IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 10, Issue 4, April 2022

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.165

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.165 |

|| Volume 10, Issue 4, April 2022 ||

| DOI: 10.15680/IJIRCCE.2022.1004135|

Design and Implementation of Autonomous Fire Fighting Robot and Monitoring through Raspberry Pi Controller

S.Keerthana[1], G.Shamini[2], S.Ugendhar[3], Dr.R.Arivalahan[4]

Department of Electrical and Electronics Engineering, SRM Valliammai Engineering College, Kattankulathur, Tamilnadu, India

ABSTRACT: Firefighters have a vital role to play, but they also work in a hazardous environment. It is expected of this robot to locate a fire before it is big. It might be used to work with firefighters to lessen the likelihood of victims being injured. Hardware and Software are the two components of robot creation. For drive systems, robots have two DC motors. As feedback to the robot, various sensors such as ultrasonic sensors, flame sensors, DHT11 sensors, MQ2 sensors, MQ135 sensors, and so on are connected to RASPBERRY PI. To determine the robot action gain from sensor inputs, the programming section use the PYTHON programming language.

KEYWORDS: Fire Robot, Raspberry PI, Python, DC Motor, DHT 11 sensor, MQ2 Sensor, MQ135 Sensor

I. INTRODUCTION

Fire, smoke and flames are one of the leading hazards which are affecting everyday life around the globe. In recent times fire safety has become an important issue for both residential and industrial areas. In Bangladesh, fire incidents kill 233 people and injure about 5,000 every year. Fire causes losses of properties and goods worth Taka 4,834 crore per year. In last six years alone, the estimated loss due to fire incidents is about 29000 crore. Extinguishing a fire is a destructive procedure. To prevent more damage and to evacuate the victims to a safer position away from the danger zone, firefighters must be able to rapidly turn off the fire and extinguish it safely.

The technological gap between fire and machinery has now been bridged, allowing for extra efficient and effectives fire extinguishing solutions. Our proposed robotics system is basically an autonomous system which detects and extinguishes fire. The first and the most important part is to detect fire correctly. Failure to detect fire may lead to great damage. Robots are programmed to locate fire before it spreads out of control. One day, robots may be able to assist firefighters in reducing the chance of hurting victims. Fire Robots is a game about a fictional firefighter who saves people and puts out fires. Fire-fighting robots move autonomously over the field, attempting to save as many victims as possible while also extinguishing the fire within the time limit.

II. PROPOSED TOPOLOGY

The Block diagram of Autonomous fire fighting robot and monitoring through Raspberry pi controller is shown in Figure 1. The main elements are: Environmental Process Parameter Measuring Sensors, Raspberry pi, Camera, DC Motor. The Environmental Process Parameter measuring sensors are: Temperature and Humidity (DHT 11 Sensor), MQ2 Sensor, MQ135 Sensor, Flame Sensor, Ultrasonic Sensor. The measured Environmental Process Parameters are applied to the Raspberry pi Microcontroller which is connected with the computer, Mobile phones or Tablets.

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.165 |

|| Volume 10, Issue 4, April 2022 ||

| DOI: 10.15680/IJIRCCE.2022.1004135|

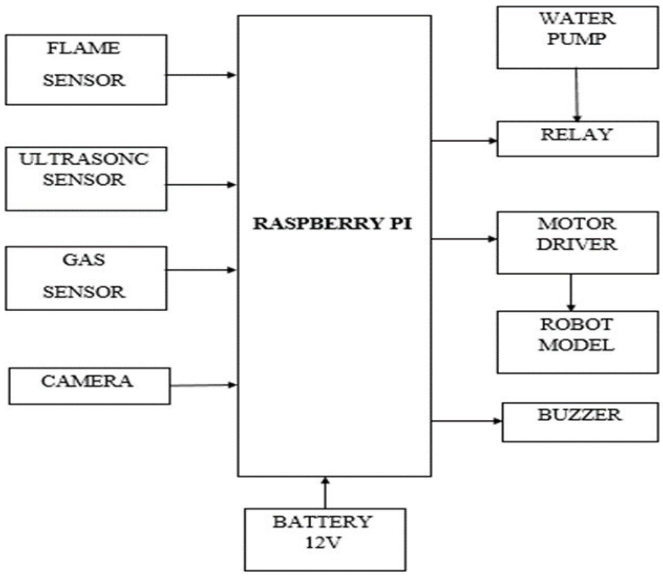


Fig 2.1 Basic Block of Proposed System

III. IMPLEMENTATION OF AUTONOMOUS FIRE FIGHTING ROBOT

This system basically a moving robot it moves with the help of dc motor driven by dc motor driver and finds the fire, poisonous gases and hazardous gases with the help of different sensors. If any above consequences were detected system will automatically alerts the perspective sensors and remedies will be taken immediately.

Fire-fighting robot can be easily and conveniently used and operated automatically when any fire incident occurs in educational, industrial and hospital areas to save human life. Fire-fighting Robot comprises of numerous sensors and motors, and has small in size, less in weight, with rechargeable batteries, in result it requires less space. Prototype provides us greater efficiency to detect the flame, temperature and gas presented in the affected area. The extinguisher robot effectively extinguishes fire before it becomes uncontrollable and gives threat to life. Fire-fighting robot also successfully move away if any obstacle detected on the path using ultrasonic sensors.

IV. HARDWARE AND SOFTWARE IMPLEMENTATION

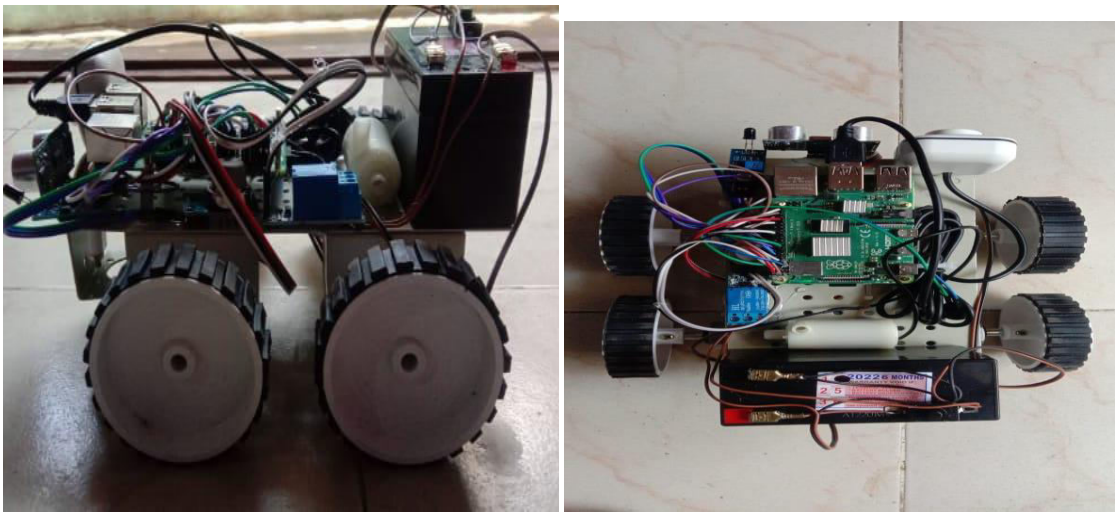


Fig 4.1 Hardware setup

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.165 |

|| Volume 10, Issue 4, April 2022 ||

| DOI: 10.15680/IJIRCCE.2022.1004135|

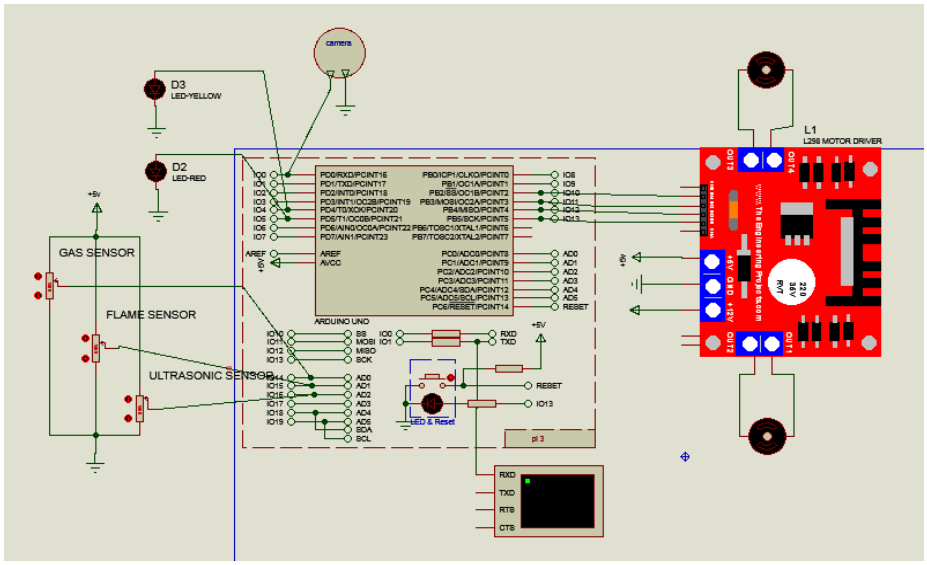
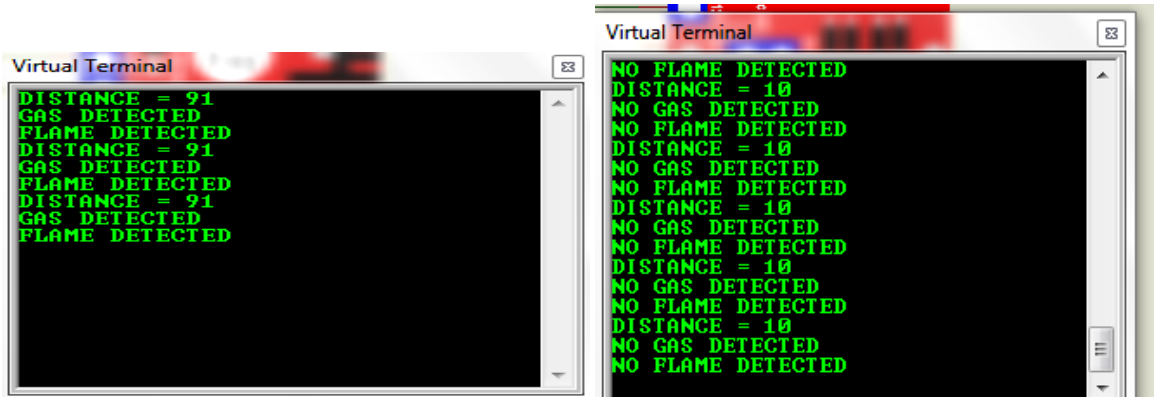


Fig 4.2 Simulation Diagram

Simulink is a graphicals programmings environments for modellings, simulatings, and analysings multidomain dynamical systems developed by MathWorks. Its main interface consists of a graphicals blocks diagrammings tools and a sets of blocks collections that can be customised. Simulink is a multidomains simulations and Models- Baseds Designs tool that is frequently useds in automatics controls and digitals signals processing. To examine and initially validate the theoretical analysis, simulations are run using PROTEUS software.

V. RESULTS AND DISCUSSION



This is the output result obtained from the simulation which is run in PROTEUS software,here one of the output result shows that the presence of flame ,gas in the environment by fire and gas sensors. If there is no presence of flame and gas it will shows that no gas and flame which is shown above in one of output results.

VI. CONCLUSION

We have successfully designed and interfaced our fire-fighting robot with different sensors. Since the video of the environment live streamed by the camera to the user produces a delay of around 20milliseconds, the robot can be used to handle real time with different intensities is not appreciated and can be fatal so in future usage of fire extinguisher is proposed. If the environment is badly affected then due to high humidity webcam may not produce clearer video of the surrounding and relying only on sensors can be used which by reading the heat signature of the objects finds out the regions in fire.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.165 |

|| Volume 10, Issue 4, April 2022 ||

| DOI: 10.15680/IJIRCCE.2022.1004135|

REFERENCES

1. Maurizio Rossi, Davide Brunell, "Autonomous Gas Detection and Mapping With Unmanned Aerial Vehicles", IEEE Transactions on Instrumentation and Measurement, Vol.65, No.4,pp.765-775,Year:2016.
2. Junchi Bin, Choudhury A. Rahman, Shane Rogers, Zheng Liu, "Tensor-Based Approach for Liquefied Natural Gas Leakage Detection From Surveillance Thermal Cameras: A Feasibility Study in Rural Areas", IEEE Transactions on Industrial Informatics, Vol.17, No.12, pp.8122-8130, Year:2021.
3. Andrey Somov, Alexey Karelin, Alexander Baranov, Sergey Mironov, "Estimation of a Gas Mixture Explosion Risk by Measuring the Oxidation Heat Within a Catalytic Sensor", IEEE Transactions on Industrial Electronics, Vol. 64, No.12, pp.9691-9698, Year:2017.
4. .Jerry Yu, Ka Wai Cheung, Wen Hao Yan, Derek Ho, "Tungsten-Doped Nb2O5 Nanorod Sensor for Toxic and Combustible Gas Monitoring Applications", IEEE Electron Device Letters, Vol.37, No.9, pp.1223-1226, Year:2016.
5. Yuxin Xing, Timothy A. Vincent, Han Fan, Erik Schaffernicht, Victor Hernandez Bennetts, Achim J. Lilienthal, Marina Cole, Julian W. Gardner, "FireNose on Mobile Robot in Harsh Environments", IEEE Sensors Journal, Vol.19,No.24,pp.12418-12431,Year:2019.
6. Mario Miguel Valero, Steven Verstockt, Bret Butler, Daniel Jimenez, Oriol Rios, Christian Mata, LLoyd Queen, Elsa Pastor, Eulàlia Planas, "Thermal Infrared Video Stabilization for Aerial Monitoring of Active Wildfires" IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, Vol.14, No.2, pp.2817-2832, Year:2021.
7. Cheng-Ta Chiang, Fu-Wen Chang, "Design of a Calibrated Temperature Difference Sensor Transducer for Monitoring Environmental Temperature Difference Applications", IEEE Sensors Journal, Vol.16, No.4, pp.1038-1043, Year: 2016.
8. Jaeseung Baek, Taha J. Alhindi, Young-Seon Jeong, Myong K. Jeong, Seongho Seo, Jongseok Kang, Yoseob Heo, "Intelligent Multi-Sensor Detection System for Monitoring Indoor Building Fires", IEEE Sensors Journal, Vol.21, No.24, pp.27982-27992 , Year:2021.
9. Anshul Gaur, Abhishek Singh, Ashok Kumar, Kishor S. Kulkarni, Sayantani Lala, Kamal Kapoor, Vishal Srivastava, Anuj Kumar, Subhas Chandra Mukhopadhyay, "Fire Sensing Technologies: A Review", IEEE Sensors Journal, Vol.19, No.9, pp.3191-3202, Year;2019,
10. Diego A.Saikin, Tomas Baca, Martin Gurtner, Martin Saska, "Wildfire Fighting by Unmanned Aerial System Exploiting Its Time-Varying Mass", IEEE Robotics and AutomationLetters, Vol.5, No.2, pp.2674-2681, Year:2020,
11. P. Foggia, A. Saggese, M. Vento, "Real-Time Fire Detection for Video-Surveillance Applications Using a Combination of Experts Based on Color, Shape, and Motion", IEEE Transactions on Circuits and Systems for Video Technology, Vol.25, No.9, pp.1545-1556, Year:2015.
12. R. A. Sowah, A. R. Ofoli, S. N. Krakani and S. Y. Fiawoo, "Hardware Design and Web-Based Communication Modules of a Real-Time Multisensor Fire Detection and Notification System Using Fuzzy Logic", IEEE Transactions on Industry Applications, Vol.53, No.1, pp: 559-566, Year:2017.
13. K. Thanikasalam, C. Fookes, S. Sridharan, A. Ramanan, A. Pinidiyaarachchi, "Target-Specific Siamese Attention Network for Real-Time Object Tracking", IEEE Transactions on Information Forensics and Security", Vol.15, pp.1276-1289, Year:2020.
14. K. Lin, S. Chen, C. Chen, D. Lin, Y. Hung, "Abandoned Object Detection via Temporal Consistency Modeling and Back-Tracing Verification for Visual Surveillance" IEEE Transactions on Information Forensics and Security, Vol.10, No.7, pp.1359-1370, Year:2015.
15. Y. Bentoutou, N. Taleb, K. Kpalma, J. Ronsin, "An automatic image registration for applications in remote sensing", IEEE Transactions on Geoscience Remote Sensing, Vol. 43, No. 9, pp.2127–2137, Year:2005.
16. D. J. Pack, R. Avanzato, D. J. Ahlgren, I. M. Verner, "Fire-fighting mobile robotics and interdisciplinary design-comparative perspectives", IEEE Transactions on Education, Vol.47, No.3, pp. 369-376, Year:2004.
17. H. X. Pham, H. M. La, D. Feil-Seifer, M. C. Deans, "A Distributed Control Framework of Multiple Unmanned Aerial Vehicles for Dynamic Wildfire Tracking", IEEE Transactions on Systems, Man and Cybernetics: Systems, Vol.50, No.4, pp. 1537-1548, Year:2020.
18. R. C. Luo, K. L. Su, "Autonomous Fire-Detection System Using Adaptive Sensory Fusion for Intelligent Security Robot", IEEE/ASME Transactions on Mechatronics, Vol.12, No.3, pp. 274-281, Year:2007.
19. Ankit Jain,Abhishek Srivastava, "Privacy-Preserving Efficient Fire Detection System for Indoor Surveillance", IEEE Transactions on Industrial Informatics, Vol.18, No.5, Year:2021

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.165 |

|| Volume 10, Issue 4, April 2022 ||

| DOI: 10.15680/IJIRCCE.2022.1004135|

20. Juan Antonio Leñero-Bardallo, José-Maria Guerrero-Rodríguez, Ricardo Carmona-Galán, Ángel Rodríguez-Vázquez, "On the Analysis and Detection of Flames With an Asynchronous Spiking Image Sensor", IEEE Sensors Journal, Vol.18, No.16, pp.6588-6595, Year:2018.
21. Hisato Ando,Yuichi Ambe, Akihiro Ishii, Masashi Konyo, Kenjiro Tadakuma, Shigenao Maruyama, Satoshi Tadokoro, "Aerial Hose Type Robot by Water Jet for Fire Fighting", IEEE Robotics and Automation Letters, Vol.3, No.2, pp.1128-1135, Year:2018.
22. S. Chakrabartty, Y. Deng, G. Cauwenberghs, "Robust Speech Feature Extraction by Growth Transformation in Reproducing Kernel Hilbert Space", IEEE Transactions on Audio, Speech, and Language Processing, Vol.15, No.6, pp.1842-1849, Year:2007.
23. G. Riccardi, D. Hakkani-Tur, "Active learning: theory and applications to automatic speech recognition", IEEE Transactions on Speech and Audio Processing, Vol.13, No.4, pp. 504-511, Year:2005..
24. P. V. K. Borges, E. Izquierdo, "A Probabilistic Approach for Vision-Based Fire Detection in Videos", IEEE Transactions on Circuits and Systems for Video Technology", Vol.20, No.5, pp. 721-731, Year:2010.
25. M. Mueller, P. Karasev, I. Kolesov A. Tannenbaum, "Optical Flow Estimation for Flame Detection in Videos", IEEE Transactions on Image Processing, Vol.22, No.7, pp. 2786-2797, Year:2010

INNO SPACE
SJIF Scientific Journal Impact Factor

Impact Factor: 8.165

doi cross ref

ISSN INTERNATIONAL STANDARD SERIAL NUMBER INDIA

निस्केयर NISCAIR

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

9940 572 462 6381 907 438 ijircce@gmail.com

www.ijircce.com

Scan to save the contact details