Automated Conduit Bending Machine (ACBM)

Presented by Ray Beck, Kevin H. Jin, Earl Knight, Peter Shepard

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Team Number: 12

Introduction

- Design an automated conduit bender that has the characteristics of being user friendly, and at the same time can be produced with a realistic low manufacturing cost.
- The entire process will be controlled by a microcontroller. The only thing the user has to do is tell the computer what degree bends to make.

Personal Goals and Expectations

- This project is to be an endeavor for a team of four to be challenged and learn all the necessary skills of working together.
- To explore possibilities of each individual's creativity and conquer any odds that may present itself.
- The project team is to undergo all aspects and conditions of undertaking a project of such magnitude, requiring extensive mechanical, electrical and programming knowledge.
- It is expected that the project will have its up and downs with trials of personal hardship and possible difficult working environment.

Project Expectations

- Prototype of approximately 40 lbs.
- Dimensions of 4 ft by 3 ft by 2 ft.
- ACBM will feed and bend test copper pipes of 3/8 inch in diameter.
- Limited user input with automated response in operation.
- Finished product is to be a prototype for the production line with commonly manufactured parts combined with low production cost.
- Innovation in low cost production, advancing the profit margin.

Teamwork and Collaborations

- Ray Beck: Research and Market Specialist
- Kevin H. Jin: Project Manager and Research Specialist
- Earl Knight: Chief Design Engineer
- Peter Shepard: Chief Programming Engineer

Teamwork and Collaborations

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Hardware Design

- Pitman DC motor
  - 24v dc
  - 28ohm resistance
  - 112 gear ratio
  - 300-800mA at high pull

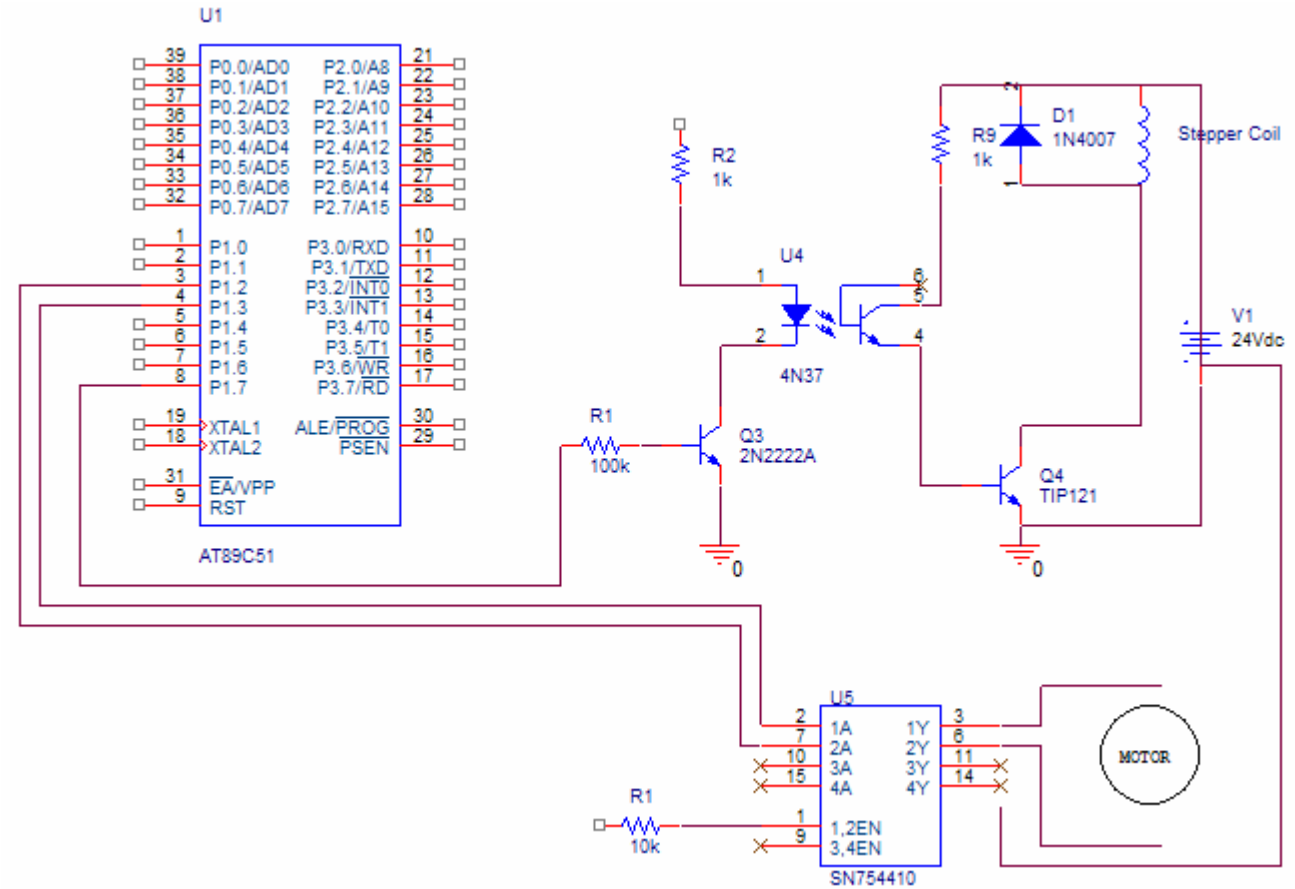
Hardware Design

- AMP Step Motor
  - Center tap instead of Bipolar
  - 24v dc
  - 19 ohm resistance
  - Full or Half steps

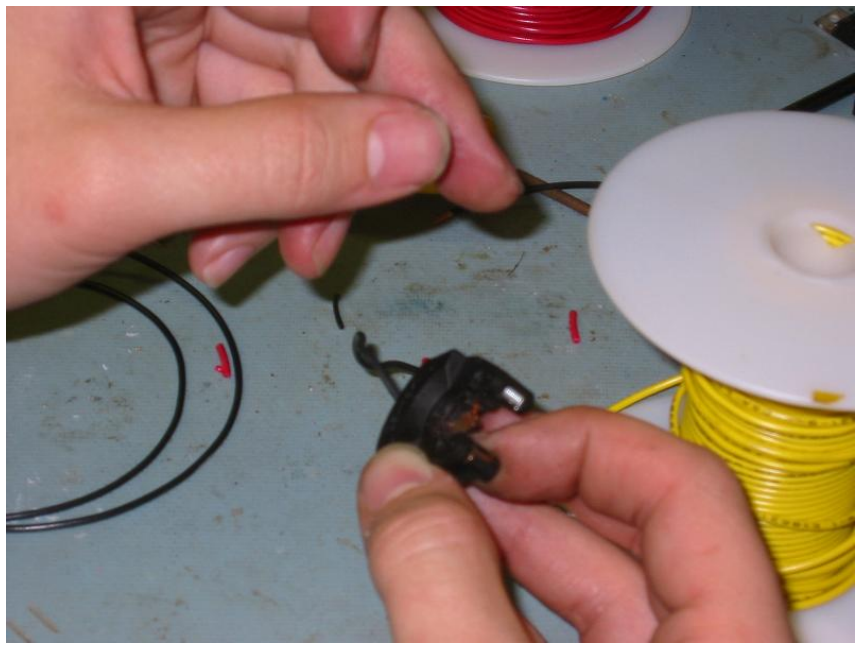
Hardware Design

- Full H Bridge
- 8051 Minmax Micro-controller
- LCD
- Keypad
- Resistors, Inductors, Capacitors, boards and wires.
- Metal turning wheels, wood
- Power Converter (120v AC @60 HZ to 24v DC)

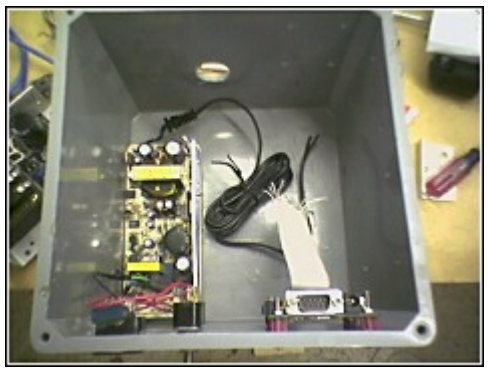
Hardware Design

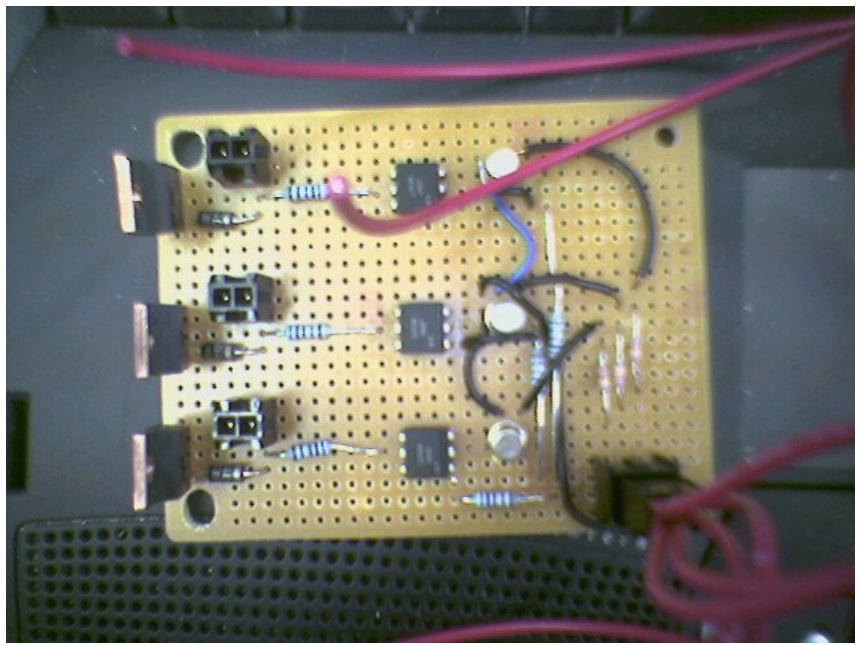


Hardware Design



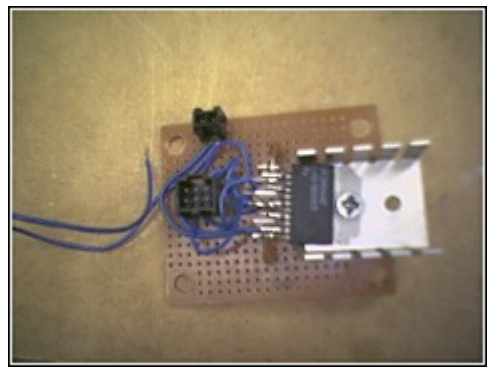
Hardware Design



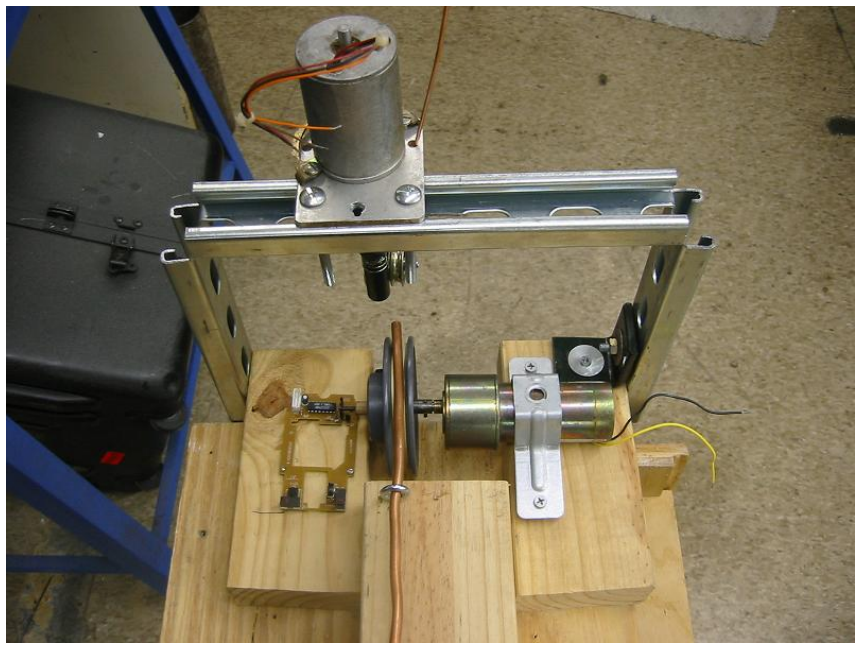


Hardware Design

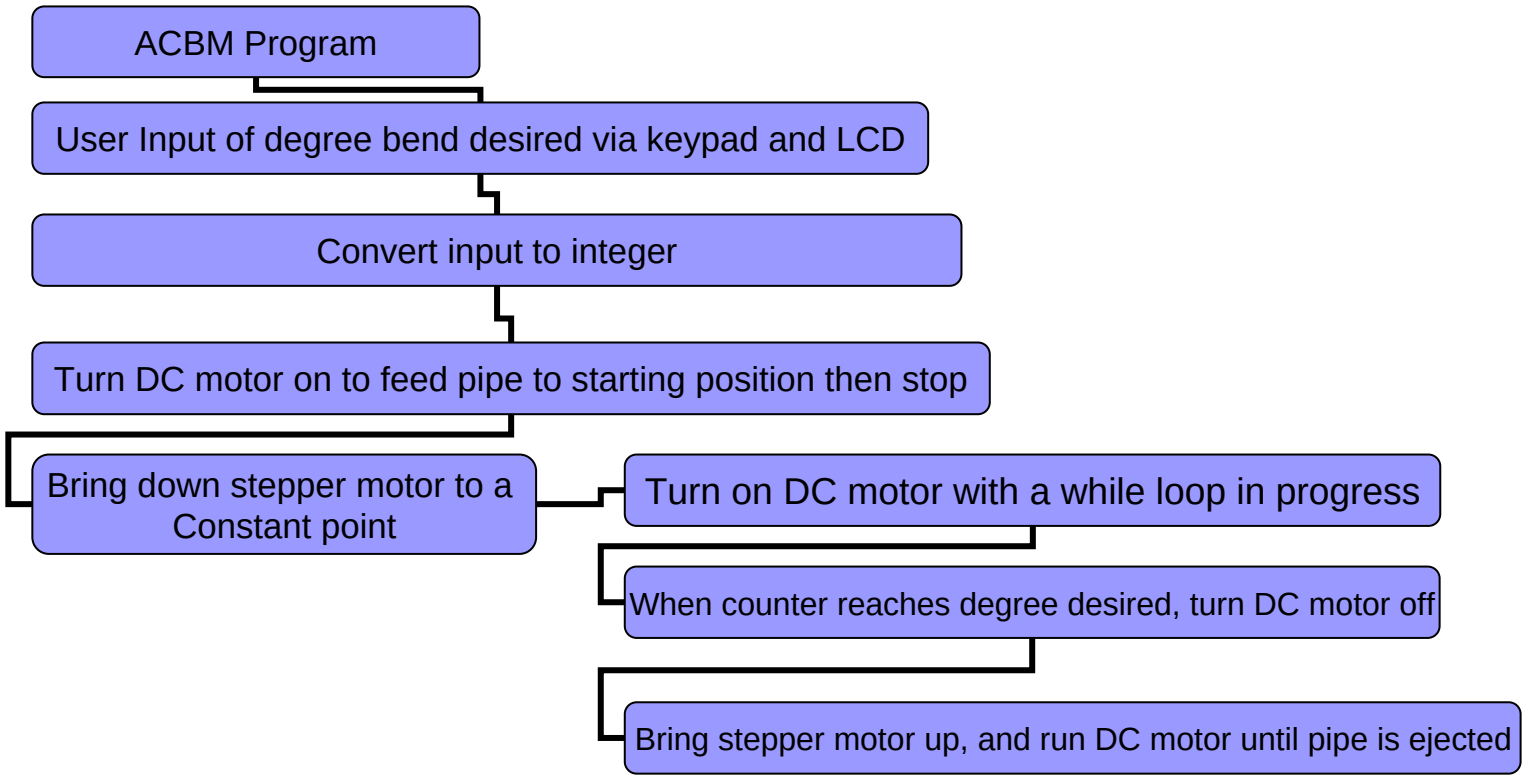
- New H Bridge



Hardware Design



Software Design



Design Alternatives

- Higher power Motors/Actuators
- Quality Parts
- Interfacing with AutoCAD
- Usage of shaft encoder
- Gearing the motor to rotation
- Remote operation capabilities

Project Short Comings

- Funding: More funding flexibilities that would allow for obtaining more professional parts, rather than old used parts that left a lot of guess work.
- Time restraints: More realistic time frames were desired so that we could have the opportunity to design a more professional project. Heavy schedules due to course load and work, forced the team to make many sacrifices and difficult to get together outside of the scheduled lab time, where enormous amount of time is needed to do a thorough and competent job. With more time, the ACBM would be able to perform and exhibit what is intended to be, a true prototype that could possibly land in the production circle.

ACBM Wish List

- Stronger materials such as steel or aluminum, with more powerful motors that would be able to bend the conduit with less stress, for a lasting product.
- Making the team's etched circuit boards.
- The ability of obtaining up to date parts and components needed to construct the prototype.
- Loads of time to be used in constructing every relevant circuit with quality parts that would allow for the optimal operation of the ACBM.

Project Obstacles and Challenges

- Time management: Getting the group together was not always successful, we had our set dates when we would meet up but there was always someone working that would not allow the entire group to get together..
- Little Bumps on the road: Small misfortunes, such as car trouble; getting lost going to the work site; and personal lives in general.
- Technical Roadblocks: Most of the members had to learn many new things to be contributing factors. The parts acquired were not of recent production date and were difficult to get information on. We also had a problem with a couple of the prototyping boards purchased from EPO, when soldering our circuits some of the copper tags would come loose and make contact with other pins.

Projected Costs

Hardware Cost: $70 (LCD, Keypad, H-Bridge, pipe, other circuit components)

Freebie Cost: $215 (DC Motor, Stepper Motor, Micro-Controller, various materials)

Total Labor Hours: 216 hours

Total Labor Cost: $12,960.00

Total Cost (including R&D): $32,795.00

Project Obstacles and Challenges

- Technical Speed-bumps: Due to limited funding and the desire to keep the cost down, most parts had to be made from other parts that we had lying around in garages and at the work shop.
- Health Hazards: Unexpected shocks via AC power supply. Caffeine and fast food became the teams diet due to the amount of work required to finish the project.

Actual Costs

- Hardware Costs:
  Circuits and parts------ $50
  Keypad and LCD------ $30
  Total---------- $80
- Labor Costs:
  Labor Hours--------- 50 X 4 = 200 Hours
  Total-------200 X 2.5 x $25 = $12500
- Total Prototype Costs: $12580

Estimated Project Schedule

- Project Conception Date: 08-27-04
- Project Research and Design: 09-04-04
- Initial Project Presentation: 09-29-04
- Projected Construction Date: 10-15-04
- Estimated Operational Date: 11-21-04
- Final Presentation Date: 12-01-04

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Commercial Usage

- Handyman's New Best Friend (A.C.B.M)
- Portable design enables onsite operations at minimum cost is desired by any mechanically driven business.
- New Hot Selling Item at Grainger.com.

Thank You !!!!

- We just want to say thanks to LHR Technologies for all there help and giving us a wonderful place to work our project and also Access Electric for also giving us a place to work and many of the parts that were used.

- Questions and/or Comments!!