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i GUJARAT TECHNOLOGICAL UNIVERSITY GOVERNMENT ENGINEERING COLLEGE, MODASA PROJECT REPORT On "SMART CITY" Under subject of Final Year Project B. E. Semester – VIII (Computer Engineering.) Submitted by:- Group:- 1. Basita Ronak (180163107002) 2. Riyaz Pathan (180163107027) 3. Chavda Darshan (180163107010) Guided by:- Prof. Viral R. Patel Head of the Department Prof. M.B.Chaudhary Academic year (2020-2021)

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iii ABSTRACT ➤ Smart City is an IOT based project. Internet of things can be used to build a smart city in which all places in a smart city are interconnected with each other with IOT component for efficient usage of resources. ➤ Smart city can have smart parking system, smart waste management, smart water supply for home or public water tanks, automatic street lights any many other things. ➤ Smart city project is about managing different modules that are used in daily routine like different corporate department of city automatically by using Information Technology, Digital Electronics and some help of Electronic Engineering.

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1 CHAPTER – 1 INTODUCTION 1.1 Project Goal and Objectives 1.2 Overview of proposed system 1.3 Scope

2 INTRODUCTION ➤ "Smart City" is an IOT based project. The internet of things can be used to build a smart city in which all the places/modules in smart city are interconnected with each other with IOT components for efficient usage of resources. ➤ Smart city can have smart parking system, smart waste management, smart water supply for home or public water tanks, automatic street light, etc. ➤ Our project is about managing different modules that are used in daily routine like different corporate department of city automatically by using Information Technology, Digital Electronics and some help of Electronic Engineering. ➤ There is no limit of the things we can include in a smart city. ➤ In this project, we implement this all modules using Microcontroller, Some IDEs to program the microcontroller, some electronic sensors and sending the data to database and receiving the data from database. 1.1 Project Goal and Objectives ➤ The objective of "Smart City" Project is about automation of some places that are in the city like Smart parking system, Automatic street light, Smart waste management, smart water supply for home or public tanks to promote cities that provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment. ➤ Primary Modules of Project: o Smart Parking System o Smart Waste Management o Automatic Street Light o Smart Water System

3 1.2 Overview of proposed system ➤ In "Smart City" project our team is just trying to manage different places of city with the help of some electronic devices, Information technology and IOT technology. ➤ Here we are going to discuss the overview of different primary modules of project. 1. Smart Parking System ➤ In smart parking system the status of all parking areas of city is maintained online on database and displaying the status of all parking area on websites and LCD display which is installed outside the parking. ➤ In parking area, we use different types of sensors to calculate the numbers of vehicle available in parking and free space in parking. ➤ If there is no free space in parking area, the car will not be allowed to be entered.

4 2. Smart Waste System ➤ One of the modules of Smart city is Smart Garbage, as we know there is no automation at all in our current waste system, so there are many problems in present days with workers of waste system like somewhere a dustbin is full but they have no idea about it. ➤ Our system will cover this problem with the facilities like providing notification service to dumping station so that worker can know about the status of dustbin like if the dustbin is full or not.

➤ The notification will be sent to dumping station using Arduino microcontroller, ESP8266 Module, Ultrasonic sensor and database and dumping station worker can also observe the status of dustbin. 3. Smart Water System

5 ➤ in smart water distribution system, we will manage the level of water tank of the area automatically using water sensors and microcontroller. ➤ If the level of water tank goes above 90% the motor will automatically turn off, the supplement of water will be stopped. ➤ And the water level of tank goes down below 10% the motor will turn on automatically the supplement of water will be resumed. 4. Street Light System ➤ Presently Street Lights remains on even though no necessary. ➤ We will cover this problem by providing Each Light the dedicated sensors so if there is no object detect then the lights remain off and if the object is detected then the lights are automatically on using the Arduino microcontroller, LDR sensor, Motion sensor and Database for observing the status of street lights. ➤ So, using this we can save the electricity.

6 1.3 Scope ➤ The user needs an internet connection, with help of internet connection user or vehicle driver can see the status of parking area and if the parking slots is full then it will not allow to park their vehicle and if parking slot is not full then it allows to enter and park their vehicle in particular parking slot. And also, in the smart waste the notification will sent to dumping station from dustbin using an internet connection, database and microcontroller. ➤ In water supply system also, we need an internet for observing the water level of water tanks. If user don't have internet then it cannot see the current status of any area in smart city. ➤ In street light system there is a motion sensor which detects the movement in its surrounding and if any movement is detected then motion sensor sends the signal to microprocessor which controls the light according to the signal. ➤ No internet service is required for this purpose but if admin wants to observe the status of different street light online, then internet connection is required.

7 CHAPTER – 2 SYSTEM ANALYSIS & SPECIFICATION 2.1 User characteristics 2.2 Feasibility study

8 2.1 User Characteristics:- The user or citizens of the city plays his/her role as a client and they get the services from the microcontroller and database using an internet connection. Citizens: The citizens of the city can observe the details of the parking slots online through website as well as the on the LCD screen located outside the parking area. The citizen can check the water level and status of the water pump online through website. He cannot change the water pump status remotely. Admin: The admin of water distribution system can observe the level of water tank online using the website as well as through the LED indicator on the board. And he can also control the motor/water pump of the water tank. The admin of the dumping station can observe the status of all dustbin of the area via the website and according to that, he can take proper action while on time. He can also receive the notification of dustbins with the help of website

9 2.2 Feasibility Study Once scope has been identified, it is reasonable to ask whether we can build the system that meets this scope. Is this project feasible? 2.2.1. Technical feasibility ➤ The user of this system shouldn't require high technical skills to operate it, but yes, he/she needs basic knowledge of the electronic component used. ➤ Arduino is a very popular and easy to use microcontroller, so we can easily develop our project using it. ➤ Arduino programming is comfortable and different sensors can easily be managed using Arduino microcontroller. ➤ Smart city is an IOT project and it will be created using some micro-controllers, some electronic sensors to observe the environment around them and some cloud database to store sensors' data which is used to program micro-controller to do some specific well defined task as well as it gives real time updates to the application and website. 2.2.2. Economic feasibility ➤ As we building this project for whole city, and most of the modules of our project is fully or partially related to government departments. ➤ The Arduino Microcontroller, Arduino Shields and NodeMCU microcontroller are very cheaper electronic devices. ➤ Despite using more tools, we can make projects in a lower budget. ➤ There is a high chance of develop our project in cost effective manner. ➤ Automation brings cost saving with AI based and IOT technologies automating city resources such as water, electricity, and saving significant amount of money by doing so. ➤ A sustainable ecosystem with reduced emission and cleaner city, greatly increase the standards of living, happiness and leads to economic growth. ➤ Smart Cities are great investment that can impact the economy in a positive way.

10 2.2.3. Social Impact ➤ The Smart City project will give Quality life to the people of city and make their life easier and more convenient. ➤ Using this project people can save their time, water, electricity and also make their city clean which helps to provide core infrastructure and gives decent quality of life to its citizens, a clean and sustainable environment.

11 CHAPTER – 3 DESIGN & MODELING 3.1 Activity Diagram 3.2 Usecase Diagram

12 3.1 Activity diagram The activity diagram represents the flow of activity in terms of behavior and designing an activity diagram helps the development team to recognize when the activity starts, which activity starts and when it gets terminated. ➤ Activity Diagram of Water supply system

13 ➤ Activity Diagram of Parking System

14 3.2 Usecase diagram The use case diagram is an UML diagram which represents the modules as actors of the system and their attachments which the use cases define in the system box. ➤ Usecase diagram of waste management system

15 CHAPTER – 4 METHODOLOGY 4.1 Methodology 4.2 Required Components 4.3 Platforms

16 4.1. METHODOLOGY ➤ We have used the Arduino microcontroller which is used to control the all IOT devices and it is an open source IOT platform and worldwide used for various purpose. We need to program this microcontroller. To program Arduino microcontroller we used Arduino IDE. ➤ The version of Wi-Fi Module used is ESP-8266 Wi-Fi module and we need to interface it with our Arduino microcontroller for connecting our devices to internet. The another components that required are Ultrasonic Sensor, LDR sensor, Water level measure sensor, LED, IR sensors, LCD Display, Relay Module, Temperature and Humidity for performing various task. ➤ We have connect our microcontroller with database for sending or receiving the data to or from firebase real-time database using ESP-8266 WIFI Module(NodeMCU). ➤ We supply 5V power to Microcontroller. Sensors send the signal (Analog and Digital) to microcontroller and then Using ESP-8266 Wi-Fi Module microcontroller send data to database and depend upon the value of database the action will be performed like send notification to Dumping Station, turn on Street Lights, Supply Water to water tanks and allowing to park vehicle or not etc.

17 4.2. Required Components:- ➤ Arduino Microcontroller ➤ NodeMCU Microcontroller ➤ ESP 8266 Module ➤ Ultrasonic Sensor ➤ LDR sensor ➤ Water level measure sensor ➤ LEDs ➤ IR sensors ➤ LCD Display ➤ Relay Module 4.3. Platforms:- ➤ Arduino IDE ➤ Tinkercad ➤ MIT App Inventor ➤ Blynk Cloud ➤ Google FireBase Database

18 CHAPTER – 5 DESIGN AND DEVELOPMENT 5.1 Project description 5.2 Platform 5.3 Module description 5.4 Live demo pictures

19 5.1Project Description • The above figure illustrates the working of all over the project. • Different types of the sensors are placed in the environment which sense the environment around them and according to that it sends signals to microcontroller. • The Microcontroller sense the signal and take appropriate action according to the condition. • The Microcontroller control other devices and also send the data online to the database which is used further for website and mobile application which gives real time update of the particular module.

20 5.1.1 Components used: 1. Arduino Microcontroller 2. NodeMCU Microcontroller 3. ESP 8266 4. Relay Module 5. LDR Sensor 6. Water level sensor 7. Ultrasonic Sensor 8. LED 9. LCD display ➤ Arduino Uno: o Arduino Uno microcontroller board is

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based on ATmega328P.It has 14 digital input/output pins, 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack and a reset button.

It requires 5 V power supply to activate. o We program this microcontroller using Arduino IDE to control all different types of sensors and modules etc.

21 ➤ NodeMCU o NodeMCU is also one kind of Microcontroller but what makes NodeMCU so special is that it has in-built Wi-fi Chip. o NodeMCU has built-in Wifi Module which saves lots of efforts of the developer and makes it easy to connect to the cloud for the developer. o It also has different GPIO pin which is used as digital pins for sensing he input signal and output pins are used for output purpose. ➤ ESP-8266 Wi-Fi Module: o ESP-8266 Wi-Fi Module is the main component of our project. It connects our Microcontroller and electronic sensor or module to internet. Using this microcontroller can send the data to database and receive the data from database.

22 o In Arduino Microprocessor we need to interface esp-8266 externally and it can be controlled from local Wi-Fi network or internet. ➤ Relay Module o Relay Module is one kind of mechanical switch which works on 5v to 12v. o It controls other devices with the help of signal which it receives. o The relay module separate two different system from each other which work on different voltages. ➤ Ultrasonic sensors: o Ultrasonic sensor is an electronic device that measure the distance of object by sending ultrasonic sound wave. It has two components.one is transmitter and second is receiver. Transmitter send ultrasonic wave and receiver receives ultrasonic wave. Transmitter send ultrasonic wave and if any object is in front of ultrasonic sensor than the wave is reflected and received by receiver.

23 o In order to calculate the distance between the sensor and object,

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<https://www.instructables.com/Distance-Measure ...>

the formula is $D=(T*C)/2$ where, D is the distance, T is the time, and C is the speed

of sound ~ 343 meters/second. ➤ LDR Sensor: o LDR sensor is also called photoresistor sensor. When lights fall on it then it gives low signal to the microprocessor if there is not then it gives HIGH signal to microprocessor. ➤ LED: o Led is used for the lighting purpose. In our project depends on the current status of Motion Sensor and LDR Sensor it will turn OFF and ON. ➤ LCD Display: o LCD require 5v current to operate. LCD used for displaying the data on the screen and it is connected to the microcontroller and depends on program it gives the displaying the data on screen. It can be also used for reading and writing.

24 5.2 Platforms: Arduino IDE • The Arduino IDE is the tool, which we used to program the micro- controller of the Arduino. • Arduino software is easy to use and free open source also available for all operating system like Windows, Linux, and Mac etc. • That software is based on C++ and we can easily write and verify, upload the program in Arduino board. Language: Arduino (Consists: Java, Python, C++, C, etc.)

25 Firebase Database: • we have used google firebase real time database for storing the data coming from the microcontroller and we are getting the data from firebase to website or mobile application for displaying the status of our modules in interactive view. • we are getting the data from the firebase to microcontroller for controlling some electronic modules like water pump. • Firebase database gives real time updates to the website or mobile application. • We have used firebase API for getting the real time data from the firebase database to our webpage.

26 5.3 Module Description: Smart Parking System • In smart parking system we have used arduino microcontroller , Nodemcu microcontroller, Ultrasonic sensor, Servo motor, Firebase relatime database, 16*2 lcd display. • Ultrasonic sensor measure the distance from the object and if the object is near from the given condition then the data sends from arduino microcontroller to nodemcu microcontroller using the software serial library and after reaching the data at nodemcu it sends that data to firebase database and we get that data to our website and arduino for displaying the status of parking area. Smart Waste System

27 • In smart waste system we have used Nodemcu microcontroller, Ultrasonic sensor, Firebase relatime database, blynk cloud database. • Ultrasonic sensor measure the distance in the dustbin and if the garbage is near from the given condition then the data sends from nodemcu microcontroller to firebase database or blynk cloud and we get that data to our website and sends the notification to mobile application. Automatic street lights • In Automatic street light, we have used Arduino microcontroller, ldr sensors, ir sensors, led lights. • LDR sensor is an light dependent sensor which is active in low light so we have used this to measure light and if it sends the signal high then we measure the distance of object from ir or pir sensor if any object is detected then the intensity of led lights are increased and goes to high and if any object is not detected then the intensity of led lights will remains low until any object is detected.

28 Smart Water System • In smart water system we have used Arduino Nano microcontroller, Nodemcu microcontroller, Relay module, Water level measure sensor, waterpump, led lights, Firebase database. • Water level measure sensor measure the level of water tank and sends the data related to level to the Arduino nano then after nano send this data to nodemcu using software serial communication. After data coming to node it sends this data to firebase database. • After stroing the data to database we get that data to microcontroller and depend on the value coming from the firebase database we control relay module. • Relay module is connected to the water motor and it will be control by Nodemcu microcontroller depend on the data coming from database.

29 5.4 Live Demo Pictures: Website Images: Login Register

30 Parking System: Water System:

31 Smart Parking System

32

33 Smart Waste System

34 Automatic Street Light

35

36 Smart Water System

37

38 CHAPTER – 6 LIMITATION AND CONCLUSION 6.1 Advantages and Disadvantages 6.2 Future Scope 6.3 Conclusion 6.4 References

39 6.1 Advantages and disadvantages of the system As every existing system has some advantages and limitations. The advantages and disadvantages of our project is given below. 6.1.1. Advantages ➤ Reliable: o The proposed System is reliable and trustworthy as until any electricity overload, it serves a user the best functionality. ➤ Easy to Access: o It can be easily accessed by any citizen in the city because it has simple UI for observing the status of some places in city and dumping worker can easily know the location of the overflowed dustbin. ➤ Simple: o The platform used for configuring it, has a user-friendly environment and easily understood by everyone. ➤ Internet Access: o User can use it from anywhere using an internet connection. 6.1.2. Disadvantages ➤ Needs Maintenance: o As the proposed system is based on hardware equipment, each and every module has a risk of get damaged by time so between some period of time the maintenance is needed. ➤ Complex Wiring: o The pin number, electronic sensors and module has possibilities of mismatching and thus the proper table must be maintained, otherwise it will no more an accurate service. ➤ Network connection: o For providing online data at database all the modules of project are required to be connected to the internet every time.

40 6.2 Conclusion ➤ In simple words our project is about to automate the city with the help of modern technologies to simplify the work of normal human being as easy as possible. ➤ The Smart City agenda entails improving the citizens quality of life, strengthening and diversifying the lifestyle while prioritizing environment sustainability through adoption of smart solutions. 6.3 Future Scope ➤ As we know there is no limit that can include in the smart city. ➤ We have completed our primary module we will going to develop other modules like • Traffic Management System, • Air Pollution Management, • Smart Irrigation System, • Home Automation System, • Smart Building etc... 6.4 References: - ➤ Online IDE for Circuit Designing • <https://www.tinkercad.com/dashboard> ➤ Open Source IDE for Arduino Development • <https://create.arduino.cc> ➤ GitHub: • <https://github.com/> ➤ Google Firebase • <https://firebase.google.com/> ➤ Blynk Cloud • <https://blynk.io/>

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