Real-Time Simulation of IoT Based Smart Home System and Services Using RFID

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Abstract

IoT plays a remarkable role in human life, By using the services of IoT, workload and pressure on human life is decreasing. As the use of IoT in smart homes and smart societies can change the lifestyle of humans, it can also play a vital role to save human life. Human life is a significant factor that is always ignored by human itself. Anything in this world cannot replace the life of any human. In this paper, we are going to facilitate our users with the smart home. For example, the tap water remains open and little children play freely in home so there could be a chance of drawing up of that child but using IoT we can inform the users that their tap is open, when the Gas cylinder leaks then IoT can also inform users about the leakage of gas and so on. We simulate the IoT based architecture diagram in Porteous simulator. These new IoT concepts in smart homes can be applied along with RFID technologies. This technology provides us with benefits in terms of cost to save human life, energy consumption, and complexity. Many smart home use cases such as water taps, washing machine, kitchen, gas cylinder,and so on, are described in examples that make use of this system. The RFID reader reads the information from home devices and sends the information to the Android device so that users can play more smartly in homes and human efforts reduce more precisely.

Keyword: Smart Civilization, Smart Homes, Internet of Things & RFID, GSM, Arduino UNO

1 Introduction

Smart home technology utilizes apparatus linked for the Internet of Thing (IoT) to automate and track home techniques. It stands out for self-monitoring identification and reporting technologies. The technology was initially created by IBM and has been known for predictive collapse investigation. The very first modern smart home technology goods became open to shoppers amongst 1998 along with the Ancient 2000s. Smart house technology permits users to command and track their connected home apparatus from wise residence programs, smart-phones, or alternative networked apparatus. Users may control linked house processes if they are dwelling or are even away. That enables more effective electricity and electrical usage as nicely as ensuring that the house is not secure. Smart house technology leads to wellness along with well-being enhancement by adapting individuals who have unique wants, especially elderly Men and women. The smart house technology is presently used to create wise metropolitan

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areas. An intelligent city acts such as an intelligent residence, precisely where systems have been tracked to a lot more efficiently operate on the metropolitan areas and spend less [1].

Some devices at the lower end of the proposed capabilities use the existent smart home systems [2]. Typically, these devices can respond to the user's command by using a computer, tablets, and smartphones that store data by using Wi-Fi or Bluetooth. IoT carries a new method of home management, intelligence, surveillance, integration of devices also the connectivity of these devices. In these devices, intelligence may be embedded completely, this could be within a platform where all devices connect to perform some functions, or it can be combined in the platform by using the cloud. Therefore, devices in the smart home can provide enhanced benefits and include the capabilities inherent in the IoT [3]. These devices can be a static object such as lights, smart plugs and a sensor that can measure the status and physical condition of the objects, in these sensors we have actuators that can perform several operations for example; turning on/off the appliance and opening doors. Both services can be combined using several devices [4]. Also, Data and information on smart home devices can be integrated with external data and information from other IoT systems. In the example, it shows the value-added services like the health care system [5].

RFID Systems with TWN4 is an RFID/NFC reader unit supporting all the conventional RFID technologies for 13.56 MHz 134.2 KHz, and 125 KHz frequencies are packed in a 31x17.8x2.5mm footprint. It provides easy placement on the main board with the component mounted to one side. In this latest version, all pins are already soldered that will support easy implementation and quicker working. This RFID reader is more suitable for working in industrial and mobile applications due to the small size, and with the verity of external antenna options also it supports expanded temperature range. For communication with smart phones, this RFID reader and NFC is making it a healthy choice for applications [6]. From the 13.56MHz RFID platform, the reader needs to boot clock, electricity, and info for the RFID label. Power distribution into the length of the label of blanking sign periods is simply 2-3ua s. Thus, standers utilize compacted information PPM, NRZ, and altered miller. The transmitter blended provider indicates having compressed electronic information. The blended signal will be routed into the label, and the affiliated RFID chip reacts with all the requested advice, like an identification quantity or date. It was not until coming mixed signal which the label is still working out. For increased efficacy and low energy intake; info move out of RFID label into this reader employs load modulation together with all the sub-carrier [7]. Even the sub-carrier frequency is significantly different by the criteria. By employing different coded information, the modulation used by sub-carrier is going to be worked. This sub-carrier is going to be gotten by a binary branch of this company frequency. To modify the loading immunity, adjuster controlled using the sub-carrier sign can be utilized. After creating the frequency spectrum created the main benefit of modulation using sub-carrier gets evident [8].

Arduino is an open-source, hardware and applications corporation, user and project network which models and produces single-board micro-controllers and micro-controller fittings to digital construction apparatus and interactive items which may control and sense both digitally and physically. Arduino boards can be bought commercially from a pre-assembled sort

or as homemade fittings [9]. Arduino board layouts work with an assortment of microprocessors and controls.

The boards have been built with collections of analog and digital input/output (I/O) hooks which could be interfaced to several enlargement boards or breadboards along with also other circuits. The boards comprise sequential communications ports, which include Universal Serial Bus (USB) on a few types, that can be additionally utilized for loading apps out of computers. Even the micro-controllers are on average programmed with a dialect of characteristics from programming languages and C++. Besides using current compiler tool chains, the Arduino endeavor supplies a development environment (IDE) dependent around the Processing terminology undertaking [10].

From the full earth, GSM can be popular utilize digital cell anti-virus technique. GSM utilizes three leading digital radio telecommunication systems which are GSM works on 900 MHz or even 1800MHz frequency group, right after digitizing and squeezing, the GSM sends info down to a station with just two other flows of consumer data with their time slot. Together with the Development of wireless cellular telecommunications, GSM performs a critical section along with different technologies which have normal packet radio process High speed Circuit-Switched Data (HSCSD), Universal Mobile Telecommunications Assistance (UMTS) and Improved Data GSM Environment (EDGE) [11].

2 Literature Review

The internet of things (IoT) was recognized in many softwares throughout different domain names, like inside the medical industry. IoT continues to be known because of its revolution in simplifying new health together with long-term wide-range possibilities, for example, economic, technical,and societal. This analysis intends to set up IoT-based sensible home-security solutions to real life wellness tracking engineering in telemedicine structure. A multi-layer taxonomy is now driven and ran inside this review. At the very first coating, a comprehensive study on telemedicine, that centers upon the customer and host components, exhibits the other studies related to IoT-based sensible dwelling software have many limits that continue to be unaddressed. Mainly, distant patient tracking healthcare software introduces various centers and rewards by embracing IoT-based sensible dwelling technologies without undermining the stability conditions along with a potentially high quantity of dangers.

A comprehensive investigation will be executed to spot posts that cope with such topics, linked software will be reviewed, and a coherent taxonomy for those content is created. Afterward, the content articles predicated on IoT scientific tests which are connected using telemedicine software are all filtered. Six posts are chosen and categorized to just two classes. The first class that balances for 22.22% (n =2/9) comprises polls on telemedicine posts along with also their programs. The next group that accounts for 77.78% (n =7/9) comprises posts about the customer and host components of telemedicine structure. The accumulated studies show the critical necessity of building a second taxonomy coating and examine IoT-based sensible home-security research workers [12].

Even the current differences and tendencies within this region need to be researched to present invaluable fantasies for specialized surroundings as well as research workers. So, 67 content is got from the subsequent coating of the taxonomy and so are categorized into 6 classes. From the first class, 25.37% (n =17/67) of these content concentrate on the design layout. From the next group, 17.91% (n =12/67) comprises safety evaluation posts that explore the study area at the safety field of IoT-based smart house software. From the fourth group, 17.91% (n =12/67) includes safety evaluation. From the category, 13.43% (n =9/67) investigations safety protocols. From the closing group, 14.92% (n =10/67) diagnoses the safety frame [12].

Smart homes may employ new Internet of Things theories together side RFID systems for producing omnipresent products and services. This paper presents a book read out a system to get a wireless Master Slave RFID reader design of multi-standard NFC (Near Field Communication) and UHF (Ultra High Frequency) systems to construct a wiser dwelling service technique which benefits regarding expenditure, electricity intake, and sophistication. Many sensible dwelling service usage cases like washing machines, shopping, cooking, along with older wellness treatment are clarified as illustrations which use this system [13]. In this paper, an IoT-based sensible household process is constructed,which is made up of various subsystems demanded to get an intelligent residence. All these subsystems are vital parameters tracking together with attentive, security devices, power keeping approach, electric machine controller, and tracking platform. An in-depth study was accomplished to come across the proper components and applications tools to match the absolute essentials of the wise residence. Basic safety is just one among the significant factors for IoT app that continues to be addressed utilizing a protected cloud system that offers that the authentication is working with the login ID and password management technique. This newspaper suggests a comfortable, productive,and robust structure [14].

Home-automation established IoT is adaptable and hot software. In-house automation, most all dwelling appliances are all networked with each other and equipped to use with no human participation. Home-automation supplies a substantial shift in humans' life that presents smart functioning of appliances [15]. Which prompted us to build up a brand-new method which controls several appliances for the home such as lighting, supporter, door cartons, electricity ingestion, and grade of this gas tube utilizing a variety of detectors. Such as LM35, IR detectors, LDR module, and Node MCU ESP8266, along with Arduino UNO. The suggested strategy employs the detector and finds that the existence or lack of a specific thing while in the sanity consequently. Our answer also supplies advice regarding the vitality absorbed by the home proprietor from the kind of concept [16].

This outstanding issue stipulates a new medium for content articles that review mobile IoT-based CE apparatus, programs, and programs or even research novel investigation paradigms like smart houses and bright metropolitan areas. Inside this matter, discover posts on wise home surroundings, business apparatus to the border of both IoT and user cognitive programs, and newfound solitude. The prospective audience comprises teachers, investigators, and college students that are participated in IoT-based investigation and instruction [17].

3 Smart Home Master-Slave RFID System Architecture

In master-slave architecture, several readers comprised in home such an RFID reader system architecture is introduced in this paper. Smart home environment architecture is illustrated like UHF, which is one of the RFID standard protocols between tag and reader communication protocol. The system is consisting of the following reader components [18].

A Master Reader (MR)

The master reader is either direct or wireless. A stable connection could be an ordinary active static reader into a home server. Around the wise property process, require reader providers have been completed outside however in the servant reader that it starts the scanning procedure and some other inactive tags wake-up into almost any new agency initiation or even power up. Additionally, it gathers the item-level info andfor additional processing forward it into the backend. In smart homes, for advice assistance provisioning any MR can keep in touch together with almost any different MR in between remote or regional host systems along with MRFID reader may perhaps work as a proxy as shown at "Figure 1" [18].

B Several Slave Readers (SR)

Several Slave Readers are acting as relays because capturing tag ID information of the master reader by direct radio transmission is not reachable. In home appliances, Slave Readers could be integrated; when the system knew the slave reader physical location than for the localization of tags, Slave Readers location can be used.

C Master Reader (MR)

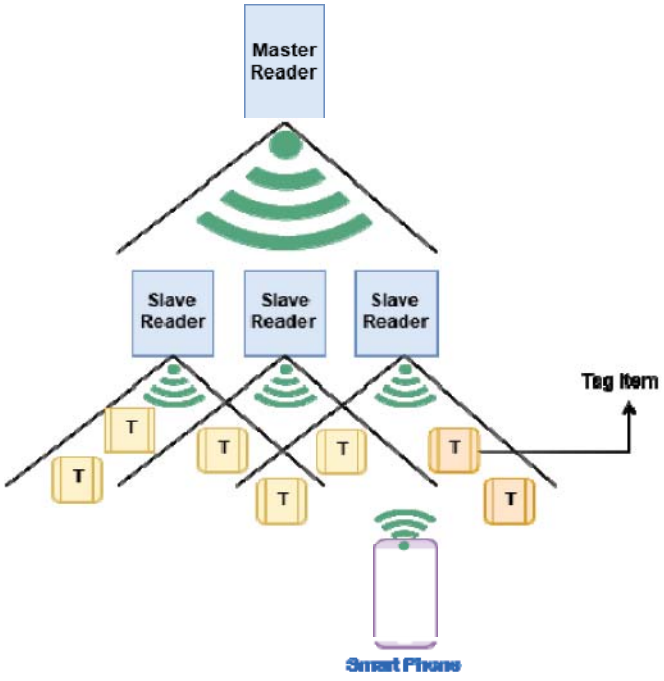

Figure 1: RFID Master-Slave Architecture Diagram

D Mobile RFID (MRFID) Reader

MRFID readers have many functionalities such as communication with remote or local servers, tag collision management, initiating the writing/reading process and waking up passive tags. These processes are very power-hungry. For 100% detection of tags, they need bigger reading window sizes depending on reading distance or human movement for MRFID reader, which implies longer active operation time. In the proposed architecture, wake up tags are energizing for operation and as "RF Energy Generator" master-slave reader act. Therefore, wakened and powered up by master or slave readers tags are always faces by MRFID reader. That is why to initiate purpose MRFID reader does not need any wake-up procedure and acts as a passive reader. For localization of tags and fault tolerance, information from tags is used. Theoretically, more responsibility could take by the slave reader in tag information processing. On the complexity and cost restrictions, slave readers intelligence is determined [18]. Also, whether mobile devices are embedding or not which capabilities of an RFID reader that can support our system from mobile devices to initiated RFID services. There can be four possibilities:

E RFID reader services for smartphones

To access RFID tag information, smart phones can be used to some extent. Communication with master-slave reader system can be done wirelessly like WLAN that is used by the mobile phone. Information about an item which is of our interest is sent through a smart phone.

F The conventional way of MRFID tag interaction and reader

In this method, as a case study user wants to know some specific item information through direct touch and with mobile RFID reader, the user equipped the information. For a small operation, this method works very well, but as mentioned earlier, with multiple, it can be mighty and time-consuming.

G MRFID reader and tag communication through master or slave reader

As a proxy master-slave system is used to communicate MRFID reader with tags. For example, to the master-slave reader, a search profile is sent by MRFID reader. Item of interest location is navigating or in the propinquity of MRFID reader, wakes up right tags is done by the master-slave reader. In the first case, the items answer (the item in proximity) and in listening mode information is consumed by MRFID reader. In this case, the mobile reader is initiated by the multiple tag collision processes; possibility to avoid power consumption is the advantage. Mobile reader delegation possibility is another benefit for the master-slave reader, as shown in "Figure 2"

H Master or slave reader as a power source

The main difference in this system acts for operation and wake-up of tags only as an RF energy source. Otherwise, between tags and MRFID reader, communication is as usual. Communication needs to be synchronized in MRFID and master-slave. So, only first MRFID reader sends a wake-up signal (step (6)). With the second wake-up call, the master-slave reader continues to tag

synchronic signal of MRFID reader first wake-up (step (7)). The ID information of tags is sent to tags (step (8)). In listen mode, information is consuming by MRFID for the navigation and automatic identification tagged.

I RFID Reader Service Communication

The identification process is initiated towards the RFID reader system through smart spaces identification service application: (1) in "Figure 2". Responsibility is taken by a master reader in radio range of its wake-up tags and slave readers in step (2). In the same way, slave readers proceed to step (3) if tags are not woken up by the first wake-up call of master readers then in their range wake-up the tags. Master reader, identification information of slave tags and readers, is sent by its own, and that is a step (4), for further processing sends to smart spaces object server finally, but before it, redundant information is collected and removes in step (5). With device identification tag MRFID tag is equipped in an optimal case that is identified automatically from master-slave reader system. For this purpose, let us take an example; when it enters a shopping section identification tag with the mobile reader from section slave or master readers, it will be detected in step (9). In smart spaces, there is navigation or localization of user of the RFID reader; such additional services are allowed by this feature. From any other information servers, external objects can query by MRFID reader in all these steps (13-16).

J Smart Home NFC and RFID Services

Smart home services are based on NFC, RFID,or both.

1) NFC services

RFID, NFC, or both can be based on smart home services. In an application like (medication and presence) shopping and care of older adults, NFC services can be used. The user makes charts of their exciting items for shopping and home appliances like shelves, fridge and so on and plugs them. For checking the availability of cooking items,users visit shelves or fridge. With an appliance, a chart of items is attached to it and loaded from it in case of missing items. It is attached to a plastic cover, or A4 paper NFC tags are charts of an array. Printed picture of items with the A4 paper is fixed on top of the plastic cover.

2) RFID based services

In this case, it is much easier to control the stack of the item, because multiple tags simultaneously can be read by UHF readers. The user opens shelves or fridge, and all items can be read by just one touch. With the cooking recipe, a stack list is controlled by shopping application and automatically generates a shopping list, and this is the combined service of NFC and RFID.

3) RFID and NFC combined services

To find items potential location,this solution helps us very well, for example; in shelf NFC tag, items with their location are associated in this case. Before putting items inside, ID of the shelf is read by mobile NFC reader. While placing it on the shelf, every item is read from NFC reader

and with this application items IDs and shelf are associated together. During search service, all items can read by an RFID reader at once and from the previous step using location context, read items can localize by the application as shown in "Figure 2".

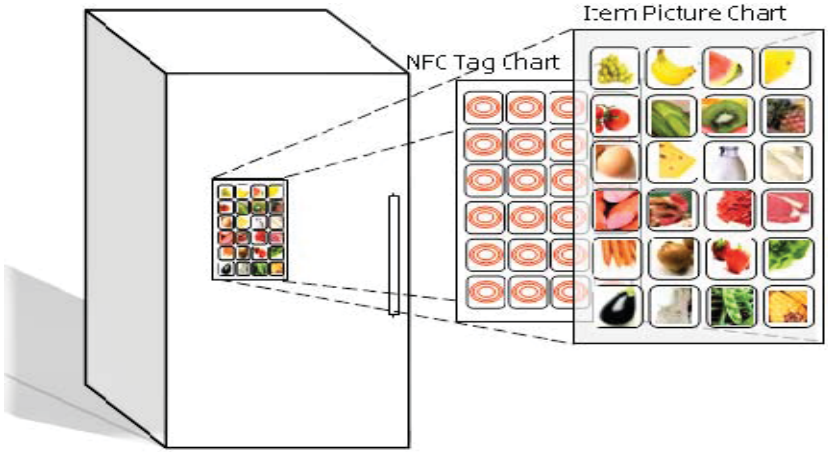

Figure 2: Fridge item chart with NFC tags[18]

4 Block Diagram for Real-Time Simulation Using RFID

In the proposed architecture diagram of the smart home system and services, we can see that our smart home devices or tag items like washing machine, air conditioner,and so on relates to the RFID reader. This reader relates to the Arduino UNO that will send the SMS that is transferred by the GSM module by using the wireless medium, this SMS or information will be sent on any Android device so users can collect the information from any tagged item in the smart home more easily and precisely as shown in the "Figure 3".

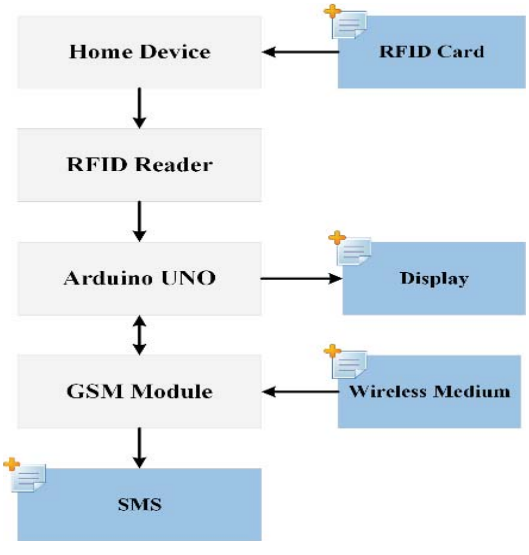

Figure 3: Architecture Diagram of smart home system and service

5 Results and Discussion

A Hardware component

1. Android Device as Virtual Terminal
2. TWN413.56MHz is an RFID/NFC reader
3. Arduino UNO
4. GSM
5. Tag Item or Home Device

B Real-time simulation using Proteus Simulator

The diagram illustrates the working of a Smart home with an RFID reader. We have used Arduino UNO with TWN4 RFID reader based on ATmega328P. Arduino UNO is a micro-controller board, it has 14 digital I/O pins, and 16 MHz clock speed whereas TWN4 RFID reader is a super small, well established and highly flexible RFID that is capable of dynamically reading a broad spectrum of radio frequencies and tags. This reader is a multi-frequency reader that nearly supports all types of transponders in one reader. It can communicate with UART (TTL, RS232), CAN, ETHERNET, USB, 12C, Clock/Data, Wiegand and SPI. We have 8 GPIO pins on TWN4 RFID reader that can directly be connected to the Arduino UNO. For Simulation, we have used the serial port where Rx is connected to the Rx of Arduino and Tx is connected to the Tx of Arduino. The circuit is shown in "Figure 4".

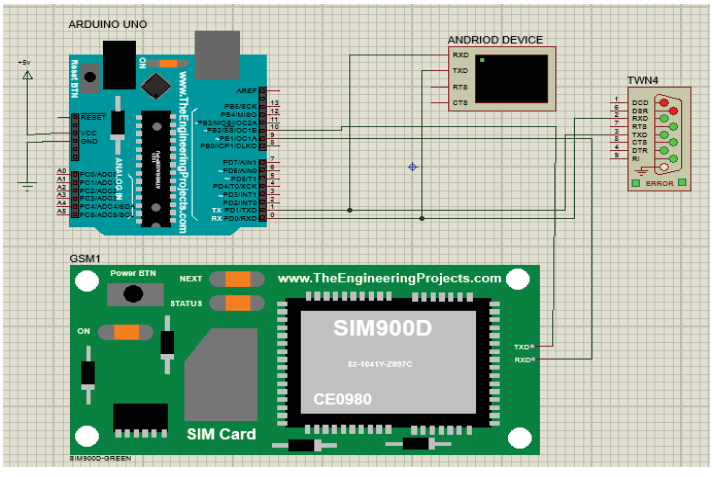

Figure 4: Simulation diagram before receiving SMS

That is a general simulation of TWN4 for washing machine, refrigerator and so on. The RFID reader is attached to Arduino, and this is attached to a specific device. When the device wants to send a message, it will use GSM to send a message to an android device. For example, RFID tags are attached to clothes that will represent the information about the material of clothes, suitable washing program and the color of the clothes. In the smart home, washing machine includes a TWN4 reader in dirty clothes container, clean clothes shelves, and the washing machine. So, this smart home application while washing clothes can monitor the number of clothes with an RFID reader and generate alarms automatically when amount of clothes reaches a specific threshold value. This machine works on energy-aware washing

program identifies the time to wash clothes and sends message to the Android device. Also, the system automatically checks if some clothes in the machine are still left dirty then the machine informs users that some clothes are still dirty. This whole result is shown in “Figure 5”.

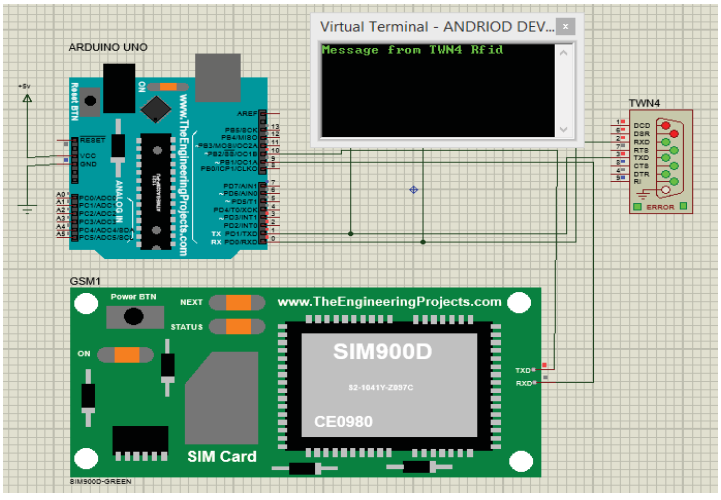

Figure 5: Simulation diagram after receiving SMS

C Use cases of IoT based smart home system and service using RFID

1) Water Tap

RFID tags can be attached to the water taps of bathroom and nay tap in the smart home; if the tap of water remains open, then this RFID reader will send SMS on the Android phones that the tap of water is open or leaked, so the user can readily do some act for this information. There could be a severe scenario that little children play freely in the home so there could be a chance that they drown in water of that child. So using IoT, we can inform users that their tap is open, by this user will be saved from a significant loss and human life could be saved.

2) Washing machine

RFID tags are attached to clothes that will represent the information about the material of clothes, suitable washing program and the color of the clothes. In the smart home washing machine includes an RFID reader in dirty clothes container, clean clothes shelves, and the washing machine. So, this smart home application in regard of washing clothes can monitor the number of clothes with an RFID reader and generates alarm automatically when amount of clothes reaches a specific threshold value. This machine works on energy-aware washing program that identifies the time to wash clothes and sends message to the Android device. Also, the system automatically checks if some clothes in the machine are still left dirty then the machine informs the users that some clothes are still dirty.

3) Kitchen

In the use case of the kitchen, we have used RFID and internet services in the cooking. It will propose a food recipe based on strong preference and other requirements like healthcare and

wellness. The tags in the oven, shelves, gas cylinder and fridge communicate with RFID reader in the kitchen. In the area of shopping, list user interacts with the server for the latest item stack situation.

4) Aquarium

There should be tags on the transparent side in every aquarium where animals or aquatic plants are kept and displayed. The information we get from the tags inside the aquarium is oxygen, food availability and water replacement.

5) Furniture

In the smart home, we can attach tags with the furniture as we can get information from them. Information could be the location of these dummy things in our home. As a man working in agencies, he needs information from all dummy things because, intelligence companies are very possessive about the unique information from all the things.

6 Conclusion and Future work

IoT predicts the interconnection between applications and humans also can interconnect billions of things by using a new way of the machine to machine communications. On behalf of the user's things can interact with each other automatically, rather than always interacting with the users. This paper is based on the technology of Smart home system using the RFID reader, which is a cost-effective and energy efficient system. Using this RFID, human life can be safe and get more fruitful results. We have done an extensive simulation for this, as shown in the paper above. This system solves the serious power consumption problem of a current mobile RFID reader for technologies like RFID/UHF (Ultra High Frequency). The result is also shown in a form that RFID sends an SMS to Android device. This technology provides us with remuneration in terms of complexity, energy consumption,and costs to save human lives. Many smart home use cases such as water taps, washing machine, Kitchen and Gas cylinder so on are described as examples that make use of this system.

In the future, we can enhance the efficiency and can develop more cost-effective system by using latest Multi-standard systems and enhance the security of the system more precisely. They are also building blocks of IoT. IoT represents a confluence of many modern technologies working together namely hardware, sensors, cloud computing and machine learning, more data, better outcomes, smart, physical workspaces, safer places to work, increased customer centricity, industry revenue impact.

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The Analysis on the usage of the Video Conferencing Rooms using Classification

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Abstract

The ways and means of collaboration have been changed over the last few decades. They have extended beyond interaction within the same meeting room. Nowadays, all multinationals are installing video conference rooms in their offices globally in order to collaborate with their clients online to save travel cost and time. These video conference rooms are meant to capture the huge amount of data. Keeping in view the growth of the data in this situation, we performed an analysis on the usage of video conferencing rooms using data mining techniques. The data have been taken from a Norway based company named Cyviz . The data set is then further preprocessed and analyzed. Data reduction and data transformation have been done on the selected attributes to get better and appropriate results. A well-known data mining tool named WEKA[5] is used to perform the classification on the dataset taken into consideration. Classification algorithms named Naïve Bayes and Random Tree are applied to the dataset after preprocessing and their results are compared and analyzed. This study is an effort to analyze the usage of the video conference room so that appropriate usage of the resources can be ensured.

Keyword: Video Conference, Audio Conference, Naive Bayes, Random Tree, Classification, Data Mining, WEKA

1 Introduction

Cyviz is a technological organization which is based on research and development. They are having 120 employees who are operating globally. It has customers in 50 countries around the world. Cyviz started back in 1999 and with its 20 years of experience they now develop and produce softwares and hardwares that are used in collaboration systems and visualization. This comprises huge display walls with high resolution and collaboration rooms that enable consumers a proficient use of display walls. Previously, the users had ability to use display walls for presentations and high resolution videos while Cyviz introduced the flexible control system which is called CDC (Cyviz Display Controller) for the concept of the collaboration rooms. It enables consumers to utilize the same display wall for sharing presentations and video conferencing with other users. In advance, there was an only one point of control for display walls.

The CDC enables to configure the admittance of numerous consumers to control the system. The 20 years of focus and dedication on the technology of large displays has given

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[5]*WEKA Website: https://www.cs.waikato.ac.nz/ml/weka/*

Cyviz a unique perception which enables them to understand the requirements of different businesses. In order to improve the portfolio of their product the company is determinedly spending in new technology [1].

Cyviz has provided meeting rooms to the Fortune 500 and the government customers. These meeting rooms have different features and they are installed according to the customer's requirement. These features are providing information about the usability of the conference rooms. The features of video conferencing rooms are like audio detected, room in use, the room booked through exchange, presence detected, picture in picture active, stereo on, audio or video conference active, audio call active, video call active and some others.

This study is based on the analysis of available features of the conference rooms and extracting meaningful information out of it.

2 Background Knowledge

Video conferencing is the means of communication using a combination of audio, video, text and graphics to support real time communication between distributed groups sharing same interests or working in the same domain like business meetings, playing games, learning and entertainment [4]. Our study is a statistical analysis of a system using video conferencing determining the availability and non-availability of rooms using the features provided by the organization. Weka is an application that runs almost on every system and is developed using JAVA. It provides an interface to multiple algorithm and also support pre and post processing of data to extract results from different data sets [4]. Random trees are used to predict results using multiple decision trees that grow in different subsets in the same domain, the idea was proposed by Leo Breiman in 2000 [5]. Naïve Bayes is a simple classifier that calculates the probabilities of frequency and uses different combination of values from a data set, the algorithm is helpful in supervised learning [6]. Depending upon our best knowledge and research study, we tried to analyze the data set received from Cyviz using above mentioned data mining techniques in order to find meaningful knowledge.

3 Methodology and Results

The machine learning view of Knowledge Data Discovery (KDD), shown in the Figure 1, is followed in the whole research process.

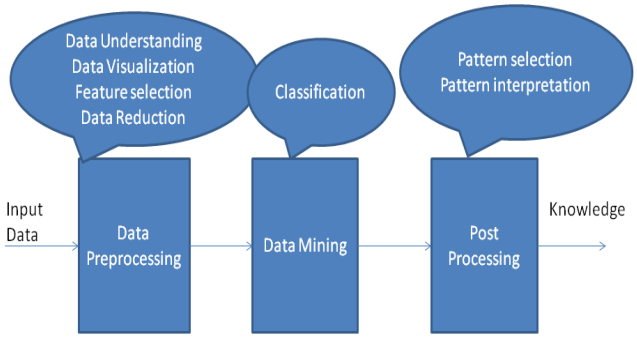

Figure 1: KDD process a machine learning view

A Data Preprocessing

The phase is handling the data manipulation Procedure of data preprocessing consists of data understanding, data visualization, feature selection and data reduction.

1) Data Understanding

The research started from getting familiarity and understanding of the available data. The initial data provided for analysis were having around 30 features of the video conference rooms. These features were capturing the usage time in number of seconds, more precisely the number of seconds each feature had been used in any particular room. For example, in one transaction for any particular date if Audio conference feature is having 3600 value, then the room used the feature of audio conference for an hour. The features were studied thoroughly to figure out their usage and any possible relation.

2) Data Visualization

In order to get more understanding of the data all available features were plotted in MATLAB. Some of the plots that are understandable are shown in Figure 2, Figure 3 and Figure 4.

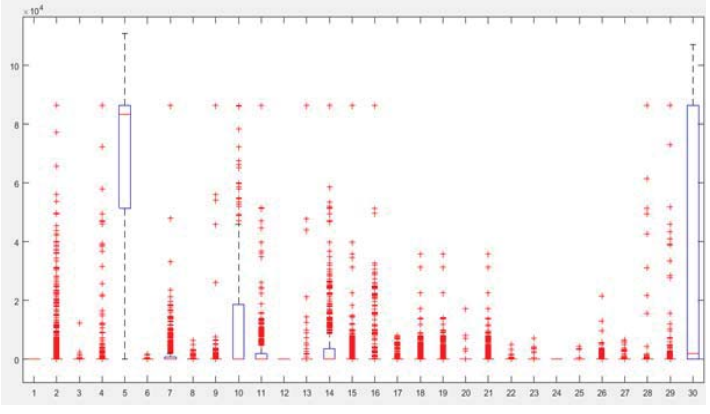

Figure 2: Boxplot showing all features of the video conference room

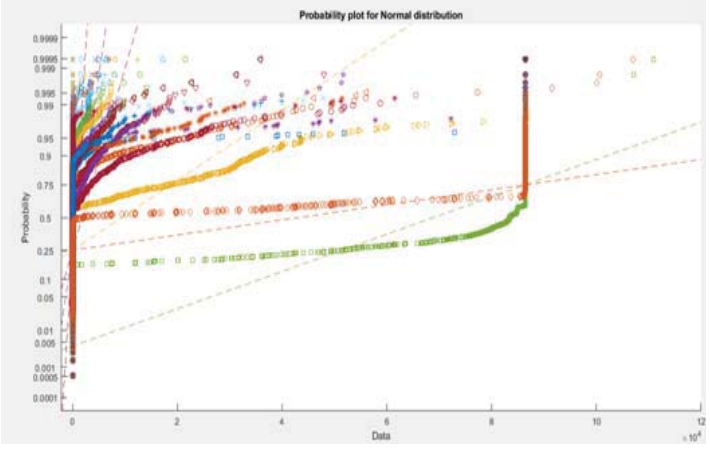

Figure 3: Probability plot for Normal distribution

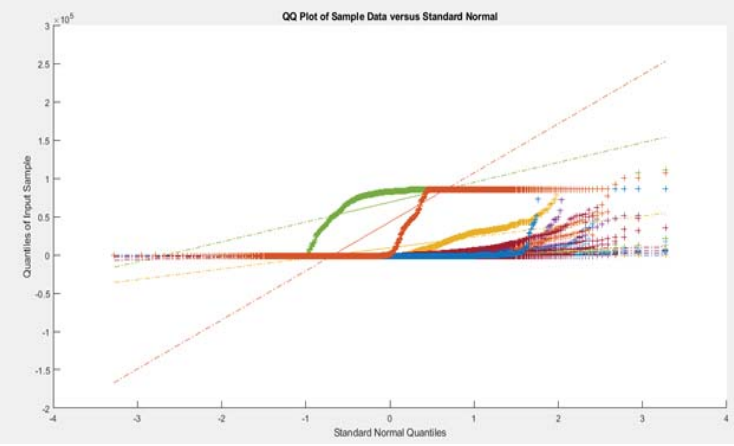

Figure 4: QQ Plot of sample data versus standard Normal

3) Data Reduction

From the visualization of data, it was figured out that in order to understand the patterns which were more informative, it was important to reduce the data size by selecting some maximum information giving features. The selected features of the study are shown in Table 1.

Table 1: The selected feature of video conference room

Feature	Description
Room Name	The name of the room. The name uses name space notation, showing the region, country and city of that room.
Day	The day of the week on which this information is recorded. The data is captured against particular date and day is derived from that date.
Is Room In Use	The number of seconds for which room was in use on a particular day
Is Pip Active	The number of seconds for which picture in picture was active on a particular day
Is Audio Video Conference Active	The number of seconds for which audio and video conference both were active. It has sum of Audio and video active time collectively on a particular day

4) Statistical Description

The statistical description of selected features is shown in the Table 2 below.

Table 2: The usage data in number of seconds

Description	Is Room In Use	Is Pip Active	Is Audio Video Conference Active
Mean	5114,80129	2627,081	1500,87895
Median	0	0	0
Mode	0	0	0
Standard Error	349,335813	229,8189	201,5143526

Standard Deviation	15094,3797	9930,199	8707,192431
Minimum	0	0	0
Maximum	89999	86400	86400

The average use of all rooms together is 85 minutes.

Mean: = 5114,80129/60 = 85 minutes

The average use of Picture in picture for all rooms is 44 minutes.

Mean: = 2627,081/60 = 44 minutes

The average use of audio and video conference feature for all rooms is 25 minutes

Mean: 1500,87895/60 = 25 minutes

5) Data Transformation

In order to apply data mining algorithms on all the selected features, they were transformed. The transformed data are shown in Table 3.

Table 3: The data before and after transformation

Feature	Actual Data	Transformed Data
Room Name	Number of seconds	Nominal
Day	Day against each date	Day
Room Used	Number of seconds	Boolean
Picture in picture	Number of seconds	Boolean
Audio or video conference	Number of seconds	Boolean

The main objective of data transformation was to generate meaningful knowledge after applying data mining techniques. The rules that were followed for transformation are defined in Table 4.

Table 4: The rules set for data transformation

Feature	Actual Data	Transformed Data
Room Used	= 0 > 0 &<= 120 mins >120 &<= 360 mins >360 mins	No Usage Low Usage Normal High
Picture in Picture	= 0 > 0	N Y
Audio or Video conference	= 0 > 0	N Y

Table 4 above is giving us the following insights about the features we took into consideration:

a) Room used

If there is no meeting at all then recorded data is 0 seconds, which is transformed into No usage of room. If the room is used for 1 minute to 2 hours (120 mins) then the usage of the room is Low. If the room is used for 2 hours to 6 hours (360 mins) then the usage is Normal. For more than 6 hours the usage is transformed into High.

b) Picture in Picture sharing

If the data of picture in picture sharing feature are 0 then it is transformed into N otherwise it is Y.

c) Audio and video conference

If the data of audio and video conference feature is 0 then it is transformed into N otherwise it is Y.

B Data Mining

1) Data Sample

There are 6 attributes and Room used is the class attribute. The total number of transactions is 2449. The sample data is shown in Table 5.

Table 5: The sample dataset after preprocessing

Room	Day	Room Used	PIP	Audio Video	Usability
Room 1	Tuesday	No Usage	N	N	no usability
Room 1	Wednesday	Low	Y	Y	full utilized
Room 1	Thursday	Low	Y	N	min-use
Room 1	Monday	Normal	Y	Y	full utilized

2) Weka Tool for Classification

Weka is providing different machine learning algorithms for the tasks of data mining [4]. The research classifiers are implemented in it.

3) Naïve Bayes Classification

The Naviebayes classifier is based on Baye's theorem of posterior probability. It is assumed that features or attributes are independent of each other. The value of one attribute is independent of the other attribute of a class [2]. The summary of accuracy generated by Naive Bayes Classifier is shown in Table 6.

Table 6: The summary of accuracy by Naive Bayes

Correctly Classified Instances	1838	75.051%
Incorrectly Classified Instances	611	24.949%

The implementation of Naive Bayes Classifier is shown in the Figure 5.

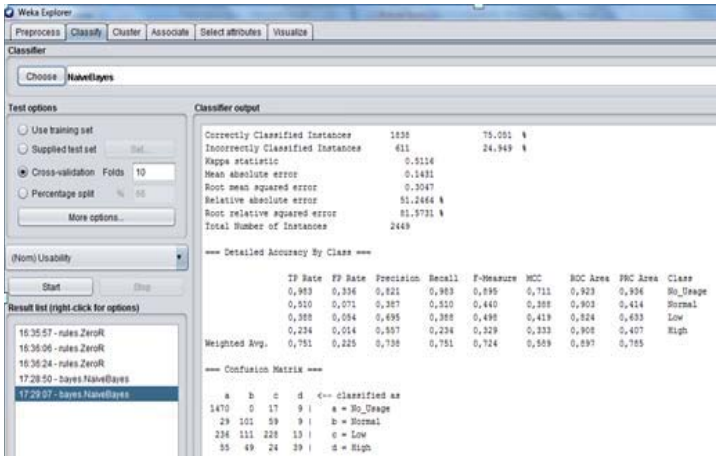

Figure 5: Implementation of Naive Bayes using WEKA

The confusion matrix using Naive Bayes classifier is shown in the Table 7.

Table 7: The confusion matrix using Naive Bayes classifier

A	B	C	D	Classified As
1470	0	17	9	A = No Usage
29	101	59	9	B = Normal
236	111	228	13	C = Low
55	49	24	39	D = High

4) Random Tree Classification

Random tree is an ensemble machine learning algorithm which generates numerous different learners. In order to produce a random set of data for constructing a decision tree it uses a bagging idea [4]. An alternative classifier is used in the research study to get better accuracy. The summary of accuracy generated by the random tree is shown in the Table 8.

Table 8: The summary of accuracy by random tree

Correctly Classified Instances	1878	76.684%
Incorrectly Classified Instances	571	23.316%

The implementation of Random tree classifier is shown in the Figure 6.

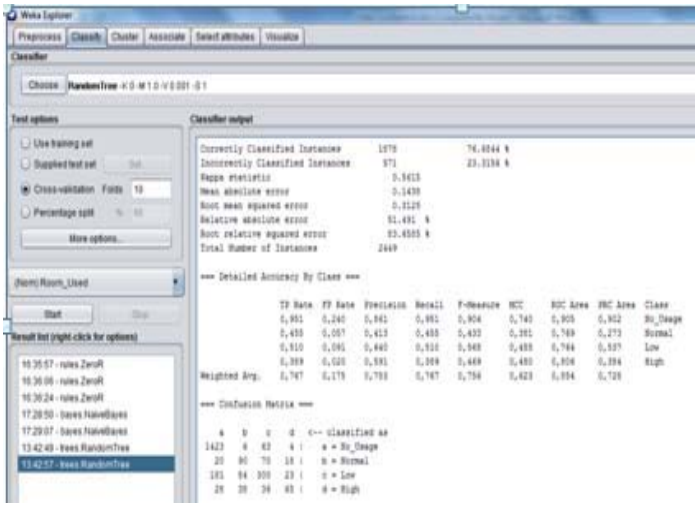

Figure 6: Implementation of Random Tree classifier using WEKA

The confusion matrix generated in WEKA using the random tree classifier is given below in Table 9.

Table 9: The confusion matrix using Random Tree classifier

A	B	C	D	Classified As
1423	6	63	4	A = No Usage
20	90	70	18	B = Normal
181	84	300	23	C = Low
28	38	36	65	D = High

C Post Processing

The proposed classifiers have divided the data into four categories No usage, low, medium and high room usage. They are giving two different accuracies and can predict the usage of the room on the basis of defined attributes.

4 Conclusion & Future Research Directions

The selected features of the video conference room are showing the level of utilization of that particular room. In future, work we are interested to figure out that on which day, week or a month meeting room is busy or it can predict about the availability of the room on any particular day or week. As the company is ready to provide more data for analysis so we have a room to expand our work in different directions. We also suggest the company to keep the record of the camera installed in the room in order to check the correct usage of a conference room. Through camera we can obtain image data and can relate this to the existing features.

Acknowledgment

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