

AUGMENTED VISUALIZER FOR REAL TIME DATA THROUGH VIRTUAL REALITY IN AUTOMATION AND CONTROL OVER INTERNET

A project report Phase -II

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering Degree in Electronics and
Communication Engineering

by

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHOOL OF ELECTRICAL AND ELECTRONICS

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade“A” by NAAC | 12B status by UGC JEPPI-
AAR NAGAR, RAJIV GANDHI SALAI, CHENNAI-600119**

APRIL 2023



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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **GADIKOTA NITHISH (Reg.No:39130132)** and **BOORA ADHARSH (Reg.No:39130079)** who carried out the project entitled with "**AUGMENTED VISUALIZER FOR REAL TIME DATATHROUGH VIRTUAL REALITY IN AUTOMATION AND CONTROL OVER INTERNET** " under my supervision from November 2022 to April 2023.

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DECLARATION

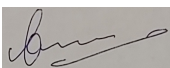
We **Gadikota Nithish (39130132)** and **Boora Adharsh (39130079)** here by declare that the Project Report entitled **AUGUMENTED VISUALISER FOR REAL TIME DATA THROUGH VIRTUAL REALITY IN AUTOMATION AND CONTROL OVER INTERNET** done by us under the guidance of **Dr.T.RAVI,M.E.,Ph.D.**, is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

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ABSTRACT

With roots going back to Ivan Sutherland's research in the 1960s, virtual reality (VR) reached a plateau in the early 1990s when the promise was demonstrable in universities and research laboratories. The latest 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”. Recently, smart speakers have become commercially common operation methods for controlling home appliances, and they have solved some of the problems with remote control operations. However, smart speakers also have some problems. For example, it is difficult to use voice recognition in a noisy environment. In addition, it takes a long time to check the current status of home appliances because users have to ask their smart speakers questions or give commands and wait for answers. To investigate other remote operation methods, we propose AR Smart Home, which uses augmented reality technology and gesture recognition technology. Through evaluating the prototype system, we found that operating home appliances with gestures and interacting with virtual 3D home appliances instead of the actual home appliances are acceptable in terms of usability. In this project, we will use unity along with Vuforia to Make an AR-based IoT Virtual Switch that can control any device connected to a Local Network Controller through an HTTP request.

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CHAPTER 1

INTRODUCTION

1.1 AUGMENTED REALITY

Augmented reality (AR) is an interactive experience of a real-world environment where the objects that reside in the real world are enhanced by computer-generated perceptual information, sometimes across multiple sensory modalities, including visual, auditory, haptic, somatosensory, and olfactory. AR can be defined as a system that incorporates three basic features: a combination of real and virtual worlds, real-time interaction, and accurate 3D registration of virtual and real objects. The overlaid sensory information can be constructive (i.e. additive to the natural environment), or destructive (i.e. masking of the natural environment). This experience is seamlessly interwoven with the physical world such that it is perceived as an immersive aspect of the real environment.



Figure 1.1 Real-time Augmented Gadget

In this way, augmented reality alters one's ongoing perception of a real-world environment, whereas virtual reality completely replaces the user's real-world

environment with a simulated one. Augmented reality is related to two largely synonymous terms: mixed reality and computer-mediated reality. The primary value of augmented reality is the manner in which components of the digital world blend into a person's perception of the real world, not as a simple display of data, but through the integration of immersive sensations, which are perceived as natural parts of an environment. The earliest functional AR systems that provided immersive mixed reality experiences for users were invented in the early 1990s, starting with the VirtualFixtures system developed at the U.S.

Air Force's Armstrong Laboratory in 1992. Commercial augmented reality experiences were first introduced in entertainment and gaming businesses. Subsequently, augmented reality applications have spanned commercial industries such as education, communications, medicine, and entertainment. In education, content may be accessed by scanning or viewing an image with a mobile device or by using marker less AR techniques.

Augmented reality is used to enhance natural environments or situations and offer perceptually enriched experiences. With the help of advanced AR technologies (e.g. adding computer vision, incorporating AR cameras into smartphone applications, and object recognition) the information about the surrounding real world of the user becomes interactive and digitally manipulated. Information about the environment and its objects is overlaid in the real world.

This information can be virtual. Augmented Reality is an experience that is artificial and which adds to the already existing reality, or real, e.g. seeing other real sensed or measured information such as electromagnetic radio waves overlaid in exact alignment with where they actually are in space. Augmented reality also has a lot of potential in the gathering and sharing of tacit knowledge. Augmentation techniques are typically performed in real-time and in semantic contexts with environmental elements. Immersive perceptual information is sometimes combined with supplemental information like scores over a live video feed of a sporting event. This combines the benefits of both augmented reality technology and heads-up display technology (HUD).

1.2 COMPARISON WITH VIRTUAL REALITY

In virtual reality (VR), the users' perception of reality is completely based on virtual information. In augmented reality (AR) the user is provided with additional computer-generated information within the data collected from real-life that enhances their perception of reality.

For example, in architecture, VR can be used to create a walk-through simulation of the inside of a new building; and AR can be used to show a building's structures and systems superimposed on a real-life view.

Another example is through the use of utility applications. Some AR applications, such as Augment, enable users to apply digital objects into real environments, allowing businesses to use augmented reality devices as a way to preview their products in the real world.

Similarly, it can also be used to demo what products may look like in an environment for customers, as demonstrated by companies such as Mountain Equipment Co-op or Lowe's who use augmented reality to allow customers to preview what their products might look like at home through the use of 3D models.

1.3 TECHNOLOGY

Augmented reality (AR) differs from virtual reality (VR) in the sense that in AR part of the surrounding environment is actually 'real' and just adds layers of virtual objects to the real environment. On the other hand, in VR the surrounding environment is completely virtual. A demonstration of how AR layers object onto the real world can be seen with augmented reality games.

Wallace is an augmented reality game application that allows users to hide messages in real environments, utilizing geolocation technology in order to enable users to hide messages wherever they may wish in the world. Such applications have many uses in the world, including in activism and artistic expression.

1.3.1 Hardware

Hardware components for augmented reality are a processor, display, sensors, and input devices. Modern mobile computing devices like smartphones and tablet computers contain these elements, which often include a camera and microelectromechanical systems (MEMS) sensors such as an accelerometer, GPS, and solid-state compass, making them suitable AR platforms. There are two technologies used in augmented reality: diffractive waveguides and reflective waveguides.



Figure 1.2 Man Wearing Smart Glasses

1.3.2 Display:

Various technologies are used in augmented reality rendering, including optical projection systems, monitors, handheld devices, and display systems, which are worn on the human body.

A head-mounted display (HMD) is a display device worn on the forehead, such as a harness or helmet-mounted. HMDs place images of both the physical world and virtual objects over the user's field of view. Modern HMDs often employ sensors for six degrees of freedom monitoring that allow the system to align virtual information to the physical world and adjust accordingly with the user's head movements. HMDs can provide VR users with mobile and collaborative experiences. Specific providers, such as uSens and Gestigon, include gesture controls for full virtual immersion

1.3.3 Eyeglasses

AR displays can be rendered on devices resembling eyeglasses. Versions include eyewear that employs cameras to intercept the real-world view and re-display its augmented view through the eyepieces and devices in which the AR imagery is projected through or reflected off the surfaces of the eyewear lens pieces.

1.3.4 HUD

A head-up display (HUD) is a transparent display that presents data without requiring users to look away from their usual viewpoints. A precursor technology to augmented reality, heads-up displays were first developed for pilots in the 1950s, projecting simple flight data into their line of sight, thereby enabling them to keep their "heads up" and not look down at the instruments.

Near-eye augmented reality devices can be used as portable head-up displays as they can show data, information, and images while the user views the real world. Many definitions of augmented reality only define it as overlaying the information. This is basically what a head-up display does; however, practically speaking, augmented reality is expected to include registration and tracking between the superimposed perceptions, sensations, information, data, and images, and some portion of the real world.



Figure 1.3 Headset Computer

1.3.5 Contact lenses:

Contact lenses that display AR imaging are in development. These bionic contactlenses might contain the elements for display embedded into the lens including integrated circuitry, LEDs and an antenna for wireless communication. The first contactlens display was patented in 1999 by Steve Mann and was intended to work in combination with AR spectacles, but the project was abandoned, then 11 years later in 2010–2011. Another version of contact lenses, in development for the U.S. military, is designed to function with AR spectacles, allowing soldiers to focus on close-to-the-eye AR images on the spectacles and distant real world objects at the same time.

At CES 2013, a company called Innovega also unveiled similar contact lenses that required being combined with AR glasses to work. The futuristic shortfilm *Sight* features contact lens-like augmented reality devices.

Many scientists have been working on contact lenses capable of different technological feats. A patent filed by Samsung describes an AR contact lens, that, when finished, will include a built-in camera on the lens itself. The design is intended to control its interface by blinking an eye. It is also intended to be linked with the user's smartphone to review footage and control it separately. When successful, the lens would feature a camera or sensor inside of it. It is said that it could be anything from a light sensor, to a temperature sensor.

The first publicly unveiled working prototype of an AR contact lens not requiring the use of glasses in conjunction was developed by Mojo Vision and announced and shown off at CES 2020.

1.3.6 Virtual retinal display

A virtual retinal display (VRD) is a personal display device under development at the University of Washington's Human Interface Technology Laboratory under Dr. Thomas A. Furness III. With this technology, a display is scanned directly onto the retina of a viewer's eye. This results in bright images with high resolution and high contrast. The viewer sees what appears to be a conventional display floating in space. Several of tests were done to analyse the safety of the VRD. In one test, patients with partial loss of vision—having either macular degeneration (a disease that degenerates the retina) or keratoconus—were selected to view images using the technology. In the macular degeneration group, five out of eight subjects preferred the VRD images to the cathode-ray tube (CRT) or paper images and thought they were better and brighter and were able to see equal or better resolution levels.

The Keratoconus patients could all resolve smaller lines in several line tests using the VRD as opposed to their own correction. They also found the VRD images to be easier to view and sharper. As a result of these several tests, virtual retinal display is considered safe technology.

Virtual retinal display creates images that can be seen in ambient daylight and ambient room light. The VRD is considered a preferred candidate to use in a surgical display due to its combination of high resolution and high contrast and brightness. Additional tests show high potential for VRD to be used as a display technology for patients that have low vision.

1.3.7 Eye Tap

The Eye Tap (also known as Generation-2 Glass) captures rays of light that would otherwise pass through the center of the lens of the wearer's eye, and substitutes synthetic computer-controlled light for each ray of real light. The Generation-4 Glass (Laser Eye Tap) is similar to the VRD (i.e. it uses a computer-controlled laser light source) except that it also has infinite depth of focus and causes the eye itself to, in effect, function as both a camera and a display by way of exact alignment with the eye and resynthesize (in laser light) of rays of light entering the eye.

1.3.8 Handheld

A Handheld display employs a small display that fits in a user's hand. All handheld AR solutions to date opt for video see-through. Initially handheld AR employed fiducial markers,

and later GPS units and MEMS sensors such as digital compasses and six degrees of freedom accelerometer–gyroscope. Today simultaneous localization and mapping (SLAM) marker less trackers such as PTAM (parallel tracking and mapping) are starting to come into use. Handheld display AR promises to be the first commercial success for AR technologies. The two main advantages of handheld AR are the portable nature of handheld devices and the ubiquitous nature of camera phones. The disadvantages are the physical constraints of the user having to hold the handheld device out in front of them at all times, as well as the distorting effect of classically wide-angled mobile phone cameras when compared to the real world as viewed through the eye.

Games such as Pokémon Go and Ingress utilize an Image Linked Map (ILM) interface, where approved geotagged locations appear on a stylized map for the user to interact with.

1.3.9 Projection mapping

Projection mapping augments real-world objects and scenes, without the use of special displays such as monitors, head-mounted displays or hand-held devices. Projection mapping makes use of digital projectors to display graphical information onto physical objects. The key difference in projection mapping is that the display is separated from the users of the system. Since the displays are not associated with each user, projection mapping scales naturally up to groups of users, allowing for collocated collaboration between users.

Examples include shader lamps, mobile projectors, virtual tables, and smart projectors. Shader lamps mimic and augment reality by projecting imagery onto neutral objects. This provides the opportunity to enhance the object's appearance with materials of a simple unit—a projector, camera, and sensor.

Other applications include table and wall projections. One innovation, the Extended Virtual Table, separates the virtual from the real by including beam-splitter mirrors attached to the ceiling at an adjustable angle. Virtual showcases, which employ beam splitter mirrors together with multiple graphics displays, provide an interactive means of simultaneously engaging with the virtual and the real. Many more implementations and configurations make spatial augmented reality display an increasingly attractive interactive alternative.

A projection mapping system can display on any number of surfaces in an indoor setting at once. Projection mapping supports both a graphical visualization and passive haptic sensation for the end users. Users are able to touch physical objects in a process that provides passive haptic sensation.

1.3.10 Tracking

Modern mobile augmented-reality systems use one or more of the following motion tracking technologies: digital cameras and/or other optical sensors, accelerometers, GPS, gyroscopes, solid state compasses, radio-frequency identification (RFID). These technologies offer varying levels of accuracy and precision. These technologies are implemented in the ARKit API by Apple and ARCore API by Google to allow tracking for their respective mobile device platforms.

1.3.11 Networking

Mobile augmented reality applications are gaining popularity because of the wide adoption of mobile and especially wearable devices. However, they often rely on computationally intensive computer vision algorithms with extreme latency requirements. To compensate for the lack of computing power, offloading data processing to a distant machine is often desired. Computation offloading introduces new constraints in applications, especially in terms of latency and bandwidth. Although there are a plethora of real-time multimedia transport protocols, there is a need for support from network infrastructure as well.

1.3.12 Input devices

Techniques include speech recognition systems that translate a user's spoken words into computer instructions, and gesture recognition systems that interpret a user's body movements by visual detection or from sensors embedded in a peripheral device such as a wand, stylus, pointer, glove or other body wear. Products which are trying to serve as a controller of AR headsets include Wave by See Bright Inc. and Nimble by Intugine Technologies.

1.3.13 Computer

The computer analyses the sensed visual and other data to synthesize and position augmentations. Computers are responsible for the graphics that go with augmented reality. Augmented reality uses a computer-generated image which has a striking effect on the way the real world is shown. With the improvement of technology and computers, augmented reality is going to lead to a drastic change on one's perspective of the real world. According to Time, in about 15–20 years it is predicted that augmented reality and virtual reality are going to become the primary use for computer interactions.

Computers are improving at a very fast rate, leading to new ways to improve other technology. The more that computers progress, augmented reality will become more flexible and more common in society. Computers are the core of augmented reality. The computer receives

data from the sensors which determine the relative position of an objects' surface. This translates to an input to the computer which then outputs to the users by adding something that would otherwise not be there. The computer comprises memory and a processor.

The computer takes the scanned environment then generates images or a video and puts it on the receiver for the observer to see. The fixed marks on an object's surface are stored in the memory of a computer. The computer also withdraws from its memory to present images realistically to the onlooker. The best example of this is of the Pepsi Max AR Bus Shelter.

1.3.14 Projector

Projectors can also be used to display AR contents. The projector can throw a virtual object on a projection screen and the viewer can interact with this virtual object. Projection surfaces can be many objects such as walls or glass panes.

CHAPTER – 2

LITERATURE REVIEW

2.1 INTRODUCTION:

The following shows a survey done for Augmented Reality and Virtual learning for an imaginary environmental automation through target image scanning with QR codes and physical image detection from an android application using electronic gadgets like tablet or mobile. Further the study was extended to multiple operation platforms like Linux, Windows and IOS are discussed as follows.

2.2 LITERATURE SURVEY:

2.2.1 Pranav Bedekar and Snehal Nargundi , IJSR “A Review on Home Automation using”, IJSR Transaction on Computer Science Engineering 2016.

discussed the use of augmented reality in the field of home automation. Augmented reality increases the interactive control of the devices and appliances with the users operating them. Now a days it is possible to communicate and control the appliances remotely with the emergence of smart devices.

Many methods are used to 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, we use augmented reality (AR) technology for easier operation of home appliances connected by home networks.

AR technology can provide virtual graphics and apply additional information to specific areas through camera displays. This paper presents how augmented reality is used for controlling home appliances.

Pros:

Target scaling factor is efficient throughout the multiple platform switching

Cons:

Slower transit cycles when compared to CoAP, low scalability and lack of security encryption

2.2.2 Ali El-Moursy¹, Fadi N. Sibai², Jahanzeb Rehman¹, Omar M. Gouda¹, Abdelrahman T. Gaber¹, Ahmed M. Khedr¹, IEEE “Home Automation using Augmented Reality (HAAR)”, IEEE Transactions on Augmented Reality, 2021

explained about the development of Smart Home Controllers has seen rapid growth in recent years, especially for smart devices, that can utilize the Internet of Things (IoT). However, a large portion of the household devices and appliances already in use, are not IoT enabled, and therefore, requires their default control mechanisms for the devices to operate.

They propose a smart appliance controller that uses Augmented Reality, MQTT, and other up-to-date platforms to control aftermarket home appliances in the most efficient manner. The proposed work integrates mobile AR with IoT, to control household appliances, with the help of infrared (IR) signals. The characteristics of the system are evaluated through a series of tests and performance measures.

The results of the test highlight the quick response time of MQTT for the implementation of a Home Automation System, when compared to the request-reply protocol: CoAP (4 times as fast). Keywords: Augmented Reality, IoT, Infrared, MQTT, Smart Home Controller

Pros:

Implementation IR Interface was an excellent Idea for creating universal remote

Cons:

System Uses Infrared Radiation for data transfer which is much faster than CoAP but could be easily mapped with 38 kHz of regular frequency

2.2.3 Avni Sharma, Rinkesh Patel, IJEEE “Home Automation Using Augmented Reality”, IJEEE Transactions on Electrical and Electronics Engineers, 2017

As the human life is heading towards busy schedule it becomes necessary to automate our home appliances. Human error is something that cannot be completely erased. With the busy schedule in hand there is definitely a possibility of missing something that may be trivial to us but can result into a catastrophe.

For these reasons home automation can increase efficiency, security and reliability. With the advent of technology the use of smart devices, laptops, is increasing widely also people are getting more conversant with these technologically advancing gadgets. AR also plays a major role in developing the concept of smart city.

We can control and handle different types of appliances using various applications. One of them is AR which has recently evolved for the automation of various electrical appliances.

Augmented reality (AR) is used to allow virtual pop ups when the camera of the cell phone is pointed towards the element (lamps, Air conditioners etc.) the pop up enables us to turn on or off the supply by simple touch selection thus improving ways of automation. AR uses the concept of image tracking, processing and communicating to control the applications. The remote web control feature is used to enhance the operation of appliances over mobile devices.

The control data is sent to the General Purpose Input Output Pins of microcontroller (GPIO) which triggers the household DC and AC appliances. The status can then be analysed through the web browser or through mobile web interface and control them using internet.

Voice control technique can also be implemented by using speech recognition so that the user can provide the controlling commands via voice. AR automation along with conventional system of remote controlling from anywhere will prove highly beneficial.

Pros:

Fast and secured since the data encryption is 64bit ratio and it follows MQTT protocol

Cons:

Does not support large database size, and it has no support for ROLE, COMMIT and stored Procedures

2.2.4 Abdul Saboor¹, Aya Ihab Rexeika², Piotr Stawicki³ and Felix Gembler⁴, “Development of an Online Home Appliance Control System Using Augmented Reality and an SSVEP-Based Brain Computer Interface”, Transactions on Artificial Neural Networks, 2019

Steady state visual evoked potentials (SSVEPs)-based Brain-Computer Interfaces (BCIs) can provide hand-free human interaction with the environment. In the presented study, visual stimuli were displayed on Epson Moverio BT-200 augmented reality glasses, which can be easily used in smart homes.

QR codes were used to identify the devices to be controlled with the BCI. In order to simulate a real life scenario, participants were instructed to go out of the lab to get a coffee. During this task light switches, elevator and a coffee machine were controlled by focusing on SSVEP

stimuli displayed on the smart glasses.

An average accuracy of 85.70% was achieved, which suggests that augmented reality may be used together with SSVEP to control external devices.

Pros:

Bringing AR with Deep Neural schema is an Excellency and this system can be integrated with the 7 sense of future world.

Cons:

It has a range of support between 3.5Hz to 75Hz which in turns directly matches with the neural frequency that potentially mess up sensory organs.

2.2.5 Manuel Alonso-Rosa , Aurora Gil-de-Castro , Antonio Moreno-Munoz , Joaquín Garrido-Zafra , Elena Gutierrez-Ballesteros and Eduardo Cañete- Carmona, MDPI “An IoT Based Mobile Augmented Reality Application for Energy Visualization in Buildings Environments”, MDPI Transactions on Applied Science, 2020

Augmented reality (AR) improves how we acquire, understand, and display information without distracting us from the real world. These technologies can be used in different applications and industries as they can incorporate domain-specific visualizations on a real-world screen. Mobile augmented reality (MAR) essentially consists of superimposing virtual elements over real objects on the screen, to give added value and enrich the interaction with reality. In numerous plants, it is being used for maintenance and repair tasks, as well as training. The Internet of Things (IoT) is increasingly pervading every aspect of our lives, including the power infrastructure of our buildings. IoT-enabled devices offer many connectivity options for helping supervise all-important energy assets. Aggregating data to cloud-based platforms enables operations teams to have on-time information access to make fast decisions and have a fast response regarding energy use, while maintenance teams keep on top of the appliance power quality and reliability needed by using MAR. A combined solution of MAR with IoT technologies is employed. Engineered solutions' hands-free way to get data about surrounding appliances reduces the complexity, saves energy, and speeds up the operations.

Pros:

High Visual and Artificial Database was integrated which can be a link between and virtual and physical world. Creative contextual database has created a huge responsive factor

Cons:

Superimposing virtual environmental capacity has no range of lower frequency AR camera support

2.2.6 Rosalino Rodríguez Calderón, Rafael Santillana Arbesú, Procedia Computer Science, “Augmented Reality in Automation”, Procedia Computer Science Transactions on Mobile Device, 2015

Nowadays the engineering labs have the necessary physical devices to perform experiments that reinforce the theoretical knowledge of the course. However, there are not enough elements that can generate an ordinary applied system that commonly involves technologies beyond the course, leaving much to the imagination. Augmented Reality Automation (ARA) is an innovation that incorporates augmented reality technology to the classical experiments, allowing the integration and interaction of several technologies, developing mixed experiments, both real and virtual, that is visualized through a mobile device, such as smartphone or tablet, for the purpose of creating deeper and clearer vision of knowledge. That is the focus of this paper.

Pros:

Implementing local server reduces cognitive allocation in server.

Cons:

Error Factors are high since it is purely based on local server data.

2.2.7 R. Silva, J. C. Oliveira, G. A. Giralddi, INCC “Introduction to Augmented Reality”, INCC Transactions on National Security Science and Computation, 2018

discussed an overview of basic aspects of Augmented Reality (AR) and the main concepts of this technology. It describes the main fields in which AR is applied nowadays and important AR devices. Some characteristics of Augmented Reality systems will be discussed

Pros:

Only few notable parameters throughout the project

Cons:

Rate of prediction is proportionally less when compared to real-world predictions

2.2.8 Jonathan J. Hull, Berna Erol, Jamey Graham, Qifa Ke, Hidenobu Kishi, Jorge Moraleda, Daniel G. Van Olst, Research Gate “Paper-Based Augmented Reality”, Research Gate Transaction on Camera and Paper documentation, 2007

A new method for augmenting paper documents with electronic information is described that does not modify the format of the paper document in any way. Applicable to both commercially printed documents as well as documents that are output from PC's, the technique we call Paper-Based Augmented Reality substantially improves the utility of paper. We describe the recognition technology that makes this possible as well as several applications. An implementation on a camera phone is discussed that lets users retrieve data and access links from paper documents to electronic data. Recognition is performed at 4 frames per second on a Treo 700w and support is provided for several user applications, including “clickable paper” – printed web pages whose appearance is unchanged but that can be navigated with a camera phone.

Pros:

Augmented reality with virtual automation was brought to physical world with paper content

Cons:

Linking patches of text will increase lot of security reasons

2.2.9 Mikko Kytö^{1,2}, Barrett Ens², Thammathip Piumsomboon², Gun A. Lee², and Mark Billingham², Research Gate “Pinpointing: Precise Head- and Eye- Based Target Selection for Augmented Reality”, Research Gate Transactions on Augmented Reality in Computer Science Engineering, 2018

Head and eye movement can be leveraged to improve the user's interaction repertoire for wearable displays. Head movements are deliberate and accurate, and provide the current state-of-the-art pointing technique. Eye gaze can potentially be faster and more ergonomic, but suffers from low accuracy due to calibration errors and drift of wearable eye-tracking sensors. This work investigates precise, multimodal selection techniques using head motion and eye gaze.

A comparison of speed and pointing accuracy reveals the relative merits of each method, including the achievable target size for robust selection. We demonstrate and discuss example applications for augmented reality, including compact menus with deep structure, and a proof-of-concept method for on-line correction of calibration drift.

Pros:

Accuracy has reached 97% with simple algorithm

Cons:

97% precise and accurate but depends purely on real time saturation and hue point of target images

2.2.10 Subramani Roy Choudri, A. Divija, G. V V N Vijayalakshmi, P. Vamsi, JARTMS “TOUCHLESS HOME AUTOMATION USING AUGMENTED REALITY”, JARTMS Transactions on Augmented Reality and Web Interface, 2021

As the human life is heading towards busy schedule it becomes necessary to automate our home appliances. Human error is something that cannot be completely erased. With the busy schedule in hand there is defiantly a possibility of missing something that may be trivial to us but can result into a catastrophe. For these reasons Our Project home automation can increase efficiency, security and reliability. AR which has recently evolved for the automation of various electrical appliances by popping virtual objects into real world.

Pros:

Target Image can be linked to Virtual world

Cons:

Target Image can be linked to automation with augmented environment but in case of wet hands this linking process will not produce tokens to respective servers.

2.3 PROBLEM STATEMENT:

To develop an Augmented realistic home automation system that works through the real time data transfer through internet using Augmented Reality and various Digital image processing Algorithms.

Gestures have the power to act as effective tools of communication and also on Real-time Automation. Augmented Reality is that it creates unique digital experiences that blend the best of digital and physical worlds. Augmented Reality presents information in neatly summarized digital snippets. AR can help users take quick decisions without cognitive overload. Augmented Reality is the integration of digital information with the user's environment in real-time. Our proposed system can show the live status of a machine to the operator through his AR glasses or tablet.

In our augmented reality application the position of the label is determined by images, text labels or by QR codes. This methodology will make the user benefited by showing the live data from the unit when the camera of the label scans the corresponding card. Which in turn makes it possible to control your environment with augmented reality.

Augmented Reality would be the one and only choice to handle impossible situations that occurs due to Fire, flood and other Natural Calamities.

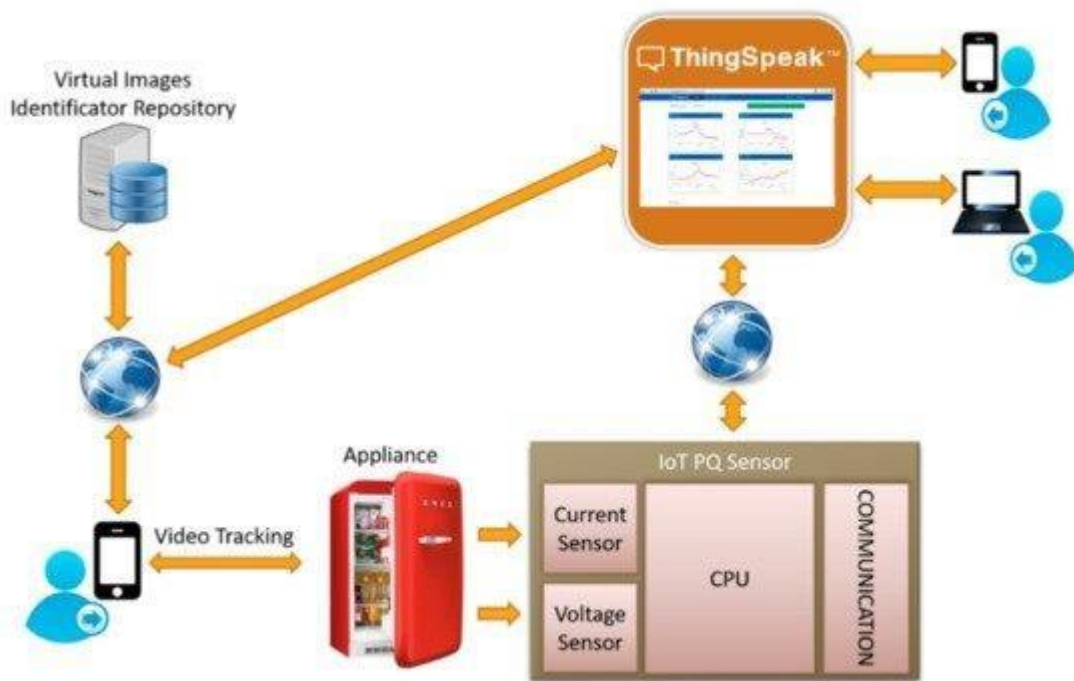


Figure 2.1 Proposed Block Diagram

CHAPTER – 3

SYSTEM ANALYSIS

3.1 EXISTING SYSTEM:

Voice commands are used to prompt different activities, from delivering news reports and playing music, to setting timers and checking train times. As well as saving you time, they could also save you money by keeping your house energy efficient and secure. Recently, smart speakers have become commercially common operation methods for controlling home appliances, and they have solved some of the problems with remote control operations. It is difficult to use voice recognition in a noisy environment. In addition, it takes a long time to check the current status of home appliances because users have to ask their smart speakers questions or give commands and wait for answers. To investigate other remote operation methods, SSVEP (Steady State Visually Evoked Potential) protocol is been used in current smart speaker designs. It has a range of support between 3.5Hz to 75Hz which in turns directly matches with the neural frequency that potentially mess up sensory organs.

3.2 DISADVANTAGES OF EXISTING SYSTEM:

- On considering a lot of environmental and virtual barrier still we face some limitations in our proposed model
- We designed this algorithm which is suitable for Android and IOS based platform through unity.
- This works well only with Android but not performing good in IOS.
- Still we are trying to figure out the pipe-line breakage failure for IOS
- Through some of the bench mark results shows that IOS has a strong security access for third party application control for installation
- But still we can make the application work with IOS, occasionally we face some application failure and restart errors
- At the end virtual reality environment can be little more interactive based on upcoming application and add-on supports in future

3.3 PROPOSED SYSTEM:

In our proposed system we use augmented reality as medium of virtual communication. Everyone prefers less messy as well as user friendly interface and hence we are moving towards augmented reality in home automation. AR allows a virtual pop up whenever the user points his/her camera towards the object to be controlled or the switch. Focusing AR, a software development kit (SDK) will be required.

It provides Application build configuration and automatic file generation. Thus we can build our very own AR app which enables virtual image mounted over real time camera image which allows the user to choose ON/OFF option when the camera of the smart device is pointed towards the object. AR uses the concept of image tracking, processing and communicating to control the applications.

3.4 ADVANTAGES OF THE PROPOSED SYSTEM:

- In our Proposed system we breakthrough the barriers and limitations of network constraints, Security blockage, Firewall Breakage, Voice Amplitude error, Physical Failure of wet hand access and 3d illusion error rate.
- Our working model is purely based on gesture controlled on virtual buttons which would be floating on air under the virtual environment.
- Due to Fiber optic data transmission on MQTT brokers there would be a fast and end to end data transfer with 64 bit high level security API key encryption.
- Physical barrier on Image selection based on hue point failure would have been reduced to maximum since we implement our model by training high picture resolution frames as our target image.
- In addition our model is based on gesture based automation so there would not be any failure due to voice amplitude from external environment.
- Finally highly effective since we use low power fiber optic lines for data transmission.

3.4 APPLICATIONS:

- Enhanced Surgical Training and Performance
- Property Tours and 3D Real Estate Models
- Immersive Therapy
- Apprentice Training In Skilled Trades
- Heavy Machinery Training
- Oil and Gas Industry Training
- Specialized Auto Maintenance
- Retail/Hospitality Training
- Military Training and Readiness
- Entertainment

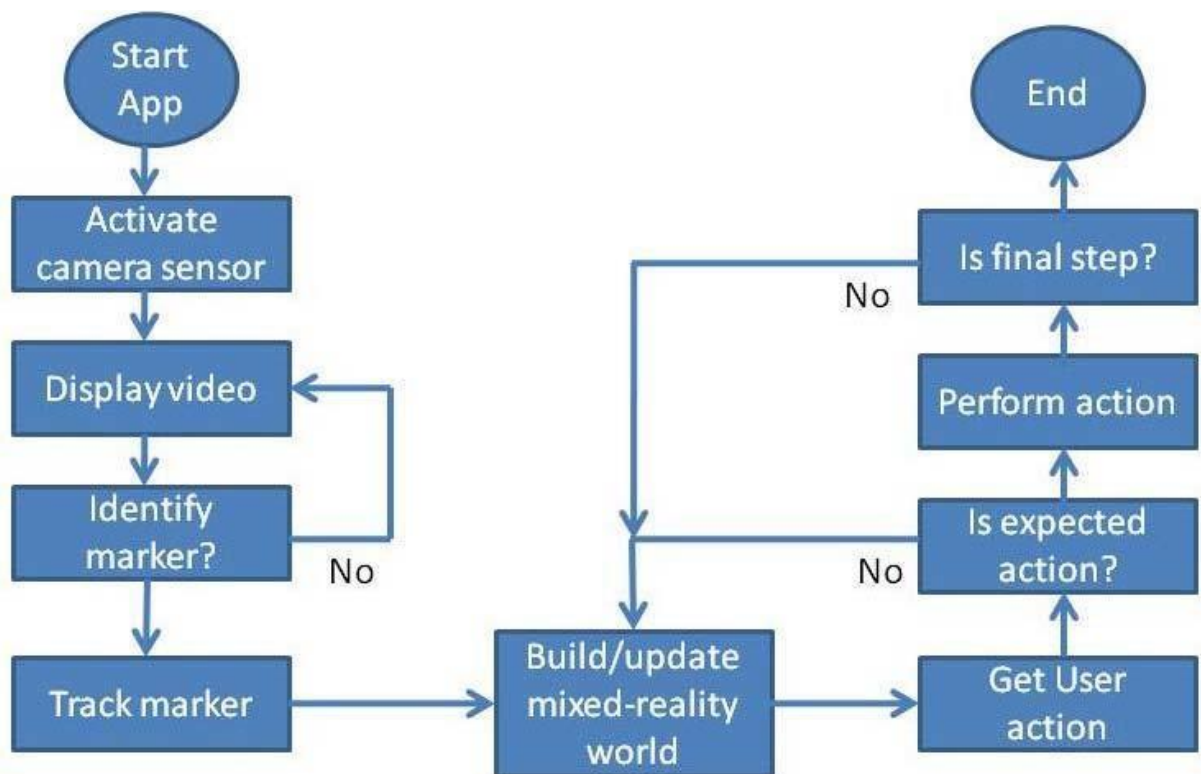


Figure 3.1 Workflow Chart

CHAPTER: 4

SYSTEM DESIGN

4.1 SOFTWARE AND ALGORITHM

A key measure of AR systems is how realistically they integrate augmentations with the real world. The software must derive real world coordinates, independent of camera, and camera images. That process is called image registration, and uses different methods of computer vision, mostly related to video tracking. Many computer vision methods of augmented reality are inherited from visual odometry. An augogram is a computer generated image that is used to create AR. Augography is the science and software practice of making augograms for AR.

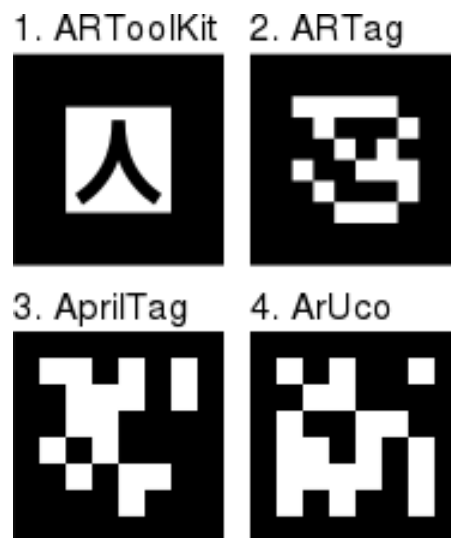


Figure 4.1 Comparison of some augmented reality for computer vision

Usually those methods consist of two parts. The first stage is to detect interest points, fiducial markers or optical flow in the camera images. This step can use feature detection methods like corner detection, blob detection, edge detection or thresholding, and other image processing methods. The second stage restores a real world coordinate system from the data obtained in the first stage. Some methods assume objects with known geometry (or fiducial markers) are present in the scene. In some of those cases the scene 3D structure should be calculated beforehand. If part of the scene is unknown simultaneous localization and mapping (SLAM) can map relative positions. If no information about scene geometry is available, structure from motion methods like bundle adjustment are used. Mathematical methods used in the second stage include projective geometry, geometrical algebra, and rotation representation with exponential map, Kalman and particle filters, nonlinear optimization, robust statistics.

In augmented reality, the distinction is made between two distinct modes of tracking, known as marker and marker less. Markers are visual cues which trigger the display of the virtual information. A piece of paper with some distinct geometries can be used. The camera recognizes the geometries by identifying specific points in the drawing. Marker less tracking, also called instant tracking, does not use markers. Instead, the user positions the object in the camera view preferably in a horizontal plane. It uses sensors in mobile devices to accurately detect the real-world environment, such as the locations of walls and points of intersection.

Augmented Reality Mark-up Language (ARML) is a data standard developed within the Open Geospatial Consortium (OGC), which consists of Extensible Mark-up Language (XML) grammar to describe the location and appearance of virtual objects in the scene, as well as ECMAScript bindings to allow dynamic access to properties of virtual objects. To enable rapid development of augmented reality applications, some software development applications such as Lens Studio from Snapchat and Spark AR from Facebook were launched including Software Development kits (SDKs) from Apple and Google have emerged.

4.1.1 Development

The implementation of augmented reality in consumer products requires considering the design of the applications and the related constraints of the technology platform. Since AR systems rely heavily on the immersion of the user and the interaction between the user and the system, design can facilitate the adoption of virtuality. For most augmented reality systems, a similar design guideline can be followed. The following lists some considerations for designing augmented reality applications.

4.1.2 Environmental/context design

Context Design focuses on the end-user's physical surrounding, spatial space, and accessibility that may play a role when using the AR system. Designers should be aware of the possible physical scenarios the end-user may be in such as:

1. Public, in which the users use their whole body to interact with the software
2. Personal, in which the user uses a smartphone in a public space
3. Intimate, in which the user is sitting with a desktop and is not really moving
4. Private, in which the user has on a wearable

By evaluating each physical scenario, potential safety hazards can be avoided and changes can be made to greater improve the end-user's immersion. UX designers will have to define user journeys for the relevant physical scenarios and define how the interface reacts to each.

Especially in AR systems, it is vital to also consider the spatial and surrounding elements that change the effectiveness of the AR technology. Environmental elements such as lighting and sound can prevent the AR device sensor from detecting necessary data and ruin the immersion of the end-user.

Another aspect of context design involves the design of the system's functionality and its ability to accommodate user preferences. While accessibility tools are common in basic application design, some consideration should be made when designing time-limited prompts (to prevent unintentional operations), audio cues and overall engagement time. It is important to note that in some situations, the application's functionality may hinder the user's ability. For example, applications that is used for driving should reduce the amount of user interaction and use audio cues instead.

4.1.3 Interaction design

Interaction design in augmented reality technology centres on the user's engagement with the end product to improve the overall user experience and enjoyment. The purpose of interaction design is to avoid alienating or confusing the user by organizing the information presented. Since user interaction relies on the user's input, designers must make system controls easier to understand and accessible. A common technique to improve usability for augmented reality applications is by discovering the frequently accessed areas in the device's touch display and design the application to match those areas of control. It is also important to structure the user journey maps and the flow of information presented which reduce the system's overall cognitive load and greatly improves the learning curve of the application.

In interaction design, it is important for developers to utilize augmented reality technology that complement the system's function or purpose. For instance, the utilization of exciting AR filters and the design of the unique sharing platform in Snapchat enables users to augment their in-app social interactions. In other applications that require users to understand the focus and intent, designers can employ a reticle or raycast from the device. Moreover, augmented reality developers may find it appropriate to have digital elements scale or react to the direction of the camera and the context of objects that can be detected.

Augmented reality technology allows to utilize the introduction of 3D space. This means that a user can potentially access multiple copies of 2D interfaces within a single AR application.

4.1.4 Visual design

In general, visual design is the appearance of the developing application that engages the user. To improve the graphic interface elements and user interaction, developers may use visual cues to inform the user what elements of UI are designed to interact with and how to interact with them. Since navigating in an AR application may appear difficult and seem frustrating, visual cue design can make interactions seem more natural.

In some augmented reality applications that use a 2D device as an interactive surface, the 2D control environment does not translate well in 3D space making users hesitant to explore their surroundings. To solve this issue, designers should apply visual cues to assist and encourage users to explore their surroundings.

It is important to note the two main objects in AR when developing VR applications: 3D volumetric objects that are manipulated and realistically interact with light and shadow; and animated media imagery such as images and videos which are mostly traditional 2D media rendered in a new context for augmented reality. When virtual objects are projected onto a real environment, it is challenging for augmented reality application designers to ensure a perfectly seamless integration relative to the real-world environment, especially with 2D objects.

As such, designers can add weight to objects, use depth maps, and choose different material properties that highlight the object's presence in the real world. Another visual design that can be applied is using different lighting techniques or casting shadows to improve overall depth judgment. For instance, a common lighting technique is simply placing a light source overhead at the 12 o'clock position, to create shadows on virtual objects.

4.2 POSSIBLE APPLICATIONS

Augmented reality has been explored for many applications, from gaming and entertainment to medicine, education and business. Example application areas described below include archaeology, architecture, commerce and education. Some of the earliest cited examples include augmented reality used to support surgery by providing virtual overlays to guide medical practitioners, to AR content for astronomy and welding.

4.2.1 Archaeology

AR has been used to aid archaeological research. By augmenting archaeological features onto the modern landscape, AR allows archaeologists to formulate possible site configurations from extant structures. Computer generated models of ruins, buildings, landscapes or even ancient people have been recycled into early archaeological AR applications. For example,

implementing a system like VITA (Visual Interaction Tool for Archaeology) will allow users to imagine and investigate instant excavation results without leaving their home. Each user can collaborate by mutually "navigating, searching, and viewing data". Hrvoje Benko, a researcher in the computer science

department at Columbia University, points out that these particular systems and others like them can provide "3D panoramic images and 3D models of the site itself at different excavation stages" all the while organizing much of the data in a collaborative way that is easy to use. Collaborative AR systems supply multimodal interactions that combine the real world with virtual images of both environments.

4.2.2 Architecture

AR can aid in visualizing building projects. Computer-generated images of a structure can be superimposed onto a real-life local view of a property before the physical building is constructed there; this was demonstrated publicly by Trimble Navigation in 2004. AR can also be employed within an architect's workspace, rendering animated 3D visualizations of their 2D drawings. Architecture sight-seeing can be enhanced with AR applications, allowing users viewing a building's exterior to virtually see through its walls, viewing its interior objects and layout.

With continual improvements to GPS accuracy, businesses are able to use augmented reality to visualize georeferenced models of construction sites, underground structures, cables and pipes using mobile devices. Augmented reality is applied to present new projects, to solve on-site construction challenges, and to enhance promotional materials. Examples include the Daqri Smart Helmet, an Android-powered hard hat used to create augmented reality for the industrial worker, including visual instructions, real-time alerts, and 3D mapping.

Following the Christchurch earthquake, the University of Canterbury released CityViewAR, which enabled city planners and engineers to visualize buildings that had been destroyed. This not only provided planners with tools to reference the previous cityscape, but it also served as a reminder of the magnitude of the resulting devastation, as entire buildings had been demolished.

4.2.3 Urban design and planning

AR systems are being used as collaborative tools for design and planning in the built environment. For example, AR can be used to create augmented reality maps, buildings and data feeds projected onto table tops for collaborative viewing by built

environment professionals.^[111] Outdoor AR promises that designs and plans can be superimposed on the real-world, redefining the remit of these professions to bring in- situ design into their process. Design options can be articulated on site, and appear closer to reality than traditional desktop mechanisms such as 2D maps and 3d models.

4.2.4 Education

In educational settings, AR has been used to complement a standard curriculum. Text, graphics, video, and audio may be superimposed into a student's real-time environment. Textbooks, flashcards and other educational reading material may contain embedded "markers" or triggers that, when scanned by an AR device, produce supplementary information to the student rendered in a multimedia format. The 2015 Virtual, Augmented and Mixed Reality: 7th International Conference mentioned Google Glass as an example of augmented reality that can replace the physical classroom. First, AR technologies help learners engage in authentic exploration in the real world, and virtual objects such as texts, videos, and pictures are supplementary elements for learners to conduct investigations of the real-world surroundings.

As AR evolves, students can participate interactively and interact with knowledge more authentically. Instead of remaining passive recipients, students can become active learners, able to interact with their learning environment. Computer- generated simulations of historical events allow students to explore and learning details of each significant area of the event site.

In higher education, Construct3D, a Studiers tube system, allows students to learn mechanical engineering concepts, math or geometry. Chemistry AR apps allow students to visualize and interact with the spatial structure of a molecule using a marker object held in the hand. Others have used HP Reveal, a free app, to create AR notecards for studying organic chemistry mechanisms or to create virtual demonstrations of how to use laboratory instrumentation. Anatomy students can visualize different systems of the human body in three dimensions. Using AR as a tool to learn anatomical structures has been shown to increase the learner knowledge and provide intrinsic benefits, such as increased engagement and learner immersion.

4.2.5 Industrial manufacturing

AR is used to substitute paper manuals with digital instructions which are overlaid on the manufacturing operator's field of view, reducing mental effort required to operate. AR makes machine maintenance efficient because it gives operators direct access to a machine's maintenance history. Virtual manuals help manufacturers adapt to rapidly-changing product designs, as digital instructions are more easily edited and distributed compared to physical manuals.

Digital instructions increase operator safety by removing the need for operators to look at a screen or manual away from the working area, which can be hazardous. Instead, the instructions are overlaid on the working area. The use of AR can increase operators' feeling of safety when working near high-load industrial machinery by giving operators additional information on a machine's status and safety functions, as well as hazardous areas of the workspace.

4.2.6 Commerce

The AR-Icon can be used as a maker of print as well as on online media. It signals the viewer that digital content is behind it. The content can be viewed with a smartphone or tablet

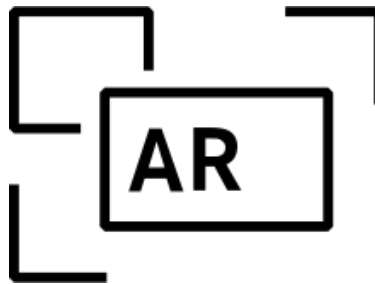


Figure 4.2 AR-Icon used as a maker

AR is used to integrate print and video marketing. Printed marketing material can be designed with certain "trigger" images that, when scanned by an AR-enabled device using image recognition, activate a video version of the promotional material. A major difference between augmented reality and straightforward image recognition is that one can overlay multiple media at the same time in the view screen, such as social media share buttons, the in-page video even audio and 3D objects. Traditional print-only publications are using augmented reality to connect different types of media.

AR can enhance product previews such as allowing a customer to view what's inside a product's packaging without opening it. AR can also be used as an aid in selecting products from a catalogue or through a kiosk. Scanned images of products can activate views of additional content such as customization options and additional images of the product in its use. By 2010, virtual dressing rooms had been developed for e-commerce.

In 2012, a mint used AR techniques to market a commemorative coin for Aruba. The coin itself was used as an AR trigger, and when held in front of an AR-enabled device it revealed additional objects and layers of information that were not visible without the device.

In 2018, Apple announced USDZ AR file support for iPhones and iPads with iOS 12. Apple has created an AR Quick Look Gallery that allows masses to experience augmented reality on their own Apple device.

In 2018, Shopify, the Canadian e-commerce company, announced ARkit2 integration. Their merchants are able to use the tools to upload 3D models of their products. Users will be able to tap on the goods inside Safari to view in their real-world environments.

In 2018, Twinkl released a free AR classroom application. Pupils can see how York looked over 1,900 years ago. Twinkl launched the first ever multi-player AR game, Little Red and has over 100 free AR educational models.

Augmented reality is becoming more frequently used for online advertising. Retailers offer the ability to upload a picture on their website and "try on" various clothes which are overlaid on the picture. Even further, companies such as Body metrics install dressing booths in department stores that offer full-body scanning. These booths render a 3-D model of the user, allowing the consumers to view different outfits on themselves without the need of physically changing clothes. For example, JC Penney and Bloomingdale's use "virtual dressing rooms" that allow customers to see themselves in clothes without trying them on. Another store that uses AR to market clothing to its customers is Neiman Marcus.^[145] Neiman Marcus offers consumers the ability to see their outfits in a 360-degree view with their "memory mirror". Makeup stores like L'Oreal, Sephora, Charlotte Tilbury, and Rimmel also have apps that utilize AR. These apps allow consumers to see how the makeup will look on them. According to Greg Jones, director of AR and VR at Google, augmented reality is going to "reconnect physical and digital retail".

AR technology is also used by furniture retailers such as IKEA, Houzz, and Wayfair. These retailers offer apps that allow consumers to view their products in their home prior to purchasing anything. In 2017, Ikea announced the Ikea Place app. It contains a catalogue of over 2,000 products nearly the company's full collection of sofas, armchairs, coffee tables, and storage units which one can place anywhere in a room with their phone. The app made it possible to have 3D and true-to-scale models of furniture in the customer's living space. IKEA realized that their customers are not shopping in stores as often or making direct purchases anymore. Shopify's acquisition of Primer, an AR app aims to push small and medium sized sellers towards interactive AR shopping with easy to use AR integration and user experience for both merchants and consumers.

4.2.7 Literature

The first description of AR as it is known today was in *Virtual Light*, the 1994 novel by William Gibson. In 2011, AR was blended with poetry by nika from Sekai Camera in Tokyo,

Japan. The prose of these AR poems come from Paul Celan, *Die Niemandrose*, expressing the aftermath of the 2011 Tōhoku earthquake and tsunami.



Figure 4.3 An example of an AR Code Containing QR Code

4.2.8 Visual art

AR applied in the visual arts allows objects or places to trigger artistic multidimensional experiences and interpretations of reality.

Augmented reality can aid in the progression of visual art in museums by allowing museum visitors to view artwork in galleries in a multidimensional way through their phone screens. The Museum of Modern Art in New York has created an exhibit in their art museum showcasing AR features that viewers can see using an app on their smartphone. The museum has developed their personal app, called MoMAR Gallery, that museum guests can download and use in the augmented reality specialized gallery in order to view the museum's paintings in a different way. This allows individuals to see hidden aspects and information about the paintings, and to be able to have an interactive technological experience with artwork as well.



Figure 4.4 Augmented Reality Multiplayer Game, Art Installation

AR technology was also used in Nancy Baker Cahill's "Margin of Error" and "Revolutions," the two public art pieces she created for the 2019 Desert X exhibition. AR technology aided the development of eye tracking technology to translate a disabled person's eye movements into drawings on a screen. AR technology can also be used to place objects in the user's environment. A Danish artist, Olafur Eliasson, is placing objects like burning suns, extra-terrestrial rocks, and rare animals, into the user's environment.

4.2.9 Fitness

AR hardware and software for use in fitness includes smart glasses made for biking and running, with performance analytics and map navigation projected onto the user's field of vision, and boxing, martial arts, and tennis, where users remain aware of their physical environment for safety. Fitness-related games and software include Pokemon Go and Jurassic World Alive.

4.2.10 Human Computer Interaction

Human Computer Interaction is an interdisciplinary area of computing that deals with design and implementation of systems that interact with people. Researchers in HCI come from a number of disciplines, including computer science, engineering, design, human factor, and social science, with a shared goal to solve problems in the design and the use of technology so that it can be used more easily, effectively, efficiently, safely, and with satisfaction.

4.3 REMOTE COLLABORATION

Primary school children learn easily from interactive experiences. As an example, astronomical constellations and the movements of objects in the solar system were oriented in 3D and overlaid in the direction the device was held, and expanded with supplemental video information. Paper-based science book illustrations could seem to come alive as video without requiring the child to navigate to web-based materials. In 2013, a project was launched on Kickstarter to teach about electronics with an educational toy that allowed children to scan their circuit with an iPad and see the electric current flowing around. While some educational apps were available for AR by 2016, it was not broadly used. Apps that leverage augmented reality to aid learning included Sky View for studying astronomy, AR Circuits for building simple electric circuits, and Sketch AR for drawing. AR would also be a way for parents and teachers to achieve their goals for modern education, which might include providing more individualized and flexible learning, making closer connections between what is taught at school and the real world, and helping students to become more engaged in their own learning.

4.3.1 Emergency management/search and rescue

Augmented reality systems are used in public safety situations, from super storms to suspects at large.

As early as 2009, two articles from Emergency Management discussed AR technology for emergency management. The first was "Augmented Reality—Emerging Technology for Emergency Management", by Gerald Baron. According to Adam Crow, "Technologies like augmented reality (ex: Google Glass) and the growing expectation of the public will continue to force professional emergency managers to radically shift when, where, and how technology is deployed before, during, and after disasters.

Another early example was a search aircraft looking for a lost hiker in rugged mountain terrain. Augmented reality systems provided aerial camera operators with a geographic awareness of forest road names and locations blended with the camera video. The camera operator was better able to search for the hiker knowing the geographic context of the camera image. Once located, the operator could more efficiently direct rescuers to the hiker's location because the geographic position and reference landmarks were clearly labelled.

4.3.2 Social interaction

AR can be used to facilitate social interaction. An augmented reality social network framework called Talk2Me enables people to disseminate information and view others'

advertised information in an augmented reality way. The timely and dynamic information sharing and viewing functionalities of Talk2Me help initiate conversations and make friends for users with people in physical proximity. However, use of an AR headset can inhibit the quality of an interaction between two people if one isn't wearing one if the headset becomes a distraction.

Augmented reality also gives users the ability to practice different forms of social interactions with other people in a safe, risk-free environment. Hannes Kauffman, Associate Professor for Virtual Reality at TU Vienna, says: "In collaborative augmented reality multiple users may access a shared space populated by virtual objects, while remaining grounded in the real world. This technique is particularly powerful for educational purposes when users are collocated and can use natural means of communication (speech, gestures, etc.), but can also be mixed successfully with immersive VR or remote collaboration. Hannes cites education as a potential use of this technology.

4.3.3 Video games

The gaming industry embraced AR technology. A number of games were developed for prepared indoor environments, such as AR air hockey, Titans of Space, collaborative combat against virtual enemies, and AR-enhanced pool table games.



Figure 4.5 An AR Mobile game using a trigger image as fiducial maker

Augmented reality allowed video game players to experience digital game play in a real-world environment. Niantic released the augmented reality mobile game Pokémon Go. Disney has partnered with Lenovo to create the augmented reality game Star Wars: Jedi Challenges that works with a Lenovo Mirage AR headset, a tracking sensor and a Lightsabre controller, scheduled to launch in December 2017.

Augmented reality gaming (ARG) is also used to market film and television entertainment properties. On 16 March 2011, Bit Torrent promoted an open licensed version of the feature film Zenith in the United States. Users who downloaded the Bit Torrent client software were also encouraged to download and share Part One of three parts of the film. On 4 May 2011, Part Two of the film was made available on VODO. The episodic release of the film, supplemented by an ARG transmedia marketing campaign, created a viral effect and over a million users downloaded the movie.

4.3.4 Industrial design

AR allows industrial designers to experience a product's design and operation before completion. Volkswagen has used AR for comparing calculated and actual crash test imagery. AR has been used to visualize and modify car body structure and engine layout. It has also been used to compare digital mock-ups with physical mock-ups to find discrepancies between them.

4.3.5 Healthcare planning, practice and education

One of the first applications of augmented reality was in healthcare, particularly to support the planning, practice, and training of surgical procedures. As far back as 1992, enhancing human performance during surgery was a formally stated objective when building the first augmented reality systems at U.S. Air Force laboratories. Since 2005, a device called a near-infrared vein finder that films subcutaneous veins, processes and projects the image of the veins onto the skin has been used to locate veins. AR provides surgeons with patient monitoring data in the style of a fighter pilot's heads-up display, and allows patient imaging records, including functional videos, to be accessed and overlaid.

Examples include a virtual X-ray view based on prior tomography or on real-time images from ultrasound and confocal microscopy probes, visualizing the position of a tumor in the video of an endoscope, or radiation exposure risks from X-ray imaging devices. AR can enhance viewing a fetus inside a mother's womb. Siemens, Karl Storz and IRCAD have developed a system for laparoscopic liver surgery that uses AR to

view sub-surface tumors and vessels. AR has been used for cockroach phobia treatment and to reduce the fear of spiders.

Patients wearing augmented reality glasses can be reminded to take medications. Augmented reality can be very helpful in the medical field. It could be used to provide crucial information to a doctor or surgeon without having them take their eyes off the patient. On 30 April 2015 Microsoft announced the Microsoft HoloLens, their first attempt at augmented reality. The HoloLens has advanced through the years and is capable of projecting holograms for near infrared fluorescence based image guided surgery. As augmented reality advances, it finds increasing applications in healthcare. Augmented reality and similar computer based-utilities are being used to train medical professionals.

In healthcare, AR can be used to provide guidance during diagnostic and therapeutic interventions e.g. during surgery. Magee et al. for instance describe the use of augmented reality for medical training in simulating ultrasound guided needle placement. A very recent study by Akçayır, Akçayır, Pektaş, and Ocak (2016) revealed that AR technology both improves university students' laboratory skills and helps them to build positive attitudes relating to physics laboratory work. Recently, augmented reality began seeing adoption in neurosurgery, a field that requires heavy amounts of imaging before procedures.

4.3.6 Spatial immersion and interaction

Augmented reality applications, running on handheld devices utilized as virtual reality headsets, can also digitize human presence in space and provide a computer generated model of them, in a virtual space where they can interact and perform various actions. Such capabilities are demonstrated by Project Anywhere, developed by a postgraduate student at ETH Zurich, which was dubbed as an "out-of-body experience".

4.3.7 Flight training

Building on decades of perceptual-motor research in experimental psychology, researchers at the Aviation Research Laboratory of the University of Illinois at Urbana–Champaign used augmented reality in the form of a flight path in the sky to teach flight students how to land an airplane using a flight simulator. An adaptive augmented schedule in which students were shown the augmentation only when they departed from the flight path proved to be a more effective training intervention than a constant schedule. Flight students taught to land in the simulator with the adaptive augmentation learned to land a light aircraft more quickly than students with the same amount of landing training in the simulator but with constant

augmentation or without any augmentation.

4.3.8 Military

An interesting early application of AR occurred when Rockwell International created video map overlays of satellite and orbital debris tracks to aid in space observations at Air Force Maui Optical System. In their 1993 paper "Debris Correlation Using the Rockwell Worldview System" the authors describe the use of map overlays applied to video from space surveillance telescopes. The map overlays indicated the trajectories of various objects in geographic coordinates. This allowed telescope operators to identify satellites, and also to identify and catalogue potentially dangerous space debris.



Figure 4.6 Augmented Reality System for Soldier ARC4

Starting in 2003 the US Army integrated the SmartCam3D augmented reality system into the Shadow Unmanned Aerial System to aid sensor operators using telescopic cameras to locate people or points of interest. The system combined fixed geographic information including street names, points of interest, airports, and railroads

with live video from the camera system. The system offered a "picture in picture" mode that allows it to show a synthetic view of the area surrounding the camera's field of view. This helps solve a problem in which the field of view is so narrow that it excludes important context, as if "looking through a soda straw".

The system displays real-time friend/foe/neutral location markers blended with live video, providing the operator with improved situational awareness. As of 2010, Korean researchers are looking to implement mine-detecting robots into the military. The proposed design for such a robot includes a mobile platform that is like a tank which would be able to cover uneven distances including stairs. The robot's mine detection sensor would include a combination of metal detectors and ground-penetrating radar to locate mines or IEDs. This unique design would be immeasurably helpful in saving lives of Korean soldiers.



Figure 4.7 Circular review system of the company LimpidArmor

Researchers at USAF Research Lab (Calhoun, Draper et al.) found an approximately two-fold increase in the speed at which UAV sensor operators found points of interest using this technology. This ability to maintain geographic awareness quantitatively enhances mission efficiency. The system is in use on the US Army RQ- 7 Shadow and the MQ-1C Gray Eagle Unmanned Aerial Systems.

In combat, AR can serve as a networked communication system that renders useful battlefield data onto a soldier's goggles in real time. From the soldier's viewpoint, people and various objects can be marked with special indicators to warn of potential dangers. Virtual maps and 360° view camera imaging can also be rendered to aid a soldier's navigation and battlefield perspective, and this can be transmitted to military leaders at a remote command center. The combination of 360° view cameras visualization and AR can be use on board combat vehicles and tanks as circular reviewsystem.

AR can be very effective to virtually design out the 3D topologies of munition storages in the terrain with the choice of the munitions combination in stacks and distances between them with a visualization of risk areas. The scope of AR applicationsalso includes visualization of data from embedded munitions monitoring sensors.

4.3.9 Navigation

The NASA X-38 was flown using a hybrid synthetic vision system that overlaid map data on video to provide enhanced navigation for the spacecraft during flight tests from 1998 to 2002. It used the Landform software which was useful for times of limited visibility, including an instance when the video camera window frosted over leaving astronauts to rely on the map overlays. The Landform software was also test flown at the Army Yuma Proving Ground in 1999. In the photo at right one can see the map markers indicating runways, air traffic control tower, taxiways, and hangars overlaid on the video.

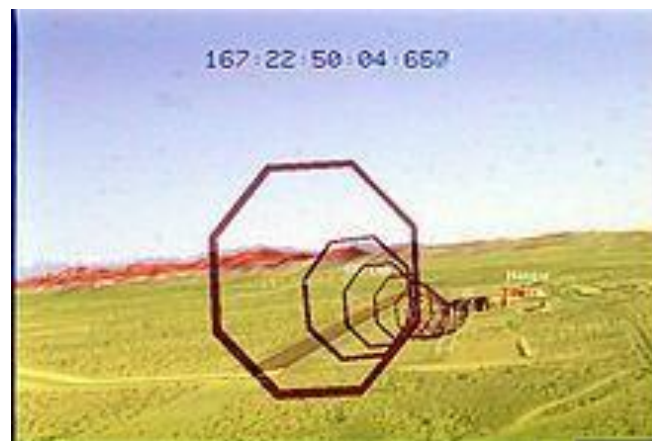


Figure 4.8 LandForm video map overlay making runways, roads and building

AR can augment the effectiveness of navigation devices. Information can be displayed on an automobile's windshield indicating destination directions and meter, weather, terrain, road conditions and traffic information as well as alerts to potential hazards in their path. Since 2012, a Swiss-based company WayRay has been developing holographic AR navigation systems that use holographic optical elements for projecting all route-related information including directions, important notifications, and points of interest right into the drivers' line of sight and far ahead of the vehicle. Aboard maritime vessels, AR can allow bridge watch-standers to continuously monitor important information such as a ship's heading and speed while moving throughout the bridge or performing other tasks.

4.3.10 Workplace

Augmented reality may have a positive impact on work collaboration as people may be inclined to interact more actively with their learning environment. It may also encourage tacit knowledge renewal which makes firms more competitive. AR was used to facilitate collaboration among distributed team members via conferences with local and virtual participants. AR tasks included brainstorming and discussion meetings utilizing common visualization via touch screen

tables, interactive digital whiteboards, shared design spaces and distributed control rooms.

In industrial environments, augmented reality is proving to have a substantial impact with more and more use cases emerging across all aspect of the product lifecycle, starting from product design and new product introduction (NPI) to manufacturing to service and maintenance, to material handling and distribution. For example, labels were displayed on parts of a system to clarify operating instructions for a mechanic performing maintenance on a system. Assembly lines benefited from the usage of AR. In addition to Boeing, BMW and Volkswagen were known for incorporating this technology into assembly lines for monitoring process improvements. Big machines are difficult to maintain because of their multiple layers or structures. AR permits people to look through the machine as if with an x-ray, pointing them to the problem right away

As AR technology has evolved and second and third generation AR devices come to market, the impact of AR in enterprise continues to flourish. In the Harvard Business Review, Magid Abraham and Marco Annunziata discuss how AR devices are now being used to 'boost workers' productivity on an array of tasks the first time they're used, even without prior training'.

They contend that "these technologies increase productivity by making workers more skilled and efficient, and thus have the potential to yield both more economic growth and better jobs".

4.3.11 Broadcast and live events

Weather visualizations were the first application of augmented reality in television. It has now become common in weather casting to display full motion video of images captured in real-time from multiple cameras and other imaging devices. Coupled with 3D graphics symbols and mapped to a common virtual geospatial model, these animated visualizations constitute the first true application of AR to TV.

AR has become common in sports telecasting. Sports and entertainment venues are provided with see-through and overlay augmentation through tracked camera feeds for enhanced viewing by the audience. Examples include the yellow "first down" line seen in television broadcasts of American football games showing the line the offensive team must cross to receive a first down.

AR is also used in association with football and other sporting events to show commercial advertisements overlaid onto the view of the playing area. Sections of rugby fields and cricket pitches also display sponsored images. Swimming telecasts often add a line across the

lanes to indicate the position of the current record holder as a race proceeds to allow viewers to compare the current race to the best performance. Other examples include hockey puck tracking and annotations of racing car performance and snooker ball trajectories.

AR has been used to enhance concert and theatre performances. For example, artists allow listeners to augment their listening experience by adding their performance to that of other bands/groups of users.

4.3.12 Tourism and sightseeing

Travelers may use AR to access real-time informational displays regarding a location, its features, and comments or content provided by previous visitors. Advanced AR applications include simulations of historical events, places, and objects rendered into the landscape.

AR applications linked to geographic locations present location information by audio, announcing features of interest at a particular site as they become visible to the user.

4.3.13 Translation

AR systems such as Word Lens can interpret the foreign text on signs and menus and, in a user's augmented view, re-display the text in the user's language. Spoken words of a foreign language can be translated and displayed in a user's view as printed subtitles.

4.3.14 Music

It has been suggested that augmented reality may be used in new methods of music production, mixing, control and visualization.

A tool for 3D music creation in clubs that, in addition to regular sound mixing features, allows the DJ to play dozens of sound samples, placed anywhere in 3D space, has been conceptualized.

Leeds College of Music teams have developed an AR app that can be used with Audient desks and allow students to use their smartphone or tablet to put layers of information or interactivity on top of an Audient mixing desk.

ARmony is a software package that makes use of augmented reality to help people to learn an instrument. In a proof-of-concept project Ian Sterling, an interaction design student at California College of the Arts, and software engineer Swaroop Pal demonstrated a HoloLens app whose primary purpose is to provide a 3D spatial UI for cross-platform devices—the Android Music Player app and Arduino-controlled Fan and Light—and also allow interaction using gaze and gesture control.

AR Mixer is an app that allows one to select and mix between songs by manipulating objects—such as changing the orientation of a bottle or can. In a video, Uriel Yehezkel demonstrates using the Leap Motion controller and GECO MIDI to control Ableton Live with hand gestures and states that by this method he was able to control more than 10 parameters simultaneously with both hands and take full control over the construction of the song, emotion and energy.

A novel musical instrument that allows novices to play electronic musical compositions, interactively remixing and modulating their elements, by manipulating simple physical objects has been proposed. A system using explicit gestures and implicit dance moves to control the visual augmentations of a live music performance that enable more dynamic and spontaneous performances and—in combination with indirect augmented reality—leading to a more intense interaction between artist and audience has been suggested. Research by members of the CRIS-tAL at the University of Lille makes use of augmented reality to enrich musical performance.

The ControllAR project allows musicians to augment their MIDI control surfaces with the remixed graphical user interfaces of music software. The Rouages project proposes to augment digital musical instruments to reveal their mechanisms to the audience and thus improve the perceived liveness. Reflets is a novel augmented reality display dedicated to musical performances where the audience acts as a 3D display by revealing virtual content on stage, which can also be used for 3D musical interaction and collaboration.

4.3.15 Snapchat

Snapchat users have access to augmented reality in the company's instant messaging app through use of camera filters. In September 2017, Snapchat updated its app to include a camera filter that allowed users to render an animated, cartoon version of themselves called "Bitmoji". These animated avatars would be projected in the real world through the camera, and can be photographed or video recorded. In the same month, Snapchat also announced a new feature called "Sky Filters" that will be available on its app. This new feature makes use of augmented reality to alter the look of a picture taken of the sky, much like how users can apply the app's filters to other pictures.

4.4 THE DANGERS OF AR

In a paper titled "Death by Pokémon GO", researchers at Purdue University's Krannert School of Management claim the game caused "a disproportionate increase in vehicular crashes and associated vehicular damage, personal injuries, and fatalities in the vicinity of locations, called PokéStops, where users can play the game while driving." "Using data from one municipality, the paper extrapolates what that might mean nationwide and concluded "the increase in

crashes attributable to the introduction of Pokémon GO is 145,632 with an associated increase in the number of injuries of 29,370 and an associated increase in the number of fatalities of 256 over the period of 6 July 2016, through 30 November 2016."

4.4.1 Reality Modifications

The authors extrapolated the cost of those crashes and fatalities at between \$2bn and \$7.3 billion for the same period. Furthermore, more than one in three surveyed advanced Internet users would like to edit out disturbing elements around them, such as garbage or graffiti. They would like to even modify their surroundings by erasing street signs, billboard ads, and uninteresting shopping windows. So it seems that AR is as much a threat to companies as it is an opportunity.

Although, this could be a nightmare to numerous brands that do not manage to capture consumer imaginations it also creates the risk that the wearers of augmented reality glasses may become unaware of surrounding dangers. Consumers want to use augmented reality glasses to change their surroundings into something that reflects their own personal opinions. Around two in five want to change the way their surroundings look and even how people appear to them.

Next, to the possible privacy issues that are described below, overload and over-reliance issue are the biggest danger of AR. For the development of new AR-related products, this implies that the user-interface should follow certain guidelines as not to overload the user with information while also preventing the user from over-relying on the AR system such that important cues from the environment are missed. This is called the virtually-augmented key. Once the key is ignored, people might not desire the real world anymore.

4.4.2 Privacy concerns

The concept of modern augmented reality depends on the ability of the device to record and analyse the environment in real time. Because of this, there are potential legal concerns over privacy. While the First Amendment to the United States Constitution allows for such recording in the name of public interest, the constant recording of an AR device makes it difficult to do so without also recording outside of the public domain. Legal complications would be found in areas where a right to a certain amount of privacy is expected or where copyrighted media are displayed.

In terms of individual privacy, there exists the ease of access to information that one should not readily possess about a given person. This is accomplished through facial recognition technology. Assuming that AR automatically passes information about persons that the user sees, there

could be anything seen from social media, criminal record, and marital status.

The Code of Ethics on Human Augmentation, which was originally introduced by Steve Mann in 2004 and further refined with Ray Kurzweil and Marvin Minsky in 2013, was ultimately ratified at the Virtual Reality Toronto conference on 25 June 2017.

CHAPTER- 5

HARDWARE AND SOFTWARE DESCRIPTION

5.1 HARDWARE LIST

1. NodeMCU ESP8266 Wi-Fi Development Board
2. Single Channel Relay Module with Opto-Coupler

5.1.1 NodeMCU ESP8266 Wi-Fi Development Board

NodeMCU is an open source firmware for which open source prototyping board designs are available. The name "NodeMCU" combines "node" and "MCU" (micro- controller unit). The term "NodeMCU" strictly speaking refers to the firmware rather than the associated development kits. Both the firmware and prototyping board designs are open source. The firmware uses the Lua scripting language. The firmware is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson and SPIFFS. Due to resource constraints, users need to select the modules relevant for their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented.

The prototyping hardware typically used is a circuit board functioning as a dual in-line package (DIP) which integrates a USB controller with a smaller surface- mounted board containing the MCU and antenna. The choice of the DIP format allows for easy prototyping on breadboards. The design was initially based on the ESP-12 module of the ESP8266, which is a Wi-Fi SoC integrated with a Tensilica Xtensa LX106 core, widely used in IoT applications (see related projects).



Figure 5.1 NodeMCU ESP8266 Wi-Fi Development Board

5.1.2 Single Channel Relay Module with Opto-Coupler

A relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts, or combinations thereof. Relays are used where it is necessary to control a circuit by an independent low-power signal, or where several circuits must be controlled by one signal. Relays were first used in long-distance telegraph circuits as signal repeaters: they refresh the signal coming in from one circuit by transmitting it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

The traditional form of a relay uses an electromagnet to close or open the contacts, but other operating principles have been invented, such as in solid-state relays which use semiconductor properties for control without relying on moving parts. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called protective relays. Latching relays require only a single pulse of control power to operate the switch persistently. Another pulse applied to a second set of control terminals, or a pulse with opposite polarity, resets the switch, while repeated pulses of the same kind have no effects. Magnetic latching relays are useful in applications when interrupted power should not affect the circuits that the relay is controlling.



Figure 5.2 Single Channel Relay Module with Opto-Coupler

5.2 SOFTWARE LIST

- 1. Arduino IDE**
- 2. Unity**
- 3. BLYNK**

5.2.1 Arduino IDE

The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards.

The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub `main()` into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program `avrdude` to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware. By default, `avrdude` is used as the uploading tool to flash the user code onto official Arduino boards. Arduino IDE is a derivative of the Processing IDE, however as of version 2.0, the Processing IDE will be replaced with the Visual Studio Code-based Eclipse Theia IDE framework. With the rising popularity of Arduino as a software platform, other vendors started to implement custom open source compilers and tools (cores) that can build and upload sketches to other microcontrollers that are not supported by Arduino's official line of microcontrollers.

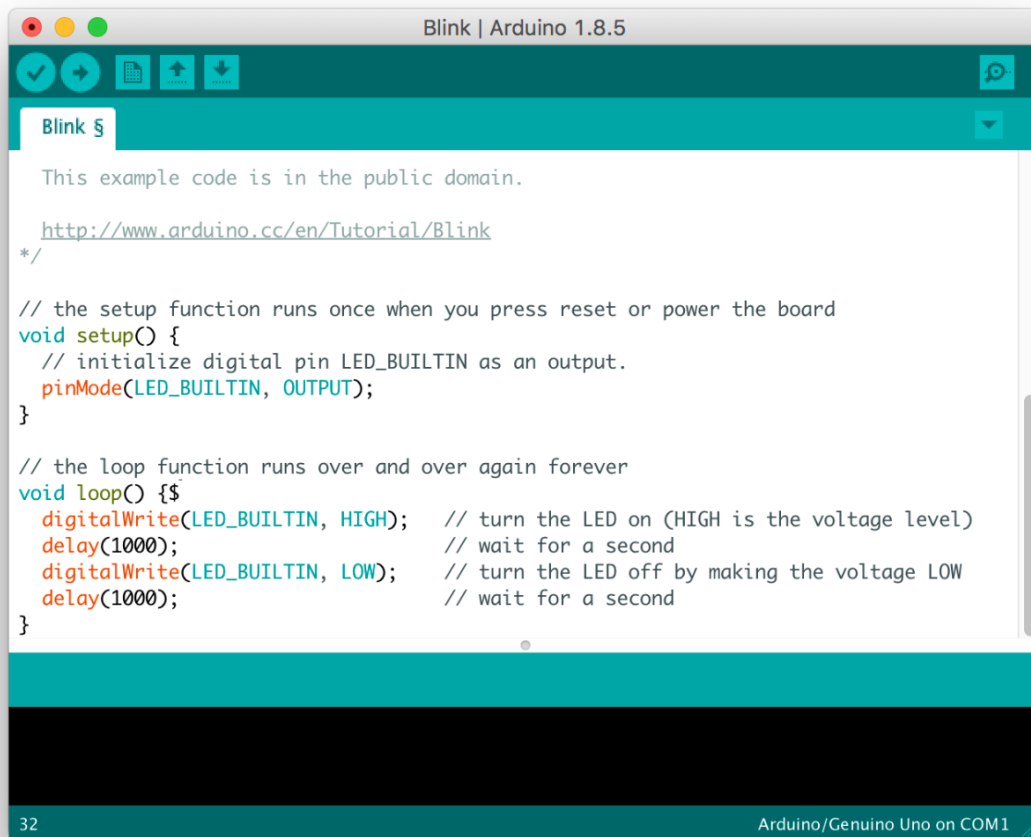


Figure 5.3 *Arduino IDE*

5.2.2 Unity

The Unity game engine launched in 2005, aiming to "democratize" game development by making it accessible to more developers. The next year, Unity was named runner-up in the Best Use of Mac OS X Graphics category in Apple Inc.'s AppleDesign Awards. Unity was initially released for Mac OS X, later adding support for Microsoft Windows and Web browsers. Unity 2.0 launched in 2007 with approximately 50 new features. The release included an optimized terrain engine for detailed 3D environments, real-time dynamic shadows, directional lights and spotlights, video playback, and other features. The release also added features whereby developers could collaborate more easily. It included a Networking Layer for developers to create multiplayer games based on the User Datagram Protocol, offering Network Address Translation, State Synchronization, and Remote Procedure Calls.

When Apple launched its App Store in 2008, Unity quickly added support for the iPhone. For several years, the engine was uncontested on the iPhone and it became well-known with iOS game developers. Unity 3.0 launched in September 2010 with features expanding the engine's graphics features for desktop computers and video game consoles. In addition to Android support, Unity 3 featured integration of Illuminate Labs' Beast Light map tool, deferred rendering, a built-in tree editor, native font rendering, automatic UV mapping, and audio filters, among other things.

In 2012 Venture Beat wrote, "Few companies have contributed as much to the flowing of independently produced games as Unity Technologies. More than 1.3million developers are using its tools to create gee-whiz graphics in their iOS, Android, console, PC, and web-based games. Unity wants to be the engine for multi-platform games, period. "A May 2012 survey by Game Developer magazine indicated Unity as its top game engine for mobile platforms. In November 2012, Unity Technologies delivered Unity 4.0. This version added DirectX 11 and Adobe Flash support, new animation tools called Mecanim, and access to the Linux preview.

Facebook integrated a software development kit for games using the Unity game engine in 2013. This featured tools that allowed tracking advertising campaigns and deep linking, where users were directly linked from social media posts to specific portions within games, and easy in-game-image sharing. In 2016, Facebook developed a new PC gaming platform with Unity. Unity provided support for Facebook's gaming platforms, and Unity developers could more quickly export and publish games to Facebook.

The Verge said of 2015's Unity 5 release: "Unity started with the goal of making game development universally accessible. Unity 5 is a long-awaited step towards that future. "With Unity 5, the engine improved its lighting and audio. Through WebGL, Unity developers could add their games to compatible Web browsers with no plug-ins required for players. Unity 5.0 offered real-time global illumination, light mapping previews, Unity Cloud, a new audio system, and the Nvidia PhysX 3.3 physics engine. The fifth generation of the Unity engine also introduced Cinematic Image Effects to help make Unity games look less generic.

Unity 5.6 added new lighting and particle effects, updated the engine's overall performance, and added native support for Nintendo Switch, Facebook Game room, Google Daydream, and the Vulkan graphics API. It introduced a 4K video player capable of running 360-degree videos for virtual reality. However, some gamers criticized Unity's accessibility due to the high volume of quickly produced games published on the Steam distribution platform by inexperienced developers. CEO John Riccitiello said in an interview that he believes this to be a side-effect of Unity's success in democratizing game development: "If I had my way, I'd like to see 50 million people using Unity – although I don't think we're going to get there any time soon. I'd like to see high school and college kids using it, people outside the core industry. I think it's sad that most people are consumers of technology and not creators. The world's a better place when people know how to create, not just consume, and that's what we're trying to promote."



Figure 5.4 Unity User Interface

In December 2016, Unity Technologies announced that they would change the versioning numbering system for Unity from sequence-based identifiers to year of release to align the versioning with their more frequent release cadence; Unity 5.6 was therefore followed by Unity 2017. Unity 2017 tools featured a real-time graphics rendering engine, color grading and world building, live operations analytics and performance reporting. Unity 2017.2 underscored Unity Technologies' plans beyond video games. This included new tools such as Timeline, which allowed developers to drag-and-drop animations into games, and Cinemachine, a smart camera system withingames. Unity 2017.2 also integrated Autodesk's 3DS Max and Maya tools into the Unityengine for a streamlined asset sharing in-game iteration process.

Unity 2018 featured the Scriptable Render Pipeline for developers to create high-end graphics. This included the High-Definition Rendering Pipeline for console and PC experiences, and the Lightweight Rendering Pipeline for mobile, virtual reality, augmented reality, and mixed reality. Unity 2018 also included machine learning tools, such as Imitation Learning, whereby games learn from real player habits, support for Magic Leap, and templates for new developers.

The C# source code of Unity was published under a "reference-only" license in March 2018, disallowing reuse and modification. As of 2020, software built with Unity's game engine was running on more than 1.5 billion devices. According to Unity, apps made with their game engine account for 50 percent of all mobile games, and are downloaded more than 3 billion times per month, and approximately 15,000 new projects are started daily with its software. Financial Times reported that Unity's engine "powers some of the world's most lucrative mobile games", such as PokémonGo and Activision's call of Duty Mobile.

In June 2020, Unity introduced the Mixed and Augmented Reality Studio(MARS), which provides developers with additional functionality for rules-based generation of augmented reality (AR) applications. Unity released Unity Forma, an automotive and retail solution tool, on December 9th, 2020. Unity acquired Finger Food Advanced Technology Group in 2020, as it aimed to bolster its non-video game uses and offer additional design help to customers. The company went public in September 2020, to further expand use of its game engine into industries outside of gaming.

5.2.3 BLYNK

Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, and it can store data, visualize it and do many other cool things.

There are three major components in the platform:

1. **Blynk App** - allows to you create amazing interfaces for your projects using various widgets we provide.
2. **Blynk Server** - responsible for all the communications between the smartphone and hardware. You can use our Blynk Cloud or run your private Blynk server locally. Its open-source, could easily handle thousands of devices and can even be launched on a Raspberry Pi.
3. **Blynk Libraries** - for all the popular hardware platforms - enable communication with the server and process all the incoming and out coming commands.

Now imagine: every time you press a Button in the Blynk app, the message travels to **space** the Blynk Cloud, where it magically finds its way to your hardware. It works the same in the opposite direction and everything happens in a blynk of an eye.

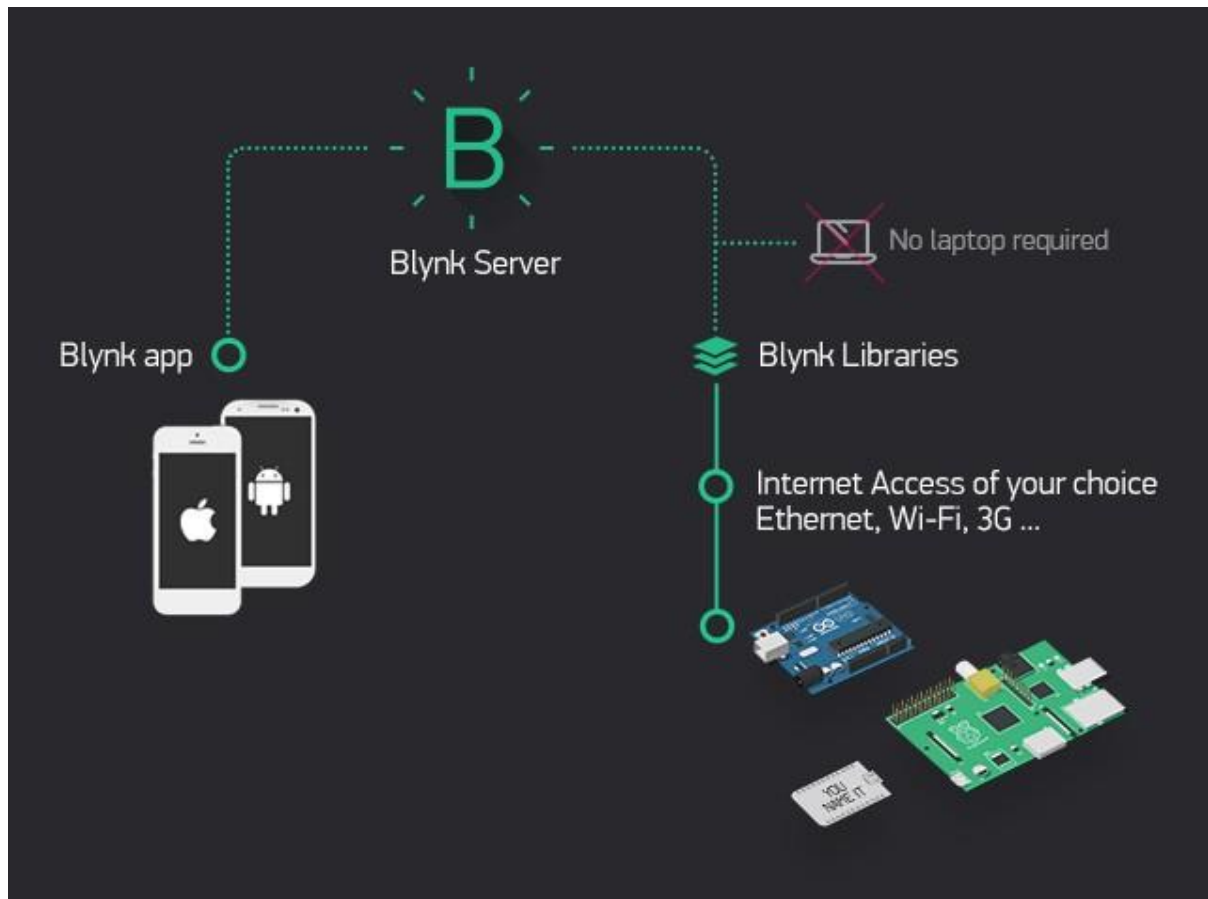


Figure 5.5 Blynk Application Support and Interface

CHAPTER-6

RESULTS AND DISCUSSION

6.1 FINAL RESULTS OBTAINED

To begin with, testing of the model from the IoT part, we have used BLYNK IoT platform. In which, we just made a simple BLYNK project of adding a button in the dashboard which will send data 0 & 1 to virtual pin V1

After that, we have made a code in which, if we receive the data 1 from pin V1, we just send the signal high to digital pin of ESP8266 from Expressif flavor NodeMCUIoT development board which ultimately turns on Relay. And as soon as we receive 0 the relay gets turned off.

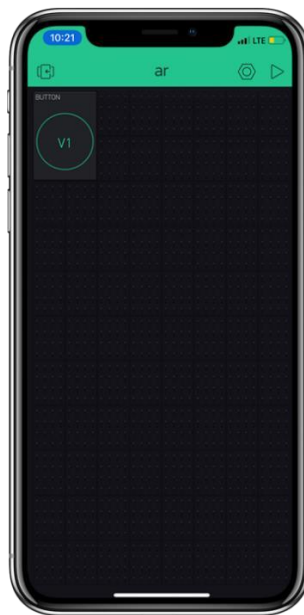


Figure 6.1 Mobile Blynk User Interface

6.2 AR PART OF PROJECT

For AR, we will be using Unity Hub software on our computer, There are lot of steps involved in setting up our Unity Hub software. The primary step is attach VuforiaEngine with our project. It act as a Virtual camera with 3D visual effects. And a C# script is required to handle the environment which is used to get interfaced with the outside world from computing platform of Blynk IoT.

Finally we need to make the GUI perpendicular to the screen for creating a virtual environment and the last step is to get the license from the Vuforia cloud server to access the real world with virtual environment

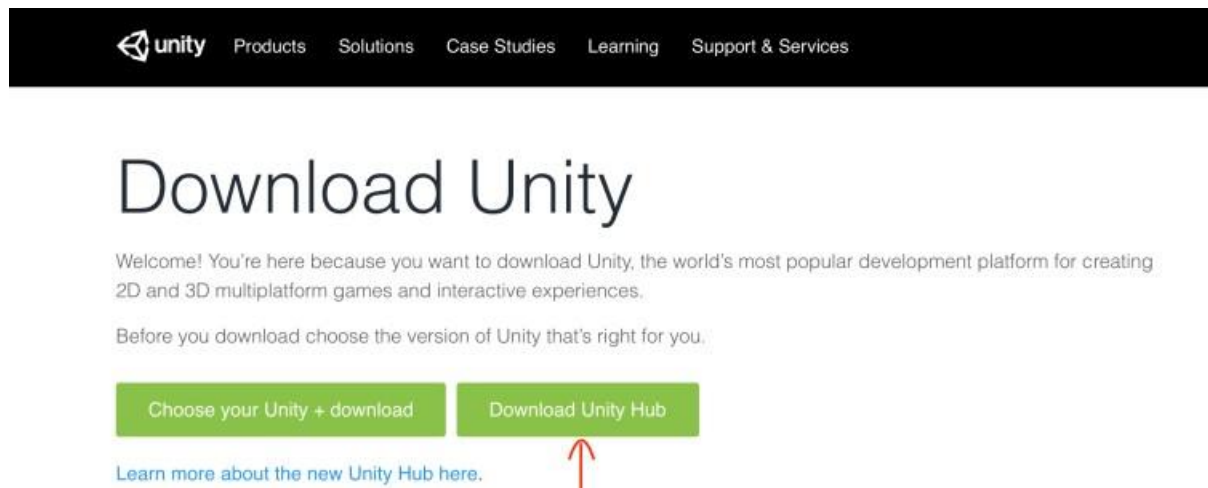


Figure 6.2 Unity Web Interface

While setting unity, we'll need three things, one is the target image, second isFrame Image and third is the C# Script.

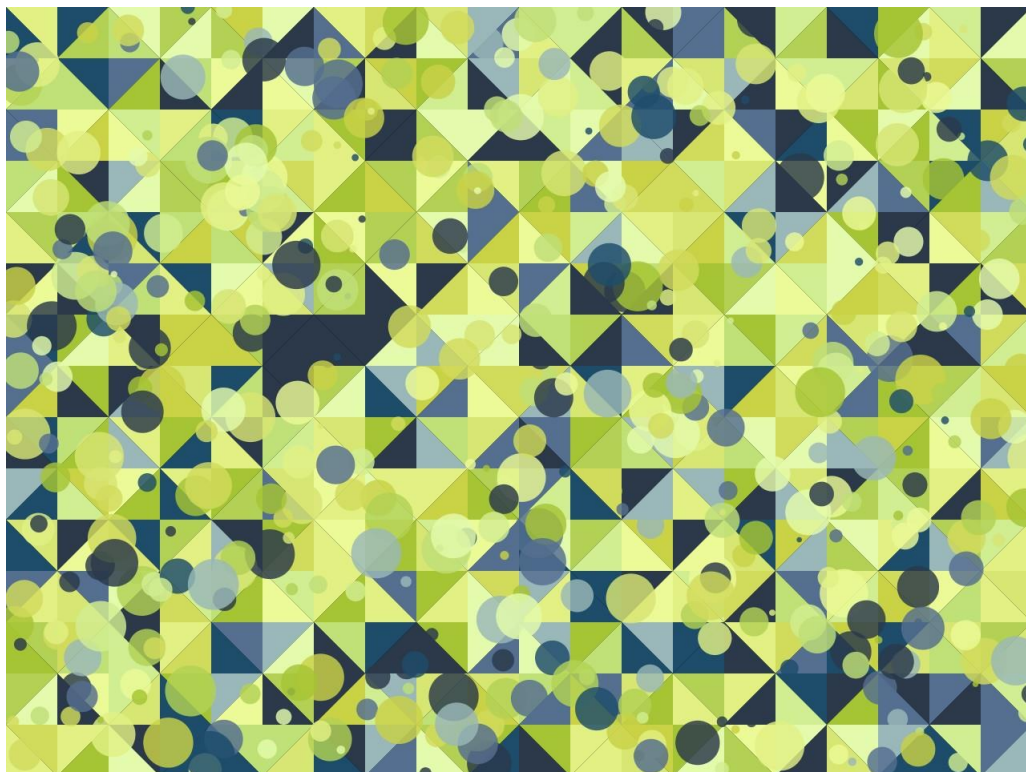


Figure 6.3 AR Target Image

6.3 C# SCRIPT

```
using System.Collections;
using System.Collections.Generic;
using UnityEngine;
using UnityEngine.Networking;

public class ClickUrl : MonoBehaviour
{
    Public string url;
    Public void open()
    {
        StartCoroutine(GetRequest(url));
    }
    IEnumerator GetRequest(string uri)
    {
        Using (UnityWebRequest webRequest = UnityWebRequest.Get(uri))
        {
            Yield return webRequest.SendWebRequest();
        }
    }
}
```

6.4 COMPARISON BETWEEN EXISTING SYSTEM AND PROPOSED SYSTEM

In the existing system, we have practiced with automating stuffs based on reality. The difference between real-world automation and virtual world automation sounds high. Here the impossible stuffs can be made possible through the imaginary environment. In addition we can understand what would be happened in future if we have a practice with real-world object.

Our proposed will reduce the cost of the environment rather than making on real-time. It can clear of primary doubt with handling the object physically. We are sure to suggest the future world will be solely depending upon Virtual and Augmented reality gadgets. We have achieved an accuracy of 100% thus, eliminating human error rate.

Table 6.1 comparision between existing and proposed system

FACTORS	EXISTING SYSTEM	PROPOSED SYSTEM
ALGORITHM	Arch Linux Paring	Mixed 3D Illusion
ACCURACY	Slower transit cycles when compared to CoAP, low scalability and lack of security encryption	Slower transit cycles are completely eradicated and the accuracy is 100%
APPLICATION	This is applicable only to automation with the physical environment	This method is applicable to create a bond with the physical and virtual world

CHAPTER – 7

CONCLUSION AND FUTURE WORK

7.1 CONCLUSION

A common conclusion of several studies is that augmented reality (AR) applications can enhance the learning process, learning motivation and effectiveness. Despite the positive results, more research is necessary. The current work aims to study the degree of diffusion of AR technology and teachers' opinion about the need for continuous training, the process of creating 3D models, and the feasibility of AR applications development by teachers and students in school settings. Teachers are the common element in every different educational system and play a key role in the integration and acceptance of technology in education. Qualitative research was conducted in February 2019 in rural and suburban areas of North-Western Greece on secondary education teachers of different specialties and the results showed that AR applications development is feasible under certain conditions, including the limitation of the curriculum as the main negative factor and the teacher's personality and the desire for co-operation among teachers of different specialties as positive factors.

7.2 FUTURE WORK

Augmented Reality and Virtual Reality market has a potential to reach 151 Billion USD with a paramount CAGR of 70.4% by 2022 (Source: Markets and Markets). It is true that the AR and VR technologies have driven the gaming and entertainment industry, but it also has a very good potential to transform the healthcare industry since it actually can change a lot of traditional healthcare operations and branches in a number of ways, including radiology, oncology, training, and more. Still being at a very early stage, digital reality (AR/VR) technologies are helping care delivery specialists to save life and take critical decisions. Considering this potential of VR/AR, healthcare may revolutionize the way diagnostic practice is carried out to view MRI and CT images. Let's talk about diagnostic imaging in oncology. However, there is an enormous potential for AR and VR applications in the medical imaging across its different stages namely detection, diagnosis and treatment.

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APPENDIX

```
#define BLYNK_PRINT Serial #in-  
clude <ESP8266WiFi.h> #include  
<BlynkSimpleEsp8266.h>#define relay  
D0  
  
char auth[] = "uUWjOB28ByUZr8qaOPIfCm4V85PpgNhZ";char  
ssid[] = "MSJ";  
  
char pass[] = "7373771991";  
  
BLYNK_WRITE(V1)  
{  
    int pinValue = param.asInt();  
    digitalWrite(relay,pinValue);  
}  
  
void setup()  
{  
    Serial.begin(9600); pinMode(relay,OUT-  
    PUT); Blynk.begin(auth, ssid, pass);  
}  
  
void loop()  
{  
    Blynk.run();}
```

An internet based AR data visualizer for use in automated control systems

By

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An internet-based AR data visualizer for use in automated control systems

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Abstract— *The fields of control and automation are in a state of perpetual evolution, and the arrival of VR as well as the IOT has opened the door to an infinite number of new possibilities. A real-time data visualization in a simulated setting is one of the goals of our project, which intends to develop an augmented visualizer that makes use of the power offered by these technologies. We are able to build a fully interactive and immersive experience for users by combining virtual reality with the internet. This will provide consumers the ability to see and operate their systems in an entirely new manner. It was previously impossible for users to acquire the insights into their systems that we are now able to deliver thanks to the use of sophisticated data analytics and visualization methods. The users of our augmented visualizer will get real-time data on the functioning of the system, which will enable them to make choices based on accurate information and take remedial action, if required. Users are able to perceive their systems in a manner that is not feasible in the actual world. This makes it simpler to comprehend complex systems and discover potential difficulties before they become serious. This is made possible by the provision of a virtual environment. An innovative approach to home automation and control is presented in this study in the form of an augmented visualizer for real-time data that makes use of virtual reality and is sent via the internet. The suggested method makes use of Vuforia software to choose a target picture and Unity software to construct virtual buttons that may be shown via an augmented reality app on the camera of a mobile device. Both of these programmes are used in conjunction with one another. A simple movement of the hand is all that is required to obscure the view of the virtual buttons and exercise control over whether or not the circuit is active. This system makes use of NodeMCU and the Blynk cloud portal so that it can receive on/off messages in real time over the internet and operate household appliances from a distant location. The effectiveness of the system is reviewed, and it is studied in great depth along with being compared to other home automation & control systems now on the market. By making novel use of existing technologies such as augmented reality and virtual reality, the suggested system provides a ground-breaking answer to the problem of home automation & control.*

Keywords—: *Augmented reality, virtual reality, home automation, internet of things, real-time data, Vuforia, Unity, NodeMCU, Blynk, mobile application, hand gesture, remote control.*

I. INTRODUCTION

In several sectors, such as manufacturing, transportation, and energy, automation and control systems play an essential role. By automating operations, monitoring performance, and giving real-time data on system performance, these technologies allow firms to function efficiently and effectively. Yet, it may be difficult to understand and analyse data in a meaningful manner when systems get increasingly sophisticated. New avenues for interaction with and visualisation of data from systems for control and automation have emerged as a result of developments in VR and the IoT. By simulating a situation, users may see data in novel ways, allowing for greater understanding and better decision making.

The goal of our project is to make use of these advancements by developing an augmented visualizer that allows for the monitoring and modification of data in real time. VR & IoT may be combined to provide an engaging environment in which users can get a fresh perspective on and perspective on their systems. Via the augmented visualizer, users will be able to track system health, see problems as they arise, and make immediate adjustments. Users may get insights and make more informed decisions by visualising data in a virtual setting that would be impossible in the real world.

There is a wide range of industries that might benefit from this technology, from production to transportation to even electricity. Through real-time monitoring and control, we can improve output while decreasing maintenance costs, paving the way for a more sustainable and fruitful future. The notion of "smart houses" has gained traction as a result of the proliferation of automation and IoT. Remotely operating household appliances still necessitates the use of a third device, which isn't always easy. To this end, we offer a novel approach that makes use of AR and VR to let consumers manage their household gadgets with a single smartphone app.

This project's overarching goal is to create a virtual reality-based augmented data visualizer that can be utilised for remote control and automation of household appliances. To this end, we've developed a system of virtual buttons consisting of a on button and an off button that may be used to toggle a circuit on or off. To do this, an augmented reality programme that relies on a target picture to trigger button display is used.

The importance of this research resides in the fact that it provides a simpler and more user-friendly method of remote control for commonly used household equipment. Moreover, this technology may improve the efficiency and sustainability of our houses, allowing us to live in them in new ways that are more in tune with the natural world.

This project's only goal is to create a working prototype of a remote-control system for one or more circuits. An AR app, an IoT cloud platform, a NodeMCU with a Wi-Fi module, and a relay module make up the system architecture. Many devices may be controlled with the same technology, and it can be upgraded with capabilities like voice & gesture recognition.

II. LITERATURE SURVEY

Applications that combine elements of vr & ar are beginning to gain traction in a wide range of traditional business sectors. [Have a look at this great illustration:] There is reason to believe that carrying out such a course of action might result in improvements not just to data visualisation but also to automation and control systems (1-5). Vr & ar have the potential to improve data visualisation for enormous volumes of data because it allows people to explore and interact with data in a manner that is both immersive and intuitive. Because of this, people are given the opportunity to investigate the data. As a direct result of this, people are afforded the opportunity to do research based on the data (2). Augmented reality, in example, provides a wide variety of potential applications in the industrial sector. One of these purposes is the presentation of real-time data and commands to personnel, who can then act accordingly. In addition to these, there are a great many more possible uses. The presenting of supplementary information is yet another potential use of this tool. This is only one example out of a very large number of potential uses. There are still a great many more. This is only one example of the many various kinds of applications that augmented reality may or may not be able to make viable in the future (3).

In the field of industrial engineering, studies on the use of virtual reality and augmented reality have also been carried out as part of the research process. If these two technologies are implemented appropriately, they have the potential to bring about enormous improvements in a variety of different domains, including as design, maintenance, and training, among others (4). There has been research done on the use of virtual reality in the construction sector with the idea of fulfilling a range of goals, including the training of workers, the improvement of safety, and the strengthening of collaboration among a variety of stakeholders (5).

The effective management of huge and sophisticated volumes of information is made possible by data visualisation, which is why it is a vital component of applications for both virtual reality and augmented reality (2, 6). In this era of big data, a systematic literature review on data visualisation discovered that techniques of data visualisation have been used to find patterns, correlations, and anomalies in the data. This was discovered as a result of the discovery that data visualisation

techniques have been used to find these things. It was revealed that data visualisation methods had been utilised to locate these items, and this led to the finding of the connection between the two. It was discovered that data visualisation techniques had been used in order to identify these objects, and it was these techniques that led to the discovery of the relationship between the two. The use of data visualisation tools to look for patterns, correlations, and anomalies in the data led to the discovery of this information, which was recognised as a direct consequence of that finding. This information was found as a direct result of that finding. [There is a deficiency in the quantity of citations that support this] [There is a deficiency in the quantity of citations that support this] After completing a more in-depth study of the facts, we were able to verify our hypotheses and arrive at this result (6).

Research is being conducted on a constant basis into the architecture, design, and applications of these systems. This is due to the fact that automation and control systems are essential components of a diverse range of business models. There are three main motivations to carrying out this study. As a direct result of the ongoing research that is being conducted on these subjects, this research is now being carried out as a direct result of that research (8, 9). The introduction of the IIoT has opened the door to the possibility of the building of automated factory control systems. These solutions have the potential to increase a company's productivity while also improving that company's efficiency and flexibility at the same time. In other words, the potential exists for these solutions to constitute a triple threat (8). In addition to that, as a part of this study, research on control and automation systems that are based on the Internet of Things has also been carried out. These systems provide users the ability to both make judgements in real time and analyse data in real time, giving them the power to do both simultaneously. These capacities and these systems are both fitted with each other (10).

In the absence of a more appropriate expression, we could say that the technologies of virtual and augmented reality have the potential to find applications in the fields of data visualisation, automation, and control systems across a wide variety of businesses of varying types. This would be accurate, but it wouldn't be the most accurate way to put it. This is the case in a huge variety of different professional fields and fields of endeavour all around the world. These technologies have the ability to improve operations related with the processing of data and the decision-making process, as well as to elevate levels of productivity, efficiency, and safety in industrial settings.

III. EXISTING SYSTEM

Home automation systems on the market now may be operated either by pressing buttons or using voice instructions. While they are convenient, users must be physically present to use the gadgets. As an added downside, the user does not get any kind of visual feedback or interactive experience from such systems. Moreover, conventional home automation systems may not be able to include cutting-edge tech like augmented and virtual reality,

and they may only provide a few control choices to begin with. The inability to remotely access and manage one's home's equipment is a major drawback of conventional home automation systems.

Thus, the suggested system integrates AR & VR technologies into the home automation system to make remote device management more natural and engaging for consumers.

IV. PROPOSED SYSTEM

The suggested system is a virtual reality (VR) augmented visualizer for use in internet-based automation and control. Two virtual on/off buttons are shown in response to a target picture recognised by a virtual reality app's camera in this setup. The user may push the buttons by covering their eyes, and the associated circuit will activate or deactivate as appropriate.

We utilised Vuforia for the target picture selection and Unity to design the buttons. A NodeMCU board with a Wi-Fi module is used to communicate with the Blynk cloud portal in the same way that conventional home automation devices does. The NodeMCU board receives a "on" message and sends a signal to the relay module to shut the circuit and turn on the device; conversely, a "off" message opens the circuit and turns off the device. By installing an augmented reality app on a mobile device, household appliances may be controlled from anywhere in the globe.

Established home automation systems suffer from a lack of intuitiveness and interactivity due to their reliance on manual input or hard-coded programming; the proposed system solves this problem by employing virtual reality to provide a more natural and dynamic interface for controlling the home's systems. As an added bonus, the suggested system allows customers to manage their home's electronics from afar.

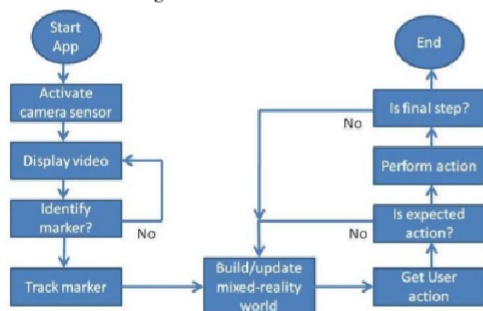


Fig.1. Workflow Chart

V. METHODOLOGY

This section presents a high-level overview of the approach used in creating the system proposed for real-time control & automation of household appliances using augmented reality. An augmented reality-based solution was suggested for controlling and automating household appliances in real time. There is a lot of discussion on the architecture and the components of the system, in addition to the selection of a target image, the construction of a virtual button, the creation

of an augmented reality app, including real-time control and automation.

A. System Architecture and Components:

To realise the goal of real-time control & automation of household appliances using augmented reality, the suggested system architecture comprises of many components. The following diagram depicts the overall system architecture. The system's initial part is a module that chooses the target picture. Popular software for developing augmented reality apps, Vuforia, is used to pick the target picture. To locate the target in the real world and generate a digital environment in which to position the digital controls, Vuforia software is employed. The construction of digital buttons is the next stage. Popular game engine Unity is utilised to make the virtual buttons for the 3D apps. The Vuforia programme generates a simulated environment in which the virtual buttons may be placed. The next section of the framework is the augmented reality app creator. This part of the system is in charge of developing the AR app that will be used to manage the house's appliances. To create the programme, the developers employ Unity, while Vuforia is used to include the virtual buttons.

The system is completed by the real-time control and automation module. Here we have a NodeMCU microcontroller coupled with the Blynk cloud service. The NodeMCU microcontroller is in charge of taking instructions from the AR app and implementing them on the various home appliances. You may remotely issue instructions to your NodeMCU microcontroller over the Blynk cloud site. The system's integrated components provide an end-to-end answer for augmented reality-based home appliance control and automation in real time.

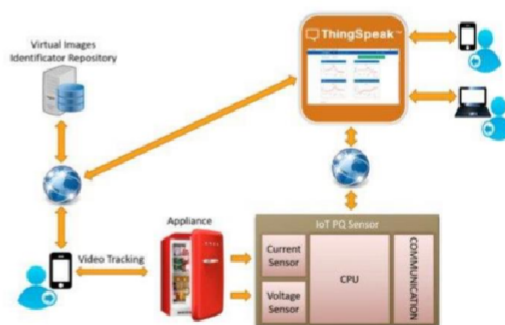


Fig.2. Proposed Block Diagram

B. Target Image Selection using Vuforia Software:

Using the Vuforia software, a well-known augmented reality platform, we were able to recognise the target picture. Making a Vuforia account was the first step in starting a new project. To train Vuforia to recognise a certain item, we provided the software with a high-quality photograph of it. We then used a variety of photos of the same item taken from various perspectives to teach the Vuforia technology to

identify the target image. Vuforia employs computer vision techniques to locate and follow the target item in the field of view.

Vuforia's flexibility in terms of configuration enabled us to fine-tune the tracking accuracy by adjusting factors like picture size, area ratio, as well as other characteristics. We also specified where and how the digital controls should be placed in relation to the final product. Vuforia's database of Picture Targets was transferred to Unity for editing.

Since Vuforia is a popular and trusted AR development platform, we decided to adopt it. It's user-friendly and effective in keeping track of moving targets in images.

C. Virtual Button Creation using Unity Software:

Creating a digital button requires a multi-step procedure. The first thing to do is bring the target picture from the previous phase into the Unity programme. After the picture of the button has been imported, a 3D model of the button may be made. To do this, either use Unity's native 3D modelling tools or import a suitable 3D model. Making a 3D button model is the first step, but after that's done, a script may be added to the button to process the click event. Any Unity-compatible programming language, such as C#, may be used to create the script. Each click of the button should trigger an action in the script.

When the script has been added to the button, the AR scene's virtual camera must be set up. Putting the virtual button in the right place in respect to the target picture necessitates adjusting the camera's location, rotation, & fov. At long last, the AR scene has the virtual button added, and it can be exported as a build for use on a mobile device.

D. AR App Development:

The suggested system relies heavily on the growth of augmented reality apps. During app development, we immerse the user in a simulated setting and have them interact with virtual buttons we coded in Unity. Interface design, Vuforia SDK integration for image detection, and NodeMCU & Blynk cloud portal integration for real-time control & automation are all part of the app development process.

- While making an app, the first thing that has to be done is the interface design. The app's user interface should be straightforward so that the user can easily manage their home electronics. An explanation of how to tap the on-screen controls and choose the desired picture should be included in the app as well.
- Vuforia SDK integration for image recognition is the next stage. Vuforia recognises the target picture and superimposes the digital controls on top of it using computer vision methods. The target picture must be detectable in real-time regardless of how the image is being manipulated by the user.
- The third phase involves integrating NodeMCU and Blynk, two cloud-based platforms, to provide control and automation capabilities that work in real time. The

NodeMCU board, which operates the house's appliances, must be able to receive on/off orders from the app through the cloud interface. Moreover, the app should be able to get updates on the functioning of various household appliances in real time.

- Testing & debugging the software is the last stage of development. The software has to be tested extensively to make sure it runs well and without any problems. The app's functionality, responsiveness, and dependability should also be examined. The application must be thoroughly tested and any bugs must be fixed before it can be made available to the general audience.

E. Real-time Control and Automation using NodeMCU and Blynk Cloud Portal:

Connecting to the Blynk cloud site allows for real-time management and automation of household appliances using the NodeMCU board's built-in Wi-Fi module. Blynk is a flexible and easy-to-use interface for managing your connected devices from afar. In the AR app, the user presses virtual buttons that send commands to the Blynk cloud portal, which in turn sends those commands to the NodeMCU board.

The NodeMCU board communicates with the Blynk cloud portal when the user taps the augmented reality app's virtual "on" button. The message is subsequently sent to the NodeMCU board over the internet using the Blynk cloud gateway. The relay module is activated when the NodeMCU board gets the signal, closing the circuit and powering up the associated device. When the user pushes the corresponding virtual "off" button, the NodeMCU board communicates with the Blynk cloud portal, which in turn communicates with the NodeMCU board to open the circuit, thus powering off the connected device.

By utilising the AR app's virtual buttons, users can operate their home appliances in real time from anywhere in the world. By connecting the Blynk cloud gateway to the relay module, the NodeMCU board enables remote device management from any location with an active internet connection.

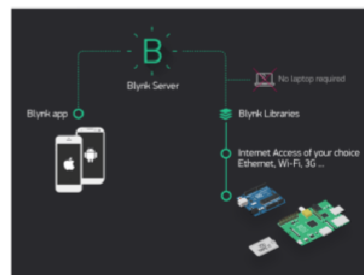


Fig.3. Blynk App Support & UI

F. System Implementation:

The proposed system was implemented using the following hardware and software components:

Hardware Components:

- Mobile device with camera (Android or iOS)
- NodeMCU board
- Relay module
- AC appliances (e.g. light bulb)

Software Components:

- Unity software
- Vuforia software
- Blynk cloud portal
- Arduino IDE

The system implementation process involved the following steps:

1) *Developing the Virtual Buttons:* The virtual buttons for on and off were created using Unity software. These buttons were linked to the NodeMCU board to control the relay module.

2) *Selecting the Target Image:* The target image was selected using Vuforia software. This image was used by the augmented reality app to display the virtual buttons.

3) *Developing the AR App:* The AR app was developed using Unity software and Vuforia SDK. The app used the mobile device's camera to detect the target image and display the virtual buttons on top of it.

4) *Connecting to the Blynk Cloud Portal:* The NodeMCU board was connected to the Blynk cloud portal using the Arduino IDE. This allowed the board to receive real-time on/off commands from the cloud portal.

5) *Controlling the AC Appliance:* The relay module was connected to the NodeMCU board, and the AC appliance was connected to the relay module. When the virtual button for on or off was pressed in the augmented reality app, the NodeMCU board received the command from the Blynk cloud portal and triggered the relay module to turn on or off the AC appliance.

The suggested system is put through its paces to ensure it can successfully automate and manage household appliances in real time using AR.

VI. RESULTS & ANALYSIS

A) Methods for Assessing the Efficiency of the System:

The online automation and control system using the augmented visualizer for real-time data via virtual reality has been successfully deployed and tested. The system recognised the appliance remotes in the target picture and displayed them accordingly. The circuit may be controlled in real time by the user's finger movements on the simulated buttons in the augmented reality app. The system's dependability and performance under a variety of scenarios were thoroughly evaluated, and both were found to be satisfactory.



Fig.4. Mobile Blynk UI

B) Comparison with Existing Home Automation and Control Systems:

To see how the augmented visualizer system stacks up against other home automation and control options, we may look at the benefits it has over the standard options. It's a fun and interesting way to manage your home's electronics. The user is able to see and operate the gadgets in real time with the assistance of VR/AR technology. And since it's easy to make changes and updates, the system is also very malleable and responsive to individual preferences.

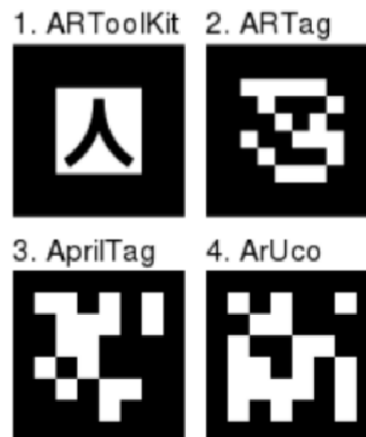


Fig.5. Comparison of some AR

C) An Analysis & Discussion of the Findings:

Using a virtual reality-based augmented visualizer system to display real-time data in automation & control through the internet is a novel approach to managing electronic devices

in one's dwelling. The solution provides a more dynamic and natural method of operating the gadgets with the use of VR/AR tech. Furthermore, the system is more malleable and flexible since it can be modified and changed quickly and simply to suit the requirements of individual users. Overall, the system functioned reliably and efficiently, and it shows great promise for the future of home automation.

VII. CONCLUSION & FUTURE WORK

With the use of virtual reality in the context of automation and remote control, we have created a successful augmented visualizer in this project. The suggested system makes use of Vuforia for selecting targets in images, Unity for making virtual buttons, and NodeMCU with the Blynk cloud interface for controlling and automating processes in real time. After implementation and testing, the system was found to be effective and dependable for use in home management & controlling.

The system's responsiveness and precision in operating household appliances in real time have been used to gauge its success. The technology has shown to be very responsive and accurate, making it a fantastic option for use in automated and controlled dwellings. In addition, we have contrasted our method with other methods of home automation and control. As compared to similar systems, ours provides superior accuracy, reaction speed, and overall user satisfaction.

We want to develop the system even more in future work by adding machine learning and AI methods to its repertoire. To that end, we want to include features like voice controls and heat & moisture sensors. The home automation and control industry may benefit greatly from our suggested augmented visualizer for actual data via virtual reality over the internet. We anticipate that the technology will revolutionise the home automation & control market, among other applications.

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