Raspberry Pi and IoT based Family Robot

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Abstract: In view of the present family security coefficient and poor family environment information control were complicated, family members can't access to environmental information conveniently, this paper proposed a Raspberry Pi as nuclear core processor used in the Internet of things of the family embedded robotic system. In this paper, a system is designed with an autonomous robot to sense environmental data such as temperature, air quality and store them on the cloud. The mobile robot is controlled and communicates with the cloud via a Raspberry Pi. The collected data are stored in a cloud server which could be viewed through a mobile app and can be used to create awareness about the environmental changes of the location under study. This work demonstrates a simple home automation system that allows the user to control home appliances through wireless. Lights and fans are among the appliances that can be used in this system. In this system, the controlling and monitoring the appliances can perform by using Smartphone based on Android application. Besides that, Android apps will exploit the services provided by restful API for controlling GPIO of Raspberry Pi. Raspberry Pi is used as the board controller to connect the appliances through input and output port. The Communication between the Smartphone and the Raspberry Pi board is wireless.

Keywords: Raspberry Pi, IoT, Family Robot, Smartphone, Mobile Robot.

I. INTRODUCTION

As prices rising, more and more people work harder and go on a business trip, travelling folk to their career. People ignore the family security, some of them even leaving children and old people at home alone. According to recent data, the urban crime rate is on the high status in our country, such as burglary, child trafficking cases. Combining family security and intelligence, we design a real-time video surveillance and convenient accurate mobile family robot is also very important, that has aroused widespread attention at home and abroad. Robots collect and monitor real-time environmental data, and protect the security at the same time, in order to control indoor environment by family members at any time, so that people. In their family can control switch air conditioning, air humidifier and so on more conveniently. Most of the family robots at home and abroad use Bluetooth and infrared remote to control them; these robots are usually poor in interactivity embedded systems, such as the limited control distance. In order to improve the human-computer interaction between the users and the robots, this system uses the android mobile phone for remote interactive control. The robots embedded system based on Raspberry Pi have more obvious advantages than the traditional robots in system cost, development difficulty, power consumption of equipment and safety coefficient.

Various smart home systems have been developed where the control is through internet, Android application and short message services (SMS) base. Wi-Fi competence is good and most of current technology gadgets have built-in adaptor that will reduce the system's cost. However, the system limits the control to within Wi-Fi range of the environment.

The proposed family robot system captures information and sends to a server where we can see this information remotely. Raspberry pi operates and controls sensors and video cameras for remote data viewing and surveillance, streams live video and stores data for future analysis. Also another advantage is that it offers privacy on both sides since it is being viewed by only one person .Other advantage is that it is a simple circuit and the system uses raspbian operating system. The raspberry pi is a very powerful, minicomputer with the dimensions of credit card which was designed with the hope for learners to be creative. This computer uses ARM (advanced RISC machine) processor, the processor at the heart of raspberry pi. All the Storage is provided from a SD card. The Raspberry Pi system functions like a computer with small setup. It contains GPIO, USB ports, Wi-Fi and Ethernet. Using these ports we can control the appliances with the sensors as well as interface the camera for surveillance. Raspberry Pi can be used for multiple purposes based on our requirement.

II. LITERATURE REVIEW

In today's age robotic has the fundamental key for new invention. The development of human-machine communications on an everyday basis has made the people to utilize the technology. Instead of giving rational methodology physical methods have been welcomed by everyone. Coding to some 100's of pages requires more instance, capital and power so to overcome that gesture recognition is enhanced. Using gesture recognition coding can be easily made by everyone. For gesture recognition many active devices such as a trackball, remote, joystick and touch

tablet are in practice. Some of the devices are used for giving motion recognizer but gesture recognition has the foremost utility. So gesture recognizer like accelerometers with 3- axes is extensively used. Gesture can be captured by wearing gloves or having wrist band attached with the MEMS whereas using vision system and data glove is very expensive hence not utilized. To have a balance of precision data collection, ―Micro Inertial Measurement Unit‖ is developed for recognizing the gestures in 3 dimensional axis x, y, z. [1]N. Sriskanthan and Tan Karand in their work have presented an application of Bluetooth Technology for Home Automation. The Bluetooth technology which emerged in late 1990's is used for implementing the wireless home automation system. Various appliances such as air conditioners, home theatres, cellular phones etc., are interconnected, thus creating a Personal Area Network in Home Environment. The communication between several client modules and the host server takes place through the Bluetooth module. A Home Automation Protocol has been developed to enhance communication between the host server and the client modules. The system also allows integration or removal of devices to the network which makes the system scalable. The wireless system aims at reducing the cost of Home Automation. But the system does not use the trending mobile technology. [2] Shahriyar, E. Hoque, M. M. Akbar, S. Sohan, I. Naim, and M. K. Khan presented a GSM based communication and control for home appliances. Different AT commands are sent to the Home Mobile for controlling different appliances. The drawback of this system is that a Graphical User Interface (GUI) is not provided to the user. Different AT commands have to be remembered by the users to control the connected devices. Also, the system supports Java enabled mobile phones. The system thus becomes less functional as now-a-days the use of Java enables phones are reducing and the use of Android phones are increasing tremendously. [3]The Home automation system uses Wi-Fi technology. System consists of three main components; web server, which presents system core that controls, and monitors users' home and hardware interface module(Arduino PCB (ready-made), Wi-Fi shield PCB, 3 input alarms PCB, and 3 output actuators PCB.), which provides appropriate interface to sensors and actuator of home automation system. The System is better from the scalability and flexibility point of view than the commercially available home automation systems. The User may use the same technology to login to the server web based application. .If server is connected to the internet, so remote users can access server web based application through the internet using compatible web browser. The application has been developed based on the android system. An interface card has been developed to assure communication between the remote user, server, raspberry pi card and the home Appliances. [4]The application has been installed on an android Smartphone, a web server, and a raspberry pi card to control the shutter of windows. Android application on a Smartphone issues command to raspberry pi card. An interface card has been realized to update signals between the actuator sensors and the raspberry pi card.

III. METHODOLOGY

FLOW CHART
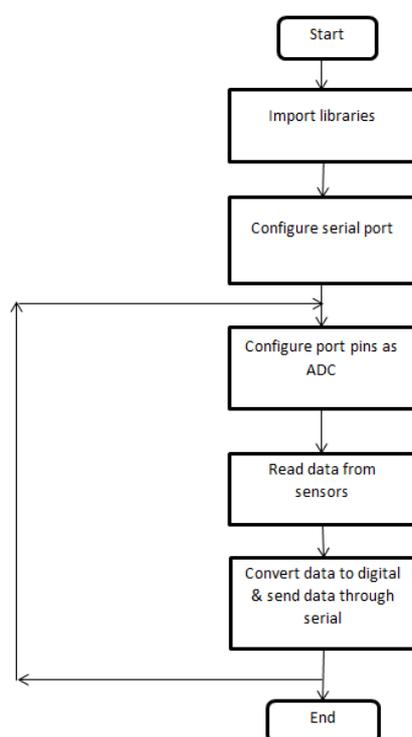
Fig 3.1.Flowchart of the Arduino part
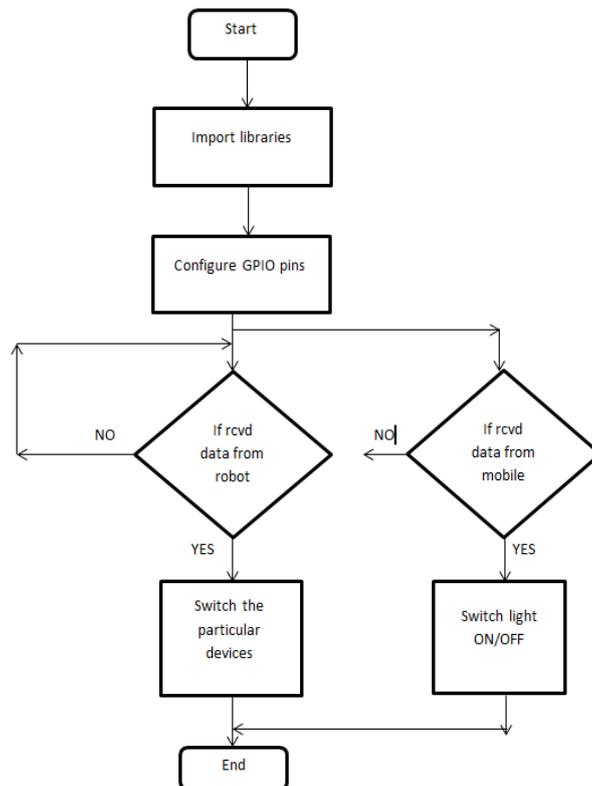
Fig 3.2.Flowchart of the Switching part
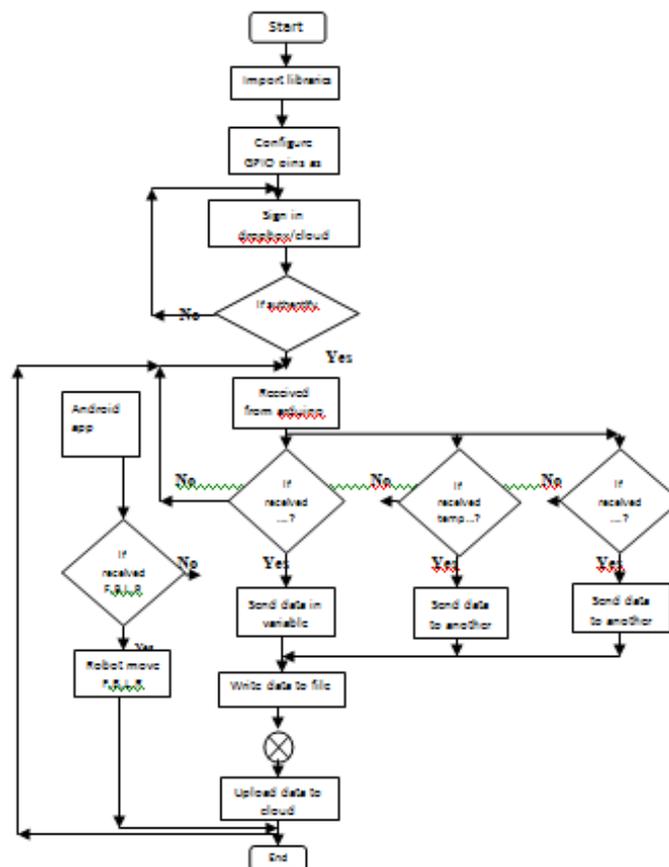
Fig 3.3.Flowchart of the robot part

BLOCK DIAGRAM
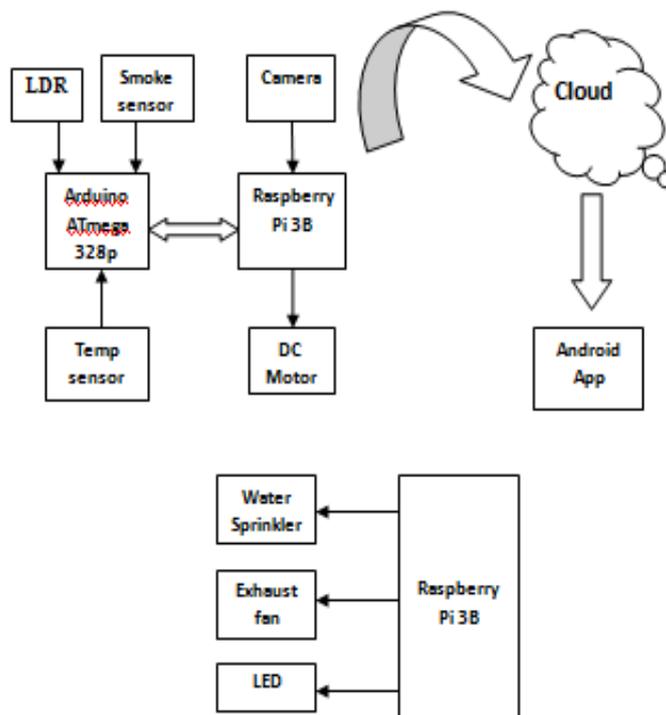
Fig 3.4. Block diagram of proposed system.

WORKING

This system adopts double microprocessor architecture, and its processor is divided into two parts: one use Arduino to drive the peripherals, such as temperature and humidity sensor, smoke sensor, light sensor, dc motor, etc., to insure that robots can work normally, and sent the data to the Raspberry Pi. The other it used Raspberry Pi as core processor, complete final processing of data, the data storage, the video signal compression, real-time video transmission and data server, after that the data will be present on the network eventually. As shown in figure.

Arduino is a high portability, convenient and quick embedded development platform of open source electronics, with AVR single chip microcomputer as the kernel. It only supports Arduino IDE and it's a new type of microcontroller which is easy to get started programming language tool for developing.

The emergence of the Arduino marks the coming of the era of electronic circuit module and electronic DIY.As it's "sister", Raspberry Pi has shown a similar appearance. Something different is that Raspberry Pi needs to carry on operating system which can be any version of Linux, Windows 10, and it may also be the derivatives of Linux - Android.
Raspberry Pi is more like a fully functional "computer". And Arduino built-in A/D, D/A conversion makes it have real-time analog to digital circuit, input and output ability, making it irreplaceable, and making people relax from PMW and AD chip.

IV. RESULTS AND ANALYSIS

This system simulates family environment in laboratory, transmitting Wi-Fi by computer simulates family router Wi-Fi environment. We use carton and foam board as raw materials to build the robot model, to control and monitor equipment testing by the mobile phone. For testing purposes, moving to a different place, the robot measures the environment such as temperature, light intensity, smoke concentration data, and stores data by Python code to grab the embedded operating system in time.

Through the data in the table we can know that its data display pages can be accessed, data presents the current time respectively and accurately, and the result of this test can determines the room number, of course, the environment is safe. Used in the tests of real-time video streaming accesses to network , and the real-time video is decoded to play, and the stable movement of the robot frame rate remains the same. Mobile real-time monitoring video test is shown in figure 4.1.

Fig 4.1. Video streaming

By figure 4.1, you can see that mobile phone can capture high-definition real-time monitoring, without distortion, and network latency number is less, but more stable.
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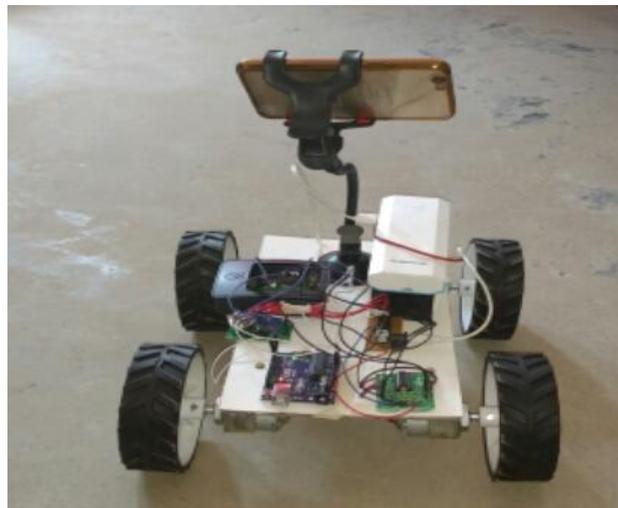
Fig 4.2. Family robot
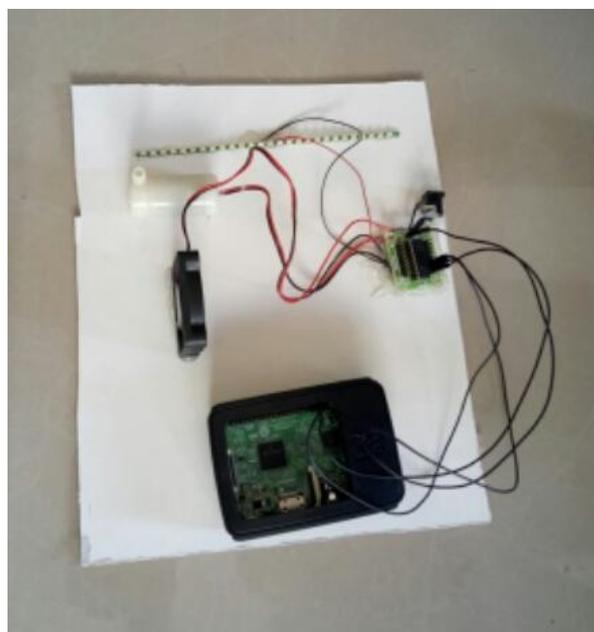
Fig 4.3. Switching part placed in home
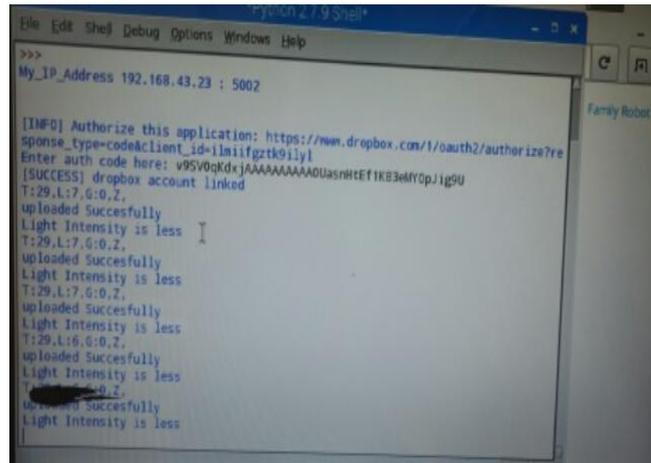
Fig 4.4. output of the system
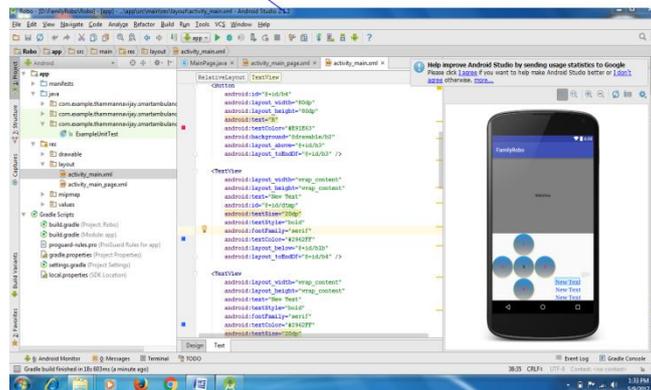
Fig 4.5. Snapshot of the android application

V. CONCLUSION

Based on Raspberry Pi family robot system, we adopt double micro control architecture of embedded design which breaks through the traditional Internet of things. Test results show that the system has high reliability, security and stability, strong anti-interference, and runs in good condition. Practice shows it is feasible that Raspberry Pi builds server and double microcontroller architecture in the Iot family robot application.

This system can be described as very useful to everyone and especially for disabled and elderly people. The result from previous chapter also show that this system work well and achieve its objective. This system also had been developed with low cost in mind and user friendly interface to allow more users will able to implement the system in their home. This system added more features such as gas sensor, temperature sensor and other function like push notification in mobile apps to alert user with changing of switching state and sensor reading. Therefore, more users are able to use the system and be more beneficial to society.

In this project, we are designing an advanced automation system which has surveillance system and which in turn reduces most of the human interactions, by supporting this system using Internet of Things (IoT). Finally, it is absolutely an affordable system. It can be associated with various other options like energy monitoring systems etc., soon, as an extension to this project a system may be developed which warns the user about the excess usage of energy.

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