Journal of Current Research in Engineering and Science
Bi-Annual Online Journal (ISSN : 2581 - 611X)
Volume 3- Issue 2, Paper 9, August 2020

IMPLEMENTATION OF LORA SYSTEMS FOR TIMELY MAINTENANCE FOR PUBLIC TOILETS FOR SMART CITIES

Vasanth M[1], Pasupathy S A[2]
[1]PG Scholar, [2]Professor and Head
Department of Electronics and Communication,
Kumaraguru College of Technology, Coimbatore, Tamilnadu, India
[1] vasanth.19mco@kct.ac.in

Abstract— *In India People's point of view, Dirty, disgusting, sloppy- typically, these are some of the nice adjectives that strike us when we are reminded of an Indian public toilet. But in some point of view, we need in urge of using public toilets. Due to its unhygienic condition people may get severe infectious diseases like diarrhea, Viral fever, jaundice, etc. In many public toilets there are some more issues like wastage of water, electricity, etc. Hence, we are going to design a system to overcome these issues by monitoring the certain parameters as mentioned below for maintaining the Cleanliness of the toilet. In this system we designed to measure the rest room odour level, Number of persons used in a restroom, Automatic light on and off and Automatic water flow in the tap. After reaching the threshold level of the rest room odour and number of persons, the data are transmitted to respective persons to take necessary actions and data are passed via mail or message through LoRa network with 100% accuracy. LoRa is a 'Long Range' low power wireless standard intended for providing a cellular style low data rate communications network with enhanced accuracy. LoRa can be also used even in remote areas. After receiving the data, the necessary actions to be taken for maintaining the cleanliness of the toilet. By using the automatic light on and off and automatic tap, the resources are conserved efficiently. This system not only implemented in public toilets, it can be also implemented in colleges, schools, shopping malls etc.*

Keywords — Long Range – LoRa, Cleanliness, Conservation of Resources, Low Data Rate, Communication Accuracy, Remote Areas, Smart Cities.

I. INTRODUCTION

An increasing trend has been seen in India with how many households have toilet facilities (36.41% in 2001, 46.9% in 2011 and 97.21% in 2020). Most of these toilets will not have a basic facility to use. Some more issues like wastage of resources (electricity, water) may also occurs. Hence, we have designed the system using LoRa network for Long Range transmission and reception of data as mentioned below.

To monitor how many persons are using the toilet per minute or per hour or per day. After the certain count, data has been sent to person who is responsible for cleaning and the necessary actions will be performed. This maintains the cleanliness of the toilets. To detect the odour of toilets (Ammonia-rotten egg smell), after the certain threshold value, the data has been sent to respective person and cleaning actions will be performed. In many toilets, peoples are wasting the water infrequently. So here we designed the automatic on/off tap (water flow). Mainly in toilets, there is lot of wastage of electricity without any need. So, we are going to design the system automatic on/off light. When person comes in light will be on or it will be in off condition. Hence, we are conserving the resources efficiently and Maintaining the cleanliness of the toilets. These all the data will be sent to the respective persons through mobile or PC via LoRa network. LoRa is meant for Long-Range communication mechanism

Journal of Current Research in Engineering and Science
Bi-Annual Online Journal (ISSN : 2581 - 611X)
Volume 3- Issue 2, Paper 9, August 2020

with enhanced speed and accuracy of data Transmission and Reception.

To maintain the Cleanliness of the toilet which prevents the people from several infectious diseases. Wastage of Electricity and Water is reduced. Hence, resources are conserved efficiently. Accurate information's are sent to respective persons and necessary actions are performed. Hence, timely information's are sent using LORA network. To achieving best performance for maintaining public toilets using latest senor like people counting sensor and automatic tap with perfect accuracy for data transmission using LORA Module. This entire setup can be achieved in low cost (Economical). Design and Analysis of LORA network as follows.

II. PROPOSED SYSTEM

The proposed system consists of In Count Sensor, Out Count Sensor, Object Sensor, Gas Sensor as inputs to detect various activities, Microcontroller to convert the analog to digital signal as Raspberry Pi takes only digital signal and it also controls the input and output devices like LoRa Gateway, LCD, Lamp and Water Pump using the drivers.

The In Count Sensor and Out Count Sensor which detects the number of persons entering and leaving the rest room and the count value gets updated accordingly and automatic light to be on and off as the person enters the rest room. The object sensor detects the objects like hand, etc. and the automatic water flow to be executed. Gas Sensor detects the odour of the rest room. After the threshold level, the data are sent to the LoRa network to respective persons. LoRa Gateway transmits the multiple signals to the receiver in a efficient manner with low data rate even in remote areas. The message is passed to external PC connected to LoRa receiver and the necessary cleanliness actions are performed by respective persons.

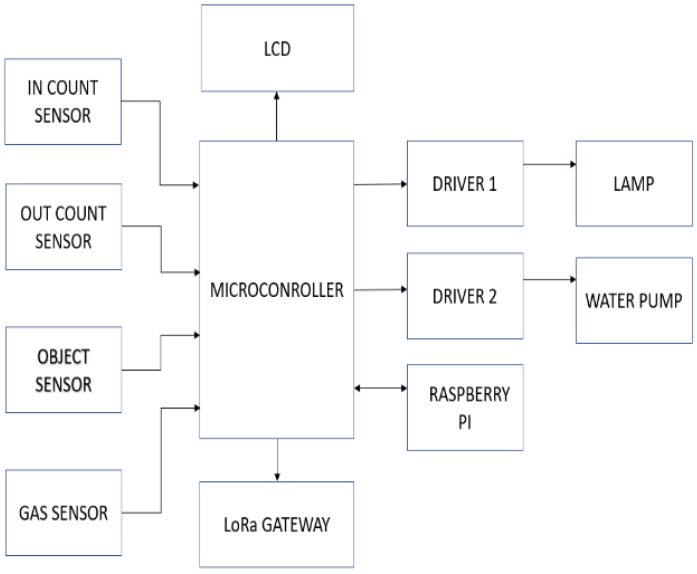

Fig. 1 Block diagram of the proposed system (Transmitter Section)

Journal of Current Research in Engineering and Science
Bi-Annual Online Journal (ISSN : 2581 - 611X)
Volume 3- Issue 2, Paper 9, August 2020

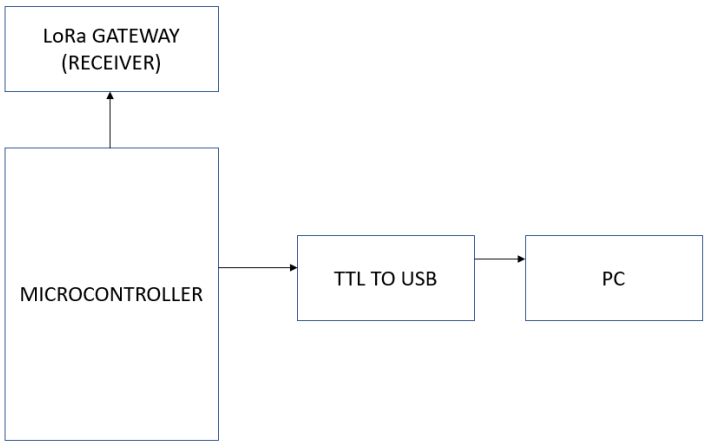

Fig. 2 Block diagram of the proposed system (Receiver Section)

III. HARDWARE SYSTEMS

A. Raspberry PI

The variant is based on a Broadcom BCM 285 system on a chip which contains at arm CPU or 32-bit CPU running at 1GHZ running the ARM 6 instruction set. There are many variants in Raspberry pi. But in this project, we used Raspberry pi zero variant due to its features and cost-efficient purpose. There are 40 GPIO pins down on the back and reset button for refreshing the board. This board actually contains Broadcom BCM 285 it does actually have 512 megabytes of ddr2 RAM. Here we have a mini-HDMI socket offering up to 1080p video at 60 frames a second and it contains two micro-USB connectors and want to connect power to the board and another one for connecting USB peripherals. It also contains the micro-SD card slot which you put our micro-SD card in to store your operating system and our programs and data are stored in this card which will be used for future reference. This module will controls and automate the overall project as discussed.

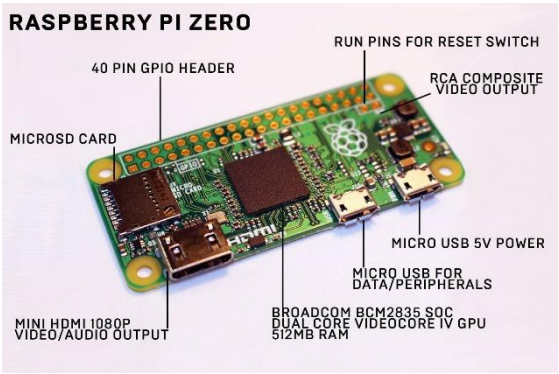

Fig. 3 Raspberry PI Zero

B. Microcontroller

The Microcontroller named ATMEGA328P is a low power controller with high performance from microchip. It is an 8-bit microcontroller with AVR RISC Architecture. It is one of the popular controllers

Journal of Current Research in Engineering and Science
Bi-Annual Online Journal (ISSN : 2581 - 611X)
Volume 3- Issue 2, Paper 9, August 2020

used in Arduino boards, etc. Here it is connected to various sensor inputs. It receives the analog inputs. The purpose of this controller is to converting the analog data to digital data which is fed into Raspberry Pi which only accepts the digital data. It has many applications but, in our project, it acts as a Analog to Digital Convertor and fed the digital data to raspberry pi module.

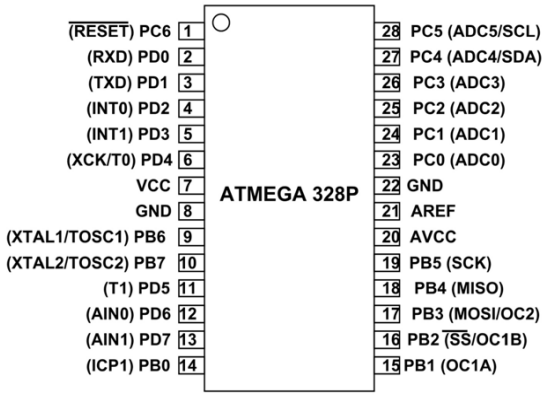

Fig.4 Pin diagram of ATMEGA328P (Micro-controller)

C. Object sensor (IR)

Infrared sensor is used to detect the motion of the object. This module consists of pyroelectric sensor which will be exposed by the heat energy. The term passive indicates that this sensor will not produce electrical or heat energy. This will utilize the energy from the upcoming objects which comes towards the sensor. This sensor will have the cover at the top called lens which focusses the entire electrical energy from object into the sensor to sense the objects motion. This IR Sensor detects the objects and it will start running the water pump and it is controlled by driver circuit built in it.

Fig.5 IR sensor

D.Gas sensor

Here we used “Flying Fish” sensor to detect the presence of odour of the rest room. It works on electrochemical principle which detects the odour of the ammonia (rotten-egg smell). The values will be detected in terms of PPM (PartsPerMillion). After the Certain threshold value, the data will be sent via LoRa network.

Journal of Current Research in Engineering and Science
Bi-Annual Online Journal (ISSN : 2581 - 611X)
Volume 3- Issue 2, Paper 9, August 2020

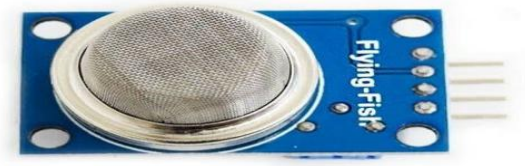

Fig.6 Gas sensor

E. Count sensor

This ultrasonic sensor module can be used for measuring distance, object sensor, motion sensors etc. Highly sensitive module can be used with microcontroller to integrate with motion circuits to make robotic projects and other distance, position & motion sensitive products. The module sends eight 40Khz square wave pulses and automatically detects whether it receives the returning signal. If there is a signal returning, a high-level pulse is sent on the echo pin. The length of this pulse is the time it took the signal from first triggering to the return echo. This will monitor the people incoming and outgoing to the rest room and controls the automatic light on and off mechanism.

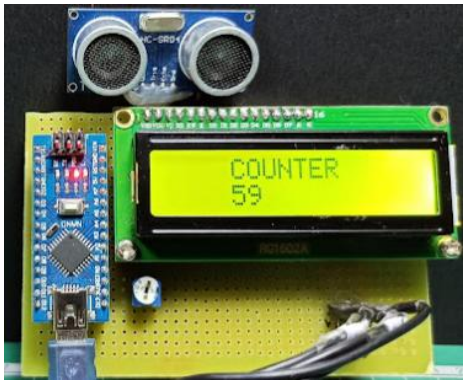

Fig. 7 Ultrasonic count sensor

F. LoRa gateway

A LoRa concentrator/gateways are sensing devices which receives the multiple signals from the LoRa transmitter. It will be connected via internet using the standard communication protocols and it will retrieve the data from the various sensors. Gateways forms, bridge between the devices. It can be also connected to networks, servers, cloud, etc. It has a -139dBm sensitivity. A Single LoRaWAN gateway can cover the entire city but it depends on the environmental surroundings. LoRaWAN has the higher link budget than any other communication protocols. Range will be highly depending on surrounding environment and obstruction in the way. This will transmit the multiple signals and it will receive the multiple signals from the microcontroller which is connected to various sensors.

Journal of Current Research in Engineering and Science
Bi-Annual Online Journal (ISSN : 2581 - 611X)
Volume 3- Issue 2, Paper 9, August 2020

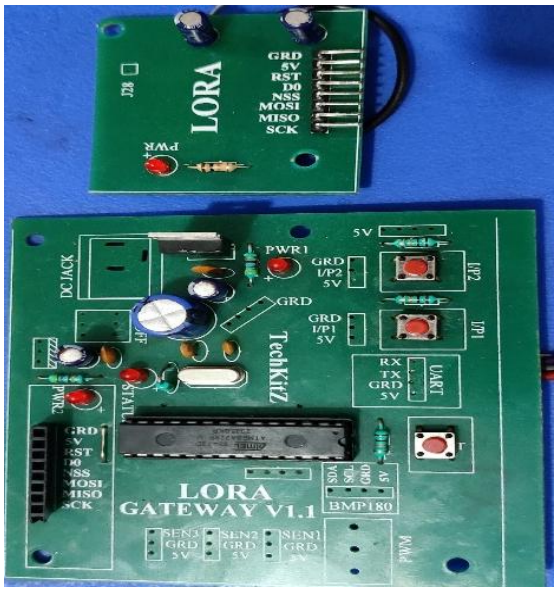

Fig .8 LoRa gateway (Transmitter and Receiver)

IV. SOFTWARE SYSTEM

Arduino IDE

Arduino Integrated Developer Environment (IDE) is a cross-platform application that is written in functions. It is used to write code and upload programs to Arduino boards. It supports computer languages like C and C++ using special rules of code structures. It supplies a software library, which provides many common input and output procedures. It converts the executable code into a text file in hexadecimal encoding.

V. RESULT AND CONCLUSION

LoRa will send the data in accurate manner with low data rate and faster transmission and reception when compared to other protocols such as Zigbee, Bluetooth, etc. Implementation of LoRa System for timely maintenance for public toilets for smart cities is discussed here. Here we have used three sensors namely PIR Sensor, Ammonia Sensor and People Counting Sensor which detects the automatic light on and off and automatic water flow in tap, it detects the odour of the rest-room and it counts the number of people used in rest-room. The sensed data are given to microcontroller and to Raspberry Pi and after processing of data is sent to the LoRa modules and it is received by the LoRa Gateway which receives the multiple signals and finally sent to PC/Mobile. Hence, by using this project we will maintain the cleanliness of the toilet and resources are conserved efficiently. Future works also implemented as automatic flush on and off as the odour threshold level increases. Hence it is simpler design and easy to implement in many places.

Journal of Current Research in Engineering and Science
Bi-Annual Online Journal (ISSN : 2581 - 611X)
Volume 3- Issue 2, Paper 9, August 2020

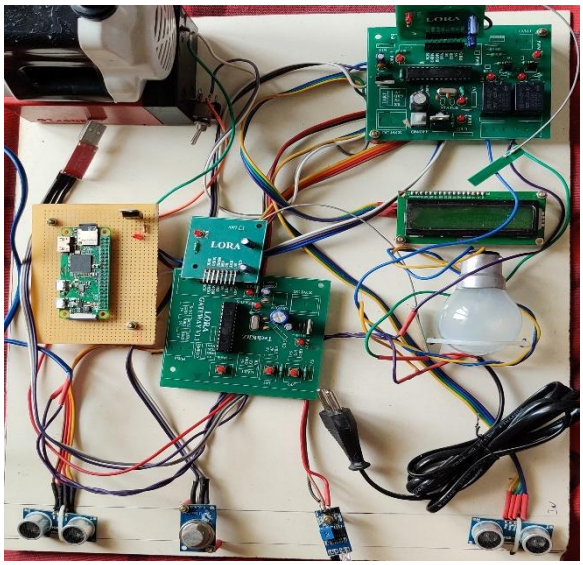

Fig. 9 Overall Setup

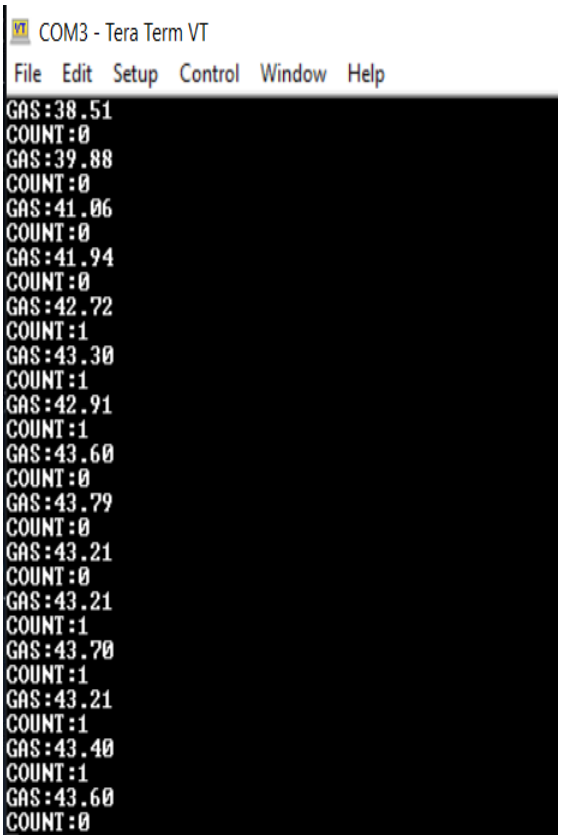

Fig. 10 Output in PC

Journal of Current Research in Engineering and Science
Bi-Annual Online Journal (ISSN : 2581 - 611X)
Volume 3- Issue 2, Paper 9, August 2020

REFERENCES

[1] S. Hemanth and K. Keshamoni, "Smart Gas Level Monitoring, Booking & Gas Leakage Detector over IoT," in 2017 IEEE 7th International Advance Computing Conference (IACC), Hyderabad, 2017 pp. 330-332.

[2] R. Brito, C. Ferrareze, J. Oliva, F. Favarim and E. Todt, "A Novel System for Ammonia Gas Control in Broiler Production Environment," in 2020 3rd International Conference on Information and Computer Technologies (ICICT), San Jose, CA, USA, 2020 pp. 336-340.

[3] N. Fotiou, A. Mertzianis, F. Favarim and G. Polyzos, "Smart IoT Data Collection," in 2018 IEEE 19th International Symposium on "A World of Wireless, Mobile and Multimedia Networks" (WoWMoM), Chania, Greece, 2018 pp. 588-599.

[4] J. Lim ,D. Kim and J. Kim, "Low-Power, Long-Range, High-Data Transmission Using Wi-Fi and LoRa," in 2016 6th International Conference on IT Convergence and Security (ICITCS), Prague, Czech Republic, 2016 pp. 1-3.

[5] R. Oliveira , C. Ferreira and J. Silva, "Low-Energy Smart Cities Network with LoRa and Bluetooth," in 2019 7th IEEE International Conference on Mobile Cloud Computing, Services, and Engineering (MobileCloud), Newark, CA, USA, 2019 pp. 24-29.

[6] K. Naseer, H. Ahmad, M. Asif and M. Alam, "Smart Street Light System Powered by Footsteps," in 2019 International Conference on Green and Human Information Technology (ICGHIT), Kuala Lumpur, Malaysia, 2019 pp. 122-124.

[7] G. Saman , S. Ullah and F. Khan, "Hand gesture recognition for automatic tap system," in 2015 Intelligent Systems and Computer Vision (ISCV), Fez, Morocco, 2015 pp. 1-5.

[8] V. Kulkarni and P. Patil , "Odour detection and classification," in 2015 International Conference on Green Computing and Internet of Things (ICGCIoT), Greater Noida, Delhi, India, 2015 pp. 426-428.

[9] S. Simha ,S. Serban, V. Bathrinarayanan, E. Corvee and F. Bremond, "Towards reliable real-time person detection," in 2014 International Conference on Computer Vision Theory and Applications (VISAPP), Lisbon, Portugal, 2014 pp. 232-239.

[10] Yin-Chan Chang , Chao-Ho Chen, Tsong-Yi Chen and Da-Jinn Wang, "People Counting System for Getting In/Out of a Bus Based on Video Processing," in Intelligent *Systems Design and Applications, International Conference on*, null, 2008 pp. 565-569.

[11] X. Zhao , L. Chen and E. Delleandra, "A People Counting System Based on Face Detection and Tracking in a Video," in *2013 10th IEEE International Conference on Advanced Video and Signal Based Surveillance*, Genova, Italy, 2009 pp. 67-72.

[12] P. Foggia , D. Conte, M. Vento and G. Percannella, "A Method Based on the Indirect Approach for Counting People in Crowded Scenes," in *2013 10th IEEE International Conference on Advanced Video and Signal Based Surveillance*, Boston, Massachusetts, 2010 pp. 111-118.