Quarterly Report #2

Development of Hand-held Thermographic Inspection Technologies
RI06-038

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Summary of Accomplishments and Activities

Work this quarter continued on Task 1, *Preliminary Study Development*. Significant progress was made on many aspects of Task 1, though the project is running slightly behind schedule. Significant developments this quarter include:

- Development of Web-based resource for weather data
- Specification and prototype testing of the field data acquisition device
- Procurement of Cameras
- Development of test block

During this task, several subtasks have been underway to develop the foundation for the project, and these tasks are summarized below.

1. Development of Field Data Acquisition System

The development of a field data acquisition system has been ongoing this month. Progress has been made, though more work is required to fully develop the field system. A web resource has been developed to report to the inspector in the field the current weather and the weather trends over the most recent two week period. A significant challenge in this development was determining where to find the required data within the framework of the National Weather Service. This data has been located and methods to query the data have been developed. To use the web site, the user will input his present coordinates, and the program determines the nearest location of a weather stations by calculating the minimum distance from the inspectors location. Three graphs are then generated, including the hourly temperatures, the hourly windspeeds and the humidity. Figure 1 shows the panel that is presented to the inspector once the coordinates are entered. This web site is still being developed, an effective scheme for storing data at MU to make it easily accessible is being finalized.

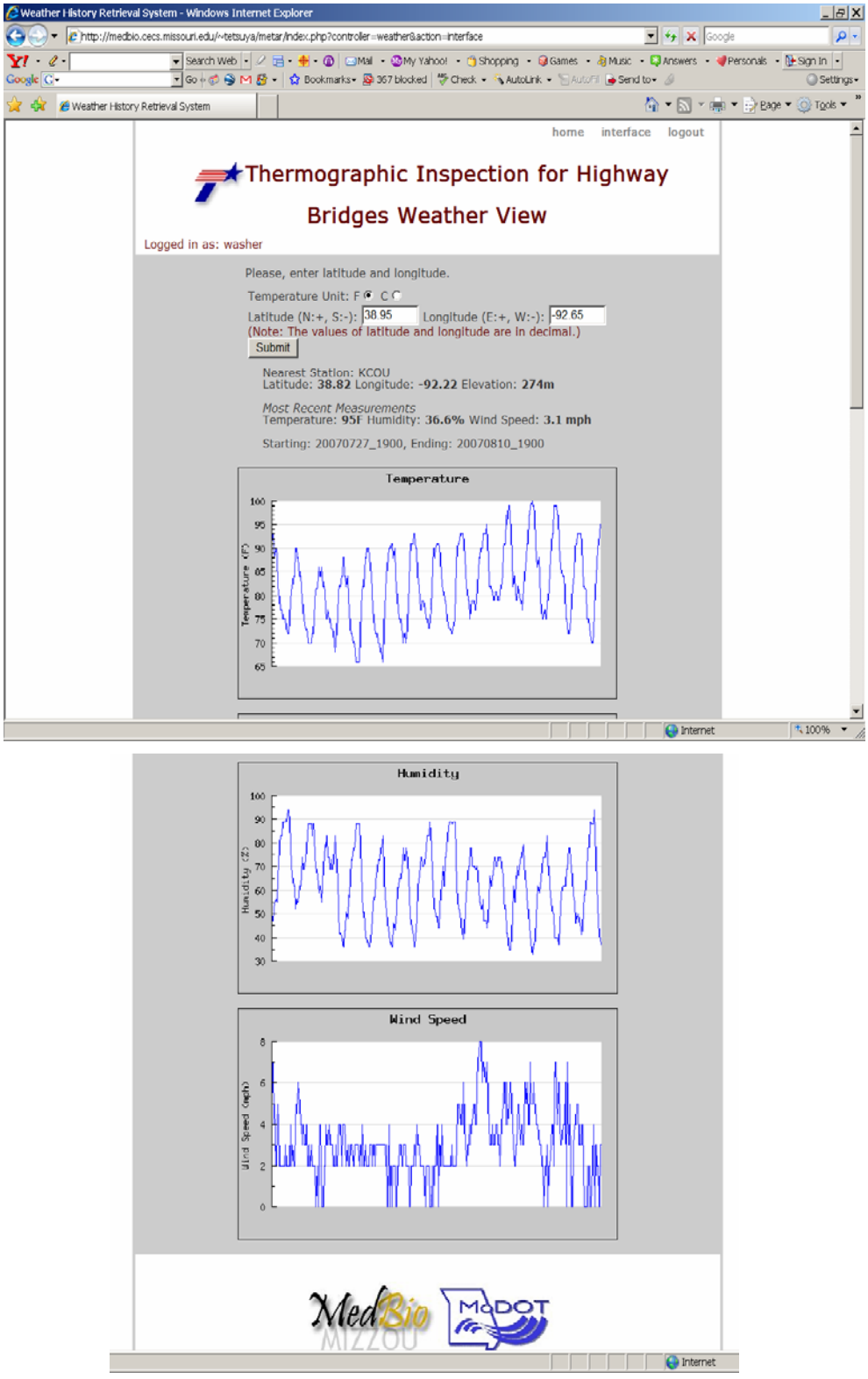

Figure 1. Image of the web page designed to report weather data to inspectors.

An initial selection of equipment to develop a fieldable device for use by inspectors has been ongoing. A mock-up has been developed in the laboratory using a tablet PC integrated with a GPS. This will allow the inspectors to determine there exact position. A satellite modem is being explored to provide access to the web. Testing in the laboratory of the system operation with automobile power supply (battery) is on-going to determine the effect of charging the camera and computer in a vehicle. Figure 2 shows the equipment that will be in the field data acquisition system mocked-up on the lab bench.

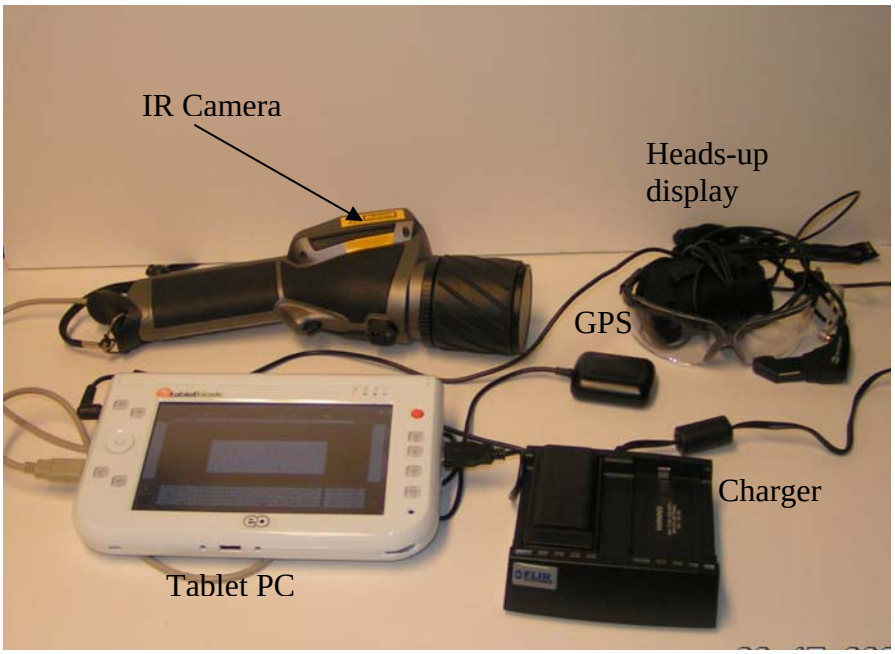

Figure 2. Mock-up of field data acquisition device showing tablet PC, IR camera, battery charger, GPS and heads-up display.

The devices shown in Figure 2 will be enclosed in a hard carrying case for field implementation. This box will plug into the cigarette lighter of a vehicle to provide power for charging the devices.

3. Test Block

There has been significant progress on the design and construction of the test block to be utilized for the laboratory study. Instrumentation for monitoring the actual temperatures within the test block has been procured and basic software developed for recording temperatures has been developed. Thermocouple arrays that will be embedded in the test block have been constructed and tested. A weather station that is capable of measuring wind speed, temperature, humidity, rainfall and solar radiation levels has been procured and tested in the lab. Footing for the test block and reinforcing steel cage have been constructed at the test site. Sensor arrays and embedded target are prepared for installation. The pouring of the test block has been delayed for several weeks due to the recent heat wave. Concerns exist that the high temperatures, combined with the size of

the test block (8’ x 8’ x 3’) could possibly result in cracking of the concrete. To avoid that possibility, pouring of the concrete is being held off until cooler weather arrives.

A mock-up of the test block was constructed in the laboratory in a effort to identify potential problems with the casting of the larger block. This mock-up consisted of a 3’ x 3’ x 6” block shown in figure 3. A thermocouple array consisting of 6 sensors distributed through the depth of the block was utilized to test the software and concept of using thermocouple embedded at different depths. Styrofoam targets measuring 6 in. x 6 in. were embedded at depths of 1 in. and 2.5 in. as shown in figure. .

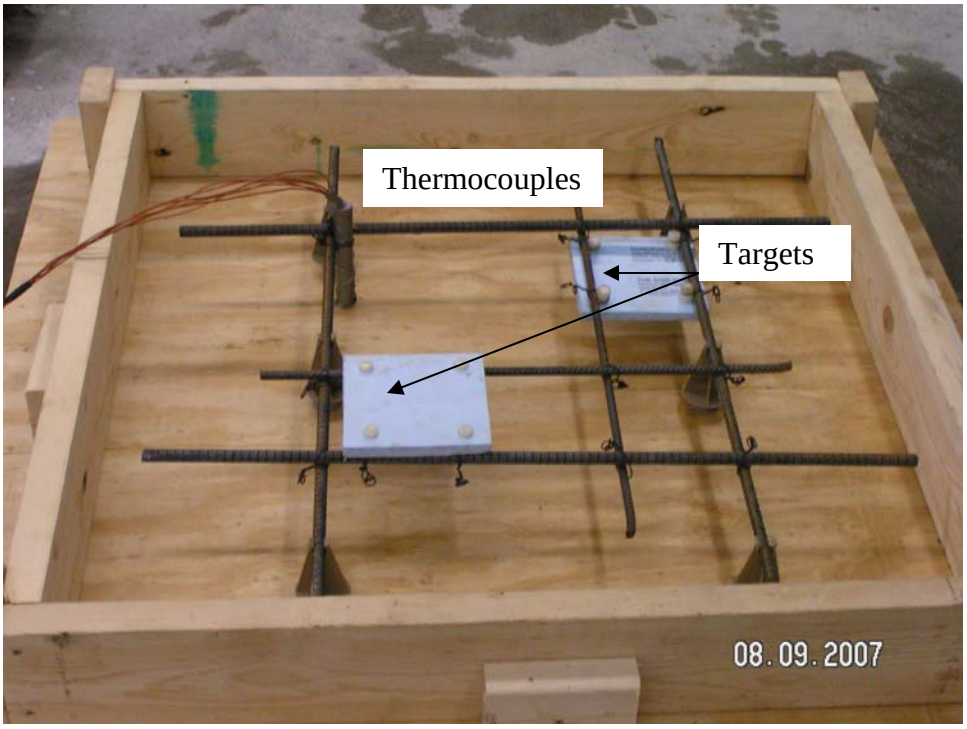

Figure 3. Mock-up of test block prior to concrete placement, showing embedded targets and thermocouple array.

Testing of the block has been ongoing, and results of this testing have given a good indication of what is to be expected from the test block in the field. Figure 4 indicates the test results from initial measurements on the test block mock-up with four images taken at different stages in heating and cooling. A 1500 watt spacer heater mounted 7 ft above the block was used for heating to simulate sunlight. As shown in the figure, the target at 1 in. depth is observable during both the heating and cooling of the block. The 2.5 in deep embedded target could be observed marginally on the cooling cycle. Figure A in an image with the heating source on, and reflection from the source can be observed. Figure B is immediately after the heating source was turned off. Figures C and D were taken during cooling of the block. These observation are preliminary at this point, but offer a demonstration of the information that will be gathered through monitoring the test block during seasonal variations.

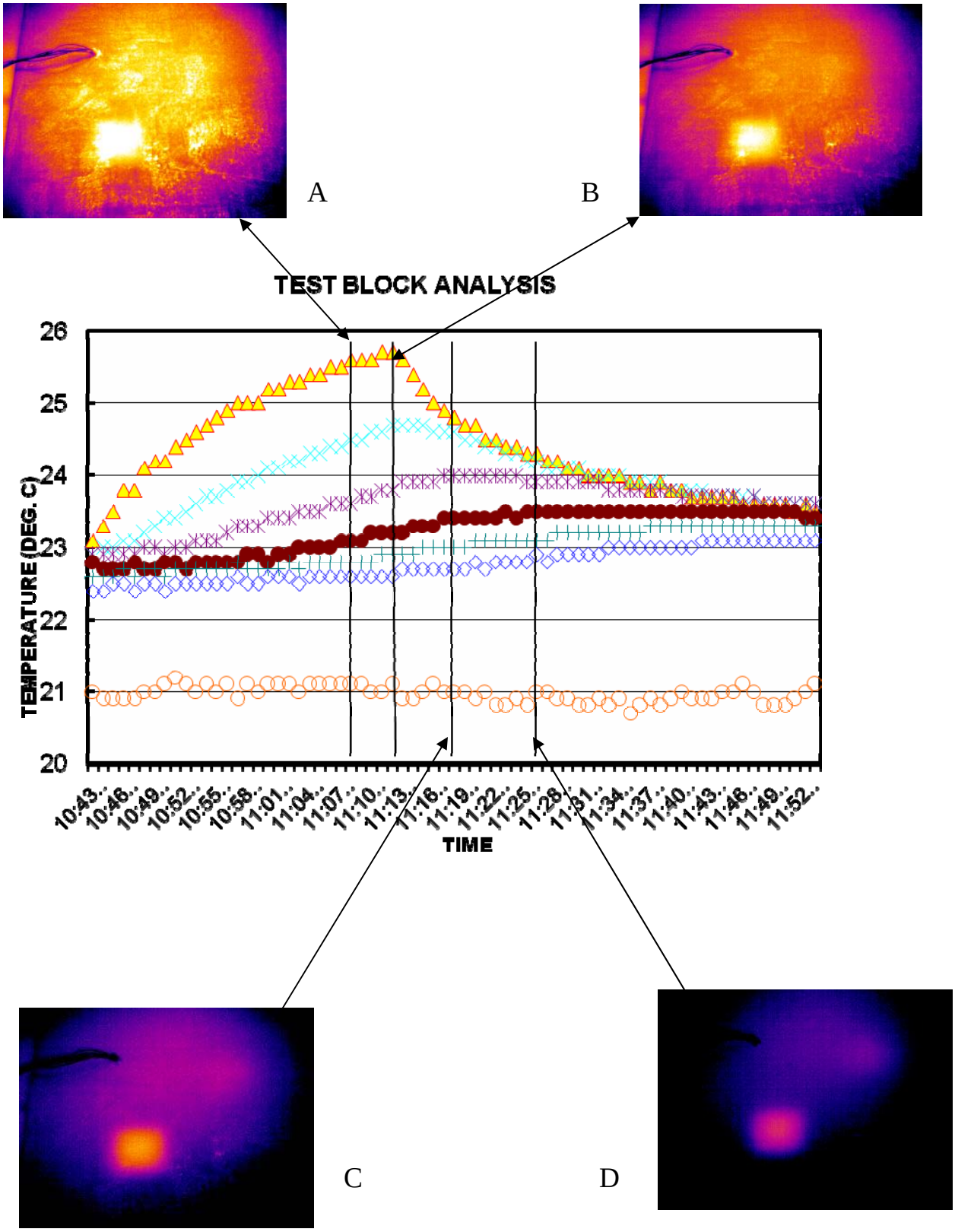

Figure 4. Images of embedded targets in the concrete block under varying heating and cooling.

5. Issues or Problems that need to be addressed.

The ordering of additional cameras for field testing has been delayed to allow for the manufacture's release of a new version of the camera that includes an integrated digital camera. A demonstration of the new camera is being arranged for the week of August 20, 2007.

The cost-matching to be provided by the University Transportation Center – Rolla (UTC) has yet to be secured due to administrative issues at the UTC. Notification of award has been made, but administrative tasks are yet to be completed. This is not expected to have any impact on the project.

Schedule

The development of the test block is approximately 1 month behind schedule, due to delays as discussed above. However, this is not expected to seriously effect the project schedule overall. The schedule to deliver the field cameras and data acquisition device anticipates October 31, 2007 date for States to receive their cameras and field data acquisition device. This appears to be a reasonable time estimate.

Table 1. Summary of project schedule.

		Months (Beginning February 1, 2007)																				
	Tasks	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J
1	Preliminary Study Development							X																	
2	Controlled Testing of Concrete Specimen																								
3	Operational Testing																								
4	Final Report																								

% of Budget Expended: Approximately 50% of the funding provided by the participating States has been expended. Approximately 50% of the University-provided funded has been expended. None of the University Transportation Center budget has been expended, because it is not yet available.