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Wellness monitoring system using fly back converter

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ABSTRACT

As in modern alive world, wellness monitoring is the leading issue. By reason of insufficiency of proper health monitoring, patient be affected from critical health issues. In the current days, to monitor the patient's health, we have a lot of IOT devices. Health specialists are also taking favor of these clever devices to keep an eye on their patient's. With tons of new technological start-up, IOT is very quickly improving the healthcare industry. IOT is a latest technological i.e., widely accepted concept that can join together the things from different fields by way of internet. For the IoT connected healthcare applications, the wireless body area network (WBAN) is gaining popularity as wearable devices spring into the market. Our project proposes a wearable device with solar energy harvesting and smart phone based transmission that enables the implementation of WBAN in the developed IOT. To monitor the patient's heartbeat and the temperature, as having more than one sensor that can be used on different parts of body. If any abnormal condition is happened for the patient, the smart phone send the data to doctor about patient's situation and doctor can see the data of the patient and then give treatment for the patient. To increase the lifetime of the wearable device, a flexible solar energy harvester with an output based MPPT technique is used. Using this project, we can prevent ourselves and take preliminary steps. In this project we use the PIC microcontroller for the hardware part and use the CCS compiler as software.

Index Terms: IOT, MPPT, PIC microcontroller, Smart phone, Solar panel, Wearable device.

INTRODUCTION

The Internet of things (IOT) is the network of devices such as vehicles, a home appliances that contain electronics, software, sensors, actuators and connectivity which allows these things to connect, interact and exchange data. Wireless body area network [WBAN] also known as body sensor network [BSN] is a wireless network to enable the health monitoring anywhere anytime around the human body. Whenever a fall detected the accelerometer wakes the micro controller up and emergency notification will sent to the hospital server. Temperature sensor is used to measure the body temperature distribution. Pulse sensor is used to measure heartbeat rate in human body. Solar energy harvester also known as a photo voltaic

(PV) module is a non linear semiconductor device that absorbs the energy of the light and converts it into electricity. It can be seen that the solar panel can output the maximum power at certain point which is called the Maximum Power Point Tracking. wearable sensor node is the micro controller, which is used to collect and process the sensor data, as well as perform power management to reduce the overall power consumption. A back battery provides power to a system when the primary source of power is unavailable. The buck boost converter is a type of DC to DC converter that has an output voltage magnitude that is either greater than or less than the input voltage magnitude. A liquid crystal display 16 characters per line and there are 2 such lines. A command is

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an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc., the data register stores the data to be displayed on the LCD. A regulator is a system designed to automatically maintain a constant voltage level.

LITERARY ANALYTICS

In the beginning stage, an event based system is developed. In this system the Middleware approach is focused on providing sensor information to multiple mobile and personal healthcare applications on mobile devices such as smart phone is developed. Though, it helps in monitoring the patients in their home environment in case of emergencies. But there is a difficulty in customization and there is no stable product. The FEH system is proposed. This mechanism is able to conform body contour is proposed for biometric monitoring. Other measures that are being researched includes that it is very flexible and self-sustainable. But there is no battery back it is used as remote monitoring of physiological parameters. Though it is wireless and easy to remove and attach and it is wireless. This is followed by MPPT technique in which there is an easy implementation and the 24hours operation is achieved.



Fig. 3.1: Solar panel

MPPT [Maximum Power Point Tracking]

The Power Point Tracker is a high-frequency DC to DC converter. They take the DC input from the solar panels, change it to high-frequency AC, and convert it back down to a different DC voltage and current to exactly match the panels to the batteries. MPPT's operate at very high audio frequencies, usually in the 20-80 kHz range. The

COMPONENT DESCRIPTION

This paper presents the implementation of autonomous WBAN towards the IoT connected healthcare applications. The major parts is a 1) solar energy harvester with MPPT;2) a IoT gateway for sensor data visualization and emergency notification.

Solar Energy Harvester

Solar panel is chosen as the primary power source for the energy harvester. Due to its flexibility, it can be easily attached to the human body for wearable applications. To extract the maximum power from the solar panel, an output based analog MPPT circuit is proposed. The harvested energy from the flexible solar panel is stored in a rechargeable battery. Because a rechargeable battery efficiency of charging and discharging is higher and the device can be used 24/7. An efficient buck-boost voltage regulator, the LTC3130-1 is adopted to connect the rechargeable battery with the sensor node. The input range of the voltage regulator is from 2.4 V to 25 V, and its output voltage is configured at 3.3 V to power the sensor node.

advantage of high- frequency circuits is that they can be designed with very high-efficiency transformers and small components. The design of high-frequency circuits can be very tricky because of the problems with portions of the circuit "broadcasting" just like a radio transmitter causing radio and TV interference.



Fig. 3.2: MPPT

Micro controller [MCU]

The core of the wearable sensor node is the MCU, which is used to collect and process the sensor data as well as perform power management to reduce the overall power consumption. The MCU used in the sensor node is the ATmega328P from Atmel due to its low power, low cost and high performance. The CPU speed of the MCU is configured to 8 MHz at 3.3 V, and it can be

throttled down to 1MHz at 1.8 V for extremely low power applications. The MCU has 32 KB flash memory with 2 KB SRAM, 6 analog input pins and 14 digital I/O pins. Therefore, the proposed wearable sensor node can be connected with other plug-in sensors such as ECG, EEG and GSR for other human body vital signals measurement in the future designs.

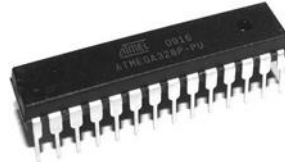


Fig. 3.3: Microcontroller

Accelerometer

The ADXL335 from Analog Devices are selected and soldered on the flexible PCB in the wearable sensor node. It is a 3-axis MEMS accelerometer with ultralow power consumption, which consumes less than 2_μA when the output data rate is 100 Hz and only 270 nA. When it is in the motion triggered wake-up mode. The motion triggered wake-up mode is one of the most notable

features of the accelerometer, and it has adjustable threshold of the sleep/wake motion activation. In the proposed wearable sensor node, the ADXL362 accelerometer is used for “fall detection” in the WBAN applications. Whenever a fall is detected, the ADXL362 wakes the MCU up and an emergency notification will be sent to the smart phone of the medical assistant through the BLE module.

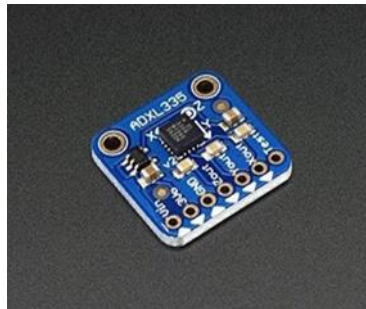


Fig. 3.4: Accelerometer

Temperature Sensor

The second onboard sensor is a temperature sensor, the MAX30205. It is chosen due to its high accuracy (0.1_°C from 37_°C to 39_°C), high resolution (16-bit) and low power consumption (600 _μA at 2.7V to 3.3 V). The MAX30205

temperature sensor can also provide a temperature alarm and communicate with the MCU through an I2C-compatible 2-wire serial interface. The temperature sensor measures the body temperature distribution when the wearable sensor node is placed at a different position of the body.

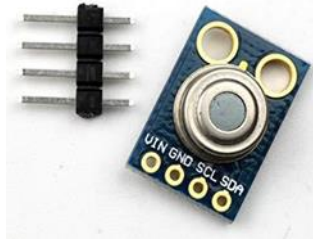


Fig. 3.5: Temperature sensor

Pulse Sensor

A commercial pulse sensor is adopted in the wearable sensor node for subject heartbeat monitoring. The pulse sensor is a plug-in PPG sensor, which is only connected to the sensor node deployed at the subject's wrist. The pulse sensor consists of the low power light photo sensor

(APDS-9008) and amplifier (MCP6001) with the typical supply current of 42 μ A and 100 μ A, respectively. By appropriate configuration, the pulse sensor can measure the heartbeat of the radial artery at the wrist instead of the fingertip thus it will not interfere with the subject's daily life.



Fig. 3.6: Pulse Sensor

Voltage Regulator

Voltage sources in a circuit may have fluctuations resulting in not providing fixed voltage outputs. A voltage regulator IC maintains

the output voltage at a constant value. 7805 IC, a member of 78xxseries of fixed linear voltage regulators used to maintain such fluctuations, is a popular voltage regulator integrated circuit (IC).



Fig. 3.7: Voltage Regulator

IoT Module

The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability produced by manufacturer Expressive Systems. From hardware perspective, it incorporates microcontroller, MAC,

baseband, and RF front end. The data is transmitted and received over radio frequency. It works by implementing the 802.11 set of protocols, helped by a radio module. The controller and the radio is often on the same chip these days.



Fig. 3.8: IoT Wi-Fi Module

Buck Boost Converter Circuit Theory Working and Applications

The buck boost converter is a DC to DC converter. The output voltage of the DC to DC converter is less than or greater than the input voltage. The output voltage of the magnitude depends on the duty cycle. These converters are also known as the step up and step down transformers and these names are coming from the analogous step up and step down transformer. The input voltages are step up/down to some level of more than or less than the input voltage. By using the low conversion energy, the input power is equal to the output power. The following expression shows the law of a conversion.

Input power (P_{in}) = Output power (P_{out})

For the step up mode, the input voltage is less than the output voltage ($V_{in} < V_{out}$). It shows that the output current is less than the input current. Hence the buck booster is a step up mode.

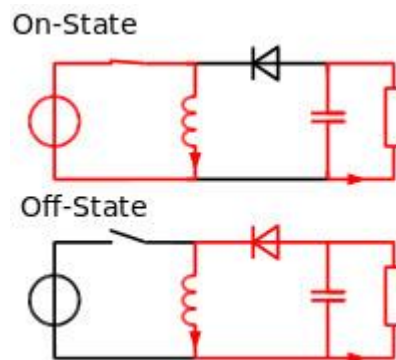
$V_{in} < V_{out}$ and $I_{in} > I_{out}$

In the step down mode the input voltage is greater than the output voltage ($V_{in} > V_{out}$). It follows that the output current is greater the input current. Hence the buck boost converter is a step down mode.

$V_{in} > V_{out}$ and $I_{in} < I_{out}$

Buck Boost Converter- Introduction

It is a type of DC to DC converter and it has a magnitude of output voltage. It may be more or less than equal to the input voltage magnitude. The buck boost converter is equal to the fly back circuit and single inductor is used in the place of the transformer. There are two types of converters in the buck boost converter that are buck converter and the other one is boost converter. These converters can produce the range of output voltage than the input voltage. The following diagram shows the basic buck boost converter.



Working principle of Buck Boost Converter

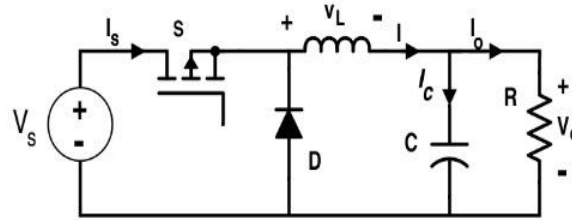
The working operation of the DC to DC converter is the inductor in the input resistance has the unexpected variation in the input current. If the switch is ON then the inductor feed the energy from the input and it stores the energy of magnetic energy. If the switch is closed it discharges the energy. The output circuit of the capacitor is assumed as high sufficient than the time constant of an RC circuit is high on the output stage. The huge time constant is compared with the switching period and make sure that the steady state is a constant output voltage $V_o(t) = V_o(\text{constant})$ and present at the load terminal.

There are two different types of working principles in the buck boost converter.

1. Buck converter
2. Boost converter.

Buck Converter Working

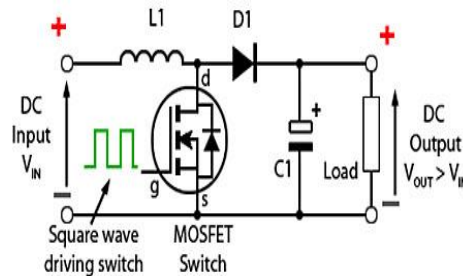
The following diagram shows the working operation of the buck converter. In the buck converter first transistor is turned ON and second transistor is switched OFF due to high square wave frequency. If the gate terminal of the first transistor is more than the current pass through the magnetic field, charging C, and it supplies the load. The D1 is the Scotty diode and it is turned OFF due to the positive voltage to the cathode.



The inductor L is the initial source of current. If the first transistor is OFF by using the control unit then the current flow in the buck operation. The magnetic field of the inductor is collapsed and the back e.m.f is generated collapsing field turn around the polarity of the voltage across the inductor. The current flows in the diode D2, the load and the D1 diode will be turned ON. The discharge of the inductor L decreases with the help of the current. During the first transistor is in one state the charge of the accumulator in the capacitor. The current flows through the load and during the off period keeping V_{out} reasonably. Hence it keeps the minimum ripple amplitude and V_{out} closes to the value of V_s

Boost Converter Working

In this converter the first transistor is switched ON continually and for the second transistor the square wave of high frequency is applied to the gate terminal. The second transistor is in conducting when the on state and the input current flow from the inductor L through the second transistor. The negative terminal charging up the magnetic field around the inductor. The D2 diode cannot conduct because the anode is on the potential ground by highly conducting the second transistor.



By charging the capacitor C the load is applied to the entire circuit in the ON State and it can construct earlier oscillator cycles. During the ON period the capacitor C can discharge regularly and the amount of high ripple frequency on the output voltage. The approximate potential difference is given by the equation below.

$$V_s + V_L$$

During the OFF period of second transistor the inductor L is charged and the capacitor C, discharged. The L, Produce the back e.m.f and the values are depending up on the rate of change of current of the second transistor switch. The amount of inductance the coil can occupy. Hence the back e.m.f can produce any different voltage through a wide range and determined by the design of the circuit. Hence the polarity of voltage across the

inductor L has reversed now. The input voltage gives the output voltage and at least equal to or higher than the input voltage. The diode D2 is in forward biased and the current applied to the load current and it recharges the capacitors to $V_s + V_L$ and it is ready for the second transistor.

Modes of Buck Boost Converters

There are two different types of modes in the buck boost converter. The following are the two different types of buck boost converters.

- Continuous conduction mode.
- Discontinuous conduction mode.

Continuous Conduction Mode

In the continuous conduction mode the current from end to end of inductor never goes to zero.

Hence the inductor partially discharges earlier than the switching cycle.

Discontinuous Conduction Mode

In this mode the current through the inductor goes to zero. Hence the inductor will totally discharge at the end of switching cycles.

INTERNET OF THINGS

The Internet of things (IOT) refers to the concept of extending internet connectivity beyond conventional computing platforms such as personal computer and mobile device and into any range of traditionally or non internet enabled physical devices and everyday objects. Embedded with electronics, Internet connectivity and other forms of hardware such as sensors these devices can communicate and interact with others over the Internet and they can be remotely monitored and controlled. The Internet of things has evolved due to convergence of multiple technologies, real-time analytics, machine learning, commodity sensors, and embedded systems. Traditional fields of embedded systems, wireless sensor networks, control systems, automation including home and building

automation and others all contribute to enabling the Internet of things.

PROPOSED SYSTEM

In this system we are implementing a Wireless Patient Monitoring System that can be used by any person at anytime and anywhere. It measures the heartbeat and pulse rate of the patient, if the patient's condition goes to an abnormal conditions thus data will be send to the doctor's server. And it is recorded as a dual option; one is the Graphical and another one as Database. At a time the doctor can see two or three patient's data. Solar Panel is used for the recharging in the sunlight. Mobile charger is used for battery charging at night time and if there is not sunlight it will be helpful. Then the solar panel absorbs the light energy from the sunlight and generates electricity. The Buck Boost Converter gives steady signal which comes out from solar panel. MPPT tracks the maximum power from the solar panel. Super capacitor it stores the harvested energy which is came from solar panel. Voltage regulator regulates the voltage level and if we. Need steady and reliable voltage we can prefer this device. It acts as buffer.

PROPOSED BLOCK DIAGRAM

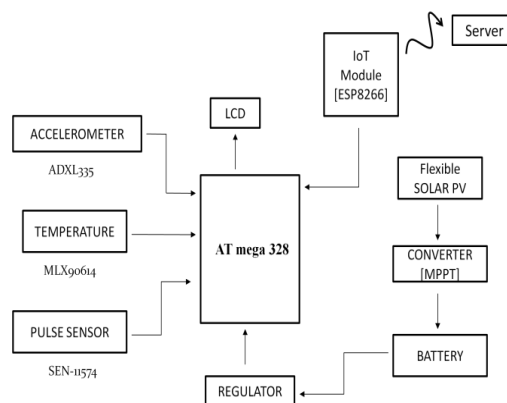


Fig. 3.8: Proposed Block Diagram

SOFTWARE DESCRIPTION

CCS Compiler

CCS C Compilers are designed specifically for the PIC® MCU architecture, unlike competitive compilers based on a GNU or common engine with

a generic code generator. Every aspect of the CCS C Compiler is specially optimized for the PIC® MCU. The Pro-Level Optimization of our PIC® compilers includes Standard C Constructs, numerous Pre-Processor Functions, and the largest library of Built-In Functions. This provides

developers with unique access to device hardware features at the embedded C language level. C syntax and special functions have a uniform syntax across all chip families, allowing for migration to a new chip trivial. Ready-to-Run Program Examples, and Device Libraries, empower rapid development of applications incorporating leading edge technologies such as capacitive touch, wired and wireless communications, motion and motor controls, and energy management. Code Composer Studio (CC Studio or CCS) is an integrated development environment (IDE) to develop applications for Texas Instruments (TI) embedded processors. This is the compiler, it senses the temperature sensor and if the temperature is above or else below it displays in the LCD. It checks the program in the microcontroller and it also checks the error. This compiler is helpful in sensing.

B.PIC Kit 2

The PG164120 is a PIC kit 2 development Programmer/Debugger. The PIC kit 2 is a low cost development tool with an easy to use interface for programming and debugging. Microchip's flash families of micro controllers. The full featured Windows programming interface supports baseline (PIC10F, PIC12F5xx, and PIC16F5xx), midrange (PIC12F6xx, PIC16F), PIC18F, PIC24, dsPIC30, dsPIC33, and PIC32 families of 8bit, 16bit, and 32bit micro controllers, and many Microchip Serial EEPROM products. With Microchip's powerful MPLAB Integrated Development Environment (IDE) the PIC kit 2 enables in circuit debugging on most PIC micro controllers. In Circuit Debugging runs, halts and single steps the program while the PIC microcontroller is embedded in the application. When halted at a breakpoint, the file registers can be examined and modified.

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CONCLUSION

The wearable device can be placed on different positions of the body to measure physical signals like the temperature and heartbeat rate. It can also detect falls using the accelerometer on the node for emergency notification through hospital server. A liquid crystal display is designed to display to sensor nodes data and send emergency notification to the hospital server. The output based MPPT technique is applied to extract the maximum power from the flexible solar panel. A secondary battery is used for backup energy storage in case of bad weather conditions. We presented the design and implementation of a device of Patient Monitoring system based on wireless technology using IOT, to send a data to the doctor. The proposed system combines two commonly used technologies namely, IOT and server. This indeed is an easy, practical, inexpensive and yet very effective way for transmitting vital information to the healthcare staff and healthcare providers. The system monitors patient's health status, such as heart rate, and temperature. In case, the value for any of these parameters exceeds preset critical values, the position parameters, from the attached sensor module, are transmitted to pre-defined phone number in form of data using smart phone module. All the information obtained from the human body from sensors is then transmitted to the microcontroller system as digital values. The values obtained from like heart rate and temperature is also displayed on to the attached LCD in alphanumeric form. In the conclusion we consider how this system can be further improved in future, may be by adding new type of sensors as well as using new approaches for the security and triggering alarm.

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