

An Unmanned Surface Vessel for Non-Combat Military Operation over Resource Constrained Networks

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ABSTRACT: The modern civilization solely depends upon the upgrading technology for everyday life. This advancement in technology has brought revolution in a lot of fields such as medical, agriculture, meteorological, warfare etc. This paper proposes a spy robot for the use in the field of modern warfare. The robot contains raspberry pi which acts as a client, video camera for live video streaming, an ultrasound sensor for distance measurement and mapping and gripper for disposal of explosives, Wi-Fi module for controlling the robot remotely by internet. A server is also created to which a number of such clients are connected. Apart from the server an android application is also developed through which all the connected clients can be controlled remotely. Due to the unique facility of controlling the connected robots remotely, the controller can sit far away from the hazardous site without risking any human lives. The operator can visualize the path of each robot connected to the server due to the presence of video camera which provides live feed of the surroundings. Due to such unique feature enemies can be spotted and necessary precautions can be laid down saving a lot of human lives.

KEYWORDS: spy camera, disposal of explosive, wireless control, localization and mapping.

I. INTRODUCTION

The rise of internet communication in the robotics industry has brought an evolution which in turn making technology more sophisticated. In this paper the proposed prototype uses the same Wi-Fi network for communicating with the robot. In the recent scenario a lot of terrorist activities such as bomb blasting, killing civilians etc. are taking place and the military forces are losing a lot of men in the combat with the terrorist or while disposal of explosives. All these casualties can be made minimal with the proposed prototype.

The ways by which these casualties can be made minimal is discussed in the later part. Earlier Radio Frequency (RF) was used for wireless communication, for making spy robot for military purpose [1][2][7][13]. Due to such up-gradation in the field of robotics, these are also used for the purpose of surveillance and are controlled through Bluetooth [3][4][8]. The field of robotics also provides human security. There are robots to which sensors are connected, such as gas, smoke etc. and got a feature of guiding itself to the predefined location by avoiding obstacles in its path for rescue missions [5][11]. There are a lot of casualties in the battlefields due to landmines. The field of robotics provides a solution to this by detection of landmines through robots, decreasing casualties to zero [6]. Introduction of 2D mapping in spy robot is a special feature as it helps to map suspicious buildings and places where probable terrorist activities may take place [9]. The use of Arduino in spy robot is another up-gradation in the field of robotics [10]. A prominent up gradation in the robotics industry is the gesture controlled

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spy robots. These robots can be controlled by simple human gestures, reducing the complexity of controlling through physical devices [12]. The multi modal and multi controlled spy robot is another breakthrough in robotics industry. In this type of robots multiple modalities can give command to the robot [14][15].

In this paper, a prototype of smart spy robot is developed which can be controlled remotely from anywhere of the world. The only thing required is an internet connection or Wi-Fi network. The developed prototype contains raspberry pi which act as a client, web camera for live video streaming, ultrasound for obstacle detection and 2D mapping and gripper for disposal of explosives. The command to control the designed prototype is processed to the spy robot through an internet connection using Wi-Fi network. Unlike the Bluetooth a Wi-Fi network is used due to enhancement of the range of operation. The prototype designed is a functional model with a good efficiency. The rest of the paper is organized as follows: the architecture is presented in section 2, the operation of the spy robot is discussed in section 3, the result and discussion is presented in section 4 and finally concluded in section 5.

II. SYSTEM ARCHITECTURE

The designed prototype spy robot consists of a number of control mechanisms. The block diagram in fig. 1 shows the whole architecture of the developed mobile spy robot. The architecture of the mobile spy robot is divided into two parts. They are as follow.

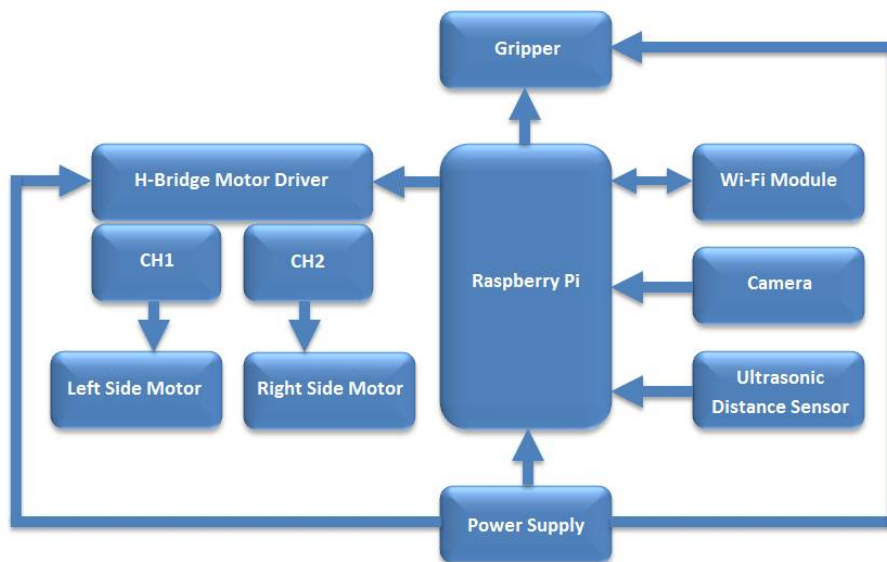


Fig.1.The Block Diagram of Proposed Unmanned Surface Vessel for Non-Combat Military Operation.

A. Hardware Implementation:

According to the block diagram alongside, the mobile spy robot consists of a raspberry pi which acts as a client in the developed prototype. The raspberry pi B+ model is used in the developed prototype. The raspberry pi is used instead of Arduino because of the high processing power, due to which the response time of the robot decreases. Another reason is that the prototype involves processing of a large python script, which can be easily stored in the raspberry pi. The accessing of Wi-Fi and Ethernet in raspberry pi is simple, therefore making the spy robot smoothly in a secured network. The movement of the mobile spy robot is controlled by H-bridge motor driver. The mechanical gripper present is used for disposal of explosives as it can rotate at an angle of 360 degree. The camera attached at the

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top the mobile spy robot is used for live streaming of video data. The ultra sound sensor present is used for 2D mapping and localization and the Wi-Fi module for controlling the spy robot. The designed spy robot can be controlled over the internet if internet connection is present. The working prototype of developed vessel is shown in figure 3.

B. Software Design:

The software part in the architecture constitutes the server and the developed android application for controlling the developed spy robot prototype. An AWS server is created forms the backbone of the whole system of the mobile spy robot. After the creation of the server a web page is designed with the help of PHP programming. To control the spy robot, the user needs to provide user id and password. After successful login from the authorized user the developed spy robot can be controlled along with all its functions. An android application is also developed through which only the movement of the mobile spy robot can be controlled remotely. For multi-function the user needs to use a web browser.

III. WORKING OF ROBOT

The developed prototype of the mobile robot can be operated remotely. This unique feature of controlling the robot remotely is due to the presence of Wi-Fi module in the designed prototype. Unlike the Bluetooth module, the range for connectivity and data transmission is expanded significantly. The designed prototype can operate over the internet if an internet connection is available. A socket is created through which the transmission of data and command takes place. The protocol used for transmission of data is http protocol. After successful login from a web browser, a user home page appears in which buttons for multiple functions are situated. The figure 2 below shows the entire network architecture for implementing unmanned surface vessel for non-combat military operation.

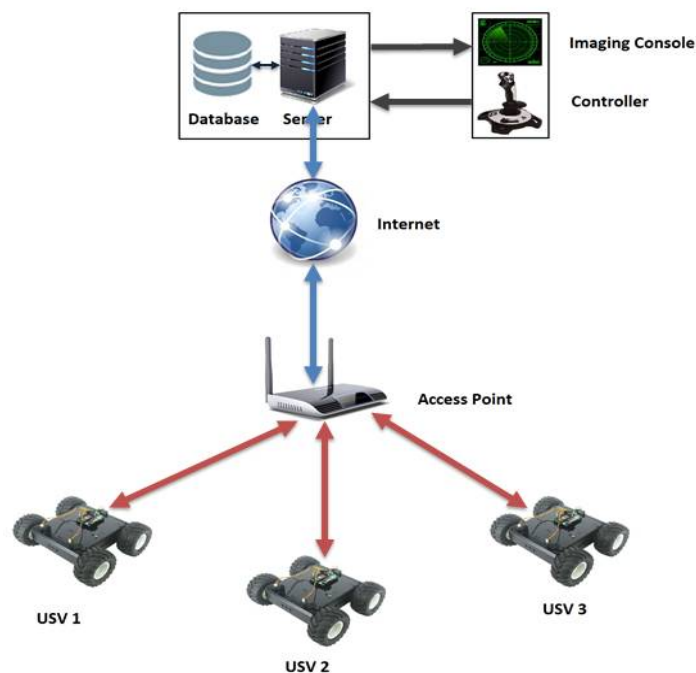


Fig. 2.The Network Architecture for Implementing Unmanned Surface Vessel (USV) for Non-Combat Military Operation.

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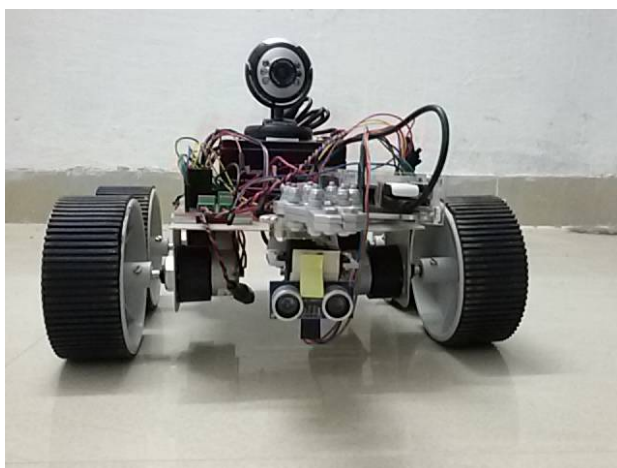
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The user or the handler of the robot connected to the web server can see the live video feed of the robot in the web browser and can control accordingly. The ultrasound sensor on the other hand keeps making 2D mapping of the surroundings. The gripper present can be opened and closed according to the command it receives from the user. The movement of the developed robot is controlled by H-Bridge motor driver i.e. moving left or right or to rotate. The Android application developed for controlling the robot needs to be installed in the smart device of the authorized user. After successful installation, the user needs to provide user id and password. Only after successful login the designed prototype can be operated remotely.

IV. RESULT AND DISCUSSIONS

The developed prototype of the robot holds the key feature of remotely controlling the robot due to the presence of Wi-Fi module. The controlling of the robot is flexible as it can be controlled through web browser as well as through the developed android application.



(a)



(b)

Fig.3.Design prototype of Unmanned Surface Vessel for Non-Combat Military Operation over Resource Constrained Networks (a) front view and (b) side view.

The above figure 3 shows the mechanism followed in the movement of the designed multipurpose robot. Apart from Wi-Fi connection the designed prototype can be controlled over the internet if a connection is available. Due to the use of raspberry pi instead of Arduino, the problem for memory and storage is zero as memory can be expanded according to the need of the user. For transmission of data http protocol is used. Along with the http protocol, a socket is created through which transmission of data from the client to the server takes place. The presence of ultrasound sensor, gripper, and camera makes the designed prototype a multipurpose robot other than spying. Therefore the designed prototype is a complete functional model providing a good efficiency.

V. CONCLUSION

The developed prototype has been proved to be a multipurpose robot with a complementary function of border security and surveillance. The robot seems to have reduced the human casualties in a significant manner in the military as well as in the civilian section of our society. The quality of the transmitted video is of high quality providing crystal clear image of the surrounding of the robot. The ultrasound sensor used provides accurate 2D mapping of the surroundings of the developed multipurpose robot. All the components attached are functional providing high accuracy

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of data to the user. The controlling system of the robot is kept simple and user friendly with minimal complications. Therefore the whole system is economical providing good efficiency in all aspect. For future work, more sensors such as temperature, gas, humidity, metal detector can be attached so that it can be used in fields such as meteorological, agriculture, household other than military.

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