Design and Evaluation of Wireless Automation Systems: Video Surveillance Robot Based on Microcontroller, Bluetooth, Mining and Android Technology

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***Abstract*—In that examination, the Arduino UNO chip device was used for remote command wireless video avoidance bicycle (WVASC). The car is equipped with a camera and Wi-Fi router and is combined with a transatlantic video transmission mining system. We have written an Android wireless video capture system to limit the terminal App so that users can supervise the original end of the smartphone tour exhibition and use the smartphone app to control WVASC. The LED illumination torch is located in the vehicle so a dark volume can be assumed. If the WVASC Informedly is cut off, the four factions of the car are equipped with ultrasonic sensors to distinguish the asylum target from the mining system, which can withdraw and avoid the WVASC hitting the obstacle or crushing the wheel frame. It can also avoid obstacles in an unpredictable atmosphere. We completed the PSoC board on the main controller and used the Arduino UNO as a sub-controller. By using the PSoC to control the WVASC, more sensors will be installed in the car, so the stability of the mining system embedded in the car also enhances communication improvements. The Android mining system will enable the rapid development of wireless communication technology. By adopting the above improvements, it can also improve the capacity and speed of the mining system process and reduce the energy consumption of the WVASC.**

***Index Terms*—Arduino programming, Android App, microcontroller, Bluetooth, mining and Android technology, Wi-Fi router**

I. Introduction

Global warming is becoming more and more serious, natural environment has changed dramatically. In recent years, major natural disasters occur frequently worldwide, causing serious casualties and property damage in human society, the extent of damage and the degree of damage is increasing. So when a disaster occurs, how to protect the rescue personnel, and people affected by the disaster, and timely rescue is what we want to explore too. Use WVASC to help with disaster relief, can reduce casualties.

The WVASC is not only the people's toys, but also equipped with camera to shoot images of environments. When natural disasters occur, people can use the WVASC to shoot scenes in remote distance, so rescue crew can immediately receive the latest scene from the

Manuscript received August 26, 2018; revised July 7, 2019.

doi: 10.18178/ijmerr.8.5.819-824

site and start dealing with the situation they faced.

In this research, Arduino single microchip is used as a controller for WVASC, Arduino is an open interactive environment development technology licensed, using open source software and hardware-based platform, constructed with simple and easy I / O interface, and may use similar Java, C language and other high-level language development environment, as shown in Fig. 1.

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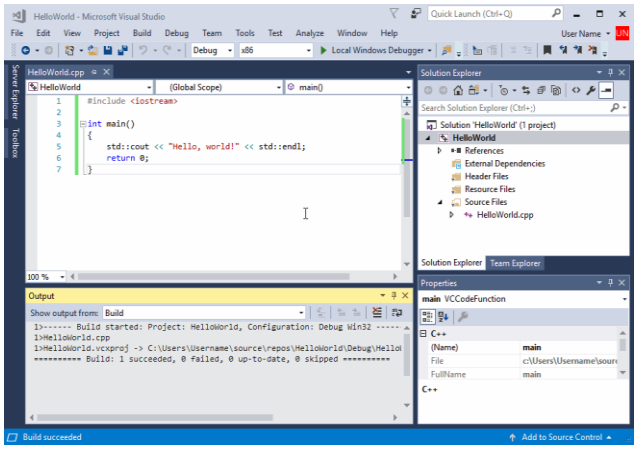

Figure 1. Arduino written program interface

II. Literature Survey

Similar concepts to this idea have already been developed. Ideas of this paper come from International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS), author Use the Android smart phone as a remote controller, combined with Arduino Yun control and Arduino Yun Wi-Fi wireless transmission function, mounted on the vehicle body Arduino Yun Development Board, and connected with the motor drive chip and control network camera module, Wi-Fi achieve real-time video transmission through a smart phone remote control [2].

In another ideas of this paper come from International Conference on Electrical Engineering and Information & Communication Technology (ICEEICT), author can design a self-propelled robot to remotely control the car, the self-propelled car can be mounted on vertical, horizontal movement of the camera platform, so that users can use the computer to monitor the far end of the scene, and may order the self-propelled car to move to the proper location. Self-propelled car is also fitted with ultrasonic distance sensor, temperature and humidity sensors and electronic compass, these sensors can be used to measure hazardous environments can also be used as self-propelled car automatic cruise and obstacle avoidance design [3].

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III. System Architecture and Stability Analysis

The Avoidance self-propelled car is fitted with Wi-Fi router, and upgrades the firmware of the router in order to connect to a camera. After video transmission mining system upgrading, Arduino can control other peripheral devices, such as dc motors and servo motors. Wireless video control terminal App, based on an Android mining system is written as a sample to control the WVASC. The Car can be viewed as a simple smart phone remote control acting availability [4], as shown in Fig. 2.

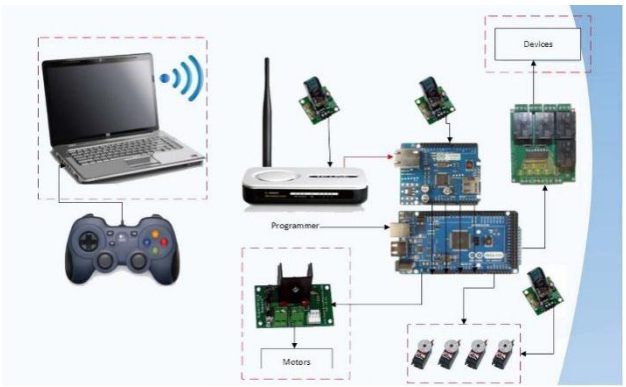

Figure 2. Arduino and Wi-Fi Router structure diagram

We begin an active model with synchronous parallel elements. Given the setup of twists at the past advance, s(t −1) = {s1(t −1), . . . , s_N (t −1)}, the spins s_i (t) from the distribution:

$$p(s_i(t)|s(t-1)) = \frac{1}{1+e^{-2\beta s_i(t)\hbar_i(t)}} \quad (1)$$

where

$$\hbar_i(t) = H_i + \sum_j J_{ij} S_j(t-1) \quad (2)$$

The parameters H_i and J_{ij} allude to the nearby fields and β is the reverse temperature of the model. Without loss of consensus, we expect β = 1.

The mean field approximation is defined as

$$\hbar_i(t) = \sum_R J_{SR} m_R(t-1)$$

$$m_R(t-1) = \frac{1}{N_R}\sum_{j\epsilon R} s_j(t-1) \quad (3)$$

where $m_R(t-1)$ is the mean field of region R.

Thus, an integrated information is defined at t + τ :

$$\phi_M^{cut}(\tau) = D(p(s(\tau_0 + \tau)|s(\tau_0)), p^{cut}(s(\tau_0 + \tau)|s(\tau_0))) \quad (4)$$

where D(p_1, p_2) represent the distance over the elements of mechanism M, cut = {S_1^C, S_2^C, S_1^f , S_2^f }, where S_1^C, S_2^C design the blocks at the current state $\{s_i(\tau_0)\}_{i\in M}$, and S_1^f, S_2^f represent the blocks of a bipartition of the units $\{s_i(t+1)\}_{i\in M}$, in the partition cut = {{S_1 (t), S_2 (t)}, {S_3 (t)}, {S_1 (t + 1), S_2 (t + 1), S_3 (t + 1)}, {}}.

Moreover, based on the interpolation method and Eq. (2), we can obtain

$$x_j(k+1)=[\sum_{q_1^{S_j}=1}^{2}\cdots\sum_{q_{R^{S_j}}^{S_j}=1}^{2}h_{q_1^{S_j}}^{S_j}(k)\cdots h_{q_{R^{S_j}}^{S_j}}^{S_j}(k)G(v^{S_j},\Psi^{S_j})$$
$$(W^{S_j}[\cdots[\sum_{q_1^2=1}^{2}\cdots\sum_{q_{R^2}^2=1}^{2}h_{q_1^2}^2(k)\cdots h_{q_{R^2}^2}^2(k)$$
$$G(v^2,\Psi^2)(W^2[\sum_{q_1^1=1}^{2}\cdots\sum_{q_{R^1}^1=1}^{2}h_{q_1^1}^1(k)\cdots h_{q_{R^1}^1}^1(k)G(v^1,\Psi^1)$$
$$(W^1X_j(k))])]\cdots])] \quad (5)$$

$$=\sum_{v_j}h_{v_j}(k)A_{v_j}(W,\Psi)X_j(k) \quad (6)$$

where

$$h_1^\tau(k),h_2^\tau(k)\in[0,\ 1],\qquad\sum_{q_l^\tau=1}^{2}h_{q_l^\tau}^\tau(k)=1,$$

$$\sum_{v^\tau}h_{v^\tau}^\tau(k)=\sum_{q_1^\tau=1}^{2}\cdots\sum_{q_{R^\tau}^\tau=1}^{2}h_{q_1^\tau}^\tau(k)\cdots h_{q_{R^\tau}^\tau}^\tau(k),$$

$$A_{v_j}(W,\Psi)\equiv G(v^{S_j},\Psi^{S_j})W^{S_j}\cdots G(v^1,\Psi^1)W^1,$$

$$\sum_{v_j}h_{v_j}(k)\equiv\sum_{v^{S_j}}\cdots\sum_{v^1}h_{v^{S_j}}^{S_j}(k)\cdots h_{v^1}^1(k)=1,$$

$$h_{v_j}(k)\geq 0.$$

According to Eq. (3), the dynamics of the jth isolated NN subsystem (6) can be rewritten as the following LDI representation:

$$X_j(k+1)=\sum_{i=1}^{R_j}\hbar_{ij}(k)\bar{A}_{ij}X_j(k) \quad (7)$$

where $\hbar_{ij}(k)\geq 0$, $\sum_{i=1}^{r_j}\hbar_{ij}(k)=1$, $\bar{A}_{ij}(k)$ is a constant matrix with appropriate dimension associated with $A_v(W,\phi)$ and r_j is a positive integer.

Based on the analysis above, the jth NN subsystem N_j with interconnections can be described as follows:

$$N_j:\begin{cases}X_j(k+1)=\sum_{i=1}^{r_j}\hbar_{ij}(k)\bar{A}_{ij}X_j(k)+\phi_j(k) & (8a)\\ \phi_j(k)=\sum_{n=1}^{J}C_{nj}X_n(k), & (8b)\end{cases}$$

where C_{nj} is the interconnection matrix between the nth and jth subsystems.

The purpose of this paper is two-fold: to stabilize the closed-loop nonlinear system and to attenuate the influence of the external disturbance b(k) on the state variable x(k). According to [10], the disturbance attenuation problem, which is characterized by means of the so-called L_2 gain of a nonlinear system, is defined as follows: Given a real number $\gamma > 0$, it is said that the exogenous input is locally attenuated by γ if there exists a neighborhood U of x(k) = 0 such that for every positive integer N and for every for which the state trajectory of the closed-loop nonlinear system starting from x(0) = 0 remains in U for all $k\in[0,N]$, the response $\boldsymbol{x}(k)\in\ell_2([0,N],\Re^m)$ satisfies

$$\sum_{k=0}^{N}\boldsymbol{x}(k)^T\boldsymbol{Q}\boldsymbol{x}(k)\leq\gamma^2\sum_{k=0}^{N}\boldsymbol{b}(k)^T\boldsymbol{b}(k)\qquad\forall N$$

where Q is a positive definite weighting matrix. The physical meaning is finding an L_2 gain less than or equal to a prescribed number γ (strictly less than 1).

IV. Self-propelled Car Architecture

The WVASC mining system uses a standard acrylic plate as its car body, and fitted with a dc motor and gear box, in front of the car also equipped with servo motor connected to camera, enable it to move horizontally and vertically, Ultrasonic sensors on four sides of the vehicle body, are installed to sense the distance, preventing users from improper operations, for instance, hit the wall, damage to the car body. Those sensors also help to avoid obstacles in dangerous environment.

The Arduino UNO core atmega328p-pu microcontroller development board is used in this research. Hardware itself has 14 groups I / O (digital inputs and outputs), six of them do PWM (pulse width modulation) output, six groups do analog inputs, 1 set UART (universal asynchronous transceiver transmitter) of hardware serial ports, using the 16 MHz crystal oscillator. As a result of using bootloader (booting), it can directly download the program via USB, without external burned devices. Users can choose to changer power from USB power supply or an external power supply by AC-TO-DC rectifier. Batteries can also be used as an external power supply, and the input voltage is 7-12v [5].

The Arduino motor drive has expansion modules, uses a LD293D motor drive chip, driving two DC motors or two stepper motors. We can use 7805 chip and design a 5V power supply. It will enable the mining system to provide a stable voltage to the system.

The car uses the GL-inet-6480A router, it is a free upgrade which allows users Openwrt router firmware. Because the upgrade firmware in the router Openwrt, the car can use all the new features freely, including the original features, for example: monitoring, intelligent home appliances, which use [6].

The car is equipped with a DC servo motor Futaba s3003, mounted below the camera, uses for controlling view direction of the camera. The High Definition camera in front of the car is BNT HD720p camera, as a wireless video surveillance camera which, can be used in rescuing

and remote monitoring User can use smart phone to watch the images from a distance.

The left and right sides of the car body are mounted with a LED lighting lamp which can be used at night and in the dark place. In the four sides of car also fitted respectively with a HC-SR04 ultrasonic sensor, to detect the distance. Its detection distance is between 2 cm to 400 cm. Its accuracy is 0.3 cm, measuring angle is 15 degrees. When sensors detect obstacles less than the minimum setting distance, it will automatically avoid them [7]. Meanwhile it can also avoid obstacles in the dangerous environment. Fig. 3 and Fig. 4 are diagrams of assembled WVASC.

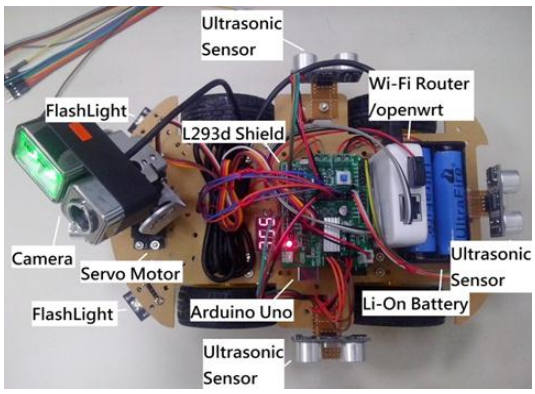

Figure 3. Wireless video avoidance self-propelled car plan view

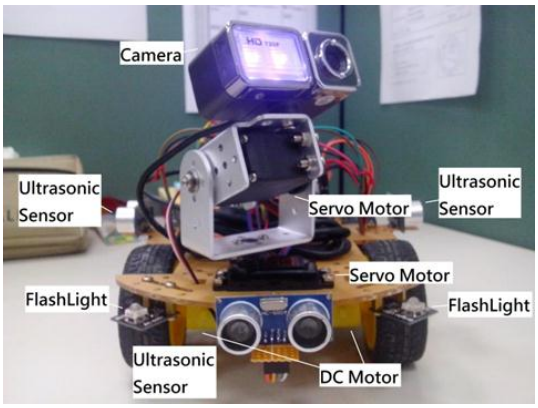

Figure 4. Wireless video avoidance self-propelled vehicle front view

V. Results

Android is a Linux-based open source operating mining system for mobile devices, mainly used in smart phones and tablet PCs. Users can use Android SDK development tools to write their own APP.

A. Android Development Tools

Eclipse is a famous free cross-platform integrated development environment (IDE). The first major development is in the Java language, but some people make it as C ++, Python, PHP and other languages development tools now. Eclipse itself is just a framework platform, but by the support from a quantity of plug-in the Eclipse would have better flexibilities. Many software developers use Eclipse IDE as a basic form to develop their own framework [8], as shown in Fig. 5.

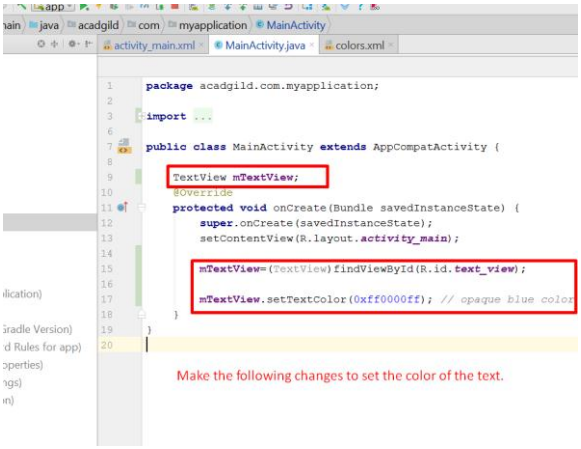

Figure 5. Android written program interface

B. My APP Program Structure

In this research, uses Eclipse to write Android App. The Eclipse program java chart as shown in Fig. 6, the main program flowchart as shown in Fig. 7, the smart phone user interface as shown in Fig. 8. On the left side controls the DC motor to move forward, backward, turn left, turn right and stop, the opposite, right side, controls the servo motor turn left, and turn right and stop. The APP program structure contains all the actions of the entire vehicle applications, these actions are part of APP program architecture which consists of four java programs, namely Main, MjpegStream, SettingsActivity and WifiCarActivity APP Wi-Fi transmission Arduino Uno and wireless router, all contained in the frame of APP program [9].

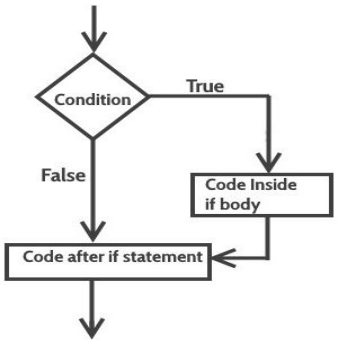

Figure 6. Eclipse program java chart

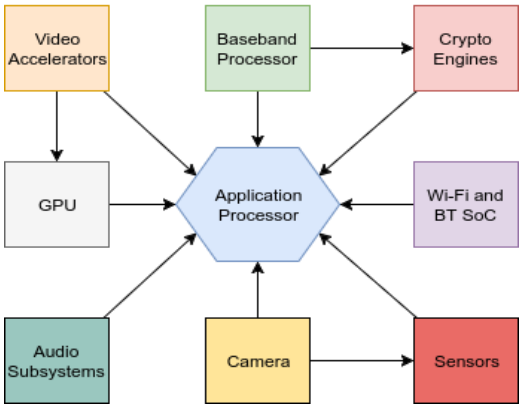

Figure 7. Android App and Wi-Fi Router structure chart

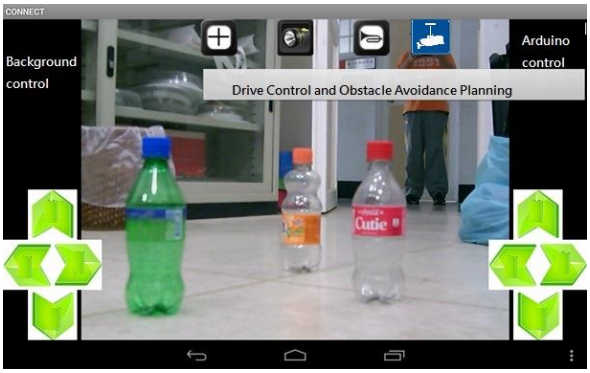

Figure 8. Smart phone user interface

VI. Discussions

In this research, from the beginning of the hardware to the software design, the most difficult part is dealing with integration issues. Because there are a variety of special hardware control modes, so I must choose the hardware characteristics carefully. Cautiously make every decision when integrated, preventing certain problems to happen during the whole development process [10], as shown in Fig. 9.

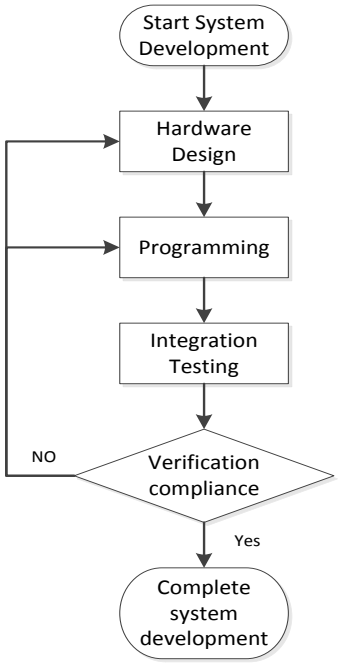

Figure 9. Software and hardware mining system development

Four problems happened when we got the test results; the first problem was that the connection between smart phone and wireless router was often failed; The second problem was when DC servo motor operating, it often unable to reach the specified coordinates rotation; The third problem was that the movements (forward, backward, turn left, turn right and stop) of WVASC had a time lag.

At first, something seems broken, but there is the time lag caused by the lack of battery power. So the solution is to divide the energy supply system into three parts, the wireless router is the first part; the Arduino microcontroller is connected to the sensor and the DC servo motor is the second part; the motor drive and DC motor are the third part; so I can solve The problem that occurred during the test is shown in Fig. 10. Besides, the future study will be considered by Deploying Internet of Things in Healthcare and Efficient Deterministic Edge Traffic Distribution Network-on-chip Routing Algorithm Design.

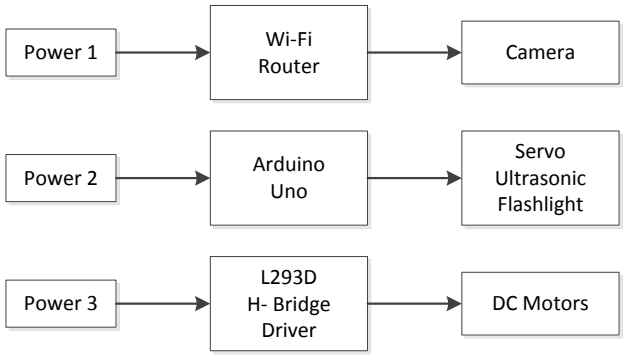

Figure 10. Power allocation structure drawing

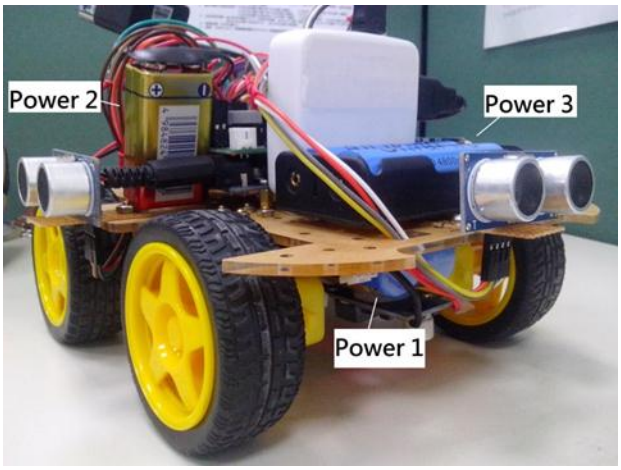

Figure 11. Power Distribution schematic

VII. Conclusions

WVASC systems are can be widely used, not only for entertainment purposes, but also for rescuing purposes. Because high-tech automation era is coming, it can offer more convenience to our daily life. It can complete many high-risk missions in different fields and achieve energy-saving and security aims. At technical level, in order to understand characteristics and controller of the WVASC body, practice of hardware and writing software must have a considerable degree of understanding. The long term, we can the PSoC board on a main-controller and put the Arduino UNO for as sub controller. More sensors will be also installed inside the car by using the PSoC to control the WVASC, thus the stability of the mining system embedded in the car are also enhance improvements in communication. Android mining system will make wireless communication technique fast-growing. By adopting improvements mentioned-above it can also increase the ability and speed of the mining system process and reduce the

energy-consumption of the WVASC.

ACKNOWLEDGMENT

The authors declare that there are no conflicts of interest regarding the publication of this paper. All analyzed data during this study are included in this article. This research was in part enlightened by the grant 106EFA0101550 of Ministry of Science and Technology.

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