

Team 5

Smart Camera to Measure Coil Diameter

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Company Information

- World's largest steel producer
- Created by Western European steelmaker Arcelor and Indian steelmaker Mittal steel in 2006
- Generates 96.3 million tons of steel in production, and ranked in the Fortune Global 500 in 2013

Executive Summary

Problem: Current System does not correctly measure steel coil diameter

Solution: Implement smart camera system with interface to correctly measure diameter of steel coil during rolling process

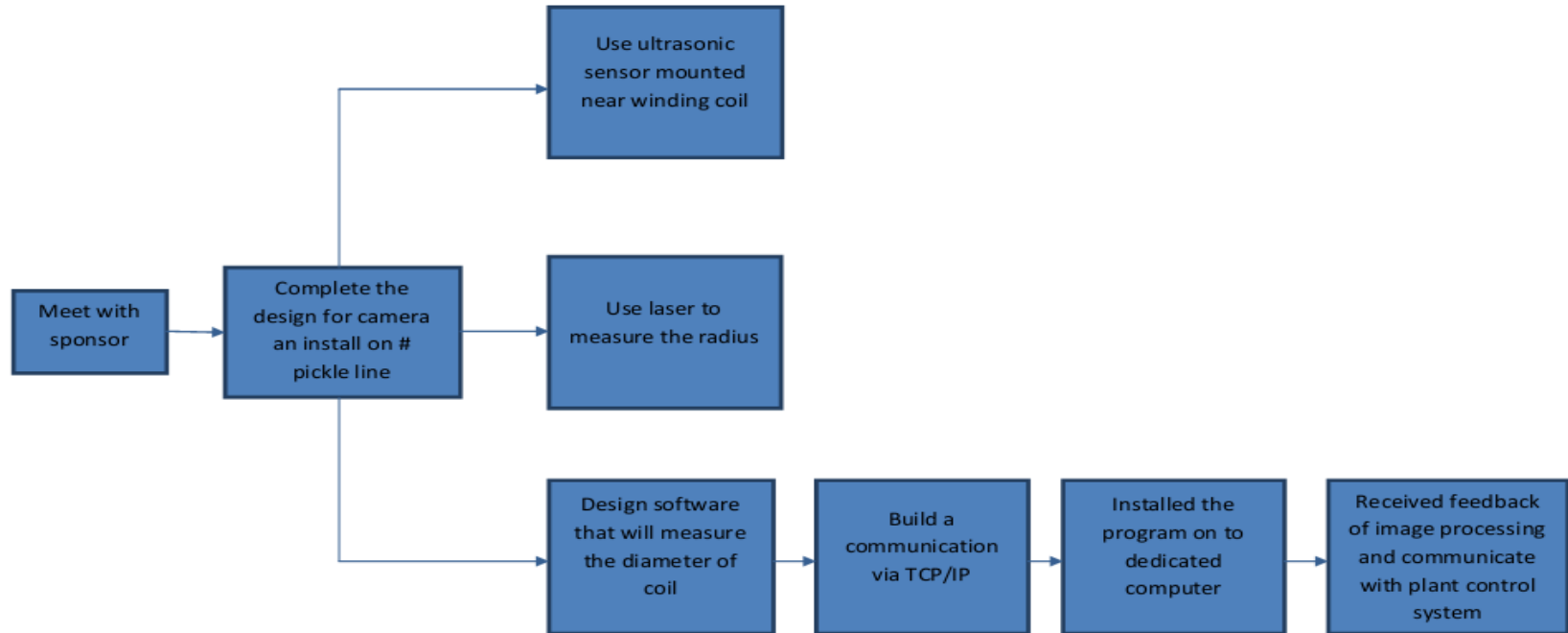
Customer Needs

- Accurate way to measure the diameter of a steel coil on a tension reel
 - Diameter needs to be accurate within an inch
- Robust measurement system
 - Ideally in a protected location away from the moving parts of the tensioner
- Ability to communicate the amount of steel back into the existing control systems

Current System

- 320p security camera being used
- Uses feed rate and steel gauge to calculate diameter as steel is being rolled
- Human Machine Interface is insufficient for quick use

FAST Diagram



Conceptual Design

- “Smart” Camera
 - 1080p, 30 fps, Type 1 PoE
- Ultrasonic Sensor
 - Max range 180 inches, sample rate up to 170 kHz
accuracy 0.25%
- Laser Sensor
 - Max Range 10 m, Sample rate up to 50 Hz, accuracy ± 5.0 mm

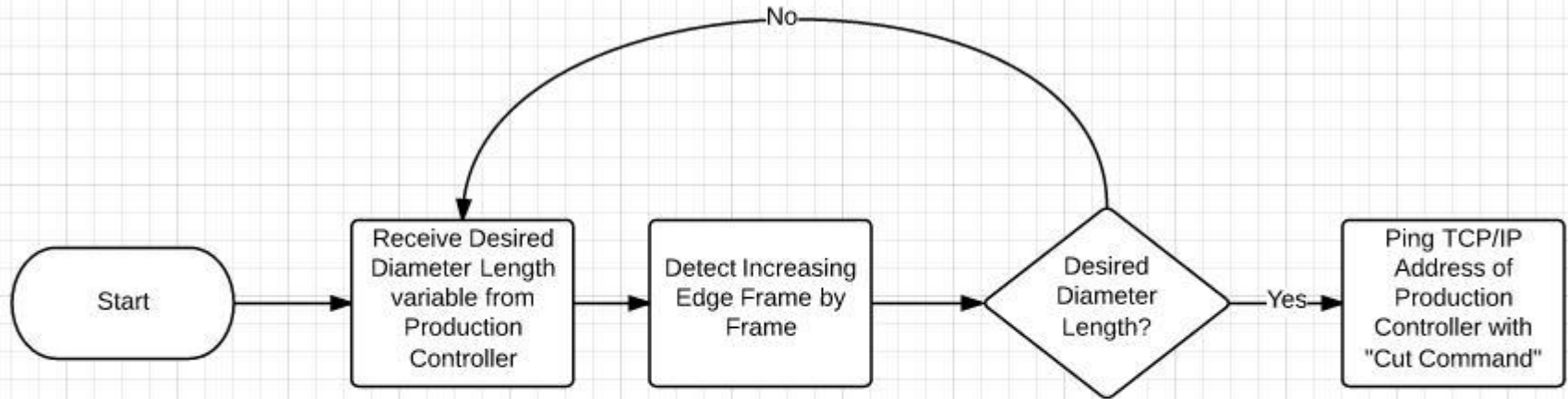
Design Rankings

Feasibility Criteria Operational Feasibility	Wt. 30%	AXIS "Smart" Camera	Ultrasonic Sensor	Laser Sensor
Functionality. A description of to what degree the candidate would benefit the organization and how well the system would work. Political. A description of how well received this solution would be from both user management, user, and organization perspective.		This system will work exceptionally well since it will be away from moving parts and easily accessible. It also has functions to communication with the network and existing software. This system will be user friendly and organized due to its simplicity and standard feature. Score: 30	This system should work moderately well since it will be close to moving parts and a dirty area. This system will not be user friendly and organized because it will be hard to get to and outside noises may cause problems Score: 20	This system will work poorly due to the possible reflection and its vicinity to moving parts. This system will not be user friendly and organized because it will be hard to get to and reflection is an issue. Score: 15
Technical Feasibility Technology. An assessment of the maturity, availability (or ability to acquire), and desirability of the computer technology needed to support this candidate. Expertise. An assessment to the technical expertise needed to develop, operate, and maintain the candidate system.	30%	"State of the art" camera. Easily acquirable. Step by Step guide to interface with networks. Moderately easy to develop. Very easy to operate. Very easy to maintain since it will be installed overhead above a walkway. Score: 27	Old technology with a moderately cheap sensor. Very easily acquirable. May have a few issues communicating with networks due to no pre-developed hardware or software. Moderately easy to develop. Difficult to operate. Difficult to maintain due to installation area near moving parts. Score: 20	Moderately new technology. Moderately available. Easy to acquire. May have a few issues communicating with networks due to no pre-developed hardware or software. Moderately easy to develop. Difficult to operate. Difficult to maintain due to installation area near moving parts. Score: 20
Economic Feasibility Cost to develop: Payback period (discounted): $\text{Payback Period} = \frac{\text{Initial Investment}}{\text{Periodic Cash Flow}}$ Net present value: $NPV = \sum_{t=1}^T \frac{C_t}{(1+r)^t} - C_0$ Detailed calculations:	30%	\$1,000+ Payback period = 7 days Net present value = Getting more information. Score: 28	\$200+ Payback period = 1.5 days Net present value = Getting more information. Score: 30	\$400+ Payback period = 2.8 days Net present value = Getting more information. Score: 29
Schedule Feasibility An assessment of how long the solution will take to design and implement.	10%	3 to 5 weeks Score: 10	4 to 6 weeks Score: 9	5 to 7 weeks Score: 8
Ranking:	100%	95	79	72

Proposed Design Solution

- Use the Axis P1355-E and a dedicated windows 7 pc to create a smart camera system
 - The camera will feed live video into the dedicated computer
 - The computer will analyze the video to find the coil diameter
 - The computer program will utilize the Sobel method to detect the edge and calculate the diameter in the image
 - The actual diameter of the coil will be calculated using the known geometry of the setup
 - The computer will then feed this value back into the existing production control system

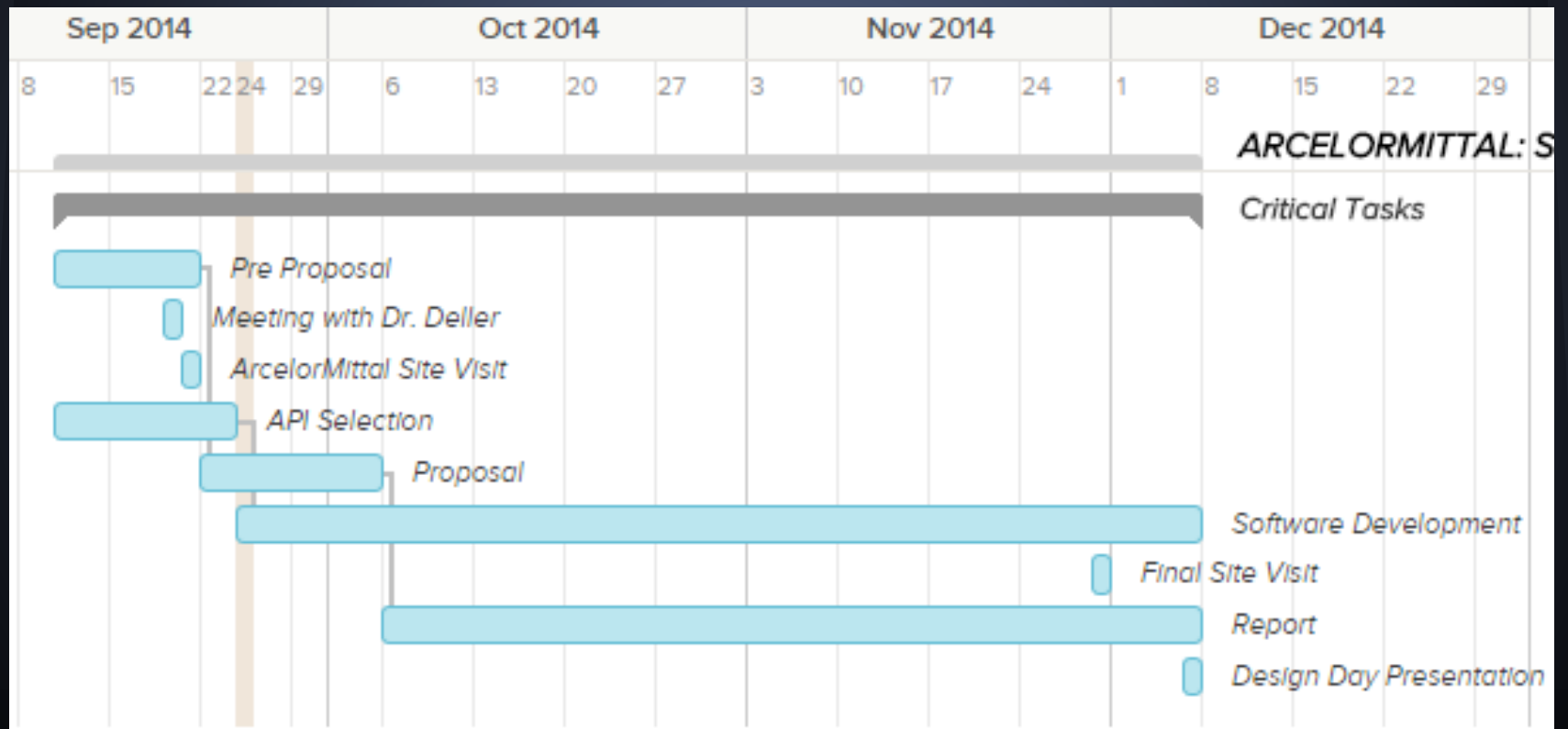
Software Design Process



Risk Analysis

Risk Level	Event	Tech. Performance	Cost	Schedule
3 High	Program Relays false data into computer system, catastrophic failure, endanger line workers	Highly unacceptable, increase in chance of accident occurring	Budget impacted due to increase of insurance liability	Project pushed back maximum of one week
2 Moderate	Computer malfunction, line forced to stop, no steel being produced	Unacceptable due to loss of profit experienced by sponsor	Budget continually impacted for duration	Project affected until computer system can be reset with bug fixed
1 Low	During Camera installation, worker could become injured	Performance not greatly affected, time and profit lost	Budget only impacted based on injuries sustained	Project pushed back no more than one day until properly installed

GANTT Chart



Budget

- Thus far, no part of the \$500 budget will be used within the foreseeable future
 - Axis P1355-E Camera - Supplied by sponsor
 - Dedicated computer - Supplied by DECS
 - VAPIX (API) \$215
 - Software - Supplied by DECS
 - MATLAB
 - Simulink
 - Microsoft Visual Studio

Progress Thus Far....

Conclusion

- New software written for ArcelorMittal's steel line computer system
- Very accurate reading of steel roll diameter based on 1080P Camera monitor

Questions?