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Home Automation Using ML

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Abstract: Automatic control of home appliances must be artificially intelligent systems that need to make itself depend on human being's action and surroundings. These systems are thoroughly examine user requirements and conditions of the neighbouring in order to estimate future actions and reduce user interactions. Here we bring a new Home automatic control system based on machine learning. In this system we put forward VGG16+LSTM Architecture to increases accuracy and efficiency of the system. The system contains three modes of operations to control home appliances, they are: emotion detection mode, automatic mode and manual mode. This system prominence given to energy consumption and prediction performed by logistic regression and also determine frequency occurring set of devices by using apriori Algorithm .The another component of this system is that we can examine power consumption of individual devices.

Keywords: Machine Learning, Association rules, VGG16, LSTM, Logistic Regression, Apriori algorithm

I.INTRODUCTION

Smart Home Systems are inevitable things in our daily life which contains smart technologies for furnishing comfort, health, safety, security and energy reduction. Moreover the quality of life can be upgraded by the automated control of appliance and accessibility services. The main purpose of home automation system is to make our home functions elegant. Our system is to control home appliances in different modes they are: manual mode, automatic mode and emotion detection mode. As the system works in emotion detection mode, we have used more accurate architecture i.e. VGG16+LSTM architecture. As we know energy is a critical economic issue due to its high demand and unsustainable supplies. This system is a solution for this issue. Our system ensures energy conservation in home appliances. The system can predict the energy to be used by each devices in future according to the previous data sets. This system can analyze the power used by each devices so that devices that consumes more energy can be find out. Hence the unnecessary usages can be avoided.

II.THEORY

[A]. Machine learning

Machine learning (ML) is a branch of Artificial Intelligence which performs learning with inputs to a machine . firstly the training data is inputted to a particular algorithm. training data may be known or unknown. based on the data, machine learning algorithms build a model and it makes decisions or predictions without being explicitly programmed. if the predicted output is not matching with the desired output, the algorithm is retrained several times until we get the desired output. it allows the machine learning algorithm to learn repeatedly and each time produces more optimal results. machine learning can be classified into supervised learning and unsupervised learning.in supervised learning we use known data .if once the machine learning model is trained with known data then we can also use unknown data to this model. then the model gets new response. in unsupervised learning, unknown data is used as training data. thisdta is given to the model and the model tries to figure out for a pattern and produce responses.

[B]. VGG16

VGG16 is also called OxfordNet.It is a convolutional neural network architecture and it is named after the visual Geometry group from Oxford,who created it.Simonyan and Zisserman are the introducers of VGG network architecture through their 2014 paper.VGG 16 is convolutional nueralnetwork named after the visual geometry group from Oxford,who developed it. Actually VGG16 was used to win the ILSVR competition in 2014 . VGG 16 is a deep 16 layerdarchitecture.we can load pretrained version of the network trained on more than a million images from the

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ImageNetdatabase.Thepretained network can arrange images into 1000object modes such as keyboard,mouse ,pencil and many animals.

[C]. LSTM

LSTM was proposed by SeppHochreiter and Jürgen Schmidhuber.By introducing Constant Error Carousel (CEC) units, LSTM deals with the vanishing gradient problem.A type of recurrent neural network is Long Short-Term Memory (LSTM) networks .It is capable of learning order dependence in sequence prediction problems. A common LSTM unit is composed of a cell, an input gate, an output gate and a forget gate. over arbitrary time intervals The cell remembers values and to regulate the flow of information use three gates and they are in and out of the cell.LSTM networks are making predictions based on time ndare well-suited to forecasts, processing since there can be lags of untold duration between major events in a time series. LSTMs were begin to deal with the vanishing gradient problem that can be run into when training traditional RNNs. Relative unconcerned to gap length is an benefit of LSTM over RNNs, hidden Markov models and other sequence learning methods in numerous applications.

[D]. Apriori Algorithm

Apriori algorithm is proposed by R. Agrawal and R. Srikant in 1994. The purpose of the algorithm is to find out frequent itemsets in a dataset. Since it uses prior knowledge of frequent itemset the name apriori is given. It is mainly used for forming assosiation rules in a relational database. The algorithm uses an iterative approach and uses k-frequent itemsets for finding k+1 itemsets. Apriori algorithm uses an important property called Apriori property which helps to improve capability of level wise generation of frequent itemsets.Apriori Property states that all non-empty subset of frequent itemset must be frequent, if any itemset is found to be infrequent, then all its supersets will be infrequent. Apriori algorithm uses two parameters they are: support and confidence.support indicates the frequency of occurence of the item and confidence refers conditional probability.

[E]. Logistic Regression

Logistic regression is originally popularised and developed primarily by Joseph Berkson in 1994.it is mainly a supervised learning algorithm and is mostly used for binary classification problems.It is commonly used for many binary classification tasks because Logistic regression is very simple yet very effective classification algorithm .Logistic function is the basis of logistic regression and it is also called as sigmund function. The function maps it to a value between 0 and 1 and takes any real value number. As input Logistic regression model takes linear equations and log odds to perform a binary classification task.

[F]. Raspberry Pi

Raspberry Pi is the low cost, small sized computer which can be connected to host controller Arduino Nano. The host controller collect all data's from the sensor and send it to Raspberry Pi controller via serial interfacing. Raspberry Pi is another controller used in this system. Arduino Nano is serially interfaced with RPi TX,RX pins of controller board. Raspberry Pi collect the data send by the host controller. Home appliance are controlled by Raspberry Pi. It will be running as MQTT client, which will send collected data from Arduino to MQTT server. 5V relays are interfaced to Raspberry Pi, collected data from host controller is used to activate each of the relays.

III.RELATED WORK

In this paper [1]Cohn-Kanade (CK) database was used for detecting individual facial expressions.one of the most widely used test-beds for algorithm voluntary and evaluation is CK database. But it has some degradations. Then introduces the Extended Cohn-Kanade (CK+) database. In this the number of subjects escalated by 27% and number of sequences is increased by 22%.It concern computer vision, machine learning and behavioral sciences.In the extended system Here added 107 sequences and 26 subjects. The peak utterance for each sequence is fully FACS coded. By emotion researchers emotion labels are reviews and validated with reference to the FACS Investigators.Here patient's face traced by estimating the shape and presence AAM parameters.Then SPTS and CAPP characters are carried. Due to the favour and comfort of access for the original Cohn-Kanade dataset seen as a very premium addition to the already existing corpora that is already in subsistence. For a fully automatic system to be bouncing for all expression in a myriad of realistic scenarios more data is required. For this to occur very large reliably coded datasets. This will require a concerted research effort from a wide array of research institutions due to the cost associated with capturing, coding, storing and distributing such data.

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In this paper [2]facial expression recognition task is build up by using Convolutional Neural Network (CNN) approach.Emotion Recognition is a wide area there are somany researches. Automatic facial expression recognition is one of the research in this area. facial expression recognition task is recognizing occurrence of facial Action Units (AUs) .This research hold dataset of extended Cohn Kanade (CK+) which is accumulated forfacial expression recognition experiment.we added contempt and neutral classes to the original CK dataset to increase the performance.The CNN contains fully-connected layers so to reduce overfitting we engagea regularization method called “dropout”.The system contains eight basic emotion classes and using different numbers of testing and training data so the average accuracy rate of the system is reaches 92.81%.From this experiment we can wind up that the error rate decreases as the training data increases.

The aim of this paper[3] is to deliver a deep learning based framework for facial expression recognition. This mechanism focuses on the major parts of our face and gives less importance to other regions on face. This paper proposes attentional convolutional network based deep learning framework to classify emotions in face images. It is clear that , while detecting an emotion not all parts of face are important. Only gives importance to specific regions to get the emotion.There are 4 convolutional layers in the feature extraction part. Then they are followed by a drop out layer and two fully connected layers. The spatial transformer includes two convolutional layers. When transformation parameters are regressed the input is changed to sampling grid. Then the model is trained by optimizing a loss function.

This paper[4] discus about A Smart home. It is an one of the application of every where computing in which the home environment check by ambient understanding to fecilitates remote control accessand services for context awareness.This paper is helpful to understand smart home researches which are occuring previously associated with technologies .The major partsand it's connections are briefly described here.This paper informs about sensors,multimedia devices ,communication protocols and systems which are used the smart home systems.This paper firm the perfect guideline for future use.This paper introduce several future scopes of smart home systems.Thedefferene types of devices are connected through a common middleware for establishing perfect home automation system.Because the multi marketing system will coexisting in future.To overcome the restrictions of the various combined devices uses a network created by middleware is a effective solution.The unhealthy remissness avoidance make the home automation isto be more smart in future and find the electricity usage of the home is also make the home automation system is to be more smart in future.In future home automation system will attain solid popularity because of center of intelligent service dissipation.

This paper[5] elaborates the idea of using an adaptive control system for managing household electricity consumption. The aim of the solution is to reduce the total electrical energy consumption,and decrease their monthly electricity bill.The solution provide high degree of adaptability to differenttype of users based on a component-oriented architectureIn terms of ways to access the application and the interaction with the individual devices and independency from various types and configurations of devices. It leverages the benefits of available tools and technologies such as device controllers, web services, mobile platforms, together with well known concepts of artificial intelligence .some of the services that will be available in the near future, such as meter data management systems. this solution can manage and monitor grid energy storage and household renewable energy sources Beside previously mentioned decrease of energy consumption., if it available, and therefore its application results in offloading power grid starting from the lowest level of granularity – the end user.

In this work [6]discus about Facial point detection. It is involved in computer vision ,there are many applications.It is a serious task,since facial shapes are vary with facial expression and pose . In this paper we labeled this problem by suggesting discriminative deep face shape model that is developed based on RestrictedBoltzmann Machines model (RBM).The joint spatial relationship amidst all facial points are captured by using discriminative deep face shape model . The discriminative deep model integrates downside-up measurements from local point detectors in a unified framework and top-down informationfrom the embedded face shape patterns. In this system used effective algorithms to extract true facial pointlocations from their measurements. Here we detect 68 facial points from an image based on the discriminative deep face shape model. The facial point detection contains several stages so the efficiency of the system is greater than other methodes. Here we can see that the effectiveness of the proposed facial pointdetection algorithm versus state-of-the-art methods from Experimental result. Through deep studies on database sets ,it is clear that the proposed methode's error rate is less than the state-of-the-art methods .The dense feature extraction step is inefficient in this system. So the future work may be emphasis on this disadvantage.

This paper[7] illustrates a perceptual model of facial expression clarity and geometry. It is by using deep learning and artistic input. Here it admits the expression of human and stylized characters by training 2 convolutional neural networks. Then by performing transfer learning technique we can learn the mapping from humans to characters which can be further used to to create a shared embedding feature space. This paper uses a perceptual model to get character expressions corresponding to humans. This model can be included to animation pipeline which helps artists and animators for finer recognition of expressions.

In this paper[8] discus about Context aware applications respond and adapt to changes in the computing environment. It is the concept of leveraging information about the end user to improve the quality of the interaction.Appearing context-enhance benefits use localization,presence,social qualities,and other surroundinginformations to forecast an end user's

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immediate needs,propose more artificialized,condition-aware homes connect all the devices and appliances in your home so these devices can communicate with each other and with user.context awareness can one of the application of smart home technology. Context awareness have a great role for developng and conserving the Smart Home. Smart home technology brings out lots of benefits,But there are also have disadvantages.One of the disadvantage of installation of smart home technology is complexity of the system over usability of the system.Consider some following points when we plan to create a system for perfect abilityof the system.The following points are How large will be the system be?,The parts of system are what kind of components,are they basic,such a light dimmer,or more effective like an alarm system or a video camera?. How intuitive will the system be to a non-user?.How many people will be required to use the system?.Who will know how to operate the system? Who will know how to maintain thesystem and address failures?.How often will people who can only operate the system be left alone in the home?. How easy is it to make changes to the interface?

In this paper[9] we propose a vision-based machine intelligence system.ON/OFF state of usually used household appliances can be sense by using this system. In terms of cost and implementation The sensor-based home automation system suffers significant complexity.In terms of cost and accomplishment ,To overcome the complexity of home automation system This system uses vision-based machine intelligence without being dependent on the number of appliances and detect the states of multiple appliances . A novel home automation system will Get by this proposed method of sensing the states of appliances. Multiple beneficents are provided by this proposed home automation interface over classical home automation interfaces which integrate the use of various discrete sensors. The visual monitoring of the home and sense of the home can be switch without transmitting images then it makes this system a bimodal approach towards Home automation.The proposed machine learning based approach update the user about the state of the appliance on a website and efficient switch ON/OFF the appliances accordingly. when the number of appliances in a home increases ,the sensors offer less complexity in terms of cost and implementation. A website that able to control the states of appliances along with monitoring the home using camera images by using bimodal approach was also discussed in the paper.The currently proposed technology for home automation is very much limited to detecting the states of Television, Fan, Tube light of a given color which acts as a major constraint to generalize the model to work on any set of Television, Fan, and Tube light.

This paper[10] is discus about a novel method to recognize facial expression. Here we use Active Appearance Model (AAM) to extract facial regions based on Facial Action Coding System (FACS). The main aim of this system is to recognize expression effectively on effective expression regionsIt contains three parts:expressionrecognition through Support Vector Machines (SVMs), extraction of facial regions based on AAM andextraction of facial features by Gabor wavelet transformation.To reduce influences of face pose the system extracted and normalized the facial regions by using AAM. AAM has better performance than other methods thus can effectively increase the recognition accuracy. The performence of Active Appearance Model in eliminations of the influence of different facial region size, head pose and lighting condition is greater than other models .Becuase of this property the AAM is used to extract facial regions before extracting features by Gabor wavelet transformation. The SVM is used here recognize expression for solving the problems of small sample size and overfitting. Through extensive studies on this system it is clear that it has high performence than other systems.

This paper[11] aims to deliver a facial expression-based emotion recognition method with transition detection for students suffering from high functioning autism. since they cannot control their emotions such as anxiety ,anger etc. It will weaken their learning processes. So here to retrieve facial based landmark signals, an emotion elicitation process is carried out. It is further used for the purpose of building classifiers according to emotions. To recognize each emotions here uses methods that are sliding window technique and support vector machine(SVM). For feature evaluations Information Gain (IG) and Chi-square were used here. This method can be used in an adaptive e-learning environment.

This paper[12] illustrates that home environment is enhanced with recognition,sensing,influence,communication and estimation facility is to be called as Smart home.which allows to conform it toinhabitants preferences and requirements.Establishing a suitable scheme of actuation on home environment can require computational task on the apprehensive data.This is one of the condition of the activity recognition.The inherent complexity of this application domain demands for tools fitted to perfectly support the design and implementation phaces.This paper suggests a framework for the design and implementation of smart home applications points on activity recognition in home environments.The framework mainly relies on the Cloud-assisted Agent-based Smart home Environment (CASE) architecture offering basic abstraction entities which easily allow to design and implement Smart Home applications.CASE is a three layered architecture which effort the distributed multi-agent paradigm and the cloud technology for offering analytics services. the CASE architecture are supplied focusing on the low-level technological issues as well as the algorithms and the methodologies useful for the activity recognition. The effectiveness of the framework is shown through a case study consisting of a daily activity recognition of a person in ahomeenvironment.This paper suugests a framework featuring activity recognition in Smart Home environment.The framework efforts the presented Cloud-assisted Agent-basedSmart home Environment (CASE) platform. CASE is a novel platform for the distributed recognition and actuation in Smart Home environments which afford a simple integration between physical entities,a distributed multi-agent system, and a cloud infrastructure. In the CASE

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architecture, agents are spread both on local nodes andon the cloud to manage sensors/actuators or to execute complex algorithms.Ongoing work points on the exhibit of a case study set up in a real home environments, wheremore activities, comprending several rooms together, can be analyzed. Future work will be attatched both to an improvement of the CASE platform and to the verifying of a wider use case that involove not only the activity recognition task but also home automation and energy optimization.

In this paper [13]communication between interconnecting devices and applications are allowed by the concept of Internet of things .We are penetrating a new era of computing technology. Whereby physicalobjects or thing communicate through the internet.Life is getting simpler and easier in all facet With the advancement of Automation technology.Here the system use a microprocessor and mobile devices to control basic home functions and features automatically through the internet from anywhere around the world. Through an internet connection The system offers from other systems by allowing the user to operate the system . A well-connected and self-sufficient smart home was provided by the system to the user. This smart home will include smart appliances, smart lights, intrusion detection, fire detector, smart thermostat, the health monitoring device embedded in the user.Also the quality of air and water can be find in smart home automation.this system will not only make a home eco-friendly by conserving electricity and water.Raspberry Pi, sensors and actuators are used in the system . the user can interact with the system easily With the help of 'Gracey'.Make our home automation system user – friendly as well by using 'Gracey' .

In this paper[14]discus about Facial Expression Recognition and Analysis devoted to intensityestimation and FACS Action Units detection on set of data .Facial expression analysis is the most growing fieldofresearch,becuase of increasing interest in human-machine communication. There are two sets of databases are used for analysis,they are BP4D and SEMAINE.The BP4D database consist of video data for testing and training and SEMAINE consistof study natural social signals from the onversations among virtual humans and people .These two databases contains more number of training sets .Because of these training sets the system can reduce time for training models.This is the first system developed by using these two databases.This analysis consist of Three parts that are: fullyautomatic AU intensity estimation,the detection of AU occurrence and the estimation of AU intensity for pre-segmented data.This system deals with problems of the expression intensity assessment and powerful detection under non-frontal head poses. This work indicating the set of data used for analysis, evaluation protocol and and the results of a guidelinemethod for the three parts.

This paper[15] presents automated facial expression recognition by deep neural network architecture. The aim of this paper is to direct the facial expression recognition problems over standard face datasets. The input of this architecture is registered facial images then classifies these images with expressions. Basically there are 2 convolutional layers in this architecture. Then each followed by max pooling and then four Inception layers. The main advantage of this method is, it achieves an increased classification accuracy on both subject independent and cross-database evaluation scenarios.

In this[16] work we createda practical person traking system to solve most of the real world problems in context of our Easy Living project in intelligent environments.For tracking multiple people during live demonstration in a living room ,we use two sets of color stereo cameras. for to locate people stereo images are used and the color images are usedfor maintaining their identities.The system runs rappidly enough to make the room feel responsive, and it tracks multiple people standing,walking, sitting, occluding,and entering and leaving the space.cameras mounted on the room's walls. Because we give live manifestations, and because we are trying to create practical scenarios, we were avoid from making many simplifying arrogance.It works with multiple people as they walk, stand, and sit. People can enter and leave the place as the demonstration proceeds. Overall, our tracking system performs reliably, and we have used it to build demonstrations that let us search issues of software architecture, geometric representation, and user interfaces for practical intelligent environments.

This paper [17]propose a dynamic texture-based approach to the recognition of facial Action Units and their temporal models in near-frontal-view facevideos. an extended version of Motion History Images and a novel method based on Nonrigid Registration using Free-Form Deformations are the Two approaches to modeling the dynamics and the appearance in the face region of an input video.In both the spatial and temporal domainthe extracted motion representation is used to derive motion orientation histogram descriptors.To detects the presence of the AU in question and its temporal segments in an input image sequence here use AU, a combination of discriminative, generative Hidden Markov Models ,frame-based GentleBoost ensemble learners .Using the Cohn-Kanade database The generalization performance of the method has been tested . on spontaneous expressions in the Sensitive Artificial Listener data set we also explored the performance.To model dynamics of facial texture in near-frontal-view face image sequences for the purposes of automatic frame-by-frame recognition of AUs and their temporal dynamics we use the proposed method based on nonrigid registration using free-form distortions . This is the first appearance-based approach to facial expression recognition that can expose all AUs and their temporal segments to the best of our knowledge. Based on Motion History Images.We have contrast this approach to an extended version of the formerly proposed approach .

The system[18] propose classification and feature extraction of 6 basic emotions: happy, surprise,sad,fear, angry,and disgust by using convolution neural network (CNN).There are many researches in the field of automatic emotion recognition.Initialy applied pre-processing steps. That are : face detection, cropping, resize, adding noise, and data normalization.This system is based on machine learning approach.Here using enhanced Convolutional Neural Network

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method(CNN).The CNN consist of different layers so it can reduce error rate and it tried to reduce variance of the data.The first phase ofthis system is capturing of input image then it put forward to next phase tha is face detection and cropping then global normalization and local normalizationext is adding noise and finally data normalization.The proposed system can give better performence on 32x32 and 64x64 resolution. The main aim of this system is to understand 6 basic emotions and improved performance in preprocessing methods through the CNN.

This paper[19] delivers facial expression recognition using Fisherface method. In recognition process feature extraction is very important thing. If the extracted features are insufficient the entire process fails to detect correct expression. Here Fisherface construction performs extraction of features of facial expression . here the classifier used is Back propagation neural network which classifies the expressions. integral projection method is also used to support the system performance. Since this method is very sensitive with illumination and noise Images with varying background are not suitable for this method.

This paper [20]proposes the issues of learning situation models for provide context aware services. Context for modeling human manner in a smart environment is exhibitted by a situation model illustrating environment, users and their activities. A framework for achieving and developing different layers of a situation modelin a smart environment is proposed. Verity of learning methods are presented as part of this framework: role detection per entity, unsupervised extraction of situations from multimodal data, supervised learning of situation representations, and the evolution of a predefined situation model with feedback. The situation model serves as frame and support for the different methods, permitting to stay in an apprehensive declarative framework. The proposed methods have been integrated into a whole system for smart home environment. The implementation is detailed and two evaluations are conducted in the smart home environment. The obtained resultsvalidate the proposed approach.Although the received results are supporting, the realization of a smart home prevention the needs and orientation of the user is still far away. First products that a user could buy in his local computer store and install himself are not mature enough. First, the sensors necessary for a reliable sensing of user activities are still too invasive. Multiple cameras, microphones or other sensors must be installed and calibrated in the home.These are still not auto-installing and not easytouse.Second, even though our results are promoting the error rates are still too high. Further progress in finding and learning algorithms are required inorder to arrange a reliable system that could be agreed by a user in his daily life. One way to alleviate this is to provide description.When errors occur the user could recognize and correct wrong system understanding and reasoning himself.

IV.CONCLUSION

Our system is to deliver a high accurate home automation system with energy consumption and prediction .The main purpose of Home automation system is to make our home function elegant. The proposed system strictly maintain energy usage by monitoring the energy used by each devices and it can also predicts energy to be consumed in next month .Due to this features the user itself could get an idea about the energy consumption, so that they can control usages accordingly. Hence our system will be stepping stone to an energy efficient society.

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