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RESEARCH ARTICLE

Eco-friendly Environment with RFID Communication Imparted Waste Collecting Robot

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Abstract

Modernization of the restaurants using electronics and communication is needed by imparting the smart technology. The technology is to be adopted for restaurants to keep the premises clean and green. Human interpretation is to be reduced to impart the technology. Smart waste collecting system enabled to develop a methodology to collect the waste material into the dustbin provided at the guided robot. An RFID (Radio-frequency identification) communication is adopted to communicate the table occupier with the mobile robot. An RFID tag is provided to each table and an RFID reader is equipped with guided robot. The command signal outputted by the table occupier will be transmitted to the central control room using RF transmitter. RF receiver at the control room will receive the signal and fed as input to the microcontroller ARM7. The microcontroller will output the necessary commands to the robot to collect the waste material from the particular table. To drive the robot to the required table, a path finding mechanism has been adopted using optimum path algorithm. An IR sensor assembly is equipped with the robot to follow the specified optimum path. The status of the task is communicated to the control room by imparting IEEE 802.15.4 communication device. The experimental results encouraged to implement the developed mechanism for real time applications.

Keywords: Waste collection robot, RFID communication, ARM7, IR sensor, IEEE 802.15.4.

Introduction

Environment pollution is a serious component in recent advancements. Majority of viruses and bacterial infections develop in polluted environment. Safe guarding the environment using technology sources is needed at present. Majority of the public environment like restaurants seems to be polluted with the waste material. So, modernization of the restaurants using electronics and communication is needed by imparting the smart technology. Various studies were proposed using RFID communication technology in recent years. Benet *et al.* (2002) proposed a new IR sensor to measure distances up to 100 cm based on back scattered light intensity from the objects and the errors expected were analyzed and modeled. Chon *et al*. (2004) proposed the RFID tags installed on the roads and navigated the system RFID reader to obtain highly accurate location GPS and gyroscope. Mohammad (2009) proposed a methodology for estimating the distance and surface properties, the angular position of the IR sensor is calculated and ultrasonic sensor provided the basic information on distance measurement. Arvin *et al*. (2009) proposed short range communication for mobile applications, for obstacle detection and data packet communication, Infrared technology was used. Pulse code modulation is used for transmitting the data. The distance estimation was done using the reflected infrared signal.

Gueaieb and Miah (2009) proposed a robot mounted with RFID reader with two receiving antennas and RFID tags attached to define the path and to navigate a mobile robot RFID tags used to provide the analog feedback. Prathyusha *et al.* (2011) implemented position of the robot and motion control strategy and developed a robot to build a map of its surroundings. RFID reader and RF tags provided the analog feedback signals to navigate the robot. An ARM micro controller was used to regulate the operations. Keeping the above facts, in this study an autonomous robot was designed to collect the waste material when a demand is received from the concerned location and table, so that the environment always appears green and safe to safeguard the human life from serious viruses and bacteria.

Materials and methods

IR sensor: Figure 1 represents an IR sensor used to detect the dustbin full status. If the dustbin is loaded with waste material, the IR sensor will fed 5 V signal to the microcontroller. Then a beep signal is generated. This signal enables to send command signal to the control room by pressing a push button provided on the table.

Fig. 1. IR sensor used to identify the status of the dustbin.

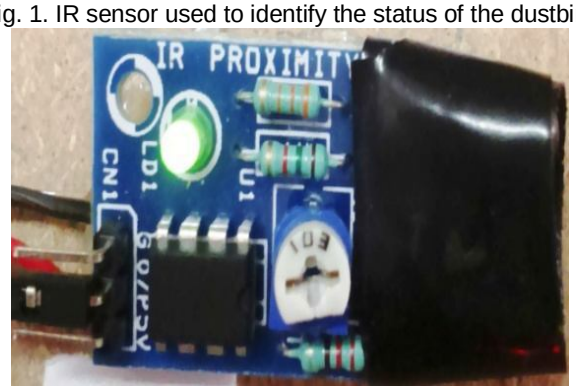


Fig. 2. Simulation of RF transmitter.

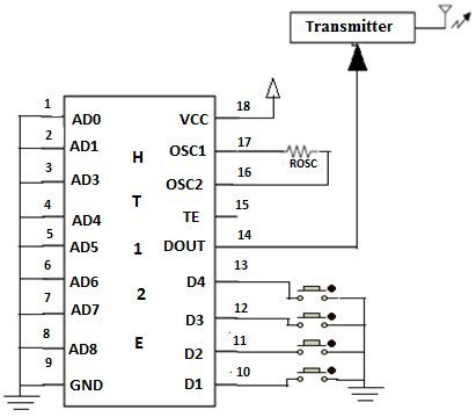
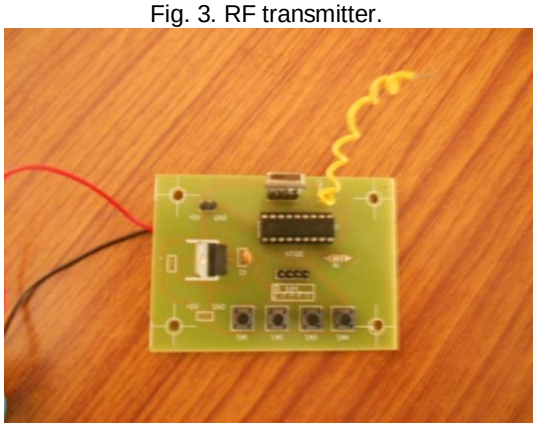


Fig. 3. RF transmitter.



Infrared range detection sensor: The infrared range detection sensor was used to determine the optimum path for the robot move to the destination. This photoelectric sensor consists of transmitter and receiver. It has visible light interference and the detection distance is adjusted to 60 cm.

Radio frequency (RF) communication: Figure 2 and 3 represents the receiver circuit simulated using proteus software and the hardware circuit used to transmit the demand signal to the control room. The signal from the IR sensor enables the buzzer indicates the dustbin full status. Then a push button provided on the table will be enabled by the table occupier.

This signal is encoded using HT12E encoder and then the encoded signal will be transmitted using RF transmitter. An electromagnetic signal is used for communication. Amplitude shift keying modulation is used to represent the change in the carrier wave amplitude. This change is represented in digital form. RF communication is selected to transmit the signal for long distances even with an obstruction in the line of sight. So that the demand signal (dustbin need to be empty) can be forwarded to the control room where the examiner constantly monitoring the status. The RF transmitter and receiver pair is programmed to operate at 434 MHz. The serial data transmits wirelessly through RF antenna. The receiver will operate with the same frequency to receive the transmitted data. The communication is established between the table demanding the signal and the robot defined to collect the waste material. Figure 4 and 5 represents the simulated circuit using proteus software and the hardware design used to receive the RF signal. The RF signal received using the RF antenna will be decoded using HT12D decoder to enable the movement of the waste collected robot.

Fig. 4. Simulation of RF receiver.

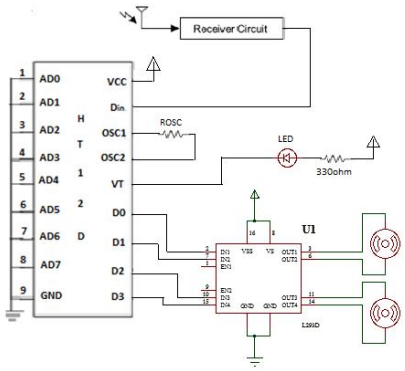
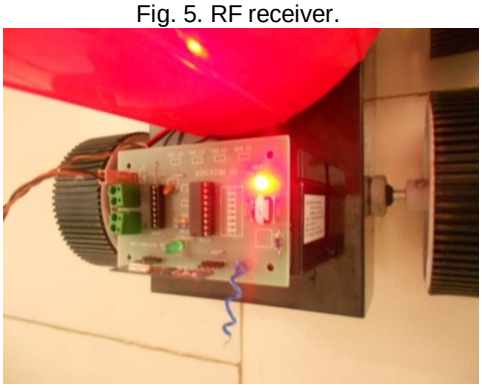


Fig. 5. RF receiver.



Encoder (HT12E): The encoder will convert 8 address bits + 4 data bits into serial form for transmission. The transmitter enable pin is pulled low. Upon receipt, transmitter enable the HT12E begins a 4-word transmission cycle and this cycle repeats until the transmitter enable pin pulled low.

Fig. 6. Simulated control circuit at the table.

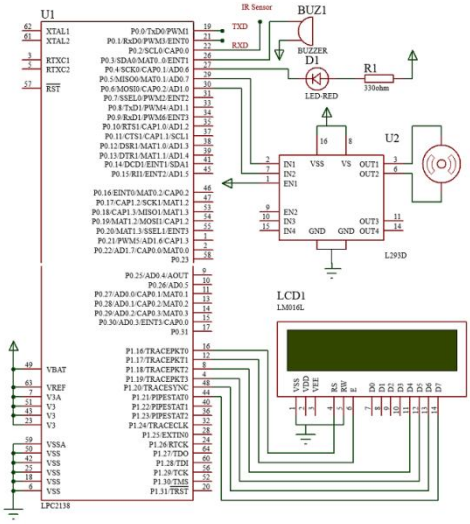
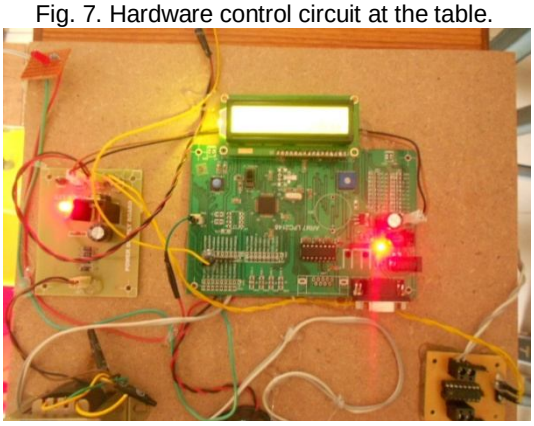


Fig. 7. Hardware control circuit at the table.



Decoder (HT 12D): The serial address and data received by RF receiver is converted into parallel using HT12d decoder. This conversion depends on the no error status. The conversion causes to pull a high signal at valid transmission (VT) pin of the decoder.

Simulated control circuit: Figure 6 represents the simulated control circuit using proteus software. The same was implemented using hardware components represented in Fig. 7 for central control room operations. An Arm 7 microcontroller is used to regulate the operation of the developed methodology. The decoded signal will be fed as input signal to the microcontroller. Then, L293D Motor driver circuit is triggered to enable the motor assembly. RFID reader is implanted to the robot and an RF tag is attached to each table. The waste collection robot verifies the RF ID tag associated with the table.

Algorithm 1
Step 1: Initialize the ports
Step 2: IR sensor Equate with port 2_0
Step 3: Read port 2_0
Step 4: if
The IR output ≥ 4 V
Then
Verify the VT signal at the decoder
If
The VT signal = logic '1'
Then
Read the decoder output
Go to next step
Step 5: Call the algorithm 2
Step 6: Enable the L293D Motor driver circuit
Step 7: Verify the RFID reader
Step 8: If
The RFID tag found match
Then Send the command signal to microcontroller
Else
Go to step 7
Step 9: Rotate the dustbin motor
Step 10: verify the position of the motor
If
The motor turns ≠ 270^0
Then go to step 9
Else go to step 11
Step 11: Reset the motor to normal state
Read the port 2_0
If
The signal output =logic '0'
Then
Go to step 3
Else
Go to step 9.
For optimum path determination
Algorithm 2
Step 1: Initialize the ports
Step 2: Read the data from Infrared range detection sensor
Step 3: Measure the distance (D1) between source point (X) and destination point (Y).
Step 4: Measure the distance (D2) via (X) to intermediate path (Z) and (Y)
Step 5: Differentiate D1 and D2
Step 6: if
D1 ≥ D2
Then
Optimum distance =D2
Else
D1= Optimum distance.
Step 6: Output the result

Results and discussion

Figure 8 represents the ready status of the robot to move towards the destination location. Figure 9 represents the full status of the dustbin. An IR sensor is used to detect the status of the dustbin to be cleaned. Figure 10 represents the status of the demand to clear the dustbin. At the control room, this status will alarm the supervisor to reinitiate the dust clearing process. Figure 11 and 12 represent the dustbin rotation positions and status of the waste collected at the control room. Figure 13 shows the completion status of the robot. The results obtained are favorably good.

Fig. 8. Ready status of the control unit.

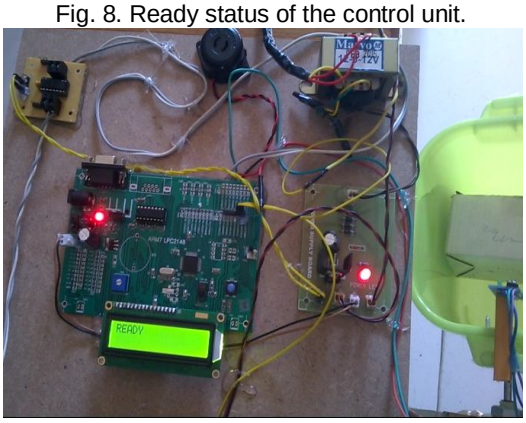


Fig. 9. Sensor triggered and dustbin full status.

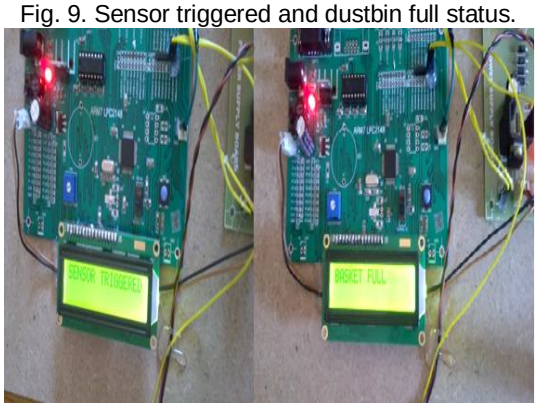
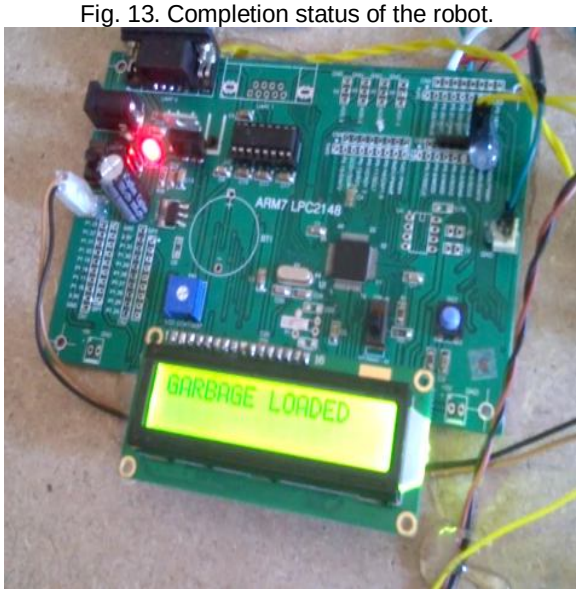


Fig. 10. Waste collecting robot status.

Fig. 11. Started position of dustbin rotation.

Fig. 12. Dustbin full rotation.

Fig. 13. Completion status of the robot.



Conclusion

With the proposed methodology, the experimental results encouraged to impart the real time applications. Waste management system may increase the potential of eco-friendly environment. This methodology can be adopted for dining room at all conference and public party places. In future, this methodology is proposed to be modified using Fuzzy logic concepts to enhance the reliability.

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References

1. Arvin, F., Samsudin, K. and Ramli, A.R. 2009. A short range infrared communication for swarm mobile robots, Int. Conf. Signal Proc. Syst., pp.454-458.
2. Benet, G., Blanes, F., Simo, J.E. and Perez, P. 2002. Using infrared sensors for distance measurement in mobile robots, Elsevier Robotics and Autonomous Systems. 40: 255-266.
3. Chon, H.D., Jun, S., Jung, H. and Won, S. 2004. Using RFID for accurate positioning. *J. Glob. Positioning Syst.* 3(2): 32-39.
4. Gueaieb, W. and Miah, M.S. 2009. A modular cost-effective mobile robot navigation system using RFID technology. *J. Commun*. 4(2): 89-95
5. Mohammad, T. 2009. Using ultrasonic and infrared sensors for distance measurement. *World Acad. Sci. Engg. Technol*. 3(3): 269-274.
6. Prathyusha, K., Harini, V. and Balaji, S. 2011. Design and development of a RFID based mobile robot. *Int. J. Engg. Sci. Adv. Technol*. 1(1): 30-35.