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Remote Patient Monitoring (RPM)

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Abstract : Remote patient monitoring (RPM) leads to improve quality of patient care on general hospital wards ,and it refers to a wide variety of technologies designed to manage and monitor a range of health conditions. (RPM) has shown itself as a viable option and it could even become a standard clinical pathway without the need of traveling the patients .Doctors and nurses can monitor their patients from remote areas. They can follow the treatment to the patients in the general wards and get ensured that they are receiving the expected care and attention.

This paper implement programmed PLC (SIMATIC S7-200) to control and operate the stepper motor .An IP address wireless camera is mounted on the rotor of the stepper motor to monitor the conditions of the patients .The camera is connected to computer via an access point and it uses internet protocol (IP) technology to enable the doctors and nurse to see and talk with their patients on video remotely in any place. RPM system can complement the role of doctors and nurses resulting in more effective and efficient care for patients and in monitoring them by video .They will be able to focus on holistic needs of patients thereby providing better personal care.

Keywords: *Remote patient monitoring (RPM) , programmable logic controller (PLC), stepper motor ,IP address wireless camera ,computer , access point*.

I INTRODUCTION

Telemedicine (also referred to as "telehealth" or "e-health") allows health care professionals to evaluate, diagnose and treat patients in remote locations using telecommunications technology. It allows patients in remote locations to access medical expertise quickly, efficiently and without travel. It also provides more efficient use of limited expert resources that can see patients in multiple locations wherever they are needed without leaving their facility. Telemedicine also reduces isolation that clinicians can experience in small medical facilities in distant locations and allows local practitioners to consult with their peers and clinical experts when needed.

Formally defined, telemedicine is the use of medical information exchanged from one site to another via electronic communications to improve a patient's clinical health status. It includes growing variety of applications and services using two-way video, email, smart phone ,wireless tools and other forms of telecommunications technology.The use of telemedicine has spread rapidly and is now becoming integrated into the ongoing operations of hospitals, specialty departments, home health agencies, private physician offices as well as consumer's homes and workplaces.

II METHODOLOGY AND SYSTEM LAYOUT

The system deals with the method of remote patient observation. The first step is to program the micro PLC (SIMATIC S7-200) by logic diagram ladder language to control and operate the stepper motor. An IP address wireless camera is mounted on the rotor of the stepper motor .This makes camera rotates round the patients to capture live video for them .The camera displays the images on the screen of the computer via an access point .An internet protocol (IP) technology is implemented to enable the doctors and nurse in the center manager to see and talk with their patients . Figure (1) illustrates the block diagram of the system.

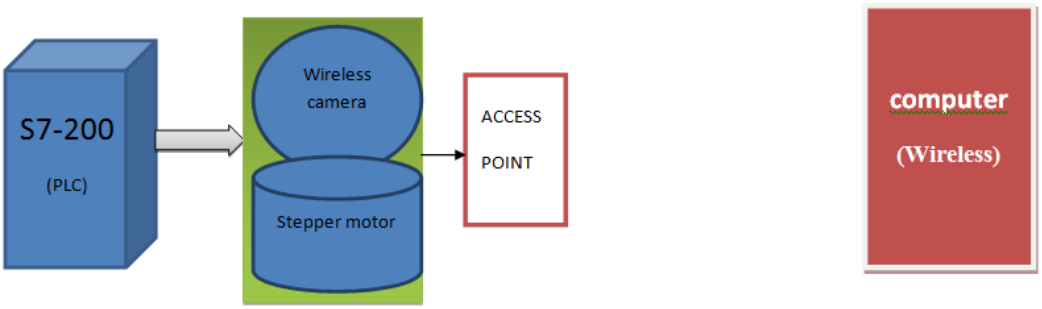

Figure (1) Block diagram of the system

SIMATIC S7-200 (PLC):

The Micro PLC (SIMATIC S7-200) is compact and highly powerful . Considering its real-time response , it is fast, features great communication options and comes with easy-to-operate software and hardware. But there is more; the Micro PLC SIMATIC S7-200 has a compact modular design – for customized solutions which are not too large, but flexible enough to be expanded anytime in the future. All this makes the SIMATIC S7-200 a great choice for open-loop control operations.

IP address wireless Camera:

The Secure View Wireless N Day/Night Pan/Tilt/Zoom Internet Camera, model TV-IP422WN, provides day and night security over a large area. Pan the camera side-to-side a remarkable 330° and tilt up-and-down 105°.Wireless n technology provides unsurpassed wireless coverage and improved streaming video quality.

This camera can be added to the wireless network Wi-Fi Protected Setup.Infrared bulbs provide night vision for distances of up to five meters (16 feet) in complete darkness. A built-in microphone and optional speakers accommodate 2-way audio communications.

Stepper Motors and Drives:

A stepper motor is a brushless, synchronous electric motor that converts digital pulses into mechanical shaft rotation. Every revolution of the stepper motor is divided into a discrete number of steps, in many cases (200 steps), and the motor must sent a separate pulse for each step. The stepper motor can only take one step at a time and each step is the same size. Since each pulse causes the motor to rotate a precise angle, typically (1.8°), the motor's position can be controlled without any feedback mechanism. As the digital pulses increase in frequency, the step movement changes into continuous rotation, with the speed of rotation directly proportional to the frequency of the pulses. Stepper motors are used every day in both industrial and commercial applications because of their low cost, high reliability, high torque at low speeds and a simple, rugged construction that operates in almost any environment.

Access point :

The access point establishes a wireless connection between the IP address and the computer.

III PROGRAMMING

The circuit is designed for a real time monitoring of patients..The stepper motor move around the patients in order to let the doctors and nurses watch their patients continuously .The PLC is programmed in ladder diagram language. The program lets the stepper motor scan the patients ward by clockwise and anti clockwise movements.

The developed algorithm for patients monitoring is as follows ;

Start
Initialization :
…. Declare a as integer.
…. Declare b as integer.
…. Let a = 10.
… Let b = 10.
Stepper clockwise :

… Activate winding-1 of stepper motor.
….. Delay 1 second.
… Activate winding-2 of stepper motor.
….. Delay 1 second.
… Activate winding-3 of stepper motor.
….. Delay 1 second.
… Activate winding-4 of stepper motor.
….. Delay 1 second.
…. Decrement a .

… If (a = 0) then go to stepper anticlockwise.
Go to stepper clockwise.
Stepper anticlockwise :
… Activate winding-4 of stepper motor.
….. Delay 1 second.
… Activate winding-3 of stepper motor.
….. Delay 1 second.
… Activate winding-2 of stepper motor.
….. Delay 1 second.
… Activate winding-1 of stepper motor.
….. Delay 1 second.
…. Decrement b .
… If (b = 0) then go to initialization.
Go to stepper anticlockwise.
End

IV RESULTS

Based on the ladder program downloaded into the memory of the PLC, we obtain a specified angle of scan for the wireless camera. Equations (1) and (2) calculate the wireless camera scan angle .

Scan angel = [(variable a) x 4] x (step angel) ……..(1)
Step angel = (360 Degree) / (200 steps) ……..(2)
By substitution ,we get ;
Scan angel = (10 x 4) x (1.8°) = 72°
The scan angle of the camera can be modified by changing the values of the variables (a and b) in the ladder program.

V CONCLUSION

Remote patient monitoring observation allows us to keep an eye on stable patients while caring for others with more urgent needs .This paper implements the programmable logic controller (PLC) as a processor to drive a stepper motor . An IP address wireless camera is used to capture real time video for the patients in the ward. The camera is connected to computer via an access point and used internet protocol (IP) technology to enable the doctors and nurse to see and talk with their patients directly**.**

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