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IP Based Surveillance Robot Using IOT

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***Abstract*— The term "Surveillance" has elevated like a most needy thing in recent world. A number of articles regarding increasing crime rate has being notable daily, but are not able to trace out due to lack of evidences. . In such a situation, one has to be with utmost care and secured with oneself, which can be provided by Surveillance. Surveillance is nothing but monitoring from a distance by means of gadgets made by electronics, such as even robots. IOT (internet of things) platform connects these gadgets so that clients can perform operations with gadgets residing anywhere on Earth. This intelligent security robot using IOT will kept at key points of home to check about the presence of any intruder. The camera fixed with robot gives the picture of intruder in a 'live-stream' method. The Node MCU attached GSM module notifies about the presence of intruder as soon as PIR sensor attached to robot detects a human and the buzzer at the user end starts sound thereby alerting him against the intruder. All these are controlled, monitored and supervised under Raspberry pi board. With the given webpage that linked to an IP address, one can operate this robot via mobile connected with Internet, which is a key asset.**

Keywords*— *Raspberry Pi, esp8266, GSM module, PIRsensor, buzzer, webpage, IP address, Internet

I. INTRODUCTION

The term Surveillance has become a very essential and crucial aspect in everyone's life regarding security purposes. Crime rate has going on increasing day by day through which we are coming across the news. So in order to deploy surveillance, the primary aim is to develop a high-level technology that serves technology with advanced speed, and to develop a very advanced capacity to control therobots. In order to realize them, some technical improvements along with the high performance are required to create a fast, accurate and more intelligent robot, which can be devised using advanced control algorithms. Earlier, wired networks have controlled robots. In recent days, to make more user friendly, they are formed thereby making user command work. To attain the requirements we can use android as multimedia to control computer science that deals with construction Operations and applications of robotics, as well as computer System for their control. The creation of a finite number of automated and controlling systems that has low cost been enabled by the accessibility as well as the availability of inexpensive, circuit board type computers like Raspberry pi. The intelligent robot using IOT proposed in this paper collaborates the use of simple instruments, wireless communication, connectivity with robot, controlling system's efficiency, advanced controlled algorithm. Robotics is a branch of engineering that involves a fine concept, prototype we thought of, manufacturing of that proto and operation to assign, which can do a person's or a group's work. Even with simple mechanism and components, one can deploy robotics using a robot that gets automated or manually or mechanically controlled. The primary objective of this project is to achieve a smart surveillance atmosphere against false situations that happens. It is an interactive robot with duplex communication technically i.e. it can communicate with human, it can perform the task given by the user and informs the user about the arrival of intruders, if any. The robot is also able to show the intruders to user. Robot is a machine that was been assigned for doing particular task. It is based on program i.e. software and hardware. Nowadays industry becoming modern and they use automated technology to perform risky jobs. This is helpful to minimize life risk of human and animals. For home security in general, we use camera, which is mounted fixed location such as doors, windows, walls and ceilings also, but includes some defects such as cost effectivity, rigidness, infrastructure, being at a fixed position and robustness. Therefore, replacing robot with camera covers these defects at a maximum extent and efficiency. This robot is control by using pc, Android mobile or a laptop via website. The camera captures video and sends it back to controller's device via internet.

II. Literature Survey

Anas f. Ahmed,Ruaa h. Ahmeed,Tamara z. Fadhil "Design and Implementation of Surveillance Robot Using ATmega328 Microcontroller" states that the human cannot record video safely in critical conditions and environments.This paper introduces design and implementation of a surveillance tanked robot based on Wi-Fi protocol and windows operating system. The movement directions of the robotic tank are controlled by a GUI design using visual studio development environment. The robot can transmit real-time video to the intended recipient. In addition, it can pick and place objects using 4-DOF robotic arms. These includes a gripper with two fingers. The advantages of this robot are robotic arms are used to pick up and place objects. The camera installed on the cradle sends the images and gives the live feed continuously. The disadvantages are the battery life is limited. The robotic arms can pick only very lighter things. Chinmay Kulkarni, Suhas Grama, Pramod Gubbi Suresh, Chaitanya Krishna, Joseph Antony "Surveillance Robot Using Arduino Microcontroller, Android APIs and the Internet" proposed a four-wheeled surveillance robot using the Android OS based mobile and Arduino UNO Microcontroller. Their project consist of GSM, a camera and a GPS module. The usage can been advantageous through APIs (Application Programming Interfaces) provided for the Android OS. Moreover, the building cost get increased to great extent as per the design. It is been controlled from internet enabled PC and a microcontroller-smart phone interface residing on the robot. The camera input of the phone is utilized to capture and archive the live video via robot. The robot is been controlled based on visual feedback from the mobile. Four motors helped achieve a zero turning radius. The camera is been attached to a stepper motor, which makes it flexible for scene capturing. The captured video's quality is been increased using further techniques of image processing on the remote PC thereby eliminating the need for extra DSP hardware on the robot. The advantage is instead of using GPS, camera and GSM modules etc. individually we use a mobile phone, which comes with all the above components inbuilt. It makes the robot low cost. The limitation is the working of robot is limited by the processing power of the mobile phone. G. Anandravisekar, Anto Clinton T. Mukesh Raj L. Naveen's "IOT Based Surveillance Robot" is about developing a robot that performs the act of surveillance even in domestic areas. It is been roamed around and provide audio-visual information from the given environment and to send that information to the existing user. As a part of this project, the robot could been controlled by oneself with the help of an electronic device through Internet of Things (IoT) and the live streaming of video could be possible both at day as well as at night with the help of wireless camera that the robot got fixed with. The robot can been automated or manually controlled with Arduino microcontroller. Various sensors have been used by the robot to collect data and lets the Arduino microcontroller to receive it, through which the behavior of robot is controlled. But some disadvantages are been observed like cost effectiveness, lack of accuracy and lack of simplicity.

III. Proposed Method

B The flowchart displayed below represents the main algorithm of functioning of our robot i.e., Fig 1.

The block diagram of the robot is as shown in Fig 2. The data from Ultrasonic and PIR sensors is given as input to Raspberry Pi. It sends and receives the data through Node MCU. Node MCU will be in duplex communication. Output signal is given to GSM module and buzzer from Node MCU. Also, motor drivers runs by Arduino board's conditions.

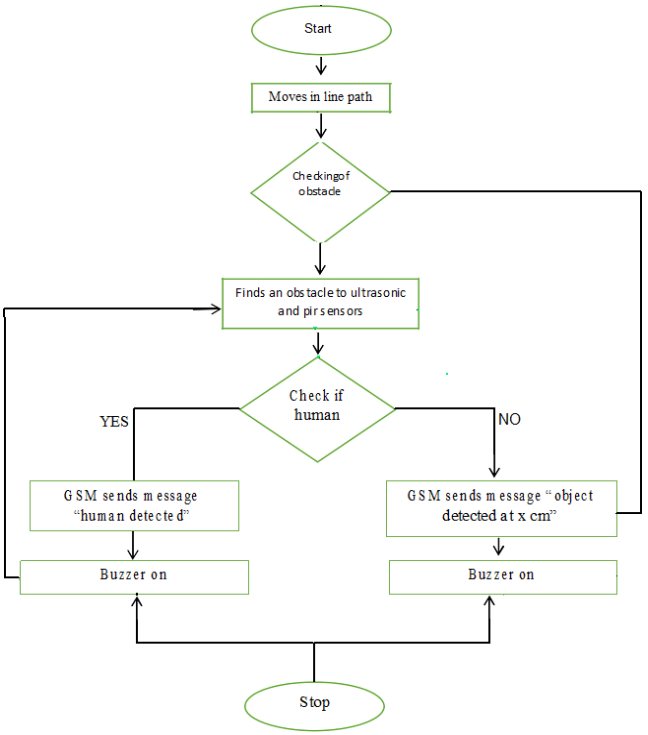

Fig 1. Flow chart of working system

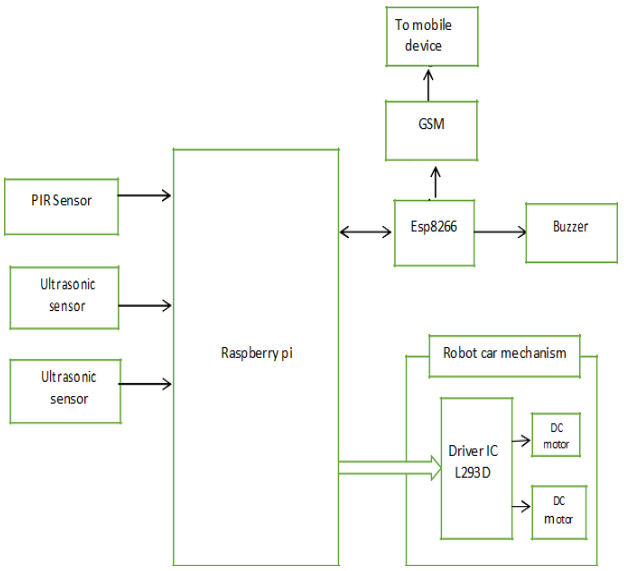

Fig 2. Block Diagram of working system

The functionality and procedure of working is explained below in detail:

- The proposed robot moves in a particular given path at a particular site through motor drivers fixed to chassis when operated by user through webpage in mobile.
- The Raspberry is the key operational board that guides the robot and components that are connected to it.
- As long as no obstacle has faced, the robot goes on taking the input from the user i.e., it indulges in giving live stream information and movement as per the directions given by user.
- As soon as it came across any obstacle, ultrasonic sensor becomes alert, along with Passive Infrared sensor.
- Now, the operation of PIR Sensor begins. PIR Sensor if been fixed in such a manner that if the person is human, it gives a signal to raspberry pi from which, Node MCU receives the signal.
- Node MCU processes the signal to both the GSM module and alarm buzzer.
- Then GSM module sends a message like “Human detected” to the given respective phone number. Along with that buzzer at watchman/person begins to make sound for a respective time.
- If the PIR sensor doesn’t detected any human, then then another signal will transmits to both the GSM module and buzzer regarding that it is not a human, so that a message will be sent as “object detected at x cm” to the receiving mobile phone. Also, the buzzer rings.
- As long as the obstacle appeared for robot, working of motor drivers gets halted for a while.

IV. Components Used

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A. Raspberry Pi

Raspberry Pi, as shown in Fig 3, is a small, credit-card sized computer. It carries all processes that a desktop delivers. Broadcom BCM 2836, processor of 900MHz clock speed with quad-core ARM Cortex A7Video Core IV GPU and with 1GB of RAM are given inbuilt. SD card would been using for exernal data storage. Also, this has an Ethernet port for network connection, USB port for connecting exterior USB devices, micro USB slot for power supply, HDMI port to connect to display and General Purpose Input Output (GPIO) pins to connect to other hardware devices.

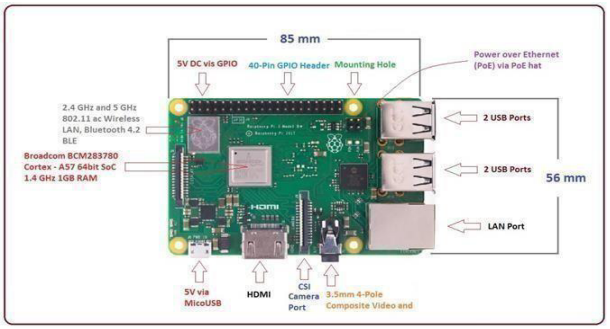

Fig 3. Raspberry Pi

B. Ultrasonic Sensor

A smart method of analyzing the distance is provided by the Ultrasonic sensor in Fig 4, through it made as an apt sensor for finite applications such as distance analysis between non-moving or moving things. Interfacing to a main circuit board is a trigger. A single I/O pin for an ultrasonic outburst signal is been used by the trigger and then the echo return pulse is listened. The time required for the echo return is been measured, and the value is returned to main circuit board as a variable- width pulse via the same I/O pin. This is used to avoid collision with obstacles.

Fig 4. Ultrasonic Sensor

C. PIR Sensor

PIR sensor, in general, is used to detect whether a human has moved in or out of the sensors range. They are small, cheap, low- powered, swift to use and doesn’t wear out. All PIRs, approximately, will have slightly different specifications, though they have same working mechanism. It sense the humans that appears within its range. If anyone been found under the range of PIR it sends the information to the raspberrypi. The structure is as shown in Fig 5. It has 3 terminals DC voltage(+5V), Ground, Output.

Fig 5. PIR Sensor

D. Buzzer

Piezo buzzer, shown in Fig 6, is a tiny speaker in general, which can be fixed directly to the main circuit board. This works on the principle “Piezoelectricity”, which is an effect where the shape of certain crystals gets changed when

electricity is applied. At the right frequency, the crystal is made to sound by the application of an electric signal. Let the sticker be pulled off, ifany. Buzzer has to be told to which pin the buzzer is on, what frequency (in Hz) wanted, and length (in milliseconds) that is wanted to keep the buzzer noisy. It is used to alert when obstacle or human is detected. It has 3 terminals VCC, I/O pin, GND.

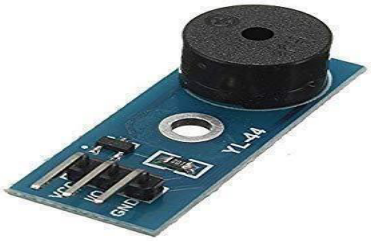

Fig 6. Buzzer

E. Node MCU

ESP8266, called as Node MCU, as shown in Fig 7, is a wifi System on Chip produced by Espressif Systems. Being highly integrated chip to provide full internet connectivityin a small package, this can be deployed in many ways like an external Wifi module, using the standard AT Command set Firmware by connecting it to main circuit board using the serial UART, or directly serve as a Wifi-enabled micro controller, by programming a new firmware using the provided SDK. The GPIO Pins allow Analog and Digital IO, positive PWM, SPI, I2C etc.

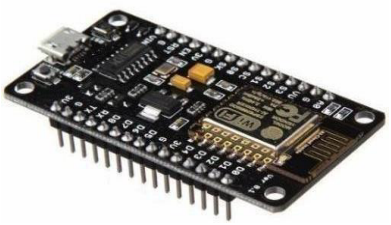

Fig 7. Node MCU

F. Chassis

Robot chassis, as shown in Fig 8, is a simple accessory that particularly supports the making of a robot. Chassis is a very essential component not only in constructing robots but also for many mechanical devices. Mainly, the PCB, accessories and various parts, which got connected to it are get supported by it as they gets fixed on the chassis. It is been particularly designed and deployed in robotics and in many other mechanical structures. The components that are interfaced, are been handled by chassis. This possess simple construction with an acrylic plate and further holes are seen on the plate for connecting components and accessories on it.

Fig 8. Chassis

G. GSM Module

A GSM module is a type of printed circuit board to establish communication between a mobile device or a computing machine and a GSM or GPRS system as shown in Fig 9. Here, the modem is an important part. It is provided with a power supply circuit and communication interfaces (like RS-232, USB 2.0, and others) for computer. A GSM modem can be employed as a dedicated modem device with a serial, USB or Bluetooth connection, or in simple, it can be used as a GSM features enabled mobile. It is used to send SMS to the user.

Fig 9. GSM Module

H. Servo Motor

Servomotors are been proposed mainly for specific applications like motion control of a particular component. Here, we used a DC servomotor to control the motion of camera attached. In power ratings, they are available. The rotor of a servo motor is designed longer in length and smaller in diameter so that it has low inertia. Fig 10 represents a servomotor in working condition. .It is been used to control the motion of camera.

Fig 10. Servo Motor

I. DC Motor

Dc motor, as shown in Fig 11, is an important component used in motion of the robot. Here we used motor of 500 rpm. It gets fixed to the wheels through the motor drivers. Feeding the power from them, these injects the movement into wheels as per the given command.These motors are used to provide motion of the robot.

Fig 11. DC Motor

J. Camera

A camera, as shown in Fig 12, is a device that is used for video streaming purposes. Not only with Raspberry pi cam, but also with a normal webcam, video streaming is possible. This webcam provides a video with fair quality along with subtle connection to main circuit board. Webcam of any specifications can be embedded with PCB used. The camera captures the images or it gives live streaming.

Fig 12. Webcam

V. RESULT

Apart of Hardware that's been used, IP plays a crucial role in connecting robot to user's Interface. For this, IP Address of Active Raspberry Pi is used. The Supply is given to Raspberry Pi to which all the other components are connected and code is placed within RPi. Here, we used "Advanced IP Scanner" to detect the IP Address of RPi. From then, to configure the code and virtual communication, a tool called "VNC Viewer" is been used. Note a point that a Strong Internet Connection is been provided to robot through local Wifi of which the credentials are known. Fig 13 shows the user interface of web page that had been connected to the IP address. With the IP Address, one can access the robot from any place, as long as the user is been provided with a good internet connection along with the robot, which has to be in ON condition. As shown in Fig 14 and 15, components that are required are been programmed and connected on the chassis provided. Robot works as per the command given by user as shown in Fig 16.

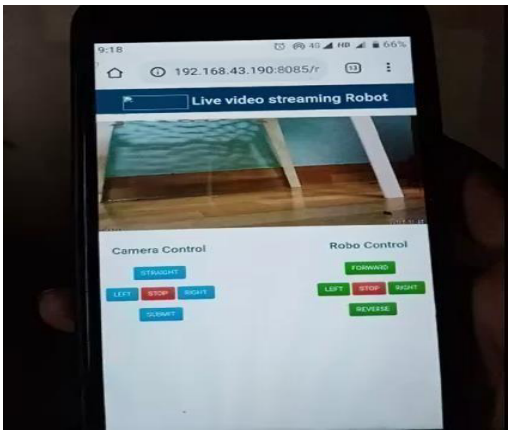

Fig 13. User Interface of Webpage

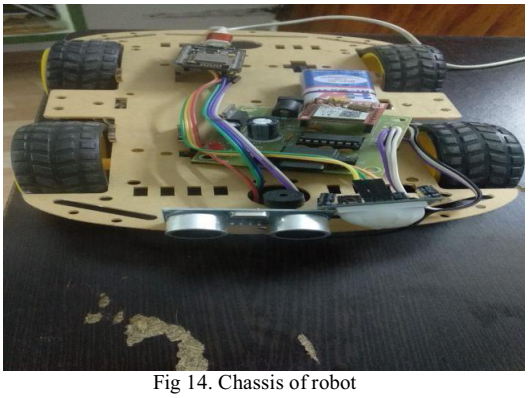

Fig 14. Chassis of robot

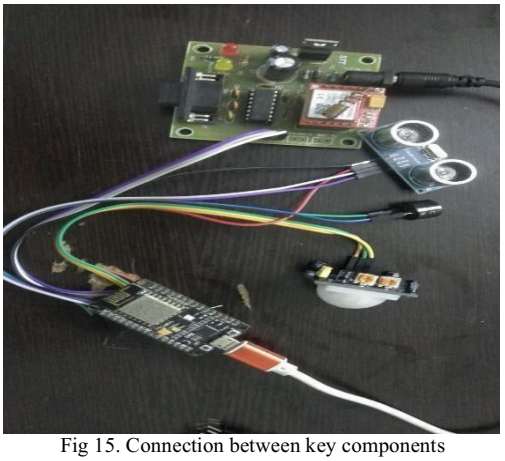

Fig 15. Connection between key components

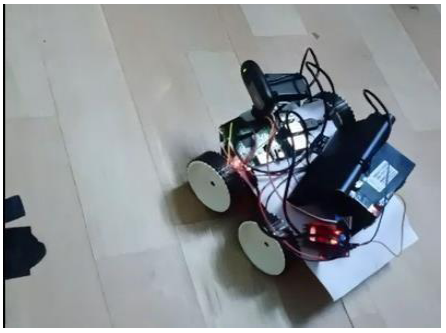

Fig 16.Equipped Robot

VI. ADVANTAGES

- Wireless surveillance can be very useful in scenarios where it is complex for the cables to be laid – Museums, Heritage buildings, Industrial plants, etc.
- Infrastructure of Wireless surveillance system is cheap to some extent to install and maintain, when compared to wired network involving Fiber Cables.
- Wireless Networks are swift and smart in data transmission.
- Indoor monitoring of warehouse, campus surveillance to check the improper activities.
- Making video surveillance of any disaster affected area where human beings can't go to rescue the victims.
- Field view surveillance of indoor & outdoor like commercial complexes, factories & government organizations. For domestic purposes, where humans cannot go and search for something, these robots can be employed.
- Mainly, these type of surveillance robots helps in areas like gated communities where the security is prior particularly in night time.

VII. CONCLUSION

This can be concluded that we can develop a handy surveillance robot to work in domestic purposes. We can use this as spying robots at night time especially where it can be helpful to manual security especially at gated community type areas. These robots can be made even with simple components and sensors thereby reducing cost and complexity. By equipping the robot with Raspberry Pi which materializes all the core functions, manipulates and mobilizes thereby making it Robust internally, Surveillance is also made efficiently functionable. In this report we explained the process of designing and implementing a prototype of smart surveillance robot which can be used even for extreme outdoor application. Using Internet of Things concept, this surveillance robot becomes much fruitful, in the form of live streaming video and duplex type of communication provided.

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