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A Survey On Surveillance Robot in Hazardous Place Using IoT Technology

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***Abstract*: This survey deals with objective of surveillance of human activities or any suspicious activities in war field and border lines with the help of a robot based on IoT technology as human access is not possible everywhere and if possible can lead to risk of losing life. Surveillance takes place through wireless camera interfacing with Arduino and various sensors. WIFI/Bluetooth module is used for communication that is controlled from a distance by smartphone or a PC. Wireless camera sends the real time video signals. Robot also collects data from various sensors send it to micro-controller. The movement of robot is controlled by the user through a smartphone or PC. The robot is fully capable to work as required in defence areas as it can be controlled automatically and manually both. According to security perspective this robot is very useful not only in defence but also in domestic areas too.**

***Keywords*: Arduino, Camera, Wi-Fi/Bluetooth, Wireless.**

1. Introduction

Technology is the future of industries acknowledging new level of achievements and maintaining the targets at higher level. One of the Industry that is doing same is robotics industry, robots have always been the miracle for any other field as it's a machine which led to the advancement of technology. Android operating system has provided a huge impact on robot technology. Robotics has many applications that required interfacing with android technology which helps people in their day to day life. Many robotic applications are deployed for security purposes. Nowadays Robots with wireless camera has advantage in surveillance security in war areas. Arduino is interfaced with WIFI/Bluetooth module for communication and camera is used to send the data for real time video. User collects the data in a mobile/PC and also give command through it to move the robot in different directions. Various sensors can be interfaced with Arduino for different purposes. Many software can be taken into use to install the codes in Arduino like Arduino IDE. Various programming languages are feasible to code the programs for Arduino like python, embedded C etc. To provide motion to the robot Cloud system, Cayenne Software etc. can be taken into use. This robot system is completely capable to take motion actions automatically and can provide the data accurately in harsh conditions.

A. Benefits of Video Surveillance

1. Availability: It's easy to notice security through camera at various places like hospitals, shopping malls etc.
2. Portable: Video surveillance can be installed in devices like pen, camera etc. So it is very easy for the user to carry the devices as it is portable.
3. Live Streaming: Surveillance use devices that provide real time video as a live streaming on the other device. Many organizations use this technology to secure their system implicitly and explicitly both.

B. Why Smart Surveillance?

Technology is reaching at its peak in providing comfort life-style to the human as human cannot reach everywhere due to their limitations. Defense areas have threats of life loss so to provide more security in war field we need a system which can provide the details of enemy areas accurately. More over if a robot gets caught it is easy to make a new one but life is precious in human order.

2. Literature Review

In [1], the author discusses a system for observing the human movement in the war field and border regions which can reduce the risk of human life as soldiers of armed forces can assess the condition of the territory before entering it. The war field robot comprises Arduino uno board which is fitted with L293D motor driver, HC-05 Bluetooth module and night vision wireless camera. Camera is mounted on the top of the robot and can monitor minimum of 100 m transmission distance. It has the feature of rotating 360 degress by the means of android application. That android application is created through MIT app inventor and is used for the total navigation control of the robot.

In [2], the author proposed a robot to execute the act of continuous surveillance in the domestic areas. It is capable to reduce the human labour as well as human error. The robot is

controlled by mobile or laptop through Internet of Things by the means of Cayenne software which is used to send commands to the robotic system. Arduino interfaced with ESP-8266 Wi-Fi module for unlimited range of operation receives those commands. DC motors, ultrasonic sensor to detect any obstruction, IR sensors and wireless camera that provides audio and video streaming data to the user end are used in this project. Arduino Integrated Development Environment which is a cross platform application is used for writing codes for Arduino board.

In [3], the author presents a cost effective robot using Arduino Uno microcontroller which can carry out the act of surveillance as well as rescue operation. The robot is equipped with passive infrared sensor, ultrasonic ranging module, DHT11 temperature and humidity sensor, MQ-135 air quality sensor, accelerometer sensor, gyroscope sensor, magnetometer sensor, GPS sensor, Bluetooth and WIFI module, motor driver and robotic arm. The robotic arm is a type of jointed arm and consists of gripper to pick up objects with ease. It is controlled remotely by end user via internet. Solar panel is also connected to provide with the facility to charge battery with solar power.

In [4], the author proposed a surveillance robot for real time video streaming and audio transfer. The wireless mini robot is controlled by android based application named as BLYNK. Arduino UNO R3 is used as robot control board and it is incorporated with NodeMcu ESP module and L293D Servo Stepper DC Motor Shield. NodeMcu ESP8266 Wi-Fi module is paired with android mobile using username and password. Username and password is only known and predefined by the programmer in the programming of the system. It makes this wireless mini robot control completely secured from trespasser.

In [5], the author put forward the monitoring and controlling of mobile robot via internet through Raspberry Pi to control the terrorist attack throughout the world. Raspberry Pi Model B+ is used to incorporate all the sensors and motor drivers. The programming language used in the system is based on LINUX platform. Low cost PIR sensor and smoke sensor is connected to Raspberry Pi microcontroller to trace out suspicious activities, intruders and to detect fire accidents. These sensors enhance the effectiveness of the project in the case of camera failure. This camera can be rotated to get the better visibility of the surrounding. For wireless connectivity Wi-Fi dongle is used. Web page is created using HTML for navigation control.

In [6], the author discusses a spy robot which is based on Raspbian operating system. Raspberry Pi 3 Model-B is used which is 3rd generation Raspberry minicomputer with a 64-Bit 1.2 GHz quad core processor, 1GB RAM, WIFI and Bluetooth 4.1 controller. Python programming language is used to write the script for client and server communication. The Raspberry Pi is connected to the H-Bridge IC L293D to control the movement of the direction of motors based to the signals received by the end user.

3. System Overview

The system design works with the overall architecture of the project and also with the various types of software and hardware used to manifest the structure of the Robot. The different kinds of sensors are used including some programming aspects to make the working of the robot more effective. The numerous sensors are used for numerous task assigned to the robot which will be handled according to the needs and requirement. It works on the internet and also various internet running platforms. Also for the connection of the user system to the Internet BLYNK software is used. It is nothing but an open source which is used to develop IOT applications so that we can easily send different commands and can easily control the robotic vehicle using this software. At the robot end, An Arduino microcontroller is placed on the body of the robot, which is the integral part of the robotic vehicle. Wheels of 30 rpm each are connected with DC motors. 12v supply is required by each motor which is supplied by means of an external battery source. The motors are interfaced with the Arduino using relay driver. The microcontroller is coded with IDE software for the movement of robot in required directions. Various sensors such as ultrasonic sensor, infrared sensor, gas sensor are also used which are connected with the microcontroller in the respective I/O pins which will continue working effectively in the case camera gets disrupted and will stop the system to become a complete failure. Reflection principle that is transmission and reception of signals is behind the working of Ultrasonic sensor.

A. System Hardware

1) Arduino Uno

A single board microcontroller for accessing interactive objects easily is so called as Arduino UNO. It can be programmed with many programming languages. Arduino is used on ATmega328P and consists of 14 input/output digital pins. Arduino is feasible to support the micro-controller because it can enable a connection to a computer via USB cable and which use AC-to-DC power adapter to get started.

Fig. 1. Arduino Uno

2) L293D Motor Driving Module

The motor driver is a module which provide current flow in both directions at voltages from 5 V to 36V. This device consists 16 pin motor drive IC which receives signal from processor and impart the relative signal to the motors. It controls two motors simultaneously in both forward and reverse

direction by using 4 micro-controller pins.

Fig. 2. L293D motor driving module

3) ESP-8266 Wi-Fi Module

The signal output voltage sends by the ESP on server using WIFI network created by itself and so the information which is being transmitted on server are going to be observed on laptops or mobiles by connecting via Wi-Fi server and by accessing the IP address. It allows any micro-controller to access Wi- Fi network as it can work as an integrated TCP/IP protocol stack. In IoT field it is used for embedded applications.

Fig. 3. ESP8266 module

4) APIR Sensor

A passive infrared sensor (PIR) is an electronic device which is used to measure infrared rays. They are most of the time comes in use with PIR based motion detectors and all the objects with the temperature above absolute zero level will emit energy in the form of radiation. Mainly this type of radiation is not visible to the human eyes because it ranges between infrared wavelength.

Fig. 4. PIR sensor

5) MQ-135 Gas Sensor

MQ-135 gas sensor is one the important sensors in IoT field as it allows one to detect or measure various other gases like NH3, Alcohol, Benzene, CO2 etc. For making the sensor to operate even without a microcontroller a digital pin is used which is present in MQ-135 gas sensor and comes in handy when only used to detect one particular gas at a moment.

Fig. 5. MQ-135 gas sensor

6) Ultrasonic Sensor

Electrical energy can be converted into acoustic waves with the help of Ultrasonic sensor and vice versa. An ultrasonic wave traveling at a frequency above 18 kHz is known as the acoustic wave. Ultrasonic waves generated at a frequency of 40 kHz by the help of HC SR04 ultra sonic sensor. Typically, a microcontroller is used for communication with an ultrasonic sensor.

Fig. 6. HC-SRO4 Ultrasonic sensor

7) Bluetooth Module

The HC-05 is the Bluetooth module used in the system. This device use 2.4GHz frequency for establishing communication between robot and user. It uses external single chip Bluetooth system with CMOS technology and with Adaptive Frequency Hopping Feature also known as AFHF. The range is upto 10 meters and connection can be in two ways either point to point or multi-point.

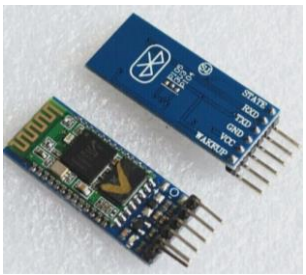

Fig. 7. HC-05 Bluetooth module

8) Temperature and Humidity Module

The DHT11 is a low cost temperature and humidity module which use humidity sensor and thermistor to check the surrounding air and provide the humidity output in percentage and temperature output in degree celsius. This sensor also consists of resistive-type humidity measurement component and the NTC temperature measurement component, which establish connection to a 8-bit microcontroller.

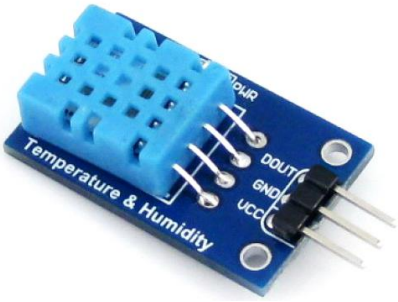

Fig. 8. Temperature and Humidity module

9) Magnetometer Sensor

The sensor which is able to detect the magnetic fields of any particular location is known as Magnetometer Sensor. This magnetometer device is used to provide the direction of the robot by pointing towards the north pole on the planet by compass. Metal detection technique is also performed by using this sensor.

Fig. 9. Magnetometer sensor

10) GPS Sensor

The global positioning system(GPS) is a satellite-navigation device that use antennas to receive the signal. It has a network of 24 satellites which use man-made stars as reference points. This location sensor detects the location of the smartphone using GPS and also via Wi-Fi networks or location of associated cell tower or Wi-Fi network.

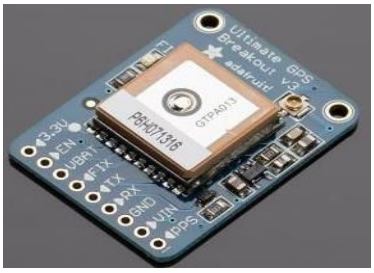

Fig. 10. GPS sensor

8) Infrared Sensor

Infrared sensor is an electronic device which is used to measure or detect infrared radiations around the nearby surroundings. The Infrared sensor has the ability to emit infrared radiation and detects the reflected radiation which is being reflected by an object. This device ranges between 2 cm to 30 cm and the operates around 3v to 5v. For the detection of edges present on the path of the robot this sensor is used.

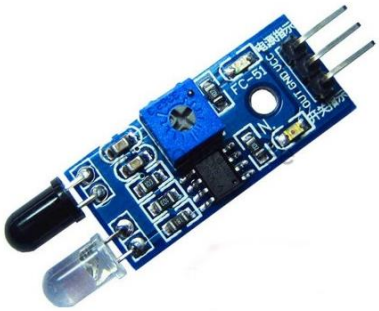

Fig. 11. Infrared Sensor

B. System Software

1) Blynk Software

For controlling and monitoring hardware remotely and displaying the sensors relevant data, Blynk software is used. Blynk App is mainly built for internet of things and it allows to create interfaces for IoT based projects using several widgets provided. Buttons, sliders, graphs and other widgets can be arranged onto the screen of the dashboard. An aspect of Blynk is a local Blynk Server that is responsible for all the communications between the smartphone and hardware from remote location. User can use the Blynk Cloud for running private Blynk server locally with inbuilt Blynk Libraries which enable communication with the server and process all the incoming and outgoing commands through it.

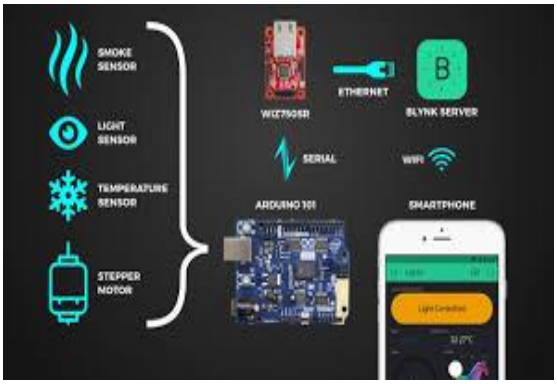

Fig. 12. Blynk software

2) Arduino Software (IDE)

It is open source software that is used to write programs, compile it and upload to Arduino boards. The Arduino Integrated Development Environment consists of two different sections: Editor and compiler. Text editor is used for writing codes. These programming codes are known as sketch and are

saved as hex file. Arduino IDE is compatible with Windows, MAC and LINUX operating system. It is suitable and simple to code for the robotic movements and also for the sensors interfaced with the Arduino board.

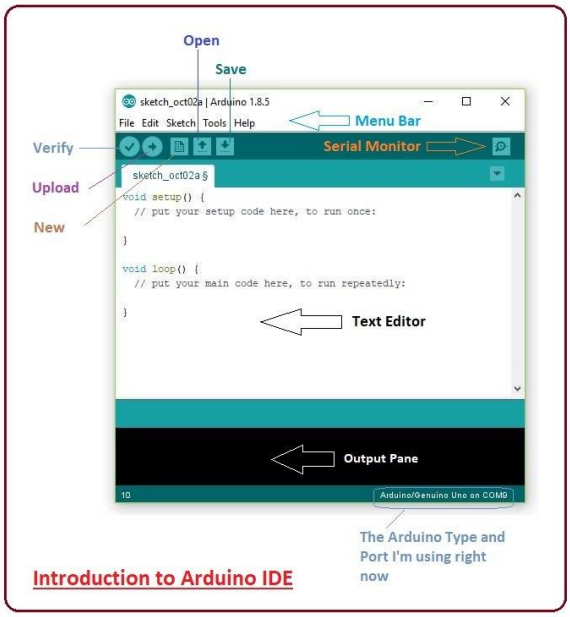

Fig. 13. Arduino IDE software

3) Cayenne Software

Cayenne is a programming system for IoT and it is used to control hardware from remote location. User can create custom dashboard with drag-and-drop widgets using Cayenne and through that they can monitor and configure their devices. A suitable sketch, i.e. an Arduino code that deals with the communication between sensors and dashboard is used to make interaction with the dashboard work. It has the facility to add, control and configure triggers for sensors and actuators.

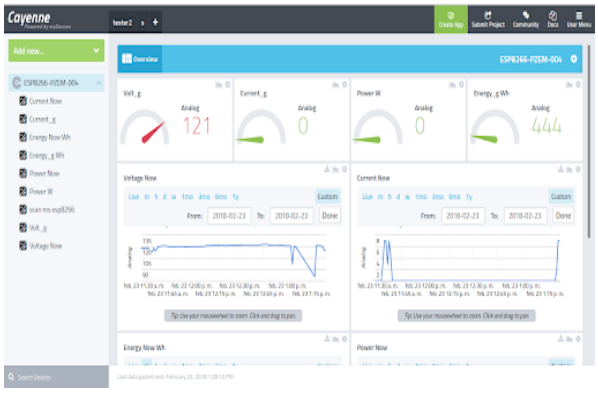

Fig. 14. Cayenne software

4. Result

Depending on the outcome of the paper the robot has various capabilities to work on several platforms and the robot moves depending on the information we provide via the remote control. This robot can roam around in the environment freely in every possible direction. It can sense various objects coming towards it or in its way. It shows proper live streaming of video contents. Every sensor has the capability to work on different aspects. These sensors can stop the complete system to become a failure by providing useful data to the user for navigation of the robot if camera fails or breaks.

FEATURES	PIC	AVR	ARDUINO	BEAGLEBONE	UDOO	RASPBERRY PI B+ MODEL	RASPBERRY PI 2 MODEL
RAM	14 KB	1KB-256KB	Upto 512KB	512MB	1GB	512MB	Upto 1GB
EXTERNAL MEMORY	NA	NA	NA	64GB	64GB	2-64GB	2-64GB
OS	NA	NA	NA	Linux Angstrom	Ubuntu, Android, Arch Linux	Linux	Raspbian
USB HOST	NA	NA	NA	1	2	4	4
NETWORK	NA	NA	NA	10/100/1000 Mbps	10/100 Mbps	10/100 Mbps	10/100 Mbps
AUDIO OUTPUT	NA	NA	NA	Analog	HDMI, Audio Jack	HDMI, 3.5 Audio Jack	HDMI, 3.5 Audio Jack
CLOCK SPEED	32MHz	32MHz	84MHz	700MHz	528MHz	700MHz	900MHz
VIDEO OUTPUT	NA	NA	NA	NA	HDMI	HDMI Components	HDMI Components
POWER	2.0-5.5 V	5V	7-12V	5V	6-15V	5V	5V
LANGUAGES	C++	C++	C++	Any for Linux OS	Embedded C	Python	Python
RELEASE YEAR	-	-	-	2012	-	2014	2015

Fig. 15. Comparison of various platform

5. Conclusion

The essential point of the surveillance robot is that it has the various capabilities of detecting and sending the signals to the authorized user from different environments. Depending on the sensor data of the robot, it provides the information to the user to move the robot in the desired direction properly like left, right, forward and backwards. Every sensor has the capability to work on different aspects like detecting gas, live human detection, motion detection. The robot can be easily controlled remotely with the help of any smartphone devices and laptops. This project is very beneficial and convenient for the places where human access is impossible and life threatening. The robot can be further enhanced by adding many more functionalities and it lays out platform for improving its capabilities.

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