Firefighting Robot

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Abstract

The overall objective of this project is to design an autonomous robot capable of navigating through a low light area, not containing obstacles, with a candle randomly placed in it, simulating a room on fire. The main challenge is to build this robot using computer aided design which will allow it to be able to navigate its way through a low light environment, detect the candle flame and extinguish it. The experimental results are included to illustrate the detailed operational mode of the robot. This project will be paving the way for a house-hold robot which would find and extinguish small home fires before they can engulf the house.

Design

In order to guide the robot, there had to be a certain layout or design implemented therefore allowing an appropriate control over the robot. This design consisted of configuring the MAX232 and the PIC16F877A and then connecting them altogether with the remote control of the robot.

Computer [Webcam] → MAX232
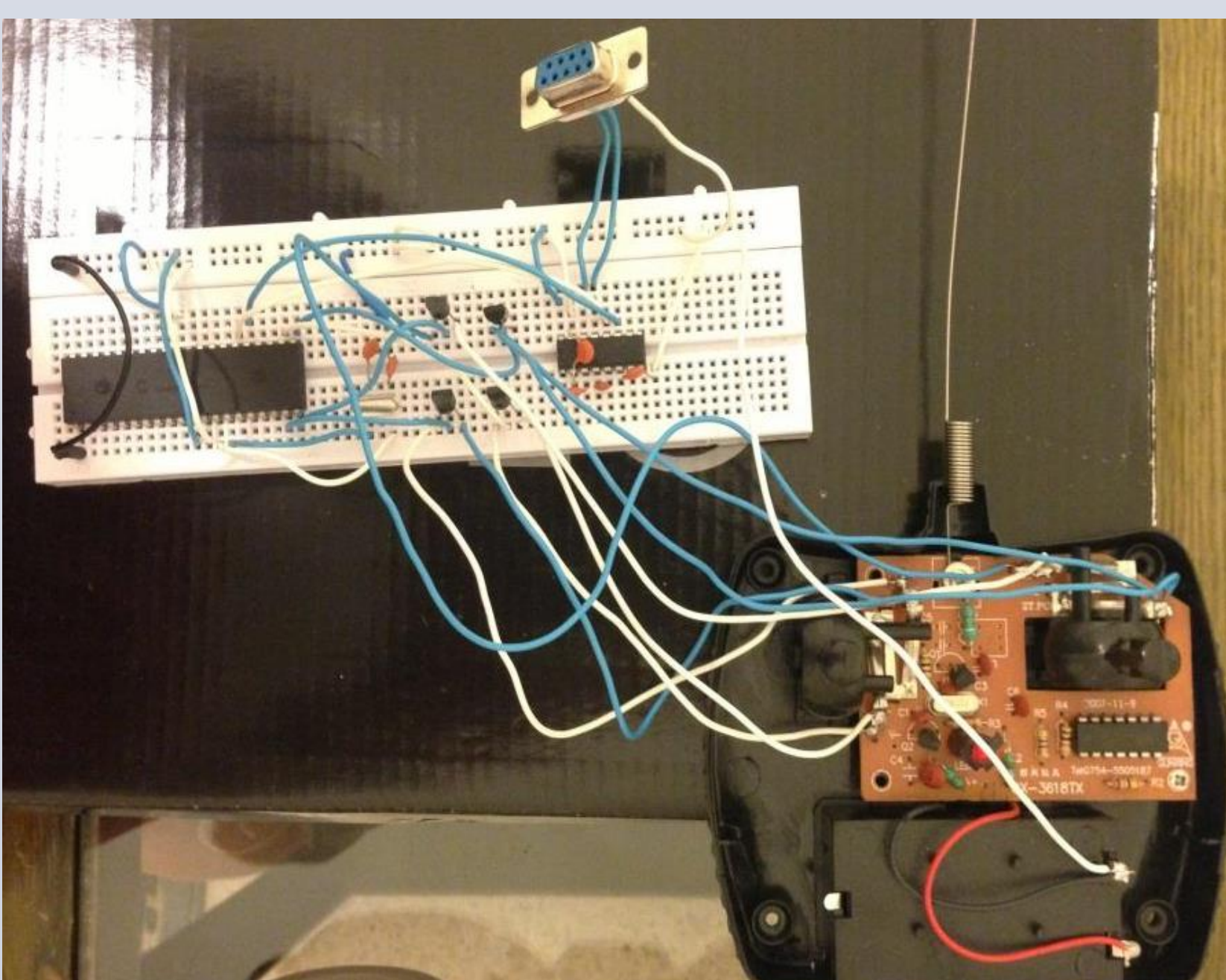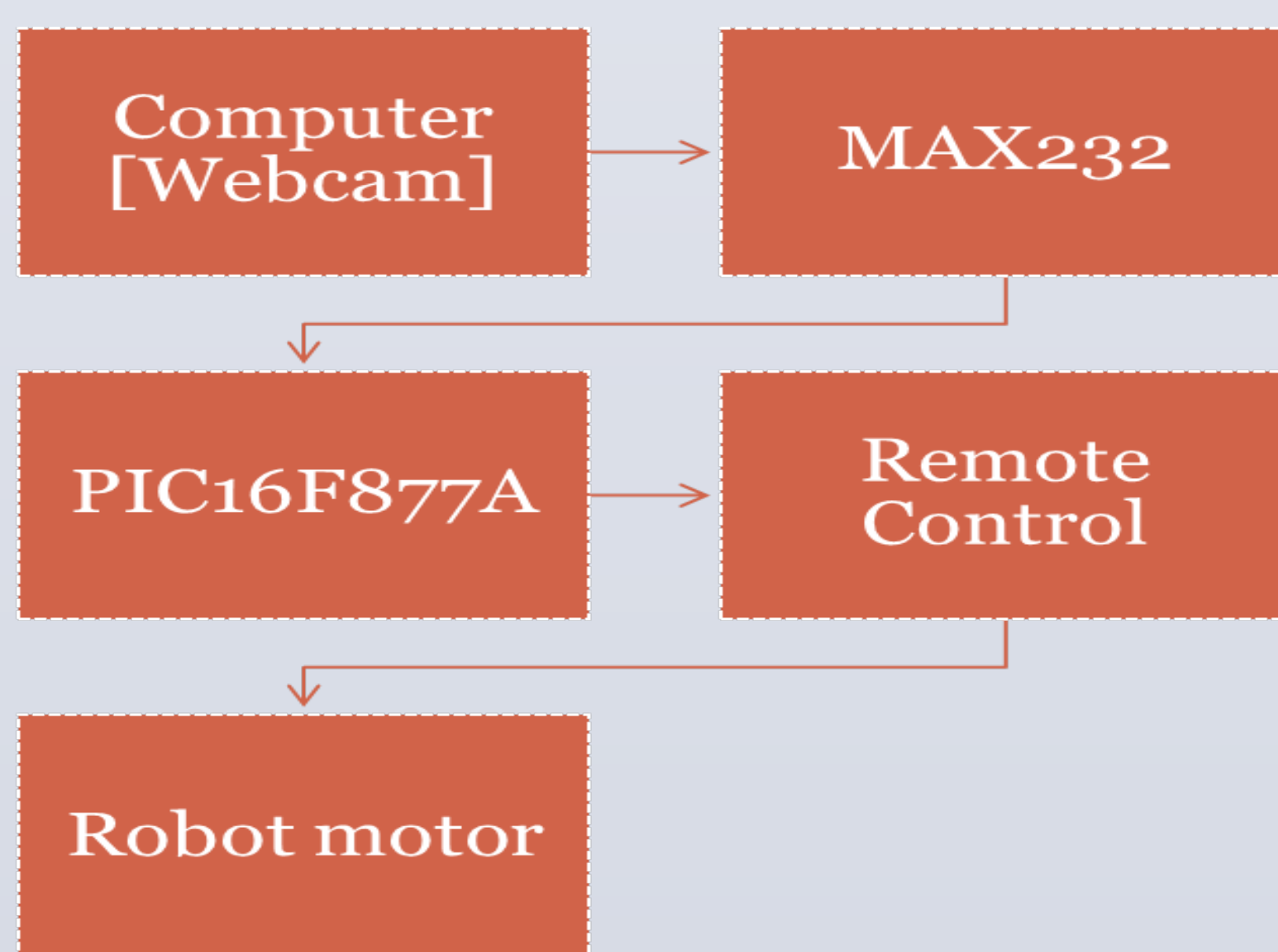PIC16F877A → Remote Control
Robot motor

Image Processing

Image Processing consists mainly of two parts both operated in Matlab. The first part is basically acquiring several images of the following: (1) a candle lit in a dark environment; (2) various position of the robot mounted webcam from the candle. Once the captured acquired images are acquired, they are converted to binary images by a code or processing algorithm written to capture a certain threshold of white space in the binary converted images. The second part will become to write a fully working control code capable of guiding the robot to find and extinguish the candlestick based on the threshold found in the first part.

Control Algorithm

Take Snapshot
Analyze Image
Analyze coordinates
Guide Robot
Extinguish Candle

Conclusion

In conclusion, this project was successfully implemented since the robot was fully capable of detecting the flame and extinguishing it. Moreover, this project helped me acquire invaluable amount of knowledge regarding hardware configuration and implementation of embedded systems. It widened my scope in learning how to tackle hardware design in engineering. Moreover, I managed to understand how serial connection is set up to ensure communication between a computer and a microcontroller which is necessary for persistent data exchange. In addition to that, I learned basic C code programming for PIC which was combined with the hardware implementation in order to control the robot.