

Design And Development Of Surveillance Robot

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ABSTRACT: This paper proposes how to design and implement a surveillance robot to be controlled without use of external source i.e. without presence of human near the robot. The main purpose of the robot is to move in a given environment while transmitting back the live data/video to the controller through the internet connection. This real time data is useful for the controller to navigate the robot in and around the given environment. The robot used here is for the military purposes. The robot is used to spy the terrorist attacks and it is also used to detect the harmful gases present around the military surroundings in the further scope. The entire processes of detecting the terrorist's attacks were handled with the beagle bone black board and the camera along with the wireless connectivity. The controlling and the movement of the robot are processed through the wireless connection in the webpage through the internet.

Keywords: Beagle Bone Black board, Camera, Robot, Object detection, Data Streaming, Wireless communication.

I. INTRODUCTION

Introduction to Proposed System

Now- a-days industries are becoming modern and they automated the technology to perform various risky jobs. This robot is helpful to minimize the life risk of the humans and the animals. With the advance technologies of the wireless communication technology in robots there can be an autonomous robot car which will be controlled manually. Surveillance is the process of continuous monitoring of the territory which is essential for military security. Here the robot is controlled by using internet in PC or Android mobile phone through the webpage. And the camera present to the robot captures the data and sends the data to the controller through internet. An computerized surveillance robot is used for safety-conscious which includes at airports, museums and government installations and so on. The wise software should reveal security cameras and detects if any difficult

behaviour takes place. Having an automatic surveillance robotic vastly increases the productivity of the human operator and increases coverage of the surveillance so that human can do best the operation or navigation of robot alternatively getting damage in the wars. Automatic surveillance robot in movement captures the stay video i.E., imparting computer-generated imagery of sensible movement, presently requires the use of a motion-capture system which can store the precise movement of a human frame using visible or radio markers. A surveillance robot is an intelligent device which does not have any particular design or a device which can perform only a particular task. The design of the robot can be changed according to the task to be performed in a particular area. Initially, a robot comprises a mechanical structure such as a wheeled platform, arm, or other construction capable of interacting with its environment. A surveillance robot is designed to help humans in almost every relevant or irrelevant task where the ease of use will be made less struggles to the human. In military, the surveillance robot is used in order to reduce the human death rate. Robot can perform even a hard or heavy or risky task easily as per the design of the robot.. The main thing is that it is not possible to humans to go any area they want. Human access is restricted in certain blocked off place. Moreover, loss of life is also main reason in the case of getting caught in the adverse territory. With the recent advances in the technology, the dangerous task of surveillance is performed by the robots instead of humans without any damage to human life. With the few chances of human loss , several surveillance robots have been developed all around the world till date.

Embedded Systems

Embedded Systems are defined as the way in which the performing of tasks, working of the system, or organizing one or multiple tasks according to few fixed sets of rules or an arrangement, in which all the units work together according to the given program of the task. These embedded systems are gaining significance because the range of structures use embedded processors, disk drives, RAM, and networks. Embedded structures range in length from simple small-scale tasks and mini-robots to big-scale systems deployed in technique manage, production, power era, defense systems, telecommunication systems, air traffic control, automotive systems, video-on-call for and video conferencing structures. In this project the embedded platform decided on the Beagle Bone Board.

Revised Manuscript Received on April 07, 2019.

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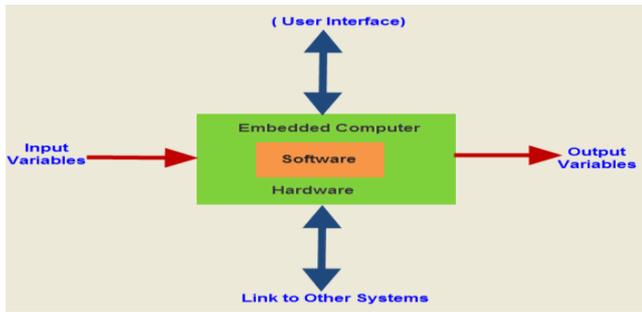


Figure 1: Embedded Systems

Beagle Bone Black

Beagle bone black is a sized as a credit card size and the board size expandable which is worked on Linux computer and connected with the Wi-Fi and it runs the software that is present in the OS of the beagle bone. It uses the Sitara AM 335x ARM Cortex A8 processors with a single cable. It uses the TI AM3358/9 SoC based on an ARM Cortex-A8 processor core using the ARMv7-A. It has storage and external SD card can also be added. It has 512 MB DDR RAM. It can manage android, UBUNTU, minix, risc OS etc. The OS installed in the project is Debian OS. The Beagle Bone has 65 pins of GPIO capability which is more suitable than the Raspberry Pi. Beagle Bone's capabilities with LED, LCD screens, motor control and battery power. It has the capability of creating its own circuits as per the project. In Beagle Bone there is no special cable that can fit the 5V connector. There are two ways to supply power to the board. The first is through the USB connection. Connecting the micro-USB connector cease of the cable to the board of connecting the standard sized USB connector to both a PC or a well matched DC strength supply that has this type of connection there may be every other option to power the board.



Figure 2: Beagle Bone Black

II. LITERATURE SURVEY

The authors Gaurav S Bagul et. Al proposed a gadget in 2018 to layout and put into effect a manually controlled IOT based Surveillance Robot. The foremost reason of the

robotic is to transport in and around the given environment while transmitting returned stay video to the floor station over the internet or Wi-Fi. This stay facts can then be used by the controller to move the robotic round. In this proposed system, the robot itself-contained with wireless transmission of information. This device will help to manipulate/spy at the terrorist assaults at some stage in the arena via tracking and manage of robot through the internet with the Raspberry Pi board. The monitoring and controlling of robot actions are navigated thru the wireless network by using the use of an internet-primarily based server and additionally storing the information and cloud and ship back to the group and we can retrieve the statistics from cloud [1]. In [2] Shubham Mittal and Jayendra Kumar Rai proposed device is a Wadoro an autonomous mobile robot for household surveillance in open-spaces like roofs in the course of night and shaded regions in day-time. This robot has the capability of detecting humans close to real-time round the clock using PIR sensors and digi-cam. The robot cycle is divided into 5 stages i.e., human detection, tracking, reputation and alert-generation with alongside the segment of self-safety. After detection of a human, it starts tracking to come across the face using a set of rules they used in the challenge after the subsequent popularity is performed using the nearby binary sample histograms method to Human face and if the face matches with the face in database and after the mismatch it offers an alert inside the form of smart phone call to the mobile smart phone of the consumer. Self-protection ensures the collision-unfastened actions of the robots and then prevent it from being stolen with the aid of generating an alert name on detecting its choose up from the ground. The challenge proposed by explained by means of Ashish U. Bokade and V. R. Ratnaparkhein [3] approximately the procedure for controlling a robot within the surveillance the use of an cellular application that's constructed through the android platform. This android application opens a web page which shows the stay streaming video display and the approach of controlling the robotic of which and the total machine is developed in the raspberry pi module. Android clever telephone and the raspberry pi board were connected thru the Wi-Fi and this android clever cell phone sends a commands which have been received by way of the raspberry pi and in step with our position which way we need to head give the instructions to the raspberry pi thru our clever phone and we are able to see video live streaming via our telephone and we can recognise the item and people are within the filed this could be used specially inside the navy software. The paper offers with the layout and implementation of cell robotic of the 3 subsystems. The obstacle avoidance, face recognition and detection leakage of combustible gases are the three subsystems of the mission. In the first subsystem of the task, an implementation of a synthetic neural network on area programmable analog array has been used to control the movement of the robot so that it may stumble on the boundaries being happened in among. In the second subsystem the robotic recognizes the face. The third subsystem uses MQ4 sensor to discover the leakage of dangerous gases in the environment which is used to implement the proposed subsystem in [4]



This robot is used to able to climbing all the surfaces like a horizontal and vertical surface areas and also imparting the controlling the consumer with the surveillance in their area. This model is used for the shooting the real time snap shots and on-line video streaming and audio streaming in-order to provide the surveillance over a field or the individual or the place in which the robot must display. Raspberry pi processor is used to govern the robot through the wi-fi verbal exchange community for a statistics processing and transmission and this is beneficial for in navy programs like tracking a person or region and the vicinity of interest and to help to offer the tactical advantages in struggle filed [5].

The framework is reconnaissance at faraway and unstable zones which had been utilizing the multifunctional robot depended on the modern generation and innovation utilized in safety and the one-of-a-kind navy applications were held. This mechanical automobile has capability to substitute the soldier at risky zones to present reconnaissance. The robotic car works each as self-enough and physically controlled robot using the webpage as correspondence medium. This multi robot used to pick out human, bombs, dangerous gases and hearth at far off and war discipline zones. Customarily, far off safety robot obsolesces due to confined recurrence range and restrained guide manipulate. These impediments are surmounted through making use of 3G innovation which has boundless variety. This framework additionally improvements the use of sustainable asset of robot with the aid of outfitting with solar-orientated board. A self-governing robot was controlled through ultrasonic sensor and infrared sensors. Whereas the Manual assignment became managed by using DTMF decoder and cellular phones applied as camcorder by way of introducing modern-day 3G video call technology and changed the manner of robot as indicated via continuous facts of encompassing. This paper likewise outlines the exploratory consequences of tilt side willpower of solar-orientated board of the guide robotic and strength utilization in programmed and manual mode. This mechanical robot is intended for statement and reconnaissance in particular situations is proposed through Kaur and Dilip Kumar in [6].

This mission offers with the wi-fi robot which gives the stay stream of video statistics, takes and save the photos and stay video statistics. The robot turned into managed via a nearby Wi-Fi server by means of a web utility. The main goal of the challenge is to broaden that may perform the more than one duties and cost effective. In this version they are used the Arduino Uno microcontroller and the 2 android phones to discover the audio and video for sending and receiving the information and the NodeMcu ESP Module for wi-fi connection to the robot [7].

III. METHODOLOGY

First, we have to make a robot by Node MCU through which the web page and the beagle bone black board microprocessor connects to the power supply. By using USB cabled camera module connected to the beagle bone black

board and it shows the live streaming data in the system through the internet. It can give only online live streaming depending upon that we can navigate the motion of the robot. In our project we have used an 18megapixel camera for the image processing of the data through the web page and in the webpage, we will have the live streaming data and we can control the robot in the webpage.

Here, the Beagle Bone Black works with an operating voltage of 5v. The USB Camera is enabled with the USB host to give an input to the Beagle Board-xM processor. The operation of the Beagle Board-xM processor is to compress and quality image for determining the motion of the camera filed and then displayed on webpage.

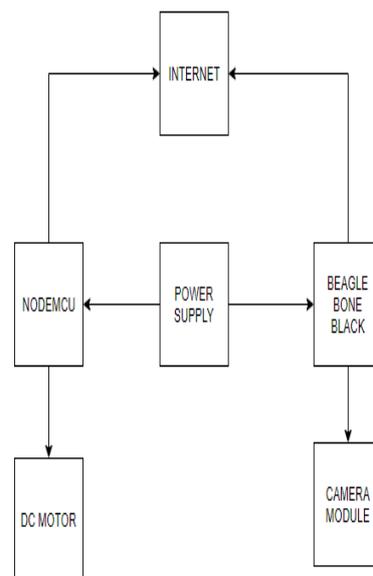


Figure 3: Block Diagram Surveillance Robot

Surveillance is defined as an automatic venture which has a new approach name Robotic surveillance. The first surveillance robotic that is used for security cause changed into “Mobile Detection Assessment and Response System”. In that first assignment of surveillance robotic, the paintings performed by means of the robotic is detecting and responding thru the mobile Smartphone. Now these surveillance robots are being used in military and safety functions. Basically, the surveillance robotic is not anything but the ordinary robot with the navigation, responding and having mechanism in conjunction with a few camera, thermal sensors and the communication systems. To get the accurate navigation the servo cars are used in robot.

Characteristics

The characteristics of the surveillance robots are mainly implemented in the project on which the whole robot module is implemented.

Sensing: The robot has capable to sense its surroundings. Here, the robot moves in and around the given environment on its wheels with the application of the DC motor.

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Adaptability: In the surveillance robot, the robot may need to perform many tasks at a time. With the adaptability feature in the robot, it can perform tasks in the surveillance area like detecting the harmful gases, human face detection, metal detection, triggering an enemy etc.

Energy: In order to carry out the actions inside the surveillance vicinity, the robotic has functionality to strength itself. The robot can power itself in many approaches like being solar powered, electrically powered and battery powered.

Intelligence: The programming or the coding centre will be taken place at the robot where it uses its intelligence. The intelligent programmable work will be done ‘smart’ with the robot.

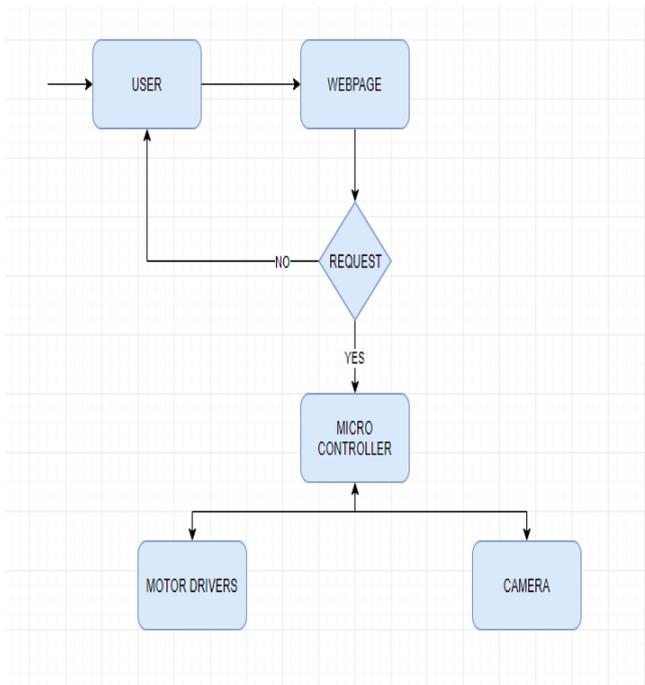


Figure 4: Flowchart

Camera Module

All existing IP cameras must meet the technical specifications here within the policy. All new IP camera deployments must adhere to the technical specifications. Minimum resolution of 640x480mpeg format, multi-stream capability to provide more than one video stream, minimum of 15 frames/second recording capability and power over Ethernet is preferred. The camera module is plug and play device which is connected with the USB to the beagle Bone black board. This camcorder is the module which is used to track the object and transmit the live data streaming to the controller with the wireless connectivity. The camera used is camera module. The camera has additional pins for horizontal and vertical sync, as well as a clock input to regulate how fast the image or live data is coming from the camera.



Figure 5: Camera module

DC Motor

It is an electrical component which converts current into mechanical power. When current is supplied to the coordinate, mechanical power follows it due to the electromagnetic impact on it. Dc motor is used to drive the robot for that we Use 500 rpm 4 dc motor. The speed of motor is depending on diameter of wheel and Rpm of motor. Rpm is inversely proportional to torque. If the speed of motor is gradually increase torque of motor will be decrease. We will be using relay to control the flow between NodeMCU and the motor because, NodeMCU needs only 3.3v.

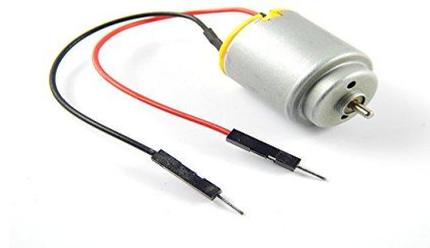


Figure 6: DC Motor

The motor uses an H-bridge chip to connect to the wheels of the robot. The entire design controls the robot to move in forward, backward, left and right direction for both the wheels. The wires connected to the motors are GPIO pins, which are used to execute inputs from the webpage.

Power Module

To ensure that every module in the robot, except the Android device, receives the required operating voltage, we need a way to change DC voltages. The sensor, camera, and control modules all require a voltage of at least 4.5V while the microcontroller requires a voltage of only 3.3V. The batteries connected in series provide a voltage of about 4.8V when fully charged and about 4.3V when fully discharged. The buck converter we used is intended to reduce the battery voltage to 3.3V for use in the microcontroller. Since the circuit spends only a small amount of time in either configuration, the storage elements do not have a chance to fully charge and discharge which results in a change in voltage from input to output.

Robust power source can be provided with our own off board regulator for Node MCU. As shown in Figure there is a 3.3v on board regulator. It is connected to Vin. So, Node MCU can be powered in this way also where it is the best way.

The regulator has maximum rating of 800mA. This should be the last option.

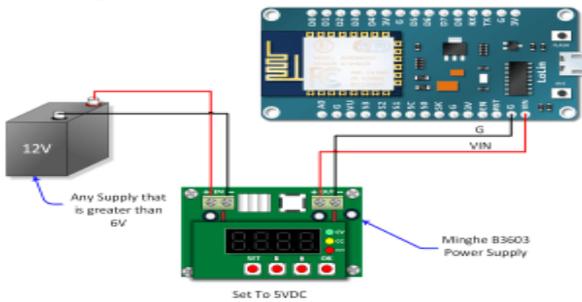


Figure 7: Bench Top Supply

You should have rechargeable batteries which has capacity of 9v power supply. Connect the positive end of the battery to the Vin pin of the Node MCU board.

Web Application

The web page designing is main part of our project to control the robot. It will be necessary that to make one platform from there we will access our robot. From the webpage we control the direction of the robot and position of the camera as well as monitor the live data stream. The web application is created using HTML and Java Script. HTML is used to display the webpage and to track the live streaming of the camera. The Java Script is used to write a code which controls the robot in the HTML web page.

IV. INSTALLATION OF OS IN BEAGLE BONE

The Beagle Bone was developed in Debian OS. It is downloaded and installed in the PC. The file downloaded will have an .img.xz extension. Then the image is compressed into the SD card. After that download the etcher and install in PC.



Figure 8: Compressing of image into SD card

After that, the cardboard is inserted into the Beagle Bone Board and then preserve down the boot button and follow the strength by way of using cable or 5V adapter or battery.

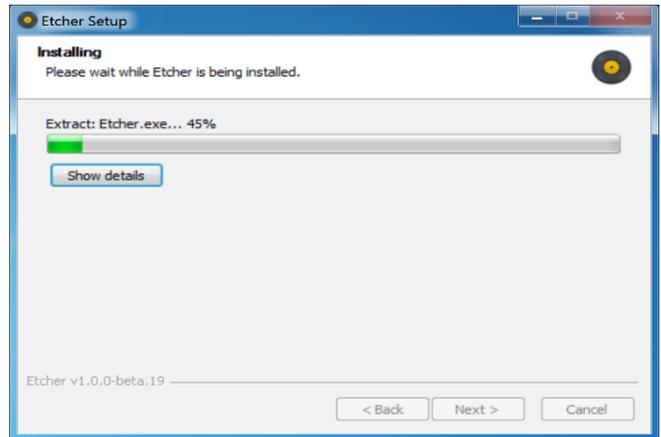


Figure 9: Installation of Etcher Setup

The manner of squeezing the picture into SD card is observed by way of the download and the set up of the Etcher Setup. Etcher is a standalone hardware device. It permits us to jot down to a couple of cards or usb drives right away. The etcher is difficult power friendly i.e., it makes pressure selection apparent to avoid wiping of the entire difficult-power. It is made with the Java Script, HTML, node.Js and electron that is the open supply platform. The etcher setup is the cross platform which works for everyone and no complications to install to the setup. Writing SD cards is a neglected and platform special affair, which means no risking and overwriting the hard drive. There were no more writing images on corrupted cards and wondering about the booting problem of the device.

Putty Terminal

Putty terminal is a loose and the open source platform. It is the terminal emulator, serial coder and community record transfer application through the packages. The name putty has no reliable that means, however it is at the start written for Microsoft home windows and it's far ported to many running structures like Debian, Linux and so on. Putty helps numerous minor and essential departures from the secure faraway terminal and offers patron authority over the SSH encryption key and conference shape, interchange figures, for example, AES, 3DES, Arc 4, Blowfish, DES, and Public-key verification in-order to have a security without causing risks inside the platform.

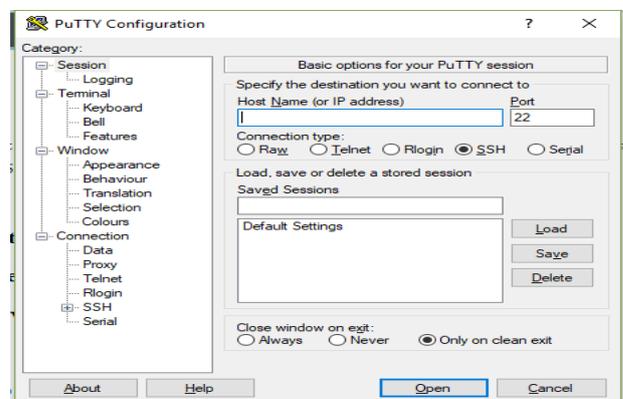


Figure 10: Putty Terminal

Tight VNC Server

Tight VNC is a cross platform and it is free to use everyone. It is remote desktop software application using the extended the RFB protocol of VNC (virtual networking computing) which allow end users to control another computer's remotely.

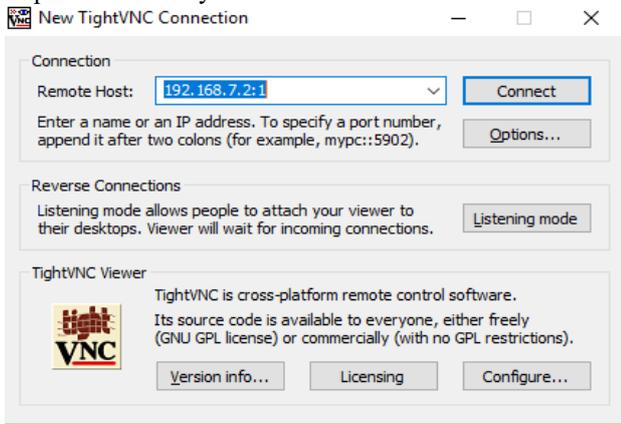


Figure 11: Tight VNC Server

V. RESULTS AND DISCUSSION

In this Project, we have described overall design for a video streaming wheel robot which is controlled using Beagle Bone Black and a webpage created using HTML and JavaScript. This is mainly a surveillance robot which streams live video via camera module through internet and displayed on the webpage which is used to control the robot movement. The robot's movement is manual and can be monitored/controlled on the webpage.

After the installation and setup of the beagle bone the following steps were used in order to run the project.

Step-1: Updating of the image i.e. the camera tracks the live motion of the system and it updates the images or live stream to the webpage.

Step-2: The USB cable is included in the beagle bone which provides the convenient way to provide both power to Beagle and connected to the system. It should always be powered. The SD card inside the Beagle Bone ought to be inserted in a way that it's far inserted in advance of imparting power. USR0 is configured in the Beagle Bone at boot to blink in a heartbeat pattern. USR1 is configured in addition the mild in the course of the accesses of the SD cards. USR2 is configured besides the mild at some stage in CPU pastime.

Step-3: Enabling of network connection in the Beagle bone setup. A network adapter should be shown up if connected through USB. The access point password is used to default the Beagle bone when the board includes the Wi-Fi.

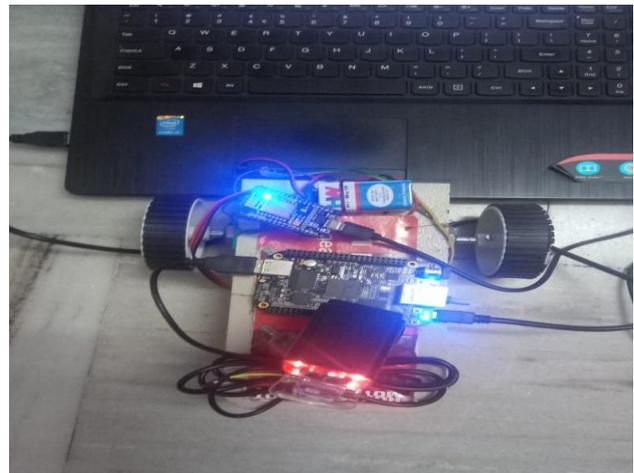


Figure 12: Hardware Setup

The entire construct isn't always high priced and clean to govern via Wi-Fi community. Even although, there may be a function and place for both manually and automatically controlled robot structures on the destiny battlefield. While working unmanned systems the robots can show highly-priced, retaining people out of harm's way is priceless. The use of unmanned gadget brings many blessings, but they ought to be complementary to in preference to replacements for present manned structures. It can be used in one of a kind type of applications like army, surveillance, security service, rebel manage, hostage scenario, police, regulation enforcement, border patrol, etc. They can also work more effectively in environmental extremes such as heat, cold, or nuclear, chemical and biological. In the hardware setup, an led is connected with the breadboard which is the indication that the robot fires the enemy when the fire button is triggered in the webpage.

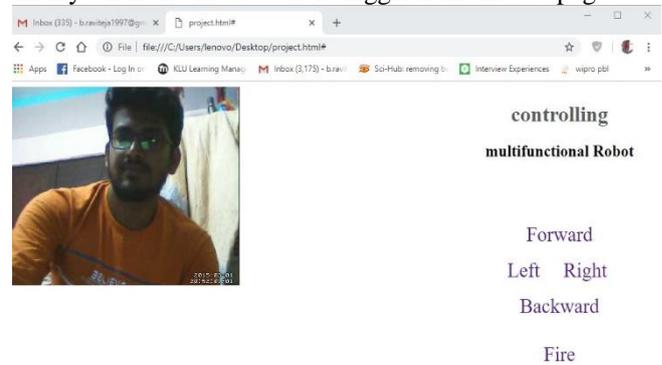


Figure 13: Webpage Output

Step-4: After enabling of the connection, using chrome browse to the web server running on the Beagle bone board. It will show the live data on the web server page and the arrows are used to navigate the robot.

The whole robot is controlled through this webpage and this makes the military's ground surveillance easy and no harm to any soldier. Even a gun can be equipped to the robot to shoot enemies at a close range by triggering on the webpage controls.

VI. CONCLUSION

The multi-functional surveillance robot is designed to deliver an affordable degree of risk saver with out causing human loss, performance and ease, presenting each person with a streamlined user revel in in the war grounds. The multifunctional robotic is aimed in imparting the tracking along with vision, movement, and fireplace with restrained setup. These varieties of robots can be custom designed and used to fuse seamlessly to any home, apartments or multi-residing devices. Based on modular designs and complete scalability, the multifunctional robotic is designed to be expandable and the led is setup to symbolize the firing of the gun. Thus enhancing the safety of our land.

VII. FUTURE SCOPE

In this project we can add the additional features like detecting any harmful gases or metals in and around the surveillance system. A criminal list can be sent to the database so that when the robot detects the face it can trigger the criminal by recognizing the face through the database.

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