Interaction Paradigm of IoT using Augmented Reality

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Abstract - IoT in other way could be a combination of physical objects with virtual representations and services. The foremost famous implementation of IOT involves Home Automation Systems. The most recent formation of IOT is now converging to IOE (Internet of Everything). While using this technology, one can access each and every device, equipment and machinery within its surrounding through any application or "middleware system". Each home will become a smart home in future, where user is going to be having remote access to every and each appliance of his/her house. For this technological enhancement The Augmented Reality (AR) is among top trending technology of today i.e creating visual solutions of digital problems and experiencing and visualizing them within the world. Augmented reality integrates the unique abilities of kinsfolk that can't be replicated by AI, and bonafide concerns about AI are raised by some visionaries.

AR only uses the camera of any smartphone and therefore the application will display the digital information associated with the environment ahead of the user by using the phone camera. My Research's goal is to combine the powerful digitizing feature of Augmented Reality with IOT. The Augmented Reality provides a way for presenting the digital information over physical objects, using this approach, we have got created a new interface paradigm for IOT. The IOT device has its particular interfaces mapped on the physical IOT device using AR. Instead of trying to appear out the interface, user are visiting be just placing his smartphone camera over the thing and interact with it directly using AR interfaces. The IOT device is also connected with every other using digital wires through AR, using this approach we are visiting connect inputs to a minimum of 1 or more outputs just by connecting digital I/O points that we have got created in our project. This provides features like sharing the feature of timer switch of oven with any device like fan or bulb, or using fan regulator not just to control speed of fan but also connect it digitally with light bulb and handle the brightness/light intensity through the regulator

Key Words: Augmented Reality, (AR), Internet of Things, IoT, tracking, interaction

1. INTRODUCTION

IoT in alternative method might be a mixture of physical objects with virtual representations and services. The foremost celebrated implementation of IOT involves Home Automation Systems. The foremost recent formation of IOT is currently connection to IOE (Internet of Everything). Whereas victimisation this technology, one will access every and each device, instrumentality and machinery inside its close through any application or "middleware system". Every home can become a sensible aim future, wherever user goes to be having remote access to each and every appliance of his/her house. For this technological improvement the increased Reality (AR) is among prime trending technology of nowadays i.e making visual solutions of digital issues and experiencing and visualizing them inside the globe. Increased reality integrates the distinctive skills of ancestry that cannot be replicated by AI, and bonafide issues concerning AI square measure raised by some visionaries. AR solely uses the camera of any smartphone and thus the appliance can show the digital data related to the atmosphere earlier than the user by victimisation the phone camera. My Research's goal is to mix the powerful digitizing feature of increased Reality with IOT. The increased Reality provides some way for presenting the digital data over physical objects, victimisation this approach, we've got created a replacement interface paradigm for IOT.

The IOT device has its specific interfaces mapped on the physical IOT device victimisation AR. rather than attempting to seem out the interface, user square measure visiting be simply putting his smartphone camera over the issue and move with it directly victimisation AR interfaces. The IOT device is additionally connected with each alternative victimisation digital wires through AR, victimisation this approach we have a tendency to square measure visiting connect inputs to a minimum of one or additional outputs simply by connecting digital I/O points that we've got got created in our project. This provides options like sharing the feature of timer switch of kitchen appliance with any device like fan or bulb, or victimisation fan regulator not simply management| to regulate| to manage speed of fan however to attach it digitally with lightweight bulb and control the brightness/light intensity through the regulator

2. AUGMENTED REALITY IN SMART ENVIRONMENT

AR describes an integrated view where virtual objects are blended into a true environment in real time (Milgram et al., 1994). While the concept of enriching a true environment with virtual objects goes back to the center of the 19th centure. New commercial products with better display and tracking functionalities like Microsoft's HoloLens are prototypes towards a future during which vision is pervasively augmented with smart contact lenses or glasses (Perlin, 2016). My approach is to integrating AR into smart living environments . I aim to enhance the traditional view with virtual interactive control elements to reinforce interaction with the environment. Therefore depend on a

wise environment platform which has a minimum of a twofold accessible interface.

3. TOOLS & TECHNOLOGIES

3.1 Software Tools
3.1.1 Unity 3DUnity:

Unity 3DUnity is also a cross-platform game engine developed by Unity Technologies, that is in the main accustomed produce laptop games and recreations for PCs, consoles and cell phones. Among the primary place declared just for OS X, at Apple's Worldwide Developers Conference in 2005, it's since been stretched to specialize in twenty seven platform.

3.1.2. Vuforia SDKVuforia :

Vuforia SDKVuforia is associate degree increased Reality computer code Development Kit (SDK) for cell phones that empowers the formation of increased Reality applications. It utilizes laptop Vision innovation to understand and track planate footage (Image Targets) and simple 3D objects, for example , boxes, more and more. This image time period ability empowers engineers to position and situate virtual articles, for example, 3D models and different media, in affiliation to real footage once these area unit seen through the camera of a phone. The virtual question at purpose} tracks the position and introduction of the image more and more so read point .the point of view the perspective} on the protest compares with their point of view on the Image Target, therefore it provides the idea that the virtual question is also a locality of this gift reality scene..

3.2 Hardware Tools
3.2.1 Arduino Micro Controller:

Arduino is associate degree ASCII text file physics platform supported easy-to-use hardware and computer code. Arduino boards area unit able to scan inputs - light-weight on a device, a finger on a button, or a Twitter message - associate degreed switch it into an output. We are going to tell your board what to undertake to by causation a gaggle of directions to the microcontroller on the board. To undertake to therefore we tend to use the Arduino artificial language (based on Wiring), and therefore the Arduino computer code (IDE), supported process.

3.2.2 ESP8266 Wi-Fi Module:

ESP8266[12] is also a system-on-a-chip (SoC) with capabilities for 2 .4 gigahertz Wi-Fi (802.11 b/g/n, supporting WPA/WPA2), general input/output (16 GPIO), Inter-Integrated Circuit (I^2C), analog-to-digital conversion (10-bit ADC), Serial Peripheral Interface (SPI), I^2S interfaces interfaces with DMA (sharing pins with GPIO), UART (on dedicated pins, plus a transmit-only UART are often enabled on GPIO2).
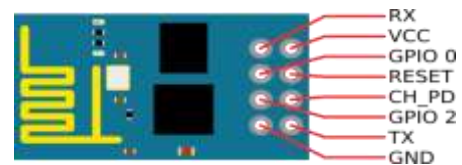

Fig -1: ESP8266 Pin Configuration

4. IMPLEMENTATION

4.1 System Design
4.1.1 Hardware Design:

There are two major parts of Hardware Design. One is creating an IoT device from micro-controller along with Wi-Fi module ESP8266 which is used to access devices over network connection. The Circuit Schematics of this is below
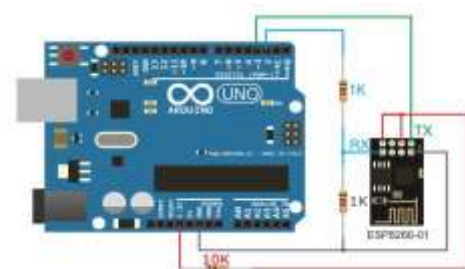

Fig -2: Enabling IoT using Arduino Micro-Controller

Second device is to control the AC device using that IoT enabled micro-controller with relay. As per condition switching pulses are passes from Arduino to relay device. Where relay switch from normally open to normally closed condition so at the output side, device get turn on, that's why relay is consider as bridging device between controller and output AC devices. The Circuit Schematics of this is designs given below
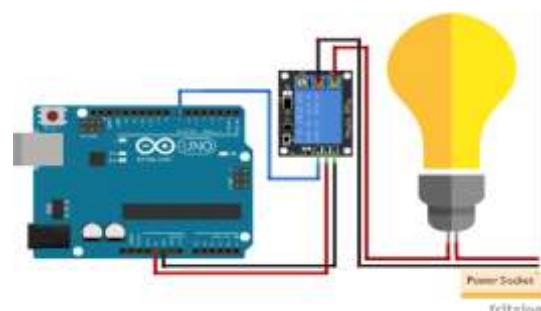

Fig -3: AC Device Controlling via Arduino

a) Arduino Flowchart

Arduino process is divided into two parts. One is controlling of Input Devices and other is controlling of Output Devices. Both process are being shown in below flowcharts.
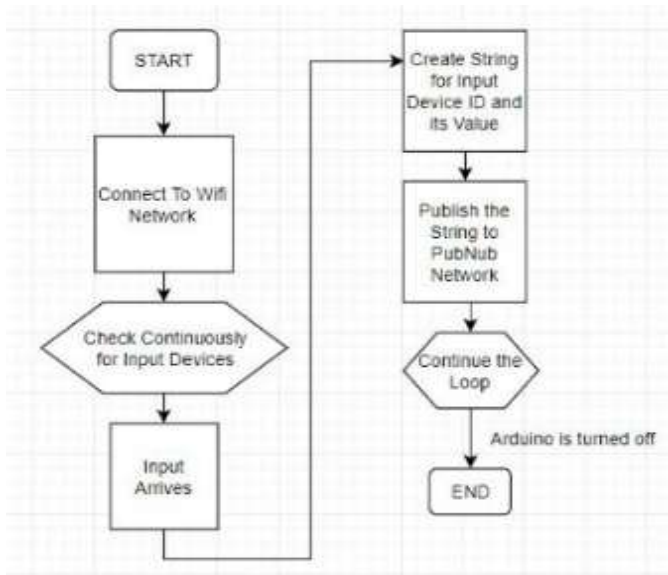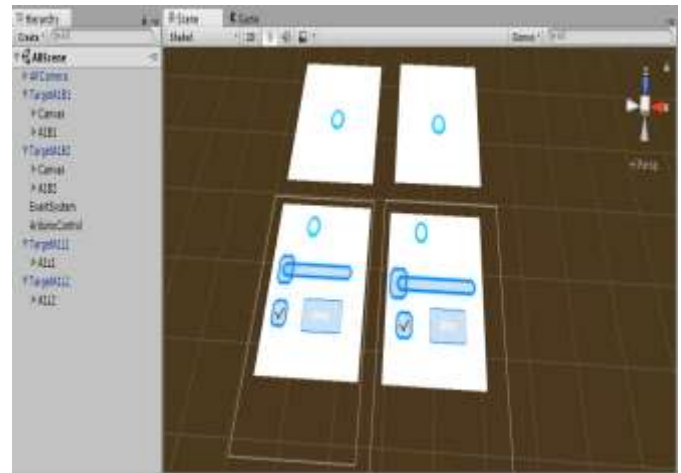
Chart -1: Input points flowchart

Chart -2: Output points flowchart

4.1.2 Software Design

The Mobile Application has been developed using cross platform development tool Unity 3D. The Designing part includes design of tracker and objects that are mapped using Augmented Reality SDK. The controlling objects are placed on tracker plane in Unity 3D as shown in figure below.

Fig -4: Objects Placement in Unity 3D environment

a) Unity 3D Program Flowchart

Mobile Application is developed using this platform. The overall working process of the application is shown in flowchart below
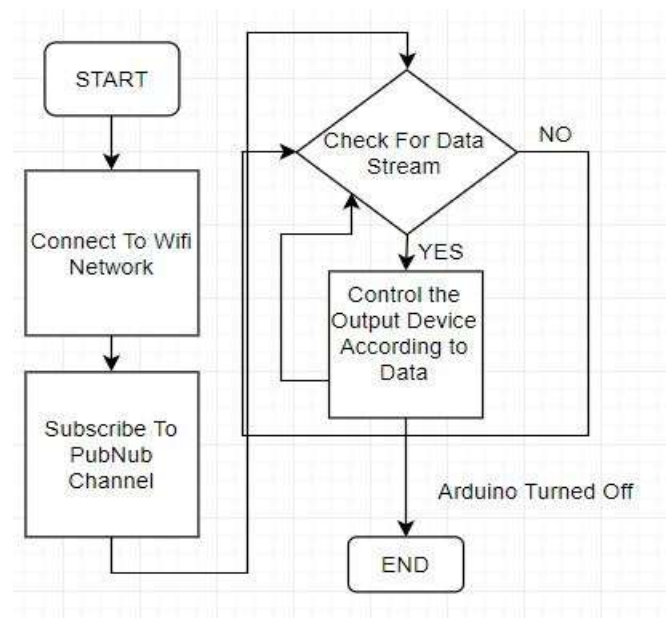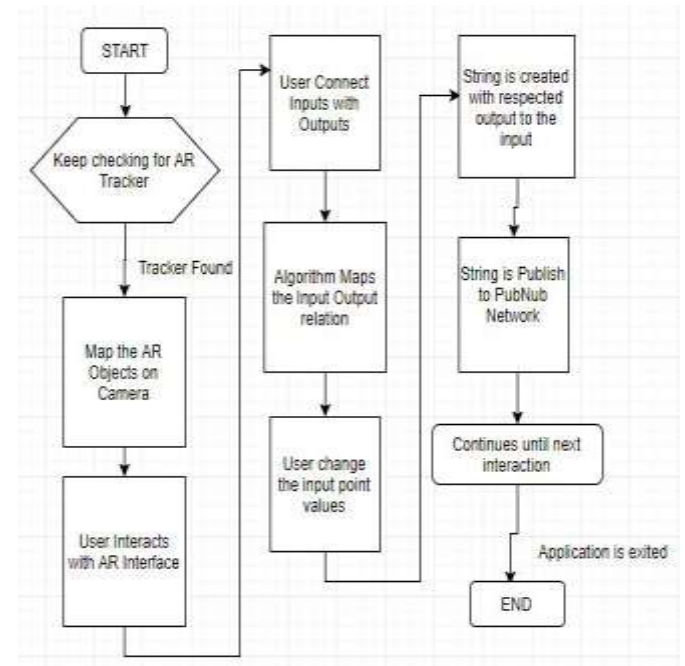

Chart -3: Mobile App Flowchart

4.1.3 PubNub Network

PubNub is nothing but a programmable network for developing real-time applications; an evolution from three-tier architecture, purpose built to handle all the complexities of knowledge streams. PubNub operates at the sting of the network to handle and apply logic to realtime data, thereby minimizing latency to a hundred milliseconds or less worldwide, and guaranteeing dependability and quantifiability. PubNub is accustomed quickly push little

messages to one or a lot of devices (smartphones, tablets, desktops, microcontrollers, etc.) basically, nearly any device which may create a TCP/IP association to net – what is more as back once more, for bi-directional communication between devices. These messages is employed for human communication (like on-line chat), machine-to-machine management, IoT, geolocation, good homes, money information, multiplayer games, and much a lot of. PubNub is aware of that security, information possession, and access management area unit crucial to any realtime application that is why we've engineered the entire information Stream Network around these core tenets.

5. PROPOSED ALGORITHMS

Our projected work for this project is creating the conception of digital wires. The digital wires are supported AR I/O purpose objects and line renderer to connect the Inputs with Outputs. Presently before shaping the procedure for creating digital wires in IoT exploitation AR, there ar few things that has got to be made public first. In Digital wire conception, the IoT has been weakened into two major parts considering the life-style interaction. In modus vivendi, we tend to tend to maneuver with exclusively two styles of electronic devices that are either Input or either Output.

Now exploitation this concept, we've broken IoT devices usefulness in to 2 categories "Input purpose Devices" and "Output purpose Devices". Exploitation this we've created the I/O points or Digital wire conception. Presently considering this interaction, we've derived one major issue i.e. "One single input can management multiple outputs but one single output can exclusively be controlled by one single input". This statement is taken into consideration as back-bone of our rule. Presently keeping this concept in mind, we've designed the code rule to figure and alter consequently thus creating the conception of digital wires

5.1 Algorithm for Working Implementation

The Algorithm is employed for writing script within the Unity 3D for the backend working of Digital Wires.

5.1.1 Global Object Pseudo Code

STEP 1: Start
STEP 2: Create Global Variable of Dictionary (A key value pair data type) in C# script
STEP 3: Create a worldwide variable of String Array
STEP 4: Create a worldwide accessible method with arguments of the input name which is looking and also the value which the input must provide
STEP 5: Then we've to test whether what quantity outputs the precise input has been connected with using line renderer
STEP 6: Then we put all the outputs the input object is connected within the temporary string array
STEP 7: End

5.1.2 Output Object Pseudo Code

STEP 1: Start
STEP 2: Create a callback method to test for mouse input on output object
STEP 3: Whenever the output object is clicked we check if the output is previously connected with the alternative input object or not by check the world Dictionary
STEP 4: If it's already there then we are visiting remove it first from that connection
STEP 5: at the moment we are visiting put the output object and also the input object within the Dictionary as Key Value Pair
STEP 6: End

5.2 Algorithm for Network side Implementation

The Data is communicated between the software mobile application and also the hardware IoT devices via the PubNub network. The algorithm is employed on both hardware side and software side of the system for communicating with one another.

5.2.1 PubNub Subscribe Pseudo Code

STEP 1: Start
STEP 2: Create PubNub thread for continuous communication with the PubNub network and for receiving and sending Data
STEP 3: Using the PubNub thread for Global Object script to send the encoded string
STEP 4: Create a separate script for PubNub Subscribe in order to receive data
STEP 5: subscribe the actual channel on which all devices are sharing data
STEP 6: Check for the encoded string data received from the network
STEP 7: Call the global object method for checking the related outputs
STEP 8: End

5.2.2 PubNub Publish Pseudo Code

STEP 1: Start
STEP 2: Create object of PubNub Thread Class
STEP 3: Provide the Generated keys of Publishing and Subscribing to thread object
STEP 4: Using PubNub thread subscribe to the particular channel
STEP 5: Publish data whenever it is required by calling in any script
STEP 6: End

5.3 Algorithm for Hardware Side Implementation

We have used Arduino micro controller to connect with the network and intercommunicate with other nodes on the network and control the devices attached physically with the Arduino. Each input or output device attached with the Arduino is acting as an IoT device and sharing or receiving data from over the network via Arduino.

5.3.1 Input Points Pseudo Code

STEP 1: Start
STEP 2: Initialize Input object as digital input and assign Pin Number STEP 3: In the Arduino loop method continuously check for high and low input STEP 4: Whenever the value is high we write the Button ID and High value and when its low we write Low value line in order to serial line for Esp8266
STEP 5: For analogue inputs we first need to map it with outputs levels
STEP 6: After then we have to write that Input ID along with output value
STEP 7: End

5.3.2 Output Points Pseudo Code

STEP 1: Start
STEP 2: Initialize digital output or analogue output accordingly and assign pin number
STEP 3: In the Arduino Loop method we need to run a loop to check the receiving data stream from the network and iterate over the stream to access the characters
STEP 4: In the stream, we need to check for encoded string for Output ID and value
STEP 5: After checking we need to send that particular value to the particular output
STEP 6: Clear the current stream and wait for another one to receive from the network
STEP 7: End

5.3.3 Networking Pseudo Code

STEP 1: Start
STEP 2: Make a connection with network using the previous algorithm
STEP 3: Connect with PubNub using the Generated Keys for Publish and Subscribe
STEP 4: Check if data is available and get the data stream using PubNub object
STEP 5: Provide the Data Stream to output Algorithm if Node is Output, keep in mind that we can only create one Arduino either as input or either as output
STEP 6: For Input Node, use the PubNub object to publish the data of Input Points Algorithm
STEP 7: End

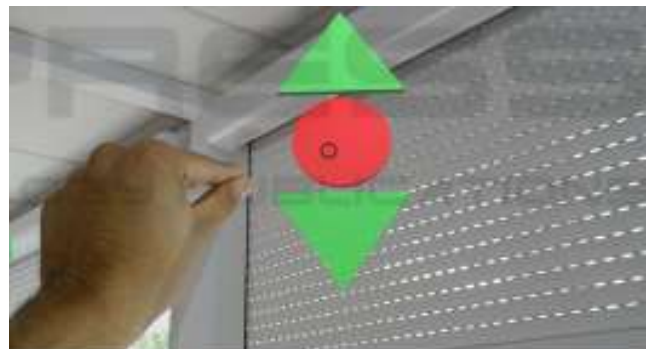**Fig -5:** Room with multiple virtual control elements

Fig -6: Control element for the roller shutter item type

Fig -7: Scanning of a QR code using the ARGI app.

6. RELATED WORK

There are many other works which aim to implement a distant control for a wise living environment. As an example, Seifried et al. presented the CRISTAL tabletop system to manage devices during a lounge with gestures (Seifried et al., 2009). While such systems provide a central remote, they'll not use in free space but are sure to a particular location.. As compared, this AR-empowered approach grants more possibilities to visualise the interaction capabilities of a tool and visual feedback. Although, this admit that a user must wear an AR device rather just like the HoloLens to be ready to use our system which could get uncomfortable the longer a user wears the device. The interaction with smart environments for a more robust assistance in adulthood isn't among the standard application domains of AR like medical

visualization, maintenance and repair, or teaching and learning (Azuma, 1997)(Wu et al., 2013). Though, Kriesten at al. purposed an AR approach to interact with a wise environment employing a mobile which is analogous to ours (Kriesten et al., 2010). However, my approach goes a step further because it enables free space gestures with the assistance of a head-mounted AR device instead of a mobile, Also ARGI relies on Eclipse Smart Home as a proved & freely available smart environment solution which is useful to extendability and reliability

7. CONCLUSION

In future, machines alone may be dominate decision-making in most examples. There will nevertheless be a fairly long interim during which the foremost intellectual advances are made by kinsfolk and computers working together in intimate association. IoT is such a section that can integrate human and computer Intelligence to unravel emerging problems. Both affect the longer term of work, organizational productivity, the blurring of industry boundaries, and other legal, policy, and governance tasks. For the nonce, appropriate IoT designs should maintain a reasonable level of human control and oversight and provides mankind an opportunity to urge familiar with delegating control to machines.

This paper presents the use of augmented reality within the sphere of home automation. AR enhances the control of the devices and appliances with the users operating them. Now a days it's possible to talk and control the appliances remotely with the emergence of smart devices. Many methods are accustomed control the appliances remotely but it becomes difficult for the users to use the smart devices because of the GUI(Graphical User Interface) control. For this solution, augmented reality (AR) technology is employed for simple operation of home appliances connected by home networks. AR technology can provide virtual graphics yet because it apply additional information to defined areas via camera displays. To create it more popular among people the AR concept should be made cheaper and affordable for folk.

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