KFRL NEWSLETTER

Computer & Information Systems Engineering, NED UET
September'16

KFRL Team started working on projects under Pakistan National Student Satellite (PNSS) program!

SUPARCO launched a program titled as Pakistan National Student Satellite (PNSS) in which different national universities i.e., NED, NUST, UET Lahore, and others participated. KFRL successfully grabbed five of the projects under this program in different areas i.e., payload processing, ground station antenna unit, battery unit, data handling unit, payload transmission unit.

Dr. Muhammad Khurram, invited hard working and self motivated students to join the team and start working on any of the projects of their choice. The call was open to all students under the faculty of Electrical, Electronics, & Computer engineering.

Two groups have been selected from Computer & Information Systems Engineering department; they will be working on Data handling and Payload transmission unit. Two groups have been selected from Electronics department; they will be working on Ground station antenna design and Payload processing unit. Last group has been selected from Electrical department and will be working on battery unit. It is a great opportunity for students to work on projects which are part of a huge project that is going to be realized.

Find Inside

Murk Marvi
M. Yaseen Aftab

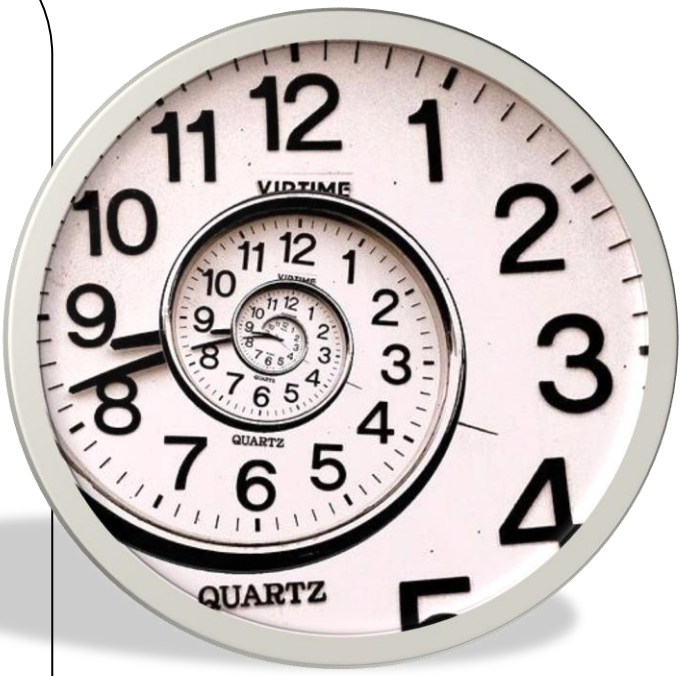
Advanced Version of Agricultural Project

Initial version of Agricultural project designed by KFRL team is already rich in features. However, for making the solution more flexible, accurate, and easy to use an advanced version of agricultural project has been proposed. The main features included in this design are discussed as under.

1

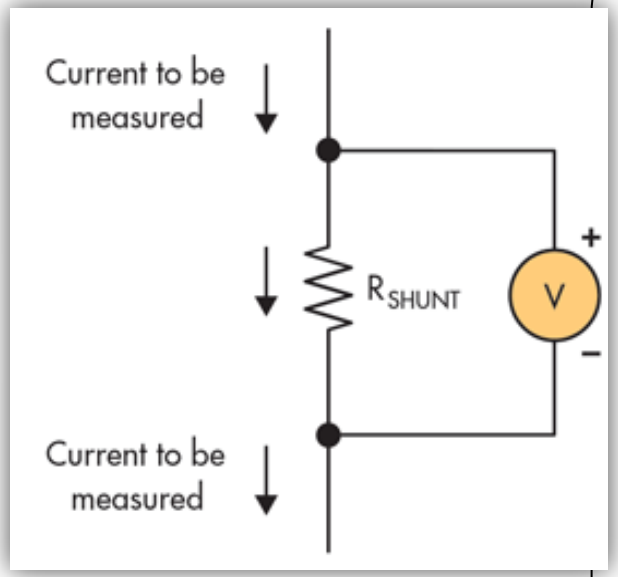
Real time clock (RTC)

Since the network is following star topology in which the gateway node is kept on all the time for providing services to sensor nodes. Although, the gateway node efficiently utilizes power and is rechargeable through solar panel. However, it is not that much power efficient and can prone to failures in cloudy seasons. Therefore, the team came up with the idea of exploiting real time clock and timers so that the gateway should wake up only when sensor nodes have data to transmit otherwise it will remain in sleep mode. The main challenge that will be faced by team is the synchronization of clocks of sensor nodes with gateway node. At sensor node it is not that difficult, since it needs to synchronize itself with gateway clock only. However, it is extremely complex to synchronize the gateway clock with the clock of each sensor node. The complexity will even increase with the increase in number of nodes.



2

Health Monitoring of Nodes



The most useful feature, for monitoring health of sensor nodes has been included in this advanced design. For making sure that, the battery of nodes deployed in the field is sufficiently charged and solar panels are operational, two additional fields have been included i.e., one for monitoring status of battery and one for solar panel. The status of battery has been monitored through a voltage divider (VDR) and for solar panel the shunt resistor has been used. Both of these circuits are controlled through transistor. Through monitoring of these variables remotely, the customers have access to additional knowledge about health of the nodes. Therefore, if the nodes due to some reasons stop operating then one can easily trap the faults to failure through accessing rich amount of information collected at cloud.

3

Advanced Sensors

In initial design of the project, simple sensors have been used which are extremely cheap. However, accuracy and long life also matters therefore in advanced version of the project different sensors have been used which are a bit expensive but are susceptible to harsh conditions and have a longer life.

4

Variable Power Source

For making the design of the project more flexible two different power sources for sensors have been defined i.e., 5V and 10V at which most of the sensors are operated. Therefore, the customers can connect different type of sensors with different power requirements. This is a very attractive feature, as per customer requirements and his cost profile the team can provide customized solutions at a faster rate.

Apart from advancement in sensor and gateway node, the team has also started working on the design of an additional node for water monitoring and actuation. This node is named as a flow node in order to distinguish it from sensor nodes. The function of this node is to measure the amount of water used during irrigation throughout the day and keep storing it in its local memory. Through local communication it will transfer the collected data to gateway node at once throughout the day which will be further transferred to cloud. Bidirectional communication, through GPRS module has already been achieved by KFRL team. Therefore, after monitoring the amount of water being used for irrigation the team can control it remotely. The system used for irrigation will be controlled by flow node through a relay, once it receives commands remotely through GPRS module.

There is much more to come in this project with time. New features will be added for making the system more reliable, efficient, and attractive for customers.

Bluetooth Enabled Stethoscope Design

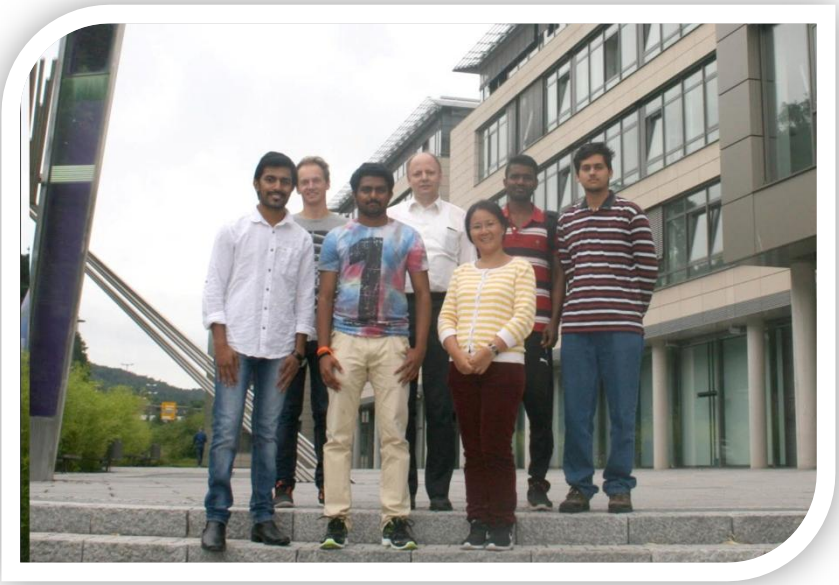
KFRL team has successfully designed Bluetooth enabled stethoscope. Audio recorded by stethoscope has been processed using DSP chips and special techniques have been used to filter out the noise. By introducing amplifiers at different stages of the circuit signal strength has been improved so that it can be successfully transmitted on wireless channel to Bluetooth enabled headset. An LCD has also been interfaced with this stethoscope for better visualization purposes. An additional feature of temporary storage has also been included through SD card. This feature helps to record the collected readings that can be stored to main server and hence can be used in future for further analysis.

Experience of Students at DFKI Germany

This summer KFRL offered opportunity to three Research Students of Computer & Information Systems Engineering department NED UET for an internship to Kaiserslautern, Germany. The duration whereof was 70 days i.e. from 1st June to 10th August 2016. This international internship opportunity at undergrad level was a first of its kind in the NED UET. It is one of the objectives of an ongoing project titled as "Water Resource Management (WaRM)" which is being funded by DAAD under "Pak-German Research Collaboration" program. This project is carried out in collaboration with German Research Center for Artificial Intelligence (DFKI). The WaRM project has two facets, one is the data acquisition or hardware part, and the other is Artificial Intelligence (AI) or the software part. The data acquisition node or sensor node will be developed here at KFRL, while DFKI will provide its expertise in the AI domain.

One of the main objectives of the internship was that students in Pakistan develop expertise in proven state of the art Machine Learning (ML) and Artificial Intelligence (AI) techniques – a field in which DFKI has globally recognized expertise. Our internship supervisor in Germany was Dr. Syed Saqib Bukhari, who is working as a Senior Researcher in DFKI Knowledge Management Group.

One of the internee also participated in European Space Agency's Mars Express Power Challenge with Ying Gu, who is a PhD student at DFKI and achieved a final result of 9th place. The competition goal was to develop a Machine Learning based model to predict power consumption for ESA Mars Express spacecraft. This competition provided an opportunity to connect with Data Scientists and ML experts based in Europe.



There, we got a chance to present project idea and progress in a “Workshop on Field and Assistive Robotics (WFAR)” held at the scenic location of Castle Dagstuhl in Saarland, Germany. The conference was graced by students and faculty from Lahore University of Management Sciences (LUMS), University of Central Punjab (UCP) and Technical University Kaiserslautern (TU KL). The discussions were led by Prof. Dr. Karsten Berns of Robotics Research Lab at TU KL. This conference also served as a networking opportunity for researchers and students from different universities in Pakistan working on Smart Agriculture, Irrigation and Forestry.

While at DFKI we worked with several different AI and ML frameworks including Google’s TensorFlow, Keras, RapidMiner and SKLearn. We also got a chance to work with R-statistical programming environment and also made acquaintance with the Long Short-Term Memory Networks (LSTMs) and their unusual effectiveness in sequence and context sensitive learning. LSTMs in fact address many short comings of traditional Neural Networks (MLPs) and Recurrent Neural Networks (RNNs). We also witnessed first-hand the impressive results of DFKI’s homegrown Optical Character Recognition Engine (OCRopus) which is based on LSTMs.

During last session of the internship, we presented summary of the work done so far and discussed future directions of the project in a farewell presentation.

Agricultural Project Deployment at Gadap

Back in Pakistan, KFRL team successfully deployed test bed of agricultural project at a farm in Gadap town, Karachi and is now eager to apply the learned methods on the data being collected and derive valuable knowledge from it.