Available online at www.sciencedirect.com

ScienceDirect

Procedia Manufacturing 35 (2019) 1129–1134

Procedia MANUFACTURING

www.elsevier.com/locate/procedia

2nd International Conference on Sustainable Materials Processing and Manufacturing (SMPM 2019)

An Android Based Mobile Robot for Monitoring and Surveillance

Azeta J*[a], Bolu C.A[a], Hinvi D[a], Abioye A.A[a], Boyo H[a], Anakhu P[a], Onwordi P[a].

[a]*Covenant University (CU), Km 10 Idiroko Road, Ota; Ogun state, Nigeria*

Abstract

We developed a sustainable surveillance robot that is cost effective using an Arduino microcontroller together with a motor shield and an Android smartphone that runs the Operating System. The robot consists of a video camera and wifi robot link. Smartphones come with superb hardware that satisfies the above needs. This can be leveraged upon through the use of APIs (Application Programming Interfaces) that is provided for the operating system. However, the building cost for the robot with a smartphone is greatly reduced. The robot can be remotely controlled using the wifi module and a microcontroller, smart phone interface embedded on the robot. The camera on the robot is used to capture and record real time video from the robot. The robot can be controlled based on visual feedback from the same smartphone. The four wheeled dc motors help to navigate the robot and ultrasonic sensor to avoid obstacles. The camera is attached to the wifi robot link which enables it to capture the environment or any object of concern. Experimental results with varied positions of obstacle show the flexibility of the robot to avoid it and have shown a decent performance and it is getting a communication range of nearly 50m, which is good enough for many surveillance applications.

Peer-review under responsibility of the organizing committee of SMPM 2019.

Keywords: Android; Arduino; Microcontroller; Motorshield; Surveillance robot

1. Introduction

Surveillance systems are broadly received in general society zone, for example, airplane terminal parlors, bookshops, parking areas, and so on. What they are most concerned about is strange practices of one individual or the group. In the family unit, understanding of human occasions is likewise essential, the observation robot can be

*Corresponding author
Email: joseph.azeta@covenantuniversity.edu.ng Tel: (+234 7066337674)

2351-9789
Peer-review under responsibility of the organizing committee of SMPM 2019.
10.1016/j.promfg.2019.06.066

utilized to help the elderly live more securely and care for children all the more helpfully. Furthermore, there are constantly some settled relatives who live in the house, so when no one is at home, the observation robot can be useful to tell who is invited into the house. The surveillance robot needs to get a few insights into a specific end goal to find where the individual is. Indications ought to have solid associations with the presence of the individual, and one of the dependable clues is the acoustic data. The observation robot utilizes anomalous sound discovery to find the interlopers. A few ventures have been done to conquer the issue and one of the essential thoughts is building up a reconnaissance portable robot. Mobile base promises additional flexibility to end user in new applications [1], [10]. A few related works are discussed.

1.1. A Wireless Mobile Robot Using Arduino

Wireless robot systems developed exploitation the Arduino microcontroller are enforced, however wireless communication between mobile and mobile is by Zigbee protocol, that limits the coverage vary of the robot [2]. A robot that performs image process utilizing the camera on associate degree android smartphone has additionally been developed. However, this model is delimited by the ability backup of the mobile, a problem that we have attended by remotely acting and imaging process operations on associate degree computer, succeeding transmission of the camera's feed [3]. The proposed system distinctive is exclusive within the sense that it is unique within the sense that it is a low-priced answer that many remotely manage a robot from any vary (by exploiting the internet) and additionally offers the live videos transmission. There is no constraint on any further process as everything is finished from a distant location [4].

1.2. Web-Based Embedded Robot for Safety and Security

In this project, an Adriano based robot is designed which uses blue tooth technology to control robot and Wi-Fi network to transmit the video. In this system, the robot and controller both should be in Loss (Line of Sight) to control the robot. The range of Bluetooth is very limited when compared to the Wi-Fi network, the controller can't move away from the region [5].

1.3. Radio Frequency Controlled Surveillance Robot

These robots are specially designed for mining accidents, earthquake disasters, and hostage situations. Many groups of researchers have developed surveillance robots with the ability to conduct emergency search and rescue work using robots, [6] presented 'Robot-Assisted Emergency Search and Rescue System with a Wireless Sensor Network', [7] presented 'Mobile Rescue Robot for Human Body Detection in Rescue Operation of Disaster'. [8] presented 'Design and Implementation of e-Surveillance Robot for Video Monitoring and Living Body Detection' and [9] presented 'Surveillance Robot Using Arduino Microcontroller, Android APIs and the Internet'. All of those researchers are based on gas sensor, LDR & metal detector to detect a bomb, PIR to sensor human movement to detect human alive or dead, LM35 to detect temperature, Distance sensors, Compass & communicating over Zig-Bee, RF & internet. By detecting human body temperature wirelessly, the system can identify whether the human is alive or dead.

2. Methodology

HINVO's surveillance system consists of an android device and a robot. The robot is controlled by a remote operator via the wifi module. The robot comprises of an Arduino microcontroller to control the robot's motion, an android smartphone running the Android operating system, and the required hardware such as chassis, motors, power supply, etc. The remote operator controls the robot via sending control signals to the smartphone which are then forwarded to the Microcontroller, which then navigates the robot in the direction desired. The camera on the smartphone sends video feedback to the remote operator concurrently over the internet as a result the operator is able to navigate the robot from a remote location. A visual representation is shown below in Figure 1.

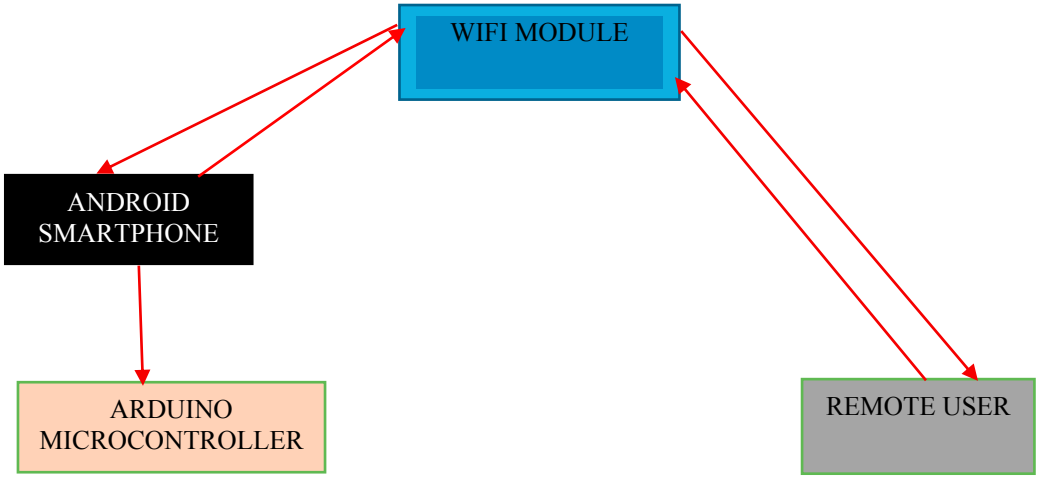

Fig. 1. Schematic configuration

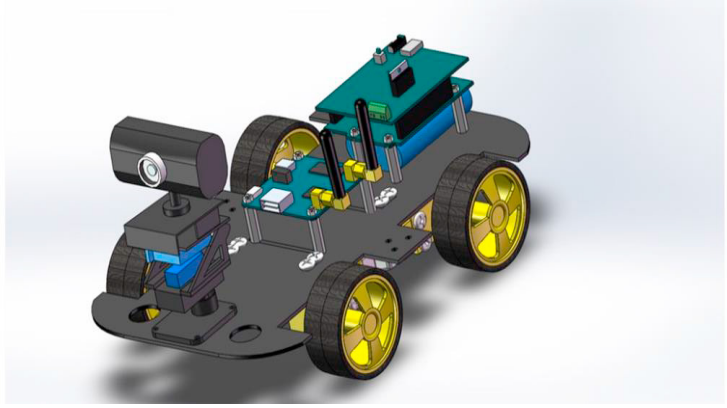

Fig. 2. 3D HINVO surveillance robot

2.1. Robot working principle

The implementation of the system was achieved using Arduino microcontroller. This model utilizes a Wi-Fi module Robot link V4.0, an Arduino motor shield driver which controls the robot through the geared dc motors. One of the advantages of this is that the operator can control the movement of the robot through the live video seen using the mobile robot control platform. The Arduino is powered by a 7.4V, 2400mAh lithium polymer battery, which sends sizeable current to the dc motor for its movement and also powers the Wi-Fi module for visual transmission and recording of data which also send current to the servo motors for tilting the robot camera module for optimum visual.

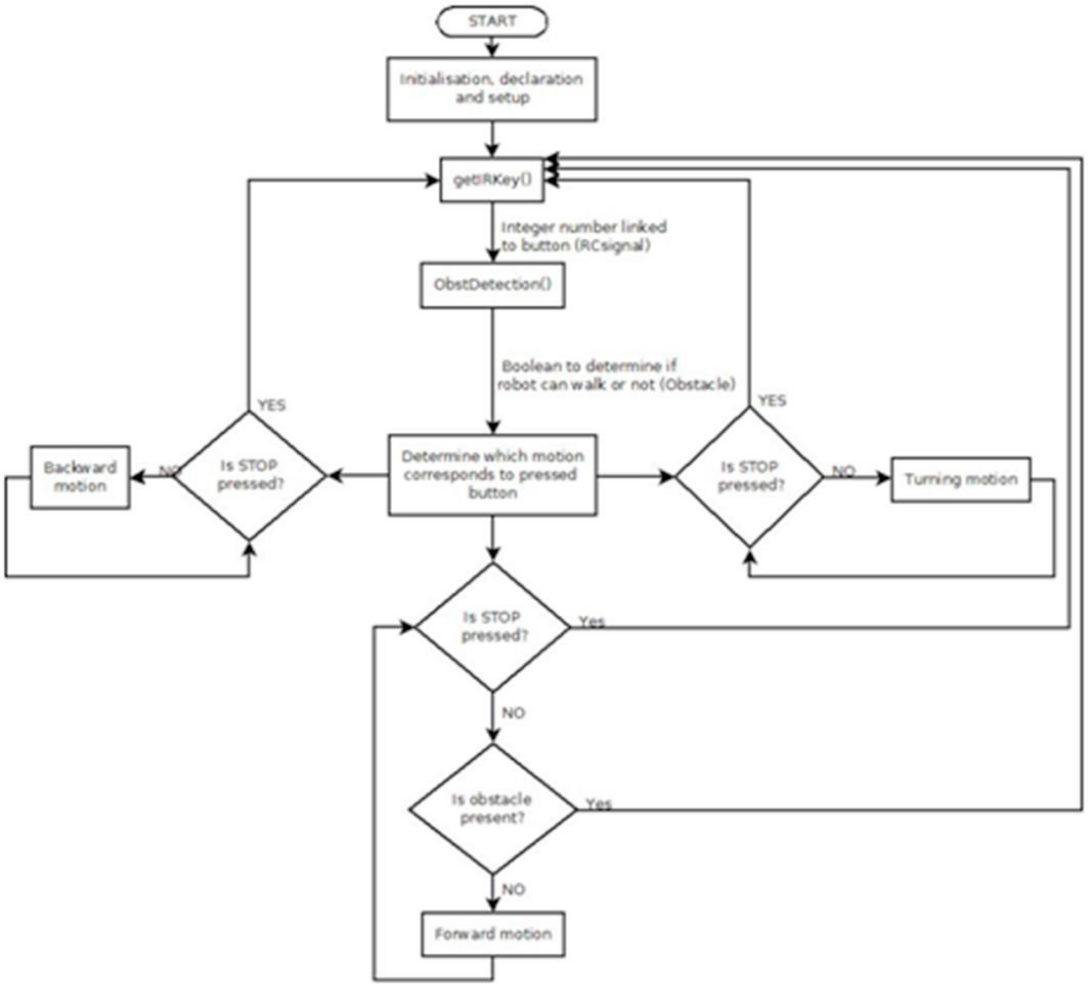

Fig. 3. Flow chart of working HINVO robot

3. Results and Discussion

Experimental results with varied positions of obstacle show the flexibility of the robot to avoid it and have shown a decent performance and it is getting a communication range of nearly 50m, which is good enough for many surveillance applications. The results of the implemented robotic system are shown in table 1. Our method for surveillance robot named HINVO has been with success enforced and it has shown an honest performance in our laboratory. The drive wheel is furnished with shaft encoders utilized for odometry mensuration. One ultrasonic sensor prevailing to see and experience the space of obstruction constantly. We have executed the calculation depicted in the above areas in our framework utilizing C++ and Arduino IDE. The after effect of video gushing with confront acknowledgment capacities utilizing Robot-Link 4.0 and transmitted using 2.4GHz.

The robot is additionally ready to acknowledge victims before it, the sensing element system is extremely low-cost as a result of it solely uses one distance sensing element.

Accuracy = (number of successful avoidances)/(number of test cases)

Table 1. figures the common precision of the robot once tried against the fluctuated environment.

Table 1. Avoidance Accuracy.

Environment	Obstacle Type	Detect Avoidance	Accuracy	Percent
Well-lit	Single solid obstacle	Yes	High	100%
Dimly-lit	Single solid obstacle	Yes	High	100%
Well-lit	Uniformly shaped surface	Yes	High	100%
Dimly-lit	Uniformly shaped surface	Yes	Low	40%
Well-lit	Double solid obstacles	Yes	High	75%
Dimly-lit	Double solid obstacles	Yes	High	70%
			Average	80.83%

Accuracy Range	
Extremely Sharp	80-100%
Slightly sharp	60-79%
Sharp	50-59%
Not sharp	0-49%

4. Conclusion

The android based mobile robot is a cost-effective solution for many surveillance applications. The mobile robot will accomplish tasks such as navigating the environment safely for monitoring and surveillance purposes that may be strenuous for humans in some special cases. Experimental results with varied positions of obstacle show the flexibility of the robot to avoid it and have shown a decent performance and it is getting a communication range of nearly 50m, which is good enough for many surveillance applications. This project developed is an android based mobile robot for surveillance. The robot developed on the Arduino platform for processing and its software package counterpart helped to speak with the robot to send parameters for surveillance and monitoring. It also has the obstacle avoidance ability; ultrasonic distance sensing element was accustomed to offer a large field of detection. The robot is remotely controlled and also has an autonomous mode, once, in the autonomous mode, the initial loading of the code needs no user intervention throughout its operation. When it is placed in an unknown environment with obstacles, it was found to avoiding all obstacles with significant accuracy. The robot is controlled

with any android gadget according to client accommodation. It might likewise be used in places like workplaces, homes and so forth since it is fantastically low esteem and open to any person.

Acknowledgement

The Authors are grateful to Covenant University for publication support

References

[1] Azeta, J., Bolu, C., Abioye, A., Festus, O. A review on humanoid robotics in healthcare. MATEC Web Conf., 153 (2018) 02004
[2] Pramod P.J, Srikanth S.V, Vivek N, Patil M.U, Sarat C.B. Intelligent intrusion detection system (In2DS) using wireless sensor networks. In2009 International Conference on Networking, Sensing and Control 2009 Mar 26 (pp. 587-591). IEEE.
[3] Liu, L, Xiaorui Z, Yi Tang. "Indoor surveillance robot controlled by a smart phone." Robotics and Biomimetics (ROBIO), 2013 IEEE International Conference on. IEEE, 2013.
[4] Ersahin, G, Herman S. "Wireless Mobile Robot Control with Tablet Computer." Procedia-Social and Behavioral Sciences 195 (2015): 2874-2882.
[5] Ramya, V., Palaniappan, B. "Web based embedded Robot for safety and security applications using Zigbee." International Journal of Wireless & Mobile Networks 4.6 (2012): 155.
[6] Ko, A, Lau, H.Y. Robot assisted emergency search and rescue system with a wireless sensor network. International Journal of Advanced Science and Technology. 3 (2009), 69-78.
[7] Bhondve, T.B., Satyanarayan, R., Mukhedkar, M. Mobile rescue Robot for Human body detection in rescue operation of disaster. International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering. 3(6) 2014: 9876-82.
[8] Dixit DS, Dhayagonde MS. Design and implementation of e-surveillance robot for video monitoring and living body detection. International Journal of Scientific and Research Publications. 4(4) 2014: 2250-3153.
[9] Kulkarni, C., Grama, S., Suresh, P.G., Krishna, C., Antony, J. Surveillance Robot Using Arduino Microcontroller, Android APIs and the Internet. In2014 Proceedings of 2014 First International Conference on Systems Informatics, Modelling and Simulation 2014.
[10] Azeta, J., Okokpujie, K.O., Okokpujie, I.P., Osemwegie, O., Chibuzor, A. A Plan for Igniting Nigeria's Industrial Revolution. International Journal of Scientific & Engineering Research, 7(11), 2016 p.489.