A test bed for Intelligent Internet of Things platform to enhance life at home

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Abstract: The integration of artificial intelligence and Internet of Things (IoT) leads to the development home automation systems and increases the status of living of civilized human life. Intelligent platform design for home systems provide home products control remotely and computerization of systems, with the purpose of improving the comfort, safety, security, luxury, and energy efficiency of home surroundings. The design of intelligent IoT platform test bed includes sensors, actuators, controllers, communication protocols, home learning technique and user interfaces. Intelligent home platform draws attention to the function of embedded devices, machine learning which act as the essential building blocks of these systems by supplying the required connectivity, processing power and soft tool techniques. The embedded system and artificial intelligence also use IoT technology, which enable smooth device interoperability and communication, learning of home machines, opening the door to highly developed flexible automation and control capabilities. This paper discusses Intelligent Internet of things platform and issues including security, privacy, standards, and user adoption and offers possible fixes as well as future research possibilities. Creating AI algorithms that will help home automation systems realize and react to user situation and preferences more effectively which can be done in future.

Keyword: AI, Home automation, IoT platform, Face recognition algorithm;

INTRODUCTION

An intelligent home automation system is to improve the energy efficiency, convenience, and security of home surroundings. With embedded devices, AI, and Internet of Things (IoT) technology, these systems integrate numerous household systems and equipment, intelligence of home machines, enabling their automation and remote control. The core components of intelligent home automation systems are embedded devices to offer the processing power and networking required to communicate with a variety of sensors, actuators, and controllers in a house. These gadgets gather and analyze data along with AI techniques to allow for real-time home function monitoring and control. By enabling objects to communicate with external systems and with one another over the internet,

IoT technologies further improve these capabilities and provide remote access and control via computers, smart phones, and tablets such as controlling the lighting and temperature to more difficult ones like energy management, security monitoring, and health monitoring. This integration of technologies allows systems at home to give personalized experiences, learn from user behaviour, and adapt to changing situations. This platform frequently gather and retain sensitive personal data, which makes them vulnerable to cyber attacks and unauthorized access, security and

privacy considerations are of utmost importance. The standard protocols among diverse devices and platforms gives rise to compatibility issues, which in turn cause challenges in the integration of goods from different manufacturers. The standards for communication protocols and device interoperability are analyzed in this platform. This platform solves all the issues of different integration.

This paper organized as methodology, implementation and discussion about results. Finally this paper discuss about the conclusion.

Mohammadzadeh et al [1] discussed about the smart city healthcare delivery innovations and systematic review of essential technologies and indicators for developing nations. Nastjuk et al [2] discussed about the smart cities and smart governance models for future cities. Ben Dhaou et al [3] analyzed the edge devices for Internet of Medical Things and technologies, techniques, and implementation. Geetanjali et al [4] discussed about the applications of Artificial Intelligence, Blockchain, and Internet-of-Things in Management of Chronic Disease. Rafiq et al [5] discussed about the IoT applications and challenges in smart cities and services.

II Methodology

This platform integrates machine learning, embedded devices and internet of things. The figure 1 shows the devices involved in the test bed of intelligent internet of things for home.

Embedded Devices: These are the essential components that provide home automation systems their necessary connectivity and processing capability. They consist of actuators, sensors, and microcontrollers that keep an eye on and manage daily activities in the home. CPU provides details about the processing capabilities of the device and is expressed in GHz.

IoT Technologies: IoT enables remote access and control by enabling device interconnection over the internet. IoT protocols like MQTT, Z-Wave, and Zigbee are implemented.

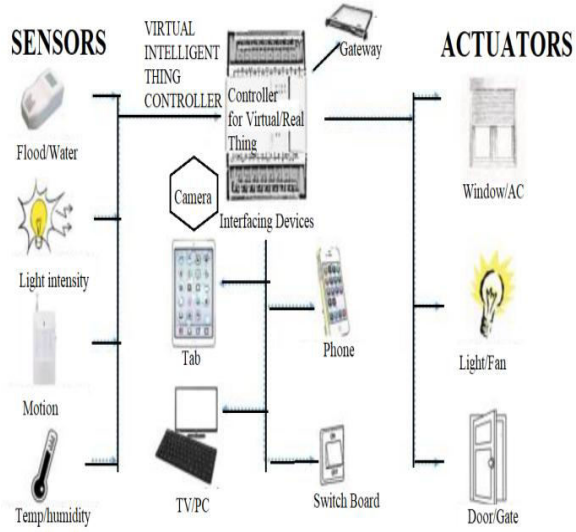

Figure1. Test bed of intelligent internet of things for home

Actuators and sensors: Sensors gather information on a range of characteristics, including light, motion, humidity, and temperature. Actuators use sensor inputs to do tasks like locking doors, regulating thermostats, and turning on lights.

User interfaces: These let people communicate with the automation system through voice assistants, control panels, and mobile apps. For interfaces to be widely adopted, they must be simple to use and intuitive.

AI application: This resource describes the type of inference that can be performed by the physical device, e.g., object detection, face recognition, and audio classification for assisting human at home.

Model: It describes the type of CNN that the device runs locally and for which it can provide an inference. Start inference trigger the execution of the inference task by a consumer application. Output provides the output of the inference, e.g., the set of detected objects in a picture or in

video source, along with the measured accuracy and the coordinates of the bounded box of the detected object.

Figure 2 shows the intelligent IoT proposed model for home. It is basically divided into 3 layers. These three layers are device layer, Network and virtual intelligent thing layer and Application layer for user interface.

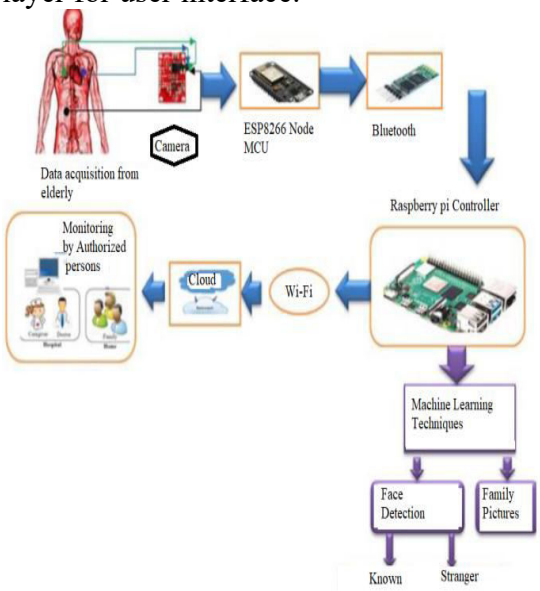

Figure 2. Intelligent IoT Proposed model for home

III System implementation

The Intelligent internet of things to enhance home platform has three layers such as device layer, network and virtual intelligent things and application layer.

Device layer:
Intelligent IoT platform first layer is the devices layer. i.e., devices equipped with AI capabilities. Through embedded sensing capabilities, they can collect data feeding the on-board inference engine. The sensors vision sensor, PIR sensor, RFID tags, Temperature /Humidity sensors and variety of sensors are interfaced with the controller for assisting human at home as shown in figure 3.

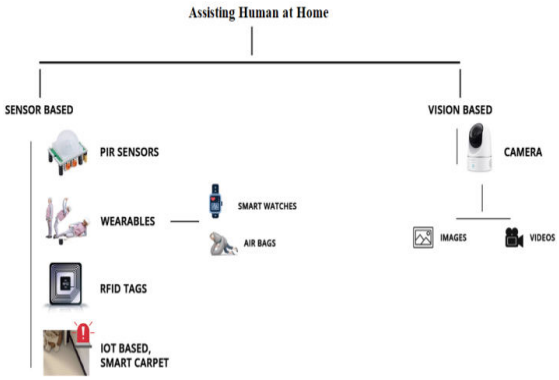

Figure 3. Device layer

Network and Virtual Intelligent thing layer:
In this proposal, AI network and virtual thing layer represented by the digital counterparts of the physical devices is hosted at the edge. Each physical device is associated with virtual intelligent thing. At the top of the architecture, network layer with intelligent IoT home applications, which may request inputs from cognitive machinery hosted in IoT devices through virtual intelligent thing. In IoT, network and virtual intelligent thing layer targets the following crucial objectives:

(i) overcoming platform heterogeneity,
(ii) ensuring interoperability between different network devices
(iii) improving search and discovery, and
(iv) Reducing the pressure on constrained devices.

It provides the semantic description of the physical AI. These AI empowered counterpart is to ensure a common understanding of its features and capabilities among all potential consumer home applications. It describes the cognitive method of embedded components by abstracting the specific hardware and software platform implementation. It acts as a alternative between the physical device and the home consumer applications. It caches the output of inference procedure performed by the

physical device. Hence, the resources of the physical device will be saved. It leads to there would be no need to re-run the inference task to reply to each request issued by different home applications. It can train the NN model, on behalf of the cloud. So that it ensure a higher closeness to the physical device where it should be injected. Hence it can optimize the pre-trained NN model. Before its injection into the device, NN also helps for face detection.

Application layer
These let people communicate with the automation system through voice assistants, control panels, and mobile apps. For interfaces to be widely adopted, they must be simple to use and intuitive. Figure 4 shows the mobile app implementation of intelligent internet of things platform for home improvement.

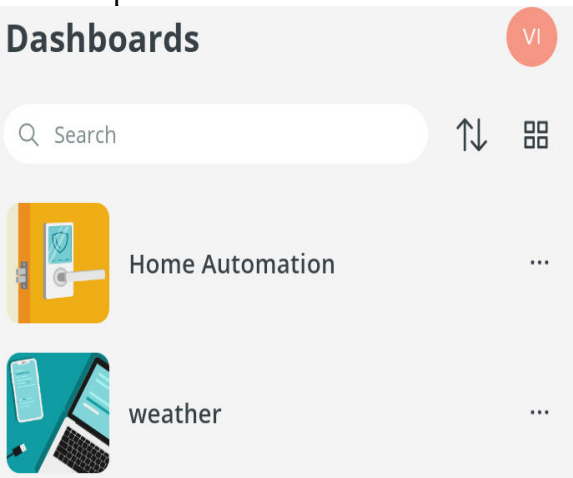

Figure 4.Mobile app Implementation

IV RESULT AND DISCUSSSION

The completed test bed implementation is shown in figure 5, which displays the product of the test. At addition, this system have validated the performance of the various machine learning algorithms by making use of the data set from the database for face detection of known persons.

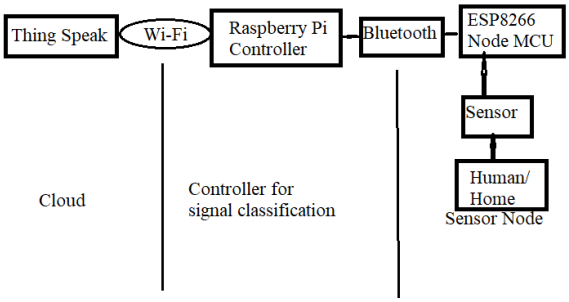

Figure 5. Hardware implementation

Algorithm for face detection:
1. Capture the Person's Image
2. Apply algorithm Face Detection
3. Extract the Region of Interest in Rectangular Bounding Box
4. Convert to gray scale, apply histogram equalization and Resize to 100x100
5. if Updating Database then
Store in Database
Else
Apply Principal Component Analysis for feature Extraction
Apply Support Vector Machine for Classification
End if
6. Post-processing

A systematic assessment of embedded devices, artificial intelligence and Internet of Things based intelligent home automation systems includes a systematic analysis of the systems development, elements, uses, advantages, drawbacks, and potential future directions. From basic automated tasks to complex ecosystems made possible by embedded devices, artificial intelligence and Internet of Things technology, intelligent home automation systems have seen tremendous evolution.

In the beginning, home automation was only concerned with basic features like HVAC and lighting control by remote and wireless. Microcontrollers, sensors, actuators, embedded systems, Neural network and communication protocols have all advanced, enabling these systems to perform sophisticated functions

including energy management, automation, security monitoring, and health monitoring. These system fundamental components are embedded devices and sensor network, which offer the connectivity and processing power required for real time data processing and control. These gadgets are specifically made for certain uses in the home, and they easily integrate with the current infrastructure because of their small size, less cost and low power consumption.

By enabling remote wireless devices and system control via smart phones or voice commands, intelligent home automation systems improve convenience and enhance life system. This includes controlling lighting, changing temperature settings, and keeping an eye on security cameras from any location. Automation systems reduce energy use by using motion sensors to regulate lighting, adjusting HVAC systems based on occupancy or weather, and incorporating renewable energy sources like solar panels and energy storage systems. Smart locks, security cameras, and motion detectors are integrated security systems that improve home security and peace of mind in elders by offering real-time alerts and remote monitoring.

With the ability to track vital signs like blood pressure, heart rate, and level of activity, IoT enabled devices can offer important information for the care of the elderly and people with long term illnesses. Now security at home is increased using this platform for elderly people and child protection system because of face detection open door system.

IoT device interconnectedness creates worries about cyber security flaws and data privacy. To safeguard user information, it is essential to have strong encryption, authentication procedures, and frequent security updates. Hence two way security system protection implemented for more security. These broader technological advancements change consumer needs, and a growing emphasis improve energy efficiency, security, and convenience. The many parts of a home automation system cooperate to monitor, regulate, and automate numerous aspects of the living space.

With the use of these parts, customers can frequently remotely or automatically regulate lighting, security, climate control, entertainment systems, and more. A home automation system central processing unit, often known as a hub or gateway, is its brain. It controls the data and command flow between all connected devices by serving as their main point of contact.

Although there are many advantages to home automation systems, there are also a lot of difficulties and worries. The primary concerns are security and privacy, since these systems gather private information that may be compromised or accessed by unwanted parties. It can be prevented by creating awareness about sharing private data among unknown. These systems complexity and usability, along with problems like device compatibility can be a barrier, especially for non-techies elderly people and children. It could be overcome by the learning of technology to them.

Furthermore, potential customers may be discouraged by the high initial and recurring costs. Hence system implementations lead difficult. System reliability is frequently questioned because of probable downtimes and software bugs. Hence proper system maintenance should be done. The capacity of home automation systems with AI is to improve convenience, security, energy efficiency, and general quality of life. It has led to their growing popularity and life style enhancement.

CONCLUSION

IoT technology is a future paradigm for smart home development to overcome problems created by elderly people. Internet connectivity of IoT systems produced enormous security issues and privacy risks that have to be overcome and solved. Number of challenges related to services, communication frameworks, protocols standardization, architecture designing and IoT device manufacturing have been discussed for future recommendations. Future directions give a way to understand and research solutions, strategies, techniques and models for making better deployment of home automation applications.

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