Efficient Energy Utilization using BOT

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ABSTRACT

In India, the future energy demand is said to be increased by 30% by 2035 [1] and energy consumption is set to be increased 4.2% per year by 2035. In order to fulfill the energy demand, the optimal energy conservation awareness and methodologies must be enabled among various stakeholders. It must be always ensured for the new buildings constructions should follow the energy conservation code and appliances used having standard energy performance. Prime Minister Mr.Modi has launched a method called Prakash Path [2] advising people to use LED lamps to reduce lighting power requirement. Even energy efficient fans are available nowadays at subsided price which are used to decrease the peak electricity load. The proposed system is concentrating on designing the efficient energy utilization plan. To achieve this, various factors that is involved in the energy utilization have been collected. The usage pattern of the stakeholders can also be analyzed to predict the optimized pattern based on certain requirements. The system will be trained with many types of pattern that are in need. When there is a new user who may require the energy utilization plan, the system will predict the one, from the knowledge base that suits the requirement. Hence efficient energy utilization would be achieved.

Key Words: *Conversational service; Chat bot, Retrieve and rank, Energy pattern.*

1. INTRODUCTION

Energy efficiency is always vital to make sure safe, consistent, reasonable and viable energy service for the future. It involves delivering equal or greater levels of "energy services" with less energy supply. Energy services include cooling, heating, lighting, driving motors, operating equipment and appliances. Finding and minimizing the maximum energy consumption to the optimal level is a great challenge. Vitality productivity and sustainable power source are said to be the twin pillars of feasible vitality arrangement. Usually, increasing energy efficiency is accomplished by embracing more advanced technology to reduce energy losses. Exchange of old appliances with the modern new appliances significantly consumes lesser energy than the previous consumption. Energy auditors and consultants use different tools and skills to analyze our home and suggest the most cost-effective measures to improve its comfort and performance. This energy monitoring is done continuously to get optimal utilization of the energy.

Future energy requirements can be predicted as a censorious component of a variety of applications that seek to conserve or improve energy resource management. For example, utilities use future demand modeling to decide how energy generation can be handled. With the recent widespread introduction of the smart grid[6], it becomes important to predict the scale of individual homes and even appliances to allow efficient demand response systems and user-side energy management. It will be a better approach if the houses are built with energy efficient metering and wiring for electricity consumption or reassigning the wiring of houses will be an alternate idea.

The rise of new technologies has driven energy costs up. End users search for ways to minimize and reduce or control consumption. IoT offers a practical way to analyze and optimize use not only at device level, but for the entire house the energy plan must be preferred and applied. This may mean switching off the lights, changing device settings and modifying multiple house settings to optimize energy use.

In the energy efficiency market, the potential benefits of IoT are said to be immense, particularly for end-users and integrators. IoT allows end users to easily track control and adjust their system to business outlook, raw material costs or energy prices. IoT should boost its ability to meet consumer needs for energy efficiency system integrators [12], rapidly reducing deployment and commissioning time. Individually, integrators can enhance the maintenance of their systems by remote product diagnostics and repairing capabilities.

II.RELATED WORK

Creating predictive models for time series data is a well-defined field, but most of the household energy efforts have focused on better models for a small sub-set of scenarios. Some research efforts have focused their work on whole home energy consumption predictions. Nonetheless, a comprehensive solution for energy management involves a broad understanding of predictive reliability from different perspectives, such as appliance and home, as well as different time horizons, such as an hour, day or week into the future. Z. Attaria Shahzeen, et. al.,Shahzeen Z. Attaria, et. al., made an online survey[14] where 500 participants were recruited in an online survey to report their perception of energy consumptions and savings. Every individual have their own observation and members with higher numeracy scores and more grounded professional ecological dispositions had progressively precise discernments.

Schneider came out saying that reducing energy use and waste is now being the active research in energy efficiency domain [15]. Energy can't be managed and improved without measuring it. Measurement can be done in three methods: (1) Comparison, (2) Indirect measurement, (3) Direct measurement. The above methods helps in the energy monitoring process. Customization and flexibility are also attained by verifying the reports generated.In their research[16], Eng. Inji Ibrahim Attia and Prof. Dr. Hamdy Ashour found that smart home innovation is a decent decision for individuals who care about security, comfort, yet additionally about vitality sparing. Sensor-based home energy management technique is introduced to mitigate the loss of household energy. To survey the connection between energy utilization and reserve funds, the numerical relationship model is utilized.

Jayashri Bangali and Arvind Shaligramin, their research work [17] depicted smart home is a house consisting of various sensors used to sense the environment and by using technology controls the electrical appliances and communicate with the outer world. Due to high benefits of Wireless Sensor Network, it is used to monitor the data which automatically gets stored in the database which can be effectively viewed from anyplace in the world.

Parag Kulkarni, et. al., [18] addressed the ambitious 20-20-20 targets. To achieve the challenge they followed the following steps. Initial step is Data collection and ICT interactions. It deals with all the data including the missing data using a tablet computer and monitoring with the help of Internet. Second step is energy monitoring and economic consideration. In this the consumed energy is taken in account and subjected to analysis by considering the economic considerations like energy consumption of the monitoring infrastructure and related costs. Thus the above steps paved the way to achieve the 20-20-20 target by the year of 2020.

Shahzeen Z. Attari, Deepak Rajagopal did the research in behavior of the people [19]. In general people don't know which behaviors are truly effective. Through reviewing current decision-making aids, resources available to help users make successful decisions, this can be based. EPA's Energy Star Program is a voluntary labeling program for consumer products that meet a minimum standard for energy efficiency and provides an online too to analyze potential energy savings. DoE's EERE number crunchers is a spreadsheet-based adding machine for every one of a few significant kinds of household appliances. It compares the initial capital costs, energy use and the payback period of high efficiency appliance relative

to low efficiency appliance. LBNL's Home Energy Saver is another advanced calculators which also exclusively focus on home energy efficiency actions.

Geertje Schuitema, Lisa Ryan, Claudia Aravena [20] came out with a common approach that energy efficiency can be achieved through increasing renewable energy resources like solar, wind. But the main challenge in this is that customers play a crucial role in achieving this energy transition. Customer's flexibility is required to score good in it. This flexibility can be achieved through the following sequence: (1) Finding consumer's Role, (2) Changing consumer's behavior, (3) Technology adoption, (4) Policies to enhance flexibility. Succeeding the above sequential steps will help customers to handle the flexible energy systems.

A broad understanding of energy utilization may be helpful to predict the design of energy management solutions by allowing a designer to tune the system to tolerate prediction error, or to make smart decisions about the efficient energy utilization.

III.PROPOSED SYSTEM

The proposed system is started with a comprehensive study to predict energy utilization pattern of different users. This energy patterns will be mainly focused in solving the problem of energy wastage, dissipation of energy. The patterns are formed in such a way that it satisfies most of the economic properties. It provides an economically efficient energy utilization plan. Hence it protects the environment resources by giving out the exact energy efficiency plan of the building that will be considered.

The proposed system will identify the set of requirements from every user by posting set of questions. Based on the user's answers, it will try to predict the appropriate pattern. If it is of new kind, then it will add it as a new type inside the database.

The proposed system must undergo a comprehensive understanding of the home energy usage. The system will follow two requirements for the dataset that serves as the basis for analysis. First, it must consider all the factors in home that is involved in the energy utilization. Second, the dataset must be diverse, for example with respect to number of persons living in a home in order to derive general insights into home energy usage. Figure.1 shows the architecture diagram of our proposed system.

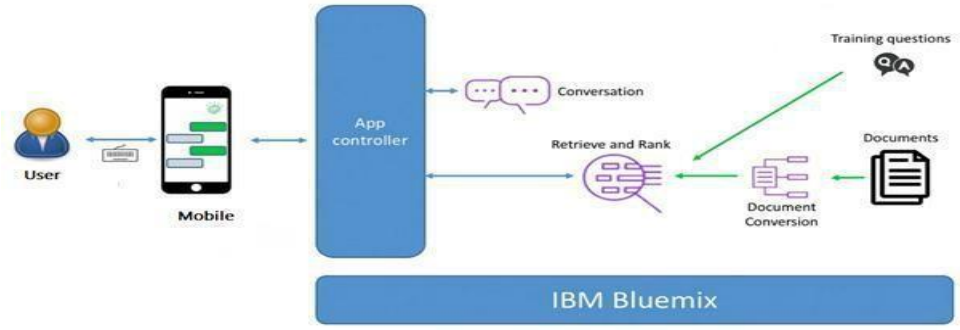

Figure. 1 Proposed Architecture Diagram

The various factors that involved in bringing out energy efficiency are as follows (i) the size of the room which we are going to apply our energy constrain, (ii) the ceiling height of that particular room, (iii) the floor number or the level number to find out the level of the room, (iv) the count of the windows in that particular room, (v) for what purpose does the room been used (vi) how many persons are living in that particular home. These factors helps us to develop the various energy patterns in turn can build the efficient energy plan. Table. 1 shows us the sample energy pattern factors.

Area	Height	Windows	Floor No	Type of room	No of Persons
10×10	8	1	1	1	3
16×10	10	2	3	2	4
11×11	8	3	2	3	5
16×11	11	4	1	1	6

Table 1. Sample energy pattern factors

A. Data Collection

It is necessary to collect data from users, by constructing an interactive service using IBM Watson. The set of related questions will be asked to each user and the answers for that will be stored back. Based on the predictive analysis algorithm the system will try to predict the approximate energy pattern. The following questions will be asked.

What is the length and breadth of the room?	In which floor does the room gets located?
For what purpose is that room been used?	Can you give me about the count of number of persons in the home?

The predictive analysis algorithm helps us in determining the economical energy plan of the electrical appliances that can be used in a home. This can be generalized for a global use in future. The end user must be able to access it where ever he needs it and whenever it is necessary. So we planned to work by incorporating the IBM's Bluemix.

B. Tools and Algorithms

The proposed system uses the IBM's Bluemix as a cloud platform. IBM Watson's (i) Conversational Service (ii) Retrieve and Rank Services are used to determine efficient energy plan. Both the services helps for the users who are requesting. It enables the IoT property of connecting anyone to anything at any time from any place to get any services from any network.

C. Conversational Service

The IBM Watson Conversation service provides users to add conversational capabilities based on their requirement. Bots are like fundamental companion which can answer questions and help you get things done faster without getting any help from another human. The Bot is created in the cloud using this Conversational service. It is trained in such a way to quickly build the natural conversational flow between the apps and the end user. It is designed with the user interface to get the necessary inputs or data related to the energy plan so that it can suggest users the efficient energy pattern which can be used in the homes to create an efficient energy plan.

As of current situation the majority of end users spend most of the time on various messaging platforms, classes are turning to these messaging platforms to better interact with end users. The increase in private messaging between end users and brand is driving companies to turn to Chat bot's for getting a huge response.

To build such a chat bot the proposed system uses IBM Watson Conversation Service. It is a simple, scalable and science-driven solution for developers. The Watson services depend on a various machine learning algorithms, most of which fall in the supervised machine learning grade. It learns the instance of the problem from sample labeled data and help make foresight on unlabeled data. Training and

implementation of a supervised machine learning system includes supplying representative information as inputs for the correct outputs. The system will learn by the training set. These pairs of representative inputs/outputs set up the "groundtruth" from which the system learns.

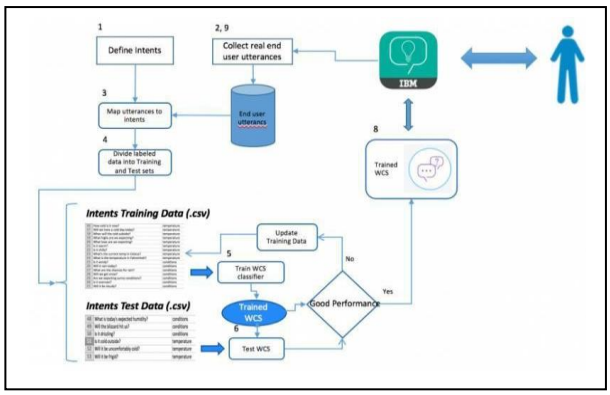

Figure. 2 Work flow of Conversational Service

Here, the Watson Conversation Service (WCS) that is very popular for developing fundamental agents and chat bots. It consists of an intent definition/training/practicing process. This action maps a short text (reply message) that the user provides (types, speaks, …) to the intent(s) with the training set. Fig. 2 shows ten steps for training the chat bot to make the bot livelier. The following are the ten steps.

Step 1: Define the intents also known as classes or categories that are going to create the chat bot for extract the words from natural language utterances. As users can define a large number of intents for a variety of reasons, it is best to focus specific intent definition on the purpose of their need in chat bot. For the proposed system the identified intents are light, fan, cross sectional area, socket, etc.

Step 2: Gather genuine end-client expressions that the framework would need Watson Conversation to map it to its goals. It is significant that every one of the expressions must originate from end-clients. Trying to guess what end users would say may be acceptable for initial configuration Collecting and analyzing real end-user comments should be expected. The system's performance can be strongly judged based on how effectively it records real end-user statements.

Step 3: Assign the statements collected in step 2 to the various attempts / classes described in step 1. This step most likely need subject matter experts (SMEs) to help with this mapping. For utterances that don't clearly map to any of the intents which were already defined, either leave those empty or map them to "other" intent. It is essential to catch and perceive expectations that are "off subject" so the application can deal with them sufficiently.

Step 4: Divide the utterances which uttered in step 3 into two sets randomly, a training set and a test set typically it is sliced as 70% of training set and 30% of test set.

Step 5: Train your chat bot with step 4 training set. The set of training will be the foundation for the curriculum.

Step 6: Run the test set against the certified classifier once the preparation is finished and gather execution measurements, for example, exactness, accuracy, and review.

Step 7: Error Analysis is done in this step by reviewing the results in step 6 to understand why the classifier missed certain utterances. Update those missed utterances to training data accordingly and iterate the process from step 5.

Step 8: When we happy with the outcomes created by the prepared framework, the framework is prepared for discharge. An instrument is utilized to gather end-client feedback.

Step 9: When chat bot is in use, end-user utterances, attempts returned by qualified communication

service and end-user feedback are continuously collected.

Step 10: Map results collected in step 9 to new training/test data. It is then allowed to go back to step 4 and repeat the circle iterate to train the bot.

When preparing an intellective framework, note that preparation/learning is an iterative procedure. It must be assured that some of the degrees of utterances that the newly trained program may not have recorded initially have been mastered. The above steps are depicted in Figure. 2.

D. Algorithm

Many machine learning algorithms fall into one of these two categories: unsupervised or supervised learning. In unsupervised learning, an algorithm segregates the unlabeled data into groups based on their primitive structure, which makes the data understandable or acceptable. A case of unsupervised learning is the k-means clustering calculation, which partitions information into groups with the closest mean. On the opposite side of the range is supervised learning. Throughout supervised learning, a collection of input variables is profiled through a mapping function (with the aim of approximating new input information for prediction) to a predefined set of output variables. This action is said to be supervised because the input data and output data are used by an algorithm to create a mapping function.

Reinforcement learning is used here as a machine learning technique in the proposed system. Strengthening learning varies from any of these learning methods. Training to improve is not quite the same as both of these ways to deal with preparing. These sides more with the ranges administered bit. The mapping of state to conduct is educated in support learning through a combined reward for its activities. Computerized mapping happens in an investigation and creation balance. IBM applied this improved preparing to IBM Watson, an inquiry and-answer program that comprehends common language and is equipped for reacting in a characteristic language. Markov Decision Process (MDP) is the computational process for determining a solution to the reinforcement-learning scenario. The implementation of the reinforcement learning is done using Deep Q-Learning algorithm is described below.

initialize Q values to 0 for all states
  set action value for terminal states as 0 for *each user login* do *initialize state s*
    while (s is in S)
      $a \leftarrow$ action for s derived by Q
      take action a, observe r, s'
      $Q(s,a) \leftarrow Q(s,a) + \alpha[r + \gamma \max_{a} Q(s',a')-Q(s,a)]$ $s \leftarrow s'$
    end
  end

The following steps describes the Q learning algorithm in detail.

1. Initialize the **Q** -Values table '**Q(s, a)'** and action value for terminal states to 0.
2. Observe the current state (**s)** which is the intent and supporting entities questions.
3. Choose an action **(a)** for that state based on mapping the states with the energy pattern.
4. Take the action, and observe the reward **(r)** and the new state (**s')**.
5. Update the Value for the state in table utilizing the watched reward.
6. Set the state to the new state and rehash the procedure until it arrives at a terminal state.

The proposed system uses the Q learning algorithm which consists of agent, states and set of actions. The operator detects a limited set S of particular states and has a limited set An of unmistakable activities.

For every client, the operator detects the state (s), picks a pertinent activity (an), and executes it. This calculation finds the Q-esteem for a given state (s) and activity (a). It keeps up the present reward (r) in addition to the greatest markdown factor (γ) future reward expected by our own table for the following state (s´).

In the proposed work state (s) represents the questions related to the intents (fans, lights, 5 amp sockets or 15 amp socket) and its corresponding factors that we considered in improving energy efficiency named as entities. Action (a) represents the answers for the question which is the energy plan values.

$$Q^{new}(s_t, a_t) \leftarrow (1-\alpha) \cdot \underbrace{Q(s_t, a_t)}_{\text{old value}} + \underbrace{\alpha}_{\text{learning rate}} \cdot \overbrace{\left(\underbrace{r_t}_{\text{reward}} + \underbrace{\gamma}_{\text{discount factor}} \cdot \underbrace{\max_a Q(s_{t+1}, a)}_{\text{estimate of optimal future value}} \right)}^{\text{learned value}}$$

Here (α) is the learning rate (0< α<1). It decides to what degree the recently obtained data will overrule the old data. If the factor is 0, the agent will not know anything, whereas if the factor is 1 the agent will only find the latest information.

The rebate variable causes us to choose how significant the conceivable future prizes is contrasted with the present compensate. This discount factor is calculated because the need of the energy may change in future based on certain factors which could affect the current energy plan to an infinite extends. So, to handle those imbalances the discount factor is added. So as to locate the ideal Q work, remunerate is added with the limited most extreme future anticipated reward. To find this optimal value (γ) takes the values between 0.7 and 0.98. This way of updating table slowly begins to obtain accurate measurements of the expected future reward. It helps the system to provide the efficient energy plan which can withhold for a long period without any changes required.

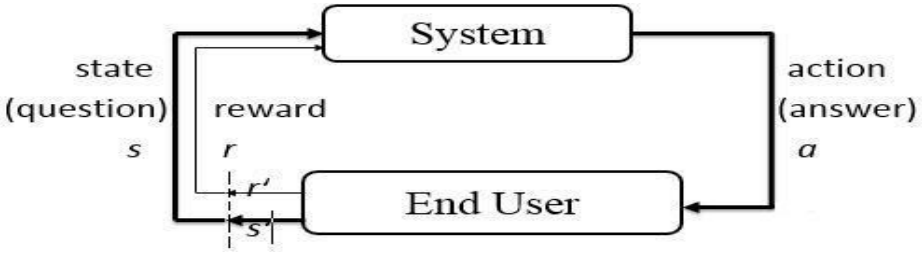

Figure. 4 Reinforcement learning

Massive parallelism: Attains massive parallelism in the consideration of multiple perceptions and hypotheses.

Many experts: Helps in the joining, application, and relevant assessment of a wide scope of approximately coupled probabilistic question and subject investigation.

Pervasive confidence estimation: No segment recognizes an answer; all parts produce features and related confidences, scoring various request and clarifications of substance

Integrate shallow and deep knowledge: Balance the utilization of severe semantic and shallow phonetic, utilizing a lot of index.

By using the above machine learning algorithm the system takes the data from the end user. It trains the bot using this self-learning algorithm and makes it capable to come out with all the possible answers for the questions asked by the end users.

IV. RESULT AND DISCUSSION

The electricity consumption of India households has been increasing rapidly in the past decades. It is projected to continue its upward trend. Based on a sound understanding of the factors which the

proposed system considered helps to identify the efficient energy pattern for different needs of the end users which helps to come out with patterns for suggesting which in turn reduces the energy wastage and dissipation of energy.

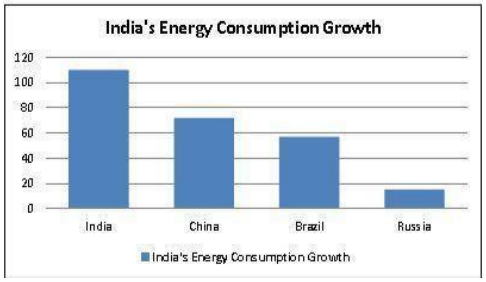

Figure. 5 Energy Consumption Growth in India

These measures can target macro-level factors such as technological developments, regulations, cultural and social norms. They can target micro-level factors such as individual decision-making of households for energy efficiency and conservation. The Chat bot is used as a medium to gather the need of the individual end users which is used for mapping the factors to the energy pattern.

Energy Pattern	Lights	Fan	5 amp socket	15 amp socket
10×10,8,1,1,1,3	2	1	2	2
16×10,10,3,2,2,6	3	2	4	3
11×11,11,2,4,3,4	2	1	3	2

It is giving out the energy efficient plan of the electrical items to be placed in a given cross sectional area of the room. When aggregating the results of all rooms it gives the efficient energy utilization plan for the entire home. It results in an energy conservation process in a different way as an early prevention technique than trying to solve the energy insufficiency which next generation people will be facing in future.

This proposed system of wiring the house based on the energy plan acts as a protection and prevention measure to conserve the energy by limiting the environmental resource usage(coal,water,etc..,). To achieve the above all the people needed to be insisted to follow the energy plan. This can be made only by passing law by the government which the energy plan must be followed by all people to their house like passed a law for rain water harvesting.

V. CONCLUSION AND FUTURE WORK

Energy efficiency is the future's wind. The world is moving quickly towards conservation of energy. At the same time, the mankind is trying to re-establish the connection which they had once with nature. An energy efficient home is an individual advance towards the course of renewable power source, natural insurance, and maintainable living. Having such homes helps house proprietors decrease their bills and gives an amazing reserve funds. Today's homes are equipped with many electronics and appliances that waste energy in standby mode and throw unacceptable heat generation. Small changes in our regular energy usage can give us an efficiency in use. The proposed system focused here aims in designing the efficient energy utilization plan based on various factors that is involved in energy utilization. Training the

various pattern in the system helps to match the efficient pattern with the stakeholder's requirements which was derived using the Chabot. Thus the efficient energy utilization was achieved for a home.

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