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RF based Automation and its application in Smart Trash Bins

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ABSTRACT
The paper is focused on the Radio Frequency (RF) based automation with Amplitude Shift Keying (ASK) application particularly for garbage Monitoring System which will indicate that whether the trash can is completely full through the RF transmitter receiver and let us know the status from anywhere. It will be very helpful and can be installed in the Trash Cans at public places as well as at home. It is a keystone to achieve the Smart Residence vision as a part of Smart City vision. In present era, the effectiveness of the Garbage Managing System in the localities has become a crucial factor to achieve the Smart Residence Vision. Usually the garbage bins in the residential area like parks, apartments are overflowed with the garbage and they deteriorate the environment of the city, residential area and affect the life of the nearby housings. Therefore, in this paper, an RF based Garbage Monitoring System is designed consists of RF transmitter receiver, Digital Encoder decoder and infra-red (IR) sensor. It will help to provide an efficient waste management and cost saving, yet environmental friendly technique to the corresponding cities or residential area. This system monitors the garbage bins and informs about the level of garbage collected in the garbage bins via a RF transmitter and send all information to receiver indicator showing the status of it.
Keywords—Amplitude Shift Keying, Infra-red, Radio frequency

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I. INTRODUCTION

Garbage monitoring systems keep our homes and communities free from unwanted clutter, either it is densely populated cities or smaller rural area. As the World's most of the population shift towards urban areas, cities have been facing complex problems in resource management, health, pollution, traffic and waste management etc [1]. But at the same time, the recent years has seen the rise of the 'smart cities', where these tough challenges are cope up with technology driven solutions. This paper presents a solution in waste monitoring of public trash bins. Smart city technologies is an emerging era and there is need to have standards, methodologies and best practices. In this regard, this project has the aim to design RF based system to monitor public trash bins and evaluate its usage [2].

The system consists of RF module and the connections between modules is achieved using the RF protocol which is enabled with 433 MHz radio frequency. RF based communication do not require line-of-sight operation. Hence, they are often used instead of infrared based system [3]. The RF transmitter modules are installed on the respective bins while the RF receiver module is installed on the processing station.

II. PROBLEM STATEMENT

In most of the urban areas and metro cities, the overflowed trash bins creates an unhygienic environment. This will further lead to different types of diseases and also degrade the standard of living. To avoid all such situations this paper gives a solution which is RF based garbage bin monitoring system to keep locality clean and safe. Also RF transmission is more strong and reliable than Infrared (IR) as RF signals can travel longer distances than Infrared with no need of line of sight. I.

III. HARDWARE REQUIREMENTS

A wireless RF transmitter and receiver can be easily designed using IR sensor, HT12D Decoder, HT12E Encoder, ASK (Amplitude Shift keying) based RF Module and seven segment display. The complete circuit is divided into different sections i.e. transmitter and receiver sections. The transmitter section consists of an RF Transmitter, HT12E encoder IC and four push buttons interfaced to the trash bins installed with IR sensors.

The receiver section consists of RF Receiver, HT12D Decoder IC and seven segment display. This is used to indicate the status of trash bins. A 1 MΩ resistor is connected between the oscillator terminals of encoder IC. This is to enable the oscillator and a 51 KΩ resistor is connected

between the oscillator pins of decoder IC. Signals can be wirelessly transmitted with the help of 433MHz ASK RF Transmitter and Receiver modules. In these modules digital data is represented by different amplitudes of the carrier wave, hence this modulation is known as Amplitude Shift Keying (ASK). Also 555 timer IC used for controlling application and on board 5V power supply is designed.

A. RF transmitter Receiver Module

The RF transmitter with a good antenna can sent data up to 500 feet in outdoor environment. The operation voltage of RF transmitter is 3.3V to 5 V and the operation voltage of RF receiver is 5V to 9V. The RF module, as the name suggests, operates at Radio Frequency. The corresponding frequency range varies between 30 kHz & 300 GHz. This RF module comprises of an RF Transmitter and an RF Receiver. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 434 MHz.

An RF transmitter receives serial data and transmits it wirelessly via RF links through its antenna connected at pin 4. The transmission occurs at the rate of 1-10Kbps. It has low cost and provides long range. The transmitter is ideal for battery-powered applications as it operates from a 1.5-12 V supply [4]. The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter [5].

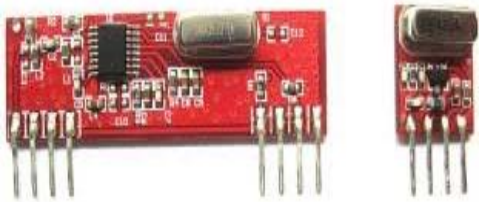

Figure.1. RF module: Transmitter and Receiver

B. Encoder (HT12E) and Decoder (H12D)

H12E is an encoder IC that converts the 4-bit parallel data from the 4 data pins (pin 10-13) into serial data in order to transmit over RF link using transmitter. The operating voltage range of HT12E is from 2.4V to 12V and has a built in oscillator which requires an external resistor of around 1 M ohm. Its power consumption is very low, with operating current of 0.1μA at 5V V_{DD} and has high immunity against noise. H12D is a decoder IC that converts the serial data received by the RF Receiver into 4-bit parallel data and drives the seven segment display accordingly.

TABLE I

Pin description for H12E	
Pin Numbers	**Connection and specification**
1-8	Assignment of receiver direction and used for changing of addresses for communication
9	V_{SS} connected to GND
10-13	For transmitting data of 4 bits
14	Transmission enable, it can be done connecting this pin to GND
15-16	In these ports it have to put a "oscillation resistor" very important use the value of 1 M ohm
17	This pin have to be connected to Data pin of our 433 MHz RF transmitter
18	This pin goes connected to VCC or our positive terminal of our power supply

TABLE II

Pin description for H12D	
Pin Numbers	**Connection and specification**
1-8	Connected to GND for enable communication with the HT12E
9	V_{SS} connected to GND
10-13	For the output data that is sent from the transmitter, in our case seven segment display for indicating receiving information
14	This pin goes connected to DATA of our 433 MHz RF receiver
15-16	In these ports it have to put a "oscillation resistor" with the value of 51 K ohm
17	No connection
18	This pin goes connected to VCC or our positive terminal of our power supply

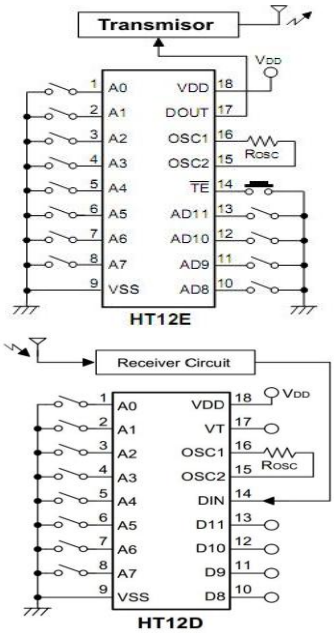

Figure.2. Encoder and Decoder Interfacing

C. IR Sensor module

The IR sensor module consists mainly of the IR Transmitter and Receiver, Opamp, Variable Resistor (Trimmer pot), output LED in brief. IR LED emits light, in the range of Infrared frequency. Photodiode acts as the IR receiver as its conducts when light falls on it. LM358 is an Operational Amplifier (Op-Amp) is used as voltage comparator in the IR sensor. The comparator will compare the threshold voltage set using the preset (pin2) and the photodiode's series resistor voltage (pin3).

If Photodiode's series resistor voltage drop is greater than threshold voltage, the Opamp output is high and when the Photodiode's series resistor voltage drop is less than threshold voltage, the Opamp output is Low. When Opamp's output is high the LED at the Opamp output terminal turns ON (Indicating the detection of Object).

D. IC555 Timer

The 555 Timer is a generally used IC designed to work in different modes of multi vibrator and produce a variety of output waveforms with the addition of an external RC network. It is a cheap and useful precision timing device can act as either a simple timer to generate single pulses or as a relaxation oscillator producing a string of waveforms of varying duty cycles. In this project we have used IC 555 in mono-stable mode to connect it with pin 10 and 12of HT12E.

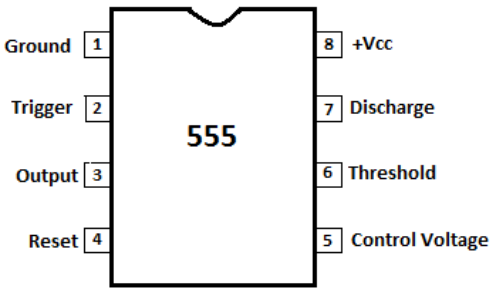

Figure.3. PINOUT for 555 IC

E. 5V designed power supply

For this power supply we have used 12-0 step down transformer, rectifying circuit using four diodes based on bridge rectifier, filtering capacitor and LM 7805 voltage regulator IC to get fix 5V voltage supply.

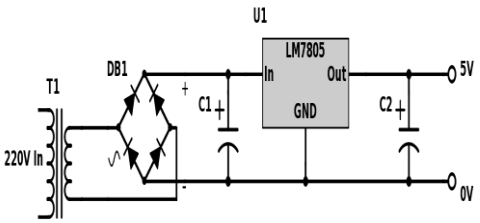

Figure. 4. Power suppy circuit

F. Seven segment display

It consists of seven LEDs (hence its name) arranged in a rectangular fashion as shown. Each of the seven LEDs is called a segment because when illuminated the segment forms part of a numerical digit (both Decimal and Hex) to be displayed.

IV. MODULATION TECHNIQUE

ASK modulation is used by RF433 to send the data using wireless link. Amplitude-shift keying (ASK) is that form of amplitude modulation in which digital data is represented as variations in the amplitude of a carrier wave. In an ASK system, transmitting a carrier wave, with fixed frequency and fixed amplitude for T seconds (bit duration), represents the binary symbol [7].

The carrier signal is transmitted, if the signal value is 1. Whereas, if the signal value is 0, nothing will be transmitted. This is the simplest and most common form of ASK. It acts as a switch, transmitting a carrier wave to denote a binary 1 and absence of carrier wave to denote a binary 0. This type of modulation is called on-off keying (OOK) [8].

The ASK/OOK signal is expressed

$S_{ASK}(t) = m(t) \times \sin(2\pi ft)$, $0 \leq t \leq T$

Where m(t) is input binary data.

V. CIRCUIT OPERATION

We have used paired HT12E encoder and HT12D decoder to transmit and receive 12 bits of parallel data serially. HT12E converts 12 bit parallel data in to serial output which can be transmitted through an RF transmitter. These 12 bit parallel data is divided in to 8 address bits and 4 data bits. By using these address pins we have provided 8 bit code for data transmission and multiple receivers may be addressed using the same transmitter. But here we have only one receiver so we have grounded all the 8 pins.

The HT12E series encoder starts a 4 word transmission cycle upon receiving transmission enable signal on TE input. This output cycle will repeats as long as the transmission is enabled. When the transmission enable (TE) signal switches to HIGH, the encoder output completes the current cycle and stops as shown above. The encoder will be in the Standby mode when the transmission is disabled.

A. Mapping HT12E encoder IC and the RF transmitter

433MHz ASK based wireless module is capable of transmitting 4-bits of information which can be directly interface with Encoder [6]. This encoder IC HT12E converts the parallel data into serial data suitable for RF transmitter module. The transmitter module takes this data from encoder, modulates it with ASK (Amplitude Shift Keying) and transmits it through antenna.

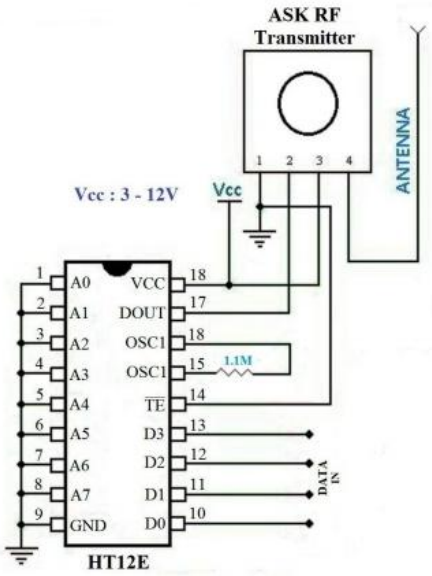

Figure.6.H12E interface with RF Tx

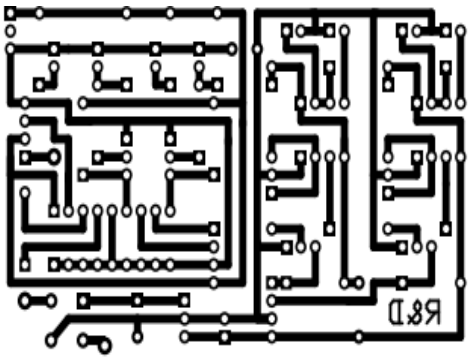

Figure.7.PCB layout for Transmission End Circuit

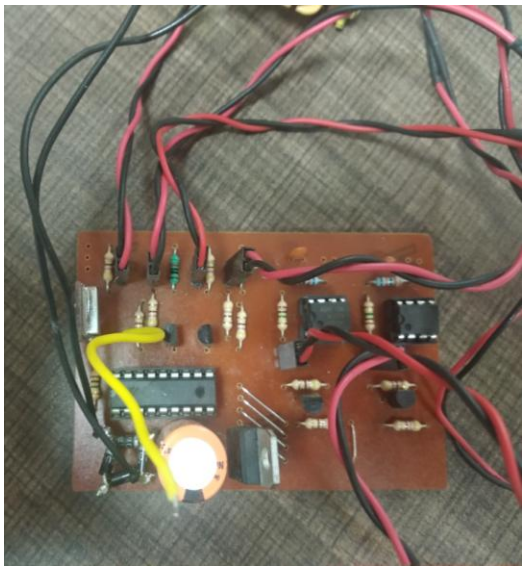

Fig. 8. Experimental setup for the transmitter end

B. Mapping HT12D Decoder IC and the RF receiver

This transmitted signal is received by the receiver antenna where it first matches the address of transmitter and receiver. If the address is same then, receiver demodulates the received signal and transfers the serial data to the decoder IC HT12D. The decoder IC decodes the serially received bits and converts it into parallel data which was actually transmitted.

Now, we have 4-bits of wirelessly transmitted data. We can use it to our trash bin level indication. If we want to control a single trash bin, we require 2-bits of information. So, to manage two bins we require 4-bits of information which we are getting. Finally with the 4 data out pins seven segment display is interfaced to show the status of trash bins received**.**

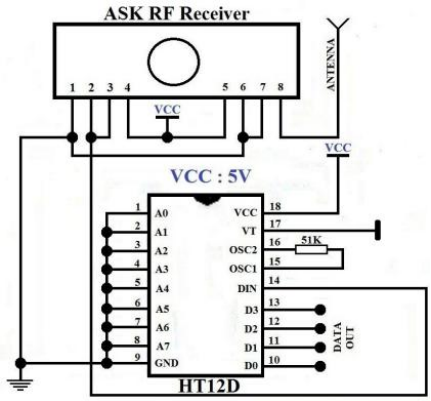

Figure.9. H12D interface with RF receiver

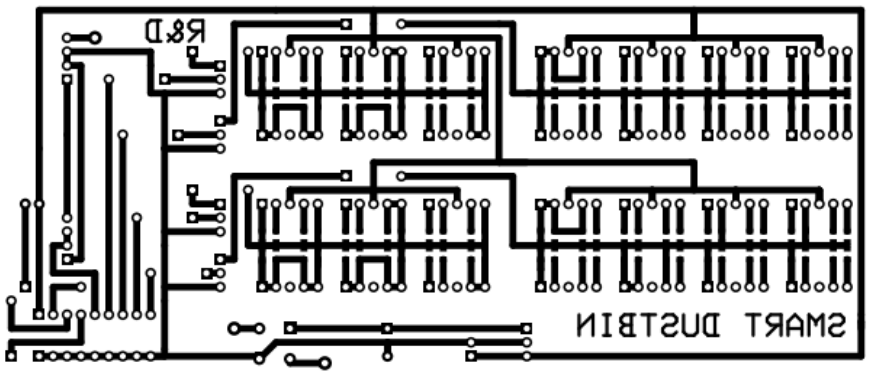

Figure.10. PCB layout for Receiver End section

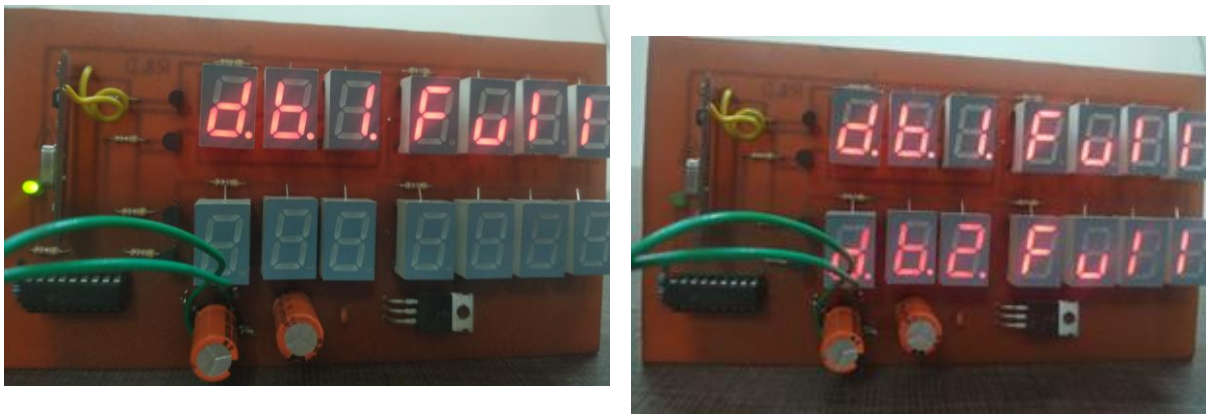

Figure.11. Results showing at the receiver End

VI. RESULTS

The following are the outcomes which are obtained from this project:

- Dry Waste level detection inside the dustbin
- Transmit the information wirelessly to concern and displayed on Seven Segment display.

• No need f line of sight and have real time status transmission to avoid the overflow of the dustbin.
This project for trash level management is very useful for smart cities in diverse aspects.

VII. CONCLUSION

The proposed smart trash bin is the cost effective and efficient RF based technique to prevent cluttering of litters and overflow of waste usually for dry waste. This project can contribute in the clean and hygienic environment reducing the manpower by monitoring the bins wirelessly. Although there are various methods available for this level sensing but our project is cheap, easy to implement and install providing the real time status. Also this is designed for only two dustbins which can be further extended for larger numbers. We have designed PCB for this project which helps the students to make their own application. It can be further modified for wet waste by using ultrasonic sensor and to increase the area for communication via GSM.

REFERENCES

[1]. https://www.postscapes.com › smart-trash
[2]. Prof. Dr. Sandeep M. Chaware1, Shriram Dighe, Akshay Joshi, Namrata Bajare, Rohini Korke. "Smart Garbage Monitoring System using Internet of Things (IOT)", International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering ISSN (Online) 2321 – 2004 ISSN (Print) 2321 – 5526Vol. 5, Issue 1, January 2017
[3]. Fahmida Ahmed, Shakh Md. Alimuzjaman Alim, Md. Shafiqul Islam, Kanti Bhusan Roy Kawshik, Shafiul Islam. "433 MHz (Wireless RF) Communication between Two Arduino UNO", American Journal of Engineering Research (AJER) e-ISSN: 2320-0847 p-ISSN: 2320-0936, Volume-5, Issue-10, pp-358-362-2016
[4]. RF transmitter. [Online]. Available: http://www.quasaruk.co.uk/acatalog info QAM TX1 433.html.
[5]. RF receiver [Online] Available:http://www.quasaruk.co.uk/acatalog/info QAM RX1 433.html
[6]. Yoshinori Kuno, Saturo Nakanishi, Teruhisa Murashima, Nobutaka Shimada, and Y. Shirai, "Robotic Wheelchair with Three Control Modes."" proceedings of the 1999 IEEE International Conference on Robotics & Automation., pp. 2590-2595, May 1999.
[7]. I. Ichitsubo, G.-W. Wang, and W. Wang, "RF front-end module for wireless communication devices." Google Patents, 2004.
[8]. M. Sonmez and A. Akbal, "FPGA-Based BASK and BPSK Modulators Using VHDL: Design, Applications and Performance Comparison for Different Modulator Algorithms," Int. J. Comput. Appl., vol. 42, no. 13, pp. 34–40, 2012
[9]. [9] Monika K A, Nikitha Rao, Prapulla S B, Shobha G, "Smart Dustbin-An Efficient Garbage Monitoring System", DOI 10.4010/2016.1694, ISSN 2321 3361- 2016 IJESC

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