IoT BASED MOTION CONTROL SYSTEM OF A ROBOTIC CAR

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ABSTRACT - *In this paper, we presents compact portable robot with Arduino NodeMCU as central driving functional unit with novel features of wireless control using Wifi module with the activation and deactivation of obstacle detection in the path of the robot .The main contribution of the paper is that it leverages the efficiency of robot's motion controlling system .These innovative technologies have potentials to build a board less communication society a symbolic society between humans and robots. The GPS system is incorporated, hence the client can trace the car. Commands and data are stored in cloud services which delivers to device when it is ready to receive. The system has IR obstacle sensors for avoiding obstacles coming in its path. We present the architecture and design of arduino communication and how to control the car by means of commands and application.*

Keywords: Arduino NodeMCU, Motor driver, IR obstacle sensors, IoT.

1. INTRODUCTION

Arduino is designed as an open-source electronics prototyping platform providing schematics and flexible development kits for enthusiastic users who intend to produce interactive objects or environments. Arduino can be used to sense surroundings by utilising various transducers to read and interpret inputs in order to make responses for example through the controlling of motors or transferring of data. In today's world there is a significant development in the field of robotic control. Mobile robotic vehicles are light, small and portable enough to be carried by an individual[5].

Our design serves as a solution to demonstrate how the control of the dc geared motors in coordination of the signals obtained from Wi-Fi module in conjunction of Arduino is used to achieve high degree of precise path control from the user side to achieve standard operations like moving at a particular target location, collecting data and avoiding any obstacle to prevent collision .In existing literature many works have been done on the implementation and analysis of the robotics for various aspects like disaster management, working in nuclear areas, photography and military application. Cloud robotics uses computing resources to enable great memory, computational power and collective learning for robotics applications. When computational or storage demands exceed the on-board capacity of a robot, they are offloaded to the cloud, here the massive resources of a data centre can supplement the limited local resources of robots .Cloud robotics also represents a significant advance for robot learning[3]. The collision and detection protocol has been incorporated and well executed by using infrared sensors which prevents collision and sends the signal to the user mobile of obstacle detection. The robot direction can be changed by using the buttons available in the application .The robot is equipped with a pick and drop arm which can pick and drop up to 60 grams of weight. Our user end equipment mobile is equipped with an application control the path of the robotic car achieve its target location avoiding obstacles.

2. OVERVIEW

A smart mobile device and an embedded system side are involved in this project. The overall framework should contain a user, an Android smartphone field, an Arduino-based car with assistance of the Arduino integrated development environment (IDE) in the PC, sketches are compiled and uploaded into the Arduino board via a USB transmission line .The car and mobile phone are linked via wireless communication. By touching or pressing on the screen of an Android phone, a manipulator can send commands to the Arduino microcontroller on the car through wi-fi and observe the corresponding executions accomplished by actuators, for example motors[6]. Two gear motors, two wheels, a battery holder, batteries, a switch and a baseboard compose the chassis of the car. Uncomplicated operations and compact user interfaces are preferred. Initially the commands include: move forward, move backward, turn left, turn right, rotate left, rotate right, activate obstacle detection, and deactivate obstacle detection. These commands can be given via user application. It is possible to locate the car continuously in the UI and get the feedback and data regarding to the car[2].There is a provision of feedback signals to the controlling device like mobile/PDA in which the graphical control interface is installed thus avoiding collision and changing of path is very easy in our design.

3. SYSTEM CONFIGURATION

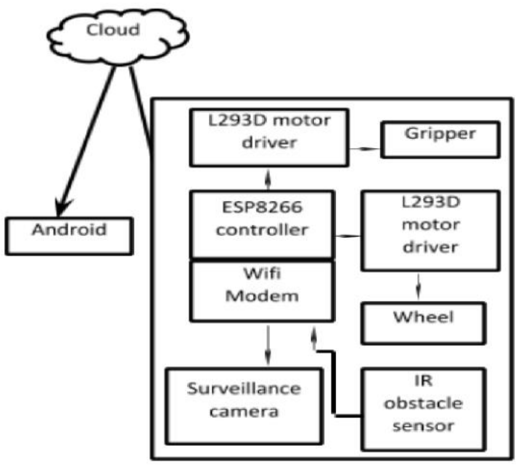

Fig 1. System Configuration

3.1 Sending command

The mode of sending command to the car is by manually clicking buttons visible in the user interface which is the android application developed in the android studio with buttons controlling movements like move forward and backward, turn right and left, stop,pick and drop.

3.2 Checks for command validation

On successful decoding the dedicated event handlers take care of the rest of the task. But on unsuccessful decoding the client is requested to generate any command from the set of valid commands. This request is in actual a message displayed on the user interface of the application.

3.3 Stores commands in a cloud service

Queue provides a well-defined and flexible service to this system. As both car information and commands are needed to be transferred at the desired places or devices and at the same time, so two queues were used- one for data and another for command. The arduino in the car listens to the Command Queue and it sends data to the Data Queue. On the other hand the android application in the controller end listens to the Data Queue and it sends command to the Command Queue.

3.4 Processor (Mobile) collects the command and passes to the Arduino

There are basically four modes of command signals that the Arduino receives from the processor. These are: 1. Move according to the command signals sent by the user, 2.pick and drop any object, 3.To send GPS sensor values acquired from the GPS, 4.To send the data received from the obstacle detector.

3.5 Arduino takes action according to the command

Based on the command received Arduino takes appropriate action. For example: acquiring GPS sensor value, acquiring obstacle sensor reading and changing the car's direction of motion or state.The GPS sensor continuously pings for getting the actual location of the car. Arduino also pings the IR obstacle sensor for distance of obstacle before the car. Based on the commands, Arduino changes the direction and speed of the motors using the motor controllers.

3.6 Updates GPS position of the car

Whenever the Robotic Car is commanded to change its position, Arduino polls the GPS sensor to get the updated GPS position and then when it is commanded to send the GPS position then this location is sent to the Data queue of the cloud service bus. This data is later received by the android application which updates the UI accordingly.

3.7 Surveillance camera provides visual track of the robotic car

The robotic car here is equipped with a surveillance camera which enables the user to be aware of the motion of the car and the environment in which the car is being operated.

Left motors	Right motors	Outcome
Forward	Forward	Forward
Forward	Static	Left
Static	Forward	Right
Backward	Backward	Backward

Table 1. Different steering methods

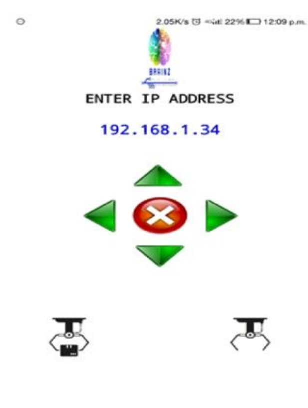

Fig 3. Android application's user interface

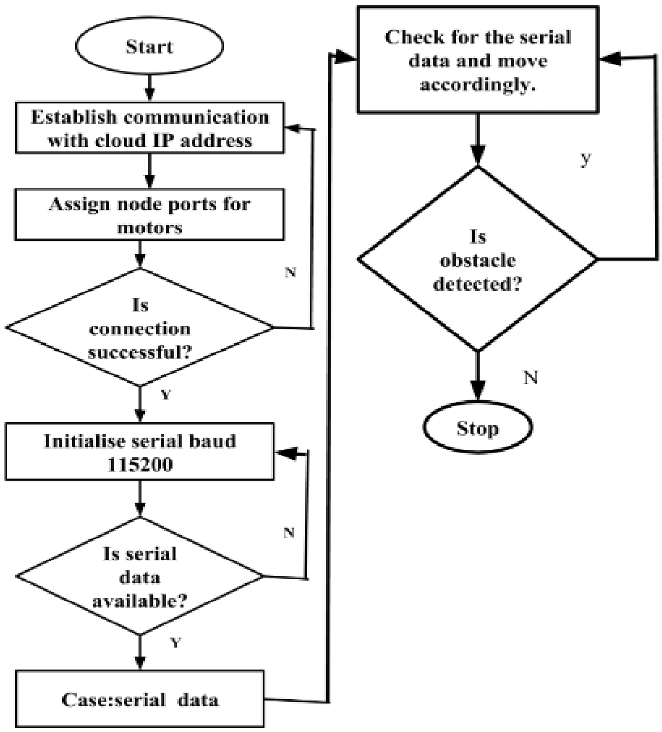

Fig 2.Workflow

4. COMPONENTS

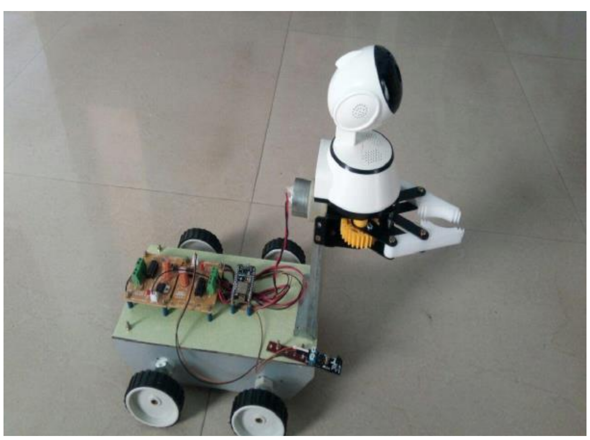

Fig 4. Hardware module

4.1 NodeMCU

The NodeMCU is an open source software and hardware development environment. The ESP8266 arduino compatible module is a low-cost WiFi chip with full TCP/IP capability, and the amazing (IoT) thing is that this little board has a MCU gives the possibility to control I/O digital pins via simple like programming language.

4.2 Motor driver-L293D

The L293D is a 16-pin Motor Driver IC which can control a two sets of DC motors simultaneously in any direction. The L293D is designed to provide bidirectional drive currents of up to 600 mA (per channel) at voltages from 4.5 V to 36 V.

5. RESULT

Two modes have been designed in this paper. The first mode is wireless control and the second mode is for obstacle avoidance. When the car is operated in mode I, the only method for controlling the car is by operation from the smartphone via Wifi. The fundamental functions are forward, left, right and reverse movements as well as a stop, pick and drop actions based on the touching of arrows in the user interface. In mode 2, the car keeps going forward until an obstacle appears within a defined threshold distance. After exploring the barrier, it will stop and waits for the command from the user.

6. CONCLUSION AND FUTURE SCOPE

In this paper an efficient control system of a robotic car is incorporated with IoT. The cloud service helps the system to reduce memory load. Stored messages are automatically removed after a certain amount of time. The performance results prove that if the incorporation is efficient. The wireless range is too small. It can be efficient if GPRS, Zigbee module is used for wireless medium. Including object detection method is one of the main future works that needs to be implemented.

7. REFERENCES

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