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Smart Village: An IOT Based Digital Transformation

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Abstract: *Almost 46% of the world's population resides in a rural landscape. Smart villages, alongside smart cities, are in need of time for future economic growth, improved agriculture, better health, and education. The smart village is a concept that improves the traditional rural aspects with the help of digital transformation. The smart village is built up using heterogeneous digital technologies pillared around the Internet-of-Thing (IoT). There exist many opportunities in research to design a low-cost, secure, and efficient technical ecosystem. This article identifies the key application areas, where the IoT can be applied in the smart village. The article also presents a comparative study of communication technology options. The proposed systems will eventually regulate automatically by operating during off-peak energy hours and connect to sensors to monitor occupancy, waste collection system, lighting conditions, and also optimized irrigation management for those attributes are incorporated. This paper will address and discuss the technical solutions for the energy management, smart irrigation system and waste management which can be adopted in the rural development mission.*

Keywords: IOT, Smart Village, Waste Management System, Sensor, Microcontroller

I. INTRODUCTION

Village equipped with all the modern technology without destroying the nature can be defined as smart village. The number of villages where proper and immediate care is not taken against abnormalities like garbage overflow, water supply problems, checking quality of water, the digital display of government offers and subsidies and also against electrical issues like street light monitoring. Using the proposed system, the problems can be solved. The proposed system also aims at internet of Things (IOT) is a recent communication paradigm that envisions a near future, in which the objects of everyday life will be equipped with microcontrollers, transceivers for digital communication, and suitable protocol stacks that will make them able to communicate with one another and with the users, becoming an integral part of the Internet Village equipped with all the modern technology without destroying the nature can be defined as smart village. The system consists of centralized microprocessor interfaced with many sensors for making the villages cleaner and smarter. The system aims to bring smartness in four different aspects of any village such as digital display of the government subsides and offers to farmers, smart garbage management, intensity-based street light monitoring and digital water supply system. The internet of things (IOT) is recent communication paradigm that envisions a near future in which the objects of everyday life will be equipped with micro-processer, transceivers for digital communication, and suitable protocol stacks that will make them able to communicate with one another and with the users, becoming an integral part of the internet. The IOT concept, hence, aims at making the internet even more immersive and pervasive.

In the present scenario garbage removal system is managed through the trucks coming door to door to collect the waste. Garbage collection is restricted to particular time in a day; hence the waste can be found in an open space, hence this leads to a environmental pollution. Other issue is the street light monitoring system which is the major requirement in today's life, it is required to switch ON/OFF light manually when not in use, this system gives a solution to minimize power consumption and manpower. In the manual water control system, one has ON and OFF the switch and this leads to unnecessary wastage of water. The "swatch Bharat" project influence to design IoT based smart village which would probably solve the basic issues with the proposed model. The system consists of a centralized Raspberry pi interfaced with many sensors for

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providing a model to make the villages clean and smart. This paper presents a smart garbage management, automatic street light control and water control system with the check for quality of water. The IoT is a recent communication paradigm that envisions a near future in which the objects of everyday life will be equipped with micro-controllers, transceivers for digital communication, and suitable protocol stacks that will make them able to communicate with one another and with the users, becoming an integral part of the Internet. The IoT concept, hence, aims at making the Internet even more immersive and pervasive. Furthermore, by enabling easy access and interaction with a wide variety of devices, for instance, home appliances, surveillance cameras, monitoring sensors, actuators, displays, vehicles, and so on, the IoT will foster the development of a number of applications that make use of the potentially enormous amount and variety of data generated by such objects to provide new services to citizens, companies, and public administrations. This paradigm indeed finds application in many different domains, such as home automation, industrial automation, medical aids, mobile health care, elderly assistance, intelligent energy management and smart grids, automotive, traffic management and many others.

II. LITERATURE SURVEY

In this paper, competence of the street lightning system is improved by ZigBee and sensors. Less energy utilization by the system is done. But the range of communication of the ZigBee is almost 50 meters. hence, ZigBee is not suitable for street lightning system [1]. In [2] the camera and the load sensor are used, which are placed at the bottom of the trash can and the camera takes the continuous snapshot of bin and the output of camera and load sensor is compared with threshold level. The authors in [3] used an ultrasonic sensor and GSM. The sensor measures the level of garbage when the waste crosses the level, sensor receives the data of the filled level and then it is sent to the authorized person through GSM to take a further action. In [4] the light sensor and photo electric sensor was used. This system was designed to detect the vehicles on highways to switch ON and OFF the light to save the energy. But during the night all the lights on the highways remain ON for, hence waste of power, and there is a lot of power becomes waste when there is no movement of vehicle. In [5], the authors include the garbage and street light monitoring to reduce power consumption and manpower.

III. PROPOSED SYSTEM

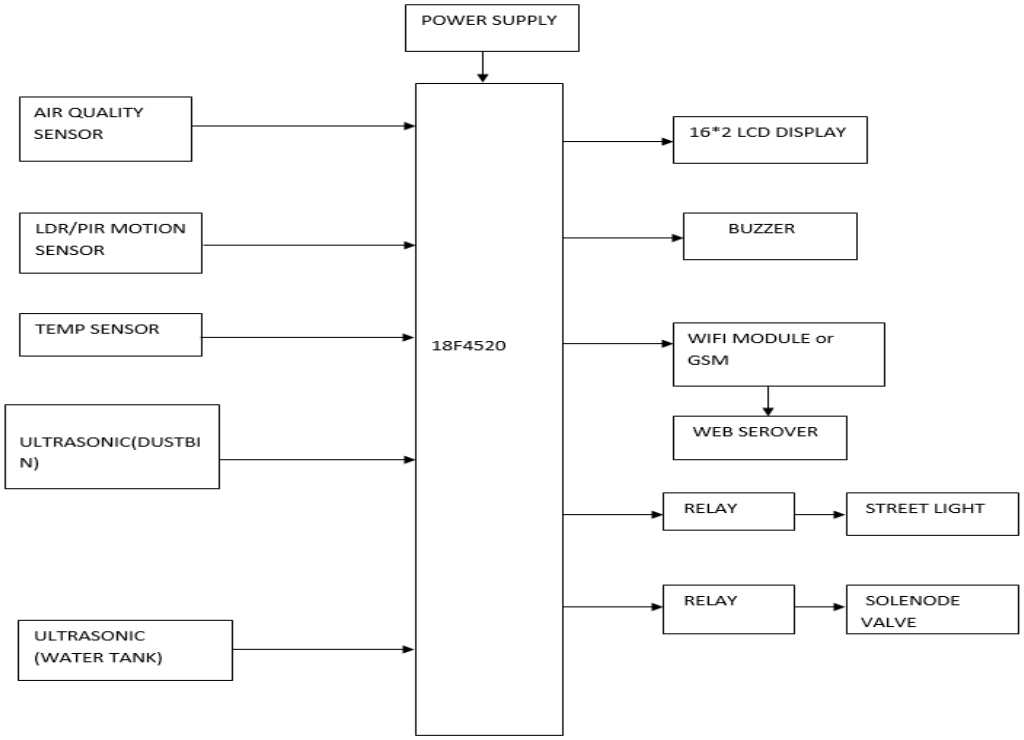

Figure 1: Block Diagram

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This project IOT based smart village is a very innovative system which will help to keep the cities clean. This system monitors the garbage bins and informs about the level of garbage collected in the garbage bins via a web page. For this the system uses ultrasonic sensors placed over the bins to detect the garbage level and compare it with the garbage bins depth. The system makes use of PIC family microcontroller, LCD screen, Wi-Fi modem for sending data and a buzzer. The system is powered by a 12V transformer. The LCD screen is used to display the status of the level of garbage collected in the bins. Whereas a web page is built to show the status to the user monitoring it. The web page gives a graphical view of the garbage bins and highlights the garbage collected in colour in order to show the level of garbage collected. The LCD screen shows the status of the garbage level. The system puts on the buzzer when the level of garbage collected crosses the set limit. Thus, this system helps to keep the city clean by informing about the garbage levels of the bins by providing graphical image of the bins via a web page.

This system is made to fulfill the purpose and need of the society to monitor and check the live air quality and solid waste pollution in an area through IOT. The system uses air sensors to check the presence of harmful and hazardous gases/ compounds [such as Methane, propane, Butane, alcohol, noxious gases, carbon monoxide etc.] in the air and also uses the ultrasonic sensor to keep measuring solid west level in the dust bin. MQ2 is the air sensors which are used to collect air pollutants. These sensors interact with microcontroller which processes this data and then transmit it over the mobile application. To send the data over remote location WIFI modem or GSM modem is also installed. And whenever the air pollution is detected, a buzzer immediately beeps and when there is a noise pollution an LED starts blinking continuously. With this system not only the authorities but also the localized people can check the transmitted data through their mobile phone and that too without spending single penny and the people can act against it on their level and try to bring the pollution level under control. This system would contribute as a part in the building of a healthy society.

3.1 PIC 18f4520 Microcontroller

It is an 8-bit enhanced flash PIC microcontroller that comes with nanoWatt technology and is based on RISC architecture. Many electronic applications house this controller and cover wide areas ranging from home appliances, industrial automation, security system and end-user products. This microcontroller has made a renowned place in the market and becomes a major concern for university students for designing their projects, setting them free from the use of a plethora of components for a specific purpose, as this controller comes with inbuilt peripheral with the ability to perform multiple functions on a single chip.

- Data Memory up to 4k bytesn Data register map - with 12-bit address bus 000-FFF
- Divided into 256-byte banks
- There are total of F banks
- Half of bank 0 and half ofbank 15 form a virtual (oraccess) bank that is accessibleno matter which bank isselected – this selection isdone via 8-bit
- Program memory is 16-bits wide accessed through a separate program data bus and address bus inside the PIC18.
- Program memory stores the program and also static data in the system.
- On-chip External
- On-chip program memory is either PROM or EEPROM.
- The PROM version is called OTP (one-time programmable) (PIC18C) The EEPROM version is called Flash memory (PIC18F).
- Maximum size for program memory is 2M n Program memory addresses are 21-bit address starting at location 0x000000

Figure 3: PIC18F4520

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3.2 Air Quality Sensor (MQ135)

Air quality sensor for detecting a wide range of gases, including NH3, NOx, alcohol, benzene, smoke and CO2.Ideal for use in office or factory. MQ135 gas sensor has high sensitivity to Ammonia, Sulfide and Benze steam, also sensitive to smoke and other harmful gases. It is with low cost and particularly suitable for Air quality monitoring application.

Features

- High Sensitivity
- High sensitivity to Ammonia, Sulfide and Benze
- Stable and Long Life
- Detection Range: 10 - 300 ppm NH3, 10 - 1000 ppm Benzene, 10 - 300 Alcohol
- Heater Voltage: 5.0V
- Dimensions: 18mm Diameter, 17mm High excluding pins, Pins - 6mm High
- Long life and low cost

Figure 4: MQ135 Air Quality sensor

3.3 Temp Sensor (LM35)

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°Cover a full -55 to +150°C temperature range. Low cost is assured by trimming and calibration at the water level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35D is rated to operate over a 0° to +100°C temperature range.

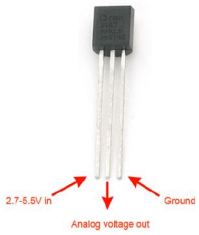

Figure 5: Temp Sensor (LM35)

3.4 LCD Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

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A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD.

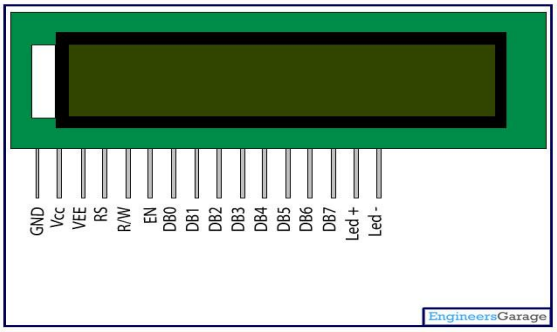

Figure 6: LCD Display

3.5 GSM Module

This GSM modem has a SIM800A chip and RS232 interface while enables easy connection with the computer or laptop using the USB to Serial connector or to the microcontroller using the RS232 to TTL converter. Once you connect the SIM800 modem using the USB to RS232 connector, you need to find the correct COM port from the Device Manger of the USB to Serial Adapter. Then you can open Putty or any other terminal software and open an connection to that COM port at 9600 baud rate, which is the default baud rate of this modem. Once a serial connection is open through the computer or your microcontroller you can start sending the AT commands. When you send AT commands for example: "AT\r" you should receive back a reply from the SIM800 modem saying "OK" or other response depending on the command send.

SIM800 is a complete Quad-bands/GPRS solution in a LGA type which can be embedded in the customer applications. SIM800H support Quad-band 850/900/1800/1900MHz, it can transmit Voice, SMS and data information with low power consumption. With tiny size of 15.8*17.8*2.4 mm, it can fit into slim and compact demands of customer design.

Figure 7: GSM Module

3.6 LDR

A Light Dependent Resistor is a device which has a resistance varies according to the amount of light falling on its surface, when light falls upon it then the resistance changes. The most common type of LDR has a resistance that falls with an increase in the light intensity falling upon the device (as shown in the image above). The resistance of an LDR may typically have the following resistances:

Daylight= 5000Ω

Dark= 20000000Ω

You can therefore see that there is a large variation between these figures. If you plotted this variation on a graph, you would get something similar to that shown by the graph shown above.

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Figure 8: LDR

3.7 Ultrasonic Sensor

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules include ultrasonic transmitters, receiver and control circuit. The basic principle of work:

1. Using IO trigger for at least 10us high level signal,
2. The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.
3. IF the signal back, through high level, time of high output IO duration is the time from sending ultrasonic to returning.

Test distance = (high level time×velocity of sound (340M/S) / 2,

Figure 9: Ultrasonic Sensor

IV. CONCLUSION

Internet of Things serves as powerful, reliable and cost-effective technology to implement the idea of „Smart Village" that aims to empower villages with advance rural connectivity through web service, measurement of environment factors like Soil moisture, temperature, humidity and implementation of cloud computing along with real time monitoring using GSM system. Though the investment cost for the project to be implemented in villages is pretty much, it helps reducing manpower for the same. One should also admit the fact that project will result in an environmentally friendly, quick responding, disciplined and tidy atmosphere all around the village.

LDR is used for automatic street light monitoring. Street lights are ON during night time and lights are OFF at day time with the help of LDR. Using the proposed system, the model can be made completely automated and hence the objective of is to keep rural/urban area clean and avoid from environmental pollution by garbage monitoring system, and through automatic street light control the manpower and energy can be saved and from automatic water supply the power can be saved. Thus, it can be concluded with respect to the result obtained that the proposed prototype can be a better and play a vital role in projects like "swatch bharat" and in making Indian smart and clean. The proposed system can be further modified on different levels of designing and implementation. Many more facilities can be added. Through this model the India can be made smarter like aspects of any village such as Digital Display of the Government Subsidies and offers to farmers, E-learning for the students in schools to digitize the India.

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