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User-Configuration Universal Windows Platform SCADA System Base on I^{2}c Bus Communication

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Abstract: The UWP now provides a common app platform available on every device that runs Windows 10, (Devices IoT, Mobile, PC, XBOX, Surface Hub, etc.) Which Are UWP .This means you can create a single app package that can be installed onto a wide range of devices and, with that single app package, the Windows Store provides a unified distribution channel to reach all the device types your app can run on. In this paper will discuss the design and implementation of monitoring and supervisory control system using a windows system platforms from the Windows 10(device IoT), especially after winning support from the Microsoft Company for these (devices IoT) which is belong the universal windows platform (UWP) such as Raspberry Pi2 widows 10 platform as a Master terminal Unit (MTU) and I will discuss the extended of the SCADA system vertically and Horizontally (by using GPIO Pin of the MTU , one type of bus (Modbus , I2C bus , UART) respectively , in case the horizontally extended I will use the Remote Terminal Unit (RTU) design by suing AVR microcontroller family (ATemage328PU) . the IDE will be used to developed the code for the MTU (visual Studio community 2015) and the IED use to developed the code for the RTU (visual C++/C) also use one of (emulator and Proteus software) to simulate the code before activation. at the end, the system easily to the configuration as the end user wish because the system User configurable

Keywords: Windows Run Time (WinRT), Universal Windows Platform (WUP), Internet of things (IoT), Master Terminal Unit (MTU), Remote Terminal Unit (RTU), inter-integrated circuit Bus (I2C), integrated Development environments (IDE).

I. INTRODUCTION

Windows systems environment created a good interactive with the end user. And achieved success on the marketing level by being easy to handle as well as get the output in a simple and accessible to anyone, regardless of his scientific background. Microsoft Company adopted this case since 1995. It began to release the first OS that supports Windows environment so that became the more popular and sales in global markets compared with global production companies for operating systems (such as Linux and Mac). Especially after Microsoft's approach to change and support for the product which represented in the case of the new update for any issuing will became free and without need to format the platform, or to the reconfiguration and return the installation as well as the lack of loss of any software or data,

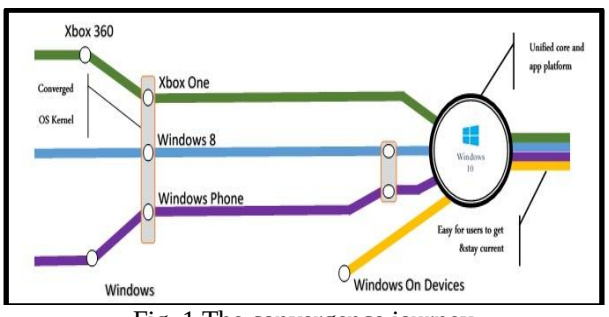

Fig. 1 The convergence journey

The arrival of the Windows 8, which introduced the Windows Runtime (WinRT), which was an evolution of the Windows app model. It was intended to be a common application architecture. When Windows Phone 8.1 became available, the Windows Runtime was aligned between Windows Phone 8.1 and Windows. This enabled developers to create Universal Windows 8 apps that target both Windows and Windows Phone using a shared codebase. Windows 10 introduces the Universal Windows Platform (UWP), as show in figure 1 the convergence journey.

Which further evolves the Windows Runtime model and brings itinto the Windows 10 unified core. As part of the core, the UWPnow provides a common app platform available on every devicethat runs Windows 10, (Devices IoT, Mobile, PC, XBOX, Surface Hub, etc.)Shown in figure 2 different kinds of windows 10 platform .This means you can create a single app package that can be installed onto a wide range of provides a unified distribution channel to reach devices and, with that single app Package, the Windows Store all the device types which your app can run on

Windows 10 IoT Core is a version of Windows 10 that is optimized for smaller devices with or without a display, and that runs on the Raspberry Pi 2 and 3, Arrow DragonBoard 410c & MinnowBoard MAX.Windows 10

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IoT Core utilizes the rich, extensible Universal Windows Platform (UWP) API for building great solutions. This means you can create a single app package by using same integrated development environment which is (**Visual Studio 2015 IDE)** as shown in figure3

- Every project type (Desktop, Windows, Phone, Service, Web, Game, More ….)
- Every developer task Code edit, Architecture design, UX design, Debug, Profile, Review, Test, More…
- Every development language C++/CX, C#, Visual Basic, JavaScript, XAML, HTML, More…

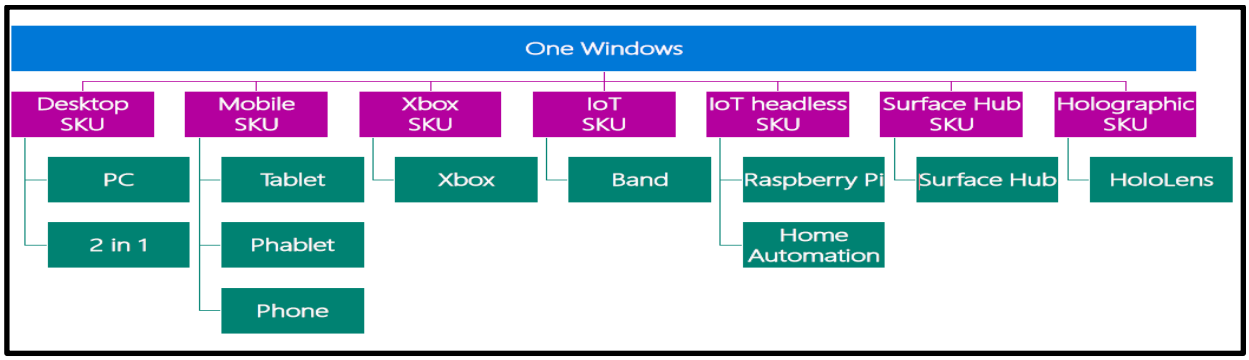

Fig. 2 kinds of windows 10 platform

Fig. 3one store one ide for all WUP

Because of this convergence provided by Microsoft Corp. to unify the Core for operating systems for various platforms which will be used in the aspect of embedded systems, specifically in the field of home automation. Andmost of the engineers are on the familiar by use of development environment (Visual Studio 2015 IDE) ,as well as Arrival of the Raspberry Pi as (UWP), all these reasons led to design system easily through window interactive with end user and easily reconfiguration according to the opinion of the end user

The thesis is on Home Automation. It covers the area of monitoring and controlling appliances in home as per user's configuration and control. As the automation is performed on Raspberry Pi device along with RTU board, it combines the overall benefits from both devices and thus useful in implementing our tasks.

It primarily focus on safety and then other facilities extended along with it. Services like knowing temperature reading, lights On/Off condition, fan On/Off and other services are featured in this Home Automation. The Alarm system is also major part in Home Automation which secure the home and update user with right information in right time to avoid accident and loss. The controlling section is great importance in Home Automation. User will have automatic settings to control the appliances. Further, this service is good and one of the reliable way to encapsulate home from internal and external danger. People in job or outside home can work freely and smartly having control to their home. They can just sit and login browser and see what is going on in their home in just a second and feel that their home is with them all time. Home Automation is truly one of the needs in today's world. People rely and feel safe and warmth in their home with their family. Home Automation brings closer and more safer to them

II. SCADA SYSTEM

What is SCADA? :- (Supervisory Control and Data Acquisition)

Supervisory :- (Operator/s, engineer/s, supervisor/s, etc.)

Control: - (Monitoring, Limited, Telemetry, Remote/Local)

Data acquisition :- (Access and acquire information or data from the equipment, Sends it to different sites through (telemetry, Analog / Digital))

2.1 SCADA system performs four functions:

1. Data acquisition
2. Networked data communication
3. Data presentation
4. Control

2.2 Elements of a SCADA system

1. Sensors and actuators

Types of sensors:

1. Pressure sensors
2. Temperature sensors
3. Light sensors
4. Humidity sensors
5. Wind speed sensors
6. Water level sensors
7. Distance sensors

2. RTUs/PLCs

RTU – Remote Terminal Unit

1. Intelligent to control a process and multiple processes
2. Data logging and alarm handling
3. Expandable

4. Asks the field devices for information
5. Can control IEDs (Intelligent Electronic Device)
6. Slave/Master device
3. Communication
Modbus Communication, I2C Bus, CAN Bus, etc.
4. MTU
Front End Processor
SCADA server
Historical/Redundant/Safety Server
HMI computer
HMI software

III. HOME AUTOMATION

Home automation is more than just a remote control for your TV! Examples include programming your DVR to record your favorite shows, setting the AC unit to come on when it reaches 76 degrees Fahrenheit, and installing a fancy alarm system that contacts the police in the instance of a break-in

3.1 A history of home automation
Concepts for home and building automation were around for decades before becoming reality and featured in the writing of the 19th century sci-fi author HG Wells, comics, and cartoons such as the Jetsons.

3.1.1 The Electronic Computing Home Operator (ECHO)
Was featured in the April 1968 edition of Popular Mechanics and had been expanded from a set of spare electronics - both in the physical and literal sense.

3.1.2 X10 – a standard is born
The beginning of modern home automation technology can be argued to be found with the introduction of the X10 technology standard. Conceived in 1975 by Pico Electronics, X10 laid out the framework for allowing remote control access of domestic appliances. The X10 standard was designed to allow transmitters and receivers to work over existing electrical wiring systems by broadcasting messages such as "turn off" and "turn on" via radio frequency bursts.

3.1.3 The dot.com boom and open source – a new set of technologies
With the explosion of technologies that followed the birth of the web in the '90s, home computing and networking technologies were now available to the public and could easily and cheaply be installed at home. It was only a small step from PC to PC communication to appliance to PC communication
These devices have provided mobile computing platforms that can run complex software and be small enough to fit in the user's pocket. As a result of this, applications have been developed for the iPhone and Android that allow the user to control consumer electronics such as the TV.

3.1.4 Arrival of the Raspberry Pi
With the arrival of the Raspberry Pi and the Raspberry Pi to Arduino shield, a set of open source technologies now exist that combine the power of the PC, the communication and multimedia technologies of the web, the ability to interact with the environment of a microcontroller, and the portability of a mobile device.

3.2 Three types of home automation systems
3.2.1 Individual control devices,
Individual devices control only one appliance or function, examples include; programmable thermostats, motion detectors, occupancy sensors, photocell lighting controls and timers.

3.2.2 Distributed-control systems.
A distributed-control system allows for individual appliances to communicate internally with each other over the existing electrical wiring without a central controller (although keyboard entry is possible using telephones or personal computers)

3.2.3 Centrally controlled systems.
A centrally controlled communication system routes signals between a central computer and appliance controllers or environmental sensors

IV. OBJECTIVE

1. To help people to monitor electrical appliance in their house.
2. To develop Automated House by using Raspberry Pi.
3. To explore the concept of using Raspberry Pi belong UWP device

V. SYSTEM PROPOSE

SCADA system is developed to control the process at a distance. Different parameters can be controlled by the same master station. Control parameters are sent to the master station by remote terminal units. Communication channel work as a bridge between master station and remote terminal units. Total parameter sending capacity depends on the communication channel type. SCADA is a concept that is used to refer to the management and procurement of data that can be used in developing process management criteria. As in a SCADA system many RTUs are connected to the same MS through channel. Hence using an efficient communication channel is of much importance.

This system consists of three important parts: a master terminal unit module aRaspberry Pi board. The version of the board or the model (A or B) doesn't really matter, but keep in mind that you will have to connect it to your local network, so you will need a Wi-Fi dongle if you are using the A model which doesn't have an Ethernet port. In this paper, we used a Raspberry Pi model B with the Wi-Fi dongle, channel as made communication between MTU and RTU (AVR microcontroller) as A REMTE terminal unit and group of sensor (PIRsensor, LM35 Temperature sensor, light dependence Sensor). The I^2C bus is used to send and receive instructions between the MTU and the RTU. The Raspberry Pi board is a "brain" unit of the system because it is responsible for controlling all parts of the system as shown in figure 4.

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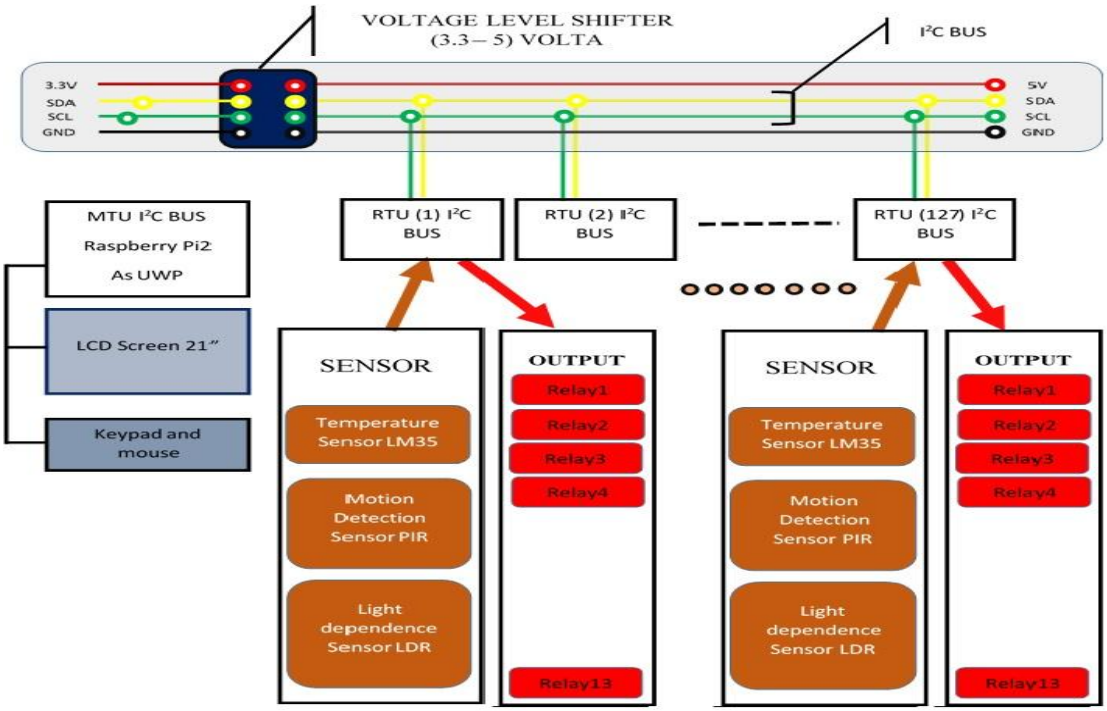

Fig.4proposer system layout

5.1 Raspberry Pi (MTU)

The Raspberry Pi is a credit-card-sized single-board computer developed in the UK by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science in schools. The Raspberry Pi has a Broadcom BCM2835 system on a chip (SoC), which includes an ARM1176JZF-S 700 MHz, Video Core IV GPU, and was originally shipped with 256 megabytes of RAM, later upgraded to 512 MB. It does not include a built-in hard disk or solid-state drive, but uses an SD card for booting and long-term storage. [1].

5.2 Bus Communication

The I2C bus over 20 years ago and has an extensive collection of specific use and general purpose devices. a broad overview of how the I2C bus compares to other serial buses, how the I2C bus works, ways to overcome previous limitations, new uses of I2C such as in the Intelligent Platform Management Interface, overview of the various different categories of I2C devices and patent/royalty information.

Fig. 5 serial bus overview

Buses come in two forms, serial and parallel. The data and/or addresses can be sent over 1 wire, bit after bit, or over 8 or 32 wires at once. Always there has to be some way to share the common wiring, some rules, and some synchronization. Figure3 shows a serial data bus with three shared signal lines, for bit timing, data, and R/W. The selection of communicating partners is made with one separate wire for each chip. As the number of chips grows, so do the selection wires. The next stage is to use multiplexing of the selection wires and call them an address bus.

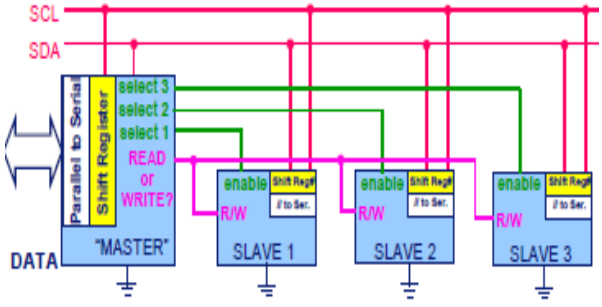

Fig. 6 general concept for serial communication

If there are 8 address wires we can select any one of 256 devices by using a 'one of 256' decoder IC. In a parallel bus system there could be 8 or 16 (or more) data wires. Taken to the next step, we can share the function of the wires between addresses and data but it starts to take quite a bit of hardware and worst is, we still have lots of wires. We can take a different approach and try to eliminate all except the data wiring itself. Then we need to multiplex the data, the selection (address), and the direction info - read/write. We need to develop relatively complex rules for that, but we save on those wires. This presentation

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covers buses that use only one or two data lines so that they are still attractive for sending data over reasonable distances - at least a few meters, but perhaps even km.

5.3 Remote Terminal Unit (RTU)

To demonstrate my paper I well design RTU by using one microcontroller from AVR family ATmega 328PU as shown in figure 7.

In this RTU I will discuss all option of RTU

5.3.1 Interface to sensor
5.3.2 Remote Local Option
5.3.3 Handle data on line
5.3.4 Commend

As show in figure 1st component there are three sensor connected to microcontroller (LDR light dependence resister, LM35 temperature sensitive and PIR Passive infrared radiation) which arefirst two are analog sensor and last one is digital sensor which are very helpfully to make one RTU for Home automation to keep the level of power consumption and also to keep continuous monitoring to the select area if when us interested to make this area belong monitoring condition.

The 2nd component in this RTU as show in figure ULN3208 driver which use to drive the unit control (relay)I use the driver to keep save my microcontroller from high current drain to switch (ON/OFF) relays.

The 3rd component in this RTU change the control between local/remote which use to make RTU with full controller from center control (MTU) as well as local control to do switch (ON/OFF) locally when the control failed from the MTU because of there are many reasons coming from Bus of bad frame message on the data packet to avoid this problem I will use this option.

The 4th component voltage level regulator in this board there are two level voltage (5 voltage which is microcontroller site) (12 voltage controller for relay circuit include driver and relays).

The 5th component is a brain on this RTU which is microcontroller ATmega 328 PU and the basic circuit to operation this microcontroller which include one crystal 16MHz within 22PF capacitor to generate the clock this microcontroller content on cheap 13 pin GPIO digital and 6 pin GPIO analog ,

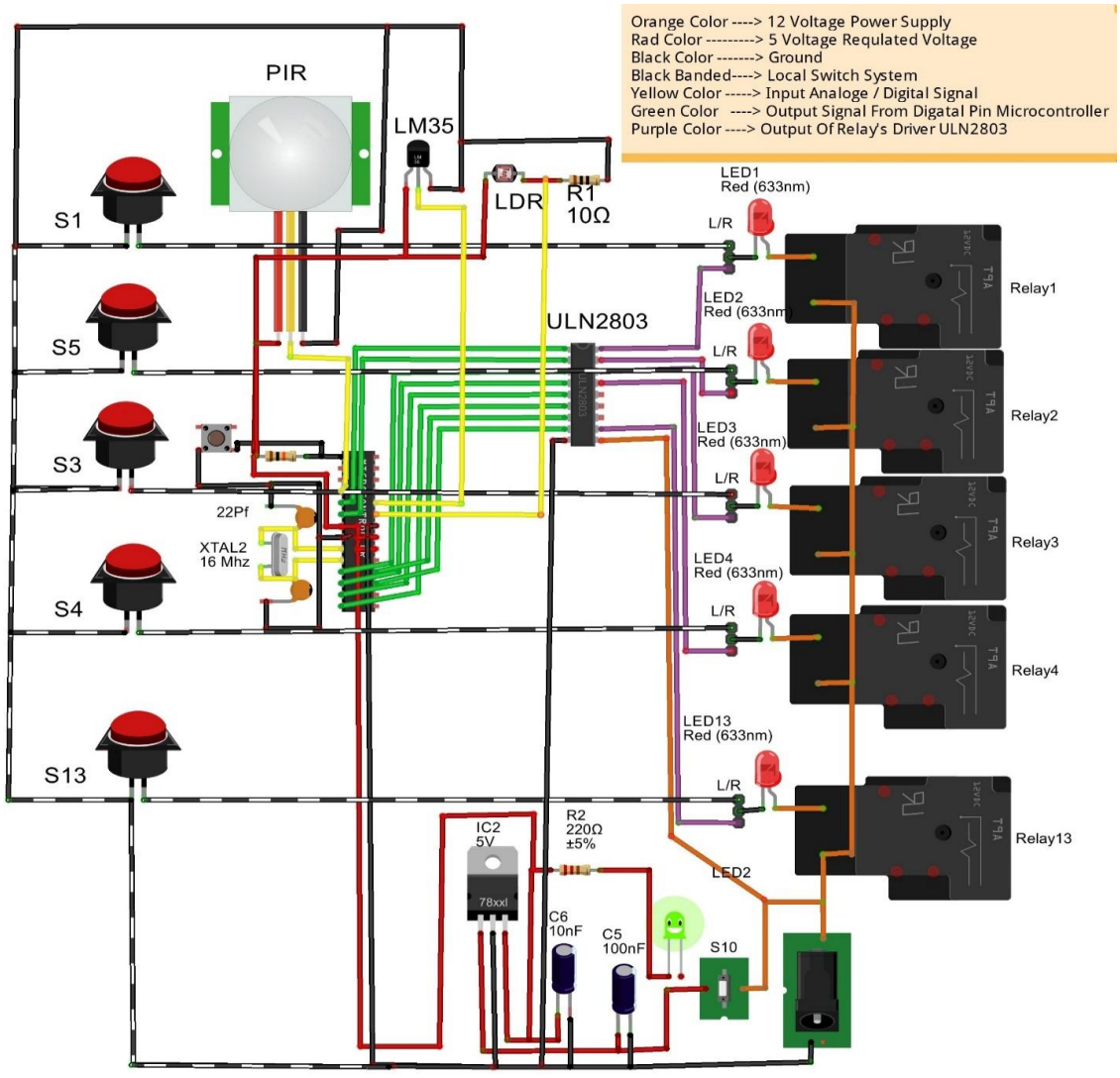

Fig.7 RTU design remote terminal unit

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VI. RESUIT

6.1 MASTERLOG FILE

At time pooling of MTU I make log file to check the data coming from RTU to compere between the values which is display on LCD and row data and to help us to diagnostic the program execute at RUN TIME this steps very benefit to developer ,the log file only for developer engineering as show in figure 8.From this figure we see the vale coming from RTU is a one byte but the actual row vale 10-bit because ADC RTU based on ATmega 328P microcontroller so that I was using the mapping function to converted from the 10-bit to 8-bit ADC in side RTU

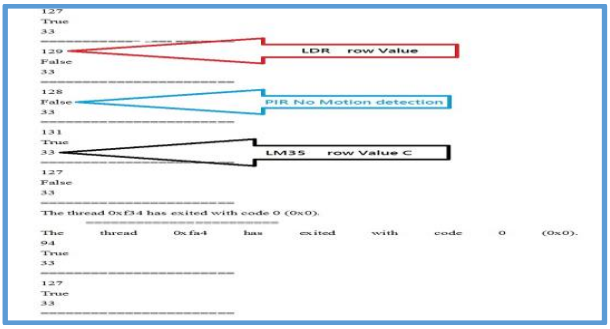

Fig. 8 log system on line

From the figure 8 we can see the row value of sensor with one byte each value transmit from RTU to MTU and processor and display on GUI and make it easy to understand end user .

VII. FUTURE WORKS

There is no limitation when it comes to features, In future, we can add capability to communicate over remote devices using Radiofrequency (nRF24 Modem or ZBee WSN) instead of I2C bus. Web-management portal using Azure can be integrated for mobile devices. So there is no limitation for this new Windows 10 IoT Core platform for Raspberry Pi 2.

VIII. CONCLUSIONS

These kinds of SCADA systems based on Raspberry pi2 belong IOT windows operating system with IDE Visual Studio 2015it's easy to handle because a wide range of an engineering is familiar with this IDE and also the RTU coming with AVR ATmage 328P microcontroller it's also easy to installation and configuration via C-language finally the system it's easy for both developer and end user.

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BIOGRAPHIES

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