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Internet Controlled Remote Vehicle with Live Video Relay and Local Memory

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Abstract*— A surveillance system is of the utmost importance in any area or domain, but the process of planning, building and executing this surveillance system is based on the use-case. The use-case of this particular surveillance system is used for post-destruction areas and areas that dissipate chemical radiation. The objective of this paper is to design the model and assemble an Internet Controlled Remote Vehicle that is managed and controlled through the web page, where the user can also access and view the live video relay. The end goal of this paper to draft an interface that consists of the application, settings, camera, and devices general navigation purpose, to achieve this objective the remote-controlled vehicle uses wireless technology and the data is given to the device for the navigation. The device assists in situations where a building might have many levels so the surveillance of such building would be difficult as the installation of cameras would be expensive, difficult and even with the assistance of security guards it would be difficult as there would be many blind spots and too much area to cover. Another such condition where the device can be used to counter the difficulty is probably in the areas where there has been a chemical, toxic gas leak or radiation. The device provides the above challenges or situations via the implementation of a dynamic monitoring system based on an IP camera navigated or steered by a Wi-Fi remote-controlled car. The car is steered by the user, using the web page designed for the dedicated movement the user desires. The IP camera acts as eyes for viewing the area in front of viewing on the web page. Wi-Fi System is used to connect the user via a server.

Keywords*— Autonomous Remote Vehicle, H-Bridge, IoT, Surveillance.

I. INTRODUCTION

Internet of Things or IOT refers to the number of physical devices and microcontrollers that are connected through the internet to collect and share data. Nowadays it is very easy to add digital intelligence to physical devices and it is very easy to communicate real-time data without any human interaction. The idea of adding sensors to the physical devices came up in 1980-1990.

One of the first IoT applications was RFID tags that have been installed in the higher value equipment and are used to track the location of the equipment. IoT was initially most interesting in the business and manufacturing industries. Where most of the applications were the machine to machine interaction, nowadays it occupies most of our houses, offices and smart devices.

As per a survey, around 8.4 billion IoT devices were in use in 2017, and at the end of 2020 it is estimated to reach up to 20.4 billion and the total spending on the IoT devices will come up to three trillion. The benefit of IoT devices depends upon the implementation as per the business and user requirements. The main key is that it should contain all the data about their systems and products. Recently, most of the manufacturing companies use sensors to keep track of their product data and it helps the companies to recover easily from possible damages and loss of data. The large data collection about the product helps the IOT device to respond almost instantly. IoT has been widely spread in two areas; the first being, health care industry or real-time location, and the second, major industries use IoT devices such as security systems, warehouse management. IoT systems make our environment smarter and easily measurable. Monitoring systems make security surveillance easier because of its live relay and the ability to view the surroundings inside and outside. Autonomous vehicles make transportation easier depending on unique requirement conditions. Security has been one of the biggest issues in IoT because it collects intensive data including our daily actions, the temperature of the surroundings, and extrasensory such as touch, etc. With the help of the data extracted, an internet controlled remote vehicle is designed and built with wireless technology module which helps us in the surveillance of large areas and posts destructed areas emitting toxic gases, thereby causing a threat to human lives. The data that is transmitted from the remote device is stored in the localhost. As the availability and accessibility of sensors and communication modules continue to increase, implementation of IoT based devices has become easier and cost-effective.

1.1 Advantages of our System

1) Existing models use Bluetooth for data transmission and wireless connection purposes whereas we use the Wi-Fi using TP-LINK Router which allows a range of up to 100 meters between the monitor and remote vehicle.
2) One of the most unique features is that Pulse Modulation Technique is used which enables the pulses from the motors to be varied in a certain respect, in order to control the power consumption of the battery, thereby prolonging the life of the vehicle.
3) The possibility of saving human lives that is prone to danger and various other long-term health hazards and fatal diseases.

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4) Important segments of the video can now be viewed in the form of photos which was not available in the previous devices

II. INTERNET OF THINGS

There are various methods to collect and receive data but most of the devices use a common technology called wireless technology. Most of the offices and houses use Bluetooth or Wi-Fi technology while other devices used for advanced levels of communication use satellite. Nevertheless, most of the devices right now use wireless technology. In the next few years, the field of communication and network will expand into 5G technology. 5G technology allows over one million 5G devices in a square kilometer showing the possibility of having numerous sensors within a small area. Right now, the United Kingdom has started 5G along with many IoT devices in the small industries. In the upcoming IoT devices, the data that is sent to the cloud will be reduced and most of the data will be processed on the devices itself and only the necessary data is sent to the cloud, thereby enabling cost reduction. This strategy is called Edge computing. This type of IoT based device is used in the field of surveillance implementing the latest technology. Almost seventy-one percent of Information Technology leaders are now collecting data from IoT devices. According to 451 surveys, the expenditure of global IoT is going to be 1.23 trillion in the upcoming years. There are about five industries that successfully use the Internet of Things are logistic companies that plan their route, remote site surveys which play the major roles of surveillance.

2.1 Elements of an Internet of Things

IoT has five important elements that are mentioned below.

1. **Identification:** This is the first element of IoT which plays a crucial role in matching and naming service products and unique codes that are used in different electronic products that are ultimately used as examples of identification.
2. **Sensing:** The next element is sensing. Sensing is the collection of data from the different devices and storage in the database. The saved database is used for further research based on the requirement.
3. **Communication Technology:** This is one of the important elements of IoT based on what communication method the devices are connected. Mostly used communication methods are Wi-Fi, Bluetooth, z-wave, IEEE 802.15.4, LTE advanced, Ultra-wide bandwidth, etc.
4. **Computation:** The main element of IoT is computation which is done using the hardware processing units like Arduino, Raspberry-Pi, system on chips, gate arrays, etc. The important computational product is the cloud that can process various data in real-time and show the saved data.
5. **Services of IoT:** The biggest element of IoT is the service to the consumers. They are classified into four classes

- Identity-related services: This is the foundation for other services. For any object to map with the virtual world identification is the important process
- Information aggregation services: They gather and store the information and the raw report is summarized and then processed and reported.
- Ubiquitous services: This service is used to offer the collaborative aware service to anyone based on their demand.

6. Semantics: It is the ability to absorb the data and process it at the same time. The semantic process includes various steps they are

- Discovering resources
- Utilizing resources
- Modeling information
- Recognizing the data
- Analyzing the data
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Overview of Internet controlled remote vehicle

Robots are becoming part of our day to day life from the health care system to surveillance of large places. This upcoming technology changes the entire RC car technology that was before. This dynamic concept has created a dynamic vehicle design. The main purpose of the project is to use the remote vehicle and collect the data using the wireless technology and survey the destructed and large areas that help in minimizing the risk that is caused by the destruction of the area. The battery power allows the router to connect with the other local devices and transmit the live relay, and the data that is transmitted through is saved and used for later purposes. This technology saves a lot of time and reduces human life risk.

III. LITERATURE REVIEW

"Android Based Robot Implementation for Pick and Retain of Objects" [1] is a paper written by Ranjith Kumar Goud and B. Santhosh Kumar which was proposed for mainly industrial and military applications. The main addressed functionality of this robot was to enable safe bomb diffusion. The device was invented to pick up and drop items with the use of a robotic arm. This robotic arm was given operation by the use of a pair of motors, while another set of motors were used to provide movement to the device. LPC2148 is the micro-controller being used on the device with communication established using Bluetooth. To enable surveillance properties to the device a wireless camera is also attached to the device.

In Jorge Kazacos Winter's paper on "Android Controlled Mobile Robot" [2], the main objective was to create robot automation controlled using android. It was required for the transfer of information between a smart-phone and the robot wirelessly. The cost of developing this communication system is also low along with the use of open-source philosophy. Parametrical modeling software is used while the robot structure is styled by using a 3D design technique. The 3D printer takes the style as the input and prints the parts of the robot in a layered manner sequentially and then reassembles the robot simply using these parts.

The main objective of the paper titled "Control Design Based on Smartphone" [3] written by Xiao Lu, Wenjun Liu, Haixia Wang, and Qia Sun, IEEE, 978-1-4673-1382, pp-2820-2823 is to allow smart-phones to possess the capability of IFLYTEK voice along with handwritten input.

IFLYTEK is a Chinese information technology company, est. 1999, which creates a voice-based internet / mobile products covering many domains of IT industry. The design created is robust, suitable, has practical usage, and ensures the reliability of the system Connectivity between the smart-phone and the device is done via the use of Wi-Fi.

The use of Wi-Fi makes it easy and convenient for controlling the robot so that it can act according to the commands.

"The paper Design of a Bluetooth Enabled Android Application for a Microcontroller Driven Robot" [4] written by Vito M. Guardi proposes a methodology that uses evolved Bluetooth capabilities for the communication between a smart-phone and micro-controller. The robot is operated using an Android application on the smart-phone. The central idea of the device is to show that a single android application can be operated on completely independent and different electronic devices. The communication protocol was invented over Bluetooth for the robotic platform and Android smart-phone.

"Smart phone-based robotic control for surveillance applications" [5] written by M. Selvam has projected a design to develop a robotic system that has a wireless camera attached to it for surveillance. Bluetooth was implemented in this project for providing a connection between robot and smart-phone. A wireless night vision camera was used for providing remote surveillance. The video which is recorded by the camera is then transmitted to the TV unit through Radio Frequency signal. Radio Frequency (RF) is the oscillating rate of alternating energy field readings ranging from electrical current to mechanical systems within a particular frequency range of 20 kHz to 300 GHz. 8051 microcontrollers is used for the robotic unit.

"Android phone controlled robot using Bluetooth" [6] written by Arpit Sharma, Reetesh Verma, Saurabh Gupta, and Sukhdeep Kaur Bhatia describes a Bluetooth controlled device that has been configured using an Android smart-phone. The phone uses motion sensors and records the gestures sent via an android mobile phone. These gestures are like real-world actions, which include swiping, tapping, scrolling and pinching, to control the onscreen objects, together with a virtual keyboard for taking input in text form. It also has an inbuilt accelerometer and Bluetooth module for controlling the movements of a robot.

The paper titled as "Android-based wireless gesture controlled robot" [7] written by A. Ganihar, S. Joshi, G. Rahul, R. Hongal and U. Mudenagudi can be used to show the ever-expanding requirement and demand of robotic systems in operations with factors such as human intervention are not possible or dangerous circumstances of the region. The objective of robotic systems is to improve the efficiency, accuracy, and accessibility of the operation being performed. The device developed is a color segmentation based gesture robot controlled with an ultrasonic sensor for monitoring the 3D spatial coordinates in the region. Bluetooth communication protocol is used to control the gesture robot and tested under various lighting conditions

The paper "Experimental test-bed and distributed algorithm for cooperative driving in VII simulation" [8] written by Weihua Sheng, Qingyan Yang and Yi Guo presents an experimental test-bed to conduct research on Vehicle Infrastructure Integration (VII) in Intelligent Transportation Systems (ITS). A robotic vehicle is developed and an overhead vision system is used to localize the vehicles. A single lane tracking control algorithm is used to provide functionality. Then a distributed cooperative driving algorithm is developed to control multiple vehicles to drive through an intersection without collision. This can be used as a testing platform for studying vehicle-to-vehicle communication based cooperative driving in ITS.

Hou-Tsan Lee, Wei-Chuan Lin, Ching-Hsiang Huang, Yueh-Hua Hsu Huang's paper on "Wireless Indoor Surveillance Robot" [9] proposes a self-propelling vehicle that can be used for periodic patrolling of a designated area to provide safety similar to the safety provided by men. The advantages of this self-propelled vehicle are the reduction of required manpower and well-performing surveillance. This is better than traditional propelling systems as it can move over wider ranges of the area and also record the monitored image for a pre-programmed patrolling route. Communication with this robot is done by the use of the internet with a website or smart device interface. The instruction given to the robot is done remotely from the server end by the user. The position of the vehicle in question can be tracked by the use of RFID readers mounted on the walls of the patrolling path for the sake of feedback. Discriminating analysis and face tracker is done by the Wi-Fi on the image feed provided from the IP-camera that is mounted on the vehicle. A built-in MSN module is used as an alarm report function to notify users of the occurrence of a pre-defined event.

"Design of Cell Phone Operated Multipurpose Security Robot for Military Applications using Solar Panel" [10] written by Tarunpreet Kaur and Dilip Kumar proposes a robot car with multipurpose features such as an intruder, fire, metal, detection which alerts this information to the user who administers this device in the backend. Machine intelligence provides immediate responses from these attached sensors. Alert messages are sent to the user within a specific range upon the activation of the sensor. The primary advantage of this device is that it can be used with unplanned and uneven surface areas. The two modes provided for this robot are the automatic and manual modes. The automatic mode activated the sensors automatically without any external specifications from the user. Whereas, the manual mode that is controlled via a smart-phone by the user, a dual-tone frequency is generated this, in turn, is detected by a DTMF decoder and manually controls it. To allow users to control the path of the robot according to the surroundings a camera is provided for visual monitoring. The camera also has an inbuilt microphone that wirelessly transmits audio feed to the user.

IV. METHODOLOGY

In this paper, our main focus is on surveillance of a post disastrous area or a chemical radiation region where it is unsafe for humans and may cause casualties. The vehicle is sent into the said unsafe region for the user to monitor the surroundings of the live relay. Images are captured whenever or wherever necessary.

4.1 Creating Database

The database is a set of data that is stored in a structural manner on the computer and is the source of information for all back end operations that are required.

In this particular case, all the user authentication details are contained in the database as a form of ensuring security and data integrity, so that the live relay and the images captured from it are not manipulated.

4.2 User Interface on the local device

The user interface on the local device provides a way of ensuring easy navigation of the hazardous region that the IoT based device traverses upon. The user interface provides authentication of the user before loading to the main page that allows the user to view the live relay, navigate using the buttons, and capture the live relay in the form of photos whenever necessary.

4.3 Pulse Modulation Technique

Pulse Width Modulation is the method of reducing the average power consumed by converting it into discrete parts. On-Off pulsing is done to control the speed in the device which effectively reduces the power consumption of the motors. The load and application are the factors that affect the rate or frequency at which power supply must alter.

4.4 Wireless Module

Wireless Technology is a module that allows communication between two or more entities over large distances without the use of any sort of wires or cables. The various types of wireless communication are Infrared wireless, Satellite, Bluetooth, Zigbee, Wi-Fi. Interference between two signals over the same medium is low which enables multiple users to communicate simultaneously.

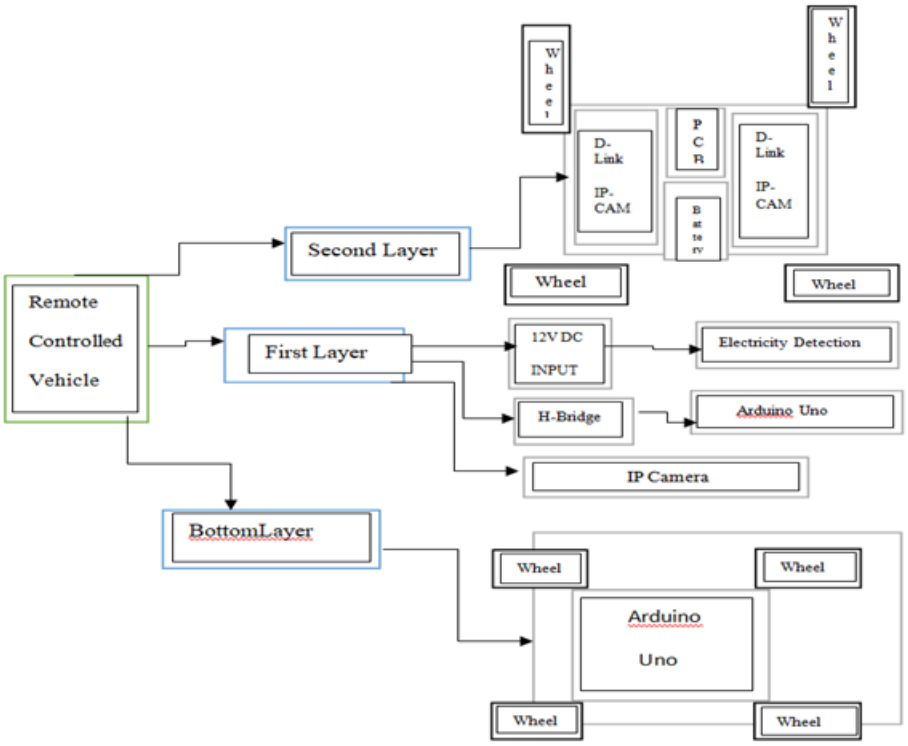

Fig. 1. The architecture of the application

H-Bridge:

This device is used to control the DC motor to allow the vehicle to move either in forwarding or backward direction. This is generally used in a microprocessor; in this case, it is used with the Arduino Uno. The DC motor spins either forward or backward based on the connection how the negative and positive are connected. The H-Bridge gets its name due to its 'H' like shape, where the switches denote the parallel lines of 'H' and the load or DC motor (in this case) is in the center which is connected to the switches. The VCC denotes the power source that is connected to the circuit. For the most part, the switches can be operated independently. By using pulse modulation on the designated pin, the movements for the front, back, left and right was achieved. The basic functionality of the H-Bridge is simple; the switches are turned on in an alternate manner to provide movement for the device. In the above diagram we can see that where if the Switch 1 and Switch 4 are turned on and connected to the VCC (i.e. the power source) then the left side of the motor will be in contact with the power supply while the right side will be grounded meaning that Switch 1 will be connected to the power source and the Switch 4 will be grounded. As the current starts to flow through the motor, the surge of power allows the motor to move in the forward direction. Similarly, if the Switch S2 and S3 are turned on then the inverse effect of what we achieved when the Switch 1 and Switch 3 will occur. Therefore, the left-hand side which is the Switch 2 is grounded and

Table 1: Tested output

DISTANCE	STEP DETAILS	EXPECTED OUTCOME(IMAGE CLARITY)	ACTUAL OUTCOME (IMAGE CLARITY)
20 METERS	Running the vehicle using the navigation buttons on the webpage.	CLEAR IMAGE OUTPUT	CLEAR IMAGE OUTPUT
40 METERS	Running the vehicle using the navigation buttons on the web page.	CLEAR IMAGE OUTPUT	CLEAR IMAGE OUTPUT
60 METERS	Running the vehicle using the navigation buttons on the webpage.	CLEAR IMAGE OUTPUT	CLEAR IMAGE OUTPUT
80 METERS	Running the vehicle using the navigation buttons on the webpage.	CLEAR IMAGE OUTPUT	CLEAR IMAGE OUTPUT
100 METERS	Running the vehicle using the navigation buttons on the webpage.	CLEAR IMAGE OUTPUT	PIXELATE IMAGE OUT-PUT
105 METERS	Running the vehicle using the navigation buttons on the webpage.	BLURRED IMAGE OUTPUT	PIXELATE IMAGE OUT-PUT
120 METERS	Running the vehicle using the navigation buttons in the webpage	BLURRED IMAGE OUTPUT	NO SIGNAL

Switch 3 is connected to the power source due to which the motor gets the energy to move in the reverse direction. But if all the Switches are in the On-state at the same time then it would cause a short circuit that would damage the power source and some parts of the circuit.

V RESULTS

The testing has been done for this robot was in the account of the distance of the robot to the remote device and based on that the clarity provided to the video feed. When the device was within the Wi-Fi frequency range it provided a clear video relay to the user. However, as the distance increased and went beyond that range, it provided an initial distorted image before vanishing entirely.

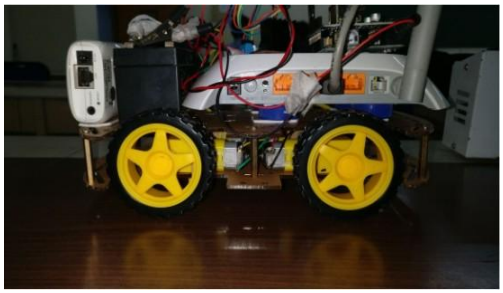

Fig. 2. Lateral view of the robotic car

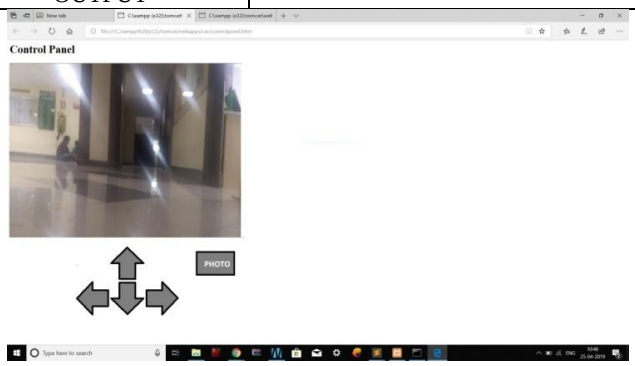

Fig. 3. User Interface with Clear Image Quality

V. CONCLUSION

During recent times, as the continued rise in dangerous or harmful situations and human casualties affects the society we live in, the alarming need for safer methods of dealing with such situations has become a priority. Hence, the use of robotics implemented as a machine in the form of a surveillance entity has been designed to fit the purpose of our needs. Though autonomous vehicles could revolutionize mass transportation as we know it, their safety has been widely debated. To address this concern, remote operation brings a safety mechanism that allows public places to be monitored and controlled by a remote operator from a distance.

The UI is secured with an authentication page to avoid misuse of the platform that is made available. Timely and live video relay provides real-time assessment of the situation and provides an insight into the region that was affected. The vehicle does not emit any harmful radiation, thereby protecting human health. Casualties from post-destructed areas would radically decline. As the vehicle is small in size, it has relatively low power and weight and does not possess any physical harm to anyone around in the surroundings. It follows the layman's concept of a driver-less car. If needed, the vision of operators scanning screens & on-hand to intervene if necessary should contribute to public acceptance of autonomous vehicles.

FUTURE SCOPE

Internet controlled remote vehicle is a device that can be employed for military purposes. Upon future development, in Android Development the robot can also be accessed using a mobile device such as smartphones. Sensors can be added to the device to detect fire, smoke, temperature, humidity, etc. based on the requirement. The entire device can be given the source of energy for operation using solar panels, thus making it economically sustainable. The robotic arm could be fixed on the device by implementing machine earning and artificial intelligence.

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