Automated Bridge System

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***Abstract*— our project aims to build an automated three way bridge system where gate will be opened when it is required. The project concerns about automatic gate opening and closing system. An automatic gate of bridge control system includes a sensor for sensing car approaching towards the gate. Systems and methods are very common in the art for opening and closing doors to enter and exit buildings, facilities etc. This system is mainly controlled by FPGA Spartan 6 using VHDL programming language.**

Keywords—FPGA; Servo; LDR; MSP430; Automated

I. INTRODUCTION

The recent advances in FPGA (Field Programmable Gate Array) technology have made it possible to implement digital control algorithms in hardware solution with low costs. It has wide integration capability with higher performance and reduced latency. Our system concerns about the gate opening and closing system automatically by detecting the existence of a car.

A. *Objective*

Our objective was to learn a new language VHDL and to do a successful project using our knowledge of VHDL. Automated Bridge system is a good and secured system for a two way bridge where traffic controlling is a challenge. Our system will open and close the gates automatically sensing a car near the gate. It will not need any human interaction which will reduce the time waste as well.

II. SYSTEM DESIGN

We have used several components including arm cortex, several sensors and module for this project. Here we are explaining which components we used for which reasons.

A. *FPGA Spartan 6*

Spartan-6 FPGA family delivers an optimal balance of low risk, low cost, low power, and performance for cost-sensitive applications. These FPGAs use a proven low-power 45nm process technology. Also, the Spartan-6 series offers an advanced power management technology, up to 150k logic cells, integrated PCI Express® blocks, advanced memory support, 250 MHz DSP slices, and 3.2 Gbps low-power transceivers. FPGAs are large-scale, runtime programmable logic devices which generally include hundreds of customizable I/O pins. The Xilinx Spartan-6 is a family of low cost, low power consumption, logic-optimized FPGAs that provide fast and comprehensive connectivity. They offer an efficient, dual-register 6-input lookup table (LUT) logic and a rich selection of built-in system-level blocks. Critical Link's MityDSP family of System on Modules (SoMs) combine a Xilinx FPGA along with a DSP and/or ARM processor. The MityDSP family includes a number of boards utilizing TI's OMAP-L, C6000, and Sitara processors.

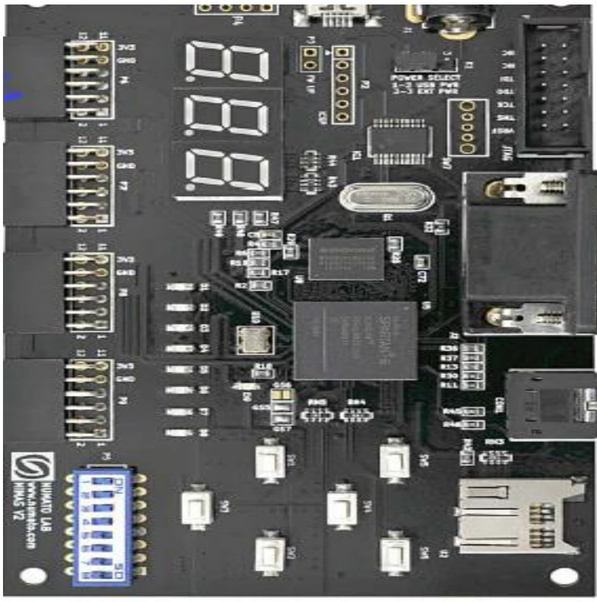

Figure1: FPGA

These SOMs – the MityDSP-L138F and the MitySOM-1808F – are designed for applications with requirements for low-power usage and rapid time to market. Each of these boards offer an optional Xilinx Spartan-6 FPGA, the XC6SLX16, for expanded I/O, co-processing, and signal processing, or to support high speed data acquisition.

B. *MSP430*

We used EXP430G2 Launchpad as a microcontroller as its features are simpler and complex coding also can be done in such a way that is easy to understand. Furthermore, this microcontroller has its own USB connection, a power jack and a reset button. It is standard on microcontrollers, most pins connect to a more specialized peripheral, but if that peripheral is not needed, the pin may be used for general purpose I/O.

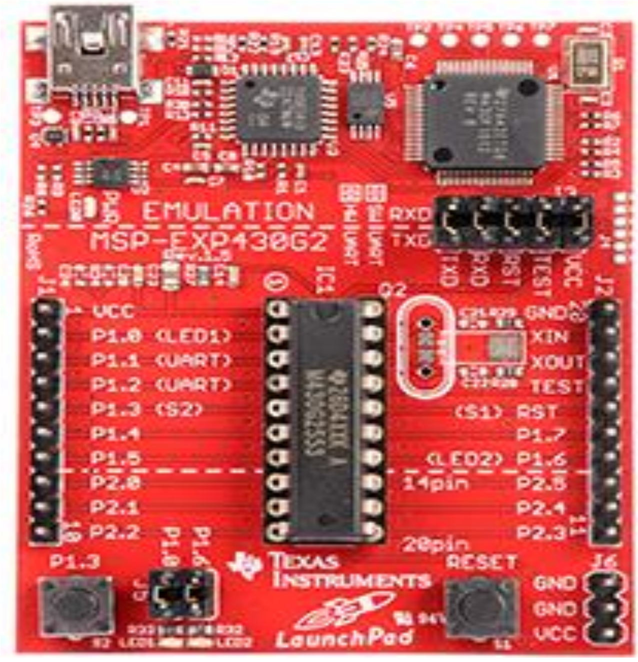

Figure 2: MSP430

The pins are divided into 8-bit groups called "ports", each of which is controlled by a number of 8-bit registers. [8] In some cases, the ports are arranged in pairs which can be accessed as 16-bit registers. This device is just needed to connect to the computer with a USB cable to begin uploading the necessary coding

C. *Servo Motor*

Different than normal motor, the servo circuitry is built right inside the motor unit and has a positional shaft, which usually is fitted with a gear (as shown below as shown Fig 3.2.). The motor is controlled with an electric signal which controls the shaft movement.

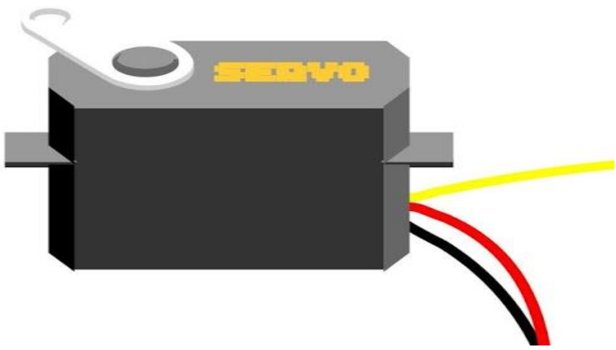

Figure 3: Servo Motor

Inside the servo is a simple set-up: a small DC motor, potentiometer and a control circuit. As the motor rotates, the potentiometer's resistance changes, thus the control circuit can precisely regulate how much movement there is and in also which direction to turn. [9]This is possible due to the motor is attached by gears to the control wheel. When the shaft of the motor is at the desired position, power supplied to the motor is stopped. If not, the motor is turned in the appropriate direction. The desired position is sent via electrical pulses through the signal wire.

D. *Light Dependent Resistor and Lighr Emitting Diode*

A Light Dependent resister (LDR) is a component that has a (variable) resistance that changes with the light intensity that falls upon it. This allows them to be used in light sensing circuits. When the light level decreases, the resistance of the LDR increases. As this resistance increases in relation to the other Resistor, which has a fixed resistance, it causes the voltage dropped across the LDR to also increase.[10] We used LDR for detecting the amount of food, as it is a threat for the fish inside the water. We wanted to use the LDR covered with black paper so that the external light cannot affect its value and a led just before the LDR for detecting the addled water. But for the black cover, LDR was not able to detect any light and was giving the maximum value. So we uncovered it.

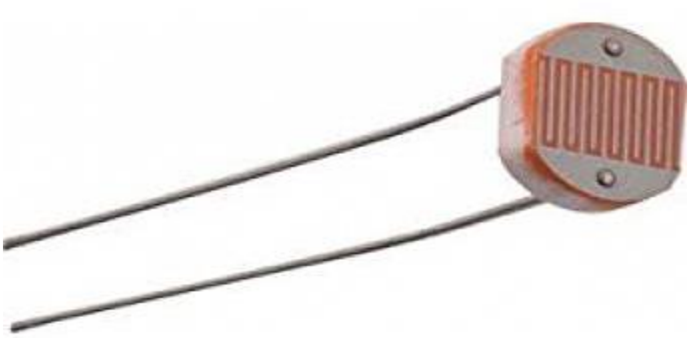

Figure 4: LDR

E. *Buzzer*

A buzzer or beeper is an audio signalling device, which may be electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

Figure 5: Buzzer

F. *Experimental Setup*

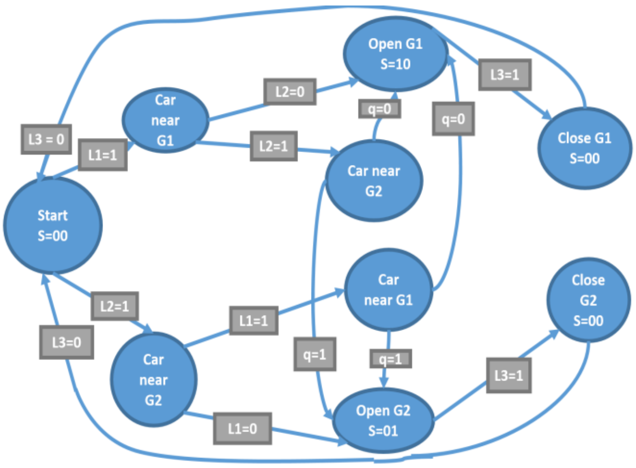

Figure 6: State diagram of bridge automation

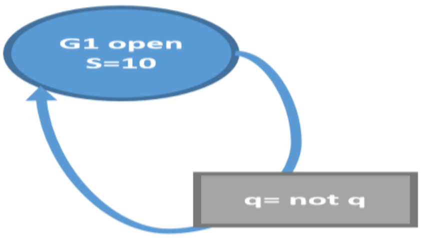

Figure 7: State Diagram of automated bridge

Figure 1 and 2 shows the state diagram of our project where we used two consecutive project. One is for the whole gate open and closing process, another is for a signal which will determine the direction of the gate when both of the gates are occupied!

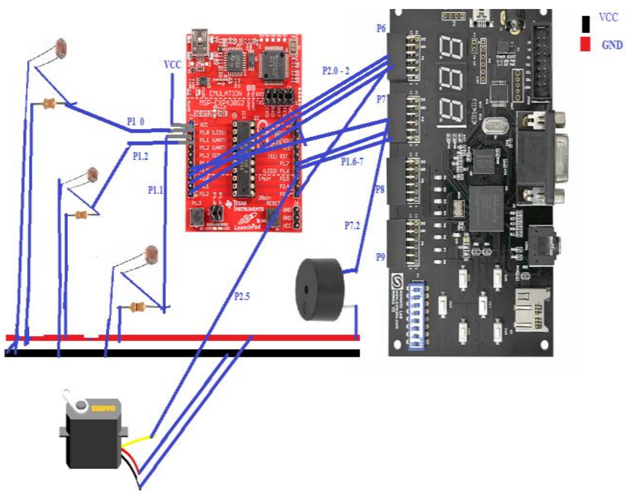

Figure 8: PIN diagram of the whole project

III. RESULT

As we are using these modules and some sensors with FPGA for the first time, we could not do the whole project very efficiently. We struggled a lot. We examined the buzzer and it was working fine. Then we tried to use the servo motor for controlling the gate, it was not working properly. As we used Xilinx as our IDE, It was a big challenge for us to work with a language VHDL which we had no idea about previously. However, using LDR for measuring food amount was a bad idea. LDR does not give constant value in different places. We tried to cover the LDR with the black straw but when we did that, it could not detect the light intensity at all. So we had to see the value in serial port in different place and write the code accordingly. Despite all difficulties, overall, the project was working fine.

IV. FUTURE PLAN

Our future plan is to do something better than this current project. We considered only one two way gate here. In the next project we will work with 4 way bridge system and will use more advanced sensors and components to get better result.

Next, we will try to work with home automation system using FPGA to gift a better and comfortable life to people of all ages.

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