

State Dependency to Optimize Access of Home Appliances using Remote Control

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Abstract

Internet of Things (IoT) is a combination of hardware and software technology that produces trillions of data by connecting multiple devices and sensors with the cloud and computing and accessing the required data through intelligent means of connecting and utilizing various tools. With numerous connected devices and appliances, the smart home is one of the emphasized areas of IoT. Smart home concept deals with inter connecting the working of multiple devices using IoT. In view of this, multiple home appliances are operated using the common remote controller access. When IoT devices are meant to operate based on remote control there is an immense role of identifying the state dependencies of various devices. If one device is in ON state, then it will show the status of other devices also whether to be in ON state or OFF state or choice of none of devices to be in state of ON or OFF. Till now, state dependencies of devices in home appliances are manually identified. Therefore, in order to control devices of home appliances with in a precise location, a design issue based on identification of state dependencies by using graph matrices for multiple devices can be made for better utilization to save energy and also to restrict the unnecessary access of devices.

Keywords: Intuitive control; iot; graph matrices; remote control.

1. Introduction

IOT is an innovation that associates constantly on things and the web in place will accomplish those results over a smarter route. Toward incorporating brainpower for identifying devices, IoT need been generally connected On Different fields similar to advanced smart homes [5], keen agribusiness [6] and advanced mobile therapeutic analysis [7] and so on. . Those requisition about sensors to advanced mobile homes fuse brilliance under home zones for ease, safety, security, healthcare, and vitality preservation. The requirement to solace and a helpful an aggregation will be particularly significant done advanced mobile homes. Thus, home mechanization [8] will be a standout amongst those the vast majority significant What's more basic parts to those IoT-based keen home engineering. Home mechanization frameworks need aid used to control home gadgets alternately appliances done advanced mobile homes What's more give programmed remote control [9] inside or outside the homes. In spite of the fact that remote control gives accommodation Also straightforwardness about use, exactly real issues require thought Furthermore improvement, for example, such that how will gatherings give an natural Also easy to understand remote control plan on IoT-based keen homes. A portion future purchaser requisitions imagined for IoT heartless such as science fiction, Yet a portion of the a greater amount useful Also reasonable sounder possibilities for those engineering organization that include: getting warnings ahead your telephone or might be wearable gadget At IoT networks recognize a portion physical risk will be distinguished close-by or self-parking automobiles Also programmed requesting from claiming groceries Also other home supplies, programmed following about practice propensities Also different normal individual action including

objective following Also general Advance reports. It is produced apparent that The greater part of the units associated In IoT innovation have will fill in view of different states. Also each state change necessity will make identifier in place to purpose the clash from claiming operations. The point of the present outline methodology will be should create state reliance ID number about multi-purpose remote control framework for home appliances.

2. Literature Review

In the study carried out by Ali Ziya Alkar [1] a design of low cost, flexible, wireless solution to the home automation was proposed. The study is about the migration of initial control mechanism of devices with simple functionality to more complex devices.

Vaishnavi S. Gunge [2] proposed the android based smart home application communicates with the Raspberry pi via an internet. Using android application user can control and monitor the home appliances. A system can be used to communicate to a number of devices. It is used to minimize wastage of electricity and less time consuming.

In the work done by Prof. R.S. Suryavanshi [3] an approach is carried out in which a model of Home Automation System using Android and WIFI technology which really offers easy and really much awaited Home Automation System(HAS) was implemented. In the study of Lisa Mohur [4] the main objective considered is to design GSM based electrical appliances and also accessing its performance is modeled. They used devices like fan, light, buzzer etc. All electronic circuits have been simulated by protease and implemented in bread board.

3. Proposed System

In most of the existing systems of IoT home appliances, multiple devices are interconnected over an Arduino board or Raspberry are observed to be connected based on the manual trial-and-error method of connection establishment. In the proposed work, compatibility of connections adopted is assessed and then connections are given over the board based on the design issues considered at early stages.

In this context, it is essential to know in prior what kind of appliances are interconnected and what is the need to assess compatibility? To address these questions, a heuristic based compatibility is considered in the usage of multiple commonly used home appliances like fans, lights etc.

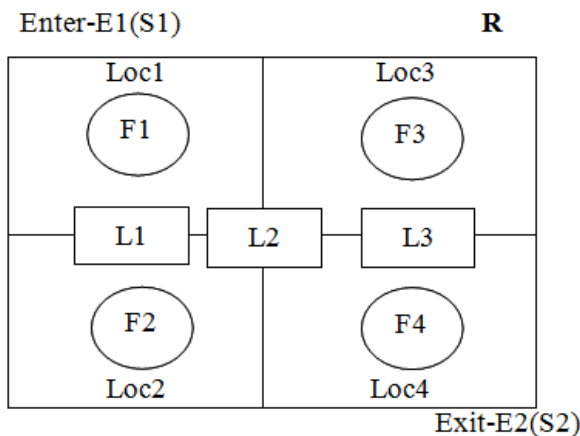


Fig. 1. Architecture of a Room(R).

In our proposed work multiple fans and multiple lights compatibility is verified. It may happen that in a work place when many people need to occupy their places and are expected to float frequently, there will not be proper fixed use of lights and fans being used. For instance, consider a room in which multiple fans and lights are existing. The count of humans enter and exit the room will specify the need of how many fans and lights to be used in that area and our design helps to restrict the use of lights and fans depending on the occupancy of the room.

As per the proposed work, we considered a room R which is marked to make into four locations L1, L2, L3 and L4 as shown in Fig.1 with 4 fans F1, F2, F3 and F4 respectively and 3 lights notated as L1, L2 and L3. Room will have two doors one to Enter through E1 and other to Exit, E2. There are two Pyroelectric Infrared (PIR) sensors S1, S2, one is at the entrance and other is at the exit respectively to increment the count of persons who enter and exit the room. Locations can be divided based on the fixation of fans and lights in a room. As per the design issues considered, the following table Table1. Specifies the seating capacity for each of the locations specified.

Table 1. Estimated Seating Capacity in each location

Location	Seating Capacity
Loc1	4
Loc2	5
Loc3	3
Loc4	6

In view of the scenario of persons entering the room, persons need to occupy the seats according to the chart shown i.e., they have to occupy other location only after filling the first location. When persons are seated in location1 then fan1 and light1 will be in ON state, other fans and lights will be in OFF state. Even if they try to ON also they won't work as there are no persons in other location, remote doesn't have access to other fans and lights.

Table 2. Compatibility map of states to access the appliances

Appliances	L1	L2	L3
F1	Loc1		
F2	Loc2		
F3		Occupancy seating capacity	Loc3
F4			Loc4

According to the arrangement of lights and fans in the room, a compatibility map of states to access the appliances can be designed and made available in the room by sticking it near the switch board. The compatibility to access the devices considered in the design are shown in Table2. According to the above map, if persons are seated in Loc1, then F1 and L1 will be in ON state. If persons are seated in Loc2, then F2 and L1 will be in ON state. If persons are seated in Loc3, then F3 and L3 will be in ON state. If persons are seated in Loc4, then F4 and L3 will be in ON state.

From the above stated map, the device utilization of (F1,L2), (F1,L3), (F2,L2), (F2,L3), (F3,L1), (F4,L1), (F4,L2) is highly reduced out of twelve possibilities to access the appliances, which means 58% of utilization of appliances and power can be saved. A special consideration in the above stated map is the utilization of (F3, L2). In some situations, it is possible that the number of persons in the room may exceed the seating capacity for all the four locations. In our consideration, the estimated seating capacity in the room is eighteen. But, some additional chairs could be added which results in the increase of seating capacity. Then (F3, L2) can be used which is the extreme case of the design. In this situation, it may happen that the design may not be restricted to benefit more. However, in a room where floating audience are expected is negligible to meet this special consideration.

A. Remote Control Operations based on the Map

The key design issue of the proposed work is to access the appliances by using a remote control device, once the state map is well defined. When a remote control is used all the states need to be accessed based on the buttons available in it. In the proposed work, a user defined button access remote control is proposed to use in a Bluetooth smart mobile device. The operation of buttons is as shown in Table3.

Table3: Control operation of remote control based on state dependency.

Appliance	F1	F2	F3	F4	L1	L2	L3
F1	-	D	D	D	S1	D	D
F2	D	-	D	D	S2	D	D
F3	D	D	-	D	D	S5	S3
F4	D	D	D	-	D	D	S4
L1	S1	S2	D	D	-	D	D
L2	D	D	S5	D	D	-	D
L3	D	D	S3	S4	D	D	-

*D-Disabled, S-State

The possible operations depending on the states are:

- 1) When the persons are in Loc1, except (F1, L1) all other states are disabled. Hence, only
- 2) When the persons are in Loc2, except (F2, L1) all other states are disabled.
- 3) When the persons are in Loc3, except (F3, L3) all other states are disabled.
- 4) When the persons are in Loc4, except (F4, L3) all other states are disabled.
- 5) When the number of persons in the room is exceeding the estimated seating capacity of eighteen, then (F3, L2) can be enabled.

For instance, if a room R contains seven persons then the following states are determined.

Table4: Lights to be in ON/OFF state based on seven persons entered.

Location	Fan to be in ON /OFF state	Light to be in ON /OFF state
Loc1	F1-ON	L1-ON
Loc2	F2-ON	L1-ON
Loc3	F3-OFF	L3-OFF
Loc4	F4-OFF	L3-OFF

A scenario of 7 persons entering a room is considered in which the location map as shown in Table4, the persons need tom occupy their positions i.e., four persons will be seated in Loc1 and remaining persons will be seated in Loc2.Then F1,F2 and L1 will be in ON state and remaining will be in OFF state.

Another design consideration is that in case if opposite gender people are populated in a room R, then for convenience two locations are enabled.

4. State Dependency and Finite State Machine Representation

The above mentioned control operations are represented in the form of a state matrix where 1 represents enabled state, 0 represents disabled state and X represents indeterminate state as shown in table5.

Table5: State matrix for remote control operation

Appliances	F1	F2	F3	F4	L1	L2	L3
F1	X	0	0	0	1	0	0
F2	0	X	0	0	1	0	0
F3	0	0	X	0	0	1	1
F4	0	0	0	X	0	0	1
L1	1	1	0	0	X	0	0
L2	0	0	1	0	0	X	0
L3	0	0	1	1	0	0	X

Also, for proper identification of repeat operations a state graph is represented to identify any loops in operations. The state graph is as shown in Fig. 2.

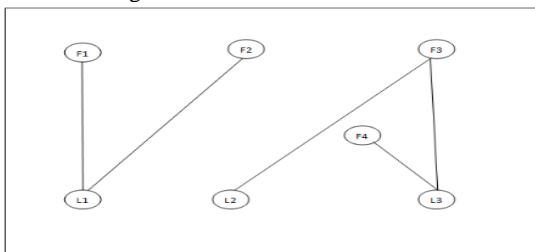


Fig. 2. State graph for remote control operations.

As if no loops are identified it is clear that there are no repeat operations which raise the computational cost of connection establishment on a board.

5. Hardware Requirement and Circuit Diagram

Arduino Uno [11]: Fig. 3. Arduino is an open source physical processing hardware which is based on a micro controller board and an incorporated development environment for the board to be programmed. Arduino can run on any platform that includes windows Linux operating systems etc. Arduino is used to develop an interactive interface, get inputs from a diverse collection of switches as well as sensors and simultaneously control the output from various physical devices including lights, fans and other appliances. The reason for choosing Arduino UNO is due to the reason that it is less expensive, compatible with all the operating systems like Windows, Linux and easy to program, allows easy and fast prototyping where there are a number of pre-wiring and

free code libraries which help to test an idea instead of spending time in building and creating an excessive amount of low level codes.



Fig. 3. Arduino Uno

Bluetooth Module[12]: Fig. 4. Bluetooth is the most common and popular technology available in almost all electronic gadgets around the world. It includes PDA, cell phones, laptops, iPods and other devices. Bluetooth is a wireless connection and is good substitution that uses wires. According to official Bluetooth website, the communication via Bluetooth can be a point to point or multi point connection. Security is a important aspect while performing a wireless transmission and Bluetooth guarantees the security. Advantage of Bluetooth usage includes cost-efficiency, ease of use, less complexity and less consumption of energy. Bluetooth provides a good platform as it is readily available in almost all the smart phones which are present in the market today and is easy to understand and use this provides flexibility to people of all ages to use Bluetooth in a handy manner. Arduino UNO cannot communicate with the android devices on its own hence Bluetooth module is implemented.

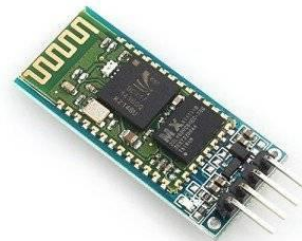


Fig. 4. Bluetooth module

PIR Sensor [13]: Fig. 5. PIR sensor detects a human being moving around within approximately 10m from the sensor. This is an average value, as the actual detection range is between 5m and 12m. In the proposed model we consider two PIR sensors S1 and S2 which are placed at Enter and Exit doors respectively



Fig. 5. PIR sensor

5v Dc Power Supply: Dc power supply is one that supplies a constant dc voltage to its load depending on its design a dc power may be powered from an Ac source or Dc source such as power mains. A power supply is a electrical device that supplies an

electrical power to an electrical load. The primary function of the power supply is to convert electric current from a source to the correct voltage and frequency to the power load.

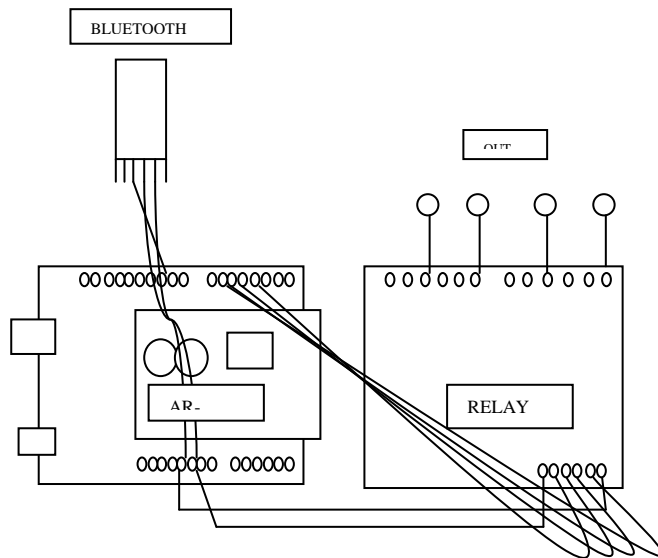


Fig. 3. Connection diagram

6. Conclusion

It is essential to identify the dependency of operations performed to access home appliances to reduce the utilization of devices, power consumption and also to provide ease of access. A simple design objective is proposed to address the issues stated above by in view of the states and dependencies of operations. Ease of access is provided by the use of remote control operations. This proposed method uses a state matrix and a state graph to identify the dependencies. The design process of device access in a specified location of a room is considered and the use of home appliances like fans and lights are depicted in the form of a room map and access control. It is clear form of the design perspective to meet the objectives required. The design is proposed to reduce 42% of device usage by following the stated design issues. Also, the hardware required to implement the design is identified to be a blue tooth access of mobile remote control. The required hardware in order to sit the design issues is also specified. The future work can be extended to implement the current design and compare the results with the existing works.

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