October 6 University

Faculty of Engineering

Smart city and Smart home

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Project Report

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Dedication

This project is dedicated to my university.

Acknowledgments

In this project we want to thank our friends who supported us as well as we want to thank our doctors and teaching assistants for helping us and giving us the information we needed.

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Symbols and Abbreviations

You may include a list of alphabetically ordered symbols and abbreviations here

Nomenclature

Symbol	Quantity
x, y, z	Cardinal coordinate components

Greek Letters

Symbol	Quantity
β	Thermal expansion coefficient, K^{-1}
Δ	Change interval of any property
$\boldsymbol{\delta}$	Delta function

Superscripts and Subscripts

Symbol	Quantity
—	Mean Property
→	Vector
'	Fluctuating component of any property
T	Transpose
Av	Average
eff	Effective property
i, j, k	Donates Cartesian coordinate direction takes the value of axis X,Y, Z,
I	Species *i*

Abbreviations

Symbol	Quantity
2D	Two Dimensional configurations
3D	Three Dimensional configurations
3DHVAC	Three-dimensional HVAC program package
ACH	Air Changes per Hour
AMG	Algebraic Multigrid
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers

Abstract

Smart cities and smart homes are two concepts that are transforming the way we live and interact with our environment. A smart city is a city that uses advanced technology to improve the quality of life for its citizens, enhance sustainability, and streamline services. Smart homes, on the other hand, use connected devices and automation to make daily living more convenient, comfortable, and efficient. In a smart city, sensors and other data-gathering devices are used to monitor everything from traffic flow to air quality. This data is then analyzed to optimize services such as public transportation, waste management, and energy consumption. Smart cities also prioritize citizen engagement through digital platforms that allow residents to provide feedback on services or report issues. In a smart home, connected devices such as thermostats, lighting systems, security cameras, and appliances can be controlled remotely through smartphones or voice-activated assistants.

These devices can also learn from user behavior to automatically adjust settings for maximum comfort or energy efficiency. Additionally, smart homes can integrate with other technologies such as renewable energy sources or electric vehicles for further sustainability benefits. Both smart cities and smart homes have significant potential for improving quality of life while reducing environmental impact. However, there are also concerns around privacy and security in these highly connected environments. As these technologies continue to evolve and become more widespread, it will be important to address these issues while ensuring equitable access for all citizens.

Chapter 1 Introduction

Smart technology has always been the future of the world as it took part in many applications in every industry and as we use it daily (at work, school, university, …etc.)

Our smart technology project "SMARTI" is a prototype of an industry that is now a huge part of the future as it talks about smart cities and smart homes using specific security systems it facilitates living for human beings.

Smarti shows the development of smart living and technology as it helps the world to solve many problems we used to have, problems talking about here are the difficulty of living and huge errors and mistakes we pass every day due to human involvement as it solves much lack of security caused by small faults that may cause huge problems.

In our project we used programming development to program a smart compound that will be used as a prototype for a huge industrial project as many countries start building projects like this, also we are programming smart homes for the compound we are building.

Also, security systems took a huge part in smarti as we developed a security system to make sure that the citizens will have the best security system to secure their private information about their homes.

As smarti has a mobile application that is used by the citizens to facilitate the usage of smarti technology as well as administrators uses also the application to make sure everything is going as should and everyone is safe.

A smart city is an urban area that leverages cutting-edge technologies and innovative solutions to enhance the quality of life for its residents while reducing environmental impact and increasing economic competitiveness. A smart city is built upon a foundation of digital infrastructure that connects people, devices, and data in real time, allowing for the optimization of services, resources, and systems. This includes everything from intelligent transportation systems and public safety solutions to energy management and waste reduction initiatives.

The goal of a smart city is to improve the efficiency and sustainability of urban life by leveraging data and technology to create more responsive, connected, and livable environments. By using data analytics and predictive modeling, a smart city can anticipate and respond to the needs of its citizens in real time, resulting in better service delivery, improved safety, and a higher quality of life.

Some of the key features of a smart city include a robust digital infrastructure, advanced communication networks, sensor technology, and data analytics. By integrating these elements into city planning and operations, a smart city can create more efficient and sustainable systems for transportation, energy, water management, waste reduction, and more.

The goal of a smart home is to create an environment that is more responsive to the needs and preferences of its occupants. By using sensors, cameras, and other smart devices, a smart home can monitor and adjust the temperature, lighting, security, and other key factors to create a personalized and efficient living experience.

Some of the key features of a smart home include voice-activated assistants, smart thermostats, automated lighting systems, security cameras, and connected appliances. By integrating these elements into a cohesive system, a smart home can create a seamless and intuitive living experience that adapts to the needs of its occupants.

The programming of a smart city involves the development and implementation of software and other digital solutions that enable the efficient and effective operation of urban systems and services. This includes everything from transportation and energy management to public safety and waste reduction.

One of the key aspects of programming for a smart city is the development of digital infrastructure that can support a wide range of connected devices and systems. This requires the use of advanced communication networks, data analytics tools, and other technologies that can enable real-time monitoring and control of urban systems.

Another important aspect of programming for a smart city is the use of data to inform decision-making and improve service delivery. This involves collecting and analyzing data from a wide range of sources, including sensors, cameras, and other smart devices, to identify patterns and trends that can inform urban planning and policy decisions.

In addition to infrastructure and data management, programming for a smart city also involves the development of applications and other digital solutions that can enhance the user experience and enable greater citizen engagement. This includes everything from mobile apps that provide real-time transit information to interactive maps that enable citizens to report potholes and other infrastructure issues.

The programming of a smart home involves the development and implementation of software and other digital solutions that enable the efficient and effective operation of home systems and services. This includes everything from home security and lighting to temperature control and entertainment.

One of the key aspects of programming for a smart home is the development of a central hub or app that can control all of the connected devices and systems within the home. This requires the use of advanced communication protocols and interfaces that can enable seamless integration and control.

Another important aspect of programming for a smart home is the use of data to inform decision-making and improve the user experience. This involves collecting and analyzing data from a wide range of sensors and smart devices to identify patterns and trends that can inform home automation and optimization.

In addition to infrastructure and data management, programming for a smart home also involves the development of applications and other digital solutions that can enhance the user experience and enable greater control and customization. This includes everything from voice-activated assistants to mobile apps that provide remote access and control of home systems.

The programming of security systems for smart cities and smart homes involves the development and implementation of software and other digital solutions that enable the efficient and effective operation of security systems and services. This includes everything from surveillance cameras and alarm systems to access control and monitoring.

One of the key aspects of programming for security systems in smart cities and smart homes is the development of digital infrastructure that can support a wide range of connected devices and systems. This requires the use of advanced communication networks, data analytics tools, and other technologies that can enable real-time monitoring and control of security systems.

Another important aspect of programming for security systems in smart cities and smart homes is the use of data to inform decision-making and improve threat detection and response. This involves collecting and analyzing data from a wide range of sources, including sensors, cameras, and other smart devices, to identify patterns and anomalies that may indicate potential security threats.

In addition to infrastructure and data management, programming for security systems in smart cities and smart homes also involves the development of applications and other digital solutions that can enhance the user experience and enable greater control and customization. This includes everything from mobile apps that provide remote access and control of security systems to intelligent threat detection and response systems that can automate security processes.

Overall, a smart city is a vision for the future of urban life that is focused on leveraging technology to create more livable, sustainable, and resilient communities.

A smart home is a living space that uses cutting-edge technology to enhance the quality of life for its residents while increasing convenience, comfort, and energy efficiency. A smart home is built upon a foundation of connected devices and appliances that can communicate with each other, as well as with the homeowner, via a central hub or mobile app.

a smart home is a vision for the future of residential living that is focused on using technology to create a more comfortable, efficient, and personalized home environment. By leveraging the power of the Internet of Things (IoT) and artificial intelligence (AI), smart homes are revolutionizing the way we live and interact with our living spaces. programming for a smart city requires a multidisciplinary approach that involves collaboration between city planners, engineers, data scientists, and software developers.

By leveraging the power of technology and data, smart city programming has the potential to revolutionize urban life by improving efficiency, enhancing sustainability, and increasing citizen engagement. programming for a smart home requires a multidisciplinary approach that involves collaboration between software developers, data scientists, and designers. By leveraging the power of technology and data, smart home programming has the potential to revolutionize residential living by improving efficiency, enhancing comfort, and increasing convenience. programming for security systems in smart cities and smart homes requires a multidisciplinary approach that involves collaboration between security experts, software developers, data scientists, and designers.

By leveraging the power of technology and data, security system programming has the potential to revolutionize urban and residential security by improving efficiency, enhancing threat detection and response, and increasing user control and customization.

Smart cities and smart homes are trying to solve a wide range of problems related to urban and residential living.

1.1 problems they are trying to solve include:

1. Resource Management: Smart cities and smart homes are trying to address issues related to resource management, such as energy consumption, water usage, and waste reduction. By leveraging data and technology, they aim to optimize resource usage and reduce waste.
2. Traffic Congestion: Smart cities are trying to address issues related to traffic congestion by developing smart transportation systems, such as intelligent traffic management systems and autonomous vehicles. These systems aim to reduce traffic congestion, improve mobility, and increase safety.
3. Environmental Sustainability: Smart cities and smart homes are trying to address issues related to environmental sustainability, such as air pollution, greenhouse gas emissions, and climate change. By leveraging data and technology, they aim to reduce environmental impact and promote sustainable living.
4. Safety and Security: Smart cities and smart homes are trying to address issues related to safety and security, such as crime prevention, emergency response, and disaster management. By leveraging data and technology, they aim to improve public safety and enhance emergency response.
5. Convenience and Comfort: Smart homes are trying to address issues related to convenience and comfort, such as home automation and customization, and seamless integration of different home systems. By leveraging data and technology, they aim to enhance the user experience and increase convenience.

1.2 Working steps:

1. Planning: The first step is to plan the project by identifying the goals and objectives, defining the scope of the project, and establishing a project timeline and budget.
2. Infrastructure Development: The next step is to develop the necessary infrastructure to support the smart home or smart city systems, including communication networks, data storage, and processing systems, and hardware components such as sensors and smart devices.
3. System Integration: The next step is to integrate the different systems and devices within the smart home or smart city, including security systems, transportation systems, energy management systems, and other systems. This requires the development of software and interfaces that can enable seamless integration and control of the different systems.

Data Management and Analysis: Once the systems are integrated, the next step is to manage and analyze the data generated by the different systems. This involves collecting data from sensors and other sources, storing and processing the data, and using data analytics tools to identify patterns and trends that can inform decision-making and improve system performance.

4. User Experience and Customization: Another important aspect of completing a smart home or smart city project is the development of user interfaces and applications that can enhance the user experience and enable customization. This includes everything from mobile apps that provide remote access and control to voice-activated assistants that can automate home tasks.
5. Testing and Deployment: The final step is to test and deploy the smart home or smart city systems. This involves conducting system testing to ensure that the systems are functioning correctly and deploying the systems to the target audience.

Smart home and smart city projects are becoming increasingly popular as technology continues to advance. These projects aim to create more efficient, sustainable, and convenient living environments for individuals and communities. Background information for doing a smart home project includes understanding the various technologies and devices that can be used to automate and control various aspects of the home.

This may include smart thermostats, lighting systems, security cameras, appliances, and entertainment systems. Additionally, knowledge of networking and communication protocols such as Wi-Fi, Bluetooth, Zigbee, and Z-Wave is essential. In terms of a smart city project, background information involves understanding the various components that make up a smart city ecosystem. This may include sensors for collecting data on traffic flow, air quality, energy usage, waste management systems, public transportation systems, and emergency response services.

Additionally, knowledge of data analytics and machine learning techniques is important for analyzing the vast amounts of data generated by these systems. Both smart home and smart city projects require an understanding of cybersecurity best practices to ensure that these systems are secure from cyber threats.

It is also important to consider ethical considerations related to privacy when implementing these technologies. Overall, a successful smart home or smart city project requires a multidisciplinary approach that involves collaboration between engineers, urban planners, policymakers, community members, and other stakeholders.

1.3 Objectives for a smart home project:

1. Improve energy efficiency and reduce energy consumption

2. Enhance security and safety through advanced surveillance and monitoring systems

3. Increase convenience and comfort through the automation of household tasks

4. Enable remote access and control of devices and appliances

5. Improve health and well-being through smart lighting, temperature, and air quality control

Objectives for a smart city project:

1. Enhance sustainability by reducing carbon emissions and promoting renewable energy sources

2. Improve transportation systems through intelligent traffic management and public transit optimization

3. Increase safety through advanced surveillance systems, emergency response planning, and disaster management protocols

4. Promote economic development by attracting new businesses, creating jobs, and improving access to resources

5. Improve the quality of life for residents by providing better access to healthcare, education, public services, and cultural amenities.

1.4 Objectives for smart City project:

1. Improving quality of life: The primary objective of smart city projects is to improve the quality of life for citizens. This includes providing better access to basic services such as healthcare, education, transportation, and housing.

2. Enhancing sustainability: Smart cities aim to reduce their carbon footprint and promote sustainable practices. This includes implementing energy-efficient technologies, reducing waste, and promoting green spaces.

3. Promoting economic growth: Smart cities are designed to attract investment and create job opportunities. By promoting innovation and entrepreneurship, they can help drive economic growth.

4. Improving safety and security: Smart city projects can help enhance safety and security by implementing advanced surveillance systems, emergency response systems, and disaster management plans.

5. Improving mobility: Smart cities aim to improve mobility by providing better transportation options such as public transit systems, bike-sharing programs, and pedestrian-friendly infrastructure.

6. Enhancing citizen engagement: Smart city projects promote citizen engagement by providing platforms for citizens to participate in decision-making processes and provide feedback on city services.

7. Providing better access to information: Smart cities aim to provide citizens with better access to information through digital platforms such as mobile apps, websites, and social media channels.

8. Enhancing efficiency: Smart city projects aim to enhance efficiency by using data analytics tools to optimize resource allocation and improve service delivery.

Chapter 2 Literature Review

In today's world, technology has become an integral part of our lives. With the rapid advancement in technology, we have seen a significant shift towards smart cities and smart homes. These projects are aimed at making our lives more comfortable, convenient, and sustainable.

Smart cities are designed to use technology to improve the quality of life for citizens. They use sensors and data analytics to manage resources such as energy, water, and transportation. Smart cities also provide citizens with access to information and services through mobile applications and other digital platforms.

Smart homes, on the other hand, are designed to make our daily lives more comfortable and convenient. They use automation technologies such as smart thermostats, lighting systems, security systems, and appliances that can be controlled remotely through mobile devices.

The importance of smart city and smart home projects cannot be overstated. These projects have the potential to revolutionize the way we live by making our lives more efficient, sustainable, and connected. Smart cities can help reduce energy consumption by optimizing resource management while providing citizens with better access to public services such as healthcare and education.

Smart homes can help reduce energy consumption by automating household tasks such as turning off lights when not in use or adjusting the temperature based on occupancy patterns. They can also provide greater security by allowing homeowners to monitor their homes remotely through mobile devices.

In conclusion, smart city and smart home projects are essential for creating a better future for ourselves and future generations. By embracing these technologies, we can create a more sustainable world that is both efficient and convenient. As we move forward into an increasingly digital age, it is crucial that we continue to invest in these projects so that we can build smarter communities that work for everyone.

2.1 literature survey on smart cities

Researchers often understand a smart city from different perspectives. In this paper, They provide a gateway to better understanding the concept of a smart city through the analysis of its definition and application domains.

They propose that any smart city definition should consider four key perspectives: technical infrastructure, the application domain, system integration and data processing. Also they classified smart city application domains into four essential domains: government, citizens, business and environment.

They defined a smart city as a systematic integration of technological infrastructures that relies on advanced data processing, with the goals of making city governance more efficient, citizens happier, businesses more prosperous and the environment more sustainable. By reviewing the literature, They have shown that smart city architectures are considered to have datacentric and multidisciplinary characteristics.

They proposed a new smart city architecture composed of four layers of: data acquisition, data vitalization, common data and services, and domain application. Also They have summarized several key enabling technologies for smart cities from a data-centric viewpoint. Among them, data vitalization is considered to be a core technology, which can transform isolated data into an organic entirety, and recreate associations among data in information systems.

Urban data are collected, analyzed, vitalized and used to realize smartness in urban domains. We have presented some recent research progress in smart city domains, such as city traffic, citizen behavior and city planning.

The surveyed related research work tries to provide fundamental support techniques and theories for different smart application domains through massive urban data. Throughout the literature, we found two challenges in urban data processing research: first, there is a contradiction between accuracy and computing cost for urban rules modelling; second, for building associations among different domain data, we need to reduce the coupling between obtained data and irrelevant features, and build strong correlations with the target domain. [1]

2.2 Sustainable Cities and Society

Smart city concept emerged as an application domain of IoT. Among various concepts that utilize ICT in urban environments i.e. digital city, green city, sustainable city, intelligent city, etc. smart city stands out owing to its holistic vision. In other terms, smart city act as a composition of other forms of urban environment management strategies. This paper presented fundamentals of a smart city in terms of definitions, standards, and implications.

The characteristics and features are described in a simple manner to understand the gist of smart city notion. Moving on to more technical details, generic architecture of a smart city is described after thorough examining among proposed smart city architectures. Smart city is a system that facilitates interoperability among various sub systems to improve the QoL of urban citizens.

Henceforth, to acknowledge the importance of the composition, major components that builds a smart city are described elaborately. The literature survey identified that the realization of smart city highly relies on expedite data processing, ubiquitous accessibility, and platform dependent interoperability among devices. Real-world implementations of smart cities are presented towards the end of the article along with some latest statistics.

Even though, smart cities has become a buzzword in modern world, it still faces some serious challenges and issues due to prodigious data processing demands and heterogeneity of connected smart things. In order to enrich the knowledge base and to provide guidance for future research, we described some challenges identified and opportunities for improvements. [2]

2.4 Smart Cities—A View of Societal Aspects

Different cities and countries, depending on the level of development, policies, and resources have different way of looking at the concepts of smart city and smart tourism destinations.

Tourism destinations are the amalgams of tourism products and services and these systems are difficult to understand and manage. Therefore, some definitional boundaries are important to guide cities in this direction. Smart tourism destinations can be perceived as cities or places which utilize the available technological tools, innovations and techniques to enable pleasure, and experiences for the tourist and profit for the organizations and the destinations. In fact, smart cities act as a ladder for the establishment of smart tourism destinations.

Smart tourism destinations are smart cities which utilize the information technology and innovations to enable pleasure, and experiences for the tourist. Hence, it's clear that smart tourism is a fundamental part of the smart cities. In the 21st century there is growth in popularity of smart cities and smart tourism destinations.

Therefore, it is the need of the hour today is to understand these concepts and make and execute sustainable plans for the development of smart cities which will ultimately lead the way to smart tourism destinations in future. [3]

2.5 Applications of big data to smart cities

Smart city and big data are two modern and important concepts; therefore, many started integrating them to develop smart city applications that will help reach sustainability, better resilience, effective governance, enhanced quality of life, and intelligent management of smart city resources.

This study explored both concepts and their different definitions and we came to identify some common attributes for each. Despite the varying definitions each concept has a number of characteristics that uniquely defines it. Relying on these common characteristics, They were able to identify the general benefits of using big data to design and support smart city applications. From there, As they discussed the various opportunities available and this will result in building smart applications capable of utilizing all available data to enhance their operations and outcomes.

They also discussed the various challenges in this domain and identified several issues that may hinder big data applications development efforts. Based on that discussion, we suggested a list of general requirements for big data smart city applications.

There requirements are necessary to design and implement effective and efficient applications. In addition, these requirements also try to address the challenges and propose different ways to resolve some of the issues and generate better results. Finally we discussed some of the main open issues that need to be further investigated and addressed to reach a more comprehensive view of smart cities and develop hem in a holistic well thought out model.

Building and deploying successful big data smart city applications will require addressing the challenges and open issues, following rigorous design and development models, having well trained human resources, utilizing simulation models and being ell prepared and well supported by the governing entities. With all success factors in place and better understanding of the concepts, making a city smart will be possible and further enhancing it for smarter models and services will be an attainable and sustainable goal. [4]

2.6 Smart homes and their users: a systematic analysis and key challenges

Smart homes are an advancing wave of technological development whose success depends on a coalescence between the visions of technology developers for enhanced functionality and energy management, and the needs and demands of households in the complex places that are homes. User-focused research on smart homes is growing, dominated by engineering, technical sciences and design, but with a sizeable niche of health care-related research, and increasing attention from social scientists ranging from ethnographers and domestication theorists to economists and applied energy researchers.

Yet there is a wide and growing recognition of the need to develop a better picture of who users are and how they might use smart homes. Although two of the themes analysed from the literature (on ‘‘user-technology interactions’’ and ‘‘acceptability and usability’’) are most strongly informed by research on user-centred design, these themes have not typically been entry points for thinking about the purpose and use of smart homes.

Rather, they have emerged as a consequence of a technological vision that is struggling to gain user acceptance. The result is that current visions of smart homes have a limited appeal to users and are perceived as failing to meet user needs. This has given rise to what Nyborg and Røpke term ‘‘funwashing’’ as smart home developers seek to broaden the appeal of smart homes because the basic functionality they offer has not proven as attractive as initially hoped.

A systematic review of published literatures on smart homes and their users reveals a wide range of research themes and lines of enquiry, often characterised by particular and partial questions. An integrative approach to smart home user research is neither desirable nor practical, but a comprehensive framework for positioning and interrelating research is. Our thematic analysis of the literature proposes such an organising framework.

They illustrated how this framework can advance future research on smart homes and their users in relation to two major concerns: privacy and control. In so doing, we argue that it provides a valuable tool to help others navigate the existing terrain of research on smart homes and to help map out new and more fruitful avenues for future research. [5]

2.7 A review of Internet of Things for smart home: challenges and solutions

This paper addresses the vision that the residential buildings would shift themselves toward modern households that would be an evolution of the passive household. They would have their own solar panels and small wind turbines to produce their own energy, thus they would be able to buy/sell energy from/to the smart power grid.

As it is expected for smart objects to become omnipresent on the market and respectively in consumers' households within the next few years, the need for IoT-based services for smart home will be inevitable. In this paper, a methodology is developed using different search queries to select the most relevant papers from the literature that address this topic. Selected papers were semantically divided into two main categories: WSN solutions and IoT concepts.

This was rather expected considering that WSN is the pivotal technology which enabled the development of IoT. Although the WSN solutions are real life implementations that integrate devices inside a smart home, two disadvantages are identified, as they: · work separately and the data is used only for local optimization; · make an assumption of a fully (or near fully) automated home, which is a costly solution for most of the households. The second category of papers concerning IoT mainly presents concepts, theoretical frameworks and visions for possible smart home/grid solutions.

There is a lack of a unifying platform that would transform these separate individual applications into a single infrastructure, a platform that can be further used for advanced data mining and knowledge extraction. The desired solution should aggregate all available smart home data within a selflearning engine in order to create personalized recommendations for all users, regardless of the level of automation present at their homes.

The solution should not entail any additional cost for the consumers, as it should not require any particular hardware. The main contribution of this paper is the IoT based holistic framework, which incorporates different components from IoT architectures/frameworks proposed in the literature. This integral IoT framework is specific to the smart home application domain, with the cloud being the central element in the system that serves not only to collect and store data, but also as a gateway to third-parties interested in developing applications. In this context, we additionally survey the smart home management system, and we identify a model with a set of specific tasks that should be performed at each level in order to meet the system requirements. [6]

Chapter 3 Mechanical Design

Material : Foam

Dimension : 70*50

All designs are made from foam material and glued together with a glue gun and super glue and some nails, even mechanisms are made with this material, such as the door mechanism

Chapter 4 Electronic and Electrical Design

Main System : Smart City

Sub Systems : Smart Home – Light Traffic – Basket and Service Room – Night Mode – Gates – Anemometer – Water Level.

Let’s Study Every Component In Every Subsystem :

4.1 Smart Home

1.4.1 Control

Microcontroller used is Arduino Uno

Properties :

Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button.

Alternative option : Teensy 4 – Node MCU

Why we used Arduino Uno : Low cost , Flexible , Easy to use.

1.4.2 Sensors

- LM35
  LM35 is a temperature sensor that outputs an analog signal which is proportional to the instantaneous temperature. The output voltage can easily be interpreted to obtain a temperature reading in Celsius. 10 mv = 1°C.

  Accuracy : ±0.5°C.

  Alternative : TMP36

  We used LM35 : The LM35 sensor is moderately precise and its robust construction makes it suitable for various environmental conditions. Additionally, you don't need any external component to calibrate this circuit and it has a typical accuracy of ±0.5°C at room temperature and ±1°C over a full −55°C to +155°C temperature range.

- Gas Sensor MQ-2

  Used to sense if there is gas leakage and show it on application.

  Alternative :MQ3-MQ4

  Why we used The MQ2 gas sensor : It can easily detect smoke, liquefied natural gas (LNG), butane, propane, methane, alcohol, and hydrogen in the air.

  Accuracy : it is expected that the results of accuracy reach 80% with the distance from the gas sensor to the point of leakage about 0-10 cm.

1.4.3 Actuators

- Fans

  Can be turned on be application.

- Servo Motor

  Used to open the home door by application.

  Why Servo : It is convenience that using the servo motor to control motivation of doors/curtain of the house and speed .

1.4.4 Display

- Heavy Load Lamp with Relay

  Can be turned on and off by application.

- Relay

  To control the flow of electricity in a circuit.

Note : Bluetooth Module is needed in the home to provide a connection between mobile application and the Arduino board to get home data (sensors)and actuators.

4.2 Traffic Light

4.2.1 Control

Microcontroller used is AVR Atmega32

Properties : 2 Kilo bytes of internal Static RAM.

32 X 8 general working purpose registers.

32 Kilo bytes of in system self programmable flash program memory.

1024 bytes EEPROM.

Programmable serial USART.

8 Channel, 10 bit ADC.

One 16-bit timer/counter with separate prescaler, compare mode and capture mode.

Other Microcontrollers could have been used : Arduino Uno

Why we chose AVR Atmega 32 : you can upload any Arduino sketch to the microcontroller and use this circuit for any arduino project instead of Arduino UNO.

4.2.2 Sensors

No Sensor is used.

4.2.3 Actuators

- Push Button

  When pressed Led turns to yellow for 3 seconds then turns red 7-segment counts 2 seconds then a buzzer warn that the train is coming.

- Buzzer

  Used to warn that a train is coming.

4.2.4 Display

- 7-segment

  Used in Traffic Light to display Numbers Counting

- Red ,Yellow ,Green Leds

  Used to show driver either he stops , reduce speed or continue.

- LCD 16*2

  Used to display number of cars in city and a warning message in case of fire or gas leakage.

Note : 600 Ohm Resistances are used with 7-segment and Leds

4.3 Basket

4.3.1 Control

Microcontroller used is AVR Atmega32

Properties : 2 Kilo bytes of internal Static RAM.

32 X 8 general working purpose registers.

32 Kilo bytes of in system self programmable flash program memory.

1024 bytes EEPROM.

Programmable serial USART.

8 Channel, 10 bit ADC.

One 16-bit timer/counter with separate prescaler, compare mode and capture mode.

Other Microcontrollers could have been used : Arduino Uno

Why we chose AVR Atmega 32 : you can upload any Arduino sketch to the microcontroller and use this circuit for any arduino project instead of Arduino UNO.

4.3.2 Sensors

- UltraSonic

  To calculate the distance that rubbish took and use it to calculate the percentage of non free rubbish distance in the basket upon it led in service room will be green or red.

  The distance of object (in cm) = (sound velocity * Timer)/2.

  Alternative : Radar_ IR

  Why we used UltraSonic : UltraSonic Sensors are more reliable than IR.

  Accuracy : 0.1 – 0.2% of the detected range under perfectly controlled conditions.

4.3.3 Actuators

- Push Button

  When Pressed the basket cover opens.

- Buzzer

  Put in the service room warns when basket is full at 90%.

- Servo Motor

  Used to open the basket cover.

4.3.4 Display

- Green , Red Leds

  They are in the service room if percentage is <=50% Led is Green , If it reached 70% Led is Red finally if it reached 90% Led is still Red and Buzzer turns on.

4.4 Night Mode

4.4.1Control

Microcontroller used is AVR Atmega32

Properties : 2 Kilo bytes of internal Static RAM.

32 X 8 general working purpose registers.

32 Kilo bytes of in system self programmable flash program memory.

1024 bytes EEPROM.

Programmable serial USART.

8 Channel, 10 bit ADC.

One 16-bit timer/counter with separate prescaler, compare mode and capture mode.

Other Microcontrollers could have been used : Arduino Uno

Why we chose AVR Atmega 32 : you can upload any Arduino sketch to the microcontroller and use this circuit for any arduino project instead of Arduino UNO.

4.4.2 Sensors

- LDR (Light Dependent Resistor)

  Used to measure intensity of light in street.

  Alternative: Photodiode

  Why we used LDR : The response time of a photodiode is relatively less than that of the LDR, which makes it comparatively faster.

  Accuracy: Not very accurate.

- Ultrasonic

  Used to sense if there is a car passing.

  Alternative : Radar_ IR

  Why we used UltraSonic : UltraSonic Sensors are more reliable than IR.

  Accuracy : 0.1 – 0.2% of the detected range under perfectly controlled conditions.

4.4.3 Actuators

No Actuator is used.

4.4.4Display

- Red Led

  It Lights the street when 2 conditions are true light intensity in street is low ultrasonic sense a car passing.

  Note : A Resistance 1k ohm is used.

4.5 Gates

4.5.1 Control

Microcontroller used is AVR Atmega32

Properties : 2 Kilo bytes of internal Static RAM.

32 X 8 general working purpose registers.

32 Kilo bytes of in system self programmable flash program memory.

1024 bytes EEPROM.

Programmable serial USART.

8 Channel, 10 bit ADC.

One 16-bit timer/counter with separate prescaler, compare mode and capture mode.

Other Microcontrollers could have been used : Arduino Uno

Why we chose AVR Atmega 32 : you can upload any Arduino sketch to the microcontroller and use this circuit for any arduino project instead of Arduino UNO.

4.5.2 Sensors

- 2xIR (Infrared Sensor)

  Used to sense if there is a car coming.

  Alternative : Ultrasonic

  Accuracy : ±1°C

4.5.3 Actuators

- 2xServo Motor

  Used to open gate if IR sense a car on the gate.

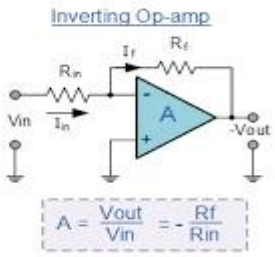
4.5.4Display

- LCD 16*2

  Used to display number of people entered , left , remaining in the city.

4.6 Anemometer Sensor

Anemometer is a sensor to measure wind speed in the city , the core idea based on the dc generator ,The wind rotate the propellers which generate an emf across terminals of the generator (motor), then the emf is amplified as its very small (few millivolts),according to this value we calculate the wind speed.



This is signal conditioning; equation of anemometer is a Limitation.

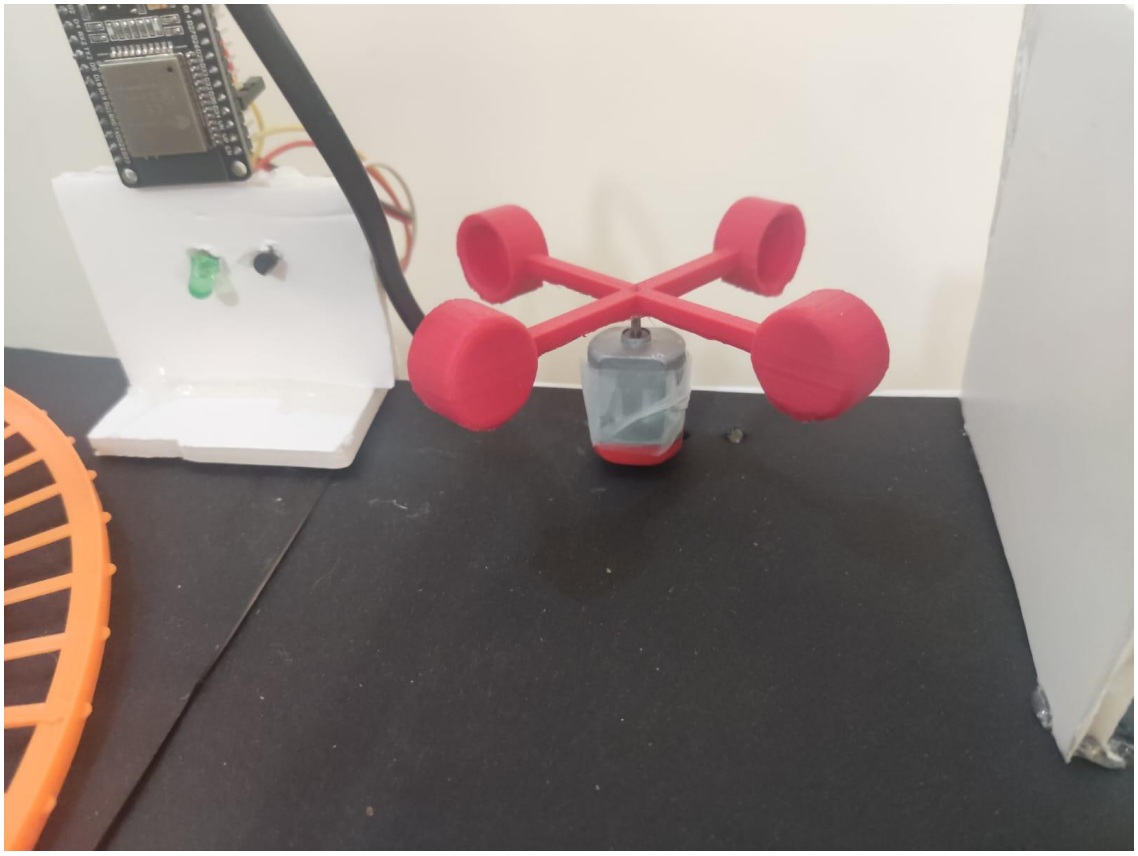


Figure 1

4.7 Water Tank Level Sensor

Used to detect level of water in the tank that feeds the city .

Consists of : Transistors BC-547

Resistances

Battery 9v.

3 Green ,1 Red Led :

The tank is divided to 4 levels when we reach first level first led turns green and the same takes place in second and third levels but when water reaches fourth one led turns red.

Chapter 5
Control Design

5.1 Software Programs used

Figure 2

5.1.1 Arduino IDE 2.1.0

The Arduino integrated development environment (IDE) is a cross-platform application (for Microsoft Windows, macOS, and Linux) that is written in the Java programming language. It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one-click mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus. 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.

From version 1.8.12, Arduino IDE windows compiler supports only Windows 7 or newer OS. On Windows Vista or older one gets "Unrecognized Win32 application" error when trying to verify/upload program. To run IDE on older machines, users can either use version 1.8.11, or copy "arduino-builder" executable from version 11 to their current install folder as it's independent from IDE.

An initial alpha preview of a new Arduino IDE was released on October 18, 2019, as the Arduino Pro IDE. The beta preview was released on March 1, 2021, renamed IDE 2.0. On September 14, 2022, the Arduino IDE 2.0 was officially released as stable.

The system still uses Arduino CLI (Command Line Interface), but improvements include a more professional development environment, autocompletion support, and Git integration. The application frontend is based on the Eclipse Theia Open Source IDE.

Its main new features are:

- Modern, fully featured development environment
- Dual Mode, Classic Mode (identical to the Classic Arduino IDE) and Pro Mode (File System view)
- New Board Manager
- New Library Manager
- Board List
- Basic Auto-Completion (Arm targets only)
- Git Integration
- Serial Monitor
- Dark Mode

Programmers use Arduino IDE because it is a simple and easy-to-use development environment specifically designed for programming Arduino boards. It provides a user-friendly interface with built-in libraries, examples, and tools that make it easier to write, compile, and upload code to the board. Additionally, Arduino IDE supports multiple operating systems such as Windows, Mac OS X, and Linux, making it accessible to a wide range of users.

The IDE also provides a serial monitor that allows programmers to interact with the board in real-time and debug their code. Overall, the simplicity and ease of use of Arduino IDE make it an attractive choice for beginners and experienced programmers alike.

5.1.2 Eclipse

Figure 3

Eclipse was inspired by the Smalltalk-based VisualAge family of integrated development environment (IDE) products. Although fairly successful, a major drawback of the VisualAge products was that developed code was not in a component-based software engineering model. Instead, all code for a project was held in a compressed database using SCID techniques (somewhat like a zip file but in a proprietary format called .dat). Individual classes could not be easily accessed, certainly not outside the tool.

A team primarily at the IBM Cary, NC lab developed the new product as a Java-based replacement .[failed verification] In November 2001, a consortium was formed with a board of stewards to further the development of Eclipse as open-source software.

It is estimated that IBM had already invested nearly $40 million by that time. The original members were Borland, IBM, Merant, QNX Software Systems, Rational Software, Red Hat, SuSE, TogetherSoft, and WebGain The number of stewards increased to over 80 by the end of 2003. In January 2004, the Eclipse Foundation was created.

Eclipse 3.0 (released on 21 June 2004) selected the OSGi Service Platform specifications as the runtime architecture.

The Association for Computing Machinery recognized Eclipse with the 2011 ACM Software Systems Award on 26 April 2012.

Programmers use Eclipse for several reasons, including:

Integrated Development Environment (IDE): Eclipse is an IDE that provides a comprehensive set of tools and features for software development. It includes a code editor, debugger, compiler, and other tools that help programmers write and test their code efficiently.

Cross-platform compatibility: Eclipse is a cross-platform program that can be used on different operating systems such as Windows, Mac OS X, and Linux. This allows programmers to work on different platforms without having to switch between different programs.

Extensibility: Eclipse is highly extensible, which means it can be customized to meet the specific needs of individual developers or teams. There are many plugins available for Eclipse that can enhance its functionality and make it more efficient.

5.1.3 Proteus

Figure 4

The first version of what is now the Proteus Design Suite was called PC-B and was written by the company chairman, John Jameson, for DOS in 1988. Schematic Capture support followed in 1990, with a port to the Windows environment shortly thereafter. Mixed mode SPICE Simulation was first integrated into Proteus in 1996 and microcontroller simulation then arrived in Proteus in 1998.

Shape based autorouting was added in 2002 and 2006 saw another major product update with 3D Board Visualisation. More recently, a dedicated IDE for simulation was added in 2011 and MCAD import/export was included in 2015. Support for high speed design was added in 2017. Feature led product releases are typically biannual, while maintenance based service packs are released as it is required.

Programmers use Proteus for the following reasons:

Simulation: Proteus provides a powerful simulation environment that allows programmers to test their designs before implementation. This helps to identify any potential errors or bugs in the design, which can save time and money in the long run.

Ease of use: Proteus is user-friendly and easy to learn, making it an ideal choice for both beginners and experienced programmers.

Comprehensive library: Proteus has a comprehensive library of components that includes microcontrollers, sensors, and other electronic devices. This makes it easy for programmers to design complex systems without having to create every component from scratch.

Overall, Proteus is a powerful tool that provides a comprehensive simulation environment and ease of use for programming projects.

Table 1

P.O.C	Arduino IDE	Eclips	Proteous
Developer	Arduino software	Eclipse foundation	Labcenter Electronics Ltd.
Release	21 Dec. 2021	29 Nov 2001	1988
Type	Integrated development environment	Programming tool, integrated development environment (IDE)	Electronic design automation

5.4 Flow chart

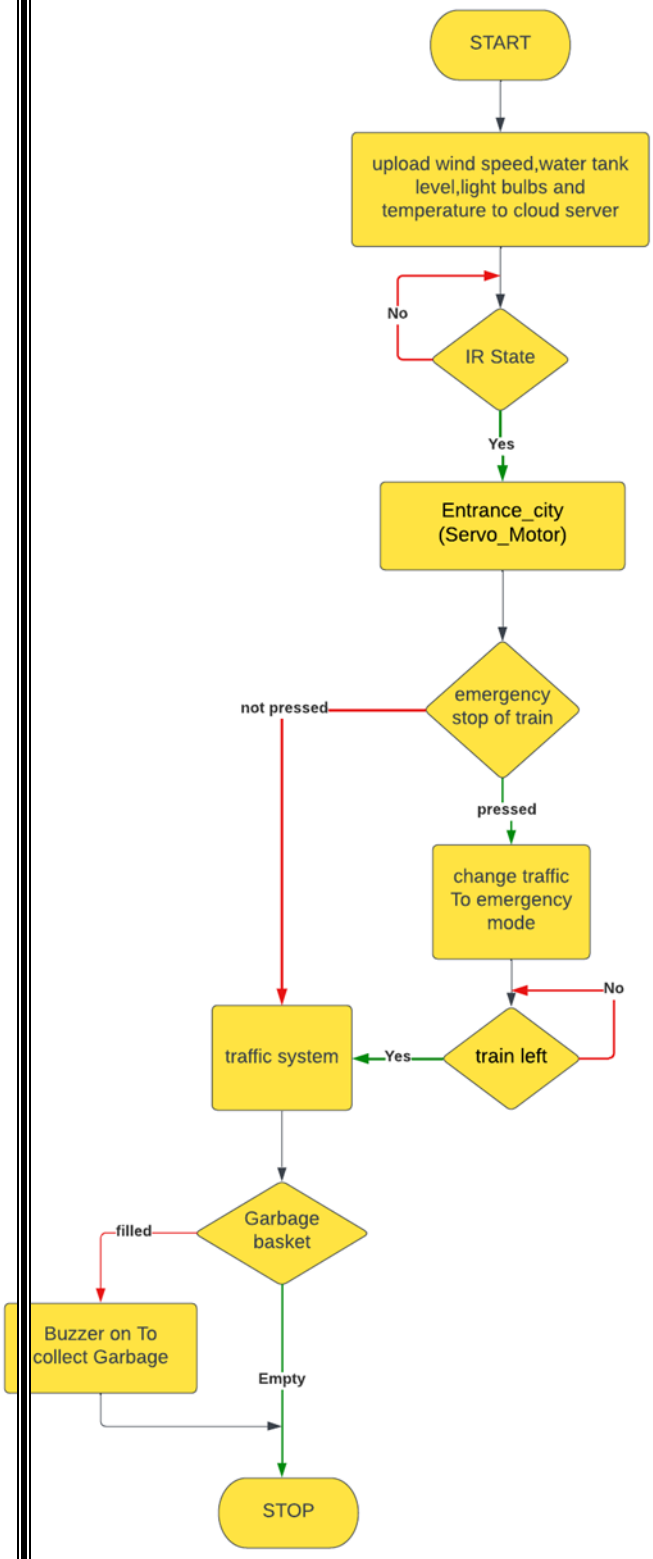


Chart 2

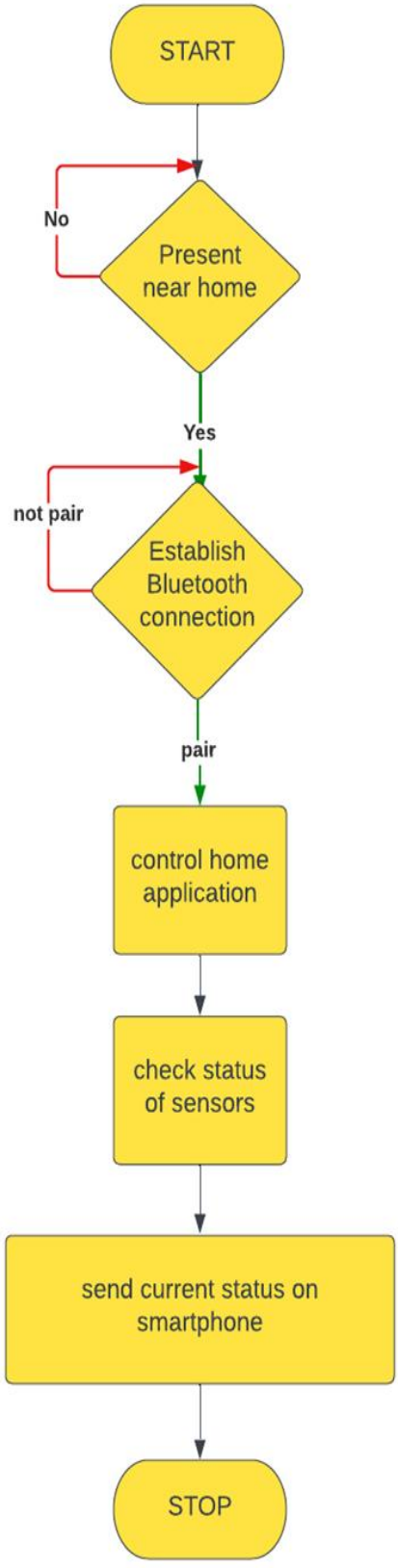


Chart 1

Chapter 6 Results and Discussion

Smart Basket :

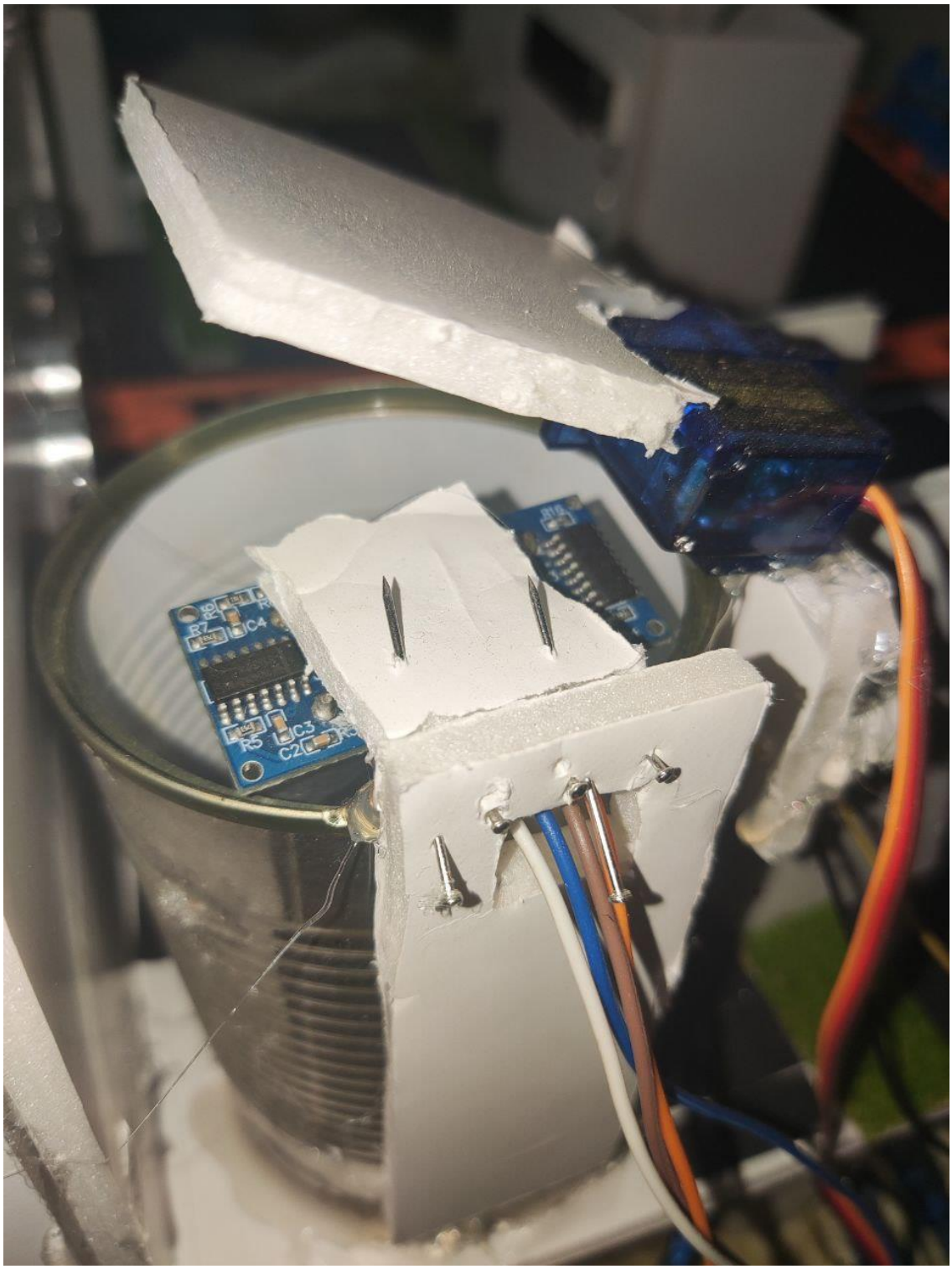


Figure 5

2- Smart Traffic :

Figure 6

3- Smart Home :

Figure 7

A-Heavy Load Lamp

Turn on/off light by application.

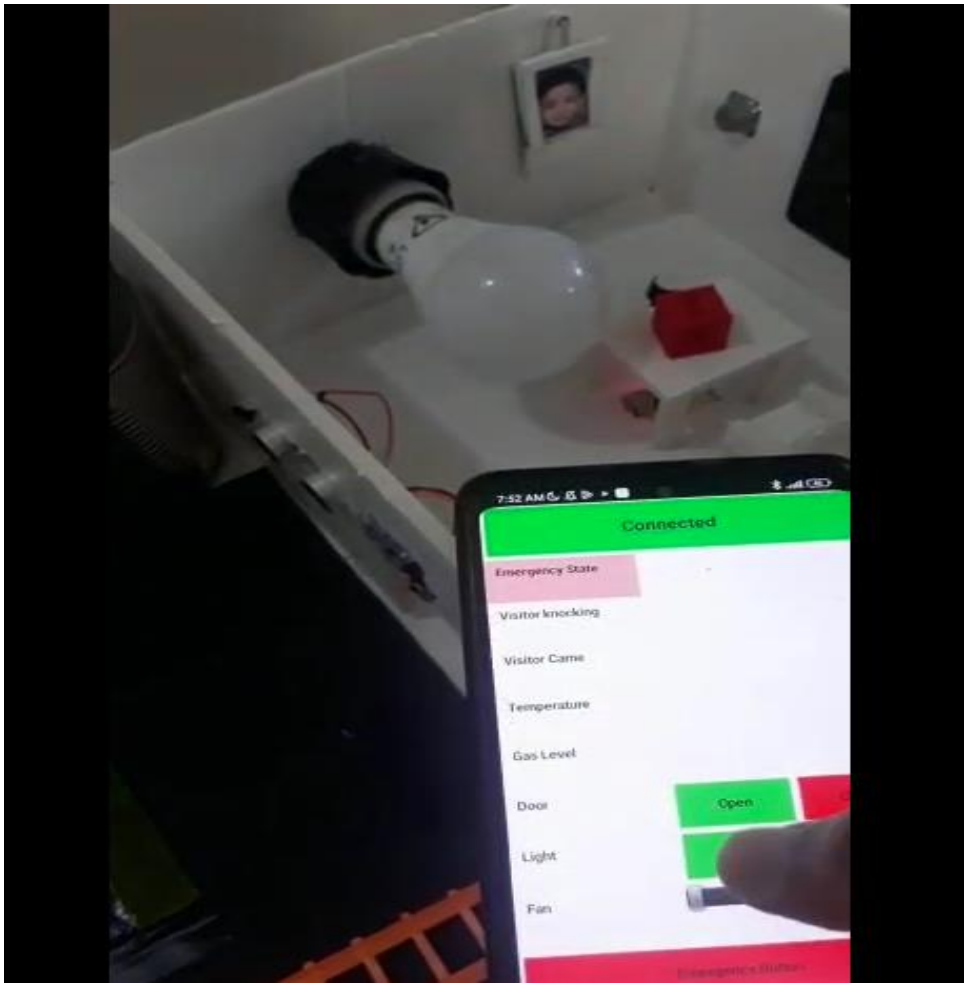


Figure 8

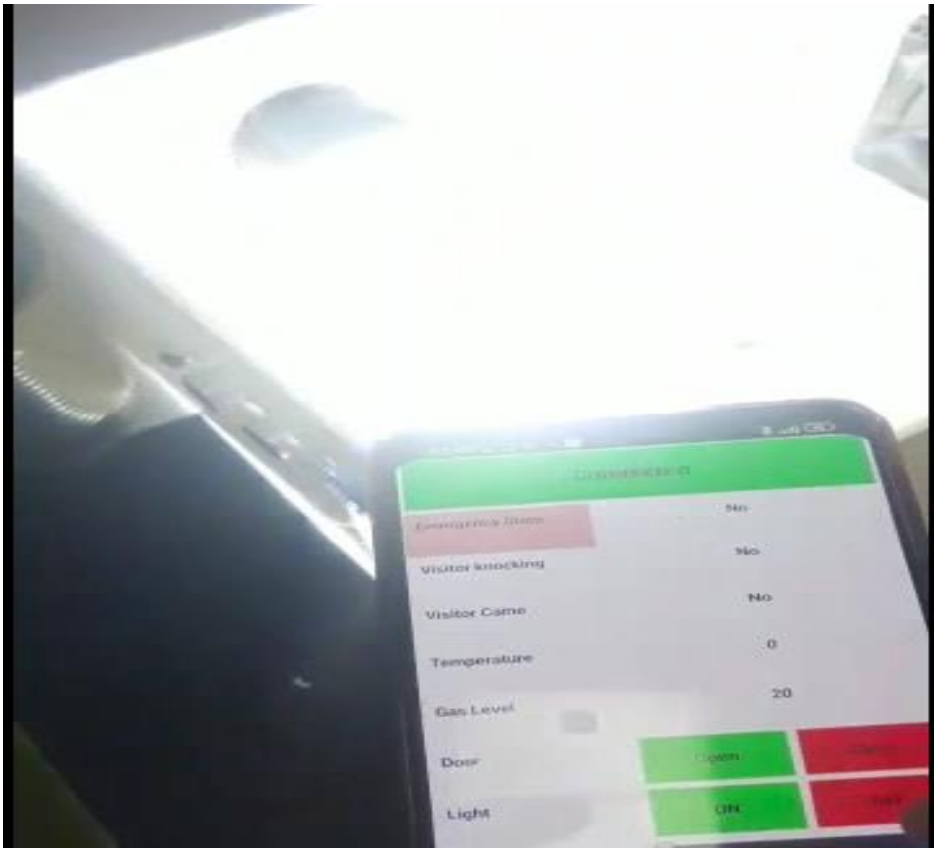

Visitor knocking
No
Visitor Came
No
Temperature
0
Gas Level
20
Door
Light
ON

Figure 9

B- Door

Door opens and closes by application.

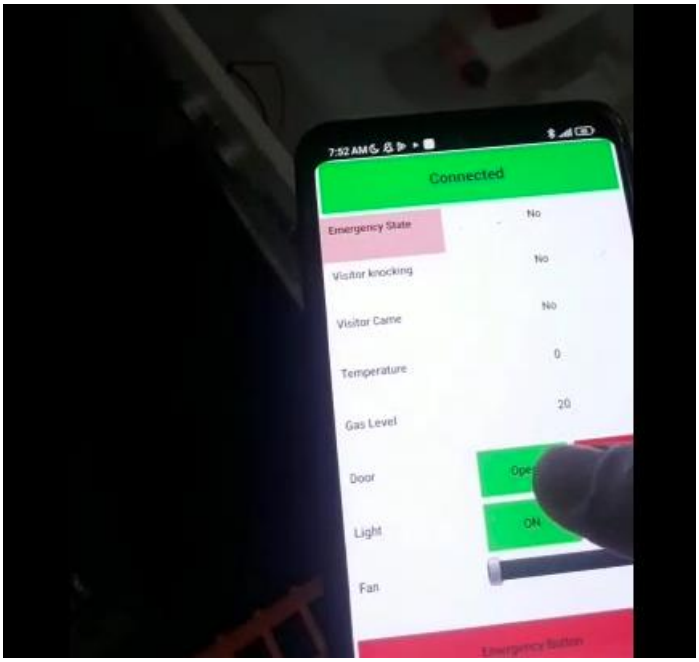


Figure 10

Figure 11

C- Visitor came

Ultrasonic senses if there is someone on the door and show it on application.

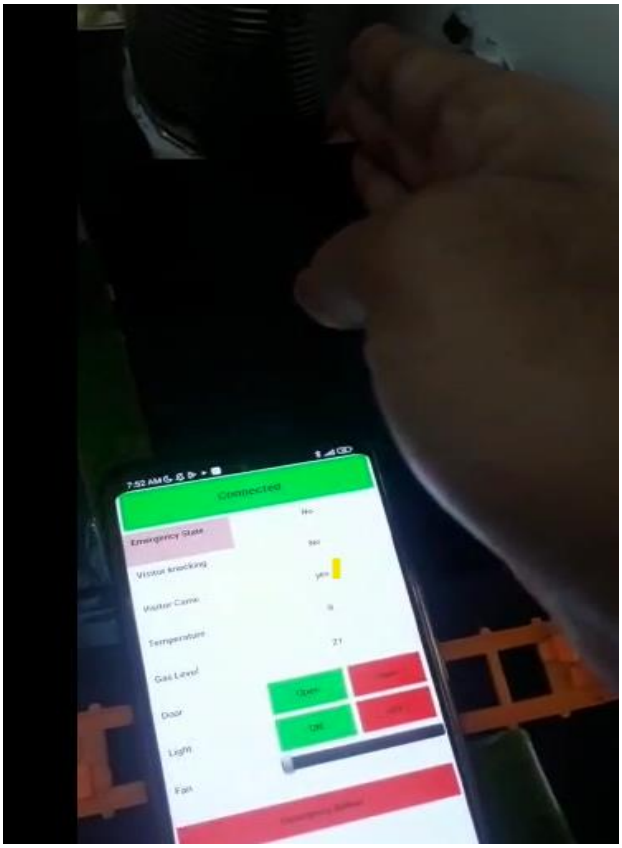


Figure 12

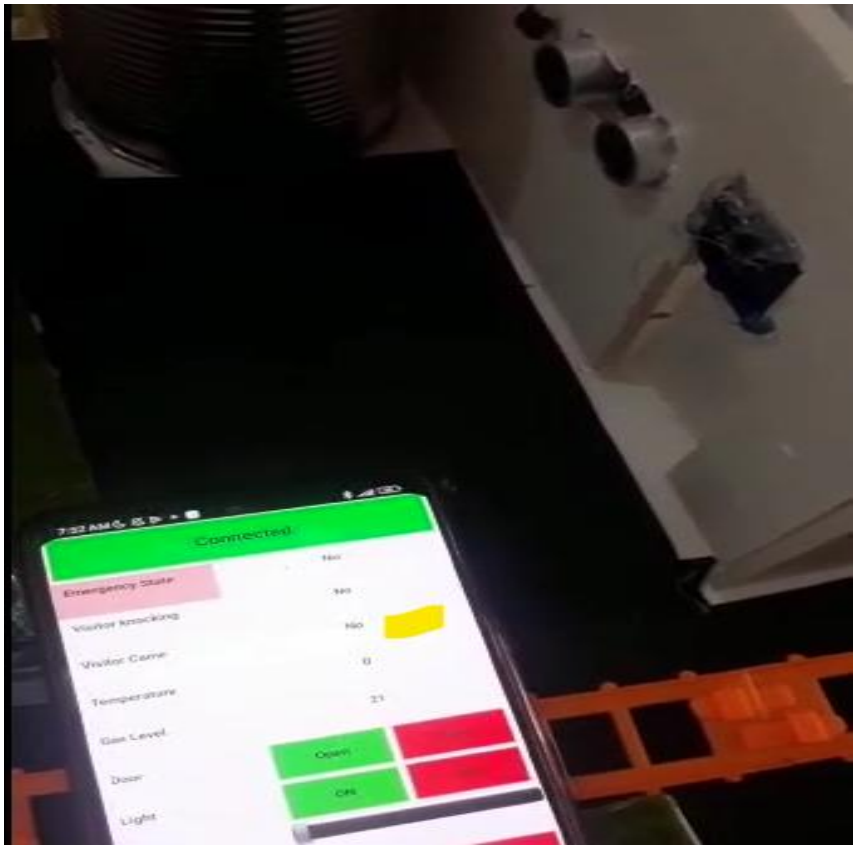


Figure 13

4- Smart Night Mode :

5- Smart Gates :

IR senses one entering and opens the door when IR doesn’t sense body it turns off again.

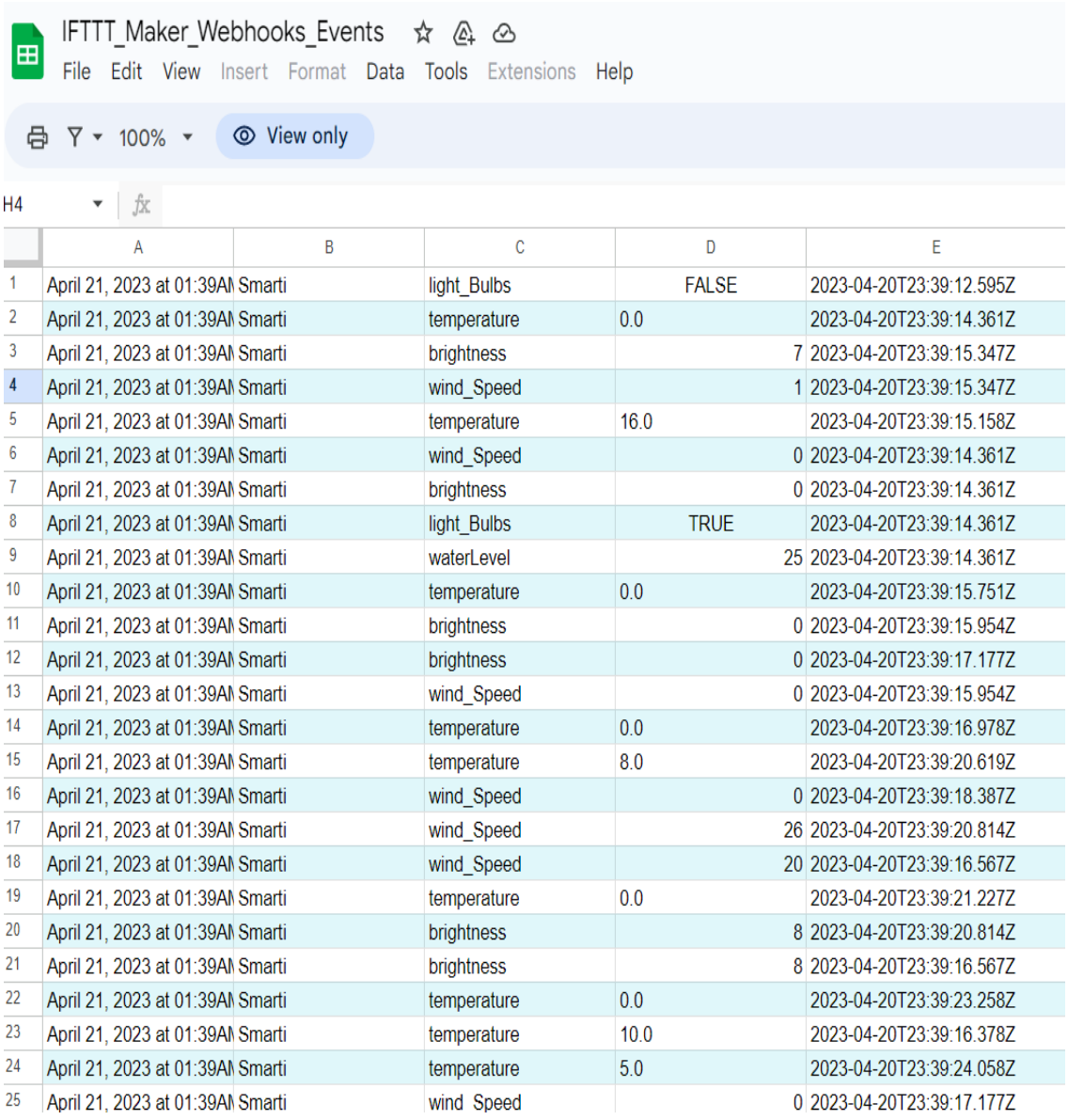
Figure 14

IR senses one leaving city and second one entering it ;servo opens gates for them and LCD displays number of people entered ,left , remaining in the city on screen .

Figure 15

6- Servers Results

Table 2



IFTTT_Maker_Webhooks_Events

File Edit View Insert Format Data Tools Extensions Help

100% View only

H4

	A	B	C	D	E
1	April 21, 2023 at 01:39AM	Smarti	light_Bulbs	FALSE	2023-04-20T23:39:12.595Z
2	April 21, 2023 at 01:39AM	Smarti	temperature	0.0	2023-04-20T23:39:14.361Z
3	April 21, 2023 at 01:39AM	Smarti	brightness	7	2023-04-20T23:39:15.347Z
4	April 21, 2023 at 01:39AM	Smarti	wind_Speed	1	2023-04-20T23:39:15.347Z
5	April 21, 2023 at 01:39AM	Smarti	temperature	16.0	2023-04-20T23:39:15.158Z
6	April 21, 2023 at 01:39AM	Smarti	wind_Speed	0	2023-04-20T23:39:14.361Z
7	April 21, 2023 at 01:39AM	Smarti	brightness	0	2023-04-20T23:39:14.361Z
8	April 21, 2023 at 01:39AM	Smarti	light_Bulbs	TRUE	2023-04-20T23:39:14.361Z
9	April 21, 2023 at 01:39AM	Smarti	waterLevel	25	2023-04-20T23:39:14.361Z
10	April 21, 2023 at 01:39AM	Smarti	temperature	0.0	2023-04-20T23:39:15.751Z
11	April 21, 2023 at 01:39AM	Smarti	brightness	0	2023-04-20T23:39:15.954Z
12	April 21, 2023 at 01:39AM	Smarti	brightness	0	2023-04-20T23:39:17.177Z
13	April 21, 2023 at 01:39AM	Smarti	wind_Speed	0	2023-04-20T23:39:15.954Z
14	April 21, 2023 at 01:39AM	Smarti	temperature	0.0	2023-04-20T23:39:16.978Z
15	April 21, 2023 at 01:39AM	Smarti	temperature	8.0	2023-04-20T23:39:20.619Z
16	April 21, 2023 at 01:39AM	Smarti	wind_Speed	0	2023-04-20T23:39:18.387Z
17	April 21, 2023 at 01:39AM	Smarti	wind_Speed	26	2023-04-20T23:39:20.814Z
18	April 21, 2023 at 01:39AM	Smarti	wind_Speed	20	2023-04-20T23:39:16.567Z
19	April 21, 2023 at 01:39AM	Smarti	temperature	0.0	2023-04-20T23:39:21.227Z
20	April 21, 2023 at 01:39AM	Smarti	brightness	8	2023-04-20T23:39:20.814Z
21	April 21, 2023 at 01:39AM	Smarti	brightness	8	2023-04-20T23:39:16.567Z
22	April 21, 2023 at 01:39AM	Smarti	temperature	0.0	2023-04-20T23:39:23.258Z
23	April 21, 2023 at 01:39AM	Smarti	temperature	10.0	2023-04-20T23:39:16.378Z
24	April 21, 2023 at 01:39AM	Smarti	temperature	5.0	2023-04-20T23:39:24.058Z
25	April 21, 2023 at 01:39AM	Smarti	wind_Speed	0	2023-04-20T23:39:17.177Z

Table 3

	A	B	C	D	E	F
1	Temperature	Value	Time	Brightness	Value	Time
2	1	0.0	April 21, 2023 at 01:39AM	1	7	April 21, 2023 at 01:39AM
3	2	16.0	April 21, 2023 at 01:39AM	2	0	April 21, 2023 at 01:39AM
4	3	0.0	April 21, 2023 at 01:39AM	3	0	April 21, 2023 at 01:39AM
5	4	0.0	April 21, 2023 at 01:39AM	4	0	April 21, 2023 at 01:39AM
6	5	8.0	April 21, 2023 at 01:39AM	5	8	April 21, 2023 at 01:39AM
7	6	0.0	April 21, 2023 at 01:39AM	6	8	April 21, 2023 at 01:39AM
8	7	0.0	April 21, 2023 at 01:39AM	7	0	April 21, 2023 at 01:39AM
9	8	10.0	April 21, 2023 at 01:39AM	8	8	April 21, 2023 at 01:39AM
10	9	5.0	April 21, 2023 at 01:39AM	9	9	April 21, 2023 at 01:39AM
11	10	1.0	April 21, 2023 at 01:39AM	10	8	April 21, 2023 at 01:39AM
12	11	10.0	April 21, 2023 at 01:39AM	11	0	April 21, 2023 at 01:39AM
13	12	0.0	April 21, 2023 at 01:39AM	12	0	April 21, 2023 at 01:39AM
14	13	12.0	April 21, 2023 at 01:39AM	13	8	April 21, 2023 at 01:39AM
15	14	0.0	April 21, 2023 at 01:39AM	14	0	April 21, 2023 at 01:39AM
16	15	0.0	April 21, 2023 at 01:39AM	15	1	April 21, 2023 at 01:46AM
17	16	0.0	April 21, 2023 at 01:46AM	16	0	April 21, 2023 at 01:46AM
18	17	11.0	April 21, 2023 at 01:46AM	17	15	April 21, 2023 at 01:46AM
19	18	0.0	April 21, 2023 at 01:46AM	18	13	April 21, 2023 at 01:46AM
20	19	24.0	April 21, 2023 at 01:46AM	19	0	April 21, 2023 at 01:46AM
21	20	0.0	April 21, 2023 at 01:46AM	20	0	April 21, 2023 at 01:46AM
22	21	32.0	April 21, 2023 at 01:46AM	21	0	April 21, 2023 at 01:52AM
23	22	32.0	April 21, 2023 at 01:46AM	22	1	April 21, 2023 at 01:52AM
24	23	0.0	April 21, 2023 at 01:46AM	23	13	April 21, 2023 at 01:52AM
25	24	0.0	April 21, 2023 at 01:52AM	24	0	April 21, 2023 at 01:52AM

Table 4

Water Level	Value	Time	light_Bulbs	Value	Time	wind_Speed	Value	Time
1	25	April 21, 2023 at 01:39AM	1	FALSE	April 21, 2023 at 01:39AM	1	1	April 21, 2023 at 01:39AM
2	25	April 21, 2023 at 01:46AM	2	TRUE	April 21, 2023 at 01:39AM	2	0	April 21, 2023 at 01:39AM
3	25	April 21, 2023 at 01:52AM	3	FALSE	April 21, 2023 at 01:39AM	3	0	April 21, 2023 at 01:39AM
4	25	April 21, 2023 at 02:10AM	4	TRUE	April 21, 2023 at 01:46AM	4	0	April 21, 2023 at 01:39AM
5	25	April 21, 2023 at 02:12AM	5	TRUE	April 21, 2023 at 01:46AM	5	26	April 21, 2023 at 01:39AM
#N/A	#N/A	#N/A	6	FALSE	April 21, 2023 at 01:46AM	6	20	April 21, 2023 at 01:39AM
#N/A	#N/A	#N/A	7	FALSE	April 21, 2023 at 01:46AM	7	0	April 21, 2023 at 01:39AM
#N/A	#N/A	#N/A	8	TRUE	April 21, 2023 at 01:46AM	8	34	April 21, 2023 at 01:39AM
#N/A	#N/A	#N/A	9	TRUE	April 21, 2023 at 01:46AM	9	22	April 21, 2023 at 01:39AM
#N/A	#N/A	#N/A	10	FALSE	April 21, 2023 at 01:46AM	10	0	April 21, 2023 at 01:39AM
#N/A	#N/A	#N/A	11	FALSE	April 21, 2023 at 01:46AM	11	0	April 21, 2023 at 01:39AM
#N/A	#N/A	#N/A	12	TRUE	April 21, 2023 at 01:46AM	12	31	April 21, 2023 at 01:39AM
#N/A	#N/A	#N/A	13	TRUE	April 21, 2023 at 01:46AM	13	0	April 21, 2023 at 01:39AM
#N/A	#N/A	#N/A	14	FALSE	April 21, 2023 at 01:51AM	14	17	April 21, 2023 at 01:39AM
#N/A	#N/A	#N/A	15	TRUE	April 21, 2023 at 01:52AM	15	0	April 21, 2023 at 01:46AM
#N/A	#N/A	#N/A	16	FALSE	April 21, 2023 at 01:52AM	16	0	April 21, 2023 at 01:52AM
#N/A	#N/A	#N/A	17	TRUE	April 21, 2023 at 01:52AM	17	64	April 21, 2023 at 01:52AM
#N/A	#N/A	#N/A	18	TRUE	April 21, 2023 at 01:52AM	18	0	April 21, 2023 at 01:52AM
#N/A	#N/A	#N/A	19	TRUE	April 21, 2023 at 01:52AM	19	0	April 21, 2023 at 02:10AM
#N/A	#N/A	#N/A	20	FALSE	April 21, 2023 at 01:52AM	20	64	April 21, 2023 at 02:10AM
#N/A	#N/A	#N/A	21	TRUE	April 21, 2023 at 01:52AM	21	0	April 21, 2023 at 02:10AM
#N/A	#N/A	#N/A	22	FALSE	April 21, 2023 at 01:52AM	22	0	April 21, 2023 at 02:12AM
#N/A	#N/A	#N/A	23	FALSE	April 21, 2023 at 01:52AM	23	58	April 21, 2023 at 02:12AM
#N/A	#N/A	#N/A	24	TRUE	April 21, 2023 at 01:52AM	24	0	April 21, 2023 at 02:12AM

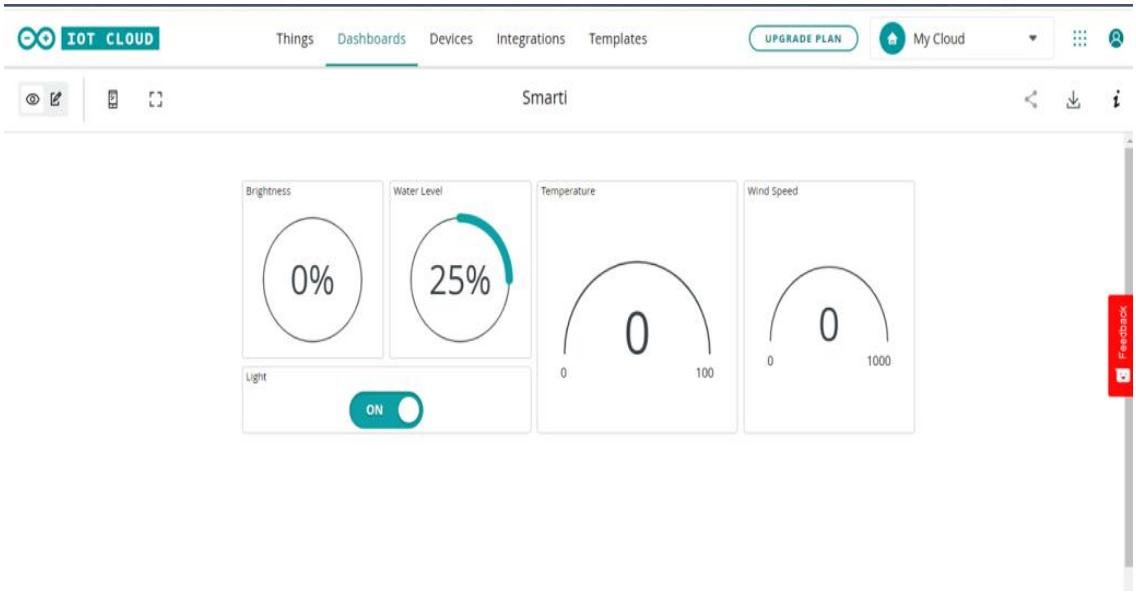


Figure 16

Chapter 7 Conclusions

For smart city:

Collaboration and stakeholder engagement are key to creating a successful smart city. Engaging citizens, businesses, and government agencies in the planning and implementation process ensures that everyone's needs are met.

Smart cities require a strong digital infrastructure to support the collection and analysis of data. This includes high-speed internet connectivity, sensors, and other technologies.

The use of data analytics and machine learning can help cities make more informed decisions about resource allocation, traffic management, public safety, and other critical issues.

Smart cities must prioritize sustainability by implementing green infrastructure and reducing energy consumption.

For smart home:

The smart home project has shown that the integration of technology into homes can greatly improve convenience, efficiency, and security. The use of smart devices such as thermostats, lighting systems, and security cameras has made it possible to control and monitor various aspects of the home remotely. This not only saves time but also reduces energy consumption and enhances safety.

The project has also highlighted some challenges that come with implementing a smart home system. These include compatibility issues between different devices, privacy concerns, and the need for regular software updates to ensure optimal performance. Overall, the benefits of a smart home system outweigh the challenges.

As technology continues to advance, we can expect more innovative solutions that will make our homes even smarter and more efficient.

Future Work

One of the most important future work is KNX :

KNX is a home automation protocol that is used to control and monitor various devices in a smart home. It is an open standard protocol that allows different devices from different manufacturers to communicate with each other seamlessly. KNX is a wired system, which means that all devices are connected through a physical cable.

One of the key benefits of KNX is its flexibility. It can be used for various applications, including lighting, HVAC, security, and audiovisual systems. The protocol also supports different communication media, including twisted pair cables, power lines, and radio frequency.

KNX uses a decentralized architecture where each device acts as an independent node on the network. This means that even if one device fails or is disconnected from the network, the rest of the system will continue to function without interruption.

Another advantage of KNX is its interoperability. Devices from different manufacturers can be integrated into the same system without any compatibility issues. This allows homeowners to choose the best products for their needs and budget without being limited by brand-specific protocols.

KNX also offers advanced features such as scheduling and scene control. Homeowners can program their system to automatically turn on lights or adjust temperature settings at specific times of the day or when certain events occur.

Overall, KNX is a reliable and flexible home automation protocol that offers homeowners complete control over their smart home devices. Its interoperability and advanced features make it an ideal choice for those looking to create a customized and efficient smart home ecosystem.

The future of the smart city will include technology driven smart city solutions that provide predictive analytics that may help identify areas that need repair and maintenance work before an infastructure failure happens.

These smart sensors can transmit data showing any structural changes such as tilts and cracks and notify personnel that there’s a need of inspection. Cities will be able to plan better with their ability to analyse relevant data on infrastructure, enabaling proactive maintenance and better planning for future demand.

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