs. It varies from simple application to sophisticated application that contains a lot of functions. In order to develop an application, an Integrated Development Environment (IDE) is necessary.

### D. Raspberry Pi

The Raspberry Pi is as shown in Fig. 2. The Raspberry Pi is a low-cost credit card-sized single-board computer developed by the Raspberry Pi Foundation. The Raspberry Pi is controlled by a modified version of Debian Linux optimized for the ARM architecture. The core of the home automation system is this minicomputer. Here we are using model 3. The setting up of Raspi consists of selecting the Raspbian OS from a prebuilt SD card. The prebuilt SD card consists of Raspbian, Arclinux, Pidora, OpenELEC, and Risc OS operating systems. After the OS selection, we need to configure the Raspberry Pi using the Raspi-config command. We can enter into the Raspi desktop using the start command.



Fig. 2: Raspberry Pi

## V. 4-CHANNEL RELAY MODULE

A relay functions as a switch that has the capability of switching multiple circuits which can either be individually, simultaneously, or in sequence. The proponents used a 4-channel relay (shown in Figure 3) to accommodate 4 output devices. Arduino Ethernet's output pins are connected to each of the input pins of the relay module.



Fig. 3: 4-Channel Relay

## VI. DESIGN CONSIDERATION

A relay functions as switch that has the capability of switching multiple circuits which can either be separately, on the same time, or in sequence. The proponents used an 4-channel relay (shown in Figure 3) to accommodate 4 output devices.

### A. Problem identification and objective statement

The study started upon the assent of the thesis adviser and the completion of the academic year requirements. Both are together with the adviser, the proponents ensure that multiple goals are explicitly considered throughout the process, provide a common vision and come up with the topic and concept of the chosen system. After setting the objectives, the proponents identified the problems that exist and prioritize the problems identified. The proponents then established the desired output and then set the objectives of the study.

### B. Definition of scopes and limitations

The proponents discussed and completed the idea of the system during the development process. The proponents planned and established all the details of the system and prototype such as the components to be used to integrate to the elements. All of these are gathered from the different studies and literatures.

### C. Hardware and Mobile Application Initial Development

This phase specially focused on the development of hardware and mobile application

#### Hardware

For the hardware part, it includes the construction of the relay circuit. From the output pins of the Raspberry Pi board, the proponents connect it to the input pins of the relay circuit. Then they connect each channel of the relay to a multipower supply system.

#### a) Raspberry Pi Board

The proponents program a raspberry Pi because it is just like a programming computer. Proponents can use the Linux API to run the program. Once the program is running on the monitor the inputs are given by the application are going to the relay circuit.

#### b) Relay Circuit

Figure 4 shows the schematic diagram of a relay channel. In the prototype, the relay circuit used is active LOW which means each relay needs GND or 0V to switch. During Raspberry Pi's boot/reset sequence, each digital pin is at HIGH state which will switch the relay if it is not active LOW which will cause problems when a power outage happens and then comes back quickly.

#### c) Software

For the software part proponents wrote the code on Raspberry Pi board works like a programming computer on which Linux OS is working. It can determine the states of an output device in relay circuit. The mobile application can be developed for controlling the system.

#### d) Android application Development

The Android application of the system includes two activities. The first one is for password purposes and another for the main program. In the main program there are for activities for controlling purpose.

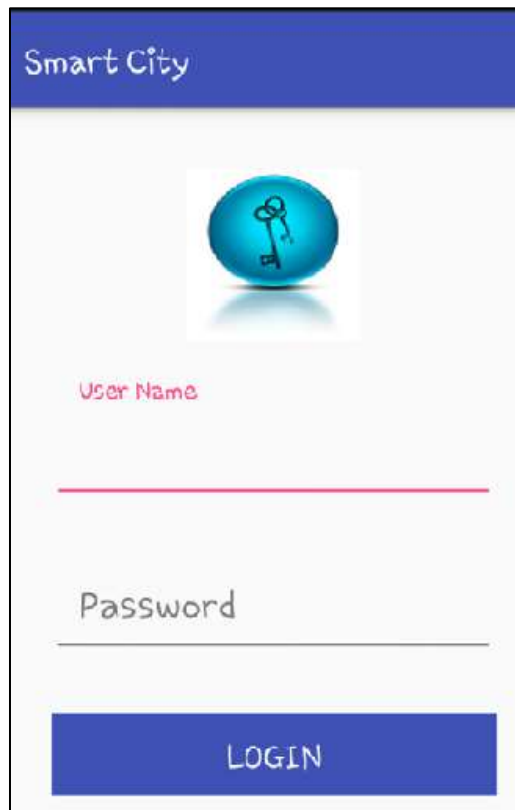


Fig. 4: Login Activity

Figure 4 shows the starting activity of the application. The user is being requested to input the password and username to access the main program. When the application is first installed the initial password is the default password. The proponents also added a feature for logout.

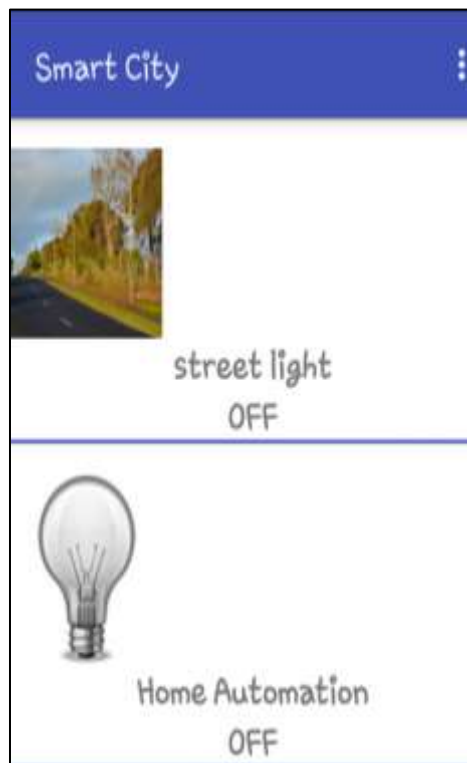


Fig. 6: Main Activity

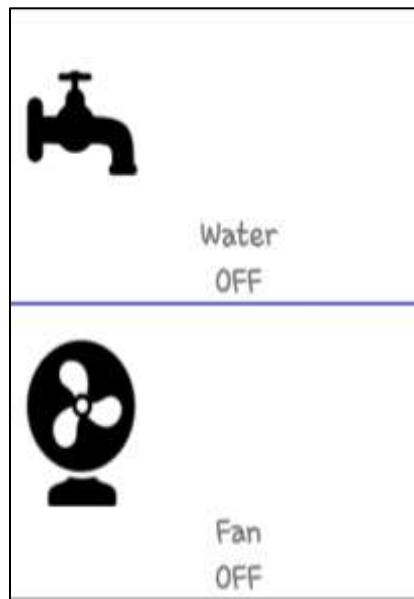


Fig. 7: Main Activity

The Fig., 6 & 7 shows the main activity program. In the main activity the user can select the option. If user wants to switch on or Off the fan and light of home then he/she can click on the icon Fan and Home Automation. If user want to switch on or Off the street light which are only controlled by authenticated user.

**D. System initial tests and evaluations**

An initial series of tests were conducted to determine if the system passed the required specifications. The proponents encountered different problems such as bugs on the mobile application. Those problems were evaluated and listed to prepare the system for finalization.

**E. Prototype and mobile application finalization**

Problems stated above were given solution. At the same time, the proponents add finishing touches to the design of the hardware and to user interface and appearance of the android application developed.

**F. System final tests and evaluations**

Finally, the system was tested and evaluated one last time to ensure that all the required specifications are met. The prototype was first tested its LAN mode and determine if every channel in the relay is working. Each mode latency is tabulated to determine if there is a delay with the switching of the output devices.

**VII.EXPERIMENTS AND ANALYSIS OF REPORTS**

For analyzed and tested the proponents can tested the results and make flow chart of it

Legend

- 0-Off or Failed
- 1-On or successful

**A. Connection functionality testing**

Internet connectivity of the user that will be used is vital part of the system. Absence of it , all functions of the system will become useless.

Table – 1  
System functionality test

Test	Expected Output	Actual output	Remarks
1	1	0	Failed
2	1	1	Successful
3	1	1	Successful
4	1	1	Successful
5	1	1	Successful
6	1	1	Successful
7	1	1	Successful

8	1	1	Successful
9	1	1	Successful
10	1	1	Successful
11	1	1	Successful
12	1	1	Successful
13	1	1	Successful
14	1	1	Successful
15	1	1	Successful
16	1	1	Successful
17	1	1	Successful
18	1	1	Successful
19	1	1	Successful
20	1	1	Successful

Table 1 shows the functionality test of the system via Wi-Fi and internet connection. The proponents conducted twenty (20) trials in which the expected output is the same as the actual test except during the first test. That first test is analyzed and it was found out that the cause of failure is due to initialization of the router since the proponents tested immediately after it was powered on. In due course, it is recommended to test the functionality of the system with at least 10 seconds delay for initialization purposes. Therefore, in functionality test, 95% successful tests were achieved and it was proven adequate.

### B. Hardware Functionality Testing

Hardware component of the system (Raspberry Pi, Relay Circuit) should be functional to carry out their respective task for the system.

Table – 2  
Test on functionality of the system (Hardware)

Test	Expected Output	Actual output	Remarks
1	1	1	Successful
2	1	1	Successful
3	1	1	Successful
4	1	1	Successful
5	1	1	Successful
6	1	1	Successful
7	1	1	Successful
8	1	1	Successful
9	1	1	Successful
10	1	1	Successful
11	1	1	Successful
12	1	1	Successful
13	1	1	Successful
14	1	1	Successful
15	1	1	Successful
16	1	1	Successful
17	1	1	Successful
18	1	1	Successful
19	1	1	Successful
20	1	1	Successful

Table 2 shows the functionality of the system hardware components. In twenty (20) trials that the proponents conducted, the result shows that the components work properly together 100% of the time during the tests.

## VIII. CONCLUSION

The system proposed in this paper is we analyzed the solutions currently available for the implementation of urban IoTs. we make an application for smart city development. It increases the Life quality of the human being. The home devices, street lights, water supply can be controlled by this system. The wastage of water and light can be manage by the application. The enabling technologies, furthermore, have reached a level of maturity that allowS for the practical realization of IoT solutions and services, starting from field trials that will hopefully help clear the uncertainty that still prevents a massive adoption of the IoT paradigm. The reliability of the system is the summary of its functionality and accuracy. According to the reliability results, the proposed system which uses Android phone, Wi-Fi connection is enogh in overall.

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