Solar Powered Passenger Information Display System

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***Abstract*— Passenger Information Display System (PIDS) is a real-time information system used to provide information to the passengers about the upcoming metro station. For this project the PIDS was powered by a renewable source of energy, i.e. Solar Energy. The system comprises of 7805 voltage regulating IC, PIC16F887 microcontroller, a 8-bit, 256 bytes EEPROM data memory microcontroller, to control the functions of displaying system, and data is displayed on LCD LM016L. The PIS of metro is developed to get charged using Photovoltaic solar panels, in order to reduce power consumption. To obtain an efficient system with uninterrupted information, solar panels are used along with a 9 volts battery. The blueprint was created in PROTEUS ISIS & ARES and the Code was written in C language, using MPLAB IDE. LEDs were used for indication of location of metro train.**

***Keywords*— PIDS, PIC16F887, LCD LM016L, PROTEUS, MPLAB IDE.**

1. INTRODUCTION

Passenger Information Display System is a system which is used in Public transportation vehicles like buses and trains to assist the passengers on board. PIDS gives information to passengers about their location on the commute and other general safety information. This system was built while keeping in mind the biggest need of the hour, which is to reduce the use of traditional sources of energy and replace it by newer conventional energy sources. This research focuses on developing a latest PIDS powered with the solar energy so as to develop a fully operational system with renewable energy source. This PIDS is built with the help of CMOS FLASH-based Microchip PIC 16f887 microcontroller. This microcontroller features 256 bytes of EEPROM data memory and works as the heart and brain of the system as it controls the functioning of the LCD display. The microcontroller is programmed such that it displays the data on the screen, which in this case is the upcoming station on the route.

The display used was 16X2 LM016L and interfaced with the microcontroller. The power was initially supplied by AC Mains which was then converted into DC via a rectifier circuit, and was passed to the microcontroller through LM7805 regulating IC for getting uninterrupted 5V to the system. Later on, the system was redeveloped to take its power supply from solar panels [1], [2] so that the system gets its required energy from a clean, green and renewable source. For this, a solar panel is used along with a 9V battery to store the power generated by solar cells before feeding it to the regulating. Alternatively, the previous source of power can also be used if a case of emergency situation arises. Thus, by doing this we have achieved a power efficient solar powered PIDS which not only reduces the burden on energy derived from Fossil Fuels but also reduces the Carbon Emissions.

2. ARCHITECTURE

The system for the project is built on an embedded system. Embedded systems are computing systems which have an operating system along with the mechanical and electrical system, beside

periodic computing problems. Embedded systems are the systems in which both hardware and software work simultaneously as a single unit. In these systems hardware is controlled by software simulation. Embedded systems are organized and handled by a single or multiple processing cores within the sort of microcontrollers or digital signal processors, field-programmable gate arrays, application-specific integrated circuits AND circuit arrays. These processing parts are integrated with parts made for handling and controlling electrical interfacing. The arrangement of this project was done as shown in the above block diagram, figure 1. The power required to display information on screen through the microcontroller was generated with the help of solar panels (20 volts) [3]. Solar panels were placed at 30 degree angle from horizontal, so that maximum amount of sunlight can be trapped through the course of the day [2]. A battery was connected in series with the solar panel. This series connected battery was acting as a power accumulator. Battery was connected so that microcontroller and other components could get an uninterrupted power supply even when there is no sunlight present. Firstly solar cells would generate the power required for project and supply directly to the battery and then to the microcontroller (through 7805 IC, which is a fixed voltage regulator). During this time microcontroller would get enough supply to operate the LCD and battery would get charged for later use. Later in the night time when the sunlight is absent battery would facilitate the aforesaid operations.

Now after microcontroller, the display was connected (as shown in the block diagram) which would show the actual information about the metro arrival, that included the time remaining for train to reach the platform, etc. Display used for this purpose was LCD LM016L. Along with the LCD screen, a parallel sequence of LEDs was connected that represented the route map. LED would glow one at a time showing the presence of the train. LEDs used for the same purpose were big flame 5 mm ultra-bright light emitting diode.

2.1 Display System

One of the most important components on this project was the displaying system. It is used to display the information to passengers about the metro arrival, LCD - LM016L was used which is a 16x2 LCD display [5]. It consists of 16 pins, all with different purpose including data bus, input voltage, ground, read, write etc. The LCD LM016L is supported by Hitachi's HD44780 controller. Most of the Liquid Crystal Displays are supported by Hitachi's HD44780 controller or some other controller that are similar to HD44580. The most used LCDs found across the market these days are the one Line, two Line or four Lines LCDs that have only single controller and support at most of eighty characters. LCDs that support above eighty characters use two of HD44780 controllers. Mostly LCDs with one controller has fourteen pins and LCDs supporting over 80 characters and using two controllers has sixteen pins. Pin description of LCD–lm016l is shown within the table below.

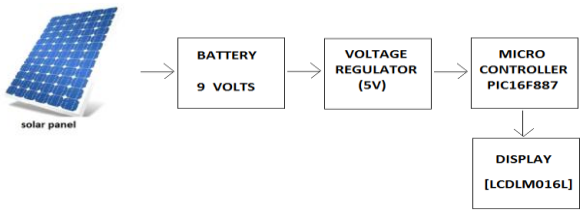

Fig. 1. Block diagram of PIDS

2.2 PV System

PV systems are basically the systems that generate and provide electrical power to the circuit. They differ from the other power generators from the material being used to build them. Operating principle of PV systems is however similar to the other electrical generators. These systems are

well established bodies that are manufactured with precise codes and standard. It is obvious that PV systems generate electricity from sunlight, as they trap energy from the photons (as name suggests Photo Voltaic cell). But some other requirements are also there to make the conduction proper and efficient like control, distribution and storage of the energy produced. For manufacture of a PV cell components and materials required are such as a DC to AC converter(inverter), charge accumulator (battery), quality and long lasting wires, circuit protectors like surge arrestor, heat sink, inductors, capacitors etc.

Photo voltaic systems are classified under many different criteria, like based on their operations types, functional requirements, components and sub components, usage for different load types etc. However major classifications are according the grid connections and stand-alone systems. The two main types of PV Systems are: (i) Power Conditioning System, (ii) Stand Alone Systems. In Grid-connected PV systems Power Conditioning Unit (PCU) is main the component. These systems are used for AC loads. Whereas standalone photo voltaic systems are for DC loads. Photovoltaic cell is a device that emits photons on application of voltage or potential difference across its terminals. Solar cell is just a photovoltaic cell that converts solar energy into electrical energy. Solar cells are semiconductor devices that are mostly made up of Silicon or Germanium, a lot of varieties of silicon solar cells are there like amorphous or crystalline or polycrystalline. Unlike other sources of energy generation, solar cell does not require any extra fuel or chemical reaction(s) to run.

Solar cells are not bulky but light weighted, its structure does not include any moving parts, there are just the layers of doped semiconductors with wires. Independent of the region of use, solar cells are of similar base structure. Light rays enter the cell through the glass and pass through anti reflection layer, and goes to silicon layers that generate electric signals. Solar cell are blue coloured because the colour of anti-reflection glass is of blue colour. These panels are designed in such a way that they do not lose any light energy and make use of most of it. Assembly of a solar panel do not end here, after the signal is generated, it needs to be stored and supplied further. For storage purpose, a battery unit is connected to it which store the electric charge and gives supply to load in absence of input light (at night) [6], [7].

2.3 Microcontroller

Microcontroller is a compact integrated circuit designed to govern a specific operation in an embedded system. A structure of microcontroller includes processor, memory and input/ output (I/0) peripherals on a single chip. A microcontroller's processor can vary by application. Choice of a microcontroller varies from the easy 4-bit, 8-bit or 16-bit processors to further complicated 32-bit or 64-bit processors. In terms of memory, microcontrollers will use random access memory (RAM); RAM is a non-volatile memory storage, read-only storage or EEPROM, FLASH EPROM. All microcontrollers design follows Harvard design or Von Neumann design; these two designs give different strategies of exchanging knowledge between the processor and memory. With the Harvard design, the information bus and instruction area units are separately manufactured, permitting the coinciding transfers. With a Von Neumann design, one bus is employed for each knowledge and direction of transfer. Almost all the microcontrollers are based on CISC concept (Complex Instruction Set Computer) [3], [4].

The Microcontroller used in this project is PIC16F887. This is widely used, CMOS FLASH -based (with only thirty five

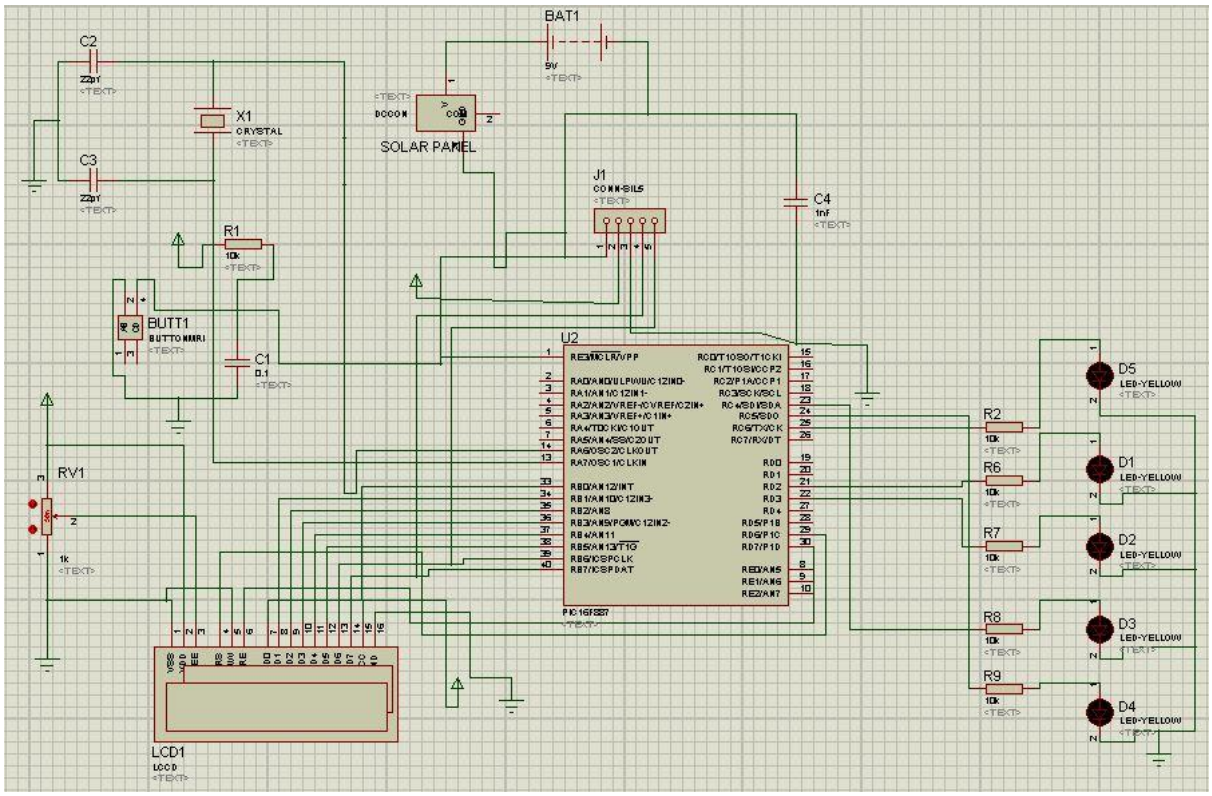

Fig. 2: The schematic architecture of PIDS

instructions), 8-bit microcontroller with forty four-pin package.

The PIC16F887 options 256 bytes of EEPROM information registry, automatic programming, an ICD, along with Comparators and fourteen channels of 10-bit (A/D) device, one capture/compare/PWM and some improvised capture/compare/PWM functions, a synchronous port that may be organized also as 3-wired Serial Peripheral Interface or the 2-wired Internally Integrated Circuit bus Associated with Nursing an increased Universal Asynchronous Receiver Transmitter (EUSART). All of those options make it ideal for a lot of advanced level A/D applications in automatic, industrial, appliances and shopper applications [8], [9].

2.4 Battery

Battery is the storage or accumulator of electric energy. Battery is basically a capacitor that stores the charge and provides the electricity when needed. Battery is used in solar panel for the same purpose. Battery of 9 volts storing capacity is used in PIDS. Before choosing a battery firstly there must be complete survey of the power of battery needed, working hours needed and round trip efficiency of the battery. These specifications must be noted before choosing a battery. Round trip efficiency of a battery is the ratio of the output power to the input power provided to battery while charging. Above shown is an example of 80% RTE battery. The architecture of the project is depicted in Figure 2, in the form of a schematic diagram.

3. WORKING

3.1 Simulation

Firstly the circuitry was designed for the Passenger Information Display System for simulation on PROTEUS ISIS. For simulation a schematic design was made in PROTEUS ISIS. For simulation purpose the source code on which the system runs is

written in C Language on MPLAB IDE. After the simulation, the circuit network was designed with the help of PROTEUS ARES. After successful simulation and network design, the circuit was printed on a PCB. When the circuit printing was done on the PCB, it was drilled, and then all the components required in the system were placed manually according to the schematic of the Passenger Information Display System. Soldering of all those components was done on their respective places [10].

3.2 AC Powered Model

In the initial stage, the model was getting its power from AC mains which was then rectified and converted into Direct Current. This Direct Current was then fed to 7805 regulating IC which in turn provided us with a constant 5V supply to power our Microcontroller. This regulating IC is required as the microcontroller requires a constant 5V supply. This Microcontroller controls the display system which displays the information and the location monitoring LEDs.

3.3 Solar Powered Model

In the later stage, the power source was altered to make the system self-sustained, so that the system does not need its required energy from an outside source but instead, generate its own energy that is also renewable and does not cause any kind of pollution. To achieve this goal PV cells (Solar Panel) were installed to trap the solar energy from sunlight which is freely available and does not require any amount of money apart from the initial investment cost. As we know that Sunlight is not consistent all times of a day, a battery was also attached to the Solar Panel to store the solar energy trapped by the Solar Panel. In figure 3, the final model of the Passenger Information Display System is shown. For days when Sun does not shine brightly or does so for a shorter period of time e.g., winter and Rainy Seasons, the previous conventional source is also left available, so that the system gets uninterrupted supply.

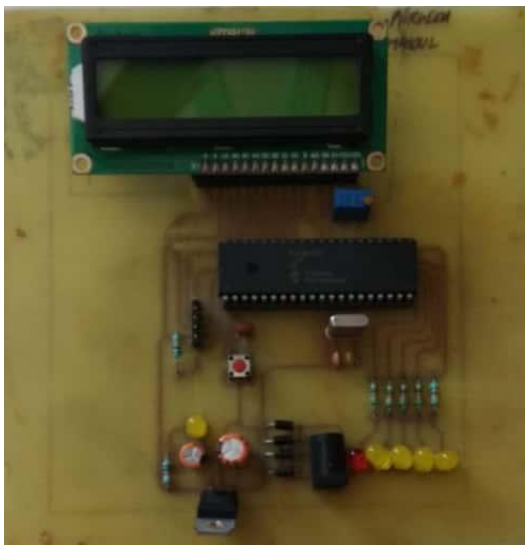

Fig. 3: Final model of Passenger Information Display System

4. RESULTS AND CONCLUSION

The solar panel is used on the roof of the metro train for the working of the of the display system of the metro train by convert electrical energy in to solar energy. This sets a basic example how energy can be saved with solar panel. As we can use solar panel for the display system we can use solar energy for the lighting of the metro train. This will reduce the power consumption from the main supply.

We have achieved success in making the display system work with the help of the solar panel. PIDS uses solar panel of 30 volts generating capacity, a battery of 9 volts storing capacity that can operate a 16x2 LCD display. We can use solar cell system for the working of the metro train. We can place solar panel on the roof of the metro train and then convert the solar energy into electrical energy which can be further used for metro train and for the night we can use batteries which will get charged in the day time from the solar cell. Solar energy can be further used in metro station. The electricity which is used for the basic necessity of the metro station such as lightning of metro station control room etc

can be done with the help of solar cell. The roof of the metro station can be used for the placement of the solar panel at every station.

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