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INTERNET OF THINGS (IOT) BASED ROBOTIC CAR

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ABSTRACT

The Internet of Things (IoT) means communication between two devices through the internet. IoT has introduced a new arena in various domains like home automation, surveillance, security, tracking systems etc. An RC Car is a battery powered automatic car that can be controlled from a specific distance using a specialized remote or a mobile application using a mobile phone. IoT is connecting computers with smart objects, including semi and fully automatic robots. One can control the robot with the help of mobile or laptop through IoT and also can get the live streaming of video, can avoid accident using ultrasonic and distance sensors. It can shut down the vehicle's fuel system by simply clicking a button in the web user interface. Using an automation car can malfunction but RC robotic car will be controlled by humans to avoid malfunctions. The most commonly used micro-controllers in a robotic car are Raspberry Pi and Arduino. A robotic device designed using Arduino is more real-time and responsive than Raspberry Pi. However, designing a robotic car using Arduino is found to be challenging than Raspberry Pi. This paper discusses the best practices for using Arduino for robotic car design. Further, it discusses IoT based robotic car implementations. The insights of the micro-controller architecture and the programming model are described and reviewed. The paper compares the different hardware and software technology compositions to achieve a real-time responsive system. Further, it tests the robotic car hardware and software implementations.

KEYWORDS — *arduino, IoT, raspberry pi, remote control, robotic car .*

I. INTRODUCTION

A robot is a program based working device which is either automatic or semi-automatic, which can execute one or more programs again and again. There are different types of robots as there are a huge number of tasks to be performed. A robot is mostly designed to make human life easier. Including IoT features in robots will make the whole robot work without any user input. A robot can be used to solve more realistic issues. Majority of projects mostly work on IoT like automatic dimming of light based on time.

IoT gives access to objects that can be controlled remotely across all existing network infrastructure. IoT helps human by reducing their efforts. When one looks at today's state of technologies, one gets a clear indication of how IoT will be implemented on a global level in near future. Any device with any type of built-in sensors can be the 'Thing' in IoT. It can send and receive commands over a network without any manual involvement.

Using mobile robot is becoming useful, making the robot closer to the people in daily life. Mobile controlled robots are light, small and portable enough to be carried by an individual. As one can easily control it using android there is no need to carry a remote-control device. It can be just connected to the app and used. Robotic cars are also capable of automatically adjusting the direction itself to help the driver and can also work on its own. It can also sense the various parameters using a different sensor like ultrasonic sensor, humidity sensor, temperature sensor, gas sensor, flame sensor and many more.

Figure 1 shows an overview of how an RC Robotic Car works. There is an ultra sonic sensor which can detect an object in front of the sensor which comes in between the transmitting and receiving of frequency. If there is an obstacle in front of the robotic car, the sensor will send data signals to the arduino and it will change the direction of the Robotic car using the motor driver (L298n) so that it changes its direction. There are four motors (M), each two motor is connected to the motor driver.

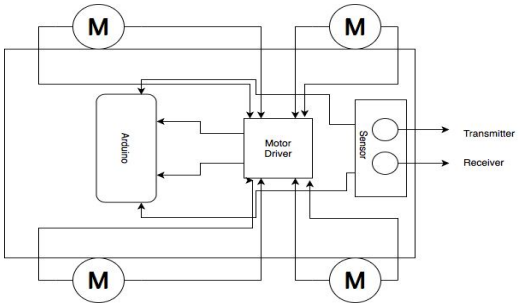

Fig. 1: General Robotic Car Block Diagram

II. LITERATURE REVIEW

This section discusses the recent existing work carried out in this domain.

An experiment by [1] created a project in which they made an IoT based car using Raspberry Pi. To detect the level of fuel level sensor was used. For detecting the presence of light an LDR was used to turn ON and OFF car's light accordingly. A door lock system was used to get the status of the door, whether locked or not.

Another experiment by [2] created a project on the robotic car based on IoT with arms and legs. In this paper, the device was controlled by an android mobile, the device is controlled by an android mobile through a bluetooth module, when a button is pressed in the UI of the RC device the command passes from the mobile to the device through the bluetooth module by sending signals.

Authors of [3] made an automation car which can avoid accidents and if a theft attempt was made the car would shut down automatically. To identify accidents and to release airbags impact sensors had been used in vehicles from the last few years. The Smart Vehicle Monitoring System (SVMS) included Raspberry Pi coincide with different sensors and modules like GSM/GPRS and GPS.

The study by [4] established an IOT based Surveillance robot which had a wireless camera controlled by the Wi-Fi module. They used an Arduino micro-controller which was placed on the body of the robot which was an integral part of the robotic vehicle.

Authors of [5] have established an IoT based robot which works on Arduino NodeMCU as a central driving functional unit and can be controlled using a Wi-Fi module. It also uses IR sensors. IR sensor enables the robot to avoid obstacles.

Research by [6] made an arm robot working on a solar panel. They call it InterBot. They used Arduino for compatibility. The main purpose of this project is for real-time monitoring in the environment.

The study by [7] established an automatic tour guide robot which was able to detect the numbers by image processing. It tracks the number, remove image noise, extract the data and then compared the data extracted.

III. PROJECT METHODOLOGY

A. Arduino

An arduino UNO has a USB interface through which it can be powered and programmed. There are two power output pins 3.3v and 5v. Mostly all parts used in Arduino board work with 3.3 volts and 5 volts. There is a voltage regulator which regulates the voltage given to the Arduino board and stabilize flowing current utilized by all the elements in the board. It is used so that there is no damage to the arduino components. There is a voltage regulator which regulates the voltage of flowing current which is given to the Arduino board and stabilize flowing current utilized by all the elements in the board so that there is no damage to the arduino components. To power the arduino through the main AC power supply we can also use Vin pin in arduino. To ground the circuit, there are many GND pins on the Arduino, any of which can be used. It also has 6 analog pins and 14 digital I/O pins these pins can be programmed to work as an input pin or as an output pin to work with different modules like LEDs, relays, etc. The analog pins are capable of reading signals from an analog sensor just like the temperature sensor or humidity sensor and convert it into a digital value which will be read by the micro-processor. It has one atmega328 IC which is an 8-bit and 28 Pin rewritable microcontroller also called as the brain of the board. The main IC on the arduino is different from other board for example attiny85. ICSP is an AVR, it is a tiny programming header for the arduino consisting of MOSI, VCC, SCK, MISO, GND, and RESET. Arduino also supports serial data communication using Tx and Rx pins which is mostly used for wireless remote-control communication. Tx (transmitter) and Rx (receiver), They appear in two places on the Arduino UNO board. The TX led flashes while sending the serial data. RX flashes during the receiving process. There are many Arduino boards in the market like Arduino Mega, Arduino Uno, Arduino Leonardo, Arduino Due, Arduino Nano, Arduino Micro, but mostly Arduino UNO is used. All Arduino boards are also capable of reading inputs, light on a sensor & displaying contents on the screen. In the diagram, the crystal oscillator helps Arduino in dealing with time issues as it calculates time by using crystal oscillator. The number written on top of the Arduino crystal (16.000H9H) which means the frequency is 16 MHz. The LED on the board should light up whenever a user plugs an Arduino into a power source which means your board is consuming energy correctly. If the LED does not light up, then there is a problem with the arduino or the connection. The abbreviation of AREF is Analog Reference. To reset an arduino board and start a program from the beginning there are two ways first, by using the onboard reset button and second, by using an external reset button which can be connected to the pins labelled as RESET.

To take benefit of all features of Arduino one can use its interface called Arduino IDE which is a universal application for all type of Arduino circuits. It is easy to use if one can work on C/C++. One can also import external modules using the library manager. To control it using a wireless interface one can connect it through a Wi-Fi or Bluetooth module. To make the whole device work module like Serial-Master should be installed first.

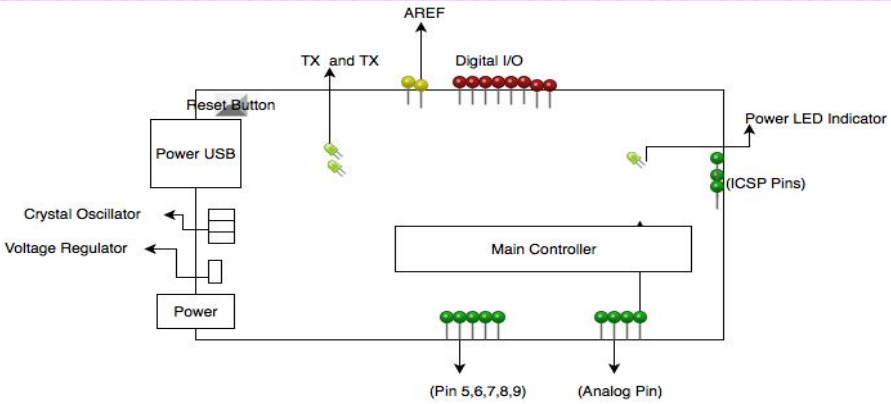

Fig. 2: Arduino UNO Block Diagram

B. Raspberry Pi

The Raspberry Pi is a mini computer. Raspberry Pi does not include peripherals and cases. But some unofficial sellers have been included it in several their bundles. Raspberry works on raspberry OS. Raspberry Pi Foundation developed a single-board computers called Raspberry Pi. The Raspberry Pi Foundation made a device which has the power of doing all the work which an actual computer can do and it also helps to bring the computer into the hands of people all over the world. It is a low-cost, high-performance computer which is capable of solving problems, and execute programs.It has an ARM CPU / GPU that can handle all the computing that makes the computer work, and the GPU can handle the output of graphics. It also has an RCA jack that allows analog TVs and similar output devices to be connected. It has an audio jack for connecting devices like headphones or speakers to the audio output. There are no inbuilt speakers. USB is used to connect peripheral devices of all types like mouse and keyboard. One can use a USB hub to increase the number of ports or plug your mouse and your keyboard. HDMI connector allows one to connect to a compatible device or monitor. And for the power supply a 5v Micro USB power connector is available. For booting the system an operating system (OS) must be installed on SD card. Raspbian operating system is easily available on the raspberry official website.

Also one can download from any other third party website.

Once downloaded and installed in SD card ,user have to mount SD card in the slot.There is a Ethernet slot available in raspberry pi board to connect with the Internet.

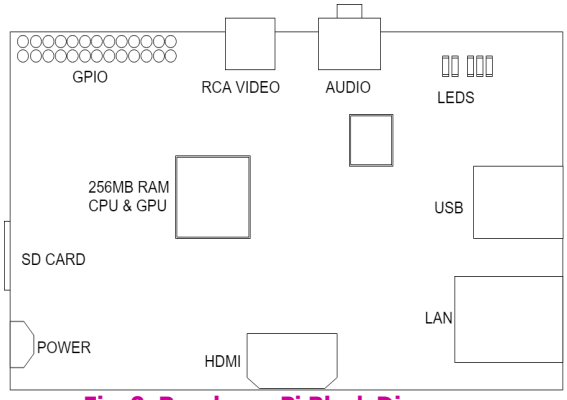

Fig. 3: Raspberry Pi Block Diagram.

Raspberry Pi is mostly used for IoT based projects because it comes with an integrated Bluetooth RFCOMM protocol. First of all, the device should be updated completely before the device starts working. After that setup all the Bluetooth packages (Bluetooth, blueman, bluez). Mostly all the programs work on python as it is an open source language.

Figure 4 has two parts, the device itself and the RC device. Both the device includes hardware and software components. In a Robotic Car there is a micro-controller, which can also be called as the brain of the device. This micro-controller can also be added to other external component or module , so that the device can be monitored/controlled by another RC device. Both the devices are included with API's. RC device controls the car motors to change the movement and direction. As soon as the ultra-sonic sensor detects an obstacle it will send a data signal to the motor driver through the micro-processor. The micro-controller sends the stop signal in response to the motors. Further, the car is controlled to move to any free path via RC device. Any additional components added to the Robotic car need to be connected with the micro-controller and eventually with the RC device.

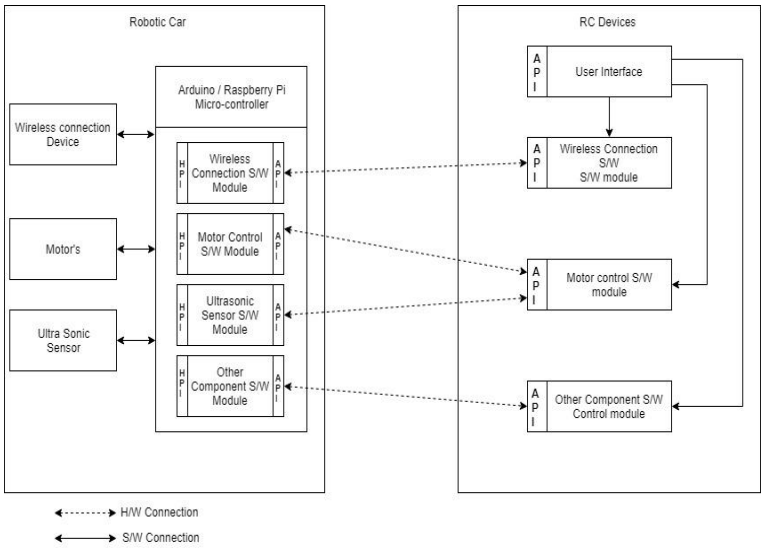

Fig. 4: Interfacing Arduino/Raspberry Pi with RC - Block diagram.

C. Comparison between Arduino and Raspberry Pi

Arduino is a micro-controller which can run only one program again and again. It can be powered using a battery. Information about sensor's codes and electronic parts of Arduino is easily available. Arduino component's prices is lower than Raspberry Pi. To connect to the internet, it requires external hardware. It can provide a little amount of onboard storage. One can connect only one USB port to the computer. Arduino uses C/C++ languages whereas Raspberry Pi is a small portable computer. In Raspberry system one can run multiple programs at a same time similar to any other operating system. It is difficult to power a Raspberry Pi with a battery. When a sensor or any other external component attached with Raspberry Pi, it requires complex tasks like installing libraries and software/utility for communicating with sensors and other components. It is expensive and time consuming process. Raspberry Pi can be easily connected to the internet using Ethernet port and USB Wi-Fi dongles. Raspberry Pi does not provide any storage on board. It provides an SD card slot for that purpose. It consists of 4 USB ports where we can connect different devices. The mostly used programming language is python but C, C++, Python, ruby are pre-installed.

IV. RESULT

This paper shows a comparison between Arduino and Raspberry Pi. It suggests that Arduino is better than Raspberry Pi, because Arduino is a bit less expensive. Also, Arduino can work on a 9V battery which means that Arduino is a portable device whereas Raspberry Pi needs a power adapter. Further in Raspberry Pi one can add multiple applications at the same time which makes Raspberry Pi very useful.

V. CONCLUSION

Many research works carried out in the past suggests that controlling multiple devices in multiple ways results in more convenience in handling a system. The cloud service can help us in reducing system memory load. Researchers estimate that a new innovative application will emerge in the near future to exploit the connectivity and accessibility of everything connected via IoT. The most integral and advanced technology is the electronic field in wireless technology. To serve our need this technology is a supreme part as surveillance act.

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